8 Maintenance

The present chapter describes the measures that are necessary for maintaining, storing and packing the instrument.

The instrument does not need a periodic maintenance. What is necessary is essentially the cleaning of the outside of the instrument.
However, it is recommended to check the rated data from time to time.

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.*

Storing and Packing

The instrument can be stored at a temperature of –40° C to +70° C. When stored for an extended period of time, the instrument should be protected against dust.

The original packing should be used, particularly the protective covers at the front and rear, when the instrument is to be transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the instrument to protect it against mechanical damage.

Exchanging the Lithium Battery

A lithium battery with a service life of approx. 5 years serves to supply the RAM with power. When the battery is discharged, the data stored will be lost. Exchanging the battery is described in the Service Manual.

9 Error Messages

The present chapter contains the error messages (short-term and long-term messages) of the SML.

Short-term message

The short-term message is displayed in the status line. Part of it overwrites the status indications and disappears after approx. 2 seconds or in the case of a new entry.
The instrument shows, e.g., short-term messages if the attempt is made to enter an overrange or if incompatible operating modes deactivate one another.

Long-term message

The long-term message is displayed in the status line by means of the message "Err". Pressing the [ERROR] key calls the ERROR page in which the messages are entered. Several messages can be entered at the same time. The long-term message remains existing until there is no cause any more. The ERROR page is exited using the [BACK] key.

The ERROR page offers access to long-term messages if the [ERROR] key is pressed.

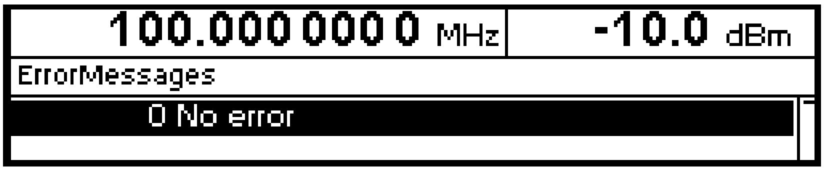


Fig. 9-1 ERROR page

Notes:

- *An error message "Err" does not necessarily point to a defect instrument. There are various operating states which can cause an ERROR message, e.g. if the instrument is set to external reference but no external reference is connected.*
- *Error -313 indicates the loss of calibration data and is also applicable in case of a cold start (key [PRESET] is pressed during switch-on). The calibration values can be restored with internal calibration routines. These routines are accessible via menu Utilities - Calib (see section on calibration).*

List of Error Messages

The following list contains all SCPI- and device-specific error messages for errors occurring in the instrument. The meaning of negative error codes is defined in SCPI, positive error codes mark device-dependent errors.

The lefthand column of the table below contains the error code. In the righthand column, the error text entered into the error/event queue and shown on the display is in bold type. Below the error text there is an explanation of the error.

SCPI-Specific Error Messages

No error

Error code	**Error text with queue poll** Explanation of error
0	**No error** This message is output if the error queue contains no entries.

Command Error – errored command; sets bit 5 in the ESR register

Error code	**Error text with queue poll** Explanation of error
-100	**Command error** The command is errored or invalid.
-101	**Invalid character** The command contains an invalid character. Example: A header contains an ampersand, "SOURCE&".
-102	**Syntax error** The command is invalid. Example: A command contains block data which the instrument does not accept.
-103	**Invalid separator** The command contains an illegal character instead of a terminator. Example: A semicolon after the command is missing.
-104	**Data type error** The command contains an invalid value information. Example: ON is entered instead of a numerical value for frequency setting.
-105	**GET not allowed** A Group Execute Trigger (GET) is entered within a command line.
-108	**Parameter not allowed** The command contains too many parameters. Example: The command `SOURce:FM:INTernal:FREQuency` allows for a frequency entry only.
-109	**Missing parameter** The command contains too few parameters. Example: The command `SOURce:FM:INTernal:FREQuency` requires a frequency entry.

Command Error, continued

Error code	**Error text with queue poll** Explanation of error
-112	**Program mnemonic too long** The header contains more than 12 characters.
-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 illegal numerical 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: The command SOURce:FREQuency:MODE requires the entry 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 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this position of the command. Example: The command *RCL does not allow for a suffix to be entered.
-141	**Invalid character data** The text parameter either contains an invalid character or it is invalid for this command. Example: spelling mistake in parameter entry; SOURce:FREQuency:MODE FIKSed.
-144	**Character data too long** The text parameter contains more than 12 characters.
-148	**Character data not allowed** The text parameter is not allowed for this command or at this position of the command. Example: The command *RCL requires the entry of a number.
-158	**String data not allowed** The command contains a valid character string at a position which is not allowed. Example: A text parameter is entered in inverted commas, eg SOURce:FREQuency:MODE "FIXed"
-161	**Invalid block data** The command contains errored block data. Example: An END message was received before the expected number of data was received.
-168	**Block data not allowed** The command contains valid block data at a position which is not allowed. Example: The command *RCL requires the entry of a number.
-178	**Expression data not allowed** The command contains a mathematical expression at a position which is not allowed.

Execution Error – error in the execution of a command; sets bit 4 in the ESR register

Error code	**Error text with queue poll** Explanation of error
-203	**Command protected** The desired command could not be executed as it is protected by a password. Use the command `SYSTem:PROTect OFF`, <password> to enable the desired command. Example: The command `CALibrate:PULSe:MEASure?` is password-protected.
-211	**Trigger ignored** The trigger (GET, *TRG or trigger signal) was ignored because of the instrument timing control. Example: The instrument was not ready to answer.
-221	**Settings conflict** The settings of two parameters are conflicting. Example: FM and PM cannot be switched on at the same time.
-222	**Data out of range** The parameter value is out of the permissible range of the instrument. Example: The command *RCL only permits entries between 0 and 50.
-223	**Too much data** The command contains too many data. Example: The instrument does not have sufficient memory space.
-224	**Illegal parameter value** The parameter value is invalid. Example: An invalid text parameter is entered, eg `TRIGger:SWEep:SOURce TASTe`
-225	**Out of memory** The available instrument memory space is exhausted. Example: An attempt was made to create more than 10 lists.
-226	**Lists not of same length** The parts of a list have different lengths. This error message is also displayed if only part of a list has been transmitted via the IEC/IEEE bus. All parts of a list have to be transmitted before the list is executed. Example: The POWer part of a list is longer than the FREQuency part, or only the POWer part has been 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 because of a hardware fault of the instrument.
-241	**Hardware missing** The command cannot be executed because of hardware missing. Example: An option is not fitted.
-255	**Directory full** The list management cannot accept any more lists since the maximum number of lists has already been attained. Example: An attempt was made to create more than the allowed number of UCOR lists.

Device Specific Error - sets bit 3 in the ESR register

Error code	**Error text with queue poll** Explanation of error
-310	**System error** This error message suggests an error within the instrument. Please inform your R&S service center.
-311	**Memory error** Error in instrument memory.
-313	**Calibration memory lost** Loss of stored calibration data. The YFOM and ALC AMP calibration data can be restored by means of internal routines (see chapter 4, section "Calibration").
-314	**Save/recall memory lost** Loss of the nonvolatile data stored with the command *SAV?.
-315	**Configuration memory lost** Loss of the nonvolatile configuration data stored by the instrument.
-330	**Self-test failed** The self-test could not be executed.
-350	**Queue overflow** This error code is entered into the error queue instead of the actual error code when the error queue is full. The code indicates that an error has occurred but has not been accepted. The error 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-C interface.

