



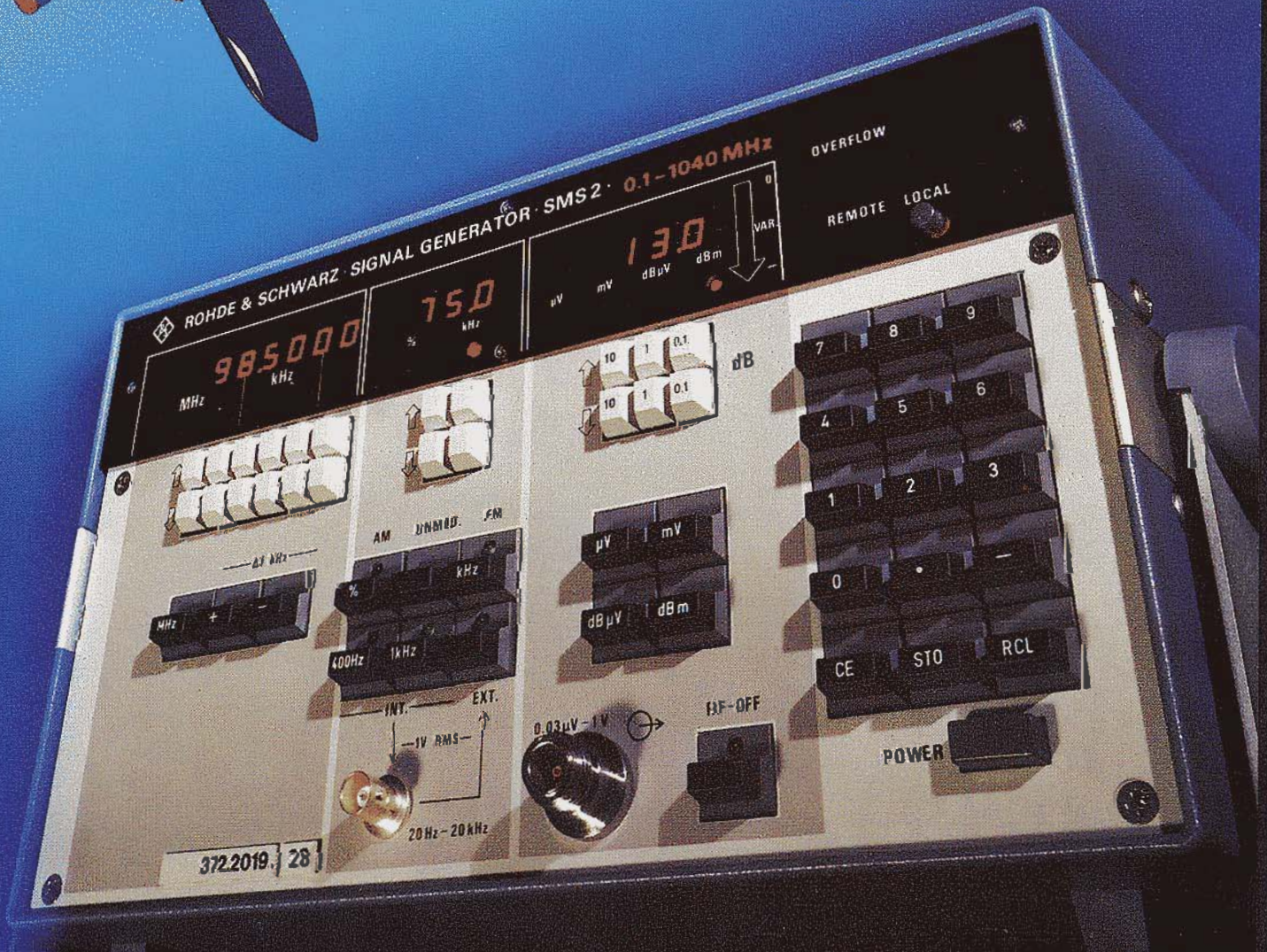
ROHDE & SCHWARZ

SMS 2

SIGNAL GENERATOR SMS 2

0.1 to 1040 MHz

General-purpose AM-FM Synthesizer



IEC 625 Bus IEEE 488

CHARACTERISTICS AND USES

- General-purpose AM-FM synthesizer for 0.1 to 520 MHz or 0.1 to 1040 MHz; low noise and excellent AM, FM and ϕ M modulation characteristics.
- Compact, low-priced signal generator for use in development, production and servicing; can be tailored to customer requirements by adding options.
- Keyboard entry and LED display of frequency, modulation and level make it easy to operate.
- Numerical value and unit can be input in ordinary notation; all the values can be varied in single steps or quasi-continuously with selectable step size.
- Wide output voltage range, exact level setting in dBm, dB μ V, μ V or mV.
- Overvoltage protection and IEC-bus programmability (setting time 40 ms) are standard features.

