

# GPS and Assisted GPS Digital Standard for R&S<sup>®</sup> Signal Generators Operating Manual



1171.5248.12 – 15

This document describes the following software options:

- R&S®AMU-K44/-K65  
1402.6406.02, 1403.0101.02
- R&S®SMATE-K44/-K65  
1404.5407.02, 1415.1372.02
- R&S®SMJ-K44  
1404.1401.02
- R&S®SMU-K44/-K65  
1161.0566.02, 1415.0053.02

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Subject to change – Data without tolerance limits is not binding.

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The following abbreviations are used throughout this manual: R&S®AMU is abbreviated as R&S AMU, R&S®SMATE is abbreviated as R&S SMATE, R&S®SMBV is abbreviated as R&S SMBV, R&S®SMJ is abbreviated as R&S SMJ, R&S®SMU is abbreviated as R&S SMU, R&S®WinIQSIM2 is abbreviated as R&S WinIQSIM2

# 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<br>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.



indicates a hazardous situation which, if not avoided, will result in death or serious injury.



indicates a hazardous situation which, if not avoided, could result in death or serious injury.



indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



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  $\pm 10\%$  shall apply to the nominal voltage and  $\pm 5\%$  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  $V_{\text{rms}} > 30 \text{ V}$ , 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.

## Basic Safety Instructions

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.



## Informaciones elementales de seguridad

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<br><br>Observar la documentación del producto       | Atención en el manejo de dispositivos de peso elevado                               | Peligro de choque eléctrico   | Advertencia: 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 identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.



ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.



ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.



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  $\pm 10\%$  sobre el voltaje nominal y de  $\pm 5\%$  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  $U_{\text{eff}} > 30 \text{ V}$  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.

## Informaciones elementales de seguridad

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 señalar 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.

## Informaciones elementales de seguridad

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.

# Qualitätszertifikat

## Certificate of quality

## Certificat de qualité

Certified Quality System  
**ISO 9001**

Certified Environmental System  
**ISO 14001**

### **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 ISO9001 und ISO14001 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 ISO9001 and ISO14001.

### **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 ISO9001 et ISO14001.

### **Engagement écologique**

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

# 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.

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# 1 Preface

## 1.1 Documentation Overview

The user documentation for the R&S Signal Generator 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 Manuals for base unit and options,
  - 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 Signal Generator and all available options.

### Quick Start Guide

The Quick Start Guide 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 Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

These manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual for the base unit, 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.

In the individual option manuals, the specific instrument functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S Signal Generator is not included in the option manuals.

These manuals can also be ordered in printed form (see ordering information in the data sheet).

### Service Manual

The 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.  |
| <i>Input</i>                        | Input to be entered by the user is displayed in italics.   |
| <a href="#">Links</a>               | Links that you can click are displayed in blue font.   |
| "References"                        | References to other parts of the documentation are enclosed by quotation marks.  |

## 2 Introduction

The R&S Signal Generator provides you with the ability to generate signals of up to four Global Positioning System (GPS) satellites per baseband path.

An instrument equipped with two-path is able to generate the GPS signal of eight satellites.

Signal generation is done in real-time and thus it is not limited to a certain time period.

The GPS implementation in the R&S WinIQSIM2 is a simplified offline version of the real-time one and provides the capability to generate an one-satellite generic signal.

The Global Positioning System (GPS) consists of several satellites circling the earth in low orbits. The satellites permanently transmit information about their current position (ephemeris) and about the orbits of all satellites (almanac). Additionally transmitted time information enables the GPS receiver to determine the runtimes of the transmitted signals. The 3D position of a receiver on the earth can be determined by carrying out delay measurements of at least four signals emitted by different satellites.

Being transmitted on a single carrier frequency, the signals of the individual satellites can be distinguished by means of correlation (Gold) codes.

With GPS, the following two ranging codes are defined:

- the Coarse/Acquisition code (C/A code) The C/A code ( $f_{ca}= 1.023$  MHz) is freely available and used for civilian purposes.
- the Precise code (P-Code). The P-Code ( $f_p=10.23$  MHz) is restricted and used for military applications.

Both ranging codes are used as spreading code for the navigation message which is transmitted at a rate of 50 baud.

There are two carriers available:

- L1 ( $f_{L1}= 1.57542$  GHz), which is modulated by both C/A code and P-code (QPSK)
- L2 ( $f_{L2}=1.2276$  GHz), modulated only with P-Code (BPSK).

### 2.1 GPS system parameters

The [table 2-1](#) gives an overview of the GPS system parameters.

**Table 2-1: GPS system parameters**

|                             |   |
|-----------------------------|---|
| Carrier frequency           | L1=1.57542 GHz<br>L2=1.2276 GHz                                   |
| Signal level, after antenna | Approx. -115 dBm, depending on receive conditions                 |
| Doppler shift               | -100 kHz to +100 kHz selectable (individually for each satellite) |
| Symbol rate                 | 1.023 Mcps (C/A code)<br>10.23 Mcps (P-code)                      |

|  |   |
|--|---|
| C/A codes                                  | 1 to 37 selectable, 1023 chips per C/A code   |
| Modulation                                 | BPSK (C/A code, P-code)<br>QPSK (C/A code and P-code)   |
| Information data rate (navigation message) | 50 Hz   |
| Frame structure of navigation data         | 25 frames consisting of 5 subframes where 1 sub-frame consists of 10 words, 1 word consists of 30 data bits, 1 data bit consists of 20460 C/A code chips. |

## 2.2 Assisted GPS (A-GPS)

Assisted GPS (A-GPS) was introduced to different mobile communication standards to significantly reduce the Time To First Fix (TTFF) of a user equipment (UE) containing a GPS receiver. This is achieved by transmitting information about the satellites directly from the base station to the UE.

In order to obtain a valid position fix, a stand-alone GPS receiver performs the following steps:

1. Find visible satellites by searching different C/A codes over different Doppler shifts. (This process is also called acquisition.)
2. Read out ephemeris data from the satellite's signal in order to get the satellite's current position.
3. Read out the complete navigation message from the satellite's signal in order to get the ionospheric model and the positions of all satellites (almanac).
4. Perform measurements to get runtimes of the different satellite signals.
5. Calculate exact location based on the satellite's positions and the measurements taken. (This process is also called navigation.)

Depending on previous knowledge, a stand-alone GPS receiver needs about 30-60 seconds for a first fix and up to 12.5 minutes to get all information (almanac).

In A-GPS "UE based mode", the base station assists the UE by providing the complete navigation message along with a list of visible satellites and ephemeris data. In addition to this information, the UE gets the location and the current time at the Base Station and that speeds up both acquisition and navigation processes of the GPS receiver and hence reduces TTFF to a few seconds.

In A-GPS "UE assisted mode", the base station is even responsible for the calculation of the UE's exact location, i.e. the base station performs the navigation based on the raw measurements provided by the UE. Since the Acquisition Assistance Data provided by the Base Station already serves speeding up the Doppler and Code Phase correlation, i.e. the acquisition process, the UE only has to perform the measurements for getting the runtimes of the different satellite signals. Complexity of the UE's GPS module is hence reduced which leads to lower power consumption.



## 2.3 Use of navigation data

The C/A code used is fundamental to the simulation of GPS signals. The C/A code specifies the satellites to be simulated.

Real navigation data (the almanac) contains the information about the currently valid space vehicle IDs. When using real navigation data, only valid SV IDs can be selected in the operating menu.

When using arbitrary data, the complete range of IDs, 1 to 37, is available.

In addition to this, navigation data play an extremely important role, since they are essential for calculating the positions of the four satellites, which are the minimum prerequisite for localization purposes. However, even if only one satellite is available, real navigation data can be used to check the decoding of navigation information (such as GPS time, almanac and ephemeris) in addition to the recognition of the C/A code.

Current almanac data can be downloaded via the Internet and stored on the harddisk of the R&S Signal Generator. The almanac data is also used for extracting the satellite-specific navigation information (ephemeris).

Almanacs are currently available at the following internet sites:

- U.S.Coast Guard Navigation Center GPS Homepage <http://www.navcen.uscg.gov/GPS/almanacs.htm>  
The almanac files are named `xxx.alm` (for YUMA files) or `xxx.al3` (for SEM files) whereas `xxx` denotes the day of a year.
- <http://www.celestrak.com/GPS/almanac/>  
The naming convention of the almanac file is: `almanac.sem/yuma.weekXXXX.YYYYYY.txt`  
whereas `xxxx` denotes the GPS week and `yyyyyy` the time of almanac (TOA).

For more detailed information on the content and frame structure of navigation data, as well as C/A code generation, refer to the specifications.

## 2.4 Functional Overview Option GPS (R&S-K44)

This chapter gives an overview of the option GPS (R&S-K44).

The GPS implementation in the R&S WinIQSIM2 is a simplified offline version of the real-time one and provides only the capability to generate an one-satellite static generic signal with constant Doppler shift.

The generic workflow is described in [chapter 2.8.8, "Generating an one-satellite static generic GPS signal with R&S WinIQSIM2"](#), on page 24, and [chapter 2.8.9, "Loading and Processing an GPS Waveform in the ARB of R&S Signal Generator"](#), on page 25.

### 2.4.1 Real-time generation

With the option GPS (R&S SMx/AMU-K44), up to four satellites per baseband can be simulated in real-time.

In case of a two-path instrument equipped with two options GPS (R&S-K44), up to 8 real satellites can be simulated and controlled within one dialog.

### 2.4.2 Multi-satellite GPS signal

The R&S Signal Generators calculates a multi-satellite GPS signal in two different modes, the generic mode and the localization mode.

In "Generic mode", static satellites with constant Doppler shifts are provided for simple receiver test.

The generic workflow is described in [chapter 2.8.1, "Generating GPS Signal for Simple Receiver Tests \(Generic Mode\)"](#), on page 19.

The signal of dynamic real-life satellites is generated in Localization mode.

To fulfill the simulation requirements of the different application fields, the following localization simulation modes are provided:

- the "Auto SV Selection" mode
- the "Auto SV Selection and Update" mode
- the "Full Configuration" mode (requires option Assisted GPS R&S-K65).

Although, both the localization modes "Auto SV Selection" and "Auto SV Selection and Update" are provided for the generation of a realistic GPS signal without limitation in the validity of the navigation data, there are some differences between them. The "Auto SV Selection and Update" mode is provided for the generation of a valid GPS signal over long period of time and supports satellite's handover. The "Auto SV Selection" mode is used whenever a static satellite constellation is to be tested.

Together with the "Full Configuration" mode, "Auto SV Selection" mode is also required for the generation of customer build A-GPS test scenarios.

### 2.4.3 Generation of realistic GPS scenarios

The signal generation localization modes "Auto SV Selection" and "Auto SV Selection and Update" are provided for the generation of a realistic GPS signal. In each of these modes, the connected GPS-receiver can be forced to obtain a valid 3D fix at a predefined or user-defined static geographical location.

Simulation of moving receiver is also possible, but this requires an instrument equipped with the option Assisted GPS R&S-K65 (see [chapter 2.6, "Moving Scenarios"](#), on page 16).

An R&S Signal Generator equipped with option GPS (R&S-K44) and working in one of the localization modes "Auto SV Selection" or "Auto SV Selection and Update" does the whole configuration of visible satellites and the generation of the ephemeris based on the

uploaded almanac. The user only needs to specify time and location; all other configurations are done automatically by the R&S Signal Generator. This assures the calculation of a realistic scenario with an optimal 4-satellite constellation i.e. minimum Position Dilution of Precision (PDOP).

The generic workflow is described in [chapter 2.8.3, "Generating GPS Signal with Flexible Simulation Time \(Localization Mode Auto SV Selection\)"](#), on page 20.

#### 2.4.4 Signal generation with projection of the ephemeris navigation data

The R&S Signal Generators employs a special algorithm for projection of the ephemeris navigation data that allows the generation of a valid navigation message without limitation in the simulation time. The ephemerides are automatically updated and the limitation problem of maximum allowed time span of two hours between the simulation time and the TOE (Time of Ephemeris) is already solved.

Any moment between the TOA and the TOA + 3.5 days can be selected as start simulation time. While testing a GPS receiver with enabled Almanac protocol check, the maximum value of the simulation time will be limited by the fact, that the almanac files are valid for period not longer than 3.5 days.

The generic workflow is described in [chapter 2.8.3, "Generating GPS Signal with Flexible Simulation Time \(Localization Mode Auto SV Selection\)"](#), on page 20.

#### 2.4.5 Satellite handover

The special signal generation localization mode "Auto SV Selection and Update" is provided for the generation of a valid GPS signal over long period of time. In this mode, the R&S Signal Generator constantly calculates the localization signal based on two criteria, the optimal 4-satellite constellation with minimum PDOP and the satellite's visibility respecting the [Satellite Elevation Mask](#). While the PDOP is a system parameter that is calculated by the R&S Signal Generator and displayed in real-time, the satellite's visibility is a configurable parameter that can be adjusted by the user to simulate satellites with different elevations.

Depending on the current satellite's conditions and the used number of satellites, a sophisticated algorithm decides how often the PDOP and the satellite's visibility have to be proved and at which moment of time the satellite's constellation has to be changed. Satellites that do not fulfill the criteria for minimum PDOP and sufficient visibility are exchanged **dynamic and on-the-fly** and the process is called satellite handover. Information about the expected time of the next upcoming handover is provided by the parameter [Get Next Handover Time](#).

The generic workflow is described in [chapter 2.8.4, "Generating GPS Signal with Satellite Handover \(Localization Mode Auto SV Selection and Update\)"](#), on page 21.

### 2.4.6 Real-Time S.P.O.T. display

The real-world situation of disappearance and re-appearance of satellites, as well as the dynamic display of several parameters like HDOP, PDOP, receiver's location, elapsed time and the trajectory of a moving receiver can be observed in real-time in the special "Real-Time S.P.O.T." (Satellites and Position Online Tracker) display. The displayed values are updated every 5 seconds.

The [Real-Time S.P.O.T.](#) display is enabled for "Auto SV Selection" and "Auto SV Selection and Update" modes only.

### 2.4.7 Multipath signal generation

The R&S Signal Generator provides the possibility to simulate the GPS signal of one or more satellites that undergoes multipath propagation effects.

The generic workflow is described in [chapter 2.8.2, "Generating Multipath Scenarios"](#), on page 20.

## 2.5 Enhancements of Option Assisted GPS (R&S-K65)

### 2.5.1 Prerequisites

The option Assisted GPS (R&S-K65) is only available for 2-path instruments equipped with two options GPS (R&S-K44). It enhances the option GPS (R&S-K44) with functionalities required for A-GPS test scenarios for 3GPP FDD and GSM.

### 2.5.2 Full set of pre-defined test scenarios for A-GPS 2G/3G Protocol and Conformance Test Cases

An R&S Signal Generator equipped with the option Assisted GPS supports all test scenarios for A-GPS Protocol and Conformance Test cases. The following predefined A-GPS test scenarios are currently supported:

- GSM Signaling Test Scenario (3GPP TS 51.010-1 v.7.7.0)
- GSM Performance Test Scenario#1 (3GPP TS 51.010-1 v.7.7.0)
- GSM Performance Test Scenario#2 (3GPP TS 51.010-1 v.7.7.0)
- GSM Performance Test Scenario#3 (3GPP TS 51.010-1 v.7.7.0)
- 3GPP FDD Signaling Test Scenario (3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0)
- 3GPP FDD Performance Test Scenario#1 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
- 3GPP FDD Performance Test Scenario#2 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

- 3GPP FDD Performance Test Scenario#3 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
- 3GPP2 Static Test Scenario (3GPP2 C.S0036-0 V1.0)
- 3GPP2 Moving Test Scenario (3GPP2 C.S0036-0 V1.0)

The generic workflow is described in [chapter 2.8.6, "Generating A-GPS Test Signal"](#), on page 23.

### 2.5.3 Custom build scenarios

The option Assisted GPS (R&S-K65) is not limited to be used for A-GPS testing exclusively. Despite the predefined scenarios, it is also possible to define any user-specific test scenario.

For testing of stand-alone GPS receivers, the option Assisted GPS (R&S-K65) offers full flexibility on the simulated satellites including definition of the satellite's orbit and the complete navigation message.

The Localization mode "Auto SV Selection" can be used to get a reasonable GPS scenario, changing to "Full Configuration" however enables the user to adjust the scenario to his exact requirements. For example, a detailed configuration of the ionospheric model for each satellite is possible.

The generic workflow is described in [chapter 2.8.5, "Generating A-GPS Custom Build Scenarios \(Localization Mode Full Configuration\)"](#), on page 22.

### 2.5.4 Generation of assistance data

Besides generating the satellite signals for an A-GPS test scenario, the option Assisted GPS (R&S-K65) is also able to provide all kinds of assistance data in line with the simulated scenario which can be provided to the UE by a protocol tester, like e.g. R&S CMU/CRTU family.

Certainly, this also applies to user-defined A-GPS test scenarios.

Refer to [chapter 2.7.1, "Example of A-GPS Test Setup"](#), on page 19 for an example of the A-GPS setup. The generic workflow is described in [chapter 2.8.7, "Generating Assistance Data"](#), on page 23.

### 2.5.5 Simulation of Moving Receivers

In addition to the possibility to generate a real GPS signal for a predefined or user-defined static geographical location, it is also possible to simulate moving receivers (see [chapter 2.6, "Moving Scenarios"](#), on page 16).

## 2.6 Moving Scenarios

As it is part of the A-GPS test scenarios for 3GPP FDD and GSM (Performance Test Scenario#3), the option Assisted GPS (R&S-K65) enhances the option GPS (R&S-K44) by user-definable moving scenarios, which can also be used for testing stand-alone GPS-receivers. The user has the possibility to define a movement by means of a so-called "waypoint" file, which will lead to a "moving" of the connected GPS-receiver.

### 2.6.1 Waypoint file's formats

Two `.txt` formats can be used for the waypoint file:

- The first format is a list of coordinates (longitude, latitude, altitude) and a respective resolution in milliseconds, as shown for the case of 3GPP Performance Test Scenario#3 "Melbourne" (WGS 84 geodetic coordinates)  
The resolution command at the beginning of the format specifies the sampling rate to be used for the WGS-84 geodetic coordinates list.

```
RESOLUTION: 50
144.966666334601,-37.8166633061788,100.00000009313
144.966662392613,-37.8166632247233,100.000000039116
144.966658453002,-37.8166630889914,100.00000008475
144.966654516955,-37.8166628990241,100.000000149943
144.966650585658,-37.8166626548785,100.000000235625
144.966646660296,-37.8166623566284,100.000000339001
144.966642742053,-37.8166620043635,100.000000461936
144.966638832109,-37.81666159819,100.000000603497
144.966634931642,-37.8166611382304,100.000000762753
144.96663104183,-37.8166606246233,100.000000941567
144.966627163843,-37.8166600575235,100.000001138076
144.96662329885,-37.8166594371019,100.000001354143
144.966619448018,-37.8166587635456,100.000001588836
144.966615612505,-37.8166580370574,100.000001840293
144.966611793469,-37.8166572578565,100.00000211224
144.96660799206,-37.8166564261776,100.00000240095
144.966574759635,-37.8166466260761,100.00000580959
etc.
```

- The second format uses a script containing the commands defined in the following table:

| Command                  | Description  |
|--------------------------|--|
| REFERENCE: lon, Lat, alt | Specifies the Cartesian Reference of the ENU coordinates system. Given as a geodetic WGS-84 point (longitude, Latitude, Altitude).   |
| START: E, N, U, Velocity | Start location i.e., initial "current location" in the ENU Cartesian coordinate of center "REFERENCE". East, North and UP (ENU) coordinates are then provided (m). The last argument is the start velocity in (m/s). |

| Command                    | Description   |
|----------------------------|---|
| ARC: E, N, Angle           | Specifies a 2-Dimensional ARC (East, North) with the first two arguments representing the center of the ARC (m) in the Cartesian basis. The last argument specifies the angle in degrees (°) of the Arc Starting the "current location". Angle sign is significant since it indicates positive direction (against clock movement) or negative direction (same as clock movement). The end edge of the arc represents the new "current location". Velocity doesn't change when using an ARC command. |
| LINE: ΔE, ΔN, Acceleration | Specifies a 2-Dimensional Line starting the "current location" as the first edge and (Current loc E + ΔE, Current loc N + ΔN) as the second edge (m). Constant acceleration/deceleration can be specified in the last argument e.g., (0 means constant velocity). Unit for acceleration is (m/s <sup>2</sup> ). The second edge is again used as the "current location" for the next command. The speed at this second edge is also used as the start speed for the next command.                   |
| STAY: Time                 | Stay at the current location for Time period (ms).  |

## 2.6.2 Example of Waypoint File

This example explains a waypoint file in the second format for the case of 3GPP Performance Test Scenario#3 "Melbourne", as described in 3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1.

The GPS signals simulate the GPS-receiver moving on a rectangular trajectory of 940m by 1 440m with rounded corners defined in [figure 2-1](#) and [table 2-2](#).

The initial reference is first defined followed by acceleration to final speed of 100 km/h in 250 m.

The UE then maintains the speed for 400 m. This is followed by deceleration to final speed of 25 km/h in 250 m. The UE then turn 90 degrees with turning radius of 20 m at 25 km/h. This is followed by acceleration to final speed of 100 km/h in 250 m.

The sequence is repeated to complete the rectangle.

**Table 2-2: Trajectory Parameters for Moving Scenario and Periodic Update Performance test case**

| Parameter                        | Distance (m) | Speed (km/h)            |
|----------------------------------|--------------|-------------------------|
| $l_{11}, l_{15}, l_{21}, l_{25}$ | 20           | 25                      |
| $l_{12}, l_{14}, l_{22}, l_{24}$ | 250          | 25 to 100 and 100 to 25 |
| $l_{13}$                         | 400          | 100                     |
| $l_{23}$                         | 900          | 100                     |





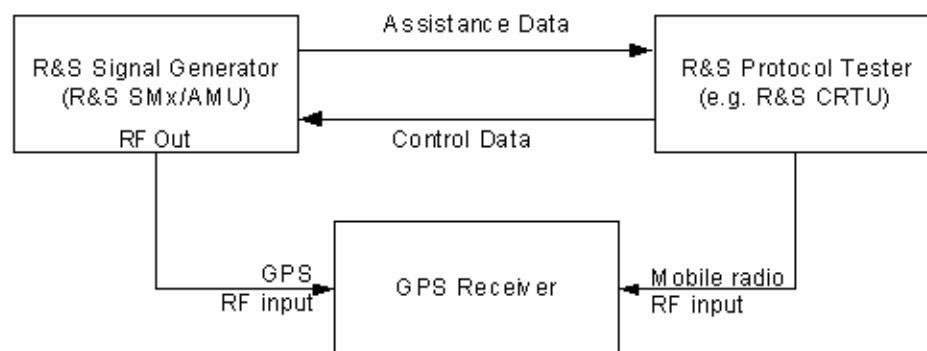
```

LINE: 0, -250, 1.44675925925925926
LINE: 0, -400, 0
LINE: 0, -250, -1.44675925925925926
ARC: 1400, 20, -90
LINE: -250, 0, 1.44675925925925926
LINE: -900, 0, 0
LINE: -250, 0, -1.44675925925925926
%%End of Trajectory description

```

## 2.7 Test Setups

### 2.7.1 Example of A-GPS Test Setup



## 2.8 Typical Workflows

This chapter provides examples of some typical generic workflows for working with:

- option GPS (R&S SMx/AMU-K44/K244)
- option Assisted-GPS (R&S SMx/AMU-K65)

### 2.8.1 Generating GPS Signal for Simple Receiver Tests (Generic Mode)

(for R&S SMx/AMU instruments only)

Enable this mode, if the generation of GPS signal of up to 4 configurable GPS satellites per baseband is required. The signal will be calculated for the selected predefined moment of time.

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select the required "RF Band".
3. Adjust the output frequency of the instrument to the frequency selected with the parameter "RF Band":
  - a) for RF instruments, select "Set to Default RF and Level" or
  - b) select the FREQ key to set the frequency in the header of the instrument.
4. Set the parameters "Simulation Mode" to "Generic Mode".
5. Select an arbitrary data or "Real Navigation Data" as "Data Source".
6. When using Real Navigation Data, use the "Select Almanac File" function and choose an almanac file.

The navigation message will be extracted from this almanac file.
7. Adjust the "Date" and the simulation time ("GPS Mean Time").
8. Select "Satellite Configurations" and configure the satellites as required.
9. Set the GPS "State" to ON to enable the GPS signal generation.

The generated GPS signal is calculated according to the satellite configuration settings, the selected almanac file and selected moment of time (date and time).

## 2.8.2 Generating Multipath Scenarios

(for R&S SMx/AMU instruments only)

1. Enable the instrument to work in "Generic Mode", "Localization Mode Auto SV Selection" or "Full Configuration" mode.
2. Select the "Satellite Configuration".
3. To simulate multipath, assign the same space vehicle ("SV ID") to more than one configuration columns (simulated satellites) and select different:
  - a) Additional Time Shift
  - b) Additional Power
  - c) Additional Doppler Shift
4. Enable the GPS signal generation.

The instrument will generate the GPS signal of satellite(s) that experiences multipath propagation.

## 2.8.3 Generating GPS Signal with Flexible Simulation Time (Localization Mode Auto SV Selection)

(for R&S SMx/AMU instruments only)

Enable this mode, if a simulation of realistic GPS scenario of up to 4 configurable GPS satellites per baseband and flexible simulation time is required. The signal will be calculated for the selected fixed or moving location. Simulation of moving receiver requires option Assisted GPS R&S SMx/AMU-K65.

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select the required "RF Band".
3. Adjust the output frequency of the instrument to the frequency selected with the parameter "RF Band":
  - a) for RF instruments, select "Set to Default RF and Level" or
  - b) select the FREQ key to set the frequency in the header of the instrument.
4. Set the parameters "Simulation Mode" to "Localization Mode".
5. Set the "Localization Mode" to "Auto SV Selection".
6. Select and configure a static predefined or user-defined "Geographic Location" or a moving receiver.
7. Use the "Select Almanac File" function and choose an almanac file. The navigation message will be extracted from this almanac file.
8. Adjust the "Date" and the simulation time ("GPS Mean Time"). Any simulation time in the week span can be selected. However, only the period between the Time of Almanac (TOA) and TOA+3.5 days ensures to lead to a receiver fix.
9. Choose the generation of GPS signal of 4 or 8 satellites.
10. Adjust the required "Satellite Elevation Mask" and set the elevation mask of the GPS receiver to this value.
11. Set the GPS "State" to ON to enable the GPS signal generation.

The R&S Signal Generator generates a realistic GPS signal for 4 or 8 satellites' constellation, calculated to fulfill the minimum PDOP criteria. The selected satellites are displayed in the "Satellite Configurations" dialog. Most of the parameters are read-only; the satellite parameters can be additionally reconfigured to simulate multipath effects for instance (see also [chapter 2.8.2, "Generating Multipath Scenarios"](#), on page 20).

Open the [Real-Time S.P.O.T.](#) display to show the position of the active and inactive satellites. The current values of the parameters "PDOP", "HDOP", "Receiver Location", "Time of Simulation" and "Elapsed Time" are also displayed.

If a moving receiver had been configured, the "Real-Time S.P.O.T." displays the ideal trajectory the receiver should have.

