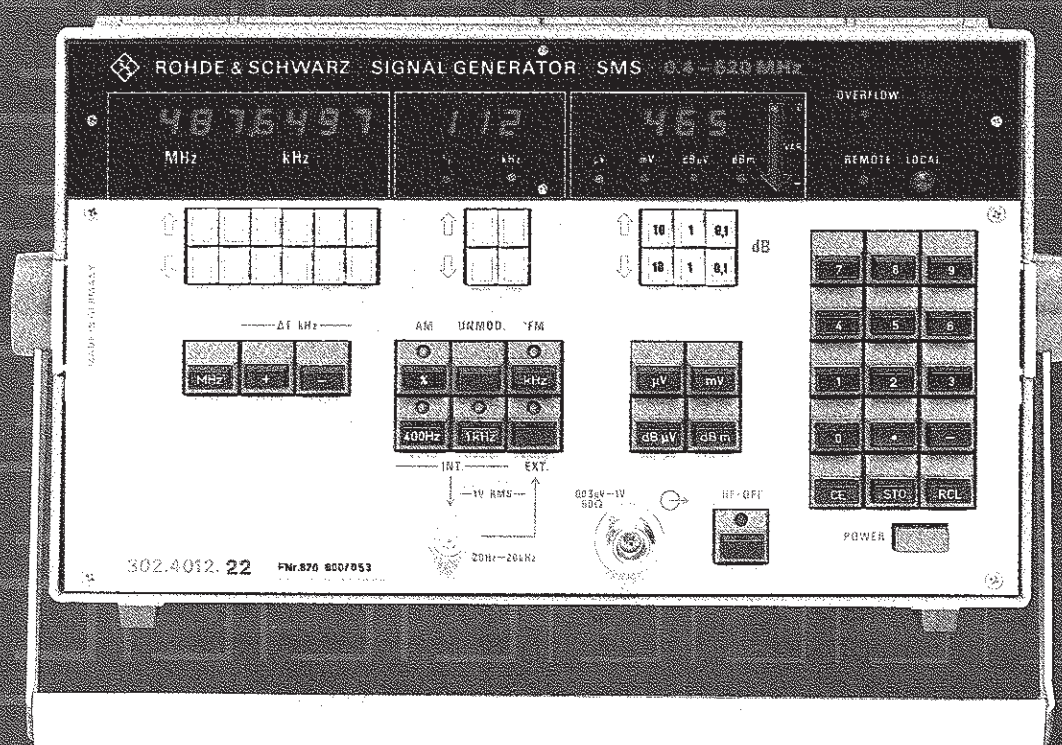


SIGNAL GENERATOR SMS

0.1/0.4 to 520 (1040) MHz



IEC 625 Bus

Summary

- General-purpose AM-FM synthesizer for 0.1 to 520 MHz (0.1 to 1040 MHz); low noise and excellent AM, FM and μ 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.

Stable output signal of high accuracy

Frequency. The wide frequency range from 400 kHz (100 kHz with Model 24) to 520 MHz 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 range can be extended to 1040 MHz by means of the Frequency Range Extension Option SMS-B2 (see page 3).

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 Δf 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 S/N ratio 20 kHz from the carrier is typically 120 dB at a test bandwidth of 1 Hz, and 145 dB at 1 MHz from the carrier.