Main improvements as against SMS:

- Low SSB phase noise.
- Conversion into any of the four level units at the push of a button.
- Addition and subtraction of freely selectable level steps in dB.
- Non-volatile storage of 40 complete device settings.
- Current device setting is saved in case of AC supply failure.
- Self-test facility.

Frequency. The wide frequency range from 100 kHz to 520 MHz (Models 24 and 26) and from 100 kHz to 1040 MHz (Model 28) covers all the sound broadcasting ranges from medium wave to shortwave to VHF, as well as the frequencies of the main radiotelephony bands and

radio services up to the UHF region. The Options SMS-B2 permit frequency range extension of the Models 24 and 26 to 1000 or 1040 MHz.

The crystal-controlled frequency is read out on the display with a resolution of 100 Hz. The Reference Oscillator Option SMS-B1 (aging $<1 \times 10^{-6}$ /year) further enhances the accuracy. A reference frequency input is provided on the rear panel of the signal generator (photograph lower right-hand side). The keys permit easy channel stepping with any desired step size (see also page 6). The output signal features low spurious deviation, only 3 Hz (CCITT) or 15 Hz (30 Hz to 20 kHz). The SSB noise 20 kHz from the carrier at a test bandwidth of 1 Hz is between -120 and -126 dBc depending on the frequency. It is -145 dBc at 1 MHz from the carrier.

Modulation. The SMS 2 is suitable for all types of modulation: AM up to $m = 95\%$ and FM up to deviation = 125 kHz are possible with the aid of the internal modulation generator (400 or 1000 Hz) or an external signal. Modulation frequency and modulation depth or frequency deviation can be entered via a keyboard and are read out on a 3-digit display with 0.05/0.5% and 50 Hz/500 Hz/1 kHz resolution.

The maximum frequency deviation of 125 kHz is available over the entire frequency range. The high resolution of the frequency deviation of 50 Hz is helpful when testing transceivers. In addition to AM and FM, the SMS 2 offers the following types of modulation:

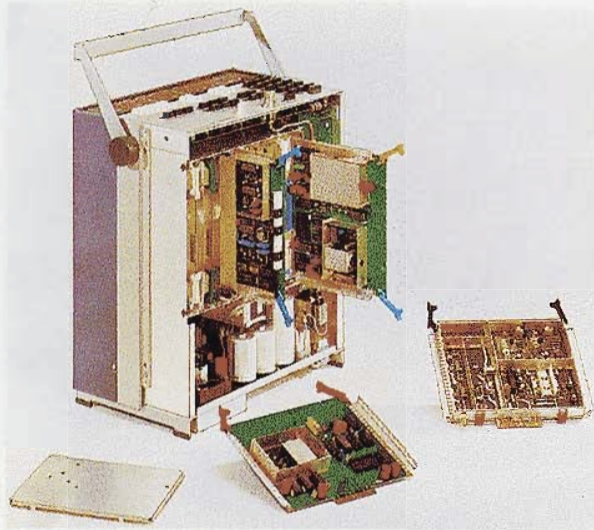
- AM + FM together
- phase modulation (ϕ M)
- frequency-shift keying for data transmission (FSK)
- external level control (ALC).

Modulation settings are preserved in the **UNMOD** position and can be called up again at the push of a button.

Computer-controlled transceiver test assembly using the Signal Generator SMS2 in conjunction with the Process Controller PUC and the Mobile Tester SMFP2.



MODELS AND OPTIONS



Easy-to-service design of the Signal Generator SMS2: plug-in circuit boards used throughout make for ready access.

The **output level** is adjustable from +13 to -137 dBm with a resolution of 0.1 dB, the error being typically 0.8 dB. Entry is in μV , mV, $\text{dB}\mu\text{V}$ and dBm via keyboards. Its minimum output voltage of $0.03 \mu\text{V}$ makes the SMS2 also suitable for measurements on extremely sensitive receivers. Non-interrupting level variation over 10 dB in 0.1-dB steps is indispensable for squelch measurements. The output level can be switched off by means of the **RF-OFF** button so calibration of measuring instruments is very convenient. RF leakage of the SMS2 is minimal, i. e. even receivers with a sensitivity of $0.2 \mu\text{V}$ (e. g. paging receivers) will not respond at a distance of 10 cm from the front panel.

