SWP

Sweep Generator SWP ♦ 0.1 to 2500 MHz

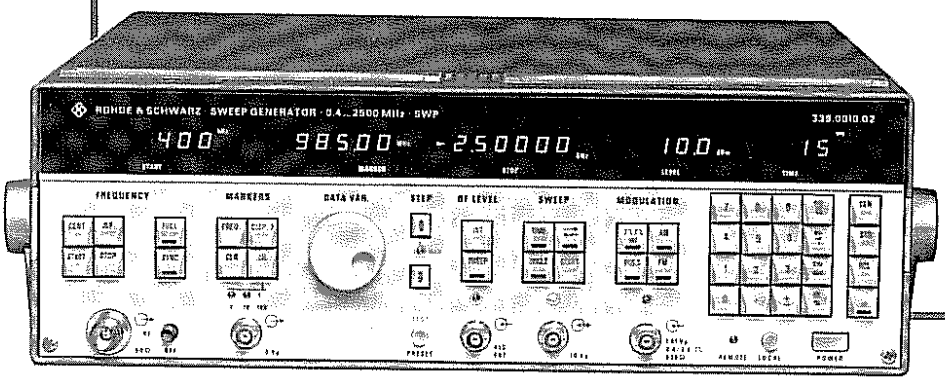
Sweeper, signal generator, synthesizer; all functions programmable

Sweeper

- Low content of harmonic and spurious signals – level sweep
- Six variable frequency markers
- Sweep time 10 ms to 100 s

Signal generator

- AM with low distortion
- Pulse and frequency modulation
- Output level +10 to −110 dBm



IEC625Bus

Sweeper + signal generator + synthesizer = SWP

Fields of application

▶ General sweep techniques

Measurement of magnitude of reflection and transmission, crystal-filter measurement,
linearity measurement on active test items by level sweeping (compression measurement)

▶ Network analysis

Ideal generator for Scalar Network Analyzer ZAS and Vector Analyzer ZPV for impedance, group-delay and s-parameter measurements

▶ Multi-source measurements (using 2 or 3 SWPs)

SWP 1 for automatic sweep,
SWP 2 for single-shot sweep triggered by SWP 1,
synchronized sweep of two or more SWPs with simultaneous frequency offset, eg of IF;
frequency converter, mixer, tuner and intermodulation measurements

▶ AM, FM and pulse modulation

Low residual FM (with Synchronizer option) and versatile modulation capabilities make the SWP ideally suited for use as a conventional signal generator, eg for measurements on receivers.

Functional features

The Sweep Generator SWP is a general-purpose signal generator for use in development, production and servicing. The output signal can be continuously swept over the **frequency** range from 0.4 to 2500 MHz.

The **Synchronizer** option makes the SWP a synthesizer and permits CW operation and narrowband sweeping above 100 kHz with low spurious FM. Frequency resolution is 1 kHz and settling time approx. 70 ms.

Output level The **output level** is calibrated and presents a very flat frequency response; harmonics and spurious signals are typically down 40 and 60 dB, respectively – extraordinary values for a sweep generator; level range from +10 to 0 dBm with 0.1 dB resolution (level settings up to +13 dBm are possible). Levels down to −130 dBm, for model 05 −110 dBm, can be set in conjunction with the **Attenuator** option.

Level sweep facilitates, for example, the determination of the compression points of amplifiers and the compensation for frequency-response roll-off in the test configuration.

Modulation The SWP has been designed for different types of modulation: squarewave modulation with an internal signal; AM, FM and pulse modulation with an external signal. This affords the SWP great versatility as a signal source.

Frequency markers A total of six variable frequency markers can be entered, the frequency of any one marker being indicated on the display. When the Synchronizer option is incorporated the markers are crystal-referenced. The **Harmonic Marker** option produces **additional markers** at 100/10/1-MHz intervals. The marker identifying the displayed frequency and the 100-MHz or 10-MHz marker are highlighted by widening of the marker pulse.

Storage/recall Up to nine* full front-panel setups can be stored and recalled with a single keystroke when needed.

* Ten including the last operating setup, which is stored when the unit is switched off.

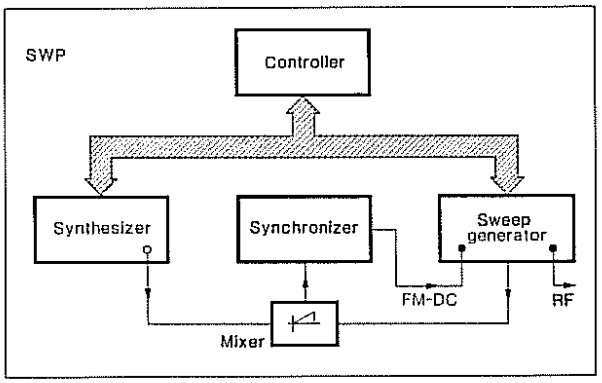
Extensions (options)

Synchronizer SWP-B1 In conjunction with the Synchronizer option the Sweep Generator SWP offers synthesizer performance with a lower frequency limit of 100 kHz. All **frequency settings,** including the markers, are **crystal-referenced** and spurious FM is greatly reduced. This opens up numerous and novel applications for the sweep generator.

