ROHDE&SCHWARZ

Operating manual

SWEEP GENERATOR 0.4 ... 2500 MHz SWP

339.0010.02

Printed in West Germany

Volume I

Manual consists of 3 volumes

Table of Contents of SWP Manual

VOLUME I

VOLUME II

VOLUME III

Table of Contents

Table of Contents

Supplement
to
Manual SWP
339.0010.02

Manual sweep up to a frequency span of 1 MHz is not possible, when the synchronizer (Option SWP-B1) is used. At wide frequency spans a correction of the start frequency is initiated by pressing the CLR key 6.

Special functions (Setting Sequences) are not included.

2. Preparation for Use and Operating Instructions

The values given in this section are not guaranteed values. Only the values given in the data sheet are binding.

All underlined figures refer to the front and rear views of the SWP (Figs. 2-1 and 2-2 in the appendix).

2.1 Explanation of the Front and Rear Views

Ref. No.	Labelling	Function
1		6-digit display of centre or start frequency or frequency marker.
	▶	Cursor. If lit, setting data can be entered.
	X	Overflow. Lights in synchronized operation (with Synchronizer Option) when frequencies ≥ 1 GHz are displayed with 1-kHz resolution.
	kHz MHz GHz	Illuminated display of frequency unit.
	CENT START MARKER	Illuminated display to indicate whether a centre or a start frequency or a frequency marker from 1 to 6 is being displayed.
2		6-digit display of frequency marker or difference between two marker frequencies.
	▶	Cursor. If lit, setting data can be entered.
	X	Overflow. Lights in synchronized operation (with Synchronizer Option) if frequencies ≥ 1 GHz are displayed with 1-kHz resolution.
	kHz MHz GHz	Illuminated display of frequency unit.
	MARKER –	MARKER : Display of frequency marker from 1 to 6.

Ref. No.	Labelling	Function
2		MARKER $\square^{\square}_{\square}$ - $\square^{\square}_{\square}$: Display of difference between any two of the six frequency markers.
3		6-digit display of sweep width, stop frequency or frequency marker.
	▶	Cursor. If lit, setting data can be entered.
	X	Overflow. Lights in synchronized operation (with Synchronizer Option) if frequencies ≥ 1 GHz are displayed with 1-kHz resolution.
	kHz MHz GHz	Illuminated display of frequency unit.
	△ F STOP MARKER $\square^{\square}_{\square}$	Illuminated display to indicate whether the frequency deviation, stop frequency or a frequency marker from 1 to 6 is being displayed.
4		4-digit display of RF output voltage or RF output level or level differences.
	▶	Cursor. If lit, setting data can be entered.
	µV mV dBm dB	Illuminated display of unit of indicated value.
	△ LEVEL	If lit, level difference is read out (level sweep). If LEVEL appears the RF output voltage (in µV or mV) or the RF output level (in dBm) is displayed.
5		3-digit display of frequency sweep time, modulation depth with AM or frequency deviation with FM.
	▶	Cursor. If lit, setting data can be entered.

Ref. No.	Labelling	Function
5	ms s kHz % MHz TIME MOD	Illuminated display of unit of sweep time (ms, s), of frequency deviation (kHz, MHz) and of modulation depth (%). Illuminated display of sweep time and modulation.
6		Keypad

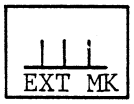
	Basic function	Second function
CLR BLK	Reset after test routine if error message has been received.	Displays switched off.
STO IEC	Storage of a complete device setup.	Indication and selection of IEC-bus address on display 2.
RCL SF	Recalling a stored device setting.	Activating special functions.

7	○	Second function shift key with LED.
8	POWER	Power switch.
9		Keypad.
	0 to 9	Numeric keys 0 to 9.
	. ±	Decimal point and polarity signs.
	kHz µV ms / MHz mV s	Unit keys for termination of entry.
	GHz dBm / dB %	

Ref. No.	Labelling	Function	
10	LOCAL	Knob to switch over from IEC-bus control to manual control.	
11	REMOTE	LED to indicate remote control via the IEC bus.	
12	MODULATION	Keypad for selection of modulation. Each key with LED.	
		Basic function	Second function
	⎍⎍ INT	Internal square-wave AM (1 kHz)	
	AM	External AM.	
	PULS	External PM.	
	FM FMDC	External FM (AC coupling)	External FM (DC coupling).
13	1,41 V 0,4/2V^{P} ⎍⎍ 600 Ω	Modulation input, BNC socket.	
14	◎	LED to indicate second function of (FM) FMDC key 12.	
15	SWEEP	Keypad for sweep operation. Each key with LED.	
		Basic function	Second function
	TIME EXT	Sweep time for frequency or amplitude sweep.	External frequency or amplitude sweep.
	⟶ / ⟵	RF blanked during flyback.	
	SINGLE MAN	Single sweep operation.	Manual frequency or level sweep (with DATA VAR. knob 24 or step keys).

Ref. No.	Labelling	Function
15	START LINE	Basic function: Triggering of single sweep. Second function: Line-synchronous sweep.
16	10 V_p	BNC socket for output of sawtooth for X deflection on scope. Sweep voltage input for external sweep operation.
17		LED to indicate second functions of SWEEP keypad 15.
18	RF LEVEL INT EXT SWEEP	Keypad for RF level. Each key with LED. Basic function: Internal RF level setting. Second function: External level control. Level sweep.
19	ALC EXT	BNC socket for connection of external level detector (control voltage input, positive detection voltages).
20		LED to indicate second function of (INT) EXT. key 18.
21	TEST PRESET	Basic function: PRESET: SWP assumes internally fixed basic setting. Second function: TEST: Execution of a test routine. If any faults are detected an error code message will appear on display 2, the parameter of measurement being displayed in hexadecimal form on 3.

Ref. No.	Labelling	Function	
		Basic function	Second function
22	STEP ↑ MAN ↓	STEP: Keys for variation of a setting with a step size automatically matched to the parameter concerned. If a key is pressed a little longer the steps are automatically repeated, the repetition rate being tripled after three steps.	MAN: Same as basic function, but with manually entered step size. LED 23 lights in this mode.
23	MAN	LED to indicate the second function MAN of the STEP keys 22 (manually entered steps).	
24	DATA VAR	Rotary knob for varying a setting parameter with a step size automatically matched to the sensitive control of the SWP.	
25	MARKERS	Keypad for frequency markers.	
		Basic function	Second function
	FREQ	Six variable frequency markers (crystal-referenced if Synchronizer Option is fitted).	
	DISP3 Δ MK	Display of three selectable markers on 1, 2, 3.	Display of absolute value of difference between any two marker frequencies on 2.
	BLK	Pulses of variable markers at marker output 26 switched off.	

Ref. No.	Labelling	Function	
25		Basic function: Crystal-referenced 1-MHz, 10-MHz or 100-MHz harmonic markers (if Harmonic Marker Option is fitted).	Second function: External markers
26		BNC socket for marker output.	
27	1 10 100	LEDs to indicate 1-MHz, 10-MHz or 100-MHz harmonic markers (if Harmonic Marker Option is fitted).	
28	OFF	Key to switch off RF voltage at the RF output 29 (on front panel) and the RF test output 35 (on rear panel). If the RF voltage is switched off the red lamp built into the key lights.	
29		RF output, N socket.	
30	FREQUENCY	Keypad for frequency setting.	
31	FULL MK-SWP	Basic setting: Sweep over entire frequency range. Indication by means of LED built into the key.	Second setting: Start and stop frequencies fixed by two selectable markers. Indication by means of LED built into the key.
	SYNC	Synchronized operation (with Synchronizer Option) for crystal-referenced frequency setting (low spurious FM). Indication by means of built-in LED.	

Ref. No.	Labelling	Function	
		Basic setting	Second setting
30			
31	CENT MK	Centre frequency, $f_m/\Delta f$ mode.	Variable frequency marker becomes centre frequency.
	ΔF CORR	Frequency deviation, $f_m/\Delta f$ mode.	Correction of frequency offset of sweep oscillator by means of DATA VAR knob 24 (only in unsynchronized operation).
	START CW	Start frequency, START-STOP mode.	CW mode.
	STOP	Stop frequency, START-STOP mode.	
32	BLANK	Output for return sweep squarewave (TTL levels, H for forward sweep, L for flyback), BNC socket.	
33	TRIGGER	Input for trigger pulse (TTL levels), BNC socket. Positive edge (L -> H) triggers single sweep in SINGLE mode 15. NOTE: While 33 is at L level, the functions START 15 and LINE 15 are disabled.	
34	REF 10 MHz	10-MHz reference output (or input after changing the connection of two links in the reference oscillator), BNC socket.	
35	RF	RF test output, N socket.	
36	IEC 625	IEC-bus connector.	

Ref. No.	Labelling	Function
37	 EXT MARK	Input for external frequency markers (only if Harmonic Marker Option is fitted).
38	 10 V f/f_{MAX}	Output for sawtooth sweep voltage, amplitude proportional to frequency, normalized to f_{max} = 2.5 GHz
39	47 - 63 Hz	AC supply receptacle.
40	110 V ~ T 2,5 D 120 V ~ 220 V ~ T 1,25 B 240 V ~	Voltage selector with power fuse and replacement fuses.

2.2 Preparation for Use

Prior to operation of the SWP check that the voltage selector 40 is set to the available AC supply voltage. It can be set to 110 V, 120 V, 220 V or 240 V ±10%. To do so, insert power fuse accordingly into voltage selector 40.

Required fuses:

110 V/120 V	T2,5D	DIN 41571
220 V/240 V	T1,25B	DIN 41571.

The voltage selector 40 contains replacement fuses.

The 19" Adapter SWP 3E 1/1 permits the SWP to be mounted in a rack.

2.3 Manual Operation

The keys and the data variation knob on the front panel of the SWP are arranged in sections according to their functions. The settings are read out on the digital displays provided above them. The associated designations and units are lit up.

The inputs and outputs required for sweep operation of the SWP are located on the front panel such that logical association with the various front-panel control sections is ensured. Test and auxiliary inputs and outputs (see Figs. 2-1 and 2-2) are located on the rear panel.

2.3.1 Switch-on

The SWP is switched on by means of the POWER key 8.
The SWP resumes its previous setting prior to switch-off (or AC supply failure) as all data are stored in a battery-backed CMOS-RAM.

2.3.2 Device Setting

The SWP can be set in four different ways by means of the provided operating controls:

a) Entry via the keypad 9.

b) Variation by means of the DATA VAR knob 24
with automatically matched step size.

c) Variation by means of the STEP keys 22
with automatically matched step size.

d) Variation by means of the STEP keys 22
with manually entered step size.

Re a) Entry via the keyboard 9

Proceed as follows:

-> Select the parameter to be set by pressing the key concerned.

In response the cursor ▶ and the designation of the parameter are lit.

-> Enter the numerical value by means of numeric keys 9.

The numerals are entered from left to right. Leading zeros are not required. If a wrong entry has been made press the key of the parameter concerned again. Now the previous setting reappears on the display and a new entry can be started.

-> Select polarity sign by means of ± key 9.

-> Terminate entry by pressing one of the unit keys 9.

After the key has been pressed the SWP assumes the new settings. The unit on the display lights to acknowledge completion of the entry.

If it is desired to vary the setting just enter the particular numerals and terminate the entry with the unit as delimiter. This can be repeated until another parameter is selected.

Any possible products of decimal power and basic units within the digital display range can be entered. For example, it is possible to enter 2500 MHz. After termination of the entry the SWP converts the entry to read out 2,500000 GHz. If the setting falls below or

exceeds the range the SWP is set to the minimum or maximum value, respectively.

Re b) Variation by means of the DATA VAR knob 24 *)
with automatically matched step size

As with the keypad entry, first select the parameter to be set:

-> Press the key associated with the parameter to be varied.

Cursor ▶ and the designation of the parameter selected are lit.

-> Vary the value by means of rotary knob 24.

The value is varied with a step size matched to the sensitive control of the SWP. One rotation of the knob corresponds to 24 steps.

Re c) Variation by means of the STEP keys 22 *)
with automatically matched step size

The function of the STEP keys 22 basically corresponds to that of the DATA VAR knob 24 (see b)). If a STEP key is pressed the setting is increased or reduced by the step size, respectively. If the key is pressed a little longer the steps are automatically repeated until the key is released again, the repetition rate being tripled after three steps.

Re d) Variation by means of the STEP keys 22 *)
with manually entered step size

Function and operation correspond to description under c).

The step size is entered as follows:

-> First press the o key 7 and then the STEP ↑ key 22.

-> Enter the step size by means of the numeric keys 9.

-> Terminate entry by pressing one of the unit keys 9.

LED 23 lights when the step size has been entered manually.

*) In sweep mode the speed of the variation depends on the sweep time to ensure that one sweep is finished before the next setting.

2.3.3 Two-function Keys

The two-function keys are engraved black and orange/red. The orange/red engraving applies to the second function. To enable the second function first press the o key 7 (orange-coloured surface). This will cause this key to light. Now press the desired key. The LED in key 7 goes out.

To disable the second function proceed in the same manner.

Since the second functions of the keypads RF LEVEL 18, SWEEP 15 and MODULATION 12 are not indicated on the displays the signal lamps 20, 17 and 14 are provided instead.

2.3.4 Frequency Setting

The sweep frequency range can be fixed by the centre frequency f_{centre} and the frequency deviation Δf or by the start and stop frequencies. The frequency is indicated on the 6-digit displays 1 and 3.