The built-in **self-test facility** checks important device functions. For instance, a RAM data test, an EPROM test and a display interface test are performed whenever the Signal Generator is switched on. Other tests can be called up via the keyboard. Errors, if any, are readily identified with the aid of the error message that appears on the frequency display.

Low cost — high versatility. The Signal Generator SMS2 offers cost-effective RF measurements in production and servicing of sound broadcasting receivers as well as for commercial receivers, such as used in aviation communications and radiotelephony, in telemetry and navigation. Thanks to its compact design the SMS2 is easily portable and can be installed in test vans. The IEC-bus programmability of the SMS2 (see page 7) with a setting time of only 40 ms makes it ideal for use in automatic test systems. Plug-in circuit boards, integrated signature analysis and self-test facilitate and speed up servicing (see photograph at left).

Models

The SMS2 comes in three models varying in frequency range and modulation characteristics. **Models 24 and 26** cover the frequency range from 100 kHz to 520 MHz, Model 26 also being suitable for FM stereo operation. **Model 28** covers the frequency range from 100 kHz to 1040 MHz.

The performance specifications over the frequency range 520 to 1040 MHz are separately listed in the "Specifications". The performance specifications of the FM stereo-compatible Model 26 are given under "Frequency modulation".

Options

Several options are available for the SMS2 to satisfy differing or special customer requirements at minimum cost. The SMS2 can on request be supplied with these options built in, or they can be retrofitted.

Temperature-controlled Reference Oscillator SMS-B1 improves the frequency stability of the signal generator. The temperature drift of $< \pm 1 \times 10^{-6}/^\circ\text{C}$ is reduced to $< \pm 1 \times 10^{-7}$ over the entire temperature range. Crystal aging is less than 5×10^{-8} /month.

1.04-GHz Frequency Range Extension SMS-B2 doubles the frequency range of the SMS2 Models 24 and 26 (to 1.04 GHz) while the full output level setting range is maintained. For applications up to 1000 MHz, Option SMS-B2 with the same characteristics but a different ordering number is available; see Specifications on page 8.

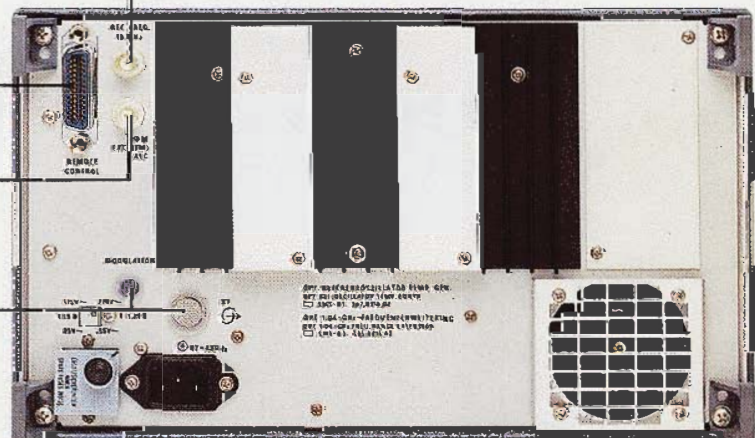
Internal 10-MHz reference frequency output (TTL level) or external reference frequency input ($> 0.5 \text{ V}$, sine wave or square wave)

IEC-bus connector

2nd modulation input for ϕM (can be switched over to FM) or AM (DC-coupled)

Openings for relocation of the RF output and ext. modulation input or int. modulation output from the front panel to the rear panel

Rear view of Signal Generator SMS2.