Query Error – error in data request; sets bit 2 in the ESR register

Error code	**Error text with queue poll** Explanation of error
-410	**Query INTERRUPTED** The query was 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 operating.

SML-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
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 minimal value of a level list is above 20 dBm. An exact level setting is no longer guaranteed.
135	**Pulse input signal missing** No pulse input signal available.
140	**This modulation forces other modulations OFF** A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off.
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.
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.
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.

Continuation: Device-dependent Error

Error code	**Error text in the case of queue poll** Error explanation
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; trunctated** 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.

Possible Error Sources

The error messages issued by the continuous monitoring of diagnosis points are described in the following table. Troubleshooting should be performed according to the order given in the table since an error mentioned further down could be caused by those above.

Table 9-1 Error messages of hardware monitoring

Displayed message	Error	Possible source
174,“Reference PLL unlocked“	The PLL of the 800 MHz reference oscillator on the main board is out of synchronization: = > Output frequency not correct	If unit is set to external reference: - No external reference signal at the 10 MHz REF connector (rear of unit) - Level or frequency of external reference does not correspond to data sheet value
175,“Main PLL unlocked“	The PLL of the main oscillator on the main board is out of synchronization: => Output frequency not correct	- Calibration is missing or erroneous for example after an exchange of modules or batteries
110,“Output unleveled; OPU1“	The level control for the output level on the main board is switched off: => Output level not correct	- Level outside the specified range - Overload at AM-EXT-DC Calibration is missing or erroneous for example after an exchange of modules or batteries

Error messages issued as a result of loss of data, for example on exchanging a battery or software update are listed in the following table.

Table 9-2 Error messages as a result of loss of data

Displayed messages	Error	Possible source and troubleshooting
-313,"Calibration memory lost ; XXXXXXXXX", [1]	Internal calibration data are missing	- Data loss due to low battery voltage - Data loss due to software update - Data loss due to "Factory Preset" Possible troubleshooting: - Perform internal calibration (see chapter 4)
-313,"Calibration memory lost; Reference Oscillator",	Calibration value is missing	- Loss of non-volatile EEPROM data Possible troubleshooting: - Adjustment of 10 MHz reference frequency (see SML service manual)
-315,“Configuration memory lost“	One or more EEPROM data blocks are missing	- Loss of non-volatile EEPROM data

[1] where XXXXXXX indicates the name of the missing calibration : IF Filter, Main Loop, Harmonic Filter, Mult Filter, Level Preset, Lfgen Level, FM Offset

10 Performance Test

The present Performance Test is valid for model SML01.

Preliminary Remark

- The rated characteristics of the signal generator are checked after a warm-up time of at least 15 minutes. A recalibration of the unit is not required. FM offset calibration is an exception, however.
- A defined default state is set prior to each measurement by pressing the **PRESET** key.
- The values stated hereafter are not guaranteed values. Only the data sheet specifications shall be binding.
- The values specified in the data sheet are guaranteed limits. The tolerances of the instruments used in the performance test must be added to the limits because of their measurement uncertainty.

Measuring Equipment and Accessories

Table 10-1 Measuring equipment and accessories

Item	Instrument type	Recommended characteristics	Suitable unit	R&S Order No.	Use/measurement
1	Frequency counter	Frequency range up to 1100 MHz. Internal reference 10 MHz	Contained in item 2 or 10		Frequency accuracy
2	RF spectrum analyzer	Frequency range up to 1100 MHz	FSEA30	1065.6000.30	Settling time level accuracy Output reflection coefficient Harmonics Spurious Pulse modulation
3	Signal generator with high spectral purity	Phase noise at 1 GHz: typ. <-128 dBc/Hz at 20 kHz	SME03 SMHU	1038.6002.03 835.0011.52	output reflection coefficient SSB phase noise Broadband noise
4	Storage oscilloscope	DC 100 MHz, 0.1V/div			SSB phase noise Pulse modulation
5	Phase noise test set	Mixer: 10 MHz to 1100 MHz Lowpass filter: approx. 500 kHz Preamplifier with gain of approx. 30 dB, input noise <2 nV (1 Hz), DC decoupling after mixer for oscilloscope			SSB phase noise
6	RF power meter	9 kHz to 1100 MHz	NRVS with NRV-Z51	1020.1809.02 857.9004.02	Level accuracy Non-interrupting level setting

Item	Instrument type	Recommended characteristics	Suitable unit	R&S Order No.	Use/measurement
7	Precision attenuators	Frequency range 9 kHz to 1100 MHz Attenuation 0 to 125 dB I = 50 Ω	RSP	0831.3515.02	Level accuracy
8	Controller	IEC-625-1 interface			Settling time
9	SWR bridge	1 MHz to 1100 MHz Directivity >40 dB	ZRC	1039.9492.55/ 1039.9492.52	Output reflection coefficient
10	Modulation analyzer	100 kHz to 1100 MHz, AM, FM, PhiM, stereo coder, stereo decoder, distortion meter, weighting filter ITU-R, ITU-T	FMB with option FMA-B1, FMA-B2, FMA-B3, FMA-B4	856.5005.52 855.2002.52 855.0000.52 856.0003.52 855.6008.52	Residual FM Residual AM AM/FM/PhiM modulation LF generator Stereo modulation
11	Sinewave generator	10 Hz to 500 kHz, 8 V (V_{peak})	ADS AFG	1012.4002.02 377.2100.02	AM/FM/PhiM modulation Overvoltage protection
12	AC/DC voltmeter	DC to 1 MHz	URE3	350.5315.03	LF generator
13	Low-noise preamplifier	5 kHz to 1100 MHz Gain >20 dB, Noise figure <10 dB			Level accuracy

Test Setups

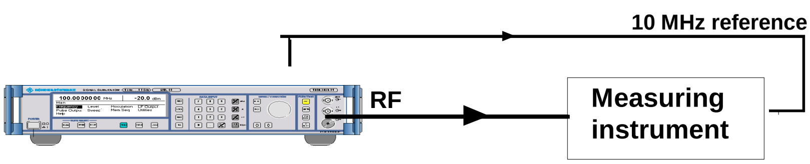
Standard Test Setup

Test setup 1:

Test equipment

- Modulation analyzer (Table Measuring equipment and accessories, item 10)
  or
- Spectrum analyzer (Table Measuring equipment and accessories, item 2)
  or
- Frequency counter (Table Measuring equipment and accessories, item 1)