2.3.4.1 Centre Frequency f_{centre} and Frequency Deviation Δf

	Key	Indication
Centre frequency f_{centre}	CENT 31	CENT on display 1
Frequency deviation Δf	ΔF 31	ΔF on display 3

The sweep generator is tuned from $f_1 = f_{centre} - \Delta f/2$ to $f_2 = f_{centre} + \Delta f/2$. If $\Delta f = 0$, a discrete frequency $f = f_{centre}$ is produced (CW mode, see also 2.3.4.4).

With the synchronizer (Option SWP-B1) switched in, the centre frequency is rounded off when odd sweeps (kHz) are entered, since its resolution is 1 kHz.

Example: Entry: Δf = 875 kHz, f_m = 10 MHz

SWP setting: Δf = 875 kHz, f_m = 9.999 MHz

2.3.4.2 START-STOP Mode

	Key	Indication
Start frequency f_{start}	START 31	START on display 1
Stop frequency f_{stop}	STOP 31	STOP on display 3

If the start frequency is equal to the stop frequency the SWP operates in the CW mode (see also 2.3.4.4). If $f_{stop} < f_{start}$ the value last entered is both the start and the stop frequency.

2.3.4.3 Alternating $f_{centre}/\Delta f$ and START-STOP Mode

Alternating $f_{centre}/\Delta f$ and START-STOP mode is controlled via the keypad 31. If the CENT and Δf keys are pressed, $f_{centre}/\Delta f$ mode is selected and if the START or STOP key is pressed the SWP operates in the START-STOP mode. After changing the mode, the frequency displays on 1 and 3 are converted accordingly.

$$\Delta f = f_{stop} - f_{start}$$

$$f_{centre} = (f_{start} + f_{stop})/2$$

or

$$f_{start} = f_{centre} - \Delta f/2$$

$$f_{stop} = f_{centre} + \Delta f/2$$

The selected mode is illuminated on the displays 1 and 3 for unambiguous identification.

2.3.4.4 CW Mode

CW mode is selected by enabling the second function of the (START) CW key 31. The discrete frequency f now corresponds to the start frequency prior to switching over. It is displayed on 1 and can be reset or varied by means of the numeric keys 9, the DATA VAR knob 24 or the STEP keys 22.

When switching over to CW mode the information on the previous stop frequency is lost.

CW mode can also be selected according to sections 2.3.4.1 and 2.3.4.2 ($\Delta f = 0$ or $f_{start} = f_{stop}$).

2.3.4.5 FULL Mode (Maximum Sweep Width)

Independent of the selected frequency setting full sweep width (0.4 to 2500 MHz) can be selected or the old frequency reset by means of the FULL key 30. The FULL mode is indicated by means of the LED provided in the FULL key.

2.3.4.6 Synchronized Operation

If the Synchronizer Option SWP-B1 is fitted the SWP functions as a synthesizer. This function is switched on and off by means of the SYNC key 30 with built-in LED.

To be able to also take advantage of the enhanced resolution of 1 kHz for frequency settings above 1 GHz an overflow symbol is provided for the 6-digit LED displays. Thus a 7-digit figure can be entered in kHz, the GHz digit being carried to overflow after entering the kHz digit. The resolution of the displays can be switch-selected such as to either read the first or the last digit (see also section 2.3.5.1).

a) Display with 10-kHz resolution for the GHz digit

   -> Press one of the function keys 31.

   -> Press the GHz key 9.

b) Display with 1-kHz resolution for the kHz digit

   -> Press one of the function keys 31.

   -> Press the kHz key 9.

2.3.4.7 Frequency Setting with Frequency Markers

Frequency setting with frequency markers is selected by enabling the second function of the (CENT) MK 31 and (FULL) MK-SWP keys 30 (see section 2.3.3).

a) Replacing the centre frequency f_{centre} by any one of the frequency markers.

   -> Activate the second function of the (CENT) MK key 31.*)

   -> Enter the marker number 1 to 6.

   Display on 1: CENT MARKER Marker number.

   It is also possible not to enter a marker number. In this case the old marker number is used.

b) Replacing the start and stop frequencies by any two of the frequency markers

   -> Activate the second function of the (FULL) MK-SWP key 30.*)

   -> Enter the marker number 1 to 6 for START.

   -> Enter the marker number 1 to 6 for STOP.

*) Repeating this entry means deactivation of function.

Display on 1: START MARKER Marker number.

Display on 3: STOP MARKER Marker number.

It is also possible not to enter marker numbers for START or for START and STOP. In this case the old marker numbers are used.

2.3.4.8 Frequency Correction CORR

In unsynchronized operation the frequency setting accuracy is mainly determined by the tuning characteristic of the sweep oscillator. The CORR key permits the difference between the setting or display and the actual frequency at any point on the tuning characteristic to be corrected. Since the oscillator is practically linear the correction covers an extended frequency range.

Frequency correction

-> Connect a frequency counter to the RF output 29 or 31.

-> Switch on CW mode (see section 2.3.4.4).

-> Enter the frequency to be corrected.

-> Correct the difference between the display on the counter and on 1 or 3 by means of the DATA VAR knob 24.

Frequency correction is also possible in sweep operation. To this end, the harmonic markers (see section 2.3.5.2) or known filter curves can be displayed on a scope.

NOTE: (see also section 2.3.8.4)

The swept output voltage is produced according to the heterodyning method. This permits frequencies $f < 0$ to be derived from the sweep oscillator. If a correction is carried out in the setting range 0.4 to 20 MHz make sure that you are on the positive side (for example, by measuring two frequencies).

2.3.5 Frequency Markers

Variable frequency markers and harmonic markers (Harmonic Marker Option) are available in pulse form at the BNC socket 26 on the front panel.

2.3.5.1 Variable Frequency Markers

a) Entry of variable markers

Key: FREQ 25

Display on 2: MARKER Marker number.

The first figure following the depression of the FREQ key 25 is understood as marker number.

A total of six frequency markers (markers numbers 1 to 6) can be entered over the overall sweep range. If a marker is to be varied, it should first be displayed on 2. The associated pulse available at the marker output 26 is expanded to distinguish it from the other marker pulses.

b) Switching off the marker pulses

The frequency marker pulses present at the marker output 26 can be switched off:

-> Press the BLK key 25.
-> Enter marker number.

If 0 is used as marker number, all marker pulses are switched off.
If the marker is called up again (see a)), the pulse reappears at the output. The use of marker number 0 in this case will switch all markers on again.

c) Synchronized operation

If the Synchronizer Option SWP-B1 is fitted the SWP offers crystal-referenced variable markers and an enhanced resolution of 1 kHz. Since the available digits are not enough for frequencies above 1 GHz the display mode can be switched over as described in section 2.3.4.6 for frequency setting.

d) Three-marker mode

If frequency display is dispensed with three marker frequencies can be displayed on 1, 2 and 3.

-> Press DISP3 key 25.

-> Enter marker number 1, marker number 2, marker number 3.

Marker number 1 assigns any desired marker to display 1, marker number 2 to display 2, etc. It is also possible to enter less than three marker numbers or none. In this case, the respective old markers are displayed. If more than three marker numbers are entered, the process is the same as for a new entry (4th marker on display 1, 5th marker on display 2, etc.).

If any of the function selector keys that influence once of the displays 1, 2 or 3 is pressed or if key DISP3 25 is again actuated, the three-marker mode is discontinued.

e) Difference between two marker frequencies
The absolute value of the difference between any two marker frequencies can be displayed on 2 which facilitates bandwidth measurements. The pulses of the respective markers available at the marker output 26 are expanded.
-> Activate the second function of the (DISP3) ΔMK key 25.
-> Enter a maximum of two marker numbers.

2.3.5.2 Harmonic Markers

The Harmonic Marker Option SWP-B9 permits crystal-referenced 1-MHz, 10-MHz and 100-MHz markers to be displayed. They can be displayed simultaneously with the variable markers.
The harmonic markers are switched on by means of the ||| key 25. By pressing the key once, the higher-order harmonic markers (depending on the set frequency deviation) are enabled, by pressing it twice, the next lower-order harmonic markers are enabled a.s.o. If there are no more markers to be selected, the key is reset to its OFF position. When varying the sweep width, the harmonic marker displayed is automatically matched (max. marker number 30, min. number 3).
If the 1-MHz markers are selected, the 10-MHz markers, and if the 10-MHz markers are selected, the 100-MHz markers are identified by expanded pulses at the marker output 26. With sweep widths $\leq$ 2 MHz, the harmonic marker operation is automatically switched off. Simultaneous display of variable markers is only possible for a period of up to 1 s.

2.3.5.3 External Frequency Marker

An external frequency marker can be applied to the BNC socket EXT MARK 37 via an RF generator. This is only possible if the Harmonic Marker Option SWP-B9 is fitted and if it is selected by the second function of key (|||) EXT MK 25. The three LEDs 27 are lit. An external marker is only displayed if all harmonic markers (see section 2.3.5.2) are switched off. If the external marker is not required, disconnect the RF generator from socket 37 to prevent any disturbances in the harmonic marker mode. If multiples of the marker frequency occur, the RF level at socket 37 is to be reduced.

2.3.6 RF Level Setting

At the RF output 29 (N socket on the front panel of the SWP), a signal of 10 dBm max. is available. With amplitude modulation (see section 2.3.8) it is reduced to 4 dBm, max. The level can be reduced in steps of 0.1 dB down to

0 dBm (down to -110 dBm if the Attenuator Option SWP-B7 is fitted). The RF OFF switch 28 permits the RF output voltage to be switched off. In the off-state, the red lamp built into 28 lights.

The RF test output 35 is provided on the rear panel of the SWP. The test level of the basic unit is about 26 dB below the set RF output voltage available at 29. If the Attenuator Option SWP-B7 is fitted, the test level is - practically independent of the selected output power - about - 18 dBm.

2.3.6.1 Level Setting

Function key: INT 18 with built-in signal lamp.
Display on 4: LEVEL.
The level can be entered in µV, mV or dBm.

2.3.6.2 Level Sweep

The set level can be increased by a selectable amount ΔLEVEL. This corresponds to a sawtooth amplitude modulation which is effected in synchronization with the X deflection of the sweeper at the sweep rate of the latter (see also section 2.3.7).
The amplitude is increased in CW mode as well as in sweep operation; the former being useful for compression measurements on twoports and the latter for the compensation of frequency-dependent cable losses in the test setup.
Switching on the level sweep
-> Press the SWEEP key 18.
-> Enter level increase by means of the numeric keys 9.
-> Terminate entry by pressing the appropriate unit key 9.
Display on 4: ΔLEVEL Level increase.
If the level switch is switched on, the SWEEP key 18 lights.

2.3.6.3 External Level Control

For external level control, a detector or an RF power meter with a positive output voltage is required. To avoid hunting of the PLL, the following detector time constants must be maintained:

< 1 µs for $f \geq 10$ MHz
< 3 µs for $f \geq 1$ to < 10 MHz
< 10 µs for $f \geq 100$ kHz to < 1 MHz

The control voltage is applied to the BNC socket ALC EXT 19. For level setting proceed as described in section 2.3.6.1, with the exception that the second function of the (INT) EXT 18 must be activated. This is indicated by the LED 20.

It should be borne in mind that the level display on 4 is no longer correct as it is based on the characteristic of the internal level detector; i.e.

display 4 provides only a tendency indication. It is best to set the RF voltage with the DATA VAR knob 24.

2.3.7 Sweeping

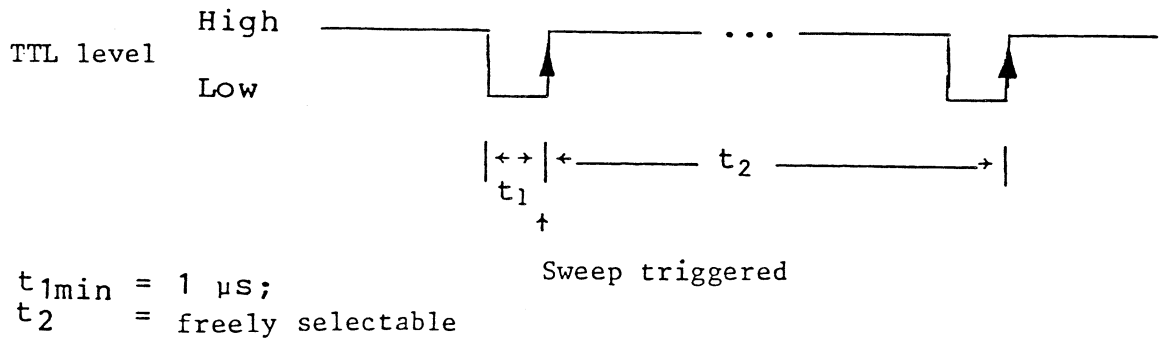
The sweep time is adjustable between 10 ms and 100 s. It is displayed on 5. The return sweep is 10 ms with forward sweeps of up to 1 s, and 100 ms for forward sweeps > 1 s. With the Synchronizer Option SWP-B1 switched on, a delay between the end of the return sweep and the beginning of the forward sweep results, which is 50 ms for narrowband sweeps ($\Delta f \leq 1$ MHz) and 38 ms for wideband sweeps ($\Delta f > 1$ MHz).
The sawtooth for the X deflection of an oscilloscope is available at the BNC socket 16 on the front panel of the SWP. It is also possible to feed an external sweep voltage into this socket (see section 2.3.7.4 b)). A voltage proportional to the frequency is brought out at the BNC socket 10 V f/f_{MAX} 38 on the rear panel of the SWP.
A TTL signal is present at the BNC socket BLANK 32 located on the rear panel, which is H during the forward sweep and L during flyback.