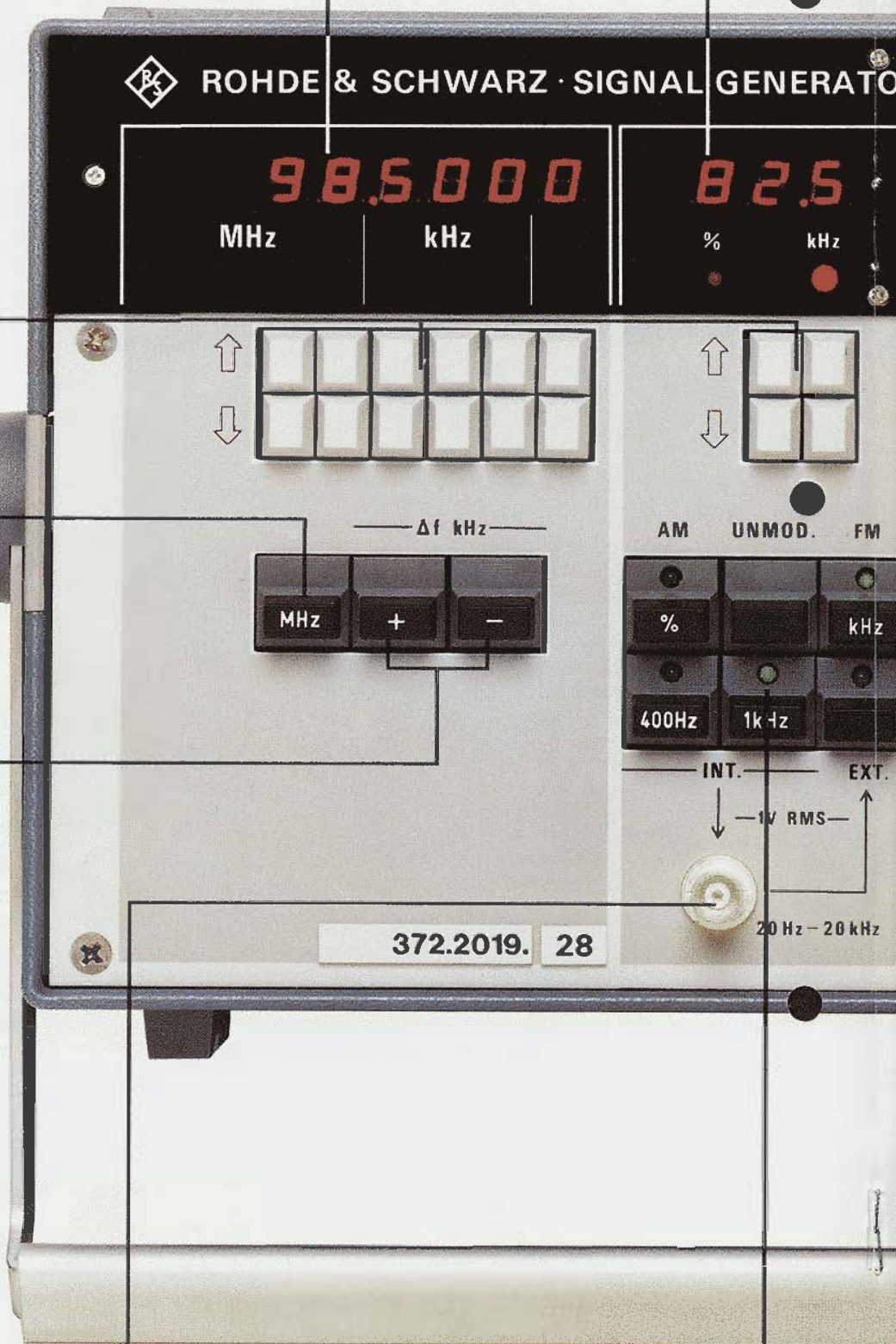
Frequency range 0.1 to 1040 MHz,
8-digit frequency readout,
resolution 100 Hz
(200 Hz above 520 MHz)

Readout of modulation in %
or deviation in kHz;
entry via keyboard

Keyboards for stepwise
or continuous variation
of settings by keys
associated with the
individual digits;
automatic carry over

Frequency in MHz;
entry via keyboard

Channel steps
of any size;
frequency entry
via keyboard,
repetition by pressing key



Input for external modulation
(AM or FM);
output for internal modulation
signal

Selection of type of modulation
AM (up to 95%)
FM (up to 125 kHz deviation)
INT.: 400 Hz or 1000 Hz
EXT.: 20 Hz to 20 kHz (FM)
20 Hz to 100 kHz (AM)
entry via keyboard

Level indication in μV , mV, $\text{dB}\mu\text{V}$ or dBm ; correct indication also with fine adjustment

Indication of fine level adjustment over a range of 0 to -10 dB

GENERATOR · SMS 2 · 0.1 - 1040 MHz

13.0

μV mV $\text{dB}\mu\text{V}$ dBm

OVERFLOW

Signal for illegal entry

REMOTE LOCAL

10 1 0.1
10 1 0.1

dB

Switchover from IEC-bus control to manual operation

Variation of RF output level in steps of 0.1, 1 or 10 dB; no interruption of RF output with 0.1-dB steps

