3 Remote Control of Instrument via IEC Bus

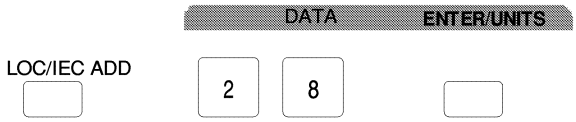
The SMY is fitted with an IEC-bus interface as a standard. The interface corresponds to the IEC 625-1/IEEE 488/1 standard.

In addition, standard IEC 625-2/IEEE 488.2 (IEEE standard codes, formats, protocols and common commands) has been considered. This includes a description of the data transmission formats and common commands.

The command set of the SMY is upward compatible with SMX, SMG, SMH, SMGU and SMHU (as far as the instruments have comparable functions).

3.1 Brief Instructions for Simple Applications

- Connect controller and SMY using the IEC bus cable.
- Set device address 28 on the SMY:



- Device settings (examples)

  The first command sent via the IEC bus interface sets the SMY to the remote status indicated by the REMOTE LED being illuminated.

BASIC command (Rohde & Schwarz BASIC)	Effect on the SMY
`IECOUT 28, "*RST"`	Instrument in basic status
`IECOUT 28, "RF 155.623458MHZ"`	Frequency (RF) is set
`IECOUT 28, "LEVEL -11.5DBM"`	Level (into 50 Ω) is set
`IECOUT 28, "AF 12.5KHZ; FM:INT 40KHZ"`	Modulation frequency (AF) and internal frequency modulation are set.

- Following actuation of the LOC/IEC ADD key, the SMY abandons the remote status and is ready for manual operation again.

3.2 Setting the Device Address

In the LOCAL mode (REMOTE LED off), the IEC bus address can be displayed and set using key LOC/IEC ADD (cf. the page preceding as well). The IEC bus address remains stored also at power-off of the instrument. The address range covers 0 to 30. The instrument is factory-set to address 28.

The address is the decimal equivalent of bits 1 to 5 of the talker or listener address. This form is also used for the IEC bus commands of the controllers.

3.3 Device Messages

Device messages are transmitted on the data lines of the IEC bus, with the attention line being High (not active). The ASCII code (ISO 7-bit code) is used (cf. Table 3-8).

- The messages from the controller to the SMY (programming messages) are referred to as commands in the following.

  They include the following four groups:

  * Device-specific setting commands
  * Device-specific data request commands
  * Common, device-independent setting commands (Common commands in accordance with IEEE 488.2)
  * Common, device-independent data request commands (Common queries in accordance with IEEE 488.2)

  The tables listed in the following specify all these commands. Their respective syntax is described in section 3.3.6.

- The messages from the SMY to the controller (response messages) are specified in combination with their associated data request commands. As to their syntax, refer to section 3.3.7.

3.3.1 Device-specific Setting Commands

All the instrument functions to be set via the SMY keyboard can also be obtained via the IEC bus. The instrument performance initiated via setting commands fully corresponds to that obtained by keyboard entries.

The shortest notation possible is shown in bold print.

Table 3-1

Header	Numeric Value	Permis-sible Units	Default Unit	Explanation
AF	Value	HZ KHZ MHZ	Hz	Modulation frequency
AF:VAR_STEP	Value	HZ KHZ MHZ	Hz	AF variation step width
AF:ON	-	-	-	Switch on AF to stored value [1]
AF:OFF	-	-	-	Switch off AF [1]
ALC:AUTO	-	-	-	Select level control bandwidth automatically
ALC:FIXED	-	-	-	Switch off level control
ALC:NARROW	-	-	-	Level control bandwidth is narrow
ALC:NORMAL	-	-	-	Switch on level control
ALC:WIDE	-	-	-	Level control bandwidth is wide
AM **AM:I**NTERNAL **AM:E**XTERNAL:**A**C **AM:E**XTERNAL:**D**C	Value	PCT	PCT (%)	Switch on AM with modulation source selected and set modulation depth 2)

Header	Numeric Value	Permis-sible Units	Default Unit	Explanation
AM:INTERNAL **AM:E**XTERNAL**:A**C **AM:E**XTERNAL**:D**C	-	-	-	As above, but set stored value of modulation depth
AM:DUAL**:A**C **AM:D**UAL**:D**C	Value	PCT	PCT (%)	Switch on two-tone AM with internal and external source and set modulation depth
AM:DUAL**:A**C **AM:D**UAL**:D**C	-	-	-	As above, but set stored value of the modulation depth.
AM:OFF	-	-	-	Switch off AM
AM:VAR_STEP	Value	PCT	PCT (%)	Variation step width of AM modulation depth
ATTENUATOR**:F**IXED	-	-	-	Non-interrupting level setting (Switch on special function 1)
ATTENUATOR**:N**ORMAL	-	-	-	Normal level setting function (switch off special function 1)
BLANK**:ON** **B**LANK**:OFF**	-	-	-	Level blanking (pulse modulation) on Level blanking (pulse modulation) off
BLANK**:I**NVERTED **B**LANK**:N**ORMAL	-	-	-	BLANK polarity inverted BLANK polarity normal
DECREMENT**:AF** **DEC**REMENT**:AM** **DEC**REMENT**:FM** **DEC**REMENT**:L**EVEL **DEC**REMENT**:PHM** **DEC**REMENT**:RF**	-	-	-	Corresponds to variation using the rotary knob. Entry of step width using VAR_STEP for the respective parameter.
FM **FM:I**NTERNAL **FM:E**XTERNAL**:A**C **FM:E**XTERNAL**:D**C	Value	HZ KHZ MHZ	Hz	Switch on FM with modulation source selected and set FM deviation 3)
FM:INTERNAL **FM:E**XTERNAL**:A**C **FM:**EXTERNAL**:D**C	-	-	-	As above, but set stored value of deviation
FM:DUAL**:A**C **FM:D**UAL**:D**C	Value	HZ KHZ MHZ	Hz	Switch on two-tone FM with external and internal source and set deviation.
FM:DUAL**:A**C **FM:D**UAL**:D**C	-	-	-	As above, but set stored value of the deviation.
FM:OFF	-	-	-	Switch off FM

Header	Numeric Value	Permis-sible Units	Default Unit	Explanation
FM:VAR_STEP	Value	HZ KHZ MHZ	Hz	Variation step width of FM deviation
HEADER**:ON** 5) **HEA**DER**:OFF**	- -	- -	- -	Messages from the SMY to the controller are sent with or without header
INCREMENT**:AF** **INC**REMENT**:AM** **INC**REMENT**:FM** **INC**REMENT**:L**EVEL **INC**REMENT**:PHM** **INC**REMENT**:RF**	-	-	-	Corresponds to rotary knob variation. Entry of step width with VAR_STEP for each parameter.
LEVEL	Value	DBM DBUV V MV UV	dBm	Level
LEVEL**:E**MF	Value	DBUV V MV UV	dBµV	Level EMF
LEVEL**:V**AR_STEP	Value	DB	dB	Variation step width of the level
LEVEL**:OFF**	-	-	-	Switch off output signal
LEVEL**:ON**	-	-	-	Switch on output signal to stored value of level again
LEVEL**:CORRECT_I**NDEX	Value	-	-	Level correction: Select correction value index, associated frequency is set (see Service Manual)
LEVEL**:CORRECTION**	Value	DB	dB	Entering correction value and storing it (see Service Manual)
LEVEL**:CORRECTION:ON** **L**EVEL**:CORRECTION:OFF**	-	-	-	Special function: Level Correction on/off
PHM: **PHM:I**NTERNAL **PHM:E**XTERNAL	Value	RAD	RAD	Switch on phase modulation with modulation source selected and set FM deviation. 3)
PHM:INTERNAL **PHM:E**XTERNAL	-	-	-	As above, but set stored value of the deviation.
PHM:DUAL	Value	RAD	RAD	Switch on two-tone phase modulation with internal and external source and set deviation.
PHM:DUAL	-	-	-	As above, but set stored value of the deviation.
PHM:VAR_STEP	Value	RAD	RAD	Variation step width of the PHM deviation
PHM:OFF	-	-	-	Switch off phase modulation
PRESET	-	-	-	Set device to basic status (see Section "Instrument Preset")

Header	Numeric Value	Permis-sible Units	Default Unit	Explanation
RECALL	Value	-	-	Call a stored device setting (same effect as *RCL)
REFERENCE_OSCILLATOR: **COR**RECTION	Value	-	-	Enter correction value for internal reference frequency
REFERENCE_OSCILLATOR: **COR**RECTION:**STO**RE	-	-	-	Store correction value for internal reference frequency
REFERENCE_OSCILLATOR:**I**NTERNAL	-	-	-	Internal reference frequency
REFERENCE_OSCILLATOR:**E**XTERNAL	-	-	-	External reference frequency
RF	Value	HZ KHZ MHZ GHZ	Hz	Frequency
RF:START **:STO**P **:STE**P	Value		Hz kHz MHz GHz	Start frequency for RF-sweep Stop frequency for RF-sweep Step size for linear sweep
RF:VAR_STEP	Value	HZ KHZ MHZ	Hz	Variation step width of the frequency
SEQUENCE	-	-	-	Sequence of stored device settings 4)
SPECIAL_FUNCTION	Value	-	-	Switching on/off a special function by means of the respective code (see Table 2-1)
STORE	Value	-	-	Store device setting (same effect as *SAV)
SWP:ON **:A**UTO **:R**ESET **:OFF**				Switch on sweep Switch off sweep
TALK_TERMINATOR:**N**L_END 5) **TA**LK_TERMINATOR:**C**R_NL_END	- -	- -	- -	Terminator in talk mode: New Line + End or Carriage Return + New Line + End
TEST:**P**OINT	Value	-	-	Selection of an internal test point (1 to 16) to measure the test voltage. Switches on special function "Diagnostic Test Point" (see Service Manual).
TEST:**OFF**	-	-	-	Switches off special function "Diagnostic Test Point"
TIME**[:RF**_SWP**]**	Value	-	s ms	Step time for selected sweep mode

1) These commands are only required if the AF output (connector AF INT) is to be used.

2) If the modulation source (INTERNAL, EXTERNAL or DUAL) is not specified,
- selection is internal if AM was not switched on before,
- the previous source is retained unchanged if AM was switched on.

3) If the modulation source (INTERNAL, EXTERNAL or DUAL) is not specified,
- selection is internal if FM/PHM was not switched on before,
- the previous source is retained unchanged if FM/PHM was switched on.

4) The 1st memory location in the sequence is defined by the *RCL command.

Example: Command sequence:	*RCL 47	SEQ	SEQ	SEQ	SEQ	...
Memory location:	47	48	49	50	47	...

5) Default setting following switch-on of operating voltage or command *RST.

