3 Remote Control

3.1 Introduction

The instrument is equipped with an IEC-bus interface according to standard IEC 625.1/IEEE 488.2, and a RS-232 interface. The connector is located at the rear of the instrument and permits connecting a controller for remote control. The instrument supports the SCPI version 1994.0 (Standard Commands for Programmable Instruments). The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers (see Section 3.5.1).

This section assumes basic knowledge of IEC-bus programming and operation of the controller. A description of the interface commands is to be obtained from the relevant manuals.
The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the respective sections. Tables provide a fast overview of the commands implemented in the instrument and the bit assignment in the status registers. The tables are supplemented by a comprehensive description of every command and the status registers. Detailed program examples of the main functions are to be found in annex D. The program examples for IEC-bus programming are all written in Quick BASIC.

Note:
*In contrast to manual control, which is intended for maximum possible operating convenience, the priority of remote control is the predictability of the device status. This means that when incompatible settings (eg activation of PM and FM at the same time) are attempted, the command is ignored and the device status remains unchanged, ie is not adapted to other settings. Therefore, IEC/IEEE-bus control programs should always define an initial device status (eg with command *RST) and then implement the required settings.*

3.2 Brief Instructions

The short and simple operating sequence given below permits fast putting into operation of the instrument and setting of its basic functions.

3.2.1 IEC Bus

It is assumed that the IEC-bus address, which is factory-set to 28 has not yet been changed.

1. Connect instrument and controller using IEC-bus cable.
2. Write and start the following program on the controller:

```
CALL IBFIND("DEV1", generator%)          Open port to the instrument
CALL IBPAD(generator%, 28)               Inform controller about instrument address
CALL IBWRT(generator%, "*RST;*CLS")      Reset instrument
CALL IBWRT(generator%, "FREQ 50MHz")     Set frequency to 50 MHz
CALL IBWRT(generator%, "POW -7.3dBm")    Set output level –7.3 dBm
CALL IBWRT(generator%, "AM:SOUR INT1")   Set AM modulation source LFGEN1
CALL IBWRT(generator%, "AM:INT1:FREQ 15kHz")  Set modulation frequency 15 kHz
CALL IBWRT(generator%, "AM 30PCT")       Set AM modulation depth 30%
CALL IBWRT(generator%, "AM:STAT ON")     Switch on AM
CALL IBWRT(generator%, "OUTPUT:STATE ON")  Switch on RF output
```

   An amplitude-modulated signal is now applied at the output of the instrument.
3. To return to manual control, press the LOCAL key at the front panel

3.2.2 RS-232 Interface

It is assumed that the configuration of the RS-232 interface at the unit has not yet been changed.

1. Connect unit and controller using the 0-modem cable
2. Enter the following command at the controller to configure the controller interface:

   mode com1: 9600, n, 8, 1
3. Create the following ASCII file:

	Switch instrument to remote control (Return key)
`*RST;*CLS`	Reset instrument
`FREQ 50MHz`	Set frequency 50 MHz
`POW -7.3dBm`	Set output level –7.3 dBm
`OUTP:STAT ON`	Switch on RF output
`AM:SOUR INT1`	Set AM modulation source LFGEN1
`AM:INT1:FREQ 15kHz`	Set modulation frequency 15 kHz
`AM 30PCT`	Set AM modulation depth 30%
`AM:STAT ON`	Switch on AM
	(Return key)

4. Transfer ASCII file to unit via RS-232 interface. Enter the following command at the controller:

   copy <fileame> com1:

   An amplitude-modulated signal is now applied at the output of the instrument.
5. To return to manual control, press the [LOCAL] key at the front panel.

3.3 Switchover to Remote Control

On power-on, the instrument is always in the manual operating state ("LOCAL" state) and can be operated via the front panel.
The instrument is switched to remote control ("REMOTE" state)

IEC bus — as soon as it receives an addressed command from a controller.

RS-232 — as soon as it receives either a carriage return <CR> (=0Dh) or a line feed <LF> (0Ah) from a controller.

During remote control, operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via IEC bus (see Sections 3.3.1.3 and 3.3.2.3). Switching from manual operation to remote control and vice versa does not affect the remaining instrument settings.

3.3.1 Remote Control via IEC Bus

3.3.1.1 Setting the Device Address

The IEC-bus address of the instrument is factory-set to 28. It can be changed manually in the UTILITIES-SYSTEM-GPIB-ADDRESS menu or via IEC bus. Addresses 0 to 30 are permissible.

Manually:

- Call UTILITIES-SYSTEM-GPIB-ADDRESS menu
- Enter desired address
- Terminate input using the [1x/ENTER] key

Via IEC bus:

```
CALL IBFIND("DEV1", generator%)                    Open port to the instrument
CALL IBPAD(generator%, 28)                         Inform controller about old
                                                   address
CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 20")   Set instrument to new address
CALL IBPAD(generator%, 20)                         Inform controller about new
                                                   address
```

3.3.1.2 Indications during Remote Control

The state of the remote control is evident by the words "IEC REMOTE" or "LOCAL" on the STATUS page. The STATUS page is always displayed in the REMOTE state.
LOCKED indicates that the key [LOCAL] is disabled, ie switchover to manual operation is only possible via IEC/IEEE bus. With UNLOCKED indicated, switchover to manual control is possible via the key [LOCAL] (see also section 3.3.1.3).

3.3.1.3 Return to Manual Operation

Return to manual operation is possible via the front panel or the IEC bus.

Manually:

- Press the [LOCAL] key.

Notes:

- *Before switchover, command processing must be completed as otherwise switchover to remote control is effected immediately.*
- *The [LOCAL] key can be disabled by the universal command LLO (see annex A) in order to prevent unintentional switchover. In this case, switchover to manual mode is only possible via the IEC bus.*
- *The [LOCAL] key can be enabled again by deactivating the REN control line of the IEC bus (see annex A).*

Via IEC bus:

```
...
CALL IBLOC(generator%)          Set instrument to manual operation.
```

3.3.2 Remote Control via RS-232-Interface

3.3.2.1 Setting the Transmission Parameters

To enable an error-free and correct data transmission, the parameters of the unit and the controller should have the same setting. To prevent any problems during binary data transmission, the RS-232 interface is set for 8 data bits, no parity and 1 stop bit. This data format corresponds to the current IEEE P1174 standard. Parameters baud rate and handshake can be manually changed in menu UTILITIES-SYSTEM-RS-232.

- Call UTILITIES-SYSTEM-GPIB-RS232 menu
- Select desired baudrate and handshake
- Terminate input using the [1x/ENTER] key

3.3.2.2 Indications during Remote Control

The state of the remote control is evident by the words "RS-232 REMOTE" or "LOCAL" on the STATUS page. The STATUS page is always displayed in the REMOTE state.

3.3.2.3 Return to Manual Operation

Return to manual operation is possible via the front panel.

- Press the [LOCAL] key.

Note: – *Before switchover, command processing must be completed as otherwise switchover to remote control is effected immediately.*

3.4 Messages

The messages transferred via the data lines of the IEC bus (see annex A) can be divided into two groups:

- **interface messages** and
- **device messages.**

For the RS-232 interface, no interface messages are defined.

3.4.1 Interface Messages

Interface messages are transferred on the data lines of the IEC bus, the "ATN" control line being active. They are used for communication between controller and instrument and can only be sent by a controller which has the IEC-bus control. Interface commands can be subdivided into

- **universal commands** and
- **addressed commands.**

Universal commands act on all devices connected to the IEC bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in annex A.

Some control characters are defined for the control of the RS-232-interface (see annex A).

3.4.2 Device Messages (Commands and Device Responses)

Device messages are transferred on the data lines of the IEC bus, the "ATN" control line not being active. ASCII code is used. The device messages are largely identical for the two interfaces.
A distinction is made according to the direction in which they are sent on the IEC bus:

- **Commands** are messages the controller sends to the instrument. They operate the device functions and request informations.
  The commands are subdivided according to two criteria:

  1. According to the effect they have on the instrument:

     Setting commands cause instrument settings such as reset of the instrument or setting the output level to 1 volt.

     Queries cause data to be provided for output on the IEC-bus,
     e.g. for identification of the device or polling the active input.

  2. According to their definition in standard IEEE 488.2:

     Common Commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and selftest.

     Device-specific commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee.

- **Device responses** are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. Section 3.5.4).

Structure and syntax of the device messages are described in Section 3.5. The commands are listed and explained in detail in Section 3.6.

3.5 Structure and Syntax of the Device Messages

3.5.1 SCPI Introduction

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure. Fig. 3-1 illustrates this tree structure using a section of command system SOURce, which operates the signal sources of the devices. The other examples concerning syntax and structure of the commands are derived from this command system.
SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see Section 3.5.4, Responses to Queries).

3.5.2 Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note: *The commands used in the following examples are not in every case implemented in the instrument.*

Common commands

Common commands consist of a header preceded by an asterix "*" and one or several parameters, if any.

Examples: **RST* RESET, resets the device
**ESE 253* EVENT STATUS ENABLE, sets the bits of the event status enable register
**ESR?* EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy: Device-specific commands are of hierarchical structure (see Fig. 3-1). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system..

Example: *SOURce* This key word denotes the command system SOURce.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example: *SOURce:FM:EXTernal:COUPling AC*

This command lies in the fourth level of the SOURce system. It sets the coupling of the external signal source to AC.

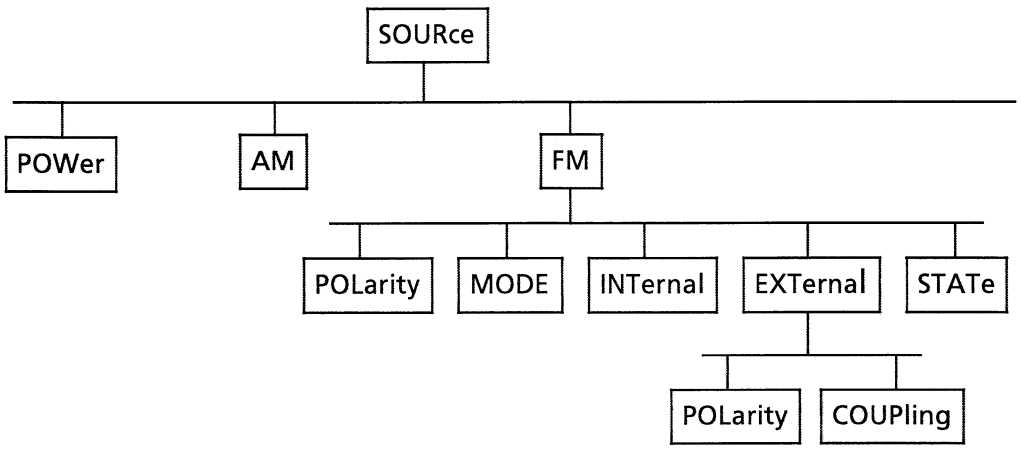


Fig. 3-1 Tree structure of the SCPI command systems using the SOURce system by way of example

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, that is to say, at which position in the header of a command they are inserted.

Example: *SOURce:FM:POLarity NORMal*

This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

SOURce:FM:EXTernal:POLarity NORMal

This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

Optional key words: Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example: *[SOURce]:POWer[:LEVel][:IMMediate]:OFFSet 1*

This command immediately sets the offset of the signal to 1 volt. The following command has the same effect:

POWer:OFFSet 1

Note: *An optional key word must not be omitted if its effect is specified in detail by a numeric suffix.*

Long and short form: The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Example: *STATus:QUEStionable:ENABle 1 = STAT:QUES:ENAB 1*

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serve the above purpose, the instrument itself does not make any difference between upper-case and lower-case letters.*

Parameter: The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to Section 3.5.5.

Example: *SOURce:POWer:ATTenuation? MAXimum* Response: *60*

This query requests the maximal value for the attenuation.

Numeric suffix: If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example: *SOURce:FM:EXTernal2:COUPling AC*

This command sets the coupling of the second external signal source.

3.5.3 Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. QuickBASIC automatically produces an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example: *CALL IBWRT(generator%,"SOURce:POWer:CENTer MINimum;:OUTPut:ATTenuation 10")*

This command line contains two commands. The first command is part of the SOURce system and is used to specify the center frequency of the output signal. The second command is part of the OUTPut system and sets the attenuation of the output signal.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 3-1). The colon following the semicolon must be omitted in this case.

Example:
CALL IBWRT(generator%, "SOURce:FM:MODE LOCKed; :SOURce:FM:INTernal:FREQuency 1kHz")

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SOURce command system, subsystem FM, i.e. they have two common levels.
When abbreviating the command line, the second command begins with the level below SOURce:FM. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

CALL IBWRT(generator%, "SOURce:FM:MODE LOCKed; INTernal:FREQuency 1kHz")

However, a new command line always begins with the complete path.

Example: *CALL IBWRT(generator%, "SOURce:FM:MODE LOCKed")*
CALL IBWRT(generator%, "SOURce:FM:INTernal:FREQuency 1kHz")

3.5.4 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter is transmitted without header.
   Example: *SOURce:EXTernal:COUPling?* Response: *AC*

2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
   Example: *FREQuency? MAX* Response: *10E3*

3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
   Example: *FREQuency?* Response: *1E6* for 1 MHz

4. Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
   Example: *OUTPut:STATe?* Response: *1*

5. Text (character data) is returned in a short form (see also Section 3.5.5.5).
   Example: *SOURce:FM:SOURce?* Response: *INT1*

3.5.5 Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description (see Section 3.6).

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). It the unit is missing, the basic unit is used.

Example: *SOURce:FREQuency 1.5 kHz = SOURce:FREQuency 1.5E3*

Special numerical values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the numerical value is provided.

Examples: Setting command: *SOURce:VOLTage MAXimum*
Query: *SOURce:VOLTage?* Response: *15*

MIN/MAX MINimum and MAXimum denote the minimum and maximum value.

DEF DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.

UP/DOWN UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.

INF/NINF INFinity, Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device reponses.

NAN Not a Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. 0 or 1 is provided in a query.

Examples: Setting command: *SOURce:FM:STATe ON*
Query: *SOURce:FM:STATe?* Response: *1*

Text

Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Examle: Setting command: *OUTPut:FILTer:TYPE EXTernal*
Query: *OUTPut:FILTer:TYPe?* Response:*EXT*

Strings

Strings must always be entered in quotation marks (' or "").

Example: *SYSTem:LANGuage "SCPI" or SYSTem:LANGuage 'SCPI'*

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example: *HEADer:HEADer #45168xxxxxxxx*

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted. Data elements comprising more than one byte are transmitted with the byte being the first which was specified by SCPI command *"FORMat:BORDer"*.

3.5.6 Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

- [:] The colon separates the key words of a command.
  In a command line the colon after the separating semicolon marks the uppermost command level.
- [;] The semicolon separates two commands of a command line. It does not alter the path.
- [,] The comma separates several parameters of a command.
- [?] The question mark forms a query.
- [*] The asterix marks a common command.
- ["] Quotation marks introduce a string and terminate it.
- [#] ASCII character # introduces block data.
- [ ] A"white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

3.6 Description of Commands

3.6.1 Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, separated according to the command system. The notation corresponds to the one of the SCPI standards to a large extent. The SCPI conformity information can be taken from the list of commands in annex C.

Table of Commands

Command: In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).

Parameter: In the parameter column the requested parameters are indicated together with their specified range.

Unit: The unit column indicates the basic unit of the physical parameters.

Remark: In the remark column an indication is made on
- whether the command does not have a query form,
- whether the command has only one query form ,
- whether this command is implemented only with a certain option of the instrument.

Indentations

The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level is, the farther the indentation to the right is. Please observe that the complete notation of the command always includes the higher levels as well.

Example: *:SOURce:FM:MODE* is represented in the table as follows:

:SOURce	first level
:FM	second level
:MODE	third level

In the individual description, the hierarchy is represented in the corresponding way. That is to say, for each command all key words above up to the left-hand margin must be considered. An example for each command is written out at the end of the individual description.

Upper/lower case notation

Upper/lower case letters serve to mark the long or short form of the key words of a command in the description (see Section 3.5.2). The instrument itself does not distinguish between upper and lower case letters.

Special characters

| A selection of key words with an identical effect exists for several commands. These key words are indicated in the same line, they are separated by a vertical stroke. Only one of these key words has to be indicated in the header of the command. The effect of the command is independent of which of the key words is indicated.

Example: :SOURce
:FREQuency
:CW|:FIXed

The two following commands of identical meaning can be formed. They set the frequency of the constantly frequent signal to 1 kHz:

:SOURce:FREQuency:CW 1E3=:SOURce:FREQuency:FIXed 1E3

A vertical stroke in indicating the parameters marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is entered.

Example: Selection of the parameters for the command
:SOURce:COUPling AC | DC

If parameter AC is selected, only the AC content is fed through, in the case of DC, the DC as well as the AC content.

[ ] Key words in square brackets can be omitted when composing the header (cf. Section 3.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.
Parameters in square brackets can optionally be incorporated in the command or omitted as well.

{ } Parameters in braces can optionally be incorporated in the command either not at all, once or several times.

3.6.2 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. Same commands have the same effect on different devices. The headers of these commands consist of an asterix "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in Section 3.8.

Command	Parameter	Unit	Remark
***CLS**			no query
***ESE**	0 to 255		
***ESR?**			only query
***IDN?**			only query
***IST?**			only query
***OPC**			
***OPT?**			only query
***PRE**	0 to 255		
***PSC**	0 | 1		
***RCL**	0 to 50		no query
***RST**			no query
***SAV**	1 to 50		no query
***SRE**	0 to 255		
***STB?**			only query
***TRG**			no query
***TST?**			only query
***WAI**			

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE** 0 to 255

EVENT STATUS ENABLE sets the event status enable register to the value indicated. Query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.
The device response is for example: *"Rohde&Schwarz, SMT03,00000001, 1.03"*
03 = variant identification
00000001 = serial number
1.03 = firmware version number

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST flag is the status bit which is sent during a parallel poll (cf. Section 3.8.3.2).

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. Section 3.7).

***OPC**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. Section 3.7).

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas. For every option, a fixed position is provided in the response.

Table 3-1 Device Response to *OPT?

Position	Option	
1	SM-B1	Reference oscillator OCXO
2	SM-B2	LF generator
3	SM-B2	2nd LF generator
4	SM-B3	Pulse modulator 1.5 GHz
5	SM-B4	Pulse generator
6		reserved
7	SM-B6	Multifunction generator
8	SM-B8	Pulse modulator 3GHz
9		reserved

Example for a device response: 0,SM-B2,0,0,0,SM-B5,0,0,0

***PRE** 0 to 255

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC** 0 | 1

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset in switching on.

*PSC = 0 causes the contents of the status registers to be maintained. Thus a service request can be triggered in switching on in the case of a corresponding configuration of status registers ESE and SRE.

*PSC ≠0 resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RCL** 0 to 50

RECALL calls the instrument state which was stored under the number supplied using command *SAV. 50 instrument states can be stored.

*** RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the [PRESET] key. The state of the RF-output is an exception: The RF-output ist deactivated after *RST, however, it is activated after the [RESET] key has been pressed. The default setting is indicated in the description of the commands.

***SAV** 1 to 50

SAVE stores the current instrument state under the number indicated (cf. *RCL as well).

***SRE** 0 to 255

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. Query *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

***TRG**

TRIGGER triggers all actions waiting for a trigger event. Special trigger events can be started by command system "TRIGger" (see section "TRIGger System").

***TST?**

SELF TEST QUERY triggers all selftests of the instrument indicated in Section 4.4, Functional Test and outputs an error code in decimal form.

***WAI**

WAIT-to-CONTINUE only permits the servicing of the subsequent commands after all preceding commands have been executed and all signals have settled (cf. Section 3.7 and *"*OPC"* as well).

3.6.3 ABORt System

The ABORt system contains the commands to abort actions triggered. After an action has been aborted, it can be triggered again at once. All commands trigger an event, thus they have no *RST value.
Further commands for the trigger system of the SMT can be found in the TRIGger system, Section 3.6.16.

Command	Parameter	Default Unit	Remarks
:ABORt			
[:SWEep]			No query
:MSEQuence			No query

:ABORt

[:SWEep]

The command aborts a sweep.

Example: *:ABOR:SWE*

:MSEQuence

The command aborts a Memory Sequence.

Example: *:ABOR:MSEQ*

3.6.4 CALibration System

The CALibration system contains the commands to calibrate the SMT. On triggering the calibration by means of *:MEASure*, response, "0" displays a faultless calibration, response "1" means that an error has occurred during calibration. As to the meaning of the data in the case of query *:DATA?*, cf. Chapter 2, Section "Calibration".

Command	Parameter	Default Unit	Remark
:CALibration			
:FM			
[:MEASure]?			Query only
:DATA?			Query only
:OFFSet?			Query only
:LEVel			
:DATA?			Query only
:FRANge	NORMal | MIXer		
:PMODulator	ON | OFF		
:STATe	ON | OFF		
:LPReset			
[:MEASure]?			Query only
:DATA?			Query only
:PULSe			Option SM-B4
[:MEASure]?			Query only
:DATA?			Query only
:ROSCillator			
[:DATA]	0 to 4095		
:VSYNthesis			
[:MEASure]?			Query only
:DATA?			Query only

:CALibration

:FM

The commands to calibrate the DC offset voltage to zero as well as the commands to calibrate the FM accuracy (slope of deviation) are under this node.

[:MEASure]

The command triggers a calibration measurement of the FM accuracy. The command triggers an event and thus has no *RST value.

Example: *:CAL:FM:MEAS?*

:DATA?

The command queries the calibration data of the FM accuracy. It returns all calibration data in the format specified in the FORMat system.

Example: *:CAL:FM:DATA?*

:OFFSet?

The command triggers a calibration measurement of the offset voltage to zero. Data which can be read out are not generated, thus there is no appropriate DATA? command. The command triggers an event and thus has no *RST value.

Example: *:CAL:FM:OFFS?*

:LEVel This node provides the commands for the management of the level correction table. The corresponding data are permanently stored in the instrument and cannot be changed. The instrument includes different level correction tables. The tables to be used are selected depending on the set frequency and the pulse modulator switched on (internal or external). The :FRANge and :PMODulator commands select the level correction tables to be read out using the DATA? command. These commands simulate the current instrument status but do not have any influence on the instrument setup. The :STATe ON command activates the level correction table corresponding to the real instrument setup.

:FRANge NORMal|MIXer

The command selects the level correction table valid for a frequency in the NORMal or in the MIXer range .*RST value is NOR

Example: *:CAL:LEV:FRAN NORM*

:PMODulator ON | OFF

The command selects the level correction table valid for an instrument setup with the pulse modulator ON or OFF.

Example: *:CAL:LEV:PMOD OFF* *RST value is OFF

:DATA?

The command queries the level correction data. It returns all level correction data in the format fixed in the :FORMat system. The other commands under this node determine the list that is returned.

Example: *:CAL:LEV:DATA?*

:STATe ON | OFF

The command switches on or off internal level correction. *RST value is ON.

Example: *:CAL:LEV:STAT OFF*

:CALibration

:LPReset

The commands to measure the values for the level presetting table are under this node (Level PReset).

[:MEASure]?

The command triggers a calibration measurement. The command triggers an event and thus has no *RST value.

Example: *:CAL:LPR:MEAS?* Response: *0*

:DATA?

The command queries the correction data. It returns all correction data in the format fixed in the :FORMat system.

Example: *:CAL:LPR:DATA?*

:PULSe

The commands to calibrate the pulse generator are under this node (option SM-B4).

[:MEASure]?

The command triggers a calibration measurement. The command triggers an event and thus has no *RST value.

Example: *:CAL:PULS:MEAS?* Response: *0*

:DATA?

The command queries the correction data. It returns the correction data as two integers separated by a comma. The first number indicates the fine adjustment, the second the coarse adjustment.

Example: *:CAL:PULS:DATA?* Response: *26,2*

:ROSCillator

The commands to calibrate the reference oscillator are under this node.

[:DATA] 0 to 4095

The command enters the correction data. For an exact definition of the calibration value, cf. Chapter 2, Section "Calibration".

Example: *:CAL:ROSC:DATA 2048*

:VSYNthesis

The commands to determine the sampling points for the frequency setting are under this node.

[:MEASure]?

The command triggers a calibration measurement. The command triggers an event and thus has no default setting value.

Example: *:CAL:VSYN:MEAS?* Response: *0*

:DATA?

The command queries the calibration data. It returns all calibration data in the format which was set in the FORMat system.

Example: *:CAL:VSYN:DATA?*

3.6.5 DIAGnostic System

The DIAGnostic system contains the commands for diagnostic test and service of the instrument. SCPI does not define DIAGnostic commands, the commands listed here are SMT-specific. All DIAGnostic commands are queries which are not influenced by *RST. Hence no default setting values are stated.

Command	Parameter	Default Unit	Remark
:DIAGnostic			
:INFO			
:CCOunt			
:ATTenuator1|2|3|4|5|6?			Query only
:POWer?			Query only
:MODules?			Query only
:OTIMe?			Query only
:SDATe?			Query only
[:MEASure]			
:POINt?			Query only

:DIAGnostic

:INFO

The commands which can be used to query all information which does not require hardware measurement are under this node.

:CCOunt

The commands which can be used to query all counters in the instrument are under this node (Cycle COunt).

:ATTenuator 1 | 2 | 3 | 4 | 5 | 6?

The command queries the number of switching processes of the different attenuator stages. The stages are designated with Z1 to Z6 within the instrument. In this command they are differentiated by a numeric suffix whose name corresponds to the number. Hence the following assignment is true:

Suffix	Name	Function
1	Z1	40-dB stage
2	Z2	20-dB stage
3	Z3	5-dB stage
4	Z4	20-dB stage
5	Z5	10-dB stage
6	Z6	40-dB stage

Example: *:DIAG:INFO:CCO:ATT1?* Response: *1487*

:DIAGnostic

:INFO

:CCOunt

:POWer?

The command queries the number of switch-on processes.

Example: *:DIAG:INFO:CCO:POW?* Response: *258*

:MODules?

The command queries the modules existing in the instrument with their model and state-of-modification numbers. The response supplied is a list in which the different entries are separated by commas. The length of the list is variable and depends on the equipment of the instrument. Each entry consists of three parts which are separated by means of blanks:

1. Name of module
2. Variant of module in the form VarXX (XX = 2 digits)
3. Revision of module in the form RevXX (XX = 2 digits)

Example: *:DIAG:INFO:MOD?* Response: *FRO Var01 Rev00, DSYN Var03 Rev12, ROSC Var01 Rev03*

:OTIMe?

The command reads out the internal operating-hours counter (Operation TIMe). The response supplies the number of hours the instrument has been in operation up to now.

Example: *:DIAG:INFO:OTIM?* Response: *19*

:SDATe?

The command queries the date of software creation. The response is returned in the form year, month, day.

Example: *:DIAG:INFO:SDAT?* Response: *1992, 12, 19*

[:MEASure]

The commands which trigger a measurement in the instrument and return the measured value are under this node.

:POINt?

The command triggers a measurement at a measuring point and returns the voltage measured. The measuring point is specified by a numeric suffix (cf. service manual, stock no. 1039.3359.24).

Example: *:DIAG:MEAS:POIN2?* Response: *3.52*

3.6.6 DISPlay System

This system contains the commands to configure the screen. If system security is activated using command *SYSTem:SECurity ON*, the display cannot be switched on and off arbitrarily (cf. below).

Command	Parameter	Default Unit	Remark
:DISPlay			
:ANNotation			
[:ALL]	ON | OFF		
:AMPLitude	ON | OFF		
:FREQuency	ON | OFF		

:DISPlay

:ANNotation

The commands determining whether frequency and amplitude are indicated are under this node.

Caution: *With SYSTem:SECurity ON, the indications cannot be switched from OFF to ON. In this case *RST does not influence the ANNotation settings either. With SYSTem:SECurity OFF, the *RST value is ON for all ANNotation parameters.*

[:ALL] ON | OFF

The command switches the frequency and amplitude indication on or off.
Command *:DISPlay:ANNotation:ALL ON* can only be executed if *SYSTem:SECurity* is set to *OFF*.

With *SYSTem:SECurity OFF* – *RST value is ON.

Example: *:DISP:ANN:ALL ON*

AMPLitude ON | OFF

The command switches on or off the amplitude indication.
Command *:DISPlay:ANNotation:AMPLitude ON* can only be executed if *SYSTem:SECurity* is set to *OFF*.

With *SYSTem:SECurity OFF* – *RST value is ON.

Example: *:DISP:ANN:AMPL ON*

FREQuency ON | OFF

The command switches the frequency indication on or off.
Command *:DISPlay:ANNotation:FREQuency ON* can only be executed if *SYSTem:SECurity* is set to *OFF*.

With *SYSTem:SECurity OFF* – *RST value is ON.

Example: *:DISP:ANN:FREQ ON*

3.6.7 FORMat System

This system contains the commands determining the format of the data the SMT returns to the controller. All queries returning a list of numeric data or a binary block are concerned. With each of these commands, this connection is pointed to in the description.

Command	Parameter	Default Unit	Remark
:FORMat [:DATA]	ASCii | REAL [,32 | 64] | PACKed		

:FORMat

[:DATA] ASCii | REAL [,32 | 64] | PACKed

The command specifies the data format.

Note: *Settings using the FORMat:DATA command are only effective for commands with which this is stated in the command description.*

ASCii — Numeric data are transmitted in plain text, separated by commas.

REAL — Numeric data are transmitted as block data. 8 (4 with setting 32, see below) successive bytes are interpreted as a double-precision floating point number (in accordance with IEEE 754). The number indicates the length of an integer in bits; 32 and 64 are valid values, 64 is preset.

PACKed — Numerical data are transmitted as binary block data. The format of the binary data itself is command-specific. Its description can be found by the respective command.

*RST value is ASCii

Example: *:FORM:DATA ASCii*

3.6.8 MEMory System

This system contains the commands for the memory management of the SMT.

Commands	Parameter	Default Unit	Remark
:MEMory			
:NSTates?			Query only

:MEMory
:NSTates?

The command returns the number of *SAV/*RCL memories available. The SMT has 50 *SAV/*RCL memories in total.

Example: *:MEM:NST?* Response: *50*

3.6.9 OUTPut System

This system contains the commands specifying the characteristics of the RF output socket and the blank socket. The characteristics of the LF socket are specified in the OUTPut2 system.

Command	Parameter	Default Unit	Remark
:OUTPut			
:AMODe	AUTO | FIXed		
:BLANk			
:POLarity	NORMal | INVerted		
:IMPedance?			Query only
:PROTection			SMT02 and SMT03
:CLEar			
:TRIPped?			Query only
[:STATe]	ON | OFF		
:PON	OFF | UNCHanged		

:OUTPut
:AMODe AUTO | FIXed

The command switches over the operating mode of the attenuator at the RF output (Attenuator MODe).

AUTO The attenuator is switched whenever possible.

FIXed The attenuator is switched when certain fixed levels are exceeded/fallen below. *RST value is AUTO

Example: *:OUTP:AMOD AUTO*

:OUTPut

:BLANk

The commands determining the characteristics of the BLANk output are under this node.

:POLarity NORMal | INVerted

The command sets the polarity of the BLANk signal.

NORMal The active BLANk state is indicated by the more positive or higher output voltage.

INVers The active BLANk state is indicated by the more negative or lower output voltage. *RST value is NORM

Example: *:OUTP:BLAN:POL NORM*

:IMPedance?

The command queries the impedance of the RF output. This permits converting the output level between units V and W. The impedances cannot be changed. With the SMT, this is the fixed value of 50 Ohm for the RF output.

Example: *:OUTP:IMP?* Response: *50*

:PROTection

The commands to configure the protective circuit of SMT02/03are under this node. The RF output is protected by a protective circuit which deactivates the output if an overvoltage is supplied from outside. This does not change the value of *OUTPut:STATe*.

:CLEar

The command resets the protective circuit after it has been triggered. The state of the output is determined by *OUTPut:STATe* again. The command triggers an event and hence has no default setting value.

Example: *:OUTP:PROT:CLE*

:TRIPped?

The command queries the state of the protective circuit. The responses mean:

"0" The protective circuit has not responded

"1" The protective circuit has responded

Example: *:OUTP:PROT:TRIP?* Response: *1*

:STATe ON | OFF

The command switches on or off the RF output. The RF output can also be switched off by the response of the protective circuit. But this has no influence on this parameter.

Note: *In contrast to the PRESET key, command *RST sets this value to OFF, the output is deactivated.*

*RST value is OFF

Example: *:OUTP:STAT ON*

:PON OFF | UNCHanged

This command selects the RF output is assume after power-on of the unit.

OFF Output is switched off

UNChanged Same state as before switch- off

It only exists for the RF output *RST does not influence the set value.

Example: *:OUTP:PON OFF*

3.6.10 OUTPut2 System

This system contains the commands specifying the characteristics of the LF output socket.

Command	Parameter	Default Unit	Remark
:OUTPut2			
:SOURce	0 | 2		Option SM-B2/SM-B6
:STEReo	MPX | PILot		Option SM-B2/SM-B6
[:STATe]	ON | OFF		
:VOLTage	0 V to 4 V	V	

:OUTPut2

:SOURce 0 | 2

This command selects which LF generator is connected with the LF output socket (only with option SM-B2 and SM-B6).

0 LF generator 1

2 LF generator 2

*RST value is 0, LF generator 1 is connected at the output.

Example: *:OUTP2:SOUR 2*

:STEReo MPX | PILot

The command determines whether the complete stereo multiplex signal (MPX) or only the pilot tone is output. The command is only effective if LF generator2 is in the STEREO operating mode and if LF generator2 is selected for OUTPut2:SOURce as well.

*RST value is MPX

Example: *:OUTP2:SOUR:STER MPX*

[:STATe] ON | OFF

The command switches the LF output on or off. *RST value is OFF

Example: *:OUTP2:STAT ON*

:VOLTage 0V to 4V

The command sets the voltage of the LF output. The voltage is a characteristic of the output, not the source. I.e., it is maintained even if another LF generator is connected to the output.

*RST value is 1 V

Example: *:OUTP2:VOLT 3.0V*

3.6.11 SOURce System

This system contains the commands to configure the RF signal source. Keyword SOURce is optional, i.e., it can be omitted. The LF signal sources (options SM-B2 and SM-B6) are configured in the SOURce0|2 system (cf. Section 3.6.12).

