R&S®SMA100A
Signal Generator
Operating Manual

ROHDE & SCHWARZ

This document describes the R&S®SMA100A, stock no. 1400.0000k02 and its options.

- R&S®SMA-B20
- R&S®SMA-B22
- R&S®SMA-B29
- R&S®SMA-B46
- R&S®SMA-B80/B81
- R&S®SMA-B103/B103L
- R&S®SMA-B106/B106L
- R&S®SMA-K23
- R&S®SMA-K24
- R&S®SMA-K25
- R&S®SMA-K26
- R&S®SMA-K27
- R&S®SMA-K28

The firmware of the instrument makes use of the operating system LINUX® and other valuable open source software packages. The most important of them together with their corresponding open source license and the verbatim license texts are provided on the user documentation CD-ROM (included in delivery).

The OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/) includes cryptographic software written by Eric Young (eay@cryptsoft.com) and software written by Tim Hudson (tjh@cryptsoft.com). LINUX® is a trademark of Linus Torvalds.

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

The following abbreviations are used throughout this manual: R&S®SMA100A is abbreviated as R&S SMA.

Grundlegende Sicherheitshinweise

Lesen und beachten Sie unbedingt die nachfolgenden Anweisungen und Sicherheitshinweise!

Alle Werke und Standorte der Rohde & Schwarz Firmengruppe sind ständig bemüht, den Sicherheitsstandard unserer Produkte auf dem aktuellsten Stand zu halten und unseren Kunden ein höchstmögliches Maß an Sicherheit zu bieten. Unsere Produkte und die dafür erforderlichen Zusatzgeräte werden entsprechend der jeweils gültigen Sicherheitsvorschriften gebaut und geprüft. Die Einhaltung dieser Bestimmungen wird durch unser Qualitätssicherungssystem laufend überwacht. Das vorliegende Produkt ist gemäß beiliegender EU-Konformitätsbescheinigung gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muss der Benutzer alle Hinweise, Warnhinweise und Warnvermerke beachten. Bei allen Fragen bezüglich vorliegender Sicherheitshinweise steht Ihnen die Rohde & Schwarz Firmengruppe jederzeit gerne zur Verfügung.

Darüber hinaus liegt es in der Verantwortung des Benutzers, das Produkt in geeigneter Weise zu verwenden. Das Produkt ist ausschließlich für den Betrieb in Industrie und Labor bzw. wenn ausdrücklich zugelassen auch für den Feldeinsatz bestimmt und darf in keiner Weise so verwendet werden, dass einer Person/Sache Schaden zugefügt werden kann. Die Benutzung des Produkts außerhalb des bestimmungsgemäßen Gebrauchs oder unter Missachtung der Anweisungen des Herstellers liegt in der Verantwortung des Benutzers. Der Hersteller übernimmt keine Verantwortung für die Zweckentfremdung des Produkts.

Die bestimmungsgemäße Verwendung des Produkts wird angenommen, wenn das Produkt nach den Vorgaben der zugehörigen Produktdokumentation innerhalb seiner Leistungsgrenzen verwendet wird (siehe Datenblatt, Dokumentation, nachfolgende Sicherheitshinweise). Die Benutzung des Produkts erfordert Fachkenntnisse und zum Teil englische Sprachkenntnisse. Es ist daher zu beachten, dass das Produkt ausschließlich von Fachkräften oder sorgfältig eingewiesenen Personen mit entsprechenden Fähigkeiten bedient werden darf. Sollte für die Verwendung von Rohde & Schwarz-Produkten persönliche Schutzausrüstung erforderlich sein, wird in der Produktdokumentation an entsprechender Stelle darauf hingewiesen. Bewahren Sie die grundlegenden Sicherheitshinweise und die Produktdokumentation gut auf und geben Sie diese an weitere Benutzer des Produkts weiter.

Die Einhaltung der Sicherheitshinweise dient dazu, Verletzungen oder Schäden durch Gefahren aller Art auszuschließen. Hierzu ist es erforderlich, dass die nachstehenden Sicherheitshinweise vor der Benutzung des Produkts sorgfältig gelesen und verstanden, sowie bei der Benutzung des Produkts beachtet werden. Sämtliche weitere Sicherheitshinweise wie z.B. zum Personenschutz, die an entsprechender Stelle der Produktdokumentation stehen, sind ebenfalls unbedingt zu beachten. In den vorliegenden Sicherheitshinweisen sind sämtliche von der Rohde & Schwarz Firmengruppe vertriebenen Waren unter dem Begriff „Produkt" zusammengefasst, hierzu zählen u. a. Geräte, Anlagen sowie sämtliches Zubehör.

Symbole und Sicherheitskennzeichnungen

Achtung, allgemeine Gefahrenstelle Produktdokumen-tation beachten	Vorsicht beim Umgang mit Geräten mit hohem Gewicht	Gefahr vor elektrischem Schlag	Warnung vor heißer Oberfläche	Schutzleiter-anschluss	Erdungs-anschluss	Masse-anschluss

Achtung beim Umgang mit elektrostatisch gefährdeten Bauelementen	EIN-/AUS-Versorgungs-spannung	Stand-by-Anzeige	Gleichstrom (DC)	Wechselstrom (AC)	Gleichstrom/-Wechselstrom (DC/AC)	Gerät durchgehend durch doppelte (verstärkte) Isolierung geschützt

Signalworte und ihre Bedeutung

Die folgenden Signalworte werden in der Produktdokumentation verwendet, um vor Risiken und Gefahren zu warnen.

GEFAHR kennzeichnet eine unmittelbare Gefährdung mit hohem Risiko, die Tod oder schwere Körperverletzung zur Folge haben wird, wenn sie nicht vermieden wird.

WARNUNG kennzeichnet eine mögliche Gefährdung mit mittlerem Risiko, die Tod oder (schwere) Körperverletzung zur Folge haben kann, wenn sie nicht vermieden wird.

VORSICHT kennzeichnet eine Gefährdung mit geringem Risiko, die leichte oder mittlere Körperverletzungen zur Folge haben könnte, wenn sie nicht vermieden wird.

ACHTUNG weist auf die Möglichkeit einer Fehlbedienung hin, bei der das Produkt Schaden nehmen kann.

Diese Signalworte entsprechen der im europäischen Wirtschaftsraum üblichen Definition für zivile Anwendungen. Neben dieser Definition können in anderen Wirtschaftsräumen oder bei militärischen Anwendungen abweichende Definitionen existieren. Es ist daher darauf zu achten, dass die hier beschriebenen Signalworte stets nur in Verbindung mit der zugehörigen Produktdokumentation und nur in Verbindung mit dem zugehörigen Produkt verwendet werden. Die Verwendung von Signalworten in Zusammenhang mit nicht zugehörigen Produkten oder nicht zugehörigen Dokumentationen kann zu Fehlinterpretationen führen und damit zu Personen- oder Sachschäden führen.

Betriebszustände und Betriebslagen

Das Produkt darf nur in den vom Hersteller angegebenen Betriebszuständen und Betriebslagen ohne Behinderung der Belüftung betrieben werden. Werden die Herstellerangaben nicht eingehalten, kann dies elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen. Bei allen Arbeiten sind die örtlichen bzw. landesspezifischen Sicherheits- und Unfallverhütungsvorschriften zu beachten.

1. Sofern nicht anders vereinbart, gilt für R&S-Produkte Folgendes:
als vorgeschriebene Betriebslage grundsätzlich Gehäuseboden unten, IP-Schutzart 2X, Verschmutzungsgrad 2, Überspannungskategorie 2, nur in Innenräumen verwenden, Betrieb bis 2000 m ü. NN, Transport bis 4500 m ü. NN, für die Nennspannung gilt eine Toleranz von ±10%, für die Nennfrequenz eine Toleranz von ±5%.

2. Stellen Sie das Produkt nicht auf Oberflächen, Fahrzeuge, Ablagen oder Tische, die aus Gewichts- oder Stabilitätsgründen nicht dafür geeignet sind. Folgen Sie bei Aufbau und Befestigung des Produkts an Gegenständen oder Strukturen (z.B. Wände und Regale) immer den Installationshinweisen des Herstellers. Bei Installation abweichend von der Produktdokumentation können Personen verletzt ggfls. sogar getötet werden.

3. Stellen Sie das Produkt nicht auf hitzeerzeugende Gerätschaften (z.B. Radiatoren und Heizlüfter). Die Umgebungstemperatur darf nicht die in der Produktdokumentation oder im Datenblatt spezifizierte Maximaltemperatur überschreiten. Eine Überhitzung des Produkts kann elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen.

Elektrische Sicherheit

Werden die Hinweise zur elektrischen Sicherheit nicht oder unzureichend beachtet, kann dies elektrischen Schlag, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen.

1. Vor jedem Einschalten des Produkts ist sicherzustellen, dass die am Produkt eingestellte Nennspannung und die Netznennspannung des Versorgungsnetzes übereinstimmen. Ist es erforderlich, die Spannungseinstellung zu ändern, so muss ggf. auch die dazu gehörige Netzsicherung des Produkts geändert werden.

2. Bei Produkten der Schutzklasse I mit beweglicher Netzzuleitung und Gerätesteckvorrichtung ist der Betrieb nur an Steckdosen mit Schutzkontakt und angeschlossenem Schutzleiter zulässig.

3. Jegliche absichtliche Unterbrechung des Schutzleiters, sowohl in der Zuleitung als auch am Produkt selbst, ist unzulässig. Es kann dazu führen, dass von dem Produkt die Gefahr eines elektrischen Schlags ausgeht. Bei Verwendung von Verlängerungsleitungen oder Steckdosenleisten ist sicherzustellen, dass diese regelmäßig auf ihren sicherheitstechnischen Zustand überprüft werden.

4. Sofern das Produkt nicht mit einem Netzschalter zur Netztrennung ausgerüstet ist, so ist der Stecker des Anschlusskabels als Trennvorrichtung anzusehen. In diesen Fällen ist dafür zu sorgen, dass der Netzstecker jederzeit leicht erreichbar und gut zugänglich ist (entsprechend der Länge des Anschlusskabels, ca. 2m). Funktionsschalter oder elektronische Schalter sind zur Netztrennung nicht geeignet. Werden Produkte ohne Netzschalter in Gestelle oder Anlagen integriert, so ist die Trennvorrichtung auf Anlagenebene zu verlagern.

5. Benutzen Sie das Produkt niemals, wenn das Netzkabel beschädigt ist. Überprüfen Sie regelmäßig den einwandfreien Zustand der Netzkabel. Stellen Sie durch geeignete Schutzmaßnahmen und Verlegearten sicher, dass das Netzkabel nicht beschädigt werden kann und niemand z.B. durch Stolperfallen oder elektrischen Schlag zu Schaden kommen kann.

6. Der Betrieb ist nur an TN/TT Versorgungsnetzen gestattet, die mit höchstens 16 A abgesichert sind (höhere Absicherung nur nach Rücksprache mit der Rohde & Schwarz Firmengruppe).

7. Stecken Sie den Stecker nicht in verstaubte oder verschmutzte Steckdosen/-buchsen. Stecken Sie die Steckverbindung/-vorrichtung fest und vollständig in die dafür vorgesehenen Steckdosen/-buchsen. Missachtung dieser Maßnahmen kann zu Funken, Feuer und/oder Verletzungen führen.

8. Überlasten Sie keine Steckdosen, Verlängerungskabel oder Steckdosenleisten, dies kann Feuer oder elektrische Schläge verursachen.

9. Bei Messungen in Stromkreisen mit Spannungen U_{eff} > 30 V ist mit geeigneten Maßnahmen Vorsorge zu treffen, dass jegliche Gefährdung ausgeschlossen wird (z.B. geeignete Messmittel, Absicherung, Strombegrenzung, Schutztrennung, Isolierung usw.).

10. Bei Verbindungen mit informationstechnischen Geräten, z.B. PC oder Industrierechner, ist darauf zu achten, dass diese der jeweils gültigen IEC60950-1 / EN60950-1 oder IEC61010-1 / EN 61010-1 entsprechen.

11. Sofern nicht ausdrücklich erlaubt, darf der Deckel oder ein Teil des Gehäuses niemals entfernt werden, wenn das Produkt betrieben wird. Dies macht elektrische Leitungen und Komponenten zugänglich und kann zu Verletzungen, Feuer oder Schaden am Produkt führen.

12. Wird ein Produkt ortsfest angeschlossen, ist die Verbindung zwischen dem Schutzleiteranschluss vor Ort und dem Geräteschutzleiter vor jeglicher anderer Verbindung herzustellen. Aufstellung und Anschluss darf nur durch eine Elektrofachkraft erfolgen.

13. Bei ortsfesten Geräten ohne eingebaute Sicherung, Selbstschalter oder ähnliche Schutzeinrichtung muss der Versorgungskreis so abgesichert sein, dass alle Personen, die Zugang zum Produkt haben, sowie das Produkt selbst ausreichend vor Schäden geschützt sind.

14. Jedes Produkt muss durch geeigneten Überspannungsschutz vor Überspannung (z.B. durch Blitzschlag) geschützt werden. Andernfalls ist das bedienende Personal durch elektrischen Schlag gefährdet.

15. Gegenstände, die nicht dafür vorgesehen sind, dürfen nicht in die Öffnungen des Gehäuses eingebracht werden. Dies kann Kurzschlüsse im Produkt und/oder elektrische Schläge, Feuer oder Verletzungen verursachen.

16. Sofern nicht anders spezifiziert, sind Produkte nicht gegen das Eindringen von Flüssigkeiten geschützt, siehe auch Abschnitt "Betriebszustände und Betriebslagen", Punkt 1. Daher müssen die Geräte vor Eindringen von Flüssigkeiten geschützt werden. Wird dies nicht beachtet, besteht Gefahr durch elektrischen Schlag für den Benutzer oder Beschädigung des Produkts, was ebenfalls zur Gefährdung von Personen führen kann.

17. Benutzen Sie das Produkt nicht unter Bedingungen, bei denen Kondensation in oder am Produkt stattfinden könnte oder ggf. bereits stattgefunden hat, z.B. wenn das Produkt von kalte in warme Umgebungen bewegt wurde. Das Eindringen von Wasser erhöht das Risiko eines elektrischen Schlages.

18. Trennen Sie das Produkt vor der Reinigung komplett von der Energieversorgung (z.B. speisendes Netz oder Batterie). Nehmen Sie bei Geräten die Reinigung mit einem weichen, nicht fasernden Staublappen vor. Verwenden Sie keinesfalls chemische Reinigungsmittel wie z.B. Alkohol, Aceton, Nitroverdünnung.

Betrieb

1. Die Benutzung des Produkts erfordert spezielle Einweisung und hohe Konzentration während der Benutzung. Es muss sichergestellt sein, dass Personen, die das Produkt bedienen, bezüglich ihrer körperlichen, geistigen und seelischen Verfassung den Anforderungen gewachsen sind, da andernfalls Verletzungen oder Sachschäden nicht auszuschließen sind. Es liegt in der Verantwortung des Arbeitsgebers/Betreibers, geeignetes Personal für die Benutzung des Produkts auszuwählen.

2. Bevor Sie das Produkt bewegen oder transportieren, lesen und beachten Sie den Abschnitt "Transport".

3. Wie bei allen industriell gefertigten Gütern kann die Verwendung von Stoffen, die Allergien hervorrufen, so genannte Allergene (z.B. Nickel), nicht generell ausgeschlossen werden. Sollten beim Umgang mit R&S-Produkten allergische Reaktionen, z.B. Hautausschlag, häufiges Niesen,

Bindehautrötung oder Atembeschwerden auftreten, ist umgehend ein Arzt aufzusuchen, um die Ursachen zu klären und Gesundheitsschäden bzw. -belastungen zu vermeiden.

4. Vor der mechanischen und/oder thermischen Bearbeitung oder Zerlegung des Produkts beachten Sie unbedingt Abschnitt "Entsorgung", Punkt 1.

5. Bei bestimmten Produkten, z.B. HF-Funkanlagen, können funktionsbedingt erhöhte elektromagnetische Strahlungen auftreten. Unter Berücksichtigung der erhöhten Schutzwürdigkeit des ungeborenen Lebens müssen Schwangere durch geeignete Maßnahmen geschützt werden. Auch Träger von Herzschrittmachern können durch elektromagnetische Strahlungen gefährdet sein. Der Arbeitgeber/Betreiber ist verpflichtet, Arbeitsstätten, bei denen ein besonderes Risiko einer Strahlenexposition besteht, zu beurteilen und zu kennzeichnen und mögliche Gefahren abzuwenden.

6. Im Falle eines Brandes entweichen ggf. giftige Stoffe (Gase, Flüssigkeiten etc.) aus dem Produkt, die Gesundheitsschäden an Personen verursachen können. Daher sind im Brandfall geeignete Maßnahmen wie z.B. Atemschutzmasken und Schutzkleidung zu verwenden.

7. Falls ein Laser-Produkt in ein R&S-Produkt integriert ist (z.B. CD/DVD-Laufwerk), dürfen keine anderen Einstellungen oder Funktionen verwendet werden, als in der Produktdokumentation beschrieben, um Personenschäden zu vermeiden (z.B. durch Laserstrahl).

Reparatur und Service

1. Das Produkt darf nur von dafür autorisiertem Fachpersonal geöffnet werden. Vor Arbeiten am Produkt oder Öffnen des Produkts ist dieses von der Versorgungsspannung zu trennen, sonst besteht das Risiko eines elektrischen Schlages.

2. Abgleich, Auswechseln von Teilen, Wartung und Reparatur darf nur von R&S-autorisierten Elektrofachkräften ausgeführt werden. Werden sicherheitsrelevante Teile (z.B. Netzschalter, Netztrafos oder Sicherungen) ausgewechselt, so dürfen diese nur durch Originalteile ersetzt werden. Nach jedem Austausch von sicherheitsrelevanten Teilen ist eine Sicherheitsprüfung durchzuführen (Sichtprüfung, Schutzleitertest, Isolationswiderstand-, Ableitstrommessung, Funktionstest). Damit wird sichergestellt, dass die Sicherheit des Produkts erhalten bleibt.

Batterien und Akkumulatoren/Zellen

Werden die Hinweise zu Batterien und Akkumulatoren/Zellen nicht oder unzureichend beachtet, kann dies Explosion, Brand und/oder schwere Verletzungen von Personen, unter Umständen mit Todesfolge, verursachen. Die Handhabung von Batterien und Akkumulatoren mit alkalischen Elektrolyten (z.B. Lithiumzellen) muss der EN 62133 entsprechen.

1. Zellen dürfen nicht zerlegt, geöffnet oder zerkleinert werden.

2. Zellen oder Batterien dürfen weder Hitze noch Feuer ausgesetzt werden. Die Lagerung im direkten Sonnenlicht ist zu vermeiden. Zellen und Batterien sauber und trocken halten. Verschmutzte Anschlüsse mit einem trockenen, sauberen Tuch reinigen.

3. Zellen oder Batterien dürfen nicht kurzgeschlossen werden. Zellen oder Batterien dürfen nicht gefahrbringend in einer Schachtel oder in einem Schubfach gelagert werden, wo sie sich gegenseitig kurzschließen oder durch andere leitende Werkstoffe kurzgeschlossen werden können. Eine Zelle oder Batterie darf erst aus ihrer Originalverpackung entnommen werden, wenn sie verwendet werden soll.

4. Zellen und Batterien von Kindern fernhalten. Falls eine Zelle oder eine Batterie verschluckt wurde, ist sofort ärztliche Hilfe in Anspruch zu nehmen.

5. Zellen oder Batterien dürfen keinen unzulässig starken, mechanischen Stößen ausgesetzt werden.

6. Bei Undichtheit einer Zelle darf die Flüssigkeit nicht mit der Haut in Berührung kommen oder in die Augen gelangen. Falls es zu einer Berührung gekommen ist, den betroffenen Bereich mit reichlich Wasser waschen und ärztliche Hilfe in Anspruch nehmen.

7. Werden Zellen oder Batterien, die alkalische Elektrolyte enthalten (z.B. Lithiumzellen), unsachgemäß ausgewechselt oder geladen, besteht Explosionsgefahr. Zellen oder Batterien nur durch den entsprechenden R&S-Typ ersetzen (siehe Ersatzteilliste), um die Sicherheit des Produkts zu erhalten.

8. Zellen oder Batterien müssen wiederverwertet werden und dürfen nicht in den Restmüll gelangen. Akkumulatoren oder Batterien, die Blei, Quecksilber oder Cadmium enthalten, sind Sonderabfall. Beachten Sie hierzu die landesspezifischen Entsorgungs- und Recycling-Bestimmungen.

Transport

1. Das Produkt kann ein hohes Gewicht aufweisen. Daher muss es vorsichtig und ggf. unter Verwendung eines geeigneten Hebemittels (z.B. Hubwagen) bewegt bzw. transportiert werden, um Rückenschäden oder Verletzungen zu vermeiden.

2. Griffe an den Produkten sind eine Handhabungshilfe, die ausschließlich für den Transport des Produkts durch Personen vorgesehen ist. Es ist daher nicht zulässig, Griffe zur Befestigung an bzw. auf Transportmitteln, z.B. Kränen, Gabelstaplern, Karren etc. zu verwenden. Es liegt in Ihrer Verantwortung, die Produkte sicher an bzw. auf geeigneten Transport- oder Hebemitteln zu befestigen. Beachten Sie die Sicherheitsvorschriften des jeweiligen Herstellers eingesetzter Transport- oder Hebemittel, um Personenschäden und Schäden am Produkt zu vermeiden.

3. Falls Sie das Produkt in einem Fahrzeug benutzen, liegt es in der alleinigen Verantwortung des Fahrers, das Fahrzeug in sicherer und angemessener Weise zu führen. Der Hersteller übernimmt keine Verantwortung für Unfälle oder Kollisionen. Verwenden Sie das Produkt niemals in einem sich bewegenden Fahrzeug, sofern dies den Fahrzeugführer ablenken könnte. Sichern Sie das Produkt im Fahrzeug ausreichend ab, um im Falle eines Unfalls Verletzungen oder Schäden anderer Art zu verhindern.

Entsorgung

1. Werden Produkte oder ihre Bestandteile über den bestimmungsgemäßen Betrieb hinaus mechanisch und/oder thermisch bearbeitet, können ggf. gefährliche Stoffe (schwermetallhaltiger Staub wie z.B. Blei, Beryllium, Nickel) freigesetzt werden. Die Zerlegung des Produkts darf daher nur von speziell geschultem Fachpersonal erfolgen. Unsachgemäßes Zerlegen kann Gesundheitsschäden hervorrufen. Die nationalen Vorschriften zur Entsorgung sind zu beachten.

2. Falls beim Umgang mit dem Produkt Gefahren- oder Betriebsstoffe entstehen, die speziell zu entsorgen sind, z.B. regelmäßig zu wechselnde Kühlmittel oder Motorenöle, sind die Sicherheitshinweise des Herstellers dieser Gefahren- oder Betriebsstoffe und die regional gültigen Entsorgungsvorschriften einzuhalten. Beachten Sie ggf. auch die zugehörigen speziellen Sicherheitshinweise in der Produktdokumentation. Die unsachgemäße Entsorgung von Gefahren- oder Betriebsstoffen kann zu Gesundheitsschäden von Personen und Umweltschäden führen.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Symbols and safety labels

Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

ON/OFF supply voltage	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double (reinforced) insulation

Tags and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

⚠ **DANGER**	indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **WARNING**	indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION**	indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	indicates the possibility of incorrect operation which can result in damage to the product. In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency.

2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or death.

3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.

2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.

3. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.

4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.

5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).

7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.

8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.

9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.

10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.

11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

12. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.

13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.

15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.

16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.

17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.

18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.

2. Before you move or transport the product, read and observe the section titled "Transport".

3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.

4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.

5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.

6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.

7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.

2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.

3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.

4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.

5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.

6. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.

7. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.

8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.

3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal

1. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

2. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Informaciones elementales de seguridad

Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad adjunto de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Símbolos y definiciones de seguridad

Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Adver-tencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

⚠ **PELIGRO**	PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.
⚠ **ADVERTENCIA**	ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.
⚠ **ATENCIÓN**	ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.
AVISO	AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo. En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal.

2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, pueden causarse lesiones o incluso la muerte.

3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.

2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.

3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.

4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.

5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).

7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.

8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.

9. En las mediciones en circuitos de corriente con una tensión $U_{eff} > 30$ V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).

10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.

11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.

13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.

14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.

15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.

16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.

17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.

18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.

2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".

3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados, los llamados alérgenos (p. ej. el níquel). Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.

4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.

6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.

7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.

2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.

2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.

3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.

4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.

5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

6. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.

7. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).

8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.

2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.

3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación

1. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.

2. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Consignes fondamentales de sécurité

Lisez et respectez impérativement les instructions et consignes de sécurité suivantes

Dans un souci constant de garantir à nos clients le plus haut niveau de sécurité possible, l'ensemble des usines et des sites du groupe Rohde & Schwarz s'efforce de maintenir les produits du groupe en conformité avec les normes de sécurité les plus récentes. Nos produits ainsi que les accessoires nécessaires sont fabriqués et testés conformément aux directives de sécurité en vigueur. Le respect de ces directives est régulièrement vérifié par notre système d'assurance qualité. Le présent produit a été fabriqué et contrôlé selon le certificat de conformité CE ci-joint et a quitté l'usine en un parfait état de sécurité. Pour le maintenir dans cet état et en garantir une utilisation sans danger, l'utilisateur doit respecter l'ensemble des consignes, remarques de sécurité et avertissements qui se trouvent dans ce manuel. Le groupe Rohde & Schwarz se tient à votre disposition pour toutes questions relatives aux présentes consignes de sécurité.

Il incombe ensuite à l'utilisateur d'employer ce produit de manière appropriée. Le produit est exclusivement destiné à l'utilisation en industrie et en laboratoire et/ou, si cela a été expressément autorisé, également aux travaux extérieurs ; il ne peut en aucun cas être utilisé à des fins pouvant causer des dommages aux personnes ou aux biens. L'exploitation du produit en dehors de son utilisation prévue ou le non-respect des consignes du constructeur se font sous la responsabilité de l'utilisateur. Le constructeur décline toute responsabilité en cas d'utilisation non conforme du produit.

L'utilisation conforme du produit est supposée lorsque celui-ci est employé selon les consignes de la documentation produit correspondante, dans la limite de ses performances (voir fiche technique, documentation, consignes de sécurité ci-après). L'utilisation du produit exige des compétences dans le domaine et connaissances de base en anglais. Il faut donc considérer que le produit ne doit être utilisé que par un personnel qualifié ou des personnes formées de manière approfondie et possédant les compétences requises. Si, pour l'utilisation des produits Rohde & Schwarz, l'emploi d'un équipement personnel de protection s'avérait nécessaire, il en serait alors fait mention dans la documentation produit à l'emplacement correspondant. Gardez les consignes fondamentales de sécurité et la documentation produit dans un lieu sûr et transmettez ces documents aux autres utilisateurs.

La stricte observation des consignes de sécurité a pour but d'exclure des blessures ou dommages survenant de tous types de danger. A cet effet, il est nécessaire de lire avec soin et de bien comprendre les consignes de sécurité ci-dessous avant l'utilisation du produit et de les respecter lors de l'utilisation du produit. Toutes les autres consignes de sécurité comme par exemple pour la protection de personnes, qui sont présentées à l'emplacement correspondant de la documentation produit, doivent également être impérativement respectées. Dans les présentes consignes de sécurité, l'ensemble des marchandises commercialisées par le groupe Rohde & Schwarz, notamment les appareils, les installations ainsi que les accessoires, est intitulé « produit ».

Symboles et marquages de sécurité

Avis, source générale de danger Se référer à la documentation produit	Attention lors de la manipulation d'appareils ayant un poids élevé	Risque de choc électrique	Avertisse-ment, surface chaude	Connexion du conducteur de protection	Point de mise à la terre	Point de mise à la masse

Avis : Prudence lors de la manipulation de composants sensibles aux décharges électrostatiques	Tension d'alimentation MARCHE / ARRET	Indicateur de veille	Courant continu (CC)	Courant alternatif (CA)	Courant continu/alternatif (CC/CA)	Appareil protégé par isolation double (renforcée)

Mots de signalisation et significations

Les mots de signalisation suivants sont utilisés dans la documentation produit pour avertir des risques et dangers.

⚠ **DANGER**   DANGER indique une situation dangereuse avec un potentiel de risque élevé, immédiat, qui entraînera la mort ou des blessures graves, si elle n'est pas évitée.

⚠ **AVERTISSEMENT**   AVERTISSEMENT indique une situation dangereuse avec un potentiel de risque moyen qui peut entraîner la mort ou des blessures (graves), si elle n'est pas évitée.

⚠ **ATTENTION**   ATTENTION indique une situation dangereuse avec un potentiel de risque faible qui est susceptible d'entraîner des blessures légères ou moyennes si elle n'est pas évitée.

AVIS   AVIS indique la possibilité d'une utilisation erronée pouvant endommager le produit.
Dans la documentation produit, est synonyme du terme PRUDENCE.

Ces mots de signalisation correspondent à la définition habituelle utilisée dans l'espace économique européen pour des applications civiles. Des définitions divergentes peuvent cependant exister dans d'autres espaces économiques ou dans le cadre d'applications militaires. Il faut donc veiller à ce que les mots de signalisation décrits ici ne soient utilisés qu'en relation avec la documentation produit correspondante et seulement avec le produit correspondant. L'utilisation des mots de signalisation en relation avec des produits ou des documentations non correspondants peut conduire à des erreurs d'interprétation et par conséquent à des dommages corporels ou matériels.

Etats et positions de fonctionnement

L'appareil ne doit être utilisé que dans les états et positions de fonctionnement indiqués par le constructeur. Toute obstruction de la ventilation doit être empêchée. Le non-respect des indications du constructeur peut provoquer des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort. Pour tous les travaux, les directives locales et/ou nationales de sécurité et de prévention d'accidents doivent être respectées.

1. Sauf stipulations contraires, les produits Rohde & Schwarz répondent aux exigences ci-après : faire fonctionner le produit avec le fond du boîtier toujours en bas, indice de protection IP 2X, indice de pollution 2, catégorie de surtension 2, utilisation uniquement à l'intérieur, altitude max. 2000 m au-dessus du niveau de la mer, transport max. 4500 m au-dessus du niveau de la mer, tolérance de ±10 % pour la tension nominale et de ±5 % pour la fréquence nominale.

2. Ne jamais placer le produit sur des surfaces, véhicules, dépôts ou tables non appropriés pour raisons de stabilité et/ou de poids. Suivre toujours strictement les indications d'installation du constructeur pour le montage et la fixation du produit sur des objets ou des structures (par exemple parois et étagères). En cas d'installation non conforme à la documentation produit, il y a risque de blessures ou même de mort.

3. Ne jamais placer le produit sur des dispositifs générant de la chaleur (par exemple radiateurs et ventilateurs à air chaud). La température ambiante ne doit pas dépasser la température maximale spécifiée dans la documentation produit ou dans la fiche technique. Une surchauffe du produit peut provoquer des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort.

Sécurité électrique

Si les consignes relatives la sécurité électrique ne sont pas ou insuffisamment respectées, il peut s'ensuivre des chocs électriques, des incendies et/ou des blessures graves pouvant éventuellement entraîner la mort.

1. Avant chaque mise sous tension du produit, il faut s'assurer que la tension nominale réglée sur le produit correspond à la tension nominale du secteur. Si la tension réglée devait être modifiée, remplacer le fusible du produit si nécessaire.

2. Pour les produits de la classe de protection I, pourvus d'un câble secteur mobile et d'un connecteur secteur, leur utilisation n'est admise qu'avec des prises munies d'un contact de protection raccordé à la terre et d'un conducteur de protection avec prise de terre.

3. Toute déconnexion intentionnelle du conducteur de protection qui relie à la terre, dans le câble ou dans le produit lui-même, est interdite. Elle entraîne un risque de choc électrique au niveau du produit. En cas d'utilisation des câbles prolongateurs ou des multiprises, ceux-ci doivent être examinés régulièrement afin de garantir le respect des directives de sécurité.

4. Si l'appareil n'est pas doté d'un interrupteur secteur pour le couper du secteur, le connecteur mâle du câble de branchement est à considérer comme interrupteur. S'assurer dans ce cas que le connecteur secteur soit toujours bien accessible (conformément à la longueur du câble de branchement soit env. 2 m). Les commutateurs fonctionnels ou électroniques ne sont pas adaptés pour couper l'appareil du secteur. Si des appareils sans interrupteur secteur sont intégrés dans des baies ou systèmes, le dispositif d'interruption secteur doit être reporté au niveau du système.

5. Ne jamais utiliser le produit si le câble secteur est endommagé. Vérifier régulièrement le parfait état du câble secteur. Prendre les mesures préventives et dispositions nécessaires pour que le câble secteur ne puisse pas être endommagé et que personne ne puisse subir de préjudice, par exemple en trébuchant sur le câble ou par des chocs électriques.

6. L'utilisation des produits est uniquement autorisée sur des réseaux secteur de type TN/TT protégés par des fusibles, d'une intensité max. de 16 A (pour toute intensité supérieure, consulter le groupe Rohde & Schwarz).

7. Ne jamais brancher le connecteur dans des prises secteur sales ou poussiéreuses. Enfoncer fermement le connecteur jusqu'au bout de la prise. Le non-respect de cette mesure peut provoquer des arcs, incendies et/ou blessures.

8. Ne jamais surcharger les prises, les câbles prolongateurs ou les multiprises, cela pouvant provoquer des incendies ou chocs électriques.

9. En cas de mesures sur les circuits électriques d'une tension efficace > 30 V, prendre les précautions nécessaires pour éviter tout risque (par exemple équipement de mesure approprié, fusibles, limitation de courant, coupe-circuit, isolation, etc.).

10. En cas d'interconnexion avec des équipements informatiques comme par exemple un PC ou un ordinateur industriel, veiller à ce que ces derniers soient conformes aux normes IEC60950-1 / EN60950-1 ou IEC61010-1 / EN 61010-1 en vigueur.

11. Sauf autorisation expresse, il est interdit de retirer le couvercle ou toute autre pièce du boîtier lorsque le produit est en cours de service. Les câbles et composants électriques seraient ainsi accessibles, ce qui peut entraîner des blessures, des incendies ou des dégâts sur le produit.

12. Si un produit est connecté de façon permanente, établir avant toute autre connexion le raccordement du conducteur de protection local et du conducteur de protection du produit. L'installation et le raccordement ne doivent être effectués que par une personne qualifiée en électricité.

13. Sur les appareils installés de façon permanente sans fusible ni disjoncteur automatique ni dispositifs de protection similaires intégrés, le circuit d'alimentation doit être sécurisé de sorte que toutes les personnes ayant accès au produit et le produit lui-même soient suffisamment protégés contre tout dommage.

14. Chaque produit doit être protégé de manière appropriée contre les éventuelles surtensions (par exemple dues à un coup de foudre). Sinon les utilisateurs sont exposés à des risques de choc électrique.

15. Ne jamais introduire d'objets non prévus à cet effet dans les ouvertures du boîtier, étant donné que cela peut entraîner des courts-circuits dans le produit et/ou des chocs électriques, incendies ou blessures.

16. Sauf spécification contraire, les produits ne sont pas protégés contre l'infiltration de liquides, voir aussi le paragraphe "Etats et positions de fonctionnement", point 1. Il faut donc protéger les appareils contre l'infiltration de liquides. La non-observation de cette consigne entraînera le risque de choc électrique pour l'utilisateur ou d'endommagement du produit, ce qui peut également mettre les personnes en danger.

17. Ne pas utiliser le produit dans des conditions pouvant occasionner ou ayant occasionné des condensations dans ou sur le produit, par exemple lorsque celui-ci est déplacé d'un environnement froid à un environnement chaud. L'infiltration d'eau augmente le risque de choc électrique.

18. Avant le nettoyage, débrancher le produit de l'alimentation (par exemple secteur ou pile). Pour le nettoyage des appareils, utiliser un chiffon doux non pelucheux. N'utiliser en aucun cas de produit de nettoyage chimique, tel que de l'alcool, de l'acétone ou un solvant à base de cellulose.

Fonctionnement

1. L'utilisation des produits exige une formation spécifique ainsi qu'une grande concentration. Il est impératif que les personnes qui utilisent le produit présent les aptitudes physiques, mentales et psychiques requises ; sinon des dommages corporels ou matériels ne pourront pas être exclus. Le choix du personnel qualifié pour l'utilisation du produit est sous la responsabilité de l'employeur/l'exploitant.

2. Avant de déplacer ou transporter le produit, lire et respecter le paragraphe "Transport".

3. Comme pour tous les biens produits de façon industrielle, l'utilisation de matériaux pouvant causer des allergies (allergènes, comme par exemple le nickel) ne peut être exclue. Si, lors de l'utilisation de

produits Rohde & Schwarz, des réactions allergiques surviennent – telles que éruption cutanée, éternuements fréquents, rougeur de la conjonctive ou difficultés respiratoires – il faut immédiatement consulter un médecin pour en clarifier la cause et éviter toute atteinte à la santé.

4. Avant le traitement mécanique et/ou thermique ou le démontage du produit, il faut impérativement observer le paragraphe "Elimination", point 1.

5. Selon les fonctions, certains produits tels que des installations de radiocommunication RF peuvent produire des niveaux élevés de rayonnement électromagnétique. Etant donné la vulnérabilité de l'enfant à naître, les femmes enceintes doivent être protégées par des mesures appropriées. Des porteurs de stimulateurs cardiaques peuvent également être menacés par des rayonnements électromagnétiques. L'employeur/l'exploitant est obligé d'évaluer et de repérer les lieux de travail soumis à un risque particulier d'exposition aux rayonnements et de prévenir tous les dangers éventuels.

6. En cas d'incendie, des matières toxiques (gaz, liquides, etc.) pouvant nuire à la santé peuvent émaner du produit. Il faut donc, en cas d'incendie, prendre des mesures adéquates comme par exemple le port de masques respiratoires et de vêtements de protection.

7. Si un produit laser est intégré dans un produit Rohde & Schwarz (par exemple lecteur CD/DVD), il ne faut pas utiliser de réglages ou fonctions autres que ceux décrits dans la documentation produit pour éviter tout dommage corporel (par exemple causé par rayon laser).

Réparation et service après-vente

1. Le produit ne doit être ouvert que par un personnel qualifié et autorisé. Avant de travailler sur le produit ou de l'ouvrir, il faut le couper de la tension d'alimentation ; sinon il y a risque de choc électrique.

2. Les travaux d'ajustement, le remplacement des pièces, la maintenance et la réparation ne doivent être effectués que par des électroniciens qualifiés et autorisés par Rohde & Schwarz. En cas de remplacement de pièces concernant la sécurité (notamment interrupteur secteur, transformateur secteur ou fusibles), celles-ci ne doivent être remplacées que par des pièces d'origine. Après chaque remplacement de pièces concernant la sécurité, une vérification de sécurité doit être effectuée (contrôle visuel, vérification conducteur de protection, résistance d'isolation, courant de fuite et test de fonctionnement). Cela assure le maintien de la sécurité du produit.

Piles, batteries et accumulateurs/cellules

Si les instructions concernant les piles, batteries et accumulateurs/cellules ne sont pas ou insuffisamment respectées, cela peut provoquer des explosions, des incendies et/ou des blessures graves pouvant entraîner la mort. La manipulation de piles, batteries et accumulateurs contenant des électrolytes alcalins (par exemple cellules de lithium) doit être conforme à la norme EN 62133.

1. Les cellules ne doivent pas être démontées, ouvertes ni réduites en morceaux.

2. Ne jamais exposer les cellules, piles ou batteries à la chaleur ni au feu. Ne pas les stocker dans un endroit où elles sont exposées au rayonnement direct du soleil. Tenir les cellules, piles et batteries au sec. Nettoyer les raccords sales avec un chiffon sec et propre.

3. Ne jamais court-circuiter les cellules, piles ou batteries. Les cellules, piles ou batteries ne doivent pas être gardées dans une boîte ou un tiroir où elles peuvent se court-circuiter mutuellement ou être court-circuitées par des matériaux conducteurs. Une cellule, pile ou batterie ne doit être retirée de son emballage d'origine que lorsqu'on l'utilise.

4. Les cellules, piles et batteries doivent être inaccessibles aux enfants. Si une cellule, pile ou batterie a été avalée, il faut immédiatement consulter un médecin.

5. Les cellules, piles ou batteries ne doivent pas être exposés à chocs mécaniques de force non admissible.

6. En cas de manque d'étanchéité d'une cellule, le liquide ne doit pas entrer en contact avec la peau ou les yeux. S'il y a contact, rincer abondamment l'endroit concerné à l'eau et consulter un médecin.

7. Il y a danger d'explosion en cas de remplacement ou chargement incorrect des cellules, piles ou batteries qui contiennent des électrolytes alcalins (par exemple cellules de lithium). Remplacer les cellules, piles ou batteries uniquement par le type Rohde & Schwarz correspondant (voir la liste des pièces de rechange) pour maintenir la sécurité du produit.

8. Il faut recycler les cellules, piles ou batteries et il est interdit de les éliminer comme déchets normaux. Les accumulateurs ou piles et batteries qui contiennent du plomb, du mercure ou du cadmium sont des déchets spéciaux. Observer les directives nationales d'élimination et de recyclage.

Transport

1. Le produit peut avoir un poids élevé. Il faut donc le déplacer ou le transporter avec précaution et en utilisant le cas échéant un moyen de levage approprié (par exemple chariot élévateur) pour éviter des dommages au dos ou des blessures.

2. Les poignées des produits sont une aide de manipulation exclusivement réservée au transport du produit par des personnes. Il est donc proscrit d'utiliser ces poignées pour attacher le produit à ou sur des moyens de transport, tels que grues, chariots élévateurs, camions etc. Vous êtes responsable de la fixation sûre des produits à ou sur des moyens de transport et de levage appropriés. Observer les consignes de sécurité du constructeur des moyens de transport ou de levage utilisés pour éviter des dommages corporels et des dégâts sur le produit.

3. L'utilisation du produit dans un véhicule se fait sous l'unique responsabilité du conducteur qui doit piloter le véhicule de manière sûre et appropriée. Le constructeur décline toute responsabilité en cas d'accidents ou de collisions. Ne jamais utiliser le produit dans un véhicule en mouvement si cela pouvait détourner l'attention du conducteur. Sécuriser suffisamment le produit dans le véhicule pour empêcher des blessures ou dommages de tout type en cas d'accident.

Elimination

1. Si les produits ou leurs composants sont travaillés mécaniquement et/ou thermiquement au-delà de l'utilisation prévue, des matières dangereuses (poussières contenant des métaux lourds comme par exemple du plomb, du béryllium ou du nickel) peuvent se dégager le cas échéant. Le démontage du produit ne doit donc être effectué que par du personnel qualifié. Le démontage inadéquat peut nuire à la santé. Les directives nationales pour l'élimination des déchets doivent être observées.

2. Si, en cas d'utilisation du produit, des matières dangereuses ou des combustibles sont dégagés qui exigent une élimination spéciale, comme par exemple liquides de refroidissement ou huiles moteurs qui sont à changer régulièrement, les consignes de sécurité du fabricant de ces matières combustibles ou dangereuses ainsi que les directives d'élimination des déchets en vigueur au niveau régional doivent être respectées. Les consignes de sécurité spéciales correspondantes dans la documentation produit sont à respecter le cas échéant. L'élimination non conforme des matières dangereuses ou combustibles peut provoquer des atteintes à la santé et des dommages écologiques.

## Kundeninformation zur Batterieverordnung (BattV)

Dieses Gerät enthält eine schadstoffhaltige Batterie. Diese darf nicht mit dem Hausmüll entsorgt werden.

Nach Ende der Lebensdauer darf die Entsorgung nur über eine Rohde&Schwarz-Kundendienststelle oder eine geeignete Sammelstelle erfolgen.

Safety Regulations for Batteries (according to BattV)

This equipment houses a battery containing harmful substances that must not be disposed of as normal household waste.

After its useful life, the battery may only be disposed of at a Rohde & Schwarz service center or at a suitable depot.
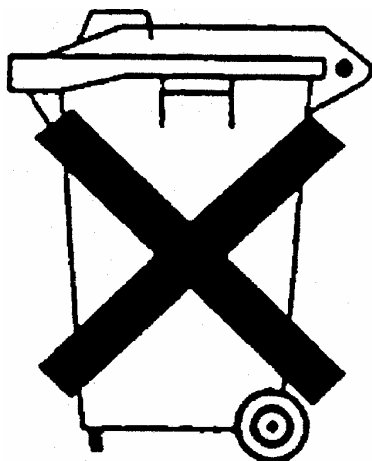
Normas de Seguridad para Baterías (Según BattV)

Este equipo lleva una batería que contiene sustancias perjudiciales, que no se debe desechar en los contenedores de basura domésticos.

Después de la vida útil, la batería sólo se podrá eliminar en un centro de servicio de Rohde & Schwarz o en un depósito apropiado.

Consignes de sécurité pour batteries (selon BattV)

Cet appareil est équipé d'une pile comprenant des substances nocives. Ne jamais la jeter dans une poubelle pour ordures ménagéres.

Une pile usagée doit uniquement être éliminée par un centre de service client de Rohde & Schwarz ou peut être collectée pour être traitée spécialement comme déchets dangereux.

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).
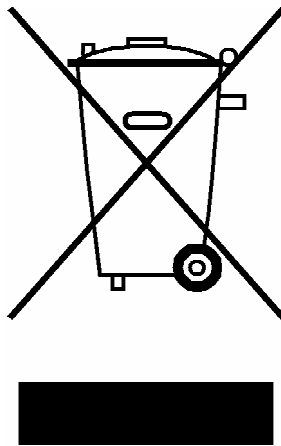
Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.

ROHDE & SCHWARZ

Qualitätszertifikat
Certificate of quality
Certificat de qualité

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde & Schwarz quality management system is certified according to standards such as ISO 9001 and ISO 14001.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde & Schwarz a été homologué, entre autres, conformément aux normes ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de gestion de l'environnement certifié selon ISO 14001

75 Years of Driving Innovation

1171.0200.11 V 04.00

ROHDE & SCHWARZ

ROHDE & SCHWARZ
EU-KONFORMITÄTSERKLÄRUNG

$C\epsilon$

Zertifikat-Nr.: 2010-5

Hiermit wird bescheinigt, dass der/die/das:

Gerätetyp	Materialnummer	Benennung
SMA100A	1400.0000.02	SIGNAL GENERATOR

mit den Bestimmungen des Rates der Europäischen Union zur Angleichung der Rechts-vorschriften der Mitgliedstaaten

- betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen (2006/95/EG)

- über die elektromagnetische Verträglichkeit (2004/108/EG)

übereinstimmt.

Die Übereinstimmung wird nachgewiesen durch die Einhaltung folgender Normen:

EN 61010-1: 2001
EN 61326-1: 2006
EN 61326-2-1: 2006
EN 55011: 2007 + A2: 2007
EN 61000-3-2: 2006
EN 61000-3-3: 1995 + A1: 2001 + A2: 2005

Bei der Beurteilung der elektromagnetischen Verträglichkeit wurden die Störaussendungs-grenzwerte für Geräte der Klasse B sowie die Störfestigkeit für Betrieb in industriellen Bereichen zugrunde gelegt.

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

München, den 05.02.2010   Zentrales Qualitätsmanagement MF-QZ / Radde

ROHDE & SCHWARZ
CE Declaration of Conformity

CE

Certificate No.: 2010-5

This is to certify that:

Equipment type	Stock No.	Designation
SMA100A	1400.0000.02	SIGNAL GENERATOR

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits
  (2006/95/EC)

- relating to electromagnetic compatibility
  (2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1: 2001
EN 61326-1: 2006
EN 61326-2-1: 2006
EN 55011: 2007 + A2: 2007
EN 61000-3-2: 2006
EN 61000-3-3: 1995 + A1: 2001 + A2: 2005

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 2009-02-05   Central Quality Management MF-QZ / Radde

ROHDE & SCHWARZ

CE Déclaration de Conformité

CE

Certificat N° : 2010-5

Nous certifions par la présente que l'appareil ci-dessous :

Type	N° de référence	Désignation
SMA100A	1400.0000.02	SIGNAL GENERATOR

est conforme aux dispositions de la Directive du Conseil de l'Union européenne concernant le rapprochement des législations des États membres

- relatives aux équipements électriques à utiliser dans des limites définies de tension (2006/95/CE)

- relatives à la compatibilité électromagnétique (2004/108/CE)

La conformité est justifiée par le respect des normes suivantes :

EN 61010-1: 2001
EN 61326-1: 2006
EN 61326-2-1: 2006
EN 55011: 2007 + A2: 2007
EN 61000-3-2: 2006
EN 61000-3-3: 1995 + A1: 2001 + A2: 2005

Pour évaluer la compatibilité électromagnétique, il a été tenu compte des limites de perturbations radioélectriques pour les appareils de la classe B ainsi que de l'immunité aux perturbations pour l'utilisation dans l'industrie.

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, le 2009-02-05   Service général de qualité MF-QZ / Radde

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

USA & Canada	Monday to Friday 8:00 AM – 8:00 PM	(except US public holidays) Eastern Standard Time (EST)
	Tel. from USA From outside USA Fax	888-test-rsa (888-837-8772) (opt 2) +1 410 910 7800 (opt 2) +1 410 910 7801
	E-mail	CustomerSupport@rohde-schwarz.com
East Asia	Monday to Friday 8:30 AM – 6:00 PM	(except Singaporean public holidays) Singapore Time (SGT)
	Tel. Fax	+65 6 513 0488 +65 6 846 1090
	E-mail	CustomerSupport@rohde-schwarz.com
Rest of the World	Monday to Friday 08:00 – 17:00	(except German public holidays) Central European Time (CET)
	Tel. Fax	+49 89 4129 13774 +49 (0) 89 41 29 637 78
	E-mail	CustomerSupport@rohde-schwarz.com

ROHDE & SCHWARZ

Contents

1 Preface

1.1 Documentation Overview

The user documentation for the R&S SMA consists of the following parts:

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
    - Online help system (*.chm) as a standalone help,
    - Operating Manual,
    - Service Manual,
    - Data sheet and specifications,
    - Links to useful sites on the R&S internet.

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. The online help contains help on operating the R&S SMA and all available options.

Quick Start Guide

This manual is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

Operating Manual

The Operating Manual is a supplement to the Quick Start Guide. The manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given. The manual can also be orderd in printed form (see ordering information in the data sheet).

Service Manual

This Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be orderd in printed form (see ordering information in the data sheet).

Release Notes

The release notes describe new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

1.2 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

2 Preparing for Use

The following topics will help you to get familiar with the instrument and perform the first steps:

● Front Panel Tour

● Rear Panel Tour

● Putting into Operation

This section explains the control elements and connectors of the Signal Generator R&S SMA with the aid of the front and rear views and describes how to put the instrument into operation. It also describes the connection of peripherals such as printer, keyboard or mouse. Specifications of interfaces can be found in the data sheet.

The chapter 3, "Getting Started", on page 45 of this manual provides an overview of the generator functions and introduces the operating concept. Detailed operating instructions and an overview of menus follow in chapter 4, "Manual Operation", on page 55.

For all reference information concerning manual and remote control of the instrument refer to the online help system or its printed/printable version. A more detailed description of the hardware connectors and interfaces is also part of the help system.

2.1 Front Panel Tour

The front panel of the R&S Signal Generator consists of the VGA display, some utility keys (left side) and the hardkey area with connectors and control interfaces (right side). The subsequent sections provide brief explanations on the controls and connectors, the hardkey area and the front panel.
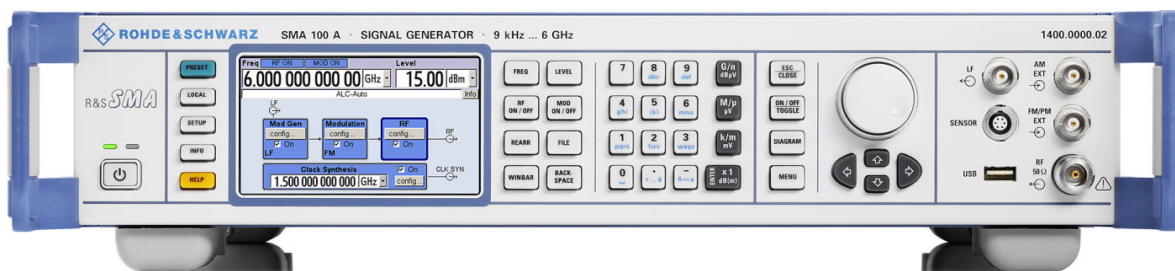
Fig. 2-1: Front panel view

2.1.1 Utility Keys

The keys to the left of the display cause the R&S SMA to return to a definite instrument state and provide information on the instrument and assistance.

For more information refer to chapter "Instrument Settings".

PRESET

Sets the instrument to a defined state (see chapter 2.3.4.4, "Default Settings", on page 29).

LOCAL

Switches from remote control to local (manual) control.

SETUP

Opens the "Setup" dialog for configuring presettings.

For more information, see chapter 5.2.3, "General Configuration of Instrument - Setup Key", on page 84.

INFO

Displays status messages, error messages and warnings.

HELP

Displays context-sensitive help text.

2.1.2 Standby LEDs and Standby Key
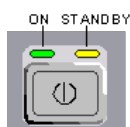
The standby LEDs and the ON/STANDBY key are located in the bottom left corner of the front panel.

The ON/STANDBY key toggles the instrument between standby and ready state (indicated by the standby LEDs).

The standby LEDs indicate the instrument states as follow:

● the green LED (left) is on when the instrument is ready for operation,
● the yellow LED (right) is on in the standby mode.

See also chapter 2.3.4.1, "Standby and Ready state", on page 28.

2.1.3 Display

The display clearly shows all main settings and signal generator states.

The display is divided into the following sections:

● Frequency and level display with info line

   – Frequency and level settings containing offset.

   – Status messages

   – Brief error messages.
     To access an window with detailed information for a message, use the INFO key.

● Block diagram
  The block diagram shows the current configuration and the signal flow in the gener-
  ator with the aid of function blocks containing an on/off switch. Selecting a function
  block opens a list of associated setting menus. Active menus, info windows and
  graphs are displayed on top of the block diagram. The block diagram can be displayed
  in the foreground anytime with the DIAGRAM key.

For detailed information, see chapter 4.2, "Display", on page 58.

2.1.4 Setup Keys

The keys to the right of the display set parameters, select views and control the windows.

2.1.4.1 Keys for Setting Paramters

These keys provide direct access to the settings in the header of the instrument and can
be used for fast changing the state of the modulation and the RF signal.

For more information refer to chapter "Instrument Functions".

FREQ
Activates frequency entry.

RF ON/OFF
Switches the RF signal on and off.

"RF OFF" is displayed in the header next to the "Frequency" field.

LEVEL
Activates level entry.

MOD ON/OFF
Switches the modulations on and off.

"MOD OFF" is displayed in the info line of the header next to the "Level" field.

REARR
Adjusts the size of the active menu to use the whole hight of the dislay.

FILE
Activates the menu for storing or loading files (see chapter 4.7, "File Management",
on page 73).

WINBAR

Toggles between the active menus.

BACKSPACE

Deletes the character to the left of the cursor.

2.1.4.2 Display Keys

The keys left of the rotary knob arrange different windows on the display.

ESC

The function of this key depends on the current cursor position.

- Calls the next higher selection level.
- Closes the open window without accepting new entries; the old value or parameter is retained.
- In dialog boxes that contain a "Cancel" button it activates that button.
- Closes all kinds of dialog boxes, if the edit mode is not active.
- Quits the edit mode, if the edit mode is active.
- Switches between different entry fields of a menu.
- Shifts the entry cursor from the header display to the previously active menu, or to the previously highlighted block in the block diagram if no menu is active.

TOGGLE

- Switches highlighted elements or a function block on and off.
- Switches between two or more settings, e.g. items of selection lists. At the end of a list, the cursor is set on the first entry again.

DIAGRAM

Brings the block diagram to the foreground. Active menus are minimized.

The display of the header section can be enlarged so that it completely covers the display by pressing the DIAGRAM key twice. The frequency, level and status information is indicated in extra large letters.

MENU

Calls the menu tree.

2.1.5 Keypad for data entry

The keys in the data entry keypad are used to enter alphanumeric data and units.

Data entry keys are only enabled while the cursor is placed on a data input field in a dialog. Their function depends on the data type of the input field.

Keys	Description
0...9/abc	Enters the corresponding numbers (in numeric input fields) or characters (character input fields).
.	Inserts a decimal point (numeric input fields) or dot (character input fields) at the cursor position. Multiple decimal points are not allowed.
Unit keys	Selects a unit and thus determine the absolute value, or changes the unit, i.e. trigger a recalculation without changing the absolute value. The function depends on the time at which the UNIT key is used during parameter entry (see chapter 4.4.5, "Working with Units ", on page 67). For unit-free values, the X1 key is equivalent to ENTER. It confirms the previous entry and deactivates the input field.
_	Adds a blank in a character input field.
*... #	Enters special characters. Toggles through the available characters if the key is pressed several times in a row.
A <-> a	Toggles between uppercase and lowercase characters.
A, B, C, D, E, F	Enters hexadecimal values. The letters assigned to the keys are automatically active when an entry field with a hexadecimal value is active.

ENTER

Pressing the rotary knob has the same effect.

● Concludes the entry of dimensionless entries. For other entries, this key can be used instead of the default unit key. The new value is accepted.
● Confirms ("OK") and closes open input windows.
● In a dialog box, selects the default or focused button.
● In a dialog box, activates the edit mode for the focused area, if available.
● In a dialog box, activates or deactivates the selected option of the focused area, if the edit mode is active.
● Calls the next menu level.

2.1.6 Rotary Knob and Navigation Keys

The rotary knob and the arrow keys are alternative control elements for data variation and navigation in the graphical user interface.

ROTARY KNOB

The rotary knob has several functions:

- Increases (clockwise direction) or decreases (counter-clockwise direction) numeric values at a defined step width in editing mode
- Moves the cursor, e.g. to a function block in the block diagram
- Scrolls within lists, tables or tree views
- Acts like the ENTER key, when it is pressed.
- Shifts the selection bar within focused areas (e.g. lists), if the edit mode is activated.

Note: Turning or pressing the rotary knob is equivalent to pressing the UP and DOWN keys or the ENTER key in the keypad.

NAVIGATION KEYS

The navigation keys consist of 4 arrow keys which are used for navigation, alternatively to the rotary knob.

UP/ DOWN KEYS	The up and down arrow keys do the following:

- In a numeric edit dialog box, increase or decrease the instrument parameter.
- In a list, table, window or dialog box, scroll vertically.

LEFT/ RIGHT KEYS — The left and right arrow keys do the following:

- In an alphanumeric edit dialog box, move the cursor forward and back.
- In a list, table, wondiw or dialog box, scroll horizontally.

2.1.7 Front Panel Connectors

The RF and LF connectors and various additional interface connectors are located on the front panel.

LF

Output for internal LF modulation generator signal.

See also data sheet and chapter 5.5.1, "LF Generator Overview", on page 281, chapter 5.5.3, "LF Output", on page 287.

AM EXT
Input for external AM modulation signals.

FM/PM EXT
Input for external FM or PhiM modulation signals (option R&S SMA-B20/-B22).

RF

Outputs for RF signal.

NOTICE! Maximum Input Levels. Do not overload the RF output. The maximum permissible back-feed is specified in the data sheet.

USB

USB (universal serial bus) interfaces of type A (host USB).

- Connection of peripherals such as mouse or keyboard
- Connection of memory stick for file transmission
- Firmware update

See also chapter 2.4.1, "Connecting USB Devices", on page 31.

SENSOR
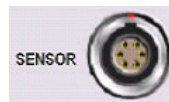
Connector for R&S NRP-Zxx sensors.

With the aid of the "User Correction" function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables.

The power sensors are connected by inserting the male connector. To disconnect hold the connector by its sleeve. Pulling on the sensor cable will not release the sensor connector.

See also chapter 5.3.5.1, "NRP-Z Power Viewer", on page 125.

2.2 Rear Panel Tour

This section gives an overview of connectors on the rear panel of the instrument. Each connector is briefly described and a reference is given to the chapters containing detailed information. For technical data of the connectors refer to the data sheet.

Fig. 2-2: Rear panel view

2.2.1 Description of the Connectors
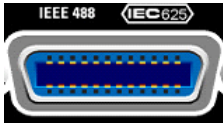
IEC 625/IEEE 488

IEC-bus (IEEE 488) interface for remote control of the instrument.

See also chapter A.1, "GPIB Bus Interface", on page 615 and chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 310.

Note: In order to avoid electromagnetic interference (EMI) caused by open lines, always terminate any connected IEC-bus cable with an instrument or a controller.

INSTR TRIG

Input for external trigger for sweeps, list mode and Fast Hopping Mode.

AUX I/O

Parallel input for FM/PhiM digital data signals as well as control signals for Fast Hopping mode.

NOTICE! Risk of instrument damage. The maximum permissible input voltage is 3.3 V DC.

For detailed description of the AUX I/O connector, refer to chapter A.2, "AUX I/O Connector", on page 616.

USB IN

USB (universal serial bus) interface of type B (device USB).

This interface can be used for remote control of the instrument.

USB CONNECTORS TYPE A

● Connection of peripherals such as mouse, keyboard, etc.
● Connection of memory stick for file transmission
● Firmware update

Further USB interface type A are available on the front panel.

See also chapter 2.4.1, "Connecting USB Devices", on page 31.

PULSE EXT

Input of external pulse signal or input of external trigger/gate signal for internal pulse generator.

See also chapter 5.4.5, "Pulse Modulation (PM)", on page 222 .

PULSE VIDEO

Output of internal pulse generator signal or external pulse signal fed in via the PULSE EXT connector (video signal).

See also chapter 5.4.5, "Pulse Modulation (PM)", on page 222 .

PULSE SYNC

Output of sync signal for pulse generator signal. The sync signal is generated at the beginning of each pulse. For double-pulse generation, the sync signal is generated at the beginning of the first pulse.

EXT TUNE

Tuning input for the internal reference frequency.

See chapter 5.3.4, "Reference Oscillator", on page 122.

LAN CONNECTOR

Ethernet interface

- For integrating signal generators in a network
- Remote control of signal generator
- Remote access to the signal generator
- Firmware update

See also:

- chapter 2.6, "Setting Up a Network (LAN) Connection", on page 33
- chapter 6.1.3, "LAN Interface", on page 307
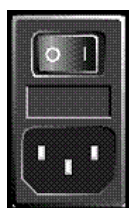
AC SUPPLY AND POWER SWITCH

When the R&S SMA is connected to the AC supply, it automatically sets itself to the correct range for the applied voltage (range: see type label). There is no need to set the voltage manually or change fuses.

The power switch can be set to two positions:

- **0**

  The instrument is disconnected from the mains.

- **I**

  The instrument is power-supplied. It is either ready for operation (STANDBY) or in operating mode, depending on the position of the ON/STANDBY switch on the instrument front.

See also data sheet and chapter 2.3.3, "Connecting the Instrument to the AC Supply", on page 27.

CF MEMORY SLOT

Slot for removable CompactFlash™ Card (option R&S SMA-B80).
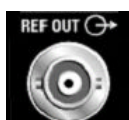
REF OUT

Output of internal reference signal.

See also chapter 5.3.4, "Reference Oscillator", on page 122.
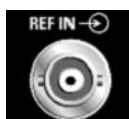
REF IN

Input for external reference signal.

See also chapter 5.3.4, "Reference Oscillator", on page 122.

SENSOR

Rear panel connector for R&S NRP-Zxx power sensors (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).
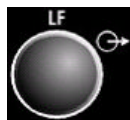
LF

Rear panel output for internal LF generator signal (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).

FM/PM EXT

Rear panel input for external FM or PhiM modulation signals (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).
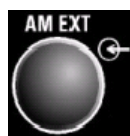
AM EXT

Rear panel input for external AM modulation signals (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).

RF OUT

Rear panel output for RF signal (option R&S SMA-B81).

This option is recommended for use of the instrument in a 19" rack. Installing the instrument in a 19" rack requires a rack adapter (refer to data sheet for Order No.).

NOTICE! Maximum Input Levels. Do not overload the RF output. The maximum permissible back-feed is specified in the data sheet.

CLK SYN

Output of clock synthesizer (option R&S SMA-B29).

NOTICE! Maximum Input Levels. Do not overload the Clock Synthesizer output. The maximum permissible back-feed is specified in the data sheet.
See data sheet and chapter 5.6, "Clock Synthesis", on page 301

2.3 Putting into Operation

This section describes the basic steps to be taken when setting up the R&S SMA for the first time.

> ⚠️ **WARNING**
>
> **Shock hazard**
>
> Do not open the instrument casing. As a rule, normal operation of the instrument does not require opening the casing. Observe the general safety instructions and regulations at the beginning of the manual.

NOTICE

Risk of instrument damage

Note that the general safety instructions also contain information on operating conditions that will prevent damage to the instrument. The instrument's data sheet may contain additional operating conditions.

NOTICE

Risk of instrument damage

Before switching on the instrument, make sure that the following conditions are met:

● Instrument casing is closed and all fasteners are tightened.
● All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
● The instrument is dry and shows no sign of condensation.
● The instrument is operated in the horizontal position on an even surface.
● The ambient temperature does not exceed the range specified in the data sheet.
● Signal levels at the input connectors are all within the specified ranges.
● Signal outputs are correctly connected and are not overloaded.

Failure to meet these conditions may cause damage to the instrument or other devices in the test setup.

NOTICE

Risk of electrostatic discharge

Protect the work area against electrostatic discharge to avoid damage to electronic components in the modules. For details, refer to the safety instructions at the beginning of this manual.

EMI impact on measurement results

Electromagnetic interference (EMI) can affect the measurement results. To avoid any impact, make sure that the following conditions are met:

● Use suitable double-shielded cables.
● Do not use USB connecting cables exceeding 1 m in length.
● Use only USB devices that remain within the permissible EMI limits.
● Always terminate any connected IEC-bus cables with an instrument or controller.

Outputs and lines have to be terminated properly with 50 Ohms.

For digital interfaces only the cable R&S SMA-Z6 is permitted for connection. The associated cable is available under part number 1415.0201.02.

2.3.1 Unpacking and Checking the Instrument

To remove the instrument from its packaging and check the equipment for completeness proceed as follows:

1. Pull off the polyethylene protection pads from the instrument's rear feet and then carefully remove the pads from the instrument handles at the front.

2. Pull off the corrugated cardboard cover that protects the rear of the instrument.

3. Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.

4. Check the equipment for completeness using the delivery note and the accessory lists for the various items.

5. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

Packing material

Retain the original packing material. If the instrument needs to be transported or shipped at a later date, you can use the material to prevent control elements and connectors from being damaged.

2.3.2 Placing or Mounting the Instrument

The R&S SMA is designed for use under laboratory conditions, either on a bench top or in a rack using a rack adapter kit (order number see data sheet).

Bench Top Operation

If the R&S SMA is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

⚠ **CAUTION**

Risk of injury

The feet may fold in if they are not folded out completely or if the instrument is shifted. Fold the feet completely in or completely out to ensure stability of the instrument and personal safety. To avoid injuries, never shift the instrument when its feet are folded out.

When the instrument is standing on its folded-out feet, do not work under the instrument and do not put anything under it, otherwise injuries or material damage could occur.

The feet may break if they are overloaded. The overall load on the folded-out feet must not exceed 500 N.

Rackmounting

The R&S SMA can be installed in a rack using a rack adapter kit (Order No. see data sheet). The installation instructions are part of the adapter kit.

NOTICE

Risk of instrument damage

For rack installation, make sure that all fan openings are unobstructed and that the airflow perforations are unimpeded. This helps to prevent the instrument from overheating.

2.3.3 Connecting the Instrument to the AC Supply

The R&S SMA is automatically adapted to the AC voltage supplied. There is no need to set the voltage manually or change fuses. The AC SUPPLY AND POWER SWITCH is at the rear of the unit.

► Connect the instrument to the AC power source using the AC power cable delivered with the instrument.

Note: The instrument is in compliance with safety class EN61010-1.
Connect the instrument only to a socket with earthing contact.

2.3.4 Starting the Instrument

Switching off the AC power
You can leave the AC power on permanently to preserve your last instrument settings. Switching off is required only if the instrument must be completely disconnected from all power supplies.
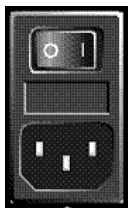
Starting up instruments with power switch

1. Connect the instrument to the AC supply.

2. To turn the power on, press the main power switch to position I (On).

   After power-up, the instrument is in standby or ready state, depending on the state of the ON/STANDBY key at the front panel of the instrument when the instrument was switched off for the last time.

3. In case the instrument is in standby mode, i.e. the yellow LED is on, press the ON/ STANDBY key to switch the instrument to ready state.

2.3.4.1 Standby and Ready state
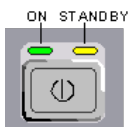
The ON/STANDBY key is located in the bottom left corner of the front panel.

Switching between standby and ready state

► Press the ON/STANDBY key briefly to switch the instrument from the standby to ready state or vice versa.

In ready state, the left, green LED is on. The instrument is ready for operation. All modules are power-supplied and the R&S SMA initiates its startup procedure.
In standby state, the right, yellow LED is on. The standby power only supplies the power switch circuits and the oven-controlled crystal oscillator to keep it at its operating temperature. In this state it is safe to switch off the AC power and disconnect the instrument from the power supply.

2.3.4.2 Start Display and Booting

The instrument boots the operating system, starts the instrument firmware and automatically performs a selftest. If the previous session was terminated regularly, the instrument uses the last setup with the relevant instrument settings.

Once the startup procedure has been terminated, the block diagram opened in the previous session is displayed and the instrument is ready for operation.

Use the PRESET key to return the instrument to its definite reset/preset state, if the current setup is not anymore relevant.

To customize the start settings, use the "File" dialog.

Rebooting the instrument
Press the STANDBY key for approx. 5 s. to reboot the instrument, if the software stops unexpectedly.

2.3.4.3 Function Check

The signal generator automatically monitors the main functions when the instrument is switched on and continuously during operation.

A detected fault is indicated by a "ERROR" message displayed in the info line together with a brief error description. For in-depth identification of the error, press the INFO key. In response, a description of the error(s) is displayed.

For more information, refer to chapter 9, "Error Messages", on page 609.

Additionaly to the automatic monitoring, the R&S SMA offers the following capabilities to ensure correct functioning:

● Internal Adjustments

Press the SETUP key and select "System > Internal Adjustments" to access the dialog for preforming and configuring of the adjustments settings. A maximum level accuracy can be obtained, for instance.

- Selftest
  A selftest is provided for service purposes. The selftest is a protected test procedure, which can be accessed if protection level 1 is disabled.

- Test points
  If required for service purposes, internal test points can be queried. This test is a protected test procedure, which can be accessed if protection level 4 is disabled. The corresponding procedure is described in the Service Manual.

2.3.4.4 Default Settings

When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched off. It is also recomended that you use the PRESET key to return the instrument to its defined preset state every time a new configuration is required or the current setup is not anymore relevant.

The R&S SMA offers a two-stage preset concept:

- Preset the instrument to a predefined state
  The PRESET key calls up a defined instrument setup. All parameters and switching states are preset (also those of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB bus address or reference oscillator source settings.

- Preset the instrument to its factory settings
  The instrument can also be forced to load its default factory settings. To access the corresponding dialog box, press the SETUP key and select the "Factory Preset". For more information and an overview of the settings affected by the factory preset function, see chapter 5.2.3.17, "Factory Preset", on page 102.

Overview of the Most Important Preset States

The following list gives an overview of the presets for the most important generator settings. The other presets can be found in the preset tables of the individual menus and the information accompanying the remote commands.

- "RF frequency" = 1 GHz
- "RF level" RF output switched off
- "Offsets" = 0
- "Modulations State" = Off
- Uninterrupted level settings are switched off
  "Level Attenuator Mode" = AUTO
- Internal level control "Level ALC" = AUTO
- User correction "Level Ucor" = OFF
- "LF output State" = Off
- "Sweep State" = Off
- "List mode State" = Off

Settings that are not affected by the PRESET key

- Reference frequency settings ("Ref Oscillator" menu)
- Power on settings ("Level/EMF" menu)
- Network settings ("Setup" menu)
- GPIB address ("Setup" menu)
- *IDN? Identification and emulation ("Setup" menu)
- Password and settings protected by passwords ("Setup" menu)
- Start/Stop Gui Update ("Setup" menu)
- Display and keyboard settings ("Setup" menu)

User-defined instrument states can be stored and called up in the "File" dialog.

2.3.5 Shutting Down the Instrument

To shut down the R&S SMA, proceed as described below.

NOTICE

Risk of losing data

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings. Furthermore, program data may be lost.

Always first press the ON/STANDBY key to shut down the application properly.

1. Press the ON/STANDBY key to save the current setup, shut down the operating system and set the instrument to standby state.

   The yellow LED must be on.

2. To turn the power off press the main power switch to position 0 (Off).

   Tip:
   Switching off the AC power

   You can leave the AC power on permanently to preserve your last instrument settings. Switching off is required only if the instrument must be completely disconnected from all power supplies.

   None of the front-panel LEDs should be on.

2.3.6 Power Fuses

The R&S SMA is fully fused by two fuses IEC60127-T3.15H/250 V.

The fuses are accommodated in the fuse holders next to the power connector. Use only fuses of the mentioned type.

⚠ WARNING

Shock hazard

Before replacing a fuse, make sure that the instrument is switched off and disconnected from all power supplies.

Always use fuses supplied by Rohde & Schwarz as spare parts, or fuses of the same type and rating.

2.4 Connecting External Accessories

The equivalent USB ports on the front and/or rear panel of the R&S SMA can be used to connect a variety of accessories.

In addition the instrument provides interfaces for network integration (see chapter 2.6, "Setting Up a Network (LAN) Connection", on page 33).

2.4.1 Connecting USB Devices

The USB interfaces on the front and (optionally) rear panels of the R&S SMA allow you to connect USB devices directly to the instrument. This number can be increased as necessary by using USB hubs. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S SMA.

The following list shows various USB devices that can be useful:

- Memory stick for easy transfer of data to/from a computer (e.g. firmware updates)
- CD-ROM drives for easy installation of firmware applications
- Keyboard or mouse to simplify the entry of data, comments, file names, etc.
- Power sensors, e.g. of the NRP Zxy family

Installing USB devices is easy under Linux, because all USB devices are plug&play. After a device is connected to the USB interface, the operating system automatically searches for a suitable device driver.

If Linux does not find a suitable driver, it will prompt you to specify a directory that contains the driver software. If the driver software is on a CD, connect a USB CD-ROM drive to the instrument before proceeding.

When a USB device is subsequently disconnected from the R&S SMA, the operating system immediately detects the change in hardware configuration and deactivates the corresponding driver.

All USB devices can be connected to or disconnected from the instrument during operation.

Connecting a memory stick or CD-ROM drive

If installation of a memory stick or CD-ROM drive is successful, the operating system informs you that the device is ready to use. The device is made available as a new drive (`/usb`). The name of the drive is manufacturer-dependent.

Connecting a keyboard

The keyboard is detected automatically when it is connected. The default input language is English – US.

Use the "Setup > Keyboard Settings" dialog to configure the keyboard properties.

Connecting a mouse

The mouse is detected automatically when it is connected.

2.5 Linux Operating System

The instrument contains the Linux operating system. To ensure that the instrument software functions properly, certain rules must be adhered to concerning the operating system.

NOTICE

Risk of causing instrument unusability

The instrument is equipped with the Linux operating system. Additional software can therefore be installed on the instrument. The use and installation of additional software may impair instrument function. Thus, run only programs that Rohde & Schwarz has tested for compatibility with the instrument software.

The drivers and programs used on the instrument under Linux have been adapted to the instrument. Existing instrument software must always be modified using only update software released by Rohde & Schwarz.

The configuration of the operating system is optimally adapted to signal generator functions in the factory. Changes in the system setup are only required when peripherals like keyboard are installed or if the network configuration does not comply with the default settings (see chapter 2.6.1, "Connecting the Instrument to the Network", on page 34). After the R&S SMA is started, the operating system boots and the instrument firmware is started automatically.

Accessing Operating System

The operating system cannot be accessed.

All necessary system settings can be made in the "Setup" dialog.

The R&S SMA provides a internal CompactFlash^TM Card, it does not contain a disk drive. The CompactFlash^TM Card holds the firmware and the stored data. However, data trans-

fer is only possible via a memory stick connected to a USB interface. The memory stick and the CompactFlash™ Card are accessed via the "File Manager".

Accsessing the File System

The instrument also supports two standard methods to access the file system form a remote client:

- FTP (file transfer protocol)
- File sharing according to the SAMBA/SMB (server message block) protocol.

Both methods allow the access to the folder `/var/user/share`.

Default password

The FTP and SAMBA file access use the user "instrument" with default password "instrument".

In is highly recomended to change this password in the Setup > Security > Change User Password dialog before connecting the instrument to the network!

Screen saver

A screen saver can be activated in the R&S SMA. When active, the display is shut off when no entries via front panel, external mouse or external keyboard are made for a period of time. The screen saver prolongs the life time of the display.

Use the "Setup > Display Settings" dialog to switch on or off the screen saver and to adjust the screen saver settings.

2.6   Setting Up a Network (LAN) Connection

The R&S SMA is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the appropriate rights have been assigned by the network administrator and the Linux firewall configuration is adapted accordingly, the interface can be used, for example:

- To transfer data between a controller and the tester, e.g. in order to run a remote control program.
  See chapter 6, "Remote Control Basics", on page 305.
- To access or control the measurement from a remote computer using the "Remote Desktop" application, the Ultr@VNC program (or a similar tool)
- To connect external network devices (e.g. printers)
- To transfer data from a remote computer and back, e.g. using network folders

This section describes how to configure the LAN interface. It includes the following topics:

- chapter 2.6.1, "Connecting the Instrument to the Network", on page 34
- chapter 2.6.2, "Assigning the IP Address", on page 34

Accessing Operating System

The operating system cannot be accessed.

All necessary system settings can be made in the "Setup" dialog.

2.6.1 Connecting the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

● A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.

● A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and is directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still performed using the TCP/IP protocol.

In both cases, an IP address has to be assigned to the instrument and the computer, see chapter 2.6.2, "Assigning the IP Address", on page 34.

The R&S SMA uses the IP addresses 192.168.xxx.yyy for this purposes, where xxx and yyy may take values between 1...254; the subnet mask is always 255.255.255.0.

NOTICE

Risk of network failure

Before connecting the instrument to the network or configuring the network, consult your network administrator. Errors may affect the entire network.

► To establish a non-dedicated network connection, connect a commercial RJ-45 cable to one of the LAN ports.
To establish a dedicated connection, connect a (crossover) RJ-45 cable between the instrument and a single PC.

If the instrument is connected to the LAN, the operating system automatically detects the network connection and activates the required drivers.

The network card can be operated with a 10 Mbps Ethernet IEEE 802.3 or a 100 Mbps Ethernet IEEE 802.3u interface.

2.6.2 Assigning the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

● If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.

- If the network does not support DHCP, the instrument tries to obtain the IP address via Zeroconf (APIA) protocol. If this attempt does not succeed or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network errors

Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

Assigning the IP address on the instrument

1. Press the SETUP key and select the "Network Settings" dialog.

2. Set the "Address Mode" to Static.

3. Select the "IP Address" and enter the IP address, for example *192.168.0.1.*. The IP address consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

4. Select the "Subnet Mask" and enter the subnet mask, for example *255.255.255.0.* The subnet mask consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.

Assigning the IP address manually on a PC

1. Obtain the IP address and subnet mask for the R&S SMA and the IP address for the local default gateway from your network administrator. If necessary, also obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network. If you use more than one LAN connector, you need separate address information for each connector.

2. Press the "Windows" key to access the operating system.

3. Open the "Control Panel" by selecting "Start > Settings > Control Panel".

4. Select "Network Connections".

5. Right-click "Local Area Connection" and select "Properties" from the context-sensitive menu, or
   click "Local Area Connection" and then "File > Properties".

6. On the "General" tab, click "Internet Protocol (TCP/IP)" and then select "Properties".

7. Select "Use the following IP address" and enter the address information as obtained from the network administrator.

8. If necessary, you can also select "Use the following DNS server addresses" and enter your own DNS addresses.

   For more information refer to the Windows XP Help.

2.6.3 Using Computer Names

Alternatively to the IP address, each PC or instrument connected in a LAN can be accessed via an unambiguous computer name. Each instrument is delivered with an assigned computer name, but this name can be changed.

Querying and changing a computer name

1. Press the "Setup" key and select "Network Settings".

   The computer name is displayed under "Hostname".

2. Press the "Setup" key, select "Protection" and enable the "Protection Level 1".

   The parameter "Hostname" in the "Network Settings" dialog is now enabled for configuration.

3. Change the "Hostname".

2.7 Remote Access via an External Controller

The R&S SMA can be remote accessed from a remote computer (external controller) via a network link. This allows convenient operation of the instrument from the desktop although the instrument is integrated in a rack somewhere else.

For an overview of the instrument's operating concept and the different ways to control and operate the instrument, see chapter 3.1, "Brief Introduction to the Instrument's Concept", on page 45.

There are different ways to establish a remote access connection to the signal generator but all of them require an established LAN connection between the instrument and the remote computer. The simplest way to remote access the instrument is to use a Web browser, such as Windows Internet Explorer or Mozilla Firefox for instance. Alternatively a remote access via a special application can be used. Two free-of-charge programs are available for setting up the remote access connection: the Windows application Remote Desktop for PCs with Window operating system and the program Ultr@VNC for PCs with Linux/Unix or Windows operating system. Using of each of this two applications requires additional istallation.

See table 2-1 for an overview of the different ways to establish a remote access connection to the signal generator.

Table 2-1: Remote access via an external computer

Remote access via	LAN connce- tion	Installation of the additional appli- cation	
		on the instru- ment	on the remote computer
Web Browser e.g. Windows Internet Explorer or Mozilla Firefox see chapter 2.7.1, "Using a Web Browser for Remote Access", on page 38	required	no	no
Remote Desktop Windows application for PCs with Window operating sys- tem	required	no	required
Ultr@VNC for PCs with Linux/Unix or Windows operating system see chapter 2.7.2, "Remote Access via Ultr@VNC", on page 38	required	required	VNC Viewer required

When the connection is set up with Remote Desktop, the device firmware of the signal generator is disabled. Direct control on the instrument is not possible while manual remote-control is active. The access of an external PC is indicated by the logon screen of Windows XP Embedded which identifies the accessing user.

When the connection is set up with Ultr@VNC, direct control on the instrument is possible while remote access is established.

For return to direct operation on the instrument, the connection must be cut. After cutting the connection, it is still enabled and can be established again any time. The connection is disabled only after deactivation of the program.

This section gives an information on how to use the Web browser for remote access, how to install the applications for remote access and how to establish the connection between the instrument and an external computer with Windows operating system. Remote access via an external computer with Linux/Unix operating system is performed accord- ingly.

Default password

Remote-access and file access require the user "instrument" with default password "instrument".

NOTICE

Changing the default user and security passwords

It is highly recommended to change the default user and security passwords in the menu "Setup > Security" before connecting the instrument to the network (see section chap- ter 5.2.3.15, "Security", on page 98).

2.7.1 Using a Web Browser for Remote Access

The instrument can be remote-accessed via any Web browser, like Windows Internet Explorer or Mozilla Firefox for instance.

To remote access the instrument via Web browser:

1. Connect the instrument and the remote computer to a LAN, see chapter 2.6.1, "Connecting the Instrument to the Network", on page 34.

2. Instal the Java Runtime Environment JRE on the remote computer.

3. Type the instruments' IP address in the address field of the Web browser on your PC, e.g. *http://10.111.11.1*

    The "VNC Authentication" screen appears.
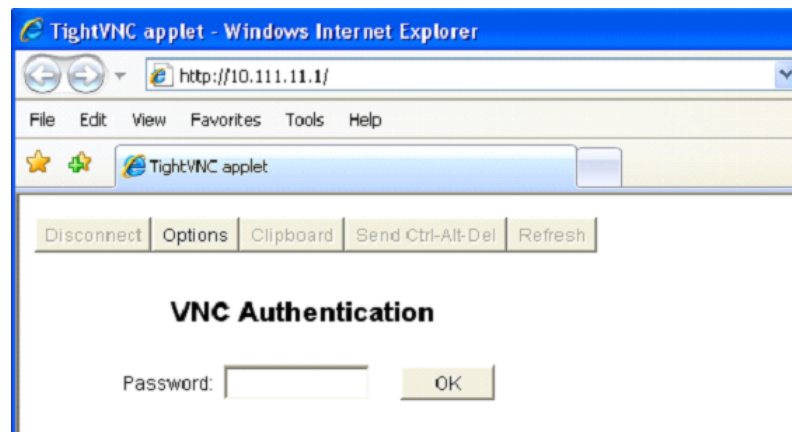
4. Enter the password and select "OK".
    The default password is "instrument".

    After the connection is established, the current signal generator screen with the block diagram is displayed and the instrument can be remote-accessed from the remote computer.

2.7.2 Remote Access via Ultr@VNC

Ultr@VNC is an application which can be used to access and control the instrument from a remote computer through a LAN connection. The program is included in operating system Linux/Unix. It is available as a free-of-charge download on the internet for operating system Window XP (http://www.uvnc.com/download/index.html) and on the instrument's CD-ROM.

> **NOTICE**
>
> **Risk of Unauthorized Access**
>
> If the VNC application is enabled on the instrument, any user in the network who knows the computer name and login data can access it. To prevent this, make sure that the VNC server service on the instrument is disabled.

Setting up a VNC connection

1. Connect the instrument and the remote computer to a LAN, see chapter 2.6.1, "Connecting the Instrument to the Network", on page 34.

2. Install the Ultr@VNC application and enable it on the instrument.

3. In the ICF firewall, enable communication on the network via Ultr@VNC program.

4. Install the VNC Viewer on the remote computer with Windows operating system, see "Installing the VNC Viewer on a Windows PC" on page 41.

5. Set up the VNC connection between the instrument and:

   a) the remote computer with Linux/Unix operating system, see "Setting up the VNC connection on the Linux/Unix remote computer" on page 41;
   b) the remote computer with Windows operating system, see "Setting up the VNC connection on the Windows remote computer" on page 42.

Enabled Direct Control

The direct control of the instrument is not disabled and the instrument can be controled from the front panel and via the remote computer alternately.

Installing the Ultr@VNC application

1. Download the program from the internet and copy it to a directory that can be accessed.

2. On the instrument, shut down firmware using the ALT+F4 key combination.

3. Double click on the setup file to start the installation.
   The setup wizard leads through the installation. This description focus only on the relevant settings.

a) Select installation of all components.
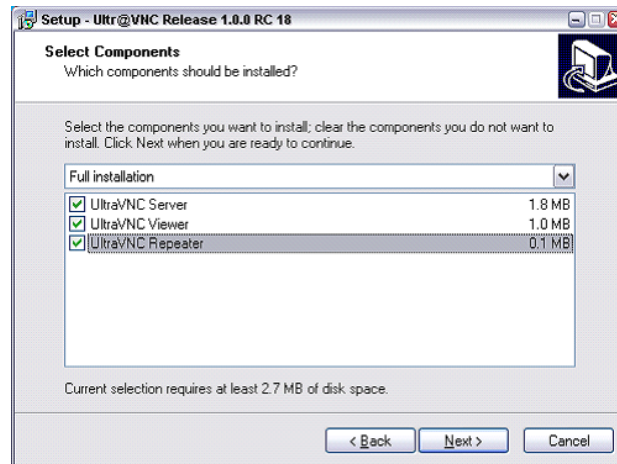
b) In the "Additional Task Panel", enable all entries.
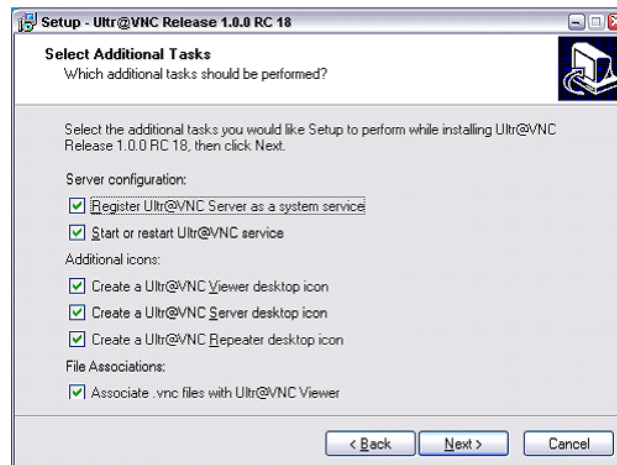
A successful installation is indicated by a message.
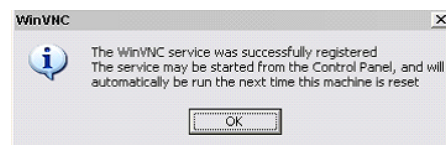
At the same time a warning is displayed stating that a password must be set.

4. Select "OK".

The "Default Local System Properties" panel opens.
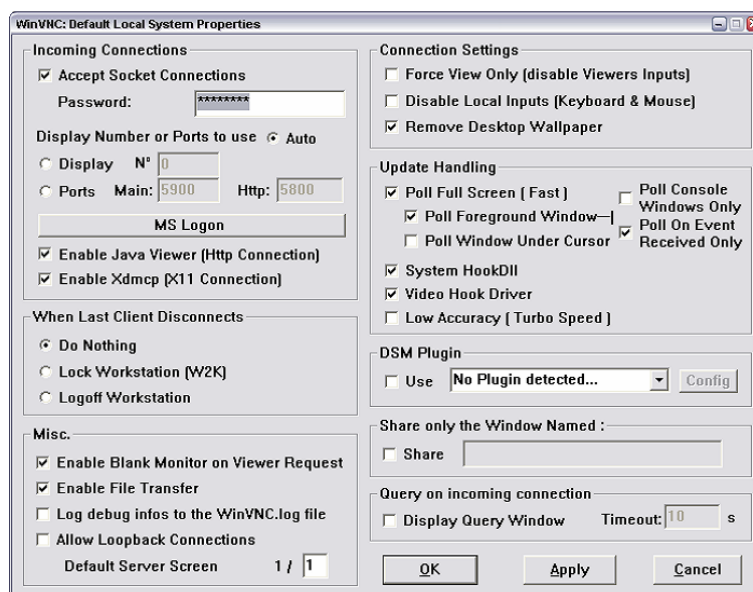
5. Enter a password with a length of at least five digits.
   This password is used on the remote computer to access the instrument. Other set-
   tings may be changed according to the user-specific security requirements.

   After the installation the Ultr@VNC program is automatically started together with the
   operating system. On mouse over, the IP address of the instrument is indicated.
   This IP address and the user-defined password are the prerequisites to enable
   remote access on the remote computer. Terminated connection is indicated by
   changed icon color.

Installing the VNC Viewer on a Windows PC

1. Download the Ultr@VNC program form internet and follow the installation instruc-
   tions.
   Only the program component VNC Viewer is required.

   Note: The VNC Viewer program is included in the download for the installation of the
   Ultr@VNC program on the signal generator if "Full installation" was selected in the
   "Select Component" panel. In this case, the program `ultr@vncviewer.exe` can
   be copied to the Windows PC.

2. Install VNC Viewer program component on the remote computer.

Setting up the VNC connection on the Linux/Unix remote computer

The VNC program is available per default for Linux/Unix operating systems.

1. Start a Web browser on the remote computer and enter the IP address of the instru-
   ment.

2. Enter the following address:
   vnc://<IP-address of the instrument>, e.g. *vnc://192.168.1.1*.

   A dialog is opend and the pssword for the remote VNC connection is requested.

3. Enter the password as defined in the "Default Local System Properties" panel of the Ultr@VNC program and select "Log On".

   The connection is established, the instrument is remote accessed and the current signal generator screen with the block diagram is displayed. The individual functions are operated using the mouse and keyboard.
   In contrast to remote access via Remote Desktop, the direct control of the instrument is not disabled and the instrument can be controled from the front panel and via the remote computer alternately.

Setting up the VNC connection on the Windows remote computer

1. Start VNC Viewer program component on the PC, select "VNC Server" and enter IP address of the instrument.
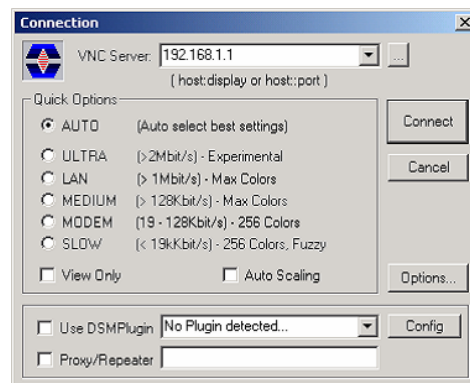
2. To initialize the connection, select "Connect".

   A message requesting the password appears.
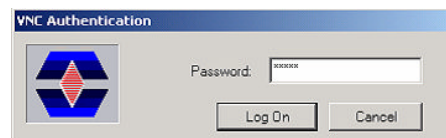
3. Enter the password as defined in the "Default Local System Properties" panel of the Ultr@VNC program and select "Log On".

   The connection is established, the instrument is remote accessed and the current signal generator screen with the block diagram is displayed. The individual functions are operated using the mouse and keyboard.

Enabled Direct Control

The direct control of the instrument is not disabled and the instrument can be controled from the front panel and via the remote computer alternately.

Terminating VNC Connection

The remote access via VNC connection can be terminated either on the R&S SMA or on the external PC. Terminating the connection does not disable it. It can be established again any time. See the notice above concerning unauthorized access due to VNC connection!

1. Terminate the connection on the R&S SMA

   a) Press the "Windows" key to access the operating system.
   b) Right-click on the VNC icon on the task bar and select "Kill all clients".

2. To terminate the connection on the external Linux/Unix PC, close the internet browser or close the signal generator window.

3. To terminate the connection on the external Windows PC, close the VNC Viewer program.

   The connection is terminated. The color of the VNC icon in the status bar of the instrument changes.
   A message on the external PC indicates the disconnection.

Disabling Remote Access via Ultr@VNC

The VNC connection can be disabled by removing the program on the instrument or by deactivating the VNC Server service.

1. Remove the VNC program

   a) Press the "Windows" key to access the operating system and open the "Add or Remove Programs" by selecting "Start > Settings > Control Panel > Add or Remove Programs".
   b) Remove the VNC program.

2. Deactivate the VNC Server service

   a) Press the "Windows" key to access the operating system and open the "Services" by selecting "Start > Settings > Control Panel > Services".
   b) Deactivate the VNC Server service.

   The connection is disabled, the VNC icon disappears from the task bar of the instrument.

3 Getting Started

This section helps you to get familiar with the R&S SMA and provides an introduction to the general concept of the instrument with a sample of the possible application fields as well as a description of the main blocks in the signal generation flow.

This section also explains the operating concept in general and includes a brief introduction to operation by a step-by-step description of the configuration. The example is intended to provide a quick overview of the settings provided. No additional equipment is required.

3.1 Brief Introduction to the Instrument's Concept

The **operating concept** of the R&S SMA employs the following three ways of instrument control:

- Manual operation
- Remote control
- Remote access

Manual Operation

The R&S SMA can be entirely operated from the front panel. Peripherals such as mouse or keyboard can be connected but are not essential.

The R&S SMA is equipped with an intuitive user interface. The central element of the display is the block diagram that shows the signal flow and processing from the left on the display to most right, i.e. the generated signal can be seen at a glance.

Each block represents a functional unit of the instrument. Thus the user always knows the position at which a parameter has an effect in the signal flow. The main settings of a block are indicated in the block. The interconnection of employed inputs and outputs is also shown. The user is thus always informed about the connection of inputs and outputs in the signal flow and where they can be configured. A window is opened for each menu where parameters can be set. When the window is opened, an entry is made in the "Winbar" below the display. All open menus are of equal priority (not modal) and can be accessed any time.

The block diagram in the figure below shows a fully equipped instrument.
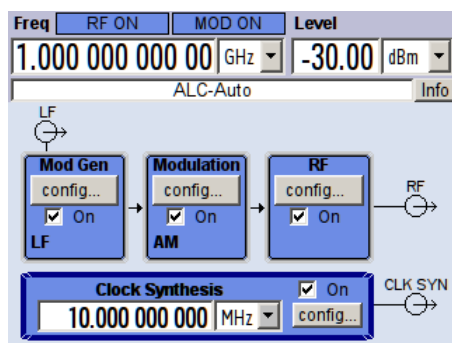
Fig. 3-1: Block diagram of a fully equipped R&S Signal Generator

With the aid of the rotary knob, the user can navigate in the block diagram and the dialogs, and can operate the instrument with one hand. The cursor is moved line by line through the block diagram or dialog. Turning the button clockwise advances the cursor. The selected block can be activated or deactivated with the TOGGLE key. Active blocks are highlighted by a colored background.

The instrument comprises a comprehensive info and help system. Context-sensitive help can be called any time with the HELP (F1) key. The help system indicates the currently selected parameter and offers additional services such as cross references, index and contents. The content of the help system corresponds to the operating manual of the instrument.

Warning and conflict messages caused by incorrect operation as well as further information are displayed in the "Info" line. A complete list of existing conflicts is displayed when the INFO (CTRL+I) key is pressed. Additional information on entries can be requested from the help system. The history function permits display of all messages.

Assistants simplify the completion of tables. After data entry in the assistant, the table is modified only after the "Accept" button has been pressed. Pressing the "Accept" button also stores the assistant data.

For an introduction into the manual operating of the instrument, detailed operating instructions and an overview of menus refer to

For an indepth description of the dialog boxes and the instrument functions refer to section

Remote Control

Remote control is an operation of the instrument by means of remote control commands or programs that automatize repeating settings. The instrument is connected to a computer running the program.

This way of operation and the instructions how to set up a connection for remote control are described in the The description of the remote control commands is provided in

Remote Access

Remote access is the operating of the instrument from a remote computer. Both the R&S SMA and the computer are connected in a LAN.

Remote access in contrast to **remote control** does not use remote-control commands but a separate software which is installed on the remote computer. After its start, the software simulates the user interface of the instrument. The instrument can thus be operated from the remote computer as on the unit itself. The individual functions are operated using the mouse and keyboard. Specific instrument functions can be executed using specific key combinations on the keyboard or a front panel key emulation that can be operated with the mouse.

This way of operation and the instructions how to set up a connection for remote access are described in

3.2 Application Field of the Instrument

The main field of application of the R&S SMA is the generation of sine wave signals with very high spectral purity. These signals are needed e.g. for adjacent channel or phase noise measurements.

In addition, the RF signal can be modulated with a wide variety of internal modulations waveforms, e.g. sine waves, triangle/rectangular/trapeze signals, and noise. Several modulation signals can be combined with variable weight.

3.3 Description of Individual Diagram Blocks

The signal path of the instrument is configured by installing a frequency option that comprises all required modules including synthesizer, output section and attenuator (optional without attenuator).

One of the following options must be installed.

● R&S SMA-B103 (up to 3 GHz)

● R&S SMA-B103L (up to 3 GHz, without attenuator)

● R&S SMA-B106 (up to 6 GHz)

● R&S SMA-B106L (up to 6 GHz, without attenuator)

Up-to-date information is available at R&S SMA homepage on the internet http://www2.rohde-schwarz.com/product/sma100a.html.

Mod Gen block
The internal modulation sources are configured in this block. Also, the "LF frequency sweep" can be activated here.

Two internal LF generators (second is optional) are available as the internal source(s) for the analog modulations AM, FM and PhiM. Different modulation shapes - sine, triangle, rectangle and noise - are offered for the second LF generator. Bandwidth and level distribution can be selected for the noise signal of the noise generator (optional).

Available modulation shapes are:
- sine
- triangle (optional)
- square (optional)
- trapeze (optional)
- noise with selectable bandwidth and level distribution (optional)

The internal modulation signals are provided at the LF output at the front of the instrument. The LF output signal and the modulations sources for the analog modulations AM, FM and PhiM can be selected independently from each other.

A pulse generator (optional with extended features) provides single and double pulse modulation with selectable pulse widths and periods.

The R&S SMA offers three different sweep types (frequency sweep, level sweep and LF sweep) to be activated alternatively. Each type has 6 modes which differ with respect to the sweep cycle mode (continuous, individual and step-by-step) and triggering mode (automatic, internal and external). In the "Mod Gen" block, the LF sweep is configured. Frequency and level sweep settings are accessed via the "RF" block.

The status display in the block shows whether LF generator and/or a sweep are active. The selected internal LF generator and/or noise source are switched on or off with the TOGGLE ON/OFF key.
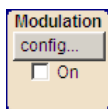
Modulation block

The internal and external analog modulations are configured and activated in this block. The MOD ON/OFF key switches the active modulation(s) on/off.

The internal modulation sources are configured in the "Mod Gen" block. The modulation inputs AM EXT, FM/PHIM EXT and PULSE EXT at the rear of the instrument are provided for external amplitude, frequency, phase and pulse modulation. AC or DC coupling for external feed is possible.

Modulation signals of up to three sources (two internal sources and one external source) can be combined for AM/FM and PhiM modulation.

Available internal and external analog modulation modes are:
- Amplitude modulation (AM)
- Frequency modulation (FM, optional)
- Phase modulation (PhiM, optional)
- Pulse modulation (Pulse)
- Chirp modulation (internal only)

In addition, external digital modulation signal can be used. The external signal for digital FM/PhiM modulation is fed in via the AUX I/O interface.
- Digital Frequency modulation (optional)
- Digital Phase modulation (optional)

Note: For modulation modes that can be simultaneously used, refer to the R&S SMA data sheet.

The status display in the block shows the active modulation(s). Use the TOGGLE ON/OFF key to switch the active modulation of the block on or off.

RF block

In this block, the RF parameters and frequency/level sweep settings are set.

The active sweep is displayed in the block. The RF ON/OFF key switches the RF signal on and off. When the signal is switched off, the switch before the RF output symbol is open.

RF settings include:
- Frequency and reference frequency
- Level settings; if required.
- NRP-Z Power Viewer and Power Analysis using power sensors
- Frequency and level sweep
- List Mode settings. In this mode, extremely fast frequency and level settings can be made.

The RF 50 OHM output connector at the front of the instrument provides the RF signal. An external trigger/gate signal for sweeps is input via the INST TRIG connector at the rear of the instrument

Note: Frequency and level are set fast with the aid of the FREQ and LEVEL keys.

Use the TOGGLE ON/OFF key to switch the RF output on or off.

Clock Synthesis
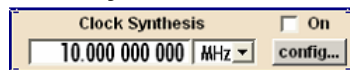
In this block, the clock synthesis is switched on or off and the frequency of the clock signal is set. For instruments equipment with modules with order number 1400.2749.02 DC offset can be defined, in addtition.

The clock frequency is displayed in the block. Use the TOGGLE ON/OFF key to switch the generation of clock signal on or off.

3.4 Example of Setup

This section provides an example on how to configure the instrument for generating of an amplitude modulated signal and of a frequency modulated signal with noise.

Generation of an Amplitude-Modulated Signal

To generate a simple AM-modulated signal, proceed as follow:

1. Activate default (preset) state
   Press the PRESET key to set a defined instrument state.
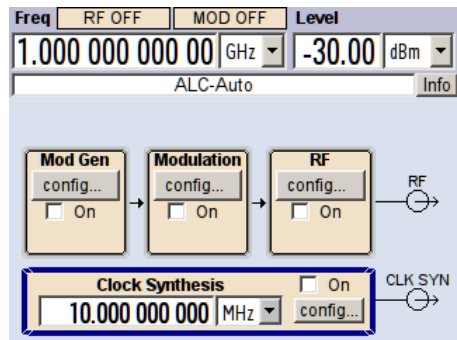
2. Select and activate AM modulation

   a) Turn the rotary knob and select the "Mod" block.

   b) Press the rotary knob to open the dialog where the modulation can be selected (different modulation modes are available depending on the options installed).
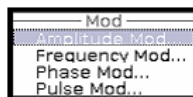
   The "Amplitude Mod..." menu is the first menu and is highlighted per default.

   c) Turn the rotary knob and highlight "Amplitude Mod...".
      Press the rotary knob to open the "Amplitude Modulation" dialog.
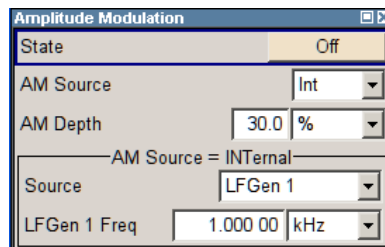
   d) Turn the rotary knob to select parameter "AM Depth", press the rotary knob to allow editing and enter the preffered AM depth with the aid of the numeric keypad and the unit keys.
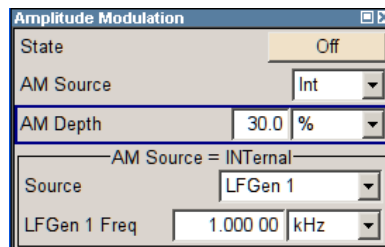
e) Finally, select "State" and press the rotary knob to switch on the AM modulation.
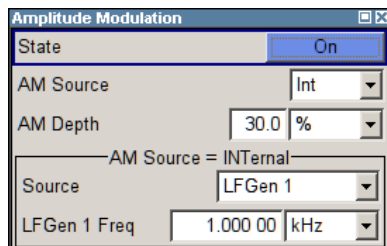
f) Press the DIAGRAM key to display the complete block diagram.

To indicate the active state, the "Mod" block is displayed in blue. The "RF" is not yet active, which means that no RF signal is output.

3. Set frequency and level and activate RF signal

a) Press the FREQ key to activate the editing mode for frequency entry. The "Frequency" entry field in the header section of the display is highlighted.
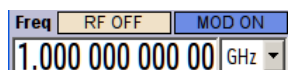
Enter the frequency using the numeric keypad and terminate the entry by pressing a unit key.

b) Press the LEVEL key and enter the level settings in the same way.

c) Press the DIAGRAM key to display the complete block diagram.

d) Turn the rotary knob to select the "RF" block.
Press the RF ON/OFF key to activate the "RF" block.

The AM modulation signal is now present at the RF output.
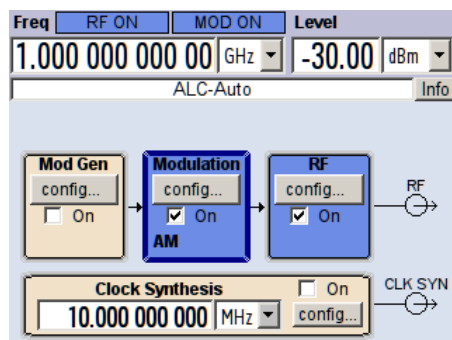
Generation of a Frequency Modulated Signal with Noise

To generate a simple FM-modulated with noise signal, proceed as follow:

This setting requires option Multifunction Generator, R&S SMA-K24.

1. Activate default (preset) state
   Press the PRESET key to set a defined instrument state.
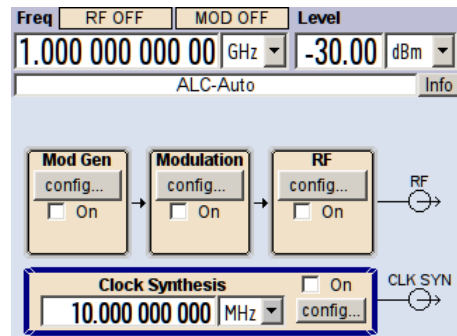
2. Select and activate FM modulation with internal noise signal and a deviation of 500 kHz

   a) Turn the rotary knob and select the "Mod" block.

   b) Press the rotary knob to open the dialog where the modulation can be selected (different modulation modes are available depending on the options installed).
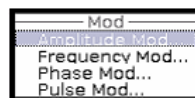
   c) Turn the rotary knob and highlight "Frequency Mod...".
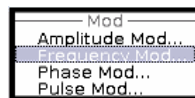
      Press the rotary knob to open the "Frequency Modulation" dialog.
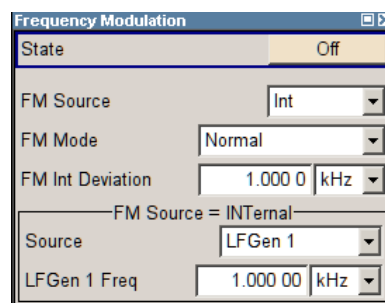
      The internal source is the LF generator 1 by default. This setting is not changed.

    d) Turn the rotary knob to select parameter "FM Internal Source", press the rotary knob to open the selection list and select "Noise".
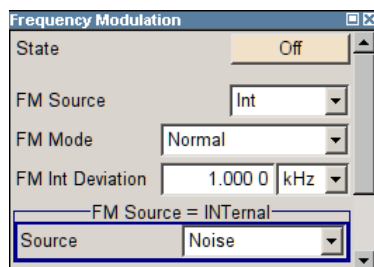
    Gauss distribution and full bandwidth (10 MHz) are the default settings for the noise signal. These settings are not changed.

    e) Turn the rotary knob to select parameter "FM Int Deviation", press the rotary knob to allow editing and enter the preffered deviation with the aid of the numeric keypad and the unit keys.
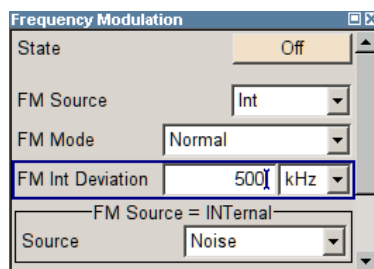
    f) Finally, select "State" and press the rotary knob to switch on the FM modulation.
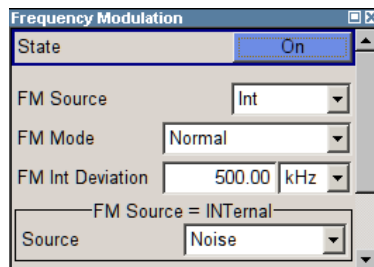
    g) Press the DIAGRAM key to display the complete block diagram.

To indicate the active state, the "Mod" block is displayed in blue. The "RF" is not yet active, which means that no RF signal is output.

3. Set frequency and level and activate RF signal

    a) Press the FREQ key to activate the editing mode for frequency entry. The "Frequency" entry field in the header section of the display is highlighted.
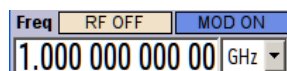
    Enter the frequency using the numeric keypad and terminate the entry by pressing a unit key.

b) Press the LEVEL key and enter the level settings in the same way.
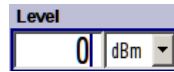
The noise now modulates the RF carrier.

c) Press the DIAGRAM key to display the complete block diagram.

d) Turn the rotary knob to select the "RF" block.
Press the RF ON/OFF key to activate the "RF" block.