3.3.2 Device-specific Data Request Commands and Messages Sent by the SMY

Table 3-2

Data Request (The shortest-possible notation is marked by bold print)	**Message the SMY sends in talker mode**						**Unit** (is not sent)	**Explanation**
	Header	Numeric value						
		Number of signs	Polarity sign	Decimal point	Exponent	Example		
AF?	AF	8	-	x	x	15.0E+3 ↑	Hz	Modulation frequency
	AF:OFF	0	-	-	-	- *)	-	
AF:VAR_STEP?	AF:VAR	6	-	-	-	25 ↑↑↑↑	Hz	AF variation step width
ALC?	ALC:AUTO:NOR	8	-	-	-	-	-	State of the level control loop
	ALC:NARR:NOR	8	-	-	-	-	-	
	ALC:WIDE:NOR	8	-	-	-	-	-	
	ALC:AUTO:FIX	8	-	-	-	-	-	
	ALC:NARR:FIX	8	-	-	-	-	-	
	ALC:WIDE:FIX	8	-	-	-	-	-	
AM?	AM:INT	4	-	x	-	37.5	PCT (%)	AM modulation depth
	AM:E:A	4	-	x	-	18.0	PCT (%)	
	AM:E:D	4	-	x	-	33.5	PCT (%)	
	AM:D:A	4	-	x	-	99.0	PCT (%)	
	AM:D:D	4	-	x	-	1.0 ↑	PCT (%)	
	AM:OFF	0	-	-	-	- *)	-	
AM:VAR_STEP?	AM:VAR	4	-	x	-	10.0	PCT (%)	Variation step width of AM modulation depth
ATTENUATOR?	ATT:FIX	0	-	-	-	-	-	Special function "Non-interrupting level setting" is switched on (FIX) or off (NOR)
	ATT:NOR	0	-	-	-	-	-	
ATTEN:CONT?	ATT:CONT	4	-	x	-	8.5 ↑	dB	Electronic distortion with ATT:FIX no numerical value with ATT:NOR
	ATT:NOR	0	-	-	-	-	-	

Data Request (The shortest-possible notation is marked by bold print)	**Message the SMY sends in talker mode**						**Unit** (is not sent)	**Explanation**
	Header	Numeric value						
		Number of signs	Polarity sign	Decimal point	Exponent	Example		
ERRORS?	ERRORS	2 per value	-	-	-	0 ↑ 4, 5,51 ↑ ↑	-	Error codes, max. 13 error codes, 0 means no errors (see Table and Section "Error Handling") 1)
FM?	FM:INT FM:E:A FM:E:D FM:D:A FM:D:D FM:OFF	8 8 8 8 8 0	- - - - - -	x x x x x -	x x x x x -	13.50E+3 0.800E+3 1.250E+3 10.00E+6 1.500E+6 - *)	Hz Hz Hz Hz Hz -	FM deviation
FM:VAR_STEP?	FM:VAR	8	-	x	x	0.100E+3	Hz	Variation step width of FM deviation
LEVEL?	LEVEL LEVEL:OFF	6 0	x -	x x	- -	-105.3 - *)	dBm -	Level
LEVEL:CORRECT_INDEX?	LEVEL: CORRECT_INDEX	3				38 ↑	-	Index of the level correction value
LEVEL:CORRECTION?	LEVEL: CORRECTION	6	x	x	-	+1.26 ↑	dB	Level correction value
LEVEL:EMF?	LEVEL:EMF LEVEL:OFF	6 0	x -	x -	- -	+120.0 - *)	dBµV	Level as EMF
LEVEL:VAR_STEP?	LEVEL:VAR	5	-	x	-	20.0 ↑	dB	Variation step width of level
PHM?	PHM:INT PHM:EXT PHM:DUA PHM:OFF	8 8 8 0	- - - -	x x x -	x x x -	1.000E+0 0.050E+0 100.0E+0 - *)	RAD RAD RAD -	Deviation of phase modulation
REFERENCE_OSCILLATOR?	REF:INT REF:EXT	0 0	- -	- -	- -	- -	- -	Reference frequency internal or external
REFERENCE_OSCILLATOR: CORRECTION?	REFERENCE_ OSCILLATOR: CORRECTION	1 to 4						Correction value for reference frequency

Data Request (The shortest-possible notation is marked by bold print)	**Message the SMY sends in talker mode**						**Unit** (is not sent)	**Explanation**
	Header	Numeric value						
		Number of signs	Polarity sign	Decimal point	Exponent	Example		
RF?	RF	14	-	x	x	1000.000000E+6	Hz	Frequency
RF:START**?**	RF	14	-	x	x	1000.000000E+6	Hz	Start frequency
RF:STOP**?**	RF	14	-	x	x	1000.000000E+6	Hz	Stop frequency
RF:STEP**?**	RF	14	-	x	x	1000.000000E+6	Hz	Step width
RF:VAR_STEP**?**	RF:VAR	14	-	x	x	2500.00E+3 ↑↑↑	Hz	Variation step width of frequency
SPECIAL_FUNCTION**?**	SPECIAL	3 per value	-	-	-	0 1, 5,112, ↑↑ ↑↑	-	Codes of special functions switched on; 0 means no special function 1)
SWP?	RF	14	-	x	x	OFF	-	Query of sweep mode (AUTO/OFF/RESET)
TEST**:P**OINT**?**	TEST:POINT TEST:OFF	2 0	- -	- -	- -	15 *)	- -	Test point
TEST**:V**OLTAGE**?**	TEST:VOLT TEST:OFF	6 0	x -	x -	- -	+4.51 ↑ *)	V -	Voltage at internal test points (see service manual)
TIME[**:RF**_SWP]**?**	RF	14	-	x	x	1000.000000E+6	s	Step time

1) With these commands, the message from the SMY can contain several numeric values, they are separated from one another by means of commas (,).
The number of characters indicated refers to one numeric value each.

Notes:
- x means present
- - means not present
- ↑ means Space
- *) A number is not transmitted with OFF; with the header switched off, only the delimiter or terminator appears.

3.3.3 Common, Device-independent Setting Commands (Common Commands in Accordance with IEEE 488.2)

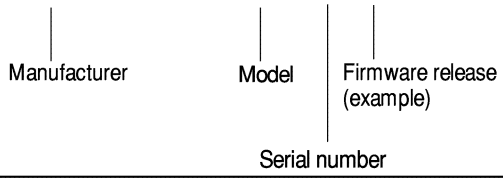
Table 3-3

Command	Number, range	Meaning
*CLS	-	Clear Status Sets the Event Status Register (ESR) to zero. The mask registers of the Service Request function (ESE and SRE) are not changed. A current Service Request message is only reset if not caused by a message in the output buffer or if *CLS is at the start of a command line. *)
*ESE	0 ... 255	Event Status Enable The Event Status Enable mask register is set to the specified value interpreted as a decimal number *).
*HDR	0 or 1	Header "0" suppresses the header in the device response to future queries. The numeric value is read out exclusively. The command is equivalent to the command HEADER:OFF: "1" activates the header in the device response to future queries. The device response can be reused as a setting command. The command is equivalent to the command HEADER:ON:
*OPC	-	Operation Complete Sets bit 0 (Operation Complete) in the Event Status register if all previous commands have been processed (see Section "Timing of command Processing and Synchronization").
*PSC	0 or 1	Power On Clear Flag If 1: The Service Request Enable mask register (SRE) and the Event Status Enable mask register (ESE) are also cleared when the instrument is switched on. If 0: The above-mentioned registers retain their contents even when the instrument is switched off and on. This enables a Service Request when the instrument is switched on. The Power On Clear Flag can be set with special function 17 and cleared with special function 18 (manual operation).
*RCL	0 ... 50	Recall Call a stored instrument setting (cf. Section "Store-Recall")
*RST	-	Reset Acts like the PRESET key (see Section "Instrument Preset") and → switches to messages with header (like command HEADER:ON), → sets the terminator in talker mode to "NEW Line + End", Does not change the status of the IEC-bus interface, the set IEC-bus address, and the registers of the Service Request function.
*SAV	1 ... 50	Save Store instrument setting (cf. Section "Store-Recall")
*SRE	0 ... 255	Service Request Enable The Service Request Enable mask register is set to the specified value interpreted as a decimal number *).
*WAI	-	Wait to Continue Interrupts command processing until all preceding commands have been executed (cf. Section "Command Processing Sequence and Synchronization")

*) See section "Service Request and Status Register"

3.3.4 Common, Device-independent Data Request Commands (Common Queries in Accordance with IEEE 488.2)

Table 3-4

Data request command	Message read out			Meaning
	Header	Data value		
		Digit number	Range	
*ESE?	*ESE	3	0...255	Event Status Enable Query The contents of the Event Status Enable mask register is output in decimal.
*ESR?	*ESR	3	0...255	Event Status Register Query The contents of the Event Status Register is output in decimal and the register is then set to zero.
*IDN?	-	26	(alpha-numeric)	Identification Query The following identification text is transmitted via the IEC bus (always without header) as a reply to the command *IDN?. ROHDE&SCHWARZ,SMY01,0,1.00 
*HDR?	-	1	0 or 1	Header Query This command returns the current state of the header setting.
*OPC?	*OPC	1	1	Operation Complete Query Message "*OPC 1" or only "1" (depending on the status of the header flag) is entered into the output buffer and bit 4 (message available) in the status byte is set if all previous commands have been processed (see Section "Timing of Command Processing and Synchronization").
*OPT?	-	1...2	(alpha-numeric)	Option Query Transmits information on an option possibly fitted via the IEC bus (always without header). B1: If option SMY-B1, Reference Oscillator, is fitted. 0: If no option is fitted.
*PSC?	*PSC	1	0 or 1	Power On Clear Query To read the status of the Power On Clear Flag, see *PSC in Table 3-3
*SRE?	*SRE	3	0...255	Service Request Enable Query The contents of the Service Request Enable mask register is output in decimal.
*STB?	*STB	3	0...255	Status Byte Query The contents of the status byte is output in decimal.
*TST?	*TST	2	0...67	Self-test Query A ROM, EEPROM and RAM test is performed. The result can be obtained from the data value of the output message: 0: no error 6: ROM error 7: RAM error 8: EEPROM error Example with several errors: 67: ROM and RAM error

3.3.5 Examples

(The Rohde & Schwarz BASIC commands have been used. The IEC bus address of the SMY has been taken to be 28).

1) Basic setting

```
IECOUT 28, "*RST"        or
IECOUT 28, "PRESET"
```

2) Device identification via IEC bus:

```
10 IECTERM 10                (input terminator: new line)
20 IECOUT 28, "*IDN?"
30 IECIN 28, A$
40 PRINT A$
```

3) RF setting

```
IECOUT 28, "RF 123.456MHz"    or
IECOUT 28, "RF 123.456E6"     or
IECOUT 28, "RF 123456000"
```

4) RF level setting

All the possibilities as outlined effectuate the same setting.

```
IECOUT 28, "LEVEL 12.5DBM"    or
IECOUT 28, "LEV 12.5"         or
IECOUT 28, "LEVEL 119.5DBUV"  or
IECOUT 28, "LEVEL 0.944V"     or
IECOUT 28, "Level 944mV"      or
IECOUT 28, "LEVEL 944MV"      or
IECOUT 28, "LEVEL:EMF 1.888V"
```

5) Non-interrupting variation of RF level between 2µV and 20 µV in steps of 0.2 dB; stop at each step for 10 ms

```
10 IECOUT 28, "LEVEL 20uV; ATTEN:FIXED; LEVEL 2uV; LEVEL:VAR 0.2"
20 FOR I% = 1 TO 100
30 IECOUT 28, "INCREMENT:LEVEL"
40 HOLD 10
50 NEXT I%
```

6) Modulation frequency (AF) and internal frequency modulation setting

```
IECOUT 28, "AF 12.5KHZ; FM:INT 40KHZ"
```

7) External amplitude modulation setting (AC coupling)

```
IECOUT 28, "AM:EXT:AC 35.5"
```

8) Storing complete instrument setting in memory location 45

```
IECOUT 28, "*SAV 45"
```

9) Switching off the modulation again

```
IECOUT 28, "FM:OFF; AM:OFF"
```

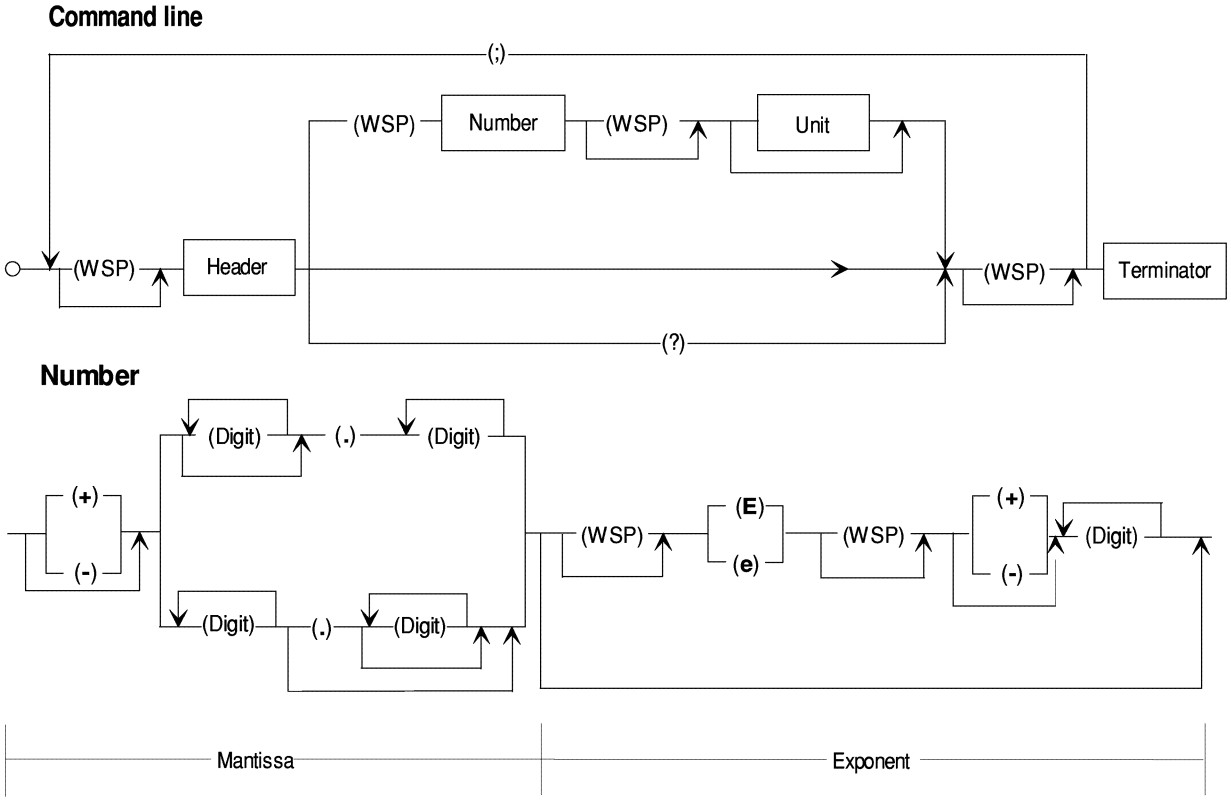
10) Reading current RF

```
10 IECTERM 10          (input terminator "new line")
20 IECOUT 28, "RF?"
30 IECIN 28, A$
40 PRINT A$
```