Test setup



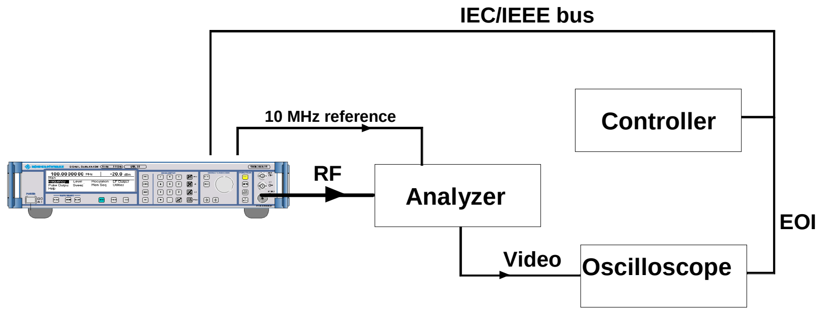
Test Setup for Setting Time

Test setup 2:

Test equipment

- Spectrum analyzer with video output (Table Measuring equipment and accessories, item 2)
- Storage oscilloscope (Table Measuring equipment and accessories, item 4)
- Controller (Table Measuring equipment and accessories, item 8)

Test setup



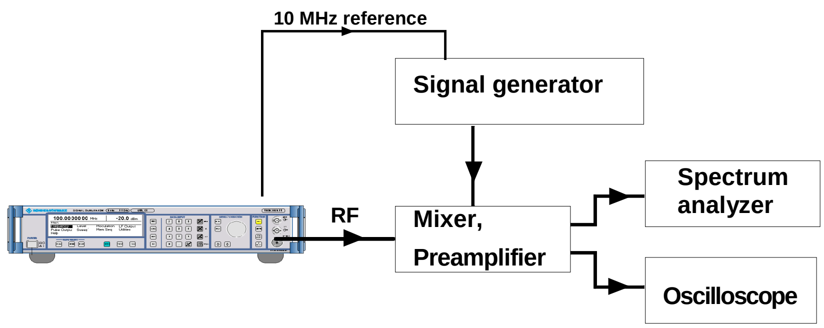
Test Setup for SSB Phase Noise and Broadband Noise

Test setup 3:

Test equipment

- Second signal generator (Table Measuring equipment and accessories, item 3)
- Phase noise test set, consisting of
- Mixer with lowpass and preamplifier (Table Measuring equipment and accessories, item 5)
- Oscilloscope (Table Measuring equipment and accessories, item 4)
- Spectrum analyzer (Table Measuring equipment and accessories, item 2)

Test setup



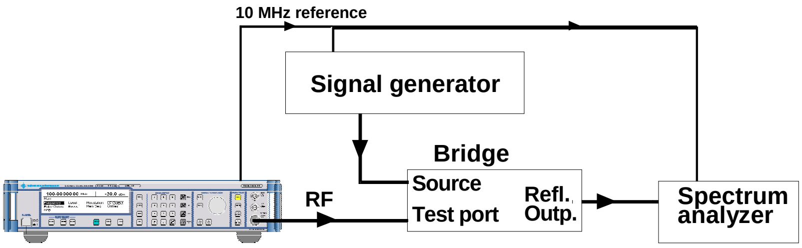
Test Setup for Output Reflection Factor

Test setup 4:

Test equipment

- SWR bridge (Table Measuring equipment and accessories, item 9)
- Second signal generator (Table Measuring equipment and accessories, item 3)
- Spectrum analyzer (Table Measuring equipment and accessories, item 2)

Test setup



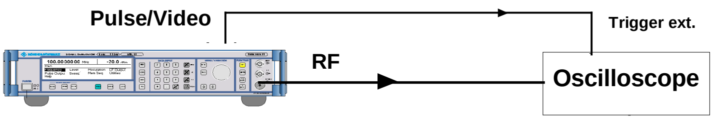
Note: *The test port of the bridge is screwed to the EUT. The INPUT connector of the directional coupler is screwed to the EUT. The second signal generator is connected to the output and the analyzer to the decoupling output (-13 dB).*

Test setup 5:

Test equipment

- Storage oscilloscope (Table Measuring equipment and accessories, item 4)

Test setup



Note: *Since the oscilloscope has a high-impedance input, the BNC line at the oscilloscope has to be terminated with 50 Ω via a T piece.*

Test Procedure

Display and Keyboard

Testing Display

- ➢ Switch on unit.
  - ⇨ The basic menu is displayed after a few seconds.
- ➢ Change setting in menu item UTILITIES DISPLAY CONTRAST using the rotary knob
  - ⇨ The contrast changes from dark to bright.

Testing Keyboard

- ➢ Press keys and check response on display.

Frequency

Frequency Setting

Test setup

- ➢ Test setup 1 with frequency counter

Settings on SML

- UTILITIES REF OSC SOURCE EXTERN
- LEVEL: 0 dBm
- FREQ: *Test frequency, frequency accuracy*
  Test frequencies, frequency accuracy: 60 MHz, 100 MHz, 250 MHz, 600 MHz, 1000 MHz

Measurement

- ➢ The measured values should be indicated at the accuracy allowed by the resolution of the frequency counter.

Setting Time

Test setup

- Test setup 2

Test method

The spectrum analyzer is operated as a slope detector with a 0 Hz span. A controller transmits the start and target frequency via the IEC/IEEE bus. The storage oscilloscope is connected to the video output of the analyzer and triggered on the EOI line of the IEC/IEEE bus by the positive edge. If the controller switches from start to end frequency, the settling process can be observed on the storage oscilloscope.

Preparation of measurement

- Synchronize reference frequencies of SML and analyzer.
- Make IEC/IEEE-bus and RF connections.
- Connect storage oscilloscope to video output of analyzer.
- Apply trigger line to EOI line (pin 5) of IEC/IEEE bus.
- Settings on storage oscilloscope
  - Time base > settling time to be measured,
  - Sensitivity according to video output of analyzer,
  - Triggering of calibration is free-running.
- Settings on spectrum analyzer
  - Reference level -5 dBm,
  - Amplitude scale 1 dB/div,
  - Resolution bandwidth 10 kHz,
  - Video bandwidth 100 kHz,
  - Span 30 kHz.
- Reduce center frequency of analyzer starting from the end frequency so that the filter edge is displayed at the center of the screen.
- Reduce span to 0 Hz and calibrate frequency scale on (free-running) oscilloscope by 100 Hz steps on SML.

Settings on SML

- LEVEL 0 dBm
- UTILITIES REF OSC SOURCE EXTERN

Measurement

- Setting on storage oscilloscope see above
  - Now external triggering on positive edge at 1.5 V.
- First send start and then end frequency from controller.
  - ⇨ The settling characteristic is shown on the display of the externally triggered oscilloscope.
- Repeat measurement by interchanging the start and end frequencies.