The following subsystems are realized in the instrument:

Subsystem	Setting
[:SOURce]	
:AM	Amplitude modulation
:CORRection	Correction of the output level
:FM	Frequency modulation
:FREQuency	Frequencies including sweep
:ILS	Test signals for ILS (Instrument Landing System)
:MARKer	Marker generation with sweeps
:MBE	Marker signals (Marker Beacon)
:PHASe	Phase between output signal and reference oscillator signal
:PM	Phase modulation
:POWer	Output level, level control and level correction
:PULM	Pulse modulation
:PULSe	Pulse generator
:ROSCillator	Reference oscillator
:STEReo	Stereo modulation
:SWEep	Sweeps
:VOR	Test signals for VOR (VHF Omnidirectional Range)

3.6.11.1 SOURce:AM Subsystem

This subsystem contains the commands to control the amplitude modulation. Up to two LF generators which serve as internal modulation sources can be fitted in the instrument (options SM-B2 and SM-B6). Part of their settings is effected under SOURce0|2.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:AM			
[:DEPTh]	0 to 100PCT	PCT	
:EXTernal			
:COUPling	AC | DC		
:INTernal 1|2			
:FREQuency	400 Hz | 1 kHz | 3 kHz | 15 kHz or	Hz	
	0.1 Hz to 500 kHz or		Option SM-B2
	0.1 Hz to 1 MHz		Option SM-B6
:POLarity	NORMal | INVerted		
:SOURce	INT1|2 | EXT | INT1|2, EXT		
:STATe	ON | OFF		

:SOURce
:AM
[:DEPTh] 0 to 100PCT
The command sets the modulation depth in percent. *RST value is 30PCT
Example: *:SOUR:AM:DEPT 15PCT*

:EXTernal
The commands to set the external AM input are under this node.

:COUPling AC | DC
The command selects the type of coupling for the external AM input.
AC The d.c. voltage content is separated from the modulation signal.
DC The modulation signal is not altered. *RST value is AC
Example: *:SOUR:AM:EXT:COUP AC*

:INTernal 1 | 2
The settings for the internal AM inputs are effected under this node.
INT1 is LF generator 1,
INT2 is LF generator 2.
Here the same hardware is set for AM, PM, FM and SOURce0|2. This means that, for example, the following commands are coupled with each other and have the same effect:
SOUR:AM:INT2:FREQ
SOUR:FM2:INT:FREQ
SOUR:PM2:INT:FREQ
SOUR2:FREQ:CW

:FREQuency 400 Hz | 1 kHz | 3 kHz | 15 kHz or 0,1 Hz to 500 kHz or 0,1 Hz to 1 MHz
The command sets the modulation frequency. Only certain specified ranges are permissible depending on the equipment of the instrument.
If neither SM-B2 nor SM-B6 are fitted, only INT1 is permissible and values 400 Hz, 1 kHz, 3 kHz and 15 kHz are true. With option SM-B2, the specified range from 0.1 Hz to 500 kHz is true, with SM-B6, from 0.1 Hz to 1 MHz. *RST value is 1 kHz
Example: *:SOUR:AM:INT:FREQ 15kHz*

:POLarity NORMal | INVerted
The command selects the polarity of the AM.
NORMal A positive modulation voltage generates a higher output level.
INVerted The AM polarity is inverted.
Example: *:SOUR:AM:POL NORM* *RST value is NORMal

:SOURce INT1|2 | EXT | INT1|2 ,EXT
The command selects the modulation source. INT1 is LF generator 1, INT2 LF generator 2 (option SM-B2 or SM-B6). An external and an internal modulation source can be indicated at the same time (see example). *RST value is INT1
Example: *:SOUR:AM:SOUR INT1, EXT*

:STATe ON | OFF
The command switches amplitude modulation on or off. *RST value is OFF
Example: *:SOUR:AM:STAT ON*

3.6.11.2 SOURce:CORRection Subsystem

The CORRection subsystem permits a correction of the output level. The correction is effected by adding user-defined table values to the output level as a function of the RF frequency. In the SMT, this subsystem serves to select, transmit and switch on USER-CORRECTION tables (see Chapter 2, Section "User Correction (UCOR)" as well).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:CORRection			
[:STATe]	ON | OFF		
:CSET			
:CATalog?			Query only
[:SELect]	"Name of table"		
:DATA			
:FREQuency	5 kHz to 1,5 GHz {,5 kHz to 1,5 GHz}	Hz	SMT03/06: to 3/6 GHz
:POWer	– 40 dB to + 6 dB {,–40 dB to + 6 dB }	dB	
:DELete	"Name of table"		

[:SOURce]

:CORRection

[:STATe] ON | OFF

The command switches the table selected using *SOURce:CORRection:CSET* on or off.

Example: *:SOUR:CORR:STAT ON* *RST value is OFF

:CSET The commands to select and edit the UCOR lists are under this node. These commands have no *RST value.

:CATalog?

The command queries the tables available. It returns a list, the entries are separated by means of commas.

Example: *:SOUR:CORR:CSET:CAT?* Response: *"UCOR1", "UCOR2", "UCOR3"*

[:SELect] "Name of table"

The command selects a correction table. This command alone does not yet effect a correction. First the table selected must be activated (cf. *:SOURce:CORRection:STATe*). If there is no table of this name (max. 7 letters), a new table is created.

Example: *:SOUR:CORR:CSET:SEL "UCOR1"*

:DATA The commands to edit the UCOR tables are under this node.

:FREQuency 5 kHz to 1,5 GHz {,5 kHz to 1,5 GHz} / SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz. The command transmits the frequency data for the table selected using *:SOURce:CORRection:CSET*.

Note: *The frequency values must be inputed in ascending order.*

Example: *:SOUR:CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz*

:POWer – 40 dB to + 6 dB {,–40 dB to + 6 dB }

The command transmits the level data for the table selected using *:SOURce: CORRection:CSET*.

Example: *:SOUR:CORR:CSET:DATA:POWer 1dB, 0,8dB, 0,75dB*

:DELete "Name of table"

The command deletes the table indicated from the instrument memory.

Example: *:SOUR:CORR:CSET:DEL "UCOR2"*

3.6.11.3 SOURce-FM-Subsystem

This subsystem contains the commands to check the frequency modulation and to set the parameters of the modulation signal. The SMT is equipped with two independent frequency modulators. They are differentiated by a suffix after FM.

SOURce:FM1
SOURce:FM2

Command	Parameter	Default Unit	Remark
[:SOURce]			
:FM1|2			
[:DEViation]	0 to 10 MHz;	Hz	SMT03: 20 Hz SMT06: 40 Hz
:EXTernal1|2			
:COUPling	AC | DC		
:INTernal			
:FREQuency	400 Hz | 1 kHz | 3 kHz | 15 kHz or 0.1 Hz to 500 kHz or 0.1 Hz to 1 MHz	Hz	 Option SM-B2 Option SM-B6
:SOURce	INT | EXT1 | EXT2		
:STATe	ON | OFF		

[:SOURce]

:FM 1 | 2

[:DEViation] 0 to 10 MHz; SMT03: 0 to 20 MHz / SMT06: 0 to 40 MHz

The command specifies the frequency variation caused by the FM. Although the LF generators are used as modulation sources, the frequency variation is independent of the voltage at the LF output. The maximally possible DEViation depends on *SOURce:FREQuency* (cf. data sheet).

*RST value is 10 kHz

Example: *:SOUR:FM1:DEV 5kHz*

:EXTernal 1 | 2

The commands to set the external FM input are under this node. The settings under EXTernal for modulations AM, FM and PM are independent of each other. The settings are always related to the socket which is determined by the numeric suffix after EXTernal. The suffix after FM is ignored then. With the following commands, e.g., the settings are both related to socket EXT2:

:SOUR:FM1:EXT2:COUP AC

:SOUR:FM2:EXT2:COUP AC

A command without suffix is interpreted like a command with suffix 1.

:COUPling AC | DC

The command selects the type of coupling for the external FM input.

AC The d.c. voltage content is separated from the modulation signal.

DC The modulation signal is not altered. *RST value is AC

Example: *:SOUR:FM:EXT:COUP AC*

[:SOURce]
:FM1|2
:INTernal

The settings for the internal FM generators are effected under this node. For FM1, this is always LF generator 1, for FM2, always LF generator 2. Here the same hardware is set for FM1, PM1, AM:INT1 as well as SOURce0, just like for FM2, PM2 and AM:INT2 as well as SOURce2. This means that, e.g., the following commands are coupled with each other and have the same effect:
SOUR:AM:INT2:FREQ
SOUR:FM2:INT:FREQ
SOUR:PM2:INT:FREQ
SOUR2:FREQ:CW

:FREQuency 400 Hz | 1 kHz | 3 kHz | 15 kHz or 0.1 Hz to 500 kHz or 0.1 Hz to 1MHz

The command sets the modulation frequency. There are different specified ranges depending on the equipment of the instrument:
If neither SM-B2 nor SM-B6 are fitted, only FM 1 is permissible and values 400 Hz, 1 kHz, 3 kHz and 15 kHz are valid. With option SM-B2, the specified range from 0.1 Hz to 500 kHz is valid, with SM-B6, from 0.1 Hz to 1 MHz. *RST value is 1 kHz

Example: *:SOUR:FM:INT:FREQ 10kHz*

:SOURce INTernal | EXTernal1 | EXTernal2

The command selects the modulation source. A command without suffix is interpreted like a command with suffix 1. LF generator 1 is INT for FM1, LF generator2 for FM2. Several modulation sources can be active at the same time (cf. example)
*RST value for FM1: INT
for FM2:EXT2

Example: *:SOUR:FM:SOUR INT1, EXT2*

:STATe ON | OFF

The command switches the frequency modulation on or off. *RST value is OFF.

Example: *SOUR:FM:STAT OFF*

3.6.11.4 SOURce:FREQuency Subsystem

This subsystem contains the commands for the frequency setting of the RF source including the sweeps.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:FREQuency			
:CENTer	5 kHz to 1.5 GHz	Hz	SMT03/06: to 3/6 GHz
[:CW|:FIXed]	5 kHz to 1.5 GHz	Hz	SMT03/06: to 3/6 GHz
:RCL	INCLude | EXCLude		
:MANual	5 kHz to 1.5 GHz	Hz	SMT03/06: to 3/6 GHz
:MODE	CW | FIXed | SWEep		
:OFFSet	–50 GHz to 50 GHz	Hz	
:SPAN	0 to 1.5 GHz	Hz	SMT03/06: to 3/6 GHz
:STARt	5 kHz to 1.5 GHz	Hz	SMT03/06: to 3/6 GHz
:STOP	5 kHz to 1.5 GHz	Hz	SMT03/06: to 3/6 GHz
:STEP			
[:INCRement]	0 to 1 GHz	Hz	

[:SOURce]

:FREQuency

:CENTer 5 kHz to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)

The command sets the sweep range by means of the center frequency. This command is coupled to commands *:SOURce:FREQuency:STARt* and *:SOURce:FREQuency:STOP*. The OFFSet value is considered with this command as with the FREQUENCY input value in the FREQUENCY menu. Thus the specified range indicated is only valid for OFFSet = 0. The specified range with other OFFSet values can be calculated according to the following formula (cf. Section 2.4.1, Frequency Offset, as well):

5 kHz + OFFSet ... 1.5 GHz + OFFSet

Example: *:SOUR:FREQ:CENT 100kHz* *RST value is (STARt + STOP)/2

[:CW | :FIXed] 5 kHz to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)

The command sets the frequency for CW operation. This value is coupled to the current sweep frequency. In addition to a numeric value, UP and DOWN can be indicated. The frequency is increased or reduced by the value set under *:SOURce:FREQuency:STEP*. (As to specified range, cf. *FREQuency:CENTer*)

Example: *:SOUR:FREQ:CW 100kHz* *RST value is 100 MHz

:RCL INCLude | EXCLude

The command determines the effect of the recall function on the frequency. *RST value has no effect to this setting.

INCLude The saved frequency is loaded when instrument settings are loaded with the [RECALL] key or with a memory sequence.

EXCLude The RF frequency is not loaded when instrument settings are loaded, the current settings are maintained.

Example: *:SOUR:FREQ:RCL INCL*

:MANual 5 kHz to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)

The command sets the frequency if *SOURce:SWEep:MODE MANual* and *SOURce:FREQuency:MODE SWEep* are set. Only frequency values between the settings with *:SOURce:FREQuency:STARt* and *:SOURce:FREQuency:STOP* are permitted. (As to specified range, cf. *FREQuency:CENTer*) *RST value is 100 MHz

Example: *:SOUR:FREQ:MAN 500MHz*

[:SOURce]
:FREQuency
:MODE CW | FIXed | SWEep
The command specifies the operating mode and hence also specifies which commands check the FREQuency subsystem. The following allocations are valid:

CW |FIXed — CW and FIXed are synonyms. The output frequency is specified by means of *:SOURce:FREQuency:CW | FIXed.*

SWEep — The instrument operates in the SWEep operating mode. The frequency is specified by means of commands *SOURce:FREQuency:STARt; STOP; CENTer; SPAN; MANual.* *RST value is CW.

Example: *:SOUR:FREQ:MODE SWE*

:OFFSet −50 to +50 GHz
The command sets the frequency offset of an instrument possibly series-connected, e.g., of a mixer. If a frequency offset is entered, the frequency entered using *SOURce: FREQuency* does no longer conform to the RF output frequency. The following connection is true:

SOURce:FREQuency = RF output frequency + OFFSet.

Entering an offset does not vary the RF output frequency, but the query value of *SOURce:FREQuency* (cf. Section 2.4.1, Frequency Offset). *RST value is 0

Example: *:SOUR:FREQ:OFFS 100MHz*

:SPAN 0 to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)
This command indicates the frequency rangefor the sweep . This parameter is coupled to the start and stop frequency. Negative values for SPAN are permitted, then STARt > STOP is true. There is the following connection:

STARt = CENTer – SPAN/2
STOP = CENTer + SPAN/2 *RST value is (STOP–STARt)

Example: *:SOUR:FREQ:SPAN 1GHz*

:STARt 5 kHz to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)
This command indicates the starting value of the frequency for the sweep operation. Parameters STARt, STOP, SPAN and CENTer are coupled to each other. STARt may be larger than STOP. (As to the specified range, cf. *FREQ:CENT*). *RST value is 100MHz

Example: *:SOUR:FREQ:STAR 1MHz*

:STOP 5 kHz to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)
This command indicates the final value of the frequency for the sweep operation (see STARt as well). (As to specified range, cf. *FREQ:CENT*). *RST value is 500MHz

Example: *:SOUR:FREQ:STOP 100MHz*

:STEP
The command to enter the step width for the frequency setting if frequency values UP or DOWN are used is under this node. This command is coupled to the KNOB STEP command in manual control. Only linear step widths can be set.

[:INCRement] 0 to 1 GHz
The command sets the step width for the frequency setting.
*RST value is 1MHz

Example: *:SOUR:FREQ:STEP:INCR 1MHz*

3.6.11.5 SOURce:ILS Subsystem

This subsystem contains the commands to control the characteristics of the test signals for ILS (Instrument Landing System) (option SM-B6, multifunction generator).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:ILS			Option SM-B6
:STATe	ON | OFF		
:SOURce	INT2 | INT2, EXT		
:TYPE	GS | GSLope | LOCalizer		
[:GS | GSLope]			
:MODE	NORM | ULOBe | LLOBe		
:COMid			
[:STATe]	ON | OFF		
:FREQuency	0.1 to 20 000 Hz	Hz	
:DEPTh	0 to 100 PCT	PCT	
:DDM			
:CURRent	– 685 uA to + 685 uA	A	
[:DEPTh]	–0.8 to + 0.8 PCT	PCT	
:DIRection	UP | DOWN		
:LOGarithmic	–999.9 to + 999.9		
:LLOBe			
[:FREQuency]	100 to 200 Hz	Hz	
:ULOBe			
[:FREQuency]	60 to 120 Hz	Hz	
:PHASe	0 to 120 deg	rad	No query
:PRESet			
:SODepth	0 to 100 PCT	PCT	
:LOCalizer			
:MODE	NORM | LLOBe | RLOBe		
:COMid			
[:STATe]	ON | OFF		
:FREQuency	0.1 to 20 000 Hz	Hz	
:DEPTh	0 to 100 PCT	PCT	
:DDM			
:CURRent	–387 to +387 uA	A	
[:DEPTh]	–0.4 to +0.4 PCT	PCT	
:DIRection	LEFT | RIGHt		
:LOGarithmic	–999.9 to + 999.9		
:LLOBe			
[:FREQuency]	60 to 120 Hz	Hz	
:RLOBe			No query
[:FREQuency]	100 to 200 Hz	Hz	
:PHASe	0 to 120 deg	rad	
:PRESet			
:SODepth	0 to 100 PCT	PCT	

[:SOURce]
:ILS

:STATe ON | OFF

The command switches the generation of ILS signals on or off. STATe ON is only possible if no amplitude modulation is switched on. Modulation generator 2 must not be switched simultaneously as a source for PM or FM either.

Example: *:SOUR:ILS:STAT ON* *RST value is OFF

:SOURce INT2 | INT2, EXT

This command determines the signal sources of the test signal.

INT2 The test signal used for ILS is generated internally by LF generator 2.

INT2 , EXT A signal from input EXT1 is added to the internal signal in addition. Switching off the internal source is not possible.

Example: *:SOUR:ILS:SOUR INT2* *RST value is INT2

[:SOURce]
:ILS
:TYPE GS|GSLope | LOCalizer
The command switches over between the two components of the ILS method. The configuration of the signals is effected under the respective node GSLobe or LOCalizer.
GS|GSLope Vertical component (Glide Slope)
LOCalizer Horizontal component (LOCalizer)
Example: *:SOUR:ILS:TYPE GS* *RST value is GS

[:GS|GSLope]
The commands to specify the characteristics of the glide slope signal are under this node. Whether this signal is output, however, is determined by command *SOURce:ILS:TYPE.*

:MODE NORM | ULOBe | LLOBe
The command specifies the type of the ILS-GS signal generated.
NORM ILS-GS signal
ULOBe (Upper LOBe) Amplitude modulation of the output signal using the *SOURce:ILS:GS:ULOBe:FREQuency* signal component (generally 90 Hz) of the ILS-GS signal. The modulation depth for *SOURce:ILS:GS:DDM:DIR DOWN* results from
AM(90Hz) = 0.5 * (ILS:GS:SODepth + ILS:GS:DDM * 100%)
and for *SOURce:ILS:GS:DDM:DIR UP* from
AM(90Hz) = 0.5 * (ILS:GS:SODepth – ILS:GS:DDM * 100%)
LLOBe (Lower LOBe) Amplitude modulation of the output signal using the *SOURce:ILS:GS:LLOBe:FREQuency* signal component (generally 150 Hz) of the ILS-GS signal. The modulation depth for *SOURce:ILS:GS:DDM:DIR DOWN* results from
AM(150Hz) = 0.5 * (ILS:GS:SODepth + ILS:GS:DDM * 100%)
and for *SOURce:ILS:GS:DDM:DIR UP* from
AM(150Hz) = 0.5 * (ILS:GS:SODepth – ILS:GS:DDM * 100%)
Example: *:SOUR:ILS:GS:MODE ULOB* *RST value is NORM

:COMid
The commands to set the ComId content (communication/identification signal) of the ILS-GS signal are under this node.

[:STATe] ON | OFF
The command activates or deactivates the ComId signal. *RST value is OFF
Example: *:SOUR:ILS:GS:COM:STAT ON*

:FREQuency 0.1 to 20 000 Hz
The command sets the frequency of the ComId signal. *RST value is 1020 Hz
Example: *:SOUR:ILS:GS:COM:FREQ 1020*

:DEPTh 0 to 100 PCT
The command sets the AM modulation depth of the ComId signal.
Example: *:SOUR:ILS:GS:COM:DEPT 10PCT* *RST value is 10 PCT

:DDM
(Difference in Depth of Modulation) The commands to set the modulation depth difference between the signal of the upper lobe (90 Hz) and the lower lobe (150 Hz) are under this node.

[:SOURce]
:ILS
[:GS | GSLope]
:DDM

:CURRent –685 uA to + 685 uA
The command enters the DDM value alternatively as a current by means of the ILS indicating instrument. This parameter is coupled with *SOURce:ILS:GS:DDM:DEPTh*.
Example: *:SOUR:ILS:GS:DDM:CURR 0* *RST value is 0

[:DEPTh] –0.8 to + 0.8 PCT
The command sets the difference of the modulation depth. This parameter is coupled with *SOURce:ILS:GS:DDM:CURRent*.
The following is true for *SOURce:ILS:GS:DDM:DIRection DOWN*
ILS:GS:DDM:DEPTh = (AM(90Hz) - AM(150Hz))/100%
and for *SOURce:ILS:GS:DDM:DIRection UP*
ILS:GS:DDM:DEPTh = (AM(150Hz) - AM(90Hz))/100%
Example: *:SOUR:ILS:GS:DDM:DEPT 0PCT* *RST value is 0PCT

:DIRection UP | DOWN
The command indicates the direction in which the pilot has to correct the course. By calculation, this setting has the same effect as a reverse of the sign of the *SOURce:ILS:GS:DDM:DEPTh* value.
UP The airplane is too low, it must climb.
DOWN The airplane is too high, it must descend.
Example: *:SOUR:ILS:GS:DDM:DIR DOWN* *RST value is UP

:LOGarithmic –999.9 dB ... + 999.9 dB
The command enters the DDM value in dB. This parameter is coupled with *SOURce:ILS:GS:DDM:DEPTh* and *:CURRent*. *RST value is 0.0 dB
Example: *:SOUR:ILS:GS:DDM:LOG 0*

:LLOBe The commands to configure the signal of the lower ILS-GS antenna lobe are under this node (Lower LOBe).

[:FREQuency] 100 to 200 Hz
The command sets the frequency. Normally, it is 150 Hz. This parameter is coupled with *SOURce:ILS:GS:ULOBe:FREQuency*. As the ratio of ULOBe:FREQuency and LLOBe:FREQuency must always be 3/5, ULOBe:FREQuency is readjusted accordingly.
Example: *:SOUR:ILS:GS:LLOB:FREQ 150* *RST value is 150 Hz

:ULOBe The commands to configure the signal of the upper ILS-GS antenna lobe (Upper LOBe) are under this node.

[:FREQuency] 60 to 120 Hz
The command sets the frequency. Normally, it is 90 Hz. This parameter is coupled with *SOURce:ILS:GS:LLOBe:FREQuency*. As the ratio of ULOBe:FREQuency and LLOBe: FREQuency must always be 3/5, LLOBe: FREQuency is readjusted accordingly.
Example: *:SOUR:ILS:GS:ULOB:FREQ 90* *RST value is 90 Hz

PHASe 0 to 120 deg
The command sets the phase between the modulation signals of the upper and the lower antenna lobe. The zero crossing of the signal of the lower lobe serves as a reference. The angle is related to the period of the signal of the lower antenna lobe.
Example: *:SOUR:ILS:GS:PHAS 0deg* *RST value is 0

[:SOURce]
:ILS
[:GS | GSLobe]
:PRESet

This command is equivalent to the following command sequence:

:ILS:SOUR INT2
:ILS:STAT ON
:ILS:TYPE GS
:ILS:GS:MODE NORM
:ILS:GS:COM OFF
:ILS:GS:COM:FREQ 1020Hz
:ILS:GS:COM:DEPT 10PCT
:ILS:GS:DDM 0.0
:ILS:GS:DDM:DIR UP
:ILS:GS:SOD 80PCT
:ILS:GS:ULOB 90Hz
:ILS:GS:LLOB 150Hz
:ILS:GS:PHAS 0

The values set correspond to the state after *SYSTEM:PRESET* or **RST*. The command neither has a query form nor an *RST value.

Example: *:SOUR:ILS:GS:PRES*

:SODepth 0 to 100 PCT

The command indicates the sum of the modulation depths of the signals of the lower lobe (90 Hz) and the upper lobe (150 Hz). *RST value is 80PCT

Example: *:SOUR:ILS:GS:SOB 80PCT*

:LOCalizer

The commands to specify the characteristics of the LOCalizer signal are under this node. Whether this signal is output, however, is determined by command *SOURce:ILS:TYPE.*

:MODE NORM | LLOBe | RLOBe

The command specifies the type of the ILS-LOC signal generated.

NORM — ILS-LOC signal

LLOBe — (Left LOBe) Amplitude modulation of the output signal using the *SOURce:ILS:LOC:LLOBe:FREQuency* signal component (generally 90 Hz) of the ILS-LOC signal. The modulation depth

for *SOURce:ILS:GS:DDM:DIR RIGHt* results from
AM(90Hz) = 0.5 * (ILS:LOC:SODepth + ILS:LOC:DDM * 100%)

and for SOURce:*ILS:GS:DDM:DIR LEFT* from
AM(90Hz) = 0.5 * (ILS:LOC:SODepth – ILS:LOC:DDM * 100%)

RLOBe — (Right LOBe) Amplitude modulation of the output signal using the *SOURce:ILS:LOC:RLOBe:FREQ* signal component (generally 150 Hz) of the ILS-LOC signal. The modulation depth

for *ILS:LOC:DDM:DIR RIGHt* results from
AM(150Hz) = 0.5 * (ILS:LOC:SODepth + ILS:LOC:DDM * 100%)

and for *ILS:LOC:DDM:DIR LEFT* from
AM(150Hz) = 0.5 * (ILS:LOC:SODepth – ILS:LOC:DDM * 100%)

Example: *:SOUR:ILS:LOC:MODE LLOB* *RST value is NORM

[:SOURce]
:ILS
:LOCalizer
:COMid

The commands to set the ComId content (communication/identification signal) of the ILS-LOC signal are under this node.

[:STATe] ON | OFF
The command activates or deactivates the ComId signal. *RST value is OFF
Example: *:SOUR:ILS:LOC:COM:STAT ON*

:FREQuency 0.1 to 20 000 Hz
The command sets the frequency of the ComId signal. *RST value is 1020 Hz
Example: *:SOUR:ILS:LOC:COM:FREQ 1020*

:DEPTh 0 to 100 PCT
The command sets the AM modulation depth of the ComId signal.
Example: *:SOUR:ILS:LOC:COM:DEPT 10PCT* *RST value is 10 PCT

:DDM

(Difference in Depth of Modulation) The commands to set the modulation depth difference between the signal of the left lobe (90 Hz) and the right lobe (150 Hz) are under this node.

:CURRENT −387 to +387 uA
The command alternatively enters the DDM value as a current by means of the ILS indicating instrument. This parameter is coupled with *SOURce:ILS:LOC:DDM:DEPTh*.
Example: *:SOUR:ILS:LOC:DDM:CURR 0* *RST value is 0 A

[:DEPTh] −0.4 to +0.4 PCT
The command sets the difference of the modulation depth. This parameter is coupled with *SOURce:ILS:LOC:DDM:CURRent*. The following is true:
for *SOURce:ILS:LOC:DDM:DIRection RIGHt*
ILS:LOC:DDM:DEPTh = (AM(90Hz) − AM(150Hz))/100%
and for *SOURce:ILS:LOC:DDM:DIRection LEFT*
ILS:LOC:DDM:DEPTh = (AM(150Hz) − AM(90Hz))/100%
Example: *:SOUR:ILS:LOC:DDM:DEPT 0PCT* *RST value is 0PCT

:DIRection LEFT | RIGHt
The command indicates the direction in which the pilot has to correct the course. By calculation, this setting has the same effect as a reverse of the sign of the *SOURce:ILS:LOC:DDM:DEPTh* value.
LEFT The airplane is too much to the right, it must turn to the left.
RIGHt The airplane is too much to the left, it must turn to the right.
Example: *:SOUR:ILS:LOC:DDM:DIR LEFT* *RST value is LEFT

:LOGarithmic −999.9 dB ... + 999.9 dB
The command enters the DDM value in dB. This parameter is coupled with *SOURce:ILS:LOC:DDM:DEPTh* and *:CURRent*.
Example: *:SOUR:ILS:LOC:DDM:LOG 0* *RST value is 0.0 dB

[:SOURce]
:ILS
:LOCalizer
:LLOBe

The commands to configure the signals of the left ILS-LOC antenna lobe (Left LOBe) are under this node.

[:FREQuency] 60 to 120 Hz

The command sets the frequency. Normally, it is 90 Hz. This parameter is coupled with *SOURce:ILS:LOC:RLOBe:FREQuency*. As the ratio of LLOBe:FREQuency and RLOBe:FREQuency must always be 3/5, RLOBe: FREQuency is readjusted accordingly.

Example: *:SOUR:ILS:LOC:LLOB:FREQ 90** RST value is 90 Hz

:RLOBe

The commands to configure the signal of the right ILS-LOC antenna lobe (Right LOBe) are under this node.

[:FREQuency] 100 to 200 Hz

The command sets the frequency. Normally, it is 150 Hz. This parameter is coupled with *SOURce:ILS:LOC:LLOBe:FREQuency*. As the ratio of LLOBe:FREQuency and RLOBe:FREQuency must always be 3/5, LLOBe: FREQuency is readjusted accordingly. *RST value is 150 Hz

Example: *:SOUR:ILS:LOC:RLOB:FREQ 150*

:PHASe 0 to 120 deg

The command sets the phase between the modulation signals of the left and the right antenna lobe. The zero crossing of the signal of the right lobe serves as a reference. The angle relates to the period of the signal of the right antenna lobe.

Example: *:SOUR:ILS:LOC:PHAS 0deg* *RST value is 0

:PRESet

This command is equivalent to the following command sequence:

:ILS:SOUR INT2
:ILS:STAT ON
:ILS:TYPE LOC
:ILS:LOC:MODE NORM
:ILS:LOC:COM OFF
:ILS:LOC:COM:FREQ 1020Hz
:ILS:LOC:COM:DEPT 10PCT
:ILS:LOC:DDM 0.0
:ILS:LOC:DDM:DIR LEFT
:ILS:LOC:SOD 40PCT
:ILS:LOC:LLOB 90Hz
:ILS:LOC:RLOB 150Hz
:ILS:LOC:PHAS 0

The values set correspond to the state after *SYSTEM:PRESET* or **RST*. The command neither has a query form nor an *RST value.

Example: *:SOUR:ILS:LOC:PRES*

:SODepth 0 to 100 PCT

The command indicates the sum of modulation depths of the signals of the left lobe (90 Hz) and the right lobe (150 Hz).

Example: *:SOUR:ILS:LOC:SOB 40PCT* *RST value is 40PCT

3.6.11.6 SOURce:MARKer Subsystem

This subsystem contains the commands to check the marker generation with sweeps. The SMT has three markers each for frequency and level sweeps which are differentiated by a numeric suffix after MARKer. The settings for frequency sweep and level sweep marker are independent of each other.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:MARKer 1 | 2 | 3			
[:FSWeep]			
:AMPLitude	ON | OFF		
:AOFF			No query
:FREQuency	5 kHz to 1.5 GHz	Hz	SMT03/06:
[:STATe]	ON | OFF		5 kHz to 3/6
:PSWeep			GHz
:AOFF			
:POWer	−144 to + 16 dBm	dBm	
[:STATe]	ON | OFF		No query
:POLarity	NORMal | INVerted		

[:SOURce]
:MARKer 1 | 2 | 3
[:FSWeep]

The commands for the markers with frequency sweep are under this node. Keyword *:FSWeep* can be omitted, then the command conforms to SCPI regulations.

:AMPLitude ON | OFF

The command specifies whether the marker influences the signal level.

ON The output level is reduced by a constant value when the marker frequency is executed.

OFF The output level remains unchanged. *RST value is OFF

Example: *:SOUR:MARK1:FSW:AMP ON*

:AOFF

Command (All markers off) switches off all frequency markers. This command triggers an event, thus it has no *RST value and no query form.

Example: *:SOUR:MARK:FSW:AOFF*

:FREQuency 5 kHz to 1.5 GHz (SMT03: 5 kHz to 3 GHz / SMT06: 5 kHz to 6 GHz)

The command sets the marker selected by the numeric suffix with MARKer to the frequency indicated.

The OFFSet value of the subsystem (menu) FREQuency is considered with this command as with the MARKER input value in menu SWEEP-FREQ. Thus the specified range indicated is only valid for *SOURce:FREQuency:OFFSet 0*. The specified range with other OFFset values can be calculated according to the following formula (cf. Section 2.4.1, Frequency Offset as well):

5 kHz – OFFSet ... 1.5 GHz –OFFSet

*RST value for MARK1: 100MHz
MARK2: 200MHz
MARK3: 300MHz

Example: *:SOUR:MARK1:FSW:FREQ 30MHz*

[:SOURce]
:MARKer1|2|3
[:FSWeep]
[:STATe] ON | OFF
The command switches the marker selected by the numeric suffix with MARKer on or off. *RST value is OFF

Example: *:SOUR:MARK1:FSW:STAT ON*

:PSWeep
The commands for the markers with level sweep are under this node (Power sweep). The three markers are differentiated by a numeric suffix after MARKer.

:AOFF
The command switches all level markers off. This command is an event and thus has no *RST value and no query form.

Example: *:SOUR:MARK:PSW:AOFF*

:POWer –144 dBm to + 16dBm
The command sets the marker selected by the numeric suffix with MARKer to the level indicated.

The OFFSet value of the subsystem (menu) POWER (LEVEL) is considered with this command by analogy with the MARKER input value in the SWEEP-LEVEL menu. Thus the specified range indicated is only valid for *SOURce:POWer:OFFSet 0.* The specified range with other OFFSet values can be calculated according to the following formula (cf. Section 2.5.1, Level Offset, as well):

–144dBm– OFFSet ... 16dBm –OFFSet

*RST value for MARK1: 1dBm
MARK2: 2dBm
MARK3: 3dBm

Example: *:SOUR:MARK1:PSW:POW –2dBm*

[:STATe] ON | OFF
The command switches the marker selected by the numeric suffix with MARKer on or off. *RST value is OFF

Example: *:SOUR:MARK1:PSW:STAT ON*

:POLarity NORMal | INVerted
The command specifies the polarity of the marker signal.

NORMal When running through the marker condition, TTL level is applied at the marker output, otherwise 0 V.

INVerted When running through the marker condition, 0 V is applied at the marker output, otherwise TTL level. *RST value is NORM

Example: *:SOUR:MARK:POL INV*

3.6.11.7 SOURce:MBEacon Subsystem

This subsystem contains the commands to control the characteristics of the marker signals (Marker BEacon) as they are used to mark the distance in the approach range of airports (option SM-B6, multifunction generator).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:MBEacon			Option SM-B6
:STATe	ON | OFF		
[:MARKer]			
:FREQuency	400 Hz | 1300 Hz | 3000 Hz	Hz	
:DEPTh	0 to 100 PCT	PCT	
:COMid			
[:STATe]	ON | OFF		
:FREQuency	0.1 to 20 000 Hz	Hz	
:DEPTh	0 to 100 PCT	PCT	

[:SOURce]
:MBEacon

:STATe ON | OFF

The command switches on or off the generation of marker beacon signals. STATe ON is only possible if no amplitude modulation is switched on. Modulation generator 2 must not be inserted simultaneously as a source for PM or FM either.

*RST value is OFF

Example: *:SOUR:MBE:STAT ON*

[:MARKer]

The commands to set the marker signal are under this node.

:FREQuency 400 Hz | 1300 Hz | 3000 Hz

The command selects the frequency of the marker signal. *RST value is 400 Hz

Example: *:SOUR:MBE:MARK:FREQ 400*

:DEPTh 0 to 100 PCT

The command sets the modulation depth of the marker signal. *RST value is 95 PCT

Example: *:SOUR:MBE:MARK:DEPT 95PCT*

:COMid

The commands to set the ComId content (communication/identification signal) of the ILS signal are under this node.