11) Recalling instrument setting stored in step 8)

```
IECOUT 28, "*RCL 45"
```

3.3.6 Syntax of Setting Commands and Data Request Commands (Programming Messages)



WSP (white space): One or several characters with ASCII code 0 to 9 or 11 to 32 decimal, especially space

Fig. 3-1 Syntax diagram of a command line (programming message)

Each command line must end with a terminator. Permissible terminators accepted by the SMY without switchover are:

- New line (ASCII code 10 decimal)
- End (EOI line active) together with:
  - the last useful character of the command line, or
  - the character "New Line", or
  - the semicolon (;)

Since the carriage return character (ASCII code 13 decimal) is permissible as an ineffectual filler before the terminator, also the combination of carriage return + new line is permissible.

A command line may require more than one line on the screen of the controller because it is only limited by the terminator. Most IEC bus controllers automatically append the terminator to the useful text.

Also, a command line may contain several commands (program message units) to be separated by semicolons (;).

The possibility of abbreviation described in IEC 625-2/IEEE 488.2 with several commands in one line,

Example: `:TEST:POINT 11; :TEST:VOLTAGE?`

abbreviated as

`:TEST:POINT 11; VOLTAGE?`

is not possible with the SMY.

A command may consist of the following parts:

- Header only

  Example: FM:OFF

- Header and question mark

  Example: FM?

  This combination requests the SMY to provide the required data in an output buffer in order to have them transferred via the IEC bus as soon as the SMY has been addressed as a talker.

- Header and number

  Example: FM 55E3 or FM 55 kHz

  Header and number are to be separated by at least one space (ASCII-Code 32 decimal). In the case of device-specific commands, the number can be supplemented by a subsequent unit.

Lower-case letters are permissible, being equivalent to the corresponding upper-case letters. Thus, units can be used in the usual form (e.g. dBm) instead of the upper-case notation (e.g. DBM), which is permissible as well.

Additional spaces may be inserted at the following positions:

- before a header,
- between header and number,
- between mantissa and exponent of the number,
- between number and unit,
- before and after a comma (,) and semicolon (;),
- before the terminator.

Headers of device-specific commands

The headers are mostly identical with or similar to the respective key designation, which results in easy-to-read (self-documenting) programs.

Two equivalent command notations are possible for special functions:

- Header 'SPECIAL_FUNCTION' and special function code (as with manual operation)

  Example: SPECIAL 1;

- Special commands with higher documentation value for each individual special function

  Example: ATTENUATOR:FIXED,

Some special functions (two-tone modulation, level emf) have no meaning in IEC bus operation. The appropriate settings are directly selected in the respective commands:

AM:DUAL:AC, FM:DUAL:DC, PHM:DUAL, LEVEL:EMF

The headers can be abbreviated at will by omitting characters at the end (e.g.: LE or LEV instead of LEVEL). The shortest-possible notations are shown in the command tables in bold print. However, so as to obtain easy-to-read programs, the headers should not be shortened too much.

Many headers consist of several parts separated by colons (:) (e.g.: "ATTENUATOR:FIXED"). Each part of the header may individually be abbreviated in this case (e.g.: "ATT:F"). According to IEEE 488.2 standard, these headers may also comprise a leading colon (e.g.: ":ATT:F") which, however, does not influence the effects of the commands with the SMY.

Some headers include the underline character (ASCII code 95 decimal) to improve readability. It must be written like the letters, but always lies in the range that can be omitted by abbreviation [1)].

Numeric value

Only decimal values are allowed as numbers, the following notations being permissible:

- With or without polarity sign
  e.g. 5, +5, -5

- With or without decimal point, any position of the decimal point being permissible.
  e.g. 1.234, -100.5, .327

- With or without exponent to base 10, "E" or "e" are used as the exponent character.
  e.g. .451, 451E-3, +4.51e-2

  Note: Specification of the exponent alone (e.g.: E-3) is not permissible, 1E-3 is correct.

- The exponent is permissible with or without sign, additional spaces are also permissible.
  e.g. 1.5E+3, 1.5E-3, 1.5E3

- Leading zeroes are permissible in mantissa and exponent.
  e.g. +0001.5, -01.5E-03

1) The underline character is generated using the "←" key with R&S controllers PCA and PUC.

- The length of the number, including the exponent, may amount to up to 20 characters. The number of digits of the mantissa and exponent is only limited by this condition. Digits which exceed the resolution of the device are rounded up or down; they are always considered for the order of magnitude (power of ten).
  e.g. 150000000, 0.00000032

All setting commands that can be assigned a number are indicated in the number column in Table 3-1.

Unit

Device-specific setting commands permit to append a unit to the number (e.g.: 125.3 kHz or 125.3E3 Hz). The permissible units are listed in Table 3-1 (table of device-specific setting commands). They can be written in lower-case or upper-case letters. If no unit is used, the default unit is valid, see Table 3-1.

3.3.7 Data Request and Syntax of the Messages Sent by the SMY to the Controller (Response Messages)

The SMY transmits messages via the IEC bus if it:

1) has been requested by one or several [1)] data requests with a question mark (query messages) to provide data in its output buffer, and

2) indicates by setting bit 4 in the status byte (MAV - message available) that the required data are now present in the output buffer (see also Section "Service Request and Status Register") and

3) has been addressed as a talker
   (BASIC command `"IECIN adr, stringvariable"`)

It must be noted that the command line with the data requests must be transmitted immediately before the talker is addressed; the output buffer is cleared if a further command line is entered in between.

If the SMY is immediately addressed as a talker following the data request without observing point 2 above, the bus handshake is blocked until the requested data are available. This method is meaningful with the SMY since only a few milliseconds are required to execute a data request (see the following program example).

Program example:

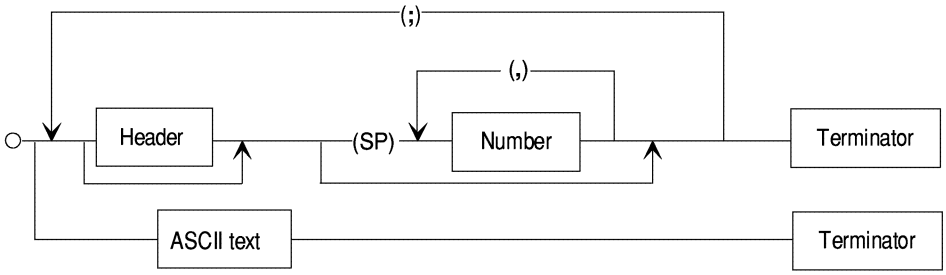
Read current frequency (R&S BASIC; address of the SMY: 28).

```
10 IECTERM 10              Input terminator: new line
20 IECOUT 28, "HEADER:ON"  Set messages with header
30 IECOUT 28, "RF?"        Data request RF frequency
40 IECIN 28, F$            Reading talker addressing and data
50 PRINT F$                RF frequency indicated on controller, e.g.: "RF 1000.000000E+6"
```

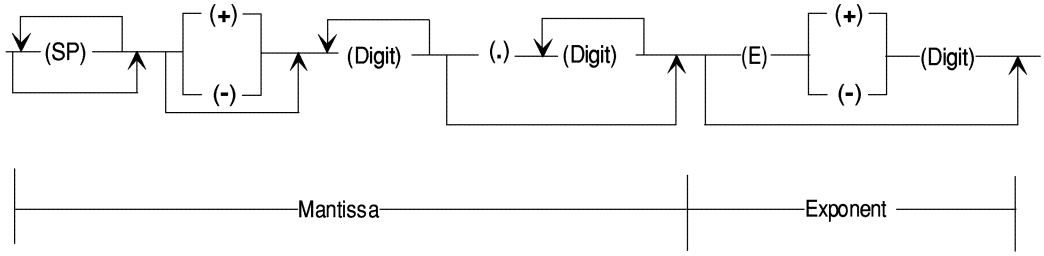
[1)] Several data requests must be within one command line if the SMY is to transmit all the relevant messages at a time.

The syntax of messages sent by the SMY is shown in Fig. 3-2. The syntax is similar to that for commands received by the SMY.

Output message line



Number



SP: Space (ASCII code 32 decimal)

ASCII text: Response to commands *IDN? and *OPT? (cf. Table 2-10)

Fig. 3-2 Syntax diagram of the messages sent by the SMY

* New line (ASCII code 10 decimal) together with End (EOI line active) is used as the terminator. It is also possible to set Carriage return + new line + end (using command TALK_TERMINATOR:CR_NL_END).

* Commands "HEADER:ON" or "HEADER:OFF" can be used to select whether only the numbers or the header and the numbers are to be transmitted.

  The setting "Header and numbers" can also be selected by

  - the command *RST (reset) or
  - by switching on the operating voltage.

The setting "Header and numbers" enables the messages transmitted by the SMY to be returned to the SMY as unmodified commands. It is then possible to read a setting entered via the keyboard, store it in the controller and repeat it later via the IEC bus.

* If the SMY receives several data requests, it also returns several messages within one line which are separated by semicolons (;).

* Headers and numbers are always separated by a space.

* The headers only consist of upper-case letters and the characters ":".

* The syntax of the numeric values is described in Fig. 3-2. Only decimal numbers are transmitted. The length of the numbers and examples for each message can be taken from Tables 3-2 and 3-3.

* Several numbers can be transmitted in response to the commands SPECIAL_FUNCTION? and ERRORS?, which are separated by commas (,).

* The messages sent by the SMY contain no units. In the case of physical quantities, the numbers are referred to the basic unit specified in Table 3.2.

3.3.8 Alternative Commands and Notations

To obtain a high degree of compatibility with regard to Rohde & Schwarz instruments of earlier production dates, the SMY features alternative commands and also accepts notations of a different syntax. The following table specifies both possibilities with the SMY, which are identical as to their effect.

Table 3-5

Preferred notation (in accordance with IEEE 488.2)	**Alternative notation**
*SAV value *RCL value	**ST**ORE value **REC**ALL value
HEADER:ON HEADER:OFF	***HDR** 1 ***HDR** 0
Unit percent: PCT	%
Write units as indicated in the command tables	Units may be abbreviated like headers: **Hz**, **K**Hz, **M**Hz, **G**Hz, **P**CT, **V**, **M**V, **U**V, **DBM**, **DBU**V, **D**B, **R**AD
Delimiter between commands: semicolon (;)	Comma (,)
Delimiter between header and numeric value: space	No delimiter necessary

3.3.9 Multiple Settings

If several IEC-bus commands are sent in a line, they will be executed in the logically correct sequence, but the modules are not activated until the end of the line when the shape of the output signal has been determined. The modules are set in the optimal sequence with regard to the best possible overlapping of the possible wait times, and the output signal switches to the desired state. This method avoids signal interference and saves setting time.

The following example shows this (Rohde&Schwarz BASIC):

```
IEC OUT 28, "*RST"
IEC OUT 28, "LEVEL 0DBM; RF 500MHZ; AM:EXT 50; FM:INT 50KHZ"
```

After the PRESET setting, the SMY next processes the entire line without affecting the output signal. Contrary to the order in the command line, the synthesizer is set first due to its settling time (the synthesizer's RF and FM are set at the same time). After the AF generator, the output section is set, whereby the level correction for the changed frequency, the new level and the activated AM are taken care of in one computer run.