μV mV
 $\text{dB}\mu\text{V}$ dBm

7 8 9
4 5 6
1 2 3
0 . -
CE STO RCL

Keyboard for entry of frequency, channel step size, modulation depth, frequency deviation or RF level without range selection; the keys can also be operated by pressing from above

0.03 μV - 1 V
50 Ω

RF-OFF

POWER

Function keys for storing 40 complete settings, which can be called up any number of times. RCL key for calling up special functions, e. g. display and setting (via keyboard) of the IEC-bus address or calling up the self-test

RF output 0.03 μV to 1 V (-137 to $+13\text{ dBm}$) overall error $< 1.5\text{ dB}$; negligible leakage. Built-in overvoltage protection protects the output against excessive external RF or DC voltage (max. 30 W)

Key for switching off the RF signal without changing any settings

Selection of level unit (conversion of level units at the push of a button)

SIGNAL GENERATOR
SMS 2

OPERATION

Easy to operate

Simple keyboard entry. The function keys and the associated displays for frequency, modulation and level are arranged in three sections on the front panel for user-oriented operation. The parameters are entered in ordinary notation, first the numerical value and next the unit. A fourth, general keyboard is provided for the entry of the numerical value.

Example: For entry of a frequency of 360 MHz, a level of -17.9 dBm, and frequency modulation with 125 kHz frequency deviation and 400 Hz internal modulation frequency simply press the following keys:



Saving data. A non-volatile memory saves the current device settings. After switching on the power and, of course, also after AC supply failure the settings of the SMS 2 prior to switching off are automatically restored.

Modulation setting storage. One current AM and one FM setting at a time are stored in the signal generator. Thus only one key needs to be pressed to switch over between AM and FM or unmodulated and modulated operation.

Example: The frequency modulation setting is switched off by means of the key **UNMOD** and switched back on again by means of the key **FM**.

Easy variation of all settings. Frequency, level and modulation can be varied by means of the keys \uparrow and \downarrow which are associated with the various digits of the displays. The selected digit is varied in unit steps with automatic carry to the next digit either by one step per keystroke or (if the key is held down) continuously. Rapid coarse tuning in 10-MHz steps as well as fine tuning in 100-Hz steps is possible.



Keys associated with the various digits permit stepwise or continuous variation of numerical values entered (e.g. frequency as here displayed).

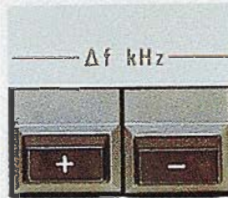
Indication of illegal entries. Entries that exceed the given setting range are not considered by the SMS 2. The last value entered is still indicated. The OVERFLOW LED flashes in the case of an illegal entry.

Frequency variation with channel stepping. The Δf kHz keys (see photograph below) permit channel stepping with any desired channel step size.

Example: For entry of a frequency step of +12.5 kHz press the following keys on the large main keyboard:



For each additional step in the positive or negative direction all there is to do is to press the **+** or **-** Δf -kHz key. The selected step size is preserved until it is overwritten by a new entry.



Key for freely selectable frequency steps in positive or negative direction.

Addition and subtraction of freely selectable level steps in dB. When adding or subtracting level steps (in dB) level display is in the selected unit (dBm, dB μ V, mV or μ V).

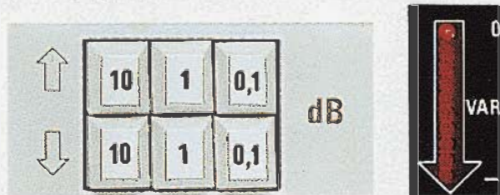
Entry of level step of -31.5 dB:



Entry of level step of +7.5 dB:



Non-interrupting fine level adjustment. The keys \uparrow and \downarrow (0.1 dB) permit non-interrupting electronic adjustment of the level in 0.1-dB steps over a range of 10 dB (indispensable for squelch measurements), the corrected value being read out on the level display. The state of the electronic level variation can be seen from an LED array (see photograph below).

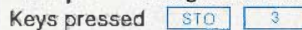


The 0.1-dB keys are used for non-interrupting electronic fine level adjustment. The state of the electronic level variation can be seen at a glance from the LED array.

Conversion of level unit. For conversion of any level unit into another simply the desired unit key need be pressed.

Storage of complete device settings. The SMS 2 can store 40 complete device settings (each setting including frequency, modulation and level) in a non-volatile memory.