[:STATe] ON | OFF

The command activates or deactivates the ComId signal. *RST value is OFF

Example: *:SOUR:MBE:COM:STAT ON*

:FREQuency 0.1 to 20 000 Hz

The command sets the frequency of the ComId signal. *RST value is 1020 Hz

Example: *:SOUR:MBE:COM:FREQ 1020*

:DEPTh 0 to 100 PCT

The command sets the AM modulation depth of the ComId signal. *RST value is 5 PCT

Example: *:SOUR:MBE:COM:DEPT 5PCT*

3.6.11.8 SOURce:PHASe Subsystem

Command	Parameter	Default Unit	Remark
[:SOURce] **:PHASe** **[:ADJust]** **:REFerence**	–360 deg to 360 deg	rad	 No query

[:SOURce]
:PHASe
[:ADJust] –360 to +360 deg

The command indicates the phase between output signal and reference oscillator signal. This setting is only accepted using *SOURce:PHASe:REFerence* (cf. below). An indication in RADian is possible. *RST value is 0.0 DEG.

Example: *:SOUR:PHAS:ADJ 2DEG*
:SOUR:PHAS:ADJ 0.1RAD

:REFerence

The command accepts the phase set using *SOURce:PHASe:ADJust* as a new reference phase. The command has no *RST value.

Example: *:SOUR:PHAS:REF*

3.6.11.9 SOURce:PM Subsystem

This subsystem contains the commands to check the phase modulation and to set the parameters of the modulation signal. The SMT is equipped with two independent phase modulators, PM1 and PM2. They are differentiated by a suffix after PM.

SOURce:PM1
SOURce:PM2

Command	Parameter	Default Unit	Remark
[:SOURce]			
:PM 1 | 2			
[:DEViation]	−360 to +360 deg	rad	
:BANDwidth	100 kHz | 2 MHz	Hz	
:EXTernal 1 | 2			
:COUPling	AC | DC		
:INTernal			
:FREQuency	400 Hz | 1 kHz | 3 kHz | 15 kHz or	Hz	
	0.1 Hz ... 100 kHz or		Option SM-B2
	0.1 Hz to 1 MHz		Option SM-B6
:SOURce	INT | EXT1|2 | INT, EXT1|2		
:STATe	ON | OFF		

[:SOURce]
:PM 1 | 2

[:DEViation] −360 to +360deg

The command sets the modulation depth in Radian (cf. Section 2.6.4.1, PM Deviation Limits). DEGree are accepted. *RST value is 1 rad

Example: *SOUR:PM:DEV 20DEGR*

:BANDwidth 100 kHz | 2 MHz

The command sets the bandwidth of the phase modulation. *RST value is 100 kHz

Example: *SOUR:PM:BAND 100 kHz*

:EXTernal 1 | 2

The commands to check the external input of the PM modulators are under this node. The settings under EXTernal for modulations AM, FM and PM are independent of each other. The settings are always related to the socket determined by the suffix after EXTernal. The suffix after PM is ignored then. With the following commands, e.g., the settings are both related to socket EXT2:

:SOUR:PM1:EXT2:COUP AC

:SOUR:PM2:EXT2:COUP AC

A command without suffix is interpreted like a command with suffix 1.

:COUPling AC | DC

The command selects the type of coupling for the external PM input.

AC The d.c. voltage content is separated from the modulation signal.

DC The modulation signal is not changed. *RST value is AC

Example: *:SOUR:PM:COUP DC*

[:SOURce]
:PM1|2
:INTernal

The settings for the internal PM generators are effected under this node. For PM1, this is always LF generator 1, for PM2, always LF generator 2. Here the same hardware is set for FM1, PM1, AM::INT1 as well as SOURce0, for FM2, PM2 and AM:INT2 and SOURce2 as well. This means that, e.g., the following commands are coupled with each other and have the same effect:

SOUR:AM:INT2:FREQ

SOUR:FM2:INT:FREQ

SOUR:PM2:INT:FREQ

SOUR2:FREQ:CW

:FREQuency 400 kHz | 1 kHz | 3 kHz | 15 kHz or 0.1 Hz...100 kHz or 0.1 Hz...1 MHz

The command sets the modulation frequency. There are different specified ranges depending on the equipment of the instrument:
If neither SM-B2 nor SM-B6 are fitted, only INT1 is permissible and values 400 Hz, 1 kHz, 3 kHz and 15 kHz are valid. With option SM-B2, the specified range from 0.1 Hz to 500 kHz is valid, with SM-B6 from 0.1 to 1 MHz. *RST value is 1 kHz

Example: *:SOUR:PM:INT:FREQ 10kHz*

:SOURce INTernal | EXTernal1|2 | INTernal, EXTernal1|2

The command selects the modulation source. A command without suffix is interpreted like a command with suffix 1. LF generator 1 is INTernal for PM1, LF generator2 for PM2. Several modulation sources can be active at the same time (see example)
*RST value for PM1: INT
for PM2:EXT2

Example: *:SOUR:PM:SOUR INT, EXT2*

:STATe ON | OFF

The command switches the phase modulation selected by the numeric suffix with PM on or off. *RST value is OFF

Example: *:SOUR:PM1:STAT OFF*

3.6.11.10 SOURce:POWer Subsystem

This subsystem contains the commands to set the output level, the level control and the level correction of the RF signal. Other units can be used instead of dBm:

- by indication directly after the numeric value (example *:POW 0.5V*),
- by altering the DEFault unit in the UNIT system (cf. UNIT:POWER, Section 3.6.17)

Command	Parameter	Default Unit	Remark
[:SOURce]			
:POWer			
:ALC			
:BANDwidth | BWIDth	100 Hz | 500 kHz	Hz	
:AUTO	ON | OFF | ONCE		
[:STATe]	ON | OFF		
[:LEVel]			
[:IMMediate]			
[AMPLitude]	−144 to +16 dBm	dBm	
:OFFSet	−100 to +100 dB	dB	
:RCL	INCLude | EXCLude		
:LIMit			
[:AMPLitude]	−144 to +16dBm	dBm	
:MANual	−144 to +16dBm	dBm	
:MODE	FIXed | SWEep		
:STARt	−144 to +16 dBm	dBm	
:STOP	−144 to +16 dBm	dBm	
:STEP			
:[:INCRement]	0.1 to 10 dB	dB	

[:SOURce]
:POWer
:ALC

The commands checking the automatic level control are under this node.

:BANDwidth | BWIDth 100 Hz | 500 kHz

The command sets the bandwidth of the level control. *RST value is 100 kHz

Example: *:SOUR:POW:ALC:BAND 100kHz*

:AUTO ON | OFF | ONCE

The command determines the mode in adapting the bandwidth.

ON The bandwidth is automatically adapted.

OFF No bandwidth adaptation.

ONCE The bandwidth is adapted once, then AUTO is automatically set to OFF.

Example: *:SOUR:POW:ALC:BAND:AUTO ON* *RST value is ON

[:STATe] ON | OFF

The command switches level control on or off.

On Level control is permanently switched on.

OFF Level control is switched on for a short period of time if the level changes. *RST value is ON

Example: *:SOUR:POW :ALC:STAT ON*

[:SOURce]
:POWer
[:LEVel]
[:IMMediate]

The commands to set the output level with operating modes CW and Sweep are under these nodes.

[:AMPLitude] −144 to + 16 dBm

The command sets the RF output level in operating mode CW. UP and DOWN can be indicated in addition to numeric values. Then the level is increased or reduced by the value indicated under *:SOURce:POWer:STEP.*

The OFFSet value is considered with this command as with the AMPLITUDE input value in menu LEVEL-LEVEL. Thus the specified range indicated is only valid for *:POWer:OFFSet 0.* The specified range with other OFFSet values can be calculated according to the following formula (cf. Chapter 2, Section "Level Offset", as well):

−144dBm + OFFSet ... 16dBm + OFFSet

The keywords of this command are optional to a large extent, thus the long as well as the short form of the command is shown in the example. *RST value is −30 dBm

Example: *:SOUR:POW:LEV:IMM:AMPL −15* or
:POW −15

:OFFSet −100 to + 100 dB

The command sets the constant level offset of a series-connected attenuator/amplifier (cf. Chapter 2, Section "Level Offset"). If a level offset is entered, the level entered using *POWer:AMPLitude* does no longer conform to the RF output level. The following connection is true:

:POWer:AMPLitude = RF output level + *:POWer:OFFSet.*

Entering a level offset does not change the RF output level but only the query value of *:POWer:AMPLitude.*

Only dB is permissible as a unit here, linear units (V, W etc.) are not permitted.

***Caution**: The level offset is also valid in the case of level sweeps!*

Example: *:SOUR:POW:LEV:IMM:OFFS 0* or *:POW:OFFS 0* *RST value is 0

:RCL INCLude | EXCLude

The command determines the effect of the recall function on the RF level.*RST value has no effect to this setting.

INCLude The saved RF level is loaded when instrument settings are loaded with the [RECALL] key or with a memory sequence.

EXCLude The RF level is not loaded when instrument settings are loaded, the current settings are maintained.

Example: *:SOUR:POW:LEV:IMM:RCL INCL*

:LIMit
[:AMPLitude] −144 to + 16 dBm

The command limits the maximum Rf output level in operating mode CW and SWEEP. It does not influence the display LEVEL and the answer to query *POW?.*

Example: *:SOUR:POW:LIM −15dBm* *RST value is + 16 dBm

[:SOURce]
:POWer

:MANual −144 to + 16 dBm
The command sets the level if *SOURce:POWer:MODE* is set to *SWEep* and *SOURce:SWEep:MODE* to MANual. Only level values between START and STOP are permissible. (As to the specified range, cf. *:POWer:AMPLitude*).
*RST value is −30 dBm

Example: *:SOUR:POW:MAN 1dBm*

:MODE FIXed | SWEep
The command specifies the operating mode and thus also by means of which commands the level setting is checked.

FIXed — The output level is specified by means of commands under *:SOURce:POWer:LEVel.*

SWEep — The instrument operates in the SWEep mode. The level is specified by means of *:SOURce:POWer;STARt; STOP; CENTer; SPAN* and *MANual.*
*RST value is FIXed

Example: *:SOUR:POW:MODE FIX*

:STARt −144 to + 16 dBm
The command sets the starting value for a level sweep. STARt may be larger than STOP, then the sweep runs from the high to the low level.(As to the specified range, cf. *:POWer:AMPLitude*). *RST value is −30dBm

Example: *:SOUR:POW:STAR −20*

:STOP −144 to + 16dBm
The command sets the final value for a level sweep. STOP may be smaller than STARt. (As to the specified range, cf. *:POWer:AMPLitude*). *RST value is −10 dBm

Example: *:SOUR:POW:STOP 3*

:STEP
The commands to set the step width are under this node.

[:INCRement] 0.1to 10 dB
The command sets the step width with the level setting if UP and DOWN are used as level values. The command is coupled with KNOB STEP in the manual control, i.e., it also specifies the step width of the shaft encoder.

Only dB is permissible as a unit here, the linear units (V, W etc.) are not permitted.
*RST value is 1 dB

Example: *:SOUR:POW:STEP:INCR 2*

3.6.11.11 SOURce:PULM Subsystem

This subsystem contains the commands to check the pulse modulation and to set the parameters of the modulation signal. The internal pulse generator (option SM-B3 and SM-B4) is set in the SOURce:PULSe subsystem.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:PULM			Option SM-B3, SM-B4 and SM-B8 SM-B9
EXTernal			
:IMPedance	50 Ohm| 10 kOhm	Ohm	
:INTernal			
:FREQuency	0.01176 Hz to 10 MHz		
:POLarity	NORMal | INVerted		
:SOURce	INTernal | EXTernal		
:STATe	ON | OFF		

[:SOURce]

:PULM

:EXTernal

The commands to check the external pulse generator input socket are under this node.

:IMPedance 50 Ohm| 10 kOhm

The command sets the impedance of the input socket for the external pulse generator. The pulse generator has an own input socket, hence this setting is independent of the corresponding settings under PM and FM.

*RST value is 10 kOhm

Example: *:SOUR:PULM:EXT:IMP 10E3*

:INTernal

The commands to check the internal modulation source are under this node.

:FREQuency 0.01176 Hz to 10 MHz

The command sets the frequency of the pulse generator. This parameter is coupled with *SOURce:PULSe:PERiod.* *RST value is 100 kHz

Example: *:SOUR:PULM:INT:FREQ 1MHz*

:POLarity NORMal | INVerted

The command specifies the polarity between modulating and modulated signal.

NORMal The RF signal is suppressed during the interpulse period.

INVerted The RF signal is suppressed during the pulse.

*RST value is NORMal

Example: *:SOUR:PULM:POL INV*

:SOURce EXTernal | INTernal

The command selects the source of the modulating signal.

INTernal Internal pulse generator (option SM-B4).

EXTernal Signal fed externally *RST value is INTernal

Example: *:SOUR:PULM:SOUR INT*

:STATe ON | OFF

The command switches on or off the pulse modulation. *RST value is OFF

Example: *:SOUR:PULM:STAT ON*

3.6.11.12 SOURce:PULSe Subsystem

This subsystem contains the commands to set the pulse generator (option SM-B3 and SM-B4). The pulse generation is triggered on principle, with the trigger certainly being able to be set to "free run" using *TRIGger:PULSe: SOURce AUTO* as well.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:PULSe			Option SM-B3,
:DELay	40 ns to 1 s	s	SM-B4 and
:DOUBle			SM-B8
:DELay	60 ns to 1 s	s	
[:STATe]	ON | OFF		
:PERiod	100 ns to 85 s	s	
:WIDTh	20 ns to 1 s	s	

[:SOURce]
:PULSe

:DELay 40 ns to 1 s
The command specifies the time from the start of the period to the first edge of the pulse. Due to the construction of the instrument, this parameter is set to 0 if *:SOURce:PULSe:DOUBle:STATe* is set to *ON*. The old value is activated again as soon as the double pulse has been switched off. *RST value is 1 µs
Example: *:SOUR:PULS:DEL 10µs*

:DOUBLe
The commands to check the second pulse are under this node. If *:SOURce:PULSe: DOUBle:STATe* is set to *ON*, a second pulse whose width (*WIDTh*) is identical to the first pulse is generated in every period.

:DELay 60 ns to 1 s
The command sets the time from the start of the pulse period to the first edge of the second pulse. *RST value is 1 µs
Example: *:SOUR:PULS:DOUB:DEL 10µs*

[:STATe] ON | OFF
The command switches the second pulse on or off.
ON The second pulse is switched on.
Parameter :SOURce:PULSe:DELay is set to 0 and cannot be changed. WIDTh > (PULSe:PERiod – PULSe:DOUBle:DELay)/2 results in error message –221, "Settings conflict".
OFF The second pulse is switched off. *RST value is OFF
Example: *:SOUR:PULS:DOUB:STAT OFF*

:PERiod 100 ns to 85 s
The command sets the pulse period.
The pulse period is the reciprocal value of the pulse frequency, thus this command is coupled to command *:SOURce:PULM:INTernal:FREQuency.* *RST value is 10 µs
Example: *:SOUR:PULS:PER 2s*

:WIDTh 20 ns to 1 s
The command sets the pulse width. *RST value is 1 µs
Example: *:SOUR:PULS:WIDT 0.1s*

3.6.11.13 SOURce:ROSCillator Subsystem

This subsystem contains the commands to set the external and internal reference oscillator.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:ROSCillator			
[:INTernal]			
:ADJust			
[:STATe]	ON | OFF		
:VALue	0 to 4095		
:SOURce	INTernal | EXTernal		

[:SOURce]
:ROSCillator
[:INTernal]

The commands to set the internal reference oscillator are under this node.

:ADJust

The commands for frequency correction (fine adjustment of the frequency) are under this node.

[:STATe] ON | OFF

The command switches the fine adjustment of the frequency on or off.

*RST value is OFF

Example: *:SOUR:ROSC:INT:ADJ:STAT ON*

:VALue 0 to 4095

The command indicates the frequency correction value. For a detailed definition, cf. Chapter 2, section "Reference Frequency Internal/External". *RST value is 2048

Example: *:SOUR:ROSC:INT:ADJ:VAL 2048*

:SOURce INTernal | EXTernal

The command selects the reference source.

INTernal The internal oscillator is used.
EXTernal The reference signal is fed externally. *RST value is INTernal

Example: *:SOUR:ROSC:SOUR EXT*

3.6.11.14 SOURce-STEReo Subsystem

This subsystem contains the commands to generate FM stereo multiplex signals conforming to standards according to the pilot-tone method (option SM-B6). The modulation signal is output in addition at the LF output socket (cf. Section 3.6.10, OUTPut2 system as well).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:STEReo			Option SM-B6
:STATe	ON | OFF		
[:DEViation]	0 Hz to 100 kHz	Hz	
:SIGNal	AUDio | ARI		
:AUDio			
[:FREQuency]	0.1 Hz to 15 kHz	Hz	
:PREemphasis	OFF | 50 us | 75 us		
:MODE	RIGHt | LEFT | RELeft | REMLeft		
:PILot			
:STATe	ON | OFF		
[:DEViation]	0 Hz to 10 kHz	Hz	
:PHASe	0 deg to 360 deg	rad	
:ARI			
:STATe	ON | OFF		
[:DEViation]	0 Hz to 10 kHz	Hz	
:TYPE	BK | DK | OFF		
:BK			
[:CODE]	A | B | C | D | E | F		

[:SOURce]

:STEReo

:STATe ON | OFF

The command switches on or off the stereo signal. *RST value is OFF

Example: *:SOUR:STER:STAT ON*

[:DEViation] 0 Hz to 100 kHz

The command sets the frequency deviation of the FM stereo multiplex signal without considering the pilot-tone content. *RST value is 40 kHz

Example: *:SOUR:STER:DEV 40kHz*

:SIGNal AUDio | ARI

The command selects which signals are generated, simulated audio signals or ARI traffic channel signals with a 19-kHz pilot tone.

AUDio Audio signals are generated, ARI is switched off.

ARI ARI signals are generated. *RST value is AUDio

Example: *:SOUR:STER:SIGN AUD*

:AUDio

The commands to set the characteristics of the audio signals generated by the SMT are under this node.

[:FREQuency] 0.1 Hz to 15 kHz

The command sets the frequency of the audio signal. The frequency applies to both channels at the same time. *RST value is 1 kHz

Example: *:SOUR:STER:AUD 1kHz*

[:SOURce]
:STEReo
:AUDio

:PREemphasis OFF | 50 us | 75 us

The command selects the preemphasis of the audio signal.

OFF	Preemphasis is switched off.	
50 us	50 µs preemphasis	
75us	75 µs preemphasis	*RST value is OFF

Example: *:SOUR:STER:AUD:PRE 50us*

:MODE RIGHt | LEFT | RELeft | REMLeft

The command selects the operating mode in which the two channels operate.

RIGHt	Audio signal only in the right channel
LEFT	Audio signal only in the left channel
RELeft	(Right Equals Left) Audio signals of same frequency and phase in both channels
REMLeft	(Right Equals Minus Left) Audio signals of same frequency but opposite phase in both channels.

*RST value is RELeft

Example: *:SOUR:STER:AUD:MODE RIGH*

:PILot

The commands to set the characteristics of the 19-kHz pilot-tone signal are under this node.

:STATe ON | OFF

The command activates or deactivates the pilot tone. The pilot tone can be activated or deactivated independently of the setting of *SOURce:STEReo:SIGNal*.

*RST value is ON

Example: *:SOUR:STER:PIL:STAT ON*

[:DEViation] 0 Hz to 10 kHz

The command sets the frequency deviation of the pilot tone. *RST value is 6.72 kHz

Example: *:SOUR:STER:PIL:DEV 6720*

:PHASe 0 deg to 360 deg

The command sets the phase of the pilot tone. The zero crossing of the suppressed 38-kHz auxiliary carrier of the stereo multiplex signal serves as a phase reference.

*RST value is 0 deg

Example: *:SOUR:STER:PIL:PHAS 10deg*

[:SOURce]
:STEReo
:ARI

The commands to specify the characteristics of the ARI traffic channel signal are under this node.

[:DEViation] 0 Hz to 10 kHz
The command sets the deviation content of the unmodulated 57-kHz ARI auxiliary carrier.

*RST value is 4 kHz

Example: *:SOUR:STER:ARI:DEV 4kHz*

:TYPE BK | DK | OFF
The command specifies which identification is generated.

BK — Area code. The AM modulation depth of the area code on the ARI auxiliary carrier, which has been selected under *SOURce:STEReo:ARI:BK:CODE* is m = 0.6.

DK — Broadcasting code. The AM modulation depth of the broadcasting code (125 Hz) on the ARI auxiliary carrier is m = 0.3.

OFF — Area and broadcasting code are deactivated.

*RST value is DK

Example: *:SOUR:STER:ARI:TYPE BK*

:BK
The commands to specify the characteristics of the BK signal are under this node.

[:CODE] A | B | C | D | E | F
The command specifies the area code.

A — Traffic area code A 23.7500 Hz
B — Traffic area code B 28.2738 Hz
C — Traffic area code C 34.9265 Hz
D — Traffic area code D 39.5833 Hz
E — Traffic area code E 45.6731 Hz
F — Traffic area code F 53.9773 Hz *RST value is A

Example: *:SOUR:STER:ARI:BK A*

3.6.11.15 SOURce:SWEep Subsystem

This subsystem contains the commands to check the RF sweep, i.e., sweeps of the RF generators. Sweeps are triggered on principle. The frequency sweep is activated by command *SOURce:FREQuency:MODE SWEep*, the level sweep by command *SOURce:POWer:MODE SWEep*.

Command	Parameter	Default Unit	Remark
[:SOURce]			
:SWEep			
:BTIMe	NORMal | LONG		
[:FREQuency]			
:DWELl	10 ms to 5 s	s	
:MODE	AUTO | MANual | STEP		
:POINts	Number		
:SPACing	LINear | LOGarithmic		
:STEP			
[:LINear]	0 to 1 GHz	Hz	
:LOGarithmic	0.01 to 50PCT	PCT	
:POWer			
:DWELl	10 ms to 5 s	s	
:MODE	AUTO | MANual | STEP		
:POINts	Number		
:SPACing	LOGarithmic		
:STEP			
:LOGarithmic	0 to 10 dB	dB	

[:SOURce]

:SWEep

:BTIMe NORMal | LONG

The command sets the blank time (Blank TIMe) of the sweep. The setting is valid for all sweeps, i.e., also for LF sweeps.

NORMal Blank time as short as possible.

LONG Blank time long enough to permit an XY recorder to return to 0.

Example: *:SOUR:SWE:BTIM LONG* *RST value is NORM

[:FREQuency]

The commands to set the frequency sweeps are under this node. Keyword [:FREQuency] can be omitted (cf. examples). The commands are SCPI compatible then unless stated otherwise.

:DWELl 10 ms to 5 s

The command sets the time per frequency step (dwell).

Example: *:SOUR:SWE:DWEL 10ms* *RST value is 15 ms

:MODE AUTO | MANual | STEP

The command specifies the run of the sweep.

AUTO Each trigger triggers exactly one entire sweep cycle.

MANual Each frequency step of the sweep is triggered by means of manual control or a *SOURce:FREQuency:MANual* command, the trigger system is not active. The frequency increases or decreases (depending on the direction of the shaft encoder) by the value indicated under *:SOURce:FREQuency:STEP: INCRement*.

STEP Each trigger triggers only one sweep step (single-step mode). The frequency increases by the value indicated under *:SOURce:SWEep: STEP:LOGarithmic*. *RST value is AUTO

Example: *:SOUR:SWE:MODE AUTO*

[:SOURce]
:SWEep
[:FREQuency]
:POINts Number

The command determines the number of steps in a sweep.
Instead of this command, commands *SOURce:SWEep:FREQuency:STEP:LINear* and *SOURce:SWEep:FREQuency:STEP:LOGarithmic* should be used, as *SOURce:SWEep:FREQuency:POINts* has been adapted to the instrument characteristics in comparison to the SCPI command.
The value of POINts depends on SPAN and STEP according to the following formulas.

The following is true for linear sweeps : POINts = SPAN / STEP:LIN + 1

The following is true for logarithmic sweeps and STARt < STOP:

POINts = ((log STOP –log STARt) / log (1+STEP:LOG))

Two independent POINts values are used for SPACing LOG and SPACing LIN. I.e., before POINts is changed, SPACing must be set correctly. A change of POINts results in an adaptation of STEP, but not of STARt, STOP and SPAN.

Example: *:SOUR:SWE:POIN 100*

:SPACing LINear | LOGarithmic

The command selects whether the steps have linear or logarithmic spacings.

*RST value is LINear

Example: *:SOUR:SWE:SPAC LIN*

:STEP

The commands to set the step width with linear and logarithmic sweeps are under this node. The settings of STEP:LIN and STEP:LOG are independent of each other.

[:LINear] 0 to 1 GHz

The command sets the step width with the linear sweep. If STEP[:LINear] is changed, the value of POINts valid for SPACing:LINear also changes according to the formula stated under POINts. A change of SPAN does not result in a change of STEP[:LINear]. Keyword [:LINear] can be omitted, then the command conforms to SCPI regulations (see example).

*RST value is 1 MHz

Example: *:SOUR:SWE:STEP 1MHz*

:LOGarithmic 0.01 to 50 PCT

The command indicates the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated according to

new frequency = prior frequency + STEP:LOG x prior frequency (if STARt < STOP)

STEP:LOG indicates the fraction of the prior frequency by which this is increased for the next sweep step. Usually STEP:LOG is indicated in percent, with the suffix PCT having to be used explicitly. If STEP:LOG is changed, the value of POINts valid for SPAC:LOG also changes according to the formula stated under POINts. A change of STARt or STOP does not result in a change of STEP:LOG. *RST value is 1 PCT

Example: *:SOUR:SWE:STEP:LOG 10PCT*

[:SOURce]
:SWEep
:POWer

The commands to set the level sweeps are under this node.

:DWELl 10 ms to 5 s

The command sets the time per level step (dwell).

*RST value is 15 ms

Example: *:SOUR:SWE:POW:DWEL 12ms*

:MODE AUTO | MANual | STEP

The command specifies the run of the sweep.

AUTO Each trigger triggers exactly one entire sweep cycle.

MANual Each level step of the sweep is triggered by means of manual control or a *SOURce:POWer:MANual* command, the trigger system is not active. The level increases or decreases (depending on the direction of the shaft encoder) by the value stated under *:SOURce:POWer:STEP:INCRement*.

STEP Each trigger triggers only one sweep step (single-step mode). The level increases by the value indicated under *:SOURce:POWer:STEP:INCRement*. *RST value is AUTO

Example: *:SOUR:SWE:POW:MODE AUTO*

:POINts Number

The command determines the number of steps in a sweep. Instead of this command, command *SOURce:SWEep:POWer:STEP:LOGarithmic* should be used, as POINts has been adapted to the instrument characteristics in comparison to the SCPI command.

The value of :POINts depends on .SPAN and :STEP according to the following formulas:

POINts = ((log STOP –log STARt) / log STEP:LOG) + 1

A change of POINts results in an adaptation of STEP but not of STARt, STOP and SPAN.

Example: *:SOUR:SWE:POW:POIN 100*

:SPACing LOGarithmic

The command specifies that the steps have logarithmic spacings. It permits the query of SPACing. *RST value is LOGarithmic

Example: *:SOUR:SWE:POW:SPAC LOG*

:STEP

The commands to set the step width with the sweep are under this node.

:LOGarithmic 0 to 10 dB

The command indicates the step width factor for logarithmic sweeps. The next level value of a sweep is calculated according to

new level = prior level + STEP:LOG × prior level

STEP:LOG indicates the fraction of the prior level by which this is increased for the next sweep step. Usually STEP:LOG is indicated in dB, with suffix dB having to be used explicitly. If STEP:LOG is changed, the value of POINts also changes according to the formula indicated under POINts. A change of STARt or STOP does not result in a change of STEP:LOG. Keyword *:LOG* can be omitted, then the command conforms to SCPI regulation (see example). *RST value is 1dB

Example: *:SOUR:SWE:STEP 10dB*

3.6.11.16 SOURce:VOR-Subsystem

This subsystem contains the commands to control the characteristics of the test signals for VOR (VHF Omnidirectional Range) (option SM-B6, multifunction generator).

Command	Parameter	Default Unit	Remark
[:SOURce]			
:VOR			Option SM-B6
:STATe	ON | OFF		
:SOURce	INT2 | INT2, EXT		
:MODE	NORM | VAR | SUBCarrier | FMSubcarrier		
[:BANGle]	0 to 360 deg	rad	
:DIRection	FROM | TO		
:VAR			
[:DEPTh]	0 to 100 PCT	PCT	
:FREQuency	20 to 40 Hz	Hz	
:SUBCarrier			
:DEPTh	0 to 100 PCT	PCT	
[:FREQuency]	5 to 15 kHz	Hz	
:REFerence			
[:DEViation]	0 to 960 Hz	Hz	
:PRESet			
:COMid			No query
[:STATe]	ON | OFF		
:FREQuency	0.1 to 20 000 Hz	Hz	
:DEPTh	0 to 100 PCT	PCT	

[:SOURce]

:VOR

:STATe ON | OFF

The command switches on or off the generation of VOR signals. STATe ON is only possible if no amplitude modulation is switched on. Modulation generator 2 must not be switched simultaneously as a source for PM or FM either.

*RST value is OFF

Example: *:SOUR:VOR:STAT ON*

:SOURce INT2 | INT2, EXT

This command determines the signal sources of the test signal.

INT2 The test signal used for VOR is generated internally by LF generator 2 (SOURce INT2).

INT2 , EXT A signal from input EXT1 is added to the internal signal in addition. Switching off the internal source is not possible.

*RST value is INT2

Example: *:SOUR:VOR:SOUR INT2*

[:SOURce]
:VOR
:MODE NORM | VAR | SUBCarrier | FMSubcarrier
The command specifies the type of VOR signal generated.

NORM — VOR signal

VAR — Amplitude modulation of the output signal with the *SOURce:VOR:VAR:FREQuency* signal content (usually 30 Hz) of the VOR signal. The modulation depth is set under *SOURce:VOR:VAR:DEPTh*.

SUBCarrier — Amplitude modulation of the output signal with the unmodulated *SOURce:VOR:SUBCarrier:FREQuency*-FM carrier (usually 9960 Hz) of the VOR signal. The modulation depth is set under *SOURce:VOR:SUBCarrier: DEPTh*.

FMSubcarrier — (FM-modulated subcarrier) Amplitude modulation of the output signal with the frequency-modulated *SOURce:VOR:SUBCarrier: FREQuency*--FM carrier (usually 9960 Hz) of the VOR signal. The frequency deviation is set under *SOURce:VOR:REFerence:DEViation*, the modulation depth under *SOURce:VOR:SUBCarrier:DEPTh*.

*RST value is NORM

Example: *:SOUR:VOR:MODE VAR*

[:BANGle] 0 to 360 deg
The command sets the bearing angle (Bearing ANGle) between the VAR signal and the reference signal. The orientation of the angle depends on the setting under *SOURce:VOR:BANGle:DIRection*. *RST value is 0 Grad

Example: *:SOUR:VOR:BANG 0deg*

:DIRection FROM | TO
The command determines the orientation of the bearing angle.

FROM — The bearing angle is measured between the geographic north and the connection line from beacon to airplane.

TO — The bearing angle is measured between the geographic north and the connection line from airplane to beacon.

*RST value is FROM

Example: *:SOUR:VOR:BANG:DIR TO*

:VAR
The commands to specify the characteristics of the VAR signal are under this node.

[:DEPTh] 0 to 100 PCT
The command sets the AM modulation depth of the VAR signal. *RST value is 30PCT

Example: *:SOUR:VOR:VAR:DEPT 30PCT*

:FREQuency 20 to 40 Hz
The command sets the frequency of the VAR signal. As VAR and reference signal must always have the same frequency, this setting is also valid for the reference signal.

*RST value is 30 Hz

Example: *:SOUR:VOR:VAR:FREQ 30*

[:SOURce]
:VOR
:SUBCarrier
The commands to specify the characteristics of the FM carrier are under this node (subcarrier).

[:FREQuency] 5 to 15 kHz
The command sets the frequency of the FM carrier. *RST value is 9960 Hz
Example: *:SOUR:VOR:SUBC:FREQ 9960*

:DEPTh 0 to 100 PCT
The command sets the AM modulation depth of the FM carrier. *RST value is30PCT
Example: *:SOUR:VOR:SUBC:DEPT 30PCT*

:REFerence
The commands to specify the characteristics of the reference signal are under this node.

[:DEViation] 0 to 960 Hz
The command sets the frequency deviation of the reference signal on the FM carrier.
*RST value is 480 Hz
Example: *:SOUR:VOR:REF:DEV 480*

:PRESet
This command is equivalent to the following command sequence:
:VOR:MODE NORM
:VOR:SOUR INT2
:VOR 0deg
:VOR:DIRection FROM
:VOR:VAR:FREQ 30Hz
:VOR:VAR 30PCT
:VOR:SUBC 9960Hz
:VOR:SUBC:DEPTh 30PCT
:VOR:REF:DEV 480Hz
:VOR:COM OFF
:VOR:COM:FREQ 1020Hz
:VOR:COM:DEPTh 10PCT
The values set correspond to the state after *SYSTEM:PRESET* or **RST*. The command neither has a query form nor an *RST value.
Example: *:SOUR:VOR:PRES*

:COMid
The commands to set the ComId component (communication/identification signal) of the VOR signal are under this node.

[:STATe] ON | OFF
The command activates or deactivates the ComId signal. *RST value is OFF
Example: *:SOUR:VOR:COM:STAT ON*

:FREQuency 0.1 to 20 000 Hz
The command sets the frequency of the ComId signal. *RST value is 1020 Hz
Example: *:SOUR:VOR:COM:FREQ 1020*

:DEPTh 0 to 100 PCT
The command sets the AM modulation depth of the ComId signal. *RST value is 10PCT
Example: *:SOUR:VOR:COM:DEPT 10PCT*

3.6.12 SOURce0|2 System

The SOURce0|2 system contains the commands to configure the LF signal sources. The following allocation is valid:

SOURce0: Standard generator.
Designated as INT1 if used as a modulation source (cf. command *SOURce:AM:SOURce INT1,* e.g.). The numbering as SOURce0 is different from the manual control.

Second optional LF generator (option SM-B2).
Replaces the standard generator which is cut out by this option. Is designated as INT1 if it is used as a modulation source; if it is used as an LF generator, it is designated as SOURce0 differently from the numbering of the manual control.

SOURce2 First optional LF or modulation generator (option SM-B2 or SM-B6).
Is designated as INT2 if used as a modulation source; if it is used as an LF generator, it is designated as SOURce2.