#### 2.8.4 Generating GPS Signal with Satellite Handover (Localization Mode Auto SV Selection and Update)

(for R&S SMx/AMU instruments only)

Enable this mode, if a simulation of realistic GPS scenario of up to 4 configurable GPS satellites per baseband with satellite handover is required. The signal will be calculated for the selected fixed or moving location. Simulation of moving receiver requires option Assisted GPS R&S-K65.

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select the required "RF Band".
3. Adjust the output frequency of the instrument to the frequency selected with the parameter "RF Band":
  - a) for RF instruments, select "Set to Default RF and Level" or
  - b) select the FREQ key to set the frequency in the header of the instrument.
4. Set the parameters "Simulation Mode" to "Localization Mode".
5. Set the "Localization Mode" to "Auto SV Selection and Update".
6. Select and configure a static predefined or user-defined "Geographic Location" or a moving receiver.
7. Use the "Select Almanac File" function and choose an almanac file. The navigation message will be extracted from this almanac file.
8. Adjust the "Date" and the simulation time ("GPS Mean Time").
9. Choose the generation of GPS signal of 4 or 8 satellites.
10. Adjust the required "Satellite Elevation Mask" and set the elevation mask of the GPS receiver to this value.
11. Set the GPS "State" to ON to enable the GPS signal generation.

The R&S Signal Generator generates a realistic GPS signal for 4 or 8 satellites' constellation, calculated to fulfill the minimum PDOP and satellite visibility criteria. The selected satellites are dynamically and on-the-fly exchanged as soon as a handover is necessary. The satellites parameters displayed in the "Satellite Configurations" dialog and the "Navigation Message" parameters are read-only.

Open the [Real-Time S.P.O.T.](#) display to show the position of the active and inactive satellites. The current values of the parameters "PDOP", "HDOP", "Receiver Location", "Time of Simulation" and "Elapsed Time" are also displayed. If a moving receiver had been configured, the "Real-Time S.P.O.T." displays the ideal trajectory the receiver should have.

### 2.8.5 Generating A-GPS Custom Build Scenarios (Localization Mode Full Configuration)

(for R&S SMx/AMU instruments equipped with option Assisted GPS (R&S-K65) only)

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.

2. Enable the instrument to work in "Localization Mode Auto SV Selection".  
**Note:** Do not use the "Auto SV Selection and Update" mode for the generation of A-GPS test signals.
3. Select "Full Configuration" mode.
4. Select the "Satellite Configuration" and reconfigure the satellites' parameters as required.
5. Configure the "Navigation Message" and for instance adjust the ionospheric model per satellite.
6. Set the GPS "State" to ON to enable the GPS signal generation.
7. Generate the required "Assistance Data".  
  
The R&S Signal Generator generates an A-GPS signal according to the settings made.

### 2.8.6 Generating A-GPS Test Signal

(for R&S SMx/AMU instruments equipped with option Assisted GPS (R&S-K65) only)

The generic workflow for generation of A-GPS test scenarios in conformance to A-GPS 2G/3G Protocol and Conformance Test Cases is as follow:

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select a predefined GSM or 3GPP FDD "AGPS Test Scenario".
3. Set the GPS "State" to ON to enable the GPS signal generation.

The R&S Signal Generator generates an A-GPS signal according to the selected test scenario.

### 2.8.7 Generating Assistance Data

(for R&S SMx/AMU instruments equipped with option Assisted GPS (R&S-K65) only)

The generic workflow for generation of assistance data files for A-GPS test scenarios is as follow:

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Enable the instrument to work in "Localization Mode Auto SV Selection".  
**Note:** Do not use the "Auto SV Selection and Update" mode for the generation of A-GPS test signals.
3. Enable the instrument to work in "Full Configuration" mode.
4. Set the GPS "State" to ON to enable the GPS signal generation.

5. "Synchronize" the Assistance Data (Satellite Configurations and Reference Location Configuration) with the settings that have been already made.
6. Select the "Number of Satellites" and the Satellites IDs ("SV ID") for which assistance data is to be generated.
7. Reconfigure the reference location (i.e. BS location instead of receiver location).
8. Enter the "Time", "Duration" and "Resolution of Assistance Data".
9. Generate the required assistance data (almanac file, ionospheric file, etc.).

The generated assistance data files are saved in the selected folder. Refer to the description of the corresponding file for description of the file format used. Generated almanac files can be later loaded at the instrument and used like the main almanac source.

### 2.8.8 Generating an one-satellite static generic GPS signal with R&S WinIQSIM2

The generic workflow for generating of GPS signal with R&S WinIQSIM2 and saving it as a waveform is as follow:

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select the required "RF Band".
3. Select an arbitrary data or "Real Navigation Data" as "Data Source".
4. When using Real Navigation Data, use the "Select Almanac File" function and choose an almanac file.  
The navigation message will be extracted from this almanac file.
5. Adjust the "Duration of Satellites Simulation".
6. Adjust the "Date" and the simulation time ("GPS Mean Time").
7. Select a "Marker Delay" to overcome the limitation for the second's subfield and generate a signal with time of simulation different than 0s, 6s, 12s, etc.
8. Select "Satellite Configurations" and configure the satellite as required.
9. Set the GPS "State" to ON to enable the GPS signal generation.
10. Select the "Generate Waveform File" to save the GPS signal as waveform file.

### 2.8.9 Loading and Processing an GPS Waveform in the ARB of R&S Signal Generator

The generic workflow for loading and processing of GPS waveform is as follow:

1. Enable the R&S WinIQSIM2 to generate a one-satellite static generic GPS signal with constant Doppler shift and generate a waveform file.
2. Connect the R&S WinIQSIM2 to the R&S Signal Generator.
3. Transfer the waveform file. For detailed description, refer to the WinIQSIM2 Software Manual.
4. Load the waveform in the ARB of the R&S Signal Generator.  
While loading a waveform in the "ARB" menu, a message is displayed, that states the frequency used during signal generation ("Resulting Frequency").  
**Note:** The carrier frequency of a R&S Signal Generator that processes a waveform generated with the R&S WinIQSIM2 has to match the value of the parameter "Resulting Frequency".
5. Select the **FREQ** key to set the frequency in the header of the instrument to the resulting frequency of the generated waveform.
6. Set the "ARB State" to ON to enable signal processing.

The R&S Signal Generator processes the GPS signal generated by the R&S WinIQSIM2.

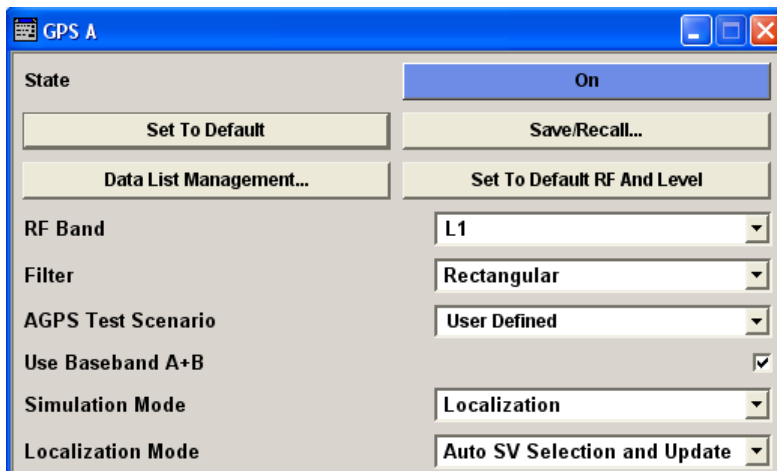
### 3 User Interface



To access the dialog for setting the GPS digital standard, select "Baseband block > Satellite Navigation > GPS" or use the MENU key under "Baseband".

The dialog is split into several sections for configuring the standard. The choice of simulation mode determines which displays and parameters are made available in the lower section.

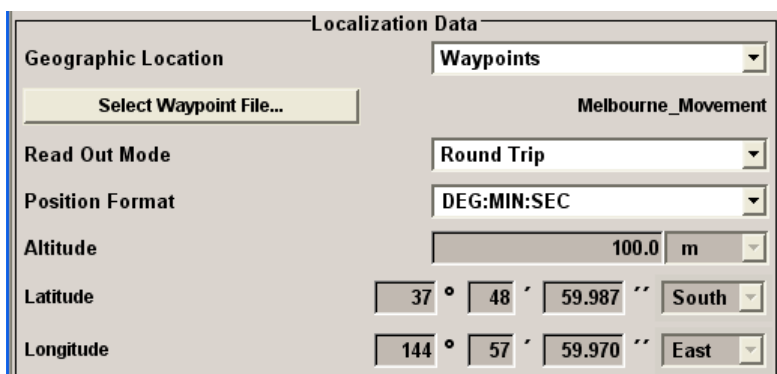
The upper section of the menu is where the GPS digital standard is enabled, the default settings are called and the simulation mode is selected. Buttons lead to the submenus for loading and saving the GPS configuration.



Buttons lead to the submenus for configuring the trigger and clock parameters.

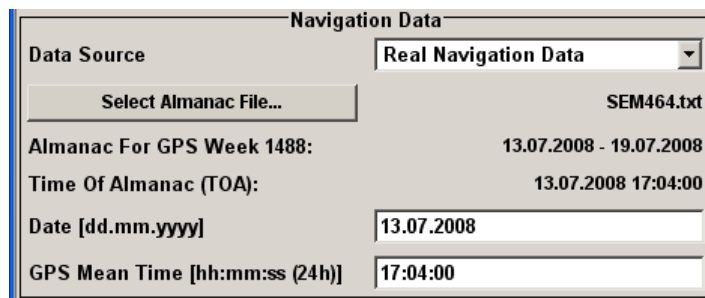


The "Localization Mode" menu section is where the satellite signals is configured corresponding to a 'real' location which can be selected by the user

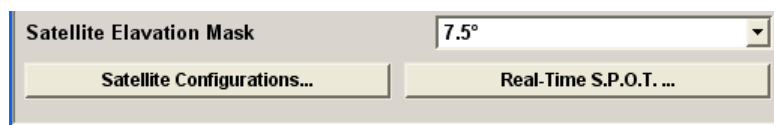


The "Navigation Data" menu section is where the data source for navigation information is selected and the data indicated (in case of real navigation data).





The button in the lower section leads to the submenu for configuring the satellite signals. Additional buttons lead to dialogs for generating the assistance data and displaying the "Real-Time S.P.O.T.".



## 3.1 GPS Main Dialog

### 3.1.1 General Settings for GPS Simulation

The upper section of the menu is where the GPS digital standard is enabled, the default settings are called. Buttons lead to the submenus for loading and saving the GPS configuration.

#### State

Enables/disables the GPS signal simulation.

Enabling this standard disables all the other digital standards and digital modulation modes in the same path.

**Note:** For two path instruments and enabled parameter "Use of Baseband A+B", enabling the GPS signal simulation will disable all other digital standards and digital modulation modes even in the path B.

For R&S SMx/AMU instruments, a continuous GPS signal is generated for up to four satellites per path in real time mode.

For R&S WinIQSIM2, a continuous offline GPS signal of one satellite is generated.

The associated signal level is set in the RF level menu.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:STATe` on page 83

#### Set to default

Calls the default settings. The following table gives an overview of the settings. The preset value for each parameter is specified in the description of the remote-control commands.

**Note:** For instruments with RF Output, the RF and level are preset with button "Set to default RF and Level".

| Parameter                      | Value                          |
|--------------------------------|--------------------------------|
| State                          | Not affected by Set to default |
| RF Band                        | L1                             |
| Filter                         | Gauss                          |
| Simulation Mode                | Generic                        |
| Navigation Data Source         | Real navigation data           |
| Select Almanac File            | SEM299                         |
| Almanac for GPS Week           | Week of Almanac                |
| Date                           | Date of TOE                    |
| Time                           | Time of TOE                    |
| GPS Mean Time                  | Time                           |
| <b>Satellite configuration</b> |                                |
| Use Spreading                  | On                             |
| State satellite 1              | On                             |
| Ranging Code                   | C/A                            |
| Doppler Shift                  | 0 Hz                           |

SCPI command:

[ :SOURce<hw> ] :BB:GPS:PRESet on page 81

### Save/Recall

Calls the Save/Recall menu.

From the "Save/Recall" menu the "File Select" windows for saving and recalling GPS configurations and the "File Manager" can be called.



GPS configurations are stored as files with the predefined file extension \*.gps. The file name and the directory they are stored in are user-definable.

The complete settings in the "GPS" menu are saved and recalled.

"Recall GPS setting" Opens the "File Select" window for loading a saved GPS configuration. The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.

"Save GPS setting" Opens the "File Select" window for saving the current GPS signal configuration. The name of the file is specified in the "File name" entry field, the directory selected in the "Save into" entry field. The file is saved by pressing the "Save" button.

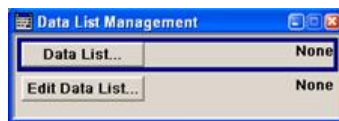
"File Manager" Calls the "File Manager".  
The "File Manager" is used to copy, delete and rename files and to create new directories.

SCPI command:

[ :SOURce<hw> ] :BB:GPS:SETTing:CATalog on page 82  
 [ :SOURce<hw> ] :BB:GPS:SETTing:LOAD on page 82  
 [ :SOURce<hw> ] :BB:GPS:SETTing:STORe on page 83  
 [ :SOURce<hw> ] :BB:GPS:SETTing:DELete on page 82

### Data List Management

Calls the "Data List Management" menu. This menu is used to create and edit a data list.



All data lists are stored as files with the predefined file extension \*.dm\_iqd. The file name and the directory they are stored in are user-definable.

**Note:** All data lists are generated and edited by means of the `SOURce:BB:DM` subsystem commands. Files containing data lists usually end with \*.dm\_iqd. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

#### Example: Creating and editing the data list:

```
SOUR:BB:DM:DLIS:SEL "GPS"
SOUR:BB:DM:DLIS:DATA 1,1,0,1,0,1,0,1,1,1,1,0,0,0
SOUR:BB:DM:DLIS:DATA:APP 1,1,0,1,0,1,0,1,1,1,1,0,0
```

### Set to default RF and Level

(For instruments with RF output only)

Calls the default RF and level settings for GPS signals.

The frequency is set to the GPS carrier frequency selected by parameter "RF Band" (L1 of 1.57542 GHz respectively L2 of 1.2276 GHz) and the output level is set to -115.0 dBm.

**Note:** To avoid any damage to connected receivers, the user must ensure that the signal level used is not too high. A downstream attenuator pad must be connected to generate output levels below -145 dBm.

SCPI command:

[ :SOURce<hw> ] :BB:GPS:PRFLevel on page 81

### Generate Waveform File...

(R&S WinIQSIM2 only)

Calls the "Generate Waveform" menu. This menu is used to store the current GPS signal as ARB signal in a waveform file.

This file can be loaded in the "ARB" menu and processed as multicarrier or multisegment signal.

The file name is entered in the submenu. The file is stored with the predefined file extension \*.wv. The file name and the directory it is stored in are user-definable.

See also section [chapter 2.8.8, "Generating an one-satellite static generic GPS signal with R&S WinIQSIM2"](#), on page 24, and [chapter 2.8.9, "Loading and Processing an GPS Waveform in the ARB of R&S Signal Generator"](#), on page 25.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:WAVEform:CREate](#) on page 84

### RF Band

Selects the GPS carrier frequency used for Doppler calculation.

"L1" Selects GPS carrier frequency L1 = 1.57542 GHz.

"L2" Selects GPS carrier frequency L2 = 1.2276 GHz.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:RFBand](#) on page 81

### Filter

Sets the filter to GPS compliant rectangular mode or to Gauss mode.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:FILTer:TYPE](#) on page 144

### Oversampling

(R&S WinIQSIM2 only)

Determines the upsampling factor.

A higher upsampling factor improves the filtering but increases the waveform size proportionally. This leads to limitation for the maximum "Duration of Satellite Simulation".

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:FILTer:OSAMpling](#) on page 144

### AGPS Test Scenario

(enabled with option Assisted GPS (R&S-K65) only)

Selects a predefined A-GPS test scenario according to A-GPS 2G/3G Protocol and Conformance Test Cases.

"User Defined" No predefined test scenario is selected. The parameters can be set by the user.

- "GSM" One of the following predefined A-GPS GSM test scenarios can be selected:
- GSM Signalling Scenario (3GPP TS 51.010-1 v.7.7.0)
  - GSM Performance Test Scenario 1 (3GPP TS 51.010-1 v.7.7.0)
  - GSM Performance Test Scenario 2 (3GPP TS 51.010-1 v.7.7.0)
  - GSM Performance Test Scenario 3 (3GPP TS 51.010-1 v.7.7.0)
- All parameters (simulated position, satellite configuration, Almanac, navigation data, etc.) will be set according to the selected test scenario.
- "3GPP FDD" One of the following predefined A-GPS 3GPP FDD test scenarios can be selected:
- 3GPP FDD Signalling Scenario (3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0)
  - 3GPP FDD Performance Test Scenario 1 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
  - 3GPP FDD Performance Test Scenario 2 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
  - 3GPP FDD Performance Test Scenario 3 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)
- All parameters (simulated position, satellite configuration, Almanac, navigation data, etc.) will be set according to the selected test scenario.
- "3GPP2" One of the following predefined A-GPS 3GPP2 test scenarios can be selected:
- 3GPP2 Static Test Scenario (3GPP2 C.S0036-0 V1.0)
  - 3GPP2 Moving Test Scenario (3GPP2 C.S0036-0 V1.0)
- All parameters (simulated position, satellite configuration, Almanac, navigation data, etc.) will be set according to the selected test scenario.

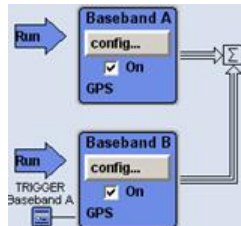
SCPI command:

`[ :SOURce<hw> ] :BB:GPS:ATSCenario` on page 73

#### Use Baseband A+B

Enables/disables control of both paths via the GPS menu.

"ON" The signal of baseband B is routed to baseband A.



A total number of eight satellites can be configured simultaneously. Both basebands are automatically set to trigger mode "Armed Retrigger" and a trigger event has to be performed to start the signal generation. Changing of any parameter restarts the signal generation in both paths.

"OFF" Corresponds to normal operation, i.e. independent configuration of both paths.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:BA[B] [ :STATe ]` on page 75

### Simulation Mode

Sets the simulation mode.

The settings of the satellite signals are provided in the dialog [Satellite Configuration](#).

"Generic" The satellite signals are configured by the user. See also [chapter 2.8.1, "Generating GPS Signal for Simple Receiver Tests \(Generic Mode\)"](#), on page 19.

"Localization" (R&S SMx/AMU instruments only) The satellite signals are configured corresponding to a 'real' location which can be selected by the user.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:SMODE` on page 83

### Duration Of Satellite Simulation

Determines the duration of the satellite simulation.

The resulting duration of the simulation is calculated as follow:

$$\text{Duration of Simulation} = \frac{\text{Duration of Satellite Simulation}}{1 + \frac{\text{Doppler Shift}}{F_{L1 \text{ or } L2}}}$$

where  $F_{L1 \text{ or } L2}$  is the frequency selected with the parameter [RF Band](#).

The maximum duration depends on the [Oversampling](#) factor and the ARB memory size of the connected instrument.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:DURation` on page 74

### Localization Mode

(R&S SMx/AMU instruments only)

Sets the localization mode.

|                                |   |
|--------------------------------|---|
| "Auto SV Selection"            | <p>Four satellites per baseband will be selected depending on the selected almanac.</p> <p>For instruments equipped with two-paths, a total number of eight satellites will be selected.</p> <p>The ephemerides are read out of the almanac and displayed in the <a href="#">Navigation Message Configuration</a> dialog.</p> <p>See also <a href="#">chapter 2.8.3, "Generating GPS Signal with Flexible Simulation Time (Localization Mode Auto SV Selection)"</a>, on page 20.</p>   |
| "Auto SV Selection and Update" | <p>In this localization mode, a new satellite will be selected as soon as the elevation of a satellite is less than the selected <a href="#">Satellite Elevation Mask</a> or a new satellite constellation with better PDOP is found.</p> <p>The ephemeris data of all satellites are updated automatically.</p> <p>In case the start time of the simulation differs to the TOA (Time of Almanac), the TOE (Time of Ephemeris) will be automatically updated.</p> <p>See also <a href="#">chapter 2.8.4, "Generating GPS Signal with Satellite Hand-over (Localization Mode Auto SV Selection and Update)"</a>, on page 21.</p> |
| "Full Configuration"           | <p>(enabled with option Assisted GPS (R&amp;S-K65) only)</p> <p>Selection "Full Configuration" as Localization mode enables the configuration of all parameter of the <a href="#">"Navigation Message"</a>.</p> <p>Neither ephemeris data nor the visible satellites are updated but all parameter of the "Navigation Message" are enabled for configuration.</p> <p>This mode is useful for the generation of A-GPS test signals different than the standardized ones (see <a href="#">chapter 2.8.5, "Generating A-GPS Custom Build Scenarios (Localization Mode Full Configuration)"</a>, on page 22).</p>                   |

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:LMODe](#) on page 75

### Trigger/Marker

Calls the menu for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal (see [chapter 3.6, "Trigger/Marker/Clock Settings"](#), on page 63).

The currently selected trigger source is displayed to the right of the button.

SCPI command:

n . a .

### Execute Trigger

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:EXECute](#) on page 132

**Clock**

Calls the menu for selecting the clock source and for setting a delay (see [chapter 3.6.4, "Clock Settings"](#), on page 70).

SCPI command:

n.a.

**3.1.2 Localization Data**

(R&S SMx/AMU instruments only)

The "Localization Mode" menu section is where the satellites signal are configured corresponding to a 'real' location which can be selected by the user.

**Geographic Location**

Selects the geographic location of the GPS receiver.

"User Defined" Enables the definition of the "Latitude", "Longitude" and "Altitude" of the GPS receiver with fixed position.

"Waypoints" (enabled with option Assisted GPS (R&S-K65) only)  
Enables defining a moving scenario, i.e. the simulation of moving receiver.  
The parameters "Latitude", "Longitude" and "Altitude" are set according to the first position of the Waypoint-File (see [chapter 2.6, "Moving Scenarios"](#), on page 16).  
For information about the current position of the receiver, open the [Real-Time S.P.O.T.](#) display and check the parameter "Receiver Location" or the displayed receiver trajectory ("Map View").

"<List of Predefined Positions>" Selects one of the predefined fixed geographic locations (e.g. Munich).  
The parameters [Latitude](#), [Longitude](#) and [Altitude](#) are set according to the selected position.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:LOCation](#) on page 76

**Select Waypoint File ...**

This selection is available only for "Geographic Location" set to Waypoints.

Call the "Select Waypoint File" menu. This menu is used to select predefined waypoint files.

A waypoint file is description of a moving scenario in form of a sequence of positions.

A waypoint file must have the extension `.txt`. See [chapter 2.6.1, "Waypoint file's formats"](#), on page 16 for detailed description of the waypoint file's format.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:LOCation:WAYPoints](#) on page 80

**Read Out Mode**

This selection is available only for "Geographic Location" set to Waypoints.

Defines the way the waypoint file is to be read.



The receiver trajectory can be observed in the "Map View" on the [Real-Time S.P.O.T.](#) display.

- "Cyclic"            The waypoint file is read out cyclic.  
Using this read out mode is only recommended for waypoint files that describe a circle moving scenario or moving scenario in which the start and the end point are close to each other.
- "One Way"           The file is read out only once.  
By reaching the end of the file, the last described position is assumed to be a static one.
- "Round Trip"        By reaching the end of the file, the file is read out backwards.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:LOCation:ROMode](#) on page 80

### Position Format

Sets the format in which the Latitude and Longitude are displayed.

- "DEG:MIN:SE C"    The display format is Degree:Minute:Second and Direction, i.e. XX°XX'XX.XX" Direction, where Direction can be North/South and East/West.

- "Decimal Degree"    The display format is decimal degree, i.e. +/-XX.XXXXX°, where "+" indicates North and East and "-" indicates South and West.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:LOCation:PFORmat](#) on page 79

### Altitude

Sets the geographic altitude.

This field is only configurable for user defined geographic locations. If a value other than "User Defined" is selected in the "Geographic Location" field, the "Altitude" field is read only.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:LOCation:ALTitude](#) on page 76

### Latitude

Sets the latitude of the user defined geographic location.

This field is only configurable for user defined geographic locations. If a value other than "User Defined" is selected in the "Geographic Location" field, the "Latitude" field is read only.

SCPI command:

for display format Degree:Minute:Second

[\[:SOURce<hw>\]:BB:GPS:LOCation:LATitude:DEGRees](#) on page 77

[\[:SOURce<hw>\]:BB:GPS:LOCation:LATitude:MINutes](#) on page 78

[\[:SOURce<hw>\]:BB:GPS:LOCation:LATitude:SECONDS](#) on page 78

[\[:SOURce<hw>\]:BB:GPS:LOCation:LATitude:DIRection](#) on page 77

for display format decimal degree

[\[:SOURce<hw>\]:BB:GPS:LOCation:LATitude](#) on page 77

**Longitude**

Sets the longitude of the user defined geographic location.

This field is only configurable for user defined geographic locations. If a value other than "User Defined" is selected in the "Geographic Location" field, the "Longitude" field is read only.

SCPI command:

for display format Degree:Minute:Second

[\[:SOURCE<hw>\]:BB:GPS:LOCATION:LONGITUDE:DEGREES](#) on page 78

[\[:SOURCE<hw>\]:BB:GPS:LOCATION:LONGITUDE:MINUTES](#) on page 79

[\[:SOURCE<hw>\]:BB:GPS:LOCATION:LONGITUDE:SECONDS](#) on page 79

[\[:SOURCE<hw>\]:BB:GPS:LOCATION:LONGITUDE:DIIRECTION](#) on page 79

for display format decimal degree

[\[:SOURCE<hw>\]:BB:GPS:LOCATION:LONGITUDE](#) on page 78

**3.1.3 Navigation Data**

The "Navigation Data" menu section is where the data source for navigation information is selected and the data indicated (in case of real navigation data).

**Data Source**

Selects data source for the navigation information.

Navigation data play an extremely important role, since they are essential for calculating the positions of the four satellites, which are the minimum prerequisite for localization purposes. It also contains the information about the currently valid space vehicle IDs.

**Note:** If "Localization" is selected as simulation mode, "Real Navigation Data" is pre-selected and no other data source can be selected.

"Real Navigation Data" "Real Navigation Data" (almanac) can be downloaded from the internet and stored on the hard disk of the generator.

The following almanac files are supported:

- SEM-files with data extension \*.txt
- YUMA almanac files.

The almanac file to be used is selected in the file manager which is called with button "Select Almanac File...". The time information of the file is indicated below the button. The simulated date and time can be set within the time interval determined by the loaded almanac (GPS week).

The satellite specific information (ephemeris) is also taken from the almanac. The time of ephemeris is indicated.

All indications and entries are made in Greenwich Mean Time.

"PRBSxx/Data List/Pattern" Arbitrary data can be used for basic tests on the GPS signals. Arbitrary data are supported only in "Generic" mode. Data sources "PN9", "PN11", "PN15", "PN16", "PN20", "PN21", "PN23", "ALL0", "ALL1", and "Pattern" are all available. If the "Pattern" data type is used, the bit pattern is defined in the "Pattern" input box. The length is limited to 64 bits. "Data lists" are selected in the "File Select" window, which is called by means of the "Data List Management" button. Signals generated in this way can be recognized by a GPS receiver. However, since there are no real navigation data on the C/A code, only the signal level of the simulated satellite(s) can be measured and displayed by the receiver. A signal of this type is usually sufficient for performing simple function tests. It should be noted, however, that the receiver to be tested may have to be switched to a special test mode, since signals without correct navigation data are often not indicated (on a display, for example).