The FM modulation signal is now present at the RF output. The LF output is not yet activated, i.e, the modulation signal is not output there.
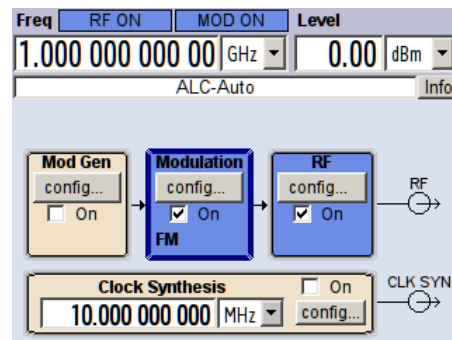
The graph below shows the FM modulated signal with noise (upper blue trace) and the unmodulated signal (lower greentrace).
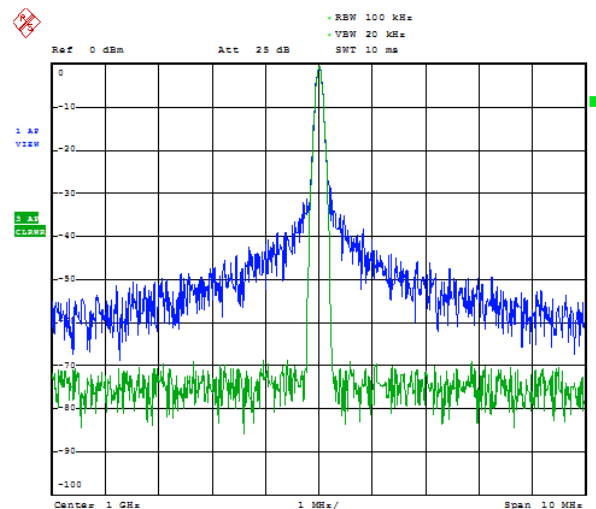
4 Manual Operation

The R&S SMA can be operated intuitively either via the interactive block diagram or via a menu tree. All menus are in the form of windows that can be operated in the same way. Rotary knob, keys and softkeys, or alternatively a mouse, allow direct and therefore convenient access to entries and settings.

The clear-cut display shows the current signal generator state. Numerous help functions support the user in signal configuration.

This section describes the concept of manual operation of the signal generator. This includes a description of the general structure of a dialog box, working with dialog boxes and the block diagram and the setting of parameters.

For an in-depth description of the dialog boxes and the instrument functions refer to section "Instrument Functions".

4.1 Key Features

The manual operating concept of the R&S SMA enables the user to make settings as intuitively as possible and at the same time gives a permanent overview of characteristics of the generated signal and of the current instrument state. Numerous online help functions support user settings.

Block diagram

The block diagram is the core of the operating concept.

A graphics display shows the current configuration and the signal flow in the form of a block diagram. All graphical elements can be accessed for operation. An element is selected by means of the arrow keys and the associated setting function is called by pressing Enter. Required menus and graphs are displayed on the block diagram which is displayed again in the foreground whenever the DIAGRAM (CTRL+D) key is pressed.

Permanent frequency and level display

The main characteristics of the RF signal, frequency and level, are permanently displayed in the header section of the screen and can be directly set in the display fields after the FREQ (CTRL+F) or LEVEL (CTRL+L) key is pressed. Status messages for the output signal are displayed in addition to frequency and level.
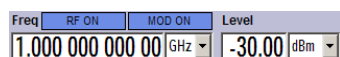
Operation via Graphical User Interface

● **Functional blocks**
Menus are assigned to the specific function blocks in the block diagram. The function blocks represent elements of signal generation. Function blocks displayed with a blue frame can be directly switched on and off by means of the TOGGLE ON/OFF (CTRL

+T) key. The menus of the highlighted function blocks can be called by pressing the
ENTER key.

– **Example:**
The "Modulation" block contains all menus required for modulation signal con-
figuration.
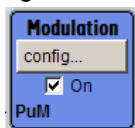
In this block all modulations can be selected.
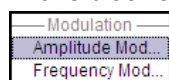
● **Signal flow**
The signal flow between the function blocks and the employed inputs and outputs are
also shown.
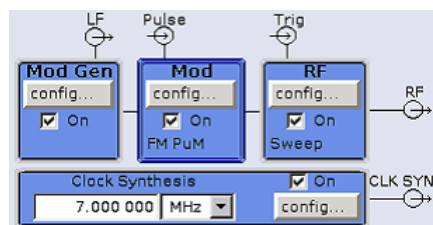
● **Menu tree**
The menu tree can be opened and closed with the MENU (CTRL+M) key. The menu
tree is organized in the same way as the directories under Windows. The function
blocks correspond to the first directory level, the menus to subdirectories.

Operation corresponds to the Windows concept

To offer the user a familiar environment, operation is very similar to operation of Windows
user interfaces. All menus and tables are made up of known elements, such as selection
lists, check boxes and entry fields.

A blue frame indicates that the selected item is active. In the highlighted element, entries
can be made.

Rotary knob

Operation is possible via front-panel keys, an external keyboard and the mouse. How-
ever, most of the settings can be easily made with the rotary knob:

● Turning the rotary knob shifts the entry focus to the target element.

- Pressing the rotary knob activates the selected entry field.
  Depending on the parameter, the submenu is called, the numeric value varied, the list entry selected or the check box activated or deactivated.
- If a value is entered, the entry is stored by another click on the rotary knob and the editing mode is exited.

Clear settings with the aid of independent subdialogs

A separate window is opened for each dialog and subdialog. The dialogs can be operated independently of each other, i.e. none of the dialogs requires that settings in other dialogs be completed before it can be closed. This ensures flexible operation at all times.

Keys with assigned simple functions

Most keys on the front panel of the R&S SMA directly perform a simple function.

Since a great number of settings can thus be made by a keystroke, operation is easy. For instance, the CLOSE (ESC) key closes the active menu; with the RF ON/OFF (CTRL +R) key the RF output signal can be switched on or off.

An exception are keys that call a menu such as the MENU (CTRL+M) key which opens the complete menu tree of the instrument, the SETUP (CTRL+E) key which opens the menus for general instrument settings or the FILE (CTRL+S) key which opens the menu for file management.

Help functions for user support

Numerous help functions support the user in signal configuration.

- **Value ranges**
  The valid setting range is displayed for each numeric parameter. This requires a short wait after activation of the entry field. The range is then displayed automatically after a few seconds.
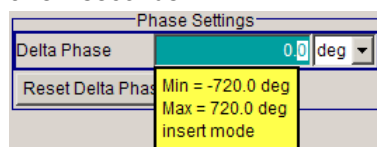
  If the entered value is outside the permissible range, the next permissible value is automatically set and a message is output.
- **Context-sensitive help**
  Context-sensitive help for each parameter can be called with the HELP or F1 key.
- **Comprehensive online help**
  Each help page is part of a comprehensive online help function which can be called by means of an index, a content tree or the "Previous/Next" buttons.

Info line with messages for indication of the current instrument state

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. With the aid of the INFO (CTRL+I) key, help pages can be called for most of the messages. They provide background information on the message and indicate operating steps that may be

required. All messages are explained in the online help which can be called with the HELP (F1) key.
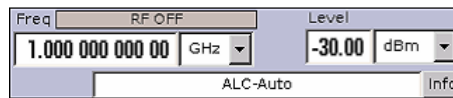
4.2 Display

The display shows the current signal generator state and offers graphical elements for direct operation. It is divided into three sections:

- The frequency and level display with info line indicates the main output signal parameters and reports the current state with status, error and warning messages.
- The block diagram shows the instrument configuration, the signal characteristic as well as the inputs and outputs used and permits interactive operation via graphics elements. Active menus and graphs are displayed on top of the block diagram.
- Winbar with labelled softkeys for menu display.

The block diagram in the figure below shows a fully equipped instrument.
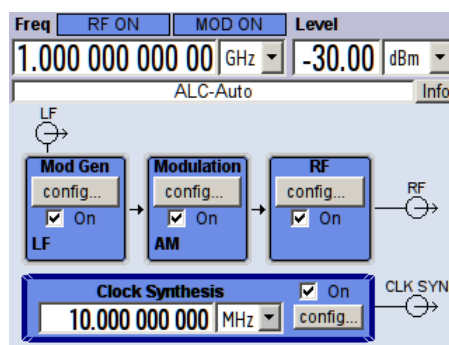
Fig. 4-1: Block diagram of a fully equipped R&S Signal Generator

4.2.1 Settings Displayed in the Header Section

Frequency/level settings and a few status messages (see chapter 4.2.2, "Status Information and Messages", on page 59) are displayed in the header field of the screen. The display may vary depending on the instrument's operating mode:

- In the sweep mode, the current frequency or level of the output signal is displayed. The status message "SweepMode" is displayed in the info line.
- In the list mode, neither the current frequency nor level is displayed, the indication is dimmed.
- If user correction is active, the status message "UCorr" is displayed in the info line.

The value displayed in the "Freq" and "Level" filed does not consider any offset set.

For more information see chapter 5.3.2, "RF Frequency Settings", on page 114 and chapter 5.3.6.1, "Overview RF Level Settings", on page 169.

The frequency and level indication can be enlarged so that it covers the complete display of the R&S SMA by using the DIAGR key. This key toggles between block diagram, magnified frequency and level indication and the display of the active dialog. This requires the "Summary Screen Toggle" to be enabled.

See also "Toggle Summary Screen" on page 94.

4.2.2　Status Information and Messages

The status information and messages are displayed in the header section of the screen. The messages differ with respect to their importance (errors, warnings, info) and the time of their appearance (brief and permanent messages). They require different treatment by the user. Further information on all messages can be called in the info window (see chapter 4.2.3, "Info Window", on page 60).

Refer to chapter 9, "Error Messages", on page 609 for an overview of all status information and messages as well as instructions for error elimination.

4.2.2.1　Status Information

The status information gives the user an overview of the main operating states and settings of the instrument. The states are indicated for information only and do not necessitate any action by the user.

Status information is displayed between the frequency and level fields, at the left of the info line or in the info line itself.
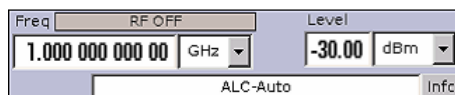
4.2.2.2　Messages

Messages indicate errors in the instrument. They are displayed in the info line in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

4.2.2.3　Volatile messages

Brief messages report automatic settings in the instrument (e.g. switching off of incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

These messages can be read from remote using SYST:ERR? or SYST:ERR:ALL?.

4.2.2.4 Permanent Messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signalled by a permanent message must be eliminated before correct instrument operation can be ensured.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

These messages can be read from remote using SYST:SERR?.

4.2.3 Info Window

A few operating states and the current message are displayed in the info line.

The INFO window with a list of current permanent messages and a detailed description of each message can be opened with the INFO (CTRL+I) key.
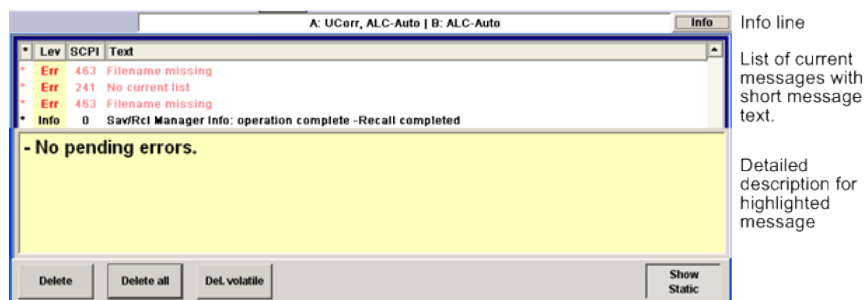
The upper section of the info window contains a list of all current permanent messages in the order of their occurrence, i.e. the most recent message is displayed first. In the lower section of the window, additional information on the highlighted message is displayed. A history of all messages that have occurred since instrument switch-on can be called with the "History" key. The most recent message is displayed first.

The messages are color-coded according to their level. Device-specific messages are red, info and remote control error are black. The level is also indicated in the "Lev" column (Err, Sys or Info). Column "SCPI" indicates the SCPI error code.

With the aid of the softkey buttons, error messages can be cleared and a history of all messages called.

Delete
Clears the highlighted message.

This button is available only if the history of the messages is displayed.

Delete All

Clears all messages.

This button is available only if the history of the messages is displayed.

History

Calls the list of all messages that have occurred since instrument switch-on. The most recent messages are displayed at the top of the list. When the button is pressed again, the list of current messages is displayed.

SCPI command:

SYSTem:ERRor[:NEXT] on page 589 or STATus:QUEue[:NEXT] on page 581

Each time a SYST:ERR? or STAT:QUE? query is sent, the oldest entry in the error queue is returned and at the same time cleared in the list.

4.2.4 Block Diagram

The block diagram shows provided options, signal configuration and the currently selected signal flow of the generator with inputs and outputs used. Signal generation can be completely operated from the block diagram. The highlighted function block can be directly switched on and off with the TOGGLE ON/OFF (CTRL+T) key. Pressing the Enter opens the associated setting menu.
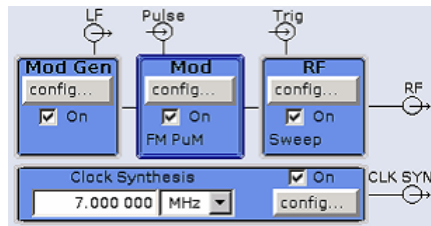
Fig. 4-2: Block diagram of the R&S SMA

4.2.4.1 Function Blocks in the Block Diagram

Each block represents a function of signal generation. The function is indicated in the headline of the block. In the check box, the respective function can be quickly activated/deactivated with the TOGGLE ON/OFF (CTRL+T) key. After activation, the block is displayed in blue. Status information is displayed below the check box. It is different for the different blocks.

Pressing the rotary knob (front panel) or the "Config..." button (mouse) opens the associated setting menu.

Example: Modulation block
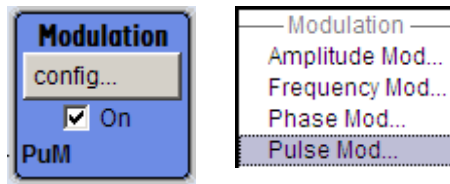
In this block, the modulation signals are set. The status information of the "Modulation" block indicates the selected modulation.

4.2.4.2 Signal Flow and Input/Output Symbols in the Block Diagram

The input/output symbols in the block diagram show the currently used inputs and outputs of the signal generator. Unused inputs and outputs are not shown. The lines indicate the signal flow.

Symbols and labels refer to the corresponding inputs and outputs on the front and rear panel of the signal generator. The direction - input or output - is indicated by an arrow.

Example:
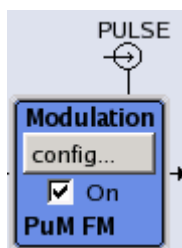
The symbols indicate the input for the external pulse signal on the instrument rear panel.

4.2.5 Structure of the Dialogs

The parameters are set in the menus. Menus are accessed either via the function blocks in the diagram or by means of the MENU (CTRL+M) key. The menus are displayed on top of the block diagram.

The WINBAR key toggles between the active menus. The REARR key toggles between the enlarged and normal sized menus.

Working with menus and dialog boxes is described in chapter 4.3, "Accessing Dialogs", on page 63; the setting of parameters in chapter 4.4, "Setting Parameters", on page 64.

The menus are in Windows format. The menus differ in details depending on their function but they consist of the same main elements. Each menu consists of a menu header and one or more menu areas with various fields for setting parameters.

The header line contains the name of the menu and the buttons for minimizing and closing the menu. To operate the buttons, use the mouse or the front key CLOSE (ESC).

Several fields of associated but separately set parameters are organized in menu areas. A menu area is framed and labelled with the function common to all parameters.

Example: Pulse Generator
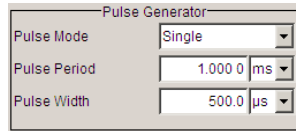
Each of the setting fields is assigned a parameter name. The kind of setting varies depending on the parameter to be set. Some settings can only be made in a specific configuration. If setting is not permitted with the specific configuration selected, the respective item is disabled and displayed in gray and the entry or selection field cannot be accessed.

4.3 Accessing Dialogs

The MENU (CTRL+M) key opens the complete menu tree. Selecting a functional block and pressing the ENTER key opens the menu associated with this block.

An alternatively way to access a dialog is to use the CLOSE (ESC), DIAGRAM (CTRL +D) and REARR (CTRL+A) keys on the front panel.

For a quick access to the dialogs, use one of the following alternative methods.

Displaying the block diagram or a dialog in the foreground

► Press the DIAGRAM (CTRL+D) key to move the cursor to the block diagram.

All active menus are minimized.

Enlarging the indication of the header section

► Press the DIAGRAM key twice to enlarge the indication of the header section.

Tip: Use the REARR key to toggle between the enlarged and normal sized dialogs.

Accessing the menu tree

► Press the MENU (CTRL+M) key to open the complete menu tree.

Calling the File or Setup dialog

► Use the FILE (CTRL+S) or SETUP (CTRL+E) keys to open the respective dialog.

Closing an active menu

► Press the CLOSE key to close an active menu.

Tip: If the cursor is at the highest menu level, you can also use the ESC key to close the active menu.

Accessing the header area

► Press the FREQ (CTRL+F) and LEVEL (CTRL+L) keys to activate the "Frequency" or "Level" entry fields in the header area.

Keyboard Shortcuts

Keyboard shortcuts (e.g. "Ctrl + D" for the displaying the block diagram in the foreground) provide direct access to all utility dialogs of the instrument (see chapter 4.8, "Legend of Front-Panel Controls", on page 77).

4.4 Setting Parameters

The R&S SMA offers several and sometimes alternative possibilities for setting parameters. Operation is possible from the front panel, with the aid of a mouse and/or from a PC keyboard.

The examples whitin this description focus on the operation from the front panel.

For more information, refer to:

● chapter 4.8, "Legend of Front-Panel Controls", on page 77 for an overview of key functions and a cross-reference between the front panel keys and the keyboard shortcuts

● section "Instrument Functions" for a detailed description of key functions.

Most of the parameters are set in the different menus. The R&S SMA provides alternative ways for accessing the dialogs. Turn the rotary knob and navigate to the corresponding block in the block diagram and press the knob to open the dialog or perform a mouse click on the "Config..." button.

An exception are the "Setup" and "File" dialogs. In the "Setup" dialog, general settings are made which are not directly concerned with signal generation, e.g. setting of the GPIB-bus address. In the "File" dialog, files and lists are managed.

These menus can only be called with the SETUP (CTRL+E) and FILE (CTRL+S) keys.

Frequency and level are directly set in the header area of the display using the FREQ and LEVEL keys.

Specific settings can also be made directly in the block diagram, e.g. activating a function block by means of the TOGGLE ON/OFF (CTRL+T) key or switching the RF output on and off with the aid of the RF ON/OFF (CTRL+R) key. Changes affecting the signal flow are immediately visible in the graphics display.

This section provides an information about the parameter handling that comprises of the following main steps:

● chapter 4.4.1, "Working with the Cursor", on page 65

4.4.1 Working with the Cursor

After the instrument is switched on, the cursor is always on the first function block of the diagram (default setting).

Moving the cursor on the display

► To move the cursor, use one of the following alternative methods:

a) Use the rotary knob or the arrow keys.
b) Use the WINBAR key to toggle between the active dialogs.
c) Use the ESC key.

Tip: Be aware that the function of the ESC key depends on the current cursor position. The function of this key depends on the current cursor position.

- Calls the next higher selection level.
- Closes the open window without accepting new entries; the old value or parameter is retained.
- In dialog boxes that contain a "Cancel" button it activates that button.
- Closes all kinds of dialog boxes, if the edit mode is not active.
- Quits the edit mode, if the edit mode is active.
- Switches between different entry fields of a menu.
- Shifts the entry cursor from the header display to the previously active menu, or to the previously highlighted block in the block diagram if no menu is active.

Moving the coursor to the heading area

► Press the FREQ (CTRL+F) or LEVEL (CTRL+L) key to move the cursor to the header area.

4.4.2 Selecting a Control Element

Control elements are always selected in the same way no matter whether a function block in the diagram, a menu in the menu tree, a parameter in the menu or an entry in a list or table is concerned.

► To activate an element, put the cursor on it.

Source   Internal ▾

An active element is highlighted by a blue frame.

4.4.3 Switching Parameters On/Off

A parameter can be activated and deactivated using a button or a check box.

1. Select the parameter.

2. To change the state of a parameter, use the "Enter" function of the different control media:
   - Press the rotary knob
   - Press ENTER
   - Press the TOGGLE ON OFF (CTRL+T) key.

Colour and label of a button change, the check box is ticked or the tick is removed.

4.4.4 Entering a Value

Numeric and alphanumeric values can be edited in the entry fields. In the editing mode, cursors of different colour are used. A blue cursor indicates the overwrite mode, a green cursor the insert mode.

Numeric and alphanumeric values can either be newly entered or the existing value can be changed. Incorrect entries are cleared with the BACKSPACE key.

Entering a new numerical value

1. Select the parameter.

2. Press a numeric key to activate the editing mode.

   The previous value is cleared and the new value can be entered.

Editing a value in the insert mode (default setting)

1. Press the rotary knob (= Enter) to activate the editing mode.

   If the cursor is placed at the right of the total value, the insert mode is always active.

2. Set the cursor to the left of the number to be changed using the LEFT/RIGHT arrow keys.

   The cursor is displayed in green.

3. Click on a numeric key to insert a new value.

   Dwell Time   10.000 | ms ▾   Dwell Time   6| ms ▾

Editing a value in the overwrite mode

1. Activate the editing mode.

2. Set the cursor on the numeric digit to be changed using the LEFT/RIGHT arrow keys.

   The cursor is displayed in blue and the number to be replaced is highlighted.

3. Click on a numeric key to overwrite the highlighted value.

Varying a value

1. Activate the editing mode.

2. Set the cursor to the left of the number to be changed using the LEFT/RIGHT arrow keys.

   The value at the cursor position is varied.

3. To vary the selected value, use the UP/DOWN arrow key or turn the rotary knob.

   The value is increased or decreased.

Entering a new alphanumerical value

1. Select the parameter.

2. Press an alphanumeric key to start the editing mode.

   The new value is entered.

Editing an alphanumerical value

An existing value, e.g. a file name, can be changed in the insert mode (see example) or in the overwrite mode.

1. Select the paramter and activate the editing mode.

2. Set the cursor to the left of the alphanumerical value using the LEFT/RIGHT arrow keys.

   Tip: If hexadecimal values are to be entered, the numeric front-panel keys are automatically changed to hexadecimal values.

3. Click on an alphanumeric key to insert a new alphanumerical value.

Terminating the entry of a numeric value

To terminate the entry of a numeric value:

1. Press the rotary knob (= Enter).

2. Press a UNIT key on the front panel.

3. Select a "Unit" in the selection field next to the parameter value.

4.4.5 Working with Units

The unit of a parameter is displayed next to the value. When the parameter is edited, the unit is selected either from the list or by means of the front-panel keys. When the entry

is completed, the unit can be changed. In this case the value remains unchanged but is automatically adapted to the new unit.

While operating the instrument by means of a mouse, assign the unit to the selected parameter before entering its value.

Assigning a unit

To assign a unit to a value, use one of the following alternatives:

1. Press a UNIT key on the front panel.

| Frequency | 10 | GHz ▾ | + | [M/µ µV] B | = | Frequency | 10.000 000 000 | MHz ▾ |

2. Select a "Unit" in the selection field next to the parameter value.
   Press the ENTER key.

   The unit displayed in the entry field next to the value is assigned.

Changing a unit

To subsequently change a unit, i.e. after the entry has been terminated and when the editing mode is not active, use one of the following alternatives:

1. Press a UNIT key on the front panel.

2. Select"Unit" in the selection field next to the parameter value.

   The value remains unchanged but the display is automatically adapted to the new unit, i.e. the value is recalculated to suit the new unit.

| Frequency | 10 000.000 000 | kHz ▾ | + | [M/µ µV] B | = | Frequency | 10.000 000 000 | MHz ▾ |

The new unit is indicated in the value field of the menu.

4.4.6 Selecting a Value from a List

Selection lists provide a list of predefined values for the selected parameter.

| Source | Internal ▾ |
| Output | Internal / External |
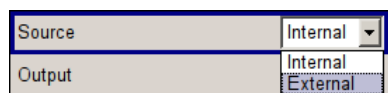
To select a item from a list, proceed as follow:

1. Press ENTER key to open the list.

2. Use one of the following alternatives to navigate through the list:

   a) Turn the rotary knob or use the UP/DOWN arrow keys.
      The selected item is highlighted.

b) Press TOGGLE ON/OFF key several times until the preferred entry is displayed in the selection field.

3. To confirm the selection, press the ENTER key.

4.4.7 Terminating Entries with Confirmation

The instrument behaves different by the termination of entries deppending on the parameter type and the way this parameter is set.

Confirming settings

► To confirm the settings, press the rotary knob or one of the UNIT keys (see also chapter 4.4.5, "Working with Units ", on page 67) .

Note: Variations by means of the rotary knob are immediately set.

Confirming multiple values

In some cases, like for instance when editing data in a user correction table, it is useful first to enter few values and to confirm them together. Such settings require additional confirmation. Not yet confirmed settings are displayed on a yellow background as an indication that the currently displayed values do not represent the target signal.

► To confirm these settings, select the "Save" or "Accept" button, respectively.

Confirming parameters with On/Off state

Most of the instrument functions with enabled and disabled states are calculated and effective only after this functions have been enabled. However, there are functions like the frequency variation of the reference oscillator for instance, that are immediately set after confirmation.

► To confirm a parameter with On/Off state, enable the parameter.

4.4.8 Restoring the Previous Value

Parameter variations with the rotary knob are immediately set and therefore not reversible.

Normally, values cannot be restored in the case of mouse control because no explicit confirmation is required in this case and entries are automatically confirmed when the entry or selection field is exited.

Restoring values

In the case of front-panel control or operation from the keyboard, previous values can be restored as long as the new value is not confirmed, i.e. the entry is not completed.

► To restore the values, press the ESC key.

Restoring values that require confirmation

All settings that are not confirmed with the "Accept" button but require this additional confirmation can be restored.

1. Press the ESC key.

   A confirmation query is displayed.
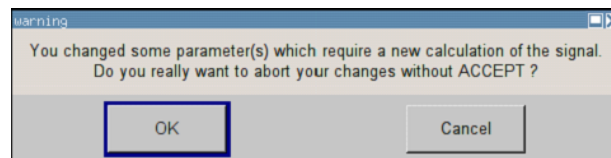
2. Confirm with "OK" to abort the changes.
   Select "Cancel" to return to the dialog. The previous selected settings are displayed.

Restoring values after an extended calculation has been started

Calculation and setting might require different period of time. Many settings are made without noticeable calculation times; such operations are indicated by a "BUSY" message displayed in the status field of the header section.

A window with a progress indicates that the instrument performs an extended calculation that requires longer calculation time. The termination of such a calculation restores the previous values.

► Press the ABORT button to terminate the calculation.

   All previous values are restored.

4.5   Editors

The R&S SMA provides user-friendly editors for defining lists. Lists containing frequency and level value pairs are used for the list mode and the user-defined level correction.

The lists are saved to files and may thus have any length. The file name of the lists and the directory to which the files are saved are user-selectable. The file prefix is different for each list type and is permanently assigned by the system.

For information about file handling and overview of the automatically assigned file pre-fixes, refer to chapter 4.7, "File Management", on page 73.

4.5.1   Working with List Editor

The "User Correction" and "List Mode" dialogs provide a list editor for defining the frequency/level value pairs.

Editing list mode data lists

1. To access a list editor and open an existing data list for editing, use the cursor keys
   to select the associated button "Edit User Correction Data..." or "Edit List Mode
   Data..." (if available) in the individual menu.

   The selected list is displayed and the cursor marks the first row of the "Frequency/
   Hz" column.

	Frequency/Hz	Power/dBm	
1	100 000.000	-140.00	
2	100 010.000	-140.00	
3	100 020.000	-140.00	
4	100 030.000	-140.00	
5	100 040.000	-140.00	
6	100 050.000	-140.00	
7	100 060.000	-140.00	
8	100 070.000	-140.00	
9	100 080.000	-140.00	

Goto	Edit	Save

   If no list has been selected, a blank list of only one row is displayed.

2. Press the LEFT/RIGHT arrow keys to change between the colums.
   Use the UP/DOWN arrow keys to mark a row.

3. Use the numeric keys to enter the value for the value pairs in the "Frequency/Hz" and
   "Power/dBm" table columns. A blank row is inserted at the end of the list.
   Terminate the entry by pressing a UNIT key.

4. To select a row, select the "GoTo" button and press the ENTER key.
   Use the numeric keys to enter the row index in the entry field and press the
   ENTER key to confirm the entry.

   The cursor moves to the selected row.

5. To insert a new row in the table, select the row above which the new row is to be
   inserted and select "Insert Row(s)".

   A row is inserted above the currently marked row.
   If no row has been selected, a row is inserted at the beginning of the list.

6. Use the "Save" function to save the edited list under its current name.
   Enter the file name in the "File Select" dialog and select the directory (see chapter 4.7.1, "File Select Dialog", on page 74).

   Only complete value pairs are taken into consideration; rows containing an entry in
   only one column are ignored.

Creating a new list mode data list

A new list can be created under a new name either by generating a blank file in the "File
Select" menu (see section chapter 4.7, "File Management", on page 73) or by changing
an existing list which will then be saved under a new name.

1. To create an empty data list, select "RF > List Mode > List Mode Data... > New
   List" or respectively "RF > User Correction > User Cor. Data... > New User Correction
   Data" and enter the file name of the new data list.

2. To open the data list for editing, select the associated button "Edit User Correction Data..." or "Edit List Mode Data..." in the individual menu.
Edit the list and save it under a new name.

4.6 How to Use the Help System

The R&S SMA is equipped with a context-sensitive help function. A help page is available for each parameter and can be called any time during instrument operation.

Compiled online help systems are also available for all functions of the R&S SMA on the CD-ROM supplied with the instrument. This help program can be called on any controller with Internet Explorer version V4.0 and higher.

Calling context-sensitive and general help

► To display the general help dialog box, press the HELP (F1) key.

The help dialog is displayed. A topic containing information about the current menu or the currently opened dialog box and its function is displayed.
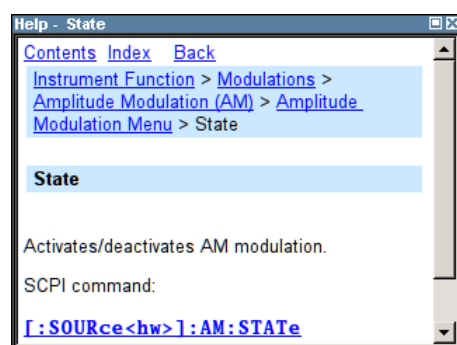
On top, the help dialog box contains a navigation bar with:

● "Contents" - accesses a table of help contents
● "Index" - switches to an index table
● "Back "/"Previous"/"Next" for navigation to further help topics

Navigating in the table of contents

1. To move through the displayed contents entries, use the UP/DOWN keys. Entries that contain further entries are marked with a plus sign.

2. To display a help topic, press the "ENTER" key.

The corresponding help topic is displayed.

Navigating in the help topics

1. To scroll through a page, use the UP/DOWN arrow keys.

2. To jump to the linked topic, press the link text.

3. Use the "Previous" or "Next" links to jump to the corresponding topic.

Using the Index

1. Select "Index".

2. Enter the first characters of the topic you are interested in. The entries starting with these characters are displayed.

3. Press the ENTER key to change the focus.

4. Use the UP/DOWN keys to navigate and select the suitable keyword.

5. Press the ENTER key to display the help topic.

   The corresponding help topic is displayed.

Closing the help window

► Press the HELP (F1) key.

4.7 File Management

The R&S SMA uses files to save all instrument data, i.e. system and user data.

The user data includes saved instrument settings and lists and the user correction.

The files are stored on the CompactFlash^{TM} card of the instrument. The `/var` directory can be used to save user-defined data; any subdirectory structure can be created on `/var`. Some default subdirectories are predefined, but can be changed at any time.

The `/opt` directory is a protected system drive and therefore unaccessible system directory. The files on this directory contain data that must not be changed. Therefore, this drive should not be accessed, since reconstruction of the system partition will lead to data loss. To prevent inadvertent deletion or overwriting of system files, this drive is not specified in the file menus.

Files can be exchanged either via a memory stick or a connected network. A memory stick is connected to the USB interface and is assigned the `/usb` drive. In the case of a connected network, all network drives that can be accessed are available. The files are accessed in a "Save/Recall" dialog in the individual menus.

The files are differentiated according to their extensions; each type of file is assigned a specific file content. The extension is usually of no consequence to the user since access to the files occurs in the individual menus where only the relevant type of file is available. See chapter 4.7.2.1, "Extensions for User Files", on page 76 for an overview of the supported file extensions.

The user data can be roughly divided into the following data types:

● Settings
Instrument settings can be saved and loaded. In case of saveing, the current setting is saved to the specified file.

● Lists

Lists, e.g. user correction lists, can be loaded. They can be generated either externally or internally. For internal generation, a new list must be created in the "File Select" dialog which will then be edited in the list editor of the individual menu.

For more information, refer to:

- chapter 4.8, "Legend of Front-Panel Controls", on page 77 for an overview of key functions and a cross-reference between the front panel keys and the keyboard shortcuts
- to section "Instrument Functions" for a detailed description of key functions.

Accessing files with user data

1. To access an editable user data file, select the "Save/Recall" or "File Manger" function in the individual dialog.

    Recall Settings
    Save Settings
    File Manager...

2. To access a loadable data file, select the "Select/New" or "File Manager" function in the individual dialog.

    Select User Correction Data
    New User Correction Data
    File Manager...
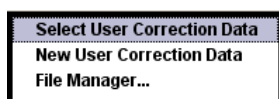
3. To access the "File Manager" function, press the SETUP (CTRL+E) key and select "Save/Recall > File Manager".

    A "File Select" window for loading, saving or creating a file or the "File Manager" dialog for managing all files is displayed.

Saving and loading of all instrument settings

All instrument settings are saved and loaded in the "File" menu.

To access the "File" menu, press the FILE (CTRL+S) key.

For more information, see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 107.

4.7.1 File Select Dialog

The "Save/Recall" dialaog displays the available drives and directories. In the upper part, "Recent Data Sets", the files last used are listed.
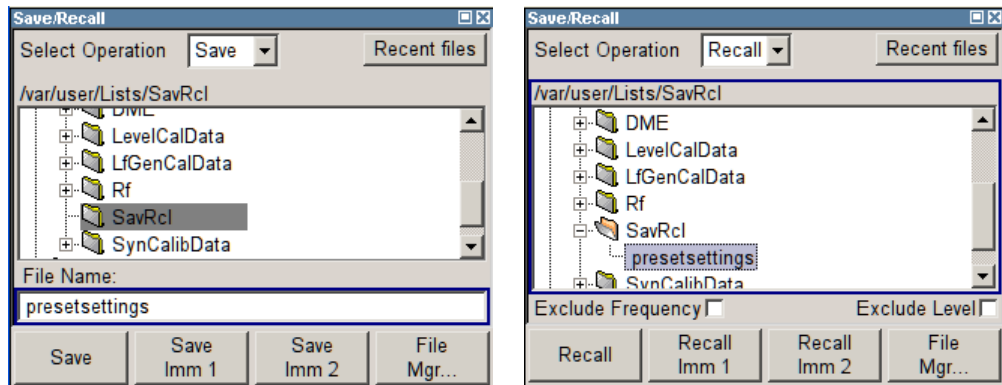
The available drives and directories and the files of the selected directory are displayed. The currently selected path is displayed above the window. Only the relevant files without file extensions are displayed. If the area is opened several times, the path last selected is displayed. When a file is saved or created, its name is user-selectable; the extension is assigned automatically and cannot be entered. The file is saved to the selected path.

In addition to the files saved by the user, some menus also offer files containing predefined contents. These files are saved to a specific directory on system drive; for this reason, this directory cannot be chosen from the "File Select" menu.

Working with the File Select dialog

1. Access the "File Select" dialog (see "Accessing files with user data" on page 74).

2. Navigate in the "File Select" dialog.

3. Load an existing file.
   In the "Recall Settings" dialog, mark a file and press the "Select" button.

4. Save a file.
   In the "Save Settings" dialog, enter file name in the "File Name:" field.
   Select the directory to which the file is to be saved and then select the "Save" button.

5. Create a new file.
   To create a new file, use the "Save Settings" functionality, i.e. specify file name and directory and save the file.

   The created file is empty; it must be filled with the necessary values in the individual editor.

4.7.2 File Manager

The "File Manager" allows general file management such as copying, shifting, renaming and deleting files as well as generating new directories.
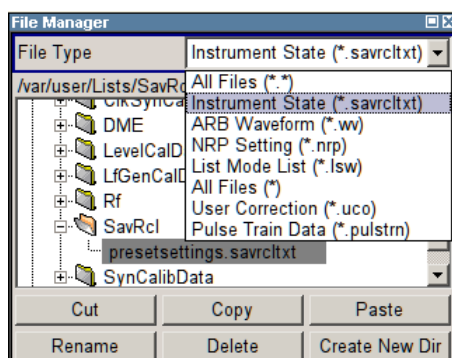
Use the "File Type" to select a file type form the list. This can be used to process either all files (all files (*) selection) or a specific selection of files. See chapter 4.7.2.1, "Extensions for User Files", on page 76 for an overview of the supported file extensions. The available drives and directories and the files of the selected directory are displayed. The currently selected path is displayed above the windows. If the area is opened several times, the path last selected is displayed. Unlike the "File Select" window, the "File Manager" displays the full file names including extensions.

Working with the File Manager dialog

1. Accessing the "File Manager" dialog (see "Accessing files with user data" on page 74).

2. Navigating in the "File Manager" dialog.
   Operation is similar to the operation of menus with several areas.

3. Moving, duplicating, deleting or renaming files
   To move a file, select the file and press the "Cut" button. Mark the directory to which the file is to be moved and select the "Paste" button. If the target directory already contains a file with the same name, a confirmation query is displayed to confirm overwriting of this file.
   Perform the similar steps and cut/copy/rename/delete the file.

   Tip: The operation corresponds to the Windows concept.

4. Creating a new directory
   Mark drive or directory level where the new directory is to be created, select the "Create New Directory" button and enter the name of the new directory in the entry window that opens. Confirm with ENTER.

4.7.2.1 Extensions for User Files

The following table list all available file extensions for user files. The currently available files on the instrument depends on the installed options.

Table 4-1: List of the automatically assigned file extensions in the instrument

Function	List type	Contents	File suffix
Instrument State	Settings	Instrument settings	*.savrcl
"User Correction"	List	User-defined level correction values	*.uco

Function	List type	Contents	File suffix
		Export Data	`*.txt` or `*.csv`
"List Mode"	List	User-defined frequency/level value pairs	`*.lsw`
		Export Data	`*.txt` or `*.csv`
"Pulse Train List"		User-defined offtime/ontime/repetition values	`*.pulstrn`
ARB Waveform		ARB Waveform	`*.wv`
NRP Settings	Settings	NRP Settings	`*.nrp`

4.8　Legend of Front-Panel Controls

The following table lists all key functions available on the front panel. Key combinations used on the PC keyboard to trigger key functions on the instrument front panel are also described. Keyboard labels are described in alphabetical order.

In addition, a front panel key emulation and an on-screen keyboard can be used for manual operation by mouse only.

Table 4-2: Cross-reference between the front panel keys and keyboard shortcuts

Front-panel key	Key of PC keyboard	Function
Turning the rotary knob	Tab key (towards the right) Shift + Tab (towards the left)	Sets the cursor with the rotary knob.
Pressing the rotary knob	Enter	Pressing the rotary knob confirms an entry; it has the same function as the ENTER key.
Arrow keys	Arrow keys	Moves the cursor.
ENTER / *1 / dB(m)	Enter ALT + F12	Terminates an entry. Confirms entries in the base unit and values without a unit. Selects dBm for the RF level and dB for level offset and level step width.
. / *...#	. / *...#	Enters a period/decimal point. Enters a special character.
- / A<->a	- / (shift+) a—z	Enters the sign. Switches between upper-case and lower-case letters.
0-9 / a...z	CTRL+ 0-9 / a...z CTRL	Enters the number/letter.
BACKSPACE	Backspace	Clears the last entry (number, sign or decimal point)
ESC / CLOSE	ESC / CTRL + G	Selects the next higher menu/selection level. When the editing mode is exited with ESC, the previous value is restored. Closes an active menu.
DIAGRAM	CTRL+ D	Sets the cursor on the block diagram and hides all menus.

Front-panel key	Key of PC keyboard	Function
FILE	CTRL + S	Activates the menu for storing instrument settings.
FREQ	CTRL+ F	Activates the frequency entry.
G/n / dBuV	ALT + F9	Selects the unit Giga/Nano, dBuV for the RF level and dBu for the LF level.
HELP	F1	Opens/closes context-sensitive help.
INFO	CTRL + I	Opens/closes the info window
k/m / mV	ALT + F11	Selects the units kilo/milli and mV for RF levels.
LEVEL	CTRL + L	Activates the level entry.
LOCAL	CTRL + Q	Switches the instrument from remote control to manual control.
M/u / uV	ALT + F10	Selects the units Mega/Micro and uV for RF levels.
MENU	CTRL + M	Calls the menu selection list.
MOD ON/OFF	CTRL + O	Switches modulation on/off. "MOD OFF" is indicated in the status line.
ON/OFF TOGGLE	CTRL + T	Switches a block or parameter on/off. Toggles between the different possibilities of setting a selection parameter.
PRESET	CTRL + P	Restores a defined basic instrument setup.
REARR	CTRL + A	Enlarges displayed menus
RF ON/OFF	CTRL + R	Switches the RF output signal on/off. "RF OFF" is indicated in the status line.
SETUP	CTRL + E	Opens the setup menu for general instrument settings.
WINBAR	CTRL + W	Toggles between the active menus.

4.8.1 Front Panel Key Emulation

The R&S SMA provides a front panel key emulation to enable execution of the front panel key functions by mouse e.g. for remote access. The emulation is called by a right mouse click. The front panel key functions are executed by a mouse click on the associated button.

5 Instrument Function

5.1 Overview of Instrument Functions

This chapter explains the functions of the R&S SMA and the options available in the setting menus. The associated SCPI command is specified for each parameter (where applicable).

The description begins with the general instrument settings which do not directly affect signal generation. The majority of these settings can be accessed by means of front-panel softkey menus and not by means of function block menus.

The signal generation functions are then described, beginning with the functions which affect the RF signal ("RF" block) and the analog modulations ("Mod" block). The configuration of the modulation generators (LF generators and pulse generator) and of the LF sweep is offered in the "Mod Gen" block. The clock synthesis signal is set in the "Clock Synthesis" block.

The general instrument settings include various functions, such as:

- Setting a defined basic setup using the PRESET key
  see chapter 5.2.2, "Default Instrument Settings - Preset Key", on page 83

- Switching from remote control to manual control using the LOCAL key
  see chapter 5.2.4, "Switching to Manual Control - Local Key", on page 102

- Configuring the generator and its interfaces in the "Setup" dialog - e.g. setting the GPIB address, starting an adjustment, querying instrument data
  see chapter 5.2.3, "General Configuration of Instrument - Setup Key", on page 84

- Calling up the online help using the HELP key
  see chapter 5.2.7, "Help System - Help Key", on page 106

- Querying messages using the INFO key
  see chapter 5.2.6, "Messages - Info Key", on page 106

- Loading and storing complete instrument settings in the "File" menu
  see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 107

The RF signal and the reference oscillator are configured in the "RF" function block:

- CW mode
  see chapter 5.3.1, "Overview of RF Signal", on page 113

- List mode
  see chapter 5.3.10, "List Mode", on page 195

- Frequency and Level Sweep mode
  see chapter 5.3.9.1, "Overview", on page 183

- Reference Oscillator
  see chapter 5.3.4, "Reference Oscillator", on page 122

- RF Level
  see chapter 5.3.6.1, "Overview RF Level Settings", on page 169

- RF Level Sweep

see chapter 5.3.9.3, "RF Level Sweep", on page 190

- ALC
  see chapter 5.3.7, "Automatic Level Control - ALC", on page 174
- Power Sensors
  see chapter 5.3.5, "Power Sensors", on page 125
- User Correction
  see chapter 5.3.8, "User Correction", on page 176

The analog and external digital modulations are activated in the "Modulation" function block:

- Amplitude Modulation
  see chapter 5.4.2, "Amplitude Modulation (AM)", on page 208
- Frequency Modulation
  see chapter 5.4.3, "Frequency Modulation (FM)", on page 211
- Phase Modulation
  see chapter 5.4.4, "Phase Modulation (PhiM)", on page 217
- Pulse Modulation
  see chapter 5.4.5, "Pulse Modulation (PM)", on page 222
- Chirp Modulation
  see chapter 5.4.6, "Chirp Modulation", on page 224
- Test signals for avionic systems
  - see chapter 5.4.7, "DME Modulation", on page 229
  - see chapter 5.4.8, "VOR Modulation", on page 248
  - see chapter 5.4.9, "ILS-GS Modulation", on page 255
  - see chapter 5.4.10, "ILS-LOC Modulation", on page 262
  - see chapter 5.4.11, "Marker Beacon Modulation", on page 272
  - see chapter 5.4.12, "ADF Modulation", on page 277

The internal LF generators, the LF frequency sweep and the pulse generator are configured in the "Mod Gen" function block:

- LF Frequency Sweep
  see chapter 5.5.2, "LF Frequency Sweep", on page 282
- LF output
  see chapter 5.5.3, "LF Output", on page 287

The clock synthesis is configured in the "Clock Synthesis" function block:

- see chapter 5.6, "Clock Synthesis", on page 301

5.2 General Instrument Settings

5.2.1 Overview of General Instrument Settings

This section describes the settings which do not directly affect signal generation. Most of these settings can only be accessed by means of menus which are opened using keys or key combinations on the external keyboard or keys on the front panel key emulation.

The general instrument settings therefore affect various functions, such as storing instrument settings using the FILE key or setting the GPIB address in the menu of the SETUP key. The order in which the descriptions are given corresponds to the layout of the keys on the front panel of the R&S SMA (from top left to bottom right).

5.2.2 Default Instrument Settings - Preset Key

The PRESET key calls up a defined instrument setup. All parameters and switching states are preset (also those of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings.

However, functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB address or reference oscillator source settings.

When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched on.

An exception is the state of the RF output. The state of the RF output power-on state can be set to be always off in the "EMF" menu of the "RF" block.

User-defined instrument states can be stored and called up in the "File" menu.

Resetting the instrument to the factory state is possible with the Factory Preset function.

Preset

Presets all parameters and switching states.

The following list gives an overview of the presets for the most important generator settings. The other presets can be found in the preset tables of the individual menus and the information accompanying the remote commands.
- "RF frequency" = 1 GHz
- "RF level" RF output switched off
- "Offsets" = 0
- "Modulations State" = Off
- Uninterrupted level settings are switched off
  "Level Attenuator Mode" = AUTO
- Internal level control "Level ALC" = AUTO
- User correction "Level Ucor" = OFF
- "LF output State" = Off
- "Sweep State" = Off

● "List mode State" = Off

Settings that are not affected by the PRESET key

● Reference frequency settings ("Ref Oscillator" menu)
● Power on settings ("Level/EMF" menu)
● Network settings ("Setup" menu)
● GPIB address ("Setup" menu)
● *IDN? Identification and emulation ("Setup" menu)
● Password and settings protected by passwords ("Setup" menu)
● Start/Stop Gui Update ("Setup" menu)
● Display and keyboard settings ("Setup" menu)

SCPI command:
*RST on page 348

5.2.3 General Configuration of Instrument - Setup Key
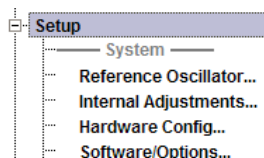
The SETUP key opens the "Setup" dialog.

The "Setup" dialog is divided into several sections.
● The "System" section is used to set general instrument parameters.
● The "Test" section is used to perform function tests.
● The "Environment" section is used to configure the controller interfaces.
● The "Remote" section is used to configure the remote control interfaces.
● The "Protection" is used to set the protection level for service functions.
● The "Settings" section contains the "Save/Recall" dialog.

Most submenus of this key can be accessed only via the SETUP key or the menu tree (MENU key), with the following exceptions:

● The "Reference Oscillator" dialog can also be called up in the "RF" block and is therefore described in the section on this block (see chapter 5.3.4, "Reference Oscillator", on page 122).
● The "Save/Recall" dialog can also be called up with the FILE key and is therefore described in the section on this key (see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 107.

5.2.3.1 Internal Adjustments

The R&S Signal Generator is extremely accurate thanks to the integrated procedures for adjustments.

All internal adjustments for which no external measuring equipment is needed can be started in the "Internal Adjustments..." dialog. The adjustments with external measuring equipment are described in the Service Manual (on CD ROM, supplied with the instrument).

Adjustment is recommended if the temperature range in which the instrument is operated changes, or prior to all applications which require maximum level and frequency accuracy.

During adjustment a bar indicates the status of progress. If an error occurs, adjustment is terminated and an error message is output in the info line.

> **NOTICE**
>
> **Risk of invalid adjustment**
>
> In order to achieve correct adjustment of the instrument, make sure that the instrument is warm before performing adjustments. The warm-up time is 30 minutes.

To access the "Internal Adjustments" dialog, press the SETUP or MENU key under "System".

The adjustments offered also depend on the installed options.
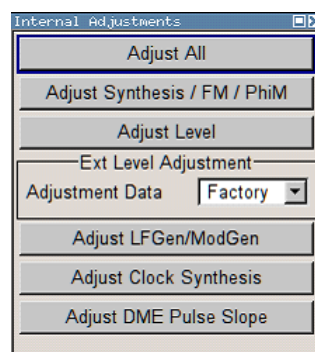
Adjust All
Starts all internal adjustments for which no external measuring equipment is needed. The adjustments with external measuring equipment are described in the Service Manual (supplied).

SCPI command:
`:CALibration:ALL[:MEASure]` on page 351

Adjust Synthesis
Performs all adjustments which affect the frequency.

This includes adjustment of following options:
- R&S SMA-B20, FM/PhiM Modulator
- R&S SMA-B22, Enhanced Phase Noise Performance and FM/PhiM Modulator
- R&S SMA-B106/106L, Frequency Extension 6GHz with/without attenuatior.

SCPI command:
`:CALibration<hw>:FREQuency[:MEASure]` on page 353

Adjust Level
Performs all adjustments which affect the level. The acquired correction values improve the settling time and the signal quality.

NOTICE! FR Level. When option R&S SMA-B103L or R&S SMA-B106L is installed, a level of approximately 12 dBm is preset at the RF output connector during level adjustment.

SCPI command:

`:CALibration<hw>:LEVel[:MEASure]` on page 353

Adjustment Data

Selects the data used for external level correction.

By default the instrument uses correction data obtained in the factory before delivery. In addition, customer data can be used for external level correction. The customer data is obtained using a R&S NRP power sensor. External level correction is a protected function (see Service Manual, chapter 2, "Adjustment").

SCPI command:

`:CALibration<hw>:LEVel:EXTern:DATA` on page 353

Adjust LF Gen/Mod Gen

Performs all adjustments which affect the internal modulation generator.

SCPI command:

`:CALibration:LFOutput[:MEASure]` on page 353

Adjust Clock Synthesis

Performs all adjustments which affect the clock synthesis.

SCPI command:

`:CALibration:CSYNthesis[:MEASure]` on page 352

Adjust DME Pulse Slope

Activates internal adjustment of the DME pulse slope for best linearity.

SCPI command:

`CALibration:DME[:MEASure]` on page 352

5.2.3.2 Hardware Config

In the "Hardware Config" dialog, the installed assemblies together with their variants and revision states can be displayed for servicing purposes.

To open the "Hardware Config" dialog, select "System" and press the SETUP or MENU key.
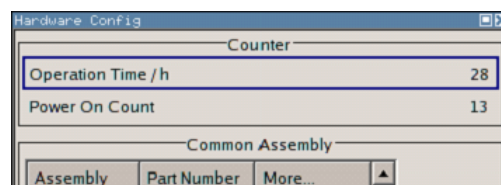
Section "Counter" in the upper part of the menu shows the "Operation Time" (in hours) and the number of power-on ("Power On Counter").

The second part of the menu is a table that lists the installed assemblies. It is divided into the sections:

- "Common Assembly"
- "RF Assembly"

Operation Time / h

Displays the operation time in hours.

SCPI command:

:DIAGnostic:INFO:OTIMe on page 357

Power On Count

Displays the number of power-on.

SCPI command:

:DIAGnostic:INFO:POCount on page 357

Assembly

The tables list the installed assemblies.

"Assembly"   Assembly name

"Part Number"   Part Number of assembly

"More"   Opens a dialog with additional information on serial number, revision and slot of assembly and used bus by assembly (serial bus or PCI bus).

SCPI command:

:DIAGnostic<hw>:BGINfo on page 356

5.2.3.3 Software / Options

The "Software/Options" dialog shows the firmware version of the instrument software as well as all installed hardware and software options.

Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in Chapter 4 of the Service Manual (supplied with the instrument).

The installation of hardware options purchased at a later stage is also described in Chapter 4 of the Service Manual (supplied with the instrument). Most hardware options need to be installed at an authorized Rohde&Schwarz service shop.

To access the "Software/Options" dialog, select "System" and press the SETUP or MENU key.

The menu is devided into the following sections:

- "Firmware"
- "Hardware Options"
- "Software Options"

Firmware

The Firmware section of the menu shows the firmware version and the version of the software platform.

Note: Your instrument is delivered with the latest firmware version available. Firmware updates as well as the Release Notes describing the improvements and modifications are provided on the Internet at the download site of the Rohde & Schwarz Signal generator home page. This home page always offers the latest information on your signal generator, e.g. also on changes of the firmware update procedure.

SCPI command:
n.a.

Hardware Options / Software Options

The tables in the sections "Hardware" and "Software" list the installed hardware and software options.

"Option"   Short name of option

"Designation"   Name of Option

SCPI command:
*OPT on page 347
*IDN on page 346

Loaded Modules

Section "Loaded Modules" is provided for service purposes. It lists all loaded software modules with their versions and offers a short description of each module.

SCPI command:
n.a.

5.2.3.4   Gui Update

The "Start/Stop Gui Update" dialog provides the possibility to switch off update of the displayed parameters in order to increase speed for certain settings.

The indicated values are not updated and may therefore differ from the intern, used values.
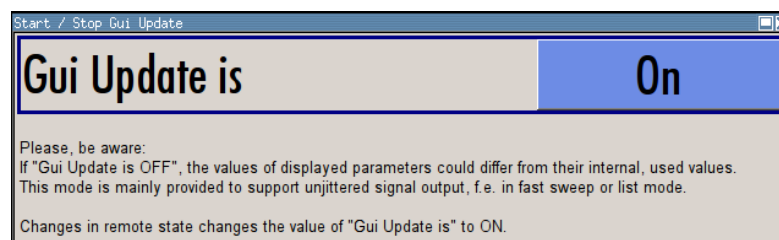
On/Off GUI Update

Switchs on/off update of the displayed parameters.

Switching off the update of the displayed parameters increases the speed for certain settings.

Note: It is especially recommended to switch off the GUI update for optimum sweep performance with short dwell times and for fast settling times.

SCPI command:

`:SYSTem:DISPlay:UPDate` on page 587

5.2.3.5   Install SW-Option

Newly purchased software options are enabled in the "Install SW-Options" menu. They are ready to operate after they are enabled by means of a key code supplied with the option.
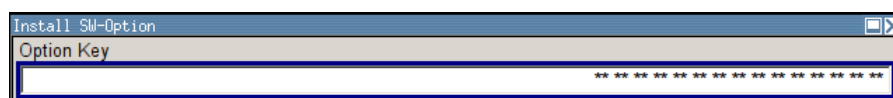
Only if the R&S Signal Generator is equipped with an older firmware version, a firmware update prior to enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option. The firmware update is described in the service manual instrument, chapter 4 (on CD ROM, supplied with the instrument).

5.2.3.6   NRP-Z Info/Update

In the "NRP-Z Info/Update…" dialog, the connected power sensors are indicated together with their serial number, revision state and features in terms of support of the R&S SMA-K28 Power Analysis option. The software of a connected sensor can be updated to a new version.

To access the "NRP-Z Info/Update…" dialog, select "System" and press the SETUP or MENU key.
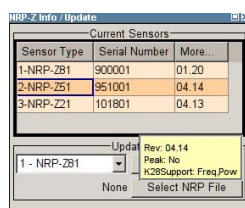
Current Sensors

Section "Current Sensors" lists the sensors that are connected to the generator and indicates their serial number, the revision state and some features.

Tip: Click on a sensor to get quick information about the firmware version and whether this sensor measures the peak of the signal.

"K28Support" indicates the R&S SMA-K28 measurement functions provided bxy the sensor.

SCPI command:

n.a.

Update

Section "Update" provides access to the file system in order to select a file for an R&S NRP sensor update (Button "Select NRP File"), the selected file is indicated to the left of the button. On the left side, the sensor to be updated is selected.

Button "Run Update" starts the update. If the update is interrupted for example by accidently pulling off the sensor, selection "Rescue" is offered to restart the update process. Prerequisite is that no other sensor is connected to the instrument.

The procedure is as follows:

- Do not reconnect the sensor but keep it ready to be connected
- Select "Rescue" in the left sensor selection field
- Activate "Run Update"
- Confirm query in message box
- Connect sensor within 4 seconds
  The update starts, a bar informs about the progress.

SCPI command:

SENSe<ch>[:POWer]:TYPE on page 418

SENSe<ch>[:POWer]:SVERsion on page 392

SENSe<ch>[:POWer]:SNUMber on page 391

5.2.3.7 Update

After a firmware update it is occasionally required to also update the "PCI-FPGA". This is enabled in the "Update" dialog.

At the first start of the new firmware, a message appears during the boot process if a "PCI-FPGA" update is required. Execute a PCI-FPGA update by pressing the "PCI-FPGA" button.

NOTICE

Impairment of instrument functions

To avoid impairment of instrument functions, the update of the "PCI-FPGA" must not be cancelled and the instrument must not be switched off during this update.
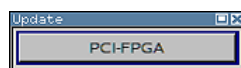
5.2.3.8 Selftest

A selftest is provided for service purposes. The selftest is a protected test procedure, which can be accessed if protection level 1 is disabled. The protection dialog is called in the "Setup" menu (see chapter 5.2.3.14, "Protection", on page 97).
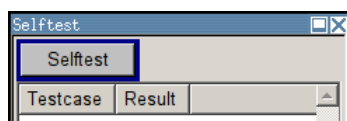
The following tests are only available via remote control:

- `:TEST<hw>:DIRect` on page 594

Selftest

Performs a selftest on all installed hardware options.

A list of the performed tests cases and the result of each of them (passed or failed) is displayed.

SCPI command:

`:TEST<hw>:ALL:STARt` on page 594

`:TEST<hw>:ALL:RESult` on page 594

5.2.3.9 Check Front Panel

The "Check Front Panel" dialog is used to check whether the front panel keys are functioning correctly. The menu displays all the front panel keys arranged in the same way as on the front panel. The respective function is executed by pressing the associated key.
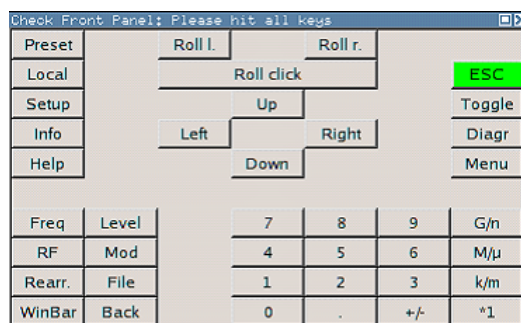
5.2.3.10 Date and Time

The "Date/Time..." dialog provides access to the system time and date settings. It is opened using the SETUP or MENU key under "Environment". The time is used on the internal controller.
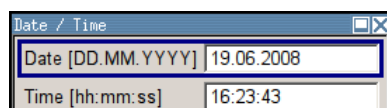
Date

Enters the date in the format day.month.year.

SCPI command:

`:SYSTem:DATE` on page 587

Time

Enters the time in the format hour.minute.second

SCPI command:

:SYSTem:TIME on page 593

5.2.3.11 Network Settings

The "Network Settings" dialog provides access to the network settings. To access this dialog, press the SETUP or MENU key under "Environment". The R&S SMA is equipped with a network interface and can be connected to an Ethernet LAN (local area network).

How to connect the signal generator to the network is described in chapter 2.6.1, "Connecting the Instrument to the Network", on page 34.

NOTICE

Risk of network errors!

Connecting errors may affect the entire network.

We recommend to coordinate the connection of the instrument to the network with the network administrator.

Do not connect or disconnect the network cable until the instrument is **switched off** (standby). Only then the network connection can be reliably detected and impairments to instrument operation can be avoided.
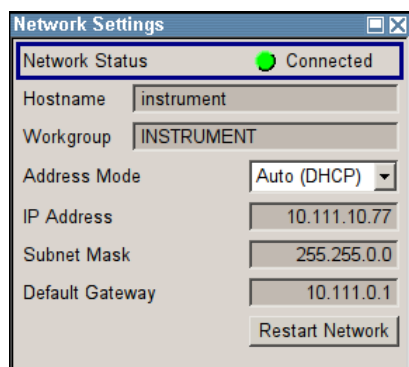
The dialog provides an access to the network settings, like settings about the general network environment and specific identification of the computer in the network, as well as an indication whether the instrument is connected to the network or not.

Network Status

Indicates whether the instrument is connected to the network or not.

SCPI command:
n.a.

Hostname

Enters the individual computer name of the R&S Signal Generator.

Note: The computer name can only be changed after protection level 1 is deactivated (see chapter 5.2.3.14, "Protection", on page 97).

A predefined name is indicated and can be used for network connections.

SCPI command:

`:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname` on page 584

Workgroup

Enters the individual windows workgroup name of the R&S Signal Generator. This parameter is necessary in case the instrument is integrated in a windows network.

Note: The workgroup can only be changed after protection level 1 is deactivated (see chapter 5.2.3.14, "Protection", on page 97).

SCPI command:

`:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup` on page 584

Address Mode

Selects if the IP address is assigned automatically or manually.

"Auto (DHCP)" The IP address is assigned automatically.
               The network used must support automatic assignment of IP address via DHCP or APIPA (Zeroconf) in order to use this function.

"Static"   The IP address is assigned manually.

SCPI command:

`:SYSTem:COMMunicate:NETWork:IPADdress:MODE` on page 584

IP Address

Displays the IP address. To enter the IP address manually, select "Static" Address Mode.

SCPI command:

`:SYSTem:COMMunicate:NETWork:IPADdress` on page 584

Subnet Mask

Displays the Subnet mask. To enter the Subnet mask manually, select "Static" Address Mode.

This number is used together with the IP address to identify the network segment the instrument is in.

SCPI command:

`:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK` on page 585

Default Gateway

Displays the IP address of the default gateway. To enter the default gateway manually, select "Static" Address Mode.

This address identifies the router on the same network as the instrument that is used to forward traffic to destinations beyond the local network.

SCPI command:

`:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway` on page 585

Restart Network

Shuts down the network connection of the instrument and subsequently re-establishes the connection.

This function can be used to resolve network problems.

Note: Only the connection of the instrument to the network restarts, the network itself is not affected.

SCPI command:

n.a.

5.2.3.12 Display/Keyboard Settings

In the "Display/Keyboard Settings" menu the power-save mode and external keyboard settings are made. It is opened using the SETUP or MENU key under "Environment".
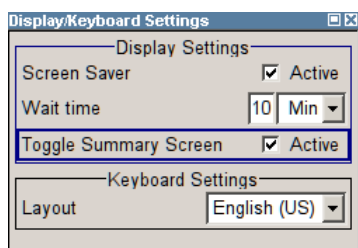
Screen Saver Active

Activates/deactivates the screen-save mode of the display.

If activated, the display including backlight is completely switched off after the elapse of the "Wait Time" when no entries via front panel, external mouse or external keyboard are made.

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

SCPI command:

:DISPlay:PSAVe[:STATe] on page 358

Wait Time

Enters the idle time that must elapse before the display lamp is shut off when no entries are made.

SCPI command:

:DISPlay:PSAVe:HOLDoff on page 358

Toggle Summary Screen

Activates/deactivates the magnified frequency and level indication. If activated, the frequency and level indication covers the complete display.

SCPI command:

n.a.

Layout (Keyboard)

Selects the keyboard layout for the selected keyboard language.

The assignment of some keys depends on the selected layout and language.

SCPI command:

`:KBOard:LAYout` on page 367

`:KBOard:LANGuage` on page 367

5.2.3.13 Remote Channel Settings

The "Remote Channel Settings" dialog provides access to the settings for remote control. The dialog is opened using the SETUP or MENU key under "Remote".

Besides the standard GPIB-setting, the selection of one of the possible emulations and a user defined definition of the `*IDN` and `*OPT` string is possible.
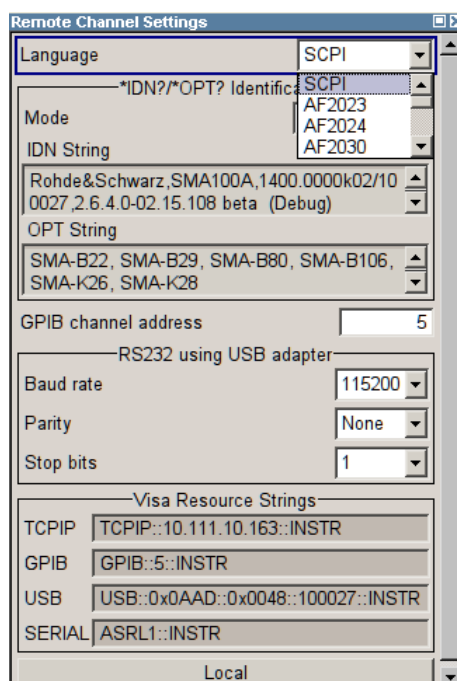
Language

Selects the instrument whose remote command set is emulated by the R&S SMA.

The R&S SMA can also be remote controlled via the command set of several other generators, e.g. of an HP generator. You find the available command sets for the generator in the selection list. This feature allows to replace a generator by an R&S SMA in existing test setups. Refer to the corresponding Application Note at the download area of the product site on the Internet. The Application Note is also provided on the user documentation CD-ROM (included in delivery).

The selected instrument also defines the identification string that is retrieved with query `*IDN?`. If required, use the parameter "Mode" and "IDN String" to change this string.

As any other parameter, the remote control command set can also be changed remotely by means of the SCPI command `SYST:LANG`. However, this remote control command is enabled only in the instrument's specific SCPI command set, i.e. it is possible to change the command set remotely from the original one (`SYST:LANG SCPI`) to the command set to be emulated but not vice versa.

Note: While working in a emulation mode, the R&S SMA specific command set is disabled, i.e. the SCPI command `SYST:LANG` will be discarded.

To return to the SCPI command set of the R&S SMA, use the appropriate command of the selected command set. If for example a HP generator is emulated, the HP command `EX` returns to the instrument-specific GPIB command set.

SCPI command:
:SYSTem:LANGuage on page 591

Identification Mode

Selects the way the instrument identification is performed.

"Automatic" The "IDN String" and the "OPT String" are set automatically for the instrument select with the parameter "Language".

"User Defined" Enables the selection of user definable "IDN String" and "OPT String" for the instrument selected with the parameter "Language".

SCPI command:
:SYSTem:IDENtification on page 590

Set to default

Overwrites the user-defined `*IDN` and `*OPT` strings with default strings. The default strings vary depending on the selected emulation mode (Language)

SCPI command:
n.a.

IDN String

Indicates the identification string of the instrument when queried with the common command `*IDN?`.

In addition to the preset values, a user defined identification string can be entered, e.g. to provide individual identification for each generator, like 'MY_R&S SMA' for instance.

SCPI command:
:SYSTem:IRESponse on page 590

OPT String

Indicates the option string of the instrument as queried with common command `*OPT?`.

If a "User Defined" Identification Mode is selected, a user defined option string can be created, additionally to the automatically created one.

SCPI command:
:SYSTem:ORESponse on page 591 for the user defined OPT String
`*OPT?`

GPIB channel address

Sets the GPIB address of the instrument.

SCPI command:

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess on page 583

RS232 using USB adapter

Requires a USB serial adapter (recommended extra, see data sheet)

Sets the parameters of the serial interface.

Either a RS232 interface or a Bluetooth connection can be used for remote control via the serial interface. The settings are effective for both interfaces (see also chapter 5.2.3.15, "Security", on page 98).

SCPI command:

:SYSTem:COMMunicate:SERial:BAUD on page 586

:SYSTem:COMMunicate:SERial:PARity on page 587

:SYSTem:COMMunicate:SERial:SBITs on page 587

Visa Resource Strings

Indicates the visa resource strings, used for remote control of the instrument. A separate string is provided for remote control via the different interfaces.

SCPI command:

:SYSTem:COMMunicate:NETWork:RESource on page 585

:SYSTem:COMMunicate:GPIB:RESource on page 586

:SYSTem:COMMunicate:USB:RESource on page 586

:SYSTem:COMMunicate:SERial:RESource on page 586

Local (Remote Channel Settings)

Switches the instrument to operate in local control mode.

Switching from remote to local control mode can be also done with one of the following actions:

- manually with the LOCAL key on the front panel
- with the interface command &GTL via the remote-control interface
- with the key combination CTRL + Q.

SCPI command:

&GTL

5.2.3.14 Protection

The "Protection" menu provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only). To deactivate the protection, the correct password has to be entered. After the instrument has been switched on, the protection levels 1 to 5 are automatically activated.
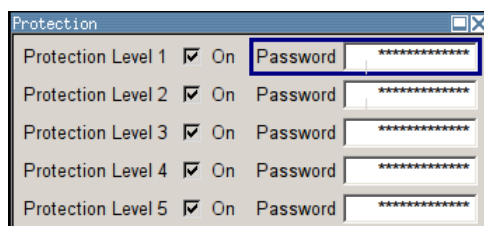
Protection Level/Password
Protection Level 1 can be activated to expand the functionality of the internal adjustment and to access the selftests.

The password is 123456.

SCPI command:
`:SYSTem:PROTect<ch>[:STATe]` on page 592

5.2.3.15   Security

The "Security" dialog provides access to the passwords and mass storage security settings. To open this menu, use the SETUP or MENU key under "Protection".

The menu is divided into the password sections and the security settings section. In the password section, the passwords for securing a controlled access to the instrument are defined and changed.

A change of passwords for the operating system and security password requires the entry of the old and new password and the conformation of the new password. All settings are only accepted after the "Change Password" button is pressed.
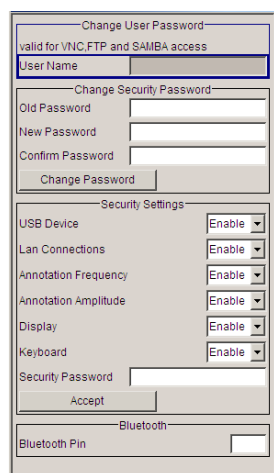
User Name
Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SAMBA access.

The user name and password are required for remote access to the instrument via VNC, FTP or SAMBA.

SCPI command:
n.a.

Old Password (User Password)

Enters the currently used user password. The default password is "instrument".

Note: It is highly recommended to change the default user password before connecting the instrument to the network.

New Password (User Password)

Enters the new security password.

The security password may contain decimal characters only.

SCPI command:
n.a.

Confirm Password (User Password)

Enters the new password for conformation.

The new password is only valid after the "Change Password" button is pressed.

SCPI command:
n.a.

Change Password (User Password)

Changes the password accordingly.

SCPI command:
n.a.

Old Password (Security Password)

Enters the currently used security password. The default password is '123456'.

Note: It is highly recommended to change the default security password before connecting the instrument to the network.

The security password is required when changing the status of the USB and LAN interface.

SCPI command:
n.a.

New Password (Security Password)

Enters the new security password.

The security password may contain decimal characters only.

SCPI command:
n.a.

Confirm Password (Security Password)

Enters the new password for conformation.

The new password is only valid after the "Change Password" button is pressed.

SCPI command:
n.a.

Change Password (Security Password)

Changes the password accordingly.

SCPI command:

n.a.

USB Device

Enables/disables the USB interfaces.

The instrument does not recognize any device connected to the USB interface when the interface is disabled.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:

n.a.

LAN Connection

Enables/disables the LAN interfaces.

It is not possible to access the instrument via LAN while the LAN connection is disabled.

An enabled LAN Connection is a prerequisite for the remote control of the instrument via VNC, FTP or SAMBA.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:

n.a.

Annotation Frequency

Enables/disables the display of the currently used frequency in the header of the instrument.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:

n.a.

Annotation Amplitude

Enables/disables the display of the currently selected level in the header of the instrument.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:

n.a.

Display

Enables/disables the display.

If this parameter is disabled, the instrument cannot be operated manually via the user interface, i.e. display, front panel keys and external keyboard are disabled. Remote control of the insrument is enabled.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

SCPI command:
:SYSTem:DLOCk on page 588

Keyboard

Enables/disables an external keyboard and mouse connected to the instrument, the front pannel keys of the instrument, the rotary knob and the on-screen keyboard.

If this parameter is disabled, the instrument cannot be manually controlled but changes in the settings are shown on the display. Remote access and remote control are enabled.

The setting requires the entry of the security password and is only accepted after the "Accept" button is pressed.

To enable the keyboard, type the security password on the external keyboard or use the SYST:KLOC OFF command over remote control.

SCPI command:
:SYSTem:KLOCk on page 591

Security Password

Enters the password that is required to enable or to disable the settings protected by a security password. Default is '123456'.

Note: It is highly recommended to change the default security password before connecting the instrument to the network.

All settings are only accepted after the "Accept" button is pressed.

SCPI command:
n.a.

Accept - Security

Accepts a new entry or selection and changes the settings accordingly.

SCPI command:
n.a.

Bluetooth Pin

Requires a USB Bluetooth adapter (recommended extra, see data sheet).

Enters the Bluetooth pin of an external Bluetooth device. The pin is required to enable remote control via an external Bluetooth device.

The interface parameters are identical to the RS232 interface parameters and can be set in the "Remote Channel Settings" dialog (see "RS232 using USB adapter" on page 97).

SCPI command:
n.a.

5.2.3.16 Save/Recall

The "Save/Recall" submenu can also be called up with the FILE key and is therefore described in the section of this key (see chapter 5.2.8, "Storing and Loading Instrument Data - File Key", on page 107).

5.2.3.17 Factory Preset

The "Factory Preset" dialog provides a function to reset the instrument's settings to their factory state. This function is activated by pressing the "Execute Factory Preset" button.
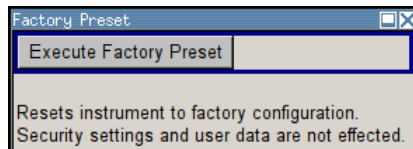
Factory Preset

Reset the instrument's settings to their factory state.

Note: Since Factory Preset resets the Remote Channel and network settings to the default values, executing Factory Preset via remote control terminates the connection to the instrument, if these settings had been configured to values different to the default ones!

The factory preset function resets nearly all instrument settings. In addition to the regular preset by means of the PRESET key, a "Factory Preset" resets also the following values:

- Reference frequency settings ("Ref Oscillator" menu)
- Power on settings ("Level/EMF" menu)
- Network settings including hostname ("Setup" menu)
- Remote Channel settings including GPIB address ("Setup" menu)
- Start/Stop Gui Update ("Setup" menu)
- Display and keyboard settings ("Setup" menu).

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.

Not affected by the "Factory Preset" are also user data, lists or instrument settings files, created for example by means of the Save/Recall function.

SCPI command:

`:SYSTem:FPReset` on page 351

5.2.3.18 Help

The "Help" dialog offers comprehensive online help for the R&S Signal Generator. A desired topic can be selected via the table of contents (select "Manual") or the index (select "Index").

For context-sensitive information about a marked parameter, press the HELP key. For a description of the "Help" menu, refer to the section covering to the HELP key (see chapter 5.2.7, "Help System - Help Key", on page 106).

5.2.4 Switching to Manual Control - Local Key

In remote control mode a status message appears in the display header. The rest of the display remains unchanged and shows the current instrument status, i.e. the status which exists under the remote control settings. The instrument can be operated (e.g. menus can be opened). However, it is not possible to enter or change values.

The status message additionally indicates whether the LOCAL key is disabled or enabled.

If the "REMOTE" status message is shown, the LOCAL key switches the instrument from remote control to manual control. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

If the "REM-LLO" status message is displayed, the instrument can be switched from remote control to manual control by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`); the LOCAL key is disabled. The key is disabled by remote control with the command LLO.

When switching from remote to manual control, the display update suppression function, if active ("SETUP > GUI Update" is Off), is automatically deactivated ("SETUP > GUI Update" is On).

5.2.5 Generating a Hard Copy of the Display

The generation of a hardcopy of the display requires that an external keyboard is connected to the instrument. The hardcopy dialog is called with the key combination CTRL +Z or CTRL+Y depending on the used keyboard settings.
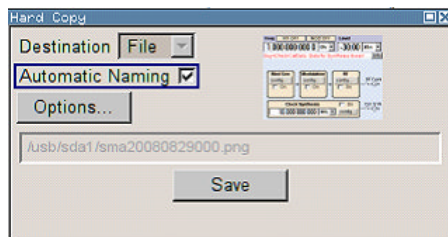
5.2.5.1 Hardcopy Dialog

Destination
Indicates that the hardcopy is stored in a file (see also "File Options" on page 104).

SCPI command:
`:HCOPy:DEVice` on page 361

Options
Opens the Hardcopy Options dialog for configuring the hardcopy parameters (see "File Options" on page 104.

SCPI command:
n.a.

File
Some configuration parameters are already offered in the Hardcopy dialog. All configuration parameters are available in "File Options" on page 104.

Automatic Naming

Activates, deactivates automatic generation of the file name. Automatic naming is configured in the "Options…" submenu, see "File Options" on page 104.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO:STATe` on page 366

File Info

Indicates the file name. The file name can be entered either manually via the file manager (button "File…") or generated automatically (Automatic naming checkbox). Automatic naming is configured in the "Options…" submenu.

SCPI command:

`:HCOPy:FILE[:NAME]` on page 362

`:HCOPy:FILE[:NAME]:AUTO:FILE` on page 363

5.2.5.2 Hardcopy Options
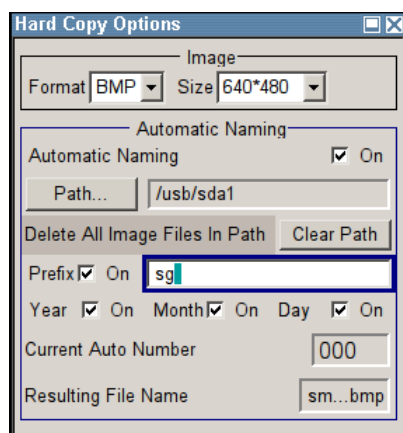
File Options

Dialog for setting the file parameters.

"Size"   Defines the size of the bitmap in terms of pixels. The first value of the size setting defines the width, the second value the height of the image.

SCPI command:

`:HCOPy:IMAGe:SIZE` on page 366

"Format"   Selects the image format. Several bitmap formats are available.

SCPI command:

`:HCOPy:DEVice:LANGuage` on page 361

"Automatic   Determines the rules to create the file names and sets the directory the
Naming"   files are saved into.
               As default the automatically generated file name is composed of:
               `<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`
               Each component can be deactivated/activated separately to individually design the file name. The resulting file name is indicated.

"Path..."   Opens the "Select Hard Copy Destination Path" dialog to select a path for storing the hardcopy.

Note: For selecting the destination path a file name must be entered as well. Otherwise the error message "The name of a list may not be empty" is displayed and the selection will be canceled.

Directory, path and file name are displayed in the infoline right to the "Path" button.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO:DIRectory` on page 363

`:HCOPy:FILE[:NAME]:AUTO` on page 362

"Clear Path"   Deletes all image files with extensions `bmp`, `img`, `png`, `xpm` and `csv` in the directory set for automatic naming.
Before deleting the image files a warning message is displayed requiring the confirmation.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar` on page 363

"Prefix"   Activates the usage of the prefix in the automatic file name. The prefix is entered in the field to the right of checkbox.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe` on page 365

"Enter prefix"   Enters the prefix for the automatically generated file name. The use of the prefix is activated in the checkbox to the left.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix` on page 365

"Date - Year / Month / Day"   Defines the components of the automatically generated file name. The selectable parameters are year, month and day. If activated the current year, month or day used in the file name.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe` on page 366

`:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe` on page 364

`:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe` on page 364

"Current Auto Number"   Indicates the number which is used in the automatically generated file name.

Note: On initially switching on the device the number will be reset to the lowest possible value. Starting with number 0 the output directory will be scanned for already existing files. As long as files with the same name are existing the number will be increased by 1. The number will be automatically set to a number so that the resulting file name will be unique within the selected path. The current number will not be saved in the save recall file but will be temporarily stored within the database. On subsequent saves the number will be increased.

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer` on page 365

"Resulting File Indicates the automatically generated file name.
Name"

SCPI command:

`:HCOPy:FILE[:NAME]:AUTO:FILE` on page 363

Save

Triggers the generation of a hardcopy.

SCPI command:

`:HCOPy[:EXECute]` on page 362

5.2.6 Messages - Info Key

The INFO key opens a window containing a detailed description of every message displayed in the info bar, see chapter 4.2.3, "Info Window", on page 60 and chapter 9, "Error Messages", on page 609.

5.2.7 Help System - Help Key

The HELP key opens a browser window containing a context-sensitive description of the highlighted parameter.
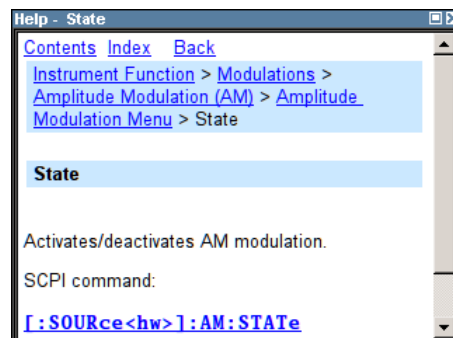
The context-sensitive page which is opened with the HELP key is part of a comprehensive help system. It is possible to move from this context-sensitive page to any page of the help system. The following navigation aids are available:

- Internal links in the text
  They open pages which are directly linked to the described function. In this way it is possible, for example, to call up the description of the GPIB command for any particular function.
- Previous/Next links
  The Previous/Next links allow scroll through the help pages. The sequence of the described functions corresponds to their position in the menus.
- Back button
  The Back button calls up the page last viewed.
- Contents in the navigation panel

The contents list is used to open the individual help pages. It has a hierarchical structure. The highlighted line indicates where the currently displayed page is within the contents list.

● Index in the navigation panel
The index is used to call up all pages which contain the selected entry. The index has an alphabetical structure and also contains all GPIB commands.

● Find
The find function allows you to look for freely selectable terms in all help pages. A list of the pages containing the entered term is displayed as the search result. The search can be limited to words in the page title to increase the number of hits.

5.2.8 Storing and Loading Instrument Data - File Key

The R&S SMA allows complete instrument settings to be stored in files on the Compact-Flash™ Card.

Defined and complex instrument settings can then be reproduced at any time by loading this data. If required, these settings can be loaded to various signal generators.

The corresponding menu is available under "Save/Recall" in the "Setup" menu or accessible by means of the FILE key. The instrument settings are saved in files which can be stored in data directories.

Additionally there are intermediate memories in which the current instrument setting can be stored and then called up again by just pressing a key. This provides fast switching between different instrument settings.

Only settings which differ from the preset values and configuration data for the operating elements (e.g. window positions) are stored. As a result the files remain relatively small. Furthermore, instrument settings can easily be transferred between different equipped signal generators since the files contain only relevant information. When loaded, the referenced settings are implemented and all non-referenced parameters are set to the associated preset values.

If list data is part of the instrument settings, e.g. a list of user correction data, a reference to this list is stored, not the list itself. The list is reactivated when the associated settings are loaded, but the list may have been modified or deleted in the meantime or may not be available on a different instrument. If the list has been modified, the new entries will be used. An error message appears if an attempt is made to access a non-existing list or to activate settings which are not supported by the instrument.

● Network settings and remote settings are not saved and restored.
● Lists are stored and loaded in the appropriate menus. For example, the user correction data list is created and stored in the "User Correction" menu.

When loading an instrument setting, it is possible to select whether the current frequency and level setting is to be retained or whether the stored settings are to be activated. It is possible to delete stored instrument settings. A file can be copied by loading it with "Recall" and then storing it under a new name.

Settings can be transferred easily between instruments with different equipment options and/or firmware versions because only the settings which differ from the preset values are affected. When settings are loaded, only those which are possible on the instrument are implemented. Error messages indicate the settings which cannot be implemented.

The stored file is transferred from one instrument to another using the memory stick.

General file management functions such as copying and moving data are available in the "File Manager" dialog.

5.2.8.1 File Menu

The settings available in the File menu "Save/Recall" depend on the operation selected under "Select Operation".

For more information, see chapter 4.7.1, "File Select Dialog", on page 74.

Select Operation
Selects the file function.

"Save…"   Calls the menu for storing the current instrument setting (see chapter 5.2.8.2, "Storing Instrument Settings", on page 108).

"Recall..."   Calls the menu for calling up a stored instrument setting (see chapter 5.2.8.3, "Loading Instrument Settings", on page 109).

5.2.8.2 Storing Instrument Settings

If "Save" is selected under "Select Operation", the File menu provides options for storing the current instrument setting in a file.
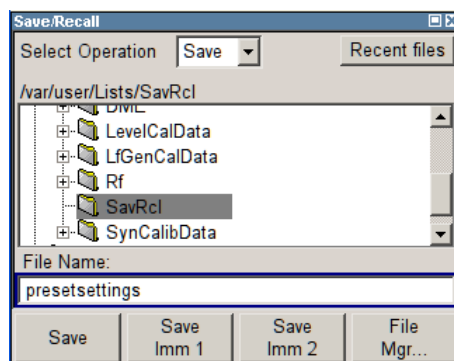
Recent data sets
Displays the files last used. The entire path is shown in plain text.

SCPI command:
n.a.

Directory
Selects the directory in which the file is to be stored.

The window opposite lists all settings files in this directory.

A new directory can be created in the "File Manager" dialog.

SCPI command:
:MMEMory:CDIRectory on page 371

File List
Displays the files which are in the selected directory.

If a file is highlighted, it is overwritten when the file is stored.

SCPI command:
:MMEMory:CATalog on page 370

File Name
Enter the file name of the file without file extension. This file is then created.

SCPI command:
n.a.

Save
Stores the current instrument settings under the specified path.

SCPI command:
*SAV on page 348
:MMEMory:STORe:STATe on page 375

Save Immediate x
Stores the current instrument setting in one of the three intermediate memories.

These instrument settings are retained until a different instrument setting is stored in the intermediate memory. When the instrument is switched off, the contents of the inter-mediate memories are retained.

SCPI command:
*SAV on page 348

File Manager
Calls the "File Management" menu.

Directories can be created and files managed in this menu (see chapter 5.2.8.4, "File Manager", on page 111).

SCPI command:
n.a.

5.2.8.3 Loading Instrument Settings

If "Recall" is selected under "Select Operation", the "File" menu provides options for loading complete instrument settings. Here it is possible to select whether the current or stored frequency and level settings are to be used.
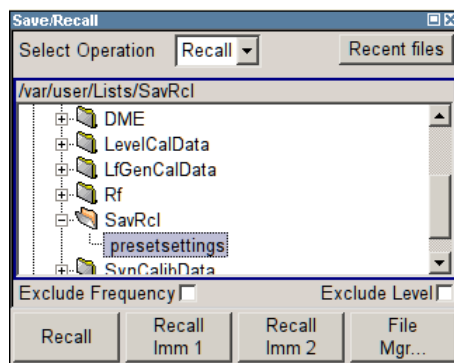
Recent data sets

Displays the files last used. The entire path is shown.

If the desired file is in the list, it can be selected.

SCPI command:

n.a.

Directory

Enter the directory in which the file with the instrument setting to be loaded is located.

The "Selected file" window lists all the files in this directory.

SCPI command:

:MMEMory:CDIRectory on page 371

File List

Selects the file with the desired instrument configuration.

SCPI command:

:MMEMory:CATalog on page 370

Exclude Frequency

The current frequency is retained when a stored instrument setting is loaded.

SCPI command:

[:SOURce<hw>]:FREQuency[:CW|:FIXed]:RCL on page 475

Exclude Level

The current level is retained when a stored instrument setting is loaded.

SCPI command:

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL on page 539

Recall

Load the selected configuration.

If an instrument setting in which a sweep was activated is stored, the sweep is started when the recall command is called.

If an instrument setting which accesses lists is stored, this list is also loaded.

If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

SCPI command:

`:MMEMory:LOAD:STATe` on page 374

`*RCL` on page 348

Recall Immediate x

Loads the selected configuration from one of the three intermediate memories.

If an instrument setting in which a sweep was activated is stored, the sweep is started when the recall command is called.

If an instrument setting which accesses lists is stored, this list is also loaded.

If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

A message appears if no instrument configuration is stored in this memory.

SCPI command:

`*RCL` on page 348

5.2.8.4 File Manager

The "File Manager" dialog provides all the functions required for file management. Directories can be created, and files copied, deleted and moved between the directories on the devices (CompactFlash™ Card and memory stick). A USB stick is automatically recognized when connected to the instrument and the USB directory `'usb/ISB_DISK (data dir)'` indicated in the file manager.
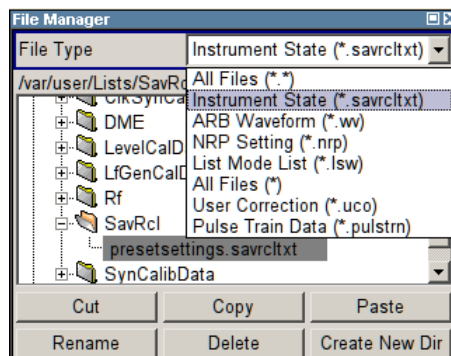
For more information, see chapter 4.7.2, "File Manager", on page 75.

File Type

Selects the file types to be indicated. If a file type with a specific file extension is selected only files with this extension are indicated in the selected directory.

SCPI command:
n.a.

Directory and File Name

Selects the directory in which the file to be deleted or copied is located. The window lists all files in this directory. The file to be deleted or copied can be highlighted. The path is indicated above the directory window.

SCPI command:

`:MMEMory:CDIRectory` on page 371

Cut

Cuts the selected file. It can be pasted into a different directory using the "Paste" button.

SCPI command:

`:MMEMory:DELete` on page 373

Copy

Copies the selected file. It can be pasted into a different or the same directory using the "Paste" button. When pasting the file into the same directory file name `Copy of <file name>` is given automatically. When pasting the file into a different directory, the original file name is kept.

SCPI command:

`:MMEMory:COPY` on page 371

Paste

Pastes the file that has been copied or cut before.

SCPI command:

n.a.

Rename

Renames the selected file or directory. The new name can be entered in the "New File-name" dialog.

SCPI command:

`:MMEMory:MOVE` on page 374

Delete

Deletes the selected file. Before the file is deleted, a message appears prompting the user to confirm deletion of the file.

SCPI command:

`:MMEMory:DELete` on page 373

Create New Directory

Creates a new directory. The name of the new directory can be entered in the "New Directory" dialog.

Note: When the subdirectory is entered, it is possible to enter an absolute path name (e.g. `/var/USER/MEAS`) or the path relative to the current directory (e.g. `../MEAS`).

The directory is created as a subdirectory in the selected level.

SCPI command:

`:MMEMory:MDIRectory` on page 374

5.3 RF Signal - RF Block

5.3.1 Overview of RF Signal

Settings for the RF output signal and analog modulation are made under "RF Signal". These settings can be accessed in the block diagram by way of the "RF" function block, or by means of the menu with the same name which is opened using the MENU key.
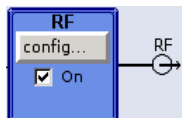
The function block is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) without additional equipment options.

5.3.1.1 RF Output

To activate and deactivate the RF output signal, use one of the following alternatives:

- by means of the RF ON/OFF key (the current entry focus is irrelevant)
- by changing the state of the "RF" functional block (see "State RF" on page 113)
- by enabling/disabling the RF in the "Configure" menu of the "RF" block (see **linktarget doesn't exist but @y.link.required='true'**).

The current state of the RF output (activated and deactivated) is indicated in the block diagram by means of the different block color and the status of the "On" checkbox.

The disconnected connection to the output is additionally shown when the output is deactivated.
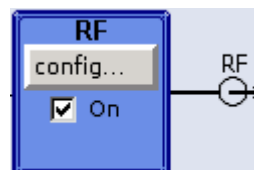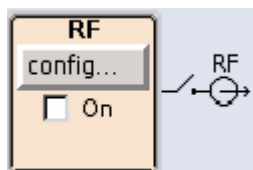
To query the impedance of the RF outputs, use the command `:OUTPut<hw>:IMPedance` on page 377.

State RF
Activated/deactivates the RF output by changing the state of the "RF" functional block.

Alternatively, the RF ON/OFF key can be used.

SCPI command:
`:OUTPut<hw>[:STATe]` on page 378

RF Output State

Activated/deactivates the RF output by enabling/disabling the RF in the "Configure" dialog of the "RF" block.
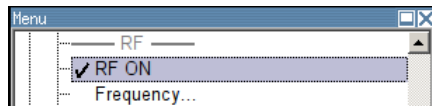
SCPI command:

`:OUTPut<hw>[:STATe]` on page 378

5.3.1.2 Overview of the RF Signal Settings

The CW, Sweep and List modes are available for generating the RF signal.

- **CW**
  The RF signal is generated with the set frequency and level. This is the default mode.

- **Sweep**
  The RF signal is generated as a sweep with the set parameters.
  It is not possible to activate frequency, level and LF sweep simultaneously.

- **List Mode**
  The RF signal is generated on the basis of a list of predefined frequency and level values. The duration of the individual steps can be predefined.

Instruments connected downstream can be taken into consideration when setting the frequency and level by entering a frequency and/or level offset.

Automatic level control ("ALC") ensures maximum level accuracy.

User-specific lists which contain level correction values for any frequency range ("User Correction") can be created to, for example, compensate the cable attenuation in a test assembly setup.

The R&S Signal Generator generates the RF signal in unmodulated or analog form. The signal generator is equipped therefore with the following sources for analog modulations:

- an internal LF generator
- an internal pulse generator
- the external modulation inputs AM EXT/FM/PM EXT and PULSE EXT.

An external trigger signal for the analog modulations, the sweeps and the LIST mode can be provided at the INST TRIG input.

The input REF IN is used to input an external instrument reference, and the output REF OUT serves as the output of the reference frequency (internal or external).

5.3.2 RF Frequency Settings

The value of the RF frequency is displayed in the header of the instrument's display ("Freq"). This field provides the direct input of the RF frequency.
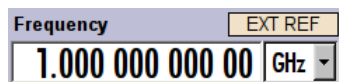
Be aware, that there is a difference between the displayed RF frequency in the header and the RF output frequency set in the "Frequency/Phase" dialog.

5.3.2.1 RF frequency vs. RF output frequency

The frequency entered and displayed in the frequency field in the header of the display takes any set frequency offset into consideration, e.g. an offset set for a downstream instrument. This means that with a frequency offset the frequency displayed in the header does not correspond to the frequency at the RF output, but rather to the frequency at the output of the downstream instrument.

A set frequency offset is indicated by the "FREQ OFFSET" status message.

This instrument allows the desired frequency at the output of a downstream to be entered in the frequency field. The R&S Signal Generator changes the RF output frequency according to the entered offset.

However, the frequency entered and displayed in the "Frequency/Phase" dialog of the "RF" function block always corresponds to the RF output frequency. Any frequency offset is not taken into consideration.

The frequency offset is entered in the "Frequency/Phase" dialog. Here it is also possible to set the frequency without taking the offset into consideration, to set the step width for the frequency entry using the rotary knob, and to set the phase for the RF output signal.

The correlation between the RF frequency, the RF output frequency and the frequency offset is as follows:

"Freq" (in header) = "RF output frequency" (Frequency in menu) + "Freq offset" (Offset in menu)
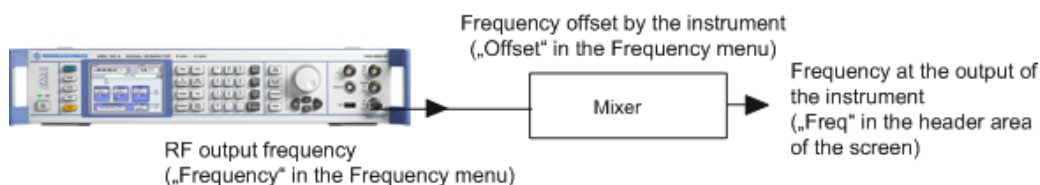
5.3.2.2 Configuring RF frequency

To change the RF frequency, press the FREQ key and enter the desired frequency. Changes to the RF frequency have an immediate effect (without confirmation with the ENTER key) on the output signal.

RF Freq
Enters the RF frequency, considering the frequency offset.

Note: The SCPI command sets the level of the "Freq" display, i.e. an entered frequency offset is taken into consideration in the frequency value.

SCPI command:

[:SOURce<hw>]:FREQuency[:CW|:FIXed] on page 475

5.3.2.3 Frequency Menu

The instrument provides an acess to the frequency settings in the combined "Frequency/ Phase" dialog.

To open the"Frequency/Phase" dialog, select "RF > Configure > Frequency" or use the MENU key under "RF".
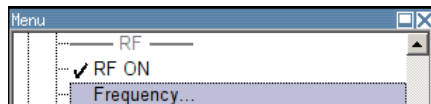
The "Frequency/Phase" dialog is divided into the several sections.

Frequency and offset of the RF output signal are set in the "Frequency Settings" section in the upper part of the group menu.
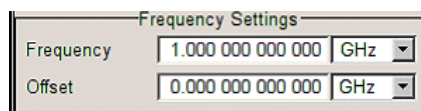
The step width which is used when setting the frequency using the rotary knob (with "Variation Active On") is set in the "User Variation" section.
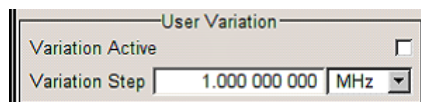
The phase of the output signal can be changed in the "Phase Settings" section. The "Phase Settings" menu is described in

Frequency Settings

The frequency and offset are set in the top section of the menu.

Frequency - RF Signal
Sets the RF frequency of the RF output connector. The frequency entered and displayed here corresponds to the frequency at the RF output, i.e. any offset entry is not taken into consideration.

Note: The SCPI command `SOUR:FREQ` sets the frequency of the "FREQ" display, i.e. the frequency containing offset.

SCPI command:
n.a.

Frequency Offset - RF Signal
Sets the frequency offset relative to the RF frequency. The frequency offset of a down-stream instrument (e.g. a mixer) is entered.

The entry does not change the value of the RF frequency at the RF output. It only changes the RF frequency displayed in the display header. The value of the RF frequency in the header corresponds to the frequency at the output of the downstream instrument.

SCPI command:

User Variation

If the frequency is set using the rotary knob, the step width is defined in the "User Variation" section.

Variation Active - RF Signal

Activates the user-defined step width used when varying the frequency value with the rotary knob.

"ON"   The frequency value set with the rotary knob is varied using the user-defined step width which is entered under "Variation Step".

"OFF"   The frequency value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

SCPI command:

[:SOURce<hw>]:FREQuency:STEP:MODE on page 481

Variation Step - RF Signal

Sets the user-defined step width. This step width is used when entering the RF frequency using the rotary knob. Frequency variation with this step width must also be activated with "Variation Active".

SCPI command:

[:SOURce<hw>]:FREQuency:STEP[:INCRement] on page 481

5.3.3 Phase Settings

The phase of the RF output signal can be changed in the "Phase Settings" section of the "RF Frequency/Phase" menu.

5.3.3.1 Phase Menu
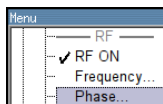
To open the "Frequency/Phase" menu, select "RF > Configure > Phase" or use the MENU key under "RF".
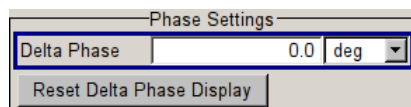
Delta Phase - RF Signal

Sets the phase of the RF signal. The current phase of the signal is used as the reference. This function allows, for example, the phase of the output signal to be synchronized with the phase of a signal from a second signal generator.

SCPI command:

[:SOURce<hw>]:PHASe on page 531

Reset Delta Phase Display - RF Signal

Resets delta phase value. The set phase is adopted as the new current phase, i.e. the delta phase value is reset to 0.

SCPI command:

`[:SOURce<hw>]:PHASe:REFerence` on page 531

5.3.3.2 Phase Continuous Frequency Setting

The phase continuous mode can be enabled in the "Phase Continuous Frequency Settings" section of the "Frequency" menu. In this mode, the output sinewave is phase continuous, i.e. there is no phase discontinuity or glitch when changing the frequency.

At the transition from one frequency to another an intermediate frequency (switching transient) occurs, which causes spurs (see figure below). The transient is due to changes of the synthesizer settings (e.g. dividers, filters, phase detectors).
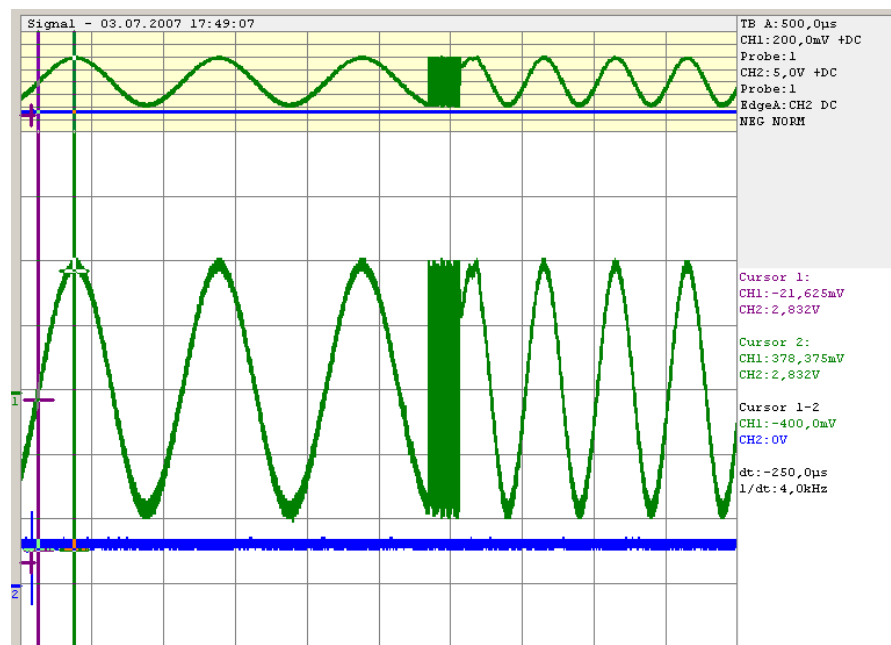
Fig. 5-1: Transition for a 1 kHz step at 1 GHz without phase continuous mode active. For the graphical display the signal is down converted into the kHz range.

The phase continuous mode freezes the settings of the synthesizer (e.g. dividers, filters, phase detectors) which could generate phase discontinuities when changed. The frequency change is effectively performed by changing the fine resolution synthesizer. This allows a phase continuous change from one frequency to another without any transients (see figure below).
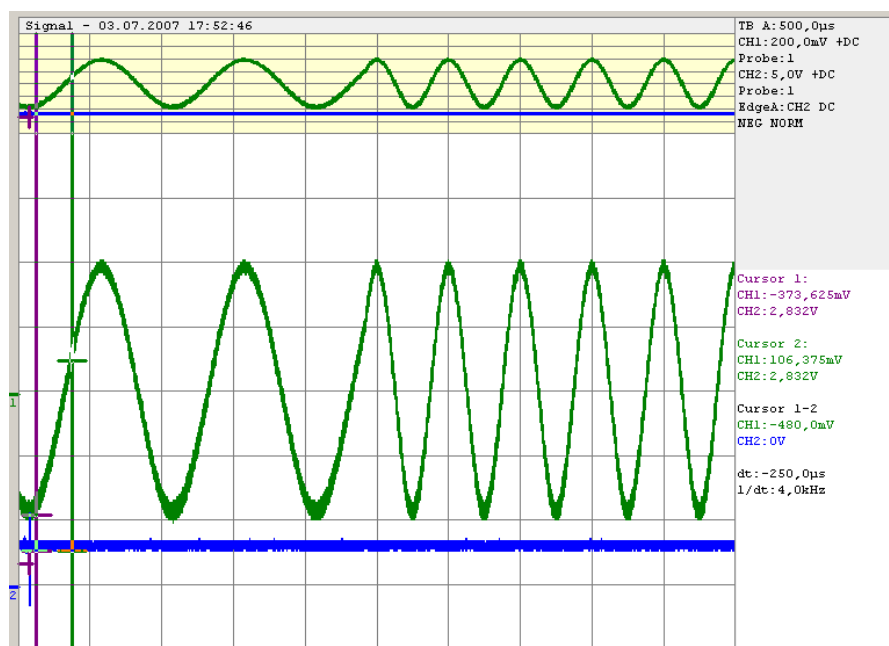
Fig. 5-2: Transition for a 1 kHz step at 1 GHz with phase continuous mode active. For the graphical display the signal is down converted into the kHz range.

The available frequency range for phase continuous settings is limited by the fine resolution synthesizer used and varies with the RF frequency setting at the point of activating the phase continuous mode.

Depending on the instrument equipment - with or without option R&S SMA-B22 - the fine resolution synthesizer used is a DDS (Direct Digital Synthesizer, with option R&S SMA-B22) or a Fractional N-Synthesizer (without option R&S SMA-B22). The DDS provides generally a wider frequency range for phase continuous settings. In addition, two modes (narrow and wide) allow a selection either in favor of higher signal quality or in favor of an especially wide frequency range.

When phase continuous frequency setting is active, data sheet values no longer apply

Activating frequency or phase modulation deactivates phase continuous settings and vice versa.

Setting a Phase Continuous Frequency Sweep

1. In the "RF Frequency Sweep" Menu, if the sweep is active, switch it off.

2. In the "RF Frequency" Menu under the "Phase Continuous Frequency Settings" dialog

   a) If the "Phase Continuous Frequency Mode" is Active, switch it off
   b) Set "Frequency Range" to "Narrow"
   c) Select the RF frequency
   d) Check displayed Frequency Range
   e) If the "Frequency Range" is corresponds with the selected frequency range, check the Phase Continuous Active box

f) If "Frequency Range" in Narrow Mode does not, select "Wide" for the Frequency Range and check the Phase Continuous Active box

3. In the "RF Frequency Sweep" dialog

   a) Modify the "Start Freq" and "Stop Freq" or "Center Frequency" and "Span" as needed.
   b) Set the RF frequency sweep State to "ON".

Optimum user settings for the phase continuous frequency sweep

In the "RF Frequency Sweep" dialog there are some settings that will improve the phase continuous sweep results for both "Narrow" and "Wide" mode choices.

1. "Step Lin": low step size
   In order to get the best spur performance during frequency change, it is recommended to reduce the step size and (if necessary) increase the sweep speed by decreasing the Dwell Time. Effectively, the sweep will be performed in the same amount of time, but with smaller step sizes.

2. "Shape": Triangle sweep
   The triangle sweep offers a uniform forward sweep and return to the beginning frequency. The saw tooth sweep produces a uniform forward sweep with an abrupt reset to the starting frequency. The abrupt reset can generate spurs.

Phase Continuous Frequency Settings Menu

The "Phase Continuous Frequency Settings" are available in the middle section of the "Frequency/Phase" dialog.
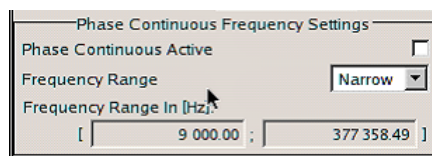
Phase Continuous Active
Activates/deactivates phase continuous frequency settings. For a given RF frequency setting, phase continuous frequency changes are possible in a limited frequency range.

An overview of the frequency ranges is provides the table in "Frequency Range - RF Signal" on page 121.

For instrument without option B22:

The range is typically +/-0.5 MHz in the main synthesizer octave of 750 MHz to 1.5 GHz.

Note: If "Phase Continuous" is "Active" a setting of the "RF Frequency" outside the available "Frequency Range" causes an error. A settings conflict is displayed.

For instrument with option B22:

The frequency range is indicated in the table table in section "Frequency Range - RF Signal" on page 121. The range indication is active even if phase continuous frequency setting is not yet activated. Thus, the desired range can be determined before activating the function. Two modes are available.

Note: If "Phase Continuous" is "Active" a setting of the "RF Frequency" outside the indicated "Frequency Range" is only possible for mode Wide. A settings conflict is displayed.

SCPI command:

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:STATe

Frequency Range - RF Signal

(instruments with R&S SMA-B22 option only)

Selects the mode for determining the frequency range for the phase continuous signal.

The frequency range depends on the selected mode.

RF frequency [MHZ]	Typ . range without R&S SMA-B22	Range with R&S SMA-B22 Narrow mode	Range with R&S SMA-B22 Wide mode
f <= 6.6	125 kHz	625 kHz	2.5 MHz
6.6 < f <= 11.71875	7.813 kHz	39.625 kHz	156.25 kHz
11.71875 < f <= 23.4375	15.625 kHz	78.125 kHz	312.5 kHz
23.4375 < f <= 46.875	31.25 kHz	156.25 kHz	625 kHz
46.875 < f <= 93.75	62.5 kHz	312.5 kHz	1250 kHz
93.75 < f <= 187.5	125 kHz	625 kHz	2.5 MHz
187.5 < f <= 375	250 kHz	1250 kHz	5 MHz
375 < f <= 750	500 kHz	2.5 MHz	10 MHz
750 < f <= 1500	1 MHz	5 MHz	20 MHz
1500 < f <= 3000	2 MHz	10 MHz	40 MHz
3000< f <= 6000	4 MHz	20 MHz	80 MHz

"Narrow"   The available frequency range is smaller than with setting wide. It is asymmetrical around the RF frequency set at the point of activating the phase continuous settings (see table above).
In the narrow mode, a DDS frequency of 15 MHz to 20 MHz is used as reference signal to the phase detector. This provides a tuning range of 5 MHz in the main synthesizer octave from 750 MHz to 1.5 GHz. When activating the phase continuous settings, the current setting of the DDS is anywhere between 15 and 20 MHz, e.g. 17 MHz. Thus, the distribution around the center frequency most likely is asymmetrical, e.g. - 2 MHz and + 3 MHz for the 17 MHz. Signal quality is high because the larger mixing products are filtered by the low-pass filter (IF max. 20 MHz).
The narrow mode is recommended whenever possible due to the better signal quality (spectral purity).
It is not possible to set frequencies outside the available frequency range.

"Wide"   The wide mode provides a larger frequency range. The frequency range
is symmetrical around the RF frequency set at the point of activating the
phase continuous settings (see table above).
Due to an additional divider by 8 in the PLL the signal quality is reduced
in this mode. At some frequencies non -harmonics will be present.
Setting frequencies outside the available frequency range is possible,
however, a settings conflict is indicated. The usable overrange depends
on the currently set RF frequency, e.g. at 1 GHz it reaches from 850 MHz
to 1030 MHZ.