Example: Storage of device setting at memory location 3:



IEC-bus programming

The Signal Generator SMS2 can also be put to use in computer-controlled test assemblies via the IEC-bus interface. Its extremely short setting time of only 40 ms makes it capable of high-speed computer-controlled frequency response measurements — even with high resolution. The control instructions are in accordance with IEC standard 625-1. Each instruction consists of a header, the numerical value and a delimiter. The numerical value is entered in unformatted form with or without sign and with or without decimal point (see table below).

Examples:	Device setting	Programming instructions
Frequency: 122.19 MHz		A122.19,
Level: -23 dBm		S-23,
Modulation: AM, 30 %		B30,

It is also possible to write several control instructions in one program line:

A122.19, S-23, B30,.

Delimiters. The following delimiters can be used for terminating a setting instruction: , (comma), NL, CR + NL, ETB and ETX.

Programming example for Process Controller PUC from Rohde & Schwarz for level, modulation and frequency setting on the Signal Generator SMS2 (address 28).

```

100 IECOUT28,"S-3.7," _____ Level setting
110 IECOUT28,"H2.8,J," _____ Modulation setting
120 FOR F=100 TO 111.5 STEP .5 _____ Frequency loop
130 IECOUT28,"A"+STR$(F)+"," _____ Frequency setting
140 NEXT F
150 END
    
```

A LED (REMOTE) lights when the SMS2 is in the remote control state (REMS). Then all the operating controls, with the exception of the LOCAL key, are disabled. By pressing the **LOCAL** key the SMS2 can again be manually operated.

Setting and display of addresses is possible via the keyboard.

Readout of IEC-bus address on the frequency display:

RCL [] [] [] [] [] [] [] []

Setting and readout of, say, address 28:

[] [] [] [] [] [] [] [] [] [] [] [] [] [] [] []

Table of setting instructions

Function	Header	Data	Delimiter
Frequency in MHz	A	Maximum of 8 digits with or without decimal point	comma, NL, CR+NL, ETB, ETX
Modulation			
AM, m in %	B	Maximum of 3 digits with or without decimal point	
FM, deviation in kHz	H		
UNMOD:	C	None	
INT, 400 Hz	I	None	
INT, 1 kHz	J	None	
EXT:	K	None	
Level			
in dBm	S	A maximum of 3 1/2 digits with or without decimal point, with negative sign or without	
in dBµV	R	A maximum of 3 1/2 digits with or without decimal point	
in µV	P		
in mV	Q		
Switchover to non-interrupting, fine adjustment:	X		
RF OFF:	Y	0	
RF ON:	Y	1	
Pause 15 ms:	@	None	

Specifications

(For performance specifications over frequency range 520 to 1040 MHz, see page 8).

Frequency

Frequency range	Model 24	0.1 to 520 MHz	up to 1040 MHz if Option SMS-B1 is fitted
	26	0.1 to 520 MHz	
	28	0.1 to 1040 MHz	

Frequency readout: 8-digit LED display; in MHz
Resolution: 100 Hz

Frequency error with reference oscillator

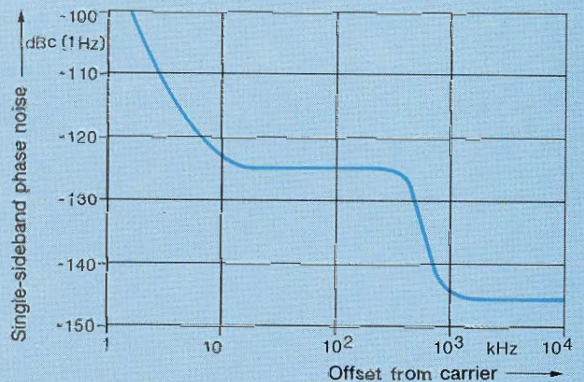
Aging	Standard	< ±1 × 10 ⁻⁶ /month	Option SMS-B1	< ±5 × 10 ⁻⁸ /month
Temperature effect		< ±1 × 10 ⁻⁶ /°C		< ±1 × 10 ⁻⁷ (5 to 45 °C)
Warm-up period		60 min		15 min

Output/input for internal/external reference frequency, 10 MHz (single connector)

