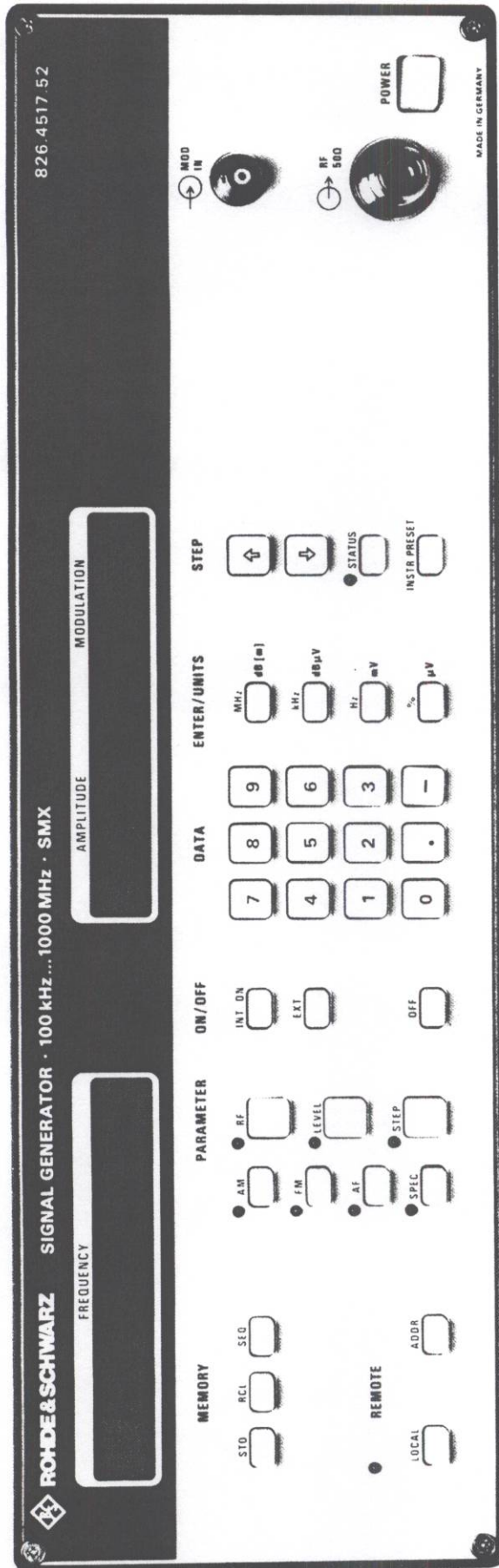




Signal Generator SMX

0.1 to 1000 MHz
AM, FM, pulse modulation

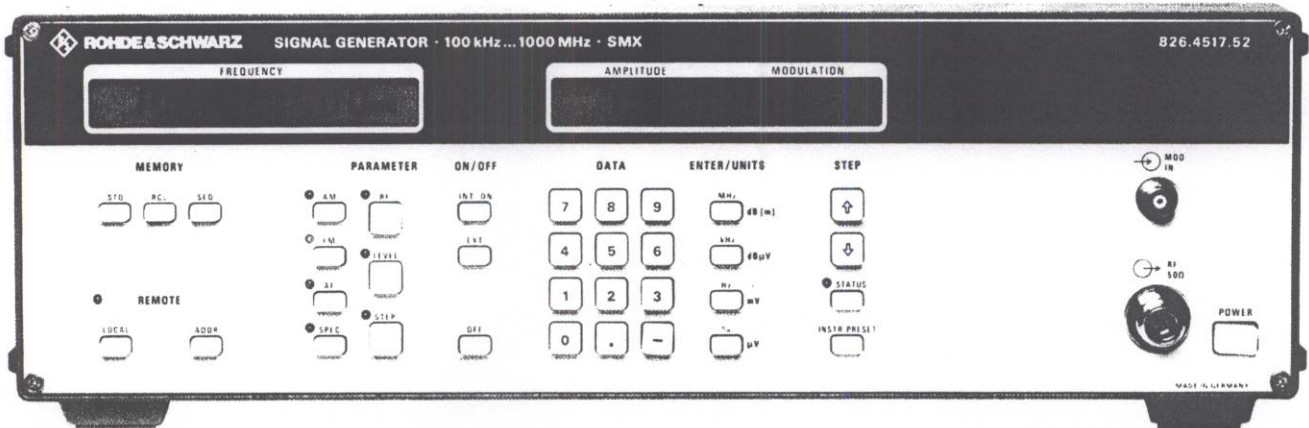
IEC 625Bus IEEE 488

enhanced spectral purity

... value for money



ROHDE & SCHWARZ



- ◆ 0.1 to 1000 MHz
- Cost-effective, system-compatible universal signal source
- Frequency increments 10/50/100 Hz