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:NAVigation:DATA` on page 89

`[ :SOURce<hw> ] :BB:GPS:NAVigation:DATA:PATtern` on page 90

`[ :SOURce<hw> ] :BB:GPS:NAVigation:DATA:DSElect` on page 89

### Select Almanac File

Opens the file manager for selecting the almanac file.

The button is only available if data source "Real Navigation Data" is selected.

The downloaded files can be copied to the R&S Signal Generator via USB interface or via a LAN network.

Almanacs are currently available at the following internet sites:

U.S.Coast Guard Navigation Center GPS Homepage (<http://www.navcen.uscg.gov/GPS/almanacs.htm>)

The almanac files are named `xxx.alm` (for YUMA files) or `xxx.a13` (for SEM files) whereas `xxx` denotes the day of a year.

<http://www.celestrak.com/GPS/almanac>

The naming convention of the almanac file is:

`almanac.sem/yuma.weekXXXX.YYYYYY.txt`

whereas `xxxx` denotes the GPS week and `yyyyyy` the time of almanac (TOA).

**Note:** Supported almanac files are SEM-files with data extension `*.txt` and YUMA almanac files.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac` on page 86

### Almanac For GPS Week

Indicates the week in which the almanac was published. The simulation time ("Date") must be set within this time interval.

In "Full Configuration" mode, however, the simulation time is not limited to the almanac week.

The indication is only available if data source "Real Navigation Data" is selected.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:BEgin:WNUmber` on page 87  
`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:BEgin:DAY` on page 86  
`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:BEgin:MONTh` on page 86  
`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:BEgin:YEAR` on page 87  
`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:END:DAY` on page 87  
`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:END:MONTh` on page 88  
`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:END:YEAR` on page 88

### Time Of Almanac (TOA)

Indicates the time of almanac, i.e. the exact time up to the second to which the navigation data refers.

The indication is only available if data source "Real Navigation Data" is selected.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:NAVigation:ALManac:TOEPHemeris` on page 88

### Date

Enters the date for the simulation. In "Auto SV Selection" mode, only values within the almanac GPS week are valid.

In "Full Configuration" mode, however, the simulation time is not limited to the almanac week.

The parameter is only available if data source "Real Navigation Data" is selected.

The date format is: DD.MM.YYYY

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:NAVigation:SIMulation[:BEgin]:DATE`  
on page 90

### GPS Mean Time

Enters the exact time for the simulation. The used time zone is Greenwich Mean Time.

The parameter is only available if data source "Real Navigation Data" is selected.

While calculating an offline GPS signals with R&S WinIQSIM2, there is a limitation for the values allowed for the second's subfield. Since a GPS subframe is 6 seconds long, to align the waveform generation to the start of a GPS subframe, only values that are aligned to 6 are allowed. i.e. 0, 6, 12, etc.

To generate an offline GPS signal with time of simulation different than these values, select a [Marker Delay](#) .

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:NAVigation:SIMulation[:BEgin]:TIME`  
on page 92

### Satellite Elevation Mask

(R&S SMx/AMU instruments only)

(enabled for "Localization" mode)

Sets the satellite's elevation, i.e. determines the minimum angular distance of a satellite above the horizon.

When the elevation decreases below the selected elevation mask, the GPS satellite is considered as invisible and hence the GPS receiver can not use this satellite for determining its position. The GPS receiver has to search for another satellite with better visibility. This process is called handover.

Satellites handover is performed in Localization mode set to "Auto SV Selection and Update" only. The expected time of the next upcoming satellites handover is displayed in the "Real-Time S.P.O.T." view with the parameter [Real-Time S.P.O.T.](#).

While analyzing the generated GPS signal, make sure that the elevation mask of the GPS receiver is set to the "Satellite Elevation Mask" used by the signal generation.

SCPI command:

[ :SOURce<hw> ] :BB:GPS:SEMask on page 81

### Satellite Configuration

Calls the dialog for configuring the satellite data (see [chapter 3.2, "Satellite Configuration"](#), on page 39).

SCPI command:

n.a.

### Real-Time S.P.O.T.

Calls the dialog for real-time display of the current PDOP and HDOP values, display of the satellites states and position and display of the receiver position (see [Real-Time S.P.O.T.](#)).

SCPI command:

n.a.

### Assistance Data Generation

(enabled with option Assisted GPS (R&S-K65) only)

This button is available only for "Localization Mode" set to "Full Configuration".

Calls the dialog for generation of assistance data (see [chapter 3.4, "Assistance Data Generation"](#), on page 52).

SCPI command:

n.a.

## 3.2 Satellite Configuration

In the Satellite Configuration menu, the signal simulation of up to four satellites per path can be activated and configured, i.e. four satellites for one path instrument and eight satellites for two path instruments.

The GPS implementation in the R&S WiniQSIM2 is a simplified offline version of the real-time GPS option. The offline version provides the possibility to generate an one-satellite generic signal, i.e. only one satellite can be activated and configured.



Configuration of eight satellites is only possible for two path instruments and enabled by parameter "Use Baseband A+B".

| GPS A: Satellite Configurations      |                  |                  |   |                  |                  |              |      |
|--------------------------------------|------------------|------------------|---|------------------|------------------|--------------|------|
| <b>Adjust Total Power To 0 dB</b>    | Total Power / dB | 0.00             | Use Spreading <input checked="" type="checkbox"/> | Initial HDOP     | 1.10             | Initial PDOP | 1.61 |
|                                      | Satellite 1      | Satellite 2      | Satellite 3                                       | Satellite 4      | Satellite 5      | S            |      |
| State                                | On               | On               | On  | On               | On               |              |      |
| Range Code                           | C/A              | C/A              | C/A   | C/A              | C/A              |              |      |
| Space Vehicle ID                     | 23               | 20               | 16  | 4                | 13               |              |      |
| Navigation Message                   | Configure...     | Configure...     | Configure...                                      | Configure...     | Configure...     |              |      |
| Time Shift /CA-Chips/40              | 2 811 016.603    | 2 828 924.117    | 2 966 705.285                                     | 3 223 624.354    | 2 992 941.851    |              |      |
| Time Shift /ms                       | 68.695           | 69.133           | 72.500  | 78.779           | 73.141           |              |      |
| Power /dB                            | -9.03            | -9.03            | -9.03   | -9.03            | -9.03            |              |      |
| Doppler Shift /Hz                    | 443.73           | -1 675.21        | -166.73   | 65.77            | 1 963.95         |              |      |
| Duration (Elevation > 7.5°) /h:mm:ss | 03:42:05         | 01:59:09         | 02:04:57  | 01:20:28         | 04:50:53         |              |      |
| Additional Time Shift /CA-Chips/40   | 0.000            | 0.000            | 0.000   | 0.000            | 0.000            |              |      |
| Additional Power /dB                 | 0.00             | 0.00             | 0.00  | 0.00             | 0.00             |              |      |
| Additional Doppler Shift /Hz         | 0.00             | 0.00             | 0.00  | 0.00             | 0.00             |              |      |
| Initial Carrier Phase /rad           | 0.00             | 0.00             | 0.00  | 0.00             | 0.00             |              |      |
| Resulting Frequency /GHz             | 1.575 420 443 73 | 1.575 418 324 79 | 1.575 419 833 27                                  | 1.575 420 065 77 | 1.575 421 963 95 | 1            |      |
| Resulting C/A Chip Rate /MHz         | 1.023 000 29     | 1.022 998 91     | 1.022 999 89                                      | 1.023 000 04     | 1.023 001 28     |              |      |
| Resulting P Chip Rate /MHz           | 10.230 002 88    | 10.229 989 12    | 10.229 998 92                                     | 10.230 000 43    | 10.230 012 75    |              |      |

### Adjust Total Power to 0dB

(R&S SMx/AMU instruments only)

Sets the power level of each satellite so that the sum of all levels results in 0 dB relative to the global level setting of the instrument.

The power ratio among the individual satellites is maintained.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:POWer:ADJust` on page 93

### Total Power

(R&S SMx/AMU instruments only)

Displays the total power of all satellites.

The total power is calculated from the power ratio of the activated satellites.

After "Adjust Total Power to 0dB", this power corresponds to 0 dB.

If the value is not equal to 0 dB, the individual activated satellites (whilst still retaining the power ratios) are internally adapted so that the "Total Power" for achieving the set output level is 0 dB.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:POWer [ :TOTal ]` on page 93

### Use Spreading

(enabled for Generic mode only)

Activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:SPReading\[:STATe\]](#) on page 98

### Initial HDOP

(R&S SMx/AMU instruments only)

Displays the HDOP (Horizontal Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

The displayed HDOP value is not updated. The dynamic "HDOP" calculated on the current satellite constellation is displayed in the [Real-Time S.P.O.T.](#) dialog.

The HDOP can be used as an indication of 2D positioning quality. The general rule here is that the smaller the HDOP the better the precision of the position fix will be.

At least four different satellites have to be configured to get a reasonable value; otherwise -1 will be displayed.

**Note:** This parameter is enabled only for "Localization" mode.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:HDOP](#) on page 85

### Initial PDOP

(R&S SMx/AMU instruments only)

Displays the PDOP (Position Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

The displayed PDOP value is not updated. The dynamic PDOP calculated on the current satellite constellation is displayed in the [Real-Time S.P.O.T.](#) dialog.

The PDOP can be used as an indication of 3D positioning quality. The general rule here is, that the smaller the PDOP the better the precision of the position fix will be.

At least four different satellites need to be configured to get a reasonable value; otherwise -1 will be displayed.

**Note:** This parameter is enabled only for Localization mode.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:PDOP](#) on page 92

### State

Activates/deactivates the generation of the satellite signal.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:SATellite<st>:STATe](#) on page 97

### Ranging Code

Selects the type of ranging code.

**Note:** Selecting the ranging code is only enabled for "Generic" simulation mode; for "Localization" mode this parameter is read-only.

The C/A code ( $f_{ca} = 1.023$  MHz) is provided for civilian purposes. The P-code ( $f_p = 10.23$  MHz) is provided for military purposes. They are used as spreading codes for the navigation data which is transmitted at a rate of 50 baud.

**Note:** For satellite 2, 3, and 4, the only available Ranging Code is C/A and cannot be changed.

"C/A" Carrier L1 ( $f_{L1} = 1.57542$  GHz) respectively carrier L2 ( $f_{L2} = 1.2276$  GHz) is modulated by C/A-code (BPSK).

"C/A + P" (only available for Satellite 1)  
Carrier L1 respectively carrier L2 is modulated by C/A code and P-code (QPSK).

"P" (only available for Satellite 1)  
Carrier L2 respectively carrier L2 is modulated by P-code (BPSK).

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:SATELLITE<st>:RCODE](#) on page 96

### Space Vehicle ID

Enters the ID of the satellite to be simulated. This value is used to generate the corresponding C/A respectively P-code.

37 IDs are defined whereas 32 codes are used for identifying satellites.

If "Real Navigation Data" is used, only the valid IDs which are listed in the almanac are selectable.

For arbitrary data, any ID can be selected.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:SATELLITE<st>:SVID](#) on page 97

### Configure Navigation Message

(R&S SMx/AMU instruments only)

Call the "Navigation Message Configurations" dialog (see [chapter 3.3, "Navigation Message Configuration"](#), on page 46).

**Note:** This parameter is enabled only for Localization mode.

SCPI command:

n. a.

### Time Shift / CA-Chips/40

(R&S SMx/AMU instruments only)

Sets a delay of the selected satellite relative to the other satellites. The time shift is set in oversampled CA chips (Oversampling = 40).

In Localization mode, this parameter is not configurable and is set automatically depending on the simulated [Geographic Location](#) and on the satellite's orbit.

**Note:** The value displayed is the initial time shift at the beginning of the simulation. This value will be updated internally to implement moving satellites and receivers. However the value displayed is not updated.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:SVID<st>:TSChips](#) on page 99



**Time Shift ms**

(R&S SMx/AMU instruments only)

Indicates the time shift of the code sequence in milliseconds.

SCPI command:

[ :SOURce<hw> ] :BB:GPS:SVID<st>:TSSeconds on page 100

**Power**

(R&S SMx/AMU instruments only)

Sets the power offset of the satellite in dB. The offset determines the power ratio of the activated satellites.

After [Adjust Total Power to 0dB](#) has been performed, the resulting level of a certain satellite is calculated according to the following:

Resulting Level = Global Level + Satellite Power + Additional Power

SCPI command:

[ :SOURce<hw> ] :BB:GPS:SVID<st>:POWer on page 99

**Doppler Shift**

Enters the Doppler shift of the simulated signal of the satellite.

The simulation of Doppler-shifted GPS signals can be used to check the receiver characteristics under more realistic conditions than with zero Doppler. In contrast to the real system, however, in "Generic mode" the set Doppler frequency is fixed.

In Localization mode, this parameter is not configurable and is set automatically depending on the simulated "Geographic Location" and on the satellite's orbit.

**Note:** The value displayed is the initial Doppler shift at the beginning of the simulation. This value will be updated internally to implement moving satellites and receivers. However the value displayed is not updated.

The relevant change to the chip rate of the C/A code is carried out automatically. The currently valid values for Doppler-shifted carrier frequency and chip rate are displayed under:

- Resulting Frequency
- Resulting C/A chip rate
- Resulting P chip rate

SCPI command:

[ :SOURce<hw> ] :BB:GPS:SVID<st>:DSHift on page 98

**Duration (Elevation > 2.5/5/7.5/10°)**

(R&S SMx/AMU instruments only)

Displays the time the satellite's elevation will be higher than 2.5, 5, 7.5 or 10° at the beginning of the simulation, as selected with the parameter [Satellite Elevation Mask](#).

The value is displayed in format hh:mm:ss.

This parameter can be used to get an impression of how long the connected GPS receiver will use this certain satellite for its position fix.

The displayed value is not updated but the elevation of each satellite is constantly monitored. Decreasing the satellite's elevation below the selected elevation mask value is one of the reasons for satellite handover. Thus, a change of the satellite constellation can occur before the initially calculated time elapses.

The expected time of each upcoming handover is displayed in the "Real-Time S.P.O.T." view by the parameter [Get Next Handover Time](#).

**Note:** This parameter is enabled only for "Localization" mode.

SCPI command:

```
[ :SOURCE<hw> ] :BB:GPS:SVID<st>:DURATION on page 98
```

### Additional Time Shift / CA-Chips/40

(R&S SMx/AMU instruments only)

Sets an additional delay of the selected satellite.

Additionally, the parameter can be used to simulate multipath conditions.

To simulate multipath, assign the same space vehicle (SV ID) to more than one configuration columns (simulated satellites) and select different "Additional Time Shift" (see also [chapter 2.8.2, "Generating Multipath Scenarios"](#), on page 20).

SCPI command:

```
[ :SOURCE<hw> ] :BB:GPS:SATELLITE<st>:ATSCHIPS on page 94
```

### Additional Power

(R&S SMx/AMU instruments only)

Sets the additional power of the satellite in dB.

Additionally, the parameter can be used to simulate multipath conditions.

To simulate multipath, assign the same space vehicle (SV ID) to more than one configuration columns (simulated satellites) and select different "Additional Power" (see also [chapter 2.8.2, "Generating Multipath Scenarios"](#), on page 20).

After [Adjust Total Power to 0dB](#) has been performed, the resulting level of a certain satellite is calculated according to the following:

Resulting Level = Global Level + Satellite Power + Additional Power

SCPI command:

```
[ :SOURCE<hw> ] :BB:GPS:SATELLITE<st>:APOWER on page 94
```

### Additional Doppler Shift

(R&S SMx/AMU instruments only)

Enters the additional Doppler shift of the simulated signal of the satellite.

Additionally, the parameter can be used to simulate multipath conditions.

To simulate multipath, assign the same space vehicle (SV ID) to more than one configuration columns (simulated satellites) and select different "Additional Doppler Shift" (see also [chapter 2.8.2, "Generating Multipath Scenarios"](#), on page 20).

SCPI command:

```
[ :SOURCE<hw> ] :BB:GPS:SATELLITE<st>:ADSHIFT on page 93
```

**Initial Carrier Phase /rad**

(R&amp;S SMx/AMU instruments only)

Sets the initial carrier phase.

Additionally, the parameter is used in case of multipath simulation.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:SATellite<st>:ICPHase` on page 96**Resulting Frequency**

Indicates the currently valid values for Doppler-shifted carrier frequency.

The resulting frequency is calculated according to the following:

$$f_{L1 \text{ or } L2 \text{ resulting}} = f_{L1 \text{ or } L2} + f_{\text{Doppler}}$$

where  $f_{L1}=1,575420\text{GHz}$  and  $f_{L2}=1,2276\text{MHz}$  as set with parameter [RF Band](#).

**Note:** The carrier frequency of a R&S Signal Generator that processes a waveform generated with the R&S WinIQSIM2 has to match the value displayed with the parameter "Resulting Frequency".

While loading a waveform in the "ARB" menu, a message is displayed, that states the frequency used during signal generation ("Resulting Frequency"). To ensure proper signal processing, set the frequency in the header of the instrument's display to this value.

For more information, see sections [chapter 2.8.8, "Generating an one-satellite static generic GPS signal with R&S WinIQSIM2"](#), on page 24 and [chapter 2.8.9, "Loading and Processing an GPS Waveform in the ARB of R&S Signal Generator"](#), on page 25.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:SATellite<st>:FREQuency` on page 95**Resulting C/A Chip Rate**

Indicates the currently valid values for the chip rate of the C/A code. The relevant change to the chip rate of the C/A code is carried out automatically if the doppler shift is changed.

The resulting C/A chip rate is calculated according to the following:

$$f_{C/A \text{ resulting}} = f_{C/A} \times \{1 + f_{\text{Doppler}} / f_{L1 \text{ or } L2}\},$$

where  $f_{L1}=1,575420\text{GHz}$  and  $f_{L2}=1,2276\text{MHz}$  as set with parameter [RF Band](#) and  $f_{C/A}$  is fixed to 1.023 MHz.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:SATellite<st>:CACRate` on page 95**Resulting P Chip Rate**

(R&amp;S SMx/AMU instruments only)

Indicates the currently valid values for the chip rate of the P-code. The relevant change to the chip rate of the P-code is carried out automatically if the doppler shift is changed.

The resulting P-chip rate is calculated according to the following:

$$f_{P\text{-resulting}} = f_P \times \{1 + f_{\text{Doppler}} / f_{L1 \text{ or } L2}\}$$

where  $f_{L1}=1,575420\text{GHz}$  and  $f_{L2}=1,2276\text{MHz}$  as set with parameter [RF Band](#) and  $f_p$  is fixed to 10.230 MHz.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:SATellite<st>:PCRate` on page 96

### 3.3 Navigation Message Configuration



The "Navigation Message Configuration" dialog is enabled only for "Localization" mode set to "Full Configuration".

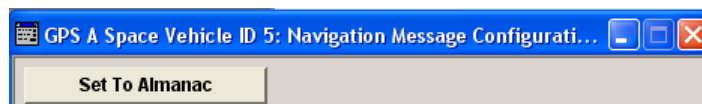
The parameters of the Navigation Message are only configurable for instrument equipped with option Assisted GPS (R&S SMx/AMU-K65).

In the "Navigation Message Configuration" dialog, the navigation message of each satellite is displayed.

The menu comprises the sections "Ephemeris and Clock Correction Parameters", "UTC Parameters", "Ionospheric Parameters" and some "Miscellaneous Parameters", where the corresponding parameters are displayed.

Although the navigation messages are fully configurable, it is recommended to use the almanac's parameter as basis for further configurations (see "[Set To Almanac](#)" on page 48).

For better readability of the parameters in the "Navigation Message Configuration" menu, the corresponding values are input as integer in the same way as they are included in the satellite's navigation message, but the scaled values and the scaling factors are also displayed.



| Ephemeris and Clock Correction Parameters |                          |                                |
|---|--------------------------|--------------------------------|
| <a href="#">&lt;&lt;&lt; Hide Details</a> |                          |                                |
| Code On L2                                | Reserved                 |                                |
| L2 P Data Flag                            | <input type="checkbox"/> |                                |
| Fit Interval Flag                         | <input type="checkbox"/> |                                |
| SV Accuracy / URA Index                   | 0                        |                                |
| SV Health                                 | 0                        |                                |
| IODC                                      | 0                        |                                |
| IODE                                      | 0                        |                                |
| T_GD                                      | 0                        | $\times 2e-31 = 0.000000e+00$  |
| t_OC                                      | 9 728                    | $\times 2e4 = 1.556480e+05$    |
| a_f2                                      | 0                        | $\times 2e-55 = 0.000000e+00$  |
| a_f1                                      | 0                        | $\times 2e-43 = 0.000000e+00$  |
| a_f0                                      | 0                        | $\times 2e-31 = 0.000000e+00$  |
| M_0                                       | -437 939 712             | $\times 2e-31 = -2.039316e-01$ |
| Delta_N                                   | 0                        | $\times 2e-43 = 0.000000e+00$  |
| e   | 0                        | $\times 2e-33 = 0.000000e+00$  |
| SQRT(A)                                   | 2 702 023 424            | $\times 2e-19 = 5.153701e+03$  |
| OMEGA_0                                   | -662 873 856             | $\times 2e-31 = -3.086747e-01$ |
| i_0                                       | 656 176 742              | $\times 2e-31 = 3.055561e-01$  |
| omega                                     | 0                        | $\times 2e-31 = 0.000000e+00$  |
| OMEGA_DOT                                 | 0                        | $\times 2e-43 = 0.000000e+00$  |
| IDOT                                      | 0                        | $\times 2e-43 = 0.000000e+00$  |
| C_uc                                      | 0                        | $\times 2e-29 = 0.000000e+00$  |
| C_us                                      | 0                        | $\times 2e-29 = 0.000000e+00$  |
| C_rc                                      | 0                        | $\times 2e-5 = 0.000000e+00$   |
| C_rs                                      | 0                        | $\times 2e-5 = 0.000000e+00$   |
| C_ic                                      | 0                        | $\times 2e-29 = 0.000000e+00$  |
| C_is                                      | 0                        | $\times 2e-29 = 0.000000e+00$  |
| TOE                                       | 9 728                    | $\times 2e4 = 1.556480e+05$    |
| SF1 Reserved 1                            | 0                        |                                |
| SF1 Reserved 2                            | 0                        |                                |
| SF1 Reserved 3                            | 0                        |                                |
| SF1 Reserved 4                            | 0                        |                                |

| UTC Parameters   |   |
|--|---|
| <input type="button" value="&lt;&lt;&lt; Hide Details"/> |   |
| A_0  | <input type="text" value="0"/> x 2e-30 = 0.000000e+00 |
| A_1  | <input type="text" value="0"/> x 2e-50 = 0.000000e+00 |
| delta t_LS   | <input type="text" value="0"/>                        |
| t_ot   | <input type="text" value="0"/> x 2e12 = 0.000000e+00  |
| WN_t   | <input type="text" value="0"/>                        |
| WN_LSF   | <input type="text" value="0"/>                        |
| DN   | <input type="text" value="0"/>                        |
| Delta t_LSF  | <input type="text" value="0"/>                        |

| Ionospheric Parameters                                   |   |
|--|---|
| <input type="button" value="&lt;&lt;&lt; Hide Details"/> |   |
| alpha_0  | <input type="text" value="0"/> x 2e-30 = 0.000000e+00 |
| alpha_1  | <input type="text" value="0"/> x 2e-27 = 0.000000e+00 |
| alpha_2  | <input type="text" value="0"/> x 2e-24 = 0.000000e+00 |
| alpha_3  | <input type="text" value="0"/> x 2e-24 = 0.000000e+00 |
| beta_0   | <input type="text" value="0"/> x 2e11 = 0.000000e+00  |
| beta_1   | <input type="text" value="0"/> x 2e14 = 0.000000e+00  |
| beta_2   | <input type="text" value="0"/> x 2e16 = 0.000000e+00  |
| beta_3   | <input type="text" value="0"/> x 2e16 = 0.000000e+00  |

| Miscellaneous Parameters  |                                |
|---------------------------|--------------------------------|
| AODO                      | <input type="text" value="0"/> |
| (A-S) Flags and SV Config | <input type="text" value="0"/> |

### Set To Almanac

This button is only enabled for Localization mode "Full Configuration".

The navigation message's parameters will be calculated according to the selected almanac.

Using this option as basis for further reconfigurations is recommended.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:SVID<st>:NMESSAGE:PRESet](#) on page 112

### Ephemeris Parameters

**Note:** The parameters of the Navigation Message are only configurable for instrument equipped with option Assisted GPS (R&S K65) and for Localization mode set to "Full Configuration".

Table 3-1: Ephemeris Parameters

| Parameter               | Description   | SCPI command  |
|-------------------------|---|---|
| Code on L2              | Type of code for L2; This value does not have any impact on the actual used ranging code of the generated satellite.<br><br>The used "Ranging Code" is set in the "Satellite Configuration" menu. <ul style="list-style-type: none"> <li>"Reserved"<br/>Reserved for future use.</li> <li>"P Code ON"<br/>Carrier L2 (f_L2= 1.2276 GHz) is modulated by P-code (BPSK).</li> <li>"C/A Code ON"<br/>Carrier L2 (f_L2= 1.2276 GHz) is modulated by C/A-code (BPSK).</li> </ul> | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:CLTMode on page 105      |
| L2 P Data Flag          | Use of carrier L2 P data flag<br><br>This value does not have an impact on whether really data is transmitted on the satellite's carrier L2 or not.   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:FIFLag on page 108       |
| Fit Interval Flag       | Indicates the curve-fit interval used by the CS (Control Segment) in determining the ephemeris parameters   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:FIFLag on page 108       |
| SV accuracy / URA Index |   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:URA on page 115          |
| SV Health               | This value does not have an impact on the actual health status of the generated satellite.  | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:HEALTh on page 108       |
| IODC                    | Issue of Data, Clock  | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:IODC on page 109         |
| IODE                    | Issue of Data, Ephemeris  | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:IODE on page 109         |
| M_0                     | Mean Anomaly at Reference Time <sup>(1)</sup>   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:MZERo on page 110        |
| Delta_N                 | Mean Motion Difference From Computed Value <sup>(1)</sup>   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:NDELta on page 110       |
| e                       | Eccentricity <sup>(1)</sup>   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:ECCentricity on page 107 |
| SQRT(A)                 | Square Root of the Semi-Major Axis <sup>(1)</sup>   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:SQRa on page 113         |
| OMEGA_0                 | Longitude of Ascending Node of Orbit Plane at Weekly Epoch <sup>(1)</sup>   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:OZERo on page 112        |
| <sup>1)</sup>           | As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".<br><br>The value of these parameters will be updated automatically.   |   |

## Navigation Message Configuration

| Parameter                         | Description   | SCPI command  |
|-----------------------------------|---|---|
| i_0                               | Inclination Angle at Reference Time <sup>(1)</sup>  | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:IZERo on page 109        |
| Omega                             | Argument of Perigee <sup>(1)</sup>  | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:OMEGa on page 111        |
| OMEGA_DOT                         | Rate of Right Ascension <sup>(1)</sup>  | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:ODOT on page 111         |
| IDOT                              | Rate of Inclination Angle <sup>(1)</sup>  | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:IDOT on page 108         |
| C_uc                              | Amplitude of the Cosine Harmonic Correction Term to the Argument of Latitude <sup>(1)</sup>   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:CUC on page 106          |
| C_us                              | Amplitude of the Sine Harmonic Correction Term to the Argument of Latitude <sup>(1)</sup>   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:CUS on page 107          |
| C_rc                              | Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius <sup>(1)</sup>   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:CRc on page 105          |
| C_rs                              | Amplitude of the Sine Harmonic Correction Term to the Orbit Radius <sup>(1)</sup>   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:CRS on page 106          |
| C_ic                              | Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination <sup>(1)</sup>   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:CIC on page 104          |
| C_is                              | Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination <sup>(1)</sup>   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:CIS on page 105          |
| TOE                               | Time Of Ephemeris <sup>(1)</sup>  | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:TOE on page 115          |
| SF1 Reserved 1/2/3/4              |   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:REServed<ch> on page 112 |
|                                   |   |   |
| AODO                              | Age of Data Offset  | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:AODO on page 103         |
| (A-S) Flags and SV Configurations |   | [ :SOURCE<hw> ] :BB:GPS:SVID<st> :NMESsage:SVConfig on page 113     |
| <sup>1)</sup>                     | As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".<br><br>The value of these parameters will be updated automatically. |   |

**Clock Correction Parameters**

**Note:** The parameters of the Navigation Message are only configurable for instrument equipped with option Assisted GPS (R&S K65) and for Localization mode set to "Full Configuration".