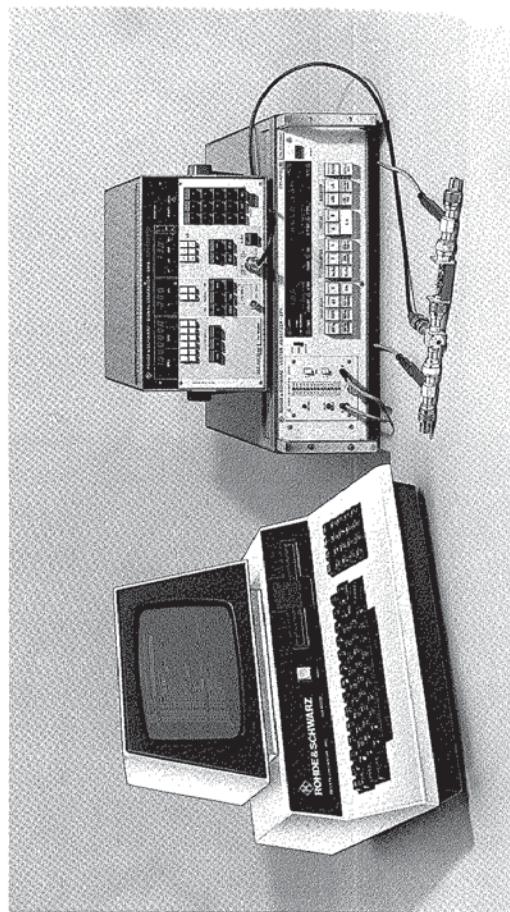
Modulation. The SMS is suitable for all types of modulation: AM up to m - 95% and FM up to deviation - 125 kHz are possible with the aid of the internal modulation generator (400 or 1000 Hz) or an external signal. Modulation frequency and modulation depth or frequency deviation can be entered via a keyboard 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 transmitters. In addition to AM and FM, the SMS offers the following types of modulation:

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

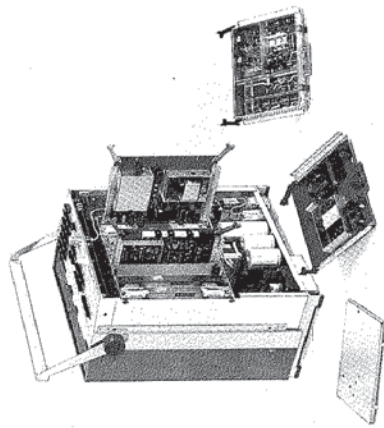
Modulation settings are preserved in the **UNDO** position and can be called up again at the push of a button.

The Signal Generator SMS being used together with the Vector Analyzer ZPV and the Process Controller PPC in a computer-controlled test assembly for s-parameter measurement.



Low cost — high versatility

The Signal Generator SMS 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 SMS is easily portable and can be installed in test vans. The IEC-bus programmability of the SMS (see page 7) with a setting time of only 40 ms makes it ideal for use in automatic test systems. Plug-in circuit boards and the designed-in signature analysis compatibility facilitate and speed up servicing (see photograph at left).



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

Options

Several options are available for the SMS to satisfy differing or special customer requirements at minimum cost. The SMS 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 SMS frequency range (to 1.04 GHz) while the full output level setting range is maintained. The harmonics and subharmonics ($1/2, 3/2, \dots$) are typically 20 dB down. 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.

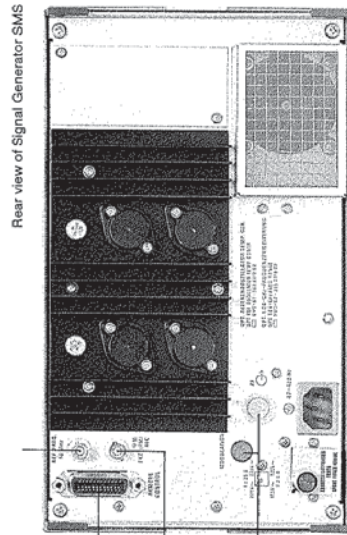
The output level is adjustable from +13 to -137 dBm with a resolution of 0.1 dB, the error being typically 0.8 dB. Entry is in μ V, mV, dB(μ V) and dBm via keyboards. Its minimum output voltage of 0.03 μ V makes the SMS also suitable for measurements on future, extremely sensitive receivers. Continuous 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 SMS is minimal, i.e. even receivers with a sensitivity of 0.2 μ V (e.g. paging receivers) will not respond at a distance of 10 cm from the front panel.