SCPI command:
[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:MODE on page 478

Frequency Range in [Hz] - RF Signal
(instruments with R&S SMA-B22 option only)

Displays the frequency range for phase continuous settings. The available frequency
range depends on the mode selection ("Narrow" or "Wide").

The range indication is active even if phase continuous frequency settings are not yet
activated. Thus, the desired range can be determined before activating the function.

SCPI command:
[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH on page 478
[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW on page 478

5.3.4   Reference Oscillator

In the internal reference mode the internal reference signal is available at the REF
OUT connector. The frequency of the internal reference signal is permanently set to 10
MHz.

External tuning can be used for **EFC (Electronic Frequency Control)**, e.g. in phase
noise measurement systems. The resulting frequency variation is in the range between
4E10-9/Volt to 30E10-9/Volt (see data sheet). It depends on the installed options and is
typ. 20 Hz/Volt for an RF output frequency of 1 GHz with option R&S SMA-B22, FM/PhiM
modulation with low phase noise. The maximum bandwidth for the EXT TUNE input is
approx. 50 Hz. The maximum bandwidth of an external PLL (Phase Locked Loop) used
in a phase noise measurement system has to be set smaller than the bandwidth of the
EXT TUNE input. If a higher bandwidth is required, the use of external FM modulation
(DC coupling) with low noise mode is recommended. FM-DC mode yields a fixed tuning
sensitivity which is independent from the set RF output frequency and which is equal to
the set FM deviation.

External impairment is possible in both "Adjustment State" states (**On** or **Off**).

In the external reference mode, an external signal with selectable frequency and defined
level must be input at the REF IN connector. This signal is output at the REF OUT con-
nector. The "EXT REF" status message appears in the display header.

The settings of the reference oscillator are not influenced by an instrument preset ("PRESET" key).

5.3.4.1 Reference Oscillator Dialog
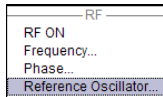
To open the "Reference Oscillator" dialog, select "RF > Configure > Reference Oscillator" or use the MENU key under "RF".

The menu is used to select the source, to enter the frequency of an external reference signal and to adjust the reference frequency.

The external mode corresponds to EFC mode (Electronic Frequency Control). See also section "How to configure the R&S SMA for EFC".
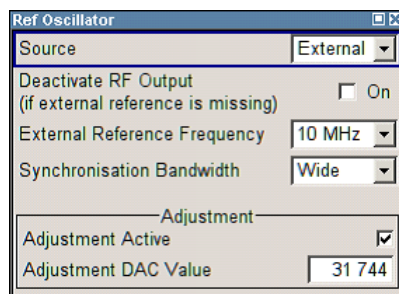
Source - Reference Oscillator

Selects the source of the reference frequency.

"Internal"   The internal reference signal of 10 MHz is used, comprising either the calibrated or a user-defined adjustment value.

"External"   An external reference signal is used. The frequency of the external reference signal must be selected under "External Reference Frequency".

SCPI command:

[:SOURce]:ROSCillator:SOURce on page 560

Deactivate RF Output - Reference Oscillator

Determines if the RF output is switched off in case of a missing external reference signal for selection external source.

If enabled, this setting ensures that no improper RF signal due to the missing external reference signal is output and used for measurements.

In addition to the error message "Ext Ref missing", the information "RF output deactivated" is indicated.

This setting is not influenced by a reset.

SCPI command:

[:SOURce]:ROSCillator:EXTernal:RFOFf:STATe on page 558

External Reference Frequency

Selects the frequency of the external reference signal. An external reference signal with a frequency of 5 MHz, 10 MHz or 13 MHz can be used.

SCPI command:

[:SOURce]:ROSCillator:EXTernal:FREQuency on page 557

Synchronization Bandwidth - RF Signal

(Source External only)

Selects the synchronization bandwidth for an external reference signal. The wideband setting is provided for using very good reference sources of high spectral purity.

"Narrow"
- Instruments without R&S SMA-B22
  Synchronization bandwidth is app. 20 Hz.

- Instruments with R&S SMA-B22
  Synchronization bandwidth is a few Hz. The internal 10-MHz OCXO is synchronized to the external signal. This setting is recommended if the phase noise of the external signal is worse than the phase noise of the internal OCXO.

"Wide"
Synchronization bandwidth is 750 Hz.

- Instruments without R&S SMA-B22
  Recommended standard mode. Synchronization bandwidth is app. 750 Hz.

- Instruments with R&S SMA-B22
  This mode is recommended for good reference sources of high spectral purity. The internal 10-MHz OCXO is bypassed and the external signal synchronizes a 100-MHz reference oscillator directly. Synchronization bandwidth is app. 100 Hz.

Note: If the frequency of the external reference signal is outside the tuning range of the internal OCXO, spurs due to the difference of the internal and external reference frequency are generated in the reference PLL. An error message is indicated in this case.

SCPI command:

[:SOURce]:ROSCillator:EXTernal:SBANdwidth on page 558

Adjustment Active - Reference Oscillator

Selects adjustment mode.

"OFF"
The calibrated adjustment value of the internal reference frequency is used. This value is determined at one of the R&S service shops during calibration.

"ON"   A user-defined adjustment value is used. The value is entered under
              "Adjustment DAC Value".
              This allows the frequency to be impaired freely, for example to simulate
              a frequency error.
              The instrument is no longer in the calibrated state. However, the cali-
              bration value is not changed and the instrument resumes the calibrated
              state after switching the "Adjustment State" to Off.

SCPI command:

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] on page 559

Adjustment DAC Value

Enters a user-defined adjustment value for the internal reference frequency. This value
is not used unless "Adjustment Active On" is selected.

SCPI command:

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue on page 559

5.3.5   Power Sensors

Up to four R&S NRP power sensors can be connected to the generator. The SENSOR
connector for the first R&S NRP power sensor is on the front panel, further R&S NRP
power sensors can be connected via the USB interfaces on the front and rear panel. The
connection via USB requires an USB adapter R&S NRP-Z3 or R&S NRP-Z4. The instru-
ment automatically detects connected R&S NRP power sensors and indicates them in
the "NRP-Z Power Viewer" dialog.

The signal generator supports the use of R&S NRP power sensors for measurement of
the output signal of the RF signal path or any freely selectable source (see chap-
ter 5.3.5.1, "NRP-Z Power Viewer", on page 125). In addition, it enables sweep meas-
urements on DUTs (see chapter 5.3.5.2, "NRP-Z Power Analysis", on page 131). Pulse
data analysis is possible with power sensor R&S NRP-Z81.

5.3.5.1   NRP-Z Power Viewer

The output signals of the RF signal path with the set RF level as rereference level can
be measured. It is also possible to select any signal source.

The average signal power is continuously measured by the R&S NRP power sensor(s)
and indicated in the "NRP-Z Power Viewer" dialog. The dialog also provides setting the
permanent display of the results in the block diagram.

The signal generator supports the use of R&S NRP power sensors for the acquisition of
level correction data. The acquired level correction data is used to create and activate
lists in which level correction values predefined by the user are freely assigned to RF
frequencies. Correction is performed by the user-defined table values being added to the
output level for the respective RF frequency (see chapter 5.3.8, "User Correction",
on page 176).

Refer to the corresponding R&S NRP-Zxx power sensor manual for detailed information on the used power sensor.

NRP-Z Power Viewer Settings

RF
RF ON
Frequency...
Phase...
Reference Oscillator...
NRP-Z Power Viewer...
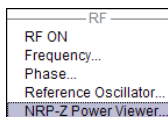
To open the "NRP-Z Power Viewer" menu, select "RF > Configure > NRP-Z Power Viewer" or use the MENU key under "RF".

The dialog shows the settings and measurement values of the sensor selected in the field next to the connector symbol. For indicating the parameters of another sensor, switch to the respective sensor in the selection list.

The instrument detects connected sensors automatically and lists all in the selection field.

"Sensor 1" is fixed to the sensor on the circled SENSOR socket. If no sensor is connected to this socket, the fields remain unaccounted. The sensors no. 2 ... 4 represent the sensors at the USB ports, according to the sequence of connection.
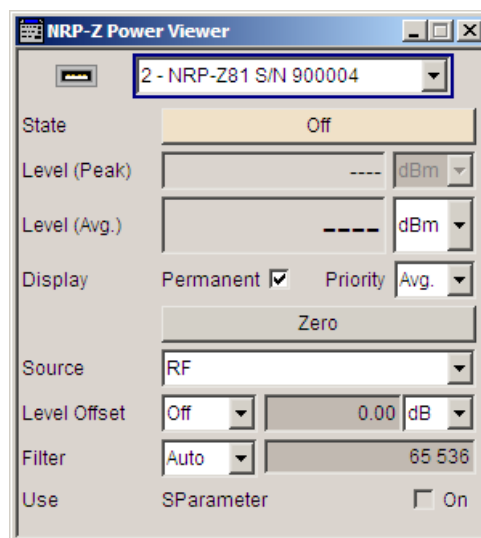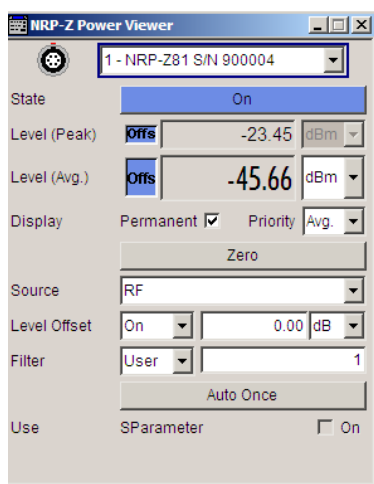
Sensor - Power Viewer
Selects the R&S NRP power sensor for indication.

Indicates the connector used for the detected sensors. The values listed below belong to the respective sensor.

In remote control, the sensors are set up using the SENSe commands. The remote measurement is triggered by the READ query which also provides the measurement results.

The sensor is selected by suffix 1, 2, 3 or 4 in key word SENSe or READ of the command header.

Suffix 1 denotes the sensor connected to SENSOR, suffix 2 the one at the first USB interface, and suffix 3 and 4 are assigned to the sensors at the following USB interfaces. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

In order to detect all connected sensors the state of all four connectors (i.e. SENsor1/ SENSor2/SENSor3/SENSor4) must be checked.

Note: The software version of the connected power sensor can be retrieved by means of the remote control command `:SENS:POW:TYPE?`.

Use the "Setup >" chapter 5.2.3.6, "NRP-Z Info/Update", on page 89 dialog to update the sensor software.

SCPI command:
`SENSe<ch>[:POWer]:STATus[:DEVice]` on page 392

Type - Power Sensors
Indicates the type and the serial number of the connected R&S NRP power sensor. The sensor type is automatically detected.

SCPI command:
`SENSe<ch>[:POWer]:TYPE` on page 418
`SENSe<ch>[:POWer]:SNUMber` on page 391

State - Power Sensors
Activates/deactivates level measurement by the power sensor.

The local state is set with the `INIT` command. Switching the local state off enhances the measurement performance.

In remote control, the sensors are set up using the `SENSe` commands. The remote measurement is triggered by the `READ` query which also provides the measurement results. The state is not influenced by these commands, measurements results can be retrieved with local State on or off.

The sensor is selected by suffix 1, 2, 3 or 4 in key word `SENSe` or `READ` of the command header.

Suffix 1 denotes the sensor connected to SENSOR, suffix 2 the one at the first USB interface, and suffix 3 and 4 are assigned to the sensors at the following USB interfaces. The suffix is identical to the index which is assigned automatically to each sensor upon connection.

In order to detect all connected sensors the state of all four connectors (i.e. SENsor1/SENSor2/SENSor3/SENSor4) must be checked.

To query the availability of a sensor at a given connector, use the command `SENSe<ch>[:POWer]:STATus[:DEVice]` on page 392.

SCPI command:
`INITiate<ch>[:POWer]:CONTinuous` on page 384

Level (Peak) - Power Sensors
With certain power sensors only, e.g. R&S NRP-Z81.

Indicates the measured peak level value with the selected unit.

SCPI command:
`READ<ch>[:POWer]` on page 385

Level (Avg.) - Power Sensors
Indicates the measured level value with the selected unit.

SCPI command:
`READ<ch>[:POWer]` on page 385

Unit - Power Sensors

Selects the unit used for result display.

The power sensor provides the measured value in Watt.

In which unit the measured value is indicated is selected here and might be Watt, dBm or dBuV.

SCPI command:
SENSe<ch>:UNIT[:POWer] on page 418

Permanent Display State - Power Sensors

Activates the permanent indication of the power measurement result in the upper right corner of the block diagram. The instrument shows the type of sensor, the corresponding connector, the measurement source and - if set - the offset.

It is possible to switch the permanent display active for several sensors, and the instrument indicates the values of the sensor with the lowest port number in the display.
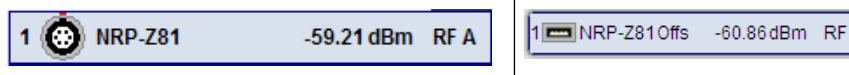
SCPI command:
SENSe<ch>[:POWer]:DISPlay:PERManent:STATe on page 388

Display Priority - Power Sensors

Selects whether the average or the peak power measurement result is indicated when permanent display is active.

SCPI command:
SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority on page 388

Zero - Power Sensors

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor (see tips below). R&S power sensors automatically detect the presence of any significant input power. This aborts zeroing and generates an error message. Zeroing can take a few seconds, depending on the sensor model; refer to the documentation of your external power sensor for more information.

Tips for zeroing

Zeroing should be performed:
● During warm-up after switching on or connecting the instrument
● After a substantial change of the ambient temperature
● After fastening the power sensor module to an RF connector at high temperature
● After several hours of operation
● When very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
● Switch off the RF power source for zeroing; do not disconnect it from the power sensor. In this way you will maintain the thermal equilibrium, and zeroing will also com-

pensate for the noise superimposed on the measured signal (e.g. from a broadband amplifier).

SCPI command:

SENSe<ch>[:POWer]:ZERO on page 418

Source - Power Sensors

Selects the source for measurement.

"RF"   Measurement source is the RF signal of the generator. The RF frequency is used as the measurement frequency of the sensor and the corresponding correction factor is used.
                      In this mode the RF frequency of the generator is send to the sensor automatically if changed.

"User"   Measurements source is any freely selectable source. The frequency is entered manually under frequency (e.g. for measurement of amplifier gain with 2 sensors).

SCPI command:

SENSe<ch>[:POWer]:SOURce on page 392

Frequency - Power Sensors

Source User only

Enters the frequency for measurement source "User".

SCPI command:

SENSe<ch>[:POWer]:FREQuency on page 391

Level Offset - Power Sensors

Activates and defines a level offset which is added to the measured value. This allows e.g. an attenuator in the signal path to be taken into account. The offset is always entered in dB, irrespective of the selected unit for result display.

SCPI command:

SENSe<ch>[:POWer]:OFFSet:STATe on page 391
SENSe<ch>[:POWer]:OFFSet on page 391

Filter Length - Power Sensors

Selects the filter length used for measurement. The filter length is the multiplier for the measurement time and thus directly influences it.

The averaging filter is used to reduce fluctuations in the measured result to the extent desired. Such fluctuations can be caused by inherent noise of the measuring instrument, modulation of the measurement signal or beats from the superposition of adjacent carriers. A more stable display has to be traded off against longer measurements. The measurement result is obtained from a two-stage averaging process.

Note: Longer measurements does not mean that it takes longer to display a new result, but rather that it takes longer for the result to settle when the power changes.

Measurements are continuously repeated in a predefined time window. The measurement result is obtained by averaging the measured values for the last 2N time windows. The number N is the filter length, the factor of 2 arises because the output signals from the microwave detector to suppress low-frequency noise are chopped at the same rate as the time windows, which means that an independent measured value can only be obtained from two consecutive values. As the filter length is the multiplier for the time window it directly influences the measurement time.

The filter length can be selected automatically or can be manually set to a fixed value. As a preliminary, you should always check if the auto mode is giving satisfactory results because you will always have to adjust an optimal, manual filter-length setting if the power is not constant.

Selection "Fixed Noise" is offered for reaching defined measurement accuracy.

"Auto"   The filter length is automatically selected and adapted to the currently measured value. With very high signals the filter length and therefore the measurement time can be short. With very low signal levels the filter length and therefore the measurement time is increased in order to reduce noise. The used filter length is indicated in the field to the right.

"User"   The filter length is set manually.
                The filter length is entered in the entry window to the right. As the filter length works as a multiplier for the time window, this results in a constant measurement time. Values 1 and 2^n are settable.

                Note: The time window varies depending on the used sensor. For most sensors it is fixed to 20 ms. For the R&S NRP-Z81 sensor it is 10 us. Therefore, the user filter length for the R&S NRP-Z81 has be about 1000 times larger than the filter length for other sensors in order to achieve the same filtering result.
                The "Auto Once" button can be used to search for the optimum filter length for the current measurement conditions. The found filter length is indicated in the field to the right.

"Fixed Noise"   The averaging factor is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content.
                The desired noise content is entered in the entry field to the right.
                To avoid very long settling times when the power is low, the averaging factor can be limited with the "Timeout" parameter.

SCPI command:
SENSe<ch>[:POWer]:FILTer:TYPE on page 390
SENSe<ch>[:POWer]:FILTer:LENGth:AUTO on page 388
SENSe<ch>[:POWer]:FILTer:SONCe on page 390
SENSe<ch>[:POWer]:FILTer:LENGth[:USER] on page 389
SENSe<ch>[:POWer]:FILTer:NSRatio on page 389
SENSe<ch>[:POWer]:FILTer:NSRatio:MTIMe on page 389

Use SParameter - Power Sensors
Activates the use of the S-Parameters correction data of the connected power sensor. For sensor with attenuator this checkbox is automatically checked.

Refer to the manual of the connected R&S NRP-Zxx power sensor for a description on how to use the s-parameters table.

SCPI command:

SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 387

Use Sensor for RF Lev. Control - Power Sensors

Enables/disables controlling of the RF level via the power sensor.

SCPI command:

n.a.

5.3.5.2 NRP-Z Power Analysis

The signal generator in combination with a connected R&S NRP probe allows sweep measurements on DUTs.

To open the "NRP-Z Analysis" dialog, select "RF > NRP-Z Power Analysis" or use the menu key under "RF".
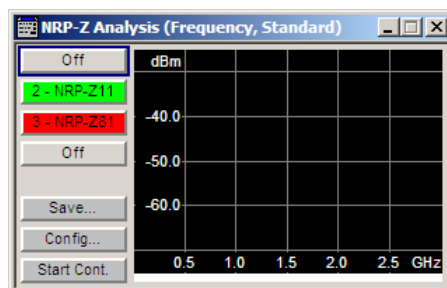
The measurement data of the sensors is displayed in traces in a measurement diagram. Four traces are available. The traces are automatically or manually assigned to the sensors. In addition to the data traces, a reference trace can be stored and recalled and/or the trace indication can be frozen temporarily (hold trace), thus enabling comparison of traces. Readout and comparison of particular values of the traces is possible by means of four markers.

Three measurement modes are offered:

- power versus frequency (frequency response)
- power versus power (power sweep, AM/AM)
  These two modes are generator driven, i.e., the generator provides the measurement signal.
- power versus time (power measurement in the time domain R&S NRP trace mode). This mode is signal driven, i.e. besides the generator signal also external signals can be analyzed. Time mode requires an additional trigger event, for which level, hysteresis and dropout time are freely selectable. The generator also features pulse data analysis in this mode, provided that R&S power sensor NRP-Z81 is connected.

The timing can be used for normal and fast measurements in all modes.

By the use of a separate frequency than the set generator frequency, measurement results retrieved at a different frequency can be displayed in the diagram (e.g. as provided at the output of the DUT).

Special functions of some hardkeys

The instrument provides hardkeys with special functions for convenient operation, when the "NRP-Z Power Analysis" dialogs are active.

The REARR key toggles between different views of the diagram, selectable in the "REARR list NRP-Z Analysis dialog", see :

● standard, diagram and buttons are displayed,

● full display, diagram with marker list but no buttons are displayed,

● full display, diagram with pulse data list but no buttons are displayed, and

● full display only diagram is displayed.

The MENU and SETUP keys directly open a special power analysis menu. Either the complete menu tree or the setup menu tree is available in addition to the power analysis menu.
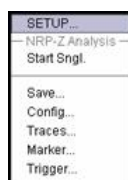
The instrument also provides this context-sensitive menu by pressing the right mouse button in the measurement diagram.

The ON /OFF key toggles between measurement start and stop.

The BACKSPACE key resets the scaling of the y-axis to suitable values after the use of auto scaling in the expanding mode. In this mode, the y scale might get too expanded due to temporary high power values. The reset function resets the diagram again, to also indicate smaller power values.

If "Auto Scale" is turned off, press the BACKSPACE button to switch to Auto Scale expanding mode, and to reset "Auto Scale".

Example Test Setup

As a power meter has no built-in selection, it is measuring all signal components from nearly DC to 40 GHz and higher. Therefore, the DUT's signal must be rather pure or subjected to external filtering (harmonics, spurious) before measured.

The test setup for the power analysis in the **power versus frequency or power versus power** is as follows:
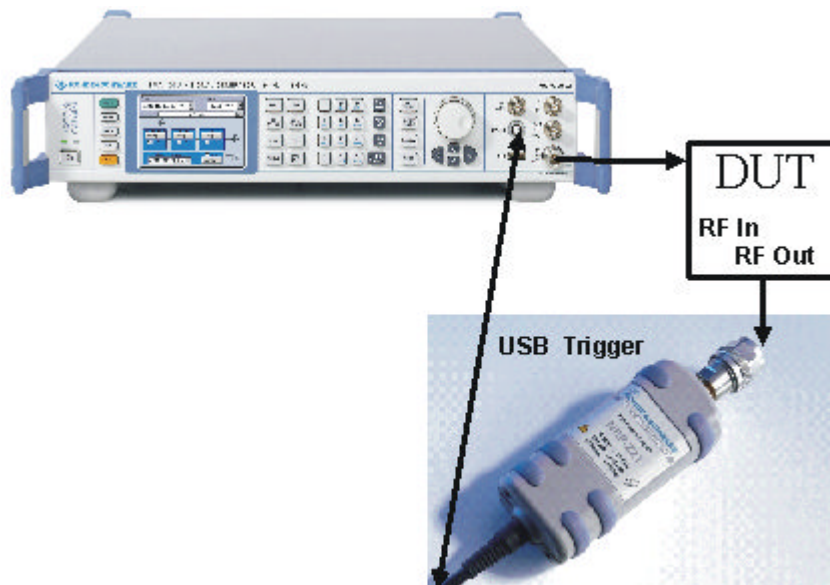
1. Connect the DUT (e.g. bandpass) to the RF output of the instrument and the RF input of the R&S NRP-Zxx sensor (e.g. R&S NRP-Z21).

2. Connect the USB output of the R&S NRP-Zxx to the SENSOR connector of the instrument.

3. Open the "NRP-Z Analysis" diagram in the "RF" block of the generator

4. Setup the measurement and scale diagram in the "Configure…" dialog (e.g. fast measurement, 200 measurement points, range, x-axis and y-axis scale).

5. Trigger measurement by pressing the "Start" button in the "NRP-Z Power Analysis" diagram.

6. If required, perform the further settings:

   a) Set markers by means of the rotary knob. To access the markers activate the "NRP-Z Analysis Frequency / Marker" diagram view with the REARR key. The markers are moved by means of the cursor and the roll key to the desired trace position.
   Note: The "NRP-Z Analysis Frequency / Marker" view is activated in the "REARR list NRP-Z Analysis" dialog (see "REARR list - Power Analysis" on page 146). Press the REARR key repeatedly until you have this view.

   b) Store a hardcopy of the measurement results "Configure Diagram", on page 145 ("Save…" submenu).

   c) Apply user correction. "Ucor" is also available for NRP-Z measurements (see chapter 5.3.8, "User Correction", on page 176).

The diagrams below show the result of the above settings, an RF frequency range of 1-6 GHz and the level range of -65 dB to 5 dB.
The graphs show the different diagram views.
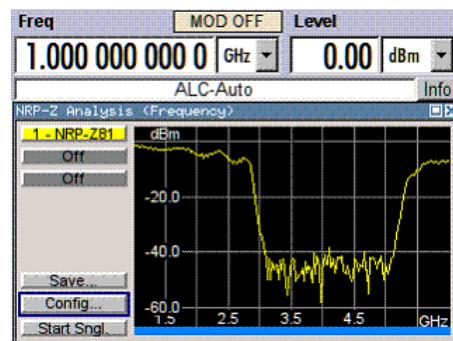
Fig. 5-3: Standard view, diagram and buttons are displayed
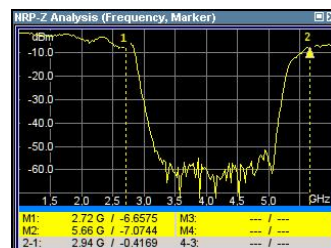
Fig. 5-4: Full screen "Marker View", diagram and marker list are displayed
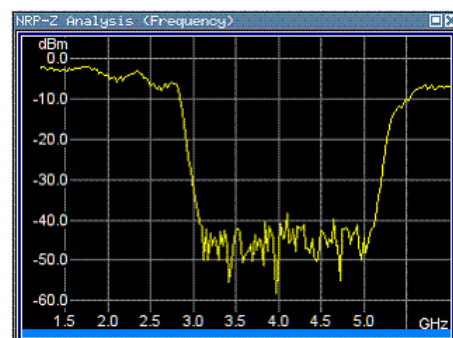
Fig. 5-5: Fullscreen view, only the diagram is displayed

Measurement Diagram
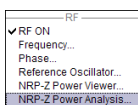
To open the "NRP-Z Power Analysis" diagram, select "RF > Configure > NRP-Z Power Analysis" or use the MENU key under "RF".

The dialog comprises the measurement diagram with start button and provides access to the dialogs for setting up the measurement and sensor parameters, for configuring the diagram and trace indication, and for storing hardcopies of the measurement results.
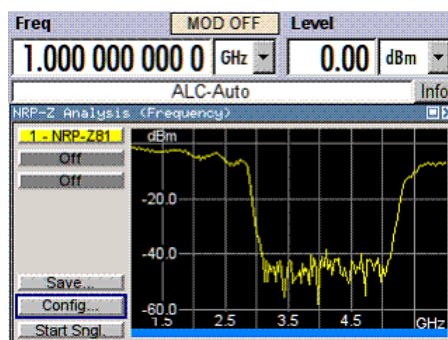
The R&S signal generator supports various graph views, according to the methods of measurement and also additional functions such as the use of markers.

Note: Activate the relevant diagram views in the "REARR list NRP-Z Analysis" dialog, see "REARR list - Power Analysis" on page 146, and switch to the currently needed view with the aid of the REARR key or STR+<A>.

Markers and the marker list are available in the "NRP-Z Analysis Frequency / Marker" view which is shown in the graph above (see also "Define Markers ", on page 163). Select a marker with the roll key. One click activates the cursor, the second click captures the selected marker to move it to the desired position. Set the focus back to the diagram with a double click on ESC.

The list below the diagram displays the numerical readout of the marker values.

The x-axis of the measurement diagram is freely scalable in the frequency or power range of the generator, the power range for the y-axis is +100 dBm to -200 dBm. In power versus frequency mode, the frequency range of the x-axis is separately scalable. The available time range for power versus time measurements is -1s to +2s.

It is possible to select single or continuous measurement mode in the "Config…" menu. Single starts a single measurement after the trigger, continuous causes a restart of the measurement after each pass. The measurement is triggered by pushing the "Start" button. In continuous mode, the "Start" button is replaced by a "Stop" button after the trigger which can be used to cancel the measurement. A progress bar indicates the current status of the measurement.

In time mode additional triggering is required which is configured in the trigger dialog.

Changing to trace source **Hold** freezes the current trace indication in the diagram.

Some front panel keys are assigned special functions if the power analysis is active (see overview of features and operation in section chapter 5.3.5.2, "NRP-Z Power Analysis", on page 131):

Marker and Pulse Data Indication - Power Analysis
The marker and pulse data value indication below the measurement diagram is only available for certain views of the diagram. The REARR key or the key combination <STR +A> toggles between the different diagram views (see chapter 5.3.5.2, "NRP-Z Power Analysis", on page 131). The marker indication in the measurement diagram is activated in the marker dialog, see "Define Markers ", on page 163.

Tip: In remote-control mode, include the markers of the diagram, their values or the pulse data in the hardcopy file.

SCPI command:

`:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe]` on page 423

`:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe]` on page 424

Buttons
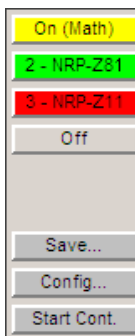
The dialog comprises at the left side a button bar with the four **trace** buttons for sensor assignment.

The "Save" button enables you to directly store the measured data, and the Config button opens the configuration dialog for setting the measurement parameters.

Execute the measurement with the Start/Stop button at the bottom.

Trace Buttons - Power Analysis
The four buttons in the upper left corner of the measurement diagram indicate the sensor assignment to the respective trace. They open the settings dialogs for the traces, see"Setup Trace", on page 137.

Save… - Power Analysis
Opens the dialog to store a screenshot of the current measurement diagram, see "Save Hardcopy", on page 164.

Config… - Power Analysis
Opens the dialog to configure the power analysis measurement, see

- "Configure Measurement", on page 141
- "Configure Diagram", on page 145
- "Configure Gate Mode", on page 148
- "Configure Sensors", on page 150
- "Configure Pulse Data NRP-Z", on page 153
- "Configure Trigger", on page 161
- "Setup Trace", on page 137
- "Define Markers ", on page 163

Start - Power Analysis

Triggers the measurements with the R&S NRP-Zxx power sensors. The measurement results are indicated in the measurement diagram. A progress bar indicates the current status of the measurement.

SCPI command:

SENSe[:POWer]:SWEep:INITiate on page 405

*OPC?

:TRACe<ch>[:POWer]:SWEep:DATA:POINts on page 421

:TRACe<ch>[:POWer]:SWEep:DATA:XVALues on page 421

:TRACe<ch>[:POWer]:SWEep:DATA:YVALues on page 421

Setup Trace

The measurement data can be current (sensor trace) or stored trace data, either in a file (reference trace) or in a temporary memory (hold trace). Up to four traces can be indicated at one time. On connection, the sensors are automatically detected and assigned to a trace. By default, connected sensors are assigned to the traces in ascending order, i.e. sensor 1 to trace 1, sensor 2 to trace 2 and so on. If the default trace is already used, the sensor has to be assigned manually in the trace dialog.
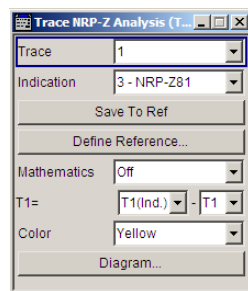
The **reference** and **hold** traces enable you to compare traces. E.g. assign a reference curve to one trace, your measured values to a second one, and switch on display. This feature provides to directly compare results in the graph, or to show deviations in a graph by using the "Mathematics" function.

Example

The current single measurement of sensor 2 which is assigned to trace 2 shall be used as reference trace.

1. Select "Trace 2" with "Indication 2" = NRP-Zx and press the "Save To Ref" button.

2. Select "Trace 1" and "Indication Ref.".

3. Press the "Diagram" button, two identical traces are now indicated.

4. Push the "Start single" button and a new measurement cycle with sensor 2 is triggered. The resulting measurement trace can be compared to the former measurement which is visible as reference trace.

Trace

Selects the index of the trace. The source for the trace data is selected below. The trace color for each of the four possible traces is preset but can be changed.

SCPI command:

n.a.

In remote control, the trace is selected by the suffix of keyword TRACe.

Indication - Power Analysis

Selects the source for the trace data.

The selection is indicated on the trace button in the measurement diagram.
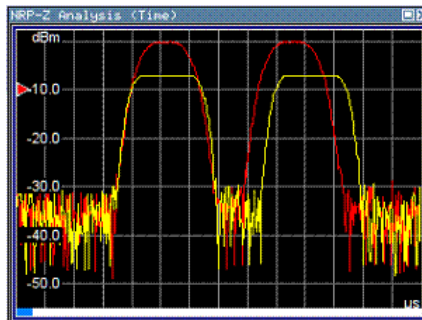
Red   = reference or hold trace
Yellow = current measurement trace

"Off"   No source is selected, the trace is not indicated.

SCPI command:

:TRACe<ch>[:POWer]:SWEep:STATe on page 427

"2 - NRP-Zxx" The current measurement results of the selected power sensor are the source for the trace data. The index at the beginning of the sensor name indicates the used connector, e.g. 2 indicates that the sensor is connected via a USB interface. The data are either continuously updated (continuous measurement) or represent a single measurement cycle (single measurement).

SCPI command:

:TRACe<ch>[:POWer]:SWEep:STATe on page 427

:TRACe<ch>[:POWer]:SWEep:FEED on page 422

"Ref"   Selects the reference trace. The reference trace represents the state of the sensor trace at the moment when it was stored. The reference trace is a static trace that was stored in a file and can be recalled.
               It is possible to store one reference trace at a time.

SCPI command:

:TRACe<ch>[:POWer]:SWEep:COPY on page 420

:TRACe<ch>[:POWer]:SWEep:FEED on page 422

:TRACe<ch>[:POWer]:SWEep:STATe on page 427

"Hold"   Freezes the current trace data. The hold trace is a temporary trace that is available until the NRP power analysis is finished. Freezing the trace of a sensor on one trace and displaying the measurement values of the same sensor on a other trace allows fast comparison between measurements.

SCPI command:

n.a.

(this feature is available for manual control only)

Save to Ref - Trace Power Analysis

Saves the selected trace as reference trace. One reference trace is available at a time.

SCPI command:

`:TRACe<ch>[:POWer]:SWEep:COPY` on page 420

Define Reference - Trace Power Analysis

Opens a dialog for defining a linear reference curve.
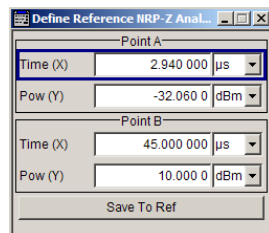
Define the reference curve by entering the coordinates of "Point A" and "Point B".

The reference curve is determined by two value pairs in the cartesian coordinates of the "NRP-Z Analysis" diagram. Depending on the measurement mode, the following values are required:

- Freq (X) / Pow (Y) in "Frequency" mode
  Determine the parameters of the frequency reference curve.
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues`
  on page 393
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues`
  on page 393
- Pow (X) / Pow (Y) in "Power" mode
  Enter the x- and y-axis values of the points A and B.
  `:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues` on page 405
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY` on page 412
- Time (X) / Pow (Y) in "Time" mode
  Enter the time values for the x-axis and the corresponding y-axis power values.
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues` on page 412
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues` on page 412
- "Save To Ref"
  Saves the selected trace as reference trace. One reference trace is available at a time.
  `:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY` on page 393
  `:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues` on page 406
  `:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY` on page 412

The reference curve consists of a certain number of coordinate points, calculated by the number of steps + 1. The first coordinate point starts at Min, and Max is the last. "Step", "Min" and "Max" are determined in the configuration dialog, see "Configure Measurement", on page 141.

Tip: You can assign the X and Y coordinates of the markers automatically in marker view. By pressing the "Fill Point" button, the function automatically reads the X and Y coordinates from the trace data and derives the intersection point of the selected marker and the trace curve.

Mathematics - Trace Power Analysis
Activates / deactivates the mathematic function.

The function allows to determine the deviation of two test series, either of measurement traces, or also of traces that contain math results or stored reference curves. I.e. you can also assign a math result to an operand for further calculation. Various nested computation steps are possible.

The math operation follows the formula:

$$T\text{<ch>}_{result} = T\text{<ch>}_{Operand1} - T\text{<ch>}_{Operand2}$$

How to proceed:

Determine $T\text{<ch>}_{Operand1}$ in the entry field next to "Tx", and then select $T\text{<ch>}_{Operand2}$ in the second entry field right to it.

The result ("$T\text{<ch>}_{result}$") is assigned to the above selected "Trace". If switched on, the graph shows the resulting curve.

Note:

Depending on the type of trace, the instrument automatically sets the appropriate unit on the y-axis:
- "dBm" if it shows only measurement traces.
- "dB" for purely mathematical curves.
- "dB/dBm" ratio scale for mixed display, i.e. measurements and mathematical curves.

Example:

Example of a nested calculation.

- T1 shows the result of the subtraction of the trace ("Trace 1"), and the reference curve.
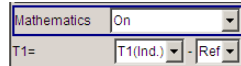
- Trace2 subtracts Ref from T1.
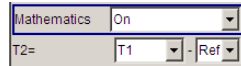
That illustrates the nested calculation, since T1 covers already a math operation.
Note: "(Ind.)" denotes the currently selected trace.

SCPI command:

`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe` on page 382

`:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract` on page 382

`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe` on page 382

`:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract` on page 383

`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe` on page 383

`:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract` on page 383

Color - Trace Power Analysis
Selects the color of the trace.

SCPI command:
`:TRACe<ch>[:POWer]:SWEep:COLor` on page 420

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

Configure Measurement

To open the "Configure NRP-Z Analysis" dialog, press the "Config..." button. The dialog is divided into several sections. The measurement section provides start and stop values for the sweep, and the corresponding parameters for the selected measurement mode.
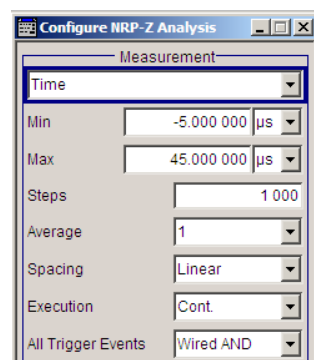
Measurement Mode - Power Analysis
Selects the measurement mode.

"Frequency"   Power versus frequency measurement (frequency response).

"Power"   Power versus power measurement (power sweep, AM/AM).

"Time"   Power versus time measurement (envelope power measurement as a
               function of time, NRP trace mode). This is done by sampling power over
               a time interval and then assigning the internal power values that have
               been determined to a number of points.
               This mode also provides gated measurement and pulse data analysis,
               e.g. with a connected R&S NRP-Z81, and the corresponding graphical
               display "Gate View" and "Pulse Data View".

SCPI command:

SENSe[:POWer]:SWEep:MODE on page 405

Min - Power Analysis

Enters the minimum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the gen-
erator and the used power sensor.

The range for the start time is -1s to +1s. Value 0 defines the trigger point. By choosing
a negative time value, the trace can be shifted in the diagram.

It is possible, that the measurement cannot be performed over the complete time range
because of limitations due to sensor settings. In this case, an error message is output.

If this value is changed for a finished single measurement, only the scaling of the x-axis
is changed. This allows to zoom the trace. However, for subsequent measurements the
measurement range is changed according to the new setting.

If this value is changed during a continuous measurement, only the scaling of the x-axis
is changed for measurement cycles that still were triggered before the change. For sub-
sequent measurement cycles the measurement range is changed according to the new
setting.

SCPI command:

SENSe[:POWer]:SWEep:FREQuency:STARt on page 395

SENSe[:POWer]:SWEep:POWer:STARt on page 408

SENSe[:POWer]:SWEep:TIME:STARt on page 415

Max - Power Analysis

Enters the maximum frequency/power/time of the measurement.

The available frequency/power range depends on the frequency/power range of the
instrument and the used power sensor.

The range for the stop time is 0 s to 2 s. Value 0 defines the trigger point.

It is possible, that the measurement cannot be performed over the complete time range
because of limitations due to sensor settings. In this case, an error message is output.

If this value is changed for a finished single measurement, only the scaling of the x-axis
is changed. This allows to zoom the trace. However, for subsequent measurements the
measurement range is changed according to the new setting.

If this value is changed during a continuous measurement, only the scaling of the x-axis is changed for measurement cycles that still were triggered before the change. For subsequent measurement cycles the measurement range is changed according to the new setting.

SCPI command:

SENSe[:POWer]:SWEep:FREQuency:STOP on page 395

SENSe[:POWer]:SWEep:POWer:STOP on page 409

SENSe[:POWer]:SWEep:TIME:STOP on page 415

Steps - Power Analysis

Enters the number of steps for the sweep. The number of measured points is steps + 1. The number of steps is one of the parameters that define the measurement speed. The higher the number of step, the longer the measurement takes (frequency and power mode).

SCPI command:

SENSe[:POWer]:SWEep:FREQuency:STEPs on page 395

SENSe[:POWer]:SWEep:POWer:STEPs on page 409

SENSe[:POWer]:SWEep:TIME:STEPs on page 415

Timing - Power Analysis

Frequency and power mode only.

Selects the timing mode of the measurement in frequency and power mode. This parameter is not available in time mode.

"Fast"   Fast measurement with an integration time of 2 ms for each measurement step.

"Normal"   A longer but more precise measurement (integration time is 20 ms/step).

SCPI command:

SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE] on page 396

SENSe[:POWer]:SWEep:POWer:TIMing[:MODE] on page 409

Average - Power Analysis

Time mode only

Selects the averaging factor in time mode. This parameter is not available in frequency and power mode.

The factor determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing. If factor 1 is selected no averaging is performed.

SCPI command:

:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt] on page 411

Spacing - Power Analysis

Sets the mode for calculating the sweep steps.

In power versus frequency mode, selection between linear and logarithmic spacing is possible.

"Linear"   • Power versus frequency
In a linear sweep, the frequency is swept in equidistant steps over the continuous frequency range. The x-axis is a linear frequency axis.

• Power versus power
The sweeps are performed at constant frequency but with variable generator power that is swept in linear, equidistant steps over a continuous range. The x-axis is a dB-linear power axis.

• Power versus time
The sweeps are performed at constant frequency and stimulus power. The measurement is repeated over a specified period of time at constant time intervals.

"Logarithmic"   Power versus frequency
In a logarithmic sweep, the frequency is swept in equidistant steps on a logarithmic scale. The x-axis is a logarithmic frequency axis.

SCPI command:

SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE] on page 395

SENSe[:POWer]:SWEep:POWer:SPACing[:MODE] on page 408

SENSe[:POWer]:SWEep:TIME:SPACing[:MODE] on page 415

Execution - Power Analysis
Selects single or continuous mode in power analysis.

The measurement is started in the diagram using the "Start" button. During measurement, the "Start" button is replaced by a "Stop" button which can be used to abort the measurement. The progress bar indicates the current status of the measurement.

Note: For time mode an additional trigger is required (see "Configure Trigger", on page 161).

"Single"   Selects single measurement.

"Cont."   Selects continuous measurements.

SCPI command:

SENSe[:POWer]:SWEep:RMODe on page 411

SENSe[:POWer]:SWEep:FREQuency:RMODe on page 393

SENSe[:POWer]:SWEep:POWer:RMODe on page 406

SENSe[:POWer]:SWEep:TIME:RMODe on page 411

All Trigger Events - Power Analysis
"All Trigger Events" determines, whether the measurement data processing starts with a trigger event in one of the sensors (Logical OR), or whether all channels have to be triggered (logical AND). Each sensor evaluates a trigger event according to its setting independently.

This function supports the internal or external trigger modes with multi-channel time measurements.

"Wired AND"   When all channels are triggered, the measurement starts.

"Wired OR"   The measurement starts when a trigger event occurs.

SCPI command:

:SENSe[:POWer]:SWEep:TIME:TEVents on page 416

Configure Diagram

The "Configure NRP-Z Analysis" dialog is divided into several sections. The diagram area covers the parameters for scaling the y-axis and the appearance of the diagram.
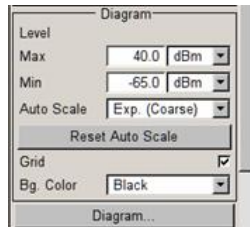
Min - Max y-Axis - Power Analysis
Selects the minimum and maximum value of the y-axis.

SCPI command:
SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum on page 397
SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum on page 397
SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum on page 410
SENSe[:POWer]:SWEep:POWer:YSCale:MINimum on page 411
SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum on page 417
SENSe[:POWer]:SWEep:TIME:YSCale:MINimum on page 418

Auto Scale - Power Analysis
Activates/deactivates autoscaling of the y-axis of the diagram. The Auto Scale function adjusts the scale divisions so that the entire trace fits into the diagram area.

"Off"	Auto scale is deactivated. Switching from activated to deactivated, the scaling is maintained.
"Exp. (Course/ Fine)"	Auto scale is activated. Automatically selects the appropriate scaling of the y-axis so that the trace is always visible. The range is expanded when a value is out of the right or the left end-of-scale value. The step width is 5 dB for selection "Exp. (Coarse)" and variable in the range of 0.2 db to 5 dB for selection "Exp. (Fine)".
"Flt. (Coarse/ Fine)"	Auto scale is activated, i.e. this parameter automatically selects the appropriate scaling of the y-axis so that the trace is always visible. The range is either expanded, when a value is out of the right/left end-of-scale value or it is reduced when the trace fits into a smaller scale area. The step width is 5 dB for selection "Flt. (Coarse)" and variable in the range of 0.2 db to 5 dB for selection "Flt. (Fine)".

SCPI command:
SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO on page 396
SENSe[:POWer]:SWEep:POWer:YSCale:AUTO on page 410
SENSe[:POWer]:SWEep:TIME:YSCale:AUTO on page 416

Reset Auto Scale - Power Analysis

Resets the scaling of the y-axis to suitable values after the use of auto scaling in the expanding mode. For this mode, the Y scale might get too expanded because of temporarily high power values. The reset function resets the diagram again, to also indicate smaller power values.

SCPI command:

`SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet` on page 397

`SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet` on page 410

`SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet` on page 417

Grid - Power Analysis

Activates/deactivates the indication of a grid in the diagram area.

SCPI command:

`:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe` on page 384

Bg Color - Power Analysis

Selects the background color of the diagram, black or white. The background color is also effective for the hardcopy of the diagram.

SCPI command:

`:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor` on page 384

REARR list - Power Analysis

The "REARR list…" button in the middle section opens the dialog for selection of diagram views. This function provides to activate only the required "Views" on the checkboxes to the right. REARR or STRG+<A> switches between all views that are activated in this dialog.
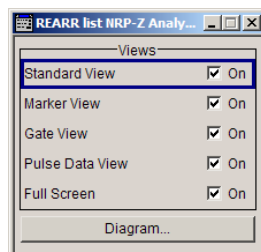
Viewing modes of frequency power and level sweep timing measurements:
- "Standard View:" shows the graph and the button bar at the left
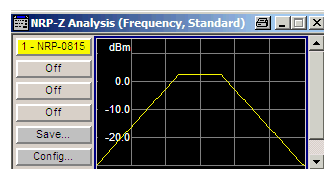
- "Marker View:" shows the graph and the corresponding marker values at the bottom
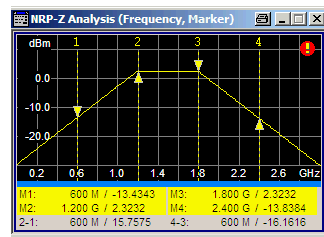
● "Full Screen:" shows the graph in fullscreen, and fades out buttons and list values
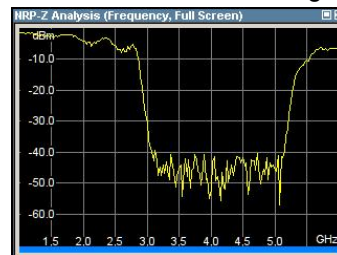
Viewing modes of time trace and pulse data measurements:

● "Gate View:" shows the graph with the corresponding gate data
Gate view provides indicating time trace measurements, as e.g. the peak envelope power of the RF signal.
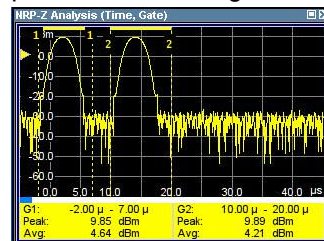
Note: This view is selectable in time mode, since gate measurement is a function of time.

● "Pulse Data View:" shows the graph and the corresponding pulse data
Pulse data view indicates pulse data measurement results of the R&S NRP-Z8x sensor family.
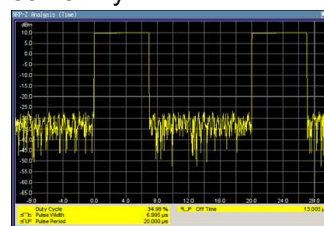
Note: This view is selectable in time mode, since pulse data measurement is a function of time.

Note: The toggle function always switches sequentially between the activated views. When you disable a view that is currently shown, the instrument automatically switches to the next active view.

At least one view must be active, i.e. the final active view cannot be switched off.

SCPI command:

`:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe]` on page 424

`:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe]` on page 423

`:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe]` on page 422

`:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe]` on page 424

`:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe]` on page 422

Pressing the "Diagram..." button returns to the "NRP-Z Analysis" diagram.

Gate Mode - Power Analysis
The "Gate Mode…" button opens the subdialog for the gate mode settings (see "Configure Gate Mode", on page 148).

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

Configure Gate Mode

The "Configure NRP-Z Analysis" dialog is divided into several sections. The "Gate Mode…" button in the middle section opens the dialog for time gate settings.

For time measurement mode only.

Almost all R&S NRP sensors also support time gated measurements of peak and average power (see the data sheet or operating manual of the respective sensor). Two user-configurable gates can be assigned to one of the traces. Both gates are active at the same time. The values are calculated from the trace data, the time resolution is determined by the resolution of the sensor. An external trigger signal or signal triggering is required for synchronization.

The following graph shows two measurement examples, one with separated gates, and another one with overlapping gates.
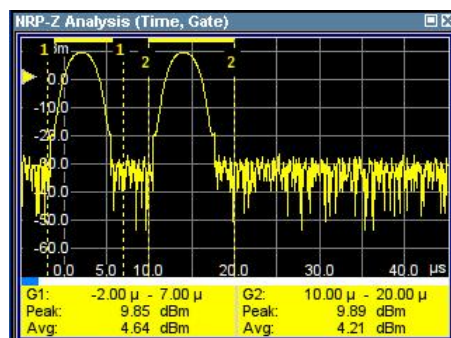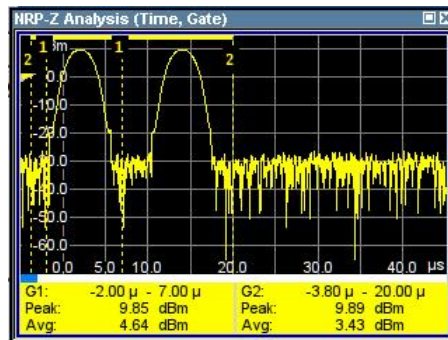
The start and stop time of the gates are indicated as gate markers, a bar between the start and stop marker shows the gate length. The indication state of the gate borders and measurement values is only available for certain diagram views which are switched with the "REARR" key. The "REARR list NRP-Z Analysis dialog" dialog provides a selection of views, between which is toggled (see).

In the remote control mode, commands for setting the indication state differ from the commands for reading the measurement values.

- **Command that defines the indication state for the diagram and for hardcopy:**
  `:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe]` on page 422

- **Commands that query the measured values:**
  `:CALCulate[:POWer]:SWEep:TIME:GATE<ch>AVERage` on page 380
  queries the measured average power.
  `:CALCulate[:POWer]:SWEep:TIME:GATE<ch>MAXimum` on page 381
  queries the measured peak power.

Trace - Gate

Selects the trace to which the gates are assigned. The sensor assignment to the respective trace is performed in the measurement diagram (trace buttons). The two gates are assigned to the same trace.

SCPI command:
`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED` on page 381

Indication

(time measurement mode only)

Indicates the type of R&S NRP power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Additionally, this sensor is indicated on the trace button in the measurement diagram.

SCPI command:

n.a.

State - Gate

Enables time gated measurement. The measurement is started with the "Start" button in the main measurement diagram. Both gates are active at one time.

The gate borders and the measurement values (average and peak power) are indicated in/below the measurement diagram. The indication is only available for certain diagram views which are switched with the "Rearrange" key.

SCPI command:

`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe` on page 382

`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>AVERage` on page 380

`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>MAXimum` on page 381

`:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe]` on page 422

Start / Stop - Gate

Sets the start and the stop times for the respective gate.

SCPI command:

`:CALCulate[:POWer]:SWEep:TIME:GATE<ch>STARt` on page 381

Diagram... - Power Analysis

Returns to the "NRP-Z Analysis" Diagram.

Configure Sensors

The "Configure NRP-Z Analysis" dialog is divided into several sections. The power sensor area additionally provides specific parameters for the power sensor. This part of the dialog might differ from the following description depending on the sensor used. Refer to the manual of the power sensor in this case.
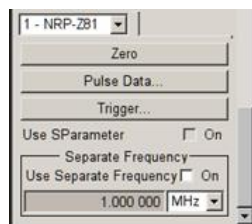
The "Pulse Data..." button is displayed only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Power Sensor - Power Analysis

Selects the power sensor to be set if more than one sensor is connected to the instrument.

SCPI command:

n.a.

In remote control the sensor is selected via the numeric suffix in the sense key word of the command, e.g. `SENSe2:POWer:SWEep:`….

Zero - Power Analysis

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor (see tips below). R&S power sensors automatically detect the presence of any significant input power. This aborts zeroing and generates an error message. Zeroing can take a few seconds, depending on the sensor model; refer to the documentation of your external power sensor for more information.

Tips for zeroing

Zeroing should be performed:

● During warm-up after switching on or connecting the instrument
● After a substantial change of the ambient temperature
● After fastening the power sensor module to an RF connector at high temperature
● After several hours of operation
● When very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
● Switch off the RF power source for zeroing; do not disconnect it from the power sensor. In this way you will maintain the thermal equilibrium, and zeroing will also compensate for the noise superimposed on the measured signal (e.g. from a broadband amplifier).

SCPI command:

SENSe<ch>[:POWer]:ZERO on page 418

Pulse Data… - Power Analysis

Only for measurement mode time and if an R&S NRP-Z81 power sensor is connected.

Opens the "Pulse Data NRP-Z-Analysis" dialog for configuring the parameters for pulse data analysis (see "Configure Pulse Data NRP-Z", on page 153.

SCPI command:

n.a.

Trigger… - Power Analysis

Only for measurement mode time.

Opens a settings dialog to set the trigger for time measurement mode, see "Configure Trigger", on page 161.

Use S-Parameter - Power Analysis

Activates the use of the s-parameters correction data of the connected power sensor. For sensors with attenuator this checkbox is automatically checked.

Refer also to the manual of the connected R&S NRP power sensor for a description on how to use the s-parameters table.

SCPI command:

SENSe<ch>[:POWer]:CORRection:SPDevice:STATe on page 387

Use Separate Frequency- Power Analysis
This setting is offered for measurements with DUTs that change the measurement frequency (e.g. modulators), thus changing the input frequency of the sensor.

The dialog differs depending on the measurement modes:
● Power versus frequency measurement
  Activates the use of a different frequency range other than the set signal generator frequency range for the measurement. The separate minimum and maximum frequency values are entered below.
  The x-scale of the diagram can be adjusted to the separate frequency range with functions "Use as X Scale" and "Map to X Scale".
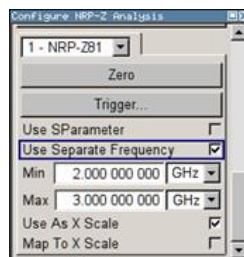
● Power versus power measurement / Power versus time measurement
  Activates the use of a different frequency other than the set signal generator frequency for the measurement. The separate frequency value is entered in the entry window below.
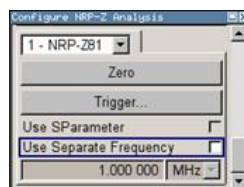
SCPI command:

SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe]
on page 394
SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe
on page 406
SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency on page 406
SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe on page 413
SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency on page 413

Min Frequency - Power Analysis
Power versus frequency measurement active Use Separate Frequency only.

Enters the minimum frequency of the measurement.

SCPI command:

:SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt
on page 394

Max Frequency - Power Analysis

Power versus frequency measurement active Use Separate Frequency only.

Enters the maximum frequency of the measurement.

SCPI command:
SENSe<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP on page 394

Use as X Scale - Power Analysis

Measurement Mode Frequency only.

Activates the use of the separate frequency min and max values for the scaling of the x-axis. Thus, the trace for this sensor is visible in the diagram , especially for frequency ranges that differ substantially from the generator settings.

If more than one sensor is active and uses separate frequency, this options is only available for one sensor. To indicate the traces of the other sensors, function "Map to X Scale" has to be used.

SCPI command:
n.a.

Map to X Scale - Power Analysis

Mode Frequency and active Use Separate Frequency only.

Maps the trace of a sensor that uses separate frequency to the current scaling of the diagram. Usually the scale is determined by the set frequency range of the generator. If more than one sensor is active and uses separate frequency the scale can also be determined by the separate frequency range of one of the other sensors.

SCPI command:
n.a.

Configure Pulse Data NRP-Z

For time measurement mode and power sensor R&S NRP-Z81 only.

The power sensors R&S NRP-Z81 enable pulse data analysis in measurement mode time. All important pulse parameters are measured after setting the threshold levels. The following graph shows most of these parameters:
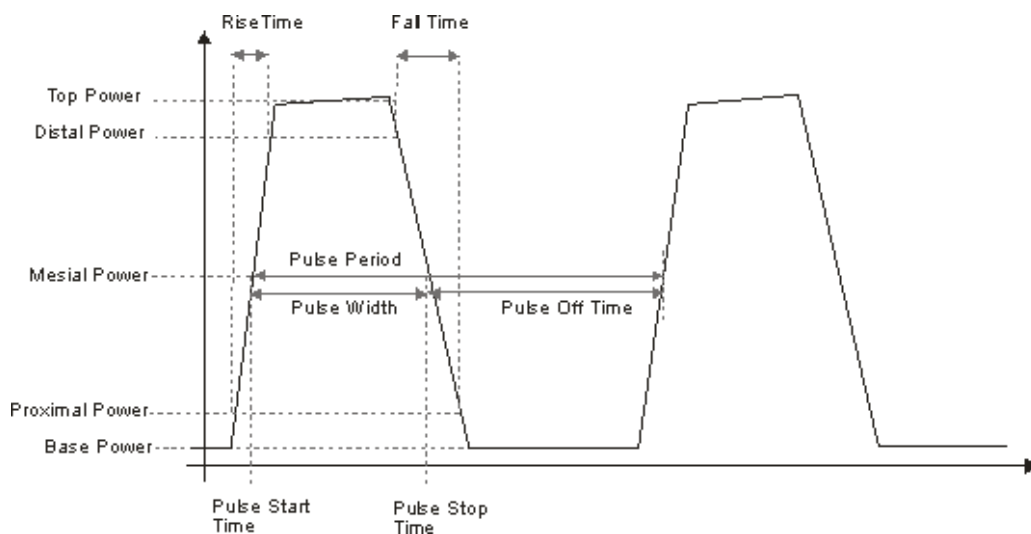
The sensor calculates the pulse parameters from each measurement. The sensor delivers the results to the R&S signal generator.

The "Pulse Data" button opens the submenu to configure and enable pulse data analysis:

- The "Pulse Data NRP-Z- Analysis" dialog is divided into several sections. In the upper section the trace is selected and the pulse data analysis enabled. For information on traces and the measurement data on traces refer to "Setup Trace", on page 137.

- The "Thresholds" section covers the thresholds for detecting time values of a pulsed signal. Thresholds are used to calculate the time parameters. The thresholds can either be related to power or voltage. For information on parameters and terms refer to "Voltage / Power Related - Pulse Data Analysis" on page 156, "Mesial - Pulse Data Analysis" on page 156 and "Proximal - Pulse Data Analysis" on page 157.

- The "Notifications" section covers Duty Cycle, Pulse Width, Pulse Period and Pulse Off Time (see "Notifications - Pulse Data Analysis" on page 157.

- The "Transition Times" section covers Rise Time, Pulse Start Time, Overshoot for the rising or falling edges, Fall Time and Pulse Stop Time (see "Transition Times - Pulse Data Analysis" on page 158).

- The "Signal Power" section covers Minimal Power, Peak Power and Average Power (see "Signal Power - Pulse Data Analysis" on page 159).

- The "Pulse Power" section covers Top Power and Base Power, and Mesial Proximal and Distal Power (see "Pulse Power - Pulse Data Analysis" on page 160).

The indication state of the parameters also affects the hardcopy function. Storing the measurement diagram as hardcopy includes the parameters selected in this dialog. For information on storing measurement data refer to "Save Hardcopy", on page 164.

A total of 6 parameters can be indicated at one time. Structured hierarchically, trace 1 features top priority and trace 4 is addressed with the lowest weighting. This means that only the first 6 checked parameters are indicated, starting with the settings of trace 1.

The pulse data is only visible for certain zoom levels of the diagram. The REAR-RANGE key or the key combination <STR+A> on an external keyboard toggles between the different zoom levels.
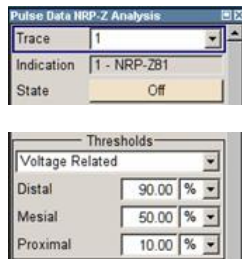
In the remote control mode, commands for setting the indication state differ from the commands for reading the values of the corresponding pulse data parameters.

In the description of the checkboxes, the different remote control commands are listed as shown in the example below:

● Commands that define the indication state for the diagram and for hardcopy:
:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay: ANNotation[:STATe] on page 425
activates indication of the measured duty cycle.
:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay: ANNotation[:STATe] on page 425
activates indication the measured top level.

● Commands that query the measured values:
:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle on page 423
queries the measured duty cycle.
:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP
on page 423
queries the measured top level.

Trace
Selects the index of the trace. The source for the trace data is selected below. The trace color for each of the four possible traces is preset but can be changed.

SCPI command:
n.a.
In remote control, the trace is selected by the suffix of keyword TRACe.

Indication
(time measurement mode only)

Indicates the type of R&S NRP power sensor assigned to the selected trace. This field is automatically updated if the sensor is connected or disconnected. Additionally, this sensor is indicated on the trace button in the measurement diagram.

SCPI command:
n.a.

State - Pulse Data Analysis

Enables pulse data analysis. The measurement is started with the "Start" button in the main measurement diagram.

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe on page 407

Voltage / Power Related - Pulse Data Analysis

Selects how the threshold parameters are calculated, either voltage related or power related. The voltage-related parameters represent the normal case, as the usual representation when defining the pulse parameters (rise/fall time, pulse width) is U(t). To achieve a display with equivalent power-related values, the voltage-related threshold values must be converted (squared) (see example in table below).

	Distal	Mesial	Proximal
Voltage related:	90%	50%	10%
Power related:	81%	25%	1 %
log. Scale (e.g.): (approx., difference between top- base power > 30 dB)	-0.9dB	-6dB	-20dB

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE on page 407

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE on page 426

Distal - Pulse Data Analysis

Sets the upper reference level in terms of percentage of the overall pulse level (power or voltage related). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:HREFerence on page 407

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence on page 426

Mesial - Pulse Data Analysis

Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define the pulse width (τ) and pulse period.

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:REFerence on page 408

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence on page 426

Proximal - Pulse Data Analysis

Sets the lower reference level in terms of percentage of the overall pulse level (power or voltage related).

The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer: LREFerence on page 408

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence on page 427

Notifications - Pulse Data Analysis

Selects the pulse parameters to be indicated below the measurement diagram.

Note: The "Rearrange" key or the key combination <STR+A> toggle between the diagram views.
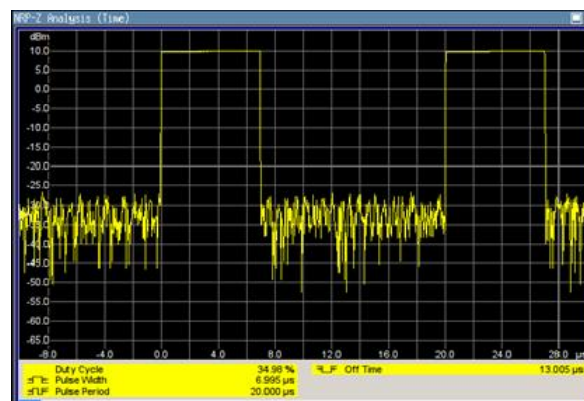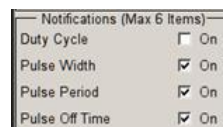
"Duty Cycle"   Indicates the ratio between the pulse duration (τ) and the pulse period (T) of the measured pulse signal in per cent:
Duty Cycle = (pulse duration / pulse period) * 100

SCPI command:

:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay: ANNotation[:STATe] on page 425

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle on page 423

"Pulse Width"   Indicates the pulse duration of the pulse data measurement in seconds.

SCPI command:

:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay: ANNotation[:STATe] on page 425

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation on page 423

"Pulse Period"   Indicates the time the pulse signal needs to complete one cycle.

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:`
`ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod` on page 423

"Pulse Off   Determines the time the pulse signal is low, i.e. as long as the signal level
Time"   is below the proximal value.

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay:`
`ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation` on page 423

Transition Times - Pulse Data Analysis
Selects the transition parameters of the pulse signal to be indicated below the measurement diagram.

The R&S NRP-Z sensor searches for the first rising edge and the first falling edge in the trace.

Note: The "Rearrange" key or the key combination <STR+A> toggle between diagram views.
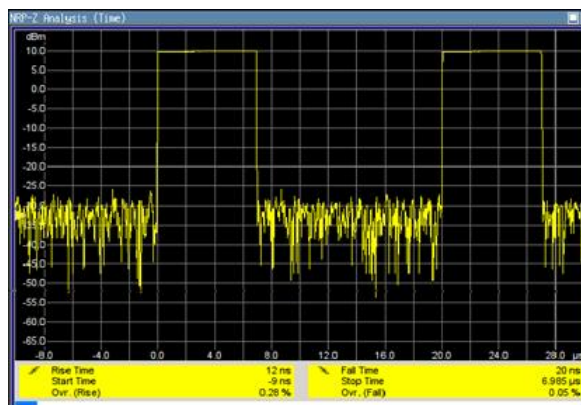
"Rise Time / Fall Time"   Display the time the signal requires from crossing low reference until it reaches high reference level and vice versa.

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation` on page 423

"Pulse Start Time / Pulse Stop Time"   Display the time when the pulse signal crosses the medial reference level.

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence` on page 423

"Overshoot (Rising Edge / Falling Edge)"   Display the maximum value of the pulse signal following a rising transition and the minimum value of the signal after a falling transition, respectively.

Overshoot values are given in per cent of the pulse amplitude as shown below:

- Overshoot(pos) = 100* (maximum - top level) / (top level - base level)
- Overshoot(neg) = 100* (base level - minimum) / (top level - base level)

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot` on page 423

Signal Power - Pulse Data Analysis

Selects the power parameters of the pulse signal to be indicated below the measurement diagram.

Note: The REARRANGE key or the key combination <STR+A> toggle between the diagram views.
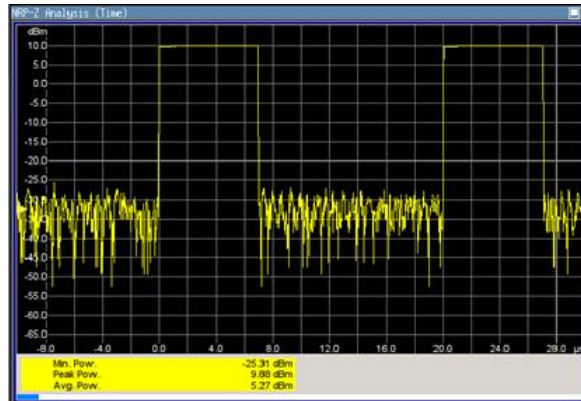
"Minimal / Peak / Average Power" display the minimum, the maximum and the average power of the pulse signal in dBm.

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage` on page 423

Pulse Power - Pulse Data Analysis
Selects which pulse power parameters are indicated in the diagram (pulse data view only).

Note: The "Rearrange" key or the key combination "<STR+a>" toggles between the diagram views.
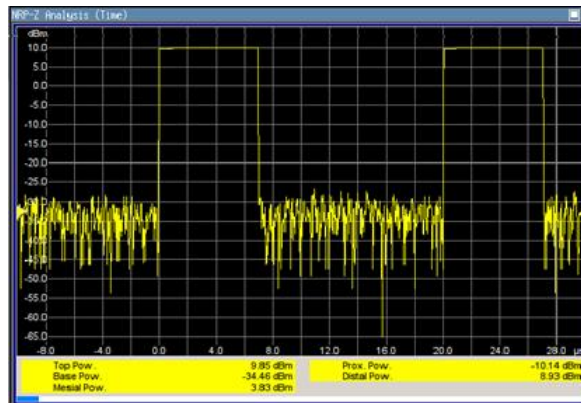
"Top / Base lindicate the pulse top and base level of the analyzed signal in dBm.
Power"

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE` on page 423

"Distal / Mesial /Display the absolute power values of the medial, low and high reference
Proximal   level in dBm.
Power"

SCPI command:

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence` on page 423

`:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:ANNotation[:STATe]` on page 425

`:TRACe<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence` on page 423

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

Configure Trigger

The "Trigger…" button opens the "Trigger NRP-Z Analysis" dialog. The button is only
active for time measurement mode. For this mode, the measurement start has to be
known to the sensor as the measurement is controlled by the sensor.
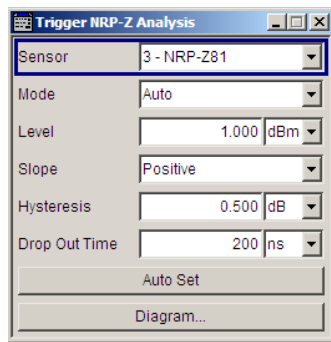
Power Sensor - Power Analysis

Selects the power sensor to be set if more than one sensor is connected to the instrument.

SCPI command:

n.a.

In remote control the sensor is selected via the numeric suffix in the sense key word of the command, e.g. `SENSe2:POWer:SWEep:…`.

Mode - Power Analysis

Selects if the measurement is free running, or starts only after an internal or external trigger event.

SCPI command:

`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce` on page 414

Level - Power Analysis

Sets the trigger threshold. This setting is also possible by means of the trigger marker on the left side of the diagram.

SCPI command:

`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel` on page 414

Hysteresis - Power Analysis

Sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

SCPI command:

`SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis`
on page 414

Drop out Time - Power Analysis

Determines the minimum time for which the signal must be below (above) the power level defined by "Level" and "Hysteresis" before triggering can occur again. This prevents the trigger system from being activated too early if the trigger threshold is briefly underranged or exceeded.

The dropout time parameter is useful when dealing with, for example, GSM signals with several active slots. When performing a measurement in sync with the signal, a trigger event is to be produced at A, but not at B or C. As the RF power between the slots is below the threshold defined by "Level" and "Hysteresis", the trigger hysteresis alone cannot prevent triggering at B or at C. This is why the dropout time parameter is selected to be greater than the time elapsed between points E and B and between F and C, but less than the time elapsed between G and A. This ensures that triggering will take place at A.
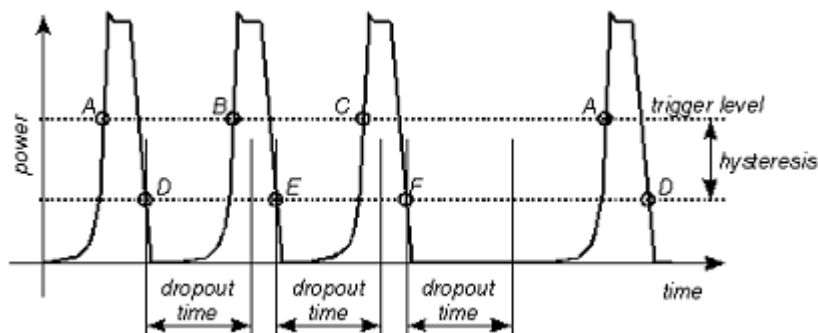
As the mechanism associated with the dropout time parameter is reactivated whenever the trigger threshold is crossed, unambiguous triggering can also be obtained for many complex signals. By contrast, all triggering is suppressed during the hold-off time. For the example described, this would mean that although stable triggering conditions could be obtained with a suitable hold-off time (regular triggering at the same point), it would not be possible to set exclusive triggering at A.

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe on page 413

Auto Set - Power Analysis
Sets the trigger level, the hysteresis and the drop out time to default values.

SCPI command:

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO on page 413

Diagram.. - Power Analysis
Returns to the "NRP-Z Analysis Diagram".

Define Markers

Readout and comparison of particular values of the traces is possible by means of four markers. The markers can be edited either in the diagram or in the "Marker" dialog that is called with the SETUP key in the "NRP-Z Analysis" diagram.

In the "Marker" dialog, the marker can be made visible ("Visible") and assigned to a certain trace ("Trace"). The exact position still has to be defined in the diagram.

Markers and the marker list are available in the medium zoom level which is shown in the graph below. To access the markers activate the "NRP-Z Analysis (Time, Marker)" view with the "Rearrange" key. The markers are moved by means of the cursor and the roll key to the desired trace position. One click activates the marker cursor, the second click attaches the cursor to the selected marker which now can be moved to the desired position. Two clicks on the ESC key set the focus back to the diagram. The position of a active markers are indicated in the marker list.
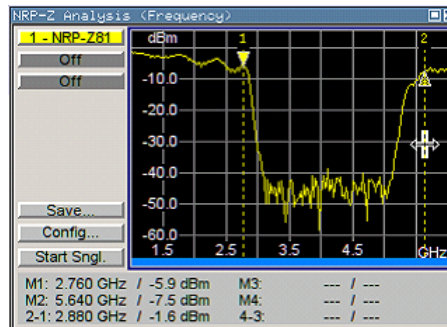
Marker - Power Analysis

Selects the marker to be configured.

SCPI command:
n.a.

Visible - Power Analysis

Selects if the marker and the marker list is visible in the diagram.

SCPI command:
n.a.

Trace - Power Analysis

Selects the trace to which the marker is assigned.

SCPI command:
n.a.

Diagram.. - Power Analysis

Returns to the "NRP-Z Analysis" diagram.

SCPI command:
n.a.

Save Hardcopy

The "Save …" button in the "Power Analysis" diagram opens a dialog to store a screenshot of the current measurement diagram. The current screen shot is stored as indicated, i.e. with or without marker indication. The different diagram views are toggled with the "Rearrange" key or the key combination <STR+A> on an external keyboard (see overview of features and operation in chapter 5.3.5.2, "NRP-Z Power Analysis", on page 131.
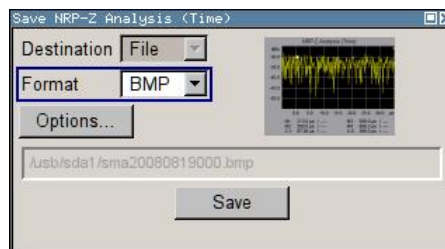
Destination - Power Analysis

Indicates that the hardcopy is stored in a file.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:DEVice on page 398

Format - Power Analysis

Selects the file format.

Several bitmap graphic format are offered. In addition, format *.csv is available which stores the measurement values as ASCII data. The csv settings are performed in the "Options…" submenu.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage on page 399

File name - Power Analysis

Indicates the file name.

The file name can be entered either manually via the file manager (button "File…") or generated automatically. Automatic naming is activated and configured in the "Options…" subdialog

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] on page 401

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe on page 404

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE on page 402

Save Hardcopy - Power Analysis

Stores the current measurement diagram as hardcopy in a graphic file format or the trace data in a csv-file, depending on the selected file format.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy[:EXECute] on page 400

Save Options - Power Analysis

Opens a submenu to enter the screenshot format and size and also to activate and select the automatic naming settings.
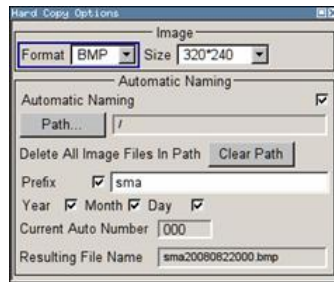
"Format"   Selects the hardcopy format. In addition to several bitmap formats, format "*.csv" is available which stores the measurement values as ASCII data.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage` on page 399

"Size"   Defines the size of the bitmap in terms of pixels. The first value of the size setting defines the width, the second value the height of the image.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE` on page 400

"Automatic   Selects that file names are created by rules if checked. The filename
Naming"   includes at least number and optionally additional information which is determined below.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe` on page 404

"Path"   Sets the directory the files are saved into. The "Clear Path" button deletes all image files with extensions "`bmp`", "`img`", "`png`", "`xpm`" and "`csv`" in the directory set for automatic naming.

SCPI command:

`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory` on page 401
`SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar`
on page 401

"Prefix, Year, Month, Day"   "Prefix, Year, Month, Day" are included in the file name if checked and automatic naming is selected. The Auto Number used for file name creation and the resulting file name are indicated below.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe
on page 404

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix
on page 403

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe
on page 402

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY on page 402

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe
on page 403

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh
on page 403

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe
on page 404

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR on page 404

"Current Auto Number"   Automatic naming only
Indicates the number which is used in the automatically generated file name.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer
on page 403

"Resulting File Name"   Automatic naming only
Indicates the automatically generated file name.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE on page 402

SCPI command:

SENSe[:POWer]:SWEep:HCOPy[:EXECute] on page 400

CSV Options Hardcopy- Power Analysis

If file format *.csv is selected, the trace data is saved as an ASCII file with separated values. Additional settings are available in the hardcopy options submenu.

CSV files can be imported into the program MS Excel and then processed further. Adjust the value separator and the decimal point according to the language version, to import the data correctly.
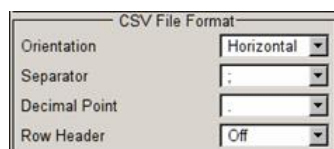
"Orientation" Defines the orientation of the X/Y value pairs:

- **Horizontal:**
  X/Y values of trace 1 in rows 1 and 2,
  X/Y values of trace 2 in rows 3 and 4,
  X/Y values of trace 3 in rows 5 and 6,
  X/Y values of trace 4 in rows 7 and 8.

  Example:

  Trace1,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace1,Y[dBm]: -20.09; -19.17; -18.19; -15.43; ...

  Trace2,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace2,Y[dBm]: -19.09; -18.17; -17.19; -14.43; ...

  Trace3,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace3,Y[dBm]: -21.09; -20.17; -19.19; -16.43; ...

  Trace4,X[Hz]: 10000.0; 10010.0; 10020.0; 10030.0; ...

  Trace4,Y[dBm]: -22.07; -20.14; -21.56; -17.67; ...

- **Vertical:**
  X/Y values of trace 1 in column 1 and 2,
  X/Y values of trace 2 in column 3 and 4,
  X/Y values of trace 3 in column 5 and 6,
  X/Y values of trace 4 in column 7 and 8.

  Example:

  Trace1,X[Hz]; Trace1,Y[dBm]; Trace2,X[Hz]; Trace2,Y[dBm]; Trace3,X[Hz]; Trace3,Y[dBm]; Trace4,X[Hz]; Trace4,Y[dBm];

  10000.0;-20.09;10000.0; -19.09;10000.0;21.09;10000.0;22.07;

  10010.0;-19.17;10010.0;-18.17;10010.0; -20.17;10010.0; -20.14;

  10020.0;-18.19;10020.0;-17.19;10020.0;-19.19;10020.0;-21.56;

  10030.0; -15.43;10030.0; -14.43;10030.0;-16.43;10030.0;-17,67;...

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation
on page 399

"Separator" Defines which character should be used to separate the values, either tabulator, semicolon, comma or blank.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator
on page 400

"Decimal Point" Defines which character should be used as the decimal point of the values, either dot or comma.

SCPI command:

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint on page 399

"Row Header"   Defines whether each row (or column depending on the orientation)
should be preceded by a header containing information about the trace,
i.e. the index of the trace and the type of value (frequency or power or
time).

Example:

Trace=2;Source=detecting..;X[Hz]";"Trace=2;Source=detect-
ing..;Y[dBm]"

SCPI command:
`SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer` on page 399

5.3.6   RF Level/EMF

5.3.6.1   Overview RF Level Settings

Message "Level overrange/underrange"

If this message appears in the status line, the set level ("Level") is in the overrange (see
data sheet).

The correct level setting cannot be guaranteed for the entire frequency range if the set
level is in the overrange/underrange.
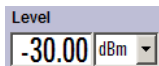
The value of the RF level is displayed in the level field in the header of the instrument's
display and the easiest way to set the RF level is to set it directly in this field.

Be aware, that there is a difference between the RF level displayed in the header and
the RF output level set in the "Level/EMF" dialog of the "RF" block.

RF level vs. RF output level

The level entered and displayed in the "Level" field takes the offset of any downstream
attenuators/amplifiers into consideration by way of calculation. This means that with a
level offset the level displayed in the header does not correspond to the level at the RF
output, but rather to the level at the output of the downstream instrument.

This allows the desired level at the output of downstream instruments to be entered. The
R&S Signal Generator changes the RF output level according to the set offset.

However, the level entered and displayed in the "Level" menu of the "RF" function block
always corresponds to the RF output level. Any level offset is not taken into consideration.

The level offset is entered in the "Level" menu. Here it is also possible to set the level
without taking the offset into consideration, and to make other settings, such as level
offset, attenuator mode, power-on state.

The correlation is as follows:

"Level" (in header) = "RF output level" (Level in menu) + "Level offset" (Offset in menu)
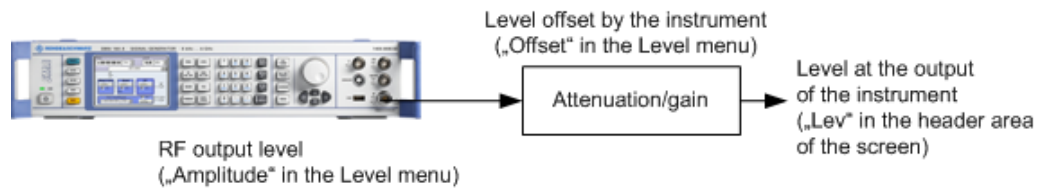
The RF output is protected against overloading by an external signal applied to the RF output (see "Overvoltage Protection", on page 173).

Setting the RF level

To change the RF level, press the LEVEL key and enter the desired level. Changes to the RF level have an immediate effect (without confirmation with the Enter key) on the output signal.

RF Level

Enters the RF level, considering the level offset.

dBm, dBuV, mV and uV can be used as the level units. The 4 unit keys are labeled with these units.

Note: The SCPI command sets the level of the "Level" display, i.e. an entered level offset is taken into consideration in the level value.

SCPI command:

`[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` on page 538

5.3.6.2 RF Level
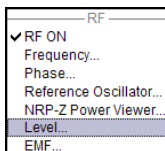
To open the "RF Level/EMF" dialog, select "RF > Configure > Level" or use the MENU key under "RF".

The combined menu "RF Level / EMF" is divided into the several sections.

The top sections of this dialog provide access to the level settings.

The offset-free level, level offset and level limit are set in the top section of the menu. The attenuator mode is set in the "Attenuator Settings" section.

The step width which is used when setting the level using the rotary knob (with "Variation Active On") is set in the "User Variation" section.
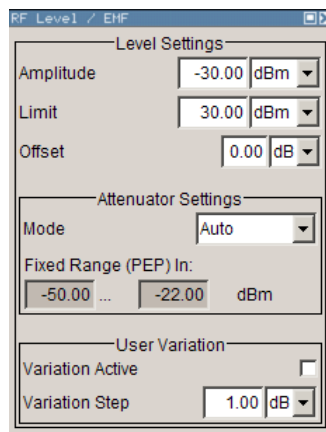
The power-on behavior of the instrument and the level display in the display header are set in the "Power-On / EMF Settings" section (see chapter 5.3.6.3, "Power-On/EMF Settings", on page 173).

Level Settings

The offset-free level, attenuation mode, level offset and level limit are set in the top section of the menu.

Amplitude - RF Signal

Sets the RF level of the RF output connector.

The level entered and displayed here corresponds to the level at the RF output, i.e. any offset entry is not taken into consideration.

Note: The SCPI command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the "Level" display, i.e. the level containing offset.

SCPI command:
`[:SOURce<hw>]:POWer:POWer` on page 541

Limit - RF Signal

Sets the level limit.

The value specifies the upper limit of the level at the RF output connector. A message appears if an attempt is made to set a level above this limit and the level at the RF output is confined to the upper limit. However, the level indication is not influenced.

The value is not affected by an instrument preset (PRESET key), `*RST` and the "Save/Recall" function. This parameter is influenced only by the Factory Preset and its factory value is equal to the upper limit.

SCPI command:
`[:SOURce<hw>]:POWer:LIMit[:AMPLitude]` on page 539

Offset (Level) - RF Signal

Sets the level offset relative to the RF level.

The level offset of a downstream instrument (e.g. an attenuator or amplifier) is entered.

The entry does not change the value of the RF level at the RF output. It only changes the RF level displayed in the display header. The value of the RF level in the header corresponds to the level at the output of the downstream instrument.

SCPI command:

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet on page 538

Attenuator Settings

The attenuator mode is set in the Attenuator Settings section.

Attenuator Mode - RF Signal
Sets the attenuator mode at the RF output.

"Auto"   Standard mode.
                The entire level range is available. The level settings are made in the area of the electronically switching attenuator as well as in the area of the relay-switched high-power-bypass (longer switchover time, wear).

"Normal"   The level settings are made only in the area of the electronically switching attenuator. The high level ranges are not available.
                This setting is wear-free, as the relays are not switched.

"High Power"   The level settings are made only in the area of the high-power bypass. Only the high level range is available. The relays are not switched.

"Fixed"   The level settings are made without switching the attenuator and the relays.
                When this operating mode is switched on, the attenuator and the relays are fixed in their current positions and the resulting variation range is defined. The range is displayed under "Attenuator Fixed Range".
                If automatic level control is activated ("ALC State = On"), the level settings are made without interruption.
                If the normal variation range is overranged or underranged, level errors increase considerably and the warning "Level under/overrange" appears in the info line. The spectral purity of the output signal decreases with high attenuation.

SCPI command:

:OUTPut<hw>:AMODe on page 377

Fixed Range (PEP) In
Displays the level range in which the level is set without interruption for the "Attenuator Mode fixed" setting.

SCPI command:

:OUTPut<hw>:AFIXed:RANGe:UPPer on page 377
:OUTPut<hw>:AFIXed:RANGe:LOWer on page 376

User Variation

If the level is set using the rotary knob, the step width is defined in the "User Variation" section.

Variation Active - RF Level

Activates the user-defined step width used when varying the level value with the rotary knob.

"ON"   The level value set with the rotary knob is varied using the user-defined step width which is entered under "Variation Step".

"OFF"   The level value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

SCPI command:

[:SOURce<hw>]:POWer:STEP:MODE on page 543

Variation Step - RF Level

Sets the user-defined step width for entering the RF level using the rotary knob. Level variation with this step width must also be activated with "Variation Active".

SCPI command:

[:SOURce<hw>]:POWer:STEP[:INCRement] on page 542

Overvoltage Protection

The overvoltage protection prevent overloading by an external signal applied to the RF output of the R&S Signal Generator.

The overload protection is tripped when the power of the external signal becomes too high. A relay opens and interrupts the connection between the RF output and attenuator. This condition is indicated in the display header by the "OVERLOAD" status message.

Overvoltage

If an "Overload" status message is indicated in the display header, reset the overload protection by pressing the RF ON/OFF key.

The RF input is activated when the overload protection is reset.

SCPI command:

:OUTPut<hw>:PROTection:TRIPped on page 378

:OUTPut<hw>:PROTection:CLEar on page 378

:OUTPut<hw>[:STATe] on page 378

5.3.6.3 Power-On/EMF Settings
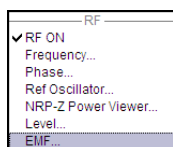
The power-on behavior of the R&S SMA and the level display in the display header are set in the "Power-On / EMF Settings" section of the "RF Level/EMF" dialog.

To open the "RF Level/EMF" dialog, select "RF > Configure > EMF" or use the MENU key under "RF".
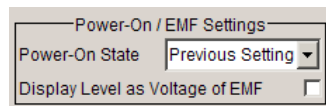
Power-On State - RF Signal

Selects the state which the RF output is to assume after the instrument is switched on.

"RF Off"   The output is deactivated when the instrument is switched on.

"Previous Set- When the instrument is switched on, the output assumes the same state
ting"   as it had when the instrument was switched off.

SCPI command:
:OUTPut<hw>[:STATe]:PON on page 379

Display Level as Voltage of EMF - RF Level
Activates display of the signal level as voltage of the EMF (no-load voltage). If this setting
is deactivated, the level is displayed as a voltage over a 50 Ohm load (preset state).

SCPI command:
n.a.

5.3.7 Automatic Level Control - ALC

Automatic level control (**A**utomatic **L**evel **C**ontrol) can be used with almost all applica-
tions, except for pulse modulation with very small pulse width.

The level control status is permanently displayed as a status message in the info line.
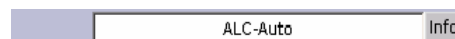
In the standard mode, the level control is active to provide the highest level accuracy.

By default, the instrument operates in "Auto" mode and automatically adjusts the level
control to the operating conditions.

Level control can be switched to "Sample&Hold" or "On" for particular applications.

The "Sample&Hold" state (level control Off) is recommended e.g. for two-tone measure-
ments with two R&S SMA.

If "Sample&Hold" is selected, the level is recalibrated for every level and frequency set-
ting. For this purpose, level control is activated briefly at a defined signal, the level adjuster
is then held at the attained value and level control is activated.

If "On" and "Attenuator Mode Fixed" is selected, the level is recalibrated for every level
and frequency setting.

For this purpose, level control is activated briefly at a defined signal, the level adjuster is
then held at the attained value and level control is deactivated.

Automatic Level Control is deactivated with pulse modulation!

When pulse modulation is activated, the ALC state of the R&S SMA is automatically changed to "ALC OFF" ("Sample & Hold"). In this state, the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting.

In the following cases the nominal ON level is present for typically 3...5 ms after level or frequency setting:

- No attenuator is fitted (frequency option R&S SMA-B103L/B106L)
- in High Power Mode
- in Auto mode if the level is in the High Power range, i.e. the mechanical relay bypass is switched.

The level is decreased by 30 dB during "Sample&Hold" measurement.

5.3.7.1 Automatic Level Control Settings

To open the "Automatic Level Control" dialog, select "RF > Configure > Automatic Level Control" or use the MENU key under "RF".
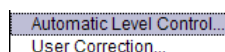
The combined dialog "ALC / UCOR" is divided into the several sections and provides access to the "Automatic Level Control" settings and to function "User Correction", see chapter 5.3.8, "User Correction", on page 176).

External Level Control is possible using R&S NRP power sensors, see chapter 5.3.5.1, "NRP-Z Power Viewer", on page 125.
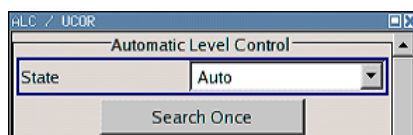
State - ALC

Activates/deactivates internal level control.

Note: Automatic Level Control is deactivated with pulse modulation!. When pulse modulation is activated, the ALC state of the R&S SMA is automatically changed to "ALC OFF" ("Sample & Hold"). In this state, the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting.
In the following cases the nominal ON level is present for typically 3...5 ms after level or frequency setting:

- No attenuator is fitted (frequency option R&S SMA-B103L/B106L)
- in High Power Mode

in Auto mode if the level is in the High Power range, i.e. the mechanical relay bypass is switched.

The level is decreased by 30 dB during "Sample&Hold" measurement.

"Off (Sample & Hold)"	Internal level control is deactivated.
"Auto"	Default state. Level control is automatically adapted to the operating states.
"On"	Internal level control is permanently activated.

SCPI command:

[:SOURce<hw>]:POWer:ALC[:STATe] on page 537

Search Once - ALC
Manually activates level control briefly to allow the level to be calibrated (the "Sample&Hold" setting must be selected).

SCPI command:

[:SOURce<hw>]:POWer:ALC:SONCe on page 537

5.3.8 User Correction

The "User Correction" function is used to create and activate lists in which level correction values predefined by the user are freely assigned to RF frequencies. Correction is performed by the user-defined table values being added to the output level for the respective RF frequency.

With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

The lists are created in the "List Editor". Each list is stored in its own file with the predefined file extension *. uco. The name of the User Correction file can be freely selected. The files are loaded from the "Lists..." file manager. Externally created tables with pairs of frequency and level values can be converted into User Correction files using the import function. The external files must have the file extension *.txt or *.csv. These file formats are provided e.g. by the Microsoft Excel program. The separators for table columns and for decimal floating-point numerals can be set. In addition, internally created User Correction data can be exported into ASCII files using the export function.

The amplitude can also be linearized automatically by means of an R&S NRP power sensor connected to one of the generator output signals. With the aid of the "Fill with Sensor" function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables. The User Correction list with the correction values acquired by the sensor is generated in the "Edit User Correction List" menu. The correction values can be acquired any time irrespective of the modulation settings of the generator.

If user correction is activated, the "UCOR" display (User Correction) is shown in the header together with the "Level" display. The RF output level is the sum of both values.

"Level" + "UCOR" = Output level

If activated, user correction is effective in all operating modes.

5.3.8.1 User Correction Menu

To open the "User Correction" menu, select "RF > Configure > User Correction" or use the MENU key under "RF".

The combined menu "ALC/UCOR" is divided into the several sections.

User Correction Settings

The "User Correction" settings are set in the most lower section of the combined dialog; this section is used to activate/deactivate user correction, and to create, select and activate the lists.

The upper section provides access to the automatic level control settings, see chapter 5.3.7, "Automatic Level Control - ALC", on page 174.
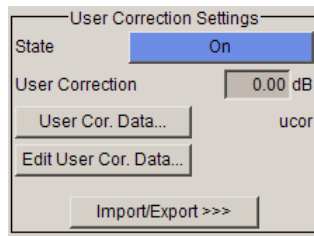
State - User Correction
Activates/deactivates user correction.

The "UCOR" status message appears in the frequency and level display.

SCPI command:
[:SOURce<hw>]:CORRection[:STATe] on page 447

User Correction Value - User Correction
Indicates the current value for level correction.

SCPI command:
[:SOURce<hw>]:CORRection:VALue on page 447

User Cor. Data - User Correction
Calls the "File Select" menu for selecting and creating a list or the "File Manager".
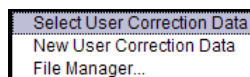
SCPI command:
[:SOURce]:CORRection:CSET:DELete on page 442
[:SOURce<hw>]:CORRection:CSET[:SELect] on page 447

Edit User Cor. Data - User Correction
Calls the editor for editing the selected user correction list.

A list consists of any number of frequency/level value pairs. The currently selected list is displayed.

Each list is saved as a separate file with extension `*.uco`. The file name and the directory to which the file is saved are user-selectable.

Note: Save list only after filling both columns (frequency and level), otherwise the entries are lost.

"Frequency / Hz"	Enters the frequency to which the level correction value applies.
	Note: The "Fill..." function allows to automatically enter any number of frequencies with freely selectable range and increment. Using the "Fill With Sensor" function of the "Edit" sub menu requires only the entry of the frequency values. The level values are automatically acquired by the connected power sensor.
"Power/dB"	Enters the level correction value to which the specified frequency applies. The values can be entered manually or automatically with the "Fill With Sensor" function (available in the "Edit" sub menu). The "Fill With Sensor" function requires option R&S SMA-K83.
"Goto"	Selects row for editing.
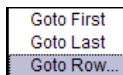
If Goto row is selected, a window opens for entering the requested row.
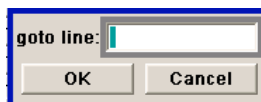
"Edit"	Calls a selection of possible actions described below.
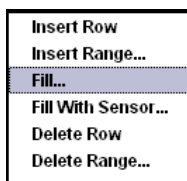
"Insert Row"	Insert a new row before the marked row.
"Insert Range"	Insert new rows before the marked row. The number of rows to be inserted can be defined in an entry window.
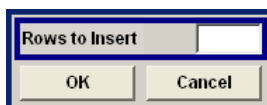
"Fill...."   Opens a sub menu for defining a set of list values to be automatically entered in the ucor list (see chapter 5.3.8.2, "Filling the Correction List automatically", on page 181).

"Fill With Sensor"   Calls the menu to activate the filling of the user correction list with level values acquired by the selected power sensor (see chapter 5.3.8.3, "Filling the Correction List with Power Sensor Measurement Data", on page 182).

"Delete Row"   Deletes the marked row.

"Delete Range..."   Allows to delete any number of rows starting with the marked row. The number of rows to be deleted can be defined in an entry window.
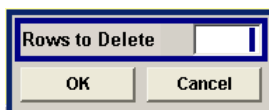
"Save"   The list is saved under its current name.

SCPI command:

[:SOURce<hw>]:CORRection:CSET[:SELect] on page 447

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency on page 441

[:SOURce<hw>]:CORRection:CSET:DATA:POWer on page 441

Import/Export

User correction list can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the "Import/Export" button.

Import/Export >>>

Expands the menu with the area for import and export of user correction files.

Externally edited Excel tables with any number of frequency/level value pairs can be imported as text or CSV-files and used for user correction.

Conversely, you can also export internally created user correction lists as text or CSV-files.
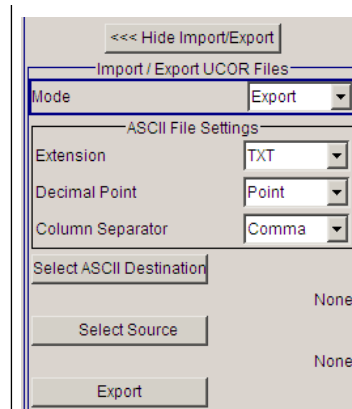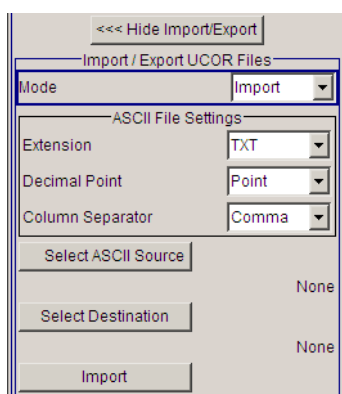
Mode - User Correction

Selects if user correction lists should be imported or exported. The settings offered depend on the selected mode.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:MODE on page 446

Extension - User Correction

Selects the file extension of the ASCII file to be imported or exported. Selection "TXT" (text file) or "CSV" (Excel file) is available.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension on page 443

Decimal Point - User Correction

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal
on page 445

Column Separator- User Correction

Selects the separator between the frequency and level column of the ASCII table the user correction list is exported to or imported from.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn
on page 444

Select ASCII Source / Destination - User Correction

Calls the "File Manager" for selecting the ASCII file to be imported into a user correction list (source) or the ASCII file the user correction list is exported (destination) in.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect on page 444

Destination / Source - User Correction

Calls the "File Manager" for selecting the user correction list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:SELect on page 446

Import / Export - User Correction

Starts the export or import of the selected file.

When import is selected, the ASCII file is imported as user correction list.

When export is selected, the user correction list is exported into the selected ASCII file.

SCPI command:

[:SOURce<hw>]:CORRection:DEXChange:EXECute on page 445

5.3.8.2 Filling the Correction List automatically

The "Fill Table" menu enables you to automatically set the level correction values.

The start line and the number of rows to be filled are defined under "From" and "Range."

The column to be filled is selected under "Select column to fill". Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters. The filling of the column with the selected value settings is started with button "Fill".

The correction list entries are only computed when the "Fill" button is pressed.

From
Sets the start value of the index range.

SCPI command:
n.a.

Range
Sets the range for filling the table.

SCPI command:
n.a.

Select column to fill
Selects either the frequency or the level column to be filled with the value defined below.

SCPI command:
n.a.

Start value
Sets the start value for the frequency or the level entries.

SCPI command:
n.a.

End value
Displays the end value for the frequency or the level entries.

SCPI command:
n.a.

Increment value

Sets the increment for the frequency or the level entries.

SCPI command:

n.a.

Fill

Fills the selected column in the set range with values, starting with the start value and using the set increment.

SCPI command:

n.a.

5.3.8.3 Filling the Correction List with Power Sensor Measurement Data

The level correction values for the user correction list can be acquired by means of R&S NRP power sensors. The R&S NRP sensors are connected to either the SENSOR connector or to one of the USB interfaces. Configuration of the connection is performed in the "Power Sensor" menu (see chapter 5.3.5.1, "NRP-Z Power Viewer", on page 125). The filling of the ucor list with measurement data is performed in the ucor list editor (see "Edit User Cor. Data - User Correction" on page 177).

In the editor, the frequencies for which the correction values are to be acquired are entered in the frequency column (either manually or by means of the "Fill..." menu).

Do not save the list at this point, because the frequency entries are lost as long as there are no entries for the level column also. In the following these entries are automatically acquired by the connected power sensor.

All level correction values for the given frequency values are measured using the Power Sensor and automatically filled in the selected list after the "Execute" button is pressed. The list is automatically stored and recalled again after filling.

Fill User Correction Data with Sensor Settings

The "Fill with Sensor" button of the "Edit User Correction Data" menu opens the associated menu.
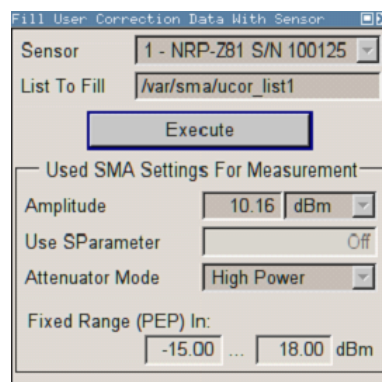
The menu indicates the relevant generator settings.

Fill User Correction Data with Sensor

All settings are read-only, except the "Sensor". In case more than one sensor is connected to the instrument, the sensor can be selected in the "Sensor" field of menu.

The "Execute" button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

SCPI command:

`[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe`
on page 442

5.3.9 Sweep Mode

5.3.9.1 Overview

The R&S Signal Generator offers three different sweep types (frequency sweep, level sweep and LF sweep) to be activated alternatively. Each type has 6 modes which differ with respect to the sweep cycle mode (continuous, individual and step-by-step) and triggering mode (automatic, internal and external).

> Sweeps and List mode can not be activated simultaneously, they deactivate each other.

A phase continuous frequency sweep can be generated after activating the phase continuous mode, see "Setting a Phase Continuous Frequency Sweep" on page 119.

Setting a sweep

A sweep is set in five basic steps which are shown below taking a frequency sweep as an example.

> The LF sweep is activated and configured in the "Mod Gen" block.

1. Set the sweep range ("Start Freq" and "Stop Freq" or "Center Freq" and "Span").

2. Select linear or logarithmic sweep spacing ("Spacing").

3. Set the step width ("Step Lin/Log") and dwell time ("Dwell Time").

4. Activate the sweep ("Mode" to Auto, Single, Step or Extern Single, Extern Step).

5. Trigger the sweep, except for Auto mode ("Execute Single Sweep", Current Frequency or External Trigger Signal).

> It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 88).

5.3.9.2 RF Frequency Sweep
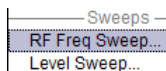
The dialog is used to activate and configure a sweep for the RF frequency.

— Sweeps —
RF Freq Sweep...
Level Sweep...

To open the "Frequency Sweep" menu, select "RF > Configure > RF Frequency Sweep" or use the menu tree of the MENU key under "RF".

In the top section of the menu, the RF sweep mode is activated and the sweep mode is selected.

The buttons are used to reset the RF sweep (all sweep modes) or to execute the RF sweep ("Single" mode).

The sweep range, sweep spacing and dwell time are set in the bottom section.

The sweep range of the RF sweep can be entered in two ways, either by entering the "Start" and "Stop" value or by entering the "Center" and "Span".

The two sets of parameters influence each other in the following way:

- "Start Freq" = "Center Freq" - "Span"/2
- "Stop Freq" = "Center Freq" + "Span"/2
- "Center Freq" = ("Start Freq" + STOP FREQ)/2
- "Span" = "Stop Freq" - "Start Freq"
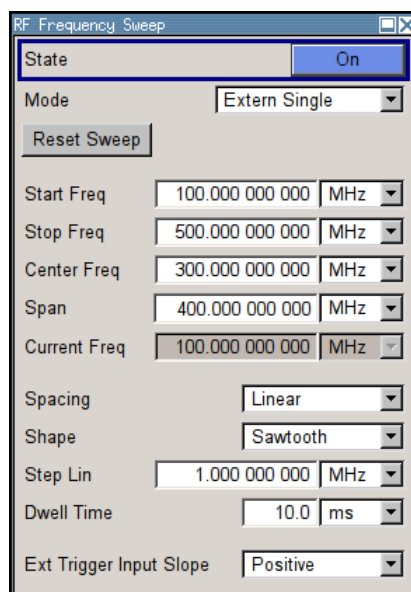
RF Frequency Sweep Settings

State - Frequency Sweep
Activates/deactivates RF sweep mode.

Note: Activating the RF-Sweep mode automatically disables other sweep modes, and the list mode.

SCPI command:
[:SOURce<hw>]:FREQuency:MODE on page 476

Mode - Frequency Sweep

Selects the sweep instrument operating mode and the sweep mode.

"Auto"   Sets an automatic repeated sweep cycle. If a different sweep mode was activated prior to the "Auto" mode, the cycle continues from the current sweep setting.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

SOUR:SWE:FREQ:MODE AUTO

TRIG:FSW:SOUR AUTO

SOUR:FREQ:MODE SWE

"Single"   Sets a single sweep cycle. The sweep is triggered by the "Execute Single Sweep" button.
If a different sweep mode was activated prior to the "Single" mode, the current sweep is stopped. The "Single" sweep always starts at the start frequency when triggered.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

SOUR:SWE:FREQ:MODE AUTO

TRIG:FSW:SOUR SING

SOUR:FREQ:MODE SWE

SOUR:SWE:FREQ:EXEC

"Step"   Sets a step-by-step sweep cycle.
If this mode is activated, the cursor moves to the value displayed for "Current Freq". Any variation to the "Current Freq" value triggers a sweep step. The step width is set below at entry field "Step Lin" or "Step Log".
If a different sweep mode was activated prior to the "Step" mode, the current sweep is stopped. The "Step" sweep starts at the current RF frequency when triggered.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

SOUR:SWE:FREQ:MODE MAN

SOUR:FREQ:MODE SWE

SOUR:SWE:FREQ:SPAC LIN

SOUR:SWE:FREQ:STEP:LIN 0.5E4

SOUR:FREQ:MAN 1GHz

The value entered with command SOUR:SWE:FREQ:STEP:LIN|LOG sets the step width.

The value entered with command SOUR:FREQ:MAN has no effect, the command only triggers the next sweep step. However, the value has to be in the currently set sweep range (start to stop). In remote control only a step-by-step sweep from start to stop frequency is possible.

"Extern Single"   Sets a single sweep cycle. The sweep is triggered by an external trigger signal.

If a different sweep mode was activated prior to the "Extern Single" mode, the current sweep is stopped. The "Extern Single" sweep always starts at the start frequency when triggered.

Refer to the description of the rear panel for information about the connectors for external trigger signal input (see chapter 2.2, "Rear Panel Tour", on page 21).

The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:SWE:FREQ:MODE AUTO

TRIG:FSW:SOUR EXT

SOUR:FREQ:MODE SWE (External trigger)
```

"Extern Step"   Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width is set below at entry field "Step Lin" or "Step Log".

If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the start frequency when triggered.

The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:SWE:FREQ:MODE STEP

SOUR:SWE:FREQ:SPAC LIN

SOUR:SWE:FREQ:STEP:LIN 1MHz

TRIG:FSW:SOUR EXT

SOUR:FREQ:MODE SWE (External trigger)
```

"Extern Start/ Stop" — Sets an automaticly repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.

The first external trigger signal starts the sweep (Start).

The next external trigger signal stops the sweep at the current frequency (Stop).

The third external trigger signal starts the sweep at the start frequency (Start).

If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.

The "Reset" button resets the sweep to the start frequency.

Refer to the description of the rear panel for information about the connectors for external trigger signal input.

The external trigger signal is input at the rear of the instrument (BNC connector INST TRIG).

Example:

SOUR:SWE:FREQ:MODE AUTO

TRIG:FSW:SOUR EAUT

SOUR:FREQ:MODE SWE (External trigger)

SCPI command:

[:SOURce<hw>]:SWEep[:FREQuency]:MODE on page 562

:TRIGger<hw>:FSWeep:SOURce on page 596

[:SOURce<hw>]:FREQuency:MODE on page 476

Execute Single Sweep - Frequency Sweep

Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

SCPI command:

[:SOURce<hw>]:SWEep[:FREQuency]:EXECute on page 562

Reset Sweep - Frequency Sweep

Resets the sweep. The start frequency is set and the next sweep starts from there.

SCPI command:

[:SOURce<hw>]:SWEep:RESet[:ALL] on page 569

Start Freq - Frequency Sweep

Sets the start frequency.

SCPI command:

[:SOURce<hw>]:FREQuency:STARt on page 480

Stop Freq - Frequency Sweep

Sets the stop frequency.

SCPI command:

[:SOURce<hw>]:FREQuency:STOP on page 480

Center Freq - Frequency Sweep

Sets the center frequency.

SCPI command:

[:SOURce<hw>]:FREQuency:CENTer on page 474

Span - Frequency Sweep

Sets the span.

SCPI command:

[:SOURce<hw>]:FREQuency:SPAN on page 479

Current Freq - Frequency Sweep

Displays the current frequency.

If "Step" is set, the frequency for the next frequency step of the sweep is entered here.

SCPI command:

[:SOURce<hw>]:FREQuency:MANual on page 476

Spacing - Frequency Sweep

Selects linear or logarithmic sweep spacing.

"Linear"   With the linear sweep, the step width is a fixed frequency value which is
                 added to the current frequency. The step width is entered below.

"Logarithmic"   With the logarithmic sweep, the step width is a constant fraction of the
                 current frequency. This fraction is added to the current frequency. The
                 logarithmic step width is entered below in %.

SCPI command:

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing on page 563

Shape - RF Frequency Sweep
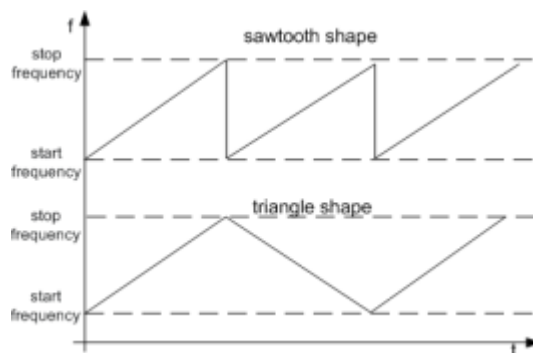
Selects the cycle mode for a sweep sequence (shape).

"Sawtooth"   One sweep runs from start to stop frequency. Each subsequent sweep
                 starts at the start frequency, i.e. the shape of the sweep sequence
                 resembles a sawtooth.