**Table 3-2: Clock Correction Parameters**

| Parameter | Description                               | SCPI command  |
|-----------|---|---|
| T_GD      | L1-L2 Correction Term <sup>(1)</sup>      | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:TGD on page 113    |
| t_OC      | Clock Correction Parameter <sup>(1)</sup> | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:TOC on page 114    |
| a_f2      |   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:AFTwo on page 102  |
| a_f1      |   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:AFOne on page 101  |
| a_f0      |   | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:AFZero on page 102 |

<sup>1</sup>: As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".

The value of these parameters will be updated automatically.

### UTC Parameters

**Note:** The parameters of the Navigation Message are only configurable for instrument equipped with option Assisted GPS (R&S K65) and for Localization mode set to "Full Configuration".

| Parameter     | Description                | SCPI Command   |
|---------------|----------------------------|--|
| "A_0"         | Parameter $A_0$            | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:AZERo on page 103 |
| "A_1"         | Parameter $A_1$            | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:AONE on page 103  |
| "delta t_LS"  | Parameter $\Delta t_{LS}$  | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:TLS on page 114   |
| "t_ot"        | Parameter $t_{ot}$         | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:TOT on page 115   |
| "WN_t"        | Parameter $WN_t$           | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:WNT on page 116   |
| "WN_LSF"      | Parameter $WN_{LSF}$       | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:WLSF on page 116  |
| "DN"          | Parameter DN               | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:DN on page 107    |
| "Delta t_LSF" | Parameter $\Delta t_{LSF}$ | [ :SOURce<hw> ] :BB:GPS:SVID<st> :NMESsage:TLSF on page 114  |

### GPS Ionospheric Parameters

**Note:** The parameters of the Navigation Message are only configurable for instrument equipped with option Assisted GPS (R&S SMx/AMU-K65) and for Localization mode set to Full Configuration.

Changing the ionospheric model has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".

| Parameter            | Description  | SCPI Command  |
|----------------------|--|---|
| "alpha_0 .. alpha_3" | Displays the parameter alpha_0 .. alpha_3 of the satellite's navigation message. | [ :SOURCE<hw> ] :BB:GPS : SVID<st> :NMESSAGE : ALPHA<ch0> on page 102 |
| "beta_0 .. beta_3"   | Displays the parameter beta_0 .. beta_3 of the satellite's navigation message.   | [ :SOURCE<hw> ] :BB:GPS : SVID<st> :NMESSAGE : BETA<ch0> on page 104  |

### 3.4 Assistance Data Generation



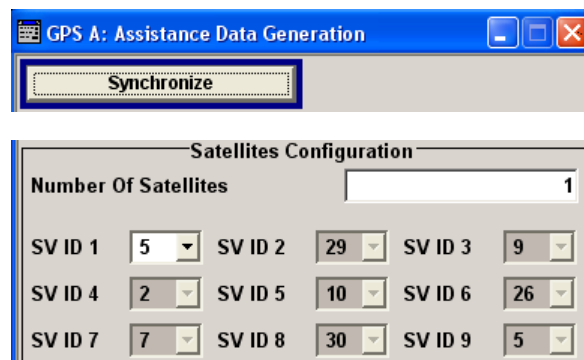
The "Assistance Data Generation" dialog is only available for instrument equipped with option Assisted GPS (R&S SMx/AMU-K65).

To access the "Assistance Data Generation" dialog, select "Main Dialog > Simulation Mode Localization", set the "Localization Mode" to *Full Configuration* and select "Assistance Data Generation".

The "Assistance Data Generation" dialog is used to generate assistance data files for Assisted-GPS testing. These files can be formatted into mobile communication's message formats and passed by the protocol tester to the DUT in order to speed up Time To First Fix (TTFF).

See also [chapter 2.8.7, "Generating Assistance Data"](#), on page 23.

The upper part of the "Assistance Data Generation" menu is where the "Satellites Configuration" is set. A maximum of 9 satellites can be selected at one time for assistance data generation.



The middle part of the menu is where the parameters of the "Reference Location" and "Time Configuration" are set.

The image shows two dialog boxes. The top one is titled "Reference Location Configuration" and contains the following fields: "Position Format" set to "DEG:MIN:SEC", "Altitude" set to "0.9 m", "Latitude" set to "0° 52' 30.639'' North", and "Longitude" set to "0° 52' 30.639'' East". The "Uncertainty Radius" is set to "3 000 m". The bottom dialog box is titled "Assistance Data Generation" and contains five buttons: "Generate Almanac File...", "Generate Ionospheric File...", "Generate Navigation File...", "Generate UTC File...", and "Generate Acquisition File...".

The lower part of the menu offers assistance in the generation of the "Almanac", "Ionospheric", "Navigation", "UTC" and "Acquisition" files.

### Synchronize

Synchronizes the parameters of the satellites configuration and of the reference location configuration blocks as well as the parameter "Time of Assistance Data" with the settings made in the "Satellite Configuration" dialog and in the Main Dialog.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:SYNChronize](#) on page 126

### Number Of Satellites

Sets the number of satellites for which the assistance data will be generate.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:SCOUNT](#) on page 126

### SV ID 1 .. 9

Sets the ID for the corresponding satellite (space vehicle) for which the assistance data will be generate.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:SATELLITE<st>:SVID](#) on page 125

### Position Format (Assistance Data Generation)

Sets the format in which the Latitude and Longitude are displayed.

"DEG:MIN:SE C" The display format is Degree:Minute:Second and Direction, i.e. "XX°XX'XX.XX" Direction, where direction can be North/South and East/West.

"Decimal Degree" The display format is decimal degree, i.e. "+/-XX.XXXXX°", where "+" indicates North and East and "-" indicates South and West

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:PFORmat](#) on page 123

**Altitude (Assistance Data Generation)**

Sets the geographic altitude of the reference location in meters above sea level.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:ALTitude](#) on page 120

**Latitude (Assistance Data Generation)**

Sets the latitude of the reference location.

SCPI command:

for display format Degree:Minute:Second

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LATitude:DEGREes](#)

on page 120

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LATitude:MINutes](#)

on page 121

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LATitude:SECONDS](#)

on page 121

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LATitude:DIRection](#)

on page 121

for display format decimal degree

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LATitude](#) on page 120

**Longitude (Assistance Data Generation)**

Sets the longitude of the reference location.

SCPI command:

for display format Degree:Minute:Second

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LONGitude:DEGREes](#)

on page 122

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LONGitude:MINutes](#)

on page 122

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LONGitude:SECONDS](#)

on page 122

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LONGitude:DIRection](#)

on page 122

for display format decimal degree

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:LATitude](#) on page 120

**Uncertainty Radius**

Sets the Uncertainty Radius, i.e. sets the maximum radius of the area within which the two dimensional location of the UE is bounded.

The uncertainty radius determines the required sensitivity of the DUT.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:LOCATION:URADius](#) on page 123

**Time of Assistance Data**

Sets the starting time and date of the assistance data as GPS TOW (Time of Week).

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:ADGeneration:TIME](#) on page 126

**Duration of Assistance Data**

Sets the duration (in seconds) of the GPS Assistance Data.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:ADGeneration:DURation](#) on page 119

**Resolution of Assistance Data**

Sets the resolution (in seconds) of the GPS Assistance Data.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:ADGeneration:RESolution](#) on page 124

**Generate Almanac File ...**

Opens the "Generate Almanac File" window for saving the generated Almanac File.

The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The almanac file is generated either in a GPS standard almanac file `.rs_al` format (see table below) or as standard Yuma formatted file `.rs_yuma` and can be therefore used as the main almanac source for GPS.

| Parameter | Unit             |
|-----------|------------------|
| SatID     | -                |
| e         | dimensionless    |
| toa       | sec              |
| delta_i   | semi-circles     |
| OMEGADOT  | semi-circles/sec |
| SV Health | boolean          |
| SQRT(A)   | meters           |
| OMEGA0    | semi-circles     |
| M0        | semi-circles     |
| w         | semi-circles     |
| af0       | seconds          |
| af1       | sec/sec          |

The generated almanac file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0 and 3GPP TS 51.010-1v.7.7.0.

The file lists all possible satellites, available from the source [Select Almanac File](#).

See [chapter 2.8.7, "Generating Assistance Data"](#), on page 23 for description of the workflow for generation of assistance data.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:ADGeneration:ALManac:CREate](#) on page 119

**Generate Ionospheric File ...**

(enabled with option Assisted GPS (R&S-K65) only)

Opens the "Select Ionospheric File" window for saving the generated ionospheric model. The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The generated ionospheric file is file with extension `.rs_ion`.

The parameters listed in this file (see table below) are according to the parameters used for describing the near satellite ionospheric model "Klobuchar".

| Parameter | Unit                            |
|-----------|---------------------------------|
| SatID     | -                               |
| alpha_0   | seconds                         |
| alpha_1   | sec/semi-circles                |
| alpha_2   | sec/(semi-circles) <sup>2</sup> |
| alpha_3   | sec/(semi-circles) <sup>3</sup> |
| beta_0    | seconds                         |
| beta_1    | sec/semi-circles                |
| beta_2    | sec/(semi-circles) <sup>2</sup> |
| beta_3    | sec/(semi-circles) <sup>3</sup> |

The generated ionospheric file contains one row per satellite (maximum 9) that was assigned in the "Assistance Data Generation" menu.

See [chapter 2.8.7, "Generating Assistance Data"](#), on page 23 for description of the workflow for generation of assistance data.

SCPI command:

`[ :SOURCE<hw> ] :BB:GPS:ADGeneration:IONospheric:CREate` on page 119

#### Generate Navigation File ...

(enabled with option Assisted GPS (R&S-K65) only)

Opens the "Select Navigation File" window for saving the generated navigation model (ephemeris).

The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The generated navigation file is a file with extension `.rs_nav`.

The generated navigation file comprises the GPS standard ephemeris parameters of the Navigation Model (see table below).

| Parameter      | Unit    |
|----------------|---------|
| SatID          | -       |
| Sat Status     | -       |
| C/A or P on L2 | boolean |
| URA Index      | boolean |

| Parameter         | Unit                  |
|-------------------|-----------------------|
| SV Health         | boolean               |
| IODC              | -                     |
| L2 P Data Flag    | boolean               |
| SF 1 Reserved     | -                     |
| $T_{GD}$          | sec                   |
| $t_{oc}$          | sec                   |
| af2               | sec/sec <sup>2</sup>  |
| af1               | sec/sec               |
| af0               | sec                   |
| $C_{rs}$          | meters                |
| delta_n           | semi-circles/sec      |
| $M_0$             | semi-circles          |
| $C_{UC}$          | radians               |
| e                 | -                     |
| $C_{US}$          | radians               |
| $(A)^{1/2}$       | meters <sup>1/2</sup> |
| $T_{oe}$          | sec                   |
| Fit Interval Flag | boolean               |
| AODO              | sec                   |
| $C_{IS}$          | radians               |
| $l_0$             | semi-circles          |
| $C_{rc}$          | meters                |
| omega             | semi-circles          |
| OMEGAdot          | semi-circles/sec      |
| ldot              | semi-circles/sec      |

The generated navigation file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0 and 3GPP TS 51.010-1v.7.7.0.

The file contains one row per satellite (maximum 9) that was assigned in the "Assistance Data Generation" menu.

See section [chapter 2.8.7, "Generating Assistance Data"](#), on page 23 for description of the workflow for generation of assistance data.

SCPI command:

`[ :SOURCE<hw> ] :BB:GPS:ADGeneration:NAVigation:CREate` on page 123

**Generate UTC File ...**

(enabled with option Assisted GPS (R&S-K65) only)

Opens the "Select UTC" File window for saving the generated UTC file.

The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The generated UTC file is a file with extension `.rs_utc`.

The file contains all standard UTC parameters (`SatID`, `A_0`, `A_1`, `delta_t_LS`, `t_ot`, `WN_t`, `WN_LSF`, `DN`, and `Delta_t_LSF`) that are necessary to transform GPS time to the normal UTC time.

The generated UTC file contains one row per satellite (maximum 9) that was assigned in the "Assistance Data Generation" menu.

See [chapter 2.8.7, "Generating Assistance Data"](#), on page 23 for description of the workflow for generation of assistance data.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:ADGeneration:UTC:CREate` on page 126

**Generate Acquisition File ...**

(enabled with option Assisted GPS (R&S-K65) only)

Opens the "Select Acquisition File" window for saving the generated acquisition file.

The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The generated Acquisition file is a file with extension `.rs_acq`.

This file consists of one or more rows, each corresponding to the Receiver Referenced GPS Time of Week (GPS TOW). The number of generated rows depends on the settings made for in the "Assistance Data Generation" dialog and is calculated as follow:

Number Of Generated Rows = "Duration Of Assistance Data" / "Resolution of Assistance Data"

Each row includes several sequential Acquisition Blocks; each block comprises the parameters listed in table below.

The number of the acquisition blocks depends on the "Number Of Satellites" (maximum 9) that was assigned in the "Assistance Data Generation" menu.

The generated navigation file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0 and 3GPP TS 51.010-1v.7.7.0.

| Parameter                            | Unit   |
|--------------------------------------|--------|
| SatID                                | -      |
| Doppler (0 <sup>th</sup> order term) | Hz     |
| Doppler (1 <sup>st</sup> order term) | Hz/sec |
| Doppler Uncertainty                  | Hz     |
| Code Phase                           | chips  |
| Integer Code Phase                   | -      |
| GPS Bit Number                       | -      |



| Parameter                | Unit  |
|--------------------------|-------|
| Code Phase Search Window | chips |
| Azimuth                  | deg   |
| Elevation                | deg   |

See [chapter 2.8.7, "Generating Assistance Data"](#), on page 23 for description of the workflow for generation of assistance data.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:ADGeneration:ACQuisition:CREate` on page 118

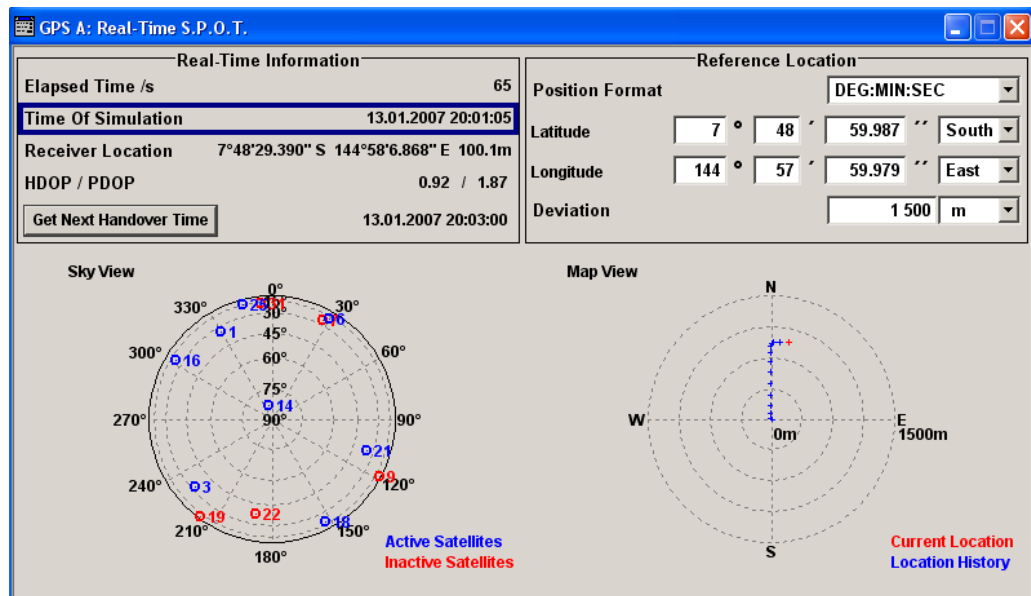
### 3.5 Real-Time S.P.O.T.



The "Real-Time S.P.O.T." display is available for R&S SMx/AMU instrument only.

The "Real-Time S.P.O.T." (Satellites and Position Online Tracker) view is a dynamic display of the current satellite's constellation and receiver position.

The display is enabled for "Auto SV Selection" and "Auto SV Selection and Update" modes only.

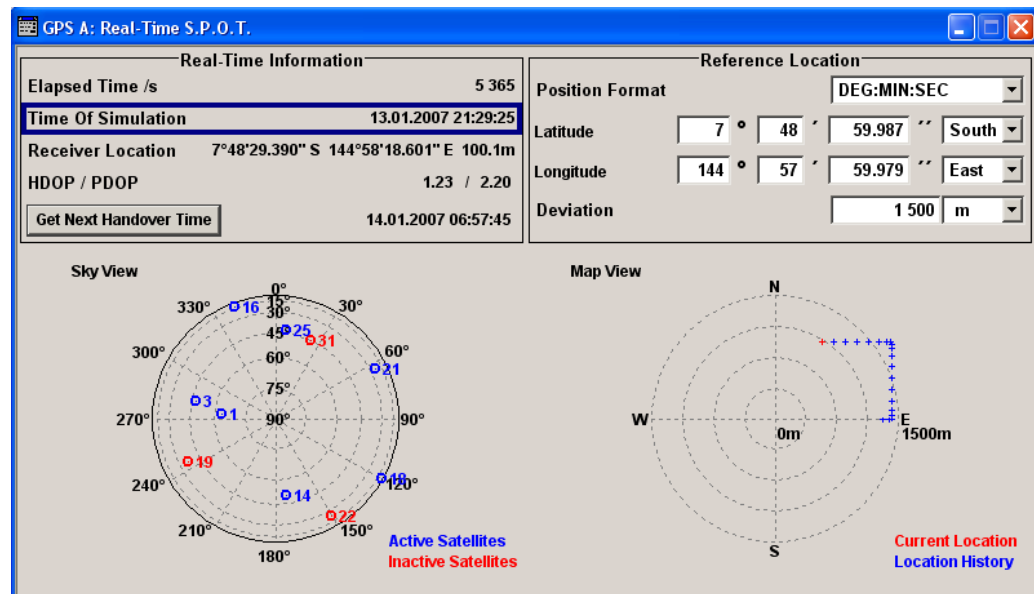


The "Real-Time S.P.O.T." view provides dynamic information about several parameters like HDOP, PDOP, receiver's location, elapsed time and trajectory of moving receiver, as well as the currently used satellite's constellation.

The "Sky View" section displays the current position and state (active or inactive) of the satellites. When "Auto SV Selection and Update" mode is selected, the real-world situation of disappearance and re-appearance of satellites can be observed.

The "Real-Time S.P.O.T." display is updated every 5 second and a special dynamic time tuning algorithm is used to optimize the presentation of the "Map View" display. However, if GPS receiver software is used to analyze the generated GPS signal, a slight difference between the receiver position displayed on the Map View and the position displayed on the receiver software may be noticed at the beginning of a simulation. This accuracy of the "Map View" display is progressively increasing with the time elapsed and after the first satellite handover the deviation should completely disappear.

### Example:



Both figures in this section show the "Real-Time S.P.O.T." display of the same custom build GPS scenario with satellite handover but the second one is made around an hour and a half later (compare the values of the parameters "Time of Simulation" and "Elapsed Time" in both figures).

The "Map View" shows the current position of the receiver which in this particular case is a moving receiver with "Read Out Mode" set to "Round Trip" (compare both trajectories, the receiver on the first one is moving clockwise and on the second one counterclockwise).

The current position and state of the satellites is displayed on the "Sky View". This is a GPS scenario with 8 satellites and a satellite handover had been performed (compare the satellite constellations, the position and number of active and inactive satellites is different; satellites with SV ID 6, 1 and 9 had disappeared behind the horizon).

### 3.5.1 Real-Time Information

The "Real-Time Information" section provides dynamic real-time information about several parameters like "HDOP", "PDOP", "Receiver Location", "Elapsed Time" and "Time of Simulation".

#### Elapsed Time

Displays the time elapsed from the beginning of the simulation.

The value is displayed in second and is updated every 5 sec.

SCPI command:

n . a .

#### Time Of Simulation

Displays the current time of the simulation.

The current time is calculated from the selected "GPS Mean Time" and the "Elapsed Time".

The value is displayed in format HH:MM:SS and is updated every 5 sec.

SCPI command:

n . a .

#### Receiver Location

Displays the current location of the receiver .

For static [Geographic Location](#), the "Receiver Location" is as selected in the Localization Data section of the main menu.

For moving receivers however, the receiver position specified in the "Localization Data" section of the main menu is the initial location of the receiver. The current receiver location is retrieved from the waypoints file as function of the [Elapsed Time](#). The value is displayed in the "Real-Time S.P.O.T." display.

| Real-Time Information  |                             |
|------------------------|-----------------------------|
| Elapsed Time /s        | 1 360                       |
| Time Of Simulation     | 13.01.2007 20:22:40         |
| Receiver Location      | -7.816657 144.966624 100.0m |
| HDOP / PDOP            | 0.98 / 1.84                 |
| Get Next Handover Time | 13.01.2007 22:37:30         |

The display format depends on the [Position Format \(S.P.O.T.\)](#) selected for the Reference Location.

| Real-Time Information         |  |
|-------------------------------|--|
| Elapsed Time /s               | 1 375                                  |
| Time Of Simulation            | 13.01.2007 20:22:55                    |
| Receiver Location             | 7°48'54.842" S 144°57'59.360" E 100.0m |
| HDOP / PDOP                   | 0.98 / 1.84                            |
| <b>Get Next Handover Time</b> | 13.01.2007 22:37:30                    |

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:ALTITUDE](#) on page 127  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LATITUDE](#) on page 128  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LONGITUDE](#) on page 130  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LATITUDE:DEGREES](#) on page 128  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LATITUDE:MINUTES](#) on page 129  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LATITUDE:SECONDS](#) on page 129  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LATITUDE:DIIRECTION](#) on page 129  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LONGITUDE:DEGREES](#) on page 130  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LONGITUDE:MINUTES](#) on page 131  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LONGITUDE:SECONDS](#) on page 131  
[\[:SOURCE<hw>\]:BB:GPS:RLOCATION:LONGITUDE:DIIRECTION](#) on page 130

#### HDOP / PDOP

Displays the current HDOP and PDOP value of the selected satellite constellation.

The HDOP (Horizontal Dilution of Precision) can be used as an indication of 2D positioning quality.

The PDOP (Position Dilution of Precision) can be used as an indication of 3D positioning quality.

The general rule here is that the smaller the HDOP and PDOP are, the better the precision of the position fix will be.

SCPI command:

n.a.

#### Get Next Handover Time

(enabled for "Auto SV Selection and Updated" mode)

Displays the expected time of the upcoming satellites handover.

The time is expressed as a time offset (in seconds) to the beginning of the simulation set with the parameter [GPS Mean Time](#).

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:SPOT:NHOTIME](#) on page 127

### 3.5.2 Reference Location

In the "Reference Location" section the reference location can be configured.

#### Position Format (S.P.O.T.)

Sets the format in which the Latitude and Longitude are displayed.

The Position Format selected here changes the format the [Receiver Location](#) is displayed.

"DEG:MIN:SE C" The display format is Degree:Minute:Second and Direction, i.e. XX°XX'XX.XX" Direction, where Direction can be North/South and East/West.

"Decimal Degree" The display format is decimal degree, i.e. +/-XX.XXXXX°, where "+" indicates North and East and "-" indicates South and West.

SCPI command:  
n.a.

#### Latitude (S.P.O.T.)

Sets the latitude of the receiver location.

For static receivers, the initial value is automatically set to the latitude of the [Geographic Location](#) selected in the Localization Data section of the main menu.

When simulating moving receivers, the initial value is derived from the waypoints file and set to the latitude of the first receiver position.

SCPI command:  
n.a.

#### Longitude (S.P.O.T.)

Sets the longitude of the receiver location.

For static receivers, the initial value is automatically set to the longitude of the [Geographic Location](#) selected in the Localization Data section of the main menu.

When simulating moving receivers, the initial value is derived from the waypoints file and set to the longitude of the first receiver position.

SCPI command:  
n.a.

#### Deviation

Sets the deviation in terms of meters from the Reference Location and determines the radius of the "Map View" display.

SCPI command:  
n.a.

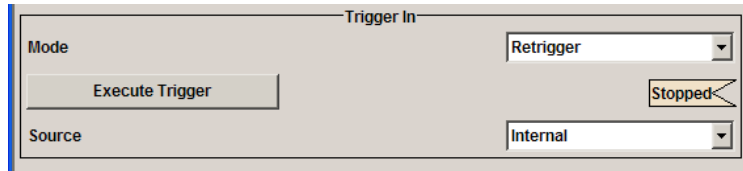
## 3.6 Trigger/Marker/Clock Settings



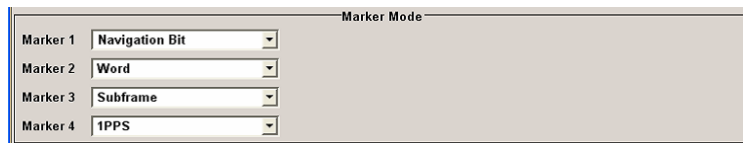
The trigger, clock, and marker delay functions are available for R&S SMx and R&S AMU instruments only.

To access this dialog, select "Main Menu > Trigger/Marker".

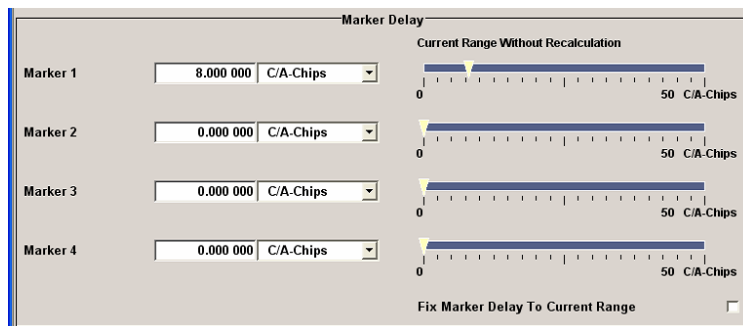
The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



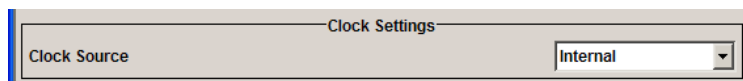
The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.