Output	TTL level
Input	> 0.5 V (sinewave) or TTL level

Spectral purity

Harmonics	down ≥ 30 dBc ¹⁾
Non-harmonic spurious responses	down ≥ 65 dBc ¹⁾ , typ. 75 dB (≥ 5 kHz from carrier)
Spurious deviation, rms	
0.3 to 3 kHz	≤ 4 Hz (weighted in accordance with CCITT)
0.03 to 20 kHz	≤ 16 Hz
Spurious AM, rms	
0.03 to 20 kHz	≤ 0.02%
Single-sideband phase noise (see also diagram below)	down 120 to 126 dBc ¹⁾ , depending on f _{carrier} (test bandwidth 1 Hz, 20 kHz from carrier)
Single-sideband broadband noise	typ. down 145 dBc ¹⁾ (test bandwidth 1 Hz, > 2 MHz from carrier)



Typical single-sideband phase noise of Signal Generator SMS2 (f_{carrier} = 480 MHz).

Level

Output level	with CW and FM	-137 to +13 dBm (0.03 µV to 1 V) into 50 Ω
	with AM ¹⁾	-137 to +7 dBm (0.03 µV to 0.5 V) into 50 Ω

Readout: 3 1/2-digit LED display in µV, mV, dBµV, dBm
Resolution: 0.1 dB
Fine adjustment: 0.1 to -10 dB with 0.1 dB resolution; without interrupting RF output

Level error: in range +13 to -20 dBm: ≤ ±0.5 dB + frequency response²⁾
-20 to -137 dBm: ≤ ±1 dB + frequency response²⁾

Frequency response of output level: flat ±0.5 dB (8 to 520 MHz); flat ±1 dB (< 8 MHz)

Level reduction with RF OFF: > 80 dB
Output: N connector
Characteristic impedance: 50 Ω
VSWR: ≤ 1.2 (level: ≤ 3 dBm)²⁾

Overvoltage protection: protects the FIF output of the SMS2 from externally applied RF 11 to 1000 MHz) or DC voltage

Max. input power	30 W
Max. input DC voltage	35 V
Max. pulse energy (pulse duration < 10 µs)	1 mJ or 150 V _r

¹⁾ dBc = relative level referred to carrier amplitude.
²⁾ With fine level adjustment = 0 dB.

SPECIFICATIONS

Page 7 cont'd

Modulation

Amplitude modulation

Frequency range AM EXT.	20 Hz to 20 kHz (8 to 520 MHz)
	20 Hz to 2 kHz (0.1 to 8 MHz)
AM INT.	400 Hz and 1 kHz, $\pm 3\%$
Modulation depth m	0 to 95%
Readout	3-digit LED display
Resolution, m = 0 to 9.95%	0.05%
m = 10 to 95%	0.5%
Readout error (m < 90%, 20 Hz to 20 kHz)	8 to 520 MHz: $\leq 4\%$ of reading + 1% ²⁾ < 8 MHz: $\leq 7\%$ of reading + 1% ²⁾

Envelope distortion

($f_{mod} = 0.4/1$ kHz)	
m = 80%	$\leq 1.5\%$
m = 90%	$\leq 3\%$

Input voltage requirement 1 V into 600 Ω (V_{rms})

Spurious ϕM (peak value at 30% AM) < 0.1 rad up to 520 MHz
< 0.15 rad up to 1040 MHz

Frequency modulation

Frequency range FM EXT.	20 Hz to 100 kHz
FM INT.	400 Hz and 1 kHz, $\pm 3\%$
Frequency deviation	0 to 125 kHz ($\leq f_{carrier} - 100$ kHz; 125 kHz max.)
Readout	3-digit LED display
Resolution, 0 ... 9.95 kHz	50 Hz
10 to 99.5 kHz	500 Hz
100 to 125 kHz	1 kHz
Error (at 1 kHz)	$\leq 5\%$ of reading
Frequency response	up to 20 kHz: ± 0.1 dB up to 100 kHz: ± 1 dB

FM distortion

($f_{mod} = 0.4/1$ kHz, deviation 75 kHz) $\leq 1\%$

Distortion with stereo modulation (10.7 MHz and 87 to 108 MHz, AF 50 Hz to 10 kHz, deviation 40 kHz) < 0.4%, typ. 0.2% Model 26

Stereo crosstalk (10.7 MHz and 87 to 108 MHz, AF 50 Hz/1 kHz/10 kHz) typ. down 40/45/45 dB

Unweighted S/N ratio (stereo) (10.7 MHz and 87 to 108 MHz, deviation 40 kHz, deemphasis 50 μs) typ. 70 dB

Input voltage requirement 1 V into 600 Ω (V_{rms})