2.3.7.1 Sweep Time

Function key: TIME 15 with built-in signal lamp
Display on 5: TIME
The entry can be made in ms or s.
Frequency deviation and modulation depth are also displayed on 5. Switchover is accomplished by pressing the particular function keys (see section 2.3.8).

2.3.7.2 Single Sweep

This function can be switched on and off by means of the SINGLE key 15 with built-in LED or triggered by a TTL pulse at the BNC socket TRIGGER 33 (on the rear panel). During single sweep, the signal lamp in 15 lights.
External trigger pulse at 33:



t_{1min} = 1 µs;
t_2 = freely selectable

NOTE: While socket 33 is at low level, START (LINE) key 15 is disabled.

2.3.7.3 Blanked Flyback

In this mode the RF output voltage at 29 (and at the test output RF 35 on the rear panel) is switched off during flyback. This function is controlled by the ⇄ key 15 with built-in signal lamp.

2.3.7.4 Special Sweep Functions

All of the following functions are second functions of the keypad 15. If they are enabled the respective key and lamp 17 lights.

a) Line-synchronous sweep (START) LINE 15

In this mode the sweep start is synchronous with the line frequency.

NOTE: This function is disabled while the BNC socket TRIGGER 33 is at L (see section 2.3.7.2).

b) External sweep (TIME) EXT 15

The SWP is swept with an externally produced sweep voltage of between 0 and 10 V which is applied to BNC socket 16. Forward sweep and flyback must not be shorter than 10 ms.

c) Manual sweep (SINGLE) MAN 15

The sweep generator can be tuned through the selected frequency range by means of the DATA VAR knob 24 with the sweep voltage at socket 16 tracking accordingly.

2.3.8 Modulation

Of the four modulation modes possible only one can be activated at a time, i.e. the keys cancel each other. The activated modulation mode can be switched off by means of the corresponding key.

For internal squarewave modulation the 1-kHz oscillation is derived from the built-in reference oscillator and for amplitude, pulse and frequency modulation an external generator can be connected to the modulation input 13 on the front panel.

2.3.8.1 Internal Squarewave Modulation

The RF signal is switched off and on with the internally produced 1-kHz squarewave oscillation. This modulation mode is activated by means of the ⎍ INT 12 key with built-in signal lamp.

2.3.8.2 Amplitude Modulation

Function selector key: AM 12 with signal lamp
Indication: MOD on display 5.

The modulation depth is entered in %.

Since the 3-digit LED display 5 also reads out the sweep time it can be switched over accordingly by means of the function selector keys TIME 15 and AM 12 (see also section 2.3.7.1).

The set or displayed modulation depth (0 to 80%) refers to an AF voltage of 1 V at input 13. Since time constants must be switched over in the level detector at carrier frequencies below 10 MHz or 1 MHz, the upper modulation frequency is decreased from 10 kHz to 3 kHz and 1 kHz, respectively.

2.3.8.3 Pulse Modulation

Pulse modulation mode is activated by means of the PULSE key 12 with internal LED. Voltages > 2 V at the modulation input 13 switch the RF signal on and voltages < 0.5 V switch it off (Schmitt-Trigger input).

At carrier frequencies below 20 MHz pulse modulation is not possible. Pulse modulation is only possible in CW mode and with the synchronization (Option SWP-B1) switched off (see section 2.3.4.1).

2.3.8.4 Frequency Modulation

Frequency modulation is possible only in CW mode (see section 2.3.4.4).
If the carrier frequency is set to between 0.4 and 20 MHz the actual frequency may be in the negative range because of inaccuracies of the sweep oscillator (this danger does not exist in synchronized operation or if the sweep oscillator is corrected with CORR; see sections 2.3.4.6 and 2.3.4.8).

A negative carrier frequency means a phase shift of 180° for frequency modulation (see also b)).

a) FM with AC coupling

Function selector key: FM 12 with signal lamp
Indication: MOD on display 5.

The frequency deviation can be entered in kHz or MHz.

Thanks to AC coupling (C bypass) the DC drift cannot affect the sweep oscillator.

As for the two displays (TIME and MOD) on 5 the same applies as under amplitude modulation (see section 2.3.8.2). The set or displayed frequency deviation (0 to 10 MHz) refers to an AF voltage of 1 V at input 13.

b) FM with DC coupling

DC coupling is useful when the SWP is used as VCO in frequency control loops. Operation at negative carrier frequencies (see above) must, however, be avoided, otherwise the control loop will become unstable.

Proceed as under a) with the exception that the second function of the (FM) FMDC key 12 must be activated. In this mode the LED built into the key and lamp 14 light.

2.3.9 Storage of Device Settings

Nine complete device settings can be stored and recalled with the exception of the step sizes manually entered via the STEP keys 23.

Storage or recalling

-> Press the key STO or RCL 6, respectively.

-> Enter the program number (1 to 9).

2.3.10 Setting Sequences

Up to three complete settings can be called up in a sequence, the sequence being repeated cyclically. Such setting sequences can be stored under a program number as described in section 2.3.9.

The device settings that are to be recalled in a sequence must be stored according to the desired order of sequence in the stores 7, 8 and 9 (see section 2.3.9).

Sequence of two device settings

-> Store settings in the stores 7 and 8.

-> Activate the second function of the (RCL) SF key 6.

-> Enter figures 7, 8.

Sequence of three device settings

-> Store settings in the stores 7, 8 and 9.

-> Activate second function of the (RCL) SF key 6.

-> Enter figures 7, 9.

Now all displays are blanked except 2 on which "SF 7 8" or "SF 7 9" is displayed.

Termination of the sequence

-> Press RCL key 6.

-> Enter program number (0 to 9).

RCL 0 recalls the last device setting prior to calling up setting sequences.

With a setting sequence it is not possible to vary a setting parameter.
In order to vary a setting parameter the setting sequence must be terminated by means of RCL X, X = 7 to 9. For orientation the content of the stores 7, 8 and 9 can be displayed for 10 s on the front panel while a setting sequence is being called up:

-> Activate the second function of the (RCL) SF key 6.

-> Enter figures 70, 80 or 90.

As a result, the setting program 7, 8 or 9 is displayed.
(Error message for SINGLE, MAN, CW)

2.3.11 Switching off the Displays

All LED displays operate according to the multiplexing method. This may cause very sensitive test items to be affected by noise voltages. To prevent this the displays can be switched off. The second function of the (CLR) BLK key 6 is provided for this purpose.

2.3.12 PRESET and TEST

a) PRESET

An internally preprogrammed basic setting can be selected by pressing the red key PRESET 21.

-> The cursor > on display 1 is lit up.

-> All second functions are disabled.

Second functions with setting variables use the preset values of equivalent basic functions.

Frequency settings

-> SWP in START-STOP mode.

-> FULL 30 and synchronization (SYNC 30) disabled.

-> Setting data: f_{start} = 400 kHz
f_{stop} = 2.5 GHz

-> Indication: START 400 kHz on display 1
STOP 2.50000 GHz on display 3.

Frequency markers:

-> All variable and harmonic markers are switched off.

-> (BLK 30, ||| 30).

-> Preset variable markers:

Marker number	Frequency
1	400 kHz
2	0.5 GHz
3	1.0 GHz
4	1.5 GHz
5	2.0 GHz
6	2.5 GHz

-> Display on 2: MARKER 3 1.00000 GHz.

RF level setting

-> RF level at output RF 29 0 dBm (INT 18).

-> Level sweep (SWEEP 18) off.

-> Value Δ LEVEL 0 dBm.

-> Indication on display 4: LEVEL 0.0 dBm.

Sweep

-> Sweep time (TIME 15) 20 ms.

-> Automatic sweep (SINGLE 15 off).
RF level not blanked during flyback ($\rightleftarrows$ 15 off).

-> Indication on display 5: TIME 20 ms.

Modulation

-> All modulation modes off ($\underset{\text{INT}}{\sqcap\!\sqcap}$ 12, AM 12, FM 12, PULS 12).

-> Setting data AM: modulation depth m = 0%
FM: frequency deviation f = 0 kHz

-> No indication on displays.

b) TEST

The second function of the (PRESET) TEST key 21 initiates a test routine during which a coded error message is displayed on 2 if a fault has been detected. The corresponding hexadecimal value of measurement appears on display 3. The error messages and measurement values are explained in the service manual.

During the test run all displays are blanked. No settings are made. If the test result is positive (no fault) the basic setting is restored. If a fault has been detected the fault messages are preserved in the displays 2 and 3 until the CLR 6 key is pressed. The setting prior to the test run is then restored.

NOTE: It is advisable to isolate sensitive test items from the RF output 29 since the full output power (10 dBm) is reached during the test run.

2.3.13 10-MHz Reference Oscillator

All fixed frequencies required in the SWP are derived from a 10-MHz reference signal which is either produced by an internal crystal oscillator or externally applied via the input/output REF 10 MHz 34 on the rear panel. In place of the standard crystal oscillator the Reference Oscillator Option SWP-B11 with oven-controlled crystal can be used. To switch over from internal operation to external operation remove the reference oscillator from the SWP and unscrew the upper cover of the oscillator (see section 2.5). Connect the links accordingly.

a) Internal reference

The SWP is supplied from the factory for internal operation. The links BR4 and BR5 are inserted. The BNC socket 34 is used as an output.

b) External reference

Unplug links BR4 and BR5. Plug one of the links onto the pins opposite BR4 and BR5. The BNC socket 34 can now be used as an input.

2.4 Remote Control - IEC Bus

The Sweep Generator SWP can be remote controlled via a byte-serial bus system according to IEC standard 625-1 (IEEE 488.1975). IEC-bus connector 36 is on the rear panel of the SWP. For a mating connector a 24-pole connector according to the American standard 488.1975 is used. Connnection to systems fitted with equivalent connectors according to the European IEC standard is possible by using an adapter.

The pin location can be seen in Fig. 2-3.

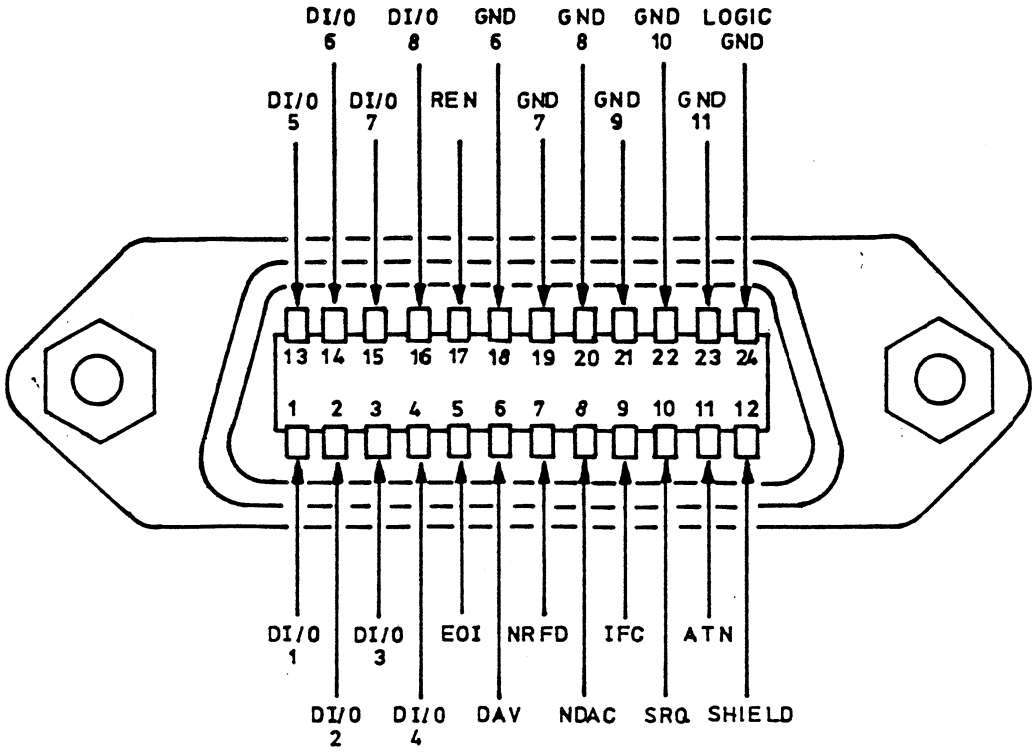


Fig. 2-3 Pin allocation

For data transfer ISO-7-bit-code (ASCII-code) characters are used, DI/01 being the least significant bit. An exception is the transfer of device control blocks (DCB) where the ASCII header is followed by a sequence of 8-bit control bit patterns which may contain all possible 255 bit combinations (see section 2.4.3.8).

2.4.1 IEC-bus Functions

The Sweep Generator SWP can serve as listener and talker. The following interface functions are implemented:

SH1	Source handshake function, complete capability
AH1	Acceptor handshake function, complete capability
T6	Talker function, capability to answer serial poll, unaddressing if MLA
L4	Listener function, unaddressing if MTA
SR1	Service request, complete capability
RL1	Remote/local switchover function, complete capability
PP1	Parallel poll function, remote-controllable configuration
DC1	Device clear function, complete capability
DT1	Device trigger function, complete capability
CØ	Control function, no capability.