- Modulation generator with fixed frequencies 0.4/1/3/15 kHz
- Non-volatile memory for 40 instrument setups

- Overload protection up to 30 W
- Options: synthesizer modulation generator and oven-controlled reference oscillator
- Modification kit for low rate FM

The **Signal Generator SMX** is a cost-effective, fully system-compatible synthesizer with excellent signal characteristics and comprehensive basic configuration. It is an economical solution for universal use in laboratory and production as well as for receiver and module testing.

- Overload protection up to 30 W
- Non-volatile memory for 40 complete instrument setups
- Modulation generator with four fixed frequencies
- Remote-control interface IEC 625-1 (IEEE 488)

- Oven-controlled Reference Oscillator SMX-B1 for extremely high frequency accuracy
- AF Synthesizer SMX-B2 (10 Hz to 100 kHz) as an internal modulation source; can be used as AF signal source for external applications

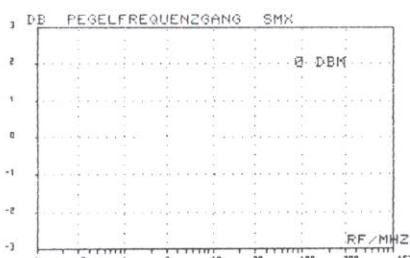
The wide frequency range is produced without a doubler. Underranging is possible down to a lower limit of 10 kHz. The synthesis method of the SMX allows the frequency to be set in increments of 10 Hz in the range up to 100 MHz, of 50 Hz in the

range from 100 to 500 MHz and 100 Hz above 500 MHz. These increments (min. 10 Hz) make the SMX ideally suited for measurements on narrowband test items.

The low total level error of less than ± 1.5 dB ensures accurate and reproducible sensitivity measurements. There are no problems with test items susceptible to overdriving, since no interfering overshoot occurs when changing the level.

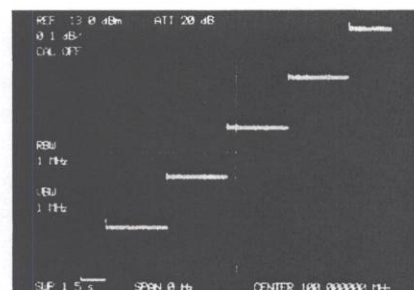
For determining the squelch hysteresis or for testing ALC characteristics, the SMX is provided with non-interrupting level setting over a range of 10 dB, the full 10-dB range being always available irrespective of the preset level.

The low residual FM (< 2 Hz at 250 MHz in line with CCITT) as well as the low single-sideband phase noise and excellent suppression of non-harmonic spurious signals (< -60 dBc up to 1000 MHz) are the outstanding features of the SMX in this class of equipment and price range. The SMX provides the spectral purity that is required for in-channel measurements on AM, FM and SSB receivers. Microphonically generated instabilities remain extremely low, since the RF oscillators are made up of particularly stable coaxial-line resonators.



Typical level frequency response of SMX with 0 dBm output level

Level-settling characteristic with level variations in 0.2-dB steps



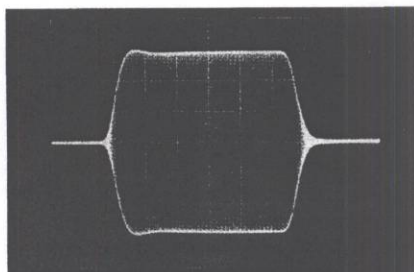
The versatile modulation capabilities of the SMX include AM, FM and pulse modulation (separately and combined AM + FM or PM + FM). The internal or an external modulation source may be used.

For two-tone modulation, the internal and external sources can be switched on simultaneously. The following settings are possible for AM: INT, EXT, INT + EXT; for FM: INT, EXT, INT + EXT and for pulse modulation: EXT.