The computing times for the AF generator and the output section, as well as the wait times due to the switching attenuator, overlap completely with the settling time of the synthesizer. The total setting time corresponds to the setting time of the slowest parameter, which in this case is the RF.

In a similar way, the level of the instrument can be varied:

```
IEC OUT 28, "LEVEL 10DBM; ATTEN:FIX; LEVEL 0DBM"
```

When this line has been processed, the SMY directly outputs a level of 0 dBm with non-interrupting setting possibilities up to +10 dBm, without a level of 10 dBm first being present at the output.

If desired, the hardware setting can be forced in a command line with *wai or *opc.

3.4 Interface Messages

Interface messages (according to IEC 625-1 and IEEE 488 standard) are transmitted to the SMY on the data lines with the attention line being active (Low).

3.4.1 Universal Commands

The universal commands are in the code range 10 to 1F hex. (see Table 3-8). They are effective, without previous addressing, on all devices connected to the bus.

Table 3-6

Command	BASIC command with R&S controllers	Effect on SMY
DCL (Device Clear)	IECDCL	Aborts processing of commands just received and sets the command processing software to a defined initial status. Clears the output buffer The device setting is not changed.
LLO (Local Lockout)	IECLLO	The LOC key is inhibited.
SPE (Serial Poll Enable)	IECSPE [1)]	Ready for Serial Poll.
SPD (Serial Poll Disable)	IECSPD [1)]	End of Serial Poll.

1) The BASIC command "IECSPL addr, status" contains the commands "IECSPE" and IECSPD", additionally reads the status of the device with address "addr" and stores it in the integer variable "status".

3.4.2 Addressed Commands

The addressed commands are in the code range 00 to 0F hex. (Table 3-8). They only act on devices addressed as Listeners (by the BASIC command "IECLAD addr").

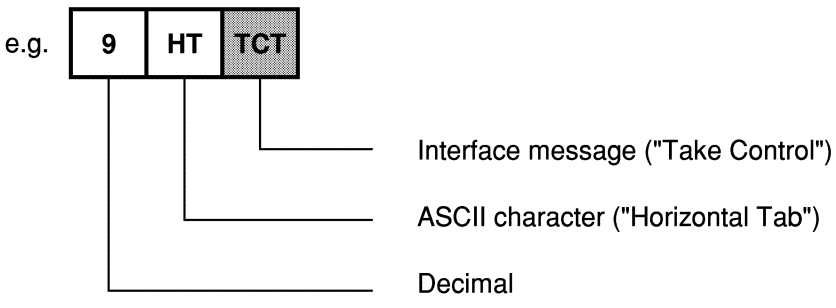
Table 3-7

Command	BASIC command with R&S controllers	Effect on SMY
SDC (Selected Device Clear)	IECSDC	Aborts processing of commands just received and sets the command processing software to a defined initial status. Clears the output buffer The device setting is not changed.
GTL (Go To Local)	IECGTL	Switchover to local status (manual operation).

Table 3-8 ASCII/ISO- and IEC character set

Control						Numbers Symbols				Upper case				Lower case			
0	NUL		16	DLE		32	SP	48	0	64	@	80	P	96	‘	112	p
1	SOH	GTL	17	DC1	LLO	33	!	49	1	65	A	81	Q	97	a	113	q
2	STX		18	DC2		34	"		2	66	B	82	R	98	b	114	r
3	ETX		19	DC3		35	#	51	3	67	C	83	S	99	c	115	s
4	EOT	SDC	20	DC4	DCL	36	$	52	4	68	D	84	T	100	d	116	t
5	ENQ	PPC	21	NAK	PPU	37	%	53	5	69	E	85	U	101	e	117	u
6	ACK		22	SYN		38	&	54	6	70	F	86	V	102	f	118	v
7	BEL		23	ETB		39	´	55	7	71	G	87	W	103	g	119	w
8	BS	GET	24	CAN	SPE	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	TCT	25	EM	SPD	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF		26	SUB		42	*	58	:	74	J	90	Z	106	j	122	z
11	VT		27	ESC		43	+	59	;	75	K	91	[	107	k	123	{
12	FF		28	FS		44	,	60	<	76	L	92	\	108	l	124	|
13	CR		29	GS		45	-	61	=	77	M	93	]	109	m	125	}
14	SO		30	RS		46	.	62	>	78	N	94	^	110	n	126	~
15	SI		31	US		47	/	63	?	79	O	95	-	111	o	127	DEL
Addressed Commands			Universal Commands			Listener Addresses				Talker Addresses				Secondary addresses and commands			

Key for control:



3.5 Service Request and Status Register

Fig. 3-3 shows the status registers and the links between them. In line with IEEE 488.2, the status byte (STB) and its associated mask register (SRE), which are also present with older instruments, have been supplemented by the event status register (ESR) and its mask register, event status enable (ESE).

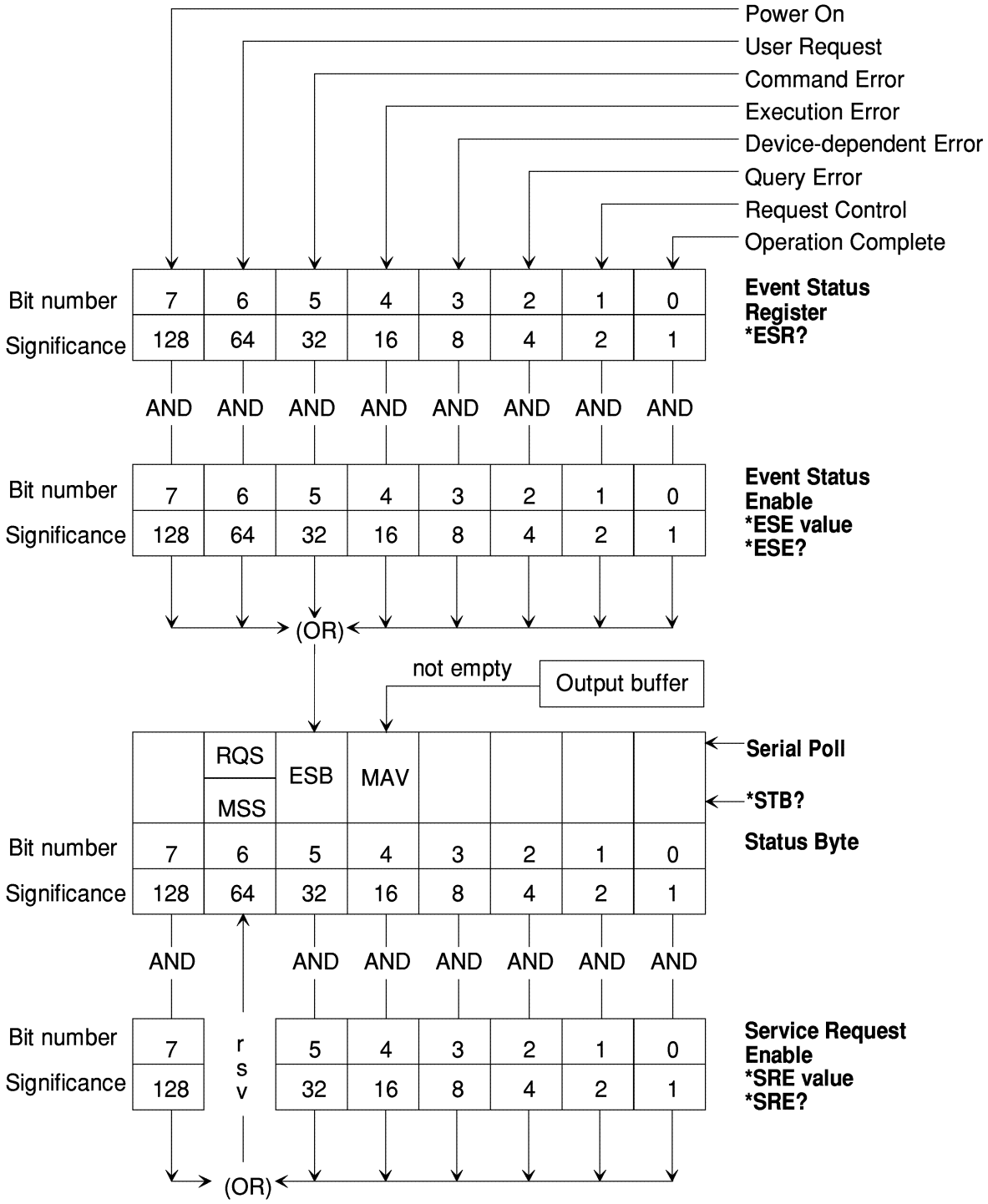


Fig. 3-3 Status registers

A bit is set to 1 in the **event status register (ESR)** with certain events (e. g. fault, ready message); see Table 3-9.

These bits remain set until cleared by one of the following conditions:

* by reading the event status register (by command *ESR?)
* the command *CLS
* the power supply is switched on (the Power On bit is set afterwards, however).

Table 3-9 Meaning of the event status register

Bit 7	**Power On** is set when the SMY is switched on or if the AC supply is restored after a failure.
Bit 6	**User Request** The operator can set this bit by activating special function 19 in the local status via the keyboard and thus initiate a Service Request with a corresponding setting of the mask registers. This function is useful if test sequences require manual operation as well as control via the IEC bus.
Bit 5	**Command Error** This is set if one of the following errors is detected during analysis of the received commands: • Syntax error (error 50), • Illegal unit (error 52), • Illegal header (error 53), • A number has been combined with a header for which a subsequent numerical value is not envisaged (error 50, e. g. INCREMENT:RF 10 KHZ). In addition, the corresponding error code is displayed and stored internally just as when entering via the keyboard.
Bit 4	**Execution Error** is set if one of the following errors has been detected during execution of the received commands • A number is outside the permissible range (for the respective parameter) (error 51). • The command AF: OFF has been sent although AM or FM/PHM was still switched on (error 54). • A parameter is to be varied although it is not switched on (error 56). • The FM deviation or the RF cannot be set because the FM deviation is too large for the selected RF (error 55). Attention must be paid to the correct sequence if both the FM deviation and the RF are changed. This error may briefly occur if the sequence is incorrect and if the deviation values are large and acceptance of a parameter value is then prevented. • FM DC center frequency calibration was called without first switching on FM DC. • Overrange/underrange settings (error 70 to 72 and 75 to 77, see Table 2-3). The setting is nevertheless executed in these cases.
Bit 3	**Device-dependent Error** is set • if function errors occur (errors 1 to 15, see Table 2-3) or • if the external modulation signal is outside the tolerance range (Error 73 and 74).
Bit 2	**Query Error** This bit is set: • If the controller wishes to read data from the SMY but a data request (query message) has not been previously output. • If the data present in the output buffer of the SMY have not been read out and a new command line has been sent to the SMY instead. In this case the output buffer is cleared. • If the requested data exceed the capacity of the output buffer (approx. 200 characters).
Bit 1	**Request Control** Not used in SMY.
Bit 0	**Operation Complete** This bit is set by the command "*OPC" if all previous commands have been processed and executed.

Using the **event status enable mask register (ESE)**, the user can select the bits in the event status register which also set the sum bit ESB (bit 5 in the status byte) through which a service request can be triggered. The sum bit is only set if at least one bit in the ESR and the corresponding bit in the ESE are set to 1. The sum bit is automatically cleared again if the above condition is no longer satisfied, e. g. if the bits in the ESR have been cleared by reading the ESR or if the ESE has been changed.

The event status enable mask register is written by the command "*ESE value" ("value" is the contents in decimal) and can be read again using the command *ESE?. It is set to zero when the power supply is switched on if the Power On Clear flag is 1 (*PSC 1).

It is not changed by other commands or interface messages (DCL, SDC).

Only the following bits are used in the **status byte (STB)**:

Bit No.	Bus Line	Designation	Meaning
4	DIO 5	MAV	Message Available Indicates that a message is present in the output buffer which can be read. The bit is 0 if the output buffer is empty.
5	DIO 6	ESB	Sum bit of the event status register
6	DIO 7	RQS MSS	Request Service (read by Serial Poll) Master Status Summary (read by *STB?)