2.4.2 Setting the Device Address

The device address is set and called up via the function keys on the front panel with the SWP switched on. The decimal equivalent of the address (0 to 30) which is identical for the listener and the talker is displayed and set. The set address is stored in a battery-buffered RAM and is thus preserved during switch-off.

If the battery supply is interrupted, for example when replacing the batteries, the SWP is set to an address which is determined by a shorting plug on the IEC-bus module. The device address is set to 15 at the factory.

The IEC-bus address is called up by the second function of the (STO) IEC key 6 whereupon the message IEC XX (XX = decimal equivalent of the IEC-bus address according to Table 2-2) is displayed on 2.

A new device address can now be set by pressing two numeric keys. The new address is transferred after pressing any one of the unit keys. If the number is above the permissible range an error message is obtained and the last set number is retained.

2.4.3 Setting Instructions

For entering the functions of the Sweep Generator SWP via the IEC bus basically two types of control character strings are used.

a) For functions that can only be activated and deactivated the string consists of a two-ASCII-letter header and the identification 1 for activation and Ø for deactivation.

b) For functions that require a number the two-letter header is followed by the number in fixed-point or exponential representation according to the IEC recommendation 625-2.

   If the number is omitted only the parameter is activated which is to respond to a variation key (STEP 22, DATA VAR knob 24).

A space is permissible anywhere. A delimiter must be used between two setting instructions (Table 2-1).

If instructions contain two numeric parameters a delimiter must also be used between the two (e.g. MK 3, 3.7 EB = marker 3 = 3.7 MHz).

The applicable delimiters are listed in Table 2-1.

Table 2-1 Delimiters

Symbol	Designation	ASCII decimal equivalent	Use
,	Comma	44	Delimiter
CR	Carriage Return	13	Terminating delimiter
LF	Line Feed	10	" "
CRLF	Carr. Ret., Line Feed	13, 10	" "
ETB	End of Transm. Block	23	" "
ETX	End of Text	3	" "
END	EOI with last byte	-	" "

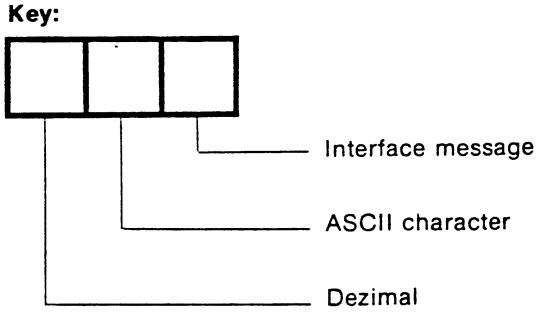
Table 2-2 Setting the device address

ASCII character		Decimal equivalent
Listener address	Talker address	
(SPACE)	@	ØØ
!	A	Ø1
"	B	Ø2
#	C	Ø3
$	D	Ø4
%	E	Ø5
&	F	Ø6
'	G	Ø7
(	H	Ø8
)	I	Ø9
*	J	1Ø
+	K	11
´	L	12
-	M	13
.	N	14
/	O	15
Ø	P	16
1	Q	17
2	R	18
3	S	19
4	T	2Ø
5	U	21
6	V	22
7	W	23
8	X	24
9	Y	25
:	Z	26
;	[	27
<	\	28
=	]	29
>	^	3Ø

Table 2-3 ASCII code

CONTROL						NUMBERS SYMBOLS				UPPER CASE				LOWER CASE			
0	NUL		16	DLE		32	SP	48	0	64	@	80	P	96	`	112	p
1	SOH	GTL	17	DC1		33	!	49	1	65	A	81	Q	97	a	113	q
2	STX		18	DC2		34	"	50	2	66	B	82	R	98	b	114	r
3	ETX		19	DC3		35	#	51	3	67	C	83	S	99	c	115	s
4	EOT	SDC	20	DC4	DCL	36	$	52	4	68	D	84	T	100	d	116	t
5	ENQ	PPC	21	NAK	PPU	37	%	53	5	69	E	85	U	101	e	117	u
6	ACK		22	SYN		38	&	54	6	70	F	86	V	102	f	118	v
7	BEL		23	ETB		39	'	55	7	71	G	87	W	103	g	119	w
8	BS	GET	24	CAN	SPE	40	(	56	8	72	H	88	X	104	h	120	x
9	HT	TCT	25	EM	SPD	41	)	57	9	73	I	89	Y	105	i	121	y
10	LF		26	SUB		42	*	58	:	74	J	90	Z	106	j	122	z
11	VT		27	ESC		43	+	58	;	75	K	91	[	107	k	123	{
12	FF		28	FS		44	,	60	<	76	L	92	\	108	l	124	|
13	CR		29	GS		45	—	61	=	77	M	93	]	109	m	125	}
14	SO		30	RS		46	.	62	>	78	N	94	^	110	n	126	~
15	SI		31	US		47	/	63	? / UNL	79	O	95	—	111	o	127	DEL
ADRESSED COMMANDS			UNIVERSAL COMMANDS			LISTEN ADDRESSES				TALK ADDRESSES				SECONDARY ADDRESSES OR COMMANDS			

Key:



2.4.3.1 Frequency Functions

Key	Function	Symbol	Remarks
CENT	Centre frequency	FC f	Unit Hz
ΔF	Frequency deviation	FD f	" "
START	Start frequency	FL f	" "
STOP	Stop frequency	FU f	" "
FULL	Full sweep:		
	On	FS 1	
	OFF	FS Ø	
SYNC	Synchronization:		
	On	SY 1	if Synchronizer Option is fitted
	Off	SY Ø	
↓MK	Marker n as centre frequency:		
	On	FK n	n = 1 to 6 (marker number)
	Off	FK Ø	
↓CORR	YIG adjustment	YG	
↓CW	Fixed frequency	CW f	Unit Hz
MK-SWP	Sweep from MK n_1 to MK n_2:		
	On	MS n_1, n_2	n_1 = 1 to 6 (marker number)
	Off	MS Ø	

f = frequency in fixed point or exponential representation

↓ = second function

Maximum of nine significant numbers are evaluated.

Max. frequency setting resolution according to data sheet.

2.4.3.2 Marker Functions

Key	Function	Symbol	Remarks
FREQ	Variable marker marker number n	MK n, f	n = 1 to 6
BLK	Variable marker marker number n, cleared	CM n	MK n, Ø
DISP.3	3 markers displayed:		
	On	MD n_1, n_2	n_1 = 1 to 6 (marker number)
	Off	MD Ø	n_2 = 1,2,3 (display number)
			If MD n_1, n_2 is not entered three times with n_2 = 1,2,3 the previous markers are retained in the displays not called up.
⊥⊥⊥	Harmonic markers:		
	1 MHz	HM 1	
	10 MHz	HM 2	
	100 MHz	HM 3	
	Off	HM Ø	
↓ MK	Marker difference /MK n_2 - MK n_1 /:		
	On	DM n_1, n_2	n_1, n_2 = 1 to 6
	Off	DM Ø	

f = frequency in fixed-point or exponential representation

↓ = second function.

2.4.3.3 Level Functions

Key	Function		Symbol	Remarks
INT	RF level setting		LD 1 LV 1	Unit: dBm Unit: V
↓ EXT	External level:			
		On	ED 1, 1	Unit: dBm
			EV 1, 1	Unit: V
		Off	ED Ø	
			EV Ø	
SWEEP	Level sweep:			
		On	LS 1, 1	Unit: dB
		Off	LS Ø	

1 = level in fixed point or exponential representation

↓ = second function

2.4.3.4 Sweep Functions

Key	Function	Symbol	Remarks
INT	Sweep time setting	TM t	Unit: s
⟶ / ⟵	Flyback blanking:		
	On	RB 1	
	Off	RB Ø	
SINGLE	Single sweep:		
	On	SS 1	
	Off	SS Ø	
START	Sweep START:	GET *)	GET = Group execute trigger
↓EXT	External sweep:		
	On	ET 1	
	Off	ET Ø	
↓LINE	Line trigger:		
	On	LT 1	
	Off	LT Ø	

t = sweep time in fixed point or exponential representation

↓ = second function

*) Make sure that all device settings have been performed (e.g. by @ @ @ , refer also to 2.4.3.7) prior to triggering the single sweep.

2.4.3.5 Modulation Functions

Key	Function	Symbol	Remarks
⎍⎍⎍ INT	Internal modulation:		
	On	IM 1	
	Off	IM Ø	
PULS	Pulse modulation:		
	ON	PM 1	
	Off	PM Ø	
AM	Amplitude modulation:		
	On	AM 1, m	Unit: %
	Off	AM Ø	
FM	Frequency modulation, external, AC coupling:		
	On	FM 1, f	Unit: Hz
	Off	FM Ø	
↓FMDC	Frequency modulation, external, DC coupling:		
	On	DF 1, f	Unit: Hz
	Off	DF Ø	

m = modulation depth in fixed point or exponential representation

f = frequency deviation in fixed point or exponential representation

↓ = second function

2.4.3.6 Miscellaneous Functions

Key	Function	Symbol	Remarks
STO	Devise setting number n store	ST n	n = 1 to 9
RCL	Device setting number n recall	RC n	n = 1 to 9
CLR	Device reset	CL	
↓BLK	Multiplex display		
	On	BL 1	
	Off	BL Ø	
RF OFF	RF switched off	RF Ø	
	RF switched on	RF 1	
PRESET	Basic device setting	PS	
↓TEST	Test program activated	TP	End of test SRQ and status byte

↓ = second function

2.4.3.7 Functions without Manual Entry Capability

Function	Symbol	Remarks
Device control block number n		
read	LN n	n = Ø, 1 to 9 n = Ø = current device setting n = 1 to 9 = stored device setting No. n
write	WR n, XXX...X	XXX to X = 64 bytes, binary data
Bus hold-off	@ @@	Holds off the bus until the device setting data are ensured; only permissible as last instruction

All setting sequences are activated only after the terminating delimiter or the @@@ instruction has been executed.

2.4.4 Service Request and Serial Poll Status Byte

If the device recognizes illegal instructions or incompatible parameters of setting instructions or activates the test routine, it sends a Service Request to the controller and a Serial Poll status byte with error coding. The Service Request cannot be suppressed by instructions.

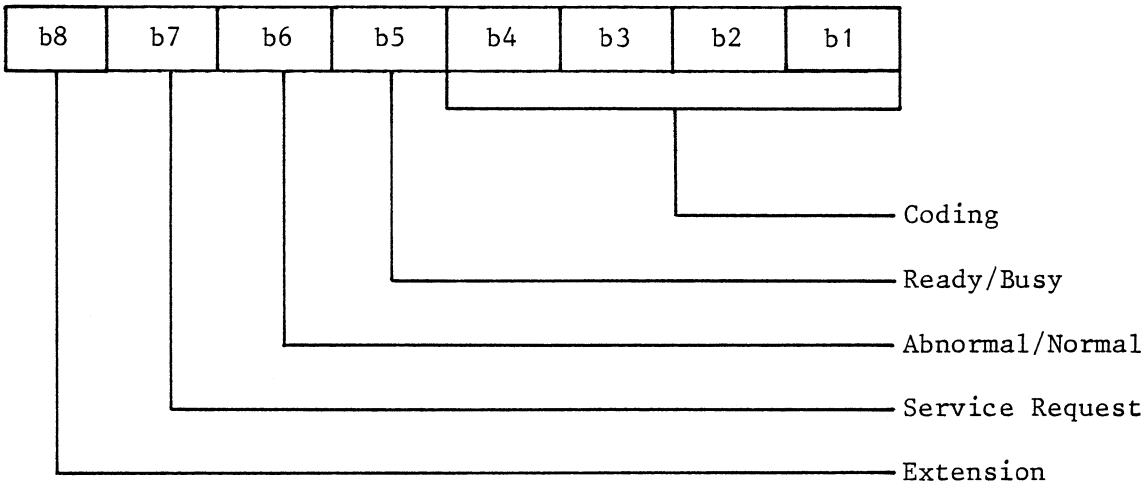


Fig. 2-4 Status byte

Table 2-4

Status byte								Explanation
b8	b7	b6	b5	b4	b3	b2	b1	
0	1	0	1	0	0	0	Q	Error-free (Self test)
0	1	0	1	0	0	0	1	Sweep end
0	1	1	0	0	0	0	0	IEC syntax error
0	1	1	0	0	0	0	1	IEC function error
0	1	1	0	0	0	1	1	Signal unlocked
0	1	1	0	0	1	0	0	Self test error
0	1	1	0	0	1	0	1	Broadband amplifier switched off

2.4.5 Group of Addressed and Universal Commands

2.4.5.1 Remote/Local

If the Sweep Generator SWP is addressed from an IEC-bus controller it will switch over to remote operation and remain in this state until either the command GTL (Go to local) is sent or the LOCAL key is pressed. The LED 11 lights in the remote state.

During remote operation the front-panel controls are disabled.

The LOCAL key can be disabled by the command LLO (local lockout) sent from the controller.

2.4.5.2 Device Clear

If the IEC-bus controller sends the universal command DCL (Device clear) or the addressed command SDC (Selected device clear) the current setting is repeated. If the device setting is not accepted because of incompatible parameters the nearest valid parameter value is selected and the device setting executed.

2.4.5.3 Device Trigger

On receiving the addressed command GET (Group execute trigger) a single sweep is started if the SWP has been previously set to single sweep with the command SS1. For the execution of the GET command the same restrictions apply as for the START key.