"Triangle"   One sweep runs from start to stop frequency and back, i.e. the shape of
                   the sweep resembles a triangle. Each subsequent sweep starts at the
                   start frequency.

SCPI command:

`[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe` on page 563

Step Lin/Log - Frequency Sweep
Sets the step width for the individual sweep steps. This entry is effective for all sweep
modes.

"Step Lin" or "Step Log" is displayed depending on whether "Spacing Lin" or "Log" is
selected.

"Step Lin"   With the linear sweep, the step width is a fixed frequency value which is
                   added to the current frequency. The linear step width is entered in Hz.

SCPI command:

`[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear]` on page 564

"Step Log"   With the logarithmic sweep, the step width is a constant fraction of the
                   current frequency. This fraction is added to the current frequency. The
                   logarithmic step width is entered in %.

SCPI command:

`[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic` on page 565

Dwell Time - Frequency Sweep
Sets the dwell time. The dwell time determines the duration of the individual sweep steps.

The "Dwell Time" set by the user is used as the step time of the sweep. The effective net
dwell time is shorter, reduced by the setting time. This setting time may be greater than
the time specified in the data sheet.

Note:
It is recommended to switch off the GUI update for optimum sweep performance espe-
cially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 88).

SCPI command:

`[:SOURce<hw>]:SWEep[:FREQuency]:DWELl` on page 561

Trigger Input Slope

Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive"   The rising edge of the trigger signal is active.

"Negative"   The falling edge of the trigger signal is active.

SCPI command:

[:SOURce]:INPut:TRIGger:SLOPe on page 498

5.3.9.3 RF Level Sweep
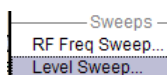
To open the "Level Sweep" menu, select "RF > Configure > Level Sweep" or use the MENU key under "RF".

RF Level Sweep Settings

The "RF Level Sweep" dialog is used to activate and configure a sweep for the RF level.

In the top section, the Level Sweep is activated and the sweep mode is selected. The buttons are used to reset the level sweep (all sweep modes) or to execute the level sweep ("Single" mode).

The sweep range, sweep spacing and dwell time are set in the bottom section.
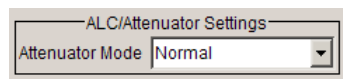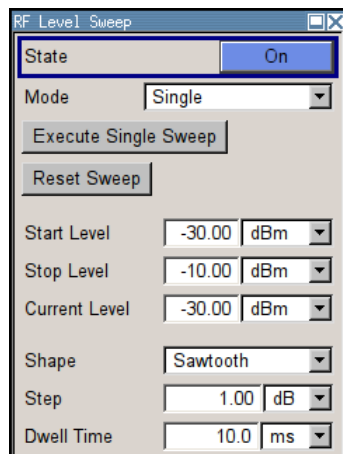
State - Level Sweep

Activates Level Sweep mode.

Note: Activating the RF level sweep mode automatically disables other sweep modes, and the list mode.

SCPI command:

[:SOURce<hw>]:POWer:MODE on page 541

Mode - Level Sweep

Selects the level sweep instrument operating mode and the sweep mode.

"Auto"   Sets an automatically repeated sweep cycle. If a different sweep mode was activated prior to the "Auto" mode, the cycle continues from the current sweep setting.
The "Reset Sweep" button resets the sweep to the start level.

Example:

SOUR:SWE:POW:MODE AUTO

TRIG:PSW:SOUR AUTO

SOUR:POW:MODE SWE

"Single"   Sets a single sweep cycle. The sweep is triggered by the "Execute Single Sweep" button.
If a different sweep mode was activated prior to the "Single" mode, the current sweep is stopped. The single sweep always starts at the start level.
The "Reset Sweep" button resets the sweep to the start level.

Example:

SOUR:SWE:POW:MODE AUTO

TRIG:PSW:SOUR SING

SOUR:POW:MODE SWE

SOUR:SWE:POW:EXEC

"Step"   Sets a step-by-step sweep cycle.
If this mode is activated, the cursor moves to the value displayed for "Current Level". Each sweep step is triggered by a variation of the value in the "Current Level" entry window. The step width is set below at entry field "Step".
If this mode is activated, the cursor moves to the value displayed for "Current Level". If a different sweep mode was activated prior to the "Step" mode, the current sweep is stopped. The step sweep starts at the current level value.
The "Reset Sweep" button resets the sweep to the start level.

Example:

SOUR:SWE:POW:MODE MAN

SOUR:SWE:POW:STEP 0.5

SOUR:POW:MODE SWE

SOUR:POW:MAN -16

The value entered with command SOUR:SWE:POW:STEP sets the step width.

The value entered with command SOUR:POW:MAN has no effect, the command only triggers the next sweep step. However, the value has to be in the currently set sweep range (start to stop). In remote control only a step-by-step sweep from start to stop frequency is possible.

"Extern Single" Sets a single sweep cycle. The sweep is triggered by an external trigger signal.
If a different sweep mode was activated prior to the "Extern Single" mode, the current sweep is stopped. The "Extern Single" sweep always starts at the start level.
Refer to the description of the rear panel for information about the connectors for external trigger signal input (see chapter 2.2, "Rear Panel Tour", on page 21).
The "Reset Sweep" button resets the sweep to the start level.

Example:

SOUR:SWE:POW:MODE AUTO

TRIG:PSW:SOUR EXT

SOUR:POW:MODE SWE (External trigger)

"Extern Step" Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width corresponds to the step width of the rotary knob.
If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the start level.
The "Reset Sweep" button resets the sweep to the start level.

Example:

SOUR:SWE:POW:MODE STEP

SOUR:SWE:POW:STEP 0.5

TRIG:PSW:SOUR EXT

SOUR:POW:MODE SWE (External trigger)

"Extern Start/ Stop"	Sets an automatically repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.
	The first external trigger signal starts the sweep (Start).
	The next external trigger signal stops the sweep at the current frequency (Stop).
	The third external trigger signal starts the sweep at the start frequency (Start).
	If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.
	The "Reset" button resets the sweep to the start level.
	Refer to the description of the rear panel for information about the connectors for external trigger signal input (see chapter 2.2, "Rear Panel Tour", on page 21).

Example:

```
SOUR:SWE:POW:MODE AUTO
TRIG:PSW:SOUR EAUT
SOUR:POW:MODE SWE (External trigger)
```

SCPI command:

[:SOURce<hw>]:SWEep:POWer:MODE on page 566

:TRIGger<hw>:PSWeep:SOURce on page 598.

[:SOURce<hw>]:POWer:MODE on page 541

Reset Sweep - Level Sweep

Resets the sweep. The start level is set and the next sweep starts from there.

SCPI command:

[:SOURce<hw>]:SWEep:RESet[:ALL] on page 569

Execute Single Sweep - Level Sweep

Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

Example:

```
SOUR:SWE:POW:MODE AUTO
TRIG:PSW:SOUR SING
SOUR:POW:MODE SWE
SOUR:SWE:EXEC
```

SCPI command:

[:SOURce<hw>]:SWEep:POWer:EXECute on page 566

Start Level - Level Sweep

Sets the start level.

SCPI command:

[:SOURce<hw>]:POWer:STARt on page 542

Stop Level - Level Sweep

Sets the stop level.

SCPI command:

`[:SOURce<hw>]:POWer:STOP` on page 543

Current Level - Level Sweep

Displays the current level.

If "Step" is set, the level for the next level step of the sweep is entered here.

SCPI command:

`[:SOURce<hw>]:POWer:MANual` on page 540

Shape - RF Level Sweep

Selects the cycle mode for a sweep sequence (shape).

"Sawtooth"   One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

"Triangle"   One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start level again.

SCPI command:

`[:SOURce<hw>]:SWEep:POWer:SHAPe` on page 567

Step - Level Sweep

Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

With the level sweep, the logarithmic step width is a constant fraction of the current level. This fraction is added to the current level. The logarithmic step width is entered in dB.

SCPI command:

`[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic]` on page 568

Dwell Time - Level Sweep

Enters the dwell time and determines the duration of the individual sweep steps.
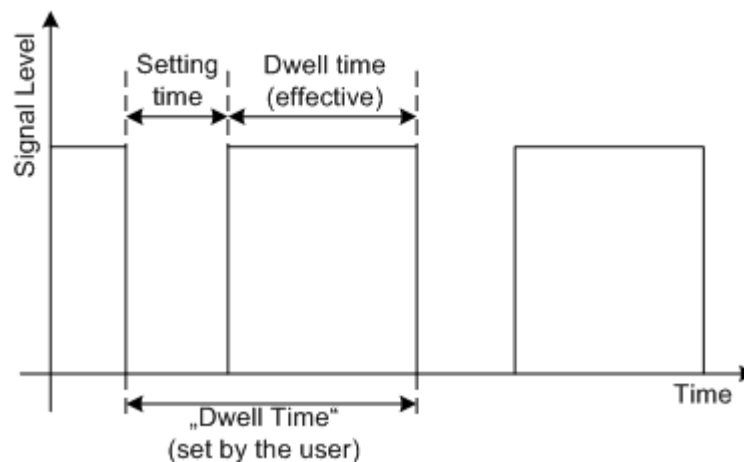
The "Dwell Time" set by the user is used as the step time of the sweep. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

Note:
It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 88).

SCPI command:
[:SOURce<hw>]:SWEep:POWer:DWELl on page 566

Trigger Input Slope
Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive"   The rising edge of the trigger signal is active.

"Negative"   The falling edge of the trigger signal is active.

SCPI command:
[:SOURce]:INPut:TRIGger:SLOPe on page 498

Attenuator Mode - Level Sweep with High Power Option
(High Power Option only)

Sets the ranges of level settings for the level sweep. The sweep is either performed in the low level (electronically switching attenuator) or in the high level (relay-switched high-power-bypass) ranges.

Note: An error message is generated and the best possible level is set if the level setting for the current sweep step is outside the selected range.

"Normal "   The level settings for the level sweep are made in the area of the electronically switching attenuator. The high level ranges are not available.

"High Power "   The level settings for the level sweep are made in the area of the option. Only the high level range is available.

SCPI command:
[:SOURce<hw>]:SWEep:POWer:AMODe on page 565

5.3.10   List Mode

Similar to a sweep, a series of previously defined frequency and level points is processed in List mode. In contrast to a sweep, however, a list with freely selectable value pairs (frequency and level) can be created. The value range for frequency and level covers the entire configurable value range of the instrument.

List mode and sweeps can not be activated simultaneously, they deactivate each other.

The lists can be created in the "List Editor". Each list is stored in its own file with the predefined file extension *.lsw. The name of the list file can be freely selected. The files are loaded from the "Lists..." file manager. Externally created tables with pairs of fre-

quency and level values can be converted into List files using the import function. The external files must have the file extension `*.txt` or `*.csv`. These file formats are provided e.g. by the Microsoft®Excel program. The separators for table columns and for decimal floating-point numerals can be set. In addition, internally created List data can be exported into ASCII files using the export function.

The necessary hardware settings are calculated the first time a list is processed. With long dwell times, this calculation can be performed while the list is being processed; the entered dwell times are observed. With very short dwell times, calculation of the hardware settings increases the dwell time for the initial processing cycle; the entered value is only observed from the second processing cycle onwards. In this case a message appears to inform the user that there is a deviation between the current and set dwell times. No further calculations are required after the first run through a list. The current dwell times will definitely no longer deviate from the set dwell times.

The list is either processed from the beginning to the end of the list (modes "Auto", ("External") "Single", ("External") "Step") or by hopping from one freely selectable list index (frequency/level pair) to the next (modes "Extern Hop", "Extern Hop Direct").

5.3.10.1 List Mode Extern Hop

The Extern Hop control signals (clock, strobe and data) are supplied via the serial FHOP bus on the "AUX I/O" interface at the rear of the instrument.

Data transmission starts with the MSB (most significant bit). A strobe marks the LSB (least significant bit) and thus the end of a valid data sequence (40 bits). The data bits determine the RF path, the Extern Hop mode (direct or not) and the processed list index. The timing of the control signals is illustrated in the following figure.
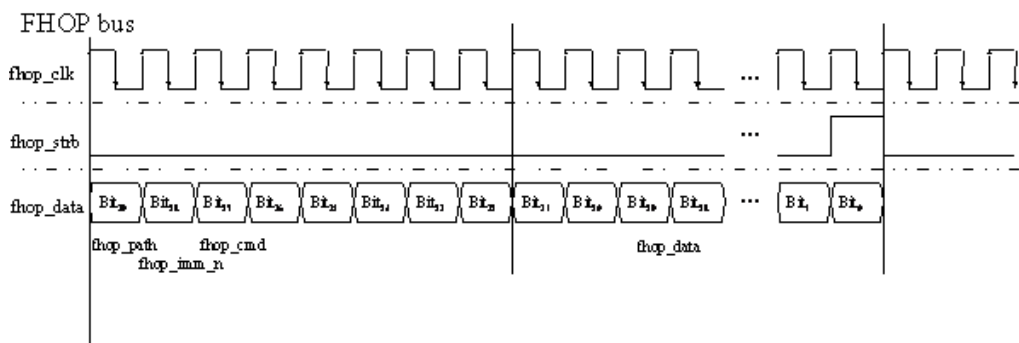
Fig. 5-6: Input control signals for List Modes Fast Hop and Fast Hop Direct on the serial FHOP bus

Table 5-1: Function of data bits of FHOP bus (fhop_data line) and their function for controlling fast frequency hopping

Data bit name (bit number)	Function
path (39)	Bit 39 must be set to 0

imm_n (38)	Selects Fast Hop mode:
	• 0 = Fast Hop Direct
	  the selected settings are performed at once after data transfer of a complete sequence (40 bits) without additional triggering
	• 1 = Fast Hop
	  the selected settings are performed after an instrument trigger

cmd (37 to 32)	Selects function for fast hop mode. Bit 32 must be set to 1 (= List Mode) Bit 37 to 33 must be set to 0 (= reserved for future extensions)
data (31 to 0)	Data bits Determine the list index (frequency/level setting) to be processed for List Mode

Example:

The bit sequence 0100-0010-0000-0000-0000-0000-0000-0000-0000-1010 on data line "fhop_data" selects the list index 10 of the currently loaded list on Path A. The frequency and level setting associated with this index are performed after the next instrument trigger.

Preconditions:

List Mode "Extern Hop" is selected in the "List" menu and a list with at least 10 entries is loaded.

An external trigger is provided at the INST TRIG connector.

5.3.10.2 List Mode Dialog
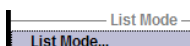
List Mode –
List Mode...

To open the "List Mode" menu, select "RF > Configure > List Mode" or use the MENU key under "RF".

The menu is used to activate/deactivate the operating mode List, to create, select and activate the lists, and to select the trigger mode and the dwell time.
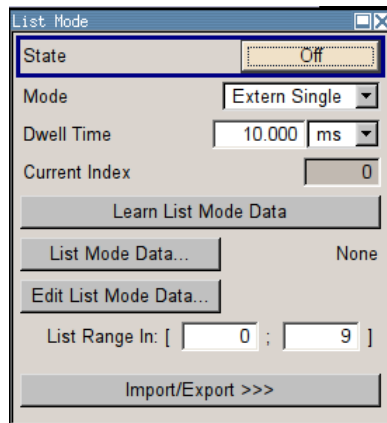
General Settings

State - List Mode
Activates/deactivates the List mode. The currently selected list is processed.

In case of a new or modified list, the necessary hardware settings are automatically determined on activation of the list mode. The data determined in this way is stored along with the list and is available whenever the list is used again.

This means that when activating the list mode, the system checks whether any hardware settings are present. If so, the list is started immediately, but if not they are automatically determined (the list is learnt).

A "Learn List Mode Data" button is available for deliberately activating list learning.

Note: Activating the list mode automatically deactivates all sweeps. During list mode the frequency and level indications do not display the currently set values.

SCPI command:

[:SOURce<hw>]:FREQuency:MODE on page 476

Attenuator Mode – List Mode with High Power Option
(High Power Option only)

Sets the ranges of level settings for the level sweep. The sweep is either performed in the low level (electronically switching attenuator) or in the high level (relay-switched high-power-bypass) ranges.

Note: An error message is generated and the best possible level is set if the level setting for the current sweep step is outside the selected range.

"Normal "   The level settings for the level sweep are made in the area of the electronically switching attenuator. The high level ranges are not available.

"High Power "   The level settings for the level sweep are made in the area of the option. Only the high level range is available.

SCPI command:

[:SOURce<hw>]:LIST:POWer:AMODe on page 519

Mode - List Mode
Selects the cycle mode of the List mode.

"Auto"   Cycle from the beginning to the end of the list with automatic restart at the beginning. If a different mode was activated prior to the Auto mode, the cycle continues from the beginning of the list. The duration of a list step is determined by the set dwell time.
Button "Reset" restarts the list at the starting point.

"Single"   Single cycle from the beginning to the end of the list. If "Single" is selected, the cycle is not started immediately. The "Execute Single" button appears under the "Mode" line. The cycle is started with this button. The duration of a list step is determined by the set dwell time.
Button "Reset" restarts the list at the starting point.

"Step"   Manual, step-by-step processing of the list. Activating "Step" stops the current list and the cursor moves to the value displayed for "Current Index". It is now possible to scroll up and down in the list in discrete steps by varying the index. The duration of a list step is determined by the time between two index entries.
Button "Reset" restarts the list at the starting point.

"Extern Single" Single cycle from the beginning to the end of the list as with "Single", but started by an external trigger.
The external trigger signal is input at the BNC connector INST TRIG.
Button "Reset" restarts the list at the starting point.

"Extern Step"   Step-by-step cycle using the external trigger signal. Each trigger event starts a single step. The duration of a list step is determined by the time between two trigger events.
The external trigger signal is input at the BNC connector INST TRIG.
Button "Reset" restarts the list at the starting point.

"Extern Hop"   Index-by-index cycle.
The processed list index is determined by the external control signals provided via the serial FHOP bus on the AUX I/O interface at the rear of the instrument (see chapter 5.3.10.1, "List Mode Extern Hop", on page 196).
The external trigger signal is used. Each trigger event starts the processing of the frequency and level settings associated with selected index (trigger source as described under "Extern Single"). The duration of a list step is determined by the time between two trigger events. Note that the fhop_imm_n bit has to be disabled on the fhop_data line (=1).

"Extern Hop   Index-by-index cycle. The processed list index is determined by the
Direct"   external control signals provided via the serial FHOP bus.
Processing of the frequency and level settings associated with selected index is automatically started at the end of data transmission. Note that the fhop_imm_n bit has to be enabled on the fhop_data line (= 0).

SCPI command:

[:SOURce<hw>]:LIST:MODE on page 519

[:SOURce<hw>]:LIST:TRIGger:SOURce on page 521

Execute Single - List Mode

Triggers the list manually. This button is available only if mode "Single" is selected.

SCPI command:

[:SOURce<hw>]:LIST:TRIGger:EXECute on page 521

Reset - List Mode

Resets the list to the starting point.

SCPI command:

[:SOURce<hw>]:LIST:RESet on page 520

Dwell Time - List Mode

Enters the dwell time. The dwell time determines the duration of a list step in list operating modes "Auto", "Single" and "Extern Single". In these modes a complete list is processed either once or continuously.

In list operating modes "Step" and "Extern Step", the set dwell time does not affect signal generation. In this case, the duration of a list step is determined by the time between two (internal or external) trigger events.
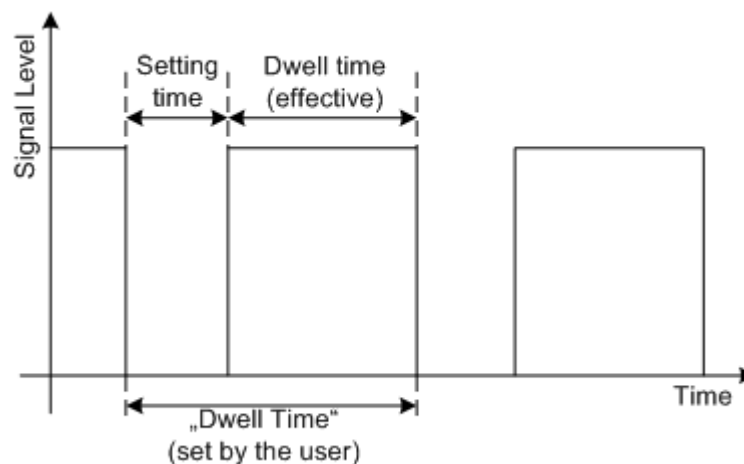
The "Dwell Time" set by the user is used as the step time of the list mode. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

SCPI command:

[:SOURce<hw>]:LIST:DWEL1 on page 516

Current Index - List Mode

Sets the list index in "Step" mode.

SCPI command:

[:SOURce<hw>]:LIST:INDex on page 517

Learn List Mode Data... - List Mode

Starts the determination of the hardware setting for the selected list. The data determined in this way is stored along with the list.

It may be necessary to deliberately activate list learning in the event of greatly altered environmental conditions that require new hardware settings.

If this is not done, a previously learned hardware setting will continue to be used when list mode is switched on ("State = On"). If no setting is available, e.g. when the list is used for the first time, learning is automatically activated.

SCPI command:

[:SOURce<hw>]:LIST:LEARn on page 518

List Mode Data... - List Mode

Calls the "File Select" menu for selecting and creating a list or the "File Manager".

SCPI command:

[:SOURce<hw>]:LIST:SELect on page 520

[:SOURce<hw>]:LIST:DELete on page 511

[:SOURce<hw>]:LIST:DELete:ALL on page 511

Edit List Mode Data... - List Mode

Calls the editor for editing the selected list. A list consists of any number of frequency/level value pairs. The currently selected list is displayed.

"Frequency / Hz"   Enter the frequency of the frequency/power value pair.

SCPI command:

[:SOURce<hw>]:LIST:FREQuency on page 516

"Power /dBm"   Enter the level of the frequency/power value pair.

SCPI command:

[:SOURce<hw>]:LIST:POWer on page 519

"Goto"   Selects row for editing.

If "Goto row" is selected, a window opens for entering the requested row.
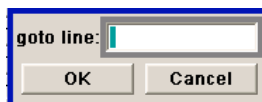
"Edit"   Calls a selection of possible actions described below.
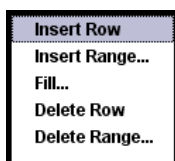
"Insert Row"   Inserts a new row before the marked row.

"Insert Range"   Inserts new rows before the marked row. The number of rows to be inserted can be defined in an entry window.
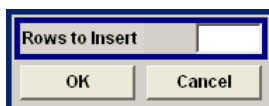
"Fill...."   Opens a sub menu for defining a set of list values to be automatically entered in the List Mode table (see chapter 5.3.10.3, "Filling the List Mode Data automatically", on page 204).

"Delete Row"   Deletes the marked row.

"Delete Range..."   Allows to delete any number of rows starting with the marked row. The number of rows to be deleted can be defined in an entry window.
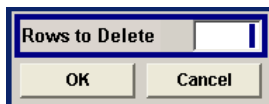
"Save as"   Open the file menu to save the list under a new name.
Each list is saved to the R&S Signal Generator CompactFlash™ Card as a separate file with the file prefix `* .lsw`. The file name and the directory to which the file is saved are user-selectable.

"Save"   The list is saved under its current name.

List Range In - List Mode
Defines an index range in the current list by setting the start and stop index. Only the values in the selected index range are processed in List mode, all other list entries are ignored.

SCPI command:

[:SOURce<hw>]:LIST:INDex:STARt on page 517

[:SOURce<hw>]:LIST:INDex:STOP on page 518

Trigger Input Slope

Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive"   The rising edge of the trigger signal is active.

"Negative"   The falling edge of the trigger signal is active.

SCPI command:

[:SOURce]:INPut:TRIGger:SLOPe on page 498

Import/Export

Lists can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the "Import/Export" button.

Import/Export - List Mode

Expands the menu with the area for import and export of list mode files.
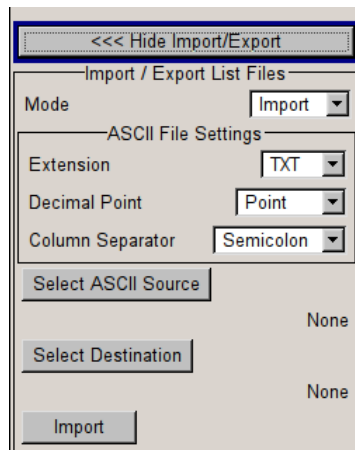
Externally edited Excel tables with frequency/level pairs can be imported as text or CSV-files and used for list mode.

On the other hand, internally created list mode lists can be exported as text or CSV-files.

Mode - List Mode

Selects if list mode lists should be imported or exported. The settings offered below depend on the selected mode.

SCPI command:

[:SOURce<hw>]:LIST:DEXChange:MODE on page 515

Extension - List Mode

Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

SCPI command:

[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension on page 512

Decimal Point - List Mode

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

SCPI command:

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal` on page 514

Column Separator- List Mode

Selects the separator between the frequency and level column of the ASCII table.

SCPI command:

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn` on page 513

Select ASCII Source / Destination - List Mode

Calls the "File Manager" for selecting the ASCII file to be imported into a list mode list (source) or the ASCII file the list mode list is exported (destination) in.

SCPI command:

`[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect` on page 513

Select Destination / Source - List Mode

Calls the "File Manager" for selecting the list mode list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

SCPI command:

`[:SOURce<hw>]:LIST:DEXChange:SELect` on page 515

Import / Export - List Mode

Starts the export or import of the selected file.

When import is selected, the ASCII file is imported as list mode list.

When export is selected, the list mode list is exported into the selected ASCII file.

SCPI command:

`[:SOURce<hw>]:LIST:DEXChange:EXECute` on page 514

5.3.10.3 Filling the List Mode Data automatically

The "Fill List Mode Data" menu enables you to automatically set the values in the List Mode table.
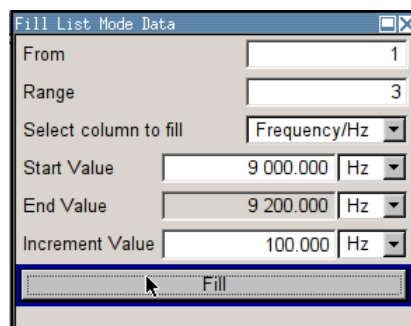
The start line and the number of rows to be filled are defined under "From" and "Range".

The column to be filled is selected under "Select column to fill". Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters.

The filling of the column with the selected value settings is started with button "Fill".

The list entries are only computed when the "Fill" button is pressed.

From
Sets the start value of the index range.

SCPI command:
n.a.

Range
Sets the range for filling the table.

SCPI command:
n.a.

Select column to fill
Selects either the frequency or the level column to be filled with the value defined below.

SCPI command:
n.a.

Start value
Sets the start value for the frequency or the level entries.

SCPI command:
n.a.

End value
Sets the end value for the frequency or the level entries.

SCPI command:
n.a.

Increment value
Sets the increment for the frequency or the level entries.

SCPI command:
n.a.

Fill
Fills the selected column in the set range with values, starting with the start value and using the set increment.

SCPI command:
n.a.

5.4 Modulations

5.4.1 Overview

The R&S SMA provides amplitude modulation (AM), frequency modulation (analog and digital), phase modulation (analog and digital), pulse modulation and chirp modulation. In addition, the RF signal can be modulated with a wide variety of internal modulations waveforms, e.g. sine waves, triangle/rectangular/trapeze signals, and noise. Test signals for avionic systems can be generated VOR (VHF Omnidirectional Range), ILS-GS (Instrument Landing System - Glide Slope), ILS-LOC (Instrument Landing System - Localizer) and Marker Beacon).

Analog amplitude and pulse modulation are available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) without additional equipment options. A standard LF generator and a pulse generator are provided for internal modulation.

Frequency modulation (FM) and phase modulation (PhiM) require option R&S SMA-B20 (FM/PhiM Modulator) or R&S SMA-B22 (Enhanced Phase Noise Performance andFM/PhiM Modulator). Chirp modulation is available with one of these options and an interface board with part number 1400.0530.02.

Option Multifunction Generator, R&S SMA-K24, provides a second LF Generator and a Noise generator. The LF Generator can be used as a second modulation source with extended frequency range and selectable signal shapes. The noise source provides white noise with selectable bandwidth and level distribution as additional modulation source.

Extended pulse modulation features are provided by option R&S SMA-K23, Pulse Generator. Option R&S SMA-K27, Pulse Train, enables generation of pulse trains.

The test signals for avionic systems are available with option R&S SMA-K25, VOR/ILS modulation. DME modulation requires option R&S SMA-K26.

Settings for the modulation are made in separate modulation menus. These menus can be accessed in the block diagram by way of the "Modulation" function block, or by means of the menu with the same name which is opened using the MENU key.

5.4.1.1 Enabling/Disabling Analog Modulations using the MOD On/Off Key

The MOD ON/OFF key switches the modulations on and off.

MOD ON/OFF
Press the MOD ON/OFF key to enable/disable analog modulations.

Pressing the key again restores the status that was active before the last switch-off. "MOD OFF" is displayed in the info line of the header next to the "Level" field.

SCPI command:
[:SOURce<hw>]:MODulation[:ALL]:STATe on page 528

5.4.1.2 Modulation Sources

The following modulations use internal and external modulation sources:

● Amplitude modulation
● Pulse modulation
● Frequency modulation
● Phase modulation
● VOR/ILS modulation

Marker Beacon modulation only uses the internal modulation sources. For external digital FM and PhiM only external modulation sources can be used.

Internal Modulation Sources

Two LF generators, a noise generator and a pulse generator are available as internal modulation sources for a fully equipped instrument.

The first LF generator supplies sinusoidal signals. The second LF generator supplies signals with selectable shapes. The frequency range is extended. The pulse generator provides single and double pulse modulation with selectable pulse widths and periods or a user-definable pulse train. The LF generator is also used for the generation of the VOR/ILS signals.

The noise generator supplies white noise with selectable bandwidth and level distribution.

See also chapter 5.5.1, "LF Generator Overview", on page 281.

External Modulation Sources

The modulation inputs AM EXT, FM/PM EXT and PULSE EXT at the rear of the instrument are provided as the external modulation source for amplitude, pulse, frequency and phase modulation. The external signal for digital FM/PM modulation is fed in via the AUX I/O interface. The AM EXT connector can be used to feed in external VOR/ILS signal in addition.

The external modulation signal at the input must have a voltage of $U_S = 1$ V ($U_{EFF} = 0.707$ V) in order to achieve the displayed modulation depth and range. The input voltage should not exceed 1.1 Vs, otherwise modulation distortions might occur. With external pulse modulation, the switching point is max. 2.4 V and the voltage at the input should not exceed 5 V. The maximum modulation frequency is 10 MHz for frequency and phase modulation.

Simultaneous Operation of Several Modulations or Other Operating Modes

The table shows the modulations and operating modes which can be activated simultaneously (+) or which deactivate each other (-).

	AM	FM	dig FM	PhiM	dig PhiM	Pulse	VOR	ILS	MB	ADF	DME
Amplitude modulation (AM)	/	+	+	+	+	-	-	-	-	-	-
Frequency modulation (FM)	+	/	-	-	-	+	+	+	+	+	+

	AM	FM	dig FM	PhiM	dig PhiM	Pulse	VOR	ILS	MB	ADF	DME
Digital Frequency modulation (FM)	+	-	/	-	+	+	+	+	+	+	+
Phase modulation (PhiM)	+	-	-	/	+	+	+	+	+	+	+
Digital Phase modulation (PhiM)	+	-	-	-	/	-	-	-	-	-	-
Pulse modulation	-	+	+	+	+	/	-	-	-	-	-
VOR modulation	-	+	+	-	+	-	/	-	-	-	-
ILS modulation	-	+	+	-	+	-	-	/	-	-	-
Marker Beacon modulation (MB)	-	+	+	-	+	-	-	-	/	-	-
ADF modulation	-	+	+	-	+	-	-	-	-	/	-
DME modulation	-	+	+	-	+	-	-	-	-	-	/

5.4.2 Amplitude Modulation (AM)

An internal and/or external source can be selected for amplitude modulation. Two LF modulation generators and a noise generator are available as the internal source for a fully equipped instrument. Two-tone AM is possible by simultaneously switching on the external and internal or both internal sources.

The AM EXT input connector for external feed of analog modulation signals is at the front of the instrument. The coupling mode of the input (AC or DC) can be selected.

The AM modulation depth is limited by the maximum peak envelope power (PEP).

5.4.2.1 Amplitude Modulation Menu
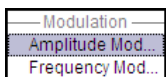
To open the "Amplitude Modulation" menu, select "Modulation > Configure > Amplitude Modulation" or use the MENU key under "Modulation".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The modulation source can be selected independently for the different modulation types and the LF output.

The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu or in the "LF Output" menu (internal source only).

These settings affect all modulations which use the same modulation source.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.
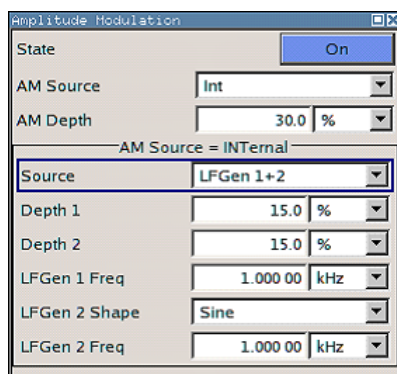
If an avionic modulation (VOR/ILS) is activated this modulation is deactivated and an error message indicated in the info line.

State

Activates/deactivates AM modulation.

SCPI command:

[:SOURce<hw>]:AM:STATe on page 435

AM Source

Selects the source for the AM signal.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.

"Internal"   Selects the internal LF generator as the source for AM modulation.

"External"   Selects the external source.
                 The external signal is input via the AM EXT connector.

"Intern +   Selects the internal and external source at the same time. This setting
Extern"   enables two-tone AM modulation.

SCPI command:

[:SOURce<hw>]:AM:SOURce on page 435

AM Depth

Sets the modulation depth in percent.

Note: With two-tone modulation, observe that the set modulation depth is valid for both signals and the sum modulation depth is determined by doubling the set modulation depth. This results in overmodulation if the maximal value for modulation depth is exceeded (see data sheet).

SCPI command:

[:SOURce<hw>]:AM[:DEPTh] on page 433

Internal Source

Source Internal only

Selects which internal modulation source is used. The available selection depends on the options fitted.

"None"   Switches off all internal modulation sources.

"LFGen1 /   Selects one of the internal LF generators as the source for AM modula-
LFGen2"   tion.

"LFGen1+2"   Selects both internal LF generators as the source for AM modulation. LF
                frequency and modulation depth can be set separately. The added mod-
                ulation depths of the two modulation generators must not exceed the
                overall modulation depth.
                This selection enables two-tone AM modulation.

"Noise"   Selects noise signal. The modulation signal is white noise either with
                Gaussian distribution or equal distribution.
                This setting affects all analog modulations which use the noise generator
                as the internal modulation source.
                See also chapter 5.5.3.2, "Noise Settings", on page 290.

"LFGen1+Nois   Selects one LF generator as the source for AM modulation and the noise
e /   signal. In addition to the AM modulation signal, white noise is used as
LFGen2+Noise   modulation signal.
"

SCPI command:
[:SOURce<hw>]:AM:INTernal:SOURce on page 434

Depth 1/Depth 2
Source Internal, LFGen1+2 only

Selects the modulation depth for the two LF generators. The sum of the two values must
not exceed the overall modulation depth set in the upper part of the menu.

SCPI command:
[:SOURce<hw>]:AM:INTernal<ch>:DEPTh on page 434

LF Gen 1/2 Freq
Source Internal, LFGen1+2 only

Sets the frequency of the two LF generators.

SCPI command:
[:SOURce]:LFOutput<ch>:FREQuency on page 499

LF Gen 2 Shape
Source Internal, LFGen2 only

Selects the shape of the second LF generator signal. In case of selection Trapeze, addi-
tional settings concerning the duration of the single trapeze elements can be made (see
chapter 5.5.3.1, "LF Output Menu", on page 288).

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe on page 507

AM Sensitivity
(Source External only)

Displays the input sensitivity of the AM EXT input in %/V.

The modulation depth entered under "AM Depth" is reached with 1 volt modulation of the input.

SCPI command:

`[:SOURce<hw>]:AM:SENSitivity` on page 435

AM External Coupling
(Source External only)

Selects the coupling mode (AC or DC) for external feed.

Note: Coupling for external feed via input EXT MOD can be set independently for all modulations with external source.

SCPI command:

`[:SOURce<hw>]:AM:EXTernal:COUPling` on page 433

5.4.2.2 Noise Settings

In case of internal modulation source, the settings for the noise source are offered in the "Noise" section. This setting affects all analog modulations which use the noise generator as the internal modulation source. The settings are described in chapter 5.5.3.2, "Noise Settings", on page 290.

5.4.3 Frequency Modulation (FM)

Frequency modulation requires option R&S SMA-B20 (FM/PhiM Modulator) or option R&S SMA-B22 (Enhanced Noise Performance and FM/PhiM Modulator).

An internal and/or external source can be selected for frequency modulation. Two LF modulation generators and a noise generator are available as internal sources for a fully equipped instrument. Two-tone FM is possible by simultaneously switching on the external and internal source.

The FM/PM EXT input connector for external feed of analog modulation signals is at the front of the instrument. The coupling mode of the input (AC or DC) and the input impedance (50 Ohm or high) can be selected.

The digital FM signal is fed in via the AUX I/O interface.

Selection between Low Noise mode (with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation, see data sheet) and standard mode is possible (option R&S SMA-B22 only).

It is not possible to use analog frequency modulation simultaneously with digital frequency modulation or with analog or digital phase modulation.

5.4.3.1 Frequency Modulation Settings
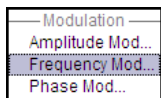
To open the "Frequency Modulation" menu, select "Modulation > Configure > Frequency Modulation" or use the MENU key under "Modulation".

In the upper section of the menu, the modulation source is selected and the modulation is switched on. The modulation source can be selected independently for the different modulation types and the LF output.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.
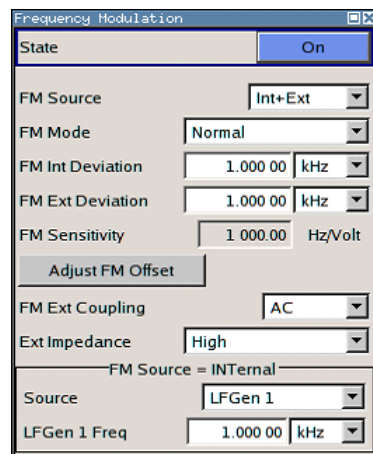
State

Activates/deactivates FM modulation.

Activation of FM deactivates phase modulation.

SCPI command:

`[:SOURce<hw>]:FM:STATe` on page 473

FM Source

Selects the source for the FM signal.

"Internal"   Selects the internal LF generator as the source for FM modulation.

"External"   Selects the external source.
                    The external signal is input via the FM/PM EXT connector.

"Internal +   Selects the internal and external source at the same time.
External"   This setting enables two-tone FM modulation.

"Ext digital"   Selects the external source. The external digital signal is input via the AUX I/O connector.
This mode is provided for fast frequency hopping. The FM-Data bus is directly connected to the DDS of the synthesizer module. Thus, very fast frequency hopping (settling times of <=10 us) is possible for frequency bandwidth up to 40/80 MHz, depending on the RF frequency. The accuracy of the set frequency deviation is limited to 50ppm.
The binary format of the external digital data can be selected (see "Binary Format " on page 215).

SCPI command:
[:SOURce<hw>]:FM:SOURce on page 473

FM Mode

Selects the mode for the frequency modulation.

"Normal"   The maximum range for modulation bandwidth and FM deviation is available.

"Low Noise"   (requires option R&S Signal Generator-B22)
Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

SCPI command:
[:SOURce<hw>]:FM:MODE on page 472

FM Deviation

Sets the modulation deviation in Hz.

The deviation is given as the absolute deviation in relation to the set center frequency, e.g. a deviation 5 MHz at a center frequency of 1 GHz leads to a frequency modulation between 995 MHz and 1005 MHz.

The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

The deviation of the internal source must not exceed the deviation of the external source in case of modulation source "Int+Ext".

SCPI command:
[:SOURce<hw>]:FM[:DEViation] on page 470

Internal Source

Source Internal only

Selects which internal modulation source is used. The available selection depends on the options fitted.

"None"   Switches off all internal modulation sources.

"LFGen1 / LFGen2"   Selects one of the internal LF generators as the source for FM modulation.

"LFGen1+2"   Selects both internal LF generators as the source for FM modulation. LF frequency and modulation depth can be set separately. The added modulation depths of the two modulation generators must not exceed the overall modulation depth.
This selection enables two-tone FM modulation.

"Noise"   Selects noise signal. The modulation signal is white noise either with Gaussian distribution or equal distribution.
This setting affects all analog modulations which use the noise generator as the internal modulation source.
See also chapter 5.5.3.2, "Noise Settings", on page 290.

"LFGen1+Noise / LFGen2+Noise"   Selects one LF generator as the source for FM modulation and the noise signal. In addition to the FM modulation signal, white noise is used as modulation signal.

SCPI command:
[:SOURce<hw>]:FM:INTernal:SOURce on page 472

Deviation 1/Deviation 2
Source Internal, LFGen1+2 only

Selects the deviation for the two frequency modulation signals. The sum of the two values must not exceed the overall modulation deviation set in the upper part of the menu.

SCPI command:
[:SOURce<hw>]:FM:INTernal<ch>:DEViation on page 471

LF Gen 1/2 Freq
Source Internal, LFGen1+2 only

Sets the frequency of the two LF generators.

SCPI command:
[:SOURce]:LFOutput<ch>:FREQuency on page 499

LF Gen 2 Shape
Source Internal, LFGen2 only

Selects the shape of the second LF generator signal. In case of selection Trapeze, additional settings concerning the duration of the single trapeze elements can be made (see chapter 5.5.3.1, "LF Output Menu", on page 288).

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe on page 507

FM Sensitivity
(Source External only)

Displays the input sensitivity of the FM/PM EXT input in Hz/V.

The modulation depth entered under "FM Depth" is reached with 1 Volt (= U_{peak}) of the input signal.

Note: The input voltage should not exceed 1.1 V$_p$ otherwise modulation distortions might occur.

SCPI command:

`[:SOURce<hw>]:FM:SENSitivity` on page 472

Adjust FM Offset
Starts the adjustment for the FM/PhiM modulator. The option is adjusted with respect to DC-offset.

SCPI command:

`:CALibration<hw>:FMOFfset[:MEASure]` on page 352

FM External Coupling
(Source External only)

Selects the coupling mode (AC or DC) for external feed.

Note: Coupling for external feed via input EXT MOD can be set independently for all modulations with external source.

"AC"   The d.c. voltage content is separated from the modulation signal.

"DC"   The modulation signal is not altered.

SCPI command:

`[:SOURce<hw>]:FM:EXTernal:COUPling` on page 470

External Input Impendance
(Source External only)

Selects the impedance for external feed via the FM/PM EXT input.

Selection 50 Ohm and high (>100 kOhm) is available.

Note: This setting affects all analog modulations which use the external modulation source.

SCPI command:

`[:SOURce<hw>]:INPut:MODext:IMPedance` on page 497

Binary Format
Source External only

Selects the binary format for external digital frequency modulation (see table 5-2). The data is input via the AUX I/O interface.

NOTICE! Risk of instrument damage!. The maximum possible input voltage is 3.3 V dc.

Table 5-2: Binary data formats

Scale	Example for set frequency deviation = 10 MHz	Offset Binary	Two's Complement
+ full scale	10 MHz	1111….1111	0111….1111
+0.75 full scale	7.5 MHz	1110….0000	0110….0000
+0.5 full scale	5 MHz	1100….0000	0100….0000
+0.25 full scale	2.5 MHz	1010….0000	0010….0000
0	0 MHz	1000….0000	0000….0000

Scale	Example for set frequency deviation = 10 MHz	Offset Binary	Two's Complement
-0.25 full scale	-2.5 MHz	0110….0000	1110….0000
-0.5 full scale	- 5 MHz	0100….0000	1100….0000
- 0.75full scale	-7.5 MHz	0010….0000	1010….0000
- full scale + 1LSB	- 9.999695 MHz	0000….0001	1000….0001
- full scale	- 10 MHz	0000….0000	1000….0000

Table 5-3: Pin connection for input of digital FM data via AUX I/O connector

Connection	Parallel data input with 16-bit word width for digital FM modulation data.
11 - FM_DAT	FM_DATA 15 (MSB)
12 - FM_DAT	FM_DATA 14
13 - FM_DAT	FM_DATA 13
14 - FM_DAT	FM_DATA 12
15 - FM_DAT	FM_DATA 11
16 - FM_DAT	FM_DATA 10
17 - FM_DAT	FM_DATA 9
18 - FM_DAT	FM_DATA 8
19 - FM_DAT	FM_DATA 7
20 - FM_DAT	FM_DATA 6
21 - FM_DAT	FM_DATA 5
22 - FM_DAT	FM_DATA 4
23 - FM_DAT	FM_DATA 3
24 - FM_DAT	FM_DATA 2
25 - FM_DAT	FM_DATA 1
26 - FM_DAT	FM_DATA 0 (LSB)

"Offset Binary"   Offset Binary code is selected. This code represents analog values between full scale and minus full scale.

"Two's Comple-Two's Complement code is selected.
ment"

SCPI command:
[:SOURce<hw>]:FM:EXTernal:DIGital:BFORmat on page 471

5.4.3.2   Noise Settings

In case of internal modulation source, the settings for the noise source are offered in the "Noise" section. This setting affects all analog modulations which use the noise generator

as the internal modulation source. The settings are described in

5.4.4 Phase Modulation (PhiM)

Phase modulation requires option R&S SMA-B20 (FM/PhiM Modulator) or option R&S SMA-B22 (Enhanced Noise Performance and FM/PhiM Modulator).

It is not possible to use analog phase modulation simultaneously with digital phase modulation or with analog or digital frequency modulation.

An internal and/or external source can be selected for phase modulation. Two LF modulation generators and a noise source are available as internal sources for a fully equipped instrument.

The FM/PM EXT input connector for external feed of analog modulation signals is at the front of the instrument. The coupling mode of the input (AC or DC) and the input impedance (50 Ohm or high) can be selected.

The digital PM signal is fed in via the AUX I/O interface.

Selection between the following modulation modes is possible:

- "High Bandwidth" mode with full setting range for modulation bandwidth and limited PhiM deviation.

- "Low Noise" mode with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation (see data sheet)

- "High Deviation" mode with full setting range for PhiM deviation and a reduced setting range for modulation bandwidth. Phase noise is reduced in the lower modulation frequency range compared to the default mode.

5.4.4.1 Phase Modulation Menu
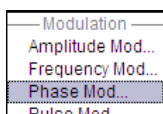
To open the "Phase Modulation" menu, select "Modulation > Configure > Phase Modulation" or use the MENU key under "Modulation".
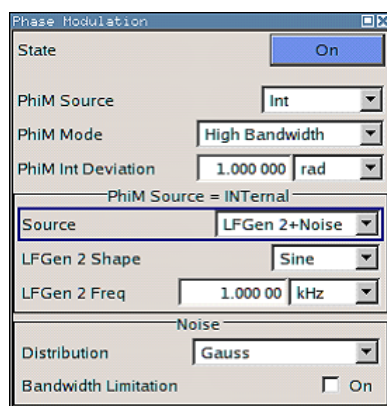
In the upper section of the menu, the modulation source is selected and the modulation switched on. The modulation source can be selected independently for the different modulation types and the LF output.

The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu (internal source only).

These settings affect all modulations which use the same modulation sources.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.

State
Activates/deactivates PhiM modulation.

Activation of PhiM deactivates frequency modulation.

SCPI command:
`[:SOURce<hw>]:PM:STATe` on page 536

PhiM Source
Selects the source for the PhiM signal.

For a fully equipped instrument two LF generators and a noise generator are available as internal sources.

"Internal"	Selects the internal LF generator as the source for PhiM modulation.
"External"	Selects the external source. The external signal is input via the FM/PM EXT connector.
"Internal + External"	Selects the internal and external source at the same time.
"Ext digital"	Selects the external source. The external digital signal is input via the AUX I/O connector.

SCPI command:
`[:SOURce<hw>]:PM:SOURce` on page 535

PhiM Mode
Selects the mode for the phase modulation.

"High Band-width"	The maximum range for modulation bandwidth is available. However, phase noise is increased for low frequencies. The range for PhiM deviation is limited. This mode is recommended for high modulation frequencies.
"High Deviation"	The maximum range for PhiM deviation is available. Phase noise is improved for low frequencies compared to the default mode. The range for modulation frequency is limited (see data sheet). This mode is recommended for low modulation frequencies and/or high PhiM deviation.

"Low Noise"   (with option R&S SMA-B22 only)
Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PM deviation is limited (see data sheet).
This mode is useful for generating a tailed CW signal.

SCPI command:
[:SOURce<hw>]:PM:MODE on page 534

PhiM Deviation
Sets the modulation depth in RAD or degrees.

The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

SCPI command:
[:SOURce<hw>]:PM[:DEViation] on page 532

Internal Source
Source Internal only

Selects which internal modulation source is used. The available selection depends on the options fitted.

"None"   Switches off all internal modulation sources.

"LFGen1 /   Selects one of the internal LF generators as the source for phase mod-
LFGen2"   ulation.

"LFGen1+2"   Selects both internal LF generators as the source for phase modulation.
                LF frequency and modulation depth can be set separately. The added
                modulation depths of the two modulation generators must not exceed the
                overall modulation depth.

"Noise"   Selects noise signal. The modulation signal is white noise either with
                Gaussian distribution or equal distribution.
                This setting affects all analog modulations which use the noise generator
                as the internal modulation source.
                See also chapter 5.5.3.2, "Noise Settings", on page 290.

"LFGen1+Nois   Selects one LF generator as the source for phase modulation and the
e /   noise signal. In addition to the phase modulation signal, white noise is
LFGen2+Noise   used as modulation signal.
"

SCPI command:
[:SOURce<hw>]:PM:INTernal:SOURce on page 534

Deviation 1/Deviation 2
Source Internal, LFGen1+2 only

Selects the deviation for the two frequency modulation signals. The sum of the two values must not exceed the overall modulation deviation set in the upper part of the menu.

SCPI command:
[:SOURce<hw>]:PM:INTernal<ch>:DEViation on page 534

LF Gen 1/2 Freq

Source Internal, LFGen1+2 only

Sets the frequency of the two LF generators.

SCPI command:

[:SOURce]:LFOutput<ch>:FREQuency on page 499

LF Gen 2 Shape

Source Internal, LFGen2 only

Selects the shape of the second LF generator signal. In case of selection Trapeze, additional settings concerning the duration of the single trapeze elements can be made (see chapter 5.5.3.1, "LF Output Menu", on page 288).

SCPI command:

[:SOURce]:LFOutput<ch>:SHAPe on page 507

PhiM Sensitivity

(Source External only)

Displays the input sensitivity of the FM/PM EXT input in RAD/V.

The modulation depth entered under "PhiM Depth" is reached with 1 volt (=U_{peak}) of the input signal.

Note: The input voltage should not exceed 1.1 V_p otherwise modulation distortions might occur.

SCPI command:

[:SOURce<hw>]:PM:SENSitivity on page 535

Mod External Coupling

Selects the coupling mode (AC OR DC) for external feed.

Note: Coupling for external feed via input EXT MOD can be set independently for all modulations with external source.

"AC"   The DC voltage content is separated from the modulation signal.

"DC"   The modulation signal is not altered.

SCPI command:

[:SOURce<hw>]:PM:EXTernal:COUPling on page 532

External Input Impendance

(Source External only)

Selects the impedance for external feed via the FM/PM EXT input.

Selection 50 Ohm and high (>100 kOhm) is available.

Note: This setting affects all analog modulations which use the external modulation source.

SCPI command:

[:SOURce<hw>]:INPut:MODext:IMPedance on page 497

Ext PhiM Binary Format

Source External only

Selects the binary format for external digital frequency modulation (see table 5-4). The data is input via the AUX I/O interface.

NOTICE! Risk of instrument damage!. The maximum possible input voltage is 3.3 V dc.

Table 5-4: Binary data formats

Scale	Example for set phase devia-tion = 120 DEG	Offset Binary	Two's Complement
+ full scale	120 DEG	1111….1111	0111….1111
+0.75 full scale	90 DEG	1110….0000	0110….0000
+0.5 full scale	60 DEG	1100….0000	0100….0000
+0.25 full scale	30 DEG	1010….0000	0010….0000
+ 0	0 DEG	1000….0000	0000….0000
-0.25 full scale	-30 DEG	0110….0000	1110….0000
-0.5 full scale	- 60 DEG	0100….0000	1100….0000
- 0.75full scale	- 90 DEG	0010….0000	1010….0000
- full scale + 1LSB		0000….0001	1000….0001
- full scale	- 120 DEG	0000….0000	1000….0000

Table 5-5: Pin connection for input of digital PM data via AUX I/O connector

Connection	Parallel data input with 16-bit word width for digital PM modulation data.
11 - FM_DAT	FM_DATA 15 (MSB)
12 - FM_DAT	FM_DATA 14
13 - FM_DAT	FM_DATA 13
14 - FM_DAT	FM_DATA 12
15 - FM_DAT	FM_DATA 11
16 - FM_DAT	FM_DATA 10
17 - FM_DAT	FM_DATA 9
18 - FM_DAT	FM_DATA 8
19 - FM_DAT	FM_DATA 7
20 - FM_DAT	FM_DATA 6
21 - FM_DAT	FM_DATA 5
22 - FM_DAT	FM_DATA 4
23 - FM_DAT	FM_DATA 3
24 - FM_DAT	FM_DATA 2
25 - FM_DAT	FM_DATA 1
26 - FM_DAT	FM_DATA 0 (LSB)

5.4.4.2 Noise Settings

In case of internal modulation source, the settings for the noise source are offered in the "Noise" section. This setting affects all analog modulations which use the noise generator as the internal modulation source. The settings are described in chapter 5.5.3.2, "Noise Settings", on page 290.

5.4.5 Pulse Modulation (PM)

Pulse modulation is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) without additional equipment options.

A standard pulse generator is available for internal modulation. Internal Pulse Modulation with extended features, e.g. generation of double pulse, requires option R&S SMA-K23, Pulse Generator. Option R&S SMA-K27, Pulse Train, enables generation of pulse trains.

An internal or external source can be selected for pulse modulation. In case of external source, the external signal is input via the PULSE EXT connector at the rear of the instrument. In case of internal source, this connector can be used as external trigger or gate signal input for internal pulse modulation. The polarity and input impedance of the connector can be selected.

The pulse signal is output at the PULSE VIDEO connector at the rear of the instrument.

> **Automatic Level Control is deactivated with pulse modulation!**
>
> When pulse modulation is activated, the ALC state of the R&S SMA is automatically changed to "ALC OFF" ("Sample & Hold"). In this state, the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting.
>
> In the following cases the nominal ON level is present for typically 3...5 ms after level or frequency setting:
>
> * No attenuator is fitted (frequency option R&S SMA-B103L/B106L)
> * in High Power Mode
> * in Auto mode if the level is in the High Power range, i.e. the mechanical relay bypass is switched.
>
> The level is decreased by 30 dB during "Sample&Hold" measurement.

5.4.5.1 Pulse Modulation Settings
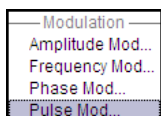
To open the "Pulse Modulation" menu, select "Modulation > Configure > Pulse Modulation" or use the MENU key under "Mod".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.

The menu varies according to the selected modulation source.

In case of modulation source pulse generator, the settings for the pulse characteristics and the trigger are offered in the "Pulse Generator" section of the "Pulse Modulation" dialog. Option R&S SMA-K23 offers extended features, e.g. generation of double pulse or selection of trigger mode. For description of the pulse generator dialog, see chapter 5.5.4, "Pulse Generator", on page 291.

Option R&S SMA-K27 enables the generation of pulse trains. For description of the pulse train dialog, see chapter 5.5.4.2, "Pulse Train Generation", on page 297.

State
Activates/deactivates pulse modulation.

Activation of pulse modulation deactivates ALC and power ramping.

When the internal modulation source (pulse generator) is selected, the pulse generator is switched on automatically and the video/sync signal is output at the PULSE VIDEO output at the rear of the instrument. Signal output can be switched off in the "Pulse Generator" dialog (see chapter 5.5.4, "Pulse Generator", on page 291).

SCPI command:
[:SOURce<hw>]:PULM:STATe on page 547

Source
Selects the source for the pulse modulation signal.

"Pulse Genera-   Selects the Pulse Generator as modulation source.

tor"   The settings for the pulse characteristics and the trigger are offered in the "Pulse Generator" section of the "Pulse Modulation" menu.

The internal pulse generator signal is provided at the PULSE VIDEO output, the sync signal at the PULSE SYNC output.

- Without option R&S SMA-K23:
  The internally generated rectangular signal is used for the pulse modulation. The frequency of the internal signal can be set in the LF Output menu.

- With option R&S SMA-K23:
  If option R&S SMA-K23 is installed, the characteristics of the generated pulse can be set in a wide range, and double pulse generation is possible. The settings are made in the "Pulse Generator" section of the menu.

"External"   Selects the external source.

The external modulation signal is input via the PULSE EXT connector.

The external modulation is provided at the PULSE VIDEO output.

SCPI command:

[:SOURce<hw>]:PULM:SOURce on page 547

Polarity

(External Source only)

Selects the polarity of the modulation signal.

"Normal"   The RF signal is **On** while the level is high at the modulation input.

"Inverted"   The RF signal is **Off** while the level is high at the modulation input.

SCPI command:

[:SOURce<hw>]:PULM:POLarity on page 546

5.4.6 Chirp Modulation

Chirp modulation is used in radar technique to achieve pulse compression. Pulse compression increases the sensitivity and resolution of radar systems by modifying transmitted pulses to improve their auto-correlation properties. To chirp the radar signal is one way of accomplishing this. A chirp is a signal in which the frequency increases or decreases over time.

The R&S SMA always uses chirp modulation together with pulse modulation. The modulation signals for FM and Pulse modulator are generated and synchronized internally. The internal pulse generator is used as the modulation source for the pulse modulator and the internal LF generator as source for the frequency modulation. Normal FM mode is used. Using external modulation signals is not possible for chirp modulation.

The following graph shows the FM demodulated signal of chirped pulses with a chirp bandwidth of 80 MHz and a pulse width of 80 us. Chirp direction is up.
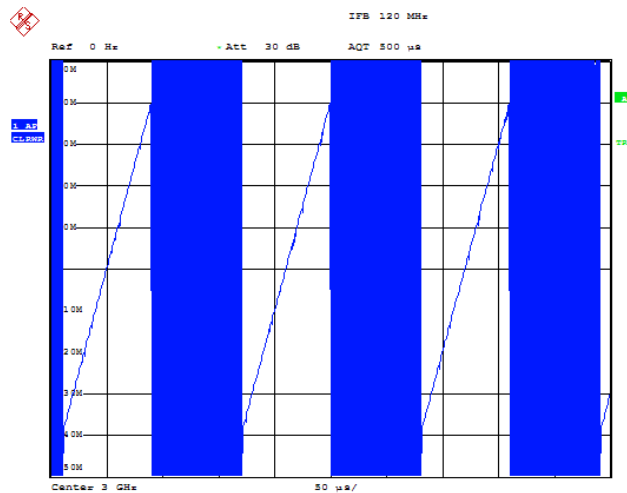
Date: 10.MAR.2008 15:38:01

Chirp modulation is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-B20 or B22 and interface board with part number 1400.0530.02 or 1400.0552.02.

Chirp Modulation with extended ranges for resolution, pulse width and period requires option R&S SMA-K23, Pulse Generator.

The PULSE EXT connector at the rear of the instrument can be used as external trigger or gate signal input.

The polarity and input impedance of the connector can be selected.

The pulse signal is output at the PULSE VIDEO connector at the rear of the instrument, the sync signal at the PULSE SYNC output.

The FM modulation signal can be output at the LF connector.

All other analog modulations are deactivated during chirp modulation!

When chirp modulation is activated, any active analog modulation is automatically switched off.

> **Automatic Level Control (ALC) is deactivated with chirp modulation!**
>
> When pulse modulation is activated, the ALC state of the R&S SMA is automatically changed to "ALC OFF" ("Sample & Hold"). In this state, the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting.
>
> In the following cases the nominal ON level is present for typically 3...5 ms after level or frequency setting:
>
> * No attenuator is fitted (frequency option R&S SMA-B103L/B106L)
> * in High Power Mode
> * in Auto mode if the level is in the High Power range, i.e. the mechanical relay bypass is switched.
>
> The level is decreased by 30 dB during "Sample&Hold" measurement.

> The Sample&Hold measurement for the ALC is performed at the chirp center frequency. Therefore, the frequency response of the RF path may result in level errors for the FM modulated carrier especially with high chirp bandwidths.

5.4.6.1 Chirp Modulation Settings
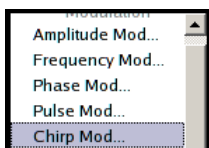
The "Chirp modulation" dialog is opened in the "Modulation" function block or using the MENU key under "Modulation".

In the upper section of the menu, the modulation is configured and switched on. The configuration of the trigger source is performed in the lower section of the menu.
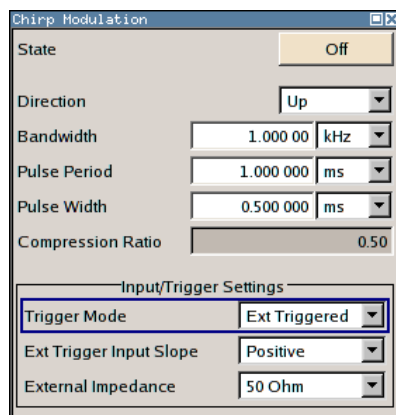
Option R&S SMA-K23 offers an extended range for resolution, pulse period and pulse width settings.

State - Chirp Modulation
Activates/deactivates chirp modulation

Note: Any active modulation is automatically switched off when chirp modulation is activated.

The pulse generator signal is provided at the "PULSE VIDEO" output, the sync signal at the "PULSE SYNC" output.

These outputs are automatically switched on/off according to the chirp modulation state. The FM modulation signal can be output at the LF connector.
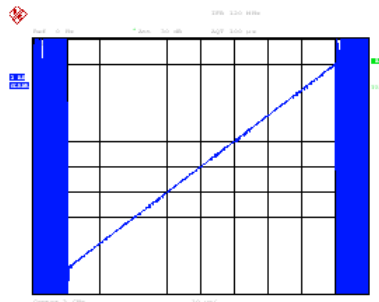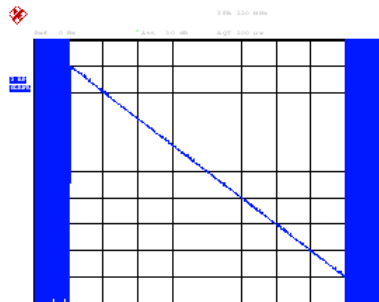
SCPI command:

[:SOURce<hw>]:CHIRp:STATe on page 438

Direction - Chirp Modulation
Selects the direction of the chirp modulation.

"Up"   The chirp starts with the lower frequency.

"Down"   The chirp starts with the higher frequency.

SCPI command:

[:SOURce<hw>]:CHIRp:DIRection on page 437

Bandwidth - Chirp Modulation
Sets the modulation bandwidth in Hz.

The bandwidth denotes the difference between the maximum and minimum frequency, e.g. a bandwidth of 10 MHz at a center frequency of 1 GHz leads to a frequency modulation between 995 MHz and 1005 MHz.

The maximum bandwidth depends on the currently set RF frequency (see data sheet). It is possible to enter a bandwidth that is too high for a certain RF frequency or to vary the RF frequency to a range in which the bandwidth can no longer be set. In this case the maximum possible bandwidth is set and an error message is displayed.

SCPI command:

[:SOURce<hw>]:CHIRp:BANDwidth on page 436

Pulse Period - Chirp Modulation

Sets the period of the generated chirp. Option R&S SMA-K23 provides a resolution of 20 ns.

SCPI command:

[:SOURce<hw>]:CHIRp:PULSe:PERiod on page 437

Pulse Width - Chirp Modulation

Sets the width of the generated chirp. The pulse width must be at least 1 us less than the set pulse period. Option R&S SMA-K23 provides a resolution of 20 ns.

SCPI command:

[:SOURce<hw>]:CHIRp:PULSe:WIDTh on page 437

Compression Ratio - Chirp Modulation

Indicates the pulse compression ratio, i.e. the product of pulse width [s] and bandwidth [Hz]. Pulse compression increases the range resolution as well as the signal to noise ratio of pulsed signals.

SCPI command:

[:SOURce<hw>]:CHIRp:COMPression:RATio on page 436

Trigger Mode - Chirp Modulation

Selects the trigger mode for chirp modulation signals.

Note: An external trigger signal is supplied via the PULSE EXT connector.

"Auto"   The chirp modulation signals are generated continuously.

"Ext Triggered" The chirp modulation signals are triggered by an external trigger event.

"Ext Gated"   The chirp modulation signals are gated by an external gate signal.

SCPI command:

[:SOURce<hw>]:CHIRp:TRIGger:MODE on page 439

External Trigger Input Slope - Chirp Modulation

(External Trigger only)

Sets the polarity of the active slope of an applied trigger signal.

Note: An external trigger signal is supplied via the PULSE EXT connector.

"Positive"   The chirp modulation signals are triggered on the positive slope of the external trigger signal.

"Negative"   The chirp modulation signals are triggered on the negative slope of the external trigger signal.

SCPI command:

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:SLOPe on page 439

Gate Input Polarity - Chirp Modulation

(External Gate only).

Selects the polarity of the Gate signal.

Note: An external gate signal is supplied via the PULSE EXT connector.

"Positive"   The chirp modulation signals are generated while the gate signal is high.

"Negative"   The chirp modulation signals are generated while the gate signal is low.

SCPI command:

`[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:GATE:POLarity` on page 438

External Impedance - Chirp Modulation

(External trigger or gate only)

Selects the input impedance for the external trigger and gate signal input (10 kOhm or 50 Ohm).

SCPI command:

`[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:IMPedance` on page 438

5.4.7 DME Modulation

Option R&S SMA-K26 enables DME modulation on the R&S SMA.

DME (Distance Measurement Equipment) is a radar system which determines the slant distance between the aircraft and the ground station. On the aircraft, the time is measured which the radio signal takes to travel from the aircraft to the ground station and back. The aircraft is equipped with an interrogator and the ground station with a transponder.
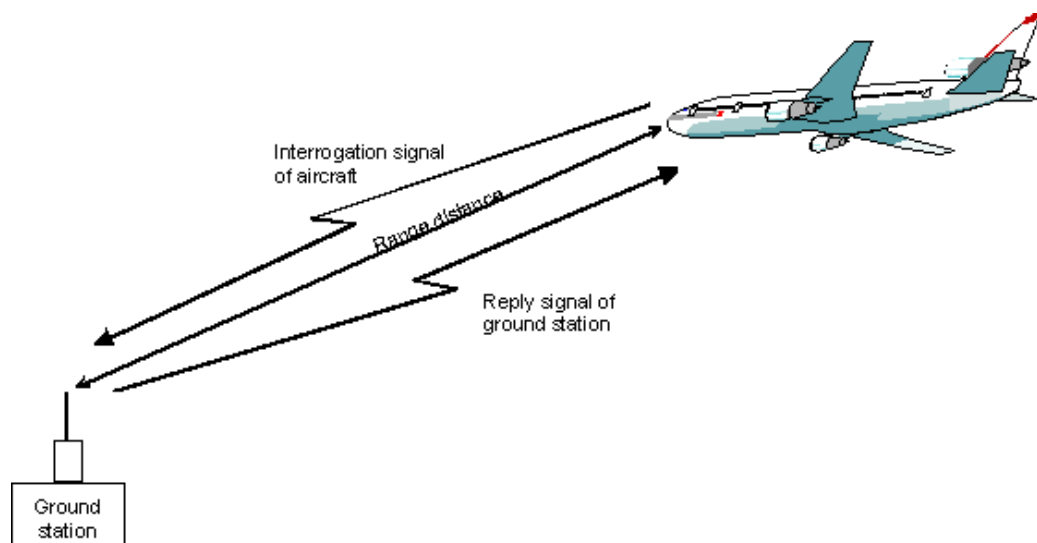
The DME channels are paired with the VOR frequencies, they are in the range between 1025 to 1150 MHz for the interrogator and 962 and 1213 MHz for the transponder. The spacing for all channels is 1 MHz. X and Y channels differ in the spacing between the two pulses of the pulse pair and in the delay for the reply pulse.

The interrogator transmits a stream of pulse pairs with fixed duration and spacing. The ground based transponder receives the pulse train and re-transmits them after a defined delay on a frequency which is +/-63MHz from the interrogation frequency. The airborne interrogator identifies its own stream of pulses and measures the time between the start of interrogation and response from the ground transponder in order to evaluate the slant distance. The distance is given in nautic miles (nm). 1 nm is 1852.01 meters and corresponds to a run time of 12.359 us.

Two different modes are offered for the DME test signal:

●   DME Interrogation
pulse stream from the interrogator, X or Y channel (simulation of aircraft interrogator)

●   DME Reply
reply pulses from the transponder + optional ID signal, X or Y channel (simulation of ground station)

In addition a single test pulse can be generated.

The following graph shows the timing of the pulse pairs (slant range distance = 0 nm).
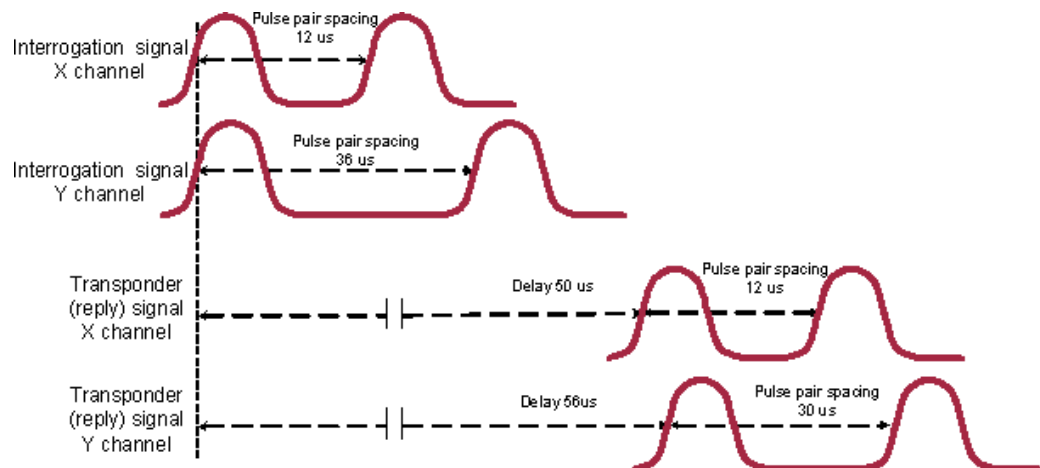
Fig. 5-7: Timing of the pulse pairs (slant range distance = 0 nm)

5.4.7.1   DME Modulation Menu

The "DME modulation" menu is opened in the "Mod" function block or using the MENU key under "Mod".
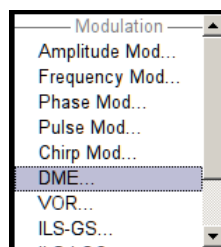
In the upper section of the menu, the modulation is configured and switched on. The configuration of the pulse pairs and the trigger source is performed in the lower section of the menu. Reply response measurement is enabled using a R&S NRP-Z81 power sensor.
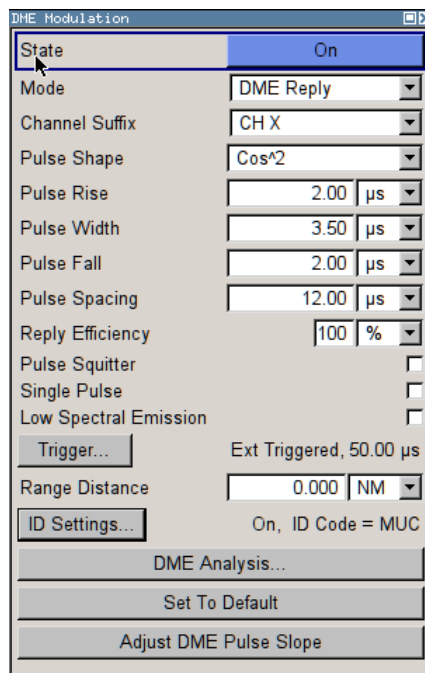
State - DME Modulation

Activates/deactivates DME modulation

Note: Modulations PULSE, VOR, ILS-GS, ILS-LOC, MKR-BCN, ADF, AM, and internal FM/PhiM are automatically switched off when DME modulation is activated. Also, the pulse generator is automatically switched off.

The DME modulation signal can be output at the LF connector.

SCPI command:

[:SOURce]:DME:STATe on page 465

Mode - DME Modulation

Selects the mode of the DME modulation. The mode determines the signal type that is simulated. The exact timing of the signal for each mode is determined by the selected channel (X or Y, see below).

The timing and shape of the pulses can be freely selected. By default these values are set according to the standard.

"DME Interrogation CH X/Y" The interrogation signal of the airborne transmitter is simulated. The following graph shows the interrogation signal of channel X.
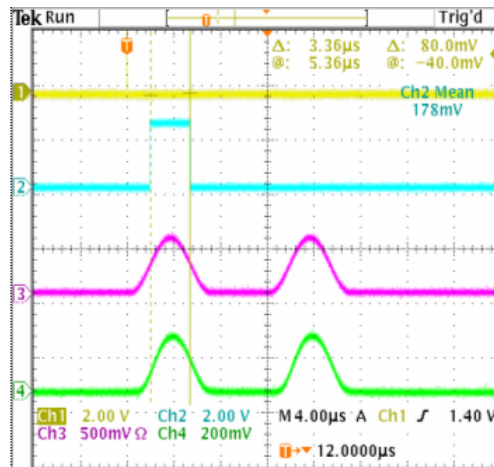
Fig. 5-8: DME Interrogation CH X (Trigger = Auto)

1 = SYNC signal (pulse width 50ns)
2 = VIDEO signal (active with 50 % pulse width of first DME pulse)
3 = LF Output signal (DME modulation signal)
4 = RF Output signal (measured with external detector)

"DME Reply CH
X/Y"

The reply signal of the ground based transponder is simulated. The trigger is automatically set to external and the default trigger delay either to 50 us (channel X) or 56 us (channel Y) depending on the selected channel. The trigger signal is input via the PULSE EXT connector.

The interval between the pulse pairs can be set to a fixed value (repetition rate) or to random generation (pulse squitter).

The following graph shows the reply signal of channel X (Trigger = External). In case of a trigger event, the reply pulse pair is generated after the set trigger delay.
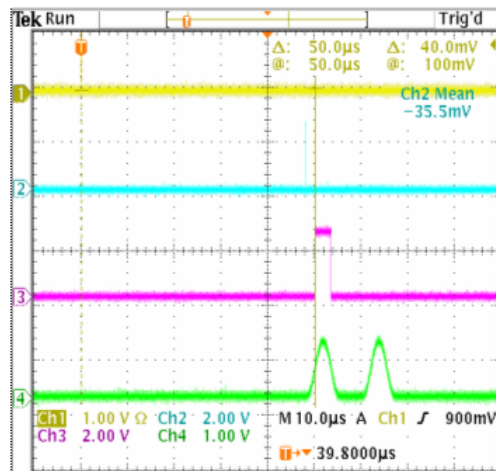

Fig. 5-9: DME Reply CH X (Trigger = External)

1 = external TRIGGER signal (T: pulse width 50ns)
2 = SYNC signal (pulse width 50ns)
3 = VIDEO signal with a delay of 50 us between external trigger and Video signal (= range distance of 0 nm) (active with 50 % pulse width of first DME pulse)
4 = LF Output signal (DME modulation signal)

SCPI command:

[:SOURce]:DME:MODE on page 461

Channel Suffix - DME Modulation
Selects the channel that is simulated.

Standard compliant X and Y channels differ in the spacing between the two pulses of the pulse pair and the delay of the ground station (see table below).

Channel	Pulse spacing interrogation mode	Pulse spacing reply mode	Reply delay 1st pulse	Reply delay 2nd pulse
X	12 us	12 us	50 us	50 us
Y	36 us	30 us	56 us	50 us

SCPI command:

[:SOURce]:DME:CSUFfix on page 455

Pulse Shape - DME Modulation
Selects the pulse shape.

"Cos^2"   The falling and the rising edge of the pulse are cos^2 shaped.

"Cos Cos^2"   The rising edge is cos shaped and the falling edge is cos^2 shaped.

"Linear"   The falling and the rising edge of the pulse are shaped linear.

SCPI command:

[:SOURce]:DME:SHAPe on page 463

Pulse Rise - DME Modulation
Sets the rise time of the pulse (10% to 90% of peak voltage).

SCPI command:

[:SOURce]:DME:RISE on page 463

Pulse Width - DME Modulation
Sets the pulse width (50% to 50% of peak voltage).

SCPI command:

[:SOURce]:DME:WIDTh on page 469

Pulse Fall - DME Modulation
Sets the fall time of the pulse (90% to 10% of peak voltage).

SCPI command:

[:SOURce]:DME:FALL on page 456

Pulse Spacing - DME Modulation
Sets the spacing between the first and second pulse of a pulse pair (time between half-voltage points on the leading edge of each pulse).

SCPI command:

[:SOURce]:DME:PPS on page 462

Reply Efficiency - DME Modulation
(for Reply mode on only)

Sets the relation between reply pulse pairs and received trigger signals, e.g. with a set efficiency of 50% only every second trigger event leads to the generation of a reply pulse pair.

SCPI command:

[:SOURce]:DME:EFFiciency on page 456

Pulse Squitter - DME Modulation
The average repetition rate is 2700 pp/s. The pulse spacing is distributed randomly in the range of 60 us to about 1500 us according to EUROCAE EN-54 6.2.12.

The squitter pulses are constantly sent by the ground station in order to ensure proper operation and in order to ease synchronization of the aircraft interrogator to the ground station.

SCPI command:

[:SOURce]:DME:SQUitter on page 464

Pulse Repetition Rate - DME Modulation
* In "Interrogation mode"

Sets the pulse repetition rate for trigger setting "Auto" or "Ext Gated".

● In "Reply Mode"
Indicates the mean pulse repetition rate in squitter mode.

SCPI command:

[:SOURce]:DME:RATE on page 462

Single Pulse - DME Modulation
Activates generation of a single test pulse.

SCPI command:

[:SOURce]:DME:SINGle on page 464

Low Spectral Emission - DME Modulation
Activates the generation of a DME signal with higher spectral purity but less dynamic compared to the default mode. The ON/OFF ratio of the pulses is reduced from typ. >100 dB to typ. 35 dB.

SCPI command:

[:SOURce]:DME:LOWemission on page 461

Trigger - DME Modulation
The button opens the menu for setting the trigger (see chapter 5.4.7.2, "Trigger Settings for DME", on page 236).

Range Distance - DME Modulation
(Reply mode only)

Sets the simulated distance between interrogator and transponder for reply mode. The distance is given in nautic miles (nm). 1 nm is 1852.01 meters and corresponds to a run time of 12.359 us.

The range distance and the external trigger delay are interdependent according to:

"Range Distance" = ("Trigger Delay" – X/Y mode delay)/12.359 µs/nm, where

X mode delay = 50 us, Y mode delay = 56 us

Changing one value automatically changes the other value.

SCPI command:

[:SOURce]:DME:RDIStance on page 463

ID Settings - DME Modulation
(Reply mode only)

Opens the menu for setting the DME ID signal (see chapter 5.4.7.3, "ID Settings for DME Reply Mode", on page 239).

Composite AM... - DME Modulation
(Reply mode only)

Opens the menu for defining the two-tone signals that can be additionally superimposed on the pulses (see chapter 5.4.7.4, "DME Composite AM", on page 242).

DME Analysis - DME Modulation
Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Opens the menu for setting the DME Analysis (see chapter 5.4.7.5, "DME Analysis", on page 243).

Set To Default - DME Modulation
Sets a default DME signal (interrogation mode channel X).

Selects the default settings for the pulse parameters according to standard (EUROCAE ED57/ED54 and ICAO ANNEX 10 to the convention of international civil aviation).

The state of the modulation is not influenced by this button.
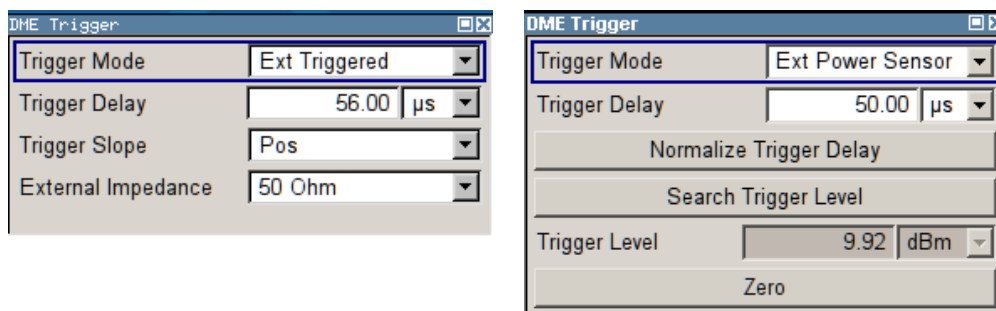
SCPI command:

[:SOURce]:DME:PRESet on page 462

Adjust DME Pulse Slope
Activates internal adjustment of the DME pulse slope for best linearity.

SCPI command:

CALibration:DME[:MEASure] on page 352

5.4.7.2   Trigger Settings for DME

Trigger Mode - DME Modulation
Selects the trigger mode for DME modulation signals. For "Reply Mode" only external trigger is possible

"Auto"   The DME modulation signals are generated continuously.

"Ext Triggered" The DME modulation signals are triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

"Ext Gated"   The DME modulation signals are gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

"Ext Power   Sensor R&S NRP-Z81 provides the trigger signal.
Sensor"   An external DME interrogation signal is feed into a sensor. The 50% voltage point of this signal is used by the R&S NRP-Z81 sensor to generate the trigger for the R&S SMA. The R&S SMA simulates the ground station ("Reply Mode") and sends the reply signal after the set trigger delay.

SCPI command:

[:SOURce]:DME:TRIGger on page 466

Trigger Delay - DME Modulation

(External Trigger and Ext Power Sensor only)

Sets the delay between the external trigger and the first DME output pulse (50% voltage point of first pulse). For DME Reply mode this simulates the defined delay of the DME transponder and twice the run time of the signal (from interrogator to transponder and back). The delay is a measure of the range distance, thus, the two values are interdependent according to:

Delay = X/Y mode delay + range distance * 12.359 nm/µs, where

X mode delay = 50 us, Y mode delay = 56 us

Changing one value automatically changes the other value.

SCPI command:

[:SOURce]:DME:TRIGger:DELay on page 467

Trigger Slope - DME Modulation

(External Trigger only)

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

"Positive"   The DME modulation signals are triggered on the positive slope of the external trigger signal.

"Negative"   The DME modulation signals are triggered on the negative slope of the external trigger signal.

SCPI command:

[:SOURce]:DME:TRIGger:SLOPe on page 469

Gate Input Polarity - DME Modulation

(External Gate only)

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

"Normal"   The DME modulation signal is generated while the gate signal is high.

"Inverse"   The DME modulation signal is generated while the gate signal is low.

SCPI command:

[:SOURce]:DME:TRIGger:GPOLarity on page 468

External Impedance - DME Modulation

(External Trigger or Gate only)

Selects the input impedance for the external trigger and gate signal input PULSE EXT (10 kOhm or 50 Ohm).

SCPI command:

[:SOURce]:DME:TRIGger:IMPedance on page 468

Normalize Trigger Delay - DME Modulation

(External Power Sensor only)

Performs a normalization of the test setup. The delay due to the R&S NRP-Z81 sensor is measured and subsequently considered in the trigger delay.

For normalization, the Sensor is connected directly to the RF output of the R&S SMA. "Normalize Trigger Delay" determines the delay between RF input and trigger output of the sensor. This value is sensor specific and is stored on the R&S SMA. The value is valid as long as the same sensor is used.

SCPI command:

[:SOURce]:DME:TRIGger:DELay:NORMalize on page 468

Search Trigger Level - DME Modulation

(External Power Sensor only)

Determines the trigger level = 50% voltage point of first pulse of the external DME interrogation signal.

After connecting the R&S NRP-Z81 sensor to the external interrogation signal source, "Search Trigger Level" determines the trigger point. The search function has to be executed with each change of the level of the external DME signal.

SCPI command:

[:SOURce]:DME:ANALysis:TRIGger:SEARch on page 455

Trigger Level - DME Modulation

(External Power Sensor only)

Indicates the trigger level, e.g. 9.92 dBm for an external signal with a peak level of 15.94 dBm.

SCPI command:
n.a.

Zero - Power Sensors

(External Power Sensor only)

Activates the auto zero function.

Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor (see tips below). R&S power sensors automatically detect the presence of any significant input power. This aborts zeroing and generates an error message. Zeroing can take a few seconds, depending on the sensor model; refer to the documentation of your external power sensor for more information.

Tips for zeroing

Zeroing should be performed:
● During warm-up after switching on or connecting the instrument
● After a substantial change of the ambient temperature
● After fastening the power sensor module to an RF connector at high temperature
● After several hours of operation
● When very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
● Switch off the RF power source for zeroing; do not disconnect it from the power sensor. In this way you will maintain the thermal equilibrium, and zeroing will also com-

pensate for the noise superimposed on the measured signal (e.g. from a broadband amplifier).

SCPI command:

SENSe<ch>[:POWer]:ZERO on page 418

5.4.7.3 ID Settings for DME Reply Mode

In the "DME ID" submenu the identification sequence for the reply signal is defined. Each airport identifies itself with a three letter code, for example 'MUC' for the Munich airport. This information is transmitted in morse code. The transmission of the identification sequence can be switched off.
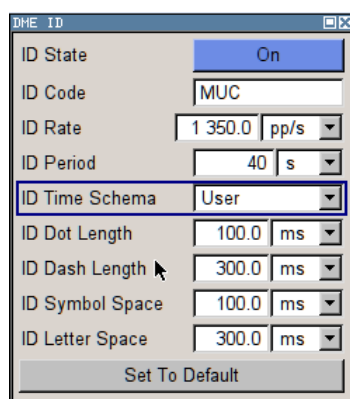
ID State - DME Modulation

(Reply mode only)

Switches on/off the generation of the identification sequence (ID signal) of the ground station. The ID signal consists of a series of pulse pairs transmitted at a rate of 1350 Hz.

The transmission of the ground signal is interrupted every 40 seconds (ID period) and one ID sequence is transmitted instead. The "key down time" of the ground signal corresponds to the period of transmission for a dot or dash in the Morse code ID sequence (e.g. 100ms for a dot). During the key down times reply pulses are not transmitted, however, they are transmitted between the key down times.

SCPI command:

[:SOURce]:DME:ID[:STATe] on page 459

ID Code - DME Modulation

(Reply mode only)

Enters the coding of the ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (ID signal).

The ID tone is sent according to the selected code (see table of Morse below table 5-6).The length of the morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

Table 5-6: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:

The following values are default values:

- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 =
3100 ms

SCPI command:
[:SOURce]:DME:ID:CODE on page 456

ID Rate - DME Modulation
(Reply mode only)

Enters the pulse repetition rate of the ID sequence.

SCPI command:
[:SOURce]:DME:ID:RATE on page 459

ID Period - DME Modulation
(Reply mode only)

Enters the period of the ID sequence by means of seconds.

SCPI command:

[:SOURce]:DME:ID:PERiod on page 458

ID Time Schema - DME Modulation

(Reply mode only)

Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (ID signal).

SCPI command:

[:SOURce]:DME:ID:TSCHema on page 460

ID Dot Length - DME Modulation

(Reply mode only)

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if standard time scheme is selected.

SCPI command:

[:SOURce]:DME:ID:DOT on page 457

ID Dash Length - DME Modulation

(Reply mode and user time schema only)

Enters the length of a morse dash by means of seconds.

SCPI command:

[:SOURce]:DME:ID:DASH on page 457

ID Symbol Space - DME Modulation

(Reply mode and user time schema only)

Enters the length of a symbol space by means of seconds.

SCPI command:

[:SOURce]:DME:ID:SYMBol on page 460

ID Letter Space - DME Modulation

(Reply mode and user time schema only)

Enters the length of a letter space by means of seconds.

SCPI command:

[:SOURce]:DME:ID:LETTer on page 458

Set To Default ID - DME Modulation

Selects the default settings for the ID signal.

SCPI command:

[:SOURce]:DME:ID:PRESet on page 459

5.4.7.4 DME Composite AM

The "DME Composite AM" menu provides the settings for a two-tone signal that can be superimposed on the DME pulses by means of amplitude modulation. This feature enables the user simulate the variation of the DME pulse amplitude for DME receiver testing.

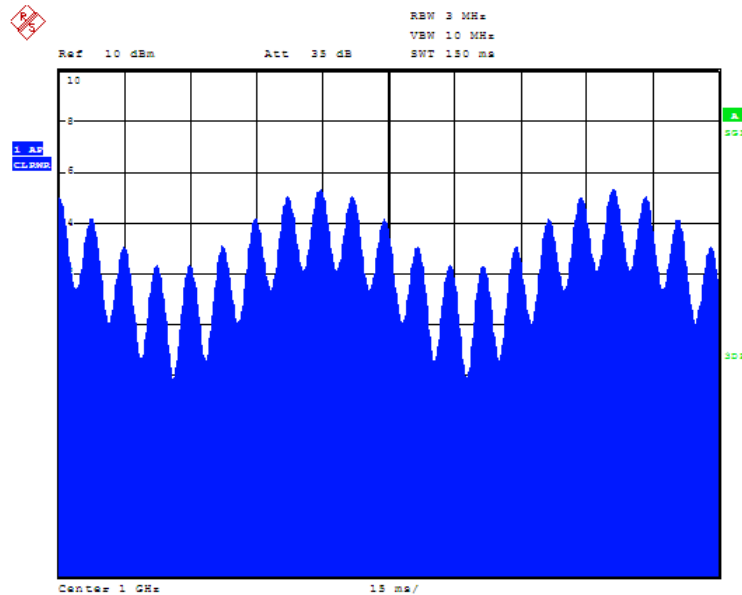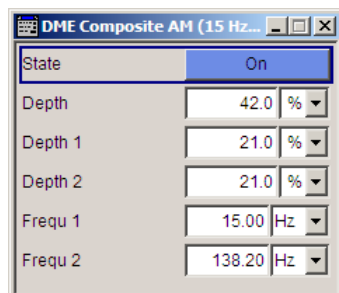The following example shows a DME signal with a superimposed two-tone signal:

Fig. 5-10: Measurement of RF envelope with DME interrogations at 6000 pp/s

DME Composite AM Menu

DME defines frequency and depth of the two-tone signal, which is superimposed to the pulse signal by means of amplitude modulation.

Composite AM State - DME Modulation
Activates/deactivates the two-tone signal.

SCPI command:
[:SOURce]:DME:TACan:STATe on page 466

Composite AM Depth - DME Modulation
Sets the modulation depth in per cent.

Note: Observe that this value is valid for both signals and the sum modulation depth is determined by doubling the set modulation depth. This results in overmodulation if the maximal value for modulation depth is exceeded (see data sheet).

SCPI command:

`[:SOURce]:DME:TACan:DEPTh` on page 465

Composite AM Depth 1/2 - DME Modulation
Determines the modulation depth in per cent for one component of the two-tone signal.

SCPI command:

`[:SOURce]:DME:TACan:INTernal<ch>:DEPTh` on page 465

Composite AM Frequency 1/2 - DME Modulation
Sets the individual frequencies of the two-tone signal.

SCPI command:

`[:SOURce]:DME:TACan<ch>:FREQuency` on page 466

5.4.7.5 DME Analysis

The DME analysis uses a R&S NRP-Z81 Power Sensor to measure the reply delay, the average peak power, the efficiency and the pulse repetition rate of the ground station transponder. The interrogation signal is simulated by the R&S SMA and transmitted to the transponder. The reply signal of the transponder is measured using the power sensor and is analyzed by internal software routines in order to determine these parameters. The measurement values are indicated in the DME menu.

DME Analysis Menu
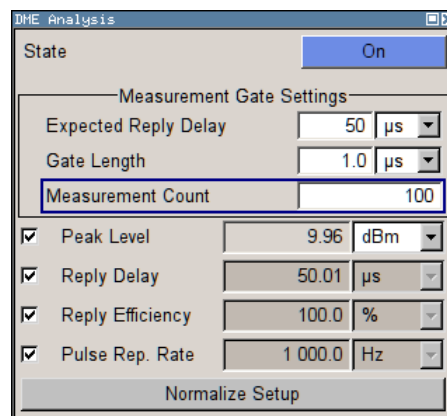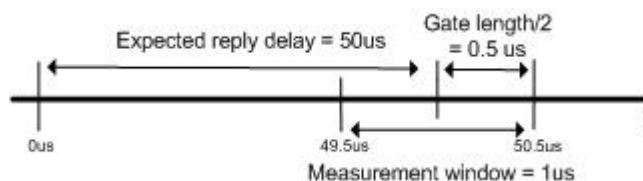

DME Analysis State - DME Modulation
Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Activates the DME analysis. The R&S SMA generates interrogation pulse pairs and starts an internal counter for time measurement.

The measurement gate settings determine the measurement window (expected reply delay +/- gate length/2). Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency. The delay measurement is averaged within the measurement cycle. The reply efficiency is calculated once for each measurement cycle.

Example:

The gate length is 1 us and the expected reply delay is 50 us. The measurement window lies in the range between 49.5 and 50.5 us. Only pulse pairs are used for the measurement whose 50% voltage point of the rising edge of the first pulse is within this range.

SCPI command:

[:SOURce]:DME:ANALysis:STATe on page 454

Expected Reply Delay - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector

Enters the expected reply delay.

SCPI command:

[:SOURce]:DME:ANALysis:GATE:EDELay on page 450

Gate Length - DME Modulation

Only if a R&S SMA NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Sets the gate length for the measurement window.

SCPI command:

[:SOURce]:DME:ANALysis:GATE[:LENGth] on page 451

Measurement Count - DME Modulation

Only if a R&S SMA NRP-Z81 power sensor is connected to the R&S SMA sensor connector

Sets the number of pulse pairs which are sent from the R&S SMA (= interrogator) to the ground station in one measurement cycle.

SCPI command:

[:SOURce]:DME:ANALysis:GATE:COUNt on page 450

Peak Level State - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector

Activates/deactivates the measurement of the average peak level of all valid pulse pairs in a measurement cycle.

SCPI command:

[:SOURce]:DME:ANALysis:POWer:STATe on page 452

Peak Level - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Indicates the measured average peak level of all pulse pairs in a measurement cycle.

SCPI command:

[:SOURce]:DME:ANALysis:POWer on page 452

Reply Delay Status- DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Activates/deactivates the measurement of the average reply delay of all valid pulse pairs in a measurement cycle.

SCPI command:

[:SOURce]:DME:ANALysis:TIME:STATe on page 455

Reply Delay - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector

Indicates the measured average reply delay of all valid pulse pairs in a measurement cycle. If there are no valid measurements available in the set measurement window 'invalid' is indicated.

SCPI command:

[:SOURce]:DME:ANALysis:TIME on page 454

[:SOURce]:DME:ANALysis:TIME:OK on page 454

Reply Efficiency State- DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Activates/deactivates the measurement of the reply efficiency in percent. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.

SCPI command:

[:SOURce]:DME:ANALysis:EFFiciency:STATe on page 450

Reply Efficiency - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Indicates the measured reply efficiency in percent. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.If there are no valid measurements available in the set measurement window 'invalid' is indicated.

SCPI command:

[:SOURce]:DME:ANALysis:EFFiciency on page 449

[:SOURce]:DME:ANALysis:EFFiciency:OK on page 449

Pulse Repetition Frequency State - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Activates/deactivates the measurement of the mean pulse repetition rate of the DME ground station. For this measurement all received pulses of the DME ground station are considered. The typical measurement time for this parameter is approx. 1 second.

This measurement and the measurement of the delay, efficiency and average peak power are performed alternately. Therefore, the speed of the pulse repetition measurement increases if all other measurements are deactivated.

SCPI command:

[:SOURce]:DME:ANALysis:PRRate:STATe on page 453

Pulse Repetition Frequency - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Indicates the measured mean pulse repetition rate of the DME ground station.

If there are no valid measurements available in the set measurement window 'invalid' is indicated.

SCPI command:

[:SOURce]:DME:ANALysis:PRRate on page 453

[:SOURce]:DME:ANALysis:PRRate:OK on page 453

Normalize Setup - DME Modulation

Only if a R&S NRP-Z81 power sensor is connected to the R&S SMA sensor connector.

Performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the reply measurements.
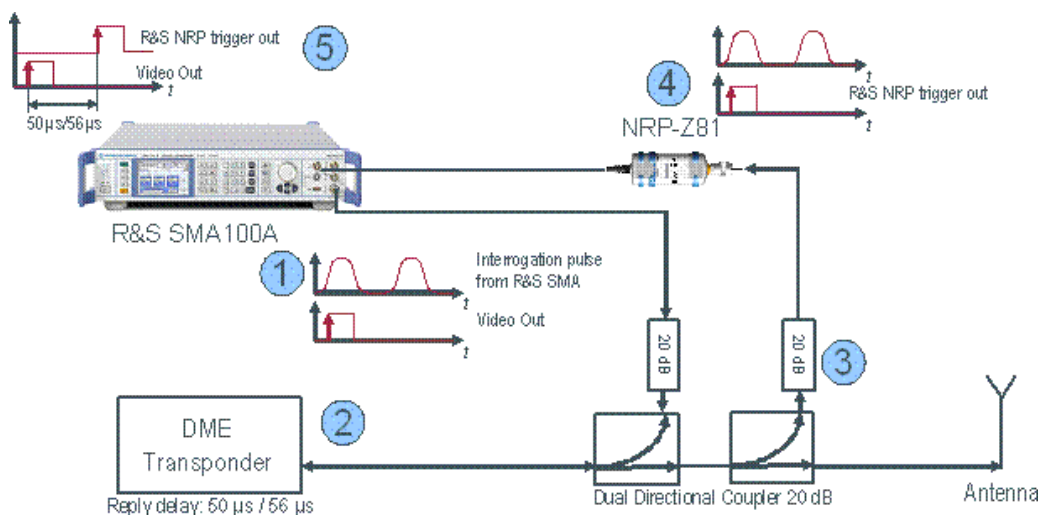
SCPI command:

[:SOURce]:DME:ANALysis:NORMalize on page 451

Test Setup for DME Analysis

See also Application Note 1GP74 "Test of DME/TACAN Transponders". The application note is available at the download area of the Rohde & Schwarz internet site (http://www2.rohde-schwarz.com/file/1GP74_1E.pdf).

> **NOTICE**
>
> **Possible damage to the power sensor**
>
> High output power of the DME transponder (up to 1 kW) might destroy the power sensor.
>
> Therefore, the attenuator at the power sensor input must be selected in such a way, that the power applied to the power sensor is in the allowed range of the R&S NRP-Z81 before connecting the power sensor to the coupler.

Procedure for DME Reply Delay measurement

1. The R&S SMA generates interrogation pulse pairs and starts an internal counter for time measurement.

2. The interrogation pulse pair is received by the DME transponder, which should reply after a 50 or 56 microsecond delay (depending on the channel) with a reply pulse pair.

3. The transmitted power is coupled to the power sensor input.

4. The transmitted reply pulse pair is received by the R&S NRP-Z81 wideband power sensor, which triggers the R&S SMA to stop the time measurement. The R&S NRP-Z81 also measures the peak pulse power and sends this information to the R&S SMA.

5. The R&S SMA100A displays the peak pulse power of the reflected reply pulse pair, the reply delay of the DME transponder (ideally 50 or 56 microseconds) and the DME transponder efficiency (the number of response pulse pairs as a percentage of interrogation pulse pairs).
   Finally, the reply delay value has to be corrected by adding twice the signal delay caused by the cable between coupler and antenna. The delay has to be added twofold because both, the delay for the received signal and the delay for the transmitted signal, have to be taken into account. The following equation provides a typical value for the twofold signal delay due to cable length:
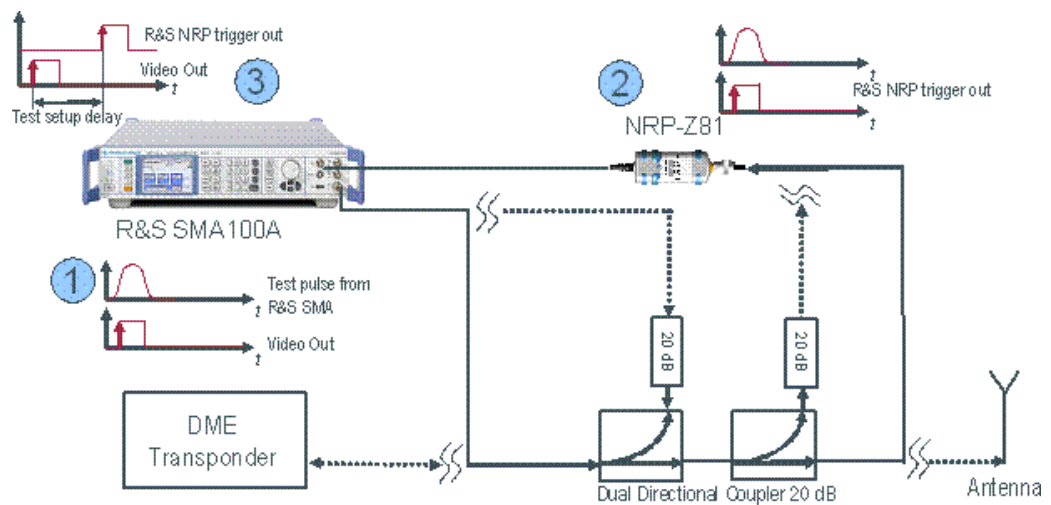
$$\Delta t = \frac{2 \times l \times \sqrt{\varepsilon_r}}{c}$$

, whereas l = cable length in meters,
ε_r = relative dielectric constant (e.g., 2.1 for teflon, 2.25 for polyethylene)
c = 3 x 10^8 m/s

Optional normalization of the test setup removes additional delays that are due to the test setup.

Procedure for Test Setup Normalization

1. The R&S SMA generates a test pulse for normalization and starts the counter for time measurement. The test pulse is transmitted to the R&S NRP-Z81 power sensor via the dual directional coupler, the connections to the DME transponder and the antenna are interrupted.

2. The test pulse is received by the R&S NRP-Z81 wideband power sensor, which triggers the R&S SMA to stop the time measurement.

3. The R&S SMA registers the test setup delay and considers it in a subsequent DME analysis measurement. The correction value is stored on the internal flash disk and therefore available also after a restart of the signal generator.

5.4.8 VOR Modulation

VOR modulation(**V**HF **O**mnidirectional **R**ange) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

VOR systems provide directional information for air planes in flight. The VOR stations transmit a carrier which is modulated with two separate 30 Hz modulations. One of the 30Hz signals (Reference signal) remains in the same phase at all reception positions around the VOR station. The other 30Hz signal received (Variable signal) will differ in phase by exactly the angular displacement of the receiver around the VOR from the Zero radial. The aircraft receiver demodulates the two 30Hz signals and compares their phase difference.

Four different modes are offered for the VOR test signal:

● Norm
  VOR modulation + optional COM/ID tone

● VAR
  Amplitude modulation of the output signal with the 30 Hz signal content of the VOR signal.

● Subcarrier

Amplitude modulation of the output signal with the unmodulated 9960 Hz FM carrier of the VOR signal

- Subcarrier + FM
  Amplitude modulation of the output signal with the frequency-modulated 9960 Hz FM carrier of the VOR signal

An external signal can be added to the internal signal (EXT AM = EXT (MOD AM)). The external signal is input via the AM EXT connector.

The VOR signal is output at the LF OUT connector at the front of the instrument.

5.4.8.1 VOR Modulation Menu
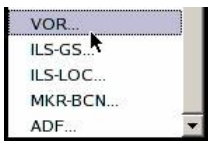
The "VOR Modulation" menu is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.
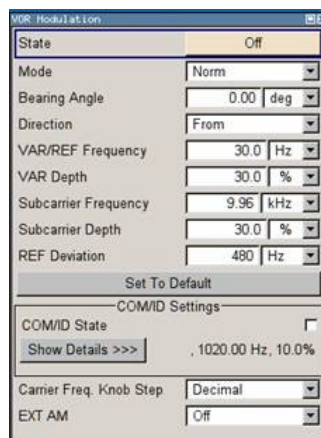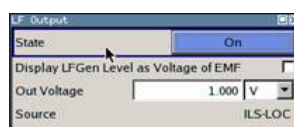

State - VOR Modulation

Activates/deactivates VOR modulation.

Activation of VOR modulation deactivates AM, ILS, Marker Beacon and ADF modulation.

Source selection is disabled in the "LF Output" menu:

SCPI command:
[:SOURce]:VOR:STATe on page 575

Mode - VOR Modulation

Selects the operating mode for the VOR modulation signal.

"Norm"   VOR modulation is active.

"VAR" Amplitude modulation of the output signal with the VAR signal component (30Hz signal content) of the VOR signal. The modulation depth of the 30 Hz signal corresponds to the value set under "Var Depth".

"Subcarrier" Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal. The modulation depth corresponds to the value set under "Subcarrier Depth".

"Subcarrier + FM" Amplitude modulation of the output signal with the frequency-modulated FM carrier (9960Hz) of the VOR signal. The frequency deviation corresponds to the value set under "Ref Deviation", the modulation depth corresponds to the value set under "Subcarrier Depth".

SCPI command:

[:SOURce]:VOR:MODE on page 573

Bearing Angle - VOR Modulation

Enters the phase angle between the 30Hz VAR signal and the 30Hz reference signal. The orientation of the angle depends on the selected direction.

SCPI command:

[:SOURce]:VOR[:BANGle] on page 577

Direction - VOR Modulation

Enters the reference position of the phase information.

"From" Selection of the beacon as a reference position. The angle set under "Bearing Angle" corresponds to the angle between the geographic north and the connection line from beacon to airplane.

"To" Selection of the airplane position as a reference position. The angle set under "Bearing Angle" corresponds to the angle between the geographic north and the connection line from airplane to beacon.

SCPI command:

[:SOURce]:VOR[:BANGle]:DIRection on page 577

VAR/REF Frequency - VOR Modulation

Enters the frequency of the VAR signal and the REF signal. As the two signals must have the same frequency, the setting is valid for both signals.

SCPI command:

[:SOURce]:VOR:VAR:FREQuency on page 576

VAR Depth - VOR Modulation

Enters the AM modulation depth of the 30Hz VAR signal. The sum of subcarrier depth, VAR depth and COM/ID and must be smaller than 100 PCT.

SCPI command:

[:SOURce]:VOR:VAR[:DEPTh] on page 576

Subcarrier Frequency - VOR Modulation

Enters the frequency of the FM carrier.

SCPI command:

[:SOURce]:VOR:SUBCarrier[:FREQuency] on page 576

Subcarrier Depth - VOR Modulation

Enters the AM modulation depth of the FM carrier. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

SCPI command:

[:SOURce]:VOR:SUBCarrier:DEPTh on page 575

REF Deviation - VOR Modulation

Enters the frequency deviation of the REF signal on the FM carrier.

Remote-control command:SOUR:VOR:REF:DEV 480

SCPI command:

[:SOURce]:VOR:REFerence[:DEViation] on page 574

Set to Default - VOR Modulation

Activates the VOR default setting.

Parameter	Value
State	Off
Mode	Norm
Source	Internal
Bearing Angle	0 deg
Direction	From
VAR / REF Frequency	30 Hz
VAR Depth	30 Percent
Subcarrier Frequency	9960 kHz
Subcarrier Depth	30 Percent
REF Deviation	480 Hz
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Period	9 s
COM/ID Depth	10 percent

SCPI command:

[:SOURce]:VOR:PRESet on page 574

COM/ID State - VOR Modulation

Switches on/off an additional communication/identification signal (COM/ID signal).

SCPI command:

[:SOURce]:VOR:COMid[:STATe] on page 573

Show Details - VOR Modulation

Reveals the detailed setting options for the COM/ID signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again. (COM/ID signal).
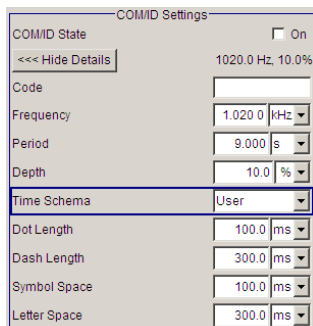
SCPI command:

n.a.

COM/ID Code - VOR Modulation

Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-7: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:

The following values are default values:

- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms the word space between the words varies accordingly.

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

SCPI command:
[:SOURce]:VOR:COMid:CODE on page 570

COM/ID Frequency - VOR Modulation

Enters the frequency of the COM/ID signals.

SCPI command:
[:SOURce]:VOR:COMid:FREQuency on page 571

COM/ID Period - VOR Modulation

Enters the period of the COM/ID signal in seconds.

SCPI command:
[:SOURce]:VOR:COMid:PERiod on page 572

COM/ID Depth - VOR Modulation

Enters the AM modulation depth of the COM/ID signal. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

SCPI command:
[:SOURce]:VOR:COMid:DEPTh on page 570

COM/ID Time Schema - VOR Modulation

Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

SCPI command:
[:SOURce]:VOR:COMid:TSCHema on page 573

COM/ID Dot Length - VOR Modulation

Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

SCPI command:

[:SOURce]:VOR:COMid:DOT on page 571

COM/ID Dash Length - VOR Modulation

(user time schema only)

Enters the length of a Morse dash by means of seconds.

SCPI command:

[:SOURce]:VOR:COMid:DASH on page 570

COM/ID Symbol Space - VOR Modulation

(user time schema only)

Enters the length of a symbol space by means of seconds.

SCPI command:

[:SOURce]:VOR:COMid:SYMBol on page 572

COM/ID Letter Space - VOR Modulation

(user time schema only)

Enters the length of a letter space by means of seconds.

SCPI command:

[:SOURce]:VOR:COMid:LETTer on page 572

Carrier Frequency Step - VOR Modulation

Selects the variation of the carrier frequency via the rotary knob.