The following settings are to be measured in both directions:

Start frequencies	Target frequencies
303 MHz	1075 MHz
75 MHz	810 MHz

Quick Basic program for controller:

```
CLS
iecadresse% = 28                                   IEC/IEEE-bus address of SML (28)
CALL IBFIND("DEV1", generator%)                    Open DEV1 and get access number
CALL IBPAD(generator%, iecadresse%)                Set IEC/IEEE-bus address of DEV1 to 28
iecterm% = &HA '                                   Set EOS to LINE FEED
CALL IBEOS(generator%, iecterm% + &H800)
CALL IBWRT(generator%, "POW 0dBm")
DO
  INPUT "Start 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$(27) '                     Quit with ESCAPE
  INPUT "Repetition (y/n)"; w$
LOOP UNTIL NOT UCASE$(w$) = "J"
END
```

Reference Frequency

Note *Warm up SML for at least 2 hours prior to measurement.*

Test equipment: Frequency counter (Section "Measuring Equipment and Accessories", item 1)

Test setup:
- ➢ Connect frequency counter to output REF EXT at rear of SML.

Measurement:
- ➢ Measure frequency.

Evaluation: The frequency error should not exceed the sum of errors made up of the frequency error in the nominal temperature range and ageing.

Spectral Purity

Harmonic Suppression

Test setup	➢ Test setup 1 with spectrum analyzer
Settings on SML	- LEVEL 10 dBm (or max. level according to data sheet) - FREQ *test frequency of harmonics* Test frequency of harmonics: 9 kHz, 5 MHz, 76 MHz, 100 MHz, 151 MHz, 200 MHz, 255 MHz, 400 MHz, 605 MHz, 700 MHz, 900 MHz, 1100 MHz
Setting on spectrum analyzer	- Reference level= test level+10 dB, 10 dB/div - Span 300 kHz, resolution 30 kHz
Measurement	➢ First measure the fundamental level as reference, then search signals at twice or three times the carrier frequency. Make sure that spectrum analyzer is not overdriven.
Evaluation	The harmonic suppression is the level difference between the measured harmonic and the SML output signal (in dBc, with reference to the carrier).

Nonharmonic Suppression

Test setup	➢ Test setup 1 with spectrum analyzer
Settings on SML	- UTILITIES REF OSC SOURCE EXTERN - LEVEL 10 dBm - FREQ *test frequency of nonharmonics* Test frequencies of nonharmonics: 899.052 MHz, 1080.003 MHz, 1086.2 MHz, 1086.9535 MHz, 1098.956 MHz, 1095.002 MHz, 979.713 MHz, 927.2776 MHz, 1022.438 MHz, 987.315 MHz, 980.729 MHz
Setting on spectrum analyzer	- Reference level= test level + 3 dB, 10 dB/div - Start frequency = test frequency – 5 kHz, span 100 kHz - Resolution 1 kHz - Switch on average: 5 samples
Measurement	➢ First measure level of fundamental as reference. Then measure level of nonharmonics, if any.
Evaluation	The nonharmonic suppression is the level difference between the measured nonharmonic and the SML output signal (in dBc with reference to the carrier).

Note: *The values for setting the spectrum analyzer are reference values and depend on the analyzer used. The required settings have to be verified prior to each measurement.*

SSB Phase Noise

Test setup

- Test setup 3

Settings on SML

- UTILITIES. REF OSC SOURCE EXTERN
- LEVEL 0 dBm (or level to mixer specification)
- FREQUENCY 1 GHz (or any test frequency)

Test method

The two signal generators are set to the test frequency and synchronized with a phase shift of 90° (phase quadrature). The RF carrier is suppressed by mixing to 0 Hz. Due to the phase quadrature the mixer supplies a voltage that corresponds to the phase difference between the input signals. The phase difference is measured by the spectrum analyzer and can be converted into SSB phase noise.

Measurement

- Set levels of two signal generators according to the specifications of the used mixer.
- For calibration purposes reduce level of EUT by 40 dB and detune a signal generator by 20 kHz. Test signal for harmonics, the 2nd and 3rd harmonic should be more than 30 dB below the fundamental. Measure and note reference value at 20 kHz on analyzer.
- Revoke detuning and establish phase quadrature. To do this, set level of EUT again and detune phase offset on auxiliary generator. Observe mixer output voltage on oscilloscope until the voltage becomes 0.
- Read noise voltage on analyzer that is normalized to a bandwidth of 1 Hz (noise level).

Evaluation

- Form the difference to the reference level and add 6 dB for the measured (correlated) second sideband and 40 dB to level switching. If the noise level of the second signal generator is not at least 10 dB better than that of the EUT, the noise component of the reference transmitter too has to be determined and calculated.

⇨ The value found gives the correct noise level.

Example: *The reference level is to be measured at 12 dBm. At 20 kHz a noise level of -78 dBm (1 Hz) is determined. The difference is 90 dB. In addition to the correction for the second sideband (6 dB) and the level switching (40 dB) a noise level of -136 dB or of -136 dBc (dB with reference to the carrier power) is obtained. If two identical signal generators are used, the result has to be reduced by 3 dB for the (uncorrelated) noise power of the reference transmitter.*

The final result is then -139 dBc.

Broadband Noise

Test setup

- Test assembly 3

Settings on SML

- UTILITIES REF OSC SOURCE EXTERN
- LEVEL 0 dBm (or level according to mixer specification)
- FREQUENCY 1 GHz (or any test frequency)

Test method

Calibration is in the same way as with SSB phase noise. To perform the measurement, the signal generators are detuned so that the difference frequency falls in the stopband range of the lowpass filter for sufficient suppression of the measurement. Then measure a section of the sum of broadband noise contributions imaged at the zero line on the spectrum analyzer. The noise spaced at the difference frequency now is at 0 Hz on the spectrum analyzer. The measurement is performed at the calibration frequency (20 kHz). This frequency should be negligibly small compared to the difference frequency. The measured power must be divided by half due to the imaging at the zero line.

Measurement

- Calibration is in the same way as with SSB phase noise.
- Detune to offset frequency (2 MHz).
- Set level of the EUT again and read noise power per Hz on analyzer at a center frequency of 20 kHz.

Evaluation

- Form the difference to the reference level and add 43 dB for the level switching and the image-frequency band.
- The measured value is the sum of the noise power of the two signal generators. If the noise level of the second signal generator is not at least 10 dB better than that of the EUT, the noise component of the reference transmitter too has to be determined. Since the reference transmitter is at the LO input, only the phase noise component has to be considered. It is 3 dB lower than the whole broadband noise (AM component is suppressed). With two identical transmitters the correction is thus another 1.8 dB. Note that the reference transmitter has a higher level which further improves the noise level.

  ⇨ The value found gives the correct noise level.

Residual FM

Test setup	➢ Test setup 1 with modulation analyzer
Settings on SML	- LEVEL 0 dBm - FREQ 1 GHz
Setting on modulation analyzer	- Demodulation: FM - Detector: RMS - Filter: ITU-T (CCIT) or 20 Hz to 23 kHz
Measurement	➢ Read frequency deviation on modulation analyzer on both filters.

Residual AM

Test setup	➢ Connect modulation analyzer to RF output of SML.
Settings on SML	- LEVEL 0 dBm - FREQ 1 GHz
Setting on modulation analyzer	- Demodulation: AM - Detector: RMS - Filter: 20 Hz to 23 kHz
Measurement	➢ Read residual AM on modulation analyzer.