It should be noted that the bits of the status registers are numbered 0 to 7 in accordance with IEEE 488.2, but the bus data lines are designated DIO 1 to DIO 8.

Using the **service request enable mask register (SRE)**, the user can determine whether the RQS bit of the status byte is also set when the MAV or ESB bit switches from 0 to 1 and if a Service Request is sent to the controller by activating the SRQ line. The following possibilities exist since each bit in the service request enable mask register is assigned to the corresponding bit in the status byte:

Contents of the SRE (decimal)	Bit no. set in the SRE	Effect
0	--	No Service Request
16	4	Service Request when the MAV bit is set (message in output buffer)
32	5	Service Request when the ESB bit is set (at least 1 bit set in the event status register and not masked)
48	4+5	Service Request in both of the above cases

The service request enable mask register (SRE) is written with the command "*SRE value" ("value" is the contents in decimal) and can be read again using the command "*SRE?". It is set to zero when the power supply is switched on if the Power On Clear flag is 1, and the Service Request function of the SMY is thus inhibited. The SRE mask register is not changed by other commands or interface messages (DCL, SDC).

Several devices can trigger a Service Request simultaneously, the open collector drivers cause an OR function on the SRQ line. The controller must read the status bytes of the devices to identify which device has triggered the Service Request. A set RQS bit (bit 6/DIO 7) indicates that the device is transmitting a Service Request.

The status byte of the SMY can be read in the following manner:

* **By the command "*STB?"**

  MSS (Master Status Summary) is transferred as bit 6. MSS is 1 if at least 1 bit in the status byte is set and the corresponding bit in the Service Request Enable mask register (SRE) is also set.

  The contents of the status byte - including MSS bit - is output in decimal. It is, however, not possible to detect a set MAV bit in this manner. The status byte is not modified by reading and a possibly present Service Request is not cleared.

* **By a Serial Poll**

  (With R&S-BASIC: IECSPL adr, status.)
  The contents is transferred in binary form as *one* byte. RQS is sent as bit 6 (Request Service). RQS is set if the addressed device has caused the Service Request. The RQS bit is subsequently set to zero and the Service Request becomes inactive, the other bits of the status byte are not changed.

  When MSS is cleared, RQS is also cleared, e. g. by setting the Service Request Enable mask register (SRE) to zero.

The status byte is cleared:

* **By *CLS at the start of a command line**

  At the start of a command line, the output buffer (and thus the MAV bit) is cleared. *CLS clears the event status register (and thus the ESB bit). This again clears the MSS or RQS bit and the Service Request message.

* **By handling the entries in the status byte**

With the MAV bit set:	By reading the contents of the output buffer	(`IECIN addr, AS`)
With the ESB bit set:	By reading the event status register	(`IECOUT addr,"*ESR?"` `IECIN addr, ES`)

  This also clears the MSS or RQS bit in the status byte and the Service Request.

Program example:

(Rohde & Schwarz BASIC has been used; the IEC bus address of the SMY has been taken to be 28).

In the program example, a service request is triggered on detection of an error, the type of error being determined from the event status register.

```
10 IECTERM 10 ——————————————— Input terminator: new line
20 ON SRQ GOSUB 100
30 IECOUT28, "*CLS; *ESE 60; *SRE 32"
.                 └───────────┘——— for Service Request in the event of error
.
.
.
100 REM---------------------------------
110 REM SERVICE REQUEST ROUTINE
120 REM---------------------------------
130 IECSPL 28, S%
140 IF (S% AND 64) = 0 THEN GOTO 300 ——— SRQ not from SMY
150 IECOUT28, "*ESR?"
160 IECIN 28, E$ ——————————————— Read Event Status Register
170 E% =VAL(E$)
180 IF (E% AND 32) <>0 THEN PRINT "COMMAND ERROR"
190 IF (E% AND 16) <>0 THEN PRINT "EXECUTION ERROR")
200 IF (E% AND 8)  <>0 THEN PRINT "DEVICE-DEPENDENT ERROR"
210 IF (E% AND 4)  <>0 THEN PRINT "QUERY ERROR"
220 ON SRQ GOSUB 100
230 RETURN
240 REM---------------------------------
300 REM Service Request not from SMY
.
.
380 ON SRQ GOSUB 100
390 RETURN
```

3.6 Command Processing Sequence and Synchronization

The signal generator features a maximal transmission rate of 8300 characters/sec. for receiving data. The commands received are first stored temporarily in an input buffer which can accomodate a maximum of 81 to 121 characters. Once the terminator has been received, the commands are processed in the sequence in which they were sent. During this time, the IEC bus can be used for communication with other devices.

Command lines which exceed the capacity of the input buffer are processed in several parts. The bus is occupied during this time.

Commands *OPC and *OPC? (Operation Complete) are used as feedback information indicating the time when processing of the received commands is terminated and the output signal of the SMY has settled on the new values:

- ***OPC** sets bit 0 in the event status register,

- ***OPC?** provides message 1 in the output buffer which sets bit 4 (MAV) in the status byte,

if all preceding commands have been completed.

If the service request enable register (SRE) (and the ESE for command *OPC) are appropriately set, both command *OPC and command *OPC? can trigger a service request.

Command *OPC? permits a more simplified method of synchronization, see the program example outlined below!

These methods of synchronization are recommended if another device which requires the settled signal of the SMY is to be requested to start a measurement via the IEC bus.

Following ***WAI,** the SMY does not process the new commands until all preceding commands have been completely executed and the output signal of the SMY has exactly settled. Thus, overlapping command execution, which may occur only in the following exceptional cases, can be avoided.

With the majority of the commands, no additonal settling time is required for the output signal following command processing. The only exceptions are the switching of the mechanical attenuator initiated by commands LEVEL, INCREMENT:LEVEL, DECREMENT:LEVEL, *RST, PRESET, *RCL, RECALL, as well as the switching on of the amplitude modulation (AM) and the switching over of the reference frequency (REFERENCE_OSCILLATOR:INTERNAL/EXTERNAL).

When commands *OPC, *OPC? or *WAI are used, this additional settling time then required is automatically taken into consideration.

Program example:

The program example shows an easy method of synchronization. The command *OPC? generates a message as soon as the preceding commands have been executed and the output signal of the SMY has settled. Since this message is to be read in line 30, the bus handshake is halted until the message is available. (Rohde & Schwarz BASIC; address of the SMY: 28)

```
10 IECTERM 10                                          input terminator: new line
20 IECOUT 28, "RF 123 MHZ; LEV 11.5DBM; *OPC?"
30 IECIN 28, A$                                        A$ is not used further
40 REM  The SMY has executed the
45 REM  commands in line 20.
50 REM  Its output signal can, e.g.,
55 REM  be used for measurements.
.    .
.    .
```

3.7 Error Handling

Any errors detected by the SMY in connection with operation via the IEC bus are indicated by setting a bit (bit 2, 4 or 5) in the event status register (see Table 3-9). Functional errors are signalled correspondingly by setting bit 3. These bits remain set until the ESR is read or cleared by the command *CLS. This is in line with the IEEE 488.2 standard and enables triggering of a service request and program-controlled evaluation of the type of error (see program example as outlined at the end of section 3.5).

More detailed information is contained in the error codes which, just like with manual operation, are read out in the right-hand display. The display is overwritten by the next command and is therefore not always visible with IEC bus operation. It is therefore possible to have these error codes read out via the IEC bus using command **'ERRORS?'**. If several errors are detected, the error codes are separated by commas. Code ' 0' indicates that no errors are currently detected. Input errors (codes 50 to 57) are cleared if a new command line is sent to the SMY. All other errors are indicated as long as the cause for error has not been removed.

3.8 Resetting Device Functions

The following table comprises the various commands and events which reset individual device functions.

Effect	Event					
	Switching on the operating voltage		DCL, SDC (Device Clear, Selected Device Clear)	Commands		
	Power On Clear Flag			*CLS	*RST	PRESET
	0	1				
Basic instrument setting (s. Section "Preset")	--	--	--	--	yes	yes
Set event status register ESR to zero	yes	yes	--	yes	--	--
Set mask registers ESE and SRE to zero	--	yes	--	--	--	--
Clear output buffer	yes	yes	yes	2)	--	--
Clear Service Request	yes	1)	--	2)	--	--
Message from SMY: setting "HEADER:ON", talker terminator new line + end	yes	yes	--	--	yes	--
Reset command processing and input buffer	yes	yes	yes	--	--	--

1) Yes, but "Service Request on Power On" is possible.

2) Yes if the command is at the beginning of a command line.

3.9 Local/Remote Switchover

The device is in the local mode (manual operation) when switched on.

If the SMY is addressed by a controller as a listener (by means of R & S BASIC commands IECOUT or IECLAD), it enters the remote status (remote control) in line with the standard and remains in this mode even after data transfer has been completed. This is indicated by the REMOTE-LED. Except for the LOC/IEC ADD key, all control elements of the front panel are disabled.

There are two possibilities to return to local:

* By the addressed command GTL (Go to Local) from the controller.

* By pressing the LOC/IEC ADD key. Data output from the controller to the SMY should be stopped before pressing the LOC/IEC ADD key or the SMY will immediately enter the remote status again. The function of the LOC/IEC ADD key can be inhibited from the controller by sending the universal command LLO (Local Lockout).

The remaining device settings are not modified by a change in status from "remote" to "local" or vice versa.

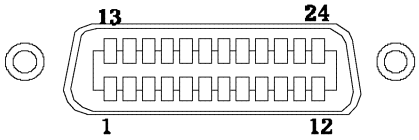
3.10 Interface Function

According to the IEC 625-1 standard, devices with remote control via the IEC bus can be equipped with different interface functions. The table lists the interface functions which apply to the SMY.

Abbreviation according to IEC 625-1	Interface functions
SH1	Source Handshake complete ability
AH1	Acceptor Handshake complete ability
L4	Listener function, complete ability, unaddressing if MTA
T6	Talker function, complete ability, ability to reply to serial poll, unaddressing if MLA
SR1	Service Request complete ability
PPO	Parallel Poll function, not available
RL1	Remote/local switchover function complete ability
DC1	Device Clear complete ability
DT0	Device Trigger not available
C0	Controller function, not available

3.11 IEC-Bus Connector and Bus Lines

The IEC bus connector is positioned at the rear panel of the instrument. The SMY is equipped with a 24-contact socket in compliance with the IEEE 488 standard.



Connector	Signal	Connector	Signal
1	Data I/O 1	13	Data I/O 5
2	Data I/O 2	14	Data I/O 6
3	Data I/O 3	15	Data I/O 7
4	Data I/O 4	16	Data I/O 8
5	EOI	17	REN
6	DAV	18	Ground (for DAV)
7	NRFD	19	Ground (for NRFD)
8	NDAC	20	Ground (for NDAC)
9	IFC	21	Ground (for IFC)
10	SRQ	22	Ground (for SRQ)
11	ATN	23	Ground (for ATN)
12	Shield	24	Logic ground

Fig. 3-4 Pin assignment

The standardized interface contains three groups of bus lines

1) **Data bus** with 8 lines DIO 1 to DIO8.

   Data transmission is bit-parallel and byte-serial and the characters can be transmitted in ISO 7-bit code (ASCII code).

   DIO 1 represents the least significant bit and DIO 8 the most significant bit.

2) **Control bus** with 5 lines.

   This is used to transmit control functions:

   ATN (Attention)
   becomes active Low during transmission of addresses, universal commands or addressed commands to the connected devices.

   REN (Remote Enable)
   enables device to be switched to remote control.

   SRQ (Service Request)
   enables a connected device to send a Service Request to the controller by activating this line.

   IFC (Interface Clear)
   is activated by the controller in order to set the IEC interfaces of the connected devices to a defined initial status.

EOI (end or Identify)
can be used to identify the end of data transmission and is used with a parallel poll.

3) **Handshake bus** with 3 lines.

This is used to control the data transmission sequence.

NRFD (Not Ready For Data)
an active Low on this line signals to the talker/controller that one of the connected devices is not ready to accept data.

DAV (Data Valid)
is activated by the talker/controller shortly after a new data byte has been applied to the data bus.

NDAC (Not Data Accepted)
is held at active Low by the connected device until the device has accepted the data present on the data bus.

More detailed information, such as the data transmission timing, can be obtained from the IEC 625-1 standard.

4 Maintenance and Troubleshooting

4.1 Maintenance

Under normal operating conditions, regular maintenance is not required. How to replace the lithium battery is described in the service manual.