The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.



The "Clock Settings" section is where the clock source is selected and - in the case of an external source - the clock type.



The buttons in the last section lead to submenu for general trigger, clock and mapping settings.



### 3.6.1 Trigger In



The trigger functions are available for R&S SMx and R&S AMU instruments only.

The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.

#### Trigger Mode

Selects trigger mode.

The trigger mode determines the effect of a trigger on the signal generation.

|                   |  |
|-------------------|--|
| "Auto"            | The signal is generated continuously.<br>This trigger mode is not allowed, if parameter "Use Baseband A+B" is enabled.   |
| "Retrigger"       | The signal is generated continuously. A trigger event (internal or external) causes a restart.<br>This trigger mode is not allowed, if parameter "Use Baseband A+B" is enabled.  |
| "Armed_Auto"      | The signal is generated only when a trigger event occurs. Then the signal is generated continuously.<br>Button "Arm" stops signal generation. A subsequent trigger event (internal with "Execute Trigger" or external) causes a restart.   |
| "Armed_Retrigger" | The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.<br>Button "Arm" stops signal generation. A subsequent trigger event (internal with "Execute Trigger" or external) causes a restart.                                    |
| "Single"          | The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration".<br>Every subsequent trigger event (internal with "Execute Trigger" or external) causes a restart.<br>This trigger mode is not allowed, if parameter "Use Baseband A+B" is enabled. |

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS\[:TRIGger\]:SEQUence](#) on page 137

#### Signal Duration Unit

Defines the unit for the entry of the length of the signal sequence to be output in the "Single" trigger mode.

SCPI command:

[\[:SOURCE<hw>\]:BB:GPS:TRIGger:SLUNit](#) on page 135

**Signal Duration**

Defines the length of the signal sequence to be output in the "Single" trigger mode.

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:SLENgth](#) on page 135

**Running/Stopped**

Displays the status of signal generation for all trigger modes. This display appears only when signal generation is enabled ("State" On).

|           |  |
|-----------|--|
| "Running" | The modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode.<br>If "Armed_Auto" and "Armed_Retrigger" have been selected, generation of signals can be stopped with the "Arm" button. A new trigger (internally with "Execute Trigger" or externally) causes a restart. |
| "Stopped" | The signal is not generated, and the instrument waits for a trigger event (internal or external).  |

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:RMODe](#) on page 134

**Arm**

Stops signal generation. This button appears only with "Running" signal generation in the "Armed\_Auto" and "Armed\_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:ARM:EXECute](#) on page 132

**Execute Trigger**

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:EXECute](#) on page 132

**Trigger Source**

Selects trigger source. This setting is effective only when a trigger mode other than "Auto" has been selected.

|                                  |   |
|----------------------------------|---|
| "Internal"                       | The trigger event is executed by "Execute Trigger".   |
| "Internal<br>(Baseband A/<br>B)" | (two-path instruments only)<br>The trigger event is executed by the trigger signal from the second path |



"External (TRIGGER 1 / 2)" The trigger event is executed with the aid of the active edge of an external trigger signal.  
The trigger signal is supplied via the TRIGGER connector.  
The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the "Global Trigger/Clock Settings" dialog.

SCPI command:

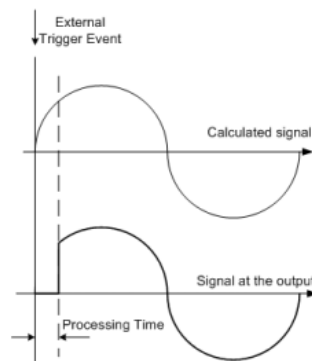
`[ :SOURce<hw> ] :BB:GPS:TRIGger:SOURce` on page 135

### Sync. Output to External Trigger

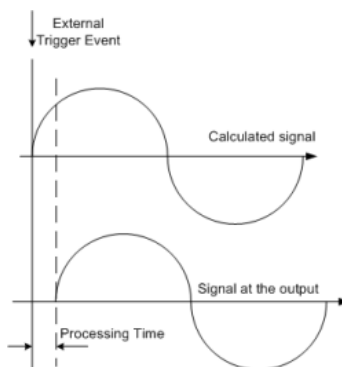
(enabled for Trigger Source External)

Enables/disables output of the signal synchronous to the external trigger event.

"On" Corresponds to the default state of this parameter.  
The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



"Off" The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted.  
This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.



SCPI command:

`[ :SOURce<hw> ] :BB:GPS:TRIGger:EXTernal:SYNChronize:OUTPut` on page 133

**Trigger Delay**

Sets the trigger signal delay in samples on external triggering or on internal triggering via the second path.

Sets the trigger signal delay in samples on external triggering.

This enables the R&S Signal Generator to be synchronized with the device under test or other external devices.

For two-path instruments, the delay can be set separately for each of the two paths.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger\[:EXTernal<ch>\]:DELay](#) on page 136

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OBASeband:DELay](#) on page 133

**Trigger Inhibit**

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in samples.

In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of samples.

This parameter is only available on external triggering or on internal triggering via the second path.

For two-path instruments, the trigger inhibit can be set separately for each of the two paths.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger\[:EXTernal<ch>\]:INHibit](#) on page 136

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OBASeband:INHibit](#) on page 134

**3.6.2 Marker Mode**

The marker output signal for synchronizing external instruments is configured in the marker settings section "Marker Mode".

**Marker Mode**

Selects a marker signal for the associated "MARKER" output.

The marker signal is always related to the first active satellite.

- |                  |  |
|------------------|--|
| "Navigation Bit" | A marker signal is generated for every navigation data bit (20460 C/A chips)   |
| "Word"           | A marker signal is generated for every navigation data word (30 navigation bits).  |
| "Subframe"       | A marker signal is generated for every navigation subframe (corresponds to 10 words).  |
| "1PPS"           | A marker signal is generated for every start of second (GPS time). The "Pulse Width" is set in the corresponding field. The input is expressed as a number of chips.<br>While generating an offline GPS signal with R&S WinIQSIM2, this marker signal is only enabled, if the "Doppler Shift" is set to 0. |

"1PP2S" A marker signal is generated for every second start of second (GPS time).  
The "Pulse Width" is set in the corresponding field. The input is expressed as a number of chips.  
While generating an offline GPS signal with R&S WinIQSIM2, this marker signal is only enabled, if the "Doppler Shift" is set to 0.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:PULSe:WIDTh](#) on page 142

"Pulse" A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the chip rate (1.023 MHz) by the divider. The input box for the divider opens when "Pulse" is selected, and the resulting pulse frequency is displayed.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:PULSe:DIVider](#) on page 141

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:PULSe:FREQuency](#)

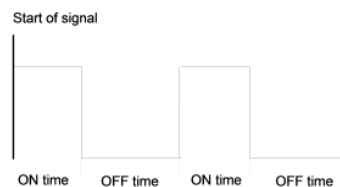
on page 141

"Pattern" A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when pattern is selected.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:PATTern](#) on page 141

"ON/OFF Period" A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.  
The "ON Time" and "OFF Time" are each expressed as a number of samples and are set in an input field which opens when ON/OFF ratio is selected.



SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:ONTime](#) on page 140

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:OFFTime](#) on page 140

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:MODE](#) on page 139

### 3.6.3 Marker Delay

The delay of the signals on the MARKER outputs is set in the "Marker Delay" section.



The marker delay functions are available for R&S SMx and R&S AMU instruments only.

**Marker x Delay**

Enters the delay between the marker signal at the marker outputs and the start of the frame or slot.

The input is expressed as a number of symbols/samples. If the setting "Fix marker delay to dynamic range" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals can be set without restarting the marker and signal.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:DELay](#) on page 138

**Current Range without Recalculation**

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:DELay:MINimum](#) on page 139

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut<ch>:DELay:MAXimum](#) on page 139

**Fix marker delay to current range**

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:TRIGger:OUTPut:DELay:FIXed](#) on page 138

### 3.6.4 Clock Settings

The Clock Settings is used to set the clock source and a delay if required.



The clock functions are available for R&S SMx and R&S AMU instruments only.

**Clock Source**

Selects the clock source.

- |            |   |
|------------|---|
| "Internal" | The internal clock reference is used to generate the symbol clock.  |
| "External" | The external clock reference is fed in as the symbol clock or multiple thereof via the CLOCK connector.<br>The symbol rate must be correctly set to an accuracy of +/-2 % (see data sheet).<br>The polarity of the clock input can be changed with the aid of "Global Trigger/Clock Settings".<br>In the case of two-path instruments this selection applies to path A. |

SCPI command:

[\[:SOURce<hw>\]:BB:GPS:CLOCK:SOURce](#) on page 143

**Clock Mode**

Enters the type of externally supplied clock.

- "Chip" A chip clock is supplied via the CLOCK connector.
- "Multiple" A multiple of the chip clock is supplied via the CLOCK connector; the chip clock is derived internally from this. The "Multiplier" window provided allows the multiplication factor to be entered.

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:CLOCK:MODE` on page 142

#### **Clock Multiplier**

Enters the multiplication factor for clock type "Multiple".

SCPI command:

`[ :SOURce<hw> ] :BB:GPS:CLOCK:MULTIPLIER` on page 143

#### **Measured External Clock**

Indicates the measured frequency of the external clock signal. This enables the user to permanently monitor the frequency of the externally introduced clock.

This information is displayed only if the external clock source has been selected.

SCPI command:

`CLOCK:INP:FREQ?`

### **3.6.5 Global Settings**

The buttons in this section lead to submenu for general trigger, clock and mapping settings.

This settings are available for R&S SMx and R&S AMU instruments only.

#### **Global Trigger/Clock Settings**

Calls the "Global Trigger/Clock/Input Settings" dialog.

This dialog is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

In the case of two-path instruments, these settings are valid for both paths.

The parameters in this menu affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the Operating Manual.

#### **User Marker / AUX I/O Settings**

Calls the "User Marker AUX I/O Settings" menu, used to map the connector on the rear of the instruments.

See also "User Marker / AUX I/O Settings" in the Operating Manual.

## 4 Remote-Control Commands

The `SOURce:BB:GPS` subsystem contains commands for the primary and general settings of the GPS standard. These settings concern activation and deactivation of the standard, setting the filter, clock, trigger and clipping settings and the sequence length, as well as the preset setting.

The `SOURce:BB:GPS:SATellite` and `SOURce:BB:GPS:NAVigation` systems contain commands for setting the characteristics of the satellite signals.

### `SOURce<hw>`

For one-path instruments, the keyword `SOURce` is optional and can be omitted.

The numeric suffix to `SOURce` distinguishes between signal generation for path A and path B in the case of two-path instruments:

- `SOURce[1]` = path A  
The keyword `SOURce` is optional and can be omitted
- `SOURce2` = path B  
The keyword `SOURce` is mandatory, i.e. the command must contain the keyword with suffix 2.

### `OUTPut<ch>`

The numeric suffix to `OUTPut` distinguishes between the available markers.

## 4.1 Primary Settings

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---

**`[:SOURce<hw>]:BB:GPS:ATSCenario` <Atscenario>**

Selects the file with the predefined A-GPS test scenario.

**Parameters:**

&lt;Atscenario&gt;

USER | GSMSIG | GSMPER1 | GSMPER2 | GSMPER3 |  
 W3GSIG | W3GPER1 | W3GPER2 | W3GPER3 | W3G2S |  
 W3G2M

**User**

No predefined test scenario is selected.

**GSMSIG**

Predefined A-GPS GSM Signalling Scenario  
 (3GPP TS 51.010-1 v.7.7.0)

**GSMPER1**

Predefined A-GPS GSM Performance Test Scenario 1  
 (3GPP TS 51.010-1 v.7.7.0)

**GSMPER2**

Predefined A-GPS GSM Performance Test Scenario 2  
 (3GPP TS 51.010-1 v.7.7.0)

**GSMPER3**

Predefined A-GPS 3GPP FDD Performance Test Scenario 3  
 (3GPP TS 51.010-1 v.7.7.0)

**W3GSIG**

Predefined A-GPS 3GPP FDD Signalling Scenario  
 (3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0)

**W3GPER1**

Predefined A-GPS 3GPP FDD Performance Test Scenario 1  
 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

**W3GPER2**

Predefined A-GPS 3GPP FDD Performance Test Scenario 2  
 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

**W3GPER3**

Predefined A-GPS 3GPP FDD Performance Test Scenario 3  
 (3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

**W3G2S**

Predefined A-GPS 3GPP2 Static Test Scenario  
 (3GPP2 C.S0036-0 V1.0)

**W3G2M**

Predefined A-GPS 3GPP2 MovingTest Scenario  
 (3GPP2 C.S0036-0 V1.0)

\*RST: USER

**Example:**

BB:GPS:ATSC W3GPER2

selects the predefined A-GPS test scenario 3GPP FDD Performance Test Scenario 2

**Options:**

R&S SMx/AMU-K65

---

**[:SOURce<hw>]:BB:GPS:DURation <Duration>**

(For R&S WinIQSIM2 only)



Determines the duration of the satellite simulation.

The resulting duration of the simulation is calculated as follow:

Duration of Simulation = [Duration of Satellite Simulation / (1±Doppler Shift/ $F_{L1 \text{ or } L2}$ )

where  $F_{L1 \text{ or } L2}$  is the frequency selected with the command `BB:GPS:RFB`.

The maximum duration depends on the Oversampling factor (`BB:GPS:FILT:OSAM`) and the ARB memory size of the connected instrument.

**Parameters:**

<Duration> float  
 Range: 20ms to 132s  
 Increment: 20ms  
 \*RST: 20ms

**Example:** `BB:GPS:DUR 1.2s`  
 selects a duration of 1,2 sec.

**[ :SOURce<hw> ]:BB:GPS:BA B[:STATe] <State>**

**Note:** This parameter is available only in path A of two path instruments.

Enables/disables control of both paths via the GPS menu of path A.

If this parameter is enabled, a total number of eight satellites can be configured.

**Note:** Configuration of eight satellites is only possible for two path instruments.

**Parameters:**

<State> 0 | 1 | OFF | ON  
 \*RST: OFF

**Example:** `BB:GPS:BA B:STAT ON`  
 Enables control of both paths via the GPS menu of path A. 8 Satellites can be configured.

**[ :SOURce<hw> ]:BB:GPS:LMODE <Lmode>**

(R&S SMx/AMU instruments only)

Sets the localization mode.

**Parameters:**

&lt;Lmode&gt;

AUTO | AUPDate | FULL

**AUTO**

Eight satellites will be selected depending on the selected almanac.

The ephemerides are read out of the almanac and displayed in the Navigation Message Configuration menu.

**Note:** The ephemerides are not automatically updated. There should be less than two hours between the simulation and the TOA (Time of Almanac).

**AUPDate**

A new satellite will be selected as soon as the elevation of a satellite is less than the selected "Satellite Elevation Mask" or a new satellite constellation with better PDOP is found.

The ephemeris data of all satellites are updated automatically.

In case the start time of the simulation differs to the TOA (Time of Almanac), the TOE (Time of Ephemeris) will be automatically updated.

**FULL**

All parameter of the navigation message are enabled for configuration.

**Note:** Full Configuration is only available for instruments equipped with option Assisted GPS (R&S-K65).

This mode is used for A-GPS simulation.

\*RST:        AUTO

**Example:**

```
BB:GPS:LMD FULL
```

sets the localization mode to full configuration.

```
[:SOURce<hw>]:BB:GPS:LOCation <Location>
```

(R&S SMx/AMU instruments only)

Sets the geographic location of the GPS receiver.

The string is not case sensitive.

**Parameters:**

&lt;Location&gt;

string

\*RST:        User Defined

**Example:**

```
BB:GPS:LOC "Munich"
```

sets the geographic location to Munich.

```
[:SOURce<hw>]:BB:GPS:LOCation:ALTitude <Altitude>
```

(R&S SMx/AMU instruments only)

Sets the geographic altitude.

This parameter is configurable only for user defined geographic locations. If a value other than "User Defined" is set for the "Geographic Location", the parameter "Altitude" is read only.

**Parameters:**

<Altitude> float  
 Range: -10000.0 to 10000.0  
 Increment: 0.1m  
 \*RST: 0.0

**Example:**

BB:GPS:LOC ALT 500  
 sets the geographic altitude to 500 m.

**[ :SOURCE<hw> ]:BB:GPS:LOCATION:LATITUDE <Latitude>**

(R&S SMx/AMU instruments only)

Sets the latitude of the geographic location expressed as decimal degree. The value will be automatically converted into DEG:MIN:SEC format.

**Parameters:**

<Latitude> float  
 Range: -90.0 to 90.0  
 Increment: 0.000001  
 \*RST: 0.0

**Example:**

BB:GPS:LOC:LAT 12.12505  
 sets the latitude to 12.12505

**[ :SOURCE<hw> ]:BB:GPS:LOCATION:LATITUDE:DEGREES <Degrees>**

(R&S SMx/AMU instruments only)

Sets the latitude of the geographic location in ° (degrees).

**Parameters:**

<Degrees> float  
 Range: 0.0 to 90.0  
 \*RST: 0.0

**Example:**

BB:GPS:LOC:LAT:DEGR 48  
 sets the latitude of the geographic location to 48° (degrees).

**[ :SOURCE<hw> ]:BB:GPS:LOCATION:LATITUDE:DIRection <Direction>**

(R&S SMx/AMU instruments only)

Sets the direction of the geographic location related to the latitude.

**Parameters:**

<Direction> NORTH | SOUTH  
 \*RST: NORTH

**Example:** `BB:GPS:LOC:LAT:DIR NORT`  
sets the direction of the geographic location to NORTH.

**[:SOURCE<hw>]:BB:GPS:LOCATION:LATITUDE:MINUTES <Minutes>**

(R&S SMx/AMU instruments only)

Sets the latitude of the geographic location in ' (minutes).

**Parameters:**

<Minutes> float  
Range: 0.0 to 59.0  
\*RST: 0.0

**Example:** `BB:GPS:LOC:LAT:MIN 9`  
sets the latitude of the geographic location to 9'.

**[:SOURCE<hw>]:BB:GPS:LOCATION:LATITUDE:SECONDS <Seconds>**

(R&S SMx/AMU instruments only)

Sets the latitude of the geographic location in " (seconds).

**Parameters:**

<Seconds> float  
Range: 0.0 to 59.0  
\*RST: 0.0

**Example:** `BB:GPS:LOC:LAT:SEC 0`  
sets the latitude of the geographic location to 0".

**[:SOURCE<hw>]:BB:GPS:LOCATION:LONGITUDE <Longitude>**

(R&S SMx/AMU instruments only)

Sets the longitude of the geographic location expressed as decimal degree. The value will be automatically converted into DEG:MIN:SEC format.

**Parameters:**

<Longitude> float  
Range: -180.0 to 180.0  
Increment: 0.000001  
\*RST: 0.0

**Example:** `BB:GPS:LOC:LONG -18.05`  
sets the longitude to -18.05

**[:SOURCE<hw>]:BB:GPS:LOCATION:LONGITUDE:DEGREES <Degrees>**

(R&S SMx/AMU instruments only)

Sets the longitude of the geographic location in ° (degrees).

**Parameters:**

<Degrees> float  
 Range: 0.0 to 180.0  
 \*RST: 0.0

**Example:**

BB:GPS:LOC:LONG:DEGR 11  
 sets the longitude of the geographic location to 11° (degrees).

**[ :SOURce<hw> ]:BB:GPS:LOCation:LONGitude:DIRection <Direction>**

(R&S SMx/AMU instruments only)

Sets the direction of the geographic location related to the longitude.

**Parameters:**

<Direction> EAST | WEST  
 \*RST: EAST

**Example:**

BB:GPS:LOC:LONG:DIR EAST  
 sets the direction of the geographic location to EAST.

**[ :SOURce<hw> ]:BB:GPS:LOCation:LONGitude:MINutes <Minutes>**

(R&S SMx/AMU instruments only)

Sets the longitude of the geographic location in ' (minutes).

**Parameters:**

<Minutes> float  
 Range: 0.0 to 59.0  
 \*RST: 0.0

**Example:**

BB:GPS:LOC:LONG:MIN 35  
 sets the longitude of the geographic location to 35'.

**[ :SOURce<hw> ]:BB:GPS:LOCation:LONGitude:SEConds <Seconds>**

(R&S SMx/AMU instruments only)

Sets the longitude of the geographic location in " (seconds).

**Parameters:**

<Seconds> float  
 Range: 0.0 to 59.999  
 \*RST: 0.0

**Example:**

BB:GPS:LOC:LAT:SEC 0  
 sets the latitude of the geographic location to 0".

**[ :SOURce<hw> ]:BB:GPS:LOCation:PFORmat <Pformat>**

(R&S SMx/AMU instruments only)

Sets the format in which the Latitude and Longitude are displayed. According to this parameter, the position can be specified in "DEG:MIN:SEC" or in "Decimal Degree" format.

**Parameters:**

<Pformat> DMS | DECimal

**DMS**

The position is specified in DEG:MIN:SEC.

**DECimal**

The position is specified in decimal degree, i.e. +/-XX.XXXXX°, where "+" indicates North and East and "-" indicates South and West.

**Example:**

```
BB:GPS:LOC:PFOR DMS
position is specified in format DEG:MIN:SEC
```

**[:SOURCE<hw>]:BB:GPS:LOCATION:ROMode <Romode>**

(R&S SMx/AMU instruments only)

Defines the way the waypoint file is to be read.

**Parameters:**

<Romode> CYCLic | RTRip | OWAY

**CYCLic**

The waypoint file is read out cyclic.

Using this read out mode is recommended only for waypoint files that describe a circle moving scenario or moving scenario in which the start and the end point are close to each other.

**OWAY**

The file is read out only once.

By reaching the end of the file, the last described position is assumed to be a static one.

**RTRip**

By reaching the end of the file, the file is read out backwards.

```
*RST: OWAY
```

**Example:**

```
BB:GPS:LOC:ROM CYCL
the waypoint file will be read out cyclic.
```

**[:SOURCE<hw>]:BB:GPS:LOCATION:WAYPoints <Waypoints>**

(R&S SMx/AMU instruments only)

Selects the waypoint file. A waypoint file must have the extension \*.txt.

See "Waypoint file's format" for detailed description of the waypoint file's format.

**Parameters:**

<Waypoints> string

**Example:** `BB:GPS:LOC:WAYP "D:\waypoints.txt"`  
selects the waypoint file

### **[[:SOURce<hw>]:BB:GPS:PRESet**

Produces a standardized default for all GPS settings. The settings correspond to the \*RST values specified for the commands.

**Example:** `BB:GPS:PRES`  
resets all the GPS settings to default values.

**Usage:** Event

### **[[:SOURce<hw>]:BB:GPS:PRFLevel**

(R&S SMx instruments only)

Sets the RF to GPS standard L1 (1.575420 GHz) and the power level to -115.0 dBm, i.e sets the commands `SOUR:FREQ` and `SOUR:POW`. The affected RF path depends on the signal routing of the selected baseband.

**Example:** `BB:GPS:PRFL`  
sets the RF level to 1.575420 GHz and the level to -115.0 dBm.

### **[[:SOURce<hw>]:BB:GPS:RFBand <Rfband>**

Sets the GPS frequency.

**Parameters:**

<Rfband>            L1 | L2  
**L1**  
 GPS carrier frequency L1 = 1.57542 GHz  
**L2**  
 GPS carrier frequency L2 = 1.2276 GHz  
 \*RST:            L1

**Example:** `BB:GPS:RFB L2`  
sets the carrier frequency to 1.2276 GHz

### **[[:SOURce<hw>]:BB:GPS:SEMAsk <Semask>**

(R&S SMx/AMU instruments only)

(enabled for "Localization" mode)

Sets the satellite's elevation, i.e. determines the minimum angular distance of a satellite above the horizon.

**Parameters:**

<Semask> 2.5 | 5 | 7.5 |  
 10 (only for instruments working in a coupling mode)  
 \*RST: 7.5

**Example:**

BB:GPS:BAW:STAT ON  
 enables control of both paths via the GPS menu of path A. 8 Satellites can be configured.  
 BB:GPS:SEM 10  
 sets the satellite elevation mask.

**[[:SOURce<hw>]:BB:GPS:SETTing:CATalog?**

Reads out the files with GPS settings in the default directory. The default directory is set using command `MMEM:CDIRECTory`. Only files with the file extension `*.gps` will be listed.

**Return values:**

<Catalog> string

**Example:**

MMEM:CDIR 'D:\user\gps'  
 sets the default directory to D:\user\gps.  
 BB:GPS:SETT:CAT?  
 reads out all the files with GPS settings in the default directory.  
 Response: 'gps\_generic', 'gps\_gen2'  
 the files `gps_generic` and `gps_gen2` are available.

**Usage:** Query only

**[[:SOURce<hw>]:BB:GPS:SETTing:DELEte <Delete>**

Deletes the selected file with GPS settings. The directory is set using command `MMEM:CDIRECTory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.gps` will be deleted.

**Setting parameters:**

<Delete> string

**Example:**

BB:GPS:SETT:DEL 'gps'  
 deletes file `gps`.

**Usage:** Setting only

**[[:SOURce<hw>]:BB:GPS:SETTing:LOAD <Load>**

Loads the selected file with GPS settings. The directory is set using command `MMEM:CDIRECTory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension `*.gps` will be loaded.



**Setting parameters:**

<Load> string

**Example:** BB:GPS:SETT:LOAD 'gps'  
loads file gps.

**Usage:** Setting only

---

**[:SOURCE<hw>]:BB:GPS:SETTING:STORE <Store>**

Stores the current GPS settings into the selected file. The directory is set using command `MMEM:CDIRECTORY`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. GPS settings are stored as files with the specific file extensions `*.gps`.

**Setting parameters:**

<Store> string

**Example:** BB:GPS:SETT:STOR 'gps\_sem299'  
stores the current settings into file `gps_sem299`.

**Usage:** Setting only

---

**[:SOURCE<hw>]:BB:GPS:SETTING:STORE:FAST <Fast>**

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

**Note:** This function is not affected by the "Preset" function.

**Parameters:**

<Fast> 0 | 1 | OFF | ON  
\*RST: 1

---

**[:SOURCE<hw>]:BB:GPS:SMODE <Smode>**

Sets the simulation mode.

**Parameters:**

<Smode> GENeric | LOCalization  
\*RST: GENeric

**Example:** BB:GPS:SMOD GEN  
generic satellite signals are generated.

---

**[:SOURCE<hw>]:BB:GPS:STATE <State>**

Activates the signal generation of simulated GPS satellites.

---

Activating this standard deactivates all the other digital standards and digital modulation modes in the same path.

**Note:** For two path instruments and enabled parameter "Use of Baseband A+B", enabling the GPS signal simulation will disable all other digital standards and digital modulation modes even in the path B.

For R&S SMx/AMU instruments, a continuous GPS signal is generated for up to four satellites per path in real time mode.

For R&S WinIQSIM2, a continuous offline GPS signal of one satellite is generated.

**Parameters:**

<State>                    0 | 1 | OFF | ON  
 \*RST:                    OFF

**Example:**

BB:GPS:STAT ON  
 activates signal generation of simulated GPS satellites.