Frequency modulation is possible up to high modulation frequencies and even with maximum deviation. The frequency response flatness remains smaller than 1 dB up to 500 kHz and is typically 3 dB up to 1 MHz.

The **Low Rate FM (SCM-U1) modification kit** ensures extremely low sag for digital modulation thanks to the very small low-end limit frequency.

With simultaneous AM and FM, modulation depth and deviation can be set separately; different modulation sources (INT, EXT) can be selected. AM and FM ensure high accuracy and low distortion. With pulse modulation full level accuracy is preserved. The RF envelope shows rise/fall times of 2 μ s, the on/off ratio is 40 dB.

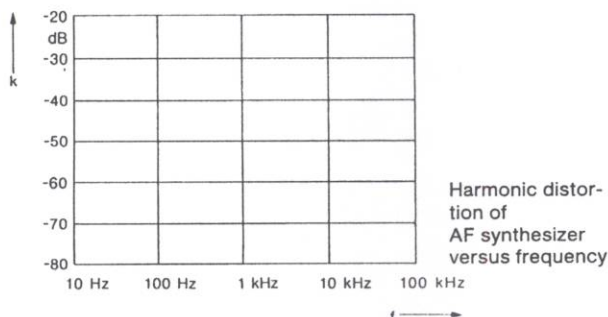


Pulse-modulation characteristics of SMX:
2 μ s/division

Internal modulation sources Two internal modulation sources are available in the SMX:

- the **standard modulation generator** with four fixed frequencies of 0.4/1/3/15 kHz or
- the **optional AF synthesizer** with a frequency range from 10 Hz to 100 kHz, resolution 1 Hz.

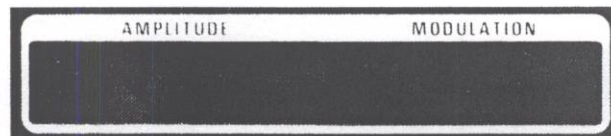
The AF synthesizer is also used as an AF signal source for external applications with an output level of 1 V. The phase-continuous frequency change is particularly noteworthy. The response time between setting command and frequency change is less than 10 ms.



Harmonic distortion of AF synthesizer versus frequency

The external modulation signal must have an input voltage of 1 V. The modulation accuracy depends on the strict compliance with this voltage value. If the modulation voltage differs by more than $\pm 3\%$ from the rated value, this will be signalled on the display.

Carrier frequency, modulation and output levels with units as well as supplementary information can be simultaneously indicated on the illuminated LCD displays. Indication of the desired modulation parameter such as AM depth, FM deviation or internal AF modulation frequency can be selected at a keystroke. Further information, e.g. IEC/IEEE-bus address, device status, special functions selected or diagnostic measurements can be displayed quite simply.



Indication of level (with unit) and modulation with mode (FM_{INT})

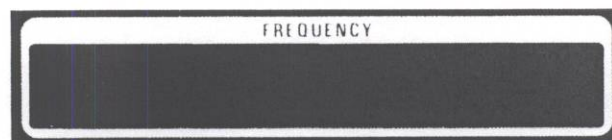
Flexible step variation The STEP keys allow each parameter to be incremented and decremented in any preset step size. When the keys are held down, the corresponding variation is made continuously.

Up to **40 complete instrument setups can be stored in a non-volatile memory** and recalled at any time. This facilitates routine measurements, in particular when using the sequence key which allows complete setups to be called up in a continuous sequence.

Conversion of units The frequency is read out in MHz, kHz or Hz, the level in dBm, dB μ V, mV or μ V. For converting the level into another unit it is only necessary to press the key of the desired unit. The RF voltage can be read out as EMF or as voltage into 50 Ω as desired.

The RF level can be switched off with the OFF key and the stored value recalled with the INT/ON key. The 50- Ω source impedance remains effective in LEVEL OFF mode.

After a **frequency offset** has been selected, OFFSET is indicated on the frequency display. The offset is entered via the keyboard and displayed.



Frequency readout with information that offset has been selected

Switchover between internal and external reference is made by keyboard entry. After selection of the external reference, REF EXT is indicated on the frequency display.

Remote control is possible for listener, talker and service request functions. All front-panel functions can be remotely controlled via the IEC/IEEE bus and in the TALK MODE all current instrument settings can be read out. The output format is the same as used for the settings. The TALK MODE can be used to integrate manually made settings in a control program by means of a user request (LEARN MODE).