4.1.1 Cleaning the Exterior of the Instrument

To clean the exterior of the instrument, use a soft, non-fraying dust cloth.

Attention! *Never use solvents such as thinner, acetone or other similar substances, as they may damage the lettering on the front panel and/or plastic components.*

4.1.2 Storage

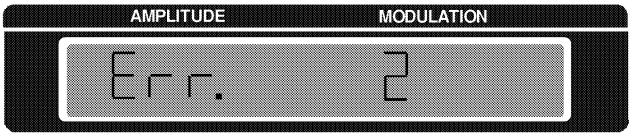
The storage temperature range of the instrument is -40 to +70 °C. If the instrument is to be stored for any length of time, protect it from dust.

4.2 Function Check (Self-test)

4.2.1 Self-test

The instrument performs a self-test after being switched on and while it is in operation. The contents of ROM are checked during the power-up process. The RAM contents are checked when memory is accessed. The most important instrument functions are automatically monitored during operation.

If an error is detected, the status LED will flash. After the status key has been pressed, the status code is shown in the modulation display and the indicator "Err." is shown in the amplitude display:



The status codes of errors are listed in chapter 2.23, table 2-3.

If necessary, the individual diagnostic test points can be directly accessed (see the service manual).

4.2.2 Calibration

By drastic changes in operating temperature, or after replacing a module or the lithium battery, it is necessary to call the internal calibration routines. To do this, use the special functions (see chapter 2.21). Only the level correction calibration requires an external measuring instrument.

5 Testing the Rated Specifications

5.1 Required Measuring Equipment and Accessories

Table 5-1

Item	Instrument	Required specifications	R&S order no.	Use described in section
1	Frequency counter	Range 10 Hz to 1040 MHz (2080 MHz for SMY02) Resolution 1 Hz	included in item 2	5.2.2 5.2.3 5.2.14
2	RF analyzer	Range 0.1 to 1040 MHz (2080 MHz for SMY02) Crystal stabilized, dynamic range 90 dB	FSB 848.0020.52	5.2.4 5.2.6 5.2.8 5.2.10 5.2.12 5.2.19 5.2.32 5.2.33
3	Power meter	Range 0.1 to 1040 MHz (2080 MHz for SMY02) Power up to 100 mW, Z = 50 Ω, error < 0.1 dB resolution < 0.02 dB	NRVS 1020.1809.02 NRVS-Z51 857.9004.02	5.2.5 5.2.7
4	Precision attenuation set	Range > 500 MHz Attenuation 0 to 120 dB Z = 50 Ω	DPSP 334.6010.02	5.2.6
5	Controller	IEC 625-1 interface	PSA15 1012.1003.03	5.2.4
6	Test generator	Range up to 1040 MHz (2080 MHz for SMY02) Low noise	SMHU 835.8011.58	5.2.8 5.2.11
7	SWR bridge	Range up to 1040 MHz (2080 MHz for SMY02) Z = 50 Ω	ZRB2 373.9017.53	5.2.8
8	RF analyzer	Range up to 2.8 GHz Dynamic range > 40 dB	FSB 848.0020.52	5.2.9
9	Mixer	Range up to 1040 MHz (2080 MHz for SMY02) Ring modulator, standard level		5.2.11
10	Lowpass filter 200 kHz	Z = 50 Ω for f > 200 kHz		5.2.11
11	Instrument amplifier	Range 1 to 20 kHz Gain 20 dB, inherent noise < 5 nV/1 Hz test bandwidth		5.2.11
12	AF analyzer	Range up to 20 kHz Sensitivity < 3 µV R_{in} > 10 kΩ	UPD 1030.7500.02	5.2.11
13	Oscilloscope	DC to 100 MHz, 0.1 V/div		5.2.11 5.2.32 5.2.33
14	Adjustable lowpass filter	Half octave intervals 30 to 1360 MHz		5.2.12
15	Deviation meter	Range up to 2080 MHz Residual FM at 250 MHz < 1 Hz (CCITT) < 2 Hz (30 Hz to 20 kHz)	FMB 856.5005.52	5.2.13

Item	Instrument	Required specifications	R&S order no.	Use described in section
16	Modulation analyzer	Frequency range up to 1040 MHz (2080 MHz for SMY02) AM, FM, ϕM, error < 1%	FAM 334.2015.54 FAM-B2 334.4918.02 FAM-B8 334.5714.02 FMB (for SMY 02)	5.2.13 5.2.16 5.2.17 5.2.18 5.2.21 to 5.2.24
17	AF generator	Frequency range up to 100 kHz Frequency response < 0.01 dB	AFG 377.2100.02	5.2.15 5.2.18 5.2.24
18	AF voltmeter	Frequency range up to 100 kHz Frequency response < 0.01 dB	URE3 350.5315.03	5.2.14 5.2.15 5.2.20 5.2.25
19	Distortion meter	Frequency range up to 100 kHz Resolution < 0.05%	included in item 16	5.2.14 5.2.17
20	Power signal generator	Level 30 dBm up to 1040 MHz (2080 MHz for SMY02)	SMGL 1020.2005.52	5.2.30 5.2.31
21	RF peak-value rectifier	Frequency range 0.1 to 1040 MHz (2080 MHz for SMY02) 50 Ω, frequency response < 1 dB		5.2.20 5.2.25

5.2 Test Procedure

5.2.1 Display and Keyboard

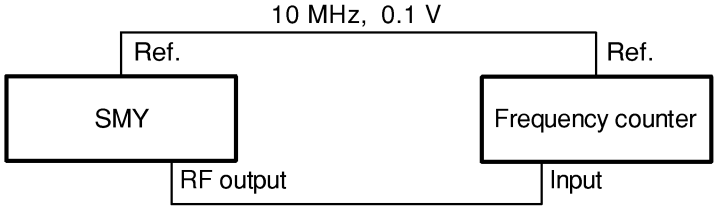
The special function "Display Test" (called up via SPECIAL 31) carries out a test of the displays. All displays are lit up.

The keys are tested by pressing them and their function checked against the display.

5.2.2 Frequency Setting

SMY setting: Unmodulated, level 0 dBm

Test setup: Synchronize reference frequency from SMY and from frequency counter.



Test: Set the following frequencies on the SMY and check using the frequency counter.

10 MHz	150 MHz	2000 MHz (for SMY02)
60 MHz	450 MHz	
90 MHz	1000 MHz	

The values on the counter must not deviate by more than ± 1 Hz.

5.2.3 Reference Frequency

- Allow at least one hour for the instrument to warm up.
- Connect a calibrated frequency counter to output REF FREQ 10MHz (rear panel).

The relative frequency error must not exceed (after 30 days of operation)

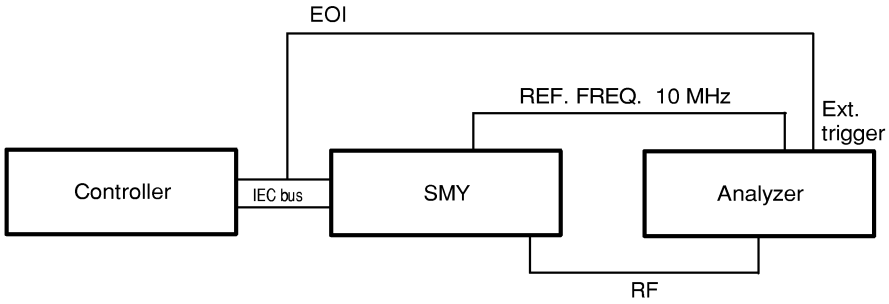
$1 \cdot 10^{-6}$/year + $2 \cdot 10^{-6}$ with the standard design
$1 \cdot 10^{-9}$/day + $5 \cdot 10^{-8}$ with the option SMY-B1 Reference Oscillator, OCXO

in the rated temperature range.

5.2.4 Settling Time

A crystal stabilized RF analyzer with a storage CRT which can be externally triggered by positive TTL edges is required to measure the settling time. The transient is made visible by edge demodulation with a 0-Hz span. Using a controller, two frequencies are set alternately on the SMY via the IEC bus. The controller should only activate the EOI line with the last data byte and must not otherwise send a terminator. The analyzer is adjusted such that one of the two frequencies lies on a filter edge. If the analyzer is triggered by the positive edge of the EOI signal, the transient appears on the CRT following the last character of the IEC-bus transmission.

Test setup:



Test: Synchronize reference frequency from the SMY and the RF analyzer. Connect the IEC bus and the RF line. Connect the EOI line (pin 5 on the IEC-bus connector) to the external trigger input of the analyzer. Set the SMY to 0 dBm and to the end value of the frequency jump to be measured. Set the reference level to -5 dBm on the analyzer, the amplitude scale to 1 dB/div, the resolution bandwidths to 1 kHz and the span to 3 kHz. Increase the centre frequency until the filter edge passes through the centre point of the CRT. The span can now be reduced to 0 Hz and the scale calibrated on the CRT using frequency steps of 100 Hz. The transient response appears on the CRT if the test program is now started and the analyzer switched to external triggering. The settling time (period up to final frequency $1 \cdot 10^{-7}$) must be < 60 ms.

Test program: Settling time

```
10 IECTERM 1
20 IECDCL : HOLD 500
30 IECOUT27, "LEV 0DBM"
40 INPUT "STARTFREQUENZ IN MHZ"; F1$
50 INPUT "STOPPFREQUENZ IN MHZ"; F2$
60 IECOUT27, "RF" + F1$ + "MHZ"
70 HOLD 200
80 IECOUT27, "RF" + F2$ + "MHZ"
90 INPUT "WIEDERHOLUNG"; W$
100 IF W$ = "J" THEN 60
110 GOTO 40
```

5.2.5 Output Level

SMY setting: Unmodulated, level 0 dBm,
frequencies 9 kHz to 1040 MHz (2080 MHz for SMY02)

Test setup: Connect power meter to RF output.

Test: The frequency response must not exeed 1 dB.

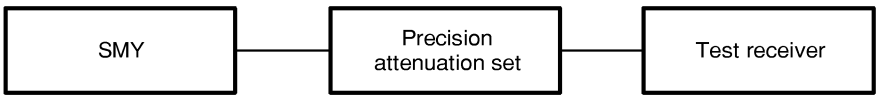
5.2.6 Attenuation Set

SMY setting: Unmodulated, 100 MHz, 13 dBm (19 dBm with option SMY-B40)

Setting of precision attenuation set: 120 dB attenuation

Test receiver setting: 100 MHz, -10 dBµV, linear, mean value,
bandwidth 7.5 kHz

Test setup:



Ensure that the cable connections are RF tight.

Test: The nominal attenuation values according to the performance test report must be taken into acount.

- Note the level displayed on the test receiver as the reference value (approx. 0 dBµV).
- Repeat the measurement with the settings shown in Table 5-2.
- The difference from the reference value must not exceed 1 dB.

Table 5-2

SMY level in dBm without option SME-B40	SMY level in dBm with option SME-B40	Attenuation of the precision attenuation set dB
13	19	120
8	14	115
3	09	110
-7	–1	100
-27	–21	80
-47	–41	60
-67	–61	40
-87	–81	20
-107	–101	0

5.2.7 Non-interrupting Level Setting

SMY setting: Unmodulated, 100 MHz, 13 dBm (19 dBm with option SMY-B40)
Level VAR STEP 5 dB,
special function "Non-interrupting level setting"

Test setup: Connect power meter to RF output.

Test: Calibrate the power meter to 0 dB (for relative level measurements) or note the absolute level. Reduce the level on the SMY in 2-dB steps using the STEP key and check the level jumps on the power meter.