**[:SOURce<hw>]:BB:GPS:WAVeform:CREate <Create>**

(For R&S WinIQSIM2 only)

This command creates a waveform using the current settings of the GPS menu. The file name is entered with the command. The file is stored with the predefined file extension \* .wv. The file name and the directory it is stored in are user-definable.

**Setting parameters:**

<Create>                    string

**Example:**

M MEM:CDIR 'D:\user\waveform'  
 sets the default directory to D:\user\waveform.  
 BB:GPS:WAV:CRE 'gps\_1'  
 creates the waveform file gps\_1.wv in the default directory.

**Usage:**

Setting only

## 4.2 Satellites Configuration and Satellites Signal Settings

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---

### `[:SOURCE<hw>]:BB:GPS:HDOP?`

(R&S SMx/AMU instruments only)

**Note:** This parameter is enabled only for "Localization" mode.

Queries the HDOP (Horizontal Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

The HDOP can be used as an indication of 2D positioning quality. The general rule here is, that the smaller the HDOP the better the precision of the position fix will be. At least three different satellites have to be configured to get a reasonable value, otherwise -1 will be set.

**Return values:**

<Hdop>                      float

**Example:**

`BB:GPS:HDOP?`

queries the initial HDOP

Response: -1

less than 3 different satellites are configured. The Initial HDOP can not be calculated

**Usage:**

Query only

**[[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac <Almanac>**

Selects the almanac providing the navigation information.

Current almanac data can be downloaded via the Internet. The files are provided as text files (\*.txt) or YUMA files.

The almanac files provided with this option are saved in the default directory of the instrument (C:\Program Files\Rohde&Schwarz\SMUFirmware\Lists\Gps\Almanac). To access the files in this default directory, only the file name is required, without the path and the file extension.

However, to access almanac files located in a directory different to the default one, the complete file path and file name are required.

**Parameters:**

<Almanac>                    string  
\*RST:                    SEM269

**Example:**

BB:GPS:NAV:ALM 'SEM299'  
the file SEM299 in the default directory (C:\Program Files\Rohde&Schwarz\SMUFirmware\Lists\Gps\Almanac) is used for retrieving navigation information.  
BB:GPS:NAV:ALM 'D:/gps/almanac/SEM299'  
the file SEM299 in the directory D:/gps/almanac is used for retrieving navigation information.

**[[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:BEGin:DAY?**

Queries the start day of the week in which the almanac was published. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURCE:BB:GPS:NAVigation:ALMananc.

**Return values:**

<Day>                    float

**Example:**

BB:GPS:NAV:ALM:BEG:DAY?  
queries the start day of the GPS week.  
Response: 12  
the GPS week starts on the 12th of the month.

**Usage:**                    Query only

**[[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:BEGin:MONTH?**

Queries the start month of the week in which the almanac was published. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURCE:BB:GPS:NAVigation:ALMananc.

**Return values:**

<Month>                    float

**Example:** BB:GPS:NAV:ALM:BEG:MONT?  
 queries the start month of the GPS week.  
 Response: 4  
 the week starts in April.

**Usage:** Query only

#### **[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:BEGin:WNUMBER?**

Queries the GPS week number of the almanac. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURCE:BB:GPS:NAVigation:ALManac.

**Return values:**  
 <Wnumber> float

**Example:** BB:GPS:NAV:ALM:BEG:WNUM?  
 queries the GPS week number of almanac.  
 Response: 1233  
 the week number is 1233.

**Usage:** Query only

#### **[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:BEGin:YEAR?**

Queries the year of the week in which the almanac was published. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURCE:BB:GPS:NAVigation:ALManac.

**Return values:**  
 <Year> float

**Example:** BB:GPS:NAV:ALM:BEG:YEAR?  
 queries the year of the GPS week.  
 Response: 2007  
 the year is 2007.

**Usage:** Query only

#### **[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:END:DAY?**

Queries the final day of the week in which the almanac was published. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAVigation:DATA RND). The almanac is loaded with command SOURCE:BB:GPS:NAVigation:ALManac.

**Return values:**  
 <Day> float

**Example:** `BB:GPS:NAV:ALM:END:DAY?`  
 queries the final day of the GPS week.  
 Response: 19  
 the GPS week ends on the 19<sup>th</sup> of the month.

**Usage:** Query only

**[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:END:MONTH?**

Queries the final month of the week in which the almanac was published. The command is only available if data source Real Navigation Data is selected (`SOURCE:BB:GPS:NAVigation:DATA RND`). The almanac is loaded with command `SOURCE:BB:GPS:NAVigation:ALMananc`.

**Return values:**  
 <Month> float

**Example:** `BB:GPS:NAV:ALM:END:MONT?`  
 queries the final month of the GPS week.  
 Response: 4  
 the GPS week ends in April.

**Usage:** Query only

**[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:END:YEAR?**

Queries the year of the week in which the almanac was published. The command is only available if data source Real Navigation Data is selected (`SOURCE:BB:GPS:NAVigation:DATA RND`). The almanac is loaded with command `SOURCE:BB:GPS:NAVigation:ALMananc`.

**Return values:**  
 <Year> float

**Example:** `BB:GPS:NAV:ALM:END:YEAR?`  
 queries the year of the GPS week.  
 Response: 2007  
 the year is 2007.

**Usage:** Query only

**[:SOURCE<hw>]:BB:GPS:NAVigation:ALManac:TOEPHemeris?**

Queries the time of almanac, i.e. the exact time in seconds to which the navigation data refers.

The command is only available if data source Real Navigation Data is selected (`SOURCE:BB:GPS:NAVigation:DATA RND`). The almanac is loaded with command `SOURCE:BB:GPS:NAVigation:ALMananc`.

**Return values:**  
 <Toephemeris> float

**Example:** `BB:GPS:NAV:ALM:TOEP?`  
 queries the time of almanac.  
 Response: 589824  
 the value is returned in seconds. Counting starts at 0.00 a.m. on Sunday of the GPS week.

**Usage:** Query only

**[ :SOURce<hw>]:BB:GPS:NAVigation:DATA <Data>**

Determines the data source for the navigation information.

**Note:**Arbitrary data are supported only in "Generic" mode.

**Parameters:**

<Data> ZERO | ONE | PATTern | PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | RNDData | USER

**RNDData**

Real navigation data provided by an almanac file is used. The file is loaded with command

`SOURce:BB:GPS:NAVigation:ALMananc.`

**DLISt**

A data list is used. The data list is selected with the command

`[ :SOURce<hw>]:BB:GPS:NAVigation:DATA:DSElect.`

**PNxx**

The pseudo-random sequence generator is used as the data source. Different random sequence lengths can be selected.

**ZERO | ONE**

Internal 0 and 1 data is used

**PATTern**

Internal data is used The bit pattern for the data is defined by the command `[ :SOURce<hw>]:BB:GPS:NAVigation:DATA:PATTern.`

\*RST: RNDData

**Example:** `BB:GPS:NAV:DATA PATT`  
 selects as the data source for the data fields of burst 0, the bit pattern defined with the following command.  
`BB:GPS:NAV:DATA:PATT #H3F,8`  
 defines the bit pattern.

**[ :SOURce<hw>]:BB:GPS:NAVigation:DATA:DSElect <Dselect>**

Selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMoRY:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

**Parameters:****<Dselect>** string**Example:**

```
BB:GPS:NAV:DATA DLIS
selects the Data Lists data source.
MMEM:CDIR 'D:\Lists'
selects the directory for the data lists.
BB:GPS:NAV:DATA:DLIS 'GPS_list1'
selects file 'GPS_list1' as the data source. This file must be in
the directory D:\Lists and have the file extension *.dm_iqd.
```

**[:SOURCE<hw>]:BB:GPS:NAVigation:DATA:PATTERN <Pattern>**

Determines the bit pattern for the PATTERN selection. The maximum length is 64 bits.

**Parameters:**

**<Pattern>** 64 bit pattern  
**\*RST:** 0

**Example:**

```
BB:GPS:NAV:DATA:PATT #H3F,8
defines the bit pattern.
```

**[:SOURCE<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:DATE <Date>**

Sets the date for the simulation. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAV:DATA RND).

**Parameters:**

**<Date>** YYYY,MM,DD  
**\*RST:** 2004,10,10

**Example:**

```
BB:GPS:NAV:SIM:DATE 2006,12,25
sets the date for the simulation.
```

**[:SOURCE<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:DAY <Day>**

Sets the simulation start day. The command is only available if data source Real Navigation Data is selected (SOURCE:BB:GPS:NAV:DATA RND).

**Parameters:**

**<Day>** float  
**Range:** 1 to 31  
**\*RST:** -

**Example:**

```
BB:GPS:NAV:SIM:DAY 10
sets the simulation start day.
```



---

**[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:HOuR <Hour>**

Sets the hour of the simulation start. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAV:DATA RND).

**Parameters:**

<Hour> float  
 Range: 0 to 23  
 \*RST: -

**Example:** BB:GPS:NAV:SIM:HOuR 10  
 sets the simulation start hour.

---

**[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:MINute <Minute>**

Sets the minute of the simulation start. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAV:DATA RND).

**Parameters:**

<Minute> float  
 Range: 0 to 59  
 \*RST: -

**Example:** BB:GPS:NAV:SIM:MIN 10  
 sets the simulation start minute.

---

**[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:MONTH <Month>**

Sets the month of the simulation start. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAV:DATA RND).

**Parameters:**

<Month> float  
 Range: 1 to 12  
 \*RST: -

**Example:** BB:GPS:NAV:SIM:MON 10  
 sets the simulation start month.

---

**[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:SECOnd <Second>**

Sets the second of the simulation start. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAV:DATA RND).

**Parameters:**

<Second> float  
 Range: 0 to 59  
 \*RST: -

**Example:** BB:GPS:NAV:SIM:SEC 10  
 sets the simulation start second.

**[[:SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME <Time>**

Enters the exact time for the simulation. The used time zone is Greenwich Mean Time. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAV:DATA RND).

While calculating the GPS signal offline with R&S WinIQSIM2, there is a limitation for the values allowed for the second's subfield. Since a GPS subframe is 6 seconds long, to align the waveform generation to the start of a GPS subframe, only values that are aligned to 6 are allowed. i.e. 0, 6, 12, etc.

To generate an offline GPS signal with time of simulation different than these values, select a Marker Delay (BB:GPS:TRIG:OUTP:DEL).

**Parameters:**

<Time> HH,MM,SS  
\*RST: 0,0,0

**Example:**

BB:GPS:NAV:SIM:TIME 12,45,36  
sets the time for the simulation.

**[[:SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:YEAR <Year>**

Sets the year of the simulation start. The command is only available if data source Real Navigation Data is selected (SOURce:BB:GPS:NAV:DATA RND).

**Parameters:**

<Year> float  
Range: -9999 to 9999  
\*RST: -

**Example:**

BB:GPS:NAV:SIM:YEAR 10  
sets the simulation start year.

**[[:SOURce<hw>]:BB:GPS:PDOP?**

(R&S SMx/AMU instruments only)

Queries the PDOP (Position Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

The PDOP can be used as an indication of 3D positioning quality.

The general rule here is, that the smaller the PDOP the better the precision of the position fix will be.

At least three different satellites need to be configured to get a reasonable value, otherwise -1 will be set.

**Note:** This parameter is enabled only for "Localization" Mode.

**Return values:**

<Pdop> float

**Example:** BB:GPS:SMOD LOC  
satellite signals are generated corresponding to a 'real' location.  
BB:GPS:PDOP?  
queries the PDOP of the selected satellite constellation.  
Response: '2.80'

**Usage:** Query only

**[:SOURce<hw>]:BB:GPS:POWER:ADJust**

(R&amp;S SMx/AMU instruments only)

Calculates the power level of each satellite so that the sum of all levels results in 0 dB.

**Example:** BB:GPS:POW:ADJ  
the total power of all satellites is set to 0 dB, the power ratio among the satellites is unchanged.

**Usage:** Event

**[:SOURce<hw>]:BB:GPS:POWER[:TOTal]?**

(R&amp;S SMx/AMU instruments only)

Queries the total power of all satellites. After "Power Adjust", this power corresponds to 0 dB.

**Return values:**

&lt;Total&gt; float

**Example:** BB:GPS:POW?  
queries the total power of all satellites.  
Response: -22.5  
the total power is -25 dB.

**Usage:** Query only

**[:SOURce<hw>]:BB:GPS:SATellite<st>:ADSHift <Adshift>**

(R&amp;S SMx/AMU instruments only)

Sets the additional Doppler shift of the simulated signal of the satellite.

Additionally, the parameter can be used to simulate multipath conditions.

To simulate multipath, assign the same space vehicle (SV ID) to more than one simulated satellites and set different "Additional Doppler Shift".

**Suffix:**

&lt;st&gt; 1 .. 37

**Parameters:**

<Adshift> float  
 Range: -100.0kHz to 100.0kHz  
 Increment: 0.1Hz  
 \*RST: 0.0Hz

**Example:**

BB:GPS:SAT1:VID 4  
 sets space vehicle 4 for the first satellite.  
 BB:GPS:SAT2:VID 4  
 sets space vehicle 4 for the second satellite.  
 BB:GPS:SAT1:ADSH 10.5kHz  
 sets the additional Doppler shift of satellite 1 to 10.5 KHz  
 BB:GPS:SAT2:ADSH 1kHz  
 sets the additional Doppler shift of satellite 2 to 1 KHz

---

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:APOWER <Apower>**

(R&S SMx/AMU instruments only)

Sets the additional power of the satellite in dB.

Additionally, the parameter can be used to simulate multipath conditions.

To simulate multipath, assign the same space vehicle (SV ID) to more than one configuration columns (simulated satellites) and set different "Additional Power".

**Suffix:**

<st> 1 .. 37

**Parameters:**

<Apower> float  
 Range: -50.0dB to 10.0dB  
 Increment: 0.1dB  
 \*RST: 0.0dB

**Example:**

BB:GPS:SAT1:VID 4  
 sets space vehicle 4 for the first satellite.  
 BB:GPS:SAT2:VID 4  
 sets space vehicle 4 for the second satellite.  
 BB:GPS:SAT1:APOW -10.0  
 sets the additional power of satellite 1 to -10dB  
 BB:GPS:SAT2:APOW -5.0  
 sets the additional power of satellite 2 to -5dB

---

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:ATSChips <Atschips>**

(R&S SMx/AMU instruments only)

Sets an additional delay of the selected satellite.

Additionally, the parameter can be used to simulate multipath conditions.

To simulate multipath, assign the same space vehicle (SV ID) to more than one simulated satellites and set different "Additional Time Shift".

**Suffix:**

<st> 1 .. 37

**Parameters:**

<Atschips> float  
 Range: 0 to 10.0e6  
 Increment: 0.001  
 \*RST: 0.0

**Example:**

```
BB:GPS:SAT1:VID 4
sets space vehicle 4 for the first satellite.
BB:GPS:SAT2:VID 4
sets space vehicle 4 for the second satellite.
BB:GPS:SAT1:ATSC 10000
sets the additional time shift of satellite 1 to 10000
BB:GPS:SAT2:ATSC 20000
sets the additional time shift of satellite 2 to 20000
```

**[[:SOURce<hw>]:BB:GPS:SATellite<st>:CACRate?**

Queries the currently valid values for the chip rate of the C/A code. The chip rate depends on the set Doppler shift.

**Suffix:**

<st> 1 .. 4

**Return values:**

<Cacrate> float

**Example:**

```
BB:GPS:SAT1:CACR?
queries the resulting C/A chip rate of satellite 1.
Response: 1023022.077
the chip rate is 1.02302208 MHz.
```

**Usage:**

Query only

**[[:SOURce<hw>]:BB:GPS:SATellite<st>:FREQuency?**

Queries the currently valid value for the doppler-shifted carrier frequency.

**Suffix:**

<st> 1 .. 4

**Return values:**

<Frequency> float

**Example:**

```
BB:GPS:SAT1:FREQ?
queries the resulting carrier frequency of satellite 1.
Response: 1575421111
the resulting carrier frequency is 1.575421111 GHz.
```

**Usage:** Query only

---

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:ICPHASE <Icphase>**

(R&S SMx/AMU instruments only)

Sets the initial carrier phase in radians.

Additionally, the parameter can be used to simulate multipath conditions.

**Suffix:**

<st> 1 .. 4

**Parameters:**

<Icphase> float

Range: 6.28 to 6.28

Increment: 0.01 radians

**Example:**

BB:GPS:SAT4:ICPH 3.14

sets the initial carrier phase of satellite 4.

---

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:PCRATE?**

(R&S SMx/AMU instruments only)

Queries the currently valid value for the resulting P-chip rate.

**Suffix:**

<st> 1 .. 4

**Return values:**

<Pcrate> float

**Example:**

BB:GPS:SAT4:PCR?

queries the resulting P-chip rate of satellite 4.

Response: 10230007.214285715

the resulting P-chip rate is 10.230007 MHz.

**Usage:** Query only

---

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:RCODE <Rcode>**

Selects the ranging code for satellite 1.

For satellite 2, 3, and 4, only C/A is available and cannot be changed.

**Note:** Selecting the ranging code is only enabled for "Generic" simulation mode; for Localization mode this parameter is read-only.

**Suffix:**

<st> 1 .. 4

**Parameters:**

<Rcode> CACode | CAPCode | PCODE

**CACode**

Carrier L1 (f<sub>L1</sub>= 1.57542 GHz) is modulated by C/A-code (BPSK).

**CAPCode**

(only available for Satellite 1)

Carrier L1 (f<sub>L1</sub>= 1.57542 GHz) is modulated by C/A code and P-code (QPSK).

**PCODE**

(only available for Satellite 1)

Carrier L1 (f<sub>L1</sub>= 1.57542 GHz) is modulated by P-code (BPSK).

\*RST: CACode

**Example:**

BB:GPS:SMOD GEN

generic satellite signals are generated.

BB:GPS:SAT1:RCOD CAC

sets the C/A ranging code for satellite 1.

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:STATE <State>**

Enables/disables generation of the signal of the selected satellite.

**Suffix:**

<st> 1 .. 4

**Parameters:**

<State> 0 | 1 | OFF | ON

\*RST: SAT1: ON ; SAT<2|3|4>: OFF

**Example:**

BB:GPS:SAT1:STAT ON

enables generation of the signal of satellite 1.

**[:SOURCE<hw>]:BB:GPS:SATELLITE<st>:SVID <Svid>**

Sets the ID of the satellite to be simulated. This value is used to generate the corresponding C/A code.

If "Real Navigation Data" is used, only the valid IDs which are listed in the almanac can be selected.

For arbitrary data, any IDs can be selected.

**Suffix:**

<st> 1 .. 4

**Parameters:**

<Svid> float

Range: 1 to 37

\*RST: SAT1: 1 / SAT2: 2 / SAT3: 3 / SAT4: 4

**Example:** `BB:GPS:SAT1:VID 4`  
sets id 4 for the first satellite.

---

**[[:SOURce<hw>]:BB:GPS:SPReading[:STATE] <State>**

The command activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

**Note:** This parameter is enabled only for "Generic" mode.

**Parameters:**

<State>            0 | 1 | OFF | ON  
\*RST:            ON

**Example:** `BB:GPS:SMOD GEN`  
selects generic mode  
`BB:GPS:SPR ON`  
activates spreading of simulated GPS satellite signals.

---

**[[:SOURce<hw>]:BB:GPS:SVID<st>:DSHift <Dshift>**

Sets the Doppler shift of the simulated signal of the selected satellite. The relevant change to the chip rate of the C/A code is carried out automatically.

The currently valid values for Doppler-shifted carrier frequency and chip rates are queried with commands:

- [\[:SOURce<hw>\]:BB:GPS:SATEllite<st>:CACRate](#) on page 95
- [\[:SOURce<hw>\]:BB:GPS:SATEllite<st>:PCRate](#) on page 96
- [\[:SOURce<hw>\]:BB:GPS:SATEllite<st>:FREQuency](#) on page 95

**Suffix:**

<st>            1 .. 8

**Parameters:**

<Dshift>            float  
Range:            -100kHz to 100kHz  
Increment:        0.01Hz  
\*RST:            0

**Example:** `BB:GPS:SVID5:SAT:DSH 5 kHz`  
sets a Doppler shift of 5 kHz for satellite 1.

---

**[[:SOURce<hw>]:BB:GPS:SVID<st>:DURATION?**

(R&S SMx/AMU instruments only)

Queries the time (in hh:mm:ss format) the satellite is visible (the satellite's elevation will be higher than 2.5/5/7.5/10°).

This value can be used to get an impression of how long the connected GPS receiver will use this certain satellite for its position fix.



**Note:** This parameter is enabled only for "Localization" Mode.

**Suffix:**

<st> 1 .. 8

**Return values:**

<Duration> float

**Example:**

BB:GPS:SMOD LOC

satellite signals are generated corresponding to a 'real' location.

BB:GPS:SVID2:DUR?

queries the time the satellite's elevation will be higher then 2.5/5/7.5/10°.

**Usage:**

Query only

**[:SOURCE<hw>]:BB:GPS:SVID<st>:POWER <Power>**

(R&S SMx/AMU instruments only)

Sets the power offset of the satellite.

The offset determines the power ratio of the activated satellites.

After "Adjust Total Power to 0dB" has been performed, the resulting level of a certain satellite is calculated according to the following:

Resulting Level = Global Level + Satellite Power + Additional Power

**Suffix:**

<st> 1 .. 8

**Parameters:**

<Power> float

Range: -50.0dB to +10.0dB

Increment: 0.1dB

\*RST: 0dB

**Example:**

BB:GPS:SAT4:POW -2 dB

sets a power offset of 2 dB.

**[:SOURCE<hw>]:BB:GPS:SVID<st>:TSChips <Tschips>**

(R&S SMx/AMU instruments only)

Sets a delay of the selected satellite relative to the other satellites. The time shift is set in oversampled CA chips (Oversampling = 40).

**Suffix:**

<st> 1 .. 8

**Parameters:**

<Tschips> float  
 Range: 0 to 10 000 000  
 Increment: 0.0001  
 \*RST: 0

**Example:**

BB:GPS:SAT4:TSCH 100232  
 sets a time shift of 100232 oversampled CA chips.

**[:SOURce<hw>]:BB:GPS:SVID<st>:TSSeconds?**

(R&S SMx/AMU instruments only)

Queries the time shift of the code sequence in seconds.

**Suffix:**

<st> 1 .. 8

**Return values:**

<Tsseconds> float

**Example:**

BB:GPS:SAT4:TSS?  
 queries the time shift in seconds.  
 Response: 0.00979  
 the time shift is 9.799 ms.

**Usage:** Query only

## 4.3 Navigation Message Configuration



The parameters of the Navigation Message are only configurable for instrument equipped with option Assisted GPS (R&S SMx/AMU-K65) and in "Full Configuration" localization mode.

**SVID<st>**

Value range: 1 .. 37

|  |     |
|--|-----|
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:AFONE.....</a>            | 101 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:AFTWo.....</a>            | 102 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:AFZero.....</a>           | 102 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:ALPHa&lt;ch0&gt;.....</a> | 102 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:AODO.....</a>             | 103 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:AONE.....</a>             | 103 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:AZERo.....</a>            | 103 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:BETA&lt;ch0&gt;.....</a>  | 104 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:CIC.....</a>              | 104 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:CIS.....</a>              | 105 |
| <a href="#">[:SOURce&lt;hw&gt;]:BB:GPS:SVID&lt;st&gt;:NMESsage:CLTMode.....</a>          | 105 |

|  |     |
|--|-----|
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:CRC</code>                | 105 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:CRS</code>                | 106 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:CUC</code>                | 106 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:CUS</code>                | 107 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:DN</code>                 | 107 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:ECCentricity</code>       | 107 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:FIFLag</code>             | 108 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:HEALth</code>             | 108 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:IDOT</code>               | 108 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:IODC</code>               | 109 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:IODE</code>               | 109 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:IZERo</code>              | 109 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:LTPData</code>            | 110 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:MZERo</code>              | 110 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:NDELta</code>             | 110 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:ODOT</code>               | 111 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:OMEGA</code>              | 111 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:OZERo</code>              | 112 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:PRESet</code>             | 112 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:RESErved&lt;ch&gt;</code> | 112 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:SQRA</code>               | 113 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:SVConfig</code>           | 113 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:TGD</code>                | 113 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:TLS</code>                | 114 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:TLFS</code>               | 114 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:TOC</code>                | 114 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:TOE</code>                | 115 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:TOT</code>                | 115 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:URA</code>                | 115 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:WLSF</code>               | 116 |
| <code>[ :SOURce&lt;hw&gt; ]:BB:GPS:SVID&lt;st&gt;:NMESsage:WNT</code>                | 116 |

---

### `[ :SOURce<hw> ]:BB:GPS:SVID<st>:NMESsage:AFONe <Afone>`

Sets the clock correction parameter `a_f1` of the satellite's navigation message.

As this parameter affects the satellite's clock correction, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)". The value of these parameters will be updated automatically.

#### Parameters:

`<Afone>` float  
Range: -32768 to 32767

#### Example:

```
BB:GPS:LMOd FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:AFON 10000
sets the value of the clock correction parameter a_f1
```

Options: R&S SMx/AMU-K65

**[ :SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:AFTWo <Aftwo>**

Sets the clock correction parameter a\_f2 of the satellite's navigation message.

As this parameter affects the satellite's clock correction, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Parameters:**

<Aftwo> float  
Range: -128 to 127

**Example:**

```
BB:GPS:LMOd FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:AFTW 100
sets the value of the clock correction parameter a_f2
```

**Options:**

R&S SMx/AMU-K65

**[ :SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:AFZero <Afzero>**

Sets the clock correction parameter a\_f0 of the satellite's navigation message.

As this parameter affects the satellite's clock correction, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)". The value of these parameters will be updated automatically.

**Parameters:**

<Afzero> float  
Range: -2097152 to 2097151

**Example:**

```
BB:GPS:LMOd FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:AFZ 10000
sets the value of the clock correction parameter a_f0
```

**Options:**

R&S SMx/AMU-K65

**[ :SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:ALPHa<ch0> <Alpha>**

Sets the ionospheric parameters alpha\_0, alpha\_1, alpha\_2 and alpha\_3 of the satellite's navigation message.

As this parameter affects the ionospheric model, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)". The value of these parameters will be updated automatically.

**Suffix:**

<ch0> 0|1|2|3

**Parameters:**

<Alpha> float  
 Range: -128 to 127  
 \*RST: 0

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
 sets the "Localization" mode to "Full Configuration"  
 BB:GPS:S<sub>VID5</sub>:N<sub>MES</sub>:ALPH0 100  
 sets the value of the ionospheric parameter alpha\_0

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:AODO <Aodo>**

Sets the parameter Age of Data Offset of the satellite's navigation message.

**Parameters:**

<Aodo> float  
 Range: 0 to 31  
 \*RST: 0

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
 sets the "Localization" mode to "Full Configuration"  
 BB:GPS:S<sub>VID5</sub>:N<sub>MES</sub>:AODO 20  
 sets the value of the parameter age of data offset

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:AONE <Aone>**

Sets the UTC parameter A1 of the satellite's navigation message.

**Parameters:**

<Aone> float  
 Range: -8388608 to 8388607  
 \*RST: 0

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
 sets the Localization mode to Full Configuration  
 BB:GPS:S<sub>VID5</sub>:N<sub>MES</sub>:AONE 10000  
 sets the value of the UTC parameter A1

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:AZERo <Azero>**

Sets the UTC parameter A<sub>0</sub> of the satellite's navigation message.