The structure of the remote-control commands is particularly logical and gives the user a wide scope. Header and unit of the command are almost identical with the front-panel marking. The commands can be written in full or abbreviated, as desired, to a minimum length.

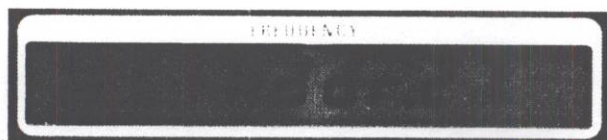
```
100 REM  SMX REMOTE-CONTROL EXAMPLES
110 REM
120 REM  IEC-BUS ADDRESS IS 27
130 REM
140 REM  SET TALK-TERMINATOR TO NEW LINE
150 REM
160 IEC TERM 10
170 REM
180 REM  FETCH SETTINGS RF, RF-OFFSET, LEVEL
190 REM
200 IEC OUT 27, "RF?:RF:OFFSET?:LEV?"
210 IEC IN 27, A$
220 REM
230 PRINT "RESPONSE MESSAGE OF SMX"
240 PRINT A$
RESPONSE MESSAGE OF SMX
RF 101.00000E+6;RF:OFFSET +0.00000E+6;LEVEL -30.0
```

Example of remote-control routine for reading out setting data

By masking of status registers the user determines in which of the following cases a **service request** is to be made:

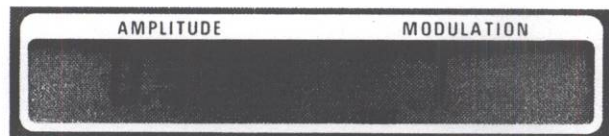
- after switching on the instrument (power on),
- after a request made by the operator via the keyboard,
- after operator errors,
- in case of functional faults of the instrument or
- after termination of a setting.

Setting and display of the IEC/IEEE-bus address is made via the keyboard.



Indication of IEC-bus address on frequency display

Due to permanent monitoring of the internal status a high percentage of functional faults, if any, which may yield erroneous measurement results, is detected. In case of a fault the erroneous conditions are indicated and output via the IEC/IEEE bus.



Indication of test point (right) and voltage value (left)

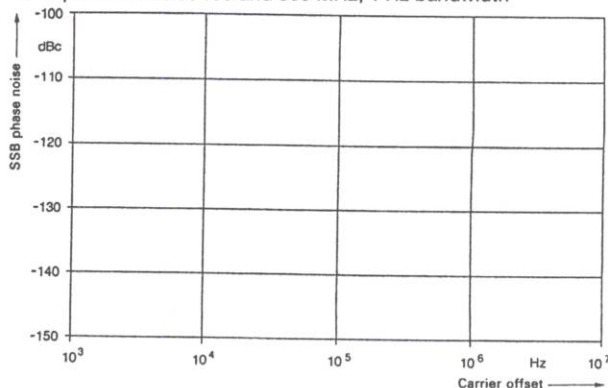
Fast fault diagnosis is possible through internal test points. The instrument can be checked without having to open it and without any external measuring devices. The test points include all essential points of signal generation as well as important RF signal levels. When a test point is called up via the keyboard or IEC/IEEE bus, the number of the test point and the measured value are shown on the display. For data logging the displayed data can be output via the IEC/IEEE bus.