2.4.6 Data Output

The Sweep Generator SWP can also be addressed as a talker. Thus it is possible to transfer complete device settings in the form of a device control block from the SWP to the IEC-bus controller. Since the SWP features an additional nine stored settings (STO/RCL 1 to 9) besides the actual settings the instruction Read Device Control Block (LN n, n = Ø, 1 to 9) should be issued prior to addressing the SWP as a talker.

The device control block is 64 bytes long in binary-bit pattern. Hence identification of the end is possible only with EOI or by the number of bytes. The actual data content of the device control block is preceded by the header LN n, i.e. the complete data content is 4 + 64 = 68 bytes.

For details about the device control block see the service manual.

2.4.7 Notes on the Transfer of Settings

To ensure that the SWP on receiving the terminating delimiter can be unaddressed only after the guaranteed output values have been reached Hold off = @ @ @ must be issued as a last command. On receiving this command, the SWP may execute the Hold off command even in the case of an asynchronous Unlisten.

2.4.8 Examples of Programming with PUC

Example 1

Start frequency: 100 MHz

Stop frequency: 600 MHz

Variable markers: MK1: 105 MHz
MK2: 223 MHz
MK3: 415 MHz

Synchronization: ON

Sweep time: 50 ms

Level: 3.3 dBm

```
1ØØ  IECOUT15,"FL1ØØE6,FU6ØØE6,MK1,1Ø5E6,MK2,223E6,MK3,415E6,SY1,TM5ØE-3,LD3.3"
11Ø  END
```

Example 2

Tune a CW frequency through the range 100 to 150 MHz in 1-MHz steps with bus hold-off.

```
1ØØ  IECOUT15,"PS,SY1"
11Ø  FOR I = Ø TO 5Ø
12Ø  IECOUT15,"CW"+STR$(1ØØ+I)+"E6@@@"
13Ø  NEXT I
14Ø  END
```

Example 3

Process a Service Request and interrogate the status byte according to the example "single sweep".

```
1ØØ  X% = Ø
11Ø  IECOUT15,"TM1,SS1@@@"
12Ø  IECLAD15
13Ø  IECGXT
14Ø  IECUNL
15Ø  IECSRQ GOTO 18Ø
16Ø  IF X% = Ø THEN GOTO 15Ø
17Ø  END
18Ø  IECSPL15,X%
19Ø  PRINT X%
2ØØ  IECRETSRQ
```

Example 4: Learn mode

Read memory 2, print out all 64 bytes in decimal equivalent and enter again into memory 3.

```
1ØØ  IECTERM13
11Ø  IEC_ERR
12Ø  IECOUT15,"LN2"
13Ø  IECTERM1
14Ø  IECTAD15
15Ø  IEC$INK$
16Ø  IF ST <> Ø THEN 15Ø
17Ø  IECUNT
18Ø  FOR I = 1 TO 64
19Ø  PRINT ASC(MID$(K$,I,1)),
2ØØ  NEXT I
21Ø  IECTERM13
22Ø  IECOUT15,"WR3"+K$
23Ø  END
```

The time control of the handshake is disabled when interrogating the PUC status byte "ST". Changing the final character from "CR" to "EOI" prevents an interruption of the transmission, provided "CR" is contained in the setting block.

2.5 Fitting the Options

Prior to fitting any option remove the upper and the lower cover panels of the cabinet. To do so, loosen the eight retaining screws on the side walls. When fitting the Reference Oscillator Option SMS-B1 only the upper cover panel need be removed.

The location of the options can be seen on Fig. 2-5. No adjustments are required.

2.5.1 Synchronizer Option SWP-B1

The option consists of the analog section, the digital section and the sync RF section. The colour code of the guide rails in the SWP corresponds to the engravings on these functional groups.

Functional group	Colour code
Digital section	Blue
Sync RF section	Red
Analog section	Black

Fitting the option:

-> Unscrew supporting plate (two screws C, Fig. 2-7).

-> Unscrew cooling baffle (screw D, Fig. 2-8).

-> Disconnect link X91 on the motherboard (Fig. 2-7).

-> Insert function groups according to colour code.

-> Screw supporting plate back in place.

-> Establish connection to RF section with SMC cable according to the table below. For location of the cables see Figs. 2-5 and 2-8.

-> Replace cooling baffle.

Cable No.	Connection
W40	Analog section X163 <-> Broadband amplifier X363
W41	Analog section X162 <-> Converter X362
W50	Sync RF section X165 <-> Converter X365
W51	Sync RF section X164 <-> Broadband amplifier X364

2.5.2 Attenuator Option SWP-B7

To facilitate fitting the Attenuator Option it is recommended that the RF unit be removed from the cabinet.

Removal of RF unit from cabinet:

-> Remove lower front-panel cover. To do so, loosen the two retaining screws A and remove the DATA VAR. knob 24 (Fig. 2-6).

-> Loosen the retaining nut F at the RF output 29 (Fig. 2-6).

-> Interrupt all connecting lines:

from the top: at the level detector: SMC socket at K output
below reference oscillator: X306

from below: at the converter: SMC connectors X362, X360, X365
(if options concerned are fitted)
at the broadband amplifier: SMC connectors X361, X364
(if options concerned are fitted)
at the motherboard: SMC connector X382
multiway connectors X50, X380, X381.

-> Remove nine retaining screws E from the underside of the RF unit (Fig. 2-8).

-> Pull out RF unit towards bottom.

Fitting the Attenuator Option into the RF unit:

-> Remove coaxial line W1 to RF output of the level detector fitted with N socket (RF output 29).

—> Unscrew bracket of level detector from chassis. The two screws B are not required any more after the option has been mounted (Fig. 2-8).

—> Insert flat cable (accessory supplied with option) into socket BU10 of the Attenuator Option.

—> Fix Attenuator Option in place in the RF unit by means of two screws according to Fig. 2-9.

—> Mount coaxial line W1 (accessory supplied with option) fitted with N socket (RF output 29) and connect to socket BU2 of the Attenuator Option. The line may not be bent!

—> Screw the RF output of the level detector onto socket BU1 of the Attenuator Option. Do not screw bracket back in place.

After the RF unit has been replaced in the basic unit, insert the flat cable of the Attenuator Option into connector X22 of the control circuit and remove link X24 (see Fig. 2-7).

2.5.3 Harmonic Marker Option SWP-B9

—> Unscrew supporting plate (two screws C, Fig. 2-7).

—> Unscrew cooling baffle (screw D, Fig. 2-8).

—> Insert PC board (guiding rail: colour code yellow same as engraving).

—> Screw supporting plate back in place.

—> Establish connections to RF unit with SMC cables according to table below. For routing of the cables, see Figs. 2-5 and 2-8.

—> Replace cooling baffle.

Cable No.	Connection
W36	Harmonic Marker Option X161 <—> broadband amplifier X361
W37	Harmonic Marker Option X160 <—> converter X360
W38	Harmonic Marker Option X169 <—> rear panel X43 (EXT MARK 37)

2.5.4 Reference Oscillator Option SWP-B11

The Reference Oscillator Option is accommodated in the shielding case of the reference oscillator circuit.

Fitting the option:

-> Withdraw reference oscillator board (release locking spring); unscrew cover and bottom of the shielding case (two screws on the cover and two screws on the underside).

-> Disconnect links BR1 and BR2.

-> Insert Reference Oscillator Option and screw down on the reference oscillator board (three screws).

After the circuit board has been replaced in the SWP check that the locking spring is locked.

3. Maintenance

3.1 Measuring Instruments and Auxiliary Equipment Required

Ref. No.	o / •	Type of instrument required, performance rating	Type designation	Order No.	See section
1	o	RF counter Range ..... 0.4 to 2500 MHz Error ..... < 1 x 10^{-8} Inp. imped. ..... 50 Ω Max. inp. volt. .. 5 V			3.2.2.1 3.2.2.2 3.2.11
2	o	Modulation analyzer Range ..... 0.4 to 2500 MHz Inp. imped. ..... 50 Ω Inp. level ..... 0 to +10 dBm AF range ..... 10 Hz to 100 kHz Mod. depth ..... 0 to 90% Freq. dev. ..... 0 to 10 MHz AF bandpass filters 30 Hz to 20 kHz 20 Hz to 15 kHz (acc. to CCIR) Distort. meas. ... 0 to 5%			3.2.3.1 3.2.3.2 3.2.13.1 3.2.13.2 3.2.15.1 3.2.15.2
3	o	RF spectrum analyzer Range ..... 0.4 to 6700 MHz Inp. imped. ..... 50 Ω Dynamic range .... > 60 dB			3.2.4.1 3.2.4.2 3.2.5.1 3.2.5.2 3.2.7 3.2.14
4	o	RF power meter Range ..... 0.4 to 2500 MHz Inp. imped. ..... 50 Ω Level ..... -116 dBm to +10 dBm Error ..... < 0.1 dB			3.2.6.1 3.2.6.2 3.2.6.3 3.2.6.4
5	o	Oscilloscope Range ..... 0 to 250 MHz			3.2.8 3.2.9 3.2.10.1 3.2.10.2 3.2.12 3.2.14

Ref. No.	o Type of instrument required, performance rating • R&S instrument recommended	Type designation	Order No.	See section
6	• Feed-through Termination Range ..... 0 to 250 MHz Inp. impedance ... 50 Ω Power-handling capacity ..... > +10 dBm	RAD	289.8966.00	3.2.12 3.2.14
7	• AF Generator Range ..... 10 Hz to 100 kHz Output level ..... 1 V into 600 Ω Distortion factor ≦ 0.1%	SPN	336.3019.02	3.2.13.1 3.2.13.2 3.2.15.1 3.2.15.2
8	• DC Power Supply Voltage range .... 0 to 5 V Output current ... ≧ 50 mA	NGT 20	117.7133.02	3.2.14
9	• Digital Voltmeter Voltage range .... 5 V Error ..... ≦ 2% Input impedance .. ≧ 20 kΩ	UDL 4	346.7800.02	3.2.14
10	o Pulse generator Range ..... 50 Hz to 50 kHz Output level ..... 5 V into 600 Ω Rise time ..... ≦ 10 µs Min. pulse width . 10 µs			3.2.14
11	• Process Controller Interface acc. to IEC 625.1 (IEEE 488)	PUC	344.8900.10	3.2.16

3.2 Performance Check

If the specifications given in this section and those in the data sheet are not identical, the latter apply. With the temperature coefficients specified in the following, the actual deviations are determined on the basis of the absolute value of the difference between the ambient temperature T_a and T_{ao} = 24°C.

3.2.1 Performance Check of Displays, Keys and DATA VAR. Knob

a) Checking the displays

At switch-on of the SWP, all LED displays and pilot lamps light for about 1 s. Then they are blanked for about 0.5 s before assuming their normal operating state.

b) Checking the keys and the DATA VAR. knob

Make entries as described in section 2.3 and check the respective displays.

3.2.2 Checking the Frequency Settings

3.2.2.1 Unsynchronized Operation

Settings on the SWP:

→ Switch on SWP (this resets the frequency correction CORR).

→ Synchronization off (if Synchronizer Option is fitted)

→ CW mode 10 MHz

→ RF level 10 dBm.

→ No modulation.

Test setup:

→ Connect frequency counter to RF output 29.

Check:

→ Allow SWP to warm up for at least 15 min.

→ The frequency should be 10 MHz ±12 MHz ±0.5 MHz/°C.

→ Set SWP to 2500 MHz

→ The frequency should be 2500 MHz ±12 MHz ±0.5 MHz/°C.

→ Set any desired frequency within setting range.

→ Accuracy approx. ±12 MHz ±0.5 MHz/°C.

3.2.2.2 Synchronized Operation (with Synchronizer Option SWP-B1)

Settings on the SWP:

→ Synchronization on.

→ CW mode, any desired frequency within setting range.

→ RF level 10 dBm.

→ No modulation.

Test setup:

→ Connect frequency counter to RF output 29.

Check:

→ Allow SWP to warm up at least 15 min.

→ Frequency locking should be in 1-kHz steps. The accuracy corresponds to that of the reference oscillator (see section 3.2.11).

3.2.3 Checking the Spurious FM

3.2.3.1 Unsynchronized Operation

Settings on the SWP.

→ CW mode, any desired frequency within setting range.

→ Synchronization off (if Synchronizer Option is fitted).

→ RF level 10 dBm.

→ No modulation.

Test setup:

→ Connect modulation analyzer to RF output 29.

Check:

→ Spurious FM should be < 5 kHz.
(Peak weighting, test bandwidth 30 Hz to 20 kHz)

3.2.3.2 Synchronized Operation (with Synchronizer Option SWP-B1)

Settings on the SWP:

→ Synchronization on.

→ CW mode, any desired frequency within setting range.

→ RF level 10 dBm.

→ No modulation.

Test setup:

→ Connect modulation analyzer to RF output 29.

Check:

→ Weighting of spurious FM according to CCIR.
(Test bandwidth 20 Hz to 15 kHz; spurious FM according to set frequency, see table below)

Frequency range	Spurious FM
0.1 to 20 MHz	< 25 Hz
> 20 to 200 MHz	< 100 Hz
> 200 to 700 MHz	< 200 Hz
> 700 to 2500 MHz	< 300 Hz

3.2.4 Checking the Harmonic Content

3.2.4.1 Unsynchronized Operation or Synchronized Operation above 20 MHz

Settings on the SWP:

→ FULL mode (0.4 to 2500 MHz).