Table 5-8: Standardized VOR transmitting frequencies (MHz)

108.00	109.40	110.80	112.10	112.80	113.50	114.20	114.90	115.60	116.30	117.05	117.75
108.05	109.45	110.85	112.15	112.85	113.55	114.25	114.95	115.65	116.35	117.10	117.80
108.20	109.60	111.00	112.20	112.90	113.60	114.30	115.00	115.70	116.40	117.15	117.85
108.25	109.65	111.05	112.25	112.95	113.65	114.35	115.05	115.75	116.45	117.20	117.90
108.40	109.80	111.20	112.30	113.00	113.70	114.40	115.10	115.80	116.50	117.25	117.95
108.45	109.85	111.25	112.35	113.05	113.75	114.45	115.15	115.85	116.55	117.30	
108.60	110.00	111.40	112.40	113.10	113.80	114.50	115.20	115.90	116.60	117.35	
108.65	110.05	111.45	112.45	113.15	113.85	114.55	115.25	115.95	116.65	117.40	
108.80	110.20	111.60	112.50	113.20	113.90	114.60	115.30	116.00	116.75	117.45	
108.85	110.25	111.65	112.55	113.25	113.95	114.65	115.35	116.05	116.80	117.50	
108.00	110.40	111.80	112.60	113.30	114.00	114.70	115.40	116.10	116.85	117.55	
109.05	110.45	111.85	112.65	113.35	114.05	114.75	115.45	116.15	116.90	117.60	

108.00	109.40	110.80	112.10	112.80	113.50	114.20	114.90	115.60	116.30	117.05	117.75
109.20	110.60	112.00	112.70	113.40	114.10	114.80	115.50	116.20	116.95	117.65	
109.25	110.65	112.05	112.75	113.45	114.15	114.85	115.55	116.25	117.00	117.70	

"Decimal"   Decimal variation according to the current cursor position.

"Defined"   Variation in predefined steps according to the standardized VOR trans-mitting frequencies (see table, values in MHz).

SCPI command:
n.a.

EXT AM - VOR Modulation
Switching on/off an external modulation. The external signal is input via the AM EXT connector.

"Off"   Selects the internal modulation source for VOR modulation.

"EXT (MOD AM)"   Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the AM EXT connector. The sensitivity is 10mV per percent modulation depth.

Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated.In order to avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining VOR signal components.

SCPI command:
[:SOURce]:VOR:SOURce on page 575

5.4.9 ILS-GS Modulation

ILS-GS modulation (**I**nstrument **L**anding **S**ystem - **G**lide **S**lope) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

ILS systems provide information relating to the position of the air plane relative to the runway during landing. The ILS-GS system indicates if the air plane is above, below or on the glide path. The carrier is modulated by a 90 Hz and a 150 Hz tone and sent to a separate directional antenna system. The antenna array is arranged so that the 90 Hz signal is stronger above of the glide path, and the 150 Hz signal is stronger below the glide path. The information on position is provided after demodulation of the signals by evaluating the difference in depth of modulation (DDM)

Three different modes are offered for the ILS-GS test signal:

● Norm
  Standard localizer/glideslope signal

● 90 Hz
  Suppression of the 150Hz modulation tone

- 150 Hz
  Suppression of the 90Hz modulation tone

An external signal can be added to the internal signal (EXT AM = EXT (MOD AM)). The external signal is input via the AM EXT connector.

The ILS-GS signal is output at the LF OUT connector at the front of the instrument.

5.4.9.1 ILS-GS Modulation Menu
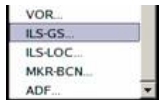
The "ILS-GS Modulation" menu is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.
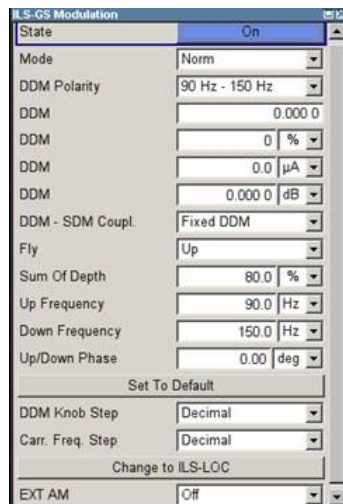
State - ILS-GS Modulation
Activates/deactivates ILS-GS modulation.

Activation of ILS-GS modulation deactivates AM, VOR, ILS-LOC, Marker Beacon and ADF modulation.

Source selection is disabled in the "LF Output" menu:

SCPI command:
[:SOURce]:ILS:GS | GSLope:STATe on page 496

Mode - ILS-GS Modulation
Selects the operating mode for the ILS-GS modulation signal.

"Norm"   ILS-GS modulation is active.

"90 Hz"   Amplitude modulation of the output signal with the upper lobe signal component (90Hz signal content) of the ILS-GS signal.

The modulation depth of the 90-Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

● "Direction Down"
   AM(90 Hz) = 0.5 × (SDM + DDM × 100%)

● "Direction Up"
   AM(90 Hz) = 0.5 × (SDM - DDM × 100%)

"150 Hz"   Amplitude modulation of the output signal with the lower lobe signal component (150-Hzsignal content) of the ILS-GS signal.

The modulation depth of the 150-Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

● "Direction Down"
   AM (150 Hz) = 0,5 × (SDM + DDM × 100%)

● "Direction Up"
   AM (150 Hz) = 0,5 × (SDM - DDM × 100%)

SCPI command:
[:SOURce]:ILS[:GS | GSLope]:MODE on page 492

DDM Polarity- ILS-GS Modulation
Defines the polarity for DDM calculation (see DDM Depth).

SCPI command:
[:SOURce]:ILS[:GS | GSLope]:DDM:POLarity on page 490

DDM Depth- ILS-GS Modulation
Enters the difference in depth of modulation between the upper lobe (90Hz) and the lower lobe (150Hz) tone of the ILS-GS modulation signal.

The DDM value is calculated to formula:
● Polarity 90 Hz - 150 Hz (default setting):
   DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
● Polarity 150 Hz - 90 Hz:
   DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

SCPI command:
[:SOURce]:ILS[:GS | GSLope]:DDM[:DEPTh] on page 488

DDM Percent- ILS-GS Modulation
Enters the difference in depth of modulation between the upper lobe (90Hz) and the lower lobe (150Hz) tone of the ILS-GS modulation signal.

The DDM value in percent is calculated to formula:
● Polarity 90 Hz - 150 Hz (default setting):
   DDM = [AM(90 Hz) - AM (150 Hz)]
● Polarity 150 Hz - 90 Hz:
   DDM = [AM(150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the value of the instrument current and the DDM value in dB.

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:DDM:PCT on page 489

DDM Current - ILS-GS Modulation
Enters the current of the ILS indicating instrument corresponding to the DDM value. the instrument current is calculated according to:

DDM uA = DDM × 857,125 uA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:DDM:CURRent on page 487

DDM Logarithmic- ILS-GS Modulation
Enters the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:DDM:LOGarithmic on page 489

DDM to SDM Coupling- ILS-GS Modulation
Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed"   The absolute DDM values stays constant when the SDM is changed.

"SDM"   The absolute DDM values changes when the SDM is changed. The DDM value expressed in dB stays constant.

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:DDM:COUPling on page 487

Fly - ILS-GS Modulation
Selects the simulation mode for the ILS-GS modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Up"   The 150-Hz modulation signal is predominant, the DDM value is negative(the airplane is too low, it must climb).

"Down"   The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:DDM:DIRection on page 488

Sum of Depth - ILS-GS Modulation

Enters the arithmetic sum of the modulation depths of the upper lobe (90Hz) and lower lobe (150Hz) ILS-GS signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones. The sum of Sum of Depth and COM/ID depth must be smaller than 100 PCT.

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:SDM on page 495

Up Frequency - ILS-GS Modulation

Enters the modulation frequency of the upper antenna lobe .

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:ULOBe[:FREQuency] on page 497

Down Frequency - ILS-GS Modulation

Enters the modulation frequency of the lower antenna lobe .

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:LLOBe[:FREQuency] on page 491

Up/Down Phase - ILS-GS Modulation

Enters the phase between the modulation signals of the upper and lower antenna lobe. The zero crossing of the lower lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the lower antenna lobe.

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:PHASe on page 494

Set to Default - ILS-GS Modulation

Activates the ILS-GS default setting.

Parameter	Value
State	Off
Mode	Norm
DDM	0
Fly	Up
Sum of Depth	80 Percent
Up Frequency	90 Hz
Down Frequency	150 Hz
Up/Down Phase	0 deg
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Depth	10 percent

SCPI command:

[:SOURce]:ILS[:GS | GSLope]:PRESet on page 495

DDM Knob Step - ILS-GS Modulation

Selects the variation of the DDM values via the rotary knob.

"Decimal"   Decimal variation according to the current cursor position.

"Defined"   Variation in predefined steps according to the standardized DDM values:

- -0.4000
- -0.1750 (Glide Sector)
- -0.0910, 0,0450
- 0.0000 (Glide Path)
- +0.0450, +0,0910
- +0.1750 (Glide Sector)
- +0.4000

SCPI command:

n.a.

Carrier Frequency Step - ILS-GS Modulation

Selects the variation of the carrier frequency via the rotary knob.

"Decimal"   Decimal variation according to the current cursor position.

"ICAO"   Activates variation in predefined steps according to the standardized ILS-GS transmitting frequencies (see table, values in MHz). The start value can be selected in the field "ICAO Channel" below.
The selection of the ICAO channel is effective on both ILS modulations. A change to modulation ILS-LOC automatically causes the RF frequency to be adapted to the localizer value which is coupled to the glide slope setting (see table).

Table 5-9: Standardized ILS-GS and ILS-LOC transmitting frequencies (MHz) and the associated ICAO channels

LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz / ICAO channel)
108.10 / 334.70 / 18X	108.70 / 330.50 / 24X	109.30 / 332.00 / 30X	109.90 / 333.80 / 36X	110.50 / 329.60 / 42X	111.10 / 331.70 / 48X	111.70 / 333.50 / 54X
108.15 / 334.55 / 18Y	108.75 / 330.35 / 24Y	109.35 / 331.85 / 30Y	109.95 / 333.65 / 36Y	110.55 / 329.45 / 42Y	111.15 / 331.55 / 48Y	111.75 / 333.35 / 54Y
108.30 / 334.10 / 20X	108.90 / 329.30 / 26X	109.50 / 332.60 / 32X	110.10 / 334.40 / 38X	110.70 / 330.20 / 44X	111.30 / 332.30 / 50X	111.90 / 331.10 / 56X
108.35 / 333.95 / 20Y	108.95 / 329.15 / 26Y	109.55 / 332.45 / 32Y	110.15 / 334.25 / 38Y	110.75 / 330.05 / 44Y	111.35 / 332.15 / 50Y	111.95 / 330.95 / 56Y
108.50 / 329.90 / 22X	109.10 / 331.40 / 28X	109.70 / 333.20 / 34X	110.30 / 335.00 / 40X	110.90 / 330.80 / 46X	111.50 / 332.90 / 52X	
108.55 / 329.75 / 22X	109.15 / 331.25 / 28Y	109.75 / 333.05 / 34Y	110.35 / 334.85 / 40Y	110.95 / 330.65 / 46Y	111.55 / 332.75 / 52Y	

SCPI command:
[:SOURce]:ILS[:GS | GSLope]:FREQuency:STEP on page 490

ICAO Channel - ILS-GS Modulation
Selects the ICAO channel, i.e., the ILS-GS transmitting frequency. The RF-frequency is set to the value selected here. A variation of the carrier frequency by the rotary knob is performed in predefined steps according to the standardized ILS-GS transmitting frequencies (see table). The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

SCPI command:
[:SOURce]:ILS[:GS | GSLope]:ICAO:CHANnel on page 491

Change to ILS-LOC - ILS-GS Modulation
Changes to ILS-LOC modulation and opens the menu. The current state of the ILS GS modulation (On or Off) is also set for ILS-LOC. The RF frequency setting automatically changes to the transmitting frequency associated with the set ICAO channel for ILS-LOC if the state is on. .

SCPI command:
n.a.

EXT AM - ILS-GS Modulation
Switching on/off an external modulation. The external signal is input via the AM EXT connector.

"Off"   Selects the internal modulation source for ILS-GS modulation.

"EXT (MOD   Selects the external source. The external signal is added to the internal
AM)"   signal. Switching off the internal source is not possible. The external sig-
                          nal is input via the AM EXT connector. The sensitivity is 10mV per per-
                          cent modulation depth.

                          Note: There can be an overmodulation as a function of the level of the
                          external signal without a corresponding caution message being gener-
                          ated.In order to avoid an overmodulation, the peak value of the external
                          signal is to be delimited corresponding to the sum of the modulation
                          depths of the remaining ILS signal components.

SCPI command:
[:SOURce]:ILS[:GS | GSLope]:SOURce on page 496

5.4.10   ILS-LOC Modulation

ILS-LOC modulation (Instrument Landing System - Localizer) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

ILS systems provide information relating to the position of the air plane relative to the runway during landing. The ILS-LOC system indicates if the air plane is to the left, right or on the glide path. The carrier is modulated by a 90 Hz and a 150 Hz tone and sent to a separate directional antenna system. The antenna array is arranged so that the 90 Hz signal is stronger on the left side of the glide path, and the 150 kHz signal is stronger on the right side of the glide path. The information on position is provided after demodulation of the signals by evaluating the difference in depth of modulation (DDM).

Three different modes are offered for the ILS-LOC test signal:

- Normal
  Standard localizer/glideslope signal + optional COM/ID tone (can be switched on)
- 90 Hz
  Suppression of 150 Hz modulation tone
- 150 Hz
  Suppression of 90 Hz modulation tone

An external signal can be added to the internal signal (EXT AM = EXT (MOD AM)). The external signal is input via the AM EXT connector at the rear of the instrument.

The ILS-LOC signal is output at the LF OUT connector at the front of the instrument.

5.4.10.1   ILS-Localizer Modulation Menu
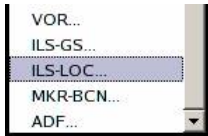
The "ILS-LOC Modulation" menu is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.
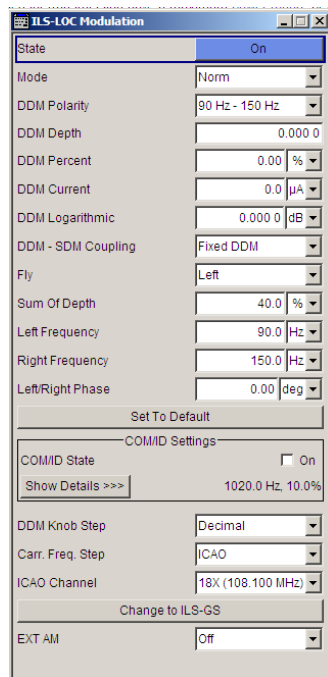
State - ILS-LOC Modulation
Activates/deactivates ILS-LOC modulation.

Activation of ILS-LOC modulation deactivates AM, VOR, ILS-GS, Marker Beacon and ADF modulation.

Source selection is disabled in the "LF Output" menu:

SCPI command:
[:SOURce]:ILS:LOCalizer:STATe on page 496

Mode - ILS-LOC Modulation
Selects the operating mode for the ILS-LOC modulation signal.

"Norm"   ILS-LOC modulation is active.

"90 Hz"   Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal.

The modulation depth of the 90Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

- parameter "Fly" = "Right"
  AM(90 Hz) = 0,5 × (SDM + DDM × 100%)

- parameter "Fly" = "Left"
  AM(90 Hz) = 0,5 × (SDM - DDM × 100%)

"150 Hz"   Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS-LOC signal.

The modulation depth of the 150Hz signal results from the settings of parameters "Sum of depth (SDM)" and "DDM" according to:

- parameter "Fly" = "Right"
  AM (150 Hz) = 0,5 × (SDM + DDM × 100%)

- parameter "Fly" = "Left"
  AM (150 Hz) = 0,5 × (SDM - DDM × 100%)

SCPI command:
[:SOURce]:ILS:LOCalizer:MODE on page 493

DDM Polarity- ILS-LOC Modulation
Defines the polarity for DDM calculation (see DDM Depth).

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM:POLarity on page 490

DDM Depth - ILS-LOC Modulation
Enters the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz).

The DDM value is calculated to formula:
- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM[:DEPTh] on page 488

DDM Percent - ILS-LOC Modulation
Enters the difference in depth of modulation between the signal of the left lobe (90 Hz) and the right lobe (150 Hz).

The DDM value in percent is calculated to formula:
- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)]
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)]

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM:PCT on page 490

DDM Current - ILS-LOC Modulation
Enters the current of the ILS indicating instrument corresponding to the DDM value. The instrument current is calculated according to:

DDM uA = DDM × 967.75 uA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB.

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM:CURRent on page 487

DDM Logarithmic- ILS-LOC Modulation
Enters the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM:LOGarithmic on page 489

DDM to SDM Coupling- ILS-LOC Modulation
Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see below).

"Fixed"   The absolute DDM values stays constant when the SDM is changed.

"SDM"   The absolute DDM values changes when the SDM is changed. The DDM value expressed in dB stays constant.

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM:COUPling on page 487

Fly - ILS-LOC Modulation
Selects the simulation mode for the ILS-LOC modulation signal. A change of the setting automatically changes the sign of the DDM value.

This setting simulates the direction in which the pilot has to correct the course.

"Left"   The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

"Right"   The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

SCPI command:
[:SOURce]:ILS:LOCalizer:DDM:DIRection on page 488

Sum of Depth - ILS-LOC Modulation

Enters the arithmetic sum of the modulation depths of the left lobe (90Hz) and right lobe (150Hz) ILS-LOC signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones. The sum of Sum of Depth and COM/ID depth must be smaller than 100 PCT.

SCPI command:

[:SOURce]:ILS:LOCalizer:SDM on page 495

Left Frequency - ILS-LOC Modulation

Enters the modulation frequency of the antenna lobe arranged at the left viewed from the air plane.

SCPI command:

[:SOURce]:ILS:LOCalizer:LLOBe[:FREQuency] on page 492

Right Frequency - ILS-LOC Modulation

Enters the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

SCPI command:

[:SOURce]:ILS:LOCalizer:RLOBe[:FREQuency] on page 495

Left/Right Phase - ILS-LOC Modulation

Enters the phase between the modulation signals of the left and right antenna lobe. The zero crossing of the right lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the right antenna lobe.

SCPI command:

[:SOURce]:ILS:LOCalizer:PHASe on page 494

Set to Default - ILS-LOC Modulation

Activates the ILS-LOC default setting.

Parameter	Value
State	Not affected by Set to default
Mode	Norm
Source	Internal
DDM	0
Fly	Up
Sum of Depth	40 Percent
Left frequency	90 Hz
Right Frequency	150 Hz
Left/Right Phase	0 deg
COM/ID State	Off
COM/ID Frequency	1020 kHz

Parameter	Value
COM/ID Period	9 s
COM/ID Depth	10 percent

SCPI command:

[:SOURce]:ILS:LOCalizer:PRESet on page 495

COM/ID State - ILS-LOC Modulation

Switches on/off an additional communication/identification signal (COM/ID signal).

SCPI command:

[:SOURce]:ILS:LOCalizer:COMid[:STATe] on page 486

Show Details - ILS-LOC Modulation

Reveals the detailed setting options for the COM/Id signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again. (COM/ID signal).
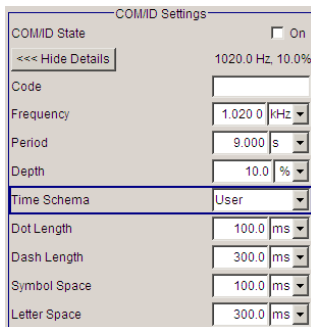
SCPI command:
n.a.

COM/ID Code - ILS-LOC Modulation

Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-10: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -

Letter	Morse Code	Letter	Morse Code
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:

The following values are default values:

- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms the word space between the words varies accordingly.

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

SCPI command:
[:SOURce]:ILS:LOCalizer:COMid:CODE on page 483

COM/ID Frequency - ILS-LOC Modulation
Enters the frequency of the COM/ID signals.

SCPI command:
[:SOURce]:ILS:LOCalizer:COMid:FREQuency on page 485

COM/ID Period - ILS-LOC Modulation
Enters the period of the COM/ID signal in seconds.

SCPI command:
[:SOURce]:ILS:LOCalizer:COMid:PERiod on page 485

COM/ID Depth - ILS-LOC Modulation

Enters the AM modulation depth of the COM/ID signal. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

SCPI command:

`[:SOURce]:ILS:LOCalizer:COMid:DEPTh` on page 484

COM/ID Time Schema - ILS-LOC Modulation

Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

SCPI command:

`[:SOURce]:ILS:LOCalizer:COMid:TSCHema` on page 487

COM/ID Dot Length - ILS-LOC Modulation

Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

SCPI command:

`[:SOURce]:ILS:LOCalizer:COMid:DOT` on page 484

COM/ID Dash Length - ILS-LOC Modulation

(user time schema only)

Enters the length of a Morse dash by means of seconds.

SCPI command:

`[:SOURce]:ILS:LOCalizer:COMid:DASH` on page 483

COM/ID Symbol Space - ILS-LOC Modulation

(user time schema only)

Enters the length of a symbol space by means of seconds.

SCPI command:

`[:SOURce]:ILS:LOCalizer:COMid:SYMBol` on page 486

COM/ID Letter Space - ILS-LOC Modulation

(user time schema only)

Enters the length of a letter space by means of seconds.

SCPI command:

`[:SOURce]:ILS:LOCalizer:COMid:LETTer` on page 485

DDM Knob Step - ILS-LOC Modulation

Selects the variation of the DDM values via the rotary knob.

"Decimal"   Decimal variation according to the current cursor position.

"Defined"   Variation in predefined steps according to the standardized DDM values:

- -0,2000
- -0.1550 (Course Sector)
- -0,0930, -0,0460
- 0,0000 (Course Line)
- +0,0460, +0,0930
- +0,1550 (Course Sector)
- +0,2000

SCPI command:
n.a.

Carrier Frequency Step - ILS-LOC Modulation
Selects the variation of the carrier frequency via the rotary knob.

"Decimal"   Decimal variation according to the current cursor position.

"ICAO"　　　　Activates variation in predefined steps according to the standardized ILS-GS transmitting frequencies (see table, values in MHz). The start value can be selected in the field "ICAO Channel" below.

The selection is effective on both ILS modulations. A change to modulation ILS-GS automatically causes the RF frequency to be adapted to the glide slope value which is coupled to the localizer setting (see table).

Table 5-11: Standardized ILS-GS and ILS-LOC transmitting frequencies (MHz) and the associated ICAO channels

LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz) / ICAO channel	LOC/GS (MHz / ICAO channel)
108.10 / 334.70 / 18X	108.70 / 330.50 / 24X	109.30 / 332.00 / 30X	109.90 / 333.80 / 36X	110.50 / 329.60 / 42X	111.10 / 331.70 / 48X	111.70 / 333.50 / 54X
108.15 / 334.55 / 18Y	108.75 / 330.35 / 24Y	109.35 / 331.85 / 30Y	109.95 / 333.65 / 36Y	110.55 / 329.45 / 42Y	111.15 / 331.55 / 48Y	111.75 / 333.35 / 54Y
108.30 / 334.10 / 20X	108.90 / 329.30 / 26X	109.50 / 332.60 / 32X	110.10 / 334.40 / 38X	110.70 / 330.20 / 44X	111.30 / 332.30 / 50X	111.90 / 331.10 / 56X
108.35 / 333.95 / 20Y	108.95 / 329.15 / 26Y	109.55 / 332.45 / 32Y	110.15 / 334.25 / 38Y	110.75 / 330.05 / 44Y	111.35 / 332.15 / 50Y	111.95 / 330.95 / 56Y
108.50 / 329.90 / 22X	109.10 / 331.40 / 28X	109.70 / 333.20 / 34X	110.30 / 335.00 / 40X	110.90 / 330.80 / 46X	111.50 / 332.90 / 52X	
108.55 / 329.75 / 22X	109.15 / 331.25 / 28Y	109.75 / 333.05 / 34Y	110.35 / 334.85 / 40Y	110.95 / 330.65 / 46Y	111.55 / 332.75 / 52Y	

SCPI command:

`[:SOURce]:ILS:LOCalizer:FREQuency:STEP` on page 490

ICAO Channel - ILS-LOC Modulation

Selects the ICAO channel, i.e., the ILS-LOC transmitting frequency. The RF-frequency is set to the value selected here. A variation of the carrier frequency by the rotary knob is performed in predefined steps according to the standardized ILS-LOC transmitting frequencies (see table). The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

SCPI command:

`[:SOURce]:ILS:LOCalizer:ICAO:CHANnel` on page 491

Change to ILS-GS - ILS-LOC Modulation

Changes to ILS-GS modulation and opens the menu. The state of the ILS LOC modulation (On or Off) is also set for ILS-GS. The RF frequency setting automatically changes to the transmitting frequency associated with the set ICAO channel for ILS-GS if the state is on.

SCPI command:
n.a.

EXT AM - ILS-LOC Modulation

Switching on/off an external modulation. The external signal is input via the AM EXT connector.

"Off"	Selects the internal modulation source for ILS-LOC modulation.
"EXT (MOD AM)"	Selects the external source. The external signal is added to the internal signal. Switching off the internal source is not possible. The external signal is input via the AM EXT connector. The sensitivity is 10mV per percent modulation depth.
	Note: There can be an overmodulation as a function of the level of the external signal without a corresponding caution message being generated.In order to avoid an overmodulation, the peak value of the external signal is to be delimited corresponding to the sum of the modulation depths of the remaining ILS signal components.

SCPI command:
[:SOURce]:ILS:LOCalizer:SOURce on page 496

5.4.11 Marker Beacon Modulation

Marker Beacon modulation is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

The Marker Beacon signal is output at the LF OUT connector at the front of the instrument.

ILS systems provide information relating to the position of the air plane relative to the runway during landing. The Markers indicate the distance of the air plane relative to the threshold of the runway. The modulation frequency changes from outer to the inner marker which are located at a defined distance from the runway. The altitude of the air plane should be 200 feet by the time the middle marker with a modulation frequency of 1300 Hz is reached.

5.4.11.1 Marker Beacon Modulation Menu
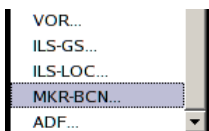
The "Marker Beacon Modulation" menu is opened in the "Mod" function block or using the MENU key under "Mod".

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.
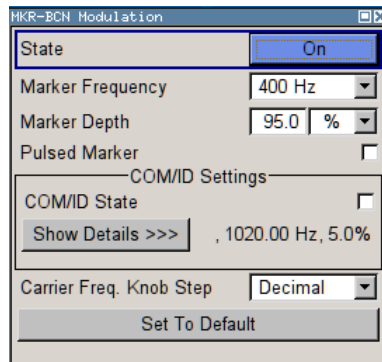
State - Marker Beacon Modulation

Activates/deactivates Marker Beacon modulation.

Activation of Marker Beacon modulation deactivates AM, VOR, ILS and ADF modulation.

Source selection is disabled in the "LF Output" menu:
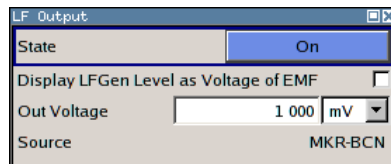
SCPI command:

[:SOURce]:MBEacon:STATe on page 527

Marker Frequency - Marker Beacon Modulation

Enters the modulation frequency of the marker signal.

SCPI command:

[:SOURce]:MBEacon[:MARKer]:FREQuency on page 527

Marker Depth - Marker Beacon Modulation

Enters the modulation depth of the marker signal.

SCPI command:

[:SOURce]:MBEacon[:MARKer]:DEPTh on page 527

Pulsed Marker - Marker Beacon Modulation

Activates/deactivates pulsed marker.

If activated, the markers are output with the following on/off ratio:

	On	Off
Outer Marker (400 Hz)	375 ms	125 ms
Middle Marker (1300 Hz)	375 ms 83 ms	125 ms 83 ms
Inner Marker (3000 Hz)	83 ms	83 ms (6dots/sec)

If deactivated, the markers are output uncoded (key down).

SCPI command:

[:SOURce]:MBEacon[:MARKer]:PULSed on page 528

COM/ID State - Marker Beacon Modulation
Switches on/off an additional communication/identification signal (COM/ID signal).

SCPI command:

[:SOURce]:MBEacon:COMid[:STATe] on page 526

Show Details - Marker Beacon Modulation
Reveals the detailed setting options for the COM/Id signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again. (COM/ID signal).
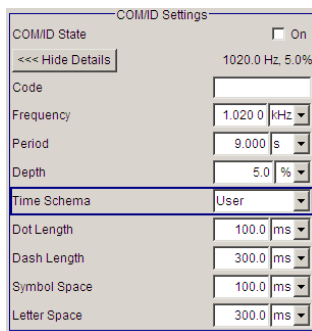
SCPI command:
n.a.

COM/ID Code - Marker Beacon Modulation
Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-12: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-

Letter	Morse Code	Letter	Morse Code
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:

The following values are default values:

- A dot (.) has a tone duration of 100 ms
- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms the word space between the words varies accordingly.

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

SCPI command:

[:SOURce]:MBEacon:COMid:CODE on page 523

COM/ID Frequency - Marker Beacon Modulation

Enters the frequency of the COM/ID signals.

SCPI command:

[:SOURce]:MBEacon:COMid:FREQuency on page 524

COM/ID Period - Marker Beacon Modulation

Enters the period of the COM/ID signal in seconds.

SCPI command:

[:SOURce]:MBEacon:COMid:PERiod on page 525

COM/ID Depth - Marker Beacon Modulation

Enters the AM modulation depth of the COM/ID signal. The sum of subcarrier depth, VAR depth and COM/ID depth must be smaller than 100 PCT.

SCPI command:

[:SOURce]:MBEacon:COMid:DEPTh on page 524

COM/ID Time Schema - Marker Beacon Modulation

Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

SCPI command:

[:SOURce]:MBEacon:COMid:TSCHema on page 526

COM/ID Dot Length - Marker Beacon Modulation

Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

SCPI command:

[:SOURce]:MBEacon:COMid:DOT on page 524

COM/ID Dash Length - Marker Beacon Modulation

(user time schema only)

Enters the length of a Morse dash by means of seconds.

SCPI command:

[:SOURce]:MBEacon:COMid:DASH on page 523

COM/ID Symbol Space - Marker Beacon Modulation

(user time schema only)

Enters the length of a symbol space by means of seconds.

SCPI command:

[:SOURce]:MBEacon:COMid:SYMBol on page 525

COM/ID Letter Space - Marker Beacon Modulation

(user time schema only)

Enters the length of a letter space by means of seconds.

SCPI command:

[:SOURce]:MBEacon:COMid:LETTer on page 525

Carrier Frequency Knob Step - Marker Beacon Modulation

Selects the variation of the carrier frequency via the rotary knob.

"Decimal"   Decimal variation according to the current cursor position.
              An RF frequency of 75 MHz is automatically set when Marker Beacon modulation is switched on.

"Defined" Variation in predefined steps according to the standardized Marker Beacon transmitting frequencies (see table, values in MHz)

Note: If Defined is selected, the current RF frequency is automatically switched over to the next Marker Beacon transmitting frequency acc. to the table when switching on the modulation.

Table 5-13: Standardized Marker beacon transmitting frequencies (MHz)

74.600	75.675	74.750	74.825	74.900	74.975	75.050	75.125	75.200	75.275	75.350
74.625	74.700	74.775	74.850	74.925	75.000	75.075	75.150	75.225	75.300	75.375
74.650	74.725	74.800	74.875	74.950	75.025	75.100	75.175	75.250	75.325	75.400

SCPI command:
n.a.

Set To Default - Marker Beacon Modulation
Activates the Marker Beacon default setting. The RF frequency is set to 75 MHz.

Parameter	Value
State	Off
Marker frequency	400 Hz
Marker Depth	95 %
Pulsed Marker	Off
COM/ID State	Off
COM/ID Frequency	1020 kHz
COM/ID Period	9 s
COM/ID Depth	10 percent
Rf frequency	75 MHz

SCPI command:
[:SOURce]:MBEacon:PRESet on page 527

5.4.12 ADF Modulation

ADF modulation (**A**utomatic **D**irection **F**inders) is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) equipped with option R&S SMA-K25.

The ADF signal is output at the LF OUT connector at the front of the instrument.

The ADF modulation provides a predefined test signal for ADF systems (Automatic Direction Finder).

ADF receivers provide the relative bearing of a basic ground based Non Directional Beacon (NDB) to the fore/aft axis of the aircraft by using a directional antenna assembly in

the aircraft. The ADF determines the direction to the NDB station relative to the aircraft and is used for instrument approaches (autopilot). It provides additional information to other navigation equipment, e.g. VOR.

5.4.12.1 ADF Modulation Menu

The "ADF Modulation" menu is opened in the "Mod" function block or using the MENU key under Mod.

In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the communication/identification signal is performed in the lower section of the menu.
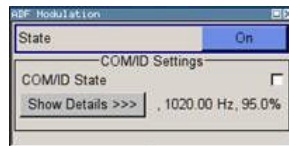
State - ADF Modulation
Activates/deactivates ADF modulation. A unmodulated carrier with a frequency of 190 kHz (default) is generated. After switching on the COM/ID tone the carrier is modulated with 95 percent AM depth at a 1,02 kHz modulation rate.

Activation of ADF modulation deactivates AM, VOR, ILS and Marker Beacon modulation.

Source selection is disabled in the "LF Output" menu:
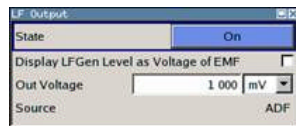
SCPI command:
`[:SOURce]:ADF:STATe` on page 433

COM/ID(A0/A2) State - ADF Modulation
Switches on/off the communication/identification signal (COM/ID signal). The COM/ID tone is modulated onto the carrier (A0/A2 transmission).

SCPI command:
`[:SOURce]:ADF:COMid[:STATe]` on page 432

Show Details - ADF Modulation
Reveals the detailed setting options for the COM/Id signal. Once the details are revealed, the labeling on the button changes to "Hide Details". Use this to hide the detailed setting options display again. (COM/ID signal).

SCPI command:

n.a.

COM/ID(A0/A2) Code - ADF Modulation

Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table of Morse below).The length of the Morse code can be varied. For selection standard time scheme, the selected dot length determines the setting of all other length parameters of the Morse code (dash length, symbol space and letter space) . For selection user time scheme, all length parameters of the code can be set independently.

The COM/ID tone is modulated onto the carrier (A0/A2 transmission).

If no coding is entered, the COM/ID tone is sent uncoded (key down).

Table 5-14: Morse Code

Letter	Morse Code	Letter	Morse Code
A	. -	N	- .
B	- . . .	O	- - -
C	- . - .	P	. - - .
D	- . .	Q	- - . -
E	.	R	. - .
F	. . - .	S	. . .
G	- - .	T	-
H	. . . .	U	. . -
I	. .	V	. . . -
J	. - - -	W	. - -
K	- . -	X	- . . -
L	. - . .	Y	- . - -
M	- -	Z	- - . .

Note:

The following values are default values:

- A dot (.) has a tone duration of 100 ms

- A dash (-) has a tone duration of 300ms
- The time between two tones is 100ms
- The time between two letters is 300ms

After each word a word space is entered. The word repetition rate is 7 words/minute. As the word length can vary between 900 ms and 4500 ms the word space between the words varies accordingly.

Example:

ID code = MUC

The word length =
300+100+300+300+100+100+100+100+300+300+300+100+100+100+300+100+100 = 3100 ms

SCPI command:

[:SOURce]:ADF:COMid:CODE on page 429

COM/ID(A0/A2) Frequency - ADF Modulation

Enters the frequency of the COM/ID signals.

SCPI command:

[:SOURce]:ADF:COMid:FREQuency on page 430

COM/ID(A0/A2) Period - ADF Modulation

Enters the period of the COM/ID signal in seconds.

SCPI command:

[:SOURce]:ADF:COMid:PERiod on page 431

COM/ID(A0/A2) Depth - ADF Modulation

Enters the AM modulation depth of the COM/ID signal.

SCPI command:

[:SOURce]:ADF:COMid:DEPTh on page 429

COM/ID(A0/A2) Time Schema - ADF Modulation

Selects if the set dot length determines the dash length (= three times the dot length) (setting Standard) or if all length parameters can be set independently (setting User). (COM/ID signal).

SCPI command:

[:SOURce]:ADF:COMid:TSCHema on page 432

COM/ID(A0/A2) Dot Length - ADF Modulation

Enters the length of a Morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry if time scheme standard is selected.

SCPI command:

[:SOURce]:ADF:COMid:DOT on page 430

COM/ID(A0/A2) Dash Length - ADF Modulation

(user time schema only)

Enters the length of a Morse dash by means of seconds.

SCPI command:

`[:SOURce]:ADF:COMid:DASH` on page 429

COM/ID(A0/A2) Symbol Space - ADF Modulation
(user time schema only)

Enters the length of a symbol space by means of seconds.

SCPI command:

`[:SOURce]:ADF:COMid:SYMBol` on page 431

COM/ID(A0/A2) Letter Space - ADF Modulation
(user time schema only)

Enters the length of a letter space by means of seconds.

SCPI command:

`[:SOURce]:ADF:COMid:LETTer` on page 431

5.5 LF Generator and LF Output - Mod Gen

5.5.1 LF Generator Overview

An LF generator providing sinusoidal and square signals in the frequency range 0.1 Hz to 1 MHz is available for the basic unit without additional equipment options.

Option Multifunction Generator, R&S SMA-K24, provides a second LF generator that can be used as a second modulation source with the frequency range of 0,1 Hz … 10 MHz and selectable signal shapes and also as source for a noise modulation signal. In addition it extends the frequency range of the first LF generator to 0,1 Hz … 10 MHz, also.

The internal LF generator is available as the internal source for the analog modulations AM, FM / PM and Pulse, and also as the signal source for the LF output at the rear of the instrument.

The frequency setting for the LF generator can be made both in the modulation menus and in the "LF Output" menu. The settings are effective for all modulations using the internal modulation source.

A change to the frequency of the LF generator automatically has an effect on modulation if the LF generator is selected as the modulation source (i.e. "Internal" is selected as "Source").

For example, a change to the frequency of the first LF generator automatically has an effect on AM modulation if the first LF generator is selected as the AM modulation source (i.e. "Internal LFGen1" is selected as Source).

The LF Sweep mode is activated in the "LF Sweep" dialog (see chapter 5.5.2, "LF Frequency Sweep", on page 282). "RF frequency" and "RF Level" sweeps are activated in the respective menus of the RF block.

The option Pulse Generator (R&S SMA-K23) enables the generation of single and double pulse signals.

The generator is activated and configured in the "Pulse Generator" menu of the "Mod Gen" block or in the "Pulse Modulation" menu of the "Modulation" block ("Pulse Generator" is selected as "Source").

5.5.2 LF Frequency Sweep
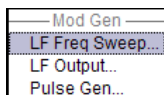
The "LF Frequency Sweep" dialog is used to activate and configure a sweep for the LF frequency.

To open the "LF Frequency Sweep" menu, select "Mod Gen > Configure > LF Frequency Sweep" or use the MENU key under "Mod Gen".

In the top section, the LF Sweep mode is activated and the sweep mode is selected. The buttons are used to reset the LF sweep (all sweep modes) or to execute the LF sweep ("Single" mode).

The sweep range, sweep spacing and dwell time are set in the bottom of the section.
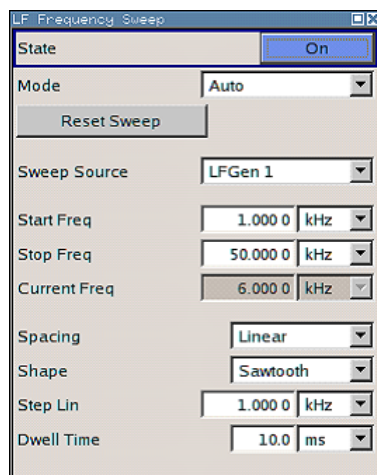
State - LF Sweep
Activates LF Sweep mode.

Note: Activating the LF frequency sweep automatically deactivates the list mode, RF level sweep and RF frequency sweep.

SCPI command:
[:SOURce]:LFOutput:FREQuency:MODE on page 500

Mode - LF Sweep
Selects the Sweep instrument operating mode and Sweep mode.

"Auto"   Sets are automatic repeated sweep cycle. If a different sweep mode was
                activated prior to the "Auto" mode, the cycle continues from the current
                sweep setting.
                The "Reset Sweep" button resets the sweep to the start frequency.

                Example:

                ```
                SOUR:LFO:SWE:FREQ:MODE AUTO
                ```
                ```
                TRIG0:SWE:SOUR AUTO
                ```
                ```
                SOUR:LFO:FREQ:MODE SWE
                ```

"Single"   Sets a single sweep cycle. The sweep is triggered by the "Execute Single
                Sweep" button.
                If a different sweep mode was activated prior to the "Single" mode, the
                current sweep is stopped. The "Single" sweep always starts at the start
                frequency.
                The "Reset Sweep" button resets the sweep to the start frequency.

                Example:

                ```
                SOUR:LFO:SWE:FREQ:MODE AUTO
                ```
                ```
                TRIG0:SWE:SOUR SING
                ```
                ```
                SOUR:LFO:FREQ:MODE SWE
                ```
                ```
                SOUR:LFO:SWE:FREQ:EXEC
                ```

"Step"   Sets a step-by-step sweep cycle. Each sweep step is triggered by a var-
                iation of the value in the "Current Freq" entry window.
                If this mode is activated, the cursor moves to the value displayed for
                "Current Freq". If a different sweep mode was activated prior to the
                "Step" mode, the current sweep is stopped. The "Step" sweep starts at
                the current LF frequency.
                The "Reset Sweep" button resets the sweep to the start frequency.

                Example:

                ```
                SOUR:LFO:SWE:FREQ:MODE MAN
                ```
                ```
                SOUR:LFO:FREQ:MODE SWE
                ```
                ```
                SOUR:LFO:SWE:FREQ:SPAC LIN
                ```
                ```
                SOUR:LFO:SWE:FREQ:STEP:LIN 1E34
                ```
                ```
                SOUR:LFO:FREQ:MAN 12 kHz
                ```

                The value entered with command
                `SOUR:LFO:SWE:FREQ:STEP:LIN|LOG` sets the step width.

                The value entered with command `SOUR:LFO:FREQ:MAN` has no effect,
                the command only sets the next sweep step. In remote control only a
                step-by-step sweep from start to stop frequency is possible

"Extern Single"   Sets a single sweep cycle. The sweep is triggered by an external trigger signal.
If a different sweep mode was activated prior to the "Extern Single" mode, the current sweep is stopped. The "Extern Single" sweep always starts at the start frequency.
The external trigger signal is input at the BNC connector INST TRIG.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:LFO:SWE:FREQ:MODE AUTO
```

```
TRIG0:SWE:SOUR EXT
```

```
SOUR:LFO:FREQ:MODE SWE
``` (External trigger)

"Extern Step"   Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under "Extern Single"). The step width corresponds to the step width set for the rotary knob.
If a different sweep mode was activated prior to the "Extern Step" mode, the current sweep is stopped. The "Extern Step" sweep always starts at the LF start frequency.
The "Reset Sweep" button resets the sweep to the start frequency.

Example:

```
SOUR:LFO:SWE:FREQ:MODE AUTO
```

```
TRIG0:SWE:SOUR EXT
```

```
SOUR:LFO:FREQ:MODE SWE
``` (External trigger)

"Extern Start/ Stop"   Sets an automatically repeated sweep cycle that is started, stopped and restartet by subsequent external trigger events.
The first external trigger signal starts the sweep (Start).
The next external trigger signal stops the sweep at the current frequency (Stop).
The third external trigger signal starts the sweep at the start frequency (Start).
If a different sweep mode was activated prior to the "Extern Start/Stop" mode, the current sweep is stopped and the "Extern Start/Stop" sweep starts at the start frequency when triggered.
The "Reset" button resets the sweep to the start frequency.
The external trigger signal is input at the BNC connector INST TRIG.

Example:

```
SOUR:LFO:SWE:FREQ:MODE AUTO
```

```
TRIG0:SWE:SOUR EAUT
```

```
SOUR:LFO:FREQ:MODE SWE
``` (External trigger)

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:MODE on page 504

:TRIGger<hw>[:SWEep]:SOURce on page 599

[:SOURce]:LFOutput:FREQuency:MODE on page 500

Execute Single Sweep - LF Sweep

Triggers the sweep manually. A manual sweep can only be triggered if "Mode Single" is selected.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute on page 503

Reset Sweep - LF Sweep

Resets the sweep. The start frequency is set and the next sweep starts from there.

SCPI command:

[:SOURce<hw>]:SWEep:RESet[:ALL] on page 569

Sweep Source - LF Sweep

Selects the sweep source.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource on page 503

Start Freq - LF Sweep

Sets the start frequency.

SCPI command:

[:SOURce]:LFOutput:FREQuency:STARt on page 501

Stop Freq - LF Sweep

Sets the stop frequency.

SCPI command:

[:SOURce]:LFOutput:FREQuency:STOP on page 501

Current Freq - LF Sweep

Displays the current frequency.

If "Step" is set, the frequency for the next frequency step of the sweep is entered here.

SCPI command:

[:SOURce]:LFOutput:FREQuency:MANual on page 500

Spacing - LF Sweep

Selects linear or logarithmic sweep spacing.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:SPACing on page 505

Shape - LF Frequency Sweep

Selects the cycle mode for a sweep sequence (shape)

"Sawtooth"   One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

"Triangle"   One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:SHAPe on page 505

Step Lin/Log - LF Sweep
Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

"Step Lin" or "Step Log" is displayed depending on whether "Spacing Lin" or "Log" is selected.

"Step Lin"   With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The linear step width is entered in Hz.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] on page 505

"Step Log"   With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

SCPI command:

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic on page 506

Dwell Time - LF Sweep
Sets the dwell time. The dwell time determines the duration of the individual sweep steps.

The "Dwell Time" set by the user is used as the step time of the sweep. The effective net dwell time is shorter, reduced by the setting time. This setting time may be greater than the time specified in the data sheet.

Note:
It is recommended to switch off the GUI update for optimum sweep performance especially with short dwell times (see chapter 5.2.3.4, "Gui Update", on page 88).

SCPI command:
`[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl` on page 503

Trigger Input Slope
Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

"Positive"   The rising edge of the trigger signal is active.

"Negative"   The falling edge of the trigger signal is active.

SCPI command:
`[:SOURce]:INPut:TRIGger:SLOPe` on page 498

5.5.3 LF Output

Mod Gen
LF Freq Sweep...
LF Output...
Pulse Gen...

To open the "LF Output" dialog, select "Mod Gen > Configure > LF Output" or use the MENU key under "Mod Gen".

The "LF Output" menu provides access to the configuration of the internal modulation generators. In addition, the LF output is configured in this menu. The available settings depend on the source selected and on the installed options.

In the upper section of the menu, the LF output source is selected and the LF output is switched on. The source can be selected independently for the different modulations and the LF output. The configuration of the selected internal source is performed in the lower section of the "LF Output" menu or in the individual modulation menus of the "Mod" block (e.g. "Amplitude Modulation" menu). These settings affect all modulations which use the same modulation sources and the LF output. For a fully equipped instrument two LF generators and a noise generator are available as internal sources.

5.5.3.1   LF Output Menu

State - LF Output

Activates/deactivates the LF output. This setting has no effect on the modulations.

The modulation signal is output at the LF OUTPUT connector of the instrument.

SCPI command:

[:SOURce]:LFOutput[:STATe] on page 502

Output Voltage - LF Output

Sets the output voltage of the LF output. The entered value determines the peak voltage.

SCPI command:

[:SOURce]:LFOutput:VOLTage on page 508

Source

Selects the internal source to be used for the LF Output signal. The available selection depends on the options fitted.

Note: VOR/ILS is indicated and selecting the source is disabled if VOR/ILS modulation is activated.

Note: If an avionic modulation (VOR/ILS) is activated all settings except for the output voltage are disabled and the avionic modulation is indicated under "Source".

In order to enable source selection again, the avionic modulation must be deactivated first.

"None"   Switches off all internal modulation sources.

"LFGen1 /   Selects one of the internal LF generators as the source for the LF Output
LFGen2"   signal.

"LFGen1+2"   Selects both internal LF generators as the source for the LF Output signal. LF frequency and output voltage can be set separately for the two LF generators. The added output voltage of the two modulation generators must not exceed the overall voltage.

"Noise"   Selects the internal noise signal. The LF output signal is white noise either with Gaussian distribution or equal distribution.
See also chapter 5.5.3.2, "Noise Settings", on page 290.

"LFGen1+Noise / LFGen2+Noise "   Selects one LF generator and the noise signal as the source for LF Output.

SCPI command:
[:SOURce<hw>]:AM:INTernal:SOURce on page 434

Output Voltage 1/2 - LF Output
(Source LFGen1+2 only)

Selects the output voltage for the two LF generators. The sum of the two values must not exceed the overall output voltage set in the upper part of the menu.

SCPI command:
[:SOURce]:LFOutput<ch>:INTernal:VOLTtage on page 502

LF Gen 1/2 Freq - LF Output
(Source LFGen1+2 only)

Sets the frequency of the two LF generators.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

Note: VOR/ILS is indicated and setting the frequency is disabled if VOR/ILS modulation is activated.

SCPI command:
[:SOURce]:LFOutput<ch>:FREQuency on page 499

LF Gen Shape
Selects the waveform shape of the LF signal.

The settings applies for "Source LFGen2" only. In case of selection Trapeze additional settings concerning the duration of the single trapeze elements can be made.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe on page 507

Trapeze Rise - LF Output
(Source LFGen2 only)

Selects the rise time for the trapeze shape of the second LF generator.

SCPI command:
[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:RISE on page 508

Trapeze High - LF Output

(Source LFGen2 only)

Selects the high time for the trapeze shape of the second LF generator.

SCPI command:

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:HIGH on page 507

Trapeze Fall - LF Output

(Source LFGen2 only)

Selects the fall time for the trapeze shape of the second LF generator.

SCPI command:

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:FALL on page 507

Trapeze Low - LF Output

(Source LFGen2 only)

Selects the low time for the trapeze shape of the second LF generator.

SCPI command:

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:LOW on page 508

DC Offset - LF Output

Sets a DC offset at the LF Output.

SCPI command:

[:SOURce]:LFOutput:OFFSet on page 502

5.5.3.2 Noise Settings

The settings for the noise source are offered in the "Noise" section of the "LF Output" menu of the "Mod Gen" block. This setting affects all analog modulations which use the noise generator as the internal modulation source

Distribution - Noise

Source Internal, Noise only

Selects the noise power density distribution of noise.

"Gaussian"   The noise power density has a Gaussian distribution.

"Equal"   The noise power density has an even distribution.

SCPI command:

[:SOURce<hw>]:NOISe:DISTribution on page 529

Bandwidth Limitation

Source Internal, Noise only

Enabled /disables bandwidth limitation of noise.

"On"   The noise signal is generated within the set frequency bandwidth. The noise level in the frequency band is indicated at "Noise Level (System Bandwidth)" ("LF Output" menu of the "Mod Gen" block).

"Off"   The noise signal is generated within the maximum bandwidth of 10 MHz. The noise level per Hz is indicated at "Noise Level - Noise" ("LF Output" menu of the "Mod Gen" block)

SCPI command:

[:SOURce<hw>]:NOISe:BWIDth:STATe on page 529

Noise Level - Noise
Indicates the level of the noise signal per Hz in the total bandwidth.

SCPI command:

[:SOURce<hw>]:NOISe:LEVel:RELative on page 530

Bandwidth
Source Internal, Noise only

Enters the noise bandwidth in case bandwidth limitation is enabled. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps (range 100 .. 1 MHz), 1 MHz (range 1 MHz .. 5 MHz) and 5 MHz (5 MHz … 10 MHz) are possible.

The noise signal is generated within the set frequency bandwidth. Noise level per Hz and noise level in the system bandwidth are indicated at "Noise Level (System Bandwidth)" ("LF Output" menu of the "Mod Gen" block).

SCPI command:

[:SOURce<hw>]:NOISe:BWIDth on page 529

Noise Level (System Bandwidth)
Indicates the noise level in the system bandwidth for enabled bandwidth limitation. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps are possible.

SCPI command:

[:SOURce<hw>]:NOISe:LEVel[:ABSolute] on page 530

5.5.4 Pulse Generator

The "Pulse Generator" dialog is used to activate and configure a pulse modulation signal.

The "Pulse Generator" menu is opened in the "Mod Gen" function block or using the MENU key under "Mod gen". The same settings can be made in the "Pulse Modulation" menu of the "Modulation" block.

5.5.4.1 Pulse Generator Settings

The dialog provides the settings for the pulse characteristics and trigger mode.

Video Sync Signal State - Pulse Generator
Switches on/off the output of the video/sync signal at the PULSE VIDEO connector. The signal output and the pulse generator are automatically switched on with activation of pulse modulation if pulse generator is selected as modulation source. The signal output can be switched off subsequently.

SCPI command:
[:SOURce<hw>]:PGEN:STATe on page 530

Pulse Mode - Pulse Generator
Sets the mode of the pulse generator.

"Single"   A single pulse is generated in one pulse period.

"Double"   Two pulses are generated in one pulse period. Additional settings for the double pulse are available in the menu.

"Train"   Requires option R&S SMA-K27.
             A user-defined pulse train is generated. Additional settings for the pulse train are available in the menu after selection of the pulse train mode (see chapter 5.5.4.2, "Pulse Train Generation", on page 297).
             A pulse train is a sequence of pulses with user-defined on and off times. The ontime/offtime value pairs are defined in a pulse train list. The currently used pulse train file is displayed in the sub menu.

SCPI command:
[:SOURce<hw>]:PULM:MODE on page 546

Pulse Period - Pulse Generator
Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

SCPI command:
[:SOURce<hw>]:PULM:PERiod on page 546

Pulse Width - Pulse Generator

Sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20 ns less than the set pulse period.

SCPI command:

`[:SOURce<hw>]:PULM:WIDTh` on page 557

Pulse Delay - Pulse Generator

(External trigger only)

Sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

SCPI command:

`[:SOURce<hw>]:PULM:DELay` on page 544

Double Pulse Width - Pulse Generator

(Double Pulse only)

Sets the width of the second pulse.

SCPI command:

`[:SOURce<hw>]:PULM:DOUBle:WIDTh` on page 545

Double Pulse Delay - Pulse Generator

(Double Pulse only)

Sets the delay from the start of the first pulse to the start of the second pulse.

SCPI command:

`[:SOURce<hw>]:PULM:DOUBle:DELay` on page 545

Trigger Mode - Pulse Generator

Selects the trigger mode for pulse modulation.

"Auto"   The pulse generator signal is generated continuously.

"Ext Triggered" The pulse generator signal is triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

Example: Generation of pulse signals using trigger modes Ext Triggered (Single Pulse)

The measurement were made using a 6-dB-attenuator.

Parameter	Value
Trigger Mode	Ext Triggered
Double Pulse State	Off
External Trigger Input Slope	Positive
Pulse Delay	100 ns
Pulse Width	100 ns
Pulse Period	-

Channel = Indicates the external trigger signal which is input at the PULSE EXT connector.
1　　　　The positive slope is active.

Channel = Indicates the sync signal. The sync signal starts after a trigger delay of typically
2　　　　50 ns (see specifications). The sync signal is output at the PULSE SYNC connector.

Channel = Indicates the pulse signal. The pulse signal starts after the set pulse delay of
3　　　　100 ns. It is output at the PULSE VIDEO connector.

Example: Generation of pulse signals using trigger modes Ext Triggered (Double Pulse)

The measurement were made using a 6-dB-attenuator.

Parameter	Value
Trigger Mode	Ext Triggered
Double Pulse State	On
External Trigger Input Slope	Negative
Pulse Width	100 ns
Double Pulse Width	100 ns

Parameter	Value
Double Pulse Delay	200 ns
Pulse Period, Pulse Delay	-

Chan-
nel 1   = Indicates the external trigger signal which is input at the PULSE EXT connector.
The negative slope is active. A second trigger signal during double pulse gen-
eration is without effect.

Chan-
nel 2   = Indicates the sync signal. The sync signal starts after a trigger delay of typically
50 ns (see specifications). The sync signal is output at the PULSE SYNC con-
nector.

Chan-
nel 3   = Indicates the double pulse signal. The first pulse starts without a delay. The
second pulse starts after the set double pulse delay (time between start of first
pulse to start of second pulse). The double pulse is output at the PULSE
VIDEO connector.

"Ext Gated"   The pulse generator signal is gated by an external gate signal.
The signal is supplied via the PULSE EXT connector.

Example: Generation of pulse signals using trigger modes Ext gated (Single Pulse)

The measurement were made using a 6-dB-attenuator.

Parameter	Value
Trigger Mode	Ext Gated
Double Pulse State	Off
External Trigger Input Slope	Positive
Pulse Delay	100 ns
Pulse Width	100 ns
Pulse Period	300 ns

Chan-nel 1	=	Indicates the external gate signal which is input at the PULSE EXT connector. The signal is active when it is high (positive).
Chan-nel 2	=	Indicates the sync signal. The sync signal starts after a trigger delay of typically 50 ns (see specifications). It is repeated after the set pulse period of 300 ns as long as the gate signal is active. The sync signal is output at the (PULSE) SYNC connector.
Chan-nel 3	=	Indicates the pulse signal. The first pulse starts after the pulse delay of 100 ns. The second pulse starts after the set pulse period. They are output at the (PULSE) VIDEO connector.

SCPI command:

External Trigger Input Slope - Pulse Generator
(External Trigger only)

Sets the polarity of the active slope of an applied trigger signal.

"Positive"   The pulse generator is triggered on the positive slope of the external trigger signal.

"Negative"   The pulse generator is triggered on the negative slope of the external trigger signal.

SCPI command:

[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe on page 552

Gate Input Polarity - Pulse Generator

(Trigger Mode External Gated only)

Selects the polarity of the Gate signal.

The signal is supplied via the PULSE EXT connector.

"Normal"   The pulse signal is generated while the gate signal is high.

"Inverse"   The pulse signal is generated while the gate signal is low.

SCPI command:

[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity on page 552

Pulse External Input Impedance

Selects the input impedance for the external trigger and gate signal input (PULSE EXT).

SCPI command:

[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance on page 552

5.5.4.2   Pulse Train Generation

Upon selection of mode pulse train the menu is extended for configuring a user-defined pulse train.

A pulse train is a sequence of pulses with user-defined on and off times. The ontime/ offtime value pairs are defined in a pulse train list. The currently used pulse train file is displayed in the sub menu.

An internally created pulse train list can be exported or externally created list can be imported.

Pulse Train Data – Pulse Generator

Calls the "File Select" menu for selecting and creating a pulse train file or to open the "File Manager".

SCPI command:

[:SOURce<hw>]:PULM:TRAin:CATalog on page 547

[:SOURce<hw>]:PULM:TRAin:SELect on page 551

[:SOURce<hw>]:PULM:TRAin:DELete on page 548

Edit Pulse Train Data – Pulse Generator
Calls the Pulse Train Dialog.

Pulse Train Dialog

The pulse train defined by the selected file is displayed.

The display of the pulse train can be zoomed, the zoom center is defined by the blue marker.

"Edit"   Calls the Edit Pulse Train Data dialog for editing the pulse train.

"Zoom Position"   Positions the blue marker in the pulse train. The marker defines the center of any zoom in or zoom out action.

"Zoom In/Out"   Zooms in or out the graphical display of the pulse train. The zoom factor of each zoom action is 2.

Edit Pulse Train Data
(For Pulse Mode Train only)

Calls the editor for editing the ontime/offtime values of the selected file. A file consists of any number of ontime/offtime value pairs. The currently selected file is displayed.

"Ontime/us"   Sets the ontime of the ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:ONTime on page 549

"Offtime/us"   Sets the offtime of the ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:OFFTime on page 548

"Count"   Sets the number of repetitions for each ontime/offtime value pair.

SCPI command:
[:SOURce<hw>]:PULM:TRAin:REPetition on page 550

"Goto" Selects row for editing.

If Goto row is selected, a window opens for entering the requested row.

(it is not possible to change individual positions of the list)

"Edit" Calls a selection of possible actions described below.

"Insert Row" Insert a new row before the marked row.

"Insert Range" Insert new rows before the marked row. The number of rows to be inserted can be defined in an entry window.

"Fill...." Opens a sub menu for defining a set of list values to be automatically entered in the list.
The start line and the number of rows to be filled are defined under "From" and "Range".
The column to be filled is selected under "Select column to fill". Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters.
The filling of the column with the selected value settings is started with button "Fill".

"Delete Row" Deletes the marked row.

"Delete Range" Deletes the selected number of rows including the marked row. The number of rows to be inserted can be defined in an entry window.

"Save As" Open the file menu to save the list under a new name.
Each list is saved to the CpompactFlash™ card as a separate file with the file prefix *.pulstrn. The file name and the directory to which the file is saved are user-selectable.

"Save" The list is saved under its current name.

Import/Export - Pulse Train Mode
Expands the menu with the area for import and export of pulse train files.

Externally edited Excel tables with on/off time and repetition triplets can be imported as text files or CSV files and used for pulse train mode.

On the other hand, internally created pulse train lists can be exported as text files or CSV files.

Mode – Import/Export Pulse Train Files

Selects if pulse train lists should be imported or exported. The settings offered below depend on the selected mode.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE on page 556

Extension – ASCII File Settings

Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension on page 554

Decimal Point - ASCII File Settings

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal
on page 555

Column Separator- ASCII File Settings

Selects the separator between the frequency and level column of the ASCII table.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn
on page 554

Select ASCII Source / Destination - Import/Export Pulse Train Files

Calls the "File Manager" for selecting the ASCII file to be imported into a pulse train list (source) or the ASCII file the pulse train list is exported (destination) in.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog on page 553
[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect on page 554

Select Destination / Source - Import/Export Pulse Train Files

Calls the "File Manager" for selecting the pulse train list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect on page 556

Import / Export - Import/Export Pulse Train Files

Starts the export or import of the selected file.

If import is selected, the ASCII file is imported as pulse train list.

If export is selected, the pulse train list is exported into the selected ASCII file.

SCPI command:

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute on page 555

5.6 Clock Synthesis

The clock synthesis provides a separate system clock with a freely selectable frequency for test setups that require an additional clock reference. For example, in a test setup that uses an A/D converter the required system clock for data sampling can be provided without the need of additional signal generator.

The generated clock reference is synchronized to the selected reference clock of the signal generator (internal or external). The differential signal is output at the "CLK SYN" and "CLK SYN N" connector at the rear of the instrument.

Settings are made in the "Clock Synthesis" block. The function block is available for the basic unit (R&S SMA + frequency option R&S SMA-B10x) including option R&S SMA-B29.

5.6.1 Clock Synthesis Dialog

To access the "Clock Synthesis" dialog, select the "Clock Synthesis" function block or use the MENU key under "Clock Synthesis".

The clock signal can be activated and deactivated directly using the TOGGLE ON/OFF key (the function block must be highlighted beforehand).

The activated and deactivated state is indicated in the block diagram by means of the different block color and the status of the "On" checkbox. The disconnected connection to the output is additionally shown when the output is deactivated.

The Clock Synthesis state can also be set in the "Configure" menu of the block:

The clock synthesis state is activated and frequency is set in the top section of the menu.

The step width which is used when setting the clock frequency using the rotary knob (with "Variation Active On") is set in the "User Variation" section.

5.6.1.1 Clock Synthesis general Settings

State - Clock Synthesis

Activates/deactivates generation of a system clock for output CLK SYN at the rear of the instrument .

SCPI command:

:CSYNthesis:STATe on page 354

Frequency - Clock Synthesis

Sets the frequency. The frequency entered and displayed here corresponds to the frequency at the CLK SYN output.

SCPI command:

:CSYNthesis:FREQuency on page 354

5.6.1.2 DC Offset

A DC offset can be defined in the "DC Offset" section.

State DC Offset - Clock Synthesis

Requires modules with part number 1400.2749.02 (see "Setup" menu).

Activates a DC offset for both clock synthesis signal outputs.

The DC offset can be used e.g. to shift the clock synthesis output signal into the trigger threshold of some logic elements.

SCPI command:

:CSYNthesis:OFFSet:STATe on page 356

DC Offset - Clock Synthesis

Requires modules with order number 1400.2749.02 (see "Setup" menu).

Enters the value of the DC offset for both clock synthesis signal outputs.

SCPI command:

:CSYNthesis:OFFSet on page 355

5.6.1.3 User Variation

If the clock frequency is set using the rotary knob, the step width is defined in the "User Variation" section.

Variation Step - Clock Synthesis

Sets the user-defined step width. This step width is used when entering the clock frequency using the rotary knob. Frequency variation with this step width must also be activated with "Variation Active".

SCPI command:

:CSYNthesis:FREQuency:STEP on page 355

Variation Active

Activates the user-defined step width used when varying the frequency value with the rotary knob.

"ON"   The frequency value set with the rotary knob is varied using the user-defined step width which is entered under "Variation Step".

"OFF"   The frequency value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

SCPI command:

:CSYNthesis:FREQuency:STEP:MODE on page 355

6 Remote Control Basics

This chapter provides basic information on operating an instrument via remote control.

6.1 Remote Control Interfaces and Protocols

The instrument supports different interfaces for remote control. The following table gives an overview.

Table 6-1: Remote control interfaces and protocols

Interface	Protocols, VISA[*)] address string	Remarks
Local Area Network (LAN)	Protocols: ● VXI-11 ● socket communication (Raw Ethernet, simple telnet) VISA[*)] address string: TCPIP::host address[::LAN device name][::INSTR]	A LAN connector is located on the front or rear panel of the instrument, or both. The interface is based on TCP/IP and supports various protocols. For a description of the protocols refer to: ● chapter 6.1.3.1, "VXI-11 Protocol", on page 308 ● chapter 6.1.3.2, "Socket Communication", on page 308
USB	VISA[*)] address string: USB::<vendor ID>::<product ID>::<serial number>[::INSTR]	USB connectors are located on the front or the rear panel of the instrument, or both. For a description of the interface refer to chapter 6.1.4, "USB Interface", on page 309
Serial Interface	VISA[*)] address string: ASRL[0-9][::INSTR]	For a description of the interface refer to chapter 6.1.5, "Serial Interface", on page 309.
GPIB (IEC/ IEEE Bus Interface)	VISA[*)] address string: GPIB::primary address[::INSTR] (no secondary address)	Optional GPIB bus interfaces according to standard IEC 625.1/ IEEE 488.1 are located on the rear panel of the instrument. For a description of the interface refer to chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 310.

[*)] VISA is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite for remote control over LAN (when using VXI-11 protocol), USB and serial interface. However, no VISA installation is necessary to remote control while using socket communication. For more information, see chapter 6.1.1, "VISA Libraries", on page 306.

Within this interface description, the term GPIB is used as a synonym for the IEC/IEEE bus interface.

SCPI (Standard Commands for Programmable Instruments)

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the

standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

6.1.1 VISA Libraries

VISA is a standardized software interface library providing input and output functions to communicate with instruments. The I/O channel (LAN or TCP/IP, USB, GPIB,...) is selected at initialization time by means of the channel–specific address string ("VISA resource string"), or by an appropriately defined VISA alias (short name). A VISA installation is a prerequisite for remote control using the following interfaces:

- chapter 6.1.3.1, "VXI-11 Protocol", on page 308
- chapter 6.1.4, "USB Interface", on page 309
- chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 310
- chapter 6.1.5, "Serial Interface", on page 309

For more information about VISA refer to the user documentation.

6.1.2 Messages

The messages transferred on the data lines are divided into the following categories:

- Interface messages
  Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They are used to communicate between the controller and the instrument. Interface messages can only be sent by instruments that have GPIB bus functionality. For details see the sections for the required interface.

- Instrument messages
  Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description. Structure and syntax of the instrument messages are described in chapter 6.3, "SCPI Command Structure", on page 324. A detailed description of all messages available for the instrument is provided in the chapter "Remote Control Commands".
  There are different types of instrument messages, depending on the direction they are sent:
  – Commands
  – Instrument responses

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:

– **Setting commands** cause instrument settings such as a reset of the instrument or setting the frequency.

– **Queries** cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by directly appending a question mark to the command header.

● According to their definition in standards:

– **Common commands**: their function and syntax are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self test.

– **Instrument control commands** refer to functions depending on the features of the instrument such as frequency settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as "SCPI compliant" in the command reference chapters. Commands without this SCPI label are device-specific, however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

6.1.3 LAN Interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols. For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. They are connected using a commercial RJ45 cable. The TCP/IP network protocol and the associated network services are preconfigured on the instrument. Software for instrument control and (for specified protocols only) the VISA program library must be installed on the controller.

VISA library

Instrument access via VXI11 protocols is usually achieved from high level programming platforms using VISA as an intermediate abstraction layer. VISA encapsulates the low level VXI or GPIB function calls and thus makes the transport interface transparent for the user. See chapter 6.1.1, "VISA Libraries", on page 306 for details.

IP address

Only the IP address or the computer name (LAN device name) is required to set up the connection. The IP address/computer name is part of the "visa resource string" used by the programs to identify and control the instrument. The visa resource string has the form:

`TCPIP::host address[::LAN device name][::INSTR]` , where:

● **TCPIP** designates the network protocol used

● **host address** is the IP address

- **LAN device name** is the computer name of the control device (alternative to IP address)

- **INSTR** indicates that the VXI-11 protocol is used

Example:

Instrument has the IP address *192.1.2.3*; the valid resource string is:

`TCPIP::192.1.2.3::INSTR`

Computer name is *RSSM1*; the valid resource string is:

`TCPIP::RSSM1::INSTR`

> **Identifying instruments in a network**
>
> If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by means of the resource string.

6.1.3.1 VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

6.1.3.2 Socket Communication

An alternative way for remote control of the software is to establish a simple network communication using sockets. The socket communication, also referred as "Raw Ethernet communication", does not require a VISA installation on the remote controller side.

The simplest way to establish socket communication is to use the build-in telnet program. The telnet program is part of every operating system and supports a communication with the software on a command-by-command basis. For better utilization and to enable automation by means of programs, user defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the host name of the instrument and the number of the port configured for remote-control. All R&S Signal Generator use port number 5025 for this purpose. The port is configured for communication on a command-to-command basis and for remote control from a program.

6.1.3.3 Interface Messages

In the LAN connection, the interface messages are called low–level control messages. These messages can be used to emulate interface messages of the GPIB bus.

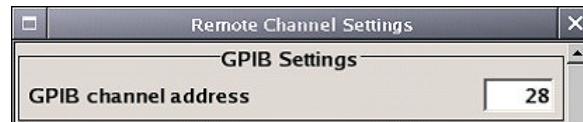| Command	Long term	Effect on the instrument
&ABO	Abort	Aborts processing of the commands just received.
&DCL	Device Clear	Aborts processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
&GTL	Go to Local	Transition to the "local" state (manual control).
&GTR	Go to Remote	Transition to the "remote" state (remote control).
&GET	Group Execute Trigger	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
&LLO	Local Lockout	Disables switchover from remote control to manual control by means of the front panel keys.
&NREN	Not Remote Enable	Enables switchover from remote control to manual operation by means of the front panel keys
&POL	Serial Poll	Starts a serial poll.

6.1.4 USB Interface

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to enter an address string or install a separate driver.

USB address

The used USB address string is:

`USB::<vendor ID>::<product ID>::<serial number>[::INSTR]`

where:

- <vendor ID> is the vendor ID for Rohde&Schwarz
- <product ID> is the product ID for the R&S instrument
- <serial number> is the individual serial number on the rear of the instrument

Example:

`USB::0x0AAD::0x0048::100001::INSTR`

0x0AAD is the vendor ID for Rohde&Schwarz

0x48 is the product ID for the R&S SMA

100001 is the serial number of the particular instrument

6.1.5 Serial Interface

Remote control via the serial interface is possible either via RS232 interface or via a Bluetooth connection. The controller/Bluetooth device and the instrument must be con-

nected via an external USB/serial-adapter (see recommended extras, data sheet) and a serial crossover (null modem) cable. A USB connection requires the VISA library to be installed on the controller. VISA will detect and configure the R&S SMA automatically when the USB connection is established.

Serial address

The used serial address string is:

`ASRL[0-9][::INSTR]`

where `ASRL[0-9]` determines the number of the COM port on the controller side, that has to be used for the serial connection.

Access via a bluetooth device requires the entry of the bluetooth pin in addition (see chapter 5.2.3.15, "Security", on page 98).

To enable an error-free and correct data transmission, the parameters of the generator and the controller must have the same setting. The serial interface is preset for a baud rate 115200, no parity and one stop bit. The parameters can be manually changed in "Remote Channel Settings" dialog (see chapter 5.2.3.13, "Remote Channel Settings", on page 95).

6.1.6 GPIB Interface (IEC/IEEE Bus Interface)

To be able to control the instrument via the GPIB bus, the instrument and the controller must be linked by a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the programming language used must be provided in the controller. The controller must address the instrument with the GPIB bus address (see chapter 6.1.6.2, "GPIB Instrument Address", on page 311).

Characteristics

The GPIB interface is described by the following characteristics:

* Up to 15 instruments can be connected
* The total cable length is restricted to a maximum of 15 m; the cable length between two instruments should not exceed 2m.
* A wired "OR"-connection is used if several instruments are connected in parallel, since the slowest instrument determines the speed.

Any connected IEC bus cable must be terminated by an instrument or controller.

6.1.6.1 GPIB Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line (ATN) being active (LOW). They are used for communication between the controller and the instrument and can only be sent by a computer which has the function of a GPIB bus controller. GPIB interface messages can be further subdivided into:

- **Universal commands**: act on all instruments connected to the GPIB bus without previous addressing
- **Addressed commands**: only act on instruments previously addressed as listeners

Universal Commands

Universal commands are encoded in the range 10 through 1F hex. They affect all instruments connected to the bus and do not require addressing.

Command	Effect on the instrument
DCL (Device Clear)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument settings.
IFC (Interface Clear) *)	Resets the interfaces to the default setting.
LLO (Local Lockout)	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	Ready for serial poll.
SPD (Serial Poll Disable)	End of serial poll.
PPU (Parallel Poll Unconfigure)	End of the parallel-poll state.
*) IFC is not a real universal command, it is sent via a separate line; however, it also affects all instruments connected to the bus and does not require addressing	

Addressed Commands

Addressed commands are encoded in the range 00 through 0F hex. They only affect instruments addressed as listeners.

Command	Effect on the instrument
GET (Group Execute Trigger)	Triggers a previously active instrument function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
GTL (Go to Local)	Transition to the "local" state (manual control).
GTR (Go to Remote)	Transition to the "remote" state (remote control).
PPC (Parallel Poll Configure)	Configures the instrument for parallel poll.
SDC (Selected Device Clear)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.

6.1.6.2 GPIB Instrument Address

In order to operate the instrument via remote control, it must be addressed using the GPIB address. The remote control address is factory preset, but it can be changed if it does not fit in the network environment. For remote control, addresses 0 through 30 are allowed. The GPIB address is maintained after a reset of the instrument settings.

Changing the GPIB address of the instrument

The GPIB address can be changed manually or using a remote control command.

1. Manually: press the SETUP key and select "Remote > GPIB".

   Select parameter "GPIB channel address" and set the GPIB address.

2. Using remote control command:
   SYST:COMM:GPIB:ADDR 18

6.2 Starting a Remote Control Session

The instrument and the controller have to be connected with the suitable cable and switched on.

A remote control program must open a connection to the instrument (using VISA functionality), before it can send commands to and receive device responses from the instrument.

Instrument Address

In order to operate the instrument via remote control it must be addressed using the defined interface address. See chapter 6.1.3, "LAN Interface", on page 307, chapter 6.1.4, "USB Interface", on page 309, chapter 6.1.5, "Serial Interface", on page 309or chapter 6.1.6, "GPIB Interface (IEC/IEEE Bus Interface)", on page 310 for details.

The VISA resource strings are indicated in the "Setup > Remote Channel Settings" menu.

Refer to chapter 6.2.3, "Examples", on page 313 for practical examples on setting up of a remote control link and starting of a remote control session.

6.2.1 Switching to Remote Control

When it is switched on, the instrument is always in the manual operating state and can be operated via the front panel controls (for instruments equipped with a display) or via mouse and external keyboard.

Starting remote control

1. Send a command from a controller to the instrument.

   The instrument is switched to remote control as soon as it receives a command from the controller.

While remote control is active, operation via the front panel or via mouse and keyboard is disabled and "REMOTE" is displayed in the status line.

The instrument remains in the remote state until it is reset to the manual state via the instrument or via the remote control interface (see chapter 6.2.2, "Returning to Manual Operation", on page 313).

Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

2. Although operation via front panel, mouse and keyboard is disabled, the dialog boxes can still be opened, e.g. to verify settings, but buttons and setting fields are displayed in gray and cannot be activated.
   Use the command `SYST:KLOC ON` to disable the access to the dialogs.

3. To prevent unintentional return to manual operation, disable the LOCAL key of the instrument using the `&LLO` command (see chapter 6.1.3.3, "Interface Messages", on page 308).

   The instrument switches to "REM-LLO" state and transition to manual mode is not anymore possible via the remote control command `*GTL`.
   Switching to manual mode is only possible via remote control then.

4. Enable the LOCAL key with the interface message `&NREN`.

6.2.2 Returning to Manual Operation

Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

► To return to manual operation, use one of the following ways:

   a) Press the LOCAL key on the front panel.
   b) Select "Setup > Remote Control Channels" and press "Local".
   c) While using the socket communication, terminate the remote control session.
   d) Send the interface command `&GTL` via the remote control interface.

   Tip: Use the `&NREN` to enable the LOCAL key if the key is disabled.

6.2.3 Examples

This sections provides examples for setting up of remote control connection and starting a remote control session over LAN and GPIB interfaces.

This section assumes basic knowledge of programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

6.2.3.1 Remote Control over GPIB

The program example in this section is written in VISUAL BASIC. A condition for programming in VISUAL BASIC is that the modules NIGLOBAL (`Niglobal.bas`) and VBIB32 (`Vbib_32.bas`) are added to the projects.

> Drivers for instrument, e.g. IVI-COM and LabVIEW drivers, are available in the download area of the product website (http://www2.rohde-schwarz.com/en/products/test_and_measurement/product_categories/signal_generation/).

Starting a remote control session over GPIB

As a prerequisite, the GPIB address of the instrument, which is factory-set to 28, must not have been changed.

1. Connect instrument and controller using GPIB cable and switch them on.

2. Execute following commands on the controller:
   a) Open port to the instrument
      ```
      CALL IBFIND("DEV1", generator%)
      ```
   b) Inform controller about instrument address
      ```
      CALL IBPAD(generator%, 28)
      ```
   c) Reset instrument
      ```
      CALL IBWRT(generator%, "*RST;*CLS")
      ```
   d) Set instrument to new address
      ```
      CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 18")
      ```
   e) Inform controller about new address
      ```
      CALL IBPAD(generator%, 18)
      ```

   The GPIB address of the instrument is changed.

3. To return to manual operation, press the LOCAL key at the front panel.

6.2.3.2 Remote Control over LAN using VXI-11 Protocol

Through the examples in this section, the program 'Measurement & Automation Explorer' from National Instruments under Windows operating system is used for setting up a LAN remote control link and starting a remote control session.

Configuring the controller

> The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

To enable the external controller to communicate with the software via TCP/IP protocol, set up a remote control link as follow:

1. Connect the controller and the instrument to the network (network cable) and switch them on.

2. Start the 'Measurement & Automation Control' program on the controller.

3. Select "Devices and Interfaces > Create New".

4. Select "VISA TCP/IP Resource" and confirm with "Next".

5. Choose the type of TCP/IP resource you wish to add and select Next.

6. Enter the IP address or the host name of the R&S SMA and select "Next".

7. Enter the alias name if required.
   The alias name must not be mistaken for the computer name. It is only used for instrument identification within the program and displayed in the menu as an option in case of an Ethernet link.

8. Confirm the settings with "Finish".
   The instrument is configured and the settings are displayed in the "TCP/IP Settings" tab.

9. To test the connection, select "Validate".
   A message indicates whether the link to the instrument can be set up or not.

If a connection cannot be set up, check whether the controller and the instrument are connected to the network (network cable) and switched on. Correct spelling of the IP address or the computer name can also be checked. For further error location, inform the network administrator. In large networks, specification of additional addresses may be required for link setup, e.g. gateway and subnet mask, which are known to the network administrator.

The instrument is now registered in the program and can be addressed via the resource string or alias name.

Starting a remote control over LAN (using VXI-11)

1. Start the 'Measurement & Automation Explorer' on the controller.

2. In the "Configuration" window, select "Device and Interfaces > VISA TCP/IP Resources", select the required instrument and select "Open VISA Test Panel".

3. In the "viWrite" tab, write the command to be send to the instrument and select "Execute".

Instrument responses are displayed on the "viRead" tab.

Tip: For further program operation refer to the online help of the program.

6.2.3.3 Remote Control over LAN using Socket Communication

This chapter provides an example on how to establish a remote control connection over telnet protocol and a simple sockets-based program example that can be further developed.

Setting up a Telnet Connection

To control the software, only a telnet program is required. The telnet program is part of every operating system.

1. To establish a Telnet connection with the R&S SMA, start the telnet program and enter the socket address.
    The socket address is a combination of the IP address or the host name of the R&S SMA and the number of the port configured for remote-control via telnet.
    Tip: The R&S SMA uses the port number 5025 for remote connection via Telnet.

The connection to the instrument is set up and remote-control commands can be sent.

2. Even if the cursor is not visible on the screen, enter blind a remote-control command and confirm with Enter.

After the first remote-control command had been send, the instrument is in the "REMOTE" state, i.e. instrument control from the front panel or via mouse and keyboard is disabled and "REMOTE" is displayed in the status line.

Telnet program examples

The following program example shows a simple TcpClient class that is intended to explain on how to get started with programming of sockets.

The example sets up a socket communication to R&S SMA and opens a simple user interface, very similar to the telnet, which allows input of commands. To enable real automation, further development of the program is required.

TcpClient.h

```
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent      HostInfoStruct;
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string         currentHostName;
    int            currentPort;
    int            currentSocketDescr;
    SockAddrStruct   serverAddress;
    HostInfoStruct * currentHostInfo;
    bool           clientIsConnected;
```

```
    int             receiveBufferSize;
};
```

TcpClient.cpp

```cpp
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent     HostInfoStruct;
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string          currentHostName;
    int             currentPort;
    int             currentSocketDescr;
    SockAddrStruct    serverAddress;
    HostInfoStruct * currentHostInfo;
    bool            clientIsConnected;
    int             receiveBufferSize;
};

#include <netdb.h>
#include <netinet/in.h>
#include <unistd.h>
#include "TcpClient.h"
TcpClient::TcpClient()
: currentHostName( "" )
, currentPort( 0 )
, currentSocketDescr( 0 )
, serverAddress ( )
, currentHostInfo( NULL )
, clientIsConnected( false )
, receiveBufferSize( 1024 )
{
}
TcpClient::~TcpClient()
{
  currentHostInfo = NULL;
}
```

```
void TcpClient::connectToServer( string &hostname, int port )
{
  currentHostInfo = gethostbyname( hostname.c_str( ) );
  if( currentHostInfo == NULL )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("error connecting host\n" );
  }
  currentHostName = hostname;
  currentPort     = port;
  currentSocketDescr = socket(AF_INET, SOCK_STREAM, 0);
  if( currentSocketDescr == 0 )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("can't create socket\n" );
  }
  serverAddress.sin_family = currentHostInfo->h_addrtype;
  serverAddress.sin_port   = htons( currentPort );
  memcpy( (char *) &serverAddress.sin_addr.s_addr,
  currentHostInfo->h_addr_list[0], currentHostInfo->h_length );
  if( connect( currentSocketDescr, ( struct sockaddr *) &serverAddress,
  sizeof( serverAddress ) ) < 0 )
  {
   throw string("can't connect server\n" );
  }
  clientIsConnected = true;
}
void TcpClient::disconnect( )
{
  if( clientIsConnected )
  {
    close( currentSocketDescr );
  }
  currentSocketDescr = 0;
  currentHostName    = "";
  currentPort        = 0;
  currentHostInfo    = NULL;
  clientIsConnected  = false;
}
void TcpClient::transmit( string &txString )
{
  if( !clientIsConnected )
  {
```

```
      throw string("connection must be established before any data can be sent\n");
    }
    char * transmitBuffer = new char[txString.length() +1];
    memcpy( transmitBuffer, txString.c_str(), txString.length() );
    transmitBuffer[txString.length()] = '\n'; //newline is needed!
    if( send( currentSocketDescr, transmitBuffer, txString.length() + 1, 0 ) < 0 )
    {
      throw string("can't transmit data\n");
    }
    delete [] transmitBuffer;
}
void TcpClient::receive( string &rxString )
{
    if( !clientIsConnected )
    {
    throw string("connection must be established before any data can be received\n");
    }
    char * receiveBuffer = new char[receiveBufferSize];
    memset( receiveBuffer, 0, receiveBufferSize );
    bool receiving = true;
    while( receiving )
    {
      int receivedByteCount = recv( currentSocketDescr,
      receiveBuffer, receiveBufferSize, 0 );
      if( receivedByteCount < 0 )
      {
        throw string("error while receiving data\n");
      }
      rxString += string( receiveBuffer );
      receiving = ( receivedByteCount == receiveBufferSize );
    }
    delete [] receiveBuffer;
}
string TcpClient::getCurrentHostName( ) const
{
    return currentHostName;
}
int TcpClient::getCurrentPort( ) const
{
    return currentPort;
}
```

TelnetClient.cpp

```
#include <iostream>
#include "TcpClient.h"
void printUsage()
{
    cout<<"usage: EthernetRawCommand <server-ip> [scpi-command]"<<endl;
}
```

```cpp
int main( int argc, char *argv[] )
{
  int errorCode        = 0; //no error
  bool useSingleCommand = false;
  string singleCommand  = "";
  string hostname       = "";
  int    port           = 5025;
  string input          = "";
  TcpClient client;
  switch( argc )
  {
    case 3:
      useSingleCommand = true;
      singleCommand    = argv[2];
    case 2:
      hostname         = argv[1];
      break;
    default:
        printUsage();
        return(-1);
  }
  try
  {
    client.connectToServer( hostname, port );
    bool terminate = false;
    while( !terminate )
    {
      char buffer[1024];
      if( useSingleCommand )
      {
        input =  singleCommand; //send string
      }
      else
      {
        cin.getline( buffer, 1024 );
        input = buffer;
        if( input == "end" )
        {
          terminate = true;
        }
      }
      if( !terminate)
      {
        client.transmit( input ); //send string
        int qPos = input.find( "?", 0 );
        //receive string only when needed
        if( qPos > 0 )
        {
          string rcStr = "";
          client.receive( rcStr );
```