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

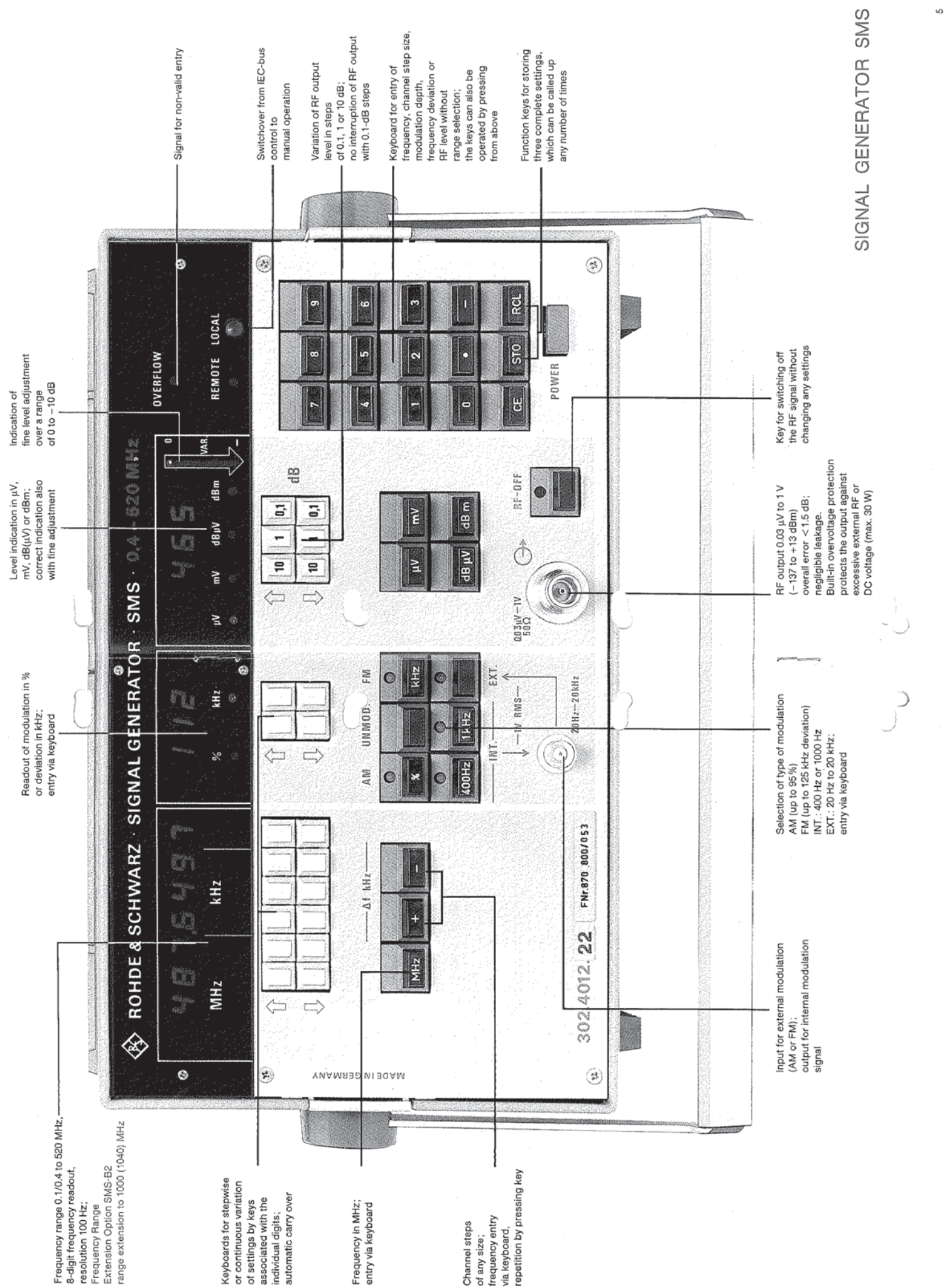
IEC-bus connector

2nd modulation input for μ M (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 SMS



Frequency range 0.1/0.4 to 520 MHz;
8-digit frequency readout,
resolution 100 Hz;
Frequency Range
Extension Option SMS-SB2
range extension to 1000 (1040) MHz

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

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

Level indication in μ V,
mV, dB(μ V) or dBm;
correct indication also
with fine adjustment

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

Signal for non-valid entry

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

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

Function keys for storing
three complete settings,
which can be called up
any number of times

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;
entry via keyboard

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

Key for switching off
the RF signal without
changing any settings

SIGNAL GENERATOR SMS

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.