→ RF level 10 dBm.

→ Internal sweep 10 s.

→ Flyback blanked.

→ No modulation.

Test setup:

→ Connect RF spectrum analyzer to RF output 29.

Check:

→ Harmonics should be down > 30 dB.

3.2.4.2 Synchronized Operation in the Range 0.4 to 20 MHz (with Synchronizer Option SWP-B1)

Settings on the SWP:

→ Synchronization on.

→ START-STOP mode 0.4 to 20 MHz.

→ RF level 10 dBm.

→ Internal sweep 10 s.

→ Flyback blanked.

→ No modulation.

Test setup:

→ Connect RF spectrum analyzer to RF output 29.

Check:

→ Harmonics should be down > 30 dB.

3.2.5 Checking the Non-harmonic Spurious Signals

3.2.5.1 Unsynchronized Operation or Synchronized Operation above 20 MHz

Settings on the SWP.

→ START-STOP mode 0.4 to 2000 MHz.

→ RF level 10 dBm.

→ Internal sweep 10 s.

→ Flyback blanked.

→ No modulation.

Test setup:

→ Connect RF spectrum analyzer to RF output 29.

Check:

→ Non-harmonic spurious signals at carrier spacing > 200 kHz should be down ≧ 50 dB.

→ Change the START and STOP frequencies over to 2000 MHz and 2500 MHz.

→ Non-harmonic spurious signals should be down ≧ 35 dB.

3.2.5.2 Synchronized Operation in the Range 0.4 to 20 MHz (with Synchronizer Option SWP-B1)

Settings on the SWP:

→ Synchronization on.

→ START-STOP mode 0.4 to 20 MHz.

→ RF level 10 dBm.

→ Internal sweep 10 s.

→ Flyback blanked.

→ No modulation.

Test setup:

→ Connect RF spectrum analyzer to RF output 29.

Check:

→ Non-harmonic spurious signals at carrier spacing > 200 kHz should be down ≧ 50 dB.

3.2.6 Checking the RF Output Level

3.2.6.1 Frequency Response in Unsynchronized Operation (or in Synchronized Operation above 20 MHz)

Settings on the SWP:

→ Synchronization off (if Synchronizer Option is fitted).

→ CW mode 100 MHz.

→ RF level 10 dBm.

→ No modulation.

Test setup:

→ Connect RF power meter to RF output 29.

Check:

→ RF power at 100 MHz is used as reference for the frequency response.

→ Enter any desired frequency within setting range.

→ Maximum permissible deviation from 100-MHz reference value ±1 dB.

3.2.6.2 Frequency Response in Synchronized Operation 0.1 to 20 MHz (with Synchronizer Option SWP-B1)

Settings on the SWP.

→ Synchronization on.

→ CW mode 100 MHz.

→ RF level 10 dBm.

→ No modulation.

Test setup:

→ Connect RF power meter to RF output 29.

Check:

→ RF power at 100 MHz is used as reference for the frequency response.

→ Enter any desired frequency between 0.1 MHz and 20 MHz.

→ Maximum permissible deviation from 100-MHz reference value ±1 dB.

3.2.6.3 Setting Accuracy of Basic Unit (without Attenuator Option SWP-B7)

Settings on the SWP.

→ CW mode 100 MHz.

→ No modulation.

Test setup:

→ Connect RF power meter to RF output 29.

Check:

→ Enter any desired level values between 0 dBm and +10 dBm or 223.6 mV and 707 mV in dBm and mV, respectively.

→ Maximum permissible deviation of RF level ±0.5 dB.

3.2.6.4 Setting Accuracy with Attenuator Option SWP-B7

Settings on the SWP:

→ CW mode 100 MHz.

→ No modulation.

Test setup:

→ Connect RF power meter to RF output 29.

Check:

→ Enter any desired level values between -110 dBm and +10 dBm or 0.7 µV and 707 mV.

→ Maximum permissible deviation of RF level ±1.5 dB.

3.2.7 Checking Level Sweeping

Settings on the SWP.

→ CW mode 100 MHz.

→ RF level 0 dBm.

→ No modulation.

→ Level sweep 10 dB sweep width.

→ Internal sweep 10 s.

Test setup:

→ Connect RF spectrum analyzer to RF output 29.

Check:

→ The RF level should be swept between 0 dBm and +10 dBm. The permissible deviation with +10 dBm is 0.- dB referred to 0 dBm.

3.2.8 Checking Internal Sweeping

Settings on the SWP:

→ FULL mode 0.4 to 2500 MHz.

→ Enter any desired sweep time between 0.01 s and 100 s.

Test setup:

→ Connect oscilloscope to BNC socket 16.

Check:

→ The forward sweep time of the sawtooth sweep signal should correspond to the value entered.

→ The sawtooth sweep signal should lie between 0 V and 10 V.

3.2.9 Checking the Variable Frequency Markers

Settings on the SWP.

→ Press PRESET key (basic setting of SWP according to section 2.3.12).

Test setup:

→ Oscilloscope in XY operation:
Connect X input to socket 16.
Connect Y input to socket 26.

Check:

→ No marker pulses are to be present.

→ Successively switch on markers (see section 2.3.5.1).

→ The marker pulses must be uniformly distributed over the frequency axis (see table below).

→ Marker 3 (display on 2) must be wider.

→ Make any desired entries according to section 2.3.5.1 and check proper execution.

Marker number	Frequency
1	400 kHz
2	0.5 GHz
3	1.0 GHz
4	1.5 GHz
5	2.0 GHz
6	2.5 GHz

3.2.10 Checking the Harmonic Markers (with Harmonic Marker Option SWP-B9)

3.2.10.1 Internal Spectral Markers

a) 1-MHz markers

Setting on the SWP:

→ fm/Δf mode,
fm anywhere between 10.9 MHz and 2489.5 MHz,
Δf = 21 MHz.

→ 1-MHz markers on.

→ RF level 10 dBm.

→ Internal sweep 50 ms.

→ No modulation.

Test setup:

→ Oscilloscope in XY operation.
Connect X input to socket 16.
Connect Y input to socket 26.

Check:

→ None of the markers may be missing.

→ Multiples of 10 MHz must be wider.

→ Repeat check with 0 dBm RF level.

b) 10-MHz markers

Settings on the SWP:

→ fm/Δf mode,
fm anywhere between 105.4 MHz and 2395 MHz,
Δf = 210 MHz.

→ 10-MHz markers on.

→ RF level 10 dBm.

→ Internal sweep 50 ms.

→ No modulation.

Test setup:

→ Oscilloscope in XY operation:

Connect X input to socket 16.
Connect Y input to socket 26.

Check:

→ None of the markers may be missing.

→ Multiples of 100 MHz must be wider.

→ Repeat check with 0 dBm RF level.

c) 100-MHz markers

Settings on the SWP:

→ FULL mode (0.4 to 2500 MHz).

→ 100-MHz markers on.

→ RF level 10 dBm.

→ Internal sweep 50 ms.

→ No modulation.

Test setup:

→ Oscilloscope in XY operation:
Connect X input to socket 16.
Connect Y input to socket 26.

Check:

→ None of the markers may be missing.

→ Multiples of 1000 MHz must be wider.

→ Repeat check with 0 dBm RF level.

3.2.10.2 External Marker

Settings on the SWP.

→ fm/Δf mode,
fm within range 50.4 to 2450 MHz according to marker frequency,
Δf = 100 MHz.

→ Harmonic markers off.

→ RF level 10 dBm.

→ Internal sweep 50 ms.

→ No modulation.

Test setup:

→ Connect RF generator to marker input 37.

→ Oscilloscope in XY operation:
Connect X input to socket 16.
Connect Y input to socket 26.

Check:

→ Set level of RF generator to 0 dBm.

→ Only one marker is to be displayed between 3 MHz and 2500 MHz.

3.2.11 Checking the 10-MHz Reference Oscillator (Basic unit and Reference Oscillator Option SWP-B11)

Settings on the SWP:

→ If socket 24 (on rear panel) is not wired as output rewire according to section 2.3.13.

Test setup:

→ Connect frequency counter to socket 34.

Check:

→ Accuracy of basic unit and Reference Oscillator Option SWP-B11; see table below.

	Aging	Temperature effect
Reference Oscillator Basic unit	$< \pm 1 \times 10^{-6}$/month	$< \pm 1 \times 10^{-6}$/°C
Reference Oscillator Option SWP-B11	$< \pm 1 \times 10^{-6}$/year	$< \pm 1 \times 10^{-7}$ over range 0 to 50°C

3.2.12 Checking the Internal Squarewave Modulation

Settings on the SWP:

→ Synchronization off (if Synchronizer Option is fitted).

→ CW mode 50 MHz.

→ RF level 10 dBm.

→ Internal squarewave modulation on.

Test setup:

→ Connect oscilloscope with 50-Ω feed-through termination to RF output 29.

Check:

→ The RF output signal should be amplitude-modulated with 1-kHz squarewave (modulation depth close to 100%).

3.2.13 Checking the External Amplitude Modulation

3.2.13.1 Unsynchronized Operation (or synchronized operation above 20 MHz)

Settings on the SWP.

→ Synchronization off (if Synchronizer Option is fitted).

→ CW mode, for carrier frequency see table below.

→ RF level 4 dBm.

→ Amplitude modulation,
modulation depth anywhere between 0 and 80%.

Test setup:

→ Connect AF generator to modulation input 13.

→ Connect AM test demodulator to RF output 29.

Check:

→ Adjust the AF level at 13 to 1 V ±10 mV.

→ Check the modulation frequency response. The deviation from the set modulation depth must be less than 8% up to f_{max} (see table below).

→ Set the AF generator to 1 kHz and the SWP to 80% modulation depth.

→ The modulation distortion must be $\leq$ 5%.

→ Check in all three carrier frequency ranges listed in the table below.

→ Repeat all measurements at an RF level of 0 dBm.

Carrier frequency	f_{max}
0.4 to 1 MHz	1 kHz
> 1 MHz to 10 MHz	3 kHz
> 10 MHz to 2500 MHz	10 kHz

3.2.13.2 Synchronized Operation 0.4 to 20 MHz (with Synchronizer Option SWP-B1)

Settings on the SWP:

→ Synchronization on.

→ CW mode, any desired frequency between 0.4 MHz and 20 MHz.

→ RF level 4 dBm.

→ Amplitude modulation,
modulation depth anywhere between 0 and 80%.

Test setup:

→ Connect AF generator to modulation input 13.

→ Connect AM test demodulator to RF output 29.

Check:

→ Adjust AF level at 13 to 1 V ±10 mV.

→ Check the modulation frequency response. The deviation from the set modulation depth must be less than 8%.

→ Set the AF generator to 1 kHz and the SWP to 80% modulation depth.

→ The modulation distortion must be < 5%.

→ Repeat all measurements at an RF level of 0 dBm.

3.2.14 Checking the External Pulse Modulation

Settings on the SWP:

→ Synchronization off (if Synchronizer Option is fitted).

→ CW mode 50 MHz.

→ RF level 10 dBm.

→ Pulse modulation.

a) DC characteristics (trigger thresholds)

Test setup:

→ Connect DC power supply and DVM to modulation input 13 (+ pole to inner conductor).

→ Connect RF spectrum analyzer to RF output 29.

Check:

→ RF level on at input voltages > 2 V.

→ RF level off at input voltages < 0.5 V.

→ On/off ratio > 80 dB at 10 kHz test bandwidth.

b) AC characteristics

Test setup:

→ Connect pulse generator to modulation input 13.

→ Connect oscilloscope with feed-through termination to RF output 29.

Check:

→ Rise and fall time must be < 0.1 µs.

→ Pulse repetition frequency 50 Hz to 50 kHz.

→ Minimum pulse width 10 µs.

3.2.15 Checking the External Frequency Modulation

3.2.15.1 Unsynchronized Operation

Settings on the SWP:

→ Synchronization off (if Synchronizer Option is fitted).

→ CW mode, carrier frequency in the range 0.4 to 2500 MHz.

→ RF level 10 dBm.

→ Frequency modulation, frequency deviation anywhere between 0 MHz and 10 MHz, at the range limits see table below.

Carrier frequency f_{carr}	Max. freq. deviation
0.4 to 10.4 MHz	f_{carr} -0.4 MHz
10.4 to 2490 MHz	10 MHz
2490 to 2500 MHz	2500 MHz $-f_{carr}$

Test setup:

→ Connect AF generator to modulation input 13.

→ Connect modulation analyzer to RF output 29.

Check:

→ Adjust the AF level at 13 to 1 V ±10 mV.

→ The frequency deviation should not differ more than 3% from set value.

→ The modulation frequency response should not be greater than ±1 dB in the range 30 Hz to 100 kHz.

→ Select FMDC mode.

→ The modulation frequency response should not be greater than ±1 dB in the range DC to 100 kHz.

→ The modulation distortion should not be greater than 1% at modulation frequencies up to 50 kHz and a frequency deviation up to 100 kHz.

3.2.15.2 Synchronized Operation (with Synchronizer Option SWP-B1)

Settings on the SWP:

→ Synchronization on.

→ CW mode, carrier frequency in the range 0.4 6o 2500 MHz.

→ RF level 10 dBm.

→ Frequency modulation, deviation anywhere between 0 kHz and 100 kHz, at the range limits see table below.