Level

Level Frequency Response and Linearity

Test equipment	- Power meter (Table Measuring equipment and accessories, item 6) - Precision attenuator (Table Measuring equipment and accessories, item 7) - Spectrum analyzer (Table Measuring equipment and accessories, item 2) - Low-noise preamplifier (Table Measuring equipment and accessories, item 13)

Test method for level in measurement range of power meter (up to approx. - 20 dBm)

Test setup	➢ Connect power meter to RF output connector.
Settings on SML	- FREQ *Test frequency level accuracy* Test frequencies: 9 kHz, 5 MHz, 5.1 MHz, 76 MHz, 77 MHz, 151 MHz, 255 MHz, 302 MHz, 605 MHz, 606 MHz, 725 MHz, 970 MHz, 1100 MHz - LEVEL *Test level 1 level accuracy* Test level 1: 13 dBm, 10 dBm, 5.1 dBm, 5 dBm, 0 dBm, -5 dBm, -10 dBm, -15 dBm, -19.9 dBm, -20.0 dBm
Settings on power meter	- Carry out a ZEROING prior to level measurements. - The level on SML is switched off with RF OFF.
Measurement	➢ Measure level at test frequencies. ⇨ The frequency response is the difference between the highest and lowest measured value. ⇨ The level error is the deviation from the set value.

Measurement procedure for low levels (>-115 dBm)

***Caution**: The precondition for correct measurement is that the used components are wholly RF-shielded.*

Test method	Levels below the measurement range of the power meter can be measured by a comparison measurement using a precision attenuator and a sensitive test receiver or spectrum analyzer. The reference is formed by a level measurement for example at 10 dBm by means of the power meter.
Test setup	➢ Connect a precision attenuator to the RF connector of SML. Connect the attenuator output to a spectrum analyzer via RF-leakage-proof test cables. ➢ Connect 10 MHz references with each other.
Settings on SML	- FREQ *Test frequency Level accuracy* Test frequencies: 9 kHz, 5 MHz, 5.1 MHz, 76 MHz, 77 MHz, 151 MHz, 255 MHz, 302 MHz, 605 MHz, 606 MHz, 725 MHz, 970 MHz, 1100 MHz - LEVEL 10 dBm - UTILITIES REF OSC SOURCE EXT

Settings on test receiver or analyzer
- Center frequency = test frequency
- Span = 0 Hz

Settings on precision attenuator
- Attenuation = 125 dB

Measurement
- ➢ Read level on test receiver or analyzer and note down as reference value. It should be at 10 dBm -125 dB. Select measurement bandwidth to small value to obtain an accurate reading.
- ➢ Now repeat measurement at the settings given in Table 10-1 "Test level 2 Level accuracy".
  SML01: reference level = 10 dBm
  - ⇨ The deviation from the reference value shown on analyzer display is the level error.

Measurement at levels <-115 dBm

***Caution**: The precondition for correct measurement is that the used components are wholly RF-shielded.*

Test setup
- ➢ Switch a low-noise preamplifier between SML and precision attenuator.

Measurement
- ➢ Perform a calibration at a measured level.
  - ⇨ It is thus possible to measure levels down to the lower limit of SML.

Table 10-1 Test level2 Level accuracy

Level on SML	**Attenuation of attenuator**
Reference level	125 dB
Reference level -5 dB	120 dB
Reference level -10 dB	115 dB
Reference level -20 dB	105 dB
Reference level -40 dB	85 dB
Reference level -60 dB	65 dB
Reference level -80 dB	45 dB
Reference level -100 dB	25 dB
Reference level -120 dB	5 dB
Reference level -125 dB	0 dB

Output Reflection Coefficient

Test setup

Test setup 4 (output reflection coefficient).

Measurement procedure

Since the SWR of a source is to be measured, a purely passive measurement using the SWR bridge is only possible at levels for which the SWR is determined by the output impedance of the electronic attenuator.

For higher levels, the effect of level control has to be considered. This is done by means of an auxiliary generator which sends a wave with a slightly offset carrier frequency (difference frequency within the level bandwidth of level control) to the EUT. The carrier frequency is superimposed by the outgoing wave. Given an ideal internal impedance, the outgoing wave of the EUT alone flows back to the SWR bridge. At any other internal impedance, there is a superposition of the two components which, due to the frequency offset, results in a beat. The SWR can be concluded from the amplitude ratio of this beat.

Settings on SML

- LEVEL 5.1 dBm, 0.1 dBm
- FREQ test frequency SWR

  Test frequency: 100 MHz, 500 MHz, 800 MHz, 1 GHz, 1.1 GHz

Settings on spectrum analyzer

- Center frequency = test frequency
- Span = 0 Hz
- Reference level= test level
- Resolution and video bandwidth = 10 kHz
- Linear level scale
- Sweep time = 30 ms

Settings on 2nd signal generator

- Frequency = test frequency – 100 Hz
- first RF OFF

Measurement

➢ Now bring displayed line to center of screen by changing the reference level and note down level as reference level.

➢ Unscrew SWR bridge from SML and increase level on second signal generator so that the reference level is again measured on the analyzer.

➢ Screw SWR bridge or directional coupler again to SML.

⇨ A more or less undulating line can now be seen on the spectrum analyzer. This line represents the SWR of SML.

Calculate SWR from the maximum and minimum voltage according to the following equation:

$$SWR = u_{max}/u_{min}.$$

Passive measurement of SWR at output levels of SML below -25 dBm

Settings on SML
- LEVEL –25 dBm, -40 dBm
- FREQ far from test frequency (>10 MHz)

Settings on 2nd signal generator
- Frequency = test frequency
- Level = 10 dBm

Measurement
- ➢ Unscrew SWR bridge from EUT and note down level measured on analyzer as reference value.
- ➢ Screw on SWR bridge or directional coupler again and determine new level on analyzer.
  - ⇨ The test level/reference level voltage ratio is the output reflection coefficient r of the EUT.
- ➢ Determine the standing wave ratio (SWR) according to the following formula
  SWR = (1+r)/(1-r).

Setting Time

Test setup

Test setup 2 (setting time)

Test method

The spectrum analyzer is operated as a fast level meter at a span of 0 Hz. A controller transmits the start and end frequency via IEC/IEEE bus. The storage oscilloscope is connected to the video output of the analyzer and triggered on the EOI line of the IEC/IEEE bus by the positive edge. If the controller switches from start to end frequency, the settling process can be seen on the storage oscilloscope.

Preparing measurement

- ➢ Synchronize reference frequencies of SML and analyzer.
- ➢ Make IEC/IEEE-bus and RF connections.
- ➢ Connect storage oscilloscope to video output of analyzer.
- ➢ Apply trigger line to EOI line (pin 5) of IEC/IEEE bus.
- ➢ Settings on storage oscilloscope
  - Timebase 5 ms/div,
  - Sensitivity according to video output of analyzer.
- ➢ Settings on spectrum analyzer
  - Reference level 10 dBm,
  - Amplitude scale 10 dB/div,
  - Resolution bandwidth 300 kHz,
  - Video bandwidth 300 kHz,
  - Span 0 Hz.