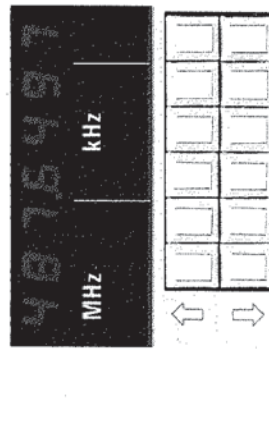
Example: For entry of a frequency of 380 MHz, a level of -17.9 dBm, and frequency modulation with 125 kHz frequency deviation and 400 Hz internal modulation frequency simply press the following keys:



Modulation setting storage. One 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 ↑ and ↓ 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 key-stroke 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. The last value entered is still indicated. The OVERFLOW LED flashes in the case of a non-valid entry.

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

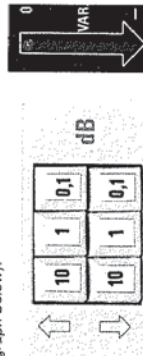
Example: For entry of a frequency step of +12.5 kHz press the following keys on the large, main keyboard:



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



Continuous fine level adjustment. The keys ↑ and ↓ (0.1 dB) permit continuous 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 continuous electronic fine level adjustment. The state of the electronic level variation can be seen at a glance from the LED array.

Storage of complete device settings. The SMS can store three complete device settings (each setting including frequency, modulation and level).

Example: Storage of device setting at memory location 3: Keys pressed [STO] [3] [ENTER] Recalling [RCL] [3].

IEC-bus programming

The Signal Generator SMS can also be put to use in computer-controlled test assemblies via the IEC-bus interface. Its extremely short settling 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 comma as the 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 instructions
Frequency: 122.19 MHz A122.19,
Modulation: AM, 30% S-23, B30,
It is also possible to write several control instructions in one program line:
A122.19, S-23, B30,.

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

```
100 JECOUT28,"S-3,7," Level setting
110 JECOUT28,"M2,8,J," Modulation setting
120 FOR F=100 TO 111.5 STEP .5 Frequency loop
130 JECOUT28,"A"+STR$(F)+", Frequency setting
140 NEXT F
150 END
```

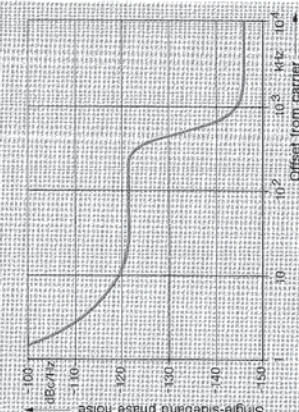
An LED (REMOTE) lights when the SMS is in the remote control state (REMS). Then all the operating controls, with the exception of the LOCAL key, are disabled. By pressing the LOCAL key the SMS can again be manually operated.

Table of setting instructions

Function	Header	Data	Delimiter
Frequency in MHz	A	Maximum of 8 digits with or without decimal point	(comma)
Modulation	B	Maximum of 3 digits with or without decimal point	
AM, m in %	C	None	
FM, deviation in kHz	D	None	
UNMOD.	E	None	
INT. 400 Hz	F	None	
INT. 1 kHz	G	None	
EXT.	H	None	
Level	I	None	
in dBm	J	None	
in dBμV	K	None	
in μV	L	None	
in mV	M	None	
Switchover to continuous fine adjustment	N	None	
RF OFF	O	None	
RF ON	P	None	
Pause 15 ms	Q	None	

Specifications

Frequency	Frequency range, Model 22: 0.5 to 320/1000 MHz	Option SMS-B2 see Specifications
Resolution	Model 24: 0.1 to 320/1000 MHz	Model 24: 8-digit LED display in MHz
Frequency error	100 Hz	Standard: 100 Hz
Frequency error with reference oscillator	Standard: 100 Hz	Option SMS-B1: 100 Hz
Temperature effect	Standard: 100 Hz	Option SMS-B1: 100 Hz
Warm-up period	Standard: 100 Hz	Option SMS-B1: 100 Hz
Output power	Standard: 100 Hz	Option SMS-B1: 100 Hz
Output impedance	Standard: 100 Hz	Option SMS-B1: 100 Hz
Output voltage	Standard: 100 Hz	Option SMS-B1: 100 Hz
Input	Standard: 100 Hz	Option SMS-B1: 100 Hz



Typical single-sideband phase noise of Signal Generator SMS (carrier = 360 MHz)