Use of the Synchronizer option is particularly interesting for **narrowband sweeping** ($\Delta f < 1$ MHz) and for **CW operation** ($\Delta f = 0$), permitting measurements on crystal filters to be performed with the SWP.

Synchronization occurs at 1-kHz intervals. The settling time is less than 100 ms. In the wideband sweep mode the frequency counter ensures accurate setting of the start frequency and of the variable frequency markers.

SWP + Synchronizer replaces several instruments. With crystal-referenced frequency setting the SWP performs tasks which up to now called for several instruments; an example is shown below.



The SWP performs the tasks of several instruments

Conventional systems handling high frequencies require for accurate frequency setting of the sweeper either an external synthesizer and a synchronizer or a microwave counter and – in some cases – a controller.

All this accessory equipment is superseded by the Sweep Generator SWP fitted with the Synchronizer option. This simplifies the test assembly and cuts down on purchase cost.

Reference Oscillator SWP-B11 This option improves the frequency stability of the Synchronizer (reducing the effects of temperature and crystal aging).

Attenuator SWP-B7 Using the Attenuator option the output level can be set in 0.1-dB steps from +10 dBm to −130 dBm.

External Sweep Control SWP-B8 In the external sweep mode, this option permits marker generation and, with the Synchronizer fitted, stabilization of the start and stop frequencies.

Harmonic Marker SWP-B9 This option permits the display of markers with 100/10/1-MHz spacings. The markers representing the higher value (10 or 100 MHz) are highlighted by broader marker pulses. External marker signals can also be applied.

Specifications (without options)

Frequency range/sweep range	0.4 to 2500 MHz	
Frequency/sweep setting	via keypad or rotary knob a) start and stop frequencies or b) centre frequency and sweep width	
Frequency display	6 digits in GHz, MHz or kHz; resolution: 10 kHz	
Resolution of sweep-width setting		
up to 20 MHz	10 kHz	
>20 to 250 MHz	60 kHz	
>250 to 2500 MHz	600 kHz	
Error limits of frequency setting CW	±12 MHz ±0.5 MHz/°C	
START[1]	≤0.01 × Δf additionally	
Δf[1]	≤2%	
Output level (with Attenuator option see page 127)		
CW	0 to +10 dBm or 224 to 707 mV (50 Ω)	
AM	0 to +4 dBm or 112 to 354 mV into 50 Ω	
Setting	via keypad or knob	
Display	4 digits in mV, µV or dBm/dB; resolution: 1% of setting or 0.1 dB	
Output level error	≤ ±0.5 dB at 100 MHz	
Frequency-response flatness	≤ ±1 dB (typ. ±0.5 dB), referred to 100 MHz	
Output (N female connector)	50 Ω, VSWR ≤1.25	
Spectral purity		
Residual FM (sweep width <20 MHz)	<5 kHz peak (30 Hz to 20 kHz)	
Harmonics[2]	>30 dB, typ. >40 dB down	
Spurious signals[2]	≥50 dB down at 0.4 to 2000 MHz ≥35 dB down at >2000 to 2500 MHz	
Level sweep		
Setting	via keypad or knob	
Setting range	0 to 10 dB	
Display/resolution	4 digits in dB, mV, µV/0.1 dB	
Error	≤0.5 dB	
RF monitoring output	N female connector on rear panel, 50 Ω	
Level into 50 Ω	≈ 26 dB below RF output level	
with Attenuator option	≈ −18 dBm CW ≈ −24 dBm with AM	
External level control	suitable for external detectors with positive detection voltage	
Connector	BNC female, Z ≈100 kΩ	
Frequency sweep	internal or external	
Internal sweep	0.01 to 100 s	
Setting	via keypad or knob, resolution: 1/10/100 ms	
External sweep[3]	via BNC female connector, Z ≈100 kΩ	
Sweep voltage	0 to 10 V	
Frequency markers	6 adjustable markers	
Setting	via keypad or knob, resolution: 10 kHz ±0.1% of sweep width setting	
Display	6 digits in GHz, MHz, kHz; 1 or 3 markers	
Error limits[1]	±12 MHz ±0.5 MHz/°C ±0.02 Δf	
Marker output	BNC female connector, ≈ 5 V	
Reference oscillator	10 MHz	
Crystal aging	$< \pm 1 \times 10^{-6}$/month	
Temperature effect	$< \pm 1 \times 10^{-6}$/°C	
Output/input (switched internally)	BNC female connector on rear panel	
Output level	TTL	
Input requirement for ext. ref.	≈ 0.5 V_{rms}	
Amplitude modulation	internal and external; internal in CW mode only	
Modulation frequencies		
Internal, squarewave	1 kHz	
External, AM	carrier freq. / mod. freq. >10 to 2500 MHz / 0 to 10 kHz >1 to 10 MHz / 0 to 3 kHz 0.4 to 1 MHz / 0 to 1 kHz	
Modulation depth	0 to 80%	
Setting	via keypad or knob	
Resolution for 0 to 9.9% mod.	0.1% steps	
10 to 80% mod.	1% steps	
Error	≤8% of mod. depth	
Modulation distortion with undistorted ext. signal	≤5% for f_{mod} = 1 kHz and 80% modulation	
Input for ext. signal	BNC female connector, Z = 600 Ω	
Input requirement	1 V ±1% or 1.41 V with DC	