Permissible deviation:

Reduction	5 dB	10 dB	15 dB	20 dB
Tolerance	± 0.2 dB	± 0.4 dB	± 0.6 dB	± 0.8 dB

5.2.8 Output Reflection Coefficient

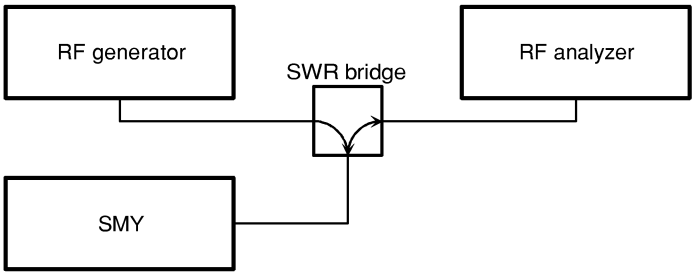
SMY setting: Frequency 5 to 1040 MHz (2080 MHz for SMY02), unmodulated,
level 0 dBm

RF generator setting: Frequency f_{SMY} - 100 Hz, unmodulated,
level -140 dBm

RF analyzer setting:

Center frequency	f_{SMY}
RES BW = Video BW	10 kHz
Span	0 Hz
Sweep Time	30 ms
Scale	linear

Test setup:



Test:

- 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 from the SMY 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 SMY again.
- A more or less wavy line representing the VSWR of the SMY is to be seen now at the spectrum analyzer. The VSWR is to be calculated from the maximal and the minimal voltage according to

  $$VSWR = \frac{V_{max}}{V_{min}}$$

  The ripple must not exceed 1.5. An upper limit value of 1.8 is valid with frequencies > 1040 MHz.

5.2.9 Harmonics

SMY setting: Unmodulated, level 10 dBm (16 dBm with OPTION SMY-B40), frequency 9 kHz to 1040 MHz (2080 MHz for SMY02)

Test setup: Connect RF analyzer to the RF output of the SMY.

Test: Sweep through the output frequency of 9 kHz to 1040 MHz (2080 MHz for SMY02) and check the harmonics on the RF analyzer.

– Without option SMY-B40, the harmonic level must not exceed –30 dBc.

– With option SMY-B40, the harmonic level must not exceed –25 dBc.

Ensure that the RF analyzer is not overloaded.

5.2.10 Spurious

SMY setting: Unmodulated, level 0.1 dBm,
frequency 100 kHz to 1000 MHz

Test setup: Connect RF analyzer to the RF output.

Test: The spurious suppression is preferably tested at the following frequencies:

Table 5-3

SMY frequency	Search frequency	Spurious suppression
64.999999 MHz	640 MHz 705 MHz 75 MHz	< -70 dBc
544.08 MHz 640.005 MHz 992.03 MHz 1024.02 MHz	544.03 MHz 640 MHz 992.058 MHz 1024.07 MHz	< -70 dBc

5.2.11 SSB Phase Noise

In order to measure the SSB phase noise, the output signal of the SMY is down-converted with a signal of the same frequency from a reference signal generator. The carrier is then rejected and the noise spectrum converted to a low frequency. This low-frequency noise spectrum can be measured using an AF spectrum analyzer.

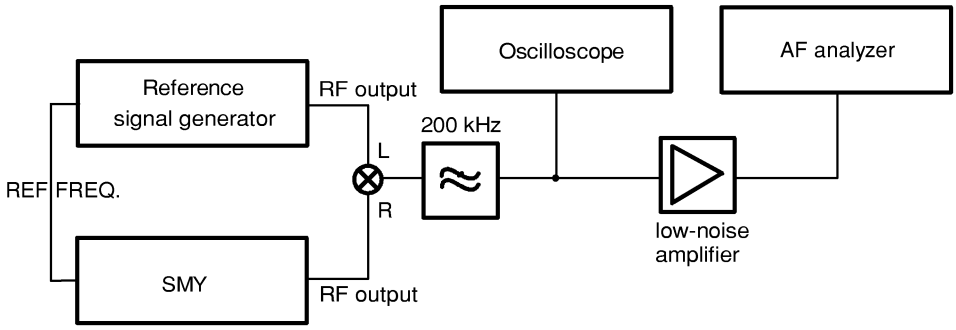
SMY setting: Unmodulated, level 0 dBm,
frequency 64 / 100 / 779 / 1040 MHz (and 2080 MHz for SMY02)

Reference generator: Unmodulated, level 7 dBm,
frequency analog to SMY setting

Oscilloscope: DC, 0.1 V/div, triggering AUTO

AF analyzer: Bandwidth 1 kHz, 5 kHz/div

Test setup:



Synchronize the reference frequencies from the SMY and the reference signal generator.

Test:

- Set SMY to 65.02 MHz. Read the reference value on the AF analyzer at 20 kHz.
- Set SMY to 65 MHz. Set a beat of 1 Hz using a step of 1 Hz upwards or downwards from the reference generator setting and stop the beat with a single step at the zero point on the oscilloscope (± 50 mV). This sets the two input signals of the mixer in the phase quadrature.
- Read the noise level on the analyzer at 20 kHz and convert to a 1-Hz bandwidth (if e.g. a bandwidth of 1 kHz is used for the measrement, 30 dB must be subtracted from the measured noise level). Take into account the form factor in the case of analyzers with mean-value rectification.
- The SSB phase noise is calculated as follows:

	Example
Measured noise level (1-Hz bandwidth)	-118 dBm
Minus reference level	-(+12 dBm)
Minus 6 dB because 2 side bands are measured	-6 dB
	-136 dBc

- Repeat the measurement at 100 MHz, 779 MHz, 1040 MHz (and 2080 MHz for SMY02).

The following values of SSB phase noise must not be exceeded:

Table 5-4

Carrier frequency	SSB phase noise at 20 kHz from carrier
64 MHz	-114 dBc
100 MHz	-132 dBc
779 MHz	-114 dBc
1040 MHz	-114 dBc
2080 MHz for SMY02	-108 dBc

SMY43 only:

Carrier frequency	Carrier offset	SSB phase noise
894 MHz	45 kHz	< -126 dBc
894 MHz	300 kHz	< -138 dBc
1990 MHz	600 kHz	< -138 dBc

Note: This measurement takes into consideration the SSB phase noise of both generators. The reference signal generator must therefore be at least 10 dB better than the SMY in order to achieve an exact measurement.

5.2.12 Broadband Noise

The carrier of the SMY is attenuated using a filter in order to measure the broadband noise using an RF analyzer.

SMY setting: Unmodulated, level 5.1 dBm witthout option B40, 11.1 dBm with option B40
frequency 100 kHz to 1000 MHz

Test setup:

Test:

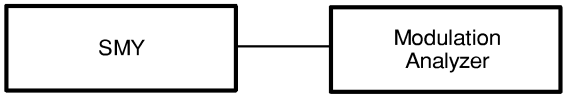
- Set the lowpass filter such that the SMY carrier is attenuated by at least 20 dB.
- Set the analyzer as sensitive as possible (no pre-attenuation). Measure the noise level in the passband of the filter and convert to a 1-Hz bandwidth. This level, referred to 0.1 dBm, is the broadband noise level.

The broadband noise level must not exceed -140 dBc.

5.2.13 Residual FM

SMY setting: Unmodulated, level 0 dBm,
frequency 520.000001 to 1040 MHz (2080 MHz for SMY02)

Test setup:



Test: Measure the residual FM with a CCITT weighting filter or unweighted (30 Hz to 20 kHz) and an RMS rectifier.

In the given frequency range, the residual FM must not exceed 10 Hz with CCITT weighting filter or 20 Hz unweighted.

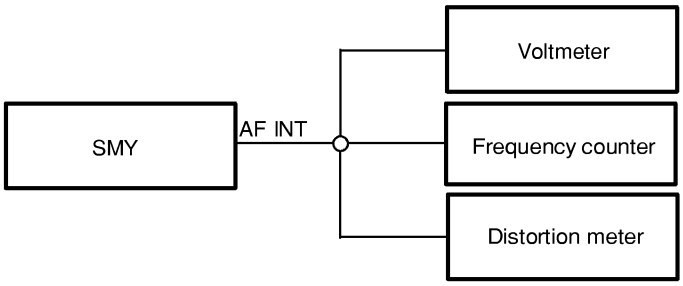
Possible test frequencies: 600, 800 and 1000 MHz.

The inherent residual FM of the modulation analyzer must be taken into account by calibration.

5.2.14 Modulation Generator

SMY setting: AF 10 Hz to 500 kHz

Test setup:



Test: Vary the frequency of the modulation generator from 10 Hz to 500 kHz and measure the level, frequency and distortion.

The level at 1 kHz must be 1 V ± 1%.

Frequency response: < 0.2 dB up to 50 kHz
< 0.3 dB up to 100 kHz

The frequency error must not exceed $5 \cdot 10^{-5}$.

The distortion at 1 kHz must not exceed 0.1%.

5.2.15 Function Test of the External Modulation Level Monitoring

SMY setting: Level 0 dBm, a) FM EXT 50 kHz
b) AM EXT 80%

Test setup: Apply a modulation signal of 1 kHz to the modulation input "FM/φM EXT" (test a) or "AM EXT" (test b).

Test: EXT LOW must light up in the modulation display with an input level of 0.97 V.

EXT HIGH must light up in the modulation display with an input level of 1.03 V.

Neither EXT LOW nor EXT HIGH is to light up with an input level of 0.99 to 1.01 V.

5.2.16 AM Modulation Depth

SMY setting: Level 0.1 dBm, frequency 0.1 to 1040 MHz (2080 MHz for SMY02)
AM INT 0.5 to 80%, AF 1 kHz

Test setup: Connect modulation analyzer to RF output.

Test: Without option SMY-B40, the deviation of the modulation depth from a set value must not exceed 4% of the display +1% (absolute).
With option SMY-B40, the deviation of the modulation depth from a set value must not exceed 4% of the display +3% (absolute).

5.2.17 AM Distortion

SMY setting: Level 0.1 dBm, frequency 0.1 to 1040 MHz (2080 MHz for SMY02)
AM INT 30% (80%), AF 1 kHz

Test setup: Connect modulation analyzer with distortion meter to RF output.

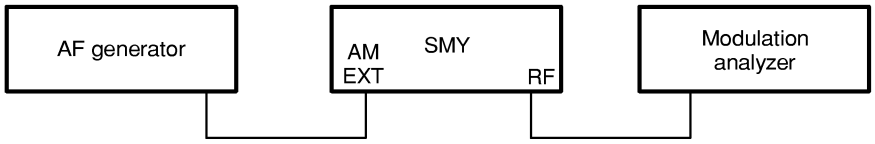
Test: without option SMY-B40:
The distortion must not exceed 1% with 30% AM.
The distortion must not exceed 2% with 80% AM.

with option SMY-B40:
for frequencies f < 10 MHz, the distortion must not exceed 3 % (5 %) with 30 % (80 %) AM
for frequencies f > 10 MHz, the distortion must not exceed 1 % (2 %) with 30 % (80 %) AM

5.2.18 AM Frequency Response

SMY setting: Level 0 dBm, frequency 0.1 to 1040 MHz (2080 MHz for SMY02),
AM EXT 60%

Test setup:



Test: Set a level of 1 V on the AF generator and vary the frequency from 10 Hz to 50 kHz.

The modulation frequency response up to 10 kHz must not exceed 0.4 dB.

The modulation frequency response up to 50 kHz must not exceed 3 dB.

5.2.19 AM DC

SMY setting: Level 0 dBm, frequency 1000 MHz, AM EXT 100%

Test setup: Connect RF analyzer to RF output of SMY.

Test: A DC voltage of +1 V applied to the AM modulation input must increase the RF level by 5.5 to 6.5 dB.

A voltage of -1 V must result in an attenuation of at least 30 dB.

5.2.20 Residual AM

SMY setting: Unmodulated, level 13 dBm,
frequency 0.1 to 1040 MHz (2080 MHz for SMY02)

Test setup: Connect RF peak-value rectifier to SMY output. Connect RMS voltmeter with 20-kHz lowpass filter connected before to the output of the rectifier.

Test: The RMS value of the measured voltage must not exceed 200 µV.

5.2.21 Incidental φM at AM

SMY setting: Level 0 dBm, frequency 4 to 1040 MHz (2080 MHz for SMY02),
AM INT 30%, AF 1 kHz

Test setup: Connect modulation analyzer to RF output.

Test: Measure the phase modulation produced at various carrier frequencies.

Permissible incidental φM: < 0.2 rad at f <1040 MHz,
< 0.4 rad at f >1040 MHz

5.2.22 FM Deviation Setting

SMY setting: Call special function 41 and special function 43,
level 0 dBm, frequency 100 MHz,
FM INT 1 to 100 kHz, AF 1 kHz

Test setup: Connect modulation analyzer to RF output.

Test: Measure the FM deviation at the following deviation settings:

1 kHz, 10 kHz, 100 kHz, 1 MHz, 10 MHz

The deviation from the set value must not exceed 3%.

5.2.23 FM Distortion

SMY setting: Level 0 dBm, frequency 100 MHz,
FM INT 50 kHz, AF 1 kHz

Test setup: Connect modulation analyzer with distortion meter to the RF output of the SMY.