Carrier frequency f_{carr}	Max. freq. deviation
0.4 to 0.5 MHz	f_{carr} -0.4 MHz
0.5 to 2499.9 MHz	0.1 MHz
2499.9 to 2500 MHz	2500 MHz -f_{carr}

Test setup:

→ Connect AF generator to modulation input 13.

→ Connect modulation analyzer to RF output 29.

Check:

→ Adjust AF level at 13 to μ V ±10 mV.

→ The modulation frequency response should not be greater than ±1 dB in the range 300 Hz to 50 kHz.

→ The modulation distortion should not be greater than 1% at modulation frequencies up to 50 kHz and a frequency deviation up to 100 kHz.

3.2.16 Checking the Interface Functions

Operate the SWP by remote control from a controller. Enter all the setting instructions given in section 2.4 and make sure that the commands are properly executed by the SWP by checking the displays on the front panels and the set values.

3.3 Performance Test Report

Rohde & Schwarz

SWEEP GENERATOR SWP

Id. No. 339.0010.02

Serial No.

Date .....

Name .....

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
1	Performance of displays, keys and DATA VAR knob	3.2.1	-	.....	-	-
2	Frequency error in unsynchronized operation	3.2.2.1				
	10 MHz					
	Setting accuracy		-	.....	±12	MHz
	Temperature effect		-	.....	±0.5	MHz/°C
	2500 MHz					
	Setting accuracy		-	.....	±12	MHz
	Temperature effect		-	.....	±0.5	MHz/°C
3	Frequency error in synchronized operation (with Synchronizer Option SWP-B1)	3.2.2.2				
	a)					
	Basic unit (10-MHz reference oscillator)					
	20 MHz					
	Temperature effect		-	.....	±20	Hz/°C
	Aging		-	.....	±20	Hz/month
	200 MHz					
	Temperature effect		-	.....	±200	Hz/°C
	Aging		-	.....	±200	Hz/month

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
	700 MHz					
	Temperature effect		-	.....	±700	Hz/°C
	Aging		-	.....	±700	Hz/month
	2500 MHz					
	Temperature effect		-	.....	±2500	Hz/°C
	Aging		-	.....	±2500	Hz/month
	b)					
	Option SWP-B11					
	20 MHz					
	Temperature effect		-	.....	±2	Hz
	Aging		-	.....	±20	Hz/year
	200 MHz					
	Temperature effect		-	.....	±20	Hz
	Aging		-	.....	±200	Hz/year
	700 MHz					
	Temperature effect		-	.....	±70	Hz
	Aging		-	.....	±700	Hz/year
	2500 MHz					
	Temperature effect		-	.....	±250	Hz
	Aging		-	.....	±2500	Hz/year
4	Frequency error of 10-MHz reference oscillator	3.2.11				
	a)					
	Basic unit					
	Temperature effect		-	.....	±10	Hz/°C
	Aging		-	.....	±10	Hz/month
	b)					
	Option SWP-B11					
	Temperature effect		-	.....	±1	Hz
	Aging		-	.....	±10	Hz/year

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
5	Spurious FM in unsynchronized operation	3.2.3.1				
	10 MHz		-	.....	5	kHz
	1000 MHz		-	.....	5	kHz
	2500 MHz		-	.....	5	kHz
6	Spurious FM in synchronized operation (with Synchronizer Option SWP-B1)	3.2.3.2				
	20 MHz		-	.....	25	Hz
	200 MHz		-	.....	100	Hz
	700 MHz		-	.....	200	Hz
	2500 MHz		-	.....	300	Hz
7	Harmonic content in unsynchronized operation	3.2.4.1				
	400 MHz down		30	.....	-	dB
	800 MHz down		30	.....	-	dB
	1200 MHz down		30	.....	-	dB
8	Harmonic content in synchronized operation (with Synchronizer Option SWP-B1)	3.2.4.2				
	0.4 MHz down		30	.....	-	dB
	10 MHz down		30	.....	-	dB
9	Non-harmonic spurious signals in unsynchronized operation	3.2.5.1				
	10 MHz down		50	.....	-	dB
	2000 MHz down		50	.....	-	dB
	2400 MHz down		35	.....	-	dB
	2500 MHz down		35	.....	-	dB

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
10	Non-harmonic spurious signals in synchronized operation (with Synchronizer Option SWP-B1)	3.2.5.2				
	20 MHz down		50	.....	-	dB
11	RF output level offset at 100 MHz	3.2.6.3 3.2.6.4				
	a)					
	Basic unit					
	0 dBm		-	.....	±0.5	dB
	10 dBm		-	.....	±0.5	dB
	b)					
	Option SWP-B7					
	-110 dBm		-	.....	±1.5	dB
	-70 dBm		-	.....	±1.5	dB
	-30 dBm		-	.....	±1.2	dB
	-10 dBm		-	.....	±1.0	dB
	0 dBm		-	.....	±0.8	dB
	2 dBm		-	.....	±0.8	dB
	6 dBm		-	.....	±0.7	dB
	8 dBm		-	.....	±0.7	dB
	10 dBm		-	.....	±0.7	dB
12	Frequency response flatness of RF output level in unsynchronized operation	3.2.6.1				
	Reference frequency:					
	100 MHz		-	0	-	dB
	10 MHz		-	.....	±1	dB
	500 MHz		-	.....	±1	dB
	1000 MHz		-	.....	±1	dB
	1500 MHz		-	.....	±1	dB
	2000 MHz		-	.....	±1	dB
	2500 MHz		-	.....	±1	dB

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
13	Frequency response flatness of RF output level in synchronized operation (with Synchronizer Option SWP-B1)	3.2.6.2				
	Reference frequency:					
	100 MHz		-	0	-	dB
	0.4 MHz		-	.....	±1	dB
	10 MHz		-	.....	±1	dB
	20 MHz		-	.....	±1	dB
14	Internal sweep time	3.2.8				
	10 ms		-	.....	-	ms
	100 ms		-	.....	-	ms
	1 s		-	.....	-	s
	10 s		-	.....	-	s
	100 s		-	.....	-	s
15	Internal sawtooth sweep voltage	3.2.8				
	Minimum: 0 V		-	.....	-	V
	Maximum: 10 V		-	.....	-	V
16	Modulation frequency with internal squarewave modulation	3.2.12				
	1 kHz		-	.....	-	kHz

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
17	External AM in unsynchronized operation	3.2.13.1				
	a)					
	Error of modulation depth setting					
	Carrier frequency 100 MHz					
	Modulation frequency 1 kHz					
	RF level 4 dBm					
	1%		-	.....	±0.08	%
	3%		-	.....	±0.24	%
	10%		-	.....	±0.8	%
	30%		-	.....	±2.4	%
	80%		-	.....	±6.4	%
	b)					
	Upper limit of modulation frequency					
	RF level 4 dBm					
	Modulation depth 80%					
	1 MHz		1	.....	-	kHz
	10 MHz		3	.....	-	kHz
	100 MHz		10	.....	-	kHz
	1000 MHz		10	.....	-	kHz
	2500 MHz		10	.....	-	kHz
	c)					
	Modulation distortion					
	RF level 4 dBm					
	Modulation frequency 1 kHz					
	Modulation depth 80%					

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
	1 MHz		-	.....	5 •	%
	10 MHz		-	.....	5	%
	100 MHz		-	.....	5	%
	1000 MHz		-	.....	5	%
	2500 MHz		-	.....	5	%
18	External AM in synchronized operation (with Synchronizer Option SWP-B1)	3.2.13.2				
	a)					
	Upper limit of modulation frequency					
	RF level 4 dBm					
	Modulation depth 80%					
	0.4 MHz		20	.....	-	kHz
	10 MHz		20	.....	-	kHz
	20 MHz		20	.....	-	kHz
	b)					
	Modulation distortion					
	RF level 4 dBm					
	Modulation frequency 1 kHz					
	Modulation depth 80%					
	0.4 MHz		-	.....	5	%
	10 MHz		-	.....	5	%
	20 MHz		-	.....	5	%

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
19	External pulse modulation	3.2.14				
	Carrier frequency 50 MHz					
	RF level 10 dBm					
	a)					
	DC characteristics					
	Modulation voltage for RF on		2	.....	-	V
	Modulation voltage for RF off		-	.....	0.5	V
	On/off ratio		80	.....	-	dB
	b)					
	AC characteristics					
	Rise time		-	.....	0.1	µs
	Fall time		-	.....	0.1	µs
	Min. pulse repetition frequency		50	.....	-	Hz
	Max. pulse repetition frequency		-	.....	50	kHz
	Min. pulse width		10	.....	-	µs

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
20	External FM in unsynchronized operation	3.2.15.1				
	a)					
	Error of frequency deviation setting					
	Carrier frequency 100 MHz					
	Modulation frequency 1 kHz					
	100 kHz		97	.....	103	kHz
	1 MHz		970	.....	1030	kHz
	10 MHz		9.7	.....	10.3	MHz
	b)					
	Modulation bandwidth					
	Carrier frequency 100 MHz					
	Frequency deviation 100 kHz					
	Lower limit frequency		-	.....	300	Hz
	Upper limit frequency		50	.....	-	kHz
	c)					
	Modulation distortion					
	Modulation frequency 50 kHz					
	Frequency deviation 100 kHz					
	10 MHz		-	.....	1	%
	100 MHz		-	.....	1	%
	1000 MHz		-	.....	1	%
	2500 MHz		-	.....	1	%

Ref. No.	Characteristic	Check acc. to section	Min.	Actual	Max.	Unit
21	External FM in synchronized operation (with Synchronizer Option SWP-B1)	3.2.15.2				
	a)					
	Modulation bandwidth					
	Carrier frequency 100 MHz					
	Frequency deviation 10 kHz					
	Lower limit frequency		-	.....	300	Hz
	Upper limit frequency		50	.....	-	kHz
	b)					
	Modulation distortion					
	Modulation frequency 1 kHz					
	Frequency deviation 100 kHz					
	20 MHz		-	.....	1	%
	200 MHz		-	.....	1	%
	700 MHz		-	.....	1	%
	2500 MHz		-	.....	1	%
22	Checking the variable frequency markers	3.2.9	-		-	
23	Checking the harmonic markers (with Harmonic Marker Option SWP-B9)	3.2.10	-		-	
24	Checking the interface functions	3.2.16	-		-	

3.4 Maintenance

3.4.1 Electrical Maintenance

For electrical maintenance check once a year the accuracy of the following functions:

→ 10-MHz reference.

→ Frequency tuning of sweep oscillator in unsynchronized operation.

→ Setting of output level.

a) 10-MHz reference
Check accuracy according to section 3.2.11.
For adjustment see service instructions for the reference oscillator and the Reference Oscillator Option SWP-B11 under section 5.2.

b) Sweep oscillator (unsynchronized)
Check according to section 3.2.2.1.
For adjustment see service instructions for complete unit under section 5.2.

c) Output level
Check according to section 3.2.6.
For adjustment see service instructions for complete unit under section 5.2.

3.4.2 Mechanical Maintenance and Cleaning

The SWP does not require mechanical maintenance at regular intervals. The blower, in particular, is maintenance-free.

The interior of the SWP, if contaminated, can be cleaned with a non-fluffy cloth, brush, vacuum cleaner or compressed air. If necessary, clean front panel with a soft cloth dipped in alcohol. Do not use aggressive cleansers, such as trichlorethylene or acetone.

3.4.3 Replacement of Batteries

The CMOS-RAMs in which the setting data are stored when the SWP is switched off are powered from two 1.5-V alcaline-manganese miniature cells (for location see Fig. 2-7). If the SWP is used regularly, the battery need not be checked since the battery voltage is checked automatically at switch-on in the course of the test routine TEST (see also section 2.3.12). If the batteries are to be replaced, an error message is obtained (see service manual). If the SWP will not be used for an extended period of time (more than six months) or is put in store, remove the batteries (see also section 3.5).

Replacement of batteries:

→ Remove upper cover panel.

→ Replace the two 1.5-V alkaline-manganese miniature cells (see Fig. 2-7).

NOTE: Use only leak-proof 1.5-V alkaline-manganese miniature cells (DIN/IEC LR6).

The SWP can also be operated without batteries. In this case, however, an error message is obtained whenever the SWP is switched on or the test routine is initiated. After pressing the CLR key 6, the SWP is ready for operation. The setting data are now, of course, lost when the SWP is switched off. The same happens if the batteries are by mistake inserted with reverse polarity. The unit proper will not suffer any damage from this.

3.5 Storage

After the batteries have been removed (see section 3.4.3), the SWP can be stored for an extended period of time. The permissible temperature range is from -40°C to +70°C. At high temperatures and relative humidity, it is advisable to seal off the SWP with plastic material or wax paper.

After extended storage at high relative humidity proceed as follows:

→ Unscrew upper and lower cover panels.

→ Allow the SWP to dry for about 4 to 6 hours at +40 to +45°C.