[1]) Sweep time >100 ms.
[2]) With 50-Ω termination, without AM.
[3]) With external sweep, marker generation and synchronization are possible only if the SWP-B8 is fitted.

SWP – Specifications (continued)

Frequency modulation ..... external
Frequency range ..... DC to 100 kHz (±1.5 dB)
Frequency deviation ..... 0 to 10 MHz
  Sweep width up to 2.5 MHz ..... 0 to 125 kHz
  Setting ..... via keypad or knob
  Display ..... 3 digits in MHz or kHz
  Resolution ..... ≤1.2% or 125 Hz
  Error ..... ≤5% + 60 Hz for f_{mod} = 1 kHz
  Modulation distortion with undistorted mod. signal ..... ≤1% for f_{mod} = 1 kHz, Δf ≤100 kHz
Input for ext. signal ..... BNC female connector, Z = 600 Ω
  Input requirement ..... 1 V ±1% or 1.41 V with DC

Pulse modulation ..... external (only without synchronization)
Carrier frequency range ..... 20 to 2500 MHz
Rise and fall times ..... <0.1 µs
Pulse repetition frequency ..... 50 Hz to 50 kHz
Minimum pulse width ..... 10 µs
On/off ratio ..... >80 dB (test bandwidth ≤10 kHz)
Input for ext. signal ..... BNC female connector, Z ≈ 600 Ω
  Input requirement ..... >2 V/<0.5 V (for on/off), max. 5 V

Blanking output ..... BNC female connector on rear panel
Level ..... TTL, high on forward sweep
low on return sweep

Output for frequency-proportional voltage ..... BNC female connector on rear panel, Z ≈100 Ω
Level ..... −10 V for f_{max} = 2500 MHz
Maximum load ..... ≥10 kΩ

Remote control ..... for all operating modes and for data transfer in listener/talker functions
IEC-bus interface ..... in line with IEC 625-1 and IEEE 488, connector: 24-contact Amphenol
Functions SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1

Data of options

Synchronizer SWP-B1
Frequency range
  Sweep width ≤1 MHz ..... 100 kHz to 2500 MHz
  >1 MHz ..... 400 kHz to 2500 MHz
Resolution
  Frequency indication
    Sweep width ≤1 MHz/>1 MHz 1 kHz/10 kHz
  Start-frequency setting
    Sweep width ≤1 MHz/>1 MHz 1 kHz/10 kHz
  Marker frequency
    Sweep width ≤1 MHz/>1 MHz 1 kHz/10 kHz
  Sweep-width setting
    Sweep width ≤1 MHz ..... 0.25 to 1.6 kHz
    >1 MHz ..... as without SWP-B1 option
Frequency error (CW) ..... see reference oscillator
  Δf ≤1 MHz: START ..... see reference oscillator ±2 kHz
    f (f_{start} ≤70 MHz)
      f ≤100 kHz ..... ≤±2%
      f >100 kHz ..... 0.003 × f ±1 kHz
    f (f_{start} ≤70 MHz)
      f ≤200 kHz ..... ≤±2%
      f >200 kHz ..... 0.003 × f ±1 kHz
  Δf >1 MHz: START ..... ≤±(5 × 10^{-4} Δf +20 kHz)
    Δf[1]) ..... reference error ±3 × 10^{-9} of
Marker-frequency error[1]) ..... set sweep width ±2 kHz

Typical residual FM (CW operation, FM on)