Level	Output level with 0W and 1W	100 W: -13 dBm (0.316 V r.m.s.) into 50 Ω
Resolution	Standard: 100 Hz	Option SMS-B1: 100 Hz
Frequency response	Standard: 100 Hz	Option SMS-B1: 100 Hz
Error of level reading	Standard: 100 Hz	Option SMS-B1: 100 Hz
Frequency response of output	Standard: 100 Hz	Option SMS-B1: 100 Hz
Level regulation with RF OFF	Standard: 100 Hz	Option SMS-B1: 100 Hz
Characteristic impedance	Standard: 100 Hz	Option SMS-B1: 100 Hz
Overvoltage protection	Standard: 100 Hz	Option SMS-B1: 100 Hz
Max. input power	Standard: 100 Hz	Option SMS-B1: 100 Hz
Max. input DC voltage	Standard: 100 Hz	Option SMS-B1: 100 Hz

SPECIFICATIONS

Page 7 cont'd

Modulation

Amplitude modulation	
Frequency range AM EXT.	20 Hz to 20 kHz (8 to 520 MHz)
AM INT.	20 Hz to 5 kHz (0.4 to 8 MHz)
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 $\pm 1\%$
	< 8 MHz: $\leq 7\%$ of reading $\pm 1\%$
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 rM	
(peak value at 30% AM)	< 0.1 rad
Frequency modulation	
Frequency range FM EXT.	20 Hz to 20 kHz
FM INT.	(response down 3 dB, typ. < 5 Hz/ > 30 kHz)
Frequency deviation	400 Hz and 1 kHz $\pm 3\%$
Readout	0 to 125 kHz
Resolution, 0 to 9.95 kHz	3-digit LED display
10 to 99.5 kHz	50 Hz
100 to 125 kHz	500 Hz
Error (20 Hz to 20 kHz)	1 kHz
FM distortion	$\leq 5\%$ of reading
($f_{mod} = 0.4/1$ kHz)	
deviation 75 kHz)	$\leq 1\%$
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 for phase modulation (pM), 20 Hz to 8 kHz; FM, 20 Hz to 20 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
pM (V_{rms})	1 V for 5 rad
FM (V_{rms})	1 V for 100 kHz deviation

Options

1.04-GHz Frequency Range Extension Option SMS-B2	
Frequency range	0.1/0.4 to 1040 MHz
Performance specifications of the SMS fitted with Option SMS-B2 over the frequency range 520 to 1040 MHz	
Resolution of the frequency indication	200 Hz
Harmonics and sub-harmonics	typ. 20 dBc! down (subharmonics 1/2, 3/2, ...)
Non-harmonic responses	
> 200 kHz from carrier	down > 60 dBc!
> 5 kHz from carrier	down > 55 dBc!
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 dBc! (test bandwidth 1 Hz)
1 MHz from carrier	down typ. 140 dBc! (test bandwidth 1 Hz)
Error of output level	$\leq \pm 1$ dB + frequency response ¹⁾
Frequency response of level	flat ± 1 dB
Error of modulation depth indication with AM (m < 90%)	$\leq 7\% \pm 1\%$ of reading
Envelope distortion	
($f_{mod} = 0.4/1$ kHz, m = 80%)	$\leq 5\%$
Other specifications same as for basic unit	
1-GHz Frequency Range Extension Option SMS-B2	
Frequency range	0.1/0.4 to 1000 MHz
All other specifications same as for 1.04-GHz Frequency Range Extension Option SMS-B2	
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	
Interface functions	AH 1: Acceptor handshake
	L2: Listener
	RL 1: Remote/Local
	DC 1: Device clear
Setting time	40 ms for all functions
	(typ. frequency error after 40 ms: < 100 Hz)

Models available

Model 22	0.4 to 520 MHz
Model 24	0.1 to 520 MHz
Specifications differing from Model 22:	
Frequency range AM EXT.	20 Hz to 2 kHz (0.1 to 8 MHz)
FM deviation	$\leq f_{carrier} - 100$ kHz (125 kHz; max.)

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 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 °C
Shelf temperature range	-40 to +70 °C
AC supply	115/125/220/235 V $\pm 10\%$, 47 to 420 Hz (55 VA)
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 (0.4 to 520 MHz) 302 4012 22
	► Signal Generator SMS (0.1 to 520 MHz) 302 4012 24

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 00
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¹⁾ dBc = relative level referred to carrier amplitude.

²⁾ With fine level adjustment = 0 dB.



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