Settings on SML
- FREQ 1 GHz

Measurement

- Setting on storage oscilloscope
  - External triggering on positive edge at 1.5 V.
- First send start and then end level from controller.
  - ⇨ The level characteristic from the moment of triggering is displayed on the externally triggered oscilloscope.
- Repeat measurement by interchanging the start and end levels.
- Measure the following settings in both directions.

Setting	Start level	End level	Remark
CW	–140 dBm	13 dBm	With electric attenuator, only to target level
CW	-24.9 dBm	13 dBm	With electric attenuator
AM 30%	2.1 dBm	10 dBm	Without electric attenuator

Quick Basic program for controller

```
CLS
iecadresse% = 28                                    IEC/IEEE-bus address of SML (28)
CALL IBFIND("DEV1", generator%)                     Open DEV1 and get access number
CALL IBPAD(generator%, iecadresse%)                 Set IEC/IEEE-bus address of DEV1 to 28
iecterm% = &HA '                                    Set EOS to LINE FEED
CALL IBEOS(generator%, iecterm% + &H800)
CALL IBWRT(generator%, "FREQ 1GHz")
DO
  INPUT "Start level in dBm";P1$
  INPUT "Stop level in dBm";P2$
  DO
   CALL IBWRT(generator%, "POW" + P1$ + "dBm")
   PRINT "Level: ";P1$; "dBm"
   DO '                                             Wait for key
     kbd$ = INKEY$
   LOOP UNTIL LEN(kbd$)
   SWAP P1$, P2$
  LOOP UNTIL kbd$ = CHR$(27) '                      Quit with ESCAPE
  INPUT "Repetition (y/n)"; w$
LOOP UNTIL NOT UCASE$(w$) = "J"
END
```

Non-interrupting Level Setting (ATTENUATOR FIXED)

Test setup — Test setup1 with spectrum analyzer

Settings on SML
- FREQ *test frequencies ATT-FIX*
  Test frequencies: 9 kHz, 5.1 MHz, 1100 MHz
- LEVEL 5.1 dBm
- LEVEL LEVEL ATTENUATOR MODE FIXED

Measurement
➢ Note down level read on analyzer as reference level or set delta marker for relative measurement to 0 dB.

➢ Now reduce level in steps of 5 dB on SML.

⇨ Do not exceed the following values.

Reduction in dB ATT FIXED	**Tolerance in dB**
5	0.4
10	0.6
15	1.2
20	3.0

Overvoltage Protection

Test equipment — Sinewave generator (Table Measuring equipment and accessories, item 11)

Test setup — ➢ Connect sinewave generator to RF output of SML.

Settings on SML
- LEVEL -140 dBm
- FREQ 100 MHz

Settings on sinewave generator
- Frequency = 20 kHz
- Output impedance = 50 Ω
- Level = 1 V
- Level offset = ±5 V

Measurement
➢ Increase output level of sinewave generator up to 10 V max. (EMF)

⇨ At a voltage (offset+EMF/2) >4 V and < 7.5 V the overvoltage protection should respond at both polarities.

Internal Modulation Generator

Note: *The setting time is a pure computing time and does not have to be measured.*

Level Accuracy

Test equipment	AC voltmeter (Table Measuring equipment and accessories, item 12)
Test setup	➢ Connect AC voltmeter to LF connector of SML.
Settings on SML	- LF OUTPUT STATE ON - LF OUTPUT LFGen 1 kHz - LF OUTPUT VOLTAGE *test level LFGen* Test level: 3 mV, 10 mV, 100 mV, 1 V, 4 V
Measurement	➢ Measure output level

Frequency Response

Test equipment	AC voltmeter (Table Measuring equipment and accessories, item 12)
Test setup	➢ Connect AC voltmeter to LF connector of SML.
Settings on SML	- LF OUTPUT STATE ON - LF OUTPUT VOLTAGE 1 V and 4 V - LF OUTPUT LFGen *test frequencies LFGen* Test frequency: 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 200 kHz to 500 kHz
Measurement	➢ Measure frequency response. ⇨ The frequency response is the difference between the highest and lowest level.

Frequency Accuracy and Distortion

Test equipment	Modulation analyzer (synchronized with SML)
Test setup	➢ Connect LF voltmeter input of modulation analyzer to LF connector of SML. ➢ Connect spectrum analyzer at frequencies >100 kHz.
Settings on SML	- LF OUTPUT STATE ON - LF OUTPUT VOLTAGE 1 V and 4 V - LF OUTPUT LFGen *test frequencies LFGen* For frequency accuracy: 100 Hz, 33.33 kHz, 1 MHz For distortion: 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz
Measurement	➢ Read actual frequency on audio or spectrum analyzer. ➢ Read distortion on audio analyzer.

Amplitude Modulation

AM Deviation Setting

Test assembly	Test setup1 with modulation analyzer
Settings on SML	- LEVEL 0 dBm - FREQ test frequencies of AM deviation Test frequencies: 100 kHz, 1 MHz, 5 MHz, 5.1 MHz, 76 MHz, 100 MHz, 200 MHz, 500 MHz, 800 MHz, 1100 MHz - MODULATION AM AM DEPTH test deviation of AM deviation Test deviation of AM deviation: 1%, 30%, 80% AM SOURCE LFGen LFGenFreq 1 kHz
Measurement	➢ Read modulation depth on modulation analyzer.

AM Frequency Response

Test assembly	Test setup1 with modulation analyzer
Settings on SML	- LEVEL 0 dBm - FREQ *test frequencies of AM frequency response* Test frequencies: 350 kHz, 5,1 MHz, 1100 MHz - MODULATION AM AM DEPTH 60% AM SOURCE: LFGen LFGenFreq 10 Hz to 50 kHz
Measurement	➢ Determine modulation frequency response by varying the LF generator frequency. ➢ Repeat measurement with external sinewave generator with setting MODULATION AM AMSOURCE EXT. (Setting on sinewave generator: 1 Vpeak) ⇨ The modulation frequency response is the difference between the highest and lowest modulation depth.

AM Distortion

Test assembly — Test setup1 with modulation analyzer

Settings on SML
- LEVEL 2.1 dBm and 8 dBm
- FREQ *test frequencies of AM distortion*
  Test frequencies: 100 kHz, 5 MHz, 5.1 MHz, 76 MHz, 100 MHz, 200 MHz, 500 MHz, 800 MHz, 1100 MHz
- MODULATION AM AM DEPTH 30%, 80%
  AM SOURCE LFGen
  LFGenFreq 1 kHz

Measurement
- ➢ Read distortion on modulation analyzer.

Residual PhiM at AM

Test assembly
- ➢ Test setup 1 with modulation analyzer

Settings on SML
- LEVEL 8 dBm
- FREQ *test frequencies of residual PhiM*
  Test frequencies: 100 kHz, 5 MHz, 5.1 MHz, 76 MHz, 100 MHz, 200 MHz, 500 MHz, 800 MHz, 1100 MHz
- MODULATION AM AM DEPTH 30%,
  AM SOURCE LFGen
  LFGenFreq 1 kHz

Measurement
- ➢ Measure the phase modulation obtained with 23-kHz lowpass filter and peak weighting on modulation analyzer.