**Parameters:**

<Azero> float  
 Range: -2147483648 to 2147483648

**Example:** BB:GPS:LMOD FULL  
sets the Localization mode to Full Configuration  
BB:GPS:SVID5:NMES:AZER 10000  
sets the value of the UTC parameter  $A_0$

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:BETA<ch0> <Beta>**

Sets the parameter beta\_0, beta\_1, beta\_2 and beta\_3 of the satellite's navigation message.

As this parameter affects the ionospheric model used, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Suffix:**  
<ch0> 0|1|2|3

**Parameters:**  
<Beta> float  
Range: -128 to 127  
\*RST: 0

**Example:** BB:GPS:LMOD FULL  
sets the Localization mode to Full Configuration  
BB:GPS:SVID5:NMES:BETA1 100  
sets the value of the ionospheric parameter beta\_1

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:CIC <Cic>**

Sets the parameter Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Parameters:**  
<Cic> float  
Range: -32768 to 32767

**Example:** BB:GPS:LMOD FULL  
sets the Localization mode to Full Configuration  
BB:GPS:SVID5:NMES:CIC 100  
sets the value of the parameter C\_ic

**Options:** R&S SMx/AMU-K65

**[[:SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:CIS <Cis>**

Sets the parameter Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Parameters:**

<Cis> float  
Range: -32768 to 32767

**Example:**

```
BB:GPS:LMOD FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:CIS 100
sets the value of the parameter C_is
```

**Options:**

R&S SMx/AMU-K65

**[[:SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:CLTMode <Clmode>**

Sets the parameter type of code for L2 of the satellite's navigation message.

This value does not have any impact on the actual used ranging code of the generated satellite. The used ranging code is set in the "Satellite Configuration" menu (see "Raging Code").

**Parameters:**

<Clmode> REServed | PCODE | CACode

**REServed**  
Reserved for future use

**PCODE**  
Carrier L2 (f<sub>L2</sub>= 1.2276 GHz) is modulated by P-code (BPSK).

**CACode**  
Carrier L2 (f<sub>L2</sub>= 1.2276 GHz) is modulated by C/A-code (BPSK).

\*RST: PCODE

**Example:**

```
BB:GPS:LMOD FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:CLTM PCOD
sets the type of raging code for L2 to P-Code
```

**Options:**

R&S SMx/AMU-K65

**[[:SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:CRC <Crc>**

Sets the parameter Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Parameters:**

<Crc> float  
Range: -32768 to 32767

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:S<sub>VID5</sub>:N<sub>MES</sub>:CRC 100  
sets the value of the parameter C<sub>rc</sub>

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:CRS <Crs>**

Sets the parameter Amplitude of the Sine Harmonic Correction Term to the Orbit Radius of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Parameters:**

<Crs> float  
Range: -32768 to 32767

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
sets the Localization mode to Full Configuration  
BB:GPS:S<sub>VID5</sub>:N<sub>MES</sub>:CRS 100  
sets the value of the parameter C<sub>rs</sub>

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:CUC <Cuc>**

Sets the parameter Amplitude of the Cosine Harmonic Correction Term to the Argument of Latitude of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of these parameters will be updated automatically.

**Parameters:**

<Cuc> float  
Range: -32768 to 32767



**Example:** BB:GPS:LMOD FULL  
sets the Localization mode to Full Configuration  
BB:GPS:SVID5:NMES:CUC 100  
sets the value of the parameter C\_uc

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:CUS <Cus>**

Sets the parameter Amplitude of the Sine Harmonic Correction Term to the Argument of Latitude of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Cus> float  
Range: -32768 to 32767

**Example:** BB:GPS:LMOD FULL  
sets the Localization mode to Full Configuration  
BB:GPS:SVID5:NMES:CUS 100  
sets the value of the parameter C\_us

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:DN <Dn>**

Sets the UTC parameter DN of the satellite's navigation message.

**Parameters:**

<Dn> float  
Range: 0 to 7

**Example:** BB:GPS:LMOD FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:DN 5  
sets the value of the parameter DN

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:ECCentricity <Eccentricity>**

Sets the parameter Eccentricity of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Eccentricity> float  
 Range: 0 to 4294967295

**Example:**

```
BB:GPS:LMD FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:ECC 1000000
sets the value of the parameter e (Eccentricity)
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:FIFLag <Fiflag>**

Sets the parameter curve-fit interval flag of the satellite's navigation message.

**Parameters:**

<Fiflag> 0 | 1 | OFF | ON  
 \*RST: OFF

**Example:**

```
BB:GPS:LMD FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:FIFL ON
enables the curve-fit interval flag
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:HEALth <Health>**

Sets the parameter SV health of the satellite's navigation message.

This value does not have an impact on the actual health status of the generated satellite.

**Parameters:**

<Health> float

**Example:**

```
BB:GPS:LMD FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:HEAL 10
sets the SV health to 10
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:IDOT <Idot>**

Sets the parameter Rate of Inclination Angle of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<ldot> float  
 Range: -8192 to 8191

**Example:**

```
BB:GPS:Lmod FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:IDOT 1000
sets the parameter IDOT
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:IODC <lodc>**

Sets the parameter Issue of Data, Clock of the satellite's navigation message.

**Parameters:**

<lodc> float  
 Range: 0 to 1023

**Example:**

```
BB:GPS:Lmod FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:IDOC 1000
sets the parameter IDOC
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:IODE <lode>**

Sets the parameter Issue of Data, Ephemeris of the satellite's navigation message.

**Parameters:**

<lode> float  
 Range: 0 to 255

**Example:**

```
BB:GPS:Lmod FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:IDOE 100
sets the parameter IDOE
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:IZERo <lzero>**

Sets the parameter Inclination Angle at reference Time of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Izero> float  
 Range: -2147483648 to 2147483647

**Example:**

```
BB:GPS:Lmod FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:IZER 100000
sets the parameter i_0
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:LTPData <Ltpdata>**

Sets the parameter use of carrier L2 P data flag of the satellite's navigation message.

This value does not have an impact on whether really data is transmitted on the satellite's carrier L2 or not.

**Parameters:**

<Ltpdata> 0 | 1 | OFF | ON  
 \*RST: OFF

**Example:**

```
BB:GPS:Lmod FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:LTPD ON
enables the L2 P data Flag
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:MZERO <Mzero>**

Sets the parameter Mean Anomaly at Reference Time of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)". The value of this parameters will be updated automatically.

**Parameters:**

<Mzero> float  
 Range: -2147483648 to 2147483647

**Example:**

```
BB:GPS:Lmod FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:MZER 100000
sets the parameter M_0
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:NDELta <Ndelta>**

Sets the parameter Mean Motion difference From Computed Value of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Ndelta> float  
Range: -32768 to 32767

**Example:**

```
BB:GPS:LMOd FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMEs:NDEL 100
sets the parameter Delta_N
```

**Options:**

R&S SMx/AMU-K65

**[:SOURce<hw>]:BB:GPS:SVID<st>:NMEsSage:ODOT <Odot>**

Sets the parameter Rate of Right Ascension of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Odot> float  
Range: -8388608 to 8388607

**Example:**

```
BB:GPS:LMOd FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMEs:ODOT 100000
sets the parameter OMEGA_DOT
```

**Options:**

R&S SMx/AMU-K65

**[:SOURce<hw>]:BB:GPS:SVID<st>:NMEsSage:OMEGa <Omega>**

Sets the parameter Argument of Perigee of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Omega> float  
Range: -2147483648 to 2147483647

**Example:** BB:GPS:LMOd FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:OMEG 100000  
sets the parameter omega

**Options:** R&S SMx/AMU-K65

**[:SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:OZERO <Ozero>**

Sets the parameter Longitude of Ascending Node of Orbit Plane at Weekly Epoch of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Ozero> float  
Range: -2147483648 to 2147483647

**Example:** BB:GPS:LMOd FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:OZER 100000  
sets the parameter OMEGA\_0

**Options:** R&S SMx/AMU-K65

**[:SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:PRESet**

Set navigation message parameters to values defined in almanac file.

Presetting the parameters of the navigation message is recommended as basis for further reconfigurations.

**Example:** BB:GPS:LMOd FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:PRS  
set navigation message parameters to values defined in almanac file

**Usage:** Event

**Options:** R&S SMx/AMU-K65

**[:SOURce<hw>]:BB:GPS:SVID<st>:NMESsage:REServed<ch> <Reserved>**

Sets the parameter SF1 Reserved 1 .. 4 of the satellite's navigation message.

**Parameters:**

<Reserved> float  
Range: 0 to 8388608

**Example:** BB:GPS:LMOD FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:RES3 100000  
sets parameter SF1 Reserved 3 to 1000000

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:SQRA <Sqra>**

Sets the parameter Square Root of the Semi-Major Axis of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Sqra> float  
Range: 0 to 4294967295

**Example:** BB:GPS:LMOD FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:SQRA 100000  
sets parameter SQRT(A) to 1000000

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:SVConfig <Svconfig>**

Sets the parameter (A-S) Flags and SV Config of the satellite's navigation message.

**Parameters:**

<Svconfig> float  
Range: 0 to 15  
\*RST: 9

**Example:** BB:GPS:LMOD FULL  
sets the "Localization" mode to "Full Configuration"  
BB:GPS:SVID5:NMES:SVC 10  
sets parameter A-S Flag and SV Config to 10

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:TGD <Tgd>**

Sets the parameter L1-L2 Correction Term of the satellite's navigation message.

As this parameter affects the satellite's clock correction, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Tgd> float  
Range: -128 to 127

**Example:**

```
BB:GPS:LMOD FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:TGD 100
sets parameter T_GD
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:TLS <Tls>**

Sets the UTC parameter  $\Delta t_{LS}$  of the satellite's navigation message.

**Parameters:**

<Tls> float  
Range: -128 to 127

**Example:**

```
BB:GPS:LMOD FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:TLS 100
sets parameter  $\Delta t_{LS}$ 
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:TLSF <Tlsf>**

Sets the UTC parameter  $\Delta t_{LSF}$  of the satellite's navigation message.

**Parameters:**

<Tlsf> float  
Range: -128 to 127

**Example:**

```
BB:GPS:LMOD FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:TLSF 100
sets parameter  $\Delta t_{LSf}$ 
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:TOC <Toc>**

Sets the clock correction parameter  $t_{OC}$  of the satellite's navigation message.

As this parameter affects the satellite's clock correction, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.



**Parameters:**

<Toc> float  
Range: 0 to 65535

**Example:**

```
BB:GPS:LMD FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:TOC 100
sets parameter t_OC
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:TOE <Toe>**

Sets the parameter Time of Ephemeris of the satellite's navigation message.

As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>10°)".

The value of this parameters will be updated automatically.

**Parameters:**

<Toe> float  
Range: 0 to 65535

**Example:**

```
BB:GPS:LMD FULL
sets the "Localization" mode to "Full Configuration"
BB:GPS:SVID5:NMES:TOE 100
sets parameter TOE
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:TOT <Tot>**

Sets the UTC parameter t0t of the satellite's navigation message.

**Parameters:**

<Tot> float  
Range: 0 to 602112

**Example:**

```
BB:GPS:LMD FULL
sets the Localization mode to Full Configuration
BB:GPS:SVID5:NMES:TOT 1000
sets parameter t_ot
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:URA <Ura>**

Sets the parameter SV accuracy/ URA index of the satellite's navigation message.

**Parameters:**

<Ura> float  
 Range: 0 to 15  
 \*RST: 0

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
 sets the Localization mode to Full Configuration  
 BB:GPS:SVID5:N<sub>MES</sub>:URA 10  
 sets parameter SV accuracy/ URA index

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:WLSF <Wlsf>**

Sets the UTC parameter  $WN_{LSF}$  of the satellite's navigation message.

**Parameters:**

<Wlsf> float  
 Range: 0 to 255  
 \*RST: 0

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
 sets the "Localization" mode to "Full Configuration"  
 BB:GPS:SVID5:N<sub>MES</sub>:WLSF 10  
 sets parameter  $WN_{LSF}$

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:SVID<st>:NMESsage:WNT <Wnt>**

Sets the UTC parameter  $WNT$  of the satellite's navigation message.

**Parameters:**

<Wnt> float  
 Range: 0 to 255  
 \*RST: 0

**Example:**

BB:GPS:L<sub>MOD</sub> FULL  
 sets the Localization mode to Full Configuration  
 BB:GPS:SVID5:N<sub>MES</sub>:WNT 100  
 sets parameter  $WNT$

**Options:**

R&S SMx/AMU-K65

## 4.4 Assistance Data Settings

The `SOURCE:BB:GPS:ADGeneration` subsystem contains commands for setting the assistance data settings.



The Assistance Data Settings are only configurable for instrument equipped with option Assisted GPS (R&S SMx/AMU-K65) and in "Full Configuration" localization mode.

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---

**`[:SOURce<hw>]:BB:GPS:ADGeneration:ACQuisition:BLOCK? <SV ID>,<TimeOffset>`**

Queries part of the current assistance data settings.

**Query parameters:**

- `<SV ID>`                    The SV ID is the ID of the space vehicle for which the assistance data is queried.
- `<Time Offset>`            Time Offset is the offset of time to the beginning of the acquisition data generation set with the command `[:SOURce<hw>]:BB:GPS:ADGeneration:TIME`.

**Return values:**

&lt;Block&gt;

<Rx Time of Week>, <Satellite ID that corresponds to the record>, <Zero Order Doppler Term>, <1st order Doppler Term>, <Uncertainty Doppler>, <Code Phase (or half-Chip index at epoch Time of Transmission (GPS Sat Time))>, <Integer Code Phase (or ms unit index at epoch Time of Transmission (GPS Sat Time))>, <Corresponding Bit number (modulo 4) at epoch Time of Transmission (GPS Sat Time)>, <Correlator Code phase Search Radius>, <Azimuth Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>, <Elevation Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>

The returned value is exactly one row of the acquisition assistance data file (2G, 3G) that can be generated by the command `[ :SOURce<hw> ] :BB:GPS:ADGeneration:ACquisition:CREate`

**Example:**

```
BB:GPS:ADG:TIME 1500
```

sets the time of assistance data.

```
BB:GPS:ADG:ACQ:BLOC? 2,0.1
```

queries the acquisition data for SV ID 2 and time offset of 0.1s, i.e. at GPS Time 1500 + 0.1 s.

Response:

```
589925,5,3733.3371910282908,0,0,599,18,1,11,
225.32801752395233,11.17712126071662
```

**Usage:**

Query only

**Options:**

R&S SMx/AMU-K65

**[ :SOURce<hw> ] :BB:GPS:ADGeneration:ACquisition:CREate <Create>**

Stores the current assistance data settings into the selected acquisition file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as acquisition file with the specific file extensions `*.rs_acq`.

**Parameters:**

<Create> string

**Example:**

```
MMEM:CDIR 'D:\acq_files'
```

sets the default directory to D:\acq\_files

```
SOUR:BB:GPS:ADG:TIME 1500
```

```
BB:GPS:ADG:ACQ:CRE 'acquisition'
```

stores the current settings into file 'acquisition'

```
SOUR:BB:GPS:ADG:ACQ:BLOC? 2,0.1
```

Response:

```
589925,5,3733.3371910282908,0,0,599,18,1,11,
225.32801752395233,11.17712126071662
```

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:ALManac:CREate <Create>**

Stores the current assistance data settings into the selected almanac file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as almanac file with the specific file extensions

`*.rs_al` or `*.rs_yuma`.

The default extension is `*.rs_al` and can be omitted in the file name.

To save an almanac file as file with extension `*.rs_yuma`, however, this extension has to be specified in the file name.

**Parameters:**

<Create>                    <file\_name>

**Example:**

```
MMEM:CDIR 'D:\almanac_files'
sets the default directory to D:\almanac_files
BB:GPS:ADG:ALM:CRE 'almanac_yuma.rs_yuma'
stores the current settings into file 'almanac_yuma.rs_yuma'
BB:GPS:ADG:ALM:CRE 'almanac'
stores the current settings into file 'almanac.rs_al'
```

**Usage:**                    Event

**Options:**                  R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:DURation <Duration>**

Sets the duration (in seconds) of the GPS Assistance Data.

**Parameters:**

<Duration>                  float  
                                  Range:        1.0e-3 s to 5.0e3 s  
                                  \*RST:        1ms

**Example:**                  `BB:GPS:ADG:DUR 150`  
                                  sets the duration of assistance data to 150s

**Options:**                  R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:IONospheric:CREate <Create>**

Stores the current assistance data settings into the selected ionospheric file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as ionospheric file with the specific file extensions

`*.rs_ion`.

**Parameters:**

<Create>                    string

**Example:** MMEM:CDIR 'D:\ionospheric\_files'  
sets the default directory to D:\ionospheric\_files  
BB:GPS:ADG:ALM:CRE 'ionospheric'  
stores the current settings into file ionospheric

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:ALTitude <Altitude>**

Sets the geographic altitude of the reference location in meters above sea level.

**Parameters:**

<Altitude> float  
Range: -10000.0 to 10000.0  
\*RST: 0

**Example:** BB:GPS:ADG:LOC:ALT 250  
sets the altitude of the reference location

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:LATitude <Latitude>**

Sets the latitude (expressed as decimal degree) of the reference location. The decimal value is automatically converted into DEG:MIN:SEC format.

**Parameters:**

<Latitude> float  
Range: -90.0 to 90.0  
\*RST: 0

**Example:** BB:GPS:ADG:LOC:LAT 12.05  
sets the latitude of the reference location

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:LATitude:DEGREes <Degrees>**

Sets the latitude of the reference location in ° (degrees).

**Parameters:**

<Degrees> float  
Range: 0 to 90.0  
\*RST: 0  
Default unit: DEG

**Example:** BB:GPS:ADG:LOC:LAT:DEGR 12  
sets the latitude of the geographic location to 12°

**Options:** R&S SMx/AMU-K65

---

**[[:SOURce<hw>]:BB:GPS:ADGeneration:LOCation:LATitude:DIRection**  
 <Direction>

Sets the direction of the geographic location related to the latitude.

**Parameters:**

<Direction>            NORTH | SOUTH  
 \*RST:                NORTH

**Example:**            BB:GPS:ADG:LOC:LAT:DIR SOUT  
 sets the direction of the reference location to south

**Options:**             R&S SMx/AMU-K65

---

**[[:SOURce<hw>]:BB:GPS:ADGeneration:LOCation:LATitude:MINutes** <Minutes>

Sets the latitude of the geographic location in ' (minutes).

**Parameters:**

<Minutes>             float  
 Range:                0.0 to 59.0  
 \*RST:                0

**Example:**            BB:GPS:ADG:LOC:LAT:MIN 15  
 sets the latitude of the geographic location to 15'

**Options:**             R&S SMx/AMU-K65

---

**[[:SOURce<hw>]:BB:GPS:ADGeneration:LOCation:LATitude:SECConds** <Seconds>

Sets the latitude of the geographic location in " (seconds).

**Parameters:**

<Seconds>             float  
 Range:                0.0 to 59.999  
 \*RST:                0

**Example:**            BB:GPS:ADG:LOC:LAT:SEC 30.123  
 sets the latitude of the geographic location to 30.123"

**Options:**             R&S SMx/AMU-K65

---

**[[:SOURce<hw>]:BB:GPS:ADGeneration:LOCation:LONGitude** <Longitude>

Sets the longitude (expressed as decimal degree) of the reference location. The decimal value is automatically converted into DEG:MIN:SEC format.

**Parameters:**

<Longitude>           float  
 Range:                -180.0 to 180.0  
 Increment:           0.000001  
 \*RST:                0

**Example:** BB:GPS:ADG:LOC:LONG 25.123456  
sets the longitude to 25.123456

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:LONGitude:DEGRees**  
<Degrees>

Sets the longitude (expressed as decimal degree) of the reference location. The decimal value is automatically converted into DEG:MIN:SEC format.

**Parameters:**

<Degrees> float  
Range: 0 to 180  
\*RST: 0

**Example:** BB:GPS:ADG:LOC:LONG:DEGR 25  
sets the longitude of the geographic location to 25°

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:LONGitude:DIRection**  
<Direction>

Sets the direction of the geographic location related to the longitude.

**Parameters:**

<Direction> EAST | WEST  
\*RST: EAST

**Example:** BB:GPS:ADG:LOC:LONG:DIR WEST  
sets the direction of the reference location west

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:LONGitude:MINutes** <Minutes>

Sets the longitude of the geographic location in ' (minutes).

**Parameters:**

<Minutes> float  
Range: 0 to 59

**Example:** BB:GPS:ADG:LOC:LONG:MIN 15  
sets the longitude of the geographic location to 15'

**Options:** R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:LONGitude:SEConds**  
<Seconds>

Sets the longitude of the geographic location in " (seconds).



**Parameters:**

<Seconds> float  
 Range: 0.0 to 59.999

**Example:**

BB:GPS:ADG:LOC:LONG:SEC 15.123  
 sets the longitude of the geographic location to 30.123"

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:PFORmat <Pformat>**

Sets the format in which the Latitude and Longitude are displayed. According to this parameter, the position can be specified in "DEG:MIN:SEC" or in "Decimal Degree" format.

**Parameters:**

<Pformat> DMS | DECimal

**DMS**

The position is specified in DEG:MIN:SEC.

**DECimal**

The position is specified in decimal degree, i.e. +/-XX.XXXXX°,

\*RST: DMS

**Example:**

BB:GPS:ADG:LOC:PFOR DMS  
 position is specified in format DEG:MIN:SEC

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:LOCation:URADius <Uradius>**

Sets the Uncertainty Radius.

**Parameters:**

<Uradius> float  
 Range: 0 to 1000000 m  
 \*RST: 3000 m

**Example:**

BB:GPS:ADG:LOC:URAD 2.5KM  
 sets the uncertainty radius to 2500m

**Options:**

R&S SMx/AMU-K65

**[:SOURCE<hw>]:BB:GPS:ADGeneration:NAVigation:CREate <Create>**

Stores the current assistance data settings into the selected navigation file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as navigation file with the specific file extensions

\*.rs\_nav.

**Parameters:**

<Create> string

**Example:** MMEM:CDIR 'D:\navigation\_files'  
sets the default directory to D:\navigation\_files  
BB:GPS:ADG:ALM:CRE 'navigation'  
stores the current settings into file navigation

**Usage:** Setting only

**Options:** R&S SMx/AMU-K65

**[[:SOURce<hw>]:BB:GPS:ADGeneration:RESolution <Resolution>**

Sets the resolution (in seconds) of the GPS Assistance Data.

**Parameters:**

<Resolution> float  
Range: 1.0e-3 to 5.0e3  
\*RST: 1 ms

**Example:** BB:GPS:ADG:DUR 100  
sets the duration of the assistance data to 100s  
BB:GPS:ADG:RES 25MS  
sets the resolution of assistance data to 25ms

**Options:** R&S SMx/AMU-K65

**[[:SOURce<hw>]:BB:GPS:ADGeneration:SAData? <SV ID>,<NumberSubframes>,<TimeOfWeek>,<WeekNumber>**

Queries a sensitivity assistance message for a specific satellite (SV ID) and at given specific time (Time of Week).

**Query parameters:**

<SV ID> The SV ID is the ID of the space vehicle for which the sensitivity assistance data is queried.  
Range: 1 to 37

<NumberSubframes> The Number of Subframes determines the length of the sensitivity assistance data to be generated.  
The maximum length of the generated sensitivity assistance data is then 125 subframes, i.e. 25 pages or one complete navigation message.  
Range: 1 to 125

<TimeOfWeek> modulo 6 values greater than 0  
Sets the starting time and date of the generated sensitivity assistance data as GPS TOW (Time of Week).  
The modulo 6 requirement is due to the fact, that the duration of one subframe is 6 sec. For Time of Week values that do not fulfill this rule, the calculation is made with the first lower modulo 6 value.

<WeekNumber> Sets the week of the generated sensitivity assistance data.

Range: 0 to 1023

**Return values:**

<Sadata> string

The R&S Signal Generator generates a sensitivity assistance message as a binary stream.

The returned value of this query for a healthy satellite is a sequence of integer values. The first integer is the size of the message in bits to be returned. The remaining, each of which is a 32 bits long block, represents the expected data bits of the navigation message.

The query returns 0, in case an unhealthy satellite has been selected.

An error will only be reported if an out of range value for any of the arguments has been selected.

**Example:**

BB:GPS:ADG:ACQ:SAD? 1,1,3600,1

queries the sensitivity assistance data for SV ID 1.

Response: 0

The selected satellite is unhealthy.

BB:GPS:ADG:SAT1:SVID 5

sets the satellite with SV ID 5 to be simulated from satellite 1

BB:GPS:ADG:ACQ:SAD? 5,1,3600,1

queries the sensitivity assistance data for SV ID 5.

Response:

300,-1962933360,78782016,68160383,-10752,43007,  
-172032,681727,-1009778689,-1

The first bits of the sensitivity assistance message are 1000 1011

...

**Usage:** Query only

**Options:** R&S SMx/AMU-K65

**[[:SOURce<hw>]:BB:GPS:ADGeneration:SATellite<st>:SVID <Svid>**

Sets the ID for the corresponding satellite (space vehicle) for which the assistance data will be generate.

**Suffix:**

<st> 1 .. 37

**Parameters:**

<Svid> float

Range: 1 to 37

**Example:**

BB:GPS:ADG:SAT4:SVID 16

sets the satellite with SV ID 16 to be simulated from satellite 4

**Options:** R&S SMx/AMU-K65

---

**[:SOURCE<hw>]:BB:GPS:ADGeneration:SCOUNT <Scout>**

Sets the Number of satellites for which the assistance data will be generate.

**Note:** Configuration of eight satellites is only possible for two path instruments.

**Parameters:**

<Scout> float  
 Range: 1 to 9  
 \*RST: 1

**Example:**

BB:GPS:BAW:STAT ON  
 enables configuration of 8 satellites  
 BB:GPS:ADG:SCO 7  
 sets the number of satellites for which assistance data will be generate to 7

**Options:** R&S SMx/AMU-K65

---

**[:SOURCE<hw>]:BB:GPS:ADGeneration:SYNChronize**

Synchronies the "assisted" satellites with GPS satellites.

**Example:**

BB:GPS:ADG:SYNC  
 synchronies the "assisted" satellites with GPS satellites

**Usage:** Event

**Options:** R&S SMx/AMU-K65

---

**[:SOURCE<hw>]:BB:GPS:ADGeneration:TIME <Time>**

Sets the starting time and date of the assistance data as GPS TOW (Time of Week).

**Parameters:**

<Time> float  
 Range: -604800 to 604800  
 Increment: 1  
 \*RST: 0

**Example:**

BB:GPS:ADG:TIME 1500  
 sets the time of assistance data

**Options:** R&S SMx/AMU-K65

---

**[:SOURCE<hw>]:BB:GPS:ADGeneration:UTC:CREate <Create>**

Stores the current assistance data settings into the selected UTC file. The directory is set using command `M MEM:CDIRECTORY`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as UTC file with the specific file extensions `*.rs_utc`.

**Parameters:****<Create>** string**Example:**