The commands to set the output voltage of the LF generators are in the OUTPut2 system (see Section 3.6.10)

Sub systems	Setting
:SOURce0 | 2	
:FREQuency	Frequency with CW and sweep operation
:FUNCtion	Waveform of the output signal
:MARKer	Marker for LF sweeps (only possible using SOURce2)
:SWEep	LF sweep (only possible using SOURce2)

3.6.12.1 SOURce0|2:FREQuency Subsystem

This subsystem contains the commands for the frequency settings in operating modes CW and SWEep. Only command *SOURce0:FREQuency:CW|FIXed* is effective for the standard LF generator (SOURce0). For LF generator2 (SOURce2), sweep commands are effective as well.

Commands	Parameter	Default Unit	Remark
:SOURce0 | 2			
:FREQuency			
[:CW|:FIXed]	400 Hz | 1 kHz | 3 kHz | 15 kHz or 0.1Hz to 500 kHz or 0.1Hz to 1MHz	Hz	 Option SM-B2 or B6
:MANual	0.1Hz to 500 kHz or 0.1Hz to 1MHz	Hz	Option SM-B2 or B6
:MODE	CW|FIXed | SWEep		
:STARt	0.1Hz to 500 kHz or 0.1Hz to 1MHz	Hz	Option SM-B2 or B6
:STOP	0.1Hz to 500 kHz or 0.1Hz to 1MHz	Hz	Option SM-B2 or B6

:SOURce0|2
:FREQuency
[:CW | :FIXed] 400 Hz | 1 kHz | 3 kHz | 15 kHz or 0.1 Hz to 500 kHz or 0.1 Hz to 1MHz
The command sets the frequency for the CW mode.
If neither SM-B2 nor SM-B6 are fitted, the values 400 Hz, 1 kHz, 3 kHz and 15 kHz are permissible for SOURce0. With option SM-B2, values from 0.1 Hz to 500 kHz are permissible, with SM-B6 from 0.1 Hz to 1 MHz. RST value is 1kHz

Example: *:SOUR2:FREQ:CW 1kHz*

:SOURce0|2
:FREQuency
:MANual 0.1 Hz to 500 kHz or 0.1 Hz to 1MHz
The command sets the frequency if *SOURce2:SWEep:MODe MANual* and *SOURce2: FREQuency: MODe SWEep* are set. In this case, only frequency values between the settings *SOURce2: FREQuency:STARt* and ... *:STOP* are allowed. (For range of values see FREQuency:CENTer).
Example: *:SOUR2:FREQ:MAN 1kHz* *RST value is 1 kHz

:MODE CW|FIXed | SWEep
The command specifies the operating mode and hence by means of which commands the FREQuency subsystem is checked. The following allocations are valid:
CW |FIXed CW and FIXed are synonyms. The output frequency is specified by means of *SOURce0|2:FREQuency:CW |FIXed.*
SWEep The generator operates in the SWEep mode. The frequency is specified by means of commands *SOURce2:FREQuency:STARt; STOP; MANual.* The SWEep setting is only possible for SOURce2.
RST value is CW
Example: *:SOUR0:FREQ:MODE CW*

:STARt 0.1 Hz to 500 kHz (option SM-B2) or 0.1 Hz to 1 MHz (option SM-B6)
This command indicates the starting value of the frequency for the sweep.
*RST value is 1kHz
Example: *:SOUR2:FREQ:STAR 100kHz*

:STOP 0.1 Hz to 500 kHz (option SM-B2) bzw. 0.1 Hz to 1 MHz (option SM-B6)
This command indicates the end value of the frequency for the sweep.
*RST value is 100kHz
Example: *:SOUR2:FREQ:STOP 200 kHz*

3.6.12.2 SOURce 0|2:FUNCtion Subsystem

This subsystem contains the commands specifying the waveform of the output signal.

Command	Parameter	Default Unit	Remark
:SOURce0|2 **:FUNCtion** **[:SHAPe]**	SINusoid | SQUare | TRIangle | PRNoise | SAWTooth		

:SOURce0|2
:FUNCtion
[:SHAPe] SINusoid | SQUare | TRIangle | PRNoise
The command specifies the waveform of the output signal. In the case of the standard generator, the waveform is specified to be sine. The optional LF generator (SOURce2, option SM-B2 or SM-B6) can be converted to all signal forms. If two options SM-B2 are installed, SOURce0 can be set to all signal forms as well.
SINusoid Sine
SQUare Square
TRIangle Triangle
PRNoise Periodic noise.
SAWTooth Sawtooth
*RST value is SIN
Example: *:SOUR2:FUNC:SHAP SQU*

3.6.12.3 SOURce2:MARKer Subsystem

This subsystem contains the commands to check the marker generation in the case of LF sweeps. Operating mode SWEep is only possible for SOURce2. The three markers existing are differentiated by a numeric suffix after marker.

Command	Parameter	Default Unit	Remark
:SOURce2			
:MARKer			Option SM-B2 or SM-B6
[:FSWeep]			No query
:AOFF			
:FREQuency	0.1 Hz to 500 kHz	Hz	
[:STATe]	ON | OFF		
:POLarity	NORMal | INVerted		

:SOURce2

:MARKer 1 | 2 | 3

[:FSWeep]

The commands for the markers with the LF frequency sweep (Frequency SWeep) are under this node. Keyword [:FSWeep] can also be omitted, then the command conforms to SCPI regulation (see examples).

:AOFF

The command switches off all LF frequency markers. This command triggers an event, thus it has no *RST value and no query form.

Example: *:SOUR2:MARK:AOFF*

:FREQuency 0.1Hz to 500 kHz

The command sets the marker selected by the numeric suffix at MARKer to the frequency indicated. *RST value for MARK1: 100kHz
MARK2: 10kHz
MARK3: 1kHz

Example: *:SOUR2:MARK1:FREQ 9000*

[:STATe] ON | OFF

The command switches on or off the marker selected by the numeric suffix at MARKer. *RST value is OFF

Example: *:SOUR2:MARK1:STAT ON*

:POLarity NORMal | INVerted

The command specifies the polarity of the marker signal as follows:

NORMal — When running through the marker condition, TTL level is applied at the marker output, otherwise 0 V.

INVers — When running through the marker condition, 0 V is applied at the marker output, otherwise TTL level. *RST value is NORM

Example: *:SOUR2:MARK1:POL INV*

3.6.12.4 SOURce2:SWEep Subsystem

This subsystem contains the commands to check the LF sweep of SOURce2. Sweeps are triggered on principle. Command *SOURce2:FREQuency:MODE SWEep* activates the LF sweep.

Command	Parameter	Default Unit	Remark
:SOURce2			
:SWEep			Option SM-B2 oder SM-B6
:BTIMe	NORMal | LONG		
[:FREQuency]			
:DWELl	10 ms to 5 s	s	
:MODE	AUTO | MANual | STEP		
:POINts	Number		
:SPACing	LINear | LOGarithmic		
:STEP			
[:LINear]	0 to 500 kHz	Hz	
:LOGarithmic	0.01 to 50 PCT	PCT	

:SOURce2

:SWEep

:BTIMe NORMal | LONG

The command sets the blank time (Blank TIMe) of the sweep. The setting is valid for all sweeps, i.e., also for RF sweeps.

NORMal Blank time as short as possible.

LONG Blank time long enough to permit an X/Y recorder to return to 0.

*RST value is NORM

Example: *:SOUR2:SWE:BTIM LONG*

[:FREQuency]

The commands to set the frequency sweeps are under this node. Keyword [:FREQuency] can be omitted. Then the commands are SCPI-compatible unless stated otherwise (see examples).

:DWELl 10 ms to 5 s

The command sets the time per frequency step (dwell).

*RST value is 15 ms

Example: *:SOUR2:SWE:DWEL 20ms*

:MODE AUTO | MANual | STEP

The command specifies the run of the sweep.

AUTO Each trigger triggers exactly one entire sweep cycle.

STEP Each trigger triggers only one sweep step (single-step mode). The frequency increases by the value indicated under *:SOURce2:SWEep :STEP*.

*RST value is AUTO

Example: *:SOUR2:SWE:MODE AUTO*

:SOURce2
:SWEep
[:FREQuency]

:POINts Number

The command determines the number of steps in a sweep. Instead of this command, commands *:SOURce2:FREQuency:STEP:LINear* and *:SOURce2:FREQuency:STEP: LOGarithmic* should be used, as *:SOURce2:SWEep:FREQuency:POINts* has been adapted to the instrument characteristics in comparison to the SCPI command. The value of POINts depends on SPAN and STEP according to the following formulas.

The following is true of linear sweeps : POINts = SPAN / STEP:LIN + 1

The following is true of logarithmic sweeps and STARt < STOP:

POINts = ((log STOP – log STARt) / log STEP:LOG) + 1

Two independent POINts values are used for SPACing LOG and SPACing LIN. That is to say, before POINts is changed, SPACing must be set correctly. A change of POINts causes an adaption of STEP, but not of STARt, STOP and SPAN.

Example: *:SOUR2:SWE:POIN 50*

:SPACing LINear | LOGarithmic

The command selects whether the steps have linear or logarithmic spacings.

*RST value is LINear

Example: *:SOUR2:SWE:SPAC LOG*

:STEP

The commands to set the step width with linear and logarithmic sweeps are under this node. The settings of STEP:LIN and STEP:LOG are independent of each other.

[:LINear] 0 to 500 kHz

The command sets the step width with the linear sweep. If STEP:LINear is changed, the value of POINts valid for SPACing:LINear also changes according to the formula indicated under POINts. A change of SPAN does not cause a change of STEP:LINear. Keyword [:LINear] can be omitted, then the command conforms to SCPI regulation (see example).

*RST value is 1 kHz

Example: *:SOUR2:SWE:STEP 10kHz*

:LOGarithmic 0.01 to 50 PCT

The command indicates the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated according to (if STARt < STOP) :

new frequency = prior frequency + STEP:LOG x prior frequency

Thus STEP:LOG indicates the fraction of the prior frequency by which this is increased for the next sweep step. Usually STEP:LOG is indicated in percent, with the suffix PCT having to be used explicitly. If STEP:LOG is changed, the value of POINts valid for SPACing:LOGarithmic also changes according to the formula stated under POINts. A change of STARt or STOP does not cause a change of STEP:LOGarithmic.

*RST value is 1 PCT

Example: *:SOUR2:SWE:STEP:LOG 5PCT*

3.6.13 STATus System

This system contains the commands for the status reporting system (c.f. Section 3.8, Status Reporting System). *RST has no influence on the status registers.

Command	Parameter	Default Unit	Remark
:STATus			
:OPERation			
[:EVENt]?			Query only
:CONDition?			Query only
:PTRansition	0 to 32767		
:NTRansition	0 to 32767		
:ENABle	0 to 32767		
:PRESet			No query
:QUEStionable			
[:EVENt]?			Query only
:CONDition?			Query only
:PTRansition	0 to 32767		
:NTRansition	0 to 32767		
:ENABle	0 to 32767		
:QUEue			
[:NEXT]?			Query only

:STATus

:OPERation

The commands for the STATus:OPERation register are under this node.

[:EVENt]?

The command queries the content of the EVENt part of the STATus:OPERation register. In reading out, the content of the EVENt part is deleted.

Example: *:STAT:OPER:EVEN?* Response: *17*

:CONDition?

The command queries the content of the CONDition part of the STATus:OPERation register. In reading out, the content of the CONDition part is not deleted. The value returned directly reflects the current hardware state.

Example: *:STAT:OPER:COND?* Response: *1*

:PTRansition 0 to 32767

The command (Positive TRansition) sets the edge detectors of all bits of the STATus:OPERation register from 0 to1 for the transitions of the CONDition bits.

Example: *:STAT:OPER:PTR 32767*

:NTRansition 0 to 32767

The command (Negative TRansition) sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Example: *:STAT:OPER:NTR 0*

:STATus

:OPERation

:ENABle 0 to 32767

The command sets the bits of the ENABle register. This register selectively enables the individual events of the appropriate status event register for the sum bit in the status byte.

Example: *:STAT:OPER:ENAB 1*

:PRESet

The command resets the edge detectors and ENABle parts of all registers to a defined value. All PTRansition parts are set to FFFFh, i.e., all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e., a transition from 1 to 0 in a CONDition bit is not detected. The ENABle parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e., all events in these registers are not passed on.

Example: *:STAT:PRES*

:QUEStionable

The commands for the STATus:QUEStionable register are under this node.

[:EVENt]?

The command queries the content of the EVENt part of the STATus:QUEStionable register. In reading out, the content of the EVENt part is deleted.

Example: *:STAT:QUES:EVEN?* Response: *1*

:CONDition?

The command queries the content of the CONDition part of the STATus:QUEStionable register. In reading out, the content of the CONDition part is not deleted.

Example: *:STAT:QUES:COND?* Response: *2*

:PTRansition 0 to 32767

The command (Positive TRansition) sets the edge detectors of all bits of the STATus:QUEStionable register from 0 to 1 for transitions of the CONDition bit.

Example: *:STAT:QUES:PTR 32767*

:NTRansition 0 to 32767

The command (Negative TRansition) sets the edge detectors of all bits of the STATus:QUEStionable register from 1 to 0 for transitions of the CONDition bit.

Example: *:STAT:QUES:NTR 0*

:ENABle 0 to 32767

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This part selectively enables the individual events of the appropriate EVENt part for the sum bit in the status byte.

Example: *:STAT:QUES:ENAB 1*

:QUEue[:NEXT]?

The command queries the entry that has been in the error queue for the longest time and thus deletes it. Positive error numbers denote errors specific of the instrument, negative error numbers error messages specified by SCPI (see annex B). If the error queue is empty, error number 0, "No error", is returned. The command is identical to *SYSTem: ERRor?*.

Example: *STATus:QUEue:NEXT?* Response: *–221, "Settings conflict"*

3.6.14 SYSTem System

In this system, a number of commands for general functions which are not immediately related to signal generation, are combined.

Command	Parameter	Default Unit	Remark
:SYSTem			
:BEEPer			
:STATe	ON | OFF		
:COMMunicate			
:GPIB			
[:SELF]			
:ADDRess	0 to 30		
:SERial			
:CONTrol			
:RTS	ON | IBFull | RFR		
:BAUD	1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200		
:PACE	XON | NONE		
:ERRor?			Query only
:KLOCk	ON | OFF		
:MODE	FIXed | MSEQuence		
:MSEQuence			
:CATalog?			
:DELete	"Name of sequence"		
:ALL		s	
:DWELl	50 ms to 60 s{,50 ms to 60 s}		
:FREE?			Query only
:MODE	AUTO | STEP		
[:RCL]	1 to 50 {,1 to 50}		
:POINts?			Query only
:SELect	"Name of sequence"		
:PRESet			
:PROTect			
[:STATe]	ON | OFF , password		
:SECurity			
[:STATe]	ON | OFF		
:SERRor?			Query only
:VERSion?			Query only

:SYSTem

:BEEPer This node contains the commands to set the beeper fitted.

:STATe ON | OFF

The command switches the beeper on or off. *RST value is OFF

Example: *:SYST:BEEP:STAT OFF*

:COMMunicate

The commands to set the remote control interface are under this node.

:GPIB The commands to check the IEC bus are under this node (GPIB = General Purpose Interface Bus).

[:SELF]

:ADDRess 1 to 30

The command sets the IEC-bus instrument address. *RST value is 28

Example: *:SYST:COMM:GPIB:ADDR 1*

:SYSTem

:COMMunication

:SERial

The command to set the serial interface are under this node. The data format is fixedly set to 8 data bits, no parity and 1 stop bit. These values cannot be changed. The device represents a DTE (Data Terminal Equipment) in relation to the serial interface. Therefore the the controller must be connected via a 0-modem.

:BAUD 1200| 2400| 4800| 9600| 19200| 38400| 57600| 115200

The commands sets the baud rate for both the transmit and the receive direction. *RST has no influence on this parameter.

Example: *:SYST:COMM:SER:CONT:BAUD 9600* *RTS value is 9600

:CONTrol

:RTS ON | IBFull | RFR

The commands sets the hardware handshake. *RST has no influence on this parameter.

ON Interface line RTS is always active.

IBFull | RFR Input Buffer Full | Ready For Receiving
Interface line RTS remains active as long as the instrument is ready to receive data.

Example: *:SYST:COMM:SER:CONT:RTS ON* *RST value is RFR

:PACE XON | NONE

The command sets the software handshake. *RST has no influence on this parameter.

XON Software handshake using the ASCII codes 11h (XON) and 13h (XOFF).

Note: *This mode is not recommended for binary data and for baud rates above 9600 bauds.*

NONE No software handshake.

Example: *:SYST:COMM:SER:PACE NONE* *RST value is NONE

:ERRor?

The command queries the entry that has been in the error queue for the longest time. Positive error numbers denote errors specific of the instrument, negative error numbers denote error messages specified by SCPI (see annex B3). If the error queue is empty, 0, "No error", is returned. The command is identical to *STATus:QUEue:NEXT?*

Example: *:SYST:ERR?* Response: *–221, "Settings conflict"*

:KLOCk ON | OFF

The command (Keyboard LOCk) disables the keyboard of the SMT including the [LOCAL] key or enables it again (OFF).

Caution: *If :SYSTem:SECurity is ON, the keyboard cannot be enabled, i.e., :SYSTem:KLOCk OFF is not accepted. If the disabling of the command is released by switching over to :SYSTem:SECurity OFF, data will be lost.*

Example: *:SYST:KLOC ON* *RST value is OFF

:SYSTem

:MODE FIXed | MSEQuence

The command sets the operating mode of the instrument.

FIXed The overall instrument state can only be switched over using **RCL*.

MSEQuence The instrument successively sets the instrument states indicated under *:SYSTem:MSEQuence:RCL*. *RST value is FIXed

Example: *:SYST:MODE FIX*

:MSEQuence

This node contains the commands to manage the memory sequences. Memory sequences each consist of a list of instrument state numbers and a time list. If *:SYSTem:MODE* is switched to *MSEQuence,* the instrument states stated in the list selected are set successively for the time stated in the time list in each case.

:CATalog?

The command queries the memory sequences available. It returns a list, the entries are separated by means of commas.

Example: *:SYST:MSEQ:CAT?* Response: "SEQ1", "DEMO", "SEQA"

:DELete "Name of sequence"

The command deletes the memory sequence indicated. This must not be selected.

Example: *:SYST:MSEQ:DEL "SEQ1"*

:ALL

The command deletes all memory sequences.The memory-sequence mode must be switched off (*:SYSTem:MODE FIXed*) as a selected sequence cannot be deleted.

Example: *:SYST:MSEQ:DEL:ALL*

:DWELl 50 ms to 60 s {,50 ms to 60 s}

For the memory sequence which has currently been selected, the command transmits a list indicating the time for which an instrument setting is "held" in each case before the instrument proceeds to the next setting. If DWELl indicates only one parameter, every item of the instrument state list is set for the same, indicated time. Lists are not influenced by *RST.

Example: *:SYST:MSEQ:DWEL 1s*

:FREE?

The command queries the space available for memory sequences. It returns two values. The first value indicates the space still vacant, the second the space already occupied.

Example: *:SYST:MSEQ:FREE?* Response: *20, 236*

:MODE AUTO | STEP

The command indicates in which way the memory sequence is to be processed (by analogy with *:SOURce:SWEep:MODE*) .

AUTO Each trigger event triggers a complete cycle of the memory sequence selected.

STEP Each trigger event only triggers one step in processing the memory sequence. *RST value is AUTO

Example: *:SYST:MSEQ:MODE AUTO*

:SYSTem

:MSEQuence

[:RCL] 1 to 50 {,1 to 50}

The command transmits the list of the instrument states to be assumed successively. The list contains integers denoting the states stored by means of **SAV*. These instrument states are set successively using a simulated **RCL* (thus the name of the list). The values of the list are between 1 and 50 (number of memory locations to be called). Lists are not influenced by *RST.

Example: *:SYST:MSEQ:RCL 30, 31, 32 ,32 ,32 , 33*

:POINts?

The command queries the length of the RCL list selected. The RCL list is user-defined and of variable length (see above). The maximal length can be queried by means of *:SYSTem:MSEQence:FREE?* (addition of the two values).

Example: *:SYST:MSEQ:RCL:POIN?* Response: *17*

:SELect "Name of sequence"

The command selects a memory sequence. The name of the sequence may be an arbitrary character string of up to 7 letters. If there is no memory sequence of the name indicated, the command creates it, i.e., this command can be used to generate new lists.

Example: *:SYST:MSEQ:SEL "SEQA"*

:PRESet

The command triggers an instrument reset. It has the same effect as the RESET key of the manual control or as command **RST*. This command triggers an event and hence has no *RST value.

Example: *:SYST:PRES*

:PROTect 1 | 2 | 3

The commands to disable certain instrument functions are under this node. A list of the functions concerned can be found in the manual control (Chapter 2, Section "Password Input with Functions Protected"). There are three protection levels which are differentiated by means of a suffix after PROTect. *RST has no effects on the disabling/enabling of the instrument functions.

[:STATe] ON | OFF, password

The command switches a protection level on or off. The passwords are 6-digit numbers. They are fixedly stored in the firmware. The password for the first level is 123456.

ON disables the functions belonging to this protection level. A password need not be indicated.

OFF deactivates the disabling again if the correct password is indicated. Otherwise an error – 224, "Illegal parameter value" is generated and STATe remains ON.

Example: *:SYST:PROT1:STAT OFF, 123456*

:SYSTem

:SECurity

The commands setting the security characteristics of the instrument are under this node.

[:STATe] ON | OFF

The command switches the security state on or off.

ON The following commands cannot be executed:
:DISPlay:ANNotation:ALL ON
:DISPlay:ANNotation:FREQuency ON
:DISPlay:ANNotation:AMPLitude ON
:SYSTem:KLOCk OFF

OFF In the transition from ON to OFF all data existing in the instrument except for the calibrating data are deleted, especially all status registers, all instrument states and all lists.

The command is not influenced by *RST and *RCL.

Example: *:SYST:SEC:STAT ON*

:SERRor?

This command returns a list of all errors existing at the point of time of the query. This list corresponds to the indication on the ERROR page with manual control (cf. Section 2.14, Error Messages).

Example: *:SYST:SERR?*

Response: *–221, "Settings conflict", 153, "Input voltage out of range"*

:VERSion?

The command returns the SCPI version number the instrument acts in accordance with. This command is a query and thus has no *RST value.

Example: *:SYST:VERS?* Response: *1994.0*

3.6.15 TEST System

This system contains the commands to execute the selftest routines (*RAM?*, *ROM?* and *BATTery?*) as well as to directly manipulate the hardware modules (*:TEST:DIRect).* The selftests return a "0" if the test has been executed successfully, otherwise a value unequal to "0". All commands of this system do not have an *RST value.

Caution: *The commands under node :TEST:DIRect directly act on the respective hardware module circumventing any security mechanisms. They are provided for service purposes and should not be used by the user. Improper use of the commands may damage the module.*

Command	Parameter	Default Unit	Remark
:TEST			
:DIRect			Query only
:ATTC	Subaddress, hex data string		
:LFGENA	Subaddress, hex data string		
:LFGENB	Subaddress, hex data string		
:MGEN	Subaddress, hex data string		
:OPU1M	Subaddress, hex data string		
:OPU3M	Subaddress, hex data string		
:OPU6M	Subaddress, hex data string		
:PUM	Subaddress, hex data string		
:TSYN	Subaddress, hex data string		
:ROSC	Subaddress, hex data string		
:RAM?			Query only
:ROM?			Query only
:BATTery?			Query only

:TEST

:DIRect

This node contains the commands directly acting on the respective hardware module circumventing any security mechanisms. The commands under this node have no short form.

:ATTC Subaddress, hex data string

The command directly acts on module ATTC. A subaddress (0 or 1) must be indicated as a parameter. The data are indicated as a <string> (i.e., an ASCII character string enclosed in quotation marks) representing hexadecimal numbers. Thus characters 0 to 9 A to F may occur in the character string.

Example: *:TEST:DIR:ATTC 0, "0010AF1F"*

:TEST

:DIRect

:LFGENA Subaddress, hex data string
The command acts on module LFGENA. (cf. *:TEST:DIR:ATTC*)

:LFGENB Subaddress, hex data string
The command acts on module LFGENB. (cf. *:TEST:DIR:ATTC*)

:MGEN Subaddress, hex data string
The command acts on module MGEN. (cf. *:TEST:DIR:ATTC*)

:OPU1M Subaddress, hex data string
The command acts on module OPU1. (cf. *:TEST:DIR:ATTC*)

:OPU3M Subaddress, hex data string
The command acts on module OPU3. (cf. *:TEST:DIR:ATTC*)

:OPU6M Subaddress, hex data string
The command acts on module OPU6. (cf. *:TEST:DIR:ATTC*)

:PUM Subaddress, hex data string
The command acts on module PUM. (cf. *:TEST:DIR:ATTC*)

:TSYN Subaddress, hex data string
The command acts on module TSYN. (cf. *:TEST:DIR:ATTC*)

:ROSC Subaddress, hex data string
The command acts on module ROSC. (cf. *:TEST:DIR:ATTC*)

:RAM?
The command triggers a test of the EPROMS (see table).

:ROM?
The command triggers a test of the main memory (see table).

:BATTery?
The command triggers a test of the battery voltage (see table).

3.6.16 TRIGger System

The TRIGger system contains the commands to select the trigger source and to configure the external trigger socket. The suffix is only important for the SWEEP subsystem and conforms to the numbering of the SOURce system:
TRIGger1 = RF generator
TRIGger2 = LFGEN2

The trigger system of the SMT is a simplified implementation of the SCPI trigger system. Compared to SCPI, the TRIGger system shows the following differences:

- No INITiate command, the instrument behaves as if *INITiate:CONTinuous ON* was set.
- There are several subsystems denoting the different parts of the instrument under TRIGger (SWEep, PULSe, MSEQuence).

Further commands as to the trigger system of the SMT can be found in the ABORt system.

Command	Parameter	Default Unit	Remark
:TRIGger1|2			
[:SWEep]			
[:IMMediate]			No query
:SOURce	SINGle | EXTernal | AUTO		
:MSEQuence			
[:IMMediate]			No query
:SOURce	SINGle | EXTernal | AUTO		
:PULSe			
:SOURce	EXTernal | AUTO		
:SLOPe	POSitive | NEGative		
:SLOPe	POSitive | NEGative | EITHer		

:TRIGger1|2
[:SWEep]

All commands to trigger a sweep are under this node. The settings here act on level and frequency sweeps for RF generator (TRIG1) and LF generator (TRIG2).

[:IMMediate]

The command immediately starts a sweep. Which sweep is executed depends on the respective MODE setting, e.g. *:SOURce:FREQuency:MODE SWEep*. The command corresponds to manual-control command EXECUTE SINGLE SWEEP. This command is an event and thus has no *RST value.

Example: *:TRIG:SWE:IMM*

:TRIGger1|2

[:SWEep]

:SOURce SINGle | EXTernal | AUTO

The command specifies the trigger source.
The naming of the parameters directly corresponds to the different settings with manual control. SCPI uses other designations for the parameters the instrument accepts as well. These designations are to be preferred if compatibility is important. The following table provides an overview:

SMT designation	SCPI designation	Command with manual control
SINGle	BUS	MODE SINGLE or STEP
EXTernal	EXTernal	MODE EXT TRIG SINGLE or EXT TRIG STEP
AUTO	IMMediate	MODE AUTO

SINGle — Triggering is effected by means of IEC-bus commands *:TRIGger:SWEep :IMMediate* or **TRG*. If *:SOURce:SWEep:MODE* is set to *STEP*, a step, in the case of the *AUTO* setting a complete sweep, is executed.

EXTernal — Triggering is effected from outside via the EXT.TRIG. socket or by the GET command via IEC/IEEE-bus (see annex A). The action triggered depends on the setting of the sweep mode as in the case of SINGle.

AUTO — The trigger is free-running, i.e., the trigger requirement is permanently met. As soon as a sweep has been terminated, the next one is started.

Example: *:TRIG:SWE:SOUR AUTO* *RST value is SINGle

:MSEQuence

This node contains all commands to trigger a memory sequence. The commands are only valid for TRIGger1.

[:IMMediate]

The command immediately starts a memory sequence. It corresponds to the EXECUTE SINGLE MODE command of the manual control in the MEMORY SEQUENCE menu. This command is an event and thus has no *RST value.

Example: *:TRIG:MSEQ:IMM*

:SOURce SINGle | EXTernal | AUTO

The command specifies the trigger source (cf. *:TRIGger:SWEep:SOURce*)

Example: *:TRIG:MSEQ:SOUR AUTO* *RST value is SINGle

:PULSe

This node contains all commands to trigger the pulse generator (option SM-B4). The commands are only valid for TRIGger1.

:SOURce EXTernal | AUTO

The command specifies the trigger source.

EXTernal — Triggering is effected from outside via the PULSE socket.

AUTO — Trigger is free-running (see above) *RST value is AUTO

Example: *:TRIG:PULS:SOUR AUTO*

:SLOPe POSitive | NEGative

The command indicates whether the action triggered is triggered at the positive or the negative edge of the trigger signal. *RST value is POSitiv

Example: *:TRIG:PULS:SLOP NEG*

:TRIGger

:SLOPe POSitive | NEGative | EITHer

The command indicates whether the external trigger input only responds to the positive, the negative or to both edges of the trigger signal. The command acts on *TRIGger1|2:SWEep* and *TRIGger1:MSEQuence*. The pulse generator has an own trigger input and thus also an own SLOPe command.

*RST value is POSitiv

Example: *:TRIG:SLOP NEG*

3.6.17 UNIT System

This system contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

Command	Parameter	Default Unit	Remark
:UNIT			
:ANGLe	DEGRee| DEGree | RADian		
:POWer	DBM | DBW | DBMW | DBUW | DBV | DBMV | DBUV | V		

:UNIT

:ANGLe DEGRee | DEGree | RADian

The command indicates the unit for angles. *RST value is RADian

Example: *:UNIT:ANGL DEGR*

:POWer DBM | DBW | DBMW | DBUW | DBV | DBMV | DBUV | V

The command indicates the unit for power. *RST value is DBM

Example: *:UNIT:POW V*

3.7 Instrument Model and Command Processing

The instrument model shown in Fig. 3.2 has been made viewed from the standpoint of the servicing of IEC-bus commands. The individual components work independently of each other and simultaneously. They communicate by means of so-called "messages".

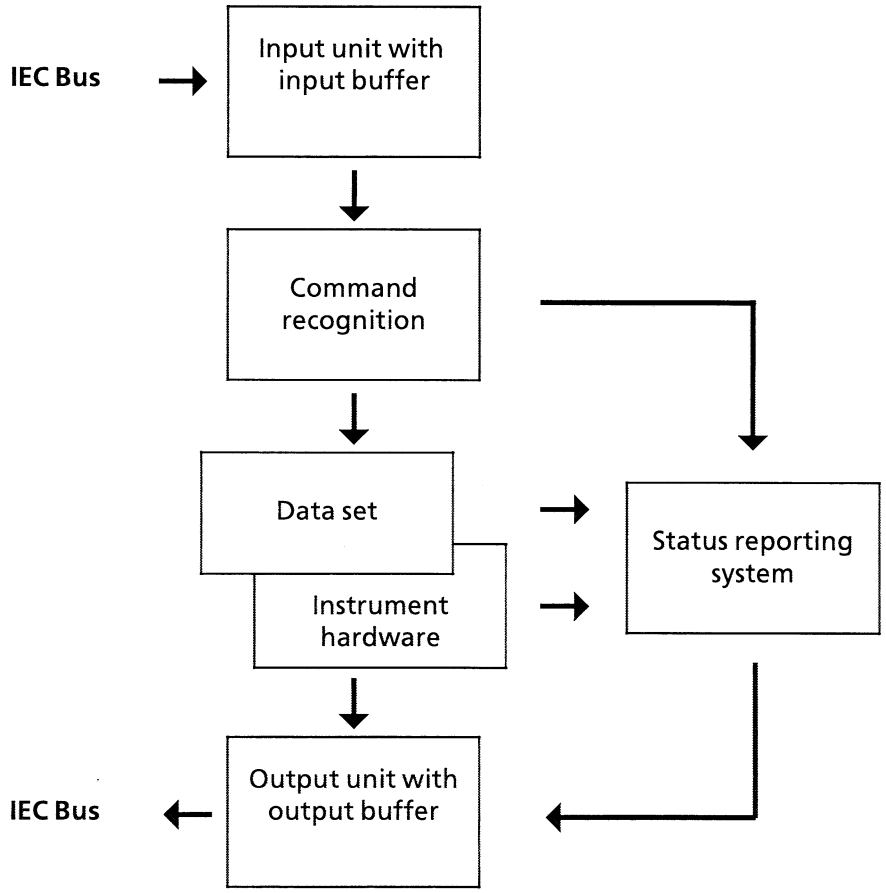


Fig. 3-2 Instrument model in the case of remote control by means of the IEC bus

3.7.1 Input Unit

The input unit receives commands character by character from the IEC bus and collects them in the input buffer. The input buffer has a size of 1024 characters. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.
If the input buffer is full, the IEC-bus traffic is stopped and the data received up to then are processed. Subsequently the IEC-bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

3.7.2 Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before as well. Each recognized command is immediately transferred to the data set but without being executed there at once.
Syntactical errors in the command are recognized here and supplied to the status reporting system. The rest of a command line after a syntax error is analysed further if possible and serviced.
If the command recognition recognizes a delimiter or a DCL, it requests the data set to set the commands in the instrument hardware as well now. Subsequently it is immediately prepared to process commands again. This means for the command servicing that further commands can already be serviced while the hardware is still being set ("overlapping execution").

3.7.3 Data Set and Instrument Hardware

Here the expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included.

The data set is a detailed reproduction of the instrument hardware in the software.

IEC-bus setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. As this is always only effected at the end of a command line, the order of the setting commands in the command line is not relevant.

The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that an execution is not possible, an "execution error" is signalled to the status reporting system. All alterations of the data set are cancelled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, it is permissible to set impermissible instrument states within one command line for a short period of time without this leading to an error message (example: simultaneous activation of FM and PM). At the end of the command line, however, a permissible instrument state must have been reached again.

Before passing on the data to the hardware, the settling bit in the STATus:OPERation register is set (cf. Section 3.8.3.4). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

IEC-bus queries induce the data set management to send the desired data to the output unit.

3.7.4 Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in Section 3.8.

3.7.5 Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer. The output buffer has a size of 1024 characters. If the information requested is longer, it is made available "in portions" without this being recognized by the controller.
If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are send on the IEC bus, the controller waits until it has reached its time limit. This behaviour is specified by SCPI.

3.7.6 Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping. Equally, setting commands within one command line are not absolutely serviced in the order in which they have been received.

In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line, that is to say, with a separate IBWRT()-call.
In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By a suitable programming, the controller can be forced to wait for the respective action to occur (cf. table 3-2).