Frequency Modulation

FM Deviation Setting

Test setup
- ➢ Test setup 1 with modulation analyzer

Settings on SML
- LEVEL 0 dBm
- FREQ 1 GHz
- MODULATION FM FM DEVIATION 100 kHz
  FM SOURCE LFGen
  LFGenFreq 1 kHz

Setting on modulation analyzer
Demodulation: FM
Detector: peak detector
Filter: 20 Hz to 23 kHz

Measurement
- ➢ Read frequency deviation on modulation analyzer

Note: *SML has a purely digital deviation control so that it is sufficient to check its functionality at one deviation setting and one frequency only.*

FM Frequency Response

Test setup

- ➢ Test setup 1 with modulation analyzer

Settings on SML

- LEVEL 0 dBm
- FREQ 1 GHz
- MODULATION FM FM DEVIATION 100 kHz
  FM SOURCE LFGen

Setting on modulation analyzer

Demodulation: FM
Detector: peak detector

Measurement

- ➢ The modulation frequency response is determined by varying the generator frequency of the internal LF generator in the FM menu from 10 Hz to 100 kHz. It is obtained from the difference between the lowest and highest measured deviation.

Note: *Since there is no difference between the FM and PHiM frequency response, the measurement of the wide FM loop can be omitted. The measurement of the wide PhiM loop can be performed on the spectrum analyzer and is thus much more easier. The modulation analyzer only has a bandwidth of approx. 200 kHz.*

FM Distortion

Test setup

Test setup 1 with modulation analyzer

Settings on SML

- LEVEL 0 dBm
- FREQ *test frequency of FM distortion*
  Test frequencies: 605.5 MHz, 650 MHz, 700 MHz, 750 MHz, 807 MHz
- MODULATION:FM:FM DEVIATION 500 kHz
  FM SOURCE: LFGen
  LFGenFreq 1 kHz

Setting on modulation analyzer

Demodulation: FM
Detector: peak detector
Audio: distortion

Measurement

- ➢ Read distortion on modulation analyzer.

Residual AM at FM

Test setup
- ➢ Test setup 1 with modulation analyzer

Settings on SML
- LEVEL 0 dBm
- MODULATION FM FM DEVIATION 40 kHz
  FM SOURCE LFGen
  LFGenFreq 1 kHz
- FREQUENCY: *test frequency of residual AM*
  Test frequencies: 10 MHz, 75 MHz, 100 MHz, 300 MHz, 500 MHz, 800 MHz, 1100 MHz

Setting on modulation analyzer
Demodulation: AM
Detector: RMS
Lowpass filter: 23 kHz

Measurement
- ➢ Set test frequencies on SML and read residual AM on modulation analyzer.

Carrier Frequency Error at FMDC

Test setup
- ➢ Test setup 1 with frequency counter

Settings on SML
- UTILITIES CALIB FM OFFSET
- UTILITIES REF OSC SOURCE EXTERN
- LEVEL 0 dBm
- MODULATION FM FM DEVIATION 100 kHz
  FM SOURCE EXT
  EXT COUPLING DC
- FREQ *test frequency FMDC*
  Test frequencies: 630 MHz, 680.5 MHz, 667.6 MHz, 674.7 MHz, 669 MHz, 672 MHz, 617.6 MHz, 641.2 MHz, 640.2 MHz, 641.1 MHz

Measurement
- ➢ Read frequency on frequency counter. The difference to the set RF frequency on SML is the center frequency error.

Note: *This value is not specified but is normally less than 0.1% of the set deviation and thus less than 100 Hz at a set deviation of 100 kHz.*

Crosstalk Attenuation at FM Stereo

Test setup	➢ Test setup 1 with modulation analyzer ➢ Connect connector AF1 of stereocoder to input MOD on SML
Settings on SML	- LEVEL 0 dBm - MODULATION FM FM DEVIATION 46.5 kHz FM SOURCE EXT EXT COUPLING DC - FREQ test frequency stereo Test frequencies: 87 MHz, 98 MHz, 108 MHz
Setting on modulation analyzer	Switch on stereo signal 1 kHz on stereocoder, set level of useful signal to peak deviation of 40 kHz and level of pilot tone to 6.5 kHz peak deviation. Demodulation: FM STEREO CHANNEL: L or R DETECTOR RMS FILTER: 10 Hz to 100 kHz Deviation measurement is relative
Measurement	➢ On stereocoder switch on left channel and perform relative measurement. Then switch to right channel on demodulator and read crosstalk attenuation. Then perform the same measurement with the right channel.

Distortion FM Stereo

Test setup	➢ See Crosstalk Attenuation at FM Stereo
Settings on SML	- See Crosstalk Attenuation at FM Stereo
Setting on modulation analyzer	- Stereo signal like for crosstalk attenuation measurement - Demodulation: FM STEREO - CHANNEL: L or R - DETECTOR RMS - FILTER: 10 Hz to 100 kHz - AUDIO: switch on distortion
Measurement	➢ Read distortion on modulation analyzer ➢ Perform measurement for left and right channel.

S/N Ratio of FM Stereo

Test setup
➢ See Crosstalk Attenuation at FM Stereo

Settings on SML
- See Crosstalk Attenuation at FM Stereo

Setting on modulation analyzer
- Stereo signal like for crosstalk attenuation measurement
- Demodulation: FM STEREO
- CHANNEL: L or R
- FILTER: CCIR WT or UNWT
- DETECTOR RMS
- Deviation measurement relative
- DEEMPHASIS 50 µs

Measurement
➢ On stereocoder switch on left or right channel and perform relative measurement. Then switch off useful signal on stereocoder and read S/N ratio. Carry out measurement for both filters (weighted and unweighted). Then switch on right channel and repeat the same measurement.

Phase Modulation

PhiM Deviation Setting

Test setup
➢ Test setup 1 with modulation analyzer

Settings on SML
- LEVEL 0 dBm
- FREQ 1 GHz
- MODULATION PhiM PHiM DEVIATION 5 rad
  PhiM SOURCE LFGen
  LFGenFreq 1 kHz

Setting on modulation analyzer
- Demodulation: PhiM
- Detector: peak detector
- Filter: 20 Hz to 23 kHz

Measurement
➢ Read phase deviation on modulation analyzer

Note: *SML has a purely digital deviation control so that it is sufficient to check its functionality at one deviation setting and one frequency only.*

PhiM Frequency Response

Test setup	➢ Test setup 1 with spectrum analyzer
Settings on SML	- UTILITIES REF OSC SOURCE EXT - LEVEL 0 dBm - FREQ 1 GHz - MODULATION PhiM PHiM DEVIATION 0.5 rad PHiM SOURCE INT PHiM BANDWIDTH STANDARD/WIDE
Setting on spectrum analyzer	- Start frequency 1 GHz - Span 500 kHz at wide loop/100 kHz at standard loop - LEVEL RANGE 20 dB - RES BW 10 kHz/3 kHz - Switch on MAX HOLD function
Measurement	➢ By varying the generator frequency of the LF generator from 1 kHz to 100 kHz or with wide loop of up to 500 kHz, the PHiM frequency response appears on the spectrum analyzer. The difference measurement between the maximum and minimum point of the characteristic is the modulation frequency response. The carrier frequency at the left margin of the spectrum analyzer is not considered.