```

MEM:CDIR 'D:\utc_files'
sets the default directory to D:\utc_files
BB:GPS:ADG:ALM:CRE 'utc'
stores the current settings into file 'utc'

```

**Options:**

R&amp;S SMx/AMU-K65

## 4.5 Real-Time S.P.O.T.

|  |     |
|--|-----|
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:SPOT:NHOTime</code> .....                  | 127 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:ALTitide</code> .....            | 127 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LATitide</code> .....            | 128 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LATitide:DEGRees</code> .....    | 128 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LATitide:DIRection</code> .....  | 129 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LATitide:MINutes</code> .....    | 129 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LATitide:SEConds</code> .....    | 129 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LONGitude</code> .....           | 130 |
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| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LONGitude:DIRection</code> ..... | 130 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LONGitude:MINutes</code> .....   | 131 |
| <code>[ :SOURce&lt;hw&gt;]:BB:GPS:RLOCation:LONGitude:SEConds</code> .....   | 131 |

---

### `[ :SOURce<hw>]:BB:GPS:SPOT:NHOTime?`

(enabled for A"uto SV Selection and Updated" mode)

Queries the expected time of the upcoming satellites handover.

The time is expressed as a time offset (in seconds) to the beginning of the simulation set with the command `[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[: BEGIN]:TIME`.

**Return values:****<Nhotime>** float

Increment: 1 sec

**Example:**

```

BB:GPS:SPOT:NHOT?
queries the time of the upcoming satellites handover.
Response: 12103

```

**Usage:**

Query only

---

### `[ :SOURce<hw>]:BB:GPS:RLOCation:ALTitide? <ElapsedTime>`

Queries the current geographic altitude of the receiver.

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `SOUR:BB:GPS:NAV:SIM:BEG:TIME`.

**Return values:**

<Altitude> float  
Increment: 0.1 m

**Example:**

`BB:GPS:RLOC:ALT? 1.2`  
queries the geographic altitude of a receiver with time offset of 1.2 sec.  
Response: 100

**Usage:** Query only

**[ :SOURce<hw> ]:BB:GPS:RLOCation:LATitude? <ElapsedTime>**

Queries the current latitude of the receiver's geographic location expressed as decimal degree.

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURce<hw> ]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME`.

**Return values:**

<Latitude> float  
Increment: 0.000001

**Example:**

`BB:GPS:RLOC:LAT? 1360`  
queries the receiver's latitude.  
Response: -7.816657

**Usage:** Query only

**[ :SOURce<hw> ]:BB:GPS:RLOCation:LATitude:DEGRees? <ElapsedTime>**

Queries the current latitude of the receiver's geographic location expressed in ° (degrees).

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURce<hw> ]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME`.

**Return values:**

<Degrees> float

**Example:** BB:GPS:RLOC:LAT:DEGR? 1375  
queries the receiver's latitude.  
Response: 7

**Usage:** Query only

**[:SOURCE<hw>]:BB:GPS:RLOCation:LATitude:DIRection? <ElapsedTime>**

Queries the current direction of the receiver's geographic location related to the latitude.

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURCE<hw> ]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME`.

**Return values:**

<Direction> NORTH | SOUTH

**Example:** BB:GPS:RLOC:RLAT:DIR? 1375  
queries the receiver's direction.  
Response: SOUTH

**Usage:** Query only

**[:SOURCE<hw>]:BB:GPS:RLOCation:LATitude:MINutes? <ElapsedTime>**

Queries the current latitude of the receiver's geographic location expressed in ' (minutes).

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURCE<hw> ]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME`.

**Return values:**

<Minutes> float

**Example:** BB:GPS:RLOC:LAT:MIN? 1375  
queries the receiver's latitude.  
Response: 48

**Usage:** Query only

**[:SOURCE<hw>]:BB:GPS:RLOCation:LATitude:SECOnds? <ElapsedTime>**

Queries the current latitude of the receiver's geographic location expressed " (seconds).

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `SOUR:BB:GPS:NAV:SIM:BEG:TIME`.

**Return values:**

<Seconds> float

**Example:**

BB:GPS:RLOC:LAT:SEC? 1275  
queries the receiver's latitude.  
Response: 54.842

**Usage:**

Query only

**[ :SOURce<hw>]:BB:GPS:RLOCation:LONGitude? <ElapsedTime>**

Queries the current longitude of the receiver's geographic location expressed as decimal degree.

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME`.

**Return values:**

<Longitude> float  
Increment: 0.000001

**Example:**

BB:GPS:RLOC:LONG? 1365  
queries the receiver's longitude.  
Response: 144.966624

**Usage:**

Query only

**[ :SOURce<hw>]:BB:GPS:RLOCation:LONGitude:DEGREes? <ElapsedTime>**

Queries the current longitude of the receiver's geographic location expressed in ° (degrees).

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURce<hw>]:BB:GPS:NAVigation:SIMulation[:BEGin]:TIME`.

**Return values:**

<Degrees> float

**Example:**

BB:GPS:RLOC:LONG:DEGR? 1375  
queries the receiver's longitude.  
Response: 144

**Usage:**

Query only

**[ :SOURce<hw>]:BB:GPS:RLOCation:LONGitude:DIRection? <ElapsedTime>**

Queries the current direction of the receiver's geographic location related to the longitude.



**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURCE<hw> ] :BB:GPS:NAVigation:SIMulation[: BEGin] :TIME`.

**Return values:**

<Direction> EAST | WEST

**Example:**

BB:GPS:RLOC:LONG:DIR? 1375  
queries the receiver's direction.  
Response: EAST

**Usage:**

Query only

`[ :SOURCE<hw> ] :BB:GPS:RLOCation:LONGitude:MINutes? <ElapsedTime>`

Queries the current longitude of the receiver's geographic location expressed in ' (minutes).

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURCE<hw> ] :BB:GPS:NAVigation:SIMulation[: BEGin] :TIME`.

**Return values:**

<Minutes> float

**Example:**

BB:GPS:RLOC:LONG:MIN? 1375  
queries the receiver's longitude.  
Response: 57

**Usage:**

Query only

`[ :SOURCE<hw> ] :BB:GPS:RLOCation:LONGitude:SECONDS? <ElapsedTime>`

Queries the current longitude of the receiver's geographic location expressed in " (seconds).

**Query parameters:**

<ElapsedTime> Mandatory argument. Elapsed Time is the offset of time (in seconds) to the beginning of the simulation set with the command `[ :SOURCE<hw> ] :BB:GPS:NAVigation:SIMulation[: BEGin] :TIME`.

**Return values:**

<Seconds> float

**Example:**

BB:GPS:RLOC:LONG:SEC? 1365  
queries the receiver's longitude.  
Response: 59.260

**Usage:**

Query only

## 4.6 Trigger Settings



The trigger settings are available for R&S SMx and R&S AMU instruments only.

### **EXTernal<ch>**

The numeric suffix to **EXTernal<ch>** distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

|  |     |
|--|-----|
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:ARM:EXECute</code> .....                  | 132 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:EXECute</code> .....                      | 132 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:EXTernal:SYNChronize:OUTPut</code> .....  | 133 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OBASeband:DELay</code> .....              | 133 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OBASeband:INHibit</code> .....            | 134 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:RMODE</code> .....                        | 134 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:SLEngth</code> .....                      | 135 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:SLUNit</code> .....                       | 135 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:SOURce</code> .....                       | 135 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger[:EXTernal&lt;ch&gt;]:DELay</code> .....   | 136 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger[:EXTernal&lt;ch&gt;]:INHibit</code> ..... | 136 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS[:TRIGger]:SEQUence</code> .....                   | 137 |

### **[:SOURce<hw>]:BB:GPS:TRIGger:ARM:EXECute**

Stops signal generation for trigger modes "Armed\_Auto" and "Armed\_Retrigger". A subsequent internal or external trigger event restarts signal generation.

#### **Example:**

```
BB:GPS:TRIG:SOUR INT
sets internal triggering.
BB:GPS:TRIG:SEQ ARET
sets Armed_Retrigger mode, i.e. every trigger event causes signal
generation to restart.
BB:GPS:TRIG:EXEC
executes a trigger, signal generation is started.
BB:GPS:TRIG:ARM:EXEC
signal generation is stopped.
BB:GPS:TRIG:EXEC
executes a trigger, signal generation is started again.
```

**Usage:** Event

### **[:SOURce<hw>]:BB:GPS:TRIGger:EXECute**

Executes a trigger. The internal trigger source must be selected using the command `:BB:GPS:TRIG:SOUR INT` and a trigger mode other than `AUTO` must be selected using the command `:BB:GPS:TRIG:SEQ`.

**Example:**

```
BB:GPS:TRIG:SOUR INT
sets internal triggering.
BB:GPS:TRIG:SEQ ARET
sets "Armed_Retrigger" mode, i.e. every trigger event causes signal generation to restart.
BB:GPS:TRIG:EXEC
executes a trigger, signal generation is started.
BB:GPS:TRIG:ARM:EXEC
signal generation is stopped.
BB:GPS:TRIG:EXEC
executes a trigger, signal generation is started again.
```

**Usage:** Event

---

**[[:SOURce<hw>]:BB:GPS:TRIGger:EXTernal:SYNChronize:OUTPut <Output>**

(enabled for "Trigger Source" External)

Enables/disables output of the signal synchronous to the external trigger event.

See also "[Sync. Output to External Trigger](#)" on page 67 for a detailed description of the applications of this parameter.

**Parameters:**

<Output> 0 | 1 | OFF | ON

**ON**

The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.

**OFF**

The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted.

\*RST: ON

**Example:**

```
BB:GPS:TRIG:SOUR EXT
sets external triggering.
BB:GPS:TRIG:EXT:SYNC:OUTP ON
enables synchronous output to external trigger.
```

---

**[[:SOURce<hw>]:BB:GPS:TRIGger:OBASeband:DELay <Delay>**

Specifies the trigger delay (expressed as a number of chips) for triggering by the trigger signal from the second path.

**Parameters:**

<Delay> float  
 Range: 0 to 2<sup>32</sup>-1  
 Increment: 1 chip  
 \*RST: 0 chips

**Example:** `BB:GPS:TRIG:SOUR OBAS`  
 sets for path A the internal trigger executed by the trigger signal from the second path (path B).  
`BB:GPS:TRIG:OBAS:DEL 50`  
 sets a delay of 50 chips for the trigger.

---

**[ :SOURce<hw> ]:BB:GPS:TRIGger:OBASeband:INHibit <Inhibit>**

Specifies the number of chips by which a restart is to be inhibited following a trigger event. Applies only for triggering by the second path (two-path instruments only).

**Parameters:**

<Inhibit> float  
 Range: 0 to  $2^{32}-1$   
 Increment: 1 chip  
 \*RST: 0 chips

**Example:** `BB:GPS:TRIG:SOUR OBAS`  
 sets for path A the internal trigger executed by the trigger signal from the second path (path B).  
`BB:GPS:TRIG:INH 200`  
 sets a restart inhibit for 200 chips following a trigger event.

---

**[ :SOURce<hw> ]:BB:GPS:TRIGger:RMODE?**

Queries the current status of signal generation for all trigger modes with GPS modulation on.

**Return values:**

<Rmode> STOP | RUN  
**RUN**  
 the signal is generated. A trigger event occurred in the triggered mode.  
**STOP**  
 the signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command `:BB:GPS:TRIG:ARM:EXECute` (armed trigger modes only).

**Example:** `BB:GPS:TRIG:MODE ARET`  
 selects the "Armed\_Retrigger" mode.  
`BB:GPS:TRIG:SOUR EXT`  
 sets external triggering via the TRIGGER 1 connector.  
`BB:GPS:TRIG:RMODE?`  
 queries the current status of signal generation.  
 Response: RUN  
 the signal is generated, an external trigger was executed.

**Usage:** Query only

**[[:SOURce<hw>]:BB:GPS:TRIGger:SEnLength <Slength>**

Defines the length of the signal sequence to be output in the "Single" trigger mode (SOUR:BB:GPS:SEQ SING). The unit of the entry is defined under "Signal Duration Unit". The maximum value for the sequence length depends on the selected unit.

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

**Parameters:**

<Slength> float  
Range: 1.0 to Max

**Example:**

```
BB:GPS:SEQ SING
sets trigger mode Single.
BB:GPS:TRIG:SEn 200
sets a sequence length of 200 chips. The first 200 chips of the
current frame will be output after the next trigger event.
```

**[[:SOURce<hw>]:BB:GPS:TRIGger:SLUNit <Slunit>**

Defines the unit for the entry of the length of the signal sequence (SOUR:BB:GPS:TRIG:SEn) to be output in the "Single" trigger mode (SOUR:BB:GPS:SEQ SING).

**Parameters:**

<Slunit> CHIP | SFRame | NBIT

**SFRame**  
Unit subframe. A single subframe is generated after a trigger event.

**CHIP**  
Unit Chip. A single chip is generated after a trigger event.

**NBIT**  
Unit Navigation Bit. A single Navigation Bit is generated after a trigger event.

\*RST: SFRame

**Example:**

```
BB:GPS:SEQ SING
sets trigger mode Single.
BB:GPS:TRIG:SLUN SFR
sets unit Subframe for the entry of signal duration.
BB:GPS:TRIG:SEn 2
sets a signal duration of 2 subframes. The current subframe will
be output twice after the next trigger event.
```

**[[:SOURce<hw>]:BB:GPS:TRIGger:SOURce <Source>**

Selects the trigger source.

**Parameters:**

&lt;Source&gt;

INTernal | EXTernal | BEXTernal | OBASeband

**INTernal**

Triggering is executed by means of the Trigger command `SOURCE:BB:GPS:TRIGGER:EXECUTE` or `*TRG` in the case of remote control and by means of Execute Trigger in the case of manual operation.

**EXTernal**

Triggering is executed by means of the signal on the TRIGGER 1 connector.

**BEXTernal**

Triggering is executed by means of the signal on the TRIGGER 2 connector.

**OBASeband**

Triggering is executed by means of the trigger signal from the second path (two-path instruments only).

**Example:**

```
BB:GPS:TRIG:SING
```

selects a trigger mode that requires a trigger.

```
BB:GPS:TRIG:SOUR EXT
```

sets external triggering via the TRIGGER 1 connector.

```
[[:SOURCE<hw>]:BB:GPS:TRIGGER[:EXTernal<ch>]:DELAY <Delay>
```

Specifies the trigger delay (expressed as a number of chips) for external triggering.

**Parameters:**

&lt;Delay&gt;

float

Range: 0.0 to 65535.0

Increment: 0.01 chip

\*RST: 0.0 chips

**Example:**

```
BB:GPS:TRIG:SOUR EXT
```

sets an external trigger via the TRIGGER 1 connector.

```
BB:GPS:TRIG:DEL 50
```

sets a delay of 50 chips for the trigger.

```
[[:SOURCE<hw>]:BB:GPS:TRIGGER[:EXTernal<ch>]:INHIBIT <Inhibit>
```

Specifies the number of chips by which a restart is to be inhibited following a trigger event. Applies only in the case of external triggering.

**Parameters:**

&lt;Inhibit&gt;

float

Range: 0 to  $2^{32}-1$ 

Increment: 1 chip

\*RST: 0 chips

**Example:** `BB:GPS:TRIG:SOUR EXT`  
 selects an external trigger via the TRIGGER 1 connector.  
`BB:GPS:TRIG:INH 200`  
 sets a restart inhibit for 200 chips following a trigger event.

---

**[:SOURce<hw>]:BB:GPS[:TRIGger]:SEQUence <Sequence>**

Selects the trigger mode.

**Parameters:**

<Sequence>

AUTO | RETRigger | AAUTo | ARETrigger | SINGLE

**AUTO**

The modulation signal is generated continuously.

**RETRigger**

The modulation signal is generated continuously. A trigger event (internal or external) causes a restart.

**AAUTo**

The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command `SOUR:BB:GPS:TRIG:ARM:EXEC` and started again when a trigger event occurs.

**ARETrigger**

The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart.

Signal generation is stopped with command

`SOUR:BB:GPS:TRIG:ARM:EXEC` and started again when a trigger event occurs.

**SINGLE**

The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command `SOUR:BB:GPS:TRIG:SLEN`. Every subsequent trigger event causes a restart.

\*RST: AUTO

**Example:**

`BB:GPS:SEQ AAUT`

sets the "Armed\_auto" trigger mode; the device waits for the first trigger (e.g. with \*TRG) and then generates the signal continuously.

## 4.7 Marker Settings

This section lists the remote control commands, necessary to configure the markers.



The marker delay settings are available for R&S SMx and R&S AMU instruments only.

### OUTPut<ch>

The numeric suffix to OUTPut distinguishes between the available markers.

|  |     |
|--|-----|
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| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OUTPut&lt;ch&gt;:DELay:MAXimum</code> .....   | 139 |
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| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OUTPut&lt;ch&gt;:OFFTime</code> .....         | 140 |
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| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OUTPut&lt;ch&gt;:PULSe:DIVider</code> .....   | 141 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OUTPut&lt;ch&gt;:PULSe:FREQuency</code> ..... | 141 |
| <code>[:SOURce&lt;hw&gt;]:BB:GPS:TRIGger:OUTPut&lt;ch&gt;:PULSe:WIDTh</code> .....     | 142 |

### `[:SOURce<hw>]:BB:GPS:TRIGger:OUTPut:DELay:FIXed` <Fixed>

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is generated.

#### Parameters:

<Fixed>                    0 | 1 | OFF | ON  
 \*RST:                    OFF

#### Example:

`BB:GPS:TRIG:OUTP:DEL:FIX ON`  
 restricts the marker signal delay setting range to the dynamic range.

### `[:SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:DELay` <Delay>

Defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of chips. Command `:BB:GPS:TRIGger:OUTPut:DELay:FIXed` can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

#### Parameters:

<Delay>                    float  
 Range:                    0 to  $2^{32} - 1$  chips  
 Increment:                1 chip  
 \*RST:                    0

#### Example:

`BB:GPS:TRIG:OUTP2:DEL 1600`  
 sets a delay of 1600 chips for the signal on connector MARKER 2.



---

**[ :SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:DELay:MAXimum?**

Queries the maximum marker delay for setting :BB:GPS:TRIG:OUTP:DEL:FIX ON.

**Return values:**

<Maximum> float

**Example:**

BB:GPS:TRIG:OUTP:DEL:FIX ON

restricts the marker signal delay setting range to the dynamic range.

BB:GPS:TRIG:OUTP:DEL:MAX?

queries the maximum of the dynamic range.

Response: 2000

the maximum for the marker delay setting is 2000 chips.

**Usage:** Query only

---

**[ :SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:DELay:MINimum?**

Queries the minimum marker delay for setting :BB:GPS:TRIGger:OUTPut: DELay:FIXed ON.

**Return values:**

<Minimum> float

**Example:**

BB:GPS:TRIG:OUTP:DEL:FIX ON

restricts the marker signal delay setting range to the dynamic range.

BB:GPS:TRIG:OUTP:DEL:MIN?

queries the minimum of the dynamic range.

Response: 0

the minimum for the marker delay setting is 0 chips.

**Usage:** Query only

---

**[ :SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:MODE <Mode>**

Defines the signal for the selected marker output.

**Parameters:**

&lt;Mode&gt;

NBIT | WORD | SFRame | PULSe | PATTern | RATio | PPS |  
PP2S | TRIGger | DISabled

**NBIT**

A marker signal is generated for every navigation data bit (20460 C/A chips).

**WORD**

A marker signal is generated for every navigation data word (30 navigation bits).

**SFRame**

A marker signal is generated for every navigation subframe (corresponds to 10 words).

**PPS**

A marker signal is generated for every start of second (GPS time). The pulse width is defined with the

`SOUR:BB:GPS:TRIG:OUTP:PULSe:WIDTh` command

**PP2S**

A marker signal is generated for every second second (GPS time). The pulse width is defined with the

`SOUR:BB:GPS:TRIG:OUTP:PULSe:WIDTh` command.

**PULSe**

A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the

`SOUR:BB:GPS:TRIG:OUTP:PULSe:DIVider` command and

can be queried with the

`SOUR:BB:GPS:TRIG:OUTP:PULSe:FREQuency?` command.

**PATtern**

A marker signal is generated according to the user defined pattern (command `SOURce:BB:GPS:TRIGger:OUTPut:PATtern`).

**RATio**

A marker signal corresponding to the Time Off / Time On specifications in the commands

`SOURce:BB:GPS:TRIGger:OUTPut:OFFT` and

`SOURce:BB:GPS:TRIGger:OUTPut:ONT` is generated.

\*RST: NBIT

**Example:**

`BB:GPS:TRIG:OUTP2:MODE WORD`

selects the word marker signal on output MARKER 2. A marker signal is generated for every navigation data word (30 navigation bits, 20460 C/A chips each).

**[ :SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:ONTTime <Ontime>**

**[ :SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:OFFTime <Offtime>**

Sets the number of chips in a period (ON time + OFF time) during which the marker signal is setting `SOURce:BB:GPS:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

**Parameters:**

<Offtime> float  
 Range: 1 to  $2^{24} - 1$  chips  
 Increment: 1 chip  
 \*RST: 1 chip

**Example:**

BB:GPS:TRIG:OUTP2:OFFT 200  
 sets an OFF time of 200 chips for marker signal 2.

**[[:SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:PATTern <Pattern>**

Defines the bit pattern used to generate the marker signal in the setting  
 SOURce:BB:GPS:TRIGger:OUTPut:MODE PATTern. 0 is marker off, 1 is marker on.

**Parameters:**

<Pattern> 64 bit pattern  
 Range: #B0,1 to #B111...1,64  
 \*RST: #B0,1

**Example:**

BB:GPS:TRIG:OUTP2:PATT #B000000011111111,15  
 sets a bit pattern.  
 BB:GPS:TRIG:OUTP2:MODE PATT  
 activates the marker signal according to a bit pattern on output  
 MARKER 2.

**[[:SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>**

Sets the divider for Pulse marker mode (SOUR:BB:GPS:TRIG:OUTP:MODE PULSe).  
 The resulting pulse frequency is derived by dividing the chip rate (1.023 MHz) by the  
 divider.

**Parameters:**

<Divider> float  
 Range: 2 to  $2^{10}$   
 Increment: 1  
 \*RST: 2

**Example:**

BB:GPS:TRIG:OUTP2:PULS:DIV 2  
 sets the divider to 2 for the marker signal on output MARKER 2.  
 BB:GPS:TRIG:OUTP2:FREQ?  
 queries the resulting pulse frequency of the marker signal.  
 Response: 511511.038  
 the resulting pulse frequency is 511.511 kHz.

**[[:SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:PULSe:FREQuency?**

Queries the pulse frequency of the pulsed marker signal in the setting  
 SOURce:BB:GPS:TRIGger:OUTPut:MODE PULSe. The pulse frequency is derived by  
 dividing the symbol rate by the divider.

**Return values:**

&lt;Frequency&gt; float

**Example:**

```
BB:GPS:TRIG:OUTP2:PULS:DIV 2
sets the divider for the marker signal on output MARKER 2 to the
value 2.
BB:GPS:TRIG:OUTP2:MODE PULS
enables the pulsed marker signal.
BB:GPS:TRIG:OUTP2:PULS:FREQ?
queries the pulse frequency of the marker signal.
Response: 511511.038
the resulting pulse frequency is 511.511 kHz.
```

**Usage:** Query only

---

```
[:SOURce<hw>]:BB:GPS:TRIGger:OUTPut<ch>:PULSe:WIDTh <Width>
```

Sets the Pulse Width for 1PPS and 1PP2S marker mode  
(SOUR:BB:GPS:TRIG:OUTP:MODE PPS | PP2S).

**Parameters:**

```
<Width> float
Range: 1 to 800
Increment: 1
*RST: 1
```

**Example:**

```
BB:GPS:TRIG:OUTP2:MODE PPS
enables the 1PPS marker signal.
BB:GPS:TRIG:OUTP1:PULS:WIDT 2
sets the pulse width for the marker signal on output MARKER 2 to
the value 2.
```

## 4.8 Clock Settings

This section lists the remote control commands, necessary to configure the clock.



The clock settings are available for R&S SMx and R&S AMU instruments only.

---

```
[:SOURce<hw>]:BB:GPS:CLOCK:MODE..... 142
[:SOURce<hw>]:BB:GPS:CLOCK:MULTIplier..... 143
[:SOURce<hw>]:BB:GPS:CLOCK:SOURce..... 143
```

---

```
[:SOURce<hw>]:BB:GPS:CLOCK:MODE <Mode>
```

Enters the type of externally supplied clock (:BB:GPS:CLOCK:SOURce EXTERNAL).

When `MCHip` is used, a multiple of the chip clock is supplied via the `CLOCK` connector and the chip clock is derived internally from this. The multiplier is entered with the command `BB:GPS:CLOCK:MULTIPLIER`.

For two-path instruments, the only numerical suffix allowed for `SOURCE` is 1, since the external clock source is permanently allocated to path A.

**Parameters:**

<Mode>                   CHIP | MCHip  
\*RST:                    CHIP

**Example:**

`BB:GPS:CLOCK:MODE CHIP`  
selects clock type "Chip", i.e. the supplied clock is a chip clock.

**[ :SOURCE<hw> ]:BB:GPS:CLOCK:MULTIPLIER <Multiplier>**

Specifies the multiplier for clock type "Multiplied" (`:BB:GPS:CLOCK:MODE MCHip`) in the case of an external clock source.

For two-path instruments, the only numerical suffix allowed for `SOURCE` is 1, since the external clock source is permanently allocated to path A.

**Parameters:**

<Multiplier>           float  
Range:                 1 to 64  
Increment:            1  
\*RST:                 4

**Example:**

`BB:GPS:CLOCK:SOUR EXT`  
selects the external clock source. The clock is supplied via the `CLOCK` connector.  
`BB:GPS:CLOCK:MODE MCH`  
selects clock type "Multiplied", i.e. the supplied clock has a rate which is a multiple of the chip rate.  
`BB:GPS:CLOCK:MULT 12`  
the multiplier for the external clock rate is 12.

**[ :SOURCE<hw> ]:BB:GPS:CLOCK:SOURCE <Source>**

Selects the clock source.

For two-path instruments, selecting `EXTERNAL` is only possible for path A, since the external clock source is permanently allocated to path A.

**Parameters:**

<Source> INTernal | EXTernal | AINTernal

**INTernal**

The internal clock reference is used to generate the chip clock (1.023 MHz).

**EXTernal**

The external clock reference is supplied to the CLOCK connector.

\*RST: INTernal

**Example:**

BB:GPS:CLOC:SOUR EXT

selects an external clock reference. The clock is supplied via the CLOCK connector.

BB:GPS:CLOC:MODE CHIP

specifies that a chip clock is supplied via the CLOCK connector.

## 4.9 Filter Settings

---

**[:SOURCE<hw>]:BB:GPS:FILTer:OSAMpling <Osampling>**

for R&S WinIQSIM2 only

The command sets the upsampling factor.

A higher upsampling factor improves the filtering but increases the waveform size proportionally. This leads to limitation for the maximum Duration of Satellite Simulation (BB:GPS:DUR).

**Parameters:**

<Osampling> float  
 Range: 2 to 32  
 Increment: 1  
 \*RST: 2

**Example:**

BB:GPS:FILT:OSAM 12

sets the upsampling factor to 12.

---

**[:SOURCE<hw>]:BB:GPS:FILTer:TYPE <Type>**

Sets the filter to GPS compliant rectangular mode or to Gauss mode.

**Parameters:**

<Type> RECTangle | GAUSs  
 \*RST: RECTangle

**Example:**

BB:GPS:FILT:TYPE RECT

sets the filter to rectangular mode.

## List of Commands

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