```
     cout << rcStr << endl;
    }
  }
  if( useSingleCommand )
  {
    terminate = true;
  }
 }
}catch( const string errorString )
{
  cout<<errorString<<endl;
}
client.disconnect( );
return errorCode;
}
```

6.3 SCPI Command Structure

SCPI commands consist of a so-called header and, in most cases, one or more param-
eters. The header and the parameters are separated by a "white space" (ASCII code 0
to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (key-
words). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common com-
mands). Common and device-specific commands differ in their syntax.

6.3.1 Syntax for Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk
(*) and possibly one or more parameters.

Examples:

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

6.3.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument.

For demonstration purposes only, assume the existence of the following commands for this section:

- `DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`
- `FORMat:READings:DATA <type>[,<length>]`
- `HardCOPy:DEVice:COLor <Boolean>`
- `HardCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HardCOPy[:IMMediate]`
- `HardCOPy:ITEM:ALL`
- `HardCOPy:ITEM:LABel <string>`
- `HardCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HardCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HardCOPy:PAGE:SCALe <numeric value>`
- `MMEMory:COPY <file_source>,<file_destination>`
- `SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
- `SENSe:FREQuency:STOP <numeric value>`
- `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`HardCOPy:DEVice:COLor ON` is equivalent to `HCOP:DEV:COL ON`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `HardCOPy:PAGE:DIMensions:QUADrant[<N>]`

Command: `HCOP:PAGE:DIM:QUAD2`

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. With GSM, for instance, slots are counted from 0 to 7. In remote control, the slots are selected using the suffixes 1 to 8. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `HardCOPy[:IMMediate]`

Command: `HCOP:IMM` is equivalent to `HCOP`

Optional mnemonics with numeric suffixes

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma (,). For a description of the parameter types, refer to .

Example:

Definition:`HardCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`

Command:`HCOP:DEV:CMAP:COL:RGB 3,32,44`

Special characters

|	**Parameters**
	 A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
	 Example:
	 Definition:`HardCOPy:PAGE:ORIentation LANDscape | PORTrait`
	 Command `HCOP:PAGE:ORI LAND` specifies landscape orientation
	 Command `HCOP:PAGE:ORI PORT` specifies portrait orientation
	
	 Mnemonics
	 A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
	 Example:
	 Definition`SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
	 The two following commands with identical meaning can be created:
	 `SENS:BAND:RES 1`
	 `SENS:BWID:RES 1`

[ ]	mnemonics in square brackets are optional and may be inserted into the header or omitted. **Example**: `HardCOPy[:IMMediate]` `HCOP:IMM` is equivalent to `HCOP`

{ }	Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
	 Example: `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`
	 The following are valid commands:
	 `SENS:LIST:FREQ 10`
	 `SENS:LIST:FREQ 10,20`
	 `SENS:LIST:FREQ 10,20,30,40`

6.3.3　SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SENSe:FREQ:STOP 1.5GHz` **=** `SENSe:FREQ:STOP 1.5E9`

Units

For physical quantities, the unit can be entered. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)
- N (nano)

If the unit is missing, the basic unit is used.

Example:

`SENSe:FREQ:STOP 1.5GHz` **=** `SENSe:FREQ:STOP 1.5E9`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

`HCOP:PAGE:SCAL 90PCT`

Special numeric values

The texts listed below are interpreted as special numeric values. In the case of a query, the numeric value is provided.

- **MIN/MAX**
  MINimum and MAXimum denote the minimum and maximum value.
- **DEF**
  DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.
- **UP/DOWN**
  UP, DOWN increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.

- **INF/NINF**

  INFinity, Negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.

- **NAN**

  Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Example:

Setting command: `SENSe:LIST:FREQ MAXimum`

Query: `SENS:LIST:FREQ?, Response: 3.5E9`

Queries for special numeric values

The numeric values associated to `MAXimum/MINimum/DEFault` can be queried by adding the corresponding mnemonics to the command. They must be entered following the quotation mark.

Example: `SENSe:LIST:FREQ? MAXimum`

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:

Setting command: `HardCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character strings

Strings must always be entered in quotation marks (' or ").

Example:

HCOP:ITEM:LABel "Test1" or HCOP:ITEM:LABel 'Test1'

Block data

Block data is a format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

FORMat:READings:DATA #45168xxxxxxxx

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a NL^END message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

6.3.4 Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterisk marks a common command.
"	Quotation marks introduce a string and terminate it.
#	The hash symbol introduces binary, octal, hexadecimal and block data. ● Binary: #B10110 ● Octal: #O7612 ● Hexa: #HF3A7 ● Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

6.3.5 Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

● a <New Line>

- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

HCOP:ITEM ALL; HCOP:IMM

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the HCOP command system, i.e. they have one level in common.

When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

HCOP:ITEM ALL;IMM

However, a new command line always begins with the complete path.

Example:

HCOP:ITEM ALL

HCOP:IMM

6.3.6 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.
  Example: HCOP:PAGE:ORI?, Response: LAND

- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
  Example: SENSe:FREQuency:STOP? MAX, Response: 3.5E9

- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command. The response 3.5E9 in the previous example stands for 3.5 GHz.

- Truth values (Boolean values) are returned as `0` (for OFF) and `1` (for ON).
  Example:
  Setting command: `HCOPy:DEV:COL ON`
  Query: `HCOPy:DEV:COL?`
  Response: `1`

- Text (character data) is returned in a short form.
  Example:
  Setting command: `HardCOPy:PAGE:ORIentation LANDscape`
  Query: `HCOP:PAGE:ORI?`
  Response: `LAND`

6.4 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command is one which finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands. Sequential commands are not implemented in the instrument, however the execution time of most commands is so short that they act as sequential commands when sent in different command lines.

- An overlapping command is one which does not automatically finish executing before the next command starts executing. Usually, overlapping commands take longer to process and allow the program to do other tasks while being executed. If overlapping commands do have to be executed in a defined order, e.g. in order to avoid wrong measurement results, they must be serviced sequentially. This is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100 :FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

As a general rule, send commands and queries in different program messages.

Example: Overlapping command with *OPC

The instrument implements `INITiate[:IMMediate]` as an overlapped command. Assuming that `INITiate[:IMMediate]` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a sweep and, after some time, setting the `OPC` bit in the `ESR`:

`INIT; *OPC`.

Sending the following commands still initiates a sweep:

`INIT; *OPC; *CLS`

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

6.4.1 Preventing Overlapping Execution

To prevent an overlapping execution of commands, one of the commands *OPC, *OPC? or *WAI can be used. All three commands cause a certain action only to be carried out after the hardware has been set. By suitable programming, the controller can be forced to wait for the corresponding action to occur.

*Table 6-2: Synchronization using *OPC, *OPC? and *WAI*

Com- mand	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Sending *WAI directly after the command whose processing should be terminated before other commands are executed.

Command synchronization using *WAI or *OPC? appended to an overlapped command is a good choice if the overlapped command takes only little time to process. The two synchronization techniques simply block overlapped execution of the command.

For time consuming overlapped commands it is usually desirable to allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods:

*OPC with a service request

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1

2. Set bit no. 5 in the SRE: *SRE 32 to enable ESB service request.

3. Send the overlapped command with *OPC

4. Wait for a service request

   The service request indicates that the overlapped command has finished.

*OPC? with a service request

1. Set bit no. 4 in the SRE: *SRE 16 to enable MAV service request.

2. Send the overlapped command with *OPC?

3. Wait for a service request

   The service request indicates that the overlapped command has finished.

Event Status Register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1

2. Send the overlapped command without *OPC, *OPC? or *WAI

3. Poll the operation complete state periodically (by means of a timer) using the sequence: *OPC; *ESR?

   A return value (LSB) of 1 indicates that the overlapped command has finished.

*OPC? with short timeout

1. Send the overlapped command without *OPC, *OPC? or *WAI

2. Poll the operation complete state periodically (by means of a timer) using the sequence: <short timeout>; *OPC?

3. A return value (LSB) of 1 indicates that the overlapped command has finished. In case of a timeout, the operation is ongoing.

4. Reset timeout to former value

5. Clear the error queue with `SYStem:ERRor?` to remove the "-410, Query interrupted" entries.

Using several threads in the controller application

As an alternative, provided the programming environment of the controller application supports threads, separate threads can be used for the application GUI and for controlling the instrument(s) via SCPI.

A thread waiting for a *OPC? thus will not block the GUI or the communication with other instruments.

6.5 Status Reporting System

The status reporting system stores all information on the current operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. Both can be queried with the commands `STATus....`

6.5.1 Hierarchy of status registers

As shown in the following figure, the status information is of hierarchical structure.
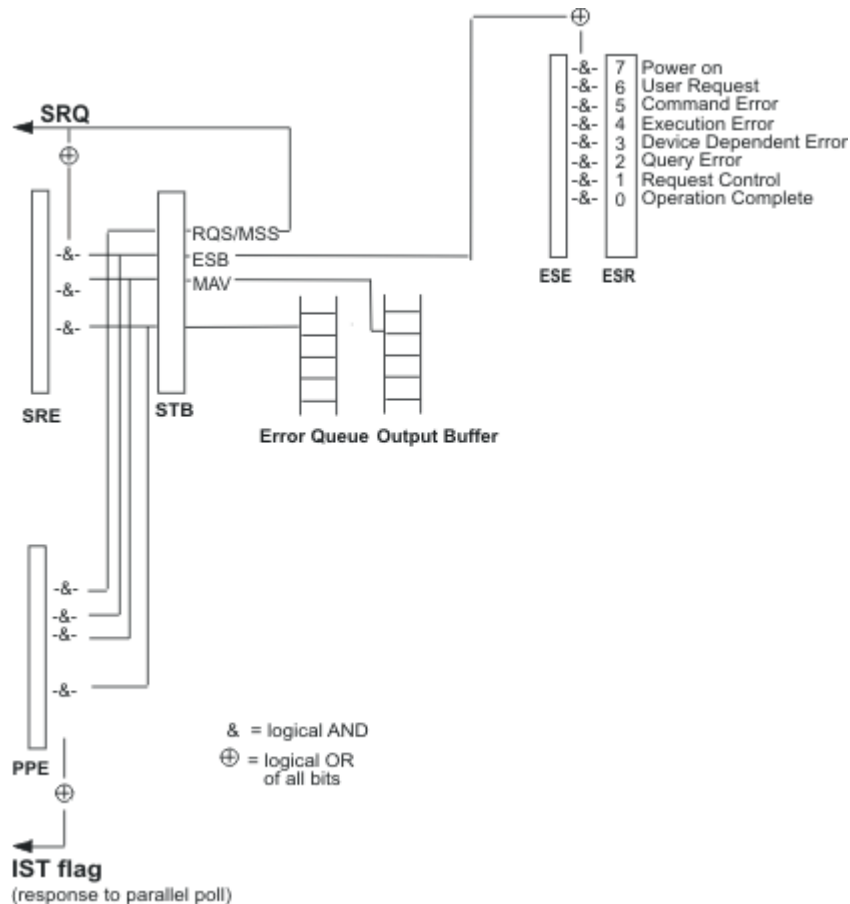
Fig. 6-1: Graphical overview of the status registers hierarchy

- **STB, SRE**
  The STatus Byte (`STB`) register and its associated mask register Service Request Enable (`SRE`) form the highest level of the status reporting system. The `STB` provides a rough overview of the instrument status, collecting the information of the lower-level registers.
- **ESR, SCPI registers**
  The STB receives its information from the following registers:
  – The Event Status Register (`ESR`) with the associated mask register standard Event Status Enable (`ESE`).

    –   The `STATus:OPERation` and `STATus:QUEStionable` registers which are defined by SCPI and contain detailed information on the instrument.

- **IST, PPE**
  The `IST` flag ("Individual STatus"), like the `SRQ`, combines the entire instrument status in a single bit. The `PPE` fulfills the same function for the `IST` flag as the `SRE` for the service request.

- **Output buffer**
  The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the `MAV` bit in the `STB` and thus is represented in the overview.

All status registers have the same internal structure.

SRE, ESE

The service request enable register `SRE` can be used as `ENABle` part of the `STB` if the `STB` is structured according to SCPI. By analogy, the `ESE` can be used as the `ENABle` part of the `ESR`.

6.5.2 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integers.
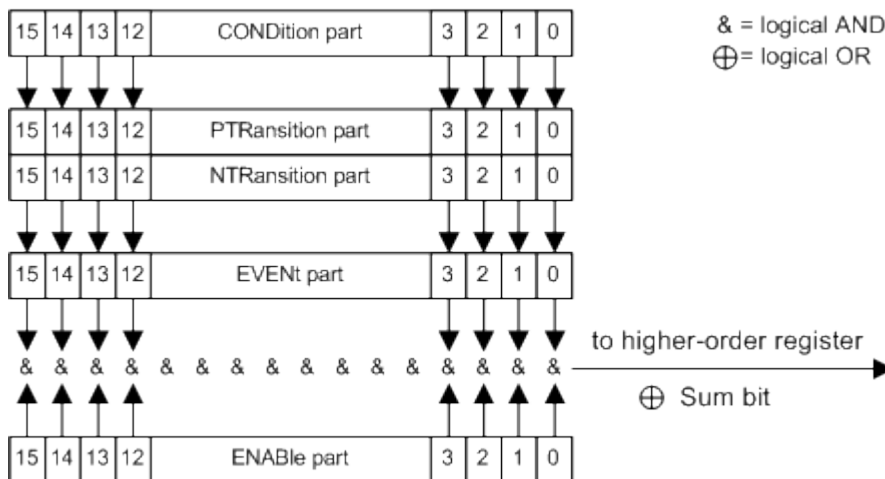
Fig. 6-2: The status-register model

Description of the five status register parts

The five parts of a SCPI register have different properties and functions:

- **CONDition**

The `CONDition` part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.

- **PTRansition**
The two transition register parts define which state transition of the `CONDition` part (none, 0 to 1, 1 to 0 or both) is stored in the `EVENt` part.
The `Positive-TRansition` part acts as a transition filter. When a bit of the `CONDition` part is changed from 0 to 1, the associated `PTR` bit decides whether the `EVENt` bit is set to 1.
  – PTR bit =1: the `EVENt` bit is set.

  – PTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.

- **NTRansition**
The `Negative-TRansition` part also acts as a transition filter. When a bit of the `CONDition` part is changed from 1 to 0, the associated `NTR` bit decides whether the `EVENt` bit is set to 1.
  – NTR bit =1: the `EVENt` bit is set.

  – NTR bit =0: the `EVENt` bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.

- **EVENt**
The `EVENt` part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.

- **ENABle**
The `ENABle` part determines whether the associated `EVENt` bit contributes to the sum bit (see below). Each bit of the `EVENt` part is "ANDed" with the associated `ENABle` bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an "OR" function (symbol '+').
`ENABle` bit = 0: the associated `EVENt` bit does not contribute to the sum bit
`ENABle` bit = 1: if the associated `EVENt` bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user as required. Its contents are not affected by reading.

Sum bit

The sum bit is obtained from the `EVENt` and `ENABle` part for each register. The result is then entered into a bit of the `CONDition` part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event can lead to a service request throughout all levels of the hierarchy.

6.5.3 Contents of the Status Registers

In the following sections, the contents of the status registers are described in more detail.

6.5.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The STatus Byte (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB is read using the command *STB or a serial poll.

The STatus Byte (STB) is linked to the Service Request Enable (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command *SRE and read using the command *SRE?.

Table 6-3: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty
	The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	Not used.
4	MAV bit (message available)
	The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	ESB bit
	Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (master status summary bit)
	The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	Not used.

6.5.3.2 IST Flag and Parallel Poll Enable Register (PPE)

As with the SRQ, the IST flag combines the entire status information in a single bit. It can be read by means of a parallel poll (see chapter 6.5.5.3, "Parallel Poll", on page 340) or using the command *IST.

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are "ANDed" with the corresponding bits of the PPE, with

bit 6 being used as well in contrast to the SRE. The IST flag results from the "ORing" of all results. The PPE can be set using commands *PRE and read using command *PRE?.

6.5.4 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. The event status register can be read out using command *ESR on page 346. The ESE is the associated enable part. It can be set using the command *ESE on page 346 and read using the command *ESE?.

Table 6-4: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device dependent error occurs. An error message with a number between 300 and 399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between 200 and 300, which denotes the error in greater detail, is entered into the error queue.
5	Command Error This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between 100 and 200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set on pressing the LOCAL key, i.e. when the instrument is switched over to manual operation.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

6.5.5 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must receive and evaluate the information of all devices. The following standard methods are used:

● **Service request** (SRQ) initiated by the instrument

- **Serial poll** of all devices in the bus system, initiated by the controller in order to find out who sent a SRQ and why
- **Parallel poll** of all devices
- Query of a **specific instrument status** by means of commands
- Query of the **error queue**

6.5.5.1 Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. An SRQ is always initiated if one or several of bits 2, 4 or 5 of the status byte are set and enabled in the SRE. Each of these bits combines the information of the error queue or the output buffer. In order to use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Example:

Use command `*OPC` to generate an SRQ .

`*ESE 1` - set bit 0 of ESE (Operation Complete)

`*SRE 32` - set bit 5 of SRE (ESB).

After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

6.5.5.2 Serial Poll

In a serial poll, just as with command `*STB`, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster.

The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

6.5.5.3 Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller using a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logical "0" or "1".

In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a Parallel Poll Enable register (PPE) which is ANDed with the STB bit by bit, considering bit 6 as well. This register is ANDed with the STB bit by bit, considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent

as a response to the parallel poll of the controller. The result can also be queried without parallel poll using the command `*IST`.

The instrument first has to be set for the parallel poll using the command `PPC`. This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using `PPE`.

The parallel poll method is mainly used to find out quickly which one of the instruments connected to the controller has sent a service request. To this effect, SRE and PPE must be set to the same value.

6.5.5.4 Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

- The common commands `*ESR?`, `*IDN?`, `*IST?`, `*STB?` query the higher-level registers.
- The commands of the `STATus` system query the SCPI registers (`STATus:QUEStionable...`)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

6.5.5.5 Error Queue

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?` or `SYSTem:ERRor:ALL?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

6.5.6 Reset Values of the Status Reporting System

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except `*RST` and `SYSTem:PRESet`, influence the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 6-5: Resetting the status reporting system

Event	Switching on supply voltage Power-On-Status-Clear		DCL, SDC (Device Clear, Selected Device Clear)	*RST or SYS-Tem:PRE-Set	STA-Tus:PRE-Set	*CLS
Effect	**0**	**1**				
Clear STB, ESR	-	yes	-	-	-	yes
Clear SRE, ESE	-	yes	-	-	-	-
Clear PPE	-	yes	-	-	-	-
Clear error queue	yes	yes	-	-	-	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	-	-	-
1) The first command in a command line that immediately follows a \<PROGRAM MESSAGE TERMINATOR\> clears the output buffer.						

6.6 General Programming Recommendations

Initial instrument status before changing settings

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the instrument status. Thus, when a command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Command sequence

As a general rule, send commands and queries in different program messages. Other-wise, the result of the query may vary depending on which operation is performed first (see also Preventing Overlapping Execution).

Reacting to malfunctions

The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried

regularly since faulty commands from the controller to the instrument are recorded there as well.

7 Remote Control Commands

In the following, all remote-control commands will be presented in detail with their parameters and the ranges of numerical values.

For an introduction to remote control and the status registers, refer to chapter 6, "Remote Control Basics", on page 305.

7.1 Common Commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

*CAL

Calibration Query

Initiates a calibration of the instrument and subsequently queries the calibration status. Responses > 0 indicate errors.

*CLS

CLear Status

Sets the status byte (STB), the standard event register (ESR) and the `EVENt` part of the `QUEStionable` and the `OPERation` registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

---

*ESE <Value>

Event Status Enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:
<Value>

Range: 0 to 255

---

*ESR?

Event Status Read

Returns the contents of the event status register in decimal form and subsequently sets the register to zero.

Return values:
<Contents>

Range: 0 to 255
Usage: Query only

---

*IDN?

IDeNtification: returns the instrument identification.

Return values:
<ID>   "Rohde&Schwarz,<device type>,<serial number>,<firmware version>"

Example: `Rohde&Schwarz,ZVA8-4Port,12345,0.10.1.23`
Usage: Query only

---

*IST?

Individual STatus query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:
<ISTflag>   0 | 1

Usage: Query only

---

*OPC

OPeration Complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used for command synchronization.

*OPT?

OPTion identification query

Queries the options included in the instrument. For a list of all available options and their description refer to the CD-ROM.

Return values:

<Options>   The query returns a list of options. The options are returned at fixed positions in a comma-separated string. A zero is returned for options that are not installed.

Usage: Query only

*PCB <Address>

Pass Control Back

Indicates the controller address to which remote control is returned after termination of the triggered action.

Setting parameters:
<Address>

           Range: 0 to 30

Usage: Setting only

*PRE <Value>

Parallel poll Register Enable

Sets parallel poll enable register to the indicated value. The query returns the contents of the parallel poll enable register in decimal form.

Parameters:
<Value>

           Range: 0 to 255

*PSC <Action>

Power on Status Clear

Determines whether the contents of the `ENABle` registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the "power-on-status-clear" flag.

Parameters:

<Action>	0 | 1
	0
	The contents of the status registers are preserved.
	1
	Resets the status registers.

---

*RCL <Number>

RECALL calls up the instrument status which was stored under the specified number using the `*SAV` command, e.g. `*SAV 4`. It also activates the instrument settings which are stored in a file and loaded using the `MMEMory:LOAD <number>, <file_name.extension>` command.

---

*RST

ReSeT

Sets the instrument to a defined default status. It is equivalent to `SYSTem:PRESet`. The default settings are indicated in the description of commands.

Usage: Setting only

---

*SAV <Number>

SAVE stores the current device state under the specified number (see also `*RCL` on page 348). The command is used to store the current instrument state in an intermediate memory. The instrument state can be recalled by using the command `*RCL` with the associated number.

To transfer the stored instrument settings in a file, use the command `:MMEMory:STORe:STATe`.

---

*SRE <Contents>

Service Request Enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents>   Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

           Range: 0 to 255

---

*STB?

STatus Byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

---

*TRG

TRiGger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal (Manual Trigger). This common command complements the commands of the TRIGger subsystem.

Usage: Event

---

*TST?

self TeST query

Triggers selftests of the instrument and returns an error code in decimal form (see Service Manual supplied with the instrument). "0" indicates no errors occured.

Usage: Query only

---

*WAI

WAIt to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and *OPC).

Usage: Event

7.2 Preset Commands

The preset commands are not bundled in one subsystem. Therefore, they are listed separately in this section. In addition, a specific preset command is provided for each digital standard and for the fader. These specific commands are described in the associated subsystems.

Four presetting actions are available:

- Activating the default state of all internal instrument functions (`*RST` on page 348). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. GPIB address or reference oscillator source settings.
- Activating the preset state of the parameters related to the selected signal path (`:SOURce<hw>:PRESet` on page 350)
- Activating the preset state of all parameters that are not related to the signal path (`:DEVice:PRESet` on page 350)
- Activating the original state of delivery (factory reset, `:SYSTem:FPReset` on page 351). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

:DEVice:PRESet

The command presets all parameters which are not related to the signal path. This includes presetting the LF generator and bit/block error measurement.

Example:	`DEV:PRES`
	presets all instruments settings that are not related to the signal path
Usage:	Event

:SOURce<hw>:PRESet

The command presets all parameters which are related to the selected signal path.

Fading (if available) and transient recorder are only preset by command `*RST`.

Example:	`SOUR:PRES`
	presets all settings that are related to signal path
Usage:	Event

SYSTem:PRESet <Preset>

The command triggers an instrument reset. It has the same effect as the PRESET key on the front panel and the `*RST` command.

For an overview of the settings affected by the preset function, see chapter 5.2.2, "Default Instrument Settings - Preset Key", on page 83.

Return values:
| <Preset> | string |

Example:	`SYST:PRES`
	All instrument settings (also those that are not currently active) are reset to their default values.
Usage:	Event
	SCPI conform

:SYSTem:FPReset

The command triggers an instrument reset to the original state of delivery.

Note: Since Factory Preset resets the Remote Channel and network settings to the default values, executing Factory Preset via remote control terminates the connection to the instrument, if these settings had been configured to values different to the default ones!

The factory preset function resets nearly all instrument settings. In addition to the regular preset by means of the PRESET key, a "Factory Preset" resets also the following values:

- Reference frequency settings ("Ref Oscillator" menu)
- Power on settings ("Level/EMF" menu)
- Network settings including hostname ("Setup" menu)
- Remote Channel settings including GPIB address ("Setup" menu)
- Start/Stop Gui Update ("Setup" menu)
- Display and keyboard settings ("Setup" menu).

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.

Not affected by the "Factory Preset" are also user data, lists or instrument settings files, created for example by means of the Save/Recall function.

Example:	SYST:FPR
	all instrument settings (also those that are not currently active) are reset to the factory values.
Usage:	Event

7.3 CALibration Subsystem

The CALibration system contains the commands for adjustment. Adjustment is triggered by the query commands. The response "0" indicates error-free adjustment, and the response "1" means that an error occurred during adjustment.

:CALibration:ALL[:MEASure]?

The command starts all internal adjustments for which no external measuring equipment is needed.

Return values:

<Measure>	0|1

Example:	CAL:ALL:MEAS?
	starts the adjustment of all functions for the entire instrument.
	Response: "0"
	adjustment has been performed successfully.
Usage:	Query only
	SCPI conform

:CALibration:CSYNthesis[:MEASure]?

The command performs all adjustments which affect the clock synthesis.

Return values:

<Measure>	0|1|OFF|ON

Example:	CAL:CSYN?
	starts the adjustment of all functions for the entire instrument.
	Response: 0
	adjustment has been performed successfully.
Usage:	Query only
	SCPI conform
Options:	R&S SMA-B29

CALibration:DME[:MEASure]?

The command starts internal adjustment of the DME pulse slope for best linearity.

Return values:

<Measure>	0|1|OFF|ON

Example:	CAL:DME?
	starts the adjustments of the DME pulse slope for best linearity.
	Response: 0
	the adjustments have been performed successfully.
Usage:	Query only

:CALibration<hw>:FMOFfset[:MEASure]?

The command starts all adjustment for the FM/PhiM modulator.

Return values:

<Measure>	0|1

Example:	CAL:FMOF?
	starts the adjustments for the FM/Phim modulator.
	Response: "0"
	the adjustments have been performed successfully

Usage: Query only

Options: R&S SMA-B20 or R&S SMA-B22

:CALibration<hw>:FREQuency[:MEASure]?

The command starts all adjustments which affect the frequency.

Return values:

<Measure> 0|1

Example: CAL:FREQ:MEAS?
starts the adjustments for maximum frequency accuracy.
Response: "0"
the adjustments have been performed successfully.

Usage: Query only

:CALibration<hw>:LEVel[:MEASure]?

The command starts level adjustment in the mixer range. The acquired correction values are only used with FM/PhiM or Pulse modulation

Return values:

<Measure> 0|1

Example: CAL:LEV:MEAS?
starts the level adjustment in the mixer range.
Response: "0"
adjustment has been performed successfully.

Usage: Query only

:CALibration<hw>:LEVel:EXTern:DATA <Data>

Selects the data used for of external level correction.

By default the instrument uses correction data obtained in the factory before delivery. In addition, customer data can be used for external level correction. The customer data is obtained using a R&S NRP power sensor. External level correction is a protected function (see service manual, chapter 2, "Adjustment").

Parameters:

<Data> FACT|CUST

*RST: FACTory

Example: CAL:LEV:EXT:DATA FACT
selects the use of the data aquired at the factory for external level correction.

:CALibration:LFOutput[:MEASure] <Measure>

Performs all adjustments which affect the internal modulation generator.

Parameters:

<Measure>

Example:	CAL:LFO?
	starts the adjustments for the modulation generators.
	Response: 0
	the adjustments have been performed successfully.

7.4 CSYNthesis Subsystem

This subsystem contains the commands used to define the frequency settings for the separate clock source (Clock Synthesis).

:CSYNthesis:FREQuency <Frequency>

The command sets the frequency of the clock synthesis output signal.

In addition to a numerical value, it is also possible to specify UP and DOWN. The frequency is then increased or decreased by the value which is set under CSYNthesis:FREQuency:STEP.

Parameters:

<Frequency>   float

	Range:	100 kHz to 1.5 GHz
	Increment:	0.01 Hz
	*RST:	10 MHz
	Default unit: Hz	

Example:	CSYN:FREQ 500kHz
	sets the frequency of clock synthesis signal to 500kHz.
Options:	R&S SMA-B29

:CSYNthesis:STATe <State>

The command activates/deactivates generation of a system clock for differential outputs CLK SYN and CLK SYN N at the rear of the instrument

Parameters:

<State>   0|1|OFF|ON

                   *RST: OFF

Example: `CSYN:STAT ON`
a clock signal with the set frequency is output.
Options: R&S SMA-B29

:CSYNthesis:FREQuency:STEP <Step>

The command sets the step width for the clock synthesis frequency setting if the frequency values UP/DOWN are used and variation mode `SOUR:FREQ:STEP:MODE USER` is selected. The command is linked to "Variation Step "for manual control, i.e. the command also sets the step width of the rotary knob for "Variation Active on".

Parameters:
<Step>   float

Range: 0 Hz to RFmax - 100 KHz
Increment: 0.001 Hz
*RST: 1 MHz
Default unit: Hz

Example: `CSYN:FREQ:STEP 50 kHz`
sets the step width for the clock synthesis frequency setting to 50 kHz.
Options: R&S SMA-B29

:CSYNthesis:FREQuency:STEP:MODE <Mode>

This command activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the clock synthesis frequency value with the frequency values UP/DOWN. The command is linked to the command "Variation Active" for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the frequency value with the rotary knob.

Parameters:
<Mode>   DECimal|USER

*RST: DECimal

Example: `CSYN:FREQ:STEP 50 kHz`
sets the step width for the clock synthesis frequency setting to 50 kHz.
`CSYN:FREQ:STEP:MODE USER`
actives this step width for clock synthesis frequency variation with the rotary knob (manual control) and with frequency values UP/DOWN (remote control).
Options: R&S SMA-B29

:CSYNthesis:OFFSet <Offset>

The command enters a DC offset which is added to both clock synthesis output signals.

Parameters:

<Offset>   float

                               Range: -5 V to +5 V
                               Increment: 10 mV
                               *RST: 0 V
                               Default unit: V

Example: CSYN:OFFS 0.25V

                       sets a DC offset of 0.25 volts

:CSYNthesis:OFFSet:STATe <State>

The command activates the addition of the DC offset to both clock synthesis output sig-nals. The DC offset value is set with command CSYNthesis:OFFSet.

Parameters:

<State>   0|1|OFF|ON

                               *RST: OFF

Example: CSYN:OFFS 0.4V

                       sets a DC offset of 0.4V
                       CSYN:OFFS:STAT ON
                       a DC offset of 0.4V is added to the clock signal

7.5 DIAGnostic Subsystem

The DIAGnostic system contains the commands used for instrument diagnosis and servicing. SCPI does not define any DIAGnostic commands; the commands listed here are all Device-specific. All DIAGnostic commands are query commands which are not influenced by *RST.

:DIAGnostic<hw>:BGINfo?

The command checks the modules available in the instrument using the variant and revi-sion state.

If the command is sent without parameters being specified, a complete list of all modules is returned (the various entries are separated by commas). The length of the list is variable and depends on the instrument equipment configuration.

If the command is sent with parameters, a list of the specified modules is returned (the various entries are separated by commas). A list of modules names can be called up using the command :DIAGnostic<hw>:BGINfo:CATalog on page 357.

Return values:

<Bginfo>   < Module name> <Module stock number incl. variant> <Module revision> <Module serial number>

       Each entry for one module consists of four parts which are separated by space characters.

Example: `DIAG:BGIN`

       Queries the instrument configuration.

       Response: `MBRD,SSYN,....`

       returns the data of all available modules.

       `DIAG:BGIN? 'MBRD'`

       Queries the configuration of the motherboard.

       Response: `MBRD 1141.3501.02 1.5.3 100023`

       Module motherboard with stock number 1141.3501.01 has revision 1.5.3 and serial number 100023.

Usage: Query only

:DIAGnostic<hw>:BGINfo:CATalog?

The command queries the names of the assemblies available in the instrument.

A complete list of all assemblies is returned (the various entries are separated by commas). The length of the list is variable and depends on the instrument equipment configuration.

Return values:

<Catalog>   string

Example: `DIAG:BGIN:CAT`

       queries the names of the assemblies.

       Response: `MBRD,SSYN,....`

Usage: Query only

:DIAGnostic:INFO:OTIMe?

The command queries the number of operation hours.

Return values:

<OTIMe>   float

Example: `DIAG:INFO:OTIM`

       queries the operation hours.

       Response: `100023`

       The instrument was operated for 100023 hours up to now.

Usage: Query only

:DIAGnostic:INFO:POCount?

The command queries the number of power-on events.

Return values:

<Pocount>	float

Example: `DIAG:INFO:POC`
queries the number of power on events.
`Response:   123`
The instrument was switched on for 123 times up to now.

Usage: Query only

7.6 DISPlay Subsystem

The DISPlay system contains the commands to set the power-save mode of the instrument.

:DISPlay:PSAVe:HOLDoff <Holdoff>

This command sets the wait time for the screen-save mode of the display. The available value range is 1 to 60 minutes, the resolution 1 minute. The entry is dimensionless.

Parameters:

<Holdoff>	float
	Range: 1 to 60
	*RST: 1
	Default unit: minute

Example: `DISP:PSAV:HOLD 10`
sets the wait for the screen saver mode to 10 minutes.

:DISPlay:PSAVe[:STATe] <State>

This command activates/deactivates the screen-save mode of the display. With the screen-save mode activated the display including backlight is completely switched off after the elapse of the wait time (see command `DISPlay:PSAVe:HOLDoff`) when no entries via front panel, external mouse or external keyboard are made.

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF

Example: `DISP:PSAV ON`
activates screen saver mode.

7.7　FORMat Subsystem

The FORMat subsystem contains the commands which determine the format of the data that the R&S SMA returns to the controller. This affects all query commands which return a list of numerical data or block data. Reference is made to this in the descriptions of the commands.

:FORMat:BORDer <Border>

The command determines the sequence of bytes within a binary block. This only affects blocks which use the IEEE754 format internally.

Parameters:

<Border>　　　　　　　　NORMal|SWAPped

　　　　　　　　　　　　NORMal
　　　　　　　　　　　　The instrument expects (with setting commands) and sends (with queries) the least significant byte of each IEEE754 floating-point number first and the most significant byte last.

　　　　　　　　　　　　SWAPped
　　　　　　　　　　　　The instrumenet expects (with setting commands) and sends (with queries) the most significant byte of each IEEE754 floating-point number first and the least significant byte last.

　　　　　　　　　　　　*RST:　　　NORMal

Example:　　　　　FORM:BORD SWAP
　　　　　　　　　　　　the data is transferred with the most significant bit first.

Usage:　　　　　　SCPI conform

:FORMat[:DATA] <Data>

The command determines the data format which the R&S Signal Generator uses to return data. When data is transferred from the control computer to the instrument, the instrument detects the data format automatically. In this case, the value set here is irrelevant.

Parameters:

<Data>　　　　　　　　ASCii|PACKed

　　　　　　　　　　　　ASCii
　　　　　　　　　　　　Numerical data is transferred as plain text separated by commas.

　　　　　　　　　　　　PACKed
　　　　　　　　　　　　Numerical data is transferred as binary block data. The format within the binary data depends on the command. The various binary data formats are explained in the description of the parameter types.

　　　　　　　　　　　　*RST:　　　ASCii

Example:	FORM ASC
	The data is transferred as ASCII data.

:FORMat:SREGister <Sregister>

The command determines the numerical format which is returned when the status registers are queried.

Parameters:

<Sregister>　　　　　ASCii|BINary|HEXadecimal|OCTal

ASCii
The register content is returned as a decimal number.

BINary
The register content is returned as a binary number. #B is placed in front of the number.

HEXadecimal
The register content is returned as a hexadecimal number. #H is placed in front of the number.

OCTal
The register content is returned as an octal number. #Q is placed in front of the number.

　　　　　　　　　　*RST:　　　　ASCii

Example:	FORM:SREG HEX
	The register content is returned as a hexadecimal number.
Usage:	SCPI conform

7.8 HCOPy Subsystem

The HCOPy subsystem contains the commands to generate a hardcopy of the display.

:HCOPy:DATA?

The commands transfers the hardcopy data directly as a NByte stream to the remote client.

Return values:

<Data>   string

Example: `HCOP:DEV:LANG JPG`
                                `HCOP:DATA?`
                                transfers the hardcopy to the remote client.
Usage: Query only

:HCOPy:DEVice <Device>

The command defines the output device. The hardcopy can be output in a file. The `HCOPy:FILE:…` commands are used for configuration. The file is accessible using the `MMEM:..` commands. In addition, the hardcopy data can be directly transferred to the remote client using command `:HCOPy:DATA`.

Parameters:

<Device>   FILE

                                *RST: FILE
Example: `HCOP:DEV FILE`
                                the hardcopy will be stored in a file.

:HCOPy:DEVice:LANGuage <Language>

The command selects the bitmap graphic format for the screenshot. It is also possible to directly retrieve the data using command `HCOP:DATA?`. This command is an alias to command `HCOPy:IMAGe:FORMat`.

Parameters:

<Language>   BMP|JPG|XPM|PNG

                                *RST: BMP
Example: `HCOP:DEV:LANG BMP`
                                selects bitmap as image format.
                                `HCOP:FILE '/usb/HCopy'`
                                defines the directory, path and file name for storing the hardcopy.
                                `HCOP`
                                triggers the hardcopy generation.

:HCOPy[:EXECute]

The command triggers the generation of a hardcopy.

The data is written into the file selected/created with the `HCOP:FILE` commands.

Example:	`HCOP`
	triggers the generation of a hardcopy of the current display.
Usage:	Event

:HCOPy:FILE[:NAME] \<Name>

This command creates/selects a file into which the hardcopy will be stored. The path is specified together with the file name. Access to the file via remote control is possible using the commands of the MMEM-Subsystem. In contrast, command `HCOPy:DATA?` transfers the hardcopy contents directly to the remote client where they can be further processed.

If automatic file naming is activated, the hardcopy is stored into a file with an automatically generated name (commands `HCOPY:FILE[:NAME]:AUTO:…`).

Parameters:

\<Name>	string

Example:	`HCOP:FILE:NAME '/usb/HCopy'`
	defines the hardcopy file name.

:HCOPy:FILE[:NAME]:AUTO?

This command queries the path including the file name of the file with automatically generated name.

Return values:

\<Auto>	string

Example:	`HCOP:DEV:LANG BMP`
	selects output format *,bmp.
	`HCOP:FILE:AUTO:DIR '/usb/HCopy'`
	defines the destination directory '/usb/HCopy'.
	`HCOP:FILE:AUTO:PREF 'gen'`
	the file name starts with the prefix 'gen'. The usage of automatic naming with prefix and date in the file name is preset (`…:STAT ON`).
	`HCOP`
	triggers the generation of a hardcopy of the current trace.
	`HCOP:FILE:AUTO?`
	queries the path including the file name
	`Response:`
	/usb/HCopy/gen101012008001.bmp'
Usage:	Query only

:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

This command defines the directory into which the hardcopy files will be stored if auto naming is activated (HCOP:FILE:AUTO:STAT ON).The directory will be created if it does not exist yet.

Parameters:

<Directory>   string

                             *RST: .\HCopy

Example: HCOP:FILE:AUTO:DIR '/usb/HCopy'
                        defines the destination directory '/usb/HCopy'

:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

This command deletes all files with extensions "bmp", "img", "png" and "xpm" in the directory set for automatic naming.

Example: HCOP:FILE:AUTO:DIR:CLE
                        deletes all image files with extensions "bmp", "img", "png" and "xpm".

Usage: Event

:HCOPy:FILE[:NAME]:AUTO:FILE?

This command queries the file name that what generated using the automatic naming settings. By default the automatically generated file name is composed of:

<Prefix><YYYY><MM><DD><Number>.<Format>.

Each component can be deactivated/activated separately to individually design the file name.

Return values:

<File>   string

Example: HCOP:DEV:LANG BMP
                        selects output format *.bmp.
                        HCOP:FILE:AUTO:DIR '/usb/HCopy'
                        defines the destination directory '/usb/HCopy'
                        HCOP:FILE:AUTO:PREF 'gen'
                        the file name starts with the prefix 'gen'. The usage of automatic naming with prefix and date in the file name is preset (…:STAT ON).
                        HCOP
                        triggers the generation of a hardcopy of the current trace.
                        HCOP:FILE:AUTO:FILE?
                        queries the file name
                        Response: 'gen101012008001.bmp'

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

The command returns the day of the current system date which will be used in the file name if automatic naming is activated.

Return values:

<Day>   float

Example: HCOP:FILE:AUTO:DAY?
                          returns the day in the date part of the automatic file name.
Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

This command activates the usage of the day in the automatic file name.

Parameters:

<State>   0|1|OFF|ON

                           *RST: ON

Example: HCOP:FILE:AUTO:DAY:STAT OFF
                          deactivates the use of the day in the automatically generated file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

This command queries the month in the date part in the automatic file name.

Return values:

<Month>   float

Example: HCOP:FILE:AUTO:MONT?
                          queries the month in the date part in the automatic file name.
Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe <State>

This command activates the usage of the month in the automatic file name.

Parameters:

<State>   0|1|OFF|ON

                           *RST: ON

Example: HCOP:FILE:AUTO:MONT:STAT OFF
                          deactivates the usage of the month in the automatic file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

This command queries the number in the automatic file name. The number is assigned in such a way that always the lowest possible value for an unique file name within the selected path is used.

On initially switching on the device the number will be reset to the lowest possible value. Starting with number 0 the output directory will be scanned for already existing files. As long as files with the same name are existing the number will be incremented by 1. The number will be automatically set to a number so that the resulting file name will be unique within the selected path. The current number will not be saved in the save recall file but will be temporarily stored within the database. On subsequent saves the number will be incremented.

Return values:

<Number>   float

Example: HCOP:FILE:AUTO:NUMB?
                  queries the number in the automatic file name.
Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

This command defines the prefix part in the automatic file name. The usage of the prefix is activated with command HCOP:FILE:AUTO:PREF:STAT ON.

Parameters:

<Prefix>   string

                  *RST: HCopy
Example: HCOP:FILE:AUTO:PREF 'Snapshot'
                  appends "Snapshot" as prefix to the generated file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe <State>

This command activates the usage of the prefix in the automatic file name. The prefix is entered with command HCOP:FILE:AUTO:PREF.

Parameters:

<State>   0|1|OFF|ON

                  *RST: ON
Example: HCOP:FILE:AUTO:PREF:STAT OFF
                  deactivates the usage of the prefix in the automatic file name.

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

This command queries the year in the date part in the automatic file name.

Return values:

<Year>   float

Example: `HCOPy:FILE:AUTO:YEAR?`

queries the year in the date part in the automatic file name.

Usage: Query only

:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

This command activates the usage of the year in the automatic file name.

Parameters:

<State>   0|1|OFF|ON

*RST: ON

Example: `HCOP:FILE:AUTO:YEAR:STAT OFF`

deactivates the usage of the year in the automatic file name.

:HCOPy:FILE[:NAME]:AUTO:STATe <State>

This command activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State>   0|1|OFF|ON

*RST: ON

Example: `HCOP:FILE:AUTO:STAT OFF`

deactivates automatic naming.

:HCOPy:IMAGe:FORMat <Format>

This command selects the bitmap graphic format for the screenshot. It is also possible to directly retrieve the data using command `HCOP:DATA?`.

This command is an alias to command `HCOPy:DEVice:LANGuage`.

Parameters:

<Format>   BMP|JPG|XPM|PNG

*RST: BMP

Example: `HCOP:IMAG:FORM XPM`

selects the image format XPM.

:HCOPy:IMAGe:SIZE <Size>

The command selects the image size of the hardcopy. The first value of the size setting defines the width, the second value the height of the image.

Parameters:

<Size>   320,640|640,480|800,600|1024,768

*RST: depends on device

Example: `HCOP:IMAG:SIZE 640,480`

sets width and height of the image.

7.9 KBOard Subsystem

The KBOard system contains the commands to set the external keyboard.

:KBOard:LANGuage <Language>

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Parameters:

<Language>   US|DE

                               *RST: US

Example: KBO:LANG US

                              selects keyboard language American English.

Usage: SCPI conform

:KBOard:LAYout?

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Return values:

<Layout>   CHINese|DANish|DUTCh|ENGUK|ENGUS|FINNish|FRENch|
                               FREBe|FRECa|GERMan|ITALian|JAPanese|KORean|
                               NORWegian|PORTuguese|RUSSian|SPANish|SWEDish

                               *RST: US

Example: KBO:LAY US

                              activates American keyboard layout.

Usage: Query only
                               SCPI conform

7.10 MMEMory Subsystem

The MMEMory subsystem (**M**ass **Mem**ory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

The files are stored on the CompactFlash™ Card of the instrument or on external USB memory devices.

The /var directory can be used to save user-defined data; any subdirectory structure can be created on /var. Some default subdirectories are predefined, but can be changed at any time.

The default directory is determined using the command MMEMory:CDIR.

The /opt directory is a protected and therefore unaccessable system director. The files on this directory contain data that must not be changed. Therefore, this directory should not be accessed, since reconstruction of the system partition will lead to data loss.

7.10.1 File Naming Conventions

To enable files in different file systems to be used, the following file naming conventions should be observed.

The file name can be of any length and no distinction is made between uppercase and lowercase letters. The file and the optional file extension are separated by a dot. All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the file name). Where possible, special characters should not be used. Use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved by the operating system, e.g. CLOCK$, CON, AUX, COM1...COM4, LPT1...LPT3, NUL and PRN.

In the R&S Signal Generator all files in which lists and settings are stored are given a characteristic extension. The extension is separated from the actual file name by a dot (see chapter 4.7.2.1, "Extensions for User Files", on page 76 for an overview the file types).

The two characters "*" and "?" function as "wildcards", i.e. they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the file name. "*.*" therefore stands for all the files in a directory.

When used in conjunction with the commands, the parameter <file_name> is specified as a string parameter with quotation marks. It can contain either the complete path including the drive, only the path and file name, or only the file name. The file name must include the file extension. The same applies for the parameters <directory_name> and <path>.

Depending on how much information is provided, either the values specified in the parameter or the values specified with the command MMEM:CDIR (default directory) are used for the path and drive setting in the commands.

Before the instrument settings can be stored in a file, they have to be stored in an intermediate memory using common command *SAV <number>. The specified number is subsequently used in the MMEM:STOR:STATe<number>, <file> command. Also, subsequently to loading a file with instrument settings with command MMEM:LOAD:STAT <number>, <file>, these settings have to be activated with the common command *RCL <number>.

Example:

In this example, the current instrument setting is always stored in the file
`test1.savrcl` in the directory `user` on the internal flash card.

`*SAV 4`

`MMEM:STOR:STAT 4,"var/rs_gen/test1.savrcl"`

If the complete path is specified, the file is stored in the specified path.

`MMEM:CDIR  'var/rs_gen'*SAV 4`

`MMEM:STOR:STAT 0,"test1.savrcl"`

If the parameter only contains the file name, the file is stored in the default directory which
was selected with the `MMEM:CDIR` command.

7.10.2 Extensions for User Files

The following table list all available file extensions for user files. The currently available
files on the instrument depends on the installed options.

Table 7-1: List of the automatically assigned file extensions in the instrument

Function	List type	Contents	File suffix
Instrument State	Settings	Instrument settings	`*.savrcl`
"User Correction"	List	User-defined level correction values	`*.uco`
		Export Data	`*.txt` or `*.csv`
"List Mode"	List	User-defined frequency/level value pairs	`*.lsw`
		Export Data	`*.txt` or `*.csv`
"Pulse Train List"		User-defined offtime/ontime/repetition values	`*.pulstrn`
ARB Waveform		ARB Waveform	`*.wv`
NRP Settings	Settings	NRP Settings	`*.nrp`

7.10.3 Remote Control Commands

:MMEMory:CATalog? <path>

Returns the content of the current or a specified directory.

Return values:

<path>   <used_memory>,<free_memory>,<file_name>,<file_entry>,...

                          <used_memory>
                          Total amount of storage currently used in the directory, in bytes.

                          <free_memory>
                          Total amount of storage available in the directory, in bytes.

                          <file_entry>
                          All files of the directory are listed with their file name, format and
                          size in bytes.

Query parameters:

<path>   string

                          String parameter to specify the directory. If the direcory is omitted,
                          the command queries the content of the current directory, queried
                          with MMEM:CDIR command.

Example: MMEM:CAT? '/usb/user'
                          reads out all files at the highest directory level of the memory stick.
                          Response: 127145265,175325184,"test,DIR,
                          0","temp,DIR,0","readme.txt,ASC,
                          1324","state.savracl,STAT,
                          5327","waveform.wv,BIN,2342"
                          the directory /usb/user contains the subdirectories test and
                          temp as well as the files readme.txt, state.savrcl and
                          waveform.wv which have different file types.

Usage: Query only

:MMEMory:CATalog:LENGth?

Returns the number of files in the current or in the specified directory.

Return values:

<Length>   <path>

                          String parameter to specify the directory. If the direcory is omitted,
                          the command queries the content of the current directory, queried
                          with MMEM:CDIR command.

<count>   Number of files

Example:　　　　　　　　`MMEM:CAT:LENG? '/usb/user'`
reads out the number of files at the highest directory level of the
memory stick.
Response:
`'1'`
there is 1 file at the highest directory level of the memory stick.
Usage:　　　　　　　　　Query only

:MMEMory:CDIRectory <Cdirectory>

Changes the default directory for mass memory storage. The directory is used for all
subsequent `MMEM` commands if no path is specified with them. It is also possible to change
to a higher directory using two dots '..' .

Setting parameters:
<Cdirectory>　　　　　　　<directory_name>

Example:　　　　　　　`MMEM:CDIR 'test'`
changes from the current directory level to the subdirectory
`test`.
Usage:　　　　　　　　Setting only
SCPI conform

:MMEMory:COPY <file_source>[,<file_destination>]

Copies an existing to a new file. Instead of just a file, this command can also be used to
copy a complete directory together with all its files.

It is also possible to specify the path using another parameter. The command is:
`MMEMory:COPY`
`<file_source><msus_source>[,<file_destination>,`
`<msus_destination>]`

Setting parameters:
<file_source>　　　　　string

String parameter to specify the name of the file to be copied.
If `<destination>` is not specified, `<source>` is copied to the
`MMEM:CDIR` directory. Files which already exist with the same
name in the destination directory are overwritten without an error
message.
It is also possible to specify the path using another parameter. The
command is: `MMEMory:COPY`
`<file_source><msus_source>[,<file_destination>,`
`<msus_destination>]`

file_destination	string
	String parameter to specify the name of the new file. If no file destination is specified, the source file is copied to the current direcotry, queried with the `MMEM:CDIR` command. Files which already exist with the same name in the destination directory are overwritten without an error message.
Example:	`MMEM:COPY '/var/USER/TEST1.SVARCL','/usb'` copies the file `test1.savrcl` in the `user` directory on the internal flash card to the memory stick without changing the file name.
Usage:	Event SCPI conform

:MMEMory:DATA <file_name>[,<binary block data>]
:MMEMory:DATA? <file_name>

Writes the block data <binary block data> to the file identified by <file_name>. The IEC/IEEE-bus terminator should be set to EOI in order to ensure correct data transfer.

The associated query command transfers the specified file from the instrument to the IEC/IEEE bus and then on to the control computer. It is important to ensure that the intermediate memory on the control computer is large enough to take the file. In this case, the setting for the IEC/IEEE-bus terminator is irrelevant. This command can be used to read/transfer stored instrument settings or waveforms directly from/to the instrument.

Parameters:

<file_name>	String parameter to specify the name of the file.

Setting parameters:

<binary block data>	#<number><length entry><block data>
	# always comes first in the binary block <number> the first digit indicates how many digits the subsequent length entry has <length entry> indicates the number of subsequent bytes <binary block data> binary block data for the specified length.
Example:	`MMEM:DATA 'TEST1.WV',#3767<binary data>` writes the block data to the file `test1.wv`. The digit "3" indicates a length entry of 3 digits; the digits "767" indicate a length of the binary data in bytes. `MMEM:DATA? 'TEST1.WV'` sends the data of the file `Test1.wv` from the instrumenet to the controller in the form of a binary block.

:MMEMory:DCATalog?

Returns the subdirectories of the current or specified directory.

Return values:

<Dcatalog>   <file_entry>

Names of the subdirectories separated by colons. The first two strings are related to the parent directory.

Query parameters:

<path_name>   String parameter to specify the directory. If the direcory is omitted, the command queries the content of the current directory, queried with `MMEM:CDIR` command.

Example: `MMEM:DCAT?`

`Response: 'test', 'wave', 'digital'`

the subdirectories `test`, `wave` and `digital` exist in the current directory.

Usage: Query only

:MMEMory:DCATalog:LENGth? [<path_name>]

Returns the number of subdirectories in the current or specified directory.

Return values:

<file_entry_count>   Number of parent and subdirectories.

Query parameters:

<path_name>   String parameter to specify the directory. If the directory is omitted, the command queries the contents of the current directory, to be queried with `MMEM:CDIR` command.

Example: `MMEM:DCAT:LENG?`

reads out the number of subdirectories in the current directory.

Response: 3

there are 3 subdirectories in the current directory.

:MMEMory:DELete <Delete>

Removes a file from the specified directory.

Setting parameters:

<Delete>   <file_name>

String parameter to specify the name and directry of the file to be removed.

Example: `MMEM:DEL '/var//user/test1.savrcl'`

deletes the file `test1.savrcl` in the `user` directory.

Usage: Event

SCPI conform

:MMEMory:LOAD:STATe <sav_rcl_state_number>, <file_name>

This command loads the specified file stored under the specified name in an internal memory.

After the file has been loaded, the instrument setting must be activated using an `*RCL` command.

Setting parameters:

<sav_rcl_state_numb er>
<numeric_value>

Determines to the specific <number> to be used with the `*RCL` command, e.g. `*RCL 4`.

<file_name>
<string>

String parameter to specify the file name with extension `*.savrcl`.

Example:
`*SAV 4`
stores the current instrument setting in an intermediate memory with number 4. This setting can be called using command `*RCL` and the associated number of the memory, e.g. `*RCL 4`.
`MMEM:STOR:STAT 4,'/var//user/test4.savrcl'`
stores the instrument setting stored with the `*SAV` command under memory number 4 in the file `test4.savrcl` in the `user` directory.
`MMEM:LOAD:STAT 4,'/var//user/test4.savrcl'`
loads the file `test4.savrcl` in the `user` directory.
`*RCL 4`
activates the instrument setting of the file `test4.savrcl`.

Usage:
Setting only

:MMEMory:MDIRectory <directory_name>

Creates a new subdirectory for mass memory storage in the specified directory. If no directory is specified, a subdirectory is created in the default directory. This command can also be used to create a directory tree.

Setting parameters:

<directory_name>
string

String parameter to specify the new directory.

Example:
`MMEM:MDIR 'carrier'`
creates the subdirectory 'carrier' in the current directory.

Usage:
Setting only

:MMEMory:MOVE <file_source>, <file_destination>

Moves an existing file to a new location or, if no path is specified, renames an existing file.

It is also possible to specify the path using another parameter. The command is:

```
MMEMory:MOVE
```

```
file_source,msus_source[, file_destination, msus_destination]
```

Setting parameters:

<file_source>	String parameter to specify the name of the file to be moved.
<file_destination>	String parameters to specify the name of the new file.

Example:　　　　　　　`MMEM:MOVE 'test1.savrcl','keep1.savrcl'`
renames the file `test1.savrcls` as `keep1.savrcl`.
`MMEM:MOVE 'test1.savrcl',`
`'\instrument_one\keep1.savrcl'`
moves the file `test1.savrcl` to the subdirectory `instru`
`ment_one` and stores it there under the name `keep1.savrcl`.

Usage:　　　　　　　　Setting only
SCPI conform

:MMEMory:MSIS <Msis>

The command is without effect for the Linux operating system.

Usage:　　　　　　　　SCPI conform

:MMEMory:RDIRectory <Rdirectory>

Removes an existing directory from the mass memory storage system. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

Setting parameters:

<Rdirectory>	string
	String parameter to specify the directory to be deleted.

Example:　　　　　　　`MMEM:RDIR 'carrier'`
deletes the subdirectory 'carrier' in the current directory.

Usage:　　　　　　　　Setting only

:MMEMory:STORe:STATe <sav_rcl_state_number>, <file_name>

Stores the current instrument setting in the specified file.

The instrument setting must first be stored in an internal memory with the same number using the common command `*SAV`.

Setting parameters:

<sav_rcl_state_numb er>	<integer>
	Corresponds to the specific <number> defined with the `*SAV` command, e.g. `*SAV 4`.

<file_name>	<string>
	String parameter to specify the file name with extension `*.savrcl`.
Example:	`*SAV 4`
	stores the current instrument setting in an intermediate memory with number 4. This setting can be called using command `*RCL` and the associated number of the memory, e.g. `*RCL 4`.
	`MMEM:STOR:STAT 4,'/var//user/test4.savrcl'`
	stores the instrument setting stored with the `*SAV` command under memory number 4 in the file `test4.savrcl` in the `user` directory.
Usage:	Event

7.11 OUTPut Subsystem

The `OUTPut` system contains the commands which set the properties of the RF output connector.

The properties of the LF output connector are set in the chapter 7.13.10, "SOURce:LFOutput Subsystem", on page 498 system.

:OUTPut<hw>:AFIXed:RANGe:LOWer?

The command queries the minimum level which can be set without the attenuator being adjusted (Attenuator FIXed).

Return values:

<Lower>	float
	Default unit: dBm
Example:	`OUTP:AFIX:RANG:LOW`
	queries the minimum level for the FIXed setting.
Example:	`Response:  -50`
	The minimum level is -50 dBm.
Usage:	Query only

:OUTPut<hw>:AFIXed:RANGe:UPPer?

The command queries the maximum level which can be set without the attenuator being adjusted (Attenuator FIXed).

Return values:

<Upper>	float
	Default unit: dBm
Example:	OUTP:AFIX:RANG:UPP
	queries the maximum level for the FIXed setting for the RF output.
Example:	Response: -27
	The maximum level is -27 dBm.
Usage:	Query only

:OUTPut<hw>:AMODe <Amode>

The command switches the mode of the attenuator at the RF output (Attenuator MODe).

Parameters:

<Amode>	AUTO|FIXed | NORMal|HPOWer

AUTO
The level settings are made in the area of the electronically switching attenuator as well as in the area of the relay-switched high power bypass. The entire level range is available.

FIXed
The level settings are made without switching the attenuator or the relays. When this operating mode is switched on, the attenuator and the relays are fixed in their current positions and the resulting variation range is defined.

NORMal
The level settings are made only in the area of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made only in the area of the high level ranges. Only the high level range is available. The relays are not switched.

*RST: AUTO

Example:	POW:ALC ON
	activates automatic level control for RF output.
	OUTP:AMOD FIX
	sets the fixed mode with uninterrupted level for RF output.

:OUTPut<hw>:IMPedance?

The command queries the impedance of the RF outputs. This permits converting the output level between units V and W. The impedances cannot be changed.

Return values:

<Impedance>	G50|G1K|G10K
	Default unit: Ohm
Example:	OUTP:IMP
	queries the impedance of RF output.
	Response: 50
	the impedance is 50 ohms
Usage:	Query only
	SCPI conform

:OUTPut<hw>:PROTection:CLEar

The command resets the protective circuit after it has been tripped. The state of the output is again determined by OUTPut:STATe.

The outputs are protected by a protective circuit which deactivates the output in the case of an externally applied overvoltage. This does not change the value of OUTPut:STATe.

Example:	OUTP:PROT:CLE
	resets the protective circuit for RF output.
Usage:	Event
	SCPI conform

:OUTPut<hw>:PROTection:TRIPped?

The command queries the state of the protective circuit.

Return values:

<Tripped>	0|1|OFF|ON
Example:	OUTP:PROT:TRIP
	Queries the state of the protective circuit for RF output A.
	Response: 0
	The protective circuit has not tripped.
	Response: 1
	The protective circuit has tripped.
Usage:	Query only

:OUTPut<hw>[:STATe] <State>

This command activates and deactivates the RF output.

Parameters:

<State>	0|1|OFF|ON
Example:	OUTP OFF
	deactivates the RF output.
Usage:	SCPI conform

:OUTPut<hw>[:STATe]:PON <Pon>

This command selects the state which the RF output assumes when the instrument is switched on.

Parameters:

<Pon>   OFF|UNCHanged

OFF
The output is deactivated when the instrument is switched on.

UNCHanged
When the instrument is switched on, the output remains in the same state as it was when the instrument was switched off.

Example: `OUTP:PON OFF`
RF output A is deactivated when the instrument is switched on.

7.12 Power Sensor Measurement Subsystems

The power sensor measurement uses several subsystems:

- The `CALCulate` subsystem is used to configure the time gated measurements in power analysis.
- The `DISPlay` subsystem is used to configure the diagram appearance.
- The `INITiate` command switches the local state of the continuous power measurement on and off.
- The `READ` system is used to start and to retrieve the measurement result of the power viewer measurement.
- The `SENSe` subsystem contains the commands for configuring the power viewer and power analysis measurements with power sensors connected to the generator.
  Up to three sensors can be connected to the signal generator.
- The `TRACe` subsystem is used to configure the traces in power analysis and to retrieve the measurement results.

Power Viewer

The power viewer measurement is started with the `READ` command, this command also retrieves the measurement results.

The sensors are distinguished by means of the suffix under `SENSe`:

- Power sensor connected to the SENSOR port = `SENSe[1]`
- First Power sensor connected to the USB interface = `SENSe2`
- Second Power sensor connected to the USB interface = `SENSe3`

Third Power sensor connected to the USB interface = `SENSe4`

Power and Pulse Data Analysis, Gated Measurements (option R&S SMA-K28)

The power analysis measurement commands are subsumed under the
`SENSe[:POWer]:SWEep:…` commands. Three measurement modes are available: Frequency, Power and Time.

The power analysis measurement is started with the
`SENSe[:POWer]:SWEep:INITiate` command and the measurement result retrieved
with the `TRACe[:POWer]:SWEep:…` commands.

The four sensors are distinguished by means of the suffix at the second key word
`SENSe`.

The time gate settings are performed using the `CALCulate[:POWer]:SWEep:…` commands.

The measurement diagram and results can be stored in a hardcopy with the
`SENSe[:POWer]:SWEep:HCOPy:…` commands.

General parameter and measurement settings are valid for all connected sensors, therefore, no suffix is used in these commands.

7.12.1 CALCulate Subsystem

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>AVERage?

This command queries the average power value of the time gated measurement.

Return values:

<Average>   float

Example: `SENS:SWE:MODE TIME`
activates time mode for power analysis.
`CALC:SWE:TIME:GATE:STAT ON`
activates time gated measurement.
`SENS:SWE:INIT`
activates a single power analysis measurement.
`CALC:SWE:TIME:GATE2:AVER?`
queries the average power in time gate 2 for trace 1 (=default).

Usage: Query only

Options: Option R&S SMA-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:FEED <Feed>

This command selects the trace for time gated measurement. Both gates are assigned to the same trace.

Parameters:

<Feed>   TRACe1|TRACe2|TRACe3

                        *RST: TRACe1

Example: CALC:SWE:TIME:GATE:FEED TRAC2

                        assignes the gates to trace 2.

Options: Option R&S SMA-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>MAXimum?

This command queries the average power value of the time gated measurement.

Return values:

<Maximum>   float

Example: SENS:SWE:MODE TIME

                        activates time mode for power analysis.

                        CALC:SWE:TIME:GATE:STAT ON

                        activates time gated measurement.

                        SENS:SWE:INIT

                        activates a single power analysis measurement.

                        CALC:SWE:TIME:GATE2:MAX?

                        queries the peak power in time gate 2 for trace 1 (=default).

Usage: Query only

Options: Option R&S SMA-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>STARt <Start/Stop>

This command sets the start time of the selected gate. Insert value and unit.

Parameters:

<Start/Stop>   float

                        *RST: Start/Stop: 5/15 (Gate1), 25/35 (Gate2)
                        Default unit: µs

Example: CALC:SWE:TIME:GATE2:STAR 20us

                        sets a start time of 20 us for gate 2.

Example: CALC:SWE:TIME:GATE2:STOP 30us

                        sets a stop time of 30us for gate 2.

Options: Option R&S SMA-K28

:CALCulate[:POWer]:SWEep:TIME:GATE<ch>:STATe <State>

This command activates gate settings for the selected trace. The measurement ist started with command `SENS:POW:INIT`. Both gates are active at one time.

Parameters:

<State>   0|1|OFF|ON

                              *RST: OFF

Example: `CALC:SWE:TIME:GATE:STAT ON`
                              'enables time gated measurement.
Options: Option R&S SMA-K28

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:STATe <State>

This command activates / deactivates the trace mathematics mode for "Frequency" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State>   0|1|OFF|ON

Example: `CALC:POW:SWE:FREQ:MATH2:STATe`
Example: switches on math mode in trace 2.
Options: R&S SMA-K28

:CALCulate[:POWer]:SWEep:FREQuency:MATH<ch>:SUBTract <Subtract>

This command executes the subtraction of the operands 1 and 2 and assigns the result to the selected trace in "Frequency" measurement mode.

Parameters:

<Subtract>   T1T1|T1T2|T1T3|T1T4|T1REF|T2T1|T2T2|T2T3|T2T4|T2REF|
                              T3T1|T3T2|T3T3|T3T4|T3REF|T4T1|T4T2|T4T3|T4T4|T4REF

Example: `CALC:POW:SWE:FREQ:MATH4:SUBT T2REF`
Example: Subtracts the **Reference** and **Trace 2**, and assigns the result to
                              Trace 4. The resulting curve is shown in the diagram.
Options: R&S SMA-K28

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:STATe <State>

This command activates / deactivates the trace mathematics mode for "Power" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State>   0|1|OFF|ON

Example:	CALC:POW:SWE:POW:MATH2:STATe
Example:	switches on math mode in trace 2.
Options:	R&S SMA-K28

:CALCulate[:POWer]:SWEep:POWer:MATH<ch>:SUBTract <Subtract>

This command executes the subtraction of the operands 1 and 2 and assigns the result to the selected trace in "Power" measurement mode.

Parameters:

<Subtract>	T1T1|T1T2|T1T3|T1T4|T1REF|T2T1|T2T2|T2T3|T2T4|T2REF|
	T3T1|T3T2|T3T3|T3T4|T3REF|T4T1|T4T2|T4T3|T4T4|T4REF

Example:	CALC:POW:SWE:POW:MATH4:SUBT T2REF
Example:	Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.
Options:	R&S SMA-K28

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:STATe <State>

This command activates / deactivates the trace mathematics mode for "Time" measurement. This feature enables to calculate the difference between the measurement values of two traces. Additionally, for further calculation a math result can also be assigned to a trace.

Parameters:

<State>	0|1|OFF|ON

Example:	CALC:POW:SWE:TIME:MATH1:STATe
Example:	switches on math mode.
Options:	R&S SMA-K28

:CALCulate[:POWer]:SWEep:TIME:MATH<ch>:SUBTract <Subtract>

This command executes the subtraction of the operands 1 and 2 and assigns the result to the selected trace in "Time" measurement mode.

Parameters:

<Subtract>	T1T1|T1T2|T1T3|T1T4|T1REF|T2T1|T2T2|T2T3|T2T4|T2REF|
	T3T1|T3T2|T3T3|T3T4|T3REF|T4T1|T4T2|T4T3|T4T4|T4REF

Example:	CALC:POW:SWE:TIME:MATH4:SUBT T2REF
Example:	Subtracts the **Reference** and **Trace 2**, and assigns the result to **Trace 4**. The resulting curve is shown in the diagram.
Options:	R&S SMA-K28

7.12.2   DISPlay Subsystem

:DISPlay[:WINDow][:POWer]:SWEep:BACKground:COLor <Color>

This command defines the background color of the measurement diagram. The background color is also effective for the hardcopy of the diagram.

Parameters:

<Color>   BLACk|WHITe

                           *RST: BLACk

Example: DISP:SWE:BACK:COL WHIT

                           the measurement is indicated with a white background.

:DISPlay[:WINDow][:POWer]:SWEep:GRID:STATe <State>

This command activates/deactivates the indication of a grid in the diagram area..

Parameters:

<State>   0|1|OFF|ON

                           *RST: ON

Example: DISP:SWE:GRID:STAT OFF

                           deactivates the indication of a grid in the diagram area.

Usage: SCPI conform

7.12.3   INITiate Command

INITiate<ch>[:POWer]:CONTinuous <Continuous>

The command switches the local state of the continuous power measurement by the R&S NRP-Zxx power sensors on and off. Switching the local state off enhances the measurement performance during remote control

The remote measurement is triggered by the READ query (command READ<ch>[:POWer]) which also provides the measurement results. The local state is not influenced by this command, measurements results can be retrieved with local state on or off.

Parameters:

<Continuous>   0|1|OFF|ON

                           *RST: OFF

Example: INIT:CONT ON

                           switches local state of continuous power measurement on.

7.12.4 READ Subsystem

READ<ch>[:POWer]?

The command triggers the measurement with power sensors and provides the power measurement result of the selected power sensor. The value is provided with the unit set with command `SENSe:UNIT[:POWer]`.

For certain power sensors, e.g. R&S NRP-Z81, two values are returned, first the value for the average level and - separated by a comma - the peak level

Note: The local state is not influenced by this command, measurements results can be retrieved with local state on or off. For long measurement times it is recommended to use a SRQ (MAV bit) for command synchronization.

Return values:

<Power>   string

Example: `SENS:UNIT DBM`
                          selects unit dBm for presentation of measurement result.
                          `READ1?`
                          queries the measurement result of the sensor connected to the SENSOR interface.
                          `Response: –45.6246576745440230`
                          -45.6 dBm were measured at the given frequency.
                          or e.g. for R&S NRP-Z81
                          `Response:`
                          `–55.62403263352178,–22.419472478812476`
                          -55,6 dbm is the measured average level, -22. 4 dBm is the measured peak level at the given frequency

Usage: Query only

7.12.5 SENSe Subsystem

SENSe<ch>[:POWer]:CORRection:SPDevice:STATe <State>

The command activates the use of the s-parameters correction data of the selected power
sensor.

Note: For power sensor with attenuator this command is automatically set to ON.

Parameters:

<State>   0|1|OFF|ON

                        *RST: OFF

Example: SENS:POW:CORR:SPD:STAT ON

                        activates the use of the s-parameters correction data of power
                        sensor 1.

SENSe<ch>[:POWer]:DISPlay:PERManent:PRIority <Priority>

The command selects which power measurement result (average or peak power) is indicated when permanent display is active.

Parameters:

<Priority>   AVERage|PEAK

                        *RST: AVERage

Example: SENS1:DISP:PERM:STAT ON

                        the permanent viewer is switched on.
                        SENS1:DISP:PERM:PRI AVER

                        the measured average power is indicated.

SENSe<ch>[:POWer]:DISPlay:PERManent:STATe <State>

The command switches on and off the permanent indication of the power measurement result in the upper right corner of the block diagram. For each sensor, the type of sensor, the connector, the measurement source and - if set - the offset is indicated.

Parameters:

<State>   0|1|OFF|ON

                        *RST: OFF

Example: SENS1:POW:DISP:PERM:STAT ON

                        the permanent viewer is switched on.

SENSe<ch>[:POWer]:FILTer:LENGth:AUTO?

The command queries the current filter length for auto filter mode
(:SENSe<[1]...3>:POWer:FILTer:TYPE AUTO)

Return values:

<Auto>   float

Example: SENS1:FILT:TYPE AUTO

                        selects auto filter mode for the power sensor connected to the
                        SENSOR connector.
                        SENS1:FILT:LENG:AUTO?

                        queries the automatically set filter length.
                        Response: 1024

Usage: Query only

SENSe\<ch>[:POWer]:FILTer:LENGth[:USER] \<User>

The command selects the filter length for user filter mode
(`SENSe:POWer:FILTer:TYPE USER`). As the filter length works as a multiplier for the
time window, a constant filter length results in a constant measurement time. Values 1
and 2^n are setable.

The time window is fixed to 20 ms.

Parameters:

\<User>   float

                         Range: 1 to 65536
                         *RST: 1

Example: `SENS:FILT:TYPE USER`
selects user filter mode.
`SENS:FILT:LENG 16`
sets a filter length of 16. The resulting measurement time is 640
ms (2x16x20 ms).

SENSe\<ch>[:POWer]:FILTer:NSRatio \<Nsratio>

The command defines the noise content for fixed noise filter mode
(`:SENSe<1>...3>:POWer:FILTer:TYPE NSRation`). This value determines the
proportion of intrinsic noise in the measured result.

Parameters:

\<Nsratio>   float

                         Range: 0.0001 to 1.0
                         *RST: 0.01

Example: `SENS1:FILT:TYPE NSR`
selects fixed noise filter mode for the power sensor connected to
the SENSOR connector.
`SENS1:FILT:NSR 0.2`
sets a noise content of 0.2.

SENSe\<ch>[:POWer]:FILTer:NSRatio:MTIMe \<Mtime>

The command defines the timeout for fixed noise filter mode
(`:SENSe<1>...3>:POWer:FILTer:TYPE NSRation`). This value ensures limited
settling times.

Parameters:

\<Mtime>   float

                         Range: 1.0 to 999.99
                         *RST: 4
                         Default unit: s

Example: `SENS1:FILT:TYPE NSR`
selects fixed noise filter mode for the power sensor connected to
the SENSOR connector.
`SENS1:FILT:NSR .2`
sets a noise content of 0.2.
`SENS1:FILT:NSR:MTIM 5`
limits the settling time to 5 seconds

SENSe<ch>[:POWer]:FILTer:SONCe

The command activates the search for the optimum filter length for the current measurement conditions. The found filter length can be retrieved with command `:SENSe:POWer:FILTer:LENGth:USER?`. This command is only available for user filter mode (`:SENSe:POWer:FILTer:TYPE USER`).

Example: `SENS:FILT:TYPE USER`
selects user filter mode.
`SENS:FILT:SONC`
activates the search for the optimum filter length.
`SENS:FILT:LENG?`
returns the found optimum filter length.
`Response: 128`
Usage: Event

SENSe<ch>[:POWer]:FILTer:TYPE <Type>

The command selects the filter mode. The filter length is the multiplier for the time window and thus directly influences the measurement time.

Parameters:

<Type>   AUTO|USER|NSRatio

          AUTO
          The filter length is automatically selected depending on the measured value. For high values, a short filter length is selected and for low values a long filter length is selected.

          USER
          The filter length is set manually. As the filter length works as a multiplier for the measurement time, this results in a constant measurement time.

          NSRatio
          The filter lenghth (averaging factor) is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content. The desired noise content is entered with command `SENSe:FILTer:NSRatio`.
          To avoid very long settling times when the power is low, the averaging factor can be limited with the Timeout parameter (command `SENSe:FILTer:NSRatio:MTIMe`).

          *RST: AUTO

Example: `SENS:FILT:TYPE AUTO`
selects automatic filter selection.

SENSe\<ch>[:POWer]:FREQuency \<Frequency>

The command sets the RF frequency of the source if the user source is selected
(`SENSe[:POWer]:SOURce USER`).

Parameters:

\<Frequency>   float

                      *RST: 1 GHz

Example: `SENS:SOUR USER`
selects user-defined source.
`SENS:FREQ 2.44 GHz`
enters the RF frequency of the source which is 2.44 GHz.

SENSe\<ch>[:POWer]:OFFSet \<Offset>

The command enters a level offset which is added to the measured level value after
activation with command `SENSe[:POWer]:OFFSet:STATe ON`. This allows e.g. an
attenuator in the signal path to be taken into account.

Parameters:

\<Offset>   float

                      Range: -100.0 to 100.0
                      *RST: 0
                      Default unit: dB

Example: `SENS:POW:OFFS 10.0`
sets a level offset of 10 dB

SENSe\<ch>[:POWer]:OFFSet:STATe \<State>

The command activates the addition of the level offset to the measured value. The level
offset value is set with command `SENSe[:POWer]:OFFSet`.

Parameters:

\<State>   0|1|OFF|ON

                      *RST: OFF

Example: `SENS1:POW:OFFS 0.4dB`
sets a level offset of 0.4 dB
`SENS1:POW:OFFS:STAT ON`
a level offset of 0.4 dB is added to the measured value.

SENSe\<ch>[:POWer]:SNUMber?

The command queries the serial number of the sensor.

Return values:

<Snumber>   string

Example: `SENS:SNUM?`
                        queries the serial number.

Usage: Query only

SENSe<ch>[:POWer]:SOURce <Source>

The command selects the signal source for the measurement.

Parameters:

<Source>   A|B|USER

                        *RST: A

Example: `SENS:SOUR A`
                        selects the RF signal as measurement source. The RF frequency
                        is used as the measurement frequency of the sensor and the cor-
                        responding correction factor is used. The level setting of the instru-
                        ment serves as reference level of the measurement.

SENSe<ch>[:POWer]:STATus[:DEVice]?

The command queries if a sensor is connected to the signal generator.

The sensor is selected by suffix in the keyword SENSe or READ of the command header.
Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor
connected first to one of the USB interfaces and suffix 3 the sensor connected second
to one of the USB interfaces.

Return values:

<DEVice>   0|1|OFF|ON

Example: `SENS:STAT?`
                        queries if a sensor is connected to the instrument.
                        `Response: 1`
                        a sensor is connected to the POWER SENSOR interface.

Usage: Query only

SENSe<ch>[:POWer]:SVERsion?

The command queries the software version of the connected R&S NRP power sensor.

Return values:

<Sversion>   string

Example: `SENS:POW:SVER?`
                        queries the software version of the R&S NRP power sensor.

Usage: Query only

SENSe[:POWer]:SWEep:ABORt <Abort>

This command aborts the power analysis with NRP power sensors.

Setting parameters:

<Abort>

	Example:	SENS:SWE:ABOR;*OPC?
		aborts the current power measurement.
Usage:	Setting only	

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:COPY

This command generates a reference curve for "Frequency" measurement.

Example:	SENS:POW:SWE:FREQ:REF:DATA:COPY
Example:	generates a reference curve in frequency mode.
Usage:	Event

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:XVALues <Xvalues>

This command sets or queries the x values of the two reference points, i.e. "Frequency X (Point A)" and "Frequency X (Point B)" in "Frequency" measurement.

Parameters:

<Xvalues>   string

Example:	SENSe:POW:SWE:FREQ:REF:DATA:XVAL 100MHZ,22GHZ
Example:	sets the x value of reference "Point A" to 10 MHz, and the value of "Point B" to 10 GHz.

:SENSe[:POWer]:SWEep:FREQuency:REFerence:DATA:YVALues <Yvalues>

This command sets or queries the y values of the two reference points, i.e. "Pow Y (Point A)" and "Power Y (Point B)" in "Frequency" measurement.

Parameters:

<Yvalues>   string

Example:	SENSe:POW:SWE:FREQ:REF:DATA:YVAL –10,25
Example:	sets the y value of reference "Point A" to -10 dBm, and the value of "Point B" to -25 dBm.

SENSe[:POWer]:SWEep:FREQuency:RMODe <Rmode>

This command selects single or continuous mode for measurement mode frequency in power analysis.

Parameters:

<Rmode>   SINGle|CONTinuous

                     *RST: SINGle

Example: SENS:SWE:FREQ:RMOD SING
                     selects single measurement

SENSe\<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge[:STATe] \<State>

This command activates the use of a frequency range for the power measurement that is different to the set signal generator frequency range. The separate frequency range is entered with commands SENS:SWE:FREQ:SENS:STAR and
SENS:SWE:FREQ:SENS:STop.

Parameters:
\<State>   0|1|OFF|ON

                     *RST: 1 MHz

Example: SENS2:SWE:FREQ:SENS:SRAN ON
                     activates use of a separate frequency range for frequency versus power measurement for sensor 2.
                     SENS2:SWE:FREQ:SENS:STAR 2.0GHZ
                     sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.
                     SENS2:SWE:FREQ:SENS:STOP 2.9GHZ
                     sets a sweep stop at 2.9 GHz irrespective of the current signal generator frequency settings.

:SENSe\<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STARt \<Start>

This command enters the start frequency for the frequency power analysis with separate frequencies.

Parameters:
\<Start>   float

                     *RST: 1 MHz

Example: SENS2:SWE:FREQ:SENS:SRAN:STAT ON
                     activates use of a separate frequency range for frequency versus power measurement for sensor 2.
                     SENS2:SWE:FREQ:SENS:STAR 2.0GHZ
                     sets a sweep start at 2 GHz irrespective of the current signal generator frequency settings.

SENSe\<ch>[:POWer]:SWEep:FREQuency[:SENSor]:SRANge:STOP \<Stop>

This command enters the stop frequency for the frequency power analysis with separate frequencies.

Parameters:
\<Stop>   float

                     *RST: 22 GHz

Example: SENS:SWE:FREQ:SENS2:SRAN:STAT ON
                      activates use of a separate frequency range for frequency versus
                      power measurement.
                      SENS:SWE:FREQ:SENS2:STAR 2.0GHZ
                      sets a sweep start at 2 GHz irrespective of the current signal gen-
                      erator frequency settings.
                      SENS:SWE:FREQ:SENS2:STOP 2.9GHZ
                      sets a sweep stop at 2.9 GHz irrespective of the current signal
                      generator frequency settings.

SENSe[:POWer]:SWEep:FREQuency:SPACing[:MODE] <Mode>

This command selects the spacing for the frequency power analysis.

Parameters:
<Mode>   LINear|LOGarithmic

                      *RST: LINear
Example: SENS:SWE:FREQ:SPAC:MODE LIN
                      sets linear spacing of the sweep

SENSe[:POWer]:SWEep:FREQuency:STARt <Start>

This command enters the start frequency for the frequency mode.

Parameters:
<Start>   float

                      *RST: 1.0 MHZ
Example: SENS:SWE:FREQ:STAR 2.0GHZ
                      'sets a sweep start at 2 GHz.

SENSe[:POWer]:SWEep:FREQuency:STEPs <Steps>

This command enters the number of measurement steps for the frequency mode.

Parameters:
<Steps>   float

                      Range: 10 to 1000
                      *RST: 500
Example: SENS:SWE:FREQ:STEP 500
                      sets 500 steps

SENSe[:POWer]:SWEep:FREQuency:STOP <Stop>

This command enters the stop frequency for the frequency mode.

Parameters:

<Stop>	float

*RST: 22.0 GHz

Example: SENS:SWE:FREQ:STOP 20.0GHZ

sets the sweep stop to 20 GHz

SENSe[:POWer]:SWEep:FREQuency:TIMing[:MODE] <Mode>

This command selects the timing for frequency mode.

Parameters:

<Mode>	FAST|NORMal|HPRecision

FAST
Selection FAST leads to a fast measurement with a short
integration times for each measurement step.

NORMal
NORMal leads to a longer but more precise measurement due to
a higher integration time for each step.

*RST: NORMal

Example: SENS:SWE:FREQ:TIM:MODE FAST

the fast measurement mode is selected.

SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO <Auto>

This command activates/deactivates autoscaling of the Y axis of the diagram.

Parameters:

<Auto>	OFF|CEXPanding|FEXPanding|CFLoating|FFLoating

OFF
Auto scaling is deactivated. If switching from activated to
deactivated Auto scaling, the scaling is maintained.

CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in
such a way, that the trace is always visible. To this end, the range
is expanded if the minimum or maximum values of the trace move
outside the current scale. The step width is 5 dB for selection
course and variable in the range of 0.2 db to 5 dB for selection
fine.

CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in
such a way, that the trace is always visible. To this end, the range
is either expanded if the minimum or maximum values of the trace
move outside the current scale or scaled down if the trace fits into
a reduced scale. The step width is 5 dB for selection course and
variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example: SENS:SWE:FREQ:YSC:AUTO OFF

deactivates auto scale

SENSe[:POWer]:SWEep:FREQuency:YSCale:AUTO:RESet

This command resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function resets the diagram in such a way that it matches smaller power values again.

Example: SENS:SWE:FREQ:YSC:AUTO:RES

resets auto scale

Usage: Event

SENSe[:POWer]:SWEep:FREQuency:YSCale:MAXimum <Maximum>

This command enters the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum>   float

   *RST: 40.0 dBm

Example: SENS:SWE:FREQ:YSC:MAX 10DBM

sets 10 dBm as the upper limit of the measurement diagram.

SENSe[:POWer]:SWEep:FREQuency:YSCale:MINimum <Minimum>

This command enters the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum>   float

   *RST: -40.0 dBm

Example: SENS:SWE:FREQ:YSC:MIN –10DBM

sets -10 dBm as the lower limit of the measurement diagram.

SENSe[:POWer]:SWEep:HCOPy:DATA?

This command queries the measurement data directly. The data is transferred to the remote client as data stream, e.g. for further processing (see chapter 6.3.3, "SCPI Parameters", on page 327, description of block data).

Readable ASCII data is available for hardcopy language CSV. The representation of the values depends on the selected orientation for the CSV format.

Return values:

<Data>   string

Example:	SENS:SWE:HCOP:DEV:LANG CSV
	selects output format *.csv.
	SENS:SWE:HCOP:DEV:LANG:CSV:ORI HOR
	selects horizontal orientation
	SENS:SWE:HCOP:DEV:LANG:CSV:SEP SEM
	selects ";" as the separator between the values
	SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT
	selects "." as decimal point
	SENS:SWE:HCOP:DATA?
	queries the measurement data of the current traces
	Response:
	#2651009500000;1019000000;1028500000;1038000000
	-9.5;-9.7;-6.3;-2.5
	The hash symbol # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 2 following digit indicates the length to be 65 characters.
	Because horizontal representation is selected, a row with all the x-values of the active trace (frequency) follows. The second row contains all the y-values of the active trace (power). The rows end with a new line (each counts as one character).
	Note: if more than one trace is active, the third row contains the x values of the second active trace, and so on.
Example:	SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT
	selects horizontal orientation
	SENS:SWE:HCOP:DATA?
	queries the measurement data of the current traces
	Response:
	#2681009500000;-9.5; 1019000000;-9.7; 1028500000;-6.3; 1038000000;-2.5;
	for vertical representation the length of the data block is 68
	the first power value, the second row contains the second frequency value of the active trace followed by the second power value, and so on. The rows end with a new line (each counts as one character).
	Note: if more than one trace is active, the first row also contains the value pairs of the second active trace, and so on.
Usage:	Query only

SENSe[:POWer]:SWEep:HCOPy:DEVice <Device>

This command defines the output device. The setting is fixed to FILE, i.e. the hardcopy is stored in a file.

Parameters:

<Device>	FILE|PRINter
	*RST: FILE
Example:	SENS:SWE:HCOP:DEV FIL
	selects output device file

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage <Language>

This command selects the bitmap graphic format for the screenshot of the power analysis trace.

In addition, ASCII file format `*.csv` is offered. If file format `*.csv` is selected, the trace data is saved as an ASCII file with comma separated values. It is also possible to directly retrieve the data using command `SENS:SWE:HCOP:DATA?`.

Parameters:

<Language>	BMP|JPG|XPM|PNG|CSV
	*RST: BMP
Example:	`SENS:SWE:HCOP:DEV:LANG BMP`
	selects output format `*.bmp`.

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:DPOint <Dpoint>

This command defines which character should be used as the decimal point of the values, either dot or comma.

Parameters:

<Dpoint>	DOT|COMMA
	*RST: DOT
Example:	`SENS:SWE:HCOP:DEV:LANG CSV`
	selects output format `*.csv`.
	`SENS:SWE:HCOP:DEV:LANG:CSV:DPO DOT`
	selects character dot for being used as decimal point.

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:HEADer <Header>

This command defines whether each row (or column depending on the orientation) should be preceded by a header containing information about the trace (see also SENSe[: POWer]:SWEep:HCOPy:DATA on page 397).

Parameters:

<Header>	OFF|STANdard
	*RST: OFF
Example:	`SENS:SWE:HCOP:DEV:LANG CSV`
	selects output format `*.csv`.
	`SENS:SWE:HCOP:DEV:LANG:CSV:HEAD STAN`
	selects the standard header for the `*.csv` file.

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV:ORIentation <Orientation>

This command defines the orientation of the X/Y value pairs. For examples on how the data are arranged see "CSV Options Hardcopy- Power Analysis" on page 167.

Parameters:

<Orientation>	HORizontal|VERTical

    *RST: HORizontal

Example: `SENS:SWE:HCOP:DEV:LANG CSV`

selects output format `*.csv`.

`SENS:SWE:HCOP:DEV:LANG:CSV:ORI VERT`

selects vertical orientation, the value pairs are written in a column like structure (separated by the selected separator, e.g. tab)

SENSe[:POWer]:SWEep:HCOPy:DEVice:LANGuage:CSV[:COLumn]:SEParator <Separator>

This command defines which character is to separate the values, either tabulator, semicolon, comma or blank.

Parameters:

<Separator>	TABulator|SEMicolon|COMMa|BLANk

    *RST: SEMicolon

Example: `SENS:SWE:HCOP:DEV:LANG CSV`

selects output format `*.csv`.

`SENS:SWE:HCOP:DEV:LANG:CSV:SEP TAB`

a tab separates the values

SENSe[:POWer]:SWEep:HCOPy:DEVice:SIZE <Size>

This command sets the size of the hardcopy in number of pixels. The first value of the size setting defines the width, the second value the height of the image.

Parameters:

<Size>	320,240 | 640,480 | 800,600| 1024,768

    *RST: 320,240

Example: `SENS:SWE:HCOP:DEV:LANG BMP`

selects output format `*.bmp`.

`SENS:SWE:HCOP:DEV:SIZE 320,240`

the size of the bitmap is 320 pixels by 240 pixels.

SENSe[:POWer]:SWEep:HCOPy[:EXECute]

This command triggers the generation of a hardcopy of the current measurement diagram. The data is written into the file selected/created with the `SENSe[:POWer]: SWEep:HCOPy:FILE[:NAME]` command.

Example: SENS:SWE:HCOP:DEV:LANG BMP

selects output format *.bmp.

SENS:SWE:HCOP:FILE:AUTO:STAT OFF

switches off automatic file naming.

SENS:SWE:HCOP:FILE 'var/nrp_trace1'

creates the file nrp_trace1.bmp in the set path.

SENS:SWE:HCOP

triggers the generation of a hardcopy of the current measurement diagram. The hardcopy is stored in the file nrp_trace1.bmp.

Usage: Event

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME] <Name>

This command creates/selects a file into which the hardcopy will be stored after the SENS:SWE:HCOP:EXEC command is sent. The directory is either defined with the command MMEMory:CDIR or the path is specified together with the file name. Access to the file via remote control is possible using the commands of the MMEM-Subsystem. In contrast, command SENSe:SWEep:HCOPy:DATA? transfers the hardcopy contents directly to the remote client where they can be further processed.

Parameters:

<Name> string

Example: SENS:SWE:HCOP:DEV:LANG BMP

selects output format *,bmp.

SENS:SWE:HCOP:FILE:AUTO:STAT OFF

switches off automatic naming.

SENS:SWE:HCOP:FILE 'var/trace/nrp_trace1'

creates the file nrp_trace1.bmp in the trace directory.

SENS:SWE:HCOP:EXEC

triggers the generation of a hardcopy of the current trace. The hardcopy is stored in the file nrp_trace1.bmp.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory <Directory>

This command defines the directory into which the hardcopy files will be stored if auto naming is activated (SENS:SWE:HCOP:FILE:AUTO:STAT ON).

Parameters:

<Directory> string

Example: SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'

hardcopy file are stored in directory var/nrp if automatic naming is activated.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar

This command deletes all files with extensions bmp , img, png, xpm and csv in the directory set for automatic naming.

Example:	`SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
	hardcopy file are stored in directory `var/nrp` if automatic naming is activated.
	`SENS:SWE:HCOP:FILEAUTO:DIR:CLE`
	deletes all hardcopy file that are stored in directory `var/nrp`.
Usage:	Event

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:FILE?

This command query the file name that what generated using the automatic naming settings.

Note: As default the automatically generated file name is composed of: `>Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`. Each component can be deactivated/activated separately to individually design the file name.

Return values:

<File>	string

Example:	`SENS:SWE:HCOP:DEV:LANG BMP`
	selects output format `*.bmp`.
	`SENS:SWE:HCOP:FILE:AUTO:DIR 'var/nrp'`
	hardcopy file are stored in directory `var/nrp` if automatic naming is activated.
	`SENS:SWE:HCOP:FILE:AUTO:PREF 'sens1'`
	the file name starts with the prefix `sens1`. The usage of automatic naming with prefix and date in the file name is preset (…`:STAT ON`).
	`SENS:SWE:HCOP`
	triggers the generation of a hardcopy of the current trace.
	`SENS:SWE:HCOP:FILE:AUTO:FILE?`
	queries the file name
Usage:	Query only

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?

This command queries the day of the date part in the automatic file name.

Return values:

<Day>	float

Example:	`SENS:SWE:HCOP:FILE:AUTO:DAY?`
	queries the day of the date part in the automatic file name.
Usage:	Query only

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe <State>

This command activates the usage of the day in the automatic file name.

Parameters:

<State>	0|1|OFF|ON

　　　　　　　　　　*RST:　　　ON

Example:　　　　SENS:SWE:HCOP:FILE:AUTO:DAY:STAT OFF
deactivates the usage of the day in the automatic file name.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?

This command queries the day of the date part in the automatic file name.

Return values:

<Month>	float

Example:　　　　SENS:SWE:HCOP:FILE:AUTO:MONT?
queries the month of the date part in the automatic file name.
Usage:　　　　Query only

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe
　　　<State>

This command activates the usage of the month in the automatic file name.

Parameters:

<State>	0|1|OFF|ON

　　　　　　　　　　*RST:　　　ON

Example:　　　　SENS:SWE:HCOP:FILE:AUTO:MONT:STAT OFF
deactivates the usage of the month in the automatic file name.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?

This command queries the generated number in the automatic file name.

Return values:

<Number>	float

Example:　　　　SENS:SWE:HCOP:FILE:AUTO:NUMB?
queries the number in the automatic file name.
Usage:　　　　Query only

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <Prefix>

This command enters the prefix part in the automatic file name.

Parameters:

<Prefix>	string

Example: SENS:SWE:HCOP:FILE:AUTO:PREF 'sensor'
the prefix sensor is used in the automatically generated file name
of the hardcopy file.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe
   <State>

This command activates the usage of the prefix in the automatic file name.

Parameters:

<State>   0|1|OFF|ON

                       *RST: ON

Example: SENS:SWE:HCOP:FILE:AUTO:PREF:STAT OFF
deactivates the usage of the prefix in the automatic file name.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?

This command queries the year of the date part in the automatic file name.

Return values:

<Year>   float

Example: SENS:SWE:HCOP:FILE:AUTO:YEAR?
queries the year of the date part in the automatic file name.

Usage: Query only

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe <State>

This command activates the usage of the year in the automatic file name.

Parameters:

<State>   0|1|OFF|ON

                       *RST: ON

Example: SENS:SWE:HCOP:FILE:AUTO:YEAR:STAT OFF
deactivates the usage of the year in the automatic file name.

SENSe[:POWer]:SWEep:HCOPy:FILE[:NAME]:AUTO:STATe <State>

This command activates/deactivates automatic naming of the hardcopy files.

Parameters:

<State>   0|1|OFF|ON

                       *RST: ON

Example: SENS:SWE:HCOP:FILE:AUTO:STAT OFF
deactivates automatic naming of the hardcopy files. The file name
and directory is now defined with command
SENS:SWE:HCOP:FILE:NAME <path>.

SENSe[:POWer]:SWEep:INITiate <Initiate>

This command starts the power analysis with NRP power sensor

Setting parameters:

<Initiate>

	Example:	SENS:SWE:INIT
		start the power measurement.
Usage:	Setting only	

SENSe[:POWer]:SWEep:MODE <Mode>

This command selects power versus frequency measurement (frequency response), power vs power measurement (power sweep, AM/AM) or power vs. time measurement.

Parameters:

<Mode>	FREQuency|POWer|TIME
	*RST: FREQuency
Example:	SENS:SWE:MODE FREQ
	selects frequency mode.

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:COPY

This command generates a reference curve for "Power" measurement.

Example:	SENS:POW:SWE:POW:REF:DATA:COPY
Example:	generates a reference curve in power mode.
Usage:	Event

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:POINts?

This command reads the number of points from the reference curve in "Power" measurement.

Return values:

<>	float
Example:	SENS:POW:SWE:POW:REF:DATA:POIN?
Example:	queries the number of points from the reference curve in power mode.
Usage:	Query only

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:XVALues <Xvalues>

This command sets or queries the x values of the two reference points, i.e. "Power X (Point A)" and "Power X (Point B)" in "Power" measurement.

Parameters:

<Xvalues>   string

Example: `SENSe:POW:SWE:POW:REF:DATA:XVAL -15DBM,20DBM`
Example: sets the x value of reference "Point A" to -15 dBm, and the value of "Point B" to 20 dBm.

:SENSe[:POWer]:SWEep:POWer:REFerence:DATA:YVALues <Yvalues>

This command sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Power" measurement.

Parameters:

<Yvalues>   string

Example: `SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`
Example: sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

SENSe[:POWer]:SWEep:POWer:RMODe <Rmode>

This command selects single or continuous mode for measurement mode power in power analysis.

Parameters:

<Rmode>   SINGle|CONTinuous

                   *RST: SINGle

Example: `SENS:SWE:POW:RMOD SING`
selects single measurement

SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency <Sfrequency>

This command defines the separate frequency used for power vs. power measurement.

Parameters:

<Sfrequency>   float

                   *RST: 1 MHz

Example: `SENS1:SWE:POW:SENS:SFR 2GHz`
'the measurement is performed at 2 GHz

SENSe<ch>[:POWer]:SWEep:POWer[:SENSor]:SFRequency:STATe <State>

This command activates the use of a different frequency for the power measurement.

Parameters:

<State>   0|1|OFF|ON

                   *RST: OFF

Example: `SENS1:SWE:POW:SENS:SFR:STAT ON`
activates the use of a separate frequency than the generator frequency for power analysis

SENSe\<ch\>[:POWer]:SWEep:TIME[:SENSor]:PULSe:STATe \<State\>

This command enables pulse data analysis. The measurement is started with command INITiate.

Note: The command are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

\<State\>	0|1|OFF|ON
	*RST: OFF
Example:	SENS1:SWE:TIM:PULS:STAT ON
	enables pulse data analysis.
Options:	Option R&S SMA-K28

SENSe\<ch\>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:BASE \<Base\>

This command selects how the threshold parameters for pulse analysis are calculated.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

\<Base\>	VOLTage|POWer
	*RST: VOLTage
Example:	SENS1:SWE:TIME:PULS:THR:BASE POW
	activates threshold calculation related to power.
Options:	Option R&S SMA-K28

SENSe\<ch\>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer: HREFerence \<Hreference\>

This command sets the upper reference level in terms of percentage of the overall pulse level (power or voltage). The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

\<Hreference\>	float
	Range: 0.0 to 100.0
	*RST: 90.0
Options:	Option R&S SMA-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:
REFerence <Reference>

Sets the medial reference level in terms of percentage of the overall pulse level (power or voltage related). This level is used to define pulse width and pulse period.

Note: The command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<Reference>	float
	Range: 0.0 to 100.0
	*RST: 50.0
Example:	SENS1:SWE:TIM:PULS:THR:REF 40
	sets the medial reference level to 40% of the overall pulse level.
Options:	Option R&S SMA-K28

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:PULSe:THReshold:POWer:
LREFerence <Lreference>

This command sets the lower reference level in terms of percentage of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Parameters:

<Lreference>	float
	Range: 0.0 to 100.0
	*RST: 10.0
Example:	SENS:SWE:TIM:PULS:THR:LREF 10
	sets the lower reference level to 10%.
Options:	Option R&S SMA-K28

SENSe[:POWer]:SWEep:POWer:SPACing[:MODE] <Mode>

This command queries the sweep spacing for the power versus power measurement. The setting is fixed to LINear.

Parameters:

<Mode>	LINear
	*RST: LINear
Example:	SENS:SWE:POW:SPAC?

SENSe[:POWer]:SWEep:POWer:STARt <Start>

This command enters the start level for the power versus power measurement.

Parameters:

<Start>   float

                           *RST: -40 dBm

Example: SENS:SWE:POW:STAR -20.0DBM

                        sets the start level to -20 dBm

SENSe[:POWer]:SWEep:POWer:STEPs <Steps>

This command enters the number of measurement steps for the power versus power measurement.

Parameters:

<Steps>   float

                           Range: 10 to 1000
                           *RST: 500

Example: SENS:SWE:POW:STEP 500

                        sets the 500 measurement steps

SENSe[:POWer]:SWEep:POWer:STOP <Stop>

This command enters the stop level for the power versus power measurement.

Parameters:

<Stop>   float

                           *RST: 30.0 dBm

Example: SENS:SWE:POW:STOP 20.0DBM

                        sets the stop level to 20 dBm

SENSe[:POWer]:SWEep:POWer:TIMing[:MODE] <Mode>

This command selects the timing mode of the measurement.

Parameters:

<Mode>   FAST|NORMal|HPRecision

                         FAST
                         Selection FAST leads to a fast measurement with a short integration times for each measurement step.

                         NORMal
                         NORMal leads to a longer but more precise measurement due to a higher integration time for each step.

                         *RST: NORMal

Example: SENS:SWE:POW:TIM:MODE FAST

                        selects fast mode.

SENSe[:POWer]:SWEep:POWer:YSCale:AUTO <Auto>

This command activates/deactivates autoscaling of the Y axis of the diagram.

Parameters:

<Auto>   OFF|CEXPanding|FEXPanding|CFLoating|FFLoating

                               OFF
Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

                               CEXPanding | FEXPanding
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

                               CFLoating | FFLoating
Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

                               *RST: OFF

Example: SENS:SWE:POW:YSC:AUTO OFF
deactivates auto scale

SENSe[:POWer]:SWEep:POWer:YSCale:AUTO:RESet

This command resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example: SENS:SWE:POW:YSC:AUTO:RES
resets auto scale
Usage: Event

SENSe[:POWer]:SWEep:POWer:YSCale:MAXimum <Maximum>

This command enters the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum>   float

                           Range: min level to max level
                           *RST: 40 dBm

Example:	SENS:SWE:POW:YSC:MAX 10DBM
	sets 10 dBm as the upper limit of the measurement diagram.

SENSe[:POWer]:SWEep:POWer:YSCale:MINimum <Minimum>

This command enters the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum>	float
	Range: min level to max level
	*RST: -40 dBm
Example:	SENS:SWE:POW:YSC:MIN –10DBM
	sets -10 dBm as the lower limit of the measurement diagram.

SENSe[:POWer]:SWEep:RMODe <Rmode>

This command selects single or continuous mode for power analysis (all measurement modes).

Parameters:

<Rmode>	SINGle|CONTinuous
	*RST: SINGle
Example:	SENS:SWE:RMOD SING
	selects single measurement

SENSe[:POWer]:SWEep:TIME:RMODe <Rmode>

This command selects single or continuous mode for measurement mode time in power analysis.

Parameters:

<Rmode>	SINGle|CONTinuous
	*RST: SINGle
Example:	SENS:SWE:TIME:RMOD SING
	selects single measurement

:SENSe[:POWer]:SWEep:TIME:AVERage[:COUNt] <Count>

This command selects the averaging factor in time mode. The count number determines how many measurement cycles are used to form a measurement result. Higher averaging counts reduce noise but increase the measurement time. Averaging requires a stable trigger event so that the measurement cycles have the same timing.

Parameters:

<Count>	1|2|4|8|16|32|64|128|256|512|1024
	*RST: NORMal

Example:	`SENS:SWE:MODE TIME`
	selects time mode
	`SENS:SWE:TIME:AVER 128`
	selects averaging factor 128
Options:	Option R&S SMA-K28

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:COPY

This command generates a reference curve for "Time" measurement.

Example:	`SENS:POW:SWE:TIME:REF:DATA:COPY`
Example:	generates a reference curve in time mode.
Usage:	Event

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:POINts?

This command reads the number of points from the reference curve in "Time" measurement.

Return values:

<>	float

Example:	`SENS:POW:SWE:TIME:REF:DATA:POIN?`
Example:	queries the number of points from the reference curve in time mode.
Usage:	Query only

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:XVALues <Xvalues>

This command sets or queries the x values of the two reference points, i.e. "Time X (Point A)" and "Time X (Point B)" in "Time" measurement.

Parameters:

<Xvalues>	string

Example:	`SENSe:POW:SWE:TIME:REF:DATA:XVAL 5,45`
Example:	sets the x value of reference "Point A" to 5 µs, and the value of "Point B" to 45 µs.

:SENSe[:POWer]:SWEep:TIME:REFerence:DATA:YVALues <Yvalues>

This command sets or queries the y values of the two reference points, i.e. "Power Y (Point A)" and "Power Y (Point B)" in "Time" measurement.

Parameters:

<Yvalues>	string

Example:	`SENSe:POW:SWE:TIME:REF:DATA:YVAL -30,10`
Example:	sets the y value of reference "Point A" to -30 dBm, and the value of "Point B" to 10 dBm.

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency <Sfrequency>

This command defines the separate frequency used for power vs. time measurement.

Parameters:

<Sfrequency>   float

                      *RST: 1 MHz

Example: SENS1:SWE:TIME:SENS:SFR 2GHz
                      the measurement is performed at 2 GHz

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:SFRequency:STATe <State>

This command activates the use of a different frequency for the power measurement.

Parameters:

<State>   0|1|OFF|ON

                      *RST: OFF

Example: SENS1:SWE:TIME:SENS:SFR:STAT ON
                      activates the use of a separate frequency than the generator fre-
                      quency for power analysis

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:AUTO <Auto>

This command sets the trigger level, the hysteresis and the dropout time to default values.

Parameters:

<Auto>   ONCE

Example: SENS1:SWE:TIME:SENS:TRIG:AUTO ONCE
                      the trigger level is automatically determined

SENSe<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:DTIMe <Dtime>

This command determines the minimum time for which the signal must be below (above) the power level defined by level and hysteresis before triggering can occur again.

Parameters:

<Dtime>   float

                      Range: 0.0 to 10.0
                      *RST: 0
                      Def. value: 200 ns
                      Default unit: s

Example: SENS1:SWE:TIME:SENS:TRIG:DTIM 10 us
                      the drop out time is 10 us

SENSe\<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:HYSTeresis \<Hysteresis>

This command sets the hysteresis of the internal trigger threshold. Hysteresis is the magnitude (in dB) the trigger signal level must drop below the trigger threshold (positive trigger slope) before triggering can occur again.

Parameters:

\<Hysteresis>	float
	Range: -10.0 to 10.0
	*RST: 0.5
	Default unit: dB
Example:	SENS1:SWE:TIME:SENS:TRIG:HYST 0.5 dB
	the hysteresis is 0.5 dB

SENSe\<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:LEVel \<Level>

This command sets the trigger threshold.

Parameters:

\<Level>	float
	Range: -200.0 to 100.0
	*RST: 1
	Default unit: dBm
Example:	SENS1:SWE:TIME:SENS:TRIG:LEV -20 dBm
	sets the trigger level to -20 dBm.

:SENSe\<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SLOPe \<TriggerSlope>

The command sets the polarity of the active slope for the trigger signals.

Parameters:

\<TriggerSlope>	POSitive | NEGative
	*RST: POSitive
Example:	SENS1:SWE:TIME:TRIG:SLOP POS
	the positive edge of a trigger signal is active.
Options:	Option R&S SMA-K28

SENSe\<ch>[:POWer]:SWEep:TIME[:SENSor]:TRIGger:SOURce \<Source>

This command selects if the measurement is free running (FREE) or starts only after a trigger event. The trigger can be applied internally or externally.

Parameters:

\<Source>	FREE|AUTO|INTernal|EXTernal
	*RST: AUTO
Example:	SENS1:SWE:TIME:SENS:TRIG:SOUR FREE
	the power versus time measurement is performed free running

SENSe[:POWer]:SWEep:TIME:SPACing[:MODE]?

This command queries the sweep spacing for the power versus time measurement. The spacing is fixed to linear.

Return values:

<Mode>	LINear
	*RST: LINear
Example:	SENS:SWE:TIME:SPAC?
	queries the sweep spacing
Usage:	Query only

SENSe[:POWer]:SWEep:TIME:STARt <Start>

This command enters the start time for the power versus time measurement. Value 0 defines the trigger point. By choosing a negative time value, the trace can be shifted in the diagram. It is possible, that the measurement cannot be performed over the complete time range because of limitations due to sensor settings. In this case, an error message is output.

Parameters:

<Start>	float
	Range: -1.0 to 1.0
	*RST: 0
	Default unit: s
Example:	SENS:SWE:TIME:STAR 0s
	sets the start time to 0 s

SENSe[:POWer]:SWEep:TIME:STEPs <Steps>

This command enters the number of measurement steps for the power versus time measurement. Value 0 defines the trigger point.

Parameters:

<Steps>	float
	Range: 10 to 1000
	*RST: 200
Example:	SENS:SWE:TIME:STEP 500
	sets the 500 measurement steps

SENSe[:POWer]:SWEep:TIME:STOP <Stop>

This command enters the stop time for the power versus time measurement.

Parameters:

<Stop>   float

                Range: 0.0 to 2.0
                *RST: 1.0ms
                Default unit: s

Example: SENS:SWE:TIME:STOP 1ms
                sets the stop time to 1 ms

:SENSe[:POWer]:SWEep:TIME:TEVents <TriggerEvents>

This command determines, whether the measurement data processing starts with a trigger event in one of the sensors (Logical OR), or whether all channels have to be triggered (logical AND). Each sensor evaluates a trigger event according to its setting independently. This function supports the internal or external trigger modes with multi-channel time measurements.

Parameters:

<TriggerEvents>   AND|OR

                    *RST: AND

Example: SENS:POW:SWE:TIME:TEV AND
                the measurement data processing starts when all channels are
                triggered.
Options: Option R&S SMA-K28

SENSe[:POWer]:SWEep:TIME:YSCale:AUTO <Auto>

This command activates/deactivates autoscaling of the Y axis of the diagram..

Parameters:

<Auto>

OFF|CEXPanding|FEXPanding|CFLoating|FFLoating

OFF

Auto scaling is deactivated. When switching from activated to deactivated Auto scaling, the scaling is maintained. When switching from deactivated to activated Auto scaling, the scaling is reset to min = max = 0.

CEXPanding | FEXPanding

Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is expanded if the minimum or maximum values of the trace move outside the current scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

CFLoating | FFLoating

Auto scale is activated. The scaling of the Y-axis is selected in such a way, that the trace is always visible. To this end, the range is either expanded if the minimum or maximum values of the trace move outside the current scale or scaled down if the trace fits into a reduced scale. The step width is 5 dB for selection course and variable in the range of 0.2 db to 5 dB for selection fine.

*RST: OFF

Example:

SENS:SWE:TIME:YSC:AUTO OFF

deactivates auto scale

SENSe[:POWer]:SWEep:TIME:YSCale:AUTO:RESet

This command resets the Y scale to suitable values after the use of auto scaling in the expanding mode. For this mode, the scale might get expanded because of temporarily high power values. The reset function allows resetting the diagram to match smaller power values again.

Example:

SENS:SWE:TIME:YSC:AUTO:RES

resets auto scale

Usage:

Event

SENSe[:POWer]:SWEep:TIME:YSCale:MAXimum <Maximum>

This command enters the maximum value for the y axis of the measurement diagram.

Parameters:

<Maximum>

float

Range: min level to max level
*RST: 40
Default unit: dBm

Example:

SENS:SWE:TIME:YSC:MAX 10DBM

sets 10 dBm as the upper limit of the measurement diagram.

SENSe[:POWer]:SWEep:TIME:YSCale:MINimum <Minimum>

This command enters the minimum value for the y axis of the measurement diagram.

Parameters:

<Minimum>　　　　　　float

　　　　　　　　　　Range:　　　min level to max level
　　　　　　　　　　*RST:　　　　-40
　　　　　　　　　　Default unit: dBm

Example:　　　　　SENS:SWE:TIME:YSC:MIN –10DBM
　　　　　　　　　　sets -10 dBm as the lower limit of the measurement diagram.

SENSe<ch>[:POWer]:TYPE?

The command queries the type of sensor. The type is automatically detected.

Return values:

<Type>　　　　　　　string

Example:　　　　　SENS:TYPE?
　　　　　　　　　　queries the type of sensor connected to the POWER SENSOR
　　　　　　　　　　connector.
　　　　　　　　　　Response: NRP-Z21
　　　　　　　　　　the R&S NRP-Z21 sensor is used.
Usage:　　　　　　Query only

SENSe<ch>[:POWer]:ZERO

The command activates the autozero function. Zeroing is required in regular interval (at least once a day) and if the temperature has varied more than about 5 °C, if the sensor has been replaced or if measurements of signals with very low power are to be performed. The RF power source must be switched off or disconnected from the sensor before starting the autozero function.

Example:　　　　　SENS:ZERO
　　　　　　　　　　activates autozero function.
Usage:　　　　　　Event

SENSe<ch>:UNIT[:POWer] <Power>

The command selects the unit used for result query with command READ. The power sensor provides the measured value in Watt. In which unit the measured value is returned is selected here and might be either Watt, dBm or dBuV.

Parameters:

<Power>　　　　　　　DBM|DBUV|WATT

　　　　　　　　　　*RST:　　　DBM

Example: SENS2:UNIT DBM

selects unit dBm for the measured value returned by command
READ.
READ2?
Response: 7.34
7.34 dBm are measured by sensor 2.

7.12.6 TRACe Subsystem

:TRACe<ch>[:POWer]:SWEep:COLor <Color>

This command defines the color of each trace..

Parameters:

<Color>   INVers|GRAY|YELLow|BLUE|GREen|RED|MAGenta

                                           *RST: trace 1 = YELLow, trace 2 = GREen, trace 3 = RED.

Example: `TRAC2:SWE:COL GRAY`

                                 trace2 is indicated in gray color

:TRACe<ch>[:POWer]:SWEep:COPY <Copy>

This commands stores the selected trace data as reference trace.

Parameters:

<Copy>   REFerence

Example: `TRAC2:SWE:COPY REF`

stores the current trace2 as reference trace'

`TRAC1:SWE:FEED REF`

assigns the reference trace to trace 1.

:TRACe<ch>[:POWer]:SWEep:DATA:POINts?

This commands queries the number of measurement points of the selected trace of the current power analysis.

Return values:

<Points>   float

Example: `TRAC1:SWE:DATA:POIN?`

Response: `624`

Measurement trace 1 contains 624 measurement points

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:XVALues?

This commands queries the x-axis values - frequency, power or time values - of the selected trace of the current power analysis.

Return values:

<Xvalues>   string

Example: `SENS:SWE:MODE FREQ`

sets measurement mode **frequency versus power**.

`SENS:SWE:RMOD SING`

selects single measurement.

`SENS:SWE:INIT`

starts the measurement.

`*OPC?`

waits until measurement is performed.

`TRAC1:SWE:DATA:XVAL?`

queries the x-axis values of trace 1.

`TRAC1:SWE:DATA:YVAL`

queries the measurement values of trace 1.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:DATA:YVALues?

This commands queries the measurement (y-axis) values of the selected trace of the current power analysis.

Return values:

<Yvalues>   string

Example: `SENS:SWE:TRAC2:DATA:YVAL?`

queries the power values of trace 2.

Usage: Query only

:TRACe\<ch\>[:POWer]:SWEep:FEED \<Feed\>

This command selects the source for the trace data.

Parameters:

\<Feed\>   SENSor1|SENSor2|SENSor3|REFerence|NONE

	*RST:	The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with number corresponding to the trace number, the preset value of the trace is "Off".

Example: `TRAC2:SWE:COPY REF`
stores trace2 as reference trace.
`TRAC1:SWE:FEED REF`
assigns the reference trace to trace 1.
`TRAC1:SWE:STAT ON`
assigns the reference trace to trace 1.
`SENS:SWE:RMOD SING`
selects single measurement
`SENS:SWE:INIT`
starts the measurement

:TRACe[:POWer]:SWEep:MEASurement:FULLscreen:DISPlay:ANNotation[:STATe] \<State\>

This command selects fullscreen display, only the diagram is displayed in the measurement diagram and in the hardcopy file.

Parameters:

\<State\>   0|1|OFF|ON

	*RST:	OFF

Example: `TRAC:SWE:MEAS:FULL:DISP:ANN ON`
the display only shows the diagram.
Options: Option R&S SMA-K28

:TRACe[:POWer]:SWEep:MEASurement:GATE:DISPlay:ANNotation[:STATe] \<State\>

This command selects if the time gate borders and values are indicated in the measurement diagram and in the hardcopy file. The gate settings are performed with the `CALC:POW:SWE:TIME:GATE:…` commands.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	TRAC:SWE:MEAS:GATE:DISP:ANN ON
	the diagram also shows the gate information.
Options:	Option R&S SMA-K28

:TRACe[:POWer]:SWEep:MEASurement:MARKer:DISPlay:ANNotation[:STATe] <State>

This command selects if the markers and the marker list are indicated in the measurement diagram and in the hardcopy file..

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	TRAC:SWE:MEAS:MARK:DISP:ANN ON
	the diagram also shows the marker information.
Options:	Option R&S SMA-K28

:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:
    OCCurrence?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence?
:TRACe\<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot?

The listed commands query the measured pulse parameters values.

Note: These commands are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Return values:

<Overshoot>	float

Example:	`TRAC1:SWE:MEAS:POW:HREF?`
	queries the measured mesial threshold level of trace 1
	`TRAC3:SWE:MEAS:POW:MAX?`
	queries the measured peak power of trace 3
Usage:	Query only
Options:	Option R&S SMA-K28

:TRACe[:POWer]:SWEep:MEASurement:PULSe:DISPlay:ANNotation[:STATe]
    <State>

This command selects if the pulse data is shown below the measurement diagram and also stored in the hardcopy file. The parameters to be indicated can be selected with the following `TRAC:SWE:MEAS:`…. commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State>	0	1	OFF	ON
	*RST: OFF
Example:	`TRAC:SWE:MEAS:PULS:DISP:ANN ON`
	activates indication of the selected pulse data.
Options:	Option R&S SMA-K28

:TRACe<ch>[:POWer]:SWEep:MEASurement:PULSe:ALL:DISPlay:ANNotation[:STATe] <State>

This command switches the indication of all pulse data of the selected trace off. The parameters to be indicated can be selected with the following `TRAC:SWE:MEAS:`…. commands. Only six parameters are indicated at one time.

Note: This command is only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State>	0	1	OFF	ON
	*RST: OFF
Example:	`TRAC:SWE:MEAS:PULS:ALL:DISP:ANN OFF`
	switches the indication of all pulse data off
Options:	Option R&S SMA-K28

:TRACe[:POWer]:SWEep:MEASurement:STANdard:DISPlay:ANNotation[:STATe]
    <State>

This command selects the standard view, i.e. diagram and buttons but no lists are displayed and also stored in the hardcopy file.

Parameters:

<State>	0|1|OFF|ON
	*RST: ON
Example:	`TRAC:SWE:MEAS:STAN:DISP:ANN ON`
	activates indication of the selected pulse data
Options:	Option R&S SMA-K28

**:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DCYCle:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:DURation:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:PERiod:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:AVERage:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:BASE:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:HREFerence:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:LREFerence:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MAXimum:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:MINimum:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:REFerence:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:POWer:PULSe:TOP:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:PULSe:SEParation:DISPlay:
    ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:DURation:
    DISPlay:ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OCCurrence:
    DISPlay:ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:NEGative:OVERshoot:
    DISPlay:ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:DURation:
    DISPlay:ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OCCurrence:
    DISPlay:ANNotation[:STATe]** <State>

**:TRACE<ch>[:POWer]:SWEep:MEASurement:TRANsition:POSitive:OVERshoot:
    DISPlay:ANNotation[:STATe]** <State>

The listed commands select the pulse parameters which are indicated in the display and hardcopy file. Only six parameters can be indicated at one time.

Note: These commands are only avalaible in time measurement mode and with R&S NRP-Z81 power sensors.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	`TRAC:SWE:MEAS:TRAC2:PULS:PER:DISP:ANN ON`
	selects the pulse period to be indicated in the display
	`TRAC:SWE:MEAS:PULS:DISP:ANN ON`
	activates indication of the selected pulse data in the display
Options:	Option R&S SMA-K28

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:BASE?

This command queries how the threshold parameters are calculated.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Base>	VOLTage|POWer
Example:	`TRAC1:SWE:PULS:THR:BAS?`
	queries the threshold base of pulse data calculation.
Usage:	Query only

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:HREFerence?

This command queries the upper threshold level of the overall pulse level. The distal power defines the end of the rising edge and the start of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Hreference>	float
Example:	`TRAC2:SWE:PULS:THR:POW:HREF?`
	queries the upper reference level of trace 2.
Usage:	Query only

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:REFerence?

This command queries the medial threshold level of the overall pulse level. This level is used to define the pulse width and pulse period.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Reference>	float

Example: `TRAC3:SWE:PULS:THR:POW:REF?`

queries the medial threshold level of trace 3.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:PULSe:THReshold:POWer:LREFerence?

This command queries the lower medial threshold level of the overall pulse level. The proximal power defines the start of the rising edge and the end of the falling edge of the pulse.

Note: This parameter is only avalaible in time measurement mode and R&S NRP-Z81 power sensors.

Return values:

<Lreference>   float

Example: `TRAC:SWE:PULS:THR:POW:LREF?`

queries the medial threshold level of trace 1.

Usage: Query only

:TRACe<ch>[:POWer]:SWEep:STATe <State>

This command activates the selected trace.

Parameters:

<State>   OFF|ON|HOLD

              *RST: The preset value for each trace is evaluated during runtime as follows: If a sensor is plugged into the generator whose number corresponds to the trace number, this sensor is used to feed the trace and the state of the trace is ON; If no sensor is found with a number corresponding to the trace number, the preset value of the trace is "Off".

Example: `TRAC2:SWE:COPY REF`

stores trace2 as reference trace'

`TRAC1:SWE:FEED REF`

assigns the reference trace to trace 1.

`TRAC1:SWE:STAT ON`

assigns the reference trace to trace 1.

`SENS:SWE:RMOD SING`

selects single measurement

`SENS:SWE:INIT`

starts the measurement

7.13   SOURce Subsystem

The `SOURce` subsystem contains the commands for configuring the digital and analog signals.

SOURce<hw>

For one-path instruments, the keyword `SOURce` is optional and can be omitted.

7.13.1   SOURce:ADF Subsystem

The ADF subsystem contains the commands for checking the ADF modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:ADF:...`. Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The signal is output at the LF OUT connector.

[:SOURce]:ADF:COMid:CODE <Code>

The command enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). The COM/ID tone is sent according to the selected code (see table 5-14). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (`ADF:COM:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`ADF:COM:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code>   string

Example: `ADF:COM:CODE 'MUC'`
                            select COM/ID code for Munich airport.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ADF:COMid:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash>   float

                            Increment: 0.1 ms
                            *RST: 300 ms

Example: `ADF:COM:CODE 'MUC'`
                            selects code for Munich airport
                            `ADF:COM:TSCH USER`
                            selects user time schema
                            `ADF:COM:DOT 200ms`
                            sets a dot length of 200 ms.
                            `ADF:COM:DASH 400ms`
                            sets a dash length of 400 ms.
                            `ADF:COM:LETT 50ms`
                            sets a letter space of 50 ms.
                            `ADF:COM:SYMB 10ms`
                            sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

[:SOURce]:ADF:COMid:DEPTh <Depth>

The command sets the frequency of the communication/identification signal.

Parameters:

<Depth>   float

Range: 0 to 100
Increment: 0.1
*RST: 95
Default unit: PCT

Example: ADF:COM:DEPT 10 PCT
                       sets the AM depth of the communication/identification signal to the
                       value of 10 PCT.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ADF:COMid:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot),
symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot>   <length>

Increment: 0.1
*RST: 100
Default unit: ms

Example: ADF:COM:CODE 'MUC'
                       selects code for Munich airport
                       ADF:COM:DOT 200ms
                       sets a dot length of 200 ms.

Example: ADF:COM:CODE 'MUC'
                       selects code for Munich airport
                       ADF:COM:DOT 200ms
                       sets a dot length of 200 ms.

Options: Option R&S SMA-K25

[:SOURce]:ADF:COMid:FREQuency <Frequency>

The command sets the frequency of the additional communication/identification signal.

Parameters:

<Frequency>   float

Range: 0.1 to 20000
*RST: 1020
Default unit: Hz

Example: ADF:COM:FREQ 1020
                       sets the frequency of the identification signal to the standard value
                       of 1020Hz.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ADF:COMid:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available user time schema only.

Parameters:

<Letter>　　　　　　　　<length>

　　　　　　　　　　　　Increment:　0.1
　　　　　　　　　　　　*RST:　　　300

Example:　　　　　　`ADF:COM:CODE 'MUC'`
　　　　　　　　　　　　selects code for Munich airport
　　　　　　　　　　　　`ADF:COM:TSCH USER`
　　　　　　　　　　　　selects user time schema
　　　　　　　　　　　　`ADF:COM:DOT 200ms`
　　　　　　　　　　　　sets a dot length of 200 ms.
　　　　　　　　　　　　`ADF:COM:DASH 400ms`
　　　　　　　　　　　　sets a dash length of 400 ms.
　　　　　　　　　　　　`ADF:COM:LETT 50ms`
　　　　　　　　　　　　sets a letter space of 50 ms.
　　　　　　　　　　　　`ADF:COM:SYMB 10ms`
　　　　　　　　　　　　sets a symbol space of 10 ms.

Options:　　　　　　Option R&S SMA-K25

[:SOURce]:ADF:COMid:PERiod <Period>

Enters the period of the COM/ID signal in seconds.

Parameters:

<Period>　　　　　　　float

　　　　　　　　　　　　Range:　　　0 ms to 120 s
　　　　　　　　　　　　Increment:　1 ms
　　　　　　　　　　　　*RST:　　　9 s

Example:　　　　　　ADF:COM:PER 22s
　　　　　　　　　　　　sets a period of 22 s for the COM/ID signal.

Options:　　　　　　Option R&S SMA-K25

[:SOURce]:ADF:COMid:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol>　　　　　　　<length>

　　　　　　　　　　　　Increment:　0.1
　　　　　　　　　　　　*RST:　　　100
　　　　　　　　　　　　Default unit: ms

Example:	`ADF:COM:CODE 'MUC'`
	selects code for Munich airport
	`ADF:COM:TSCH USER`
	selects user time schema
	`ADF:COM:DOT 200ms`
	sets a dot length of 200 ms.
	`ADF:COM:DASH 400ms`
	sets a dash length of 400 ms.
	`ADF:COM:LETT 50ms`
	sets a letter space of 50 ms.
	`ADF:COM:SYMB 10ms`
	sets a symbol space of 10 ms.
Options:	Option R&S SMA-K25

[:SOURce]:ADF:COMid:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ ID signal).

Parameters:

<Tschema>	STD|USER
	*RST: STD
Example:	`ADF:COM:CODE 'MUC'`
	selects code for Munich airport
	`ADF:COM:TSCH STD`
	'elects standard time schema
	`ADF:COM:DOT 200ms`
	sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.
Options:	Option R&S SMA-K25

[:SOURce]:ADF:COMid[:STATe] <State>

The command activates or deactivates the additional communication/identification signal.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	`ADF:COM ON`
	activates the COM/ID signal.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:ADF:STATe <State>

The command switches on or off the ADF modulation.

Parameters:

<State>   0|1|OFF|ON

                         *RST: OFF

Example: ADF ON
                         activates the ADF signal. The RF-frequency is automatically set
                         to 190 kHz.
Usage: SCPI conform

7.13.2 SOURce:AM Subsystem

The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:AM:INTernal:`. The external signal is input at the AM EXT connector.

The settings for the internal modulation source (LF generator) are made in the `SOURce:LFOutput` subsystem.

[:SOURce<hw>]:AM[:DEPTh] <Depth>

The command sets the modulation depth of the amplitude modulation in percent. The modulation depth is limited by the maximum peak envelope power (PEP).

Parameters:

<Depth>   float

                         Range: 0 to 100
                         Increment: See data sheet
                         *RST: 30
                         Default unit: PCT

Example: AM 15PCT
                         sets the AM modulation depth to 15 percent
Usage: SCPI conform

[:SOURce<hw>]:AM:EXTernal:COUPling <Coupling>

The command selects the coupling mode for the external modulation input in the case of amplitude modulation.

Parameters:

<Coupling>   AC|DC

                           AC
                           The DC voltage component is disconnected from the modulation
                           signal.

                           DC
                           The modulation signal is not changed.

                           *RST: AC

Example: AM:EXT:COUP AC
                           Selects the coupling mode AC for external amplitude modulation.

Usage: SCPI conform

[:SOURce<hw>]:AM:INTernal<ch>:DEPTh <Depth>

This command sets the modulation depth for the two LF generators. The sum of the two
values must not exceed the overall modulation depth set in the upper part of the menu.

Parameters:

<Depth>   float

                           Range: 0 to 100 PCT
                           Increment: See data sheet

Example: AM:INT2 15PCT
                           sets the AM modulation depth to 15 percent for the second LF
                           generator. With setting 30 percent for the overall modulation
                           depth, the modulation depth of the first LF generator is automati-
                           cally set to 15 percent, also.

Usage: SCPI conform

Options: R&S SMA-K24

[:SOURce<hw>]:AM:INTernal:SOURce <Source>

The command selects which internal modulation source is used. The available selection
depends on the options fitted. The selected source can be configured in the
SOURce:LFOutput subsystem.

Parameters:

<Source>   LF1|LF2|LF12|NOISe|LF1Noise|LF2Noise

Example: AM:INT:SOUR LF1
                           selects LF generator 1 as internal modulation source.

Options: Option R&S SMA-K24 for selections other than LF1

[:SOURce<hw>]:AM:SENSitivity?

The command queries the input sensitivity of the external modulation input in %/V. The command is only effective if the external modulation source is selected (`SOUR:AM:SOUR EXT`). The returned value depends on the modulation depth setting (`SOUR:AM:DEPTh`). This value is assigned to the voltage value for full modulation of the input.

Return values:

<Sensitivity>	float

Example:	`AM:DEPT 50`
	sets a modulation depth of 50 %.
	`AM:SENS?`
	queries the input sensitivity at the external modulation input input.
	`Response: 50`
	since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 50%/V.
Usage:	Query only
	SCPI conform

[:SOURce<hw>]:AM:SOURce <Source>

The command selects the modulation source for amplitude modulation.

Internal and external modulation source can be selected at the same time.

Parameters:

<Source>	INT|EXT
	INT
	INT is the internal modulation source which is selected with command `AM:SOURce:INTernal` and configured in the `SOURce:LFOutput` subsystem.
	EXT
	The external signal is input at the AM EXT connector.
	*RST: INTernal
	Def. value: INT
Example:	`AM:SOUR INT`
	selects the internal modulation source.
	`AM:INT:SOUR LF12`
	selects the LF generator 1 and 2 as internal modulation sources.
Usage:	SCPI conform

[:SOURce<hw>]:AM:STATe <State>

The command activates/deactivates amplitude modulation.

Parameters:

<State>	0|1|OFF|ON

Example: AM:STAT ON

                     activates AM modulation.

Usage: SCPI conform

7.13.3 SOURce:CHIRp Subsystem

The SOURce:CHIRp subsystem contains the commands for setting the modulation chirp.

The modulation chirp is optional and requires an interface board with part number 1400.0530.02 or 1400.0552.02. The hardware data is queried with command DIAG:BGIN? "SMA_IF".

The keyword SOURce is optional with commands and can be omitted.

[:SOURce<hw>]:CHIRp:BANDwidth <Bandwidth>

The command sets the modulation bandwidth of the modulation chirp in Hz. The maximal bandwidth depends on the RF frequency set and the selected modulation mode (see data sheet).

Parameters:

<Bandwidth>   float

                     Range: 0 Hz to 80 MHz
                     Increment: See data sheet
                     *RST: 1 kHz
                     Default unit: Hz

Example: CHIR:BAND 5E3

                     sets the modulation bandwidth to 5 kHz.

Options: R&S SMA-B20/22 and interface board 1400.0530.02 or
                     1400.0552.02

[:SOURce<hw>]:CHIRp:COMPression:RATio?

The command queries the pulse compression ratio, i.e. the product of pulse width (s) and bandwidth (Hz). Pulse compression increases the range resolution as well as the signal to noise ratio of pulsed signals.

Return values:

<Ratio>	float

Example:	CHIR:COMP:RAT?
	'queries the compression ratio.
Usage:	Query only
Options:	R&S SMA-B20/22 and interface board 1400.0530.02 or 1400.0552.02

[:SOURce<hw>]:CHIRp:DIRection <Direction>

Selects the direction of the chirp modulation.

Parameters:

<Direction>	DOWN|UP
	UP
	The chirp starts with the lower frequency.
	DOWN
	The chirp starts with the higher frequency.
	*RST: UP

Example:	SOUR:CHIR:DIR UP

[:SOURce<hw>]:CHIRp:PULSe:PERiod <Period>

The command sets the period of the generated modulation chirp. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>	5µs .. 100s | 20ns .. 100 s
	Increment: 1us | 20 ns
	*RST: 1 ms
	Default unit: s

Example:	CHIR:PULS:PER 420 ns
	the chirp period is 420 ns.
Options:	R&S SMA-B20/22 and interface board 1400.0530.02 or 1400.0552.02; The enhanced features require option R&S SMA-K23

[:SOURce<hw>]:CHIRp:PULSe:WIDTh <Width>

The command sets the width of the generated pulse. The pulse width must be at least 1us less than the set pulse period.

Parameters:

<Width>	2us … 100 s | 5 ns … 100 s

Increment: 1us \| 20 ns
*RST: 0.5 ms
Default unit: s

Example:	CHIR:PULS:WIDT 330 ns
	sets a width of 330 ns for the pulse.
Options:	R&S SMA-B20/22 and interface board 1400.0530.02 or 1400.0552.02; The enhanced features require option R&S SMA-K23

[:SOURce<hw>]:CHIRp:STATe <State>

The command activates/deactivates the generation of modulation chirps.

Parameters:

<State>	0|1|OFF|ON

*RST: OFF

Example:	CHIR:STAT ON
	activates generation of modulation chirps.
Options:	R&S SMA-B20/22 and interface board 1400.0530.02 or 1400.0552.02

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:GATE:POLarity <Polarity>

The command selects the active level of the gate signal.

Parameters:

<Polarity>	NORMal|INVerted

*RST: NORM

Example:	CHIR:TRIG:EXT:GATE:POL NORM
	selects gate polarity normal.
Options:	R&S SMA-B20/22 and interface board 1400.0530.02 or 1400.0552.02

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:IMPedance <Impedance>

The commands set the impedance for external feed via the PULSE EXT input.

Parameters:

<Impedance>	G10k|G50

G10k
10 kOhm to ground

G50
50 ohm to ground

*RST: G50

Example: CHIR:TRIG:EXT:IMP G10K
                     the PULSE EXT input is set to 10 kOhm to ground.
Options: R&S SMA-B20/22 and interface board 1400.0530.02 or
                     1400.0552.02

[:SOURce<hw>]:CHIRp:TRIGger:EXTernal:SLOPe <Slope>

The command sets the active slope of an externally applied trigger signal at the PULSE
EXT input (BNC connector at the rear of the instrument).

Parameters:
<Slope>   POS|NEG

                     *RST: POS
Example: CHIR:TRIG:EXT:SLOP
                     the active slope of the external trigger signal at the PULSE EXT
                     input is the falling slope.
Options: R&S SMA-B20/22 and interface board 1400.0530.02 or
                     1400.0552.02

[:SOURce<hw>]:CHIRp:TRIGger:MODE <Mode>

The command selects the trigger mode for modulation chirp.

Note: External trigger signals are supplied via the PULSE EXT connector.

Parameters:
<Mode>   AUTO|EXTernal|EGATe

                     AUTO
                     The modulation chirp is generated continuously.

                     EXTernal
                     The modulation chirp is triggered by an external trigger event.

                     EGATe
                     The modulation chirp is gated by an external gate signal.

                     *RST: AUTO
Example: CHIR:TRIG:EXT:MODE EXT
                     selects triggering by an external trigger event.
Options: R&S SMA-B20/22 and interface board 1400.0530.02 or
                     1400.0552.02

7.13.4 SOURce:CORRection Subsystem

The output level is corrected in the CORRection subsystem. Correction is performed by
user-defined table values being added to the output level for the respective RF frequency.
In the R&S SMA, this subsystem is used to select, transfer and activate user correction
tables.

Each list is stored as a file. The name of the user correction file can be freely selected. The file extension `*.uco` is assigned automatically and cannot be changed.

The files can be stored in a freely selectable directory and opened from there. The default directory is set using command `:MMEMory:CDIRectory` on page 371. In the case of files which are stored in the default directory, only the file name has to be specified in commands. Otherwise, the complete absolute path has to be specified with every command. The extension can be omitted in any case.

In the following command examples, the files are stored in the default directory.

The amplitude can also be linearized automatically by means of a R&S NRP power sensor connected to the generator output signal. With the aid of the command `[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe`, a list with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables. The correction values can be acquired any time irrespective of the modulation settings of the generator.

[:SOURce]:CORRection:CSET:CATalog?

The command requests a list of user correction tables. The individual lists are separated by commas.

The lists are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog>   string

Example: `MMEM:CDIR '/var//Lists/ucor'`
selects the directory for the user correction files.
`CORR:CSET:CAT?`
queries which correction tables are available.
Response:`UCOR1,UCOR2,UCOR3`
the correction tables `UCOR1, UCOR2` and `UCOR3` are available.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency <Frequency>

The command transfers the frequency data to the table selected
with `:CORRection:CSET:SELect`.

The numerical suffix at SOURce must not be used for this command.

Parameters:

<Frequency>   Frequency#1[, Frequency#2, ...]

   Range: 300 kHz to RFmax (depending on model)
   Default unit: Hz

Example: `CORR:CSET '/var//Lists/ucor/ucor1'`
selects the table `ucor1`.
`CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz,...`
enters the frequency value in the table `ucor1`.

[:SOURce<hw>]:CORRection:CSET:DATA:FREQuency:POINts?

The command queries the number of frequency values in the selected table.

The numerical suffix at SOURce must not be used for this command.

Return values:

<Points>   float

Example: `CORR:CSET '/var//Lists/ucor/ucor1'`
selects the table ucor1.
`CORR:CSET:DATA:FREQ:POIN?`
queries the number of frequency values in the table ucor1.
Response: `440`
the table ucor1 contains 440 frequency values.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA:POWer <Power>

The command transfers the level data to the table selected
with `:CORRection:CSET:SELect`.

`*RST` does not affect data lists. The numerical suffix at SOURce must not be used for this
command.

Parameters:

<Power>   Power#1[, Power#2, ...]

                           Range: -40 dB to 6 dB
                           Default unit: dB

Example: CORR:CSET '/var//Lists/ucor/ucor1'
                          selects the table ucor1.
                          CORR:CSET:DATA:POW 1dB, 0.8dB, 0.75dB,...
                          enters the level values in the table ucor1.

[:SOURce<hw>]:CORRection:CSET:DATA:POWer:POINts?

The command queries the number of level values in the selected table.

The numerical suffix at SOURce must not be used for this command.

Return values:

<Points>   float

Example: CORR:CSET '/var//Lists/ucor/ucor1'
                          selects the table ucor1.
                          CORR:CSET:DATA:POW:POIN?
                          queries the number of level values in the table ucor1.
                          Response: 440
                          the table ucor1 contains 440 level values.

Usage: Query only

[:SOURce<hw>]:CORRection:CSET:DATA[:SENSor<ch>][:POWer]:SONCe

The command fills the selected user correction list with the level values measured by the power sensor for the given frequencies.

The power sensor used is selected by the suffix in key word SENSe of the command header.

Suffix:

<ch>   1 .. 3
                           Suffix 1 denotes the sensor connected to the SENSOR connector,
                           suffix 2 the sensor connected first to one of the USB interfaces
                           and suffix 3 the sensor connected second to one of the USB inter-
                           faces.

Example: CORR:CSET:DATA:SENS:POW:SONC
                          fills the user correction list with level values acquired by the power
                          sensor connector to the SENSOR connector.

Usage: Event

[:SOURce]:CORRection:CSET:DELete <Delete>

The command deletes the specified table.

The lists are stored with the fixed file extensions `*.uco` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:CORR:CSET:CAT?`, in which case the file in the specified directory is deleted.

The numerical suffix under SOURce is irrelevant.

Setting parameters:

<Delete>	<table name>

Example:	`MMEM:CDIR '/var//Lists/ucor'`
	selects the directory for the user correction files.
	`CORR:CSET:DEL 'UCOR1'`
	deletes the table `ucor1`.
Usage:	Event

[:SOURce<hw>]:CORRection:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of user correction data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog>	string

Example:	`MMEM:CDIR '/var//lists/ucor/import'`
	selects the directory for the ASCII files with frequency and level value pairs.
	`CORR:DEXC:AFIL:EXT TXT`
	selects that ASCII files with extension `*.txt` are listed.
	`CORR:DEXC:AFIL:CAT?`
	queries the available files with extension `*.txt`.
	Response: `'ucor1,ucor2'`
	the ASCII files `ucor1.txt` and `ucor2.txt` are available.
Usage:	Query only

[:SOURce<hw>]:CORRection:DEXChange:AFILe:EXTension <Extension>

The command selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Parameters:

<Extension>	TXT|CSV	
	*RST:	TXT

Example: `MMEM:CDIR '/var//lists/ucor/import'`
selects the directory for the ASCII files with frequency and level
value pairs.
`CORR:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension *.txt are listed.
`CORR:DEXC:AFIL:CAT?`
queries the available files with extension *.txt.
Response: `'list1,list2'`
the ASCII files `ucor1.txt` and `ucor2.txt` are available.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SELect <Select>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of
the user's choice. The directory applicable to the commands is defined with the command
`MMEMory:CDIR`. A path can also be specified in command
`SOUR:CORR:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the speci-
fied directory.

Parameters:

<Select>   <ascii file name>

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are
imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL`
`'/var//user/ucor/import/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the ASCII file ucor.csv is imported into user correction
list ucor_imp.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:COLumn <Column>

The command selects the separator between the frequency and level column of the ASCII
table.

Parameters:

<Column>   TABulator|SEMicolon|COMMa|SPACe

                      *RST: SEMicolon|

Example: CORR:DEXC:MODE EXP
                     selects that the user correction list is exported into an ASCII file.
                     CORR:DEXC:AFIL:SEL
                     '/var//user/ucor/import/ucor.csv'
                     selects ASCII file ucor.csv as destination for the user correction
                     list data.
                     CORR:DEXC:AFIL:SEP:COL TAB
                     the pairs of frequency and level values are separated by a tabu-
                     lator.
                     CORR:DEXC:AFIL:SEP:DEC DOT
                     selects the decimal separator dot.
                     CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'
                     selects that the user correction list ucor_imp is imported into ASCII
                     file ucor.csv.

[:SOURce<hw>]:CORRection:DEXChange:AFILe:SEParator:DECimal <Decimal>

The command the decimal separator used in the ASCII data between '.' (decimal point)
and ',' (comma) with floating-point numerals.

Parameters:
<Decimal>   DOT|COMMa

                     *RST: DOT

Example: CORR:DEXC:MODE EXP
                     selects that the user correction list is exported into an ASCII file.
                     CORR:DEXC:AFIL:SEL
                     '/var//user/ucor/import/ucor.csv'
                     selects ASCII file ucor.csv as destination for the user correction
                     list data.
                     CORR:DEXC:AFIL:SEP:COL TAB
                     the pairs of frequency and level values are separated by a tabu-
                     lator.
                     CORR:DEXC:AFIL:SEP:DEC DOT
                     selects the decimal separator dot.
                     CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'
                     selects that the user correction list ucor_imp is imported into ASCII
                     file ucor.csv.

[:SOURce<hw>]:CORRection:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected,
the ASCII file is imported as user correction list. When export is selected, the user cor-
rection list is exported into the selected ASCII file.

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are
imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL`
`'/var//user/ucor/import/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the ASCII file ucor.csv is imported into user correction
list ucor_imp.
`CORR:DEXC:EXEC`
starts the import of the ASCII file data into the user correction file.

Usage: Event

[:SOURce<hw>]:CORRection:DEXChange:MODE <Mode>

The command selects if user correction lists should be imported or exported. Depending
on the selection her, the file select command define either the source or the destination
for user correction lists and ASCII files.

Parameters:

<Mode>   IMPort|EXPort

                            *RST: IMPort

Example: `CORR:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are
imported and transferred into user correction lists.
`CORR:DEXC:AFIL:SEL`
`'/var//user/ucor/import/ucor.csv'`
selects that ASCII file ucor.csv is imported.
`CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'`
selects that the ASCII file ucor.csv is imported into user correction
list ucor_imp.

[:SOURce<hw>]:CORRection:DEXChange:SELect <Select>

The command selects the user correction list to be imported or exported.

The user correction files are stored with the fixed file extensions `*.uco` in a directory of
the user's choice. The directory applicable to the commands is defined with the command
`MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:SEL`, in
which case the files are stored or loaded in the specified directory.

Parameters:

<Select>   <list name>

Example: CORR:DEXC:MODE IMP
selects that ASCII files with frequency and level value pairs are
imported and transferred into user correction lists.
CORR:DEXC:AFIL:SEL
'/var//user/ucor/import/ucor.csv'
selects that ASCII file ucor.csv is imported.
CORR:DEXC:SEL '/var//user/ucor/import/ucor_imp'
selects that the ASCII file ucor.csv is imported into user correc-
tion list ucor_imp.

[:SOURce<hw>]:CORRection:CSET[:SELect] <Select>

The command selects the table for user correction. Level correction must also be acti-
vated with the command SOURce<hw>:CORRection:CSET:STATe ON.

The lists are stored with the fixed file extensions *.uco in a directory of the user's choice.
The directory applicable to the commands is defined with the command
MMEMory:CDIR. A path can also be specified in command :SOUR:CORR:CSET:SEL, in
which case the files in the specified directory are selected.

Parameters:
<Select>   <table name>

Example: CORR:CSET '/var//Lists/ucor/ucor1'
selects the table ucor1.
CORR ON
activates level correction. Correction is performed using the table
ucor1.
Usage: Event

[:SOURce<hw>]:CORRection[:STATe] <State>

The command activates/deactivates level correction. Level correction is performed using
the table which has been selected with the command CORRection:CSET:SELect.

Parameters:
<State>   0|1|OFF|ON

                        *RST: OFF
Example: SOUR:CORR:CSET '/var//lists/ucor/ucor1'
selects the table ucor1.
SOUR:CORR ON
activates user correction.

[:SOURce<hw>]:CORRection:VALue?

The command requests the current value for user correction.

Return values:
<Value>   float

Example: CORR:VAL?
                        queries the value currently used for level correction.
                        Response: –3
                        the correction value is - 3 dB.
Usage: Query only

7.13.5 SOURce:DME Subsystem

The DME subsystem contains the commands for checking the DME modulation. The
characteristics of the internal modulation source are defined with commands
SOURce:DME:... The modulation signal can be output at the LF connector.

The keyword SOURce is optional with commands and can be omitted.

[:SOURce]:DME:ANALysis:EFFiciency?

The command queries the measured reply efficiency in percent. The measurement is the ratio of the number of measured valid reply pulse pairs to transmitted pulse pairs in a measurement cycle.

Return values:

<Efficiency>	float

Example:	`DME:ANAL:EFF:STAT ON`
	activates the reply efficiency measurement
	`DME:ANAL:EFF?`
	queries the measurement result
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:EFFiciency:OK?

The command queries if there are valid measurement values available in the set measurement window.

Return values:

<Ok>	0|1|OFF|ON

Example: `DME:ANAL:EFF:STAT ON`
                      activates the reply efficiency measurement
                      `DME:ANAL:EFF:OK?`
                      queries if valid measurement values are available
                      `Response: 1`
                      there are valid measurement values
                      `DME:ANAL:EFF?`
                      queries the measurement result
Usage: Query only
Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:EFFiciency:STATe <State>

The command activates the measurement of the reply efficiency of all valid pulse pairs in a measurement cycle.

Parameters:
<State>   0|1|OFF|ON

                      *RST: ON
Example: `DME:ANAL:EFF:STAT ON`
                      activates the reply efficiency measurement
                      `DME:ANAL:EFF?`
                      queries the measurement result
Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:GATE:COUNt <Count>

The command sets the number of pulse pairs which are sent from the R&S SMA (= interrogator) to the ground station in one measurement cycle. Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency.

Parameters:
<Count>   integer

                      Range: 1 to 1000
                      *RST: 100
Example: `DME:ANAL:GATE:COUN 100`
                      sets the number of sent pulse to 100.
Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:GATE:EDELay <Edelay>

The command enters the expected reply delay. The expected reply delay and the gate length determine the measurement window (expected reply delay +/- gate length/2).

Parameters:

<Edelay>	float	
	Range:	0 µs to 157 µs
	Increment:	1 µs
	*RST:	Interrogation channel X: 50 us | Interrogation channel Y: 56 us
	Default unit:	s
Example:	DME:ANAL:GATE:EDEL 50us	
	sets an expected reply delay of 50 us	
Options:	Option R&S SMA-K26	

[:SOURce]:DME:ANALysis:GATE[:LENGth] <Length>

The command sets the gate length for the measurement window.

The measurement gate settings determine the measurement window (expected reply delay +/- gate length/2). Only reply pulses for which the 50% voltage point of the rising edge of the first pulse is within the measurement window are used to evaluate the delay time and reply efficiency. The delay measurement is averaged within the measurement cycle. The reply efficiency is calculated once for each measurement cycle.

Example:

The gate length is 1 us and the expected reply delay is 50 us. The measurement window lies in the range between 49.5 and 50.5 us. Only pulse pairs are used for the measurement whose 50% voltage point of the rising edge of the first pulse is within this range.

Parameters:

<Length>	integer	
	Increment:	100 ns
	*RST:	1 µs
	Default unit:	s
Example:	DME:ANAL:GATE 1us	
	sets a gate length of 1 us.	
Options:	Option R&S SMA-K26	

[:SOURce]:DME:ANALysis:NORMalize?

The command performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the reply measurements.

Return values:

<Normalize>	0|1|OFF|ON

Example: `DME:ANAL:NORM?`
                     activates the normalization
Usage: Query only
Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:POWer?

The command queries the measured average peak level of all valid pulse pairs in a measurement cycle.

Return values:
<Power>   float

Example: `DME:ANAL:POW:STAT ON`
                     activates the average peak level measurement
                     `DME:ANAL:POW?`
                     queries the measurement result
Usage: Query only
Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:POWer:OK?

The command queries if there are measurement values available in the set measurement window.

Return values:
<Ok>   0|1|OFF|ON

Example: `DME:ANAL:POW:STAT ON`
                     activates the average peak level measurement
                     `DME:ANAL:POW:OK?`
                     queries if valid measurement values are available
                     Response: 1
                     there are valid measurement values
                     `DME:ANAL:POW?`
                     queries the measurement result
Usage: Query only
Options: Option R&S SMA-K26

[:SOURce]:DME:ANALysis:POWer:STATe <State>

The command activates the measurement of the average peak level of all valid pulse pairs in a measurement cycle.

Parameters:
<State>   0|1|OFF|ON

                     *RST: ON

Example:	DME:ANAL:POW:STAT ON
	activates the average peak level measurement
	DME:ANAL:POW?
	queries the measurement result
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:PRRate?

The command queries the measured mean pulse repetition rate of the DME ground station. For this measurement all received pulses of the DME ground station are considered.

Return values:

| <Prrate> | float |

Example:	DME:ANAL:PRR:STAT ON
	activates the mean pulse repetition rate measurement
	DME:ANAL:PRR?
	queries the measurement result
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:PRRate:OK?

The command queries if there are valid measurement values available in the set measurement window.

Return values:

| <Ok> | 0|1|OFF|ON |

Example:	DME:ANAL:PRR:STAT ON
	activates the mean pulse repetition rate measurement
	DME:ANAL:PRR:OK?
	queries if valid measurement values are available
	Response: 1
	there are valid measurement values
	DME:ANAL:PRR?
	queries the measurement result
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:PRRate:STATe <State>

The command activates the measurement of the mean pulse repetition rate of the DME ground station. For this measurement all received pulses of the DME ground station are considered.

This measurement and the measurement of the delay, efficiency and average peak power are performed alternately. Therefore, the speed of the pulse repetition measurement increases if all other measurements are deactivated.

Parameters:

\<State>	0|1|OFF|ON
	*RST: ON
Example:	DME:ANAL:PRR:STAT ON
	activates the mean pulse repetition rate measurement
	DME:ANAL:PRR?
	queries the measurement result
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:STATe \<State>

The command activates the DME analysis. The setting is only available after connecting the R&S NRP-Z81 power sensor.

Parameters:

\<State>	0|1|OFF|ON
	*RST: OFF
Example:	DME:ANAL:STAT ON
	activates the DME analysis
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:TIME?

The command queries the measured average reply delay of all valid pulse pairs in a measurement cycle.

Return values:

\<Time>	float
Example:	DME:ANAL:TIME:STAT ON
	activates the average peak level measurement
	DME:ANAL:TIME?
	queries the measurement result
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:TIME:OK?

The command queries if there are valid measurement values available in the set measurement window.

Return values:

\<Ok>	0|1|OFF|ON

Example:	DME:ANAL:TIME:STAT ON
	activates the average peak level measurement
	DME:ANAL:TIME:OK?
	queries if valid measurement values are available
	Response: 1
	there are valid measurement values
	DME:ANAL:TIME?
	queries the measurement result
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:TIME:STATe <State>

The command activates the measurement of the average reply delay of all valid pulse pairs in a measurement cycle.

Parameters:

<State>	0|1|OFF|ON
	*RST: ON
Example:	DME:ANAL:TIME:STAT ON
	activates the average reply delay measurement
	DME:ANAL:TIME?
	queries the measurement result
Options:	Option R&S SMA-K26

[:SOURce]:DME:ANALysis:TRIGger:SEARch?

Determines the trigger level = 50% voltage point of first pulse of the external DME inter-rogation signal.

This command determines the trigger point after connecting the R&S NRP-Z81 sensor to the external interrogation signal source. The search function has to be executed with each change of the level of the external DME signal.

Return values:

<Search>	0|1|OFF|ON
Example:	DME:ANAL:TRIG:SEAR ON
	executes DME trigger determination.
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:CSUFfix <Csuffix>

The command selects the channel that is simulated.

Standard compliant X and Y channels differ in the spacing between the two pulses of the pulse pair and the delay of the ground station.

Parameters:

<Csuffix>   X|Y

                            *RST: X

Example: DME:CSUF Y
                            selects simulation of channel Y
Options: Option R&S SMA-K26

[:SOURce]:DME:EFFiciency <Efficiency>

The command sets the relation between reply pulse pairs and received trigger signals, e.g. with a set efficiency of 50% only every second trigger event leads to the generation of a reply pulse pair.

Parameters:

<Efficiency>   float

                            Range: 0 PCT to 100 PCT
                            *RST: 100 PCT
                            Default unit: PCT

Example: DME:MODE REPL
                            activates the reply mode
                            DME:EFF 75PCT
                            sets a reply efficiency of 75 PCT
Options: Option R&S SMA-K26

[:SOURce]:DME:FALL <Fall>

Sets the fall time of the pulse (90% to 10% of peak voltage).

Parameters:

<Fall>   float

                            Range: 0.5 µs to 20 µs
                            Increment: 0.1 µs
                            *RST: 2 µs
                            Default unit: s

Example: DME:FALL 4us
                            sets a pulse fall time of 4 us
Options: Option R&S SMA-K26

[:SOURce]:DME:ID:CODE <Code>

Enters the coding of the ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (ID signal). The ID tone is sent according to the selected code. This command is available for reply mode only.

The length of the morse code can be varied. For selection standard time scheme (`DME:ID:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`DME:ID:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code>	string
	*RST: empty string
Example:	`DME:MODE REPL`
	selects reply mode
	`DME:ID:CODE 'MUC'`
	selects code for Munich airport
Options:	Option R&S SMA-K26

[:SOURce]:DME:ID:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for reply mode and user time schema only.

Parameters:

<Dash>	float
	Increment: 0.1 ms
	*RST: 300 ms
	Default unit: s
Example:	`DME:MODE REPL`
	selects reply mode
	`DME:ID:CODE 'MUC'`
	selects code for Munich airport
	`DME:ID:TSCH USER`
	selects user time schema
	`DME:ID:DOT 200ms`
	sets a dot length of 200 ms.
	`DME:ID:DASH 400ms`
	sets a dash length of 400 ms.
	`DME:ID:LETT 50ms`
	sets a letter space of 50 ms.
	`DME:ID:SYMB 10ms`
	sets a symbol space of 10 ms.
Options:	Option R&S SMA-K26

[:SOURce]:DME:ID:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry. This command is available for reply mode only.

Parameters:

<Dot>   float

                         Range: 50 ms to 1000 ms
                         Increment: 0.1 ms
                         *RST: 100 ms
                         Default unit: s

Example: `DME:MODE REPL`
                         selects reply mode
                         `DME:ID:CODE 'MUC'`
                         selects code for Munich airport
                         `DME:ID:DOT 200ms`
                         sets a dot length of 200 ms.

Options: Option R&S SMA-K26

[:SOURce]:DME:ID:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available for reply mode and user time schema only.

Parameters:

<Letter>   float

                         Increment: 0.1 ms
                         *RST: 300 ms
                         Default unit: s

Example: `DME:MODE REPL`
                         'selects reply mode
                         `DME:ID:CODE 'MUC'`
                         'selects code for Munich airport
                         `DME:ID:TSCH USER`
                         'selects user time schema
                         `DME:ID:DOT 200ms`
                         'sets a dot length of 200 ms.
                         `DME:ID:DASH 400ms`
                         'sets a dash length of 400 ms.
                         `DME:ID:LETT 50ms`
                         'sets a letter space of 50 ms.
                         `DME:ID:SYMB 10ms`
                         sets a symbol space of 10 ms.

Options: Option R&S SMA-K26

[:SOURce]:DME:ID:PERiod <Period>

Enters the period of the ID sequence by means of seconds This command is available for reply mode only.

Parameters:

<Period>   float

                             Range: 0 to 120 s
                             Increment: 1 s
                             *RST: 40 s
                             Default unit: s

Example: DME:MODE REPL
                             selects reply mode
                             DME:ID:CODE 'MUC'
                             selects code for Munich airport
                             DME:ID:DOT 200ms
                             sets a dot length of 200 ms.
                             DME:ID:PER 40
                             sets a period of 40 s for the ID sequence
Options: Option R&S SMA-K26

[:SOURce]:DME:ID:PRESet

The commands the default settings for the ID signal. This command is available for reply mode only.

Example: DME:ID:PRES
                             activates the default settings for all SOURce:DME:ID… com-
                             mands.
Options: Option R&S SMA-K26

[:SOURce]:DME:ID:RATE <Rate>

Enters the pulse repetition rate of the ID sequence. This command is available for reply mode only.

Parameters:

<Rate>   float

                             Range: 100 Hz to 10 kHz
                             Increment: 0.1 Hz
                             *RST: 1350 Hz
                             Default unit: Hz

Example: DME:ID:RATE 2500
                             sets a repetition rate of the ID sequence of 2.5 kHz
Options: Option R&S SMA-K26

[:SOURce]:DME:ID[:STATe] <State>

Switches on/off the generation of the identification sequence (ID signal) of the ground station. The ID signal consists of a series of pulse pairs transmitted at a rate of 1350 Hz.

The transmission of the ground signal is interrupted every 40 seconds (ID period) and one ID sequence is transmitted instead. The "key down time" of the ground signal corresponds to the period of transmission for a dot or dash in the morse code ID sequence (e.g. 100ms for a dot). During the key down times reply pulses are not transmitted, however, they are transmitted between the key down times.

Parameters:

<State>   0|1|OFF|ON

                           *RST: OFF

Example: DME:ID ON
                           activates generation of the identification sequence.

Options: Option R&S SMA-K26

[:SOURce]:DME:ID:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for reply mode and user time schema only.

Parameters:

<Symbol>   float

                           Increment: 0.1 ms
                           *RST: 100 ms
                           Default unit: s

Example: DME:MODE REPL
                           selects reply mode
                           DME:ID:CODE 'MUC'
                           selects code for Munich airport
                           DME:ID:TSCH USER
                           selects user time schema
                           DME:ID:DOT 200ms
                           sets a dot length of 200 ms.
                           DME:ID:DASH 400ms
                           sets a dash length of 400 ms.
                           DME:ID:LETT 50ms
                           sets a letter space of 50 ms.
                           DME:ID:SYMB 10ms
                           sets a symbol space of 10 ms.

Options: Option R&S SMA-K26

[:SOURce]:DME:ID:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (ID signal).

Parameters:

<Tschema>   STD|USER

                           *RST: USER

Example:	DME:MODE REPL
	selects reply mode
	DME:ID:CODE 'MUC'
	selects code for Munich airport
	DME:ID:TSCH STD
	selects standard time schema
	DME:ID:DOT 200ms
	sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.
Options:	Option R&S SMA-K26

[:SOURce]:DME:LOWemission <Lowemission>

Activates the generation of a DME signal with higher spectral purity but less dynamic compared to the default mode. The ON/OFF ratio of the pulses is reduced from typ. >100 dB to typ. 35 dB.

Parameters:

<Lowemission>	0|1|OFF|ON
	*RST: OFF
Example:	DME:LOW ON
	activates the generation of a DME signal with higher spectral purity
Options:	Option R&S SMA-K26

[:SOURce]:DME:MODE <Mode>

Selects the mode of the DME modulation. The mode determines the signal type that is simulated. The exact timing of the signal for each mode is determined by the selected channel (X or Y, SOURce:DME:CSUFfix).

Parameters:

<Mode>	INTerrogation|REPLy
	INTerrogation
	The interrogation signal of the airborne transmitter is simulated.
	REPLy
	The reply signal of the ground based transponder is simulated. The trigger is automatically set to external and the default trigger delay either to 50 us (channel X) or 56 us (channel Y) depending on the selected channel (SOURce:DME:CSUFFix). The interval between the pulse pairs can be set to a fixed value (repetition rate, SOURce:DME:RATE) or to random generation (pulse squitter, SOURce:DME:SQUitter). The trigger signal is input via the PULSE EXT connector.
	*RST: INTerrogation
Example:	DME:MODE INT
	Activates generation of the interrogation signal of the airborne transmitter.

Options: Option R&S SMA-K26

[:SOURce]:DME:PPS <Pps>

Sets the spacing between the first and second pulse of a pulse pair (time between half-voltage points on the leading edge of each pulse).

Parameters:

<Pps>   float

                     Range: 1 us to 100 us
                     Increment: 5 ns
                     *RST: 12 us
                     Default unit: s

Example: DME:PPS 14μs
                     sets a spacing of 14us
Options: Option R&S SMA-K26

[:SOURce]:DME:PRESet

The commands activate the DME default setting.

Example: DME:PRES
                     activates the DME default settings for all SOURce:DME:… commands.
Usage: Event
Options: Option R&S SMA-K26

[:SOURce]:DME:RATE <Rate>

Interrogation mode:

Sets the pulse repetition rate for trigger setting Auto or Ext Gated.

Delay mode:

Indicates the mean pulse repetition rate in squitter mode.

Parameters:

<Rate>   float

                     Range: 10 Hz to 6000 Hz
                     Increment: 1 Hz
                     *RST: 48 Hz
                     Default unit: Hz

Example: DME:MODE INT
                     selects interrogation mode
                     DME:TRIG AUTO
                     selects auto trigger mode
                     DME:RATE 48 Hz
                     sets a pulse repetition rate of 48 Hz

Options: Option R&S SMA-K26

[:SOURce]:DME:RDIStance <Rdistance>

Sets the simulated distance between interrogator and transponder for reply mode. The distance is given in nautic miles (nm). 1 nm is 1852.01 meters and corresponds to a run time of 12.359 µs. This command is available for reply mode only.

The range distance and the external trigger delay are interdependent according to:

range distance = (trigger delay – X/Y mode delay)/12.359 µs/nm

(X mode delay = 50 µs, Y mode delay is 56 µs)

Changing one value automatically changes the other value.

Parameters:
<Rdistance>   float

                       Increment: 0.001 nm
                       *RST: 0 nm
                       Default unit: nm

Example: `DME:MODE REPL`
selects reply mode
`DME:RDIS 0.1 nm`
sets a range distance of 0.1 nautic mile

Options: Option R&S SMA-K26

[:SOURce]:DME:RISE <Rise>

Sets the rise time of the pulse (10% to 90% of peak voltage).

Parameters:
<Rise>   float

                       Range: 0.5 to 20 us
                       Increment: 0.1 us
                       *RST: 2 us

Example: `DME:RISE 4us`
sets a pulse rise time of 4 us

Options: Option R&S SMA-K26

[:SOURce]:DME:SHAPe <Shape>

Selects the pulse shape.

Parameters:

<Shape>   COS2|LIN|COS

                                COS
                                The falling and the rising edge of the pulse are cos^2 shaped.

                                COS2
                                The rising edge is cos shaped and the falling edge is cos^2
                                shaped.

                                LIN
                                The falling and the rising edge of the pulse are shaped linear.

                                *RST: COS

Example: DME:SHAP COS

                                selects generation of pulses with cos shaped rising and falling
                                edges

Options: Option R&S SMA-K26

[:SOURce]:DME:SINGle <Single>

Activates generation of a single test pulse.

Parameters:

<Single>   0|1|OFF|ON

                                *RST: OFF

Example: DME:SING ON

                                a single test pulse is generated

Options: Option R&S SMA-K26

[:SOURce]:DME:SQUitter <Squitter>

Activates the random pulse repetition rate. The average repetition rate is 2700 pp/s. The
pulse spacing is distributed randomly in the range of 60 μs to about 1500 μs according
to EUROCAE EN-54 6.2.12. The squitter pulses are constantly sent by the ground station
in order to ensure proper operation and in order to ease synchronization of the aircraft
interrogator to the ground station.

This command is available for Reply mode on only.

Parameters:

<Squitter>   0|1|OFF|ON

                                *RST: OFF

Example: DME:MODE REPL
                                selects reply mode
                                DME:SQU ON
                                activates generation of squitter pulses.

Options: Option R&S SMA-K26

[:SOURce]:DME:STATe <State>

The commands activate/deactivate DME modulation. The DME modulation signal can be output at the LF connector.

Note: Modulations PULSE, VOR, ILS-GS, ILS-LOC, MKR-BCN, ADF, AM, and internal FM/PhiM are automatically switched off when DME modulation is activated. Also, the pulse generator is automatically switched off.

Parameters:

<State>   0|1|OFF|ON

                                  *RST: OFF

Example: `DME:STAT ON`
                                  activates DME modulation.

Options: Option R&S SMA-K26

[:SOURce]:DME:TACan:DEPTh <Depth>

Sets the modulation depth in per cent.

Note: Observe that this value is valid for both signal components of the two-tone signal and the sum modulation depth is determined by doubling the set modulation depth. This results in overmodulation if the maximal value for modulation depth is exceeded (see data sheet).

Parameters:

<Depth>   float

                                    Range: 0 to 100
                                    Def. value: 42
                                    Default unit: PCT

Example: `DME:TAC:DEPT 30PCT`
                                    sets the overall AM modulation depth to 30 percent. With this setting the modulation depth of the two LF generators are automatically set to 15 percent each.

Options: R&S SMA-K26

[:SOURce]:DME:TACan:INTernal<ch>:DEPTh <Depth>

This command sets the modulation depth for one component of the two-tone signal in per cent.

Note: The sum of the two components must not exceed the overall modulation depth (see data sheet).

Parameters:

<Depth>   float

                                      Range: 0.0 to 100.0
                                    *RST: 21.0
                                    Default unit: PCT

Example: DME:TAC:INT1:DEPT 20PCT
                        sets the AM modulation depth to 20 percent for the first tone. With
                        setting 42 percent for the overall modulation depth, the modulation
                        depth of the second tone is automatically set to 22 percent.
Options: R&S SMA-K26

[:SOURce]:DME:TACan<ch>:FREQuency <Frequency>

Sets the individual frequencies of the two-tone signal.

Parameters:
<Frequency>   float

                        Range: 0.10 Hz to 10.000 00 kHz
Example: SOUR:DME:TAC1:FREQ 0.7 Hz
                        SOUR:DME:TAC2:FREQ 77.33 Hz
                        sets the first frequency to 0.7 Hz, and the second to 77.33 Hz.
Options: R&S SMA-K26

[:SOURce]:DME:TACan:STATe <State>

This functions activates/deactivates the two-tone signal.

Parameters:
<State>   0|1|OFF|ON

                        Def. value: OFF
Example: DME:TAC:STAT ON
                        activates Composite AM modulation.
Options: Option R&S SMA-K26

[:SOURce]:DME:TRIGger <Trigger>

Selects the trigger mode for DME modulation signals. For Reply mode only external trigger is possible

Parameters:

\<Trigger\>	AUTO|EXTernal|EGATe|PSENsor

AUTO
The DME modulation signals are generated continuously. This mode is only available for the interrogation signal.

EXTernal
The DME modulation signals are triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

EGATe
The DME modulation signals are gated by an external gate signal. The signal is supplied via the PULSE EXT connector. This mode is only available for the interrogation signal.

PSENsor
The DME modulation signals are triggered by an external power sensor. This mode is only available for the interrogation signal.

*RST:　　　Interrogation Mode: AUTO; Reply Mode: EXTernal

Example:	DME:TRIG EXT
	activates external trigger mode
Options:	Option R&S SMA-K26

[:SOURce]:DME:TRIGger:DELay \<Delay\>

Sets the delay between the external trigger and the first DME output pulse (50% voltage point of first pulse). This command is effective for external trigger only.

For DME Reply mode this simulates the defined delay of the DME transponder and twice the run time of the signal (from interrogator to transponder and back). The delay is a measure of the range distance, thus, the two values are interdependent according to:

Delay = X/Y mode delay + range distance * 12.359 nm/µs

(X mode delay = 50 µs, Y mode delay is 56 µs)

Changing one value automatically changes the other value.

Parameters:

\<Delay\>	float

	Range:	4 us to 5 ms
	Increment:	20 ns
	*RST:	Reply X: 50 µs | Reply Y: 56 µs | Interrogation: 50 µs

Example:	DME:TRIG EXT
	activates external trigger mode
	DME:TRIG:DEL 150us
	sets a delay of 150us
Options:	Option R&S SMA-K26

[:SOURce]:DME:TRIGger:DELay:NORMalize?

Performs a normalization of the test setup. The delay due to the test setup is measured and subsequently considered in the trigger delay. This command is effective for external power sensor trigger only.

Return values:

<Normalize>	0|1|OFF|ON
Example:	DME:TRIG PSEN
	activates external power sensor trigger mode
	DME:TRIG:DEL:NORM?
	performs normalization of test setup
Usage:	Query only
Options:	Option R&S SMA-K26

[:SOURce]:DME:TRIGger:GPOLarity <Gpolarity>

Sets the polarity of the active level of the external gate trigger at the PULSE EXT connector. This command is effective for external gate only.

Parameters:

<Gpolarity>	NORMal|INVerted
	NORMal
	The DME modulation signal is generated while the gate signal is high.
	INVerted
	The DME modulation signal is generated while the gate signal is low.
	*RST: NORMal
Example:	DME:TRIG GATE
	activates external gate mode
	DME:TRIG:GPOL INV
	the signal is generated while the gate level is high.
Options:	Option R&S SMA-K26

[:SOURce]:DME:TRIGger:IMPedance <Impedance>

Selects the input impedance for the external trigger and gate signal input PULSE EXT (10 kOhm or 50 Ohm).This command is only available for external or gate trigger mode.

Parameters:

<Impedance>	G50|G10K
	*RST: G50
Example:	DME:TRIG EXT
	activates external trigger mode
	DME:TRIG:IMP G50
	sets the impedance to 50 Ohm.

Options: Option R&S SMA-K26

[:SOURce]:DME:TRIGger:SLOPe <Slope>

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector. This command is effective for external trigger only.

Parameters:

<Slope>   NEGative|POSitive

POSitive
The DME modulation signals are triggered on the positive slope of the external trigger signal.

NEGative
The DME modulation signals are triggered on the negative slope of the external trigger signal.

*RST: POSitive

Example: `DME:TRIG EXT`
activates external trigger mode
`DME:TRIG:SLOP NEG`
the active slope of the external trigger signal at the PULSE EXT input is the falling slope.

Options: Option R&S SMA-K26

[:SOURce]:DME:WIDTh <Width>

Sets the pulse width (50% to 50% of peak voltage).

Parameters:

<Width>   float

Range: 1 to 100 us
Increment: 5 ns
*RST: 3.5 us

Example: `DME:WIDT 12us`
sets a pulse width of 12us

Options: Option R&S SMA-K26

7.13.6 SOURce:FM Subsystem

The FM subsystem contains the commands for checking the frequency modulation.

The FM-specific characteristics of the internal modulation source are defined with commands `SOURce:FM:INTernal:....` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem (e.g. frequency). The external signal is input at the FM/PM EXT connector. Internal and external modulation source can be selected at the same time, thus enabling two-tone FM modulation.

For information about the required options, see chapter 5.4.3, "Frequency Modulation (FM)", on page 211.

[:SOURce<hw>]:FM[:DEViation] <Deviation>

The command sets the modulation deviation of the frequency modulation in Hz. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

Parameters:

<Deviation>	float
	Range: 0 Hz to 10 MHz
	Increment: See data sheet
	*RST: 10 kHz
	Default unit: Hz

Example:	FM 5E3
	sets the FM modulation deviation to 5 kHz.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:EXTernal:COUPling <Coupling>

The command selects the coupling mode for the external modulation input in the case of frequency modulation.

Note: Coupling for external feed via input FM/PM EXT can be set independently for modulations FM and PhiM.

Parameters:

<Coupling>	AC|DC
	AC
	The DC voltage component is disconnected from the modulation signal.
	DC
	The modulation signal is not changed.

Example:	FM:EXT:COUP AC
	selects the coupling mode AC for external frequency modulation.

Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:EXTernal:DEViation <Deviation>

The command enters the deviation of the external FM signal The deviation of the internal source must not exceed the deviation of the external source in case of modulation source Int+Ext.

Parameters:

<Deviation>	float
	Range: 0 to 40 MHz *RST: 1kHz Default unit: Hz
Example:	FM:EXT:DEV 3kHz sets an external modulation depth of 3 kHz
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:EXTernal:DIGital:BFORmat <Bformat>

The command selects the binary format for external digital frequency modulation.

Parameters:

<Bformat>	BOFFset|DCODe
Example:	FM:EXT:DIG:BFOR BOFF selects binary format binary offset.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:INTernal<ch>:DEViation <Deviation>

The command selects the deviation for the two frequency modulation signals. The sum of the two values must not exceed the overall modulation deviation set with command SOURce:FM:DEViation.

Parameters:

<Deviation>	float
	Range: 0 to 20 MHz *RST: LF1: 1 kHz, LF2: 0 kHz
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24

[:SOURce<hw>]:FM:INTernal:SOURce <Source>

Selects which internal modulation source is used. The available selection depends on the options fitted.

Parameters:

<Source>   LF1|LF2|LF12|NOISe|LF1Noise|LF2Noise

Example: FM:INT:SOUR LF2N
                    selects LF generator 2 and noise generator as internal modulation sources

Usage: SCPI conform

Options: Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24 for selections other than LF1

[:SOURce<hw>]:FM:MODE <Mode>

The command selects the mode for the frequency modulation.

Parameters:

<Mode>   NORMal | LNOise

                    NORMal
                    The maximum range for modulation bandwidth and FM deviation is available.

                    LNOise
                    Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

                    *RST: NORMal

Example: FM:MODE NORM
                    selects normal mode for external frequency modulation.

Usage: SCPI conform

Options: Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:SENSitivity?

The command queries the input sensitivity of the FM/PM EXT input in Hz/V.

The command is only effective if the external modulation source is selected (SOUR:FM:SOUR EXT). The returned value depends on the modulation deviation setting (SOUR:FM:DEViation). This value is assigned to the voltage value for full modulation of the input signal.

Return values:

<Sensitivity>   float

Example:	FM:DEV 5E3
	sets a modulation deviation of 5 kHz.
	FM:SENS
	queries the input sensitivity at the external modulation input.
	Response: 5E3
	since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 5000Hz/V.
Usage:	Query only
	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:SOURce <Source>

The command selects the modulation source for frequency modulation. Internal and external modulation source can be selected at the same time.

Parameters:

<Source>	INT|EXT|INT,EXT
	INT
	INT is the internal modulation source which is defined with command FM:SOURce:INTernal and configured in the SOURce:LFOutput subsystem.
	EXT
	The external analog signal is input at the FM/PM EXT connector. The external digital signal is input at the AUX I/O connector (selection EDIGital).
	*RST: INTernal
Example:	FM:SOUR INT
	selects the internal modulation source.
	FM:INT:SOUR LF2
	selects the LF generator 2 as internal modulation source.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:FM:STATe <State>

The command activates/deactivates frequency modulation.

Activation of FM (FM:STAT ON) deactivates phase modulation.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	FM:STAT ON
	Activates FM modulation.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

7.13.7 SOURce:FREQuency Subsystem

This subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

[:SOURce<hw>]:FREQuency:CENTer <Center>

The command sets the center frequency of the sweep. This setting in combination with the span setting (`[SOURce:]FREQuency:SPAN`) defines the sweep range.

This command is linked to the commands `[SOURce:]FREQuency:STARt` and `[SOURce:]FREQuency:STOP`, i.e. changing these values causes the CENTer value to change, and vice versa:

```
CENTer = (STARt + STOP)/2
```

As with the "Frequency" value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

300 kHz + `OFFSet` ... RF_{max} +`OFFSet`

Parameters:

<Center>	float

	Range:	300kHz to RFmax (RFmax depending on model)
	Increment:	0.01Hz
	*RST:	300MHz
	Default unit: Hz	

Example:	`FREQ:CENT 400 MHz`
	sets the center frequency for the frequency sweep to 400 MHz.
	`FREQ:SPAN 200 MHz`
	sets a span of 200 MHz. This sets the sweep range to 300 MHz to 500 MHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency[:CW|:FIXed] <Fixed>

The command sets the frequency of the RF output signal for CW mode
(`SOURce:FREQuency:MODE CW`). In Sweep mode (`SOURce:FREQuency:MODE`
`SWEep`), this value is linked to the current sweep frequency.

In addition to a numerical value, it is also possible to specify `UP` and `DOWN`. The frequency
is then increased or decreased by the value which is set under
`[SOURce<[1]|2>:]FREQuency:STEP`.

As with the "FREQ" value entered in the display, the `OFFSet` value is also taken into
consideration with this command. The specified value range is therefore only effective if
`OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using
the following formula:

300 kHz + `OFFSet` ... RF_{max} +`OFFSet`

Correlation: `FREQ` for `FREQ:MODE SWE` is linked to sweep frequency.

Parameters:
<Fixed>   float

                 Range: 300kHz to RFmax
                 Increment: 0.01Hz
                 *RST: 1GHz
                 Default unit: Hz
Example: `FREQ 500kHz`
                 sets the frequency of RF output signal A to 500 kHz.
Usage: SCPI conform

[:SOURce<hw>]:FREQuency[:CW|:FIXed]:RCL <Rcl>

The command determines whether the current frequency setting is retained or whether
the stored frequency setting is adopted when an instrument configuration is loaded.

*RST does not affect this setting.

Parameters:
<Rcl>   INCLude|EXCLude

                 INCLude
                 The stored frequency is also loaded when a stored instrument
                 configuration is loaded.

                 EXCLude
                 The RF frequency is not loaded when a stored instrument
                 configuration is loaded. The current frequency is retained.

                 *RST: no default
Example: `FREQ:RCL INCL`
                 The stored frequency is set if the Recall command is called.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:MANual <Manual>

In Sweep mode (`:SOUR:FREQ:MODE SWE`) the command sets the frequency for the next sweep step in the "Step" sweep mode (`SOUR:SWE:MODE MAN`). Here only frequency values between the settings `[SOUR]:FREQ:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `SOUR:FREQ:MAN` command.

As with the "Frequency" value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFSet` values can be calculated using the following formula:

`STARt + OFFSet ... STOP +OFFSet`

Parameters:

<Manual>	float

> Range: STARt to STOP
> Increment: 0.01Hz
> *RST: 100MHz
> Default unit: Hz

Example:	`SWE:MODE MAN`
	sets the `Step` sweep mode.
Example:	`FREQ:MAN 500MHz`
	sets an RF frequency of 500 MHz for the next step in the `Step` sweep mode.
	`FREQ:MODE SWE`
	sets the Frequency Sweep mode. An RF frequency of 500 MHz is output.
	`FREQ:MAN 550MHz`
	triggers the next sweep step with an RF frequency of 550 MHz.
Usage:	SCPI conform

[:SOURce<hw>]:FREQuency:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the output frequency.

Parameters:

<Mode>   CW|FIXed|SWEep | LIST

CW|FIXed
The instrument operates in fixed-frequency mode; `CW` and
`FIXed` are synonyms. The output frequency is set
with `:SOURce:FREQuency:CW|FIXed`.

SWEep
The instrument operates in SWEep mode. The frequency is set
using the commands `SOURce:FREQuency:STARt; STOP;`
`CENTer; SPAN; MANual`.

LIST
The instrument processes a list of frequency and level settings for
the selected path.
The List mode settings are made in the SOURce:LIST
Subsystem subsystem. The setting `SOURce:FREQuency:MODE`
`LIST` also sets the command `SOURce:POWer:MODE`
automatically to `LIST`.
Correlation: FREQ:MODE LIST sets POW:MODE LIST

*RST: CW

Example: `FREQ:MODE SWE`
sets the SWEep mode. The settings under
`SOURce:FREQuency:STARt; STOP; CENTer; SPAN; MANual`
become effective.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:OFFSet <Offset>

The command sets the frequency offset of a downstream instrument, e.g. a mixer. If a
frequency offset is entered, the frequency entered with `SOURce:FREQuency:...` no
longer corresponds to the RF output frequency. The following correlation applies:

`SOURce:FREQuency:...` = RF output frequency + `SOURce:FREQuency:OFFSet`.

Entering an offset does not change the RF output frequency, but rather the query value
of `SOURce:FREQuency:...`.

Parameters:

<Offset>   float

Range: -67GHz to 67GHz
Increment: 0.01Hz
*RST: 0Hz
Default unit: Hz

Example: `FREQ:OFFS 500kHz`
sets the frequency offset to 500 kHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:HIGH?

Queries the maximum frequency of the frequency range for phase continuous settings.

The maximum frequency of the frequency range depends on the mode selected with the command `SOURce:FREQuency:PHASe:CONTinuous:MODE`.

Return values:

<High>	float
	Increment: 0.01Hz
	Default unit: Hz
Example:	`FREQ:PHAS:CONT:MODE NARR`
	selects mode narrow.
	`FREQ:PHAS:CONT:HIGH`
	queries the max frequency.
Example:	`Response: 1 003 720 930.23`
Usage:	Query only
Options:	R&S SMx-B22

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:LOW?

Queries the minimum frequency of the frequency range for for phase continuous settings.

The minimum frequency of the frequency range depends on the mode selected with the command `SOURce:FREQuency:PHASe:CONTinuous:MODE`.

Return values:

<Low>	float
	Increment: 0.01Hz
	Default unit: Hz
Example:	`FREQ:PHAS:CONT:MODE NARR`
	selects mode narrow.
	`FREQ:PHAS:CONT:LOW`
	queries the max frequency.
	`Response: 998 720 930.20`
Usage:	Query only
Options:	R&S SMx-B22

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:MODE <Mode>

Selects the mode for determining the frequency range for the phase continuous signal (see chapter 5.3.3.2, "Phase Continuous Frequency Setting", on page 118).

The minimum and maximum frequency (`SOUR:FREQ:PHAS:CONT:HIGH` and `SOUR:FREQ:PHAS:CONT:LOW`) of the frequency range depends on the mode selected with this command.

Parameters:

<Mode>   NARRow|WIDE

NARRow
The available frequency range is smaller than with setting wide. It is asymmetrical around the RF frequency set at the point of activating the phase continuous settings.

WIDE
The wide mode provides a larger frequency range. The frequency range is symmetrical around the RF frequency set at the point of activating the phase continuous settings.

*RST: NARRow

Example: `FREQ:PHAS:CONT:MODE NARR`
selects narrow mode.
`FREQ:PHAS:CONT:LOW`
queries the max frequency.
`Response: -3 518 518.52`

Options: R&S SMx-B22

[:SOURce<hw>]:FREQuency:PHASe:CONTinuous:STATe <State>

Activates/deactivates phase continuous frequency settings. For a given RF frequency setting, phase continuous frequency changes are possible in a limited frequency range (see chapter 5.3.3.2, "Phase Continuous Frequency Setting", on page 118).

The output sinewave is phase continuous, i.e there will be no phase discontinuity or glitch when changing the frequency.

Note: Restricted structure of command line. As long as phase continuous mode is active, only one command in a command line is processed. A second command in the command line will be ignored.

Parameters:

<State>   0|1|OFF|ON

*RST: OFF

Example: `FREQ:PHAS:CONT:STAT ON`
activates phase continuous mode.

[:SOURce<hw>]:FREQuency:SPAN <Span>

This command specifies the span for the sweep. This setting in combination with the center frequency setting (`[SOUR]:FREQ:CENT`) defines the sweep range.

This command is linked to the commands `[SOUR]:FREQ:STAR` and `[:SOUR]:FREQ:STOP`, i.e. changing these values causes the `SPAN` value to change, and vice versa:

`SPAN = (STOP - STARt)`

Negative values for `SPAN` are permitted; `STARt > STOP` then applies.

Parameters:

<Span>   float

                         Range: 0 to RFmax
                         Increment: 0.01Hz
                         *RST: 400MHz

Example: FREQ:CENT 400 MHz
                         sets the center frequency of the frequency sweep to 400 MHz.
                         FREQ:SPAN 200 MHz
                         sets a span of 200 MHz. This sets the sweep range to 300 MHz
                         to 500 MHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:STARt <Start>

This command sets the start frequency for the sweep mode. STARt can be greater than STOP.

This command is linked to the commands [SOUR]:FREQ:CENT and [SOUR]:FREQ:SPAN, i.e. changing these values causes the STARt value to change, and vice versa:

STARt = (CENTer - SPAN/2).

As with the "Frequency" value entered in the header, the OFFSet value is also taken into consideration with this command. The specified value range is therefore only effective if OFFSet is set to 0. The value range for other OFFset values can be calculated using the following formula:

300 kHz + OFFSet ... RF$_{max}$ +OFFSet

Parameters:

<Start>   float

                         Range: 300kHz to RFmax
                         Increment: 0.01Hz
                         *RST: 100MHz

Example: FREQ:STARt 1 MHz
                         sets the start frequency for the frequency sweep to 1 MHz.
                         FREQ:STOP 2 GHz
                         sets the stop frequency for the frequency sweep to 2 GHz.

Usage: SCPI conform

[:SOURce<hw>]:FREQuency:STOP <Stop>

This command sets the stop frequency for the sweep mode. STOP can be less than STARt.

This command is linked to the commands [:SOUR]:FREQ:CENt and [:SOUR]:FREQ:SPAN, i.e. changing these values causes the STARt value to change, and vice versa:

```
STOP = (CENTer + SPAN/2)
```

As with the "Frequency" value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

300 kHz + `OFFSet` ... RF$_{max}$ +`OFFSet`

Parameters:

<Stop>	float
	Range: 300kHz to RFmax
	Increment: 0.01Hz
	*RST: 500 MHz
	Default unit: Hz
Example:	`FREQ:STOP 2 GHz`
	sets the stop frequency for the frequency sweep to 2 GHz.
	`FREQ:STAR 1 MHz`
	sets the start frequency for the frequency sweep to 1 MHz.
Usage:	SCPI conform

[:SOURce<hw>]:FREQuency:STEP[:INCRement] <Increment>

The command sets the step width for the frequency setting if the frequency values `UP/DOWN` are used and variation mode `SOUR:FREQ:STEP:MODE USER` is selected. The command is linked to "Variation Step" for manual control, i.e. the command also sets the step width of the rotary knob for "Variation Active" on.

Parameters:

<Increment>	float
	Range: 0Hz to RFmax - 100kHz
	Increment: 0.01Hz
	*RST: 1MHz
Example:	`FREQ:STEP 50 kHz`
	sets the step width for the frequency setting to 50 kHz.

[:SOURce<hw>]:FREQuency:STEP:MODE <Mode>

This command activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the frequency value with the frequency values `UP/DOWN`. The command is linked to the command "Variation Active" for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the frequency value with the rotary knob.

Parameters:

<Mode>	DECimal|USER
	*RST: DECimal

Example: `FREQ:STEP 50 kHz`

sets the step width for the frequency setting to 50 kHz.

`FREQ:STEP:MODE USER`

actives this step width for frequency variation with the rotary knob (manual control) and with frequency values `UP/DOWN` (remote control).

7.13.8   SOURce:ILS Subsystem

The ILS subsystem contains the commands for checking the ILS-GS and ILS-LOC modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:ILS:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The external signal is input at the AM EXT connector.

Commands `[SOURce:]ILS[:GS|GSLope]:SODepth`, `[SOURce:]ILS:LOCalizer:SODepth`, `[SOURce:]ILS:TYPE and [SOURce:]ILS:STATe` are implemented for reasons of compatibility to R&S SMT signal generator family.

[:SOURce]:ILS:LOCalizer:COMid:CODE <Code>

The command enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport).

The COM/ID tone is sent according to the selected code (see table 5-10). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (ILS:LOC:COM:TSCH STD), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (ILS:LOC:COM:TSCH USER), all length parameters of the code can be set independently.

Parameters:

<Code>   string

Example: ILS:LOC:COM:CODE 'MUC'

                        select COM/ID code for Munich airport.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash>   float

                        Increment: 0.1 ms
                        *RST: 300 ms
                        Default unit: s

Example: `ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:TSCH USER`
selects user time schema
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms.
`ILS:LOC:COM:DASH 400ms`
sets a dash length of 400 ms.
`ILS:LOC:COM:LETT 50ms`
sets a letter space of 50 ms.
`ILS:LOC:COM:SYMB 10ms`
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:DEPTh <Depth>

The command sets the frequency of the communication/identification signal.

Parameters:

<Depth>   float

                       Range: 0 to 100
                       Increment: 0.1
                       *RST: 95
                       Default unit: PCT

Example: `ILS:LOC:COM:DEPT 10 PCT`
sets the AM depth of the communication/identification signal to the value of 10 PCT.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot>   float

                       Increment: 0.1 ms
                       *RST: 100 ms
                       Default unit: s

Example: `ILS:LOC:COM:CODE 'MUC'`
selects code for Munich airport
`ILS:LOC:COM:DOT 200ms`
sets a dot length of 200 ms.

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:FREQuency <Frequency>

The command sets the frequency of the additional communication/identification signal.

Parameters:

<Frequency>   float

                           Range: 0.1 to 20000
                           Increment: 0.1
                           *RST: 1020
                           Default unit: Hz

Example: ILS:LOC:COM:FREQ 1020
                           sets the frequency of the identification signal to the standard value
                           of 1020 Hz.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available for
user time schema only.

Parameters:

<Letter>   float

                           Increment: 0.1 ms
                           *RST: 300 ms
                           Default unit: s

Example: ILS:LOC:COM:CODE 'MUC'
                           selects code for Munich airport
                           ILS:LOC:COM:TSCH USER
                           selects user time schema
                           ILS:LOC:COM:DOT 200ms
                           sets a dot length of 200 ms.
                           ILS:LOC:COM:DASH 400ms
                           sets a dash length of 400 ms.
                           ILS:LOC:COM:LETT 50ms
                           sets a letter space of 50 ms.
                           ILS:LOC:COM:SYMB 10ms
                           sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:PERiod <Period>

Enters the period of the COM/ID signal in seconds.

Parameters:

<Period>   float

                        Range: 0 ms to 120 s
                        Increment: 1 ms
                        *RST: 9 s

Example: ILS:LOC:COM:PER 888ms
                        sets a period of 888 ms for the COM/ID signal.

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid[:STATe] <State>

The command activates or deactivates the additional communication/identification signal.

Parameters:

<State>   0|1|OFF|ON

                        *RST: OFF

Example: ILS:LOC:COM ON
                        activates the COM/ID signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol>   float

                        Increment: 0.1 ms
                        *RST: 100 ms
                        Default unit: s

Example: ILS:LOC:COM:CODE 'MUC'
                        selects code for Munich airport
                        ILS:LOC:COM:TSCH USER
                        selects user time schema
                        ILS:LOC:COM:DOT 200ms
                        sets a dot length of 200 ms.
                        ILS:LOC:COM:DASH 400ms
                        sets a dash length of 400 ms.
                        ILS:LOC:COM:LETT 50ms
                        sets a letter space of 50 ms.
                        ILS:LOC:COM:SYMB 10ms
                        sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:COMid:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ ID signal).

Parameters:

<Tschema>   STD|USER

                         *RST: STD

Example: `ILS:LOC:COM:CODE 'MUC'`
                         selects code for Munich airport
                         `ILS:LOC:COM:TSCH STD`
                         selects standard time schema
                         `ILS:LOC:COM:DOT 200ms`
                         sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:DDM:COUPling <Coupling>
[:SOURce]:ILS:LOCalizer:DDM:COUPling <Coupling>

Selects if the DDM value is fixed or is changed with a change of sum of modulation depths (SDM, see `[:SOURce]:ILS:LOCalizer:SDM` on page 495).

Parameters:

<Coupling>   FIXed|SDM

                         *RST: FIXed

Example: `ILS:DDM:COUP SDM`
                         the absolute value of DDM changes with changes of the SDM value. The DDM value expressed in dB stays constant.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:DDM:CURRent <GSCurrent>
[:SOURce]:ILS:LOCalizer:DDM:CURRent <LocCurrent>

The command enters the DDM value alternatively as a current by means of the ILS indicating instrument. The instrument current is calculated according to:

DDM uA = DDM × 857,1 uA

A variation of the instrument current automatically leads to a variation of the DDM value and the DDM value in dB

Parameters:

<LocCurrent>   float

                              Range: -967.75 uA to 967.75 uA
                              *RST: 0 uA
                              Default unit: A

<GsCurrent>   float

                              Range: -857.125 uA to 857.12 uA
                              *RST: 0 uA
                              Default unit: A

Example: `ILS:DDM:CURR?`

queries the instrument current (ILS-GS modulation).

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:DDM[:DEPTh] <Depth>
[:SOURce]:ILS:LOCalizer:DDM[:DEPTh] <Depth>

The command enters the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone.The following is true:

`ILS:GS|LOC:DDM:DEPTh` = (AM(90Hz) - AM(150Hz))/100%

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Depth>   float

                              Range: -0.4 to 0.4
                              Increment: 0.0001
                              *RST: 0

Example: `ILS:DDM 0.2`

sets the difference in depth of modulation to 20 percent between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) in ILS-GS modulation.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:DDM:DIRection <GsDirection>
[:SOURce]:ILS:LOCalizer:DDM:DIRection <LocDirection>

Selects the simulation mode for the ILS-GS / ILS-LOC modulation signal.A change of the setting automatically changes the sign of the DDM value

Parameters:

<LocDirection>	LEFT|RIGHT

LEFT
The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too far to the right, it must turn to the left).

RIGHT (ILS-LOC)
The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too far to the left, it must turn to the right).

*RST: LEFT

<GsDirection>	UP|DOWN

UP
The 150-Hz modulation signal is predominant, the DDM value is negative (the airplane is too low, it must climb).

DOWN
The 90-Hz modulation signal is predominant, the DDM value is positive (the airplane is too high, it must descend).

*RST: UP

Example:	`ILS:DDM:DIR UP`
	'The airplane is too low, it must climb.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:ILS[:GS \| GSLope]:DDM:LOGarithmic <Logarithmic>
[:SOURce]:ILS:LOCalizer:DDM:LOGarithmic <Logarithmic>

The command enters the DDM value in dB. The dB value is calculated according to:

DDM dB = 20 × LOG [(SDM+DDM×100%) / (SDM-DDM×100%)]

A variation of the value automatically leads to a variation of the DDM value and the instrument current.

Parameters:

<Logarithmic>	float

	Range: -999.9 to 999.9
	*RST: 0
	Default unit: dB
Example:	`ILS:DDM:LOG 1`
	sets the difference in depth of modulation to 1 dB between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) in ILS-GS modulation.
Options:	Option R&S SMA-K25

[:SOURce]:ILS[:GS \| GSLope]:DDM:PCT <Pct>

[:SOURce]:ILS:LOCalizer:DDM:PCT <Pct>

The command enters the difference in depth of modulation between the signal of the upper/left lobe (90 Hz) and the lower/right lobe (150 Hz). The maximum value equals the sum of the modulation depths of the 90 Hz and the 150 Hz tone. The following is true for the percentage value:

`ILS:GS|LOC:DDM:DEPTh` = (AM(90Hz) - AM(150Hz))

A variation of the DDM value automatically leads to a variation of the DDM value in dB and the value of the instrument current.

Parameters:

<Pct>	float	
	Range:	-80.0 to 80.0
	*RST:	0
Example:	`ILS:DDM 20`	
	sets the difference in depth of modulation to 20 percent between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) in ILS-GS modulation.	
Usage:	SCPI conform	

[:SOURce]:ILS[:GS | GSLope]:DDM:POLarity <GsPolarity>
[:SOURce]:ILS:LOCalizer:DDM:POLarity <LocPolarity>

The command enters the polarity for DDM calculation (see `[:SOURce]:ILS:LOCalizer:DDM[:DEPTh]` on page 488).

The DDM depth calculation depends on the selected polarity:

- Polarity 90 Hz - 150 Hz (default setting):
  DDM = [AM(90 Hz) - AM (150 Hz)] / 100%
- Polarity 150 Hz - 90 Hz:
  DDM = [AM(150 Hz) - AM (90 Hz)] / 100%

Parameters:

<LocPolarity>		
	Range:	-999.9 to 999.9
	Default unit: dB	
<GsPolarity>	P90_150|P150_90	
Example:	`ILS:DDM:POL P90_150`	
	selects polarity 90 Hz - 150 Hz	
Options:	Option R&S SMA-K25	

[:SOURce]:ILS[:GS | GSLope]:FREQuency:STEP <Step>
[:SOURce]:ILS:LOCalizer:FREQuency:STEP <Step>

The command selects the variation of the carrier frequency via the rotary knob.

Parameters:

<Step>   DECimal|ICAO

DECimal
Decimal variation according to the current cursor position.

ICAO
Variation in predefined steps according to the standardized ILS-GS/LOC transmitting frequencies. The start value can be selected with command `ILS:GS|LOC:ICAO:CHANnel`. The selection of the ICAO channel is effective on both ILS modulations. A switch between the two modulations causes the RF frequency to be adapted to the associated value.

*RST: DECimal

Example: `ILS:FREQ:STEP DEC`
selects decimal variation (ILS-GS modulation).

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:ICAO:CHANnel <Channel>
[:SOURce]:ILS:LOCalizer:ICAO:CHANnel <Channel>

The command selects the ICAO channel i.e., the ILS transmitting frequency. The RF-frequency is set to the value selected here. A variation of the carrier frequency by the rotary knob is performed in predefined steps according to the standardized ILS transmitting frequencies (see table 5-11). The ICAO channel settings for ILS-GS and ILS-LOC are coupled.

Parameters:

<Channel>   CH18X|CH18Y|CH20X|CH20Y|CH22X|CH22Y|CH24X|CH24Y|
                                CH26X|CH26Y|CH28X|CH28Y|CH30X|CH30Y|CH32X|CH32Y|
                                CH34X|CH34Y|CH36X|CH36Y|CH38X|CH38Y|CH40X|CH40Y|
                                CH42X|CH42Y|CH44X|CH44Y|CH46X|CH46Y|CH48X|CH48Y|
                                CH50X|CH50Y|CH52X|CH52Y|CH54X|CH54Y|CH56X|CH56Y

*RST: 18X

Example: `ILS:ICAO:CHAN CH18X`
selects ICAO frequency channel 18X. This channel sets the RF frequency to 334.7 MHz for ILS-GS and 108.1 MHz for ILS-LOC.

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:LLOBe[:FREQuency] <Frequency>

The command enters the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane.

Parameters:

<Frequency>   float

Range:	100 to 200
Increment:	0.5
*RST:	150
Default unit:	Hz

Example: `ILS:LLOB 150`
sets the frequency of the antenna lobe at the bottom of the air plane to the standard value 150 Hz (ILS-GS modulation).

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:LLOBe[:FREQuency] <Frequency>

The command enters the modulation frequency of the antenna lobe arranged at the bottom viewed from the air plane.

Parameters:

<Frequency>   float

Range:	60 to 120
Increment:	0.3
*RST:	90
Default unit:	Hz

Example: `ILS:LOC:LLOB 90`
sets the frequency of the antenna lobe to the left of the air plane to the standard value 90 Hz (ILS-LOC modulation).

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:MODE <Mode>

Selects the operating mode for the ILS-GS modulation signal.

Parameters:

<Mode>   NORM|ULOBe|LLOBe

NORM
ILS-GS modulation is active.

ULOBe
Amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS-GS signal is active. The modulation depth of the 90Hz signal results from the settings of commands `SOURce:ILS:GS:SDM` and `SOURce:ILS:GS:DDM[:DEPTh]` according to (command `SOURce:ILS:GS:DDM:DIR UP`):
AM(90Hz) = 0.5 * (`ILS:GS:SDM` + `ILS:GS:DDM` * 100%)
and for `SOURce:ILS:GS:DDM:DIR DOWN` according to
AM(90Hz) = 0.5 * (`ILS:GS:SDM` - `ILS:GS:DDM` * 100%)

LLOBe
Amplitude modulation of the output signal with the lower lobe (150Hz) signal component of the ILS-GS signal is active. The modulation depth of the 150Hz signal results from the settings of commands `SOURce:ILS:GS:SDM` and `SOURce:ILS:GS:DDM[:DEPTh]` according to (command `SOURce:ILS:GS:DDM:DIR UP`):
AM(150Hz) = 0.5 * (`ILS:GS:SDM` + `ILS:GS:DDM` * 100%)
and for `SOURce:ILS:GS:DDM:DIR DOWN` according to
AM(150Hz) = 0.5 * (`ILS:GS:SDM` - `ILS:GS:DDM` * 100%)

*RST: NORM

Example: `ILS:MODE ULOB`
Activates amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the ILS-GS signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:MODE <Mode>

Selects the operating mode for the ILS-LOC modulation signal.

Parameters:

<Mode>   NORM|LLOBe|RLOBe

NORM
ILS-LOC modulation is active.

LLOBe
Amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal is active. The modulation depth of the 90Hz signal results from the settings of commands `SOURce:ILS:LOC:SDM` and `SOURce:ILS:LOC:DDM[:DEPTh]` according to (command `SOURce:ILS:LOC:DDM:DIR RIGHt`):

AM(90Hz) = 0.5 * (`ILS:LOC:SDM` + `ILS:LOC:DDM` * 100%) and for `SOURce:ILS:GS:DDM:DIR LEFT` according to AM(90Hz) = 0.5 * (`ILS:LOC:SDM` - `ILS:LOC:DDM` * 100%)

RLOBe
Amplitude modulation of the output signal with the right lobe (150Hz) signal component of the ILS-LOC signal is active. The modulation depth of the 150Hz signal results from the settings of commands `SOURce:ILS:LOC:SDM` and `SOURce:ILS:LOC:DDM[:DEPTh]` according to (command `SOURce:ILS:LOC:DDM:DIR RIGHt`):

AM(150Hz) = 0.5 * (`ILS:LOC:SDM` + `ILS:LOC:DDM` * 100%) and for `SOURce:ILS:GS:DDM:DIR LEFT` according to AM(150Hz) = 0.5 * (`ILS:LOC:SDM` - `ILS:LOC:DDM` * 100%)

*RST: NORM

Example: `ILS:LOC:MODE LLOB`
Activates amplitude modulation of the output signal with the left lobe (90Hz) signal component of the ILS-LOC signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:PHASe <Phase>
[:SOURce]:ILS:LOCalizer:PHASe <Phase>

The command enters the phase between the modulation signals of the upper/left and lower/right antenna lobe. The zero crossing of the lower/right lobe (150Hz) signal serves as a reference. The angle refers to the period of the signal of the lower/right antenna lobe.

Parameters:

<Phase>   float

Range: 0 to 120
Increment: 0.01
*RST: 0
Default unit: DEG

Example:	ILS:LOC:PHAS 30DEG
	sets the phase between the modulation signals of the left and right antenna lobe to 30 degrees (ILS-LOC modulation).
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:PRESet
[:SOURce]:ILS:LOCalizer:PRESet

The commands activate the ILS-GS /ILS-LOC default setting.

Example:	ILS:LOC:PRES
	activates the ILS-LOC default settings for all SOURCe:ILS:LOC:... commands.
Usage:	Event
	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:ILS:LOCalizer:RLOBe[:FREQuency] <Frequency>

The command enters the modulation frequency of the antenna lobe arranged at the right viewed from the air plane.

Parameters:

<Frequency>	float
	Range: 100 to 200
	Increment: 0.5
	*RST: 150
	Default unit: Hz
Example:	ILS:LOC:RLOB 150
	sets the frequency of the antenna lobe at the right of the air plane to the standard value 150 Hz (ILS-LOC modulation).
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:SDM <GsSdm>
[:SOURce]:ILS:LOCalizer:SDM <LocSdm>

The commands enter the arithmetic sum of the modulation depths of the upper/left lobe (90Hz) and lower/right lobe (150Hz) ILS-GS/ILS-LOC signal contents. The RMS modulation depth of the sum signal depends on the phase setting of both modulation tones.

Note:

Commands [SOURce:]ILS[:GS|GSLope]:SODepth and [SOURce:]ILS:LOCalizer:SODepth are implemented as alias commands.

Parameters:

<LocSdm>   float

                           Range: 0 to 100
                           Increment: 0.1
                           *RST: 40
                           Default unit: PCT

<GsSdm>   float

                           Range: 0 to 100
                           Increment: 0.1
                           *RST: 80
                           Default unit: PCT

Example: `ILS:SDM 80PCT`
                           sets a sum of modulation depths of 80 % for the upper lobe (90Hz)
                           and lower lobe (150Hz) ILS-GS signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:SOURce <Source>
[:SOURce]:ILS:LOCalizer:SOURce <Source>

The command selects the modulation source for ILS-GS and ILS-LOC modulation. INT is the internal modulation source. The external signal is input at the AM EXT connector. The external signal is added to the internal signal. Switching off the internal source is not possible.

Parameters:

<Source>   INT|INT,EXT|EXT

                           *RST: INTernal

Example: `ILS:SOUR INT`
                           selects the internal modulation source.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:ILS:GS | GSLope:STATe <State>
[:SOURce]:ILS:LOCalizer:STATe <State>

The commands activate/deactivate ILS-GS/ILS-LOC modulation.

Note: Commands `[SOURce:]ILS:STATe` and `[SOURce:]ILS:TYPE` are implemented for reasons of compatibility to R&S SMT(E) Signal Generator family.

Parameters:

<State>   0|1|OFF|ON

                           *RST: OFF

Example:	ILS:STAT ON
	activates ILS-GS modulation.
	ILS:LOC:STAT ON
	activates ILS-LOC modulation. The RF-frequency is automatically set to 190 kHz.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:ILS[:GS | GSLope]:ULOBe[:FREQuency] <Frequency>

The command enters the modulation frequency of the antenna lobe arranged at the top viewed from the air plane.

Parameters:

<Frequency>	float
	Range: 60 to 120
	Increment: 0.3
	*RST: 90
	Default unit: Hz
Example:	ILS:ULOB 90
	sets the frequency of the antenna lobe at the top of the air plane to the standard value 90 Hz (ILS-GS modulation).
Usage:	SCPI conform
Options:	Option R&S SMA-K25

7.13.9 SOURce:INPut Subsystem

The SOURce:INPut subsystem contains the commands for configuring the inputs for external modulation signals. The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger).

[:SOURce<hw>]:INPut:MODext:IMPedance <Impedance>

This command sets the impedance for external feed via the FM/PM EXT input.

Parameters:

<Impedance>	HIGH	G50
	HIGH
	> 100 k0hm to ground
	G50
	50 0hm to ground
	*RST: HIGH
Example:	INP:MOD:IMP HIGH
	the EXT MOD input is set to > 100 kOhm to ground.

[:SOURce]:INPut:TRIGger:SLOPe <Slope>

Sets the polarity of the active slope of an externally applied trigger signal at the trigger input (BNC connector at the rear of the instrument).

The setting is effective for both inputs at the same time.

Parameters:

<Slope>	NEGative|POSitive
	*RST: POSitive
Example:	INP:TRIG:SLOP NEG
	the active slope of the external trigger signal at the trigger input is the falling slope.

7.13.10 SOURce:LFOutput Subsystem

This subsystem contains the commands for setting the LF signal source in CW and Sweep mode as well as for analog modulation.

An LF generator is always available in the instrument. A second LF generator is optional.

The suffix for LFOutput<ch> denotes the selected LF generator. The source for the LF sweep (LF generator 1 or 2) is selected with command SOURce:LFOutput:SWEep:FREQuency:SOURce.

Example

The following example shows how to set an LF sweep.

1. Set the sweep range.
   ```
   LFOutput:FREQuency:STARt  4 kHz
   LFOutput:FREQuency:STOP  10 kHz
   ```

2. Select linear or logarithmic sweep spacing.
   ```
   LFOutput:SWEep[:FREQuency]:SPACing LIN
   ```

3. Set the step width and dwell time.
   ```
   LFOutput:SWEep[:FREQuency]:STEP[:LINear]  100 Hz
   LFOutput:SWEep[:FREQuency]:DWELl 20 ms
   ```

4. Determine the sweep mode.
   ```
   LFOutput:SWEep:MODE AUTO
   ```

5. Determine the trigger.
   ```
   TRIGger0:SOURce SINGle
   ```

6. Activate the sweep.
   ```
   LFOutput:FREQuency:MODE SWEep
   ```

7. Trigger the sweep (depending on the mode).
   ```
   LFOutput:SWEep:EXECute
   ```

[:SOURce]:LFOutput<ch>:FREQuency <Frequency>

The command sets the frequency of the LF signal for CW mode (`:SOUR:MODE CW`). The setting is valid for all analog modulations (AM/FM/PhiM) with internal modulation source and for the LF Output.

If test signals for avionic systems are generated (VOR/ILS modulation), the frequency is preset and cannot be set.

In sweep mode (`SOUR:LFO:FREQ:MODE SWE`), the frequency is linked to the sweep frequency.

Correlation: `LFO:FREQ` for `LFO:FREQ:MODE SWE` linked to sweep frequency.

Parameters:

<Frequency>	float
	Increment: 0.1 Hz
	*RST: 1KHz
Example:	`LFO2:FREQ 5kHz`
	sets the frequency of the LF generator 2 signal to 5 kHz.
Options:	Option R&S SMA-K24 is required for selection LFOutput2.

[:SOURce]:LFOutput:FREQuency:MANual <Manual>

In Sweep mode (SOUR:LFO:FREQ:MODE SWE) the command sets the frequency for the next sweep step in the "Step" sweep mode (SOUR:LFO:SWE:MODE MAN). Here only frequency values between the settings SOUR:LFO:FREQ:STAR and ...:STOP are permitted. Each sweep step is triggered by a separate SOUR:LFO:FREQ:MAN command.

Parameters:

<Manual>	float
	Range: STARt to STOP
	Increment: 0.1 Hz
	*RST: 1 kHz
Example:	LFO:SWE:MODE MAN
	sets the "Step" sweep mode.
	LFO:FREQ:MAN 5 kHz
	sets an LF frequency of 5 kHz for the next step in the "Step" sweep mode.
	LFO:FREQ:MODE SWE
	sets the LF Sweep mode. An LF frequency of 5 kHz is output.
	LFO:FREQ:MAN 5.1 kHz
	triggers the next sweep step with a frequency of 5.1 kHz.
Usage:	SCPI conform

[:SOURce]:LFOutput:FREQuency:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the output frequency.

The source for the LF sweep is selected with command [:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource.

Parameters:

<Mode>	CW|FIXed|SWEep
	CW|FIXed
	The instrument operates in fixed-frequency mode. CW and FIXed are synonyms.
	The output frequency is set with [:SOURce]:LFOutput<ch>:FREQuency.
	SWEep
	The instrument operates in SWEep mode. The frequency is set using the commands [:SOURce]:LFOutput:FREQuency:STARt, [:SOURce]:LFOutput:FREQuency:STOP or [:SOURce]:LFOutput:FREQuency:MANual.
	*RST: CW
Example:	LFO:FREQ:MODE SWE
	sets the SWEep mode. The settings under SOURce:LFOutput:FREQuency:STARt; STOP; MANual become effective.

Usage: SCPI conform

[:SOURce]:LFOutput:FREQuency:STARt <Start>

This command sets the start frequency for the LF Sweep mode.

Parameters:

<Start>   float

                     Range: 0.1 Hz to 1 MHz
                     Increment: 0.1 Hz
                     *RST: 1 kHz

Example: `RST*`
                     activates all presettings.
                     `LFO:SWE:MODE AUTO`
                     sets the `AUTO` sweep mode, i.e. each trigger triggers a complete
                     sweep.
                     `TRIG0:SOUR SING`
                     sets the `SINGle` trigger mode, i.e. the sweep is triggered by the
                     command `:LFOutput:SWEep:EXECute` or `*TRG`.
                     `LFO:FREQ:STAR 100 kHz`
                     sets the start frequency for the LF sweep to 100 kHz.
                     `LFO:FREQ:STOP 200 kHz`
                     sets the stop frequency of the LF sweep to 200 kHz.
                     `LFO:FREQ:MODE SWE`
                     sets the LF sweep mode.
                     `LFO:SWE:EXEC`
                     a one-off LF sweep from 100 kHz to 200 kHz is performed. The
                     linear step width is 1 kHz with a dwell time of 15 ms (preset values).
Usage: SCPI conform

[:SOURce]:LFOutput:FREQuency:STOP <Stop>

This command sets the stop frequency for the LF sweep.

Parameters:

<Stop>   float

                     Range: 0.1 Hz to 1 MHz
                     Increment: 0.1 Hz
                     *RST: 50 kHz

Example: `LFO:FREQ:STOP 200 kHz`
                     sets the stop frequency for the LF sweep to 200 kHz.
                     `LFO:FREQ:STAR 100 kHz`
                     sets the start frequency for the LF sweep to 100 kHz.
Usage: SCPI conform

[:SOURce]:LFOutput<ch>:INTernal:VOLTtage <Voltage>

The command sets the output voltage for the two LF generators. The sum of the two values must not exceed the overall output voltage set with command SOURce:LFOutput:VOLTage.

Parameters:

<Voltage>   float

                                           Range: 0.001 V to 4 V
                                           Increment: 0.001 V
                                           *RST: 0.5 V

Example: LFO:INT:VOLT 0.5V

                                           sets the output voltage of the first LF generator to 0.5 volts

Usage: SCPI conform

Options: Option R&S SMA-K24 is required for selection LFOutput2

[:SOURce]:LFOutput:OFFSet <Offset>

The command sets a DC offset at the LF Output.

Parameters:

<Offset>   float

                                           Range: -4 to 4 V
                                           Increment: 0.001 V
                                           *RST: 0 V

Example: LFO:OFFS 2 V

                                           sets a DC OFFSet of 2 V

Usage: SCPI conform

[:SOURce]:LFOutput:SOURce <Source>

The command selects the internal source to be used for the LF Output signal. The available selection depends on the options fitted.

If test signals for avionic systems are generated (VOR/ILS modulation), the sources are preset and cannot be changed.

Parameters:

<Source>   LF1|LF2|LF12|NOISe|LF1Noise|LF2Noise

Example: LFO:SOUR NOIS

                                           selects the noise generator as source for the LF output signal.

Options: Option R&S SMA-K24 for selections other than LF1

[:SOURce]:LFOutput[:STATe] <State>

The command activates/deactivates the LF output.

Parameters:

<State>	0|1|OFF|ON

                           *RST: OFF

Example: `LFO ON`
activates the LF output. The settings under `LFO:FREQ` and `LFO:SWE` become effective.

[:SOURce]:LFOutput:SWEep[:FREQuency]:DWELl <Dwell>

The command sets the dwell time for each frequency step of the sweep.

Tip: It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (SYSTem:DISPlay:UPDate OFF).

Parameters:

<Dwell>	float

                          Range: 1.0E-3 to 100
                          Increment: 100.0E-6
                          *RST: 15.0E-3
                          Default unit: s

Example: `LFO:SWE:DWEL 20 ms`
sets a dwell time of 20 ms.

[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute

The command immediately starts an LF sweep.

The command is only valid for sweep mode Single
(SOURce:LFOutput:SWEep:FREQuency:MODE SINGle).

The command corresponds to the manual-control Execute Single Sweep - LF Sweep.

Example: `LFO:SWE:MODE SING`
sets the single cycle mode of the LF sweep.
`LFO:SWE:EXEC`
starts one cycle of the LF sweep.
Usage: Event

[:SOURce]:LFOutput:SWEep[:FREQuency]:LFSource <Lfsource>

The command selects the source for the LF sweep.

Parameters:

<LFSource>	LF1|LF2

                           *RST: LF1

Example: `LFO:SWE:LFS LF2`
selects LF generator 2 as the LF frequency sweep source.
Options: Option R&S SMA-K24

[:SOURce]:LFOutput:SWEep[:FREQuency]:MODE <Mode>

The command sets the cycle mode of the LF sweep.

The assignment of the GPIB commands to the sweep modes is given in the description of the sweep menus.

Parameters:

<Mode>   AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each frequency step of the sweep is triggered individually, either by varying the "Current Frequency" value using the rotary knob under manual control or by means of a :LFOutput:FREQ:MAN command under remote control.
With manual control, the frequency increases or decreases (depending on the direction of the rotary encoder) by the value specified under SOUR:LFO:SWE:FREQ:STEP:LIN (linear spacing) or ...:STEP:LOG (logarithmic spacing).
With remote control, the frequency increases by the value specified under LFO:SWE:FREQ:STEP:LIN|LOG which each sent [:SOURce]:LFOutput:FREQuency:MANual command, irrespective the value entered there.

STEP
Each trigger triggers one sweep step only. The frequency increases by the value entered under
[SOURce:]LFOutput:SWEep:STEP.

*RST: AUTO

Example: LFO:SWE:MODE AUTO
selects Mode Auto.

[:SOURce]:LFOutput:SWEep[:FREQuency]:POINts <Points>

The command sets the number of steps in an LF sweep.

The command is linked to the command :LFOutput:SWEep[:FREQuency]:STEP as follows:

- for linear sweeps and STARt < STOP
  POINts = ((STOP-STARt) / STEP:LIN) + 1

- for logarithmic sweeps and STARt < STOP
  POINts = ((log STOP - log STARt) / log STEP:LOG) + 1

If POINts changes, the value of STEP is adjusted. The STARt and STOP value is retained.

Two separate POINts values are used for linear or logarithmic sweep spacing (LFOutput:SWEep[:FREQuency]:SPACing LIN | LOG). The command is always effective for the currently set sweep spacing.

Parameters:

<Points>   float

                       Increment: 1
                       *RST: 100

Example: `LFO:FREQ:STAR`
                       sets the start frequency to 2 kHz.
                       `LFO:FREQ:STOP`
                       sets the stop frequency to 20 kHz
                       `LFO:SWE:SPAC LIN`
                       sets linear sweep spacing.
                       `LFO:SWE:POIN 11`
                       sets 11 sweep steps for linear sweep spacing. The sweep step
                       width (`STEP`) is automatically set to 2 kHz.

[:SOURce]:LFOutput:SWEep[:FREQuency]:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape>   SAWTooth|TRIangle

                       SAWTooth
                       One sweep runs from start to stop frequency. Each subsequent
                       sweep starts at the start frequency, i.e. the shape of the sweep
                       sequence resembles a sawtooth.

                       TRIangle
                       One sweep runs from start to stop frequency and back, i.e. the
                       shape of the sweep resembles a triangle. Each subsequent sweep
                       starts at the start frequency.

                       *RST: SAWTooth

Example: `SOUR:LFO:SWE:SHAP TRI`
                       selects the sweep cycle with alternating ascending and descend-
                       ing sweep directions.

[:SOURce]:LFOutput:SWEep[:FREQuency]:SPACing <Spacing>

The command selects linear or logarithmic sweep spacing.

Parameters:

<Spacing>   LINear|LOGarithmic

                       *RST: LINear

Example: `LFO:SWE:SPAC LIN`
                       selects linear sweep spacing.

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP[:LINear] <Linear>

The command sets the step width for the linear sweep.

This command is linked to the command `:LFOutput:SWEep[:FREQuency]:POINts` as follow.

- for `STARt` < `STOP`:
  `POINts = (((STOP-STARt) / STEP:LIN) + 1`

If `STEP:LIN` changes, the value of `POINts` is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Linear>	float

                     Range: 0 to STOP-STARt
                     Increment: 0.1 Hz

Example: `LFO:FREQ:STAR`
sets the start frequency to 2 kHz.
`LFO:FREQ:STOP`
sets the stop frequency to 20 kHz.
`LFO:SWE:SPAC LIN`
sets linear sweep spacing.
`LFO:SWE:STEP 2 kHz`
sets the sweep step width to 2 kHz. The number of sweep steps for linear sweep spacing (`POINts`) is automatically set to 11.

[:SOURce]:LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

The command specifies the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated (for `STARt` < `STOP`) using the following formula:

New frequency = Old frequency + `STEP:LOG` x Old frequency

`STEP:LOG` therefore gives the fraction of the old frequency. The frequency is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in percent, whereby the suffix PCT must always be used.

The command is linked to the command `:LFOutput:SWEep[:FREQuency]:POINts` as follows:

- for logarithmic sweeps and `STARt` < `STOP`:
  `POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `STEP:LOG` changes, the value of `POINts` is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Logarithmic>	float

                     Range: 0.01PCT to 100PCT
                     Increment: 0.01PCT
                     *RST: 1

Example: LFO:FREQ:STAR
                 sets the start frequency to 1 kHz.
                 LFO:FREQ:STOP
                 sets the stop frequency to 100 kHz.
                 LFO:SWE:SPAC LOG
                 sets logarithmic sweep spacing.
                 LFO:SWE:STEP:LOG 10PCT
                 sets the step width for logarithmic sweep spacing to 10% of the
                 previous frequency in each instance.

[:SOURce]:LFOutput<ch>:SHAPe <Shape>

The command selects the shape of the LF generator.

Parameters:

<Shape>   SINE|SQUare | TRIangle|TRAPeze

                  TRAPeze
                  In case of selection TRAPeze additional settings concerning the
                  duration of the single trapeze elements can be made.

                  *RST: SINE

Example: LFO:SHAP SQU
                  selects a rectangular shape for the signal of the LF generator.

Usage: SCPI conform

Options: Option R&S SMA-K24

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:FALL <Fall>

The command selects the fall time for the trapeze shape of the second LF generator.

The command selects the fall time for the trapeze shape of the LF generator.

Parameters:

<Fall>   float

                  Range: 0.2 µs to 2.5 s
                  Increment: 200 ns
                  *RST: 0.25 ms

Example: SOUR:LFO2:SHAP:TRAP:FALL 100s
                  selects a fall time of 100 s for trapezoid shape of the signal of LF
                  generator 2.

Usage: SCPI conform

Options: Option R&S SMA-K24

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:HIGH <High>

The command elects the high time for the trapeze shape of the second LF generator.

The command sets the high time for the trapeze shape of the LF generator.

Parameters:

<High>	float

	Range:	0.2 μs to 2.5 s
	Increment:	200 ns
	*RST:	1μs
Example:		SOUR:LFO2:SHAP:TRAP:HIGH 100s
		selects a high time of 100 s for trapeze shape of the signal of LF generator 2.
Usage:		SCPI conform
Options:		Option R&S SMA-K24

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:LOW <Low>

The command selects the low time for the trapeze shape of the second LF generator.

Parameters:

<Low>	float

	Range:	0.2 μs to 2.5 s
	Increment:	200 ns
	*RST:	1μs
Usage:		SCPI conform
Options:		Option R&S SMA-K24

[:SOURce]:LFOutput<ch>:SHAPe:TRAPeze:RISE <Rise>

The command selects the rise time for the trapeze shape of the second LF generator.

The command selects the rise time for the trapeze shape of the LF generator.

Parameters:

<Rise>	float

	Range:	0.2 μs to 2.5 s
	Increment:	200 ns
	*RST:	0.25 ms
Example:		SOUR:LFO2:SHAP:TRAP:RISE 100s
		selects a rise time of 100 s for trapeze shape of the signal of LF generator 2.
Options:		Option R&S SMA-K24

[:SOURce]:LFOutput:VOLTage <Voltage>

The command sets the output voltage of the LF output.

Parameters:

<Voltage>   float

                        Range: 0 to 4
                        Increment: 0.001
                        *RST: 1
                        Default unit: V

Example: `LFO:VOLT 3 V`

                        sets the voltage of the LF output to 3 V.

7.13.11 SOURce:LIST Subsystem

This subsystem contains the commands for the List mode of the instrument.

The following settings are required to operate the instrument in List mode:

1. Create a list.
   If a list which does not exist is selected with the `:LIST:SEL` command, an empty list with the name of the selected list is created.
   `SOURce1:LIST:SEL "New_list"`

2. Fill the list with values.
   All list components must be of the same length. This does not apply to components of length 1. This is interpreted as if the component has the same length as the other components and as if all values are the same as the first value.
   `SOURce1:LIST:FREQ 100 MHz, 110 MHz, 120 MHz...`
   `SOURce1:LIST:POW 2dBm, -1dBm, 0dBm...`

3. Select a list.
   If a new empty file has been created with the `:LIST:SEL` command, this file is selected, otherwise an existing list must be selected before the List mode is activated.
   `SOURce1:LIST:SEL "Old_list"`

4. Set the dwell time.
   The dwell time determines the duration of the individual list steps.
   `SOURce1:LIST:DWELl 3ms`

5. Set the List mode.
   The List mode determines the way in which the list is processed. In the example the list is processed once only or repeatedly depending on the trigger setting.
   `SOURce1:LIST:MODE AUTO`

6. Determine the trigger.
   In the example each trigger causes the list to be processed once from beginning to end.
   `SOURce:LIST:TRIGger:SOURce SINGle`

7. Activate the List mode.
   `SOURce1:FREQuency:MODE LIST`

8. Trigger the list (depending on the mode).