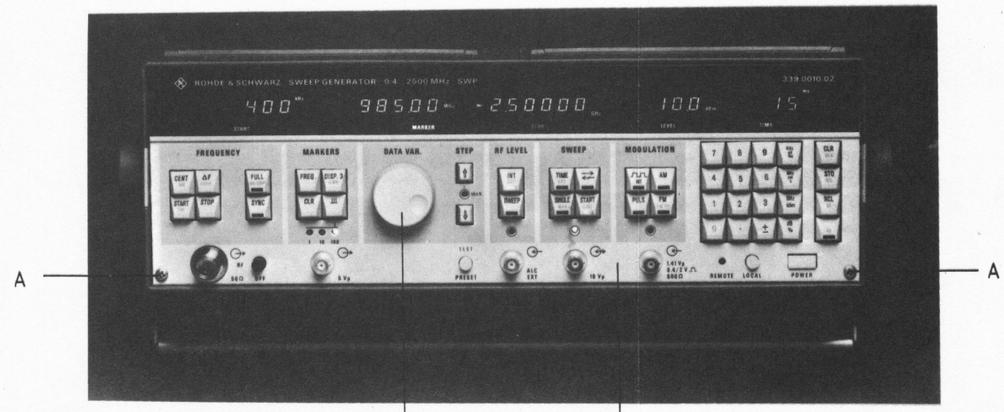
→ Insert the batteries.

→ Make performance check according to section 3.2.

ROHDE&SCHWARZ
MÜNCHEN

Bilder
Figures

R 29500 Bl. 1



24	untere Frontdeckplatte Lower front-panel cover plate	

Bild 2-6 Befestigung der unteren Frontdeckplatte
Fig. 2-6 Fixing of the lower-front-panel cover plate

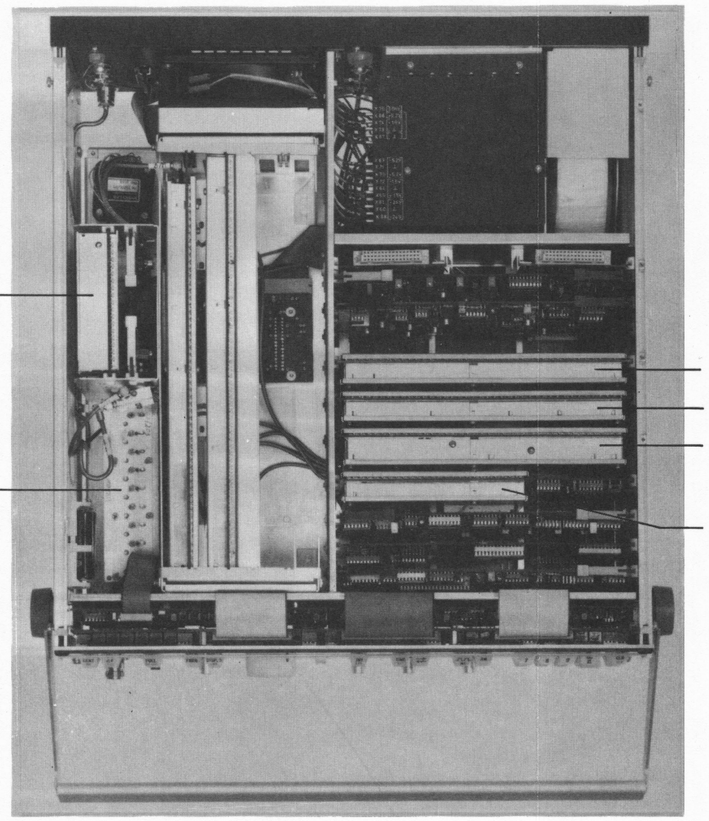


Bild 2-5 SWP,Ansicht von oben: Lage der Optionen
Fig. 2-5 Top view of SWP: location of options

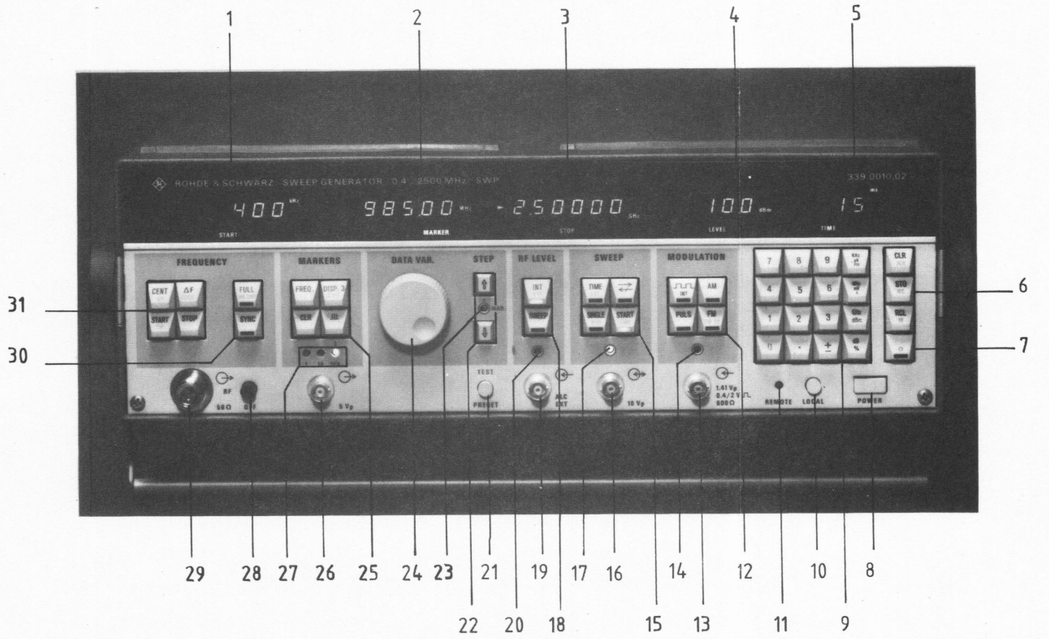


Bild 2-1 Frontansicht
Fig. 2-1 Front panel

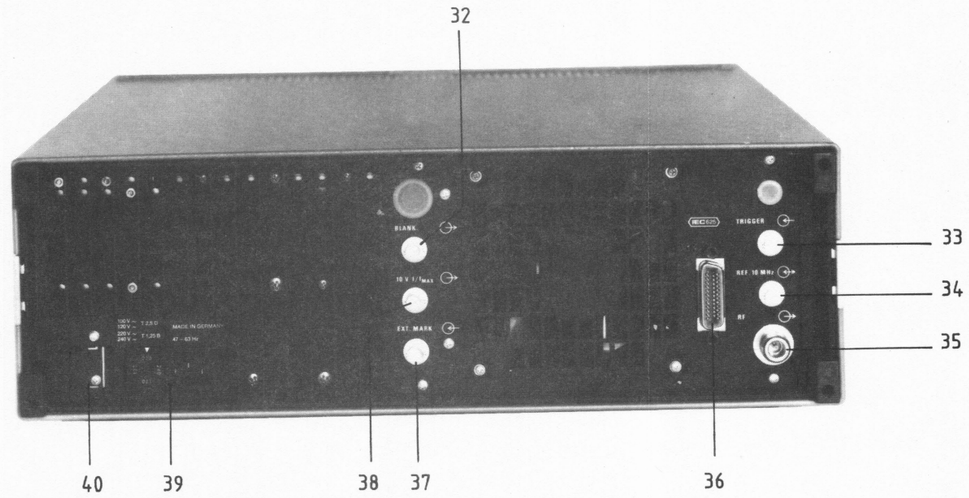


Bild 2-2 Rückansicht
Fig. 2-2 Rear panel

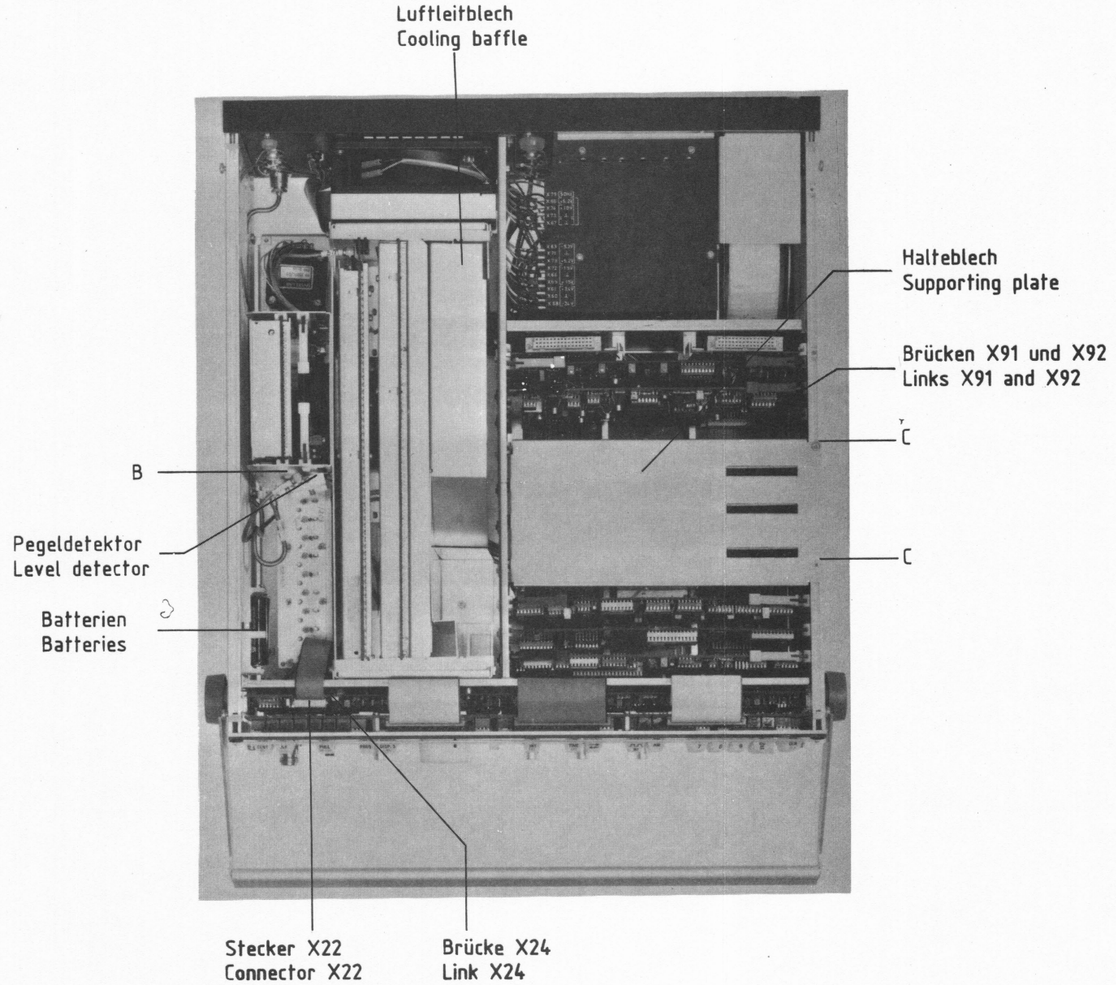


Bild 2-7 SWP,Ansicht von oben
Fig. 2-7 Top view of SWP

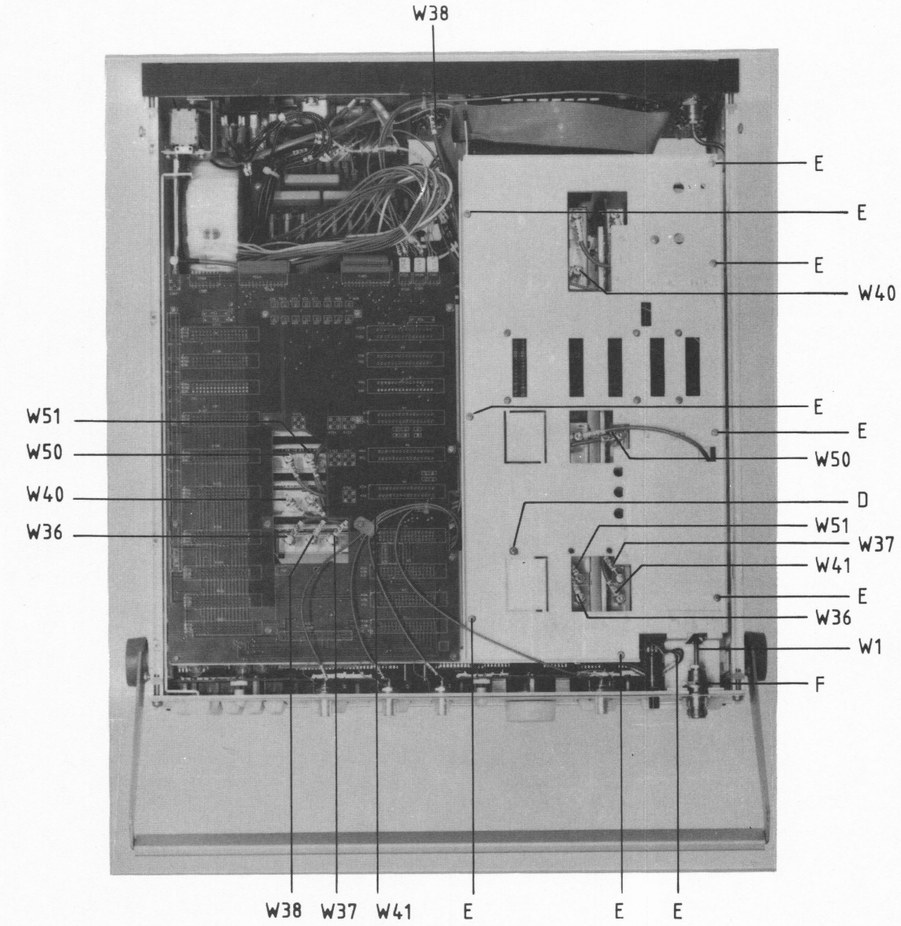


Bild 2-8 SWP,Ansicht von unten
Fig. 2-8 Bottom view of SWP