Table 3-2 Synchronization using *OPC, *OPC? and *WAI

Com-mand	Action after the hardware has settled	Programming the controller
*OPC	Setting the operation-complete bit in the ESR	– Setting bit 0 in the ESE – Setting bit 5 in the SRE – Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	Executing the next command Note: The IEC-bus handshake is not stopped	Sending the next command

An example as to command synchronization can be found in annex D "Program Examples".

3.8 Status Reporting System

The status reporting system (cf. Fig. 3-4) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out an AUTORANGE and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 3.4.

3.8.1 Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 3-3). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

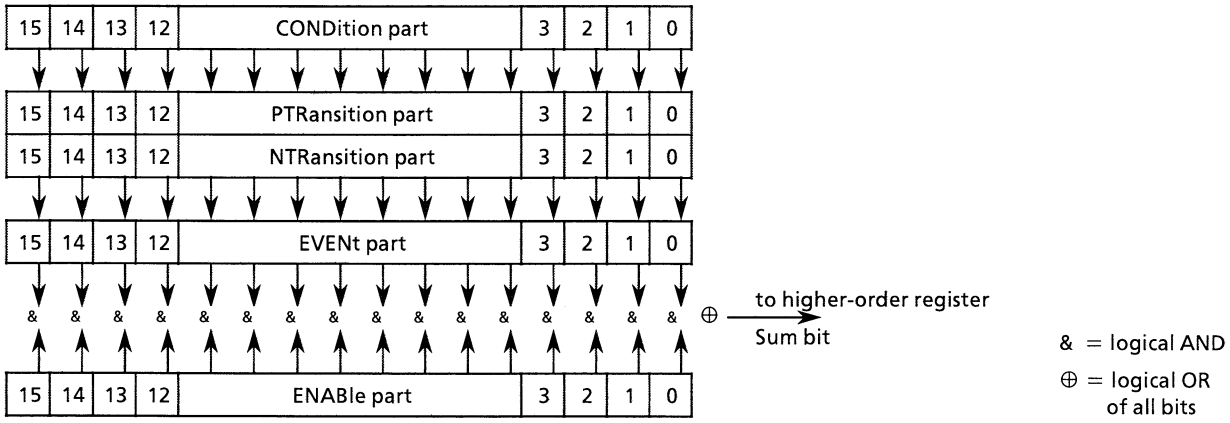


Fig. 3-3 The status-register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
PTR bit = 1: the EVENt bit is set.
PTR bit = 0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR bit = 1: the EVENt bit is set.
NTR bit = 0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part

The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. During reading, its contents is set to zero. In linguistic usage this part is often equated with the entire register.

ENABle part

The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').
ENAB bit = 0: the associated EVENt bit does not contribute to the sum bit
ENAB bit = 1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit

As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.
The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note: *The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.*

3.8.2 Overview of the Status Registers

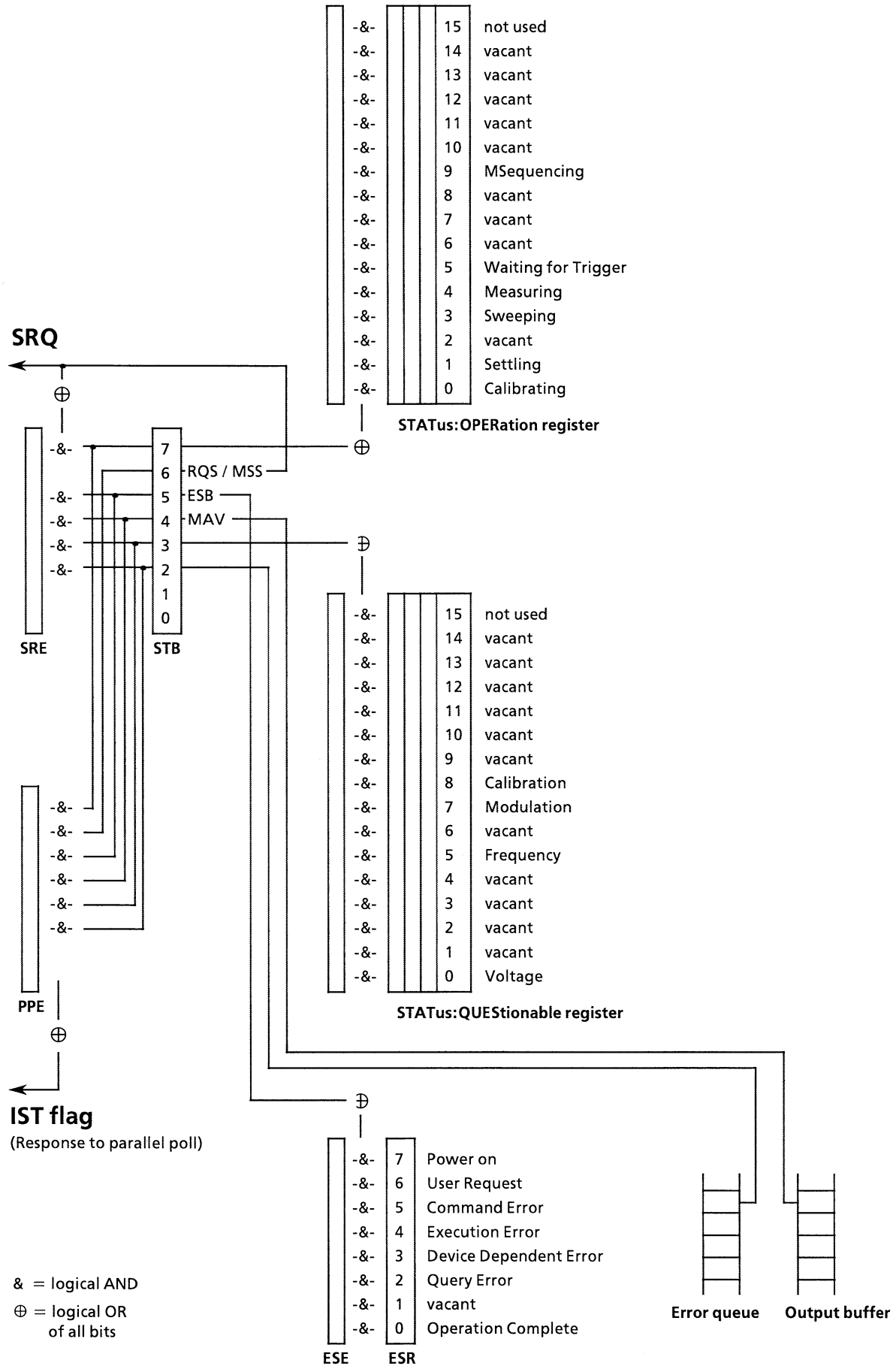


Fig. 3-4 Overview of the status registers

3.8.3 Description of the Status Registers

3.8.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.
The STATUS BYTE is read out using the command "*STB?" or a serial poll.

The STB implies the SRE. It corresponds to the ENABle part of the SCPI registers as to its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the IEC bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command *"*SRE"* and read using *"*SRE?"*.

Table 3-3 Meaning of the bits used in the status byte

Bit no.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with IEC-bus control.
3	**QUEStionable status sum bit** The bit is set if an EVENt bit is set in the QUEStionable-Status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable-Status register.
4	**MAV bit** (message available) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. annex D, program examples).
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit implies a serious error which can be specified in greater detail by polling the event status register.
6	**MSS bit** (master status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an EVENt bit is set in the OPERation-Status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by polling the OPERation-Status register.

3.8.3.2 IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. Section 3.8.4.3) or using command *"*IST?"*.

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The Ist flag results from the ORing of all results. The PPE can be set using commands *"*PRE"* and read using command *"*PRE?"*.

3.8.3.3 Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is already defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command *"*ESR?"*.
The ESE is the associated ENABle part. It can be set using command *"*ESE"* and read using command *"*ESE?"*.

Table 3-4 Meaning of the bits used in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct, however, cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
6	**User Request** This bit is set on pressing the LOCAL key, i.e., when the instrument is switched over to manual control.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

3.8.3.4 STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands *"STATus:OPERation:CONDition?"* or *"STATus:OPERation [:EVENt]?"*.

Table 3-5 Meaning of the bits used in the STATus:OPERation register

Bit No.	Meaning
0	**CALibrating** This bit is set as long as the instrument is performing a calibration.
1	**SETTling** This bit is set as long as the new status is settling after a setting command. It is only set if the settling time is longer than the command processing time.
3	**SWEeping** This bit is set while the instrument is performing a sweep.
4	**MEASuring** This bit is set while the instrument is performing a measurement.
5	**WAIT for TRIGGER** This bit is set as long as the instrument is waiting for a trigger event.
9	**MSequencing** This bit is set while the instrument is performing a memory sequence.

3.8.3.5 STATus:QUEStionable Register

This register contains information on questionable instrument states. They can occur, e.g. if the instrument is operated out of its specifications. It can be queried using commands *"STATus :QUEStionable:CONDition?"* or *"STATus:QUEStionable[:EVENt]?"*.

Table 3-6 Meaning of the bits used in the STATus:QUEStionable register

Bit No.	Meaning
0	**VOLTage** This bit is set if the voltage at an output connector is not correct, if the voltage is above or below the specified limit values, if the level limit has responded, if the overvoltage protection has responded.
5	**FREQuency** The bit is set if a frequency at the RF output is not correct or if it is lower or higher than the specified values.
7	**MODulation** The bit is set if a modulation is not correct or is operated outside the specifications.
8	**CALibration** The bit is set if a calibration is not performed properly.

3.8.4 Application of the Status Reporting System

In order to be able to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are represented in the following. Detailed program examples are to be found in annex D, Program Examples.

3.8.4.1 Service Request, Making Use of the Hierarchy Structure

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react with corresponding actions. As evident from Fig. 3.4 (Section 3.8.2), an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The corresponding setting of the ENABle parts of the status registers can achieve that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request, all bits should be set to "1" in enable registers SRE and ESE.

Examples (cf. Fig. 3.4, Section 3.8.2 and Program Examples, annex D as well):

Use of command "**OPC*" to generate an SRQ

- Set bit 0 in the ESE (Operation Complete)
- Set bit 5 in the SRE (ESB)

  After its settings have been completed, the instrument generates an SRQ.

Indication of the end of a sweep by means of an SRQ with the controller

- Set bit 7 in the SRE (sum bit of the STATus:OPERation register)
- Set bit 3 (sweeping) in the STATus:OPERation:ENABle.
- Set bit 3 in the STATus:OPERation:NTRansition so as to make sure that the transition of sweeping bit 3 from 1 to 0 (sweep end) is recorded in the EVENt part as well.

  After a sweep has been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request. A detailed example for a service request routine is to be found in annex D, Program Examples.

3.8.4.2 Serial Poll

In a serial poll, just as with command "**STB*", the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works with instruments which do not adhere to SCPI or IEEE 488.2.

The quick-basic command for executing a serial poll is "*IBRSP()*". Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the IEC bus.

3.8.4.3 Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller by means of a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to logically "0" or "1". By analogy to the SRE register which determines under which conditions an SRQ is generated, there is a parallel poll enable register (PPE) which is ANDed with the STB bit by bit as well considering bit 6. The results are ORed, the result is then sent (possibly inverted) as a response in the parallel poll of the controller. The result can also be queried without parallel poll by means of command *"*IST"*.

The instrument first has to be set for the parallel poll using quickBASIC command *"IBPPC()"*. This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using *"IBRPP()"*.

The parallel-poll method is mainly used in order to quickly find out after an SRQ which instrument has sent the service request if there are many instruments connected to the IEC bus. To effect this, SRE and PPE must be set to the same value. A detailed example as to the parallel poll is to be found in annex D, Program Examples.

3.8.4.4 Query by Means of Commands

Each part of every status register can be read by means of queries. The individual commands are indicated in the detailed description of the registers in Section 3.8.3. What is returned is always a number which represents the bit pattern of the register queried. Evaluating this number is effected by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

3.8.4.5 Error-Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be looked at in the ERROR menu via manual control or queried via the IEC bus using command *"SYSTem:ERRor?"*. Each call of *"SYSTem:ERRor?"* provides an entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

3.8.5 Resetting Values of the Status Reporting System

Table 3-7 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for **RST* and *SYSTem:PRESet* influences the functional instrument settings. In particular, *DCL* does not change the instrument settings.

Table 3-7 Resetting instrument functions

Event / Effect	Switching on supply voltage		DCL, SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
	Power-On-Status-Clear					
	0	1				
Clear STB, ESR	—	yes	—	—	—	yes
Clear SRE, ESE	—	yes	—	—	—	—
Clear PPE	—	yes	—	—	—	—
Clear EVENt parts of the registers	—	yes	—	—	—	yes
Clear Enable parts of all OPERation and QUEStionable registers, Fill Enable parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with "1", Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e., immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

4 Maintenance and Troubleshooting

The instrument does not need a periodic maintenance. What is necessary is essentially the cleaning of the instrument. However, it is recommended to check the rated data from time to time.

4.1 Maintenance

4.1.1 Cleaning the Outside

The outside of the instrument is suitably cleaned using a soft, line-free dustcloth.

Caution! *Do not use solvents such as thinners, acetone and similar things in any case, because otherwise the front panel labeling or plastic parts will be damaged.*

4.1.2 Storage

The storage temperature range of the instrument is -40 to + 70 degrees Celsius. If the instrument is to be stored for a longer period of time, it must be protected against dust.

4.2 Functional Test

The SMT carries out a selftest on switching on the instrument and permanently during operation. On switching on, the RAM and ROM contents are checked and the battery of the non-volatile RAMs tested. If an error is detected, this is indicated through a corresponding error message. The most important instrument functions are automatically monitored during operation.

If a faulty function is detected in the selftest, ERROR is displayed in the status line. To identify the error, the ERROR menu, in which the error messages are entered, can be called by pressing the [ERROR] key (cf. Chappter 2, Section "Error Messages").

The tests can additionally be called via the menu.

Access to the tests is offered by the UTILITIES-TEST menu.

Menu selection: UTILITIES - TEST

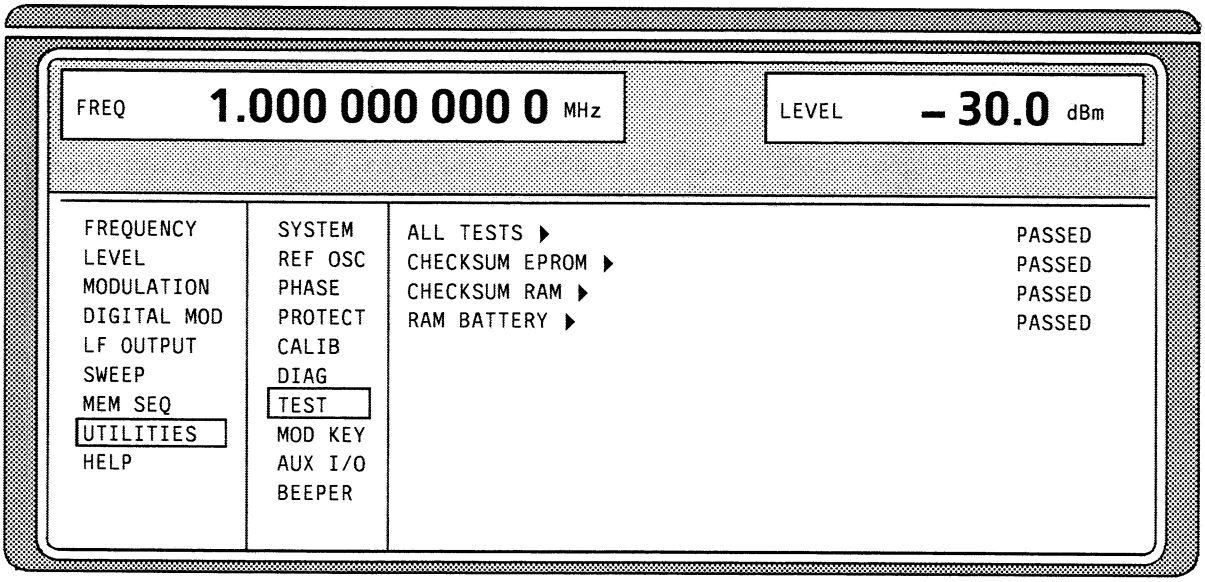


Fig. 4-1 Menu UTILITIES-TEST

ALL TESTS ▸ All tests are executed.

CHECKSUM EPROM ▸ Tests the EPROM checksum.

CHECKSUM RAM ▸ Tests the RAM checksum.

RAM BATTERY ▸ Tests the RAM battery.

5 Testing the Rated Specifications

5.1 Test Instruments and Utilities

Table 5-1 Test instruments and utilities

Item	Type of instrument	Specifications required	Suitable instrument	R&S order no.	Application
1	Frequency counter (included in item 2)	1 Hz to 1.5 GHz (SMT02) 1 Hz to 3 GHz (SMT03), 1 Hz to 6 GHz (SMT06), Resolution 0.1 Hz			5.2.2 5.2.4
2	RF spectrum analyzer	100 Hz to 5 GHz (SMT02/03), 100 Hz to 18 GHz (SMT06) synthesizer tuning, dynamic range >80 dB	FSB FSM	848.0020.52 1020.7020.52	5.1.1.3 5.2.3 5.2.5 5.2.6 5.2.7 5.2.8 5.2.11 5.2.12 5.2.28 5.2.31
3	Storage oscilloscope	100-M samples/s, averaging function			5.2.3
4	Controller	Industrial standard PC/XT/AT with IEC-625 interface,	PSA 15	1012.1003.03	5.2.3
5	Signal generator of high spectral purity	0. 1 MHz to 1.5 GHz (SMT02) 0. 1 MHz to 3 GHz (SMT03), 0.1 MHz to 6 GHz (SMT06), SSB noise level <−126 dBc with 1GHz/20 kHz FM-d.c.	SME02, SME03, SME06, SMGU, SMHU	1038.6002.02, 1038.6002.03, 1038.6002.06, 819.0010.52, 835,8011.52	5.1.1.4 5.2.7 5.2.8 5.2.12 5.2.14
6	Phase noise test setup	Mixer: 10 MHz to 1.5 GHz (SMT02) 10 MHz to 3 GHz (SMT03), 10 MHz to 6 GHz (SMT06), separating filter 2 MHz, preamplifier with 40-dB changeover switch, input noise <2nV (1Hz) output for FM-d.c.			5.2.7 5.2.8
7	Oscilloscope	Bandwidth > 100 MHz, two channels with D. C. coupling			5.1.1.3, 5.1.1.4 5.2.7 5.2.8 5.2.33
8	RF power meter	5 kHz to 1.5 GHz (SMT02) 5 kHz to 3 GHz (SMT03) 5 kHz to 6 GHz (SMT06)	NRVS with NRVS-Z51	1020.1809.02 857.9004.02	5.2.11 5.2.13
9	Precision attenuation set	Attenuation 0 to 120 dB, resolution 5 dB	DPSP RSG	8334.6010.02 1009.4505.02	5.2.11

Item	Type of instrument	Specifications required	Suitable instrument	R&S order no.	Application
10	Low-noise preamplifier	5 kHz to 1.5 GHz (SMT02) 5 kHz to 3 GHz (SMT03), 5 kHz to 6 GHz (SMT06) amplification > 20 dB, noise factor < 10 dB			5.2.11
11	VSWR bridge	1 MHz to 1.5 GHz (SMT02) 1 MHz to 3 GHz (SMT03), directivity > 40 dB	ZRC	1039.9492.55/52	5.2.12
12	D.c. voltage source	Setting range 0 to 10 V	NGT 20	117.7133.02	5.2.14
13	RF power amplifier	10 MHz to 1.5 GHz (SMT02) 10 MHZ to 3 GHz (SMT03), Power > 1W			5.2.14
14	Audio analyzer	Generator up to 100 kHz, level meter, distortion meter	UPD	1030.7500.04 1030.7500.05	5.1.1.2 5.2.30 5.2.32
15	Modulation analyzer	100 kHz to 1.5 GHz (SMT02) 100 kHz to 3 GHz (SMT03/06) AM, FM, PhiM, stereo coder, stereo decoder, distortion meter, weighting filter CCIR, CCITT	FMB	856.5005.52	5.1.1.1 5.1.1.2 5.1.1.5
16	Mixer	10 MHz to 1.5 GHz (SMT02) 10 MHz to 3 GHz (SMT03), 10 MHz to 6 GHz (SMT06), "high level"			5.1.1.4
17	Pulse generator	Pulse repetition frequency up to 10 MHz, level TTL	AFG, AFGU	377.2100.02, 377.5000.02	5.1.1.4 5.2.31 5.2.33
18	Sine-wave generator	10 Hz to 8 MHz, 1 V (U peak)	AFG	377.2100.02	5.1.1.3 5.2.28
19	AC voltmeter	10 Hz to 8 MHz	URE3	350.5315.03	5.2.32
20	Broadband FM demodulator	Delay line discriminator, input frequency 140 MHz, demodulation bandwidth 10 MHz			5.1.1.3
21	RF attenuator pad	1.5 GHz (SMT02) 3 GHz (SMT03) 6 GHz (SMT06) 3 dB			5.1.1.4
22	Lowpass filter	Attenuation up to 50 MHz < 1 dB with 100 MHz > 20 dB with 200 MHz > 40 dB			5.1.1.4
23	VSWR directional coupler	3 GHz to 6 GHz (SMT036), directivity > 40 dB			5.2.12
24	RF attenuator pad	6 GHz (SMT06) 20 dB			5.1.1.5

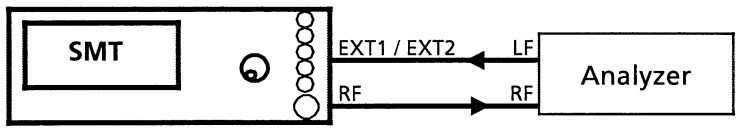
5.1.1 Test Systems to Measure Modulation Characteristics

5.1.1.1 Standard Test System

Test equipment

- Modulation analyzer (Section 5.1, item 15)

Test setup

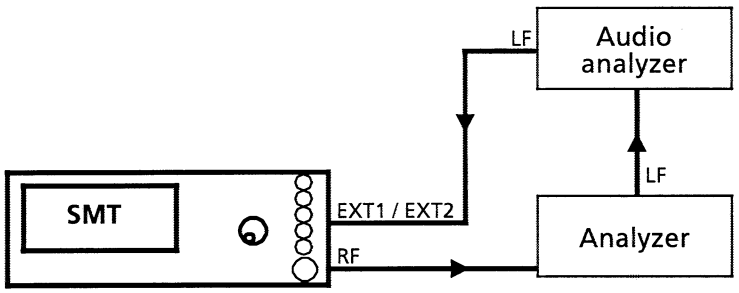


5.1.1.2 Test System with Audio Analyzer

Test equipment

- Modulation analyzer (Section 5.1, item 15)
- Audio analyzer (Section 5.1, item 14)

Test setup

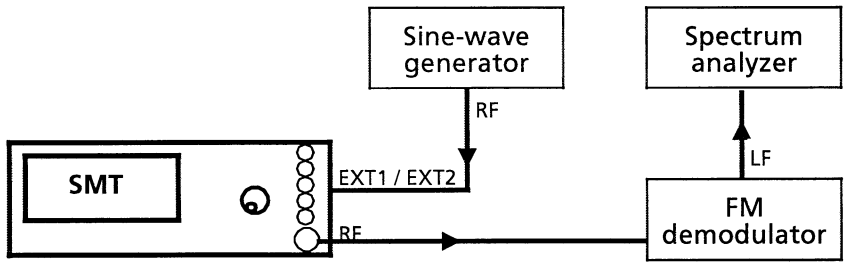


5.1.1.3 Test System for Broadband FM

Test equipment

- Spectrum analyzer (Section 5.1, item 2)
- Oszilloscope (Section 5.1, item 7)
- Sine-wave generator (Section 5.1, item 18)
- Broadband FM demodulator (Section 5.1, item 20)

Test setup

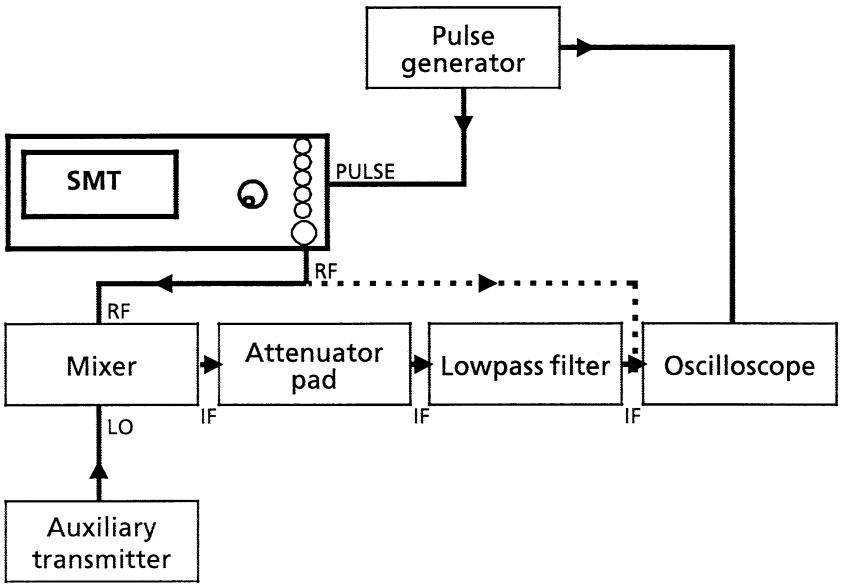


5.1.1.4 Test System for Pulse Modulation

Test equipment

- Second signal generator (Section 5.1, item 5)
- Oscilloscope (Section 5.1, item 7)
- Mixer (Section 5.1, item 16)
- Pulse generator (Section 5.1, item 17)
- RF attenuator pad (Section 5.1, item 21)
- Lowpass filter (Section 5.1, item 23)

Test setup

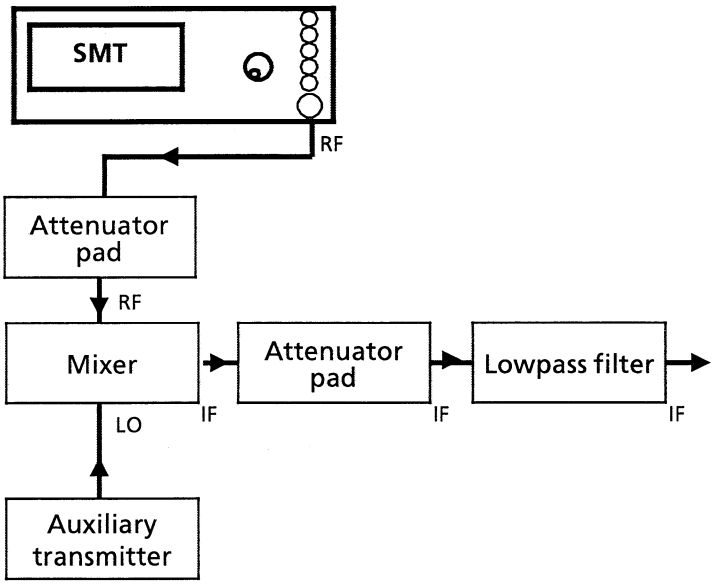


5.1.1.5 Meßplatz-Erweiterung durch Abmischen

Test equipment

- Second signal generator (Section 5.1, item 5)
- Mixer (Section 5.1, item 16)
- RF attenuator pad (Section 5.1, item 21)
- RF attenuator pad (Section 5.1, item 24)
- Lowpass filter (Section 5.1, item 22)

Test setup



5.2 Test Procedure

The rated specifications of the generator are tested after the instrument has warmed up for at least 30 minutes and a total calibration has been carried out (c.f. Chapter 2, Section "Calibration"). This is the only way to make sure that the guaranteed data are observed. The values in the following sections are not guaranteed; only the technical data in the data sheet are binding.

5.2.1 Display and Keyboard

Testing — Display

- Switch on instrument.
  The basic menu is displayed after several seconds.
- Rotate contrast control (left-hand potentiometer at the lower edge).
  The contrast is varied from dark to bright.
- Rotate brightness control (right-hand potentiometer at the lower edge).
  The brightness of the background illumination is varied.

Keyboard

- Press keys and check response at the display.

5.2.2 Frequency Setting

Test equipment: Frequency counter (Section 5.1, item 1)

Test principle: The frequency setting is checked using a frequency counter whose reference frequency is synchronized with the one of the SMT.

Measurement

- Setting at the SMT
  - Test frequency unmodulated,
  - Level 0 dBm

  The values measured must be exact within the frame of the counter resolution.

Test frequencies recommended: see table 5-2

Table 5-2 shows the synthesis-dependent changeover limits. In order to fully test the function of the instrument, we recommend measurements at these range limits.

Table 5-2, A Changeover limits of the SMT

Range	from	to
Doubler 2 (SMT06)	3000.000 000 1 MHz	6000.000 000 0 MHz
Doubler 1 (SMT03)	1500.000 000 1 MHz	3000.000 000 0 MHz
Synthesis octave	750.000 000 1 MHz	1500.000 000 0 MHz
Divider :2 Divider :4 Divider :8 Divider: 16	375.000 000 1 MHz 187.500 000 1 MHz 93.750 000 1 MHz 67.500 000 1 MHz	750.000 000 0 MHz 375.000 000 0 MHz 187.500 000 0 MHz 93.750 000 1 MHz
Mixer range	0.001 000 0 MHz	93.750 000 0 MHz
Mixer range with a large deviation	0.001 000 0 MHz	130.700 000 0 MHz

Table 5-2, B Changeover limits of the SMT — further hardware limits

Range		from	to
Lowpass filters OPU1	No. 0	1045.600 000 1 MHz	1500.000 000 0 MHz
	1	750.000 000 1 MHz	1045.600 000 0 MHz
	2	522.800 000 1 MHz	750.000 000 0 MHz
	3	375.000 000 1 MHz	522.800 000 0 MHz
	4	261.400 000 1 MHz	375.000 000 0 MHz
	5	187.500 000 1 MHz	261.400 000 0 MHz
	6	130.700 000 1 MHz	187.500 000 0 MHz
	7	93.750 000 1 MHz	130.700 000 0 MHz
	8	63.500 000 1 MHz	93.750 000 0 MHz
Bandpass filters OPU3/6 (SMT03/06)	No. 1	1500.000 000 1 MHz	1885.200 000 0 MHz
	2	1885.200 000 1 MHz	2297.200 000 0 MHz
	3	2297.200 000 1 MHz	3000.000 000 0 MHz
Bandpass filters OPU6 (SMT06)	Nr. 4	3000.000 000 1 MHz	3770.400 000 1 MHz
	5	3770.400 000 1 MHz	4594.400 000 1 MHz
	6	4594.400 000 1 MHz	6000.000 000 0 MHz
Oscillators SUM	No. 1	750.000 000 1 MHz	1100.000 000 0 MHz
	2	1100.000 000 1 MHz	1250.000 000 1 MHz
	3	1250.000 000 1 MHz	1500.000 000 0 MHz
Rectifier	before mixer	0.001 000 0 MHz	9.362 500 0 MHz
	at output OPU1	9.362 500 1 MHz	1500.000 000 0 MHz
	at output OPU3 (SMT03)	1500.000 000 1 MHz	3000.000 000 0 MHz
	at output OPU6 (SMT06)	1500.000 000 1 MHz	6000.000 000 0 MHz

5.2.3 Settling time

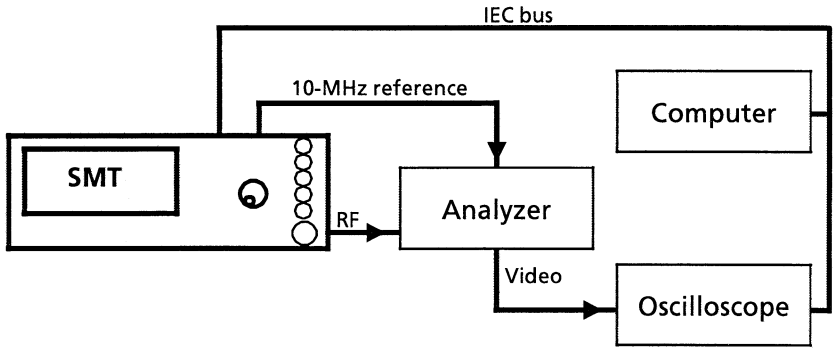
Test equipment

- Spectrum analyzer with video output (Section 5.1, item 2)
- Storage oscilloscope (Section 5.1, item 3)
- Controller (Section 5.1, item 4)

Test principle

The spectrum analyzer is operated as an edge demodulator with a 0-Hz span. A controller transmits starting and stop frequency via the IEC bus. The storage oscilloscope is connected to the video output of the analyzer and triggered by the positive edge on the EOI line of the IEC bus. If the controller switches over from the starting to the stop frequency, the settling procedure is displayed on the screen of the storage oscilloscope.

Test setup



Preparing measurement

- Synchronize the reference frequencies of SMT and analyzer.
- Establish IEC bus and RF connections
- Connect storage oscilloscope to the video output of the analyzer.
- Apply trigger connection to the EOI-line (pin 5) of the IEC bus.
- Settings at the SMT
  - Stop frequency unmodulated
  - Level 0 dBm
- Settings at the storage oscilloscope
  - Time base 2 ms/div
  - Sensitivity corresponding to the video output of the analyzer,
  - Trigger free-running with respect to calibration.
- Settings at the spectrum analyzer
  - Reference level –5 dBm,
  - Amplitude scale 1 dB/div,
  - Resolution bandwidth to 1 kHz,
  - Video bandwidth 100 kHz,
  - Span 10 kHz.
- Now increase the center frequency, starting from the stop frequency, until the visible filter edge runs through the central point of the screen.
- The span can now be reduced to 0 Hz and the frequency scale be calibrated at the (free-running) oscilloscope by means of steps of 100 Hz at the SMT.

Measurement

- Setting at the storage oscilloscope
  - Time base 2 ms/div
  - Sensitivity corresponding to the video output of the analyzer
  - Triggering externally by the positive edge at 1.5 V.
- Send the starting frequency first and then the stop frequency from the controller.

  The settling curve is displayed on the screen of the oscilloscope triggered externally.
  Relative deviation from the rated frequency after 25 ms .. $<1E-7$
- Repeat measurement with exchanged starting and stop frequencies.