Specifications

Frequency		
Range	100 kHz to 1000 MHz	
RF under-range ¹⁾	down to 10 kHz	
Resolution		
f ≤ 250 MHz	< 25 Hz	
f > 250 MHz	< 100 Hz	
Least increments		
f < 100 MHz	10 Hz	
100 MHz < f < 500 MHz	50 Hz	
f > 500 MHz	100 Hz	
Setting time¹⁾		
with AM and CW	60 ms with offset of 2×10^{-7} or 25 Hz (f < 31.25 MHz) from final frequency value	
with FM	120 ms with offset of 2×10^{-8} or 250 Hz (f < 31.25 MHz) from final frequency value	
Setting error f ≥ 31.25 MHz	< 1×10^{-7} (max. 45 Hz)	
f < 31.25 MHz	< 12 Hz	
Reference frequency		
	standard	option SMX-B1
Aging (after 30 days of operation)	100 MHz	10 MHz
Temperature effect	2×10^{-6} /year	< 1×10^{-9} /day
	2.5×10^{-6} /°C	< 2×10^{-9} /°C
	0 to 50 °C	
Warmup time	15 min	10 min
Frequency error	error of reference + setting error	
Input/output for external/internal reference frequencies		
Output	approx. 0.2 V into 50 Ω	
Frequency	10 MHz	
Input	> 0.1 V _{rms} sinewave or TTL levels	
Frequency	10 MHz ± 50 Hz	
Level		
Range	-137 to +13 dBm	
Resolution	0.1 dB	
Total error for level > -10 dBm	< ±1 dB ²⁾	
for level > -127 dBm	< ±1.5 dB ²⁾	
Frequency response flatness		
at 0 dBm output level	< 1 dB	
Characteristic impedance	50 Ω	
VSWR	< 1.5	
	< 1.8 (f < 8 MHz, level > 0 dBm)	
Setting time	< 25 ms	
Non-interrupting level setting		
Setting range	0 to -10 dB, starting from any level	
Resolution	0.1 to 0.3 dB, depending on attenuation	
Spectral purity		
Spurious signals		
Harmonics	< -30 dBc (for level < 10 dBm)	
Residual AM, rms (0.03 to 20 kHz) ..	< 0.02 % (f ≥ 8 MHz)	
	< 0.07 % (f < 8 MHz)	
	Frequency range	

	0.1 to 31.25	31.25 to 62.5	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
SSB phase noise (carrier offset 20 kHz, 1 Hz bandwidth)	< -130 typ. -136	< -130 -136	< -130 -136	< -128 -134	< -122 -128	< -116 -122	dBc
Non-harmonic spurious signals at > 5 kHz from carrier	< -60	< -72	< -72	< -72	< -66	< -60	dBc
Residual FM, rms 0.3 to 3 kHz (CCITT)	< 3	< 2	< 2	< 2	< 4	< 8	Hz
0.03 to 20 kHz ²⁾	< 8	< 5	< 5	< 5	< 10	< 20	Hz
Broadband noise²⁾							
(carrier offset > 2 MHz, 1 Hz bandwidth)	f ≥ 31.25 MHz ... < -140 dBc (typ. -145 dBc)						
	f < 31.25 MHz ... < -137 dBc (typ. -140 dBc)						

SSB phase noise at 100 and 500 MHz, 1 Hz bandwidth



Amplitude modulation

Modes	INT, EXT, INT + EXT
Modulation depth ¹⁾	0 to 99%
Resolution	0.5%
Setting error at 1 kHz (< 80%) ²⁾	< 4% of reading + resolution
AM distortion at 1 kHz ²⁾	
0 to 30% AM	< 1%
30 to 80% AM	< 2%
Modulation frequency	
AM EXT	DC to 50 kHz
AM INT	0.4/1/3/15 kHz
AM INT with option SMX-B2	10 Hz to 50 kHz
Modulation frequency response flatness ³⁾	
up to 15 kHz	< 0.4 dB (typ. 0.1 dB)
up to 50 kHz	< 1 dB (typ. 0.5 dB)
Incidental ϕ M with AM (30%), AF 1 kHz	< 0.2 rad
Modulation input	
Input impedance	100 k Ω , can be internally changed to 600 Ω
Required input voltage	
V_{rms} ⁴⁾	1 V
V_{DC} (input voltage range)	± 1.41 V
AM overrange ¹⁾	level-dependent in level range from +7 to +13 dBm

Frequency modulation

Modes	INT, EXT, INT + EXT
	Frequency range
	0.1 to 31.25 31.25 to 62.5 62.5 to 125 125 to 250 250 to 500 500 to 1000 MHz
Maximum deviation	100 50 100 200 400 800 kHz
Resolution	< 1% (min. 50 Hz)
Least increments	
up to 10 kHz deviation	50 Hz
up to 100 kHz deviation	100 Hz
above 100 kHz deviation	1 kHz
Setting error (at $f_{mod} = 1$ kHz)	< 7% of set value + spurious FM
FM distortion at 1 kHz and 50% of maximum deviation	< 0.5% (typ. 0.1%)
Modulation frequency	
FM EXT	20 Hz to 500 kHz (max. deviation from 50 Hz)
FM INT	0.4/1/3/15 kHz
FM INT with option SMX-B2	20 Hz to 100 kHz
Modulation frequency response flatness from 100 Hz to 100 kHz	< 1 dB
up to 500 kHz	typ. < 1 dB
up to 1 MHz	typ. 3 dB
Incidental AM at $f_{mod} = 1$ kHz, 40 kHz deviation	< 0.1%
Modulation input	
Input impedance	100 k Ω , can be internally changed to 600 Ω
Required input voltage ⁴⁾	1 V_{rms}
Low rate FM (with SCM-U1)	
Mode	EXT
3-dB bandwidth	< 3 Hz to > 500 kHz
Sag	typ. 30% with 12 Hz squarewave
Maximum deviation	same as with normal FM