Note: *Since there is no difference between the FM and PHiM frequency response, the standard PhiM loop can be measured analog to the FM frequency response.*

PhiM Distortion

Test setup	➢ Test setup 1 with modulation analyzer
Settings on SML	- LEVEL 0 dBm - FREQ 1 GHz - MODULATION PhiM PHiM DEVIATION 5 rad FM SOURCE LFGen LFGenFreq 1 kHz
Setting on modulation analyzer	- Demodulation: PHiM - Detector: peak detector - Audio: distortion
Measurement	➢ Read distortion on modulation analyzer

Pulse Modulation (Option SML-B3)

On/Off Ratio

Test setup
➢ Test setup 1 with spectrum analyzer

Settings on SML
- LEVEL 10 dBm
- FREQ 1 GHz
- MODULATION PULSE PULSE SOURCE OFF

Setting on spectrum analyzer
- Center 1 GHz
- Span 20 kHz
- Reference level 10 dBm
- Marker peak

Measurement
➢ Note down ON level on spectrum analyzer.

Setting on SML
- MODULATION PULSE PULSE SOURCE EXT
- Make sure that pulse input is not connected.

Setting on spectrum analyzer
- Reference level -50 dBm
- Switch on average: 5 samples
- Peak marker

Measurement
➢ Note down OFF level on spectrum analyzer.

The on/off ratio is calculated from ON and OFF levels.

Dynamic Characteristics

Rise/Fall Time

Test setup
➢ Test setup 5

Settings on SML
- LEVEL 10 dBm
- FREQ 53 MHz
- MODULATION PULSE PULSE SOURCE PULSE GEN
  PULSE PERIOD 0.100 us
  PULSE WIDTH 0.060 us
- PULSE OUTPUT PULSE SOURCE VIDEO

Setting on oscilloscope
- Trigger EXT
- Probe 1x
- X: 5 ns/div
- Y: 5 V/div
- Switch-off delay approx. 1 sec. (if possible)

Measurement
- Measure rise/fall time of 10% to 90% of pulse bursts

Video Crosstalk

Test setup	➢ Test setup 5
Settings on SM	- FREQ 1 GHz - LEVEL 10 dBm - ATT FIXED - LEVEL -100 dBm - MODULATION PULSE PULSE SOURCE PULSE GEN - PULSE PERIOD 0.100 us - PULSE WIDTH 0.060 us - PULSE OUTPUT PULSE SOURCE VIDEO
Setting on oscilloscope	- Trigger EXT - Probe 1x - X: 10 ns/div - Y: 10 mV/div - Switch-off delay approx. 1 sec. (if possible)
Measurement	➢ Measure V_{pp} of video

Performance Test Report

Table 10-2 Performance test report

ROHDE & SCHWARZ	**Performance test report**	**Signal Generator SML**	**Stock No.: 1090.3000.__**
Model (SML01):			
Serial number:			
Tested by:			
Date:			
Signature:			

Parameter tested	**Contained in**	**Min. value**	**Actual value**	**Max. value**	**Unit**	**Tolerance limit**
Display and keyboard	Page 10.5	Tested				
Frequency						
Frequency setting	Page 10.5	Tested				
Setting time	Page 10.6			10	ms	
Reference frequency, deviation	Page 10.7					
Spectral purity						
Harmonics at level ≤10 dBm	Page 10.8			-30	dBc	
Nonharmonics CW, df >10 kHz	Page 10.8			-70	dBc	
SSB phase noise 1 GHz at 20 kHz carrier spacing	Page 10.9			-122	dBc/Hz	
Broadband noise 1 GHz at 2 MHz carrier spacing	Page 10.10			-140	dBc/Hz	
Residual FM rms at 1 GHz	Page 10.11					
0.3 to 3 kHz (ITU-T)				4	Hz	
0.02 to 23 kHz				10	Hz	
Residual AM rms	Page 10.11			0.02	%	

Parameter tested	Contained in	Min. value	Actual value	Max. value	Unit	Tolerance limit
Level						
Frequency response at 0 dBm	Page 10.12			0.5	dB	
Total level error >-127 dBm (temperature range 20 to 30°C)	Page 10.12			± 0.8	dB	
Output impedance SWR	Page 10.14			1.5		
Setting time for f>100 kHz	Page 10.15			10	ms	
Non-interrupting level setting	Page 10.17	Tested				
Overvoltage protection	Page 10.17	Tested				
Internal modulation generator						
Level accuracy at f = 1 kHz	Page 10.18					
3 mV		2		4	mV	
10 mV		9		11	mV	
100 mV		98		102	mV	
1 V		0.989		1.011	V	
4 V		3.959		4.041	V	
Frequency response up to 500 kHz, level >100 mV	Page 10.18			0.5	dB	
Frequency accuracy	Page 10.19			0.24	%	
Distortion f <100 kHz, level 1 V, 4 V, load 600 Ω	Page 10.19			0.1	%	
Amplitude modulation						
Deviation setting at 1 kHz	Page 10.19					
Modulation depth 1 %		0		2	%	
30%		27.8		32.2	%	
80%		75.8		84.2	%	
Frequency response	Page 10.19			3	dB	
Distortion at 1 kHz	Page 10.20					
Modulation depth 30%				1	%	
Modulation depth 80%				2	%	
Synchronous residual PhiM at AM 30%, AF = 1 kHz	Page 10.20			0.2	rad	

Parameter tested	Contained in	Min. value	Actual value	Max. value	Unit	Tolerance limit
Frequency modulation						
Deviation error RF 1 GHz, AF 1 kHz, deviation 100 kHz	Page 10.20	96		104	kHz	
Distortion RF 1 GHz, AF 1 kHz, deviation 500 kHz	Page 10.21			0.2	%	
FM frequency response Standard bandwidth 10 Hz to 100 kHz	Page 10.21			 3	dB dB	
Residual AM at FM, AF=1 kHz, deviation 40 kHz	Page 10.22			0.1	%	
Stereo modulation						
Crosstalk attenuation AF 1 kHz	Page 10.23			50	dB	
S/N ratio AF 1 kHz unweighted, rms weighted, rms	Page 10.24			 70 70	 dB dB	
Distortion AF 1kHz	Page 10.23			0.2	%	
Phase modulation						
Deviation error RF 1 GHz, AF 1 kHz, deviation 5 rad	Page 10.24	4.78		5.22	rad	
Distortion RF 1 GHz, AF 1 kHz, deviation 5 rad	Page 10.25			0.2	%	
PhiM frequency response Standard bandwidth 10 Hz to 100 kHz Bandwidth 10 Hz to 500 kHz	Page 10.25			2 3 3	% dB dB	
Pulse modulation (option SML-B3)						
On/off ratio	Page 10.26			80	dB	
Rise time Fall time	Page 10.26			20	ns	
Video crosstalk	Page 10.27			30	mV	