Recommended measuring frequencies

Starting frequency	Stop frequency
999 MHz	1001 MHz
1249 MHz	1251 MHz
749 MHz	751 MHz
60 MHz	1001 MHz
1001 MHz	60 MHz
751 MHz	3000 MHz (SMT03)
751 MHz	6000 MHz (SMT06)

Basic program for the controller

```
CLS
iec address% = 28 '                                   IEC-bus address of the SMT (28)
CALL IBFIND("DEV1", generator%) '                     Open DEV1 and obtain access number
CALL IBPAD(generator%, iec address%) '                Set IEC-bus address of the DEV1 to 28
iecterm% = &HA '                                      Set EOS to LINE FEED
CALL IBEOS(generator%, iec term% + &H800)
CALL IBWRT(generator%, "POW 0dBm")
DO
  INPUT "Starting frequency in MHz";F1$
  INPUT "Stop frequency in MHz";F2$
  DO
   CALL IBWRT(generator%, "FREQ" + F1$ + "MHz")
   PRINT "Frequency:";F1$; "MHz"
   DO '                                               wait for key
     kbd$ = INKEY$
   LOOP UNTIL LEN(kbd$)
   SWAP F1$, F2$
  LOOP UNTIL kbd$ = CHR$(27) '                        Exit using ESCAPE
  INPUT "Repetition (y/n)"; w$
LOOP UNTIL NOT UCASES$(w$) = "Y"
END
```

5.2.4 Reference Frequency

Caution: *Allow the SMT to warm up for at least 2 hours before measurement.*

Test equipment — Frequency counter (Section 5.1, item 1)

Test setup — Connect a calibrated frequency counter to output REF (socket at the rear).

Measurement

- Measure frequency.

  Relative frequency error in the rated temperature range
  with standard equipment $<$1E-6, per year of service period +2E-6
  with option SM-B1 ..... $<$1E-9, per day of service period +5E-8

5.2.5 Harmonics Suppression / Subharmonics

Hinweis: *Die Messung der Subharmonischen gilt nur für SMT03 und SMT06, da Subharmonische nur bei Frequenzen > 1,5 GHz auftreten.*

Test equipment — Spectrum analyzer (Section 5.1, item 2)

Test setup — Connect the spectrum analyzer to the RF output of the SMT.

Measurement

SMT02
- Settings at the SMT02
  - Test frequencies of 5 kHz to 1500 MHz, unmodulated
  - Level 13 dBm or 10 dBm.

SMT03
- Settings at the SMT03
  - Test frequencies of 5 kHz to 3000 MHz, unmodulated
  - Level 13 dBm or 10 dBm.

SMT06
- Settings at the SMT06
  - Test frequencies of 5 kHz to 6000 MHz, unmodulated
  - Level 13 dBm or 10 dBm.

- Check the harmonics suppression using the spectrum analyzer. Make sure that the spectrum analyzer is not overdriven.

  Harmonics level at level 10 dBm ..... max.–30 dBc

  Harmonics level at level 13 dBm ..... max.–26 dBc

- Check the subharmonics using the spectrum analyzer. Make sure that the spectrum analyzer is not overdriven (SMT03/06 only).

  Subharmonics level f > 1.5 GHz ..... max.–40 dBc

  Subharmonics level f > 3 GHz ..... max.–34 dBc

5.2.6 Suppression of Nonharmonics

Test equipment and setup

See Section 5.2.5, Harmonics Suppression.
The test level should be 8.1 dBm unmodulated.

Measurement

Nonharmonics level with

Frequency settings ≤1.5 GHz ..... <–80 dBc

Frequency settings > 1.5 GHz (SMT03) ..... <–74 dBc

Frequency settings > 3.0 GHz (SMT06) ..... <–68 dBc

Recommended settings at the spectrum analyzer

- Span 1 kHz,
- Resolution bandwidth 10 Hz,
- Video bandwidth 30 Hz,
- Synchronize reference frequencies of analyzer and test object.

Recommended test and search frequencies

Nonharmonics of the step synthesis

Setting at the SMT	Search in the ratio
600.005 MHz	10 kHz
760.01 MHz	10 kHz
870.01 MHz	10 kHz
875.02 MHz	10 kHz
990.01 MHz	10 kHz
1120.01 MHz	10 kHz
1124.02 MHz	10 kHz
1200.00333333 MHz	10 kHz
1200.01 MHz	10 kHz
1200.005 MHz	10 kHz
1370.01 MHz	10 kHz
1374.02 MHz	10 kHz

Mixer nonharmonics of the output part 1.5 GHz

Setting at the SMT	Search at frequency
67 MHz	17 MHz
67 MHz	57 MHz
67 MHz	77 MHz
67 MHz	117 MHz
67 MHz	131 MHz

5.2.7 SSB Phase Noise

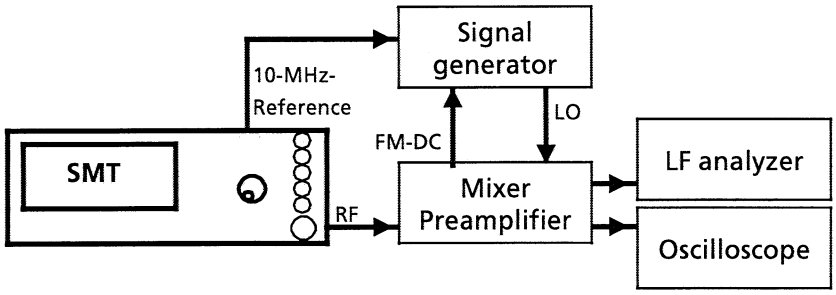
Test equipment

- Second signal generator (Section 5.1 item 5),
- Phase noise test system, consisting of mixer with lowpass filter and preamplifier (Section 5.1 item 6),
- Oscilloscope (Section 5.1 item 7)
- Spectrum analyzer (Section 5.1 item 2).

Test principle

The two signal generators are set to the test frequency and synchronized with a phase offset of 90 deg (phase quadrature). Mixing to 0 Hz suppresses the RF carrier and due to the phase quadrature the mixer supplies a voltage corresponding to the phase difference between the input signals. This is measured by the LF spectrum analyzer and can be converted into SSB phase noise.

Test setup



Measurement

- Set the levels of the two signal generators according to the specifications of the mixer used (unmodulated)
- For calibration, set the preamplifier to 0 dB and detune a signal generator by 20 kHz. Measure and note down the reference value at 20 kHz at the analyzer.
- Cancel the detuning and make the phase quadrature. Switch on test transmitter FM-DC with a deviation of 5 kHz to this effect. The output voltage of the mixer must become 0.
- Set the preamplifier to 40 dB and read the noise voltage at the analyzer, normalized to a bandwidth of 1 Hz (noise level).

Evaluation

- Subtract from the reference value and add 6 dB for the second side band measured (correlated) and 40 dB for the amplification switchover to the ratio found. If the signal-to-noise ratio of the second signal generator is not better than the one of the test object by at least 10dB, the noise component of the reference transmitter must be determined and subtracted as well.

Example: *Let the reference level be measured to be 12 dBm. A noise level of –78 dBm (1H z) is determined at 20 kHz. The difference is 90dB, in addition to the correction for the second side band (6 dB) and the amplification switchover (40 dB) there is a signal-to-noise ratio of 136d B or a noise level of –136 dBc (dB with respect to the carrier power). If two identical signal transmitters have been used, the result must be decreased by 3 dB for the (uncorrelated) noise power of the reference transmitter.*
The final result is then –139 dBc.

The following noise levels should be measured and/or not be exceeded:

Test frequency	Noise in 20-kHz ratio
6000 MHz	–103 dBc (only SMT06)
3000 MHz	–109 dBc (only SMT03/06)
2000 MHz	–110 dBc (only SMT03/06)
1000 MHz	–116 dBc
500 MHz	–122 dBc
250 MHz	–128 dBc
125 MHz	–134 dBc
80 MHz	–139 dBc
< 67.5 MHz	–120 dBc

5.2.8 Broadband Noise

Test equipment

Broadband noise is measured using the test setup of 5.2.7 (SSB Phase Noise).

Test principle

Calibration is effected in the same way as in Section 5.2.7, SSB Phase Noise. For measurement, the signal generators are detuned until the difference frequency falls into the stop band of the lowpass filter (> 10 MHz). A 1-MHz section of the sum of the broadband noise powers of both signal generators is to be measured at the spectrum analyzer then, which corresponds to the carrier frequency offset from the difference frequency up to the difference frequency minus 1MHz. Due to the mirror inversion of the spectrum at the zero line, the power measured must be halved.

Measurement

- Calibration see Section 5.2.7.
- Increase the detuning to the measurement offset frequency, (recommended offset frequency 10 MHz).
- Set the preamplifier to 40 dB and read the noise voltage at the analyzer at a center frequency of approx. 100 kHz, normalized to a bandwidth of 1 Hz (noise level).

Evaluation

- Subtract from the reference level and add 43 dB for the amplification switchover and the mirror image. The measured value is the sum of the noise powers of both signal generators. If the signal-to-noise ratio of the second signal generator is not better than the one of the test object by at least 10 dB, the noise component of the reference transmitter must be determined and subtracted as well. In the case of two identical transmitters, the correction is further 3 dB.

  Corrected measured value ..... ≤ −140 dBc

Recommended test frequencies see table 5-2.

5.2.9 Residual FM

Test equipment

Test system 5.1.1.1
Testsystem 5.1.1.5 (SMT06 only)

Measurement

- Settings at the SMT
  - Test frequencies, unmodulated,
  - Level 8.1dBm.
- Setting at the analyzer
  - FM, RMS value

  The residual FM measured must not exceed the values according to the table.

Test Frequency	Residual FM 30 Hz to 23 kHz	Residual FM CCITT
< 67.5 MHz	10 Hz	4 Hz
80 MHz	1,5 Hz	1 Hz
125 MHz	3 Hz	1 Hz
250 MHz	5 Hz	2 Hz
500 MHz	10 Hz	4 Hz
751 MHz	20 Hz	8 Hz
1000 MHz	20 Hz	8 Hz
1001 MHz	20 Hz	8 Hz
1250 MHz	20 Hz	8 Hz
1251 MHz	20 Hz	8 Hz
1500 MHz	20 Hz	8 Hz
2000 MHz	40 Hz (only SMT03/06)	16 Hz
3000 MHz	40 Hz (only SMT03/06)	16 Hz
6000 MHz	80 Hz (only SMT06)	32 Hz

5.2.10 Residual AM

Test equipment — Test system 5.1.1.1

Measurement — See Section 5.2.9, but demodulation AM

Residual AM with a measuring bandwidth of
30 Hz to 23 kHz ..... ≤0.02%

5.2.11 Output Level

Test equipment
- Power meter (Section 5.1, item 8)
- Precision attenuator (Section 5.1, item 9)
- Spectrum analyzer (Section 5.1, item 2)
- Low-noise preamplifier (Section 5.1, item 10)

Test Methods for Level in the Measuring Range of the Power Meter

Test setup — Connect power meter to the RF output socket.

Measurement
- Setting at the SMT
  - RF level to be measured (see below), unmodulated.
- Measure the level at output frequencies of 5 kHz to 1500 MHz (3000/6000 MHz with SMT03/06).

  Deviation of the output level from the rated value

  at f ≤ 3 GHz .... max. ≤ 1dB

  at f > 3 GHz .... max. ≤ 2dB

  Frequency response at 0 dBm (Difference between the lowest and the highest level) ..... max. ≤1dB

Recommended test level — 13, 10, 8, 7.9, 5, 0, –5, –10, –20, –30 dBm

Test Methods for Low Levels

Test principle — Levels below the measuring range of the power meter can be carried out by means of a comparison measurement using a precision attenuator and a sensitive test receiver or spectrum analyzer.

Test setup — Connect a precision attenuator to the RF output of the SMT and a spectrum analyzer with screened RF measurement cables to its output.

Measurement

- Settings at the SMT
  - Test frequency
  - Level 10 dBm, unmodulated
- Setting at the analyzer
  - Test frequency
- Setting at the attenuator
  - Attenuation 130 dB.
- Read the level at the analyzer and note down as a reference value. It should be approx. –110 dBm. Select the measurement bandwidth small enough to ensure an exact reading.
- Now repeat the measurement with the settings given in the table.

  Deviation of the indication at the analyzer from the reference value, in each case ..... max. 1dB

Settings

Level at the SMT	Attenuation of the attenuator
10 dBm	120 dB
5 dBm	115 dB
0 dBm	110 dB
–10 dBm	100 dB
–30 dBm	80 dB
–50 dBm	60 dB
–70 dBm	40 dB
–90 dBm	20 dB
–110 dBm	0 dB

Measurement of Lowest Levels

Caution: *No RF leakage of the components used is the prerequisite for a correct measurement*

Test setup

- Insert a low-noise preamplifier between SMT and precision attenuator.

Measurement

- Perform a subsequent calibration with a level already measured (–30 dBm). This allows measuring levels up to the lower setting limit of the SMT.

5.2.12 Output Reflection Coefficient

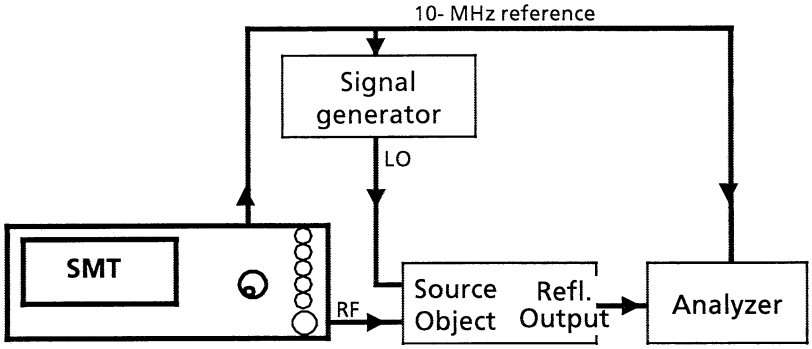
Test equipment

- VSWR bridge (Section 5.1, item 11)
- VSWR directional coupler for SMT06 (Section 5.1, item 23)
- Second signal generator (Section 5.1, item 5)
- Spectrum analyzer (Section 5.1, item 2) .

Test setup

Notes: –

– *The test port of the bridge must be directly screwed to the test object .*



Bridge (test frequency≤ 3 GHz)
Directional coupler (frequency > 3 GHz)

Measurement

- Settings at the SMT
  - Test level
  - Test frequency, unmodulated.
- Settings at the spectrum analyzer
  - Test frequency
  - Test level
  - Resolution and video bandwidth 10 kHz,
  - Span 0 Hz,
  - linear scale
  - Sweep time 30 ms.
- Settings at the second signal generator
  - Detune by 100 Hz compared to the test frequency,
  - first minimal level, unmodulated.
- At the spectrum analyzer, now bring the line indicated approx. into the center of the screen by varying the reference level and read and note down the level as a reference level.
- Screw off the bridge or the directional coupler from the SMT and increase the level at the second signal generator until the reference level is measured again at the analyzer.
- Screw the bridge or the directional coupler onto the SMT again.
- A more or less wavy line representing the VSWR of the SMT is to be seen now at the spectrum analyzer. The VSWR is to be calculated from the maximal and the minimal voltage according to

$$VSWR = u_{max}/u_{min}.$$

VSWR	f ≤ 3 GHz	3 GHz < f ≤ 5 GHz	f > 5 GHz
Level > 0 dBm	< 2	< 2	< 2
Level > 0 dBm with Option SM-B9	< 2	< 2	< 2,5
Level ≤ 0 dBm	< 1,5	< 2	< 2

Passive measurement of the VSWR with output levels of the SMT below –30 dBm

- Settings at the second signal generator
  - Test frequency
  - Level 10 dBm.
- Screw off VSWR bridge or the directional coupler from the test object and note down the level measured at the analyzer as a reference value.
- Screw on the bridge or the directional coupler again and determine the new level at the analyzer.

  The output reflection coefficient r of the test object is the voltage ratio test level/reference level. It serves to determine the voltage standing wave ratio (VSWR) according to the formula

  $$VSWR=(1+r)/(1-r).$$

5.2.13 Interrupt-free Level Setting (ATTEN FIXED)

Test equipment: Power meter (Section 5.1, item 8)

Test setup: Connect the power meter to the RF output of the SMT.

Measurement

- Settings at the SMT
  - 1000 MHz, unmodulated,
  - Level 8.0 dBm,
  - Select FIXED in the LEVEL/LEVEL ATTEN menu.
- Note down the level read at the power meter as a reference level or set the power meter to 0 dB for relative measurement.
- Now reduce the level in steps of 5 dB at the SMT.

  The following deviations should not be exceeded:

Attenuation	Tolerance
–5 dBm	±0.2 dB
–10 dBm	±0.4 dB
–15 dBm	±0.6 dB
–20 dBm	±0.8 dB

5.2.14 Overvoltage Protection (only for SMT02 and 03)

Caution: *SMT06 is not protected against overvoltage. To prevent damages to be unit*
- *never apply a DC voltage to the RF output connector,*
- *never apply more than the maximum permissible RF power (30 dBm) to the RF o output connector.*

Test equipment
- Adjustable d.c. voltage source (Section 5.1, item 12)
- Signal generator (Section 5.1, item 5)
- Power amplifier (Section 5.1, item 13)

Test setup

Connect an adjustable d.c. voltage source to the RF output socket of the SMT via a 50-Ohm resistor or a signal generator with a subsequent power amplifier with a power output of more than 1 Watt.

Testing

▸ Settings at the SMT
- 100 MHz, unmodulated,
- Level –120 dBm.

▸ Apply the d.c. voltage via the 50-Ohm resistance.

The overvoltage protection must respond at a voltage of >4V and <7V with both polarities.

▸ Connect the signal generator to the RF output socket of the SMT via the power amplifier and feed frequencies of up to 1500 MHz (in the case of SMT03 3000 MHz).

The overvoltage protection must respond at a supplied RF power of 0.5 to 1W.

5.2.15 Testing Level Monitoring at Input EXT1

Test equipment

Test system 5.1.1.2.

Test setup

Connect the generator output of the audio analyzer to external modulation input EXT1.

Testing

▸ Setting at the SMT
- Select EXT1 in the MODULATION/AM/AM SOURCE menu.

Generator level under 0.97 ±0.01 V(u_{peak}) .. indication EXT1 LOW
Generator level over 1.03 ± 0.01 V(u_{peak}) ... indication EXT1 HIGH
Generator level between 0.99 and 1.01 V(u_{peak}) .... no indication

5.2.16 Modulation Depth of AM

Test equipment

Test system 5.1.1.1
Test system 5.1.1.5 (SMT06).

Measurement

▸ Settings at the SMT
- Level 0 dBm
- Select LFGEN1 in the MOD/AM/AM SOURCE INT menu,
- Modulation depth 0.1% to 80% (recommended values 30% and 80%)
- Modulation frequency 1 kHz .

▸ Vary the carrier frequency from 9 MHz to 1500 MHz (3000/6000 MHz with SMT03/06). For recommended setting values, see table 5-2.

▸ Read off the modulation depth at the modulation analyzer.

Deviation of the modulation depth measured from the setting value
..... max. 4 % of the indication + 1 % absolutely

5.2.17 AM Frequency Response

Test equipment

Test system 5.1.1.2
Test system 5.1.1.5 (SMT06).

Measurement

- Settings at the SMT
  - Level 0 dBm,
  - Select EXT1 in the MODULATION/AM/AM SOURCE menu,
  - Modulation depth 60%.
- Vary the carrier frequency from 5 kHz to 1500 MHz (3000/6000 MHz with SMT03/06). For recommended setting values, see table 5-2.
- Setting at the audio analyzer
  - Generator level 1 V(u_{peak}).
- Determine the modulation frequency response (difference between the highest and the lowest modulation depth) by varying the generator frequency.

  Modulation frequency response from 20 Hz to 50 kHz .. max.1dB

Note: *If option SM-B2 LF generator is fitted, LFGEN2 can be selected in the MODULATION/AM/AM SOURCE menu and the test frequency be set using the internal generator for this measurement.*

5.2.18 AM Distortion Factor

Test equipment

Test system 5.1.1.1
Test system 5.1.1.5 (SMT06).

Measurement

- Settings at the SMT
  - Level 0 dBm
  - Select LFGEN1 in the MODULATION/AM/AM SOURCE INT menu,
  - Modulation depth 30%
  - Modulation frequency 1 kHz.
- Vary the carrier frequency from 9 MHz to 1500 MHz (3000/6000 MHz with SMT03/06). For recommended setting values, see table 5-2.
- Read off the distortion factor at the modulation analyzer.

  Distortion factor ..... max. 1%
- Repeat measurement with an AM of 80%.

  Distortion factor max.2%

5.2.19 Residual PhiM with AM

Test equipment

Test system 5.1.1.1
Test system 5.1.1.5 (SMT06).

Measurement

- Settings at the SMT
  - Various test frequencies
    (for recommended setting values, see table 5-2)
  - Level 0 dBm
  - Select LFGEN1 in the MODULATION/AM/AM SOURCE INT menu,
  - Modulation depth 30%
  - Modulation frequency 1 kHz.
- Measure the phase modulation resulting by means of a 23-kHz lowpass filter and peak weighting at the modulation analyzer.

  Unwanted modulation with carrier frequencies $\leq$ 3 GHz max.0.2 rad

  Unwanted modulation with carrier frequencies $>$ 3 GHz max.2 rad

5.2.20 Testing Level Monitoring at Input EXT2 (Option SM-B5)

Test equipment — Test system 5.1.1.2.

Test setup — Connect the generator output of the audio analyzer to external modulation input EXT2.

Testing

- Setting at the SMT
  - Select EXT2 in the MODULATION/FM/FM1 SOURCE menu.

  Generator level under 0.97 ±0.01 V(u_{peak}) .. indication EXT2 LOW
  Generator level over 1.03 ± 0.01 V(u_{peak}) ... indication EXT2 HIGH
  Generator level between 0.99 and 1.01 V(u_{peak}) .... no indication

5.2.21 FM Deviation Setting

Test equipment — Test system 5.1.1.1.

Measurement

- Settings at the SMT
  - Different test frequencies (cf. below)
  - Level 0 dBm
  - Select LFGEN1 in the MODULATION/FM/FM1 SOURCE menu,
  - Modulation frequency 1 kHz
  - FM Deviation 30 Hz to 600 kHz (see below).
- Read off the deviation at the modulation analyzer.

Recommended setting values, maximum deviation

FM Deviation	Test Frequency	$Deviation_{peak}$
30 Hz	1000 MHz	10 to 50 Hz
100 Hz	1000 MHz	80 to 120 Hz
300 Hz	1000 MHz	275 to 325 Hz
1 kHz	1000 MHz	950 to 1050 Hz
3 kHz	1000 MHz	2.9 to 3.1 kHz
10 kHz	1000 MHz	9.7 to 10.3 kHz
30 kHz	1000 MHz	29.1 to 30.9 kHz
100 kHz	1000 MHz	97 to 103 kHz
300 kHz	1000 MHz	291 to 309 kHz
100 kHz	70 MHz	97 to 103 kHz
300 kHz	70 MHz	291 to 309 kHz
600 kHz	70 MHz	582 to 618 kHz

5.2.22 FM Frequency Response

5.2.22.1 FM Frequency Response up to 100 kHz

Test equipment — Test system 5.1.1.2.

Measurement

- Settings at the SMT
  - Test frequency 100 MHz
  - Level 0 dBm
  - Select EXT1 in the MODULATION/FM/FM1 SOURCE menu,
  - Deviation 50 kHz .
- Setting at the audio analyzer
  - Generator level 1 V(u_{peak}) .
- Determine the modulation frequency response (difference between the highest and lowest modulation depth) by varying the generator frequency of the audio analyzer from 10 Hz to 100 kHz.

  Modulation frequency response ..... max.0.5 dB
- Repeat measurement when frequency is fed at socket EXT2 and with setting MODULATION/FM/FM2 SOURCE EXT2.

Note: *If option SM-B2 LF generator is fitted, LFGEN2 can be selected in the MODULATION/FM FM2 SOURCE menu and the test frequency be set using the internal generator for this measurement.*

5.2.22.2 FM Frequency Response up to 8 MHz

Test equipment — Test system 5.1.1.3.

Measurement

- Setting at the SMT
  - Test frequency 140 MHz
  - Level 13 dBm
  - Select EXT2 in the MODULATION/FM/FM1/SOURCE menu.
- Setting at the sine-wave generator
  - Generator level 1 V(u_{peak}) .
- Connect an oscilloscope to the output of the frequency discriminator.
- Setting at the frequency discriminator
  - Set an output voltage of 0 V with the RF frequency of the SMT (step width 10 kHz).
- Remove the oscilloscope and connect a spectrum analyzer to the output of the frequency discriminator.
- Setting at the SMT
  - Deviation 500 kHz
- Setting at the spectrum analyzer
  - Operating mode MAX HOLD
- Vary the frequency from 100 kHz to 8 MHz at the sine-wave generator and measure the modulation frequency response (difference between the largest and the smallest modulation depth).

  Modulation frequency response ..... max.3 dB

5.2.23 FM Distortion Factor

Test equipment — Test system 5.1.1.1.

Measurement

- Settings at the SMT
  - Carrier frequencies 187.5 to 375 MHz
  - Level 0 dBm
  - Select INT in the MODULATION/FM/FM1 SOURCE menu,
  - Deviation 250 kHz
  - Modulation frequency 1 kHz.
- Read off distortion factor at the modulation analyzer.

  Distortion factor ..... max. 0.5%

Recommended setting values — 187.50000001 MHz, 193.75 MHz, 200 MHz, 206.25 MHz,212.5 MHz, 218.75 MHz, 225 MHz, 231.25 MHz, 237.5 MHz, 243.75 MHz, 250 MHz, 250.0000001 MHz, 256.25 MHz, 262.5 MHz, 268.75 MHz, 275 MHz, 281.25, 287.5 MHz, 293.75 MHz, 300 MHz, 306.25 MHz, 312.5 MHz, 312.5000001 MHz, 318.75 MHz, 325 MHz, 331.25 MHz, 337.5 MHz, 343.75 MHz, 350 MHz, 356.25 MHz, 362.5 MHz, 368.75 MHz, 375 MHz.

5.2.24 Residual AM with FM

Test equipment — Test system 5.1.1.1.

Measurement

- Settings at the SMT
  - Various test frequencies > 10 MHz (for recommended settings, see table 5-2)
  - Level 0 dBm,
  - Select LFGEN1 in the MODULATION/FM/FM1 SOURCE menu,
  - Deviation 40 kHz ,
  - Modulation frequency 1 kHz.
- Measure the amplitude modulation resulting by means of a 23-kHz lowpass filter and peak weighting at the modulation analyzer.

  Unwanted modulation measured max.0.1%

5.2.25 Carrier Frequency Deviation with FM

Test equipment — Test system 5.1.1.1.

Measurement

- Settings at the SMT
  - 1 GHz
  - Level 0 dBm
  - Select FM1 DEVIATION 1MHz, FM1 SOURCE EXT1, EXT1 COUPLING DC in the MODULATION/FM menu.
- Setting at the modulation analyzer
  - Counter function
- Observe change when switching on and off FM.

  Frequency deviation when switching on FM ..... < 1 kHz.

5.2.26 FM Stereo Modulation

Test equipment

Test system 5.1.1.1.

Test setup

Connect the stereo coder output of the modulation analyzer with socket EXT1 of the SMT.

Measurement

- Settings at the SMT
  - Carrier frequencies 10.7 MHz and 85 MHz to 108 MHz
  - Select FM1 DEVIATION 46 kHz,
    FM1 SOURCE EXT1,
    EXT1 COUPLING DC in the MODULATION/FM menu.
- Setting at the stereo coder
  - Set the level such that neither EXT1 HIGH nor EXT1 LOW is indicated.
- Modulate both channels with 1 kHz, determine the distortion factor of both channels using the distortion meter in the modulation analyzer.

  Distortion factor ..... < 0.2%
- Switch over deviation measurement to relative measurement and operate both channels without a signal.
- Measure the Signal to noise ratio in both channels according to CCIR.

  The unweigthed signal to noise ratio must be more than 73 dB. The weighted signal to noise ratio must be more than 66 dB.
- Modulate only one channel with 1 kHz. Measure the crosstalk modulation in the unmodulated channel.

  It should be more than 50 dB under the reference value of the wanted modulation.

5.2.27 PhiM Deviation Setting

Test equipment

Test system 5.1.1.1.

Measurement

- Settings at the SMT
  - Carrier frequency 1000 MHz
  - Level 0 dBm
  - Select INT in the MODULATION/PM/PM1 SOURCE menu,
  - Deviation 0.01 to 100 rad (see below)
  - Modulation frequency 1 kHz.
- Read off PhiM deviation at the modulation analyzer.

  Deviation of the deviation measured from the setting value
  ..... max. 3% of the indication +0.01 rad
- Repeat measurement with a PM bandwidth of 2 MHz and a deviation of 0.01 to 5 rad.

  Deviation of the deviation measured from the setting value
  ..... max. 3% of the display +0.01 rad

Recommended setting values

0.01, 0.03, 0.1, 0.3, 1, 3, 10, 30, 100 rad

5.2.28 PhiM Frequency Response

Note: *If option SM-B2 LF generator is fitted, LFGEN2 can also be selected in the MODULATION/PM PM2 SOURCE menu and the test frequency be set using the internal generator for this measurement.*

5.2.28.1 PhiM Frequency Response with a PM Bandwidth of 100 kHz

Test equipment

Test system 5.1.1.2

Measurement

- Settings at the SMT
  - Carrier frequency 140 MHz,
  - Level 0 dBm
  - Select PM DEVIATION 5 rad,
    PM1 SOURCE EXT1,
    EXT1 COUPLING AC in the MODULATION/PM menu,
  - Deviation 5 rad.
- Setting at the audio analyzer
  - Generator level 1 V(u_{peak}).
- Determine the modulation frequency response (difference between the highest and lowest modulation depth) by varying the generator frequency of the analyzer.

  Modulation frequency response 10 Hz to 100 kHz ..... max. 3 dB
- Repeat measurement using setting PM2 SOURCE EXT2.

5.2.28.2 PhiM Frequency Response with a PM Bandwidth of 2 MHz

Test equipment

- Spectrum analyzer (Section 5.1, pos. 2)
- Signal generator (Section 5.1, pos. 18)

Test principle

The level of the modulation sidebands (–20 log (PHiM/2)) and thus the modulation index in the modulation frequency range indicated is measured using a spectrum analyzer.

Test setup

- Connect spectrum analyzer to the RF output of the SMT.
- Connect modulation generator to input EXT2 of the SMT.

Measurement

- Settings at the SMT
  - Carrier frequency 140 MHz,
  - Level 0 dBm
  - in menu MODULATION/PM
    select PM DEVIATION 0.2 rad,
    PM2 SOURCE EXT2 and
    EXT2 COUPLING AC,
- Setting at the signal generator (connected to EXT2)
  - Generator level 1 V(u_{peak}).
- Setting at the spectrum analyzer
  - Operating mode MAX HOLD
- Determine the modulation frequency response (difference between the largest and the smallest modulation depth) by varying the generator frequency from 100 kHz to 2 MHz.

  Modulation frequency response 100 kHz to 1 MHz .... max. 1 dB
  Modulation frequency response 1 MHz to 2 MHz ..... max. 3 dB

5.2.29 PhiM Distortion Factor

Test equipment — Test system 5.1.1.1

Measurement

- Settings at the SMT
  - Carrier frequency 140 MHz
  - Level 0 dBm
  - Select INT in the MODULATION/PM/PM1 SOURCE menu,
  - Deviation 12.5 rad
  - Modulation frequency 1 kHz.
- Read off the distortion factor at the modulation analyzer.
  Distortion factor ..... max. 0.5%

5.2.30 Internal Modulation Generator

Test equipment — Audio analyzer (Section 5.1, item 14)

Test setup

- Connect an audio analyzer to socket LF of the SMT to test the internal modulation generator.

Measurement

- Settings at the SMT
  - Select LFGEN1 in the LF OUTPUT/SOURCE menu,
  - Level 1 V,
  - subsequently all 4 frequencies of the internal generator.
- Read off the actual frequency at the audio analyzer.
  Deviation compared to the rated value ..... <3%
- Read off output voltage at the audio analyzer.
  Output voltage ..... 990 to 1010 mV (peak value)

5.2.31 Pulse Modulation (Option SM-B3/B8/B9)

5.2.31.1 ON/OFF - Ratio

Test equipment

- Spectrum analyzer (Section 5.1, item 2)
- Pulse generator (Section 5.1, item 17)

Test setup

- Connect a spectrum analyzer to the RF output socket of the SMT
- Connect a pulse generator to socket PULSE at the rear panel of the SMT.

Measurement

- Setting at the SMT
  - Select EXT1 in the MODULATION/PULSE/SOURCE menu.
- Determine the output level of the SMT with a present "high" and "low" signal with various carrier frequencies.
  Difference of the output level with a "high"and "low" signal
  ..... >80 dB

5.2.31.2 Dynamic Characteristics

Test equipment — Test system 5.1.1.4.

Measurement

- Simultaneously display the input signal from the pulse generator and the (down-converted) output signal on the dual-trace oscilloscope (triggering on the input signal).
- Settings at the pulse generator
  - Square-wave pulse sequence at a frequency of approx. 10 MHz, TTL level.
- Settings at the SMT
  - Carrier frequencies > 5 MHz
  - Option SM-B3: level 10 dBm.
  - Option SM-B8: level 9 dBm.
  - Option SM-B9: level 8 dBm.
- With carrier frequencies > 50 MHz, use mixer and set an IF of approx. 50 MHz using the auxiliary transmitter.
- Evaluate the modulated RF signal at the oscilloscope.
  Rising time = the time between 10% and 90% of the RF amplitude
  Fall time = the time between 90% and 10% of the RF amplitude
  Pulse delay time= the time between 50% of the input pulse amplitude and 50% of the RF amplitude

  Rising time ..... < 10 ns
  Fall time ..... < 10 ns
  Pulse delay time ..... < 70 ns

5.2.32 LF Generator (Option SM-B2)

5.2.32.1 Frequency Error

Test equipment — Audio analyzer (Section 5.1, item 14)

Test setup — Connect the audio analyzer to the LF socket of the SMT.

Measurement

- Settings at the SMT
  - Select SOURCE LFGEN2,
    VOLTAGE 1V in menu LF OUTPUT ,
  - Vary LFGEN2 FREQUENCY from 20 Hz to 100 kHz.
- Read off the actual frequency at the audio analyzer.
  Deviation from the rated value ..... <1E–4
- Read off the distortion factor at the audio analyzer.
  Rated value ..... < 0.1%
- Settings at the SMT
  - Set LFGEN2 FREQUENCY 1 kHz in menu LF OUTPUT
  - Vary VOLTAGE from 1 mV to 4 V.
- Measure the output level using the audio analyzer.
  Deviation from the rated value ..... max. 1% + 1mV.

Recommended settings — 3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 2 V, 4 V.

5.2.32.2 Frequency Response

Test equipment — AC voltmeter (Section 5.1, item 19)

Test setup — Connect AC voltmeter to the LF socket of the SMT.

Measurement

- Settings at the SMT
  - Select SOURCE LFGEN2 in menu LF OUTPUT,
  - Vary LFGEN2 FREQUENCY from 10 Hz to 500 kHz.

  Frequency response (difference between the highest and lowest level) ..... up to 100 kHz < 0.3 dB
  ..... up to 500 kHz <0.5 dB

Note: *The setting time is a mere time the computer requires and thus needs not to be re-measured.*

5.2.33 Pulse Generator (Option SM-B4)

Test equipment

- Oscilloscope (Section 5.1, item 7)
- Pulse generator (Section 5.1, item 17)

Test setup

- Connect the pulse generator to the PULSe socket.
- Connect sockets SYNC and VIDEO to the two channels of the oscilloscope.
- Switch on an input resistance of 50 Ohm at the oscilloscope or use feed-through termination.