Pulse modulation

Mode	external
Pulse on/off ratio	40 dB
Rise/fall time 10% to 90%	2 μ s
Max. repetition frequency	50 kHz
Min. pulse width	5 μ s
Modulation signal (AM setting 100%)	0 V for level on, < ± 1.41 V (min. -2.0 V) for level off
Modulation input	
Input impedance	100 k Ω , can be internally changed to 600 Ω

Internal modulation generator

Standard	
Frequency	0.4/1/3/15 kHz $\pm 3\%$

AF Synthesizer Option SMX-B2

Frequency	10 Hz to 100 kHz
Resolution	1 Hz
Readout	3-digit
Frequency error	< 4×10^{-5}
Output level	1 V_{rms} ($Z_{out} = 10 \Omega$, $Z_i > 200 \Omega$)
Level error at 1 kHz	< $\pm 3\%$ (typ. 1%)
Distortion up to 20 kHz	< 0.1% (typ. 0.03%)
up to 100 kHz	< 0.1% (typ. 0.05%)
Phase-continuous frequency change	
Response time between setting command and frequency change	< 10 ms

Remote control

System	IEC 625-1 (IEEE 488)
Connector	24-contact, Amphenol
IEC/IEEE-bus address	selectable via keyboard from 00 to 30
Interface functions	listener and talker, SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0

Overload protection

Protects the instrument against externally applied (50- Ω source)	
RF power and DC voltage	
Max. permissible RF power	30 W
Max. permissible DC voltage	35 V
Max. pulse loading capacity (pulse width < 10 μ s)	1 mWs or 150 V_p

Options

SMX-B1 Reference Oscillator	
OCXO	see specifications for frequency
SMX-B2 AF Synthesizer	see specifications for internal modulation generator

General data

Rated temperature range	0 to 50 $^{\circ}$ C
Storage temperature range	-40 to +70 $^{\circ}$ C
Power supply	100/120/220/240 V $\pm 10\%$, 47 to 440 Hz (max. 90 VA, 70 W); safety class I to VDE 0411 (IEC 348) complies with VDE 0871 and MIL-STD-461B (methods CE 03 and RE 02) requirements (radiated and conducted interference) as well as VDE 0875 requirements (limit values of radio interference grade K) shock-tested to DIN 40046, Part 7 (30 g, 11 ms) and vibration-tested to DIN 40046, Part 8 (5 to 55 Hz, 2 g); corresponding to IEC Publications 68-2-27 und 68-2-6
RF leakage	
Mechanical resistance	
Dimensions, weight	435 mm $\times$ 147 mm $\times$ 460 mm, 12.5 kg

Ordering information

Order designation	► Signal Generator SMX 826.4517.52
Accessories supplied	power cable
Recommended extras	
Option Reference Oscillator OCXO	SMX-B1 826.9519.02
AF Synthesizer	SMX-B2 826.9619.02
Modification kit:	
Low Rate FM	SCM-U1 804.1614.02
Rear-panel connectors for RF and AF	SMX-Z10 827.0250.02
19" Rack Adapter, 3 units in height, 1/1	ZZA-93 396.4892.00
Service Kit	SMX-Z2 827.0150.02

¹⁾ The specified data refer to settings without guarantee of specifications (typical values).
²⁾ Does not apply if special function "non-interrupting level setting" is selected.
³⁾ In CW mode.
⁴⁾ The modulation depth selectable within the guaranteed AM specifications linearly decreases for levels from 7 to 13 dBm. An excessive modulation depth is indicated by a status error.
⁵⁾ Deviations (HIGH/LOW indication if > 3%) cause corresponding change of modulation depth.