Test: The FM distortion must not exceed 0.3%.

5.2.24 FM Frequency Response

SMY setting: Level 0 dBm, frequency 100 MHz,
FM EXT 100 kHz

Test setup: Connect AF generator to modulation input FM/φM EXT. Connect calibrated modulation analyzer to RF output.

Test: Set a level of 1 V on the AF generator and vary the frequency from 10 Hz to 2 MHz. The modulation frequency response must not exceed 3 dB.

5.2.25 Incidental AM at FM

SMY setting: Level 0 dBm, frequency 0.1 to 1040 MHz (2080 MHz for SMY02)
FM INT 40 kHz, AF 1 kHz

Test setup: Connect RF peak-value rectifier to SMY output. Connect RMS voltmeter with 20-kHz lowpass filter connected before to the output of the rectifier.

Test: The RMS value of the measured voltage must not exceed 224 µV.

5.2.26 Stereo Modulation

SMY setting: Call special function 41 and special function 43,
level 0 dBm, frequency 93 and 108 MHz,
FM external DC, FM deviation 40 kHz

Test setup: Connect stereo coder to the FM/φM connector.
Pilot tone 6.75 kHz, AF = 1 kHz.
Connect FMB to RF output.

Test: The cross-talk attenuation must not fall below 50 dB. The signal-to-noise ratio must be better than 70 dB, the unweighted signal-to-noise ratio better than 76 dB.
The distortion must not exceed 0.3%.

5.2.27 PM Deviation Setting

SMY setting: Call special function 41 and special function 43,
level 0 dBm, frequency 100 MHz,
PM INT 10.0 rad, AF 1 kHz

Test setup: Connect spectrum analyzer to RF output.
FM demodulator (the FM demodulator is used due to the higher FM accuracy of the FMB).

Test: The FM deviation must be 10 kHz at the chosen setting. A phase deviation error of 5% corresponds to a deviation of 500 Hz from the nominal value.

5.2.28 PM Distortion

SMY setting: Level 0 dBm, frequency 100 MHz,
PM INT 12.5 rad, AF 1 kHz

Test setup: Connect modulation analyzer to RF output.

Test: The distortion must not exceed 0.5%.

5.2.29 PM Frequency Response

SMY setting: Level 0 dBm, frequency 100 MHz,
PM INT 12.5 rad, AF 20 Hz to 20 kHz

Test setup: Connect modulation analyzer to RF output.

Test: The modulation frequency response up to 20 kHz must be less than 3 dB.

5.2.30 Overvoltage Protection with OPTION SMY-B40

SMY setting: Unmodulated, level -117 dBm, frequency 100 MHz

Test setup 1: Connect a regulated power supply unit to the RF output of the SMY.

Test: Apply a DC voltage to the RF output. The overvoltage protection must trip at a voltage of ± (7.5 V to 8.5 V).

Test setup 2: Connect a power signal generator with an RF power output of 0.5 to 2 W to the RF output of the SMY.

Test: Apply a frequency of 25 to 1040 MHz (2080 MHz for SMY02) to the RF output. The overvoltage protection must trip at an RF power of 1 W to 2 W.

5.2.31 Overvoltage Protection without OPTION SMY-B40

SMY setting: Unmodulated, level -117 dBm, frequency 100 MHz

Test setup 1: Connect a regulated power supply unit to the RF output of the SMY.

Test: Apply a DC voltage to the RF output. The overvoltage protection must trip at a voltage of 6 ±1 V.

Test setup 2: Connect a power signal generator with an RF power output of 0.3 to 1.5 W to the RF output of the SMY.

Test: Apply a frequency of 25 to 1040 MHz (2080 MHz for SMY02) to the RF output. The overvoltage protection must trip at an RF power of 0.5 to 1.1 W for SMY01 and 0.3 to 0.7 W for SMY02.

5.2.32 Pulse Modulation with OPTION SMY-B40

SMY setting: Unmoduated, level 19 dBm

Test setup 1: To determine the ON/OFF ratio, connect spectrum analyzer to the RF-output socket of the SMY and a pulse generator to the PULSE socket on the rear panel of the SMY.

Test: Measure the output level of the SMY at various carrier frequencies for applied "High" and "Low" signal.
The ON/OFF-ratio must be >70 dB at 70 MHz, linearly decreasing to > 65 dB at 520 MHz, > 65 dB up to 800 MHz, linearly decreasing to > 35 dB at 2080 MHz.

Test setup 2: Use a two-channel oscilloscope to display the input signal from the pulse generator and the (mixed) output signal simultaneously. Trigger by the input signal. Set a rectangular pulse sequence with a frequency of about 1 MHz by means of the TTL-level. For carrier frequencies > 50 MHz, use mixer and set IF of about 50 MHz by means of an auxiliary signal generator. Evaluate the envelope of the keyed RF-signal on the oscilloscope.

Test: The rise time (10%/90%) must be < 20 ns.
The fall time (90%/10%) must be < 20 ns.
The pulse delay time (50%-input pulse/50%-envelope) must be < 200 ns.

5.2.33 Pulse Modulation without OPTION SMY-B40

SMY setting: Unmoduated, level 13 dBm

Test setup 1: To determine the ON/OFF ratio, connect spectrum analyzer to the RF-output socket of the SMY and a pulse generator to the PULSE socket on the rear panel of the SMY.

Test: Measure the output level of the SMY at various carrier frequencies for applied "High" and "Low" signal.
The ON/OFF-ratio must be >80 dB.

Test setup 2: Use a two-channel oscilloscope to display the input signal from the pulse generator and the (mixed) output signal simultaneously. Trigger by the input signal. Set a rectangular pulse sequence with a frequency of about 1 MHz by means of the TTL-level. For carrier frequencies > 50 MHz, use mixer and set IF of about 50 MHz by means of an auxiliary signal generator. Evaluate the envelope of the keyed RF-signal on the oscilloscope.

Test: The rise time (10%/90%) must be typically 4 µs.
The fall time (90%/10%) must be typically 4 µs.
The pulse delay time (50%-input pulse/50%-envelope) must be typically 3.5 µs.

5.3 Performance Test Report

ROHDE & SCHWARZ
SIGNAL GENERATOR SMY 01/02
Order No. 1062.5502.11/.12
SER. .....

Date: .....
Name: .....

Item	Characteristic	Measure as in section	Min	Actual	Max	Unit
1	Function of keypads and displays	5.2.1	--		--	
2	Frequency setting	5.2.2	--		--	
3	Settling time	5.2.4	--		60	ms
4	Output level	5.2.5				
	test level 0 dBm					
	frequency response		--		1	dB
5	Attenuation set error	5.2.6	--		1	dB
6	Non-interrupting level variation	5.2.7				
	Error at -5 dB		--		±0.2	dB
	-10 dB		--		±0.4	dB
	-15 dB		--		±0.6	dB
	-20 dB		--		±0.8	dB
7	Output reflection coefficient	5.2.8				
	VSWR at ≤ 1040 MHz		--		1.5	
	> 1040 MHz		--		1.8	
8	Harmonics	5.2.9				
	at 10 dBm		--		-30	dBc
	with OPTION SMY-B40 at 16 dBm				-25	dBc
9	Spurious	5.2.10				
	at 64.999999 MHz		--		-70	dBc
	544.08 MHz		--		-70	dBc
	640.005 MHz		--		-70	dBc
	992.03 MHz		--		-70	dBc
	1024.02 MHz		--		-70	dBc
10	SSB phase noise at 20 kHz from carrier	5.2.11				
	at 64 MHz		--		-114	dBc
	100 MHz		--		-132	dBc
	779 MHz		--		-114	dBc
	1040 MHz		--		-114	dBc
	2080 MHz for SMY02		--		-108	dBc
	SMY43 only:					
	894 MHz at 45 kHz from carrier		--		-126	dBc
	894 MHz at 300 kHz from carrier		--		-138	dBc
	1990 MHz at 600 kHz from carrier		--		-138	dBc
11	Broadband noise f ≥ 65 MHz	5.2.12	--		-140	dBc
	f < 65 MHz		--		-135	dBc

Item	Characteristic	Measure as in section	Min	Actual	Max	Unit
12	Residual FM, CCITT, RMS	5.2.13				
	520 MHz < f < 1040 MHz		--		10	Hz
	Residual FM (30 Hz to 20 kHz)					
	1040 MHz < f < 2080 MHz		--		20	Hz
13	AF Synthesizer	5.2.14				
	Level error at 1 kHz		--		1	%
	Frequency error		--		$5 \cdot 10^{-5}$	
14	AF synthesizer distortion	5.2.14				
	at 1 kHz		--		0.1	%
15	Ext. modulation voltage window	5.2.15	0.97		1.03	V_{eff}
16	AM modulation depth without opt. SMY-B40	5.2.16				
	at 1 MHz m = 30 %		27,8		32,2	%
	m = 80 %		75,8		84,2	%
	10 MHz m = 30 %		27,8		32,2	%
	m = 80 %		75,8		84,2	%
	100 MHz m = 30 %		27,8		32,2	%
	m = 80 %		75,8		84,2	%
	1000 MHz m = 30 %		27,8		32,2	%
	m = 80 %		75,8		84,2	%
	with opt. SMY-B40					
	bei 1 MHz m = 30 %		25,8		34,2	%
	m = 80 %		73,8		86,2	%
	10 MHz m = 30 %		25,8		34,2	%
	m = 80 %		73,8		86,2	%
	100 MHz m = 30 %		25,8		34,2	%
	m = 80 %		73,8		86,2	%
	1000 MHz m = 30 %		25,8		34,2	%
	m = 80 %		73,8		86,2	%
17	AM distortion	5.2.17				
	f_{mod} = 1 kHz					
	m = 30%					
	at 1 MHz with opt. SMY-B40		--		3	%
	without opt. SMY-B40		--		1	%
	10 MHz		--		1	%
	100 MHz		--		1	%
	1000 MHz		--		1	%
	m = 80%					
	at 1 MHz with opt. SMY-B40		--		5	%
	without opt. SMY-B40		--		2	%
	10 MHz		--		2	%
	100 MHz		--		2	%
	1000 MHz		--		2	%
18	AM frequency response	5.2.18				
	up to 10 kHz		--		0.4	dB
	up to 50 kHz		--		3	dB

Item	Characteristic	Measure as in section	Min	Actual	Max	Unit
19	Incidental ϕM at 30% AM	5.2.21	--		0.2	rad
	f > 1040 MHz (for SMY02)		--		0.4	rad
20	FM deviation setting	5.2.22				
	at 1 kHz		0.97		1.03	kHz
	3 kHz		2.91		3.09	kHz
	10 kHz		9.7		10.3	kHz
	30 kHz		29.1		30.9	kHz
	100 kHz		97		103	kHz
21	FM distortion	5.2.23	--		0.3	%
22	FM frequency response	5.2.24				
	20 Hz to 100 kHz		--		0.5	dB
	10 Hz to 2 MHz				3.0	dB
23	Stereo modulation	5.2.26				
	Cross-talk attenuation		50		--	dB
	Signal-to-noise ratio		70		--	dB
	Unweighted signal-to-noise ratio		76		--	dB
	Distortion		0.3		--	%
24	PM deviation	5.2.27	--		1	rad
25	PM distortion	5.2.28	--		0.5	%
26	Modulation frequency response	5.2.29				
	20 Hz to 20 kHz		--		3	dB
27	Response treshold of overvoltage protection without OPTION SMY-B40	5.2.31				
	with SMY01					
	for HF		0.5		1.1	W
	for DC		5		7	V
	with SMY02					
	for HF		0.3		0.7	W
	for DC		5		7	V
	with OPTION SMY-B40	5.2.30				
	for HF		1		2	W
	for DC		7,5		8,5	V
28	Pulse modulation with OPTION SMY-B40	5.2.32				
	ON/OFF-ratio					
	at f = 70 MHz		70		-	dBc
	at f = 520 MHz		65		-	dBc
	at f = 800 MHz		65		-	dBc
	at f = 2080 MHz		35		-	dBc
	rise time		-		20	ns
	fall time		-		20	ns
	pulse delay time		-		200	ns
29	Pulse modulation without OPTION SMY-B40	5.2.33				
	ON/OFF-ratio		80		-	dBc
	rise time		-		typ. 4	µs
	fall time		-		typ. 4	µs
	delay-time		-		typ. 3.5	µs

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