Measurement Single pulses

- Settings at the SMT
  In menu MODULATION/PULSE
  - SOURCE PULSE-GEN,
  - PERIOD 100 ns,
  - WIDTH 20 ns,
  - PULSE DELAY 20 ns,
  - DOUBLE PULSE STATE OFF,
  - TRIGGER MODE AUTO,
  - EXT TRIGGER SLOPE POS.
- Settings at the oscilloscope
  - Time base 20 ns/div,
  - both channels 2 V/div,
  - Triggering from the SYNCignal.

  SYNC output .... Pulse sequence with a pulse width of 40 ns ±10 ns

  VIDEO output .... Pulse sequence with a pulse width of 20 ns ±4 ns, the first edge appears after the first edge of the SYNC signal by the pulse delay of 20 ns (−11ns,+ 21 ns).

  SYNC and VIDEO output ..... Period 100 ns,

  Note: The period is derived from the internal reference frequency and has its accuracy. There must be no error within the frame of the measuring accuracy of the oscilloscope.

Double pulses

- Settings at the SMT
  In menu MODULATION/PULSE
  - DOUBLE PULSE STATE ON,
  - WIDTH 20 ns,
  - DOUBLE PULSE DELAY 60 ns

  VIDEO output ..... second pulse with a width of 20 ns ±4 ns,
  ..... Spacing to the first pulse 60 ns (+23ns, −13ns).

Ext. triggering

- Setting at the SMT
  In menu MODULATION/PULSE
  - TRIGGER MODE EXT
- Settings at the pulse generator
  - TTL pulse sequence at 10 MHz

  The pulse sequence at the oscilloscope must not change.

Trigger the oscilloscope on the PULSE input.

The pulse sequence may be offset by maximally 50 ns.

- Repeat the measurements with pulse periods of up to 85s and pulse widths, pulse delays and double pulse spacings of up to 1s.

5.2.34. Multi-Function Generator (Option SM-B6)

5.2.34.1 Frequency Error, Distortion Factor and Level

Test equipment

Audio analyzer (Section 5.1, item 14)

Test setup

Connect the audio analyzer to the LF output of the SMT.

Measurement

- SMT settings
  In menu LF OUTPUT
  - VOLTAGE 1 V
  - SOURCE LFGEN2
  - LFGEN2 SHAPE SIN
  - Vary LFGEN2 FREQ 20 Hz to 1 MHz.
- Read off the actual frequency at the audio analyzer.

  The values measured have to be precise within the scope of the counter resolution (error <0.1 Hz).
- Read off distortion factor at the audio analyzer.

  Rated value up to 100 kHz ..... <0. 1%
- SMT settings
  Menu LF OUTPUT
  - SOURCE LFGEN2
  - LFGEN2 FREQ 1 kHz
  - LFGEN2 SHAPE SIN
  - Vary VOLTAGE from 3mV to 4 V (see below)
- Measure the output level using the audio analyzer.

  Deviation from rated value ..... max. 1% + 1mV.

Recommended settings

3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 2 V, 4 V.

5.2.34.2 Frequency Response

Test equipment — AC voltmeter (Section 5.1, item 19)

Test setup — Connect the AC voltmeter to the LF socket of the SMT.

Measurement

- SMT settings
  In menu LF OUTPUT
  - SOURCE LFGEN2,
  - Vary LFGEN2 FREQUENCY from 10 Hz to 500 kHz.

  Frequency response (difference between the smallest and largest level) ..... up to 100 kHz < 0.3 dB
  ..... up to 500 kHz <0.5 dB

Note: *The setting time is a mere computer time and thus need not be remeasured.*

5.2.34.3 Distortion Factor and Crosstalk Attenuation Stereo

Test equipment — Modulation analyzer (Section 5.1, item 15)

Test setup — Connect modulation analyzer to the LF output of the SMT.

Measurement

- SMT settings
  In menu MODULATION STEREO
  - MODE R,
  - AUDIO FREQ 1kHz,

  In menu LF OUTPUT
  - STEREO OUTPUT MPX.
- Read distortion factor at the modulation analyzer (signal R)
  Rated value ..... <0.1%
- Measure the modulated signal of the right channel, note down value
- Measure the demodulated signal of the left channel
  Difference between modulated and demodulated signal
  ..... > 60 dB
- Repeat measurement using setting MODE L

5.2.34.4 Pilot Tone Level

Test equipment — AC voltmeter (Section 5.1, item 15)

Test setup — Connect AC voltmeter to the LF output of the SMT.

Measurement

- SMT settings
  In menu MODULATION STEREO
  - PILOT STATE ON
  -

  In menu LF OUTPUT
  - STEREO OUTPUT PILOT
  - LF VOLTAGE 1V
- Read AC voltage of the pilot tone
  Rated value ..... 0.707 V_{eff} ± 14mV_{eff}.

5.3 Test Report

ROHDE& SCHWARZ	SIGNAL GENERATOR SMT	1039.2000.0_

Serial number:

Person testing:

Date:

Signature:

Table 5-3 Test report

Item	Characteristic	Measurem. acc. to Section	Min.	Actual	Max.	Unit
1	Display and keyboard	5.2.1	checked	.....	—	—
2	Frequency setting	5.2.2	checked	.....	—	—
3	Settling time	5.2.3	—	.....	10	ms
4	Reference frequency	5.2.4	—	.....	—	—
5	Harmonics at 10 dBm	5.2.5	—	.....	–30	dBc
	Harmonics at 13 dBm		—	.....	–40	dBc
	Subharmonics (f > 1.5 GHz)		—	.....	–40	dBc
	Subharmonics (f > 3 GHz)		—	.....	–34	dBc
6	Spuriae	5.2.6				
	RF > 3 GHz (SMT06)		—	.....	–68	dBc
	RF>1.5 GHz (SMT03)		—	.....	–74	dBc
	RF≤1.5 GHz		—	.....	–80	dBc
7	SSB phase noise	5.2.7				
	ratio 20 kHz					
	RF< 67.5 MHz		—	.....	–120	dBc (1 Hz)
	RF= 80 MHz		—	.....	–139	dBc (1 Hz)
	RF= 125 MHz		—	.....	–134	dBc (1 Hz)
	RF= 250 MHz		—	.....	–128	dBc (1 Hz)
	RF= 500 MHz		—	.....	–122	dBc (1 Hz)
	RF= 1000 MHz		—	.....	–116	dBc (1 Hz)
	RF= 2000 MHz (SMT03706)		—	.....	–110	dBc (1 Hz)
	RF= 3000 MHz (SMT03/06)		—	.....	–109	dBc (1 Hz)
	RF= 6000 MHz (SMT06)		—	.....	–103	dBc (1 Hz)
8	Broadband noise	5.2.8	—	.....	–140	dBc (1 Hz)
9	Residual FM_{eff}	5.2.9				
	(0.02 to 20 kHz/CCITT)		—	.....		
	RF< 67.5 MHz		—	.....	10 /4	Hz
	RF 67.5 to 187.5 MHz		—	.....	3 / 1	Hz
	RF 187.5 to 375 MHz		—	.....	5 / 2	Hz
	RF 375 to 750 MHz		—	.....	10 / 4	Hz
	RF 750 to 1500 MHz		—	.....	20 / 8	Hz
	RF 1500to3000 MHz (SMT03/06)		—	.....	40 / 16	Hz
	RF 3000to6000 MHz (SMT06)		—	.....	80 / 32	Hz

Continuation: Test report

Item	Characteristic	Measurem. acc. to Section	Min.	Actual	Max.	Unit
10	Residual AM	5.2.10	—	.....	0.02	%
11	Output level, Frequency response Deviation from the rated value f ≤ 3 GHz f > 3 GHz	5.2.11	 — — —		 1 1 2	 dB dB dB
12	Output reflection coeff. Test level ≤ 0 dBm, f ≤ 3 GHz Test level ≤ 0 dBm, f > 3 GHz Test level > 0 dBm Test level > 0 dBm, f > 5 GHz with SM-B9	5.2.12	 — — — —		 1,5 2,0 2,0 2,5	 (VSWR) (VSWR) (VSWR) (VSWR)
13	Interrupt-free level setting – 5 dB –10 dB –15 dB –20 dB	5.2.13	 – 5.1 –10.2 –15.3 –20.4		 –4.9 –9.8 –14.7 –19.6	 dB dB dB dB
14	Overvoltage protection (SMT02/03) D.c. voltage RF supply	5.2.14	 4 0.5		 7 1	 V W
15	Level monitoring EXT1 lower limit upper limit	5.2.15	 0.97 1.01		 0.99 1.03	 V V
16	AM modulation depth 80% 30 %	5.2.16	 75.8 27.8		 84.2 32.2	 % %
17	AM frequency response 20 Hz to 50 kHz	5.2.17	 —		 1	 dB
18	AM distortion factor with AM 30% with AM 80%	5.2.18	 — —		 1 2	 % %
19	Residual PhiM with AM, f ≤ 3 GHz Residual PhiM with AM, f > 3 GHz	5.2.19	— —	....	0.2 2.0	rad rad
20	Level monitoring EXT2 lower limit upper limit	5.2.20	 0.97 1.01		 0.99 1.03	 V V

Continuation: Test report

Item	Characteristic	Measurem. acc. to Section	Min.	Actual	Max.	Unit
21	FM deviation setting	5.2.21				
	RF = 1 GHz			.....		
	with 30 Hz		10	.....	50	Hz
	with 100 Hz		77	.....	123	Hz
	with 300 Hz		271	.....	329	Hz
	with 1 kHz		0.95	.....	1.05	kHz
	with 3 kHz		2.89	.....	3.11	kHz
	with 10 kHz		9.68	.....	10.32	kHz
	with 30 kHz		29.08	.....	30.92	kHz
	with 100 kHz		96.98	.....	103.02	kHz
	with 300 kHz		291	.....	309	kHz
	RF = 70 MHz					
	with 100 kHz		96.98	.....	103.02	kHz
	with 300 kHz		291	.....	309	kHz
	with 600 kHz		582	.....	618	kHz
22	FM frequency response	5.2.22				
	FM1, EXT1 10 Hz to 100 kHz		—	.....	0.5	dB
	FM1, EXT2 10 Hz to 100 kHz		—	.....	0.5	dB
	FM2, EXT1 10 Hz to 100 kHz		—	.....	0.5	dB
	FM2, EXT2 10 Hz to 8 MHz		—	.....	3	dB
23	FM distortion factor	5.2.23	—	.....	0.3	%
24	Residual AM with FM	5.2.24	—	.....	0.1	%
25	Frequency deviation with FM	5.2.25				
	Deviation 1 MHz		—	.....	1	kHz
26	FM stereo modulation	5.2.26				
	Distortion factor		—	.....	0.2	%
	External voltage suppression		73	.....	—	dB
	Noise voltage suppression		66	.....	—	dB
	Channel separation		50	.....	—	dB
27	PhiM deviation setting	5.2.27				
	PM BANDWIDTH 100 kHz					
	with 30 mrad		20	.....	40	mrad
	with 0.1 rad		0.087	.....	0.113	rad
	with 0.3 rad		0.281	.....	0.319	rad
	with 1.0 rad		0.969	.....	1.031	rad
	with 3.0 rad		2.90	.....	3.10	rad
	with 10 rad		9.69	.....	10.31	rad
	with 30 rad		29	.....	31	rad
	with 100 rad		96.9	.....	103.1	rad
	PM BANDWIDTH 2 MHz					
	with 30 mrad		20	.....	40	mrad
	with 0.1 rad		0.087	.....	0.113	rad
	with 0.3 rad		0.281	.....	0.319	rad
	with 1.0 rad		0.969	.....	1.031	rad
	with 3.0 rad		2.90	.....	3.10	rad

Item	Characteristic	Measurem. acc. to Section	Min.	Actual	Max.	Unit
28	PhiM frequency response	5.2.28				
	PM BANDWIDTH 100 kHz					
	PM1, EXT1, 10Hz...100 kHz		—	.....	3	dB
	PM1, EXT2, 10Hz...100 kHz		—	.....	3	dB
	PM2, EXT1, 10Hz...100 kHz		—	.....	3	dB
	PM BANDWIDTH 2 MHz					
	PM2, EXT2, 10 Hz...1 MHz		—	.....	1	dB
	PM2, EXT2, 1 MHz...2 MHz		—	.....	3	dB
29	PhiM distortion factor	5.2.29	—	.....	0.5	%
30	Int. modulation generator	5.2.30				
	Frequency 400 Hz		388	.....	412	Hz
	Frequency 1 kHz		970	.....	1030	Hz
	Frequency 3 kHz		2910	.....	3090	Hz
	Frequency 15 kHz		14.55	.....	15.45	kHz
	Level		990	.....	1010	mV
31	Pulse modulation	5.2.31				
	ON/OFF ratio		80	.....	—	dB
	Rising time		—	.....	10	ns
	Fall time		—	.....	10	ns
	Delay time		—	.....	70	ns
32	LF generator	5.2.32				
	Frequency error		—	.....	1E0–4	—
	Distortion factor		—	.....	0.1	%
	Level			.....		
	3 mV		2	.....	4	mV
	10 mV		8.9	.....	11.1	mV
	30 mV		28.7	.....	31.3	mV
	100 mV		98.0	.....	101.0	mV
	300 mV		296	.....	304	mV
	1 V		0.989	.....	1.011	V
	2 V		1.979	.....	2.021	V
	4 V		3.959	.....	4.041	V
	Frequency response up to 100 kHz		—	.....	0.3	dB
	Frequency response up to 400 kHz		—	.....	0.5	dB
33	Pulse generator	5.2.33				
	Pulse period		checked	.....	—	
	Pulse width		–5% –3 ns	.....	+5% +3 ns	% / ns
	Pulse delay		–5% –3 ns	.....	+5% +3 ns	% / ns
	Double pulse spacing		–5% –10 ns	.....	+5% +20 ns	% / ns
	Trigger delay		—	.....	50 ns	ns

Continuation: Test report

Item	Characteristic	Measurem. acc. to Section	Min.	Actual	Max.	Unit
34	Multi-function generator	5.2.33				
	Frequency error		—	.....	1E0–4	—
	Distortion factor		—	.....	0.1	%
	Level			.....		
	3 mV		2	.....	4	mV
	10 mV		8.9	.....	11.1	mV
	30 mV		28.7	.....	31.3	mV
	100 mV		98.0	.....	101.0	mV
	300 mV		296	.....	304	mV
	1 V		0.989	.....	1.011	V
	2 V		1.979	.....	2.021	V
	4 V		3.959	.....	4.041	V
	Frequency response up to 100 kHz		—	.....	0.3	dB
	Frequency response up to 500 kHz		—	.....	0.5	dB
	Stereo			.....		
	Crosstalk attenuation		60	.....	—	dB
	Distortion factor		—	.....	0.1	%
	P ilot-tone level		0.693	.....	0.721	V

Annex A3

IEC/IEEE-Bus Interface

The instrument is equipped with an IEC/IEEE-bus connection as a standard. The mating connector according to IEEE 488 is at the rear of the instrument. A controller for remote control can be connected via the interface. The connection is effected using a shielded cable.

Characteristics of the Interface

- 8-bit parallel data transfer
- bidirectional data transfer
- three line handshake
- high data transfer rate of max. 350 kByte/s
- up to 15 devices can be connected
- maximal length of the connecting cables 15 m (single connection 2m)
- wired OR if several instruments are connected in parallel.

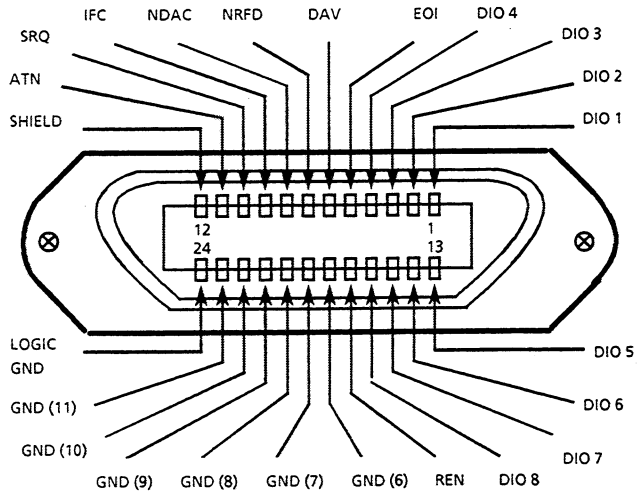


Fig. A-1 Contact Assignment of the IEC-bus socket

Bus Lines

1. **Data bus with 8 lines DIO 1 to DIO 8.**
   The transmission is bit-parallel and byte-serial in the ASCII/ISO code. DIO1 is the bit of lowest order, DIO8 the bit of highest order.

2. **Control bus with 5 lines.**
   IFC (Interface Clear),
   active low resets the interfaces of the instruments connected to the default setting.

   ATN (Attention),
   active low signals the transmission of interface messages
   inactive high signals the transmission of device-dependent messages.

SRQ (Service Request),
active low enables a device connected to send a service request to the controller.

REN (Remote Enable),
active low permits the switchover to remote control.

EOI (End or Identify),
has two functions in connection with ATN:
active low marks the end of data transmission with ATN = high
active low triggers a parallel poll with ATN = low.

3. **Handshake bus with three lines.**
   DAV (Data Valid),
   active low signals a valid data byte on the data bus.

   NRFD (Not Ready For Data),
   active low signals that one of the device connected is not ready for data transfer .

   NDAC (Not Data Accepted),
   active low as long as the instrument connected is accepting the data present on the data bus.

Interface Functions

Instruments which can be remote-controlled via IEC bus can be equipped with different interface functions. Table A-1 lists the interface functions appropriate for the instrument.

Table A-1 Interface functions

Control character	Interface function
SH1	Handshake source function (source handshake)
AH1	Handshake drain function (acceptor handshake)
L4	Listener function.
T6	Talker function, ability to respond to serial poll
SR1	Service request function (Service Request)
PP1	Parallel poll function
RL1	Remote/Local switchover function
DC1	Resetting function (Device Clear)
DT1	Trigger function (Device Trigger)

Interface Messages

Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They serve to communicate between instrument and controller.

Common Commands

The common commands are encoded in the range 10 through 1F hex. They are effective for all instruments connected to the bus without addressing them before.

Table A-2 Common Commands

Command	QuickBASIC command	Effect on the instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial poll
SPD (Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial poll
PPU (Parallel Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of the parallel-poll polling state

Addressed Commands

The addressed commands are encoded in the range 00 through 0F hex. They are only effective for instruments addressed as listeners.

Table A-3 Addressed Commands

Command	QuickBASIC command	Effect on the instrument
SDC (Selected Device Clear)	IBCLR (device%)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
GET (Group Execute Trigger)	IBTRG (device%)	Triggers a previously active device function (eg a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual control)
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configure instrument for parallel poll. The QuickBASIC command additionally executes PPE / PPD.

RS-232-C Interface

The instrument is fitted with an RS-232-C interface as standard. The 9-pin connector is at the rear panel. A controller can be connected via this interface for remote control.

Interface characteristics

- Serial data transmission in asynchronous mode
- Bidirectional data transmission via two separate lines
- Transmission rate selectable from 1200 to 115200 baud
- Logic 0 signal from + 3 V to + 15 V
- Logic 1 signal from -15 V to -3 V
- An external instrument (controller) can be connected
- Software handshake (XON, XOFF)
- Hardware handshake

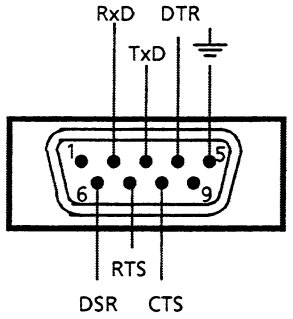


Fig. A-2 Pin assignment of RS-232-C connector

Signal lines

RxD (Receive Data),
Data line, transmission from external controller to instrument.

TxD (Transmit Data),
Data line, transmission from instrument to external controller.

DTR ,(Data terminal ready)
Output (log. 0 = active). With DTR, the instrument indicates that it is ready to receive data. The DTR line controls whether the instrument is ready for reception or not.

GND,
Interface ground, connected to instrument ground.

DSR (Data Set Ready),
(Instead of the CTS line, the DSR connector is used for instruments with a VAR2 REV3 front module.)

RTS (Request To Send),
Output (log 0 = active). With RTS, the instrument indicates that it is ready to receive data. The RTS line controls whether the instrument is ready for reception or not.

CTS (Clear to send),
Input (log 0 = active). CTS tells the instrument that the opposite station is ready to receive data.

Transmission parameters

To ensure an error-free and correct data transmission, the parameters of the instrument and the controller should have the same settings. The parameters are set in menu UTILITIES-SYSTEM-RS232.

Transmission rate (baud rate)
The following baud rates can be set in the instrument:
1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.

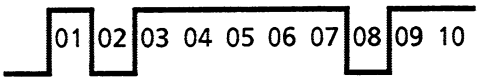
Data bits
Data transmission is in 8-bit ASCII code. The first bit transmitted is the LSB (Least Significant Bit).

Start bit
Each data byte begins with a start bit. The falling edge of the start bit indicates the beginning of the data byte.

Parity bit
A parity bit is not used.

Stop bits
The transmission of a data byte is terminated by a stop bit.

Example: Transmission of character A (41 hex) in the 8-bit ASCII code.



Bit 01 = Start bit, Bit 02...09 = Data bits,
Bit 10 = Stop bit.

Bitduration = 1/baud rate

Interface functions

For interface control, some control characters defined from 0 to 20 hex of the ASCII code can be transmitted via the interface (see Table A-4).

Table A-4 Interface functions

Control character	Interface function
<Ctrl Q> 11 hex	Enables character output (XON)
<Ctrl S> 13 hex	Inhibits character output (XOFF)
Break (at least 1 character only log 0)	Reset instrument
0Dhex, 0Ahex	Terminator <CR>, <LF> Switchover between local/remote

Handshake

Software handshake
The software handshake with the XON/XOFF protocol controls data transmission. If the receiver wishes to inhibit data entry, it sends XOFF to the transmitter. The transmitter then interrupts the data output until it receives a XON. The same function is provided at the transmitter side (controller).

Note: *Software handshake is not suitable for transmission of binary data. Use the hardware handshake.*

Hardware handshake
In case of a hardware handshake the instrument signals that it is ready for reception via line DTR and RTS. A logic 0 means "ready" and a 1 means "not ready". Whether the controller is ready for reception or not is signalled to the instrument via lines CTS or DSR (see signal lines). The transmitter of the instrument is switched on by a 0 and off by a 1. Line RTS remains active as long as the serial interface is active. Line DTR controls whether the instrument is ready for reception or not.

Connection between instrument and controller
Connection of the instrument with the controller is via a so-called 0-modem cable. In this case, the data, control and signalling lines have to be cross-connected. For a controller with a 9-pin or 25-pin connector the following circuit diagram applies.

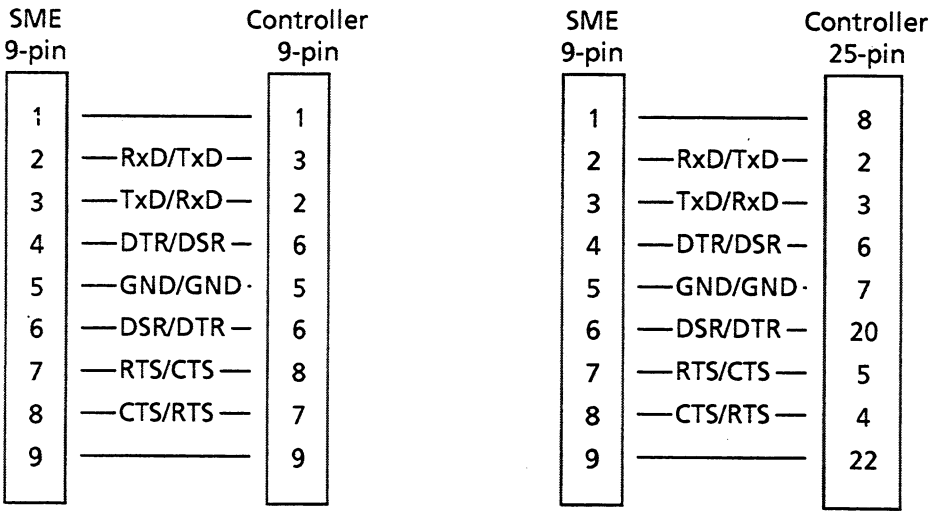


Fig. A-3 Wiring of data, control and signalling lines for hardware handshake

Annex B

List of Error Messages

The following list contains all error messages for errors occurring in the instrument. The meaning of negative error codes is defined in SCPI, positive error codes mark errors specific of the instrument.

The table contains the error code in the left-hand column. In the right-hand column the error text being entered into the error/event queue or being displayed is printed in bold face. Below the error text, there is an explanation as to the respective error.

SCPI-Specific Error Messages

No Error

Error code	**Error text in the case of queue poll** Error explanation
0	**No error** This message is output if the error queue does not contain entries.

Command Error — Faulty command; sets bit 5 in the ESR register.

Error code	**Error text in the case of queue poll** Error explanation
– 100	**Command Error** The command is faulty or invalid.
– 101	**Invalid Character** The command contains an invalid sign. Example: A header contains an ampersand, "SOURCE&".
– 102	**Syntax error** The command is invalid. Example: The command contains block data the instrument does not accept.
– 103	**Invalid separator** The command contains an impermissible sign instead of a separator. Example: A semicolon is missing after the command.
– 104	**Data type error** The command contains an invalid value indication. Example: ON is indicated instead of a numeric value for frequency setting.
– 105	**GET not allowed** A Group Execute Trigger (GET) is within a command line.
– 108	**Parameter not allowed** The command contains too many parameters. Example: Command SOURce:FM:INTernal:FREQuency permits only one frequency indication.
– 109	**Missing parameter** The command contains too few parameters. Example: Command SOURce:FM:INTernal:FREQuency requires a frequency indication.

Continuation: Command Error

Error code	**Error text in the case of queue poll** Error explanation
- 112	**Program mnemonic too long** The header contains more than 12 signs.
- 113	**Undefined header** The header is not defined for the instrument. Example: *XYZ is undefined for every instrument.
- 114	**Header suffix out of range** The header contains an impermissible numeric suffix. Example: SOURce3 does not exist in the instrument.
- 123	**Exponent too large** The absolute value of the exponent is larger than 32000.
- 124	**Too many digits** The number contains too many digits.
- 128	**Numeric data not allowed** The command contains a number which is not allowed at this position. Example: Command SOURce:FREQuency:MODE requires the indication of a text parameter.
- 131	**Invalid suffix** The suffix is invalid for this instrument. Example: nHz is not defined.
- 134	**Suffix too long** The suffix contains more than 12 signs.
- 138	**Suffix not allowed** A suffix is not allowed for this command or at this position of the command. Example: Command *RCL does not permit indicating a suffix.
- 141	**Invalid character data** The text parameter either contains an invalid sign or it is invalid for this command. Example: write error with parameter indication; SOURce:FREQuency:MODE FIKSED.
- 144	**Character data too long** The text parameter contains more than 12 signs.
- 148	**Character data not allowed** The text parameter is not allowed for this command or at this position of the command. Example: Command *RCL requires a number to be indicated.
- 158	**String data not allowed** The command contains a valid character string at a position which is not allowed. Example: A text parameter is set in quotation marks, SOURce:FREQuency:MODE "FIXed"
- 161	**Invalid block data** The command contains faulty block data. Example: An END message was received before the expected number of data had been received.
- 168	**Block data not allowed** The command contains valid block data at an impermissible position. Example: Command *RCL requires a number to be indicated.
- 178	**Expression data not allowed** The command contains a mathematical expression at an impermissible position.

Execution Error — Error in executing the command; sets bit 4 in the ESR register

Error code	**Error text in the case of queue poll** Error explanation
– 203	**Command protected** The desired command could not be executed as it was protected with a password. Use command SYSTem:PROTect OFF, <password> to enable the command. Beispiel: The command CALibrate:PULSe:MEASure? is protected with a password.
– 211	**Trigger ignored** The trigger (GET, *TRG or trigger signal) was ignored due to device timing considerations Example: The instrument was not ready to respond.
– 221	**Settings conflict** There is a settings conflict between two parameters. Example: FM1 and PM1 cannot be switched on at the same time.
– 222	**Data out of range** The parameter value is out of the range permitted by the instrument. Example: Command *RCL only permits entries in the range of 0 to 50
– 223	**Too much data** The command contains too many data. Example: The instrument does not have sufficient storage space.
– 224	**Illegal parameter value** The parameter value is invalid. Example: An invalid text parameter is indicated, TRIGger:SWEep:SOURce TASTe
– 225	**Out of memory** The storage space available in the instrument is exhausted. Example: An attempt is made to create more than 10 Memory Sequence lists.
– 226	**Lists not same length** The parts of a list have different lengths. This error message is also displayed if only a part of a list has been transmitted via IEC bus. All parts have to be transmitted always before the command is executed. Example: The DWELl list is longer than the RCL list, or only the DWELl list is transmitted
– 230	**Data corrupt or stale** The data are incomplete or invalid. Example: The instrument has aborted a measurement.
– 240	**Hardware error** The command cannot be executed due to problems with the instrument hardware.
– 241	**Hardware missing** The command cannot be executed due to missing hardware. Example: An option is not fitted.
– 255	**Directory full** The list management cannot accept any more lists as the maximum number of lists has already be attained. Example: Only 10 Memory Sequence lists can be created.

Device Specific Error — sets bit 3 in the ESR register.

Error code	Error text in the case of queue poll Error explanation
-310	**System error** This error message suggests an error within the instrument. Please inform the R&S Service.
-311	**Memory error** Error in the instrument memory.
-313	**Calibration memory lost** Loss of calibration data stored. The calibration data of VCO SYN, LEV PRESET and PULSE GEN can be restored by internal routines (See Chapter 2, Section "Calibration")
-314	**Save/recall memory lost** Loss of the non-volatile data stored using *SAV? command.
-315	**Configuration memory lost** Loss of the non-volatile configuration data stored by the instrument.
-330	**Self-test failed** The selftest could not be executed.
-350	**Queue overflow** This error code is entered into the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been accepted. The queue can accept 5 entries.
-360	**Communication error** An error has occurred during the transmission or reception of data on the IEC/IEEE bus or via the RS-232 interface.

Query Error — Error in data request; sets bit 2 in the ESR register.

Error code	Error text in the case of queue poll Error explanation
-410	**Query INTERRUPTED** The query has been interrupted. Example: After a query, the instrument receives new data before the response has been sent completely.
-420	**Query UNTERMINATED** The query is incomplete. Example: The instrument is addressed as a talker and receives incomplete data.
-430	**Query DEADLOCKED** The query cannot be processed. Example: The input and output buffers are full, the instrument cannot continue operation.

SMT-Specific Error Messages

Device-dependent Error — device-specific error; sets bit 3 in the ESR register.

Error code	**Error text in the case of queue poll** Error explanation
105	**Frequency underrange** The frequency is below the limit value guaranteed.
106	**Frequency overrange** The frequency is beyond the limit value guaranteed.
110	**Output unleveled** The level control loop is deactivated.
115	**Level overrange** The level is above the limit value guaranteed.
116	**Level underrange** The level is below the limit value guaranteed.
117	**Dynamic level range exceeded** The difference between the maximal and the minimal value of a level list is above 20 dBm. An exact level setting is no longer guaranteed.
131	**AM modulation frequency out of range** The AM modulation frequency is out of the permissible range.
132	**PM modulation frequency out of range** The PM modulation frequency is out of the permissible range.
140	**This modulation forces other modulations OFF** A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been witched off.
152	**Input voltage out of range; EXT1 too high** The input voltage at the EXT1 socket is too high.
153	**Input voltage out of range; EXT1 too low** The input voltage at the EXT1 socket is too low.
154	**Input voltage out of range; EXT2 too high** The input voltage at the EXT2 socket is too high.
155	**Input voltage out of range; EXT2 too low** The input voltage at the EXT2 socket is too low.
161	**Output protection tripped** The overvoltage protection has responded (cf. Section 2.5.8).
162	**LF output overdriven** The dependency of the LF output voltage on other parameters in stereo operation has caused that the LF output would have to supply more than 4 volts. However, the voltage has been limited to 4 volts.
171	**Oven cold** The reference oscillator has not yet reached its operating temperature.
180	**Calibration failed** Calibration could not be executed.
181	**REF OSC calibration data not used because ADJUSTMENT STATE is ON** The reference-oscillator calibration data are not used as long as ADJUSTMENT STATE is activated.
182	**Calibration data missing** Calibration data are missing in the device memory. The calibration data have to be generated first by an internal or external calibration or to be loaded into the device.

Continuation: Device-dependent Error

Error code	**Error text in the case of queue poll** Error explanation
200	**Cannot access hardware** The data transmission to a module was unsuccessful.
201	**Function not supported by this hardware revision** A later version of certain parts of the instrument is necessary to execute the function selected.
202	**Diagnostic A/D converter failure** Diagnostic A/D converter has failed.
222	**Synthesizer loop unlocked** The PLL of the synthesizer has not locked.
241	**No list defined** There is no list defined.
243	**Dwell time adjusted** A dwell time given on a list cannot be processed by the unit. The setting was automatically adjusted.
251	**No User Correction Table; zero assumed** An attempt has been made to switch on user correction, but no UCOR table has been stored in the instrument yet. The instrument behaves as if a table was called which only contains 0-values.
260	**Invalid keyboard input ignored** An invalid input via the keyboard is not considered.
265	**This parameter is read only** An attempt has been made to change a fixedly specified value.
270	**Data output aborted** Data output was aborted on the IEC/IEEE-bus. Example: The key [LOCAL] was pressed.
304	**String too long** A character string which is too long was received via the IEC bus. The names of lists may have a length of maximally seven letters.
305	**Fill pattern too long; truncated** More data have been entered with block function FILL in the list editor than the filling range (RANGE) set permits. The exceeding data are ignored.
306	**No fill pattern specified** An attempt was made to execute a filler function without having to indicate a filler pattern.

Annex C

List of Commands (with SCPI Conformity Information)

The SMT supports SCPI version 1994.0.
For remote control, commands which were specified or accepted in this SCPI version have been used to a large extent. Commands which are not part of the SCPI specification are marked "not SCPI" in the SCPI info.