Weighting	peak CCIR (30 Hz to 20 kHz)	CCITT
Frequency range		
0.1 to 20 MHz	25 Hz	5 Hz
>20 to 200 MHz	<100 Hz	<15 Hz
>200 to 2500 MHz	<250 Hz	<50 Hz

Amplitude modulation ..... 0 to 50% (external only)
Frequency modulation[2])
  FM frequency range
  0.1 to 20 MHz ..... 0.05 to 50 kHz
  >20 to 2500 MHz ..... 0.05 to 20 kHz
  Frequency response flatness .... ≤ ±2 dB referred to 1 kHz
  Frequency deviation
  0.1 to 20 MHz ..... max. 100 kHz
  >20 to 100 MHz ..... 0 to $5 \times \frac{f\,(MHz)}{f_{mod}\,(kHz)}$ kHz, 100 kHz max.
  >100 to 2500 MHz ..... 0 to $\frac{500}{f_{mod}\,(kHz)}$ kHz, 100 kHz max.

Resolution
  up to 10 kHz deviation ..... 10 to 375 Hz
  up to 100 kHz deviation ..... 0.1 to 3.75 kHz
  Error (f_{mod} = 1 kHz) ..... typ. <5% +0.5 × resolution
  Modulation distortion with undistorted ext. signal ..... ≤0.5% with f_{mod} = 1 kHz
Pulse modulation ..... not poss. with Synchr. switched on
Spurious signals (terminated with 50 Ω, without AM)
  >200 kHz from carrier ..... down ≥50 dB for 0.1 to 2000 MHz
    down ≥35 dB for >2000 MHz
  3 to 200 kHz from carrier ..... down typ. 45 dB for 0.1 to 2000 MHz
    down ≥35 dB for >2000 MHz
Sweep time ..... 20 ms to 1.1 s

Reference Oscillator SWP-B11
Crystal aging ..... < ±1 × 10^{-6}/year
Temperature effect ..... < ±1 × 10^{-7} in range 0 to 50 °C

Attenuator SWP-B7

Attenuation range ..... 138 dB in 2-dB steps
Attenuation error (1 dB max.) ..... ≤ ± (0.2 dB +1.3% of attenuation)
  Typical error (0.5 dB max.) ..... ± (0.1 dB +0.6% of attenuation)
Characteristic impedance ..... 50 Ω
VSWR up to 1 GHz/2.5 GHz ..... ≤1.2/≤1.4
Output level of SWP fitted with Attenuator option[3]) ..... −110 to +10 dBm (0.7 µV to 707 mV)
with AM ..... −110 to +4 dBm (0.7 µV to 354 mV), into 50 Ω; resolution 0.1 dB

External Sweep Control SWP-B8
Input voltage ..... 0 to 10 V
Sweep time ..... 10 ms to 100 s

Harmonic Marker SWP-B9[4])
Marker spacing selectable ..... 100/10/1 MHz (modulation and level sweep switched off, internal sweep)
Marker output ..... ≈ 5 V, BNC female connector
Frequency error ..... <1 × 10^{-6}/month/<1 × 10^{-6}/°C ±0.2% of sweep width set ±50 kHz
External marker input ..... BNC female connector on rear panel
  Level requirement ..... −3 to +3 dBm
  Marker-frequency range ..... 5 to 2500 MHz; Δf ≥4 MHz

General data

Rated/storage temperature range .. +5 to +45 °C/−40 to +70 °C
Power supply ..... 100/120/220/240 V ±10%, 47 to 63 Hz (180 VA max.)
Dimensions, weight ..... 470 mm×162 mm×483 mm, 22 kg

Ordering information

Order designation		▶ Sweep Generator SWP
SWP for 0.4 to 2500 MHz		339.0010.02
SWP for 0.1 to 2500 MHz incl. SWP-B1 and -B7		▶ Synthesizer SWP 339.0010.03
Options		
Synchronizer	SWP-B1 ...	339.5158.02
Reference Oscillator ..	SWP-B11 ..	339.9618.02
Attenuator	SWP-B7 ...	339.9718.02
Ext. Sweep Control ...	SWP-B8 ...	339.9453.02
Harmonic Marker	SWP-B9 ...	339.4716.02
19" Adapter	SWP-Z9 ...	339.9660.02

[1]) Sweep time >100 ms.
[2]) With FM, spurious frequencies may occur at ≤300 Hz from the carrier.
[3]) The minimum level adjustable for models 02, 03 and 04 is −130 dBm, values down to −110 dBm are however guaranteed only.
[4]) With mismatch (ρ >0.5) and RF output levels ≥0 dBm, individual markers may drop out if sweep times are below 50 ms or – when using special function 2 – with levels <0 dBm.