```
SOURce1:LIST:TRIGger:EXECute
```

9. Deactivate the List mode.
    ```
    SOURce1:FREQuency:MODE CW
    ```

SCPI refers to the individual lists as segments.

[:SOURce<hw>]:LIST:CATalog?

The command requests a list of available lists. The individual lists are separated by commas.

The lists are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:
<Catalog>   string

Example: `MMEM:CDIR '/var//Lists/Listmode'`
selects the directory for the list mode files.
`LIST:CAT?`
queries the available lists.
Response: `'list1,list2'`
the lists `list1` and `list2` are available.

Usage: Query only

[:SOURce<hw>]:LIST:DELete <Delete>

The command deletes the specified list.

The files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name has to be given, without the path and the file extension. A path can also be specified in command `:SOUR:LIST:CAT?`, in which case the file in the specified directory is deleted.

`*RST` does not affect data lists.

Setting parameters:
<Delete>   <list file name>

Example: `MMEM:CDIR '/var//Lists/Listmode'`
selects the directory for the list mode files.
`LIST:DEL 'LIST1'`
deletes the list `list1`.

Usage: Setting only

[:SOURce<hw>]:LIST:DELete:ALL

The command deletes all lists in the set directory. The List mode must be deactivated beforehand to ensure that no lists are selected when this command is called (`SOUR:FREQ:MODE CW or SWE`).

The files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:CAT?`, in which case all list mode files in the specified directory are deleted.

*RST does not affect data lists.

Example: `MMEM:CDIR '/var//Lists/Listmode'`
selects the directory for the list mode files.
`FREQ:MODE SWE`
deactivates the List mode for RF output and activates the Sweep mode.
`SOUR2:FREQ:MODE SWE`
deactivates the List mode for RF output and activates Sweep mode.
`LIST:DEL:ALL`
deletes all list mode files available in the set directory.

Usage: Event

[:SOURce<hw>]:LIST:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of list mode data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:
<Catalog>   string

Example: `MMEM:CDIR '/var//lists/listmode/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`LIST:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension `*.txt` are listed.
`LIST:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response:`'list1,list2'`
the ASCII files `list1.txt` and `list2.txt` are available.

Usage: Query only

[:SOURce<hw>]:LIST:DEXChange:AFILe:EXTension <Extension>

The command selects the file extension of the ASCII file to be imported or exported. Selection `TXT` (text file) or `CSV` (Excel file) is available.

Parameters:
<Extension>   TXT|CSV

                          *RST: TXT

Example: `MMEM:CDIR '/var//lists/listmode/import'`
selects the directory for the ASCII files with frequency and level value pairs.
`LIST:DEXC:AFIL:EXT TXT`
selects that ASCII files with extension `*.txt` are listed.
`LIST:DEXC:AFIL:CAT?`
queries the available files with extension `*.txt`.
Response: `'list1,list2'`
the ASCII files `list1.txt` and `list2.txt` are available.

[:SOURce<hw>]:LIST:DEXChange:AFILe:SELect <Select>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:
<Select>   <ascii_file_name>

Example: `LIST:DEXC:MODE IMP`
selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
`LIST:DEXC:AFIL:SEL`
`'/var//user/listmode/import/list.csv'`
selects that ASCII file `list.csv` is imported.
`LIST:DEXC:SEL`
`'/var//user/listmode/import/list_imp'`
selects that the ASCII file list.csv is imported into list mode list `list_imp`.

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:COLumn <Column>

The command selects the separator between the frequency and level column of the ASCII table.

Parameters:
<Column>   TABulator|SEMicolon|COMMa|SPACe

            *RST: COMMa

Example:　　　　`LIST:DEXC:MODE EXP`
selects that the list mode list is exported into an ASCII file.
`LIST:DEXC:AFIL:SEL`
`'/var//user/listmode/import/list.csv'`
selects ASCII file `list.csv` as destination for the list mode list
data.
`LIST:DEXC:AFIL:SEP:COL TAB`
the pairs of frequency and level values are separated by a tabu-
lator.
`LIST:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`LIST:DEXC:SEL`
`'/var//user/listmode/import/list_imp'`
selects that the list mode list `list_imp` is imported into ASCII file
`list.csv`.

[:SOURce<hw>]:LIST:DEXChange:AFILe:SEParator:DECimal <Decimal>

The command the decimal separator used in the ASCII data between '.' (decimal point)
and ',' (comma) with floating-point numerals.

Parameters:

<Decimal>　　　　　　DOT|COMMa

　　　　　　　　　　　*RST:　　　DOT

Example:　　　　`LIST:DEXC:MODE EXP`
selects that the list mode list is exported into an ASCII file.
`LIST:DEXC:AFIL:SEL`
`'/var//user/listmode/import/list.csv'`
selects ASCII file `list.csv` as destination for the list mode list
data.
`LIST:DEXC:AFIL:SEP:COL TAB`
the pairs of frequency and level values are separated by a tabu-
lator.
`LIST:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`LIST:DEXC:SEL`
`'root/var//user/listmode/import/list_imp'`
selects that the list mode list `list_imp` is imported into ASCII file
`list.csv`.

[:SOURce<hw>]:LIST:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected,
the ASCII file is imported as list mode list. When export is selected, the list mode list is
exported into the selected ASCII file.

Example:	`LIST:DEXC:MODE IMP`
	selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
	`LIST:DEXC:AFIL:SEL`
	`'/var//user/listmode/import/list.csv'`
	selects that ASCII file `list.csv` is imported.
	`LIST:DEXC:SEL`
	`'/var//user/listmode/import/list_imp'`
	selects that the ASCII file list.csv is imported into list mode list `list_imp`.
	`LIST:DEXC:EXEC`
	starts the import of the ASCII file data into the list mode file.

Usage:	Event

[:SOURce\<hw\>]:LIST:DEXChange:MODE \<Mode\>

The command selects if list mode lists should be imported or exported. Depending on the selection her, the file select command define either the source or the destination for list mode lists and ASCII files.

Parameters:

\<Mode\>	IMPort|EXPort
	*RST: IMPort

Example:	`LIST:DEXC:MODE IMP`
	selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.
	`LIST:DEXC:AFIL:SEL`
	`'/var//user/listmode/import/list.csv'`
	selects that ASCII file `list.csv` is imported.
	`LIST:DEXC:SEL`
	`'root/var//user/listmode/import/list_imp'`
	selects that the ASCII file `list.csv` is imported into list mode list `list_imp`.

[:SOURce\<hw\>]:LIST:DEXChange:SELect \<Select\>

The command selects the list mode list to be imported or exported.

The list mode files are stored with the fixed file extensions `*.lsw` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:DEXC:SEL`, in which case the files are stored or loaded in the specified directory.

Parameters:

\<Select\>	\<list_name\>

Example: LIST:DEXC:MODE IMP

selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.

LIST:DEXC:AFIL:SEL '/var//user/listmode/import/list.csv'

selects that ASCII file list.csv is imported.

LIST:DEXC:SEL '/var//user/listmode/import/list_imp'

selects that the ASCII file list.csv is imported into list mode list list_imp.

[:SOURce<hw>]:LIST:DWELI <Dwell>

The command sets the time for which the instrument retains a setting.

Parameters:

<Dwell> float

Range: 0.7E-3 to 100
Increment: 0.1E-3
*RST: 15.0E-3
Default unit: s

Example: LIST:DWEL 15

each setting in the list is retained for 15 ms.

[:SOURce<hw>]:LIST:FREQuency <Frequency>

The command fills the FREQuency part of the selected list with data.

*RST does not affect data lists.

Parameters:

<Frequency> <Frequency#1>{, <Frequency#2>, ...} | block data

The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see :FORMat[:DATA] on page 359).

Range: 300 kHz to RFmax (RFmax depending on model)

Example: LIST:SEL '/var//Lists/Listmode/list3'

selects list3 for editing. List3 is created if it does not yet exist.

SOUR:LIST:FREQ 1.4GHz, 1.3GHz, 1.2GHz,...

specifies the frequency values in list3. If the list already contains data, it is overwritten.

Usage: SCPI conform

[:SOURce<hw>]:LIST:FREQuency:POINts?

The command queries the length (in points) of the FREQuency component of the selected list.

Return values:

<Points>   float

Example: LIST:SEL '/var//Lists/Listmode/list3'

selects list3 for editing. List3 is created if it does not yet exist.

LIST:FREQ:POIN?

queries the number of frequency values in list3.

Response: 327

list3 has 327 frequency entries.

Usage: Query only

[:SOURce<hw>]:LIST:INDex <Index>

The command sets the list index in step mode (LIST:MODE STEP).

After the trigger signal the frequency and level settings of the selected index are processed in List mode.

Parameters:

<Index>   float

                          *RST: 0

Example: LIST:SEL '/var//Lists/Listmode/list3'

selects list3 for use in List mode.

FREQ:MODE LIST

activates List mode. List3 is processed.

LIST:MODE STEP

selects manual, step-by-step processing of the list.

LIST:IND 5

the frequency/level value pair with index 5 is executed.

TRIG:LIST:SOUR SING

selects triggering by means of the single trigger. The list is executed once.

SOUR:LIST:TRIG:EXEC

triggers the processing of the selected list.

[:SOURce<hw>]:LIST:INDex:STARt <Start>

The command sets the start index of the index range which defines a subgroup of frequency/level value pairs in the current list. Only the values in the set index range (:LIST:INDex:STARt ... :LIST:INDex:STOP) are processed in List mode.

Parameters:

<Start>   float

                              Range: 0 to list length
                              *RST: 0

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
                              selects list3 for use in List mode.
                              `LIST:IND:STAR 25`
                              sets 25 as start index of the index range.
                              `LIST:IND:STOP 49`
                              sets 49 as stop index of the index range.
                              `FREQ:MODE LIST`
                              activates List mode. The frequency/level value pairs from index 25
                              to index 49 in list3 are processed. All other entries of the list are
                              ignored.

[:SOURce<hw>]:LIST:INDex:STOP <Stop>

The command sets the stop index of the index range which defines a subgroup of fre-
quency/level value pairs in the current list. Only the values in the set index range
(`:LIST:INDex:STARt ... :LIST:INDex:STOP`) are processed in List mode.

Parameters:

<Stop>   float

                              Range: 0 to list length
                              *RST: 0

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
                              selects list3 for use in List mode.
                              `LIST:IND:STAR 25`
                              sets 25 as start index of the index range.
                              `LIST:IND:STOP 49`
                              sets 49 as stop index of the index range.
                              `FREQ:MODE LIST`
                              activates List mode. The frequency/level value pairs from index 25
                              to index 49 in list3 are processed. All other entries of the list are
                              ignored.

[:SOURce<hw>]:LIST:LEARn

The command learns the selected list, i.e. it determines the hardware setting for the entire
list. The data determined in this way is stored together with the list. When the list is acti-
vated for the first time, these settings are calculated automatically.

Example: `LIST:SEL '/var//Lists/Listmode/list3'`
                              selects list3. List3 is created if it does not yet exist.
                              `LIST:LEAR`
                              starts learning of the hardware setting for list3 and stores the set-
                              ting.
Usage: Event

[:SOURce<hw>]:LIST:MODE <Mode>

The command specifies how the list is to be processed (similar to
`SOURce:SWEep:MODE`).

Parameters:

<Mode>	AUTO|STEP
	AUTO
	Each trigger event triggers a complete list cycle. Possible trigger settings for `:LIST:TRIGger:SOURce` are `AUTO`, `SINGle` and `EXT`.
	STEP
	Each trigger event triggers only one step in the list processing cycle. The list is processed in ascending order. The external trigger has to be used (setting `:LIST:TRIGger:SOURce EXT`).
	*RST: AUTO
Example:	`LIST:MODE STEP`
	selects step-by-step processing of the list.
Usage:	SCPI conform

[:SOURce<hw>]:LIST:POWer <Power>

The command fills the Level part of the selected list with data.

*RST does not affect data lists.

Parameters:

<Power>	<Power#1>{, <Power#2>, ...} | block data
	The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see `:FORMat[:DATA]` on page 359).
	Range: Minimum level to Maximum level
	Default unit: dBm
Example:	`LIST:SEL '/var//Lists/Listmode/list3'`
	selects list3 for editing. List3 is created if it does not yet exist.
	`LIST:POW 0dBm, 2dBm, 2dBm, 3dBm,..`
	specifies the level values in `list3`. The number of level values must correspond to the number of frequency values. The previous data is overwritten.
Usage:	SCPI conform

[:SOURce<hw>]:LIST:POWer:AMODe <Amode>

The command selects the ranges of level settings for the list mode. The level settings are either performed in the low level or in the high level ranges.

Parameters:

<Amode>	NORMal|HPOWer

NORMal
The level settings are made in the range of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made in the range of the option. Only the high level range is available.

*RST: NORMal

Example: `LIST:POW:AMOD HPOW`

selects the high level ranges for List Mode.

[:SOURce<hw>]:LIST:POWer:POINts?

The command queries the length (in points) of the LEVel part of the selected list.

Return values:

<points>	float

Example: `LIST:SEL '/var//Lists/Listmode/list3'`

selects list3 for editing. List3 is created if it does not yet exist.
`LIST:POW:POIN?`
queries the number of levels in list3.
Response: `327`
LIST2 has 327 level entries.

Usage: Query only

SCPI conform

[:SOURce<hw>]:LIST:RESet

The command resets the list to the starting point.

Example: `LIST:RES`

resets the list to the starting point.

Usage: Event

[:SOURce<hw>]:LIST:SELect <Select>

The command selects the specified list. If a new list is to be created, the name can be entered here. The list is created if it does not yet exist. The list selected here is available for the further processing steps (editing) and is used in the instrument when the List mode is activated.

The files are stored with the fixed file extensions *.lsw in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:LIST:SEL` in which case the list mode file in the specified directory is selected.

*RST does not affect data lists.

Parameters:

<Select>	'<list name>'

Example:	`LIST:SEL '/var//Lists/Listmode/list3'` selects list3 for editing. List3 is created if it does not yet exist.

[:SOURce<hw>]:LIST:TRIGger:EXECute

The command immediately starts the processing of a list in list mode. It corresponds to the manual-control command "Execute Single."

Example:	`SOUR:LIST:TRIG:EXEC` triggers the processing of the selected list.
Usage:	Event

[:SOURce<hw>]:LIST:TRIGger:SOURce <Source>

The command sets the trigger source for the LIST mode.

The names of the parameters correspond to those under sweep mode. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	`MODE AUTO`
SINGle	BUS	`MODE SINGLE` or `STEP`
EXTernal	EXTernal	`MODE EXT TRIG SINGLE` or `EXT TRIG STEP`

Parameters:

<Source>	AUTO|IMMediate	SINGle|BUS	EXTernal	HOP	DHOP

AUTO|IMMediate

The trigger is free-running, i.e. the trigger condition is fulfilled continuously. The selected list in List mode is restarted as soon as it is finished.

SINGle|BUS

The list is triggered by the GPIB commands `[:SOURce<hw>]:`
`LIST:TRIGger:EXECute`. The list is executed once.

EXTernal

The list is triggered externally via the INST TRIG connector. The list is executed once.

HOP

Index-by-index cycle. The processed list index is determined by the external control signals provided via the serial FHOP bus. Processing of the frequency and level settings associated with selected index is triggered externally via the INST TRIG connector.

DHOP

Index-by-index cycle. The processed list index is determined by the external control signals provided via the serial FHOP bus. Processing of the frequency and level settings associated with selected index is automatically started at the end of data transmission.

*RST: SINGle

Example:	`LIST:TRIG:SOUR EXT`
	selects triggering by means of the external trigger.

7.13.12 SOURce:MBEacon Subsystem

The MBEacon subsystem contains the commands for checking the Marker Beacon modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:MBEacon:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The signal is output at the LF OUT connector.

[:SOURce]:MBEacon:COMid:CODE <Code>

Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal).

The COM/ID tone is sent according to the selected code (see table 5-12). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (MBE:COM:TSCH STD), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (MBE:COM:TSCH USER), all length parameters of the code can be set independently.

Parameters:

<Code>	string

Example:	MBE:COM:CODE 'MUC'
	select COM/ID code for Munich airport.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash>	float

	Increment: 0.1 ms
	*RST: 300 ms
	Default unit: s
Example:	MBE:COM:CODE 'MUC'
	selects code for Munich airport
	MBE:COM:TSCH USER
	selects user time schema
	MBE:COM:DOT 200ms
	sets a dot length of 200 ms.
	MBE:COM:DASH 400ms
	sets a dash length of 400 ms.
	MBE:COM:LETT 50ms
	sets a letter space of 50 ms.
	MBE:COM:SYMB 10ms
	sets a symbol space of 10 ms.
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:DEPTh <Depth>

The command enters the AM modulation depth of thes the additional communication/identification signal.

Parameters:

<Depth>   float

                      Range: 0 to 100 PCT
                      Increment: 0.1 PCT
                      *RST: 5 PCT

Example: MBE:COM:FREQ 1020
                      sets the frequency of the communication/identification signal to
                      the standard value of 1020Hz

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot>   float

                      Increment: 0.1 ms
                      *RST: 100 ms
                      Default unit: s

Example: MBE:COM:CODE 'MUC'
                      selects code for Munich airport
                      MBE:COM:DOT 200ms
                      sets a dot length of 200 ms.

Options: Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:FREQuency <Frequency>

The command sets the frequency of the communication/identification signal.

Parameters:

<Frequency>   float

                      Range: 0.1 Hz to 20000 Hz
                      Increment: 0.1 Hz
                      *RST: 1020 Hz
                      Default unit: Hz

Example: MBE:COM:FREQ 1020
                      sets the frequency of the communication/identification signal to
                      the standard value of 1020Hz.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available user time schema only.

Parameters:

<Letter>   float

                          Increment: 0.1 ms
                          *RST: 300 ms
                          Default unit: s

Example: MBE:COM:CODE 'MUC'
                          selects code for Munich airport
                          MBE:COM:TSCH USER
                          selects user time schema
                          MBE:COM:DOT 200ms
                          sets a dot length of 200 ms.
                          MBE:COM:DASH 400ms
                          sets a dash length of 400 ms.
                          MBE:COM:LETT 50ms
                          sets a letter space of 50 ms.
                          MBE:COM:SYMB 10ms
                          sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:PERiod <Period>

Enters the period of the COM/ID signal in seconds.

Parameters:

<Period>   float

                          Range: 0 ms to 120 s
                          Increment: 1 ms
                          *RST: 9 s

Example: MBEA:COM:PER 17s
                          sets a period of 17 s for the COM/ID signal.

Options: Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol>   float

                          Increment: 0.1 ms
                          *RST: 100 ms

Example:	`MBE:COM:CODE 'MUC'`
	selects code for Munich airport
	`MBE:COM:TSCH USER`
	selects user time schema
	`MBE:COM:DOT 200ms`
	sets a dot length of 200 ms.
	`MBE:COM:DASH 400ms`
	sets a dash length of 400 ms.
	`MBE:COM:LETT 50ms`
	sets a letter space of 50 ms.
	`MBE:COM:SYMB 10ms`
	sets a symbol space of 10 ms.
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon:COMid:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ID signal).

Parameters:

<Tschema>	STD|USER
	*RST:　　　USER
Example:	`MBE:COM:CODE 'MUC'`
	'elects code for Munich airport
	`MBE:COM:TSCH STD`
	selects standard time schema
	`MBE:COM:DOT 200ms`
	sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon:COMid[:STATe] <State>

The command switches on or off the additional communication/identification signal.

Parameters:

<State>	0|1|OFF|ON
	*RST:　　　OFF
Example:	`MBE:COM ON`
	activates the COM/ID signal.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon:PRESet

The commands activate the Marker Beacon default setting. The command also sets the RF frequency to 75 MHz.

Example:	ILS:MBE:PRES
	activates the default settings for all SOURce:MBE:… commands. It sets the RF frequency to 75 MHz.
Usage:	Event
	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon:STATe <State>

The commands activate/deactivate Marker Beacon modulation.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	MBE:STAT ON
	activates Marker Beacon modulation.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon[:MARKer]:DEPTh <Depth>

Enters the modulation depth of the marker signal.

Parameters:

<Depth>	float
	Range: 0 to 100 PCT
	Increment: 0.1 PCT
	*RST: 95 PCT
	Default unit: PCT
Example:	MBE:DEPT 30PCT
	enters a modulation depth of 30 percent for the marker.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon[:MARKer]:FREQuency <Frequency>

Enters the modulation frequency of the marker signal.

Parameters:

<Frequency>	400Hz|1300Hz| 3000Hz
	Increment: 0.1 Hz
	*RST: 400 Hz

Example:	MBE:FREQ 400
	'enters a frequency of 400 Hz for the marker.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:MBEacon[:MARKer]:PULSed <Pulsed>

The commands activate the pulsed marker.

Parameters:

<Pulsed>   0|1|OFF|ON

OFF
The markers are output uncoded (key down).

ON
The markers are output with the following on/off ratio:
Outer Marker (400 Hz): 375 ms on, 125 ms off…
Middle Marker (1300 Hz) 375 ms on, 125 ms off, 83 ms on, 83 ms off…
Inner Marker (3000 Hz) 83 ms on, 83 ms off (6dots/sec)

*RST: OFF

Example:	MBE:PULS
	activates the pulsed marker
Usage:	SCPI conform
Options:	Option R&S SMA-K25

7.13.13 SOURce:MODulation Subsystem

This subsystem contains the command for switching on/off all modulations.

[:SOURce<hw>]:MODulation[:ALL]:STATe <State>

The command switches the modulations on and off.

The command SOUR:MOD:ALL:STAT OFF switches all modulations off. A subsequent command SOUR:MOD:ALL:STAT ON restores the status that was active before the last switch-off. "MOD OFF" is displayed in the info line of the header next to the "Level" field.

Parameters:
<State>   0|1|OFF|ON

| **Example:** | MOD:STAT OFF |
| | switches off all modulations. |

7.13.14 SOURce:NOISe Subsystem

The SOURce:NOISe subsystem contains the commands for setting the noise modulation signal. The noise generator is optional.

[:SOURce<hw>]:NOISe:BWIDth <Bwidth>

This command sets the noise level in the system bandwidth for enabled bandwidth limitation. Distinct bandwidth settings between 10 kHz and 10 MHz in 100 kHz steps (range 100 .. 1 MHz), 1 MHz (range 1 MHz .. 5 MHz) and 5 MHz (5 MHz … 10 MHz) are possible.

Parameters:

<Bwidth>   float

	Range:	100 kHz to 10 MHz
	Increment:	100 kHz
	*RST:	100 kHz

Example: NOIS:BWID:STAT ON
                        enables bandwidth limitation.
                        NOIS:BWID 1 MHz
                        sets a system bandwidth of 1 MHz.
Options: R&S SMA-K24

[:SOURce<hw>]:NOISe:BWIDth:STATe <State>

Enables /disables bandwidth limitation of noise.

Parameters:

<State>   0|1|OFF|ON

                        *RST: OFF
Example: NOIS:BWID:STAT ON
                        enables bandwidth limitation.
Options: R&S SMA-K24

[:SOURce<hw>]:NOISe:DISTribution <Distribution>

Selects the noise power density distribution of the noise.

Parameters:

<Distribution>   GAUSs|EQUal

                        *RST: GAUSs
Example: NOIS:DIST GAUS ON
                        selects Gaussian distribution.
Options: R&S SMA-K24

[:SOURce<hw>]:NOISe:LEVel:RELative?

This command queries the level of the noise signal per Hz in the total bandwidth.

Return values:

<Relative>	float

Example:	`NOIS:LEV:REL?`
	queries the noise level
Usage:	Query only
Options:	R&S SMA-K24

[:SOURce<hw>]:NOISe:LEVel[:ABSolute]?

This command queries the level of the noise signal in the system bandwidth for enabled bandwidth limitation.

Return values:

<Absolute>	float

Example:	`NOIS:BWID:STAT ON`
	enables bandwidth limitation.
	`NOIS:BWID 10 MHz`
	sets a system bandwidth of 1 MHz.
	`NOIS:LEV:ABS`
	queries the noise level in the system bandwidth
Usage:	Query only
Options:	R&S SMA-K24

7.13.15 SOURce:PGEN Subsystem

This subsystem contains the commands for setting the pulse generator.

[:SOURce<hw>]:PGEN:STATe <State>

The command activates/deactivates the output of the video/sync signal at the PULSE VIDEO connector at the rear of the instrument.

The signal output and the pulse generator are automatically switched on with activation of pulse modulation if pulse generator is selected as modulation source. The signal output can be switched off subsequently.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF

Example: `PULM:SOUR INT`

selects the internal pulse generator as source for pulse modulation

`PULM:STAT ON`

activates pulse modulation. The pulse generator and the output of the signals at the PULSE VIDEO connector are automatically activated in addition.

`PGEN:STAT OFF`

deactivates the output of the pulse signal by the pulse generator at the PULSE VIDEO connector. The pulse modulation of the RF carrier must be activated with command `SOURce:PULM:STATe`.

Usage: SCPI conform

7.13.16 SOURce:PHASe Subsystem

This subsystem contains the commands for adjusting the phase of the RF output signal relative to a reference signal of the same frequency.

[:SOURce<hw>]:PHASe <Phase>

The command specifies the phase variation relative to the current phase. The variation can be specified in RADians.

Parameters:

<Phase>   float

                 Range: -359.9 to 359.9
                 Increment: 0.1 deg
                 *RST: 0.0 deg

Example: `PHAS 2DEG`

changes the phase by 2 degrees relative to the current phase.

`PHAS:REF`

adopts the set phase as the current phase.

Usage: SCPI conform

[:SOURce<hw>]:PHASe:REFerence

The command adopts the phase set with `SOURce:PHASe:ADJust` as the current phase.

Example: `PHAS 0.1RAD`

changes the phase by 0.1 RAD relative to the current phase.

`PHAS:REF`

adopts the set phase as the current phase.

Usage: Event
                  SCPI conform

7.13.17 SOURce:PM Subsystem

The PM subsystem contains the commands for checking the phase modulation. The settings for the internal modulation source (LF generator) are made in the SOURce:LFOutput subsystem.

For information about the required options, see chapter 5.4.4, "Phase Modulation (PhiM)", on page 217.

[:SOURce<hw>]:PM[:DEViation] <Deviation>

The command sets the modulation deviation of the phase modulation in RAD. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

The deviation of the internal source must not exceed the deviation of the external source in case of modulation source "Int+Ext" (PM:SOURce INT,EXT).

Parameters:

<Deviation>	float

	Range:	0 to 20
	Increment:	See data sheet
	*RST:	1
	Default unit: RAD	

Example:	PM 5
	sets the PM modulation deviation to 5 RAD
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:EXTernal:COUPling <Coupling>

The command selects the coupling mode for the external modulation input in the case of phase modulation.

Parameters:

<Coupling>	AC|DC

AC
The DC voltage component is disconnected from the modulation signal.

DC
The modulation signal is not changed.

*RST: AC

Example:	PM:EXT:COUP AC
	selects the coupling mode AC for external phase modulation.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:EXTernal:DEViation <Deviation>

The command sets the modulation deviation in case of external phase modulation in RAD. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

Parameters:

<Deviation>	float

Range: 0 to 20
Increment: See data sheet
Default unit: RAD

Example:	PM 5
	sets the PM modulation deviation for external phase modulation of 5 RAD.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:EXTernal:DIGital:BFORmat <Bformat>

The command selects the binary format for external digital phase modulation.

Parameters:

<Bformat>	BOFFset|DCODe

Example:	PM:EXT:DIG:BFOR BOFF
	selects binary format binary offset.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:INTernal<ch>:DEViation <Deviation>

The command selects the deviation for the two phase modulation signals. The sum of the two values must not exceed the overall modulation deviation set with command `SOURce:PM:DEViation`.

Parameters:

<Deviation>	float
	Range: 0 to 20
Example:	`PM:INT1:DEV 20KHZ`
	selects a deviation of 10 RAD for LF generator 1.
Options:	Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24

[:SOURce<hw>]:PM:INTernal:SOURce <Source>

Selects which internal modulation source is used. The available selection depends on the options fitted.

Parameters:

<Source>	LF1|LF2|LF12|NOISe|LF1Noise|LF2Noise
Example:	`PM:INT:SOUR LF2N`
	selects LF generator 2 and noise as internal modulation sources
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22; Option R&S SMA-K24 for selections other than LF1

[:SOURce<hw>]:PM:MODE <Mode>

The command selects the mode for the phase modulation.

Parameters:

<Mode>	HBANdwidth|HDEViation|LNOise

HBANdwidth
The maximum range for modulation bandwidth is available. However, phase noise is increased for low frequencies. The range for PhiM deviation is limited. This mode is recommended for high modulation frequencies.

HDEViation
The maximum range for PhiM deviation is available. Phase noise is improved for low frequencies. The range for modulation frequency is limited (see data sheet). This mode is recommended for low modulation frequencies and/or high PhiM deviation.

LNOise
Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PM deviation is limited (see data sheet)

*RST: HBANdwidth

Example:	PM:MODE LNO
	selects Low Noise mode for external phase modulation.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:SENSitivity?

The command queries the input sensitivity of the EXT MOD input in RAD/V. The command is only effective if the external modulation source is selected (SOUR:PM:SOUR EXT). The returned value depends on the modulation deviation setting (SOUR:PM:DEViation). This value is assigned to the voltage value for full modulation of the input.

Return values:

<Sensitivity>	float

Example:	PM:DEV 1
	sets a modulation deviation of 1RAD.
	PM:SENS?
	queries the input sensitivity at the EXT MOD input.
	Response: 1
	since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 1RAD/V.
Usage:	Query only
	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:SOURce <Source>

The command selects the modulation source for phase modulation.

Parameters:

<Source>	INTernal|EXTernal | INT,EXT | EDIGital

INTernal
INT is the LF generator. The frequency of the internal modulation signal can be set in the SOURce:LFOutput subsystem.

EXTernal
The external analog signal is input at the FM/PM EXT connector.

INT,EXT
Internal and external modulation source can be selected at the same time.

EDIGital
The external digital signal is input at the AUX I/O connector.

*RST: INTernal

Example:	`PM:SOUR INT`
	selects the internal modulation source.
	`PM:INT:SOUR LF2`
	selects the LF generator 2 as internal modulation source.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

[:SOURce<hw>]:PM:STATe <State>

The command activates/deactivates phase modulation. Activation of phase modulation deactivates frequency modulation.

Parameters:

| <State> | 0|1|OFF|ON |
| | *RST: OFF |

Example:	`PM:STAT ON`
	activates PM modulation.
Usage:	SCPI conform
Options:	Option R&S SMA-B20 or R&S SMA-B22

7.13.18 SOURce:POWer Subsystem

This subsystem contains the commands for setting the output level, level control and level correction of the RF signal.

Other units can also be used instead of dBm:

- by entering the unit directly after the numerical value (example `:POW 0.5V`)

- by changing the DEFault unit in the `UNIT` system (see the command `:UNIT:POWer`).

[:SOURce<hw>]:POWer:ALC:OMODe <Omode>

The command sets the level control mode which becomes active when automatic level control is deactivated (ALC Off).

Parameters:

<Omode>   SHOLd

                    SHOLd
                    Level control is activated briefly if the level or frequency changes ("ALC Off Sample & Hold").

                    *RST: SHOLd

Example: `POW:ALC OFF`
                    deactivates automatic level control for RF output A.
                    `POW:ALC:OMOD SHOL`
                    level control is briefly activated if the frequency or level changes.

[:SOURce<hw>]:POWer:ALC:SONCe

The command briefly activates level control for correction purposes.

Example: `POW:ALC OFF`
                    deactivates automatic level control for RF output A.
                    `POW:ALC:SONC`
                    level control is performed once only.
Usage: Event

[:SOURce<hw>]:POWer:ALC[:STATe] <State>

The command activates/deactivates automatic level control.

Parameters:

<State>   ON|OFF|AUTO

                    ON
                    Internal level control is permanently activated.

                    OFF
                    Internal level control is deactivated; Sample & Hold mode is activated.

                    AUTO
                    Internal level control is activated/deactivated automatically depending on the operating state.

                    *RST: AUTO

Example: `POW:ALC ON`
                    activates automatic level control for RF output A.
Usage: SCPI conform

[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

The command sets the RF output level in CW mode. In addition to numerical values, it is also possible to specify `UP` and `DOWN`. The level is then increased or decreased by the value specified under `[SOURce<hw>:]POWer:STEP`.

As with the **Level** value entered in the header, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFSet` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown in the example.

Parameters:

<Amplitude>	Minimum level ... Maximum level
	The value range for the level setting varies according to the instrument model.
	The values are given in the data sheet.
	Increment: 0.01 dB
	*RST: -30 dBm
	Default unit: dBm
Example:	`SOUR:POW:LEV:IMM:AMPL 15`
	or
	`:POW 15`
	sets the RF level at output A to 15 dBm.
Usage:	SCPI conform

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Note: The level offset is also effective for level sweeps!

The command specifies the constant level offset of a downstream attenuator/amplifier. If a level offset is entered, the level entered with `:POWer` no longer corresponds to the RF output level.

The following correlation applies:

`:POWer` = RF output level + `POWer:OFFSet`.

Entering a level offset does not change the RF output level, but rather the query value of `:POWer`.

For more information, see "RF level vs. RF output level", on page 169.

Only dB is permitted as the unit here. The linear units (V, W, etc.) are not permitted.

The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown in the example.

Parameters:

<Offset>	float	
	Range:	-100 dB to 100 dB
	Increment:	0.01 dB
	*RST:	0 dB
	Default unit: dB	
Example:	`SOURce:POWer:LEVel:IMMediate:OFFSet -10`	
	or	
	`POW:OFFS 10`	
	sets the RF level offset to 10 dB	
Usage:	SCPI conform	

[:SOURce<hw>]:POWer[:LEVel][:IMMediate]:RCL <Rcl>

The command determines whether the current level is retained or whether the stored level setting is adopted when an instrument configuration is loaded.

`*RST` does not affect this setting.

Parameters:

<Rcl>	INCLude | EXCLude
	INCLude
	The stored level is also loaded when a stored instrument configuration is loaded.
	EXCLude
	The RF level is not loaded when a stored instrument configuration is loaded. The current level is retained.
	*RST: no default
Example:	`POW:RCL INCL`
	the stored level is set if the Recall command is called.
Usage:	SCPI conform

[:SOURce<hw>]:POWer:LIMit[:AMPLitude] <Amplitude>

The command limits the maximum RF output level in CW and SWEEP mode. It does not influence the "Level" display or the response to the `POW?` query command.

The value is not affected by an instrument preset (PRESET key), `*RST` and the Save/ Recall function. This parameter is influenced only by the factory preset (`SYST:FPR`) and its factory value is equal to the upper limit.

Parameters:

<Amplitude>	float
	Minimum level ... Maximum level The value range for the level setting varies according to the instrument model. The values are given in the data sheet. Increment: 0.01 dB *RST: 30 dBm Default unit: dBm

Example:	`SOURce:POWer:LIMit:AMPLitude 10`
	or
	`:POW:LIM 10`
	limits the RF level to maximum +10 dBm.

Usage:	SCPI conform

[:SOURce<hw>]:POWer:MANual <Manual>

In Sweep mode (`:SOUR:POW:MODE SWE`) the command sets the level for the next sweep step in the Step sweep mode (`:SOUR:SWE:POW:MODE MAN`). Here only level values between the settings `[:SOUR]:POW:STAR` and `[:SOUR]:POW:STOP` are permitted. Each sweep step is triggered by a separate `:SOUR:POW:MAN` command.

As with the "Level" value entered in the "RF Level" menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Parameters:

<Manual>	float
	Minimum level ... Maximum level The value range for the level setting varies according to the instrument model The values are given in the data sheet. Increment: 0.01 dBm *RST: -30 dBm Default unit: dBm

Example:	`POW:SWE:MODE MAN`
	sets the Step sweep mode for RF output A.
	`POW:MAN -5 dBm`
	sets an RF level of -5 dBm for the next setting in the Step sweep mode for RF output A.
	`POW:MODE SWE`
	sets the Level Sweep mode for RF output A.
	`POW:MAN -5.5 dBm`
	triggers the next sweep step with a level of -5.5 dBm.

Usage: SCPI conform

[:SOURce<hw>]:POWer:MODE <Mode>

The command sets the instrument operating mode and therefore also the commands used to set the output level.

Parameters:

<Mode>   CW|FIXed|SWEep

          CW|FIXed
          The instrument operates at a constant level. `CW` and `FIXed` are synonyms. The output level is set with `:SOURce:POWer`.

          SWEep
          The instrument operates in SWEep mode.
          The level is set using the commands `SOURce:POWer:STARt; STOP; MANual`.

          LIST
          The instrument processes a list of frequency and level settings. The List mode settings are made in the SOURce:LIST Subsystem subsystem.
          The setting `SOURce:POWer:MODE LIST` also sets the command `SOURce:FREQuency:MODE` automatically to `LIST`.

          *RST: CW

Example: `POW:MODE SWEep`
          sets the SWEep mode. The settings under `SOURce:POW:STARt; STOP; MANual` become effective.

Usage: SCPI conform

[:SOURce<hw>]:POWer:POWer <Power>

Sets the RF level of the RF output connector.

The level entered with this command corresponds to the level at the RF output, i.e. any offset entry is not taken into consideration.

Note: The SCPI command `[:SOURce<hw>]:POWer[:LEVel][:IMMediate][:AMPLitude]` sets the level of the the "Level" display, i.e. the level containing offset.

Parameters:

<Power>   Minimum level ... Maximum level

          The value range for the level setting varies according to the instrument model.
          The values are given in the data sheet.

          Increment: 0.01 dB
          *RST: -30 dBm
          Default unit: dBm

Example: `SOUR:POW:POW 15`

                                      sets the RF level at output to 15 dBm.

[:SOURce<hw>]:POWer:STARt <Start>

The command sets the RF start level in Sweep mode.

As with the "Level" value entered in the "RF Level" menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Parameters:

<Start>   float

                                Minimum level ... Maximum level
                                The value range for the level setting varies according to the instrument model. The values are given in the data sheet.

                                Increment: 0.01 dB
                                *RST: -30 dBm
                                Default unit: dBm

Example: `POW:STAR –20 dBm`

                                      sets the start level for the level sweep to -15 dBm for RF output A.

Usage: SCPI conform

[:SOURce<hw>]:POWer:STEP[:INCRement] <Increment>

The command sets the step width for the level setting if `UP` and `DOWN` are used as the level values and variation mode `:SOUR:POW:STEP:MODE USER` is selected. The command is linked to setting "Variation Step" for manual control, i.e. the command also sets the step width of the rotary knob for "Variation Active On".

Parameters:

<Increment>   float

                                Range: 0 dB to 100 dB
                                Increment: 0.01 dB
                                  *RST: 1 dB
                                  Default unit: dB

Example: `SOURce:POWer:STEP:INCRement 2`

                                    or
                                  `POW:STEP 2`
                                  sets the step width for entering the RF level to 2 dB.

[:SOURce<hw>]:POWer:STEP:MODE <Mode>

This command activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the level value with the level values `UP/DOWN`. The command is linked to setting "Variation Active" for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the level value with the rotary knob.

Parameters:

<Mode>   DECimal|USER

                              *RST: DECimal

Example: `POW:STEP 2`
sets the step width for the level setting to 2 dB.
`POW:STEP:MODE USER`
actives this step width for level variation with the rotary knob (manual control) and with level values `UP/DOWN` (remote control).

[:SOURce<hw>]:POWer:STOP <Stop>

The command sets the stop level in Sweep mode.

As with the **Level** value entered in the **RF Level** menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Parameters:

<Stop>   float

                        Minimum level ... Maximum level
The value range for the level setting varies according to the instrument model.
The values are given in the data sheet.

                        Increment: 0.01 dB
                        *RST: -10 dBm
                        Default unit: dBm

Example: `POW:STOP 3`
sets the stop level for the level sweep to 3 dBm for RF output A.

Usage: SCPI conform

7.13.19 SOURce:PULM Subsystem

This subsystem contains the commands for setting the pulse modulation.

The LF generator is used as the internal modulation source. The pulse frequency of the internal rectangular signal is therefore set in the `SOURce:LFOutput` subsystem.

The external signal is input at the PULSE EXT connector. The connector can be used as trigger input for internal pulse modulation. The polarity and input impedance of the connector can be selected. The pulse modulation signal is output at the PULSE VIDEO connector.

[:SOURce<hw>]:PULM:DELay <Delay>

The command sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

Parameters:

<Delay>   float

                           Range: 10 ns to 100 s
                           Increment: 20 ns
                           *RST: 20 ns
                           Default unit: ns

Example:	PULM:DEL 13 us
	13 us elapse after a trigger before the first pulse is generated.
Options:	Option R&S SMA-K23

[:SOURce<hw>]:PULM:DOUBle:DELay <Delay>

The command sets the delay from the start of the first pulse to the start of the second pulse.

Parameters:

<Delay>	float
	Range: 10 ns to 100 s
	Increment: 20 ns
	*RST: 1 ms
	Default unit: ns
Example:	PULM:DOUB:DEL 22 us
	22 us elapse between the beginning of the first pulse and the beginning of the second pulse in double-pulse mode.
Options:	Option R&S SMA-K23

[:SOURce<hw>]:PULM:DOUBle:STATe <State>

The command enables/disables double pulse generation. The two pulses are generated in one pulse period.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	PULM:DOUB:STAT ON
	double-pulse mode is enabled.
Options:	Option R&S SMA-K23

[:SOURce<hw>]:PULM:DOUBle:WIDTh <Width>

The command sets the width of the second pulse in case of double pulse generation.

Parameters:

<Width>	float
	Range: 5ns to 100s
	Increment: 20ns
	*RST: 1ms
	Default unit: ns
Example:	PULM:DOUB:WIDT 33 us
	sets a width of 33 us for the second pulse.
Options:	Option R&S SMA-K23

[:SOURce<hw>]:PULM:MODE <Mode>

Sets the mode of the pulse generator.

Parameters:

<Mode>　　　　　　　　SINGle|DOUBle | PTRain

SINGle
Enables single pulse generation.

DOUBle
Enables double pulse generation. The two pulses are generated in one pulse period.

PTRain
A user-defined pulse train is generated The pulse train is defined by value pairs of on and off times that can be entered in a pulse train list.

*RST:　　　　SINGle

Example:　　　　　`PULM:MODE DOUB`
enables double pulse generation.

[:SOURce<hw>]:PULM:PERiod <Period>

The command sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Parameters:

<Period>　　　　　　　float

The min value depends on the installed option R&S R&S SMA-K22 or R&S R&S SMA-K23 respectively.

Range:　　　5us | 20ns to 100 s
Increment:　1us | 20ns
*RST:　　　　1ms

Example:　　　　　`PULM:PER 220 us`
the pulse period is 220 us.

Options:　　　　　The enhanced features require option R&S SMA-K23

[:SOURce<hw>]:PULM:POLarity <Polarity>

The command sets the polarity between modulating and modulated signal. This command is only effective for an external modulation signal.

Parameters:

<Polarity>　　　　　　NORMal|INVerted

NORMal
The RF signal is suppressed during the pulse pause.

INVerted
The RF signal is suppressed during the pulse.

*RST:　　　　NORMal

Example:	PULM:SOUR EXT
	selects the external modulation source.
Example:	PULM:POL INV
	selects inverted polarity.

[:SOURce\<hw\>]:PULM:SOURce \<Source\>

The command selects the source for pulse modulation.

Parameters:

\<Source\>   INTernal|EXTernal

INTernal
Without option R&S SMA-K23:
The internally generated rectangular signal is used for the pulse modulation. The frequency of the internal signal can be set in the SOURce:LFOutput subsystem.
With option R&S SMA-K23:
If option R&S SMA-K23 is installed, the characteristics of the generated pulse can be set in a wide range, and double pulse generation is possible.

EXTernal
The signal applied externally via the EXT MOD connector is used for the pulse modulation.

	*RST: INTernal
Example:	PULM:SOUR INT
	selects the internal modulation source.
Example:	PULM:STAT ON
	activates the pulse modulation.
Usage:	SCPI conform

[:SOURce\<hw\>]:PULM:STATe \<State\>

The command activates/deactivates the pulse modulation.

Parameters:

\<State\>   0|1|OFF|ON

	*RST: OFF
Example:	PULM:STAT ON
	activates pulse modulation with the modulation source selected under SOURce:PULM:SOURce.
Usage:	SCPI conform

[:SOURce\<hw\>]:PULM:TRAin:CATalog?

The command requests a list of available pulse train files. The individual pulse train files are separated by commas.

The files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog>   string

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
                            selects the directory for the pulse train files.
                            `PULM:TRA:CAT?`
                            queries the available files.
                            `Response: 'P_CONS','P_INCR','P_DECR'`
                            the lists `P_CONS`, `P_INCR` and `P_DECR` are available.

Usage: Query only

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:DELete <Delete>

The command deletes the specified pulse train file.

The files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name has to be given without the path and the file extension.

Setting parameters:

<Delete>   <list file name>

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
                            selects the directory for the pulse train files.
                            `PULM:TRA:DEL 'P_FIVE'`
                            deletes the list `P_FIVE`

Usage: Setting only

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:OFFTime <Offtime>

The command fills the Offtime part of the selected file with data.

*RST does not affect data lists.

Parameters:

<Offtime>   Offtime#1{, Offtime#2, ...} | binary block data

The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data.
When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see the command `FORMat:DATA`).
The maximum length is 1023 values.

Range: 5ns to 5ms

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:OFFT 10ns,15ns,40ns,...`
specifies the offtime values in `P_INCR`. If the list already contains data, it is overwritten.

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:OFFTime:POINts?

The command queries the length (in points) of the offtime component of the selected list.

Return values:

<Points>   float

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:OFFT:POIN?`
queries the number of frequency values in `P_INCR`
Response: 7
`P_INCR` has 7 offtime entries.

Usage: Query only

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:ONTime <Ontime>

The command fills the Ontime part of the selected file with data.

Parameters:

<Ontime>   Onime#1{, Ontime#2, ...} | binary block data

The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data.
When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see the command `FORMat:DATA`).
The maximum length is 1023 values.

Range: 5ns to 5ms

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:ONT 10ns,15ns,40ns,...`
specifies the ontime values in `P_INCR`. If the list already contains data, it is overwritten.

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:ONTime:POINts?

The command queries the length (in points) of the ontime component of the selected list.

Return values:

<Points>   float

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
`PULM:TRA:ONT:POIN?`
queries the number of frequency values in `P_INCR`
Response: 7
`P_INCR` has 7 ontime entries.

Usage: Query only

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:REPetition <Repetition>

The command sets the number of repetitions for each ontime/offtime value pair. The maximum number of repetitions for all value pairs is 1023 values.

*RST does not affect data lists.

Parameters:

<Repetition>	Repetition#1{, Repetition#2, ...}
	Range: 1 to max
Example:	`MMEM:CDIR 'var/lists/pulsetrain'`
	selects the directory for the pulse train files.
	`PULM:TRA:SEL 'P_INCR'`
	selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
	`PULM:TRA:ONT 10ns,15ns,40ns,...`
	specifies the ontime values in `P_INCR`. If the list already contains data, it is overwritten.
	`PULM:TRA:OFFT 10ns,15ns,40ns,...`
	specifies the offtime values in `P_INCR`. If the list already contains data, it is overwritten.
	`PULM:TRA:REP 10,15,40,...`
	specifies the number of repetitions for each value pair.
Options:	R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:REPetition:POINts?

The command queries the length (in points) of the repetition component of the selected list.

Return values:

<Points>	float
Example:	`MMEM:CDIR 'var/lists/pulsetrain'`
	selects the directory for the pulse train files.
	`PULM:TRA:SEL 'P_INCR'`
	selects `P_INCR` for editing. `P_INCR` is created if it does not yet exist.
	`PULM:TRA:REP:POIN?`
	queries the number of repetition values in `P_INCR`
	Response: 7
	`P_INCR` has 7 repetition entries.
Usage:	Query only
Options:	R&S SMA-K27

[:SOURce<hw>]:PULM:TRAin:SELect <Select>

The command selects the specified pulse train file. If a new file is to be created, the name can be entered here. The file is created if it does not yet exist. The file selected here is available for the further processing steps (editing) and is used in the instrument when the pulse train mode is activated.

The files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`.

`*RST` does not affect data lists.

Parameters:

<Select>   string

Example: `MMEM:CDIR 'var/lists/pulsetrain'`
selects the directory for the pulse train files.
`PULM:TRA:SEL 'P_INCR'`
selects `P_INCR` for editing. `P_INCR` is created if it does not yet
exist.

Options: R&S SMA-K27

[:SOURce<hw>]:PULM:TRIGger:EXTernal:GATE:POLarity <Polarity>

Selects the polarity of the Gate signal.

The signal is supplied via the PULSE EXT connector.

Parameters:

<Polarity>   NORMal|INVerted

                            *RST: NORMal

Example: `PULM:TRIG:EXT:GAT:POL NORM`
The pulse signal is generated while the gate signal is high.

Options: Option R&S SMA-K23

[:SOURce<hw>]:PULM:TRIGger:EXTernal:IMPedance <Impedance>

The command selects the impedance for external pulse trigger. The trigger is fed via the
PULSE EXT input.

Parameters:

<Impedance>   G50|G10K

                            *RST: G10K

Example: `SOUR:PULM:TRIG:EXT:IMP G50`
selects 50 Ohm as the trigger impedance for the external pulse
trigger.

Usage: SCPI conform

Options: Option R&S SMA-K23

[:SOURce<hw>]:PULM:TRIGger:EXTernal:SLOPe <Slope>

The command sets the polarity of the active slope of an applied trigger at the PULSE
EXT connector.

Parameters:

<Slope>   POS|NEG

                            *RST: POSitive

Example: PULM:TRIG:EXT:SLOP NEG

The pulse generator is triggered on the negative slope of the external trigger signal.

Options: Option R&S SMA-K23

[:SOURce<hw>]:PULM:TRIGger:MODE <Mode>

The command selects the trigger mode for pulse modulation.

Parameters:

<Mode>   AUTO|EXTernal|EGATe

AUTO
The pulse modulation is generated continuously.

EXTernal
The pulse modulation is triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

EGATe
The pulse modulation is gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

*RST: AUTO

Example: PULM:TRIG:MODE EXT

selects triggering by an external trigger event.

Usage: SCPI conform

Options: Option R&S SMA-K23; (AUTO by default without this option)

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of pulse train data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions `*.txt` or `*.csv` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Return values:

<Catalog>   string

Example: MMEM:CDIR 'var/lists/pulsetrain/import'

selects the directory for the ASCII files with ontime/offtime/repetition values.

PULM:TRA:DEXC:AFIL:EXT TXT

selects that ASCII files with extension `*.txt` are listed.

PULM:TRA:DEXC:AFIL:CAT?

queries the available files with extension `*.txt`.

Response: 'train1','train2'

the ASCII files `train1.txt` and `train2.txt` are available.

Usage: Query only

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:EXTension <Extension>

The command selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Parameters:

<Extension>	TXT|CSV
	*RST: TXT
Example:	MMEM:CDIR 'var/lists/pulsetrain/import' selects the directory for the ASCII files with ontime/offtime/repetition values. PULM:TRA:DEXC:AFIL:EXT TXT selects that ASCII files with extension *.txt are listed. PULM:TRA:DEXC:AFIL:CAT? queries the available files with extension *.txt. Response: 'train1','train2 the ASCII files train1.txt and train2.txt are available.

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SELect <Select>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions *.txt or *.csv in a directory of the user's choice. The directory applicable to the commands is defined with the command MMEMory:CDIR.

Parameters:

<Select>	string
Example:	MMEM:CDIR 'var/lists/pulsetrain/import' selects the directory for the ASCII files with ontime/offtime/repetition values. PULM:TRA:DEXC:MODE IMP selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists. PULM:TRA:DEXC:AFIL:SEL 'train.csv' selects that ASCII file train.csv is imported. PULM:TRA:DEXC:SEL 'train_imp' selects that the ASCII file train.csv is imported into pulse train list train_imp.

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:COLumn <Column>

Parameters:

<Column>	TABulator|SEMicolon|COMMa|SPACe
	*RST: SEMicolon

Example: `PULM:TRA:DEXC:MODE EXP`
selects that the pulse train list is exported into an ASCII file.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with ontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects ASCII file train.csv as destination for the pulse train list data.
`PULM:TRA:DEXC:AFIL:SEP:COL TAB`
the ontime/offtime/repetition values are separated by a tabulator.
`PULM:TRA:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the pulse train list `train_imp` is imported into ASCII file `train.csv`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:AFILe:SEParator:DECimal <Decimal>

The command selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Parameters:

<Decimal>   DOT|COMMa

                       *RST: DOT

Example: `PULM:TRA:DEXC:MODE EXP`
selects that the pulse train list is exported into an ASCII file.
`MMEM:CDIR 'var/lists/pulsetrain/import'`
selects the directory for the ASCII files with fontime/offtime/repetition values.
`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
selects ASCII file train.csv as destination for the pulse train list data.
`PULM:TRA:DEXC:AFIL:SEP:COL TAB`
the ontime/offtime/repetition values are separated by a tabulator.
`PULM:TRA:DEXC:AFIL:SEP:DEC DOT`
selects the decimal separator dot.
`PULM:TRA:DEXC:SEL 'train_imp'`
selects that the pulse train list `train_imp` is imported into ASCII file `train.csv`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected, the ASCII file is imported as pulse train list. When export is selected, the pulse train list is exported into the selected ASCII file.

Example:	`PULM:TRA:DEXC:MODE IMP`
	selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
	`MMEM:CDIR 'var/lists/pulsetrain/import'`
	selects the directory for the ASCII files withontime/offtime/repetition values.
	`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
	selects that ASCII file train.csv is imported.
	`PULM:TRA:DEXC:SEL 'train_imp'`
	selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.
	`PULM:TRA:DEXC:EXEC`
	starts the import of the ASCII file data into the pulse train file.
Usage:	Event

[:SOURce<hw>]:PULM:TRAin:DEXChange:MODE <Mode>

The command selects if pulse train lists should be imported or exported. Depending on the selection, the file select command define either the source or the destination for pulse train lists and ASCII files.

Parameters:

<Mode>	IMPort|EXPort
	*RST: IMPort
Example:	`PULM:TRA:DEXC:MODE IMP`
	selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
	`MMEM:CDIR 'var/lists/pulsetrain/import'`
	selects the directory for the ASCII files with ontime/offtime/repetition values.
	`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
	selects that ASCII file `train.csv` is imported.
	`PULM:TRA:DEXC:SEL 'train_imp'`
	selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.

[:SOURce<hw>]:PULM:TRAin:DEXChange:SELect <Select>

The command selects the pulse train list to be imported or exported.

The pulse train files are stored with the fixed file extensions `*.pulstrn` in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

Parameters:

<Select>	string

Example:	`PULM:TRA:DEXC:MODE IMP`
	selects that ASCII files with ontime/offtime/repetition values are imported and transferred into pulse train lists.
	`MMEM:CDIR 'var/lists/pulsetrain/import'`
	selects the directory for the ASCII files with ontime/offtime/repetition values.
	`PULM:TRA:DEXC:AFIL:SEL 'train.csv'`
	selects that ASCII file train.csv is imported.
	`PULM:TRA:DEXC:SEL 'train_imp'`
	selects that the ASCII file `train.csv` is imported into pulse train list `train_imp`.

[:SOURce<hw>]:PULM:WIDTh <Width>

The command sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20ns less than the set pulse period.

Parameters:

<Width>	float	
	Range:	20ns | 5ns to 100s
	Increment:	20ns
	*RST:	1ms
Example:	`PULM:WIDT 33 us`	
	sets a width of 33 us for the pulse.	
Options:	The enhanced features require option R&S SMA-K23	

7.13.20 SOURce:ROSCillator Subsystem

This subsystem contains the commands for setting the external and internal reference frequency.

> The commands of this subsystem are not affected by an instrument reset (`*RST` on page 348).

[:SOURce]:ROSCillator:EXTernal:FREQuency <Frequency>

The command informs the instrument of the frequency of the external reference.

Parameters:

<Frequency>	5MHZ|10MHZ|13MHZ

Default unit: Hz

Example: `ROSC:SOUR EXT`

selects the external source. The reference must be input at the REF IN input.

Example: `ROSC:EXT:FREQ 5MHz`

informs the instrument that the external reference frequency is 5MHz.

Usage: SCPI conform

[:SOURce]:ROSCillator:EXTernal:RFOFf:STATe <State>

The command determines if the RF output is switched off in case of a missing external reference signal for selection external source.

If enabled, this setting ensures that no improper RF signal due to the missing external reference signal is output and used for measurements.

In addition to the error message "Ext Ref missing", message "RF output deactivated' is generated.

Parameters:

<State>	0|1|OFF|ON

Example: `ROSC:SOUR EXT`

selects the external source. The reference must be input at the REF IN input.

Example: `ROSC:EXT:RFOF:STAT ON`

In case of a missing external signal, no RF signal is output.

[:SOURce]:ROSCillator:EXTernal:SBANdwidth <Sbandwidth>

The command selects the synchronization bandwidth for an external reference signal.

Parameters:

<Sbandwidth>   WIDE|NARRow

NARRow
without R&S SMA-B22
Synchronization bandwidth is approx. 20 Hz.
with R&S SMA-B22
Synchronization bandwidth is a few Hz. The internal 10-MHz
OCXO is synchronized to the external signal. This setting is
recommended if the phase noise of the external signal is worse
than the phase noise of the internal OCXO.

WIDE
without R&S SMA-B22
Synchronization bandwidth is approx. 750 Hz.
This mode is the standard mode, it is provided for using good
reference sources of high spectral purity.
with R&S SMA-B22
This mode is recommended for good reference sources of high
spectral purity. The internal 10-MHz OCXO is bypassed and the
external signal synchronizes a 100-MHz reference oscillator
directly. Synchronization bandwidth is app. 100 Hz.

Example: ROSC:SOUR EXT
selects the external source.
ROSC:EXT:FREQ 5 MHz
informs the instrument that the external reference has a frequency
of 5 MHz.
ROSC:EXT:SBAN WID
selects wideband setting for synchronization bandwidth.

[:SOURce]:ROSCillator[:INTernal]:ADJust:VALue <Value>

The command specifies the frequency correction value (adjustment value).

Parameters:

<Value>   float

                     Range: 0 to 4095
                     Increment: 1

Example: ROSC:ADJ:VAL 1400
sets the adjustment value to 1400.

[:SOURce]:ROSCillator[:INTernal]:ADJust[:STATe] <State>

The command determines whether the calibrated (OFF) or a user-defined (ON) adjust-
ment value is used for fine adjustment of the frequency. With STATe ON, the instrument
is no longer in the calibrated state. However, the calibration value is not changed and the
instrument resumes the calibrated state after switching the Adjustment State to Off.

Parameters:

<State>   0|1|OFF|ON

Example: `ROSC:SOUR INT`
selects the internal source.
`ROSC:ADJ ON`
activates use of a user-defined adjustment value.
`ROSC:ADJ:VAL 1400`
sets the adjustment value to 1400.

[:SOURce]:ROSCillator:SOURce <Source>

The command selects between internal and external reference frequency.

Parameters:

<Source>   INTernal|EXTernal

                        INTernal
                        The internal reference oscillator is used.

                        EXTernal
                        An external reference signal is used. It must be input at the REF IN connector at the rear of the instrument.
                        The instrument is informed of the frequency of the external reference signal by means of the command `[:SOURce]:ROSCillator:EXTernal:FREQuency`.

Example: `ROSC:SOUR EXT`
selects the external source.
`ROSC:EXT:FREQ 5 MHz`
informs the instrument that the external reference has a frequency of 5 MHz.

7.13.21   SOURce:SWEep Subsystem

This subsystem contains the commands for checking the RF sweeps, i.e. the sweeps of the RF generators. Sweeps are always triggered, except for the `MANual` sweep mode. The frequency sweep is activated by the command `SOURce:FREQuency:MODE SWEep`, and the level sweep by the command `SOURce:POWer:MODE SWEep`. All sweeps, including the LF sweep, can be set independently of each other.

This example shows how to set up a frequency sweep.

1. Set the sweep range.
   `[SOURce:]FREQuency:CENTer 200 MHz`
   `[SOURce:]FREQuency:SPAN 300 MHz`

2. Select linear or logarithmic spacing.
   `[SOURce:]SWEep[:FREQuency]:SPACing LIN`

3. Set the step width and dwell time.

```
[SOURce:]SWEep[:FREQuency]:STEP:LINear 20 MHz
[SOURce:]SWEep[:FREQuency]:DWELl 12 ms
```

4. Select the trigger mode.
   ```
   TRIGger:]FSWeep:SOURce SINGle
   ```

5. Select the sweep mode and activate the sweep.
   ```
   [SOURce:]SWEep[:FREQuency]:MODE AUTO
   [SOURce:]FREQuency:MODE  SWEep
   ```

6. Trigger the sweep.
   ```
   [SOURce:]SWEep[:FREQuency]:EXECute
   ```

It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (`SYSTem:DISPlay:UPDate OFF`).

[:SOURce<hw>]:SWEep[:FREQuency]:DWELl <Dwell>

The command sets the time taken for each frequency step of the sweep.

The keyword [`:FREQuency`] can be omitted (see example). The command is then SCPI-compliant.

Tip: It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (SYSTem:DISPlay:UPDate OFF).

Parameters:

<Dwell>　　　　　　　　float

　　　　　　　　　　　Range:　　　2.0E-3　to　100
　　　　　　　　　　　Increment:　100.0E-6
　　　　　　　　　　　*RST:　　　　15.0E-3
　　　　　　　　　　　Default unit: s

Example: SWE:DWEL 12 ms

sets a dwell time of 12 ms for a frequency sweep at the RF output.

[:SOURce<hw>]:SWEep[:FREQuency]:EXECute

The command triggers a sweep.

The command is only valid for sweep mode Single (SOURce:SWEep:FREQuency:MODE SINGle). The command corresponds to the manual-control command "Execute Single Sweep".

Example: SWE:FREQ:MODE SING

sets the single cycle mode of the frequency sweep

SWE:FREQ:EXEC

triggers a frequency sweep at the RF output.

Usage: Event

[:SOURce<hw>]:SWEep[:FREQuency]:MODE <Mode>

The command sets the sweep mode.

The keyword [:FREQuency] can be omitted (see example). The command is then SCPI-compliant.

Parameters:

<Mode>   AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each frequency step of the sweep is triggered individually, either by varying the "Current Frequency" value using the rotary knob under manual control or by means of a FREQ:MAN command under remote control. With manual control, the frequency increases or decreases (depending on the direction of the rotary encoder) by the value specified under FREQ:STEP:INCRement. With remote control, the frequency is set directly with the command :FREQ:MAN.

STEP
Each tcrigger triggers one sweep step only (Mode Single Step). The frequency increases by the value entered under SOUR:SWE:FREQ:STEP:LIN (linear spacing) or ...:STEP:LOG (logarithmic spacing).

*RST: AUTO

Example: SWE:MODE AUTO

selects **Mode Auto** for a frequency sweep at the RF output.

[:SOURce<hw>]:SWEep[:FREQuency]:POINts <Points>

The command sets the number of steps in an RF sweep.

The command is linked to the command `:SWEep[:FREQuency]:STEP` as follows:

- for linear sweeps
  `POINts = (SPAN / STEP:LIN) + 1`

- logarithmic sweeps and `STARt < STOP`:
  `POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `POINts` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Two separate `POINts` values are used for linear or logarithmic sweep spacing (`:SWEep[:FREQuency]:SPACing LIN | LOG`). The command is always effective for the currently set sweep spacing.

Parameters:

<Points>	float

Example: `FREQ:STAR`
sets the start frequency to 100 MHz.
`FREQ:STOP`
sets the stop frequency to 500 MHz.
`SWE:SPAC LIN`
sets linear sweep spacing.
`SWE:POIN 401`
sets 401 sweep steps for linear sweep spacing. The sweep step width (`STEP`) is automatically set to 1 MHz.

[:SOURce<hw>]:SWEep[:FREQuency]:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape>	SAWTooth|TRIangle

SAWTooth
One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

*RST: SAWTooth

Example: `SOUR:SWE:SHAP TRI`
selects the sweep cycle with alternating ascending and descending sweep directions.

[:SOURce<hw>]:SWEep[:FREQuency]:SPACing <Spacing>

The command selects the sweep spacing.

The keyword `[:FREQuency]` can be omitted (see example). The command is then SCPI-compliant.

Parameters:

<Spacing>   LINear|LOGarithmic

                         LINear
                         With the linear sweep, the step width is a fixed frequency value
                         which is added to the current frequency. The step width for linear
                         sweep is entered in Hz (see `[:SOURce<hw>]:SWEep[:`
                         `FREQuency]:STEP[:LINear]` on page 564).

                         LOGarithmic
                         With the logarithmic sweep, the step width is a constant fraction
                         of the current frequency. This fraction is added to the current
                         frequency. The logarithmic step width is entered in % (see `[:`
                         `SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic`
                         on page 565).

                         *RST: LIN

Example: `SWE:SPAC LIN`
                         selects linear sweep spacing for a frequency sweep at the RF out-
                         put.

[:SOURce<hw>]:SWEep[:FREQuency]:STEP[:LINear] <Linear>

The command sets the step width for linear sweeps.

This command is linked to the command `:SWEep[:FREQuency]:POINts` as follows:

```
POINts = (SPAN / STEP:LIN) + 1
```

If `STEP:LIN` changes, the value of `POINts` is adjusted. The `STARt` and `STOP` value is
retained.

The keywords `[:FREQuency]` and `[:LINear]` can be omitted (see example). The
command is then SCPI-compliant.

Parameters:

<Linear>   float

                         Range: 0 to (STOP - STARt)
                         Increment: 0.1Hz
                         *RST: 1MHz
                         Default unit: Hz

Example: `FREQ:STAR`
                         sets the start frequency to 100 MHz.
                         `FREQ:STOP`
                         sets the stop frequency to 500 MHz.
                         `SWE:SPAC LIN`
                         sets linear sweep spacing.
                         `SWE:STEP 2 MHz`
                         sets the step width for linear sweep spacing to 2 MHz (RF sweep
                         at the RF output. The number of sweep steps for linear sweep
                         spacing (`POINts`) is automatically set to 201.

[:SOURce<hw>]:SWEep[:FREQuency]:STEP:LOGarithmic <Logarithmic>

The comman specifies the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated (for `STARt < STOP`) using the following formula:

New frequency = Old frequency + `STEP:LOG` x Old frequency

`STEP:LOG` therefore gives the fraction of the old frequency. The frequency is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in percent, whereby the suffix `PCT` must always be used.

The command is linked to the command `:SWEep[:FREQuency]:POINts` for `STARt < STOP` as follows:

`POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `STEP:LOG` changes, the value of POINTs is adjusted. The `STARt` and `STOP` value is retained.

Parameters:

<Logarithmic>	float

Range: 0.01 to 9999
Increment: 0.01PCT
*RST: 1PCT

Example: `FREQ:STAR`
sets the start frequency to 100 MHz.
`FREQ:STOP`
sets the stop frequency to 500 MHz.
`SWE:SPAC LOG`
sets logarithmic sweep spacing.
`SWE:STEP:LOG 10PCT`
sets the step width for logarithmic sweep spacing to 10% of the previous frequency in each instance (for a frequency sweep).

[:SOURce<hw>]:SWEep:POWer:AMODe <Amode>

The command selects the ranges of level settings for the level sweep. The sweep is either performed in the low level or in the high level ranges.

Parameters:

<Amode>	NORMal|HPOWer

NORMal
The level settings are made in the range of the electronically switching attenuator. The high level ranges are not available.

HPOWer
The level settings are made in the high level range.

*RST: NORMal

Example: `SWE:POW:AMOD HPOW`
selects the high level ranges for level sweep.

[:SOURce<hw>]:SWEep:POWer:DWELl <Dwell>

The command sets the time taken for each level step of the sweep.

Tip: It is recommended to switch off the "GUI Update" for optimum sweep performance especially with short dwell times (SYSTem:DISPlay:UPDate OFF).

Parameters:

<Dwell>	float
	Range: 1.0E-3 to 100
	Increment: 100.0E-6
	*RST: 15.0E-3
	Default unit: s
Example:	SWE:POW:DWEL 12 ms
	sets a dwell time of 12 ms for a level sweep at the RF output.

[:SOURce<hw>]:SWEep:POWer:EXECute

The command triggers a sweep.

The command is only valid for sweep mode Single (SOURce:SWEep:POWer:MODE SINGle). The command corresponds to the manual-control command "Execute Single Sweep".

Example:	SOURce:SWEep:POWer:MODE SINGle
	sets the single cycle mode of the level sweep.
	SWE:POW:EXEC
	triggers a level sweep at the RF output.
Usage:	Event

[:SOURce<hw>]:SWEep:POWer:MODE <Mode>

The command sets the cycle mode of the level sweep.

Parameters:

<Mode>   AUTO|MANual|STEP

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each level step of the sweep is triggered individually, either by varying the "Current Level" value using the rotary knob under manual control or by means of a POW:MAN command under remote control.

With manual control, the level increases or decreases (depending on the direction of the rotary encoder) by the value specified under SOUR:SWE:POW:STEP. With remote control, the level increases by the value specified under SWEep:POW:STEP which each sent :POW:MAN command, irrespective the value entered there.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered under :SWEep:POWer:STEP.

*RST: AUTO

Example: SWE:POW:MODE AUTO
selects Mode Auto for a level sweep at RF output.

[:SOURce<hw>]:SWEep:POWer:POINts <Points>

The command sets the number of steps in a level sweep. The command is linked to the command :SWEep:POWer:STEP as follows:

POINts = ((STOP - STARt) / STEP:LOG) + 1

If POINts changes, the value of STEP is adjusted. The STARt and STOP value is retained.

Parameters:

<Points>   float

*RST: 20dB

Example: POW:STAR – 30 dBm
sets the start frequency to -30 dBm.
POW:STOP – 10 dBm
sets the stop frequency to -10 dBm.
SWE:POW:POIN 20
sets 20 sweep steps. The sweep step width (STEP) is automatically set to 1 dB.

[:SOURce<hw>]:SWEep:POWer:SHAPe <Shape>

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

<Shape>	SAWTooth|TRIangle

SAWTooth
One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle.Each subsequent sweep starts at the start level again.

*RST: SAWTooth

Example: SOUR:SWE:POW:SHAP TRI

selects the sweep cycle with alternating ascending and descending sweep directions.

[:SOURce<hw>]:SWEep:POWer:SPACing:MODE?

The command queries the sweep spacing. The sweep spacing for level sweeps is always linear.

Example: SWE:POW:SPAC:MODE?

queries the sweep spacing for a level sweep at RF output.
Result: LIN
linear spacing

Usage: Query only

[:SOURce<hw>]:SWEep:POWer:STEP[:LOGarithmic] <Logarithmic>

The command sets the step width factor for logarithmic sweeps. The next level value of a sweep is calculated (for STARt < STOP) using the following formula:

New level = Old level + STEP:LOG x Old level

STEP:LOG therefore gives the fraction of the old level. The level is increased by this fraction for the next sweep step. Usually STEP:LOG is given in decibels, whereby the suffix dB must always be used.

The command is linked to the command :SWEep:POWer:POINts for STARt < STOP as follows:

POINts = ((STOP - STARt) / STEP:LOG) + 1

If STEP:LOG changes, the value of POINts is adjusted. The STARt and STOP value is retained.

Parameters:

<Logarithmic>　　　　　float

　　　　　　　　　　　　　Range:　　　0.01　to　165 dB
　　　　　　　　　　　　　Increment:　0.01dB
　　　　　　　　　　　　　*RST:　　　　1
　　　　　　　　　　　　　Default unit: dB

Example:　　　　　　`SWE:POW:STEP 10dB`

　　　　　　　　　　　　　sets the step width for logarithmic sweep spacing to 10 dB of the
　　　　　　　　　　　　　previous level in each instance (for a level sweep).

[:SOURce<hw>]:SWEep:RESet[:ALL]

The command resets all active sweeps to the starting point.

Example:　　　　　　`SWE:RES`

　　　　　　　　　　　　　resets all active sweeps to the starting point.

7.13.22　SOURce:VOR Subsystem

The VOR subsystem contains the commands for checking the VOR modulation. The AM-specific characteristics of the internal modulation source are defined with commands `SOURce:VOR:...` Characteristics which are valid for all modulations and the LF Output are configured in the `SOURce:LFOutput` subsystem. The external signal is input at the AM EXT connector.

[:SOURce]:VOR:COMid:CODE <Code>

Enters the coding of the COM/ID signal by the international short name of the airport (e.g. MUC for the Munich airport). (COM/ID signal). The COM/ID tone is sent according to the selected code (see table 5-7). If no coding is entered, the COM/ID tone is sent uncoded (key down).

The length of the morse code can be varied. For selection standard time scheme (`VOR:COM:TSCH STD`), the selected dot length determines the setting of all other length parameters of the morse code (dash length, symbol space and letter space) . For selection user time scheme (`VOR:COM:TSCH USER`), all length parameters of the code can be set independently.

Parameters:

<Code>	string

Example:	`VOR:COM:CODE 'MUC'`
	select COM/ID code for Munich airport.
Usage:	SCPI conform
Options:	Option R&S SMA-K25

[:SOURce]:VOR:COMid:DASH <Dash>

Enters the length of a morse dash by means of seconds. This command is available for user time schema only.

Parameters:

<Dash>	float

	Increment:	0.1 ms
	*RST:	300 ms
Example:	`VOR:COM:CODE 'MUC'`	
	selects code for Munich airport	
	`VOR:COM:TSCH USER`	
	selects user time schema	
	`VOR:COM:DOT 200ms`	
	sets a dot length of 200 ms.	
	`VOR:COM:DASH 400ms`	
	sets a dash length of 400 ms.	
	`VOR:COM:LETT 50ms`	
	sets a letter space of 50 ms.	
	`VOR:COM:SYMB 10ms`	
	sets a symbol space of 10 ms.	
Options:	Option R&S SMA-K25	

[:SOURce]:VOR:COMid:DEPTh <Depth>

The command enters the AM modulation depth of thes the additional communication/identification signal.

Parameters:

<Depth>   float

	Range: 0 to 100
	Increment: 0.1
	*RST: 5
	Default unit: PCT

Example: `VOR:COM:FREQ 1020`

sets the frequency of the communication/identification signal to the standard value of 1020Hz

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid:DOT <Dot>

Enters the length of a morse dot by means of seconds. The length of the dash (3xdot), symbol space (=dot) and letter space (=3xdot) is also determined by this entry.

Parameters:

<Dot>   float

| | Increment: 0.1 ms |
| | *RST: 100 ms |

Example: `VOR:COM:CODE 'MUC'`

selects code for Munich airport

`VOR:COM:DOT 200ms`

sets a dot length of 200 ms.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid:FREQuency <Frequency>

The command sets the frequency of the communication/identification signal.

Parameters:

<Frequency>   float

	Range: 0.1 to 20000
	Increment: 0.1
	*RST: 1020
	Default unit: Hz

Example: `VOR:COM:FREQ 1020`

sets the frequency of the communication/identification signal to the standard value of 1020Hz.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid:LETTer <Letter>

Enters the length of a letter space by means of seconds. This command is available user time schema only.

Parameters:

<Letter>   float

                            Increment: 0.1 ms
                            *RST: 300 ms

Example: VOR:COM:CODE 'MUC'
                            selects code for Munich airport
                            VOR:COM:TSCH USER
                            selects user time schema
                            VOR:COM:DOT 200ms
                            sets a dot length of 200 ms.
                            VOR:COM:DASH 400ms
                            sets a dash length of 400 ms.
                            VOR:COM:LETT 50ms
                            sets a letter space of 50 ms.
                            VOR:COM:SYMB 10ms
                            sets a symbol space of 10 ms.
Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid:PERiod <Period>

Enters the period of the COM/ID signal in seconds.

Parameters:

<Period>   float

                            Range: 0 ms to 120 s
                            Increment: 1 ms
                            *RST: 9 s

Example: VOR:COM:PER 33s
                            sets a period of 33 s for the COM/ID signal.
Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid:SYMBol <Symbol>

Enters the length of the symbol space by means of seconds. This command is available for user time schema only.

Parameters:

<Symbol>   float

                            Increment: 0.1
                            *RST: 100
                            Default unit: ms

Example:
```
VOR:COM:CODE 'MUC'
```
selects code for Munich airport
```
VOR:COM:TSCH USER
```
selects user time schema
```
VOR:COM:DOT 200ms
```
sets a dot length of 200 ms.
```
VOR:COM:DASH 400ms
```
sets a dash length of 400 ms.
```
VOR:COM:LETT 50ms
```
sets a letter space of 50 ms.
```
VOR:COM:SYMB 10ms
```
sets a symbol space of 10 ms.

Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid:TSCHema <Tschema>

Selects if the set dot length determines the dash length (= three times the dot length) (setting STD) or if all length parameters can be set independently (setting USER). (COM/ ID signal).

Parameters:

<Tschema>   STD|USER

    *RST: STD

Example:
```
VOR:COM:CODE 'MUC'
```
selects code for Munich airport
```
VOR:COM:TSCH STD
```
selects standard time schema
```
VOR:COM:DOT 200ms
```
sets a dot length of 200 ms. The dash length and letter space is 3 x dot length, the symbol space equals the dot length.

Options: Option R&S SMA-K25

[:SOURce]:VOR:COMid[:STATe] <State>

The command switches on or off the additional communication/identification signal.

Parameters:

<State>   0|1|OFF|ON

    *RST: OFF

Example:
```
MBE:COM ON
```
activates the COM/ID signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:MODE <Mode>

Selects the operating mode for the VOR modulation signal.

Parameters:

<Mode>   NORM|VAR|SUBCarrier|FMSubcarrier

NORM
VOR modulation is active.

VAR
Amplitude modulation of the output signal with the variable signal component (30Hz signal content) of the VOR signal. The modulation depth of the 30 Hz signal corresponds to the value set with command `SOURce:VOR:VAR:DEPTh`.

SUBCarrier
Amplitude modulation of the output signal with the unmodulated FM carrier (9960Hz) of the VOR signal. The modulation depth corresponds to the value set with command `SOURce:VOR:SUBCarrier:DEPTh`.

FMSubcarrier
Amplitude modulation of the output signal with the frequency-modulated FM carrier (9960Hz) of the VOR signal. The frequency deviation corresponds to the value set with command `SOURce:VOR:REFerence:DEViation`, the modulation depth corresponds to the value set with command `SOURce:VOR:SUBCarrier:DEPTh`.

*RST: NORM

Example: `VOR:MODE VAR`
Activates amplitude modulation of the output signal with the upper lobe (90Hz) signal component of the VOR signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:PRESet

The commands activate the VOR default settings.

Example: `VOR:PRES`
activates the VOR default settings for all `SOURce:VOR:…` commands.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:REFerence[:DEViation] <Deviation>

The command sets the frequency deviation of the reference signal on the FM carrier.

Parameters:

<Deviation>	float	
	Range:	0 to 960
	Increment:	1
	*RST:	480
	Default unit: Hz	
Example:	`VOR:REF 480`	
	sets the frequency deviation of the reference signal on the FM carrier to 480 Hz.	
Usage:	SCPI conform	
Options:	Option R&S SMA-K25	

[:SOURce]:VOR:SOURce <Source>

The command selects the modulation source for VOR modulation. `INT` is the internal modulation source. The external signal is input at the AM EXT connector. The external signal is added to the internal signal. Switching off the internal source is not possible.

Parameters:

<Source>	INT|INT,EXT|EXT	
	*RST:	INTernal
Example:	`VOR:SOUR INT`	
	selects the internal modulation source.	
Usage:	SCPI conform	
Options:	Option R&S SMA-K25	

[:SOURce]:VOR:STATe <State>

The commands activate/deactivate VOR modulation.

Parameters:

<State>	0|1|OFF|ON	
	*RST:	OFF
Example:	`MBE:COM ON`	
	activates the COM/ID signal.	
Usage:	SCPI conform	
Options:	Option R&S SMA-K25	

[:SOURce]:VOR:SUBCarrier:DEPTh <Depth>

Enters the AM modulation depth of the FM carrier.

Parameters:

<Depth>   float

                       Range: 0 to 100
                       Increment: 0.1
                       *RST: 30

Example: VOR:SUBC:DEPT 30PCT

                       enters a modulation depth of 30 percent for the subcarrier.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:SUBCarrier[:FREQuency] <Frequency>

Enters the frequency of the FM carrier.

Parameters:

<Frequency>   float

                       Range: 5000 to 15000
                       Increment: 10
                       *RST: 9960
                       Default unit: Hz

Example: VOR:SUBC 9960

                       enters the standard frequency of 9960 Hz for the FM sub carrier.

Options: Option R&S SMA-K25

[:SOURce]:VOR:VAR:FREQuency <Frequency>

Enters the frequency of the variable and the reference signal. . As the two signals must have the same frequency, the setting is valid for both signals.

Parameters:

<Frequency>   float

                       Range: 20 to 60
                       Increment: 0.1
                       *RST: 30

Example: VOR:VAR:FREQ 30

                       'enters a frequency of 30 Hz for the variable and reference signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR:VAR[:DEPTh] <Depth>

Enters the AM modulation depth of the 30Hz variable signal.

Parameters:

<Depth>   float

                          Range: 0 to 100
                          Increment: 0.1
                          *RST: 30
                          Default unit: PCT

Example: `VOR:VAR 30PCT`
                          enters a modulation depth of 30 percent for the variable signal.

Usage: SCPI conform

Options: Option R&S SMA-K25

[:SOURce]:VOR[:BANGle] <Bangle>

The command sets the Bearing ANGle between the VAR signal and the reference signal.
The orientation of the angle depends on the setting under
`SOURce:VOR:BANGle:DIRection`.

Parameters:

<Bangle>   float

                          Range: 0 to 360
                          Increment: 0.01 deg
                          *RST: 0 deg
                          Default unit: deg

Example: `VOR 20DEG`
                          sets a phase angle of 20 degrees between the variable signal and
                          the reference signal

Options: Option R&S SMA-K25

[:SOURce]:VOR[:BANGle]:DIRection <Direction>

Enters the reference position of the phase information.

Parameters:

<Direction>   FROM|TO

                          FROM
                          The bearing angle is measured between the geographic north and
                          the connection line from beacon to airplane.

                          TO
                          The bearing angle is measured between the geographic north and
                          the connection line from airplane to beacon.

                          *RST: FROM

Example: `VOR:DIR FROM`
                          selects the beacon as a reference position. The angle corresponds
                          to the angle between the geographic north and the connection line
                          from beacon to airplane.

Options: Option R&S SMA-K25

7.14 STATus Subsystem

This system contains the commands for the status reporting system. *RST
on page 348 has no effect on the status registers.

Queries return the current value of the respective register, which permits a check of the
device status. A decimal value between 0 and 32767 (=2^{15}-1) is returned.

The configuration commands set the respective register thus determining which status
changes of the R&S SMA causes the status registers to be changed. A decimal value
between 0 and 32767 (= 2^{15}-1) is set.

STATus:OPERation:CONDition? <Condition >

The command queries the content of the CONDition part of the STATus:OPERation reg-
ister. This part contains information on the action currently being performed in the instru-
ment. The content is not deleted after being read out since it indicates the current hard-
ware status.

Parameters:
<Condition >   string

Example: STAT:OPER:COND
                            queries the Status:Operation:Condition register.
Usage: Query only
                            SCPI conform

STATus:OPERation:ENABle <Enable>

The command sets the bits of the ENABle part of the STATus:OPERation register. This
setting determines which events of the Status-Event part are forwarded to the sum bit in
the status byte. These events can be used for a service request.

Parameters:
<Enable>   string

Example: STAT:OPER:ENAB 32767
                            all events are forwarded to the sum bit of the status byte.

Usage: SCPI conform

STATus:OPERation[:EVENt]? <EVENt>

The command queries the content of the EVENt part of the STATus:OPERation register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:

<EVENt>   string

Example: STAT:OPER:EVEN
                  queries the STATus:OPERation:EVENt register.
Usage: Query only
                  SCPI conform

STATus:OPERation:NTRansition <Ntransition>

The command sets the bits of the NTRansition part of the STATus:OPERation register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register. The disappearance of an event in the hardware is thus registered, e.g. the end of an adjustment.

Parameters:

<Ntransition>   string

Example: STAT:OPER:NTR 0
                  a transition from 1 to 0 in the condition part of the Status:Operation register does not cause an entry to be made in the EVENt part.
Usage: SCPI conform

STATus:OPERation:PTRansition <Ptransition>

The command sets the bits of the PTRansition part of the STATus:OPERation register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENt part of the register. A new event in the hardware is thus registered, e.g. the start of an adjustment.

Parameters:

<Ptransition>   string

Example: STAT:OPER:PTR 32767
                  all transitions from 0 to 1 in the condition part of the Status:Operation register cause an entry to be made in the EVENt part.
Usage: SCPI conform

STATus:PRESet <Preset>

The command resets the status registers. All PTRansition parts are set to FFFFh (32767), i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 in a CONDition bit is not detected. The ENABle parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e. all events in these registers are not passed on.

Parameters:

<Preset>   string

Example: STAT:PRES
                       resets the status registers.

Usage: Event
                       SCPI conform

STATus:QUEStionable:CONDition? <Condition >

The command queries the content of the CONDition part of the STATus:QUEStionable register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Parameters:

<Condition >   string

Example: STAT:OPER:COND
                       queries the Status:Questionable:Condition register.

Usage: Query only
                       SCPI conform

STATus:QUEStionable:ENABle <Enable>

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This setting determines which events of the Status-Event part are enabled for the sum bit in the status byte. These events can be used for a service request.

Parameters:

<Enable>   string

Example: STAT:OPER:ENAB 1
                       problems when performing an adjustment cause an entry to be
                       made in the sum bit.

Usage: SCPI conform

STATus:QUEStionable[:EVENt]? <EVENt>

The command queries the content of the EVENt part of the STATus:QUEStionable register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Parameters:

<EVENt>	string

Example:	`STAT:QUES:EVEN?`
	queries the Status:Questionable:Event register.
Usage:	Query only
	SCPI conform

STATus:QUEStionable:NTRansition <Ntransition>

The command sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:

<Ntransition>	string

Example:	`STAT:OPER:NTR 0`
	A transition from 1 to 0 in the condition part of the Status:Questionable register does not cause an entry to be made in the EVENt part.
Usage:	SCPI conform

STATus:QUEStionable:PTRansition <Ptransition>

The command sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Parameters:

<Ptransition>	string

Example:	`STAT:OPER:PTR 32767`
	All transitions from 0 to 1 in the condition part of the Status:Questionable register cause an entry to be made in the EVENt part.
Usage:	SCPI conform

STATus:QUEue[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI. If the error queue is empty, 0 ("No error") is returned. The command is identical to `SYSTem:ERRor?`

Return values:

<NEXT>	string

Example:	STAT:QUE
	queries the oldest entry in the error queue.
	Response: 0, 'no error'
	No errors have occurred since the error queue was last read out.
Usage:	Query only
	SCPI conform

7.15   SYSTem Subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

:SYSTem:BEEPer:STATe <State>

This command switches the key beep on or off.

Parameters:

<State>	0|1|OFF|ON
	*RST: OFF
Example:	SYST:BEEP:STAT OFF
	No acoustic signal is output when a key on the front panel is pressed.
Usage:	SCPI conform

:SYSTem:COMMunicate:GPIB:LTERminator <Lterminator>

The command sets the terminator recognition for remote control via the IEC/IEEE bus.

Parameters:

<Lterminator>	STANdard|EOI
	EOI
	The terminator must be sent together with the line message EOI (End of Line). This setting is recommended for binary block transmissions where a character could coincidentally have the value LF (Line Feed) but is not intended as the terminator. This setting must be selected for block data with undefined length.
	STANdard
	An LF (Line Feed) is recognized as the terminator regardless of whether it is sent with or without EOI.
	*RST: STANdard
Example:	SYST:COMM:GPIB:LTER EOI
	only a character which is sent simultaneously with the line message EOI is accepted as the terminator.
Usage:	SCPI conform

:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

The command sets the GPIB address.

Parameters:

<Address>	float
	Range: 1 to 30
	*RST: 28
Example:	SYST:COMM:GPIB:ADDR 14
	sets GPIB address.
Usage:	SCPI conform

:SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname <Hostname>

The command enters the individual computer name of the R&S Signal Generator. The entry is only activated after sending command SYST:COMM:NETW:COMM:SET.

Note: The hostname can only be changed after deactivating protection level 1 (command SYSTem:PROTect<n>:STATe OFF, password)

Parameters:

<Hostname>   string

Example: SYST:COMM:NETW:HOST 'SIGGEN'
                     enters the individual computer name of the R&S Signal Generator.

Example: SYST:COMM:NETW:COMM:SET ON
                     activates the change of the hostname.

:SYSTem:COMMunicate:NETWork[:COMMon]:WORKgroup <Workgroup>

The command enters the individual workgroup name of the instrument.

Parameters:

<Workgroup>   string

Example: SYST:COMM:NETW:COMM:WORK 'TEST_09'
                     enters the workgroup name 'TEST_09'.

:SYSTem:COMMunicate:NETWork:IPADdress:MODE <Mode>

The command selects if the IP address is assigned automatically or manually. The entry is only activated after sending command SYST:COMM:NETW:IPAD:SET.

Parameters:

<Mode>   AUTO|STATic

                     AUTO
                     The IP address is assigned automatically. The network used must support automatic assignment of address (DHCP) in order to use this function.

                     STATic
                     The IP address is assigned manually.

                     *RST: AUTO

Example: SYST:COMM:NETW:IPAD:MODE AUTO
                     the IP address is assigned automatically (DHCP).
                     SYST:COMM:NETW:IPAD:SET ON
                     activates DHCP.

:SYSTem:COMMunicate:NETWork:IPADdress <Ipaddress>

The command enters the IP address. The entry is only activated after sending command SYST:COMM:NETW:IPAD:SET.

Parameters:

<Ipaddress>   string

                     Range: 0.0.0.0. to ff.ff.ff.ff

Example: `SYST:COMM:NETW:IPAD  7.8.9.10`
                     enters the IP address of the instrument.

Example: `SYST:COMM:NETW:IPAD:SET`
                     activates all changes of the IP address settings.

:SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway <Gateway>

The command enters the IP address of the default gateway. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters:

<Gateway>   string

                     Range: 0.0.0.0 to ff.ff.ff.ff

Example: `SYST:COMM:NETW:GAT 1.2.3.4`
                     enters the IP address of the default gateway.
                     `SYST:COMM:NETW:IPAD:SET`
                     activates all changes of the IP address settings.

:SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK <Mask>

The command enters the Subnet mask. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters:

<Mask>   string

Example: `SYST:COMM:NETW:SUBN:MASK 255.255.255.0`
                     enters the Subnet mask.
                     `SYST:COMM:NETW:IPAD:SET`
                     activates all changes of the IP address settings.

:SYSTem:COMMunicate:NETWork:RESource? <Resource>

The command queries the visa resource string. This string is used for remote control of the instrument.

Parameters:

<Resource>   string

Example: `SYST:COMM:NETW:RES`
                     queries the VISA resource string.
                     `Response: TCPIP::192.1.2.3::INSTR`

Usage: Query only

:SYSTem:COMMunicate:USB:RESource?

The command queries the visa resource string for remote control via the USB interface.

Return values:

<Resource>　　　　　　　string

Example:　　　　　　　SYST:COMM:USB:RES
　　　　　　　　　　　　queries the VISA resource string for remote control via the USB
　　　　　　　　　　　　interface.
　　　　　　　　　　　　Response: USB::72::000000::INSTR

Usage:　　　　　　　　Query only

:SYSTem:COMMunicate:GPIB:RESource?

The command queries the visa resource string for remote control via the GPIB interface.
This string is used for remote control of the instrument.

To change the GPIB address, use the command SYST:COMM:GPIB:ADDR.

Return values:

<Resource>　　　　　　　string

Example:　　　　　　　SYST:COMM:GPIB:RES
　　　　　　　　　　　　queries the VISA resource string.
　　　　　　　　　　　　Response: GPIB::28::INSTR

Usage:　　　　　　　　Query only

:SYSTem:COMMunicate:SERial:RESource?

The command queries the visa resource string for the serial remote control interface. This
string is used for remote control of the instrument.

Return values:

<Resource>　　　　　　　string

Example:　　　　　　　SYST:COMM:SER:RES
　　　　　　　　　　　　queries the VISA resource string.
　　　　　　　　　　　　Response: ASRL1::INSTR

Usage:　　　　　　　　Query only

:SYSTem:COMMunicate:SERial:BAUD <Baud>

The command enters the baudrate for the serial remote control interface.

Parameters:

<Baud>　　　　　　　　2400|4800|9600|19200|38400|57600|115200

　　　　　　　　　　　　*RST:　　　　115200

Example:　　　　　　　SYST:COMM:SER:BAUD 115200
　　　　　　　　　　　　enters the baudrate 115200.

Usage: SCPI conform

:SYSTem:COMMunicate:SERial:PARity <Parity>

The command enters the parity for the serial remote control interface.

Parameters:
<Parity>   NONE|ODD|EVEN

                     *RST: NONE
Example: SYST:COMM:SER:PAR NONE
                     selects parity NONE.
Usage: SCPI conform

:SYSTem:COMMunicate:SERial:SBITs <Sbits>

The command enters the number of stop bits for the serial remote control interface.

Parameters:
<Sbits>   1|2

                     *RST: 1
Example: SYST:COMM:SER:SBIT 2
                     selects 2 stop bits.
Usage: SCPI conform

:SYSTem:DATE <Date>

The command sets the date for the instrument-internal calendar.

Parameters:
<Date>   <year>,<month>,<day>

Example: SYST:DATE 2003,05,01
                     sets May 1, 2003.
Usage: SCPI conform

:SYSTem:DISPlay:UPDate <Update>

The command switches the update of the display on/off. A switchover from remote control to manual control always sets the status of the update of the display to ON.

Parameters:
<Update>   0|1|OFF|ON

                     *RST: ON
Example: SYST:DISP:UPD OFF
                     switches update of displayed parameter values off.

:SYSTem:DLOCk <Dlock>

This command (**D**isplay **LOC**k) disables the manual operation via the display, or enables it again (OFF).

The command disables also the front panel keyboard of the instrument including the LOCAL key.

Parameters:

<Dlock>   0|1|OFF|ON

Example: SYST:DLOC ON
                              activates the display lock. The instrument cannot be operated via
                              the display until it has been enabled with SYST:DLOC OFF.

SYSTem:ERRor:ALL? <All >

The command queries all entries in the error queue and then deletes them.

Return values:

<All >   string

                              0
                              "No error", i.e the error queue is empty.

                              positive value
                              Positive error numbers denote device-specific errors.

                              negative value
                              Negative error numbers denote error messages defined by SCPI

Example: SYST:ERR:ALL
                              queries all entries in the error queue.
                              Response: 0, 'no error'
                              No errors have occurred since the error queue was last read out.

Usage: Query only
                              SCPI conform

SYSTem:ERRor:CODE:ALL?

The command queries all entries in the error queue and then deletes them. Only the error numbers are returned and not the entire error text.

Return values:

<All>   string

                              0
                              "No error", i.e. the error queue is empty

                              positive value
                              Positive error numbers denote device-specific errors

                              negative value
                              Negative error numbers denote error messages defined by SCPI
                              (see section chapter 9, "Error Messages", on page 609)

Example:	SYST:ERR:CODE:ALL
	queries all entries in the error queue.
	Response: 0
	no errors have occurred since the error queue was last read out.
Usage:	Query only
	SCPI conform

SYSTem:ERRor:CODE[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Only the error number is returned and not the entire error text.

Return values:

<Next>	string
	0
	"No error", i.e. the error queue is empty
	positive value
	Positive error numbers denote device-specific errors
	negative value
	Negative error numbers denote error messages defined by SCPI (see section chapter 9, "Error Messages", on page 609)
Example:	SYST:ERR:CODE
	queries the oldest entry in the error queue.
	Response: 0
	No errors have occurred since the error queue was last read out.
Usage:	Query only
	SCPI conform

SYSTem:ERRor:COUNt?

The command queries the number of entries in the error queue. If the error queue is empty, '0' is returned.

Return values:

<Count>	string
Example:	SYST:ERR:COUN
	queries the number of entries in the error queue.
	Response: 1
	One error has occurred since the error queue was last read out.
Usage:	Query only
	SCPI conform

SYSTem:ERRor[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it.

The command is identical to the command STATus:QUEue:NEXT.

Return values:

<Next>   string

                          0
                          "No error", i.e. the error queue is empty

                          positive value
                          Positive error numbers denote device-specific errors

                          negative value
                          Negative error numbers denote error messages defined by SCPI
                          (see section chapter 9, "Error Messages", on page 609)

Example: SYST:ERR?
                          queries the oldest entry in the error queue.
                          Response: 0, 'no error'
                          No errors have occurred since the error queue was last read out.

Usage: Query only
                          SCPI conform

:SYSTem:IDENtification <Identification>

Enables/disables selection of user defined "IDN String" and "OPT String" for the selected
instrument (:SYST:LANG).

Note: While working in a emulation mode, the R&S SMA specific command set is disa-
bled, i.e. the SCPI command SYST:IDEN will be discarded.

Parameters:

<Identification>   AUTO|USER

                          *RST: AUTO

Example: SYST:IDEN USER
                          selects the user defined identification string.
                          SYST:IRES "Test Device"
                          defines the identification string 'test device'
                          *IDN?
                          Response: 'test device'
                          SYST:LANG 'HP8662'
                          selects command set of the HP generator. The R&S SMA's com-
                          mand set is disabled.
                          To return to the SCPI command set of the R&S SMA, use the HP
                          command EX.

:SYSTem:IRESponse <Iresponse>

The command defines the identification string for selection user defined (SYST:IDEN
USER).

Note: While working in a emulation mode, the instrument's specific command set is dis-
abled, i.e. the SCPI command SYST:IRES will be discarded.

Parameters:

\<Iresponse\>	string

Example:	`SYST:IDEN USER`
	selects an user-defined identification
	`SYST:IRES "Test Device"`
	defines the identification string 'test device'
	`*IDN?`
	`Response: 'test device'`

:SYSTem:KLOCk \<Klock\>

This command (**K**eyboard **LOC**k) disables the front panel keyboard of the instrument including the LOCAL key, or enables it again (OFF).

Parameters:

\<Klock\>	0|1|OFF|ON
	*RST: OFF
Example:	`SYST:KLOC ON`
	activates the keyboard lock. The keyboard cannot be operated again until it has been enabled with `SYST:KLOC OFF`.
Usage:	SCPI conform

:SYSTem:LANGuage \<Language\>

The command selects the command set of a different generator. The GPIB command set of the R&S SMA no longer works.

After switching to a different command set, the return to the SCPI command set of the R&S SMA can only be performed by using the appropriate command of the selected command set. For example, the HP command EX returns to the instrument-specific GPIB command set (selection 'HPxxxx').

Note: The R&S SMA can be remote controlled via the several command sets of different generators. Please check for the corresponding Application Note at the download area of the product site on the Internet.

Setting parameters:

\<Language\>	"SCPI" | "HP8662" | "HP864X" | "AF2040" | "RC3102"

Example:	`SYST:LANG "HP8662`
	activates the HP 8662A command set
Usage:	Setting only

:SYSTem:ORESponse \<Oresponse\>

The command defines the OPT string for selection user defined (`SYST:IDEN USER`).

Note: While working in a emulation mode, the instrument's specific command set is disabled, i.e. the SCPI command `SYST:ORES` will be discarded.

Parameters:

<Oresponse>   string

Example: SYST:IDEN USER
                            selects an user-defined identification
                            SYST:ORES "Test Option"
                            defines the OPT string 'test option'
                            *OPT?
                            Response: 'test option'

:SYSTem:PROTect<ch>[:STATe] <State>,<password>

The command activates and deactivates the specified protection level.

Suffix:

<ch>   Indicates the protection level.
                            There are several protection levels which disable specific service
                            functions (authorized personnel of R&S Service Departments
                            only).

Parameters:

<State>   0|1|OFF|ON

<password>   The respective functions are disabled when the protection level is
                            activated. No password is required for activation. A password must
                            be entered to deactivate the protection level. The password for the
                            first level is 123456. This protection level can be used to lock-out
                            internal adjustments.

Example: SYST:PROT1 ON
                            activates protection level 1. Internal adjustments are only possible
                            after deactivating the lock-out.
                            SYST:PROT1 OFF, 123456
                            deactivates protection level 1. Internal adjustments are enabled
                            again.

Usage: SCPI conform

SYSTem:SERRor?

This command returns a list of all errors existing at the time when the query is started.
This list corresponds to the display on the info page under manual control.

Return values:

<Serror>   string

Example: SYST:SERR
                            queries all errors existing in the error queue.

Example: Response: -221, 'Settings conflict', 153, 'Input
                            voltage out of range'
                            The two returned errors have occurred since the error queue was
                            last queried.

Usage: Query only

:SYSTem:STARtup:COMPlete?

The command queries if the startup of the instrument is completed.

Return values:

<Complete>   0|1|OFF|ON

Example: SYST:STAR:COMP

                       Response: 1

                       The startup of the instrument is completed.

Usage: Query only

:SYSTem:TIME <Time>

The command sets the time for the instrument-internal clock.

Parameters:

<Time>   0...23,0...59,0...59

Example: SYST:TIME 12,0,0

                       sets the time to precisely 12 pm.

SYSTem:VERSion? <Version >

The command queries the SCPI version with which the instrument complies.

Return values:

<Version >   string

Example: SYST:VERS

                       queries the SCPI version.

                       Response: 1996

                       The instrument complies with the version from 1996.

Usage: Query only

                   SCPI conform

7.16 TEST Subsystem

The TEST system contains the commands for performing the routines as well as for direct manipulation of the hardware assemblies (:TEST:DIRect).

The self tests return a "0" if the test is performed successfully, otherwise a value other than "0" is returned. None of the commands of this system have an *RST value.

> ## ⚠ NOTICE
>
> **Improper use could destroy the assembly!**
>
> The respective hardware assembly responds directly to the `:TEST:DIRect` command; any safety mechanisms are bypassed. The command is used for servicing purposes and should not be applied by the user.

:TEST<hw>:ALL:STARt

This command performs a selftest on all installed hardware options. The selftest result is queried with the command `:TEST<hw>:ALL:RESult` on page 594.

Example: `TEST:ALL:STAR`
                              Starts the selftest
Usage: Event

:TEST<hw>:ALL:RESult?

Queries the result of the performed selftest (command `:TEST<hw>:ALL:STARt` on page 594).

Return values:
<All>   0|1

Example: `TEST:ALL`
                              Starts the selftest
                              `:TEST:ALL:RES?`
                              Response: "0" on success, "1" on fail
Usage: Query only

:TEST<hw>:DIRect <HW_assembly>,<subadress>,<hex data string>
:TEST<hw>:DIRect? <HW_assembly>,<subadress>

The respective hardware assembly responds directly to the command; any safety mechanisms are bypassed. This function is only available via remote control.

Example: `TEST:DIR 'SSYN',0,#H12345678`
                              `TEST:DIR? 'SSYN',0`
                              Response: `#H12345678`

7.17 TRIGger Subsystem

The `TRIGger` system contains the commands for selecting the trigger source for the RF and LF sweep. The trigger input connectors are configured in the `SOURce:INPut` sub-system.

The trigger system of the R&S SMA is a simplified implementation of the SCPI trigger system. The `TRIGger` system differs from the SCPI system as follows:

- No `INITiate` command; the instrument behaves as if `INITiate:CONTinuous ON` were set.
- Under `TRIGger` several sweep subsystems exist.

Other commands associated with the trigger system of the R&S SMA can be found in the modulation and RF signal subsystems.

TRIGger<hw>

- Suffix `TRIGger<1|2>` is not permitted
- `TRIGger0` activates the LF output.

Table 7-2: Cross-reference between the manual and remote control

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	"Auto" mode
SINGle	BUS	"Single" mode.
EXTernal	EXTernal	"Ext Single" and "Ext Step" mode. Use command `LFO:SWEep:MODE` to select between the two sweep modes.
EAUTo	-	"Ext Start/Stop" mode.

TRIGger0[:SWEep]:SOURce <Source>
:TRIGger<hw>:LFFSweep:SOURce <Source>

The command sets the trigger source for the LF sweep. The trigger is triggered by the command `:SOURce:LFOutput:SWEep[:FREQuency]EXECute`.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in the table 7-2.

Parameters:

<Source>   AUTO|IMMediate | SINGle|BUS| EXTernal | EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `[:SOURce]:LFOutput:SWEep[:FREQuency]:EXECute` or `*TRG`.
The mode has to be set to AUTO (`[:SOURce]:LFOutput: SWEep[:FREQuency]:MODE`).

EXTernal
The sweep is triggered externally via the INST TRIG connector.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG:LFFS:SOUR EXT`
selects triggering with an external trigger.

:TRIGger<hw>:FSWeep[:IMMediate]

The command immediately starts an RF frequency sweep cycle.

The command is only effective for sweep mode "Single" (`SOUR:SWE:FREQ:MODE AUTO` in combination with `TRIG:FSW:SOUR SING`).

The command corresponds to the manual control "Execute Single Sweep".

Example: `SWE:FREQ:MODE AUTO`
sets the triggered sweep mode, i.e. a trigger is required to start the sweep.
`TRIG:FSW:SOUR SING`
sets the "Single" trigger mode, i.e. a trigger starts a single sweep.
`TRIG:FSW`
starts a single RF frequency sweep.
Usage: Event

:TRIGger<hw>:FSWeep:SOURce <Source>

The command sets the trigger source for the RF frequency sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in table 7-2.

Parameters:

<Source>   AUTO|IMMediate | SINGle|BUS| EXTernal | EAUTo

                               AUTO|IMMediate
                               The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

                               SINGle|BUS
                               One complete sweep cycle is triggered by the GPIB commands `[:SOURce<hw>]:SWEep[:FREQuency]:EXECute`, `:TRIGger<hw>:FSWeep[:IMMediate]` or `*TRG`. The mode has to be set to `AUTO` (`:SOURce:SWEep:FREQuency:MODE AUTO`).

                               EXTernal
                               The sweep is triggered externally via the INST TRIG connector.

                               EAUTo
                               The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

                               *RST: SINGle

Example: `TRIG:FSW:SOUR  EXT`
                            selects triggering with an external trigger.

:TRIGger<hw>:PSWeep[:IMMediate]

The command immediately starts an RF level sweep.

The command is only effective for sweep mode "Single" (`SOURce:SWEep:POWer:MODE AUTO` in combination with `TRIG:PSW:SOUR SING`).

The command corresponds to the manual control "Execute Single Sweep".

Example: `SWE:POW:MODE AUTO`
                            selects the triggered sweep mode, i.e. a trigger is required to start the sweep.
                            `TRIG:PSW:SOUR AUTO`
                            sets the Single trigger mode, i.e. a trigger starts a single sweep.
                            `TRIG:PSW`
                            starts a single RF level sweep.

Usage: Event

:TRIGger<hw>:PSWeep:SOURce <Source>

The command sets the trigger source for the RF level sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in table 7-2.

Parameters:

<Source>   AUTO|IMMediate | SINGle|BUS| EXTernal |EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `[:SOURce<hw>]:SWEep:POWer:EXECute`, `:TRIGger<hw>:PSWeep[:IMMediate]` or `*TRG`. The mode has to be set to `AUTO` (`:SOURce:SWEep:LEVel:MODE AUTO`).

EXTernal
The sweep is triggered externally via the INST TRIG connector.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG:PSW:SOUR  EXT`

selects triggering with an external trigger.

:TRIGger<hw>[:SWEep][:IMMediate]

The command starts all sweeps which are activated for the respective path. The command starts all sweeps which are activated.

The sweep to be executed depends on the respective MODE setting (`:SOUR:SWEep:POW|FREQ:MODE` and `:SOUR:LFO:SWEep[:FREQ]:MODE`).

The command corresponds to the manual-control command "Execute Trigger".

Example: `TRIG`

starts all active sweeps.

Usage: Event

:TRIGger\<hw\>[:SWEep]:SOURce \<Source\>

The command sets the trigger source for all sweeps.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in the table 7-2.

Parameters:

\<Source\>   AUTO|IMMediate | SINGle|BUS| EXTernal | EAUTo

AUTO|IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle|BUS
One complete sweep cycle is triggered by the GPIB commands `:SOURce:SWEep:POWer|FREQuency:EXEC`, `TRIGger:PSWeep|FSWeep:IMMediate` or `*TRG`.
If `:SOURce:SWEep:POWer:MODE` is set to `STEP`, one step is executed.
The mode has to be set to `AUTO`.

EXTernal
The sweep is triggered externally via the INST TRIG connector.

EAUTo
The sweep is triggered externally via the INST TRIG connector. As soon as one sweep is finished, the next sweep is started. A second trigger event stops the sweep at the current frequency, a third trigger event starts the trigger at the start frequency, and so on.

*RST: SINGle

Example: `TRIG0:SOUR EXT`
selects triggering with an external trigger. The trigger is input via the INST TRIG connector.

Usage: Setting only

7.18 UNIT Subsystem

The UNIT subsystem contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

:UNIT:ANGLe \<Angle\>

The command defines the default unit for the phase modulation angle. It is not valid for other commands which determine angle values, e.g. RF phase. It does not influence the manual control parameter unit and the display.

Parameters:

<Angle>	DEG|RAD
	*RST: RAD
Example:	UNIT:ANGL DEG
	sets default unit DEG for all commands which determine angle values.
Usage:	SCPI conform

:UNIT:POWer <Power>

The command defines the default unit for power. It is valid for all commands which determine power values. It does not influence the manual control parameter unit and the display.

Parameters:

<Power>	V|DBUV|DBM
	*RST: DBM
Example:	UNIT:POW V
	sets default unit V for all commands which determine power values.
Usage:	SCPI conform

7.19 Remote control emulation of the HP 8662A signal generator for the R&S SMA

The R&S SMA can be remote controlled via the several command sets of different generators. Please check for the corresponding Application Note at the download area of the product site on the Internet.

The R&S SMA can be remote-controlled using the instrument-specific GPIB command set as well as an emulated command set of the HP 8662A generator.

With manual operation, the command set is selected with the parameter "Setup > Remote Channel Settings > Language"(see "Language" on page 95).

When using the emulated command set of the HP 8662A generator, the instruments identifies itself either as R&S SMA or as HP86xx generator when queried with common command *IDN?. The selection can only be performed with manual operation he Setup menu "Remote Channel Settings"; under "*IDN? Identification".

With remote operation, the HP 8662A command set is selected using the GPIB command `SYSTem:LANGuage "HP8662"`. The GPIB command set of the R&S SMA no longer works. The HP command EX returns to the instrument-specific GPIB command set.

The selected command set is saved when the instrument is switched off, which means that when the instrument is switched on again, it starts up with the same setting with which it was switched off. The emulation parameters are not persistent and are lost when the instrument is switched off.

7.19.1 HP 8662A commands

The emulation software simulates the HP 8662A data model in the execution unit and transforms the HP 8662A parameters into R&S SMA parameters.

This mapping occurs in only one direction: Setting commands that arrive via the remote-control interface modify the HP 8662A parameters. These parameters are converted into R&S SMA parameters and written to the database. Modifying the R&S SMA parameters in any other manner, e.g. via manual operation, causes no changes to the HP 8662A parameters of the emulation software. While this is insignificant in pure remote-control operation, it can lead to inconsistencies when you use both manual and remote control.

Limitations and special characteristics of the emulation are explained in the Comment column of the following table.

Command	Function	*	Comment
@1	Write require service mask		The status system of the HP 8662A is not compatible with the status system implemented in the R&S SMA in accordance with IEEE 488.2.
@2	Deferred execution mode	X	Command is ignored.
@3	Immediate execution mode	X	Command is ignored.
AM	AM depth	X	
AO	AM State OFF	X	Alias = A0
AP	Amplitude	X	Alias = BLSQ, SP88, BLAP88

Command	Function	*	Comment
AS	Autosequence	X	The command sequentially and cyclically activates the instrument settings saved in registers. Limitations: Since the end of a sweep is not detected in the R&S SMA, a saved instrument setting with a sweep cannot be emulated. The timing of this function is not defined ("as fast as it can"). Therefore, the time performance of the emulation software can be expected to be very different from that of an HP 8662A.
BLR1	Knob hold		Keyboard/rotary knob commands are not implemented. The emulation is not intended to simulate manual operation.
BLR2	Knob increment		See BLR1
BLX6	All markers off		The R&S SMA has no sweep marker.
BS	Backspace		See BLR1
CT	Configure trigger	X	
DN	Step down	X	[AM|AP|FA|FB|FM |FR| FS|N3|X1 |X2|X3|X4|X5] DN
EX	Switch back to native remote-control mode	X	

Command	Function	*	Comment
FA	Start frequency	X	Different behavior: In the HP 8662A, the FA, FB, FS and FR sweep frequencies are maintained as separate and unlinked parameters. In the R&S SMA, the start and end frequencies, center frequency and span are linked. In the HP 8662A, however, the FR command sets both the frequency in the CW mode as well as the center frequency in the Sweep mode. The current and internal SweepConfiguration state determines which of the competing and possibly inconsistent parameter sets (FA, FB) or (FR, FS) is set on the R&S SMA. When setting the FA or FB values via remote control, SweepConfiguration changes to the StartStop state and the set (FA, FB) is used. When setting the FS value via remote control, SweepConfiguration changes to the Span state and the set (FR, FS) is used. Span is the initial state of SweepConfiguration.
FB	Stop frequency	X	See FA
FM	FM State ON, FM depth	X	
FR	Frequency or center frequency	X	See FA
FS	Frequency span	X	
IS	Increment setting	X	[AM|AP|FA|FB|FM |FR|FS|N3|X1 |X2|X3|X4|X5] IS

Command	Function	*	Comment
L1	Learn front panel	X	The HP 8662A has two Learn modes: The Fast Learn mode, transmitting 11 bytes per setting, and the Front Panel Learn mode, transmitting 128 bytes. The documentation of the HP 8662A does not provide a complete description of the content of the instrument settings contained in the binary block. As a result, binary blocks that have been generated or modified by a controller or by emulation software cannot be played back to an HP 8662A. However, this does not affect the data exchange between a controller and emulation software on an R&S SMA. Queries must be terminated with a question mark ("?").
L2	Fast learn mode	X	See L1
M0	Modulation off	X	Alias = MO
M1	Internal 400 Hz (mod)	X	
M2	Internal 1 kHz (mod)	X	
M3	External AC (mod)	X	
M4	External DC (mod)	X	
MS	Read status key message	X	Queries must be terminated with a question mark ("?").
N1	100 steps (lin sweep)	X	
	100 steps (lin sweep)	X	
N3	Set step size (lin sweep)	X	
N4	Log 10% steps (log sweep)	X	
N5	Log 1% steps (log sweep)	X	
R1 / R2 / R3 / R4 / R5	Resolution x10,(/10), knob off, knob hold, knob increment		See BLR1
RC	Recall instrument settings from register	X	
RD	Knob, CCW (down)		See BLR1

Command	Function	*	Comment
RM	Read require service mask		Query commands must be terminated with a question mark ("?").
RU	Knob CW (up)		See BLR1
SP00		X	Alias BLAP00
SP10		X	Alias BLAP10
SP11		X	Alias BLAP11
SP12		X	Alias BLAP12
SP30	Amplitude reference off		Alias = BLAP30 Affects only manual operation (knob), see BLR1.
SP31	Amplitude reference on		Alias = BLAP31 Affects only manual operation (knob), see BLR1.
SP40	External AM off	X	Alias = BLAP40
SP41	Int FM + ext AM (ac)	X	Alias = BLAP41
SP42	Int FM + ext AM (dc)	X	Alias = BLAP42
SP50..52	AUX FM		Alias = BLAP50 to 52 Not supported, since the R&S SMAdoes not have a second modulation input.
SP60..62	PSK toggle		Alias = BLAP60 to 62 Affects only manual operation with up/down keys, see BLR1.
SP80	SP10 to 62 off	X	Alias = BLAP80
SP81	Switch unit of level display		Alias = BLAP81 No corresponding R&S SMA parameter available.
SP85	Amplitude correction off	X	Alias = BLAP85
SP86	Amplitude correction on	X	Alias = BLAP86
SP87	HP-IB operator request response	NN	Alias = BLAP87
SQ	Sequence	X	
SS	Set sequence	X	Alias = BLST
ST	Store current instrument settings in register	X	
T1 to T3	Sweep dwell time 0.5 ms to 2 ms		R&S SMA dwell time value range ≥10 ms.

Command	Function	*	Comment
T4 / T5	10/100 ms/sweep	X	
TR	Trigger	X	
UP	Step up	X	[AM|AP|FA|FB|FM |FR| FS|N3|X1 |X2|X3|X4|X5] UP
W1	Sweep off	X	
W2	Auto sweep	X	
W3	Manual sweep	X	
W4	Single sweep	X	
X1 to X7	Sweep marker		The R&S SMA has no sweep marker.
Y0	Remote stepped sweep (RSS) clear	X	Alias = YO
Y1 / Y2	RSS with display	X	
Y3	RSS without display	X	

*X = implemented

7.19.2 Value ranges and error messages

The permissible value ranges for the setting parameters of the HP 8662A and R&S SMA are very different. No effort was made to simulate the HP 8662A limitations in the emulation software. For this reason, setting values permitted in emulation software cannot be transferred to an HP 8662A.

Most error messages and codes output by the R&S SMA are generated by deeper software layers and are not compatible with the highly instrument-specific HP 8662A error codes. A very simple mechanism for mapping the R&S SMA error codes to the HP 8662A error codes is used. It maps all R&S SMA errors to error code 43 (Wrong entry protocol. Entry ignored.) of the HP 8662A.

However, the errors detected by the execution unit of the emulator are immediately converted to suitable HP 8662A error codes where possible.

8 Maintenance

The instrument does not need a periodic maintenance. Only the cleaning of the instrument is essential. The outside of the instrument is suitably cleaned using a soft, line-free dust cloth. Make sure that the air vents are not obstructed.

⚠ **WARNING**

Shock hazard

Before cleaning the instrument, make sure that the instrument is switched off and disconnected from all power supplies.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument, e.g. cleaning agents that contain a solvent may damage the front panel labeling or plastic parts.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spares. The order no. for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and alignment.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

8.1 Storing and Packing

The storage temperature range of the instrument is given in the data sheet. If the instrument is to be stored for a longer period of time, it must be protected against dust.

Repack the instrument as it was originally packed when transporting or shipping. The two protective foam plastic parts prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

If you do not use the original packaging, use a sturdy cardboard box of suitable size and provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

9 Error Messages

This chapter describes the error messages of the R&S SMA. The error messages are output in the "Info" line on the screen and entered in the error error/event queue of the status reporting system.

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. Some error messages require that the error must be eliminated before correct instrument operation can be ensured. The info window with a list of current messages and a detailed description of each message can be opened with the INFO key.

In the remote control mode, error messages are entered in the error/event queue of the status reporting system and can be queried with the command `SYSTem:ERRor?`. If the error queue is empty, 0 ("No error") is returned.

9.1 Status Information

The status messages are displayed in the header section of the screen. The status information gives the user an overview of the main operating states and settings of the instrument. The states are indicated for information only and do not necessitate any action by the user. Status information is displayed between the frequency and level fields, at the left of the info line or in the info line itself.

9.1.1 Status information displayed between the frequency and level fields

This chapter gives an overview of the status messages displayed between the frequency and level fields.

RF OFF
The RF output is switched off

MOD OFF
All modulations are switched off

FREQ OFFSET
A frequency offset is set.

The frequency entered and displayed in the "Frequency" field takes any set frequency offset into consideration, e.g. an offset set for a downstream instrument. This means that with a frequency offset the frequency displayed in the header does not correspond to the frequency at the RF output, but rather to the frequency at the output of the downstream instrument.

This allows the target frequency at the output of a downstream instrument to be entered in the frequency field. The signal generator changes the RF output frequency according to the entered offset.

However, the frequency entered and displayed in the "Frequency/Phase" dialog of the "RF" function block always corresponds to the RF output frequency. Any frequency offset is not taken into consideration.

The correlation is as follows:

Freq in header = RF output frequency (= Freq in dialog) + Freq offset (= Offset in dialog)

OVERLOAD

The power of the external signal applied to the RF output is too high. The overload protection is tripped and the connection between the RF output and attenuator is interrupted. The overload protection is reset by pressing the RF ON/OFF key. The RF input is activated when the overload protection is reset.

LEVEL OFFSET

A level offset is set.

The level entered and displayed in the "Level" field takes the offset of any downstream attenuators/amplifiers into consideration by way of calculation. This means that with a level offset the level displayed in the header does not correspond to the level at the RF output, but rather to the level at the output of the downstream instrument.

This allows the target level at the output of downstream instruments to be entered. The signal generator changes the RF output level according to the set offset.

However, the level entered and displayed in the "Level" dialog of the "RF" function block always corresponds to the RF output level. Any level offset is not taken into consideration.

The correlation is as follows:

Level in header = RF output level (= Level in dialog) + Level offset

EXT REF

An external reference is used.

The external signal with selectable frequency and defined level must be input at the REF IN connector. It is output at the REF OUT connector.

BUSY

A setting or calculation is executed.

9.1.2 Status information displayed to the left of the Info line

This chapter gives an overview of the status messages displayed to the left of the Info line.

REMOTE

The instrument is remote controlled.

The keys on the front panel are usable, but all parameters are in read only mode.

The LOCAL key switches the instrument from remote control to manual operation. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

REM-LLO

The instrument is remote (**REM**ote) controlled. The LOCAL key is disabled by remote control with the command `LLO` (**L**ocal**L**ock**O**ut).

The keys on the front panel are usable, but all parameters are in read only mode.

The instrument can be switched from remote control to manual operation by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)` or by `&NREN`).

LOC-LLO

For operating directly the instrument is placed from remote control to manual operation (Local State). The LOCAL key was disabled by remote control with the command `LLO` (**L**ocal**L**ock**O**ut).

With the next activating of the remote control mode, the instrument cannot be switched to manual operation by the operator. The status information changes to "REM-LLO".

The instrument can be switched to manual operation by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`).

9.1.3 Status information displayed in the Info line

This chapter gives an overview of the status messages displayed in the Info line.

RFSweep / LevelSweep / LFSweep

The indicated sweep is enabled.

ALC On / Auto / S&H

The status of the automatic level control is indicated:
- ON
  automatic level control permanently on
- Auto
  automatic level control is automatically adapted to the operating states
- S&H
  automatic level control off, recalibration of the level whenever the level or frequency is set (sample and hold mode)

ListMode

List mode is active.

The values of the frequency/level pairs in the selected list are set for the chosen dwell time.

AttFixed

Attenuator fixed mode is active.

The uninterrupted level settings are made in a fixed range without attenuator switching. The variation range is set automatically when this mode is activated. The range is displayed under "Attenuator Fixed Range" in the "Level" dialog.

UCorr

User Correction is active.

The level is corrected by the given values in the selected user correction list. Correction is performed by the user-defined list values being added to the output level for the respective RF frequency. With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

OvenCold

The reference oscillator has not yet reached its nominal frequency.

When switching on from the STANDBY mode, the specified frequency accuracy is reached immediately. If the power switch was switched off, the reference oscillator needs some warm-up time to reach its nominal frequency. During this period of time, the output frequency does not yet reach its final value either.

9.2　Error Messages

Messages indicate errors in the instrument. They are displayed in the info line in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

9.2.1　Volatile messages

Volatile messages report automatic settings in the instrument (e.g. switching off of incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

SCPI command: `SYSTem:ERRor:ALL` or `SYSTem:ERRor[:NEXT]`

9.2.2　Permanent messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent message must be eliminated before correct instrument operation can be ensured.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

SCPI command: `SYSTem:SERRor`

9.3 SCPI-Error Messages

The SCPI error messages are the same in all SCPI instruments. Detailed information and an overview of all error messages as defined in SCPI standard can be found in the corresponding documentation.

The errors are assigned negative numbers. The error text being entered into the error/event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation as to the respective error.

9.4 Device-Specific Error Messages

The following table contains all error messages specific for the instrument in alphabetical order, as well as an explanation of the error situaion. The positive error codes mark the errors specific of the instrument.

The device-specific error messages set bit 3 in the ESR register.

The index provides a list of the error messages sorted according to their error codes.

Error Code	Error	Description	Remedy
50	Extern reference out of range or disconnected	External reference is selected but no external signal is applied or the signal is out of range.	• Check the selected reference signal source (internal or external) in the "Setup > Reference Oscillator" dialog. • Change setting to 'internal' if no appropriate external source is available.
140	This modulation forces other modulations off	A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off. Example: Enabling FM modulation switches PM modulation off.	
180	Adjustment failed	Adjustment could not be executed	The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the device (see chapter 5.2.3.1, "Internal Adjustments", on page 84.
182	Adjustment data missing	Adjustment data are missing.	The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the instrument.

Error Code	Error	Description	Remedy
183	Adjustment data invalid	Adjustment data are invalid and must be restored.	The adjustment data have to be generated again by an internal or external adjustment or to be loaded into the instrument.
200	Cannot access hardware	The data transmission to a module was unsuccessful.	The module is not installed, not properly installed or missing.
201	Hardware revision out of date	A later version of certain parts of the instrument is necessary to execute the function selected.	The driver does not support the installed version of a module.
202	Cannot access the EEPROM	A error occurs when writing or reading a EEPROM.	The EEPROM might be defect and has to be replaced.
203	Invalid EEPROM data	Reading a EEPROM is possible, however the data are inconsistent.	
204	Driver initialization failed	Initialization of a driver fails when booting the instrument firmware.	The driver is not compatible with the hardware or software configuration of the instrument.
241	No current list	There is no list selected. To execute the required operation, a list has to be selected in the related menu.	If no list is available, a new list must be created.
242	Unknown list type specified	The list type selected is not valid for the required operation. For instanse, the file extension for waveform list files is *.wv. It is not possible to enter another file extension when selecting a list.	Check the selected list type.
460	Cannot open file	The selected file can not be opened.	Check the path and file name.
461	Cannot write file	The file can not be written.	Check if the file is read-only.
462	Cannot read file	The file can not be read.	Check if the file contents are compatible with the file type.
463	Filename missing	The required operation cannot be executed because the file name is not specified.	A file name has to be entered when creating a new list.
464	Invalid filename extension	The file extension is not valid for the required operation.	Check the file extenssion. For instanse, the file extension for waveform list files is `*.wv`. It is not possible to enter another file extension when storing a list.
465	File contains invalid data	The selected file contains data that is not valid for the file type. The file extension determines the data that is valid for this file type. If the file extension is changed the lists are no longer recognized and the data are therefore invalid. Example: the extension of a waveform file (= `*.wv`) was changed to `*.txt`	Check the file extension.

A Hardware Interfaces

This section covers hardware related topics, like pin assignment of the GPIB bus interface.

The remote control interfaces are described in detailes in chapter 6, "Remote Control Basics", on page 305.

All other interfaces are described in chapter 2.1, "Front Panel Tour", on page 15 and chapter 2.2, "Rear Panel Tour", on page 21.

For specifications refer to the data sheet.

A.1 GPIB Bus Interface

Pin assignment

Fig. 1-1: Pin assignment of GPIB bus interface

Bus lines

● Data bus with 8 lines D0 to D7:
  The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.

● Control bus with five lines:
  IFC (Interface Clear): active LOW resets the interfaces of the instruments connected to the default setting.
  ATN (Attention): active LOW signals the transmission of interface messages, inactive HIGH signals the transmission of device messages.

SRQ (Service Request): active LOW enables the connected device to send a service request to the controller.

REN (Remote Enable): active LOW permits switchover to remote control.

EOI (End or Identify): has two functions in connection with ATN:

– ATN=HIGH active LOW marks the end of data transmission.

– ATN=LOW active LOW triggers a parallel poll.

● Handshake bus with three lines:

DAV (Data Valid): active LOW signals a valid data byte on the data bus.

NRFD (Not Ready For Data): active LOW signals that one of the connected devices is not ready for data transfer.

NDAC (Not Data Accepted): active LOW signals that the instrument connected is accepting the data on the data bus.

Interface Functions

Instruments which can be controlled via GPIB bus can be equipped with different interface functions. The interface function for the R&S SMA are listed in the following table.

Table 1-1: GPIB bus interface functions

Control character	Interface function
SH1	Handshake source function (source handshake), full capability
AH1	Handshake sink function (acceptor handshake), full capability
L4	Listener function, full capability, de-addressed by MTA.
T6	Talker function, full capability, ability to respond to serial poll, deaddressed by MLA
SR1	Service request function (Service Request), full capability
PP1	Parallel poll function, full capability
RL1	Remote/Local switch over function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability

A.2 AUX I/O Connector

Table 1-2: Pin assignment of the AUX I/O Connector connector

Pin	Signal	Description
1	FHOP_DATA	Data input for Fast Hopping list mode. See chapter 5.3.10, "List Mode", on page 195
2	Ground ⊥	Ground
3	FHOP_CLK	Clock input for Fast Hopping list mode. See chapter 5.3.10, "List Mode", on page 195
4	FHOP_STRB	Strobe input for Fast Hopping list mode. See chapter 5.3.10, "List Mode", on page 195

Pin	Signal	Description
5	RF OFF	Input for fast switching of the RF output. Active High (1) switches the RF output off. A subsequent Active Low (0) switches the RF output on again. Switching is performed very fast (10us). However, the attenuation of the switched off output is considerably less than after regular switch-off, because the attenuator is not set to maximum attenuation.
6	INST TRIG	Input for external triggering of the analog modulations, sweeps and List mode. HOP input for controlling the frequency hop mode with external source in List mode.
7	BLANK	Output for blank signal. This signal marks the blank times (invalid level indication). The signal is generated automatically.
8	OPC	Output for Operation Complete line. Active High signals that all remote control commands have been executed. The output is always active.
9 .. 10	Ground ⊥	Ground
11 .. 26	FM_DAT	Parallel data input with 16-bit word width for digital FM modulation data. The FM-Data bus is directly connected to the DDS of the syntheziser module. Thus, very fast frequency hop (settling times of 10 us) is possible for frequency bandwidth up to 80 MHz. See chapter 5.4.3, "Frequency Modulation (FM)", on page 211

List of Commands

Index