Command	Parameter	Page	SCPI-Info
:ABORt [:SWEep]		3.16	not SCPI
:ABORt :MSEQuence		3.16	not SCPI
:CALibration :FM [:MEASure]?		3.17	not SCPI
:CALibration :FM :DATA?		3.17	not SCPI
:CALibration :FM :OFFSet?		3.17	not SCPI
:CALibration :LEVel :DATA?		3.17	not SCPI
:CALibration :LEVel :FRANge	NORMal | MIXer	3.17	not SCPI
:CALibration :LEVel :PMODulator	ON | OFF	3.17	not SCPI
:CALibration :LEVel :STATe	ON | OFF	3.17	not SCPI
:CALibration :LPReset [:MEASure]?		3.18	not SCPI
:CALibration :LPReset :DATA?		3.18	not SCPI
:CALibration:PULSe [:MEASure]?		3.18	not SCPI
:CALibration :PULSe :DATA?		3.18	not SCPI
:CALibration :ROSCillator [:DATA]	0 to 4095	3.18	not SCPI
:CALibration :VSYNthesis [:MEASure]?		3.18	not SCPI
:CALibration :VSYNthesis :DATA?		3.17	not SCPI
:DIAGnostic :INFO :CCOunt :ATTenuator1| 2| 3| 4| 5| 6?		3.19	
:DIAGnostic :INFO :CCOunt :POWer?		3.20	
:DIAGnostic :INFO :MODules?		3.20	
:DIAGnostic :INFO :OTIMe?		3.20	
:DIAGnostic :INFO :SDATe?		3.20	
:DIAGnostic [:MEASure] :POINt?		3.20	
:DISPlay :ANNotation [:ALL]	ON | OFF	3.21	
:DISPlay :ANNotation :AMPLitude	ON | OFF	3.21	
:DISPlay :ANNotation :FREQuency	ON | OFF	3.21	

Command	Parameter	Page	SCPI-Info
:FORMat [:DATA]	ASCii| REAL[, 32 | 64] | PACKed	3.22	
:MEMory :NSTates?		3.23	
:OUTPut :AMODe	AUTO | FIXed	3.24	not SCPI
:OUTPut :BLANk [:POLarity]	NORMal | INVerted	3.24	not SCPI
:OUTPut :IMPedance?		3.24	
:OUTPut :PROTection:CLEar		3.24	
:OUTPut :PROTection:TRIPped?		3.24	
:OUTPut [:STATe]	ON | OFF	3.24	
:OUTPut [:STATe] :PON	OFF | UNChanged	3.24	not SCPI
:OUTPut2 :SOURce	0 | 2	3.25	not SCPI
:OUTPut2 :SOURce :STEReo	MPX | PILot	3.25	not SCPI
:OUTPut2 [:STATe]	ON | OFF	3.25	
:OUTPut2 :VOLTage	0 V to 4 V	3.25	not SCPI
[:SOURce] :AM [:DEPTh]	0 to 100 PCT	3.27	
[:SOURce] :AM :EXTernal :COUPling	AC | DC	3.27	
[:SOURce] :AM :INTernal1|2:FREQuency	400 Hz| 1 kHz | 3 kHz | 15 kHz / 0.1 Hz to 500 kHz / 0.1 Hz to 1 MHz	3.27	
[:SOURce] :AM :POLarity	NORMal | INVerted	3.27	
[:SOURce] :AM :SOURce	INT1|2 | EXT | INT1|2 , EXT	3.27	
[:SOURce] :AM :STATe	ON | OFF	3.27	
[:SOURce] :CORRection [:STATe]	ON | OFF	3.28	
[:SOURce] :CORRection :CSET :CATalog?		3.28	not SCPI
[:SOURce] :CORRection :CSET [:SELect]	"Name"	3.28	
[:SOURce] :CORRection :CSET :DATA:FREQ	5kHz..1.5GHz {,5kHz..1.5GHz} SMT03/06: 5kHz ...3/6 GHz	3.28	not SCPI
[:SOURce] :CORRection :CSET :DATA:POWer	– 40... + 6dB {, – 40... + 6dB}	3.28	not SCPI
[:SOURce] :CORRection :CSET :DELete	"Name"	3.28	not SCPI
[:SOURce] :FM1|2 [:DEViation]	0 to 10 MHz, SMT03/06: 0 to 20/40 MHz	3.29	
[:SOURce] :FM1|2 :EXTernal1|2 :COUPling	AC | DC	3.29	
[:SOURce] :FM1|2 :INTernal :FREQuency	400 Hz| 1 kHz| 3 kHz| 15 kHz / 0.1 Hz to 500 kHz / 0.1 Hz to 1 MHz	3.30	
[:SOURce] :FM1|2 :SOURce	INT | EXT1 | EXT2	3.30	
[:SOURce] :FM1|2 :STATe	ON | OFF	3.30	

Command	Parameter	Page	SCPI-Info
[:SOURce] :FREQuency :CENTer	5 kHz to1.5 GHz (SMT03/06:3/6 GHz)	3.31	
[:SOURce] :FREQuency [:CW | :FIXed]	5 kHzto1.5 GHz (SMT03/06: 3/6 GHz)	3.31	
[:SOURce] :FREQuency [:CW | :FIXed]:RCL	INCLude | EXCLude	3.31	
[:SOURce] :FREQuency :MANual	5 kHzto1.5 GHz (SMT03/06: 3/6GHz)	3.31	
[:SOURce] :FREQuency :MODE	CW|FIXed | SWEep	3.32	
[:SOURce] :FREQuency :OFFSet	– 50 to + 50 GHz	3.32	
[:SOURce] :FREQuency :SPAN	0 to 1.5 GHz	3.32	
[:SOURce] :FREQuency :STARt	5 kHz to 1.5 GHz (SMT03/06:3/6 GHz)	3.32	
[:SOURce] :FREQuency :STOP	5 kHz to 1.5 GHz (SMT03/06:3/6 GHz)	3.32	
[:SOURce] :FREQuency :STEP [:INCRement]	0 to 1 GHz	3.32	
[:SOURce] :ILS :STATe	ON | OFF	3.33	not SCPI
[:SOURce] :ILS :SOURce	INT2 | INT2, EXT	3.33	not SCPI
[:SOURce] :ILS :TYPE	GS|GSLobe | LOCalizer	3.34	not SCPI
[:SOURce] :ILS[:GS|GSLope] :MODE	NORM | ULOBe | LLOBe	3.34	not SCPI
[:SOURce] :ILS [:GS|GSLope] :COMid [:STATe]	ON | OFF	3.34	not SCPI
[:SOURce] :ILS [:GS|GSLope] :COMid :FREQuency	0.1 to 20 000 Hz	3.34	not SCPI
[:SOURce] :ILS [:GS|GSLope] :COMid :DEPTh	0 to 100 PCT	3.34	not SCPI
[:SOURce] :ILS [:GS|GSLope] :DDM [:DEPTh]	– 0.8 to + 0.8 PCT	3.35	not SCPI
[:SOURce] :ILS [:GS|GSLope] :DDM :DIRection	UP | DOWN	3.35	not SCPI
[:SOURce] :ILS [:GS|GSLope] :DDM :CURRent	– 685 to + 685 uA	3.35	not SCPI
[:SOURce}:ILS [:GS|GSLope] :DDM :LOGarithmic	– 999.9 to + 999.9	3.35	not SCPI
[:SOURce] :ILS [:GS|GSLope] :LLOBe [:FREQuency]	100 to 200 Hz	3.35	not SCPI
[:SOURce] :ILS [:GS|GSLope] :ULOBe [:FREQ]	60 to 120 Hz	3.35	not SCPI
[:SOURce] :ILS [:GS|GSLope] :PHASe	0 to 120 deg	3.35	not SCPI
[:SOURce] :ILS [:GS|GSLope] :PRESet		3.36	not SCPI
[:SOURce] :ILS [:GS|GSLope] :SODepth	0 to 100 PCT	3.36	not SCPI
[:SOURce] :ILS :LOCalizer :MODE	NORM | LLOBe | RLOBe	3.36	not SCPI
[:SOURce] :ILS :LOCalizer :COMid [:STATe]	ON | OFF	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :COMid :FREQuency	0.1 to 20 000 Hz	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :COMid :DEPTh	0 to 100 PCT	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :DDM [:DEPTh]	– 0.4 to + 0.4 PCT	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :DDM :DIRection	LEFT | RIGHT	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :DDM :CURRent	– 387 to + 387 uA	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :DDM :LOGarithmic	– 999.9 to + 999.9	3.37	not SCPI
[:SOURce] :ILS :LOCalizer :LLOBe [:FREQuency]	60 to 120 Hz	3.38	not SCPI
[:SOURce] :ILS :LOCalizer :RLOBe [:FREQuency]	100 to 200 Hz	3.38	not SCPI
[:SOURce] :ILS :LOCalizer :PHASe	0 to 120 deg	3.38	not SCPI
[:SOURce] :ILS :LOCalizer :PRESet		3.38	not SCPI
[:SOURce] :ILS :LOCalizer :SODepth	0 to 100 PCT	3.38	not SCPI

Command	Parameter	Page	SCPI-Info
[:SOURce] :MARKer1| 2 | 3 [:FSWeep] :AMPL	ON | OFF	3.39	
[:SOURce] :MARKer1| 2 | 3 [:FSWeep] :AOFF		3.39	
[:SOURce] :MARKer1| 2 | 3 [:FSWeep]:FREQuency	5 kHz to 1.5 GHz (SMT03/06:3/6 GHz)	3.39	
[:SOURce] :MARKer1| 2 | 3 [:FSWeep] [:STATe]	ON | OFF	3.40	not SCPI
[:SOURce] :MARKer1| 2 | 3 :PSWeep :AOFF		3.40	not SCPI
[:SOURce] :MARKer1| 2 | 3 :PSWeep :POWer	– 144 to + 16 dBm	3.40	not SCPI
[:SOURce] :MARKer1| 2 | 3 :PSWeep [:STATe]	ON | OFF	3.40	
[:SOURce] :MARKer :POLarity	NORMal | INVerted	3.40	not SCPI
[:SOURce] :MBEacon :STATe	ON | OFF	3.41	not SCPI
[:SOURce] :MBEacon [:MARKer] :FREQuency	400 Hz | 1300 Hz | 3000 Hz	3.41	not SCPI
[:SOURce] :MBEacon [:MARKer] :DEPTh	0 to 100 PCT	3.41	not SCPI
[:SOURce] :MBEacon :COMid [:STATe]	ON | OFF	3.41	not SCPI
[:SOURce] :MBEacon :COMid :FREQuency	0.1 to 20 000 Hz	3.41	not SCPI
[:SOURce] :MBEacon :COMid :DEPTh	0 to 100 PCT	3.41	not SCPI
[:SOURce] :PHASe [:ADJust]	– 360 to + 30 deg	3.42	
[:SOURce] :PHASe:REFerence		3.42	
[:SOURce] :PM1|2 [:DEViation]	– 360 to + 360 deg	3.43	
[SOURce] : PM1|2 :BANDwidth	100 kHz | 2 MHz	3.43	
[:SOURce] :PM1|2 :EXTernal1|2 :COUPling	AC | DC	3.43	
[:SOURce] :PM1|2 :INTernal :FREQuency	400 Hz| 1kHz| 3kHz| 15kHz 0.1 Hz to 500 kHz / 0.1Hz to1 MHz	3.44	
[:SOURce] :PM1|2 :SOURce	INT | EXT1|2 | INT, EXT1|2	3.44	
[:SOURce] :PM1|2 :STATe	ON | OFF	3.44	
[:SOURce] :POWer :ALC :BANDwidth	100 Hz | 500 kHz	3.45	
[:SOURce] :POWer :ALC :BANDwidth:AUTO	ON | OFF | ONCE	3.45	
[:SOURce] :POWer :ALC [:STATe]	ON | OFF	3.45	
[:SOURce]:POWer[:LEVel] [:IMMediate] [:AMPL]	– 144 to + 16 dBm	3.46	
[:SOURce]:POWer[:LEVel] [:IMMediate]:OFFSet	– 100 to 100 dB	3.46	
[:SOURce]:POWer[:LEVel] [:IMMediate]:RCL	INCLude | EXCLude	3.46	
[:SOURce] :POWer :LIMit [AMPLitude]	– 144 to + 16 dBm	3.46	
[:SOURce] :POWer :MANual	– 144 to + 16 dBm	3.46	
[:SOURce] :POWer :MODE	FIXed | SWEep	3.47	
[:SOURce] :POWer :STARt	– 144 to + 16 dBm	3.47	
[:SOURce] :POWer :STOP	– 144 to + 16 dBm	3.47	
[:SOURce] :POWer :STEP [:INCRement]	0.1 to 10 dB	3.47	

Command	Parameter	Page	SCPI-Info
[:SOURce] :PULM :EXTernal :IMPedance	50 Ohm | 10 kOhm	3.48	
[:SOURce] :PULM :INTernal :FREQuency	0.01176 Hz to 10 MHz	3.48	
[:SOURce] :PULM :POLarity	NORMal | INVerted	3.48	
[:SOURce] :PULM :SOURce	INTernal | EXTernal	3.48	
[:SOURce] :PULM :STATe	ON | OFF	3.48	
[:SOURce] :PULSe :DELay	40 ns to 1 s	3.49	
[:SOURce] :PULSe :DOUBle :DELay	60 ns to 1 s	3.49	
[:SOURce] :PULSe :DOUBle [:STATe]	ON | OFF	3.49	
[:SOURce] :PULSe :PERiod	100 ns to 85 s	3.49	
[:SOURce] :PULSe :WIDTh	20 ns to 1 s	3.49	
[:SOURce]:ROSCillator[:INTernal]:ADJust:STATe	ON | OFF	3.50	not SCPI
[:SOURce]:ROSCillator[:INTernal]:ADJust: VALue	0 to 4095	3.50	not SCPI
[:SOURce]:ROSCillator :SOURce	INTernal |EXTernal	3.50	
[:SOURce] :STEReo :STATe	ON | OFF	3.51	not SCPI
[:SOURce] :STEReo [:DEViation]	0 Hz to 100 kHz	3.51	not SCPI
[:SOURce] :STEReo :SIGNal	AUDio | ARI	3.51	not SCPI
[:SOURce]:STEReo:AUDio [:FREQuency]	0.1 Hz to 15 kHz	3.51	not SCPI
[:SOURce]:STEReo:AUDio :PREemphasis	OFF | 50 us | 75 us	3.52	not SCPI
[:SOURce]:STEReo:AUDio :MODE	RIGHt| LEFT| RELeft|REMLeft	3.52	not SCPI
[:SOURce] :STEReo :PILot :STATe	ON | OFF	3.52	not SCPI
[:SOURce] :STEReo :PILot [:DEViation]	0 Hz to 10 kHz	3.52	not SCPI
[:SOURce] :STEReo :PILot :PHASe	0 to 360 deg	3.52	not SCPI
[:SOURce] :STEReo :ARI [:DEViation]	0 Hz to 10 kHz	3.53	not SCPI
[:SOURce] :STEReo :ARI :TYPE	BK | DK	3.53	not SCPI
[:SOURce] :STEReo :ARI :BK:TYPE	A | B | C | D | E | F	3.53	not SCPI
[:SOURce] :SWEep :BTIMe	NORMal | LONG	3.54	not SCPI
[:SOURce] :SWEep [:FREQuency] :DWELl	10 ms to 5 s	3.54	not SCPI
[:SOURce] :SWEep [:FREQuency] :MODE	AUTO | MANual | STEP	3.54	not SCPI
[:SOURce] :SWEep [:FREQuency] :POINts	Number	3.55	not SCPI
[:SOURce] :SWEep [:FREQuency] :SPACing	LINear | LOGarithmic	3.55	not SCPI
[:SOURce] :SWEep [:FREQuency] :STEP [:LINear]	0 to 1 GHz	3.55	not SCPI
[:SOURce] :SWEep [:FREQuency] :STEP :LOG	0.01 to 50 PCT	3.55	not SCPI
[:SOURce] :SWEep :POWer :DWELl	10 ms to 5 s	3.56	not SCPI
[:SOURce] :SWEep :POWer :MODE	AUTO | MANual | STEP	3.56	not SCPI
[:SOURce] :SWEep :POWer :POINts	Number	3.56	not SCPI
[:SOURce] :SWEep :POWer :SPACing	LOGarithmic	3.56	not SCPI
[:SOURce] :SWEep :POWer :STEP :LOGarithmic	0 to 10 dBm	3.56	not SCPI

Command	Parameter	Page	SCPI-Info
[:SOURce] :VOR :STATe	ON | OFF	3.57	not SCPI
[:SOURce] :VOR :SOURce	INT2 | INT2, EXT	3.57	not SCPI
[:SOURce] :VOR :MODE	NORM | VAR | SUBCarrier | FMSubcarrier	3.58	not SCPI
[:SOURce] :VOR [:BANGle]	0 to 360 deg	3.58	not SCPI
[:SOURce] :VOR [:BANGle] :DIRection	FROM | TO	3.58	not SCPI
[:SOURce] :VOR :VAR [:DEPTh]	0 PCT to100 PCT	3.58	not SCPI
[:SOURce] :VOR :VAR :FREQuency	20 to 40 Hz	3.58	not SCPI
[:SOURce] :VOR :SUBCarrier :DEPTh	0 to 100 PCT	3.59	not SCPI
[:SOURce] :VOR :SUBCarrier [:FREQuency]	5 to 15 kHz	3.59	not SCPI
[:SOURce] :VOR :REFerence [:DEViation]	0 to 960 Hz	3.59	not SCPI
[:SOURce] :VOR :PRESet		3.59	not SCPI
[:SOURce] :VOR :COMid [:STATe]	ON | OFF	3.59	not SCPI
[:SOURce] :VOR :COMid :FREQuency	0.1 Hz to 20 kHz	3.59	not SCPI
[:SOURce] :VOR :COMid : DEPTh	0 to 100 PCT	3.59	not SCPI
:SOURce0|2 :FREQuency [:CW | :FIXed]	0.1Hz to 500kHz or 1MHz	3.60	
:SOURce0|2:FREQuency :MANual	0.1Hz to 500kHz or 1MHz	3.61	
:SOURce0|2:FREQuency :MODE	CW|FIXed | SWEep	3.61	
:SOURce2 :FREQuency :STARt	0.1Hzto500kHz / 0.1 Hzto1MHz	3.61	
:SOURce2 :FREQuency :STOP	0.1Hzto500kHz / 0.1 Hzto1MHz	3.61	
:SOURce0|2 :FUNCtion [:SHAPe]	SINusoid | SQUare | TRIangle | PRNoise | SAWTooth	3.61	
:SOURce2 :MARKer [:FSWeep] :AOFF		3.62	not SCPI
:SOURce2 :MARKer [:FSWeep] :FREQuency	0.1 Hz to 500 kHz	3.62	not SCPI
:SOURce2 :MARKer [:FSWeep] [:STATe]	ON | OFF	3.62	not SCPI
:SOURce2 :MARKer :POLarity	NORMal | INVerted	3.62	not SCPI
:SOURce2 :SWEep :BTIMe	NORMal | LONG	3.63	not SCPI
:SOURce2 :SWEep [:FREQuency] :DWELl	10 ms to 5 s	3.63	not SCPI
:SOURce2 :SWEep [:FREQuency] :MODE	AUTO | STEP	3.63	not SCPI
:SOURce2 :SWEep [:FREQuency] :POINts	Number	3.64	not SCPI
:SOURce2 :SWEep [:FREQuency] :SPACing	LINear | LOGarithmic	3.64	not SCPI
:SOURce2 :SWEep [:FREQuency] :STEP [:LIN]	0 to 500 kHz	3.64	not SCPI
:SOURce2 :SWEep [:FREQuency] :STEP :LOG	0.01 to 50 PCT	3.64	not SCPI
:STATus :OPERation [:EVENt]?		3.65	
:STATus :OPERation :CONDition?		3.65	
:STATus :OPERation :PTRansition	0 to 32767	3.65	
:STATus :OPERation :NTRansition	0 to 32767	3.65	
:STATus :OPERation :ENABle	0 to 32767	3.66	

Command	Parameter	Page	SCPI-Info
:STATus :PRESet		3.66	
:STATus :QUEStionable [:EVENt]?		3.66	
:STATus :QUEStionable :CONDition?		3.66	
:STATus :QUEStionable :PTRansition	0...32767	3.66	
:STATus :QUEStionable :NTRansition	0...32767	3.66	
:STATus :QUEStionable :ENABle	0...32767	3.66	
:STATus :QUEue [:NEXT]?		3.66	
:SYSTem :BEEPer :STATe	ON | OFF	3.68	
:SYSTem :COMMunicate :GPIB[:SELF] :ADDRess	1 to 30	3.67	
:SYSTem :COMMunicate :SERial :CONTrol :RTS	ON | IBFull | RFR	3.68	
:SYSTem :COMMunicate :SERial :BAUD	1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600 | 115200	3.68	
:SYSTem :COMMunicate :SERial :PACE	XON | NONE	3.68	
:SYSTem :ERRor?		3.68	
:SYSTem :KLOCk	ON | OFF	3.68	
:SYSTem :MODE	FIXed | MSEQuence	3.69	not SCPI
:SYSTem :MSEQuence :CATalog?		3.69	not SCPI
:SYSTem :MSEQuence :DELete	"Name of sequence"	3.69	not SCPI
:SYSTem :MSEQuence :DELete :ALL		3.69	not SCPI
:SYSTem :MSEQuence :DWELl	Number {,number}	3.69	not SCPI
:SYSTem :MSEQuence :FREE?		3.69	not SCPI
:SYSTem :MSEQuence :MODE	AUTO | STEP	3.690	not SCPI
:SYSTem :MSEQuence [:RCL]	1 to 50 {,1 to 50}	3.70	not SCPI
:SYSTem :MSEQuence [:RCL] :POINts?		3.70	not SCPI
:SYSTem :MSEQuence :SELect	"Name of sequence"	3.70	not SCPI

Command	Parameter	Page	SCPI-Info
:SYSTem :PRESet		3.70	
:SYSTem :PROTect1| 2| 3 [:STATe]	ON | OFF [,password]	3.70	not SCPI
:SYSTem :SECurity [:STATe]	ON | OFF	3.70	
:SYSTem :SERRor?		3.71	
:SYSTem :VERSion?		3.71	
:TEST :DIRect :ATTC	Subaddress {,hex data string}	3.72	
:TEST :DIRect :LFGENA	Subaddress {,hex data string}	3.73	
:TEST :DIRect :LFGENB	Subaddress {,hex data string}	3.73	
:TEST :DIRect :MGEN	Subaddress {,hex data string}	3.73	
:TEST :DIRect :OPU1M	Subaddress {,hex data string}	3.73	
:TEST :DIRect :OPU3M	Subaddress {,hex data string}	3.73	
:TEST :DIRect :OPU6M	Subaddress {,hex data string}	3.73	
:TEST :DIRect :PUM	Subaddress {,hex data string}	3.73	
:TEST :DIRect :TSYN	Subaddress {,hex data string}	3.73	
:TEST :DIRect :ROSC	Subaddress {,hex data string}	3.73	
:TEST :RAM?		3.73	
:TEST :ROM?		3.73	
:TEST :BATTery?		3.73	
:TRIGger1|2 [:SWEep] [:IMMediate]		3.74	not SCPI
:TRIGger1|2 [:SWEep] :SOURce	SINGle | EXTernal | AUTO	3.75	not SCPI
:TRIGger :MSEQuence [:IMMediate]		3.75	not SCPI
:TRIGger :MSEQuence :SOURce	SINGle | EXTernal | AUTO	3.75	not SCPI
:TRIGger :PULSe :SOURce	EXTernal | AUTO	3.76	not SCPI
:TRIGger :PULSe :SLOPe	POSitive | NEGative	3.76	not SCPI
:TRIGger :SLOPe	POSitive | NEGative | EITHer	3.76	not SCPI
:UNIT :ANGLe	DEGRee | DEGree | RADian	3.76	
:UNIT :POWer	DBM | DBW | DBMW DBUW | DBV | DBMV | DBUV | V	3.76	

Annex D

Programming Examples

The examples explain the programming of the instrument and can serve as a basis to solve more complex programming tasks.

QuickBasic has been used as programming language. However, the programs can be translated into other languages.

1. Including IEC-Bus Library for QuickBasic

```
REM ----------- Include IEC-bus library for quickbasic ---------------
'$INCLUDE: 'c:\qbasic\qbdecl4.bas'
```

2. Initialization and Default Status

The IEC bus as well as the settings of the instrument are brought into a defined default status at the beginning of every program. Subroutines `"InitController"` and `"InitDevice"` are used to this effect.

2.1. Initiate Controller

```
REM ---------------------- Initiate controller ----------------------
REM InitController
iecaddress% = 28                                  'IEC-bus address of the instrument
CALL IBFIND("DEV1", generator%)                   'Open port to the instrument
CALL IBPAD(generator%, iecaddress%)               'Inform controller on instrument address
CALL IBTMO(generator%, 11)                        'Response time to 1 sec
REM ************************************************************************
```

2.2. Initiate Instrument

The IEC-bus status registers and instrument settings of the SMT are brought into the default status.

```
REM ---------------------- Initiate instrument ----------------------------
REM InitDevice
CALL IBWRT(generator%, "*cls")                    'Reset status register
CALL IBWRT(generator%, "*rst")                    'Reset instrument
CALL IBWRT(generator%, "OUTPUT ON")               'Switch on RF output
REM ************************************************************************
```

3. Transmission of Instrument Setting Commands

Output frequency, output level and AM modulation are set in this example. The settings correspond to the sample setting for first users in manual control. By analogy to the step width setting of the rotary knob, the step width is additionally set for the alteration of the RF frequency in the case of UP and DOWN.

```
REM ---------------------- Instrument setting commands ------------------------
CALL IBWRT(generator%, "FREQUENCY 250E6")              'RF frequency 250 MHz
CALL IBWRT(generator%, "POWER 10")                     'Output power -10 dBm
CALL IBWRT(generator%, "AM 80")                        'AM with modulation index of 80%
CALL IBWRT(generator%, "AM:INTERNAL1:FREQUENCY 3KHZ")  'Modulation frequency 3 kHz
CALL IBWRT(generator%, "AM:SOURCE INT1")               'Modulation source LF generator 1
CALL IBWRT(generator%, "FREQUENCY:STEP 12500")         'Step width RF frequency 12.5 kHz
REM ************************************************************************
```

4. Switchover to Manual Control

```
REM ---------------------- Switch instrument over to manual control -------------
CALL IBLOC(generator%)                                  'Set instrument to Local state
REM ************************************************************************
```

5. Reading out Instrument Settings

The settings made in example 3 are read out here. The abbreviated commands are used.

```
REM --------------- Reading out instrument settings ----------------------
RFfrequency$ = SPACE$(20)                    'Provide text variables with 20 characters
CALL IBWRT(generator%, "FREQ?")              'Request frequency setting
CALL IBRD(generator%, RFfrequency$)          'Read value

RFlevel$ = SPACE$(20)                        'Provide text variables with 20 characters
CALL IBWRT(generator%, "POW?")               'Request level setting
CALL IBRD(generator%, RFlevel$)              'Read value

AMmodulation depth$ = SPACE$(20)             'Provide text variables with 20 characters
CALL IBWRT(generator%, "AM?")                'Request setting of modulation depth
CALL IBRD(generator%, AMmodulation depth$)   'Read value

AMfrequency$ = SPACE$(20)                    'Provide text variables with 20 characters
CALL IBWRT(generator%, "AM:INT1:FREQ?")      'Request modulation frequency setting
CALL IBRD(generator%, AMfrequency$)          'Read value

Step width$ = SPACE$(20)                     'Provide text variables with 20 characters
CALL IBWRT(generator%, "FREQ:STEP?")         'Request step width setting
CALL IBRD(generator%, step width$)           'Read value

REM ---------------------- Display values on the screen --------------
PRINT "RF frequency:       "; RFfrequency$,
PRINT "RF level:           "; RFlevel$,
PRINT "AM modulation depth:"; AMmodulation depth$,
PRINT "AM frequency:       "; AMfrequency$,
PRINT "Step width:         "; step width$
REM ************************************************************************
```

6. List Management

```
REM ---------------------------- Example of list management ------------------------
CALL IBWRT(generator%, "SYST:MSEQ:SELECT "+CHR$(34)+"MSEQ1"+CHR$(34))
                                          'Select list "MSEQ1". is generated if necessary
CALL IBWRT(generator%, "SYST:MSEQ 1,3,7,2,5,7,7")
                                                'Fill recall list with values
CALL IBWRT(generator%, "SYST:MSEQ:DWELL 0.2")       '200ms per recall
CALL IBWRT(generator%, "TRIGGER:MSEQ:SOURCE AUTO")
                                       'Permanently repeat memory sequence automatically
CALL IBWRT(generator%, "SYST:MODE MSEQ")      'Switch over instrument to memory sequence mode
REM ************************************************************************
```

7. Command synchronization

The possibilities for synchronization implemented in the following example are described in Section 3.7.6, Command Order and Command Synchronization.

```
REM ---------------------- Examples of command synchronization ---------------------
REM Command ROSCILLATOR:SOURCE INT has a relatively long execution time
REM (over 300ms). It is to be ensured that the next command is only executed
REM when the reference oscillator has settled.

REM First possibility: Use of *WAI ------------------------------------------
CALL IBWRT(generator%, "ROSCILLATOR:SOURCE INT; *WAI; :FREQUENCY 100MHZ")

REM Second possibility: Use of *OPC? ----------------------------------------
OpcOk$ = SPACE$(2)                          'Space for *OPC? - Provide response
CALL IBWRT(generator%, "ROSCILLATOR:SOURCE INT; *OPC?")
REM ----------- here the controller can service other instruments ---------------------
CALL IBRD(generator%, OpcOk$)                           'Wait for "1" from *OPC?

REM Third possibility: Use of *OPC
REM In order to be able to use the service request function in conjugation with a National
REM Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes"
REM by means of IBCONF.
CALL IBWRT(generator%, "*SRE 32")     'Permit service request for ESR
CALL IBWRT(generator%, "*ESE 1")      'Set event-enable bit for operation-complete bit
ON PEN GOSUB OpcReady                 'Initialization of the service request routine
PEN ON
CALL IBWRT(generator%, "ROSCILLATOR:SOURCE INT; *OPC")
REM Continue main program here
STOP                                   'End of program

OpcReady:
REM As soon as the reference oscillator has settled, this subroutine is activated
REM Program suitable reaction to the OPC service request.
ON PEN GOSUB OpcReady                 'Enable SRQ routine again
RETURN
REM ************************************************************************
```

8. Service Request

The service request routine requires an extended initialization of the instrument in which the respective bits of the transition and enable registers are set.
In order to be able to use the service request function in conjugation with a National Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes" by means of IBCONF.

```
REM -------- Example of initialization of the SRQ in the case of errors -------------
CALL IBWRT(generator%, "*CLS")                  'Reset status reporting system
CALL IBWRT(generator%, "*SRE 168")              'Permit service request for
                                                 STAT:OPER-, STAT:QUES- and ESR register
CALL IBWRT(generator%, "*ESE 60")               'Set event-enable bit for
                                                 command, execution, device-dependent
                                                 and query error
CALL IBWRT(generator%, "STAT:OPER:ENAB 32767")  'Set OPERation enable bit for all
                                                 events
CALL IBWRT(generator%, "STAT:OPER:PTR 32767")   'Set appropriate OPERation Ptransition
                                                 bits
CALL IBWRT(generator%, "STAT:OPER:ENAB 32767")  'Set questionable enable bits for all
                                                 events
CALL IBWRT(generator%, "STAT:OPER:PTR 32767")   'Set appropriate questionable
                                                 Ptransition bits
ON PEN GOSUB Srq                               'Initialization of the service request routine
PEN ON
REM Continue main program here
STOP                                            'End of program
```

A service request is then processed in the service request routine.
Note: The variables userN% and userM% must be pre-assigned usefully.

```
Srq:
REM ------------------- Service request routine ----------------------------
DO
   SRQFOUND% = 0
   FOR I% = userN% TO userM%                          'Poll all bus users
        ON ERROR GOTO nouser                          'No user existing
        CALL IBRSP(I%, STB%)                          'Serial poll, read status byte
        IF (STB% AND 64) > 0 THE                     'This instrument has bits set in the STB
            SRQFOUND% = 1
            IF (STB% AND 16)  > 0 THEN GOSUB Outputqueue
            IF (STB% AND 4)   > 0 THEN GOSUB Failure
            IF (STB% AND 8)   > 0 THEN GOSUB Questionablestatus
            IF (STB% AND 128) > 0 THEN GOSUB Operationstatus
            IF (STB% AND 32)  > 0 THEN GOSUB Esrread
        END IF
nouser:
   NEXT I%
LOOP UNTIL SRQFOUND% = 0
ON ERROR GOTO error handling
ON PEN GOSUB Srq: RETURN                              'Enable SRQ routine again;
                                                      'End of SRQ routine
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

```
REM ---------------- Subroutines for the individual STB bits -------------
```

```
Outputqueue:                                          'Reading the output buffer
Message$ = SPACE$(100)                                'Make space for response
CALL IBRD(generator%, Message$)
PRINT "Message in output buffer :"; Message$
RETURN
Failure:                                               'Read error queue
ERROR$ = SPACE$(100)                                   'Make space for error variable
CALL IBWRT(generator%, "SYSTEM:ERROR?")
CALL IBRD(generator%, ERROR$)
PRINT "Error text :"; ERROR$
RETURN


Questionablestatus:                                  'Read questionable status register
Ques$ = SPACE$(20)                                   'Preallocate blanks to text variable
CALL IBWRT(generator%, "STATus:QUEStionable:EVENt?")
CALL IBRD(generator%, Ques$)
IF (VAL(Ques$) AND 128) > 0 THEN PRINT "Calibration ?"    'Calibration is questionable
IF (VAL(Ques$) AND 1) > 0 THEN PRINT "Voltage ?"          'Output level is questionable
RETURN

Operationstatus:                                     'Read operation status register
Oper$ = SPACE$(20)                                   'Preallocate blanks to text variable
CALL IBWRT(generator%, "STATus:OPERation:EVENt?")
CALL IBRD(generator%, Oper$)
IF (VAL(Oper$) AND 1) > 0 THEN PRINT "Calibration"
IF (VAL(Oper$) AND 2) > 0 THEN PRINT "Settling"
IF (VAL(Oper$) AND 4) > 0 THEN PRINT "Ranging"
IF (VAL(Oper$) AND 8) > 0 THEN PRINT "Sweeping"
IF (VAL(Oper$) AND 32) > 0 THEN PRINT "Wait for trigger"
RETURN


Esrread:                                             'Read event status register
Esr$ = SPACE$(20)                                    'Preallocate blanks to text variable
CALL IBWRT(generator%, "*ESR?")                      'Read ESR
CALL IBRD(generator%, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN PRINT "Operation complete"
IF (VAL(Esr$) AND 4) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 8) > 0 THEN PRINT "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 32) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 64) > 0 THEN PRINT "User request"
IF (VAL(Esr$) AND 128) > 0 THEN PRINT "Power on"
RETURN
REM ************************************************************************


REM -------------------------- Error routine -------------------------------
Error handling:
PRINT "ERROR"                                        ' Output error message
STOP                                                 ' Stop software
```

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