Spurious AM (20 kHz deviation, FM INT.) < 0.1%

Output voltage with internal AM and FM 1 V into 600 Ω (V_{rms})

Additional modulation input at the rear of the SMS 2 for phase modulation (ϕM), 20 Hz to 8 kHz; FM, 20 Hz to 100 kHz (connection can be internally changed) or ALC (AM), DC to 20 kHz
Required input voltage into 600 Ω :

ALC (AM), DC-coupled	0 to +2.83 V for 0 to -40 dB
ϕM (V_{rms})	1 V for 5 rad
FM (V_{rms})	1 V for 100 kHz deviation

Specifications in frequency range 520 to 1040 MHz

(model 28 or models 24 and 26 with Option SMS-B2)

Resolution of the frequency indication	200 Hz
Harmonics and subharmonics	typ. 20 dBc ¹⁾ down (subharmonics $1/af, 2/af, \dots$)
Non-harmonic responses > 5 kHz from carrier	down > 60 dBc ¹⁾
Spurious deviation, rms 0.3 to 3 kHz	≤ 8 Hz (weighted in accordance with CCITT)
0.03 to 20 kHz	≤ 32 Hz
Single-sideband phase noise 20 kHz from carrier	down typ. 115 to 120 dBc ¹⁾ , depending on $f_{carrier}$ (test bandwidth 1 Hz)
1 MHz from carrier	down typ. 140 dBc ¹⁾ (test bandwidth 1 Hz)
Frequency response of level	flat ± 1 dB
Error of modulation-depth indication with AM (m < 90%)	$\leq 7\% + 1\%$ of reading
Envelope distortion ($f_{mod} = 0.4/1$ kHz, m = 80%)	$\leq 5\%$
Other specifications same as above.	

Options

1.04-GHz Frequency Range Extension Option SMS-B2

Frequency range 0.1 to 1040 MHz

1-GHz Frequency Range Extension Option SMS-B2

Frequency range 0.1 to 1000 MHz

Reference Oscillator Option SMS-B1

see under "Frequency" specifications

IEC-bus control

Interface in accordance with IEEE 488 and IEC 625-1 for control of all operating modes and for data transfer in listener operation, 24-way connector

Interface functions	AH 1 Acceptor handshake L2 Listener RL 1 Remote/Local DC 1 Device clear
---------------------	--

Setting time (after reception of last character via IEC bus) 40 ms for all functions (typ. frequency error after 40 ms: < 100 Hz)

Data transfer rate 2 kbyte/s

General data

RF leakage conforms to VDE 0871 and MIL STD 461 A in accordance with method CE 03 and RE 02 concerning radio interference and interference on the connecting cables. The SMS 2 also complies with the requirements of VDE 0875 (limit values of radio interference grade K)

Shock and vibration resistance shock-proof in accordance with DIN 40046, Part 7 (30 g, 11 ms); vibration-tested in accordance with DIN 40046, Part 8 (11 to 55 Hz, 2 g); corresponds to IEC Publications 68-2-27 and 68-2-6

Rated temperature range +5 to +45 $^{\circ}C$

Shelf temperature range -40 to +70 $^{\circ}C$

AC supply 115/125/220/235 V $\pm 10\%$, 47 to 420 Hz, safety class I (VDE 0411)

Power consumption 60 VA (80 VA with all options)

Overall dimensions (W x H x D); weight 347 mm x 198 mm x 370 mm; 14.6 kg

Ordering information

Order designation	► Signal Generator SMS 2 (0.1 to 520 MHz) 372.2019.24 Signal Generator SMS 2 (0.1 to 520 MHz, stereo-compatible) 372.2019.26 Signal Generator SMS 2 (0.1 to 1040 MHz) 372.2019.28
--------------------------	---

Accessories supplied

Power cord, manual

Options

Reference Oscillator SMS-B1 302.8918.02

1.04-GHz Frequency Range Extension SMS-B2 335.0016.02

1.0-GHz Frequency Range Extension SMS-B2 335.0016.04

Recommended extras

19" Adapter SMS-Z1 302.8860.02

¹⁾ dBc = relative level referred to carrier amplitude.

²⁾ With fine level adjustment = 0 dB.



ROHDE & SCHWARZ

GmbH & Co. KG · D-8000 München 80 · Mühldorfstr. 15 · Tel. (089) 4129-1 Int. +4989 4129-1 · Telex 523 703
Printed in the Fed. Rep. of Germany · Subject to change · Data without tolerances: order of magnitude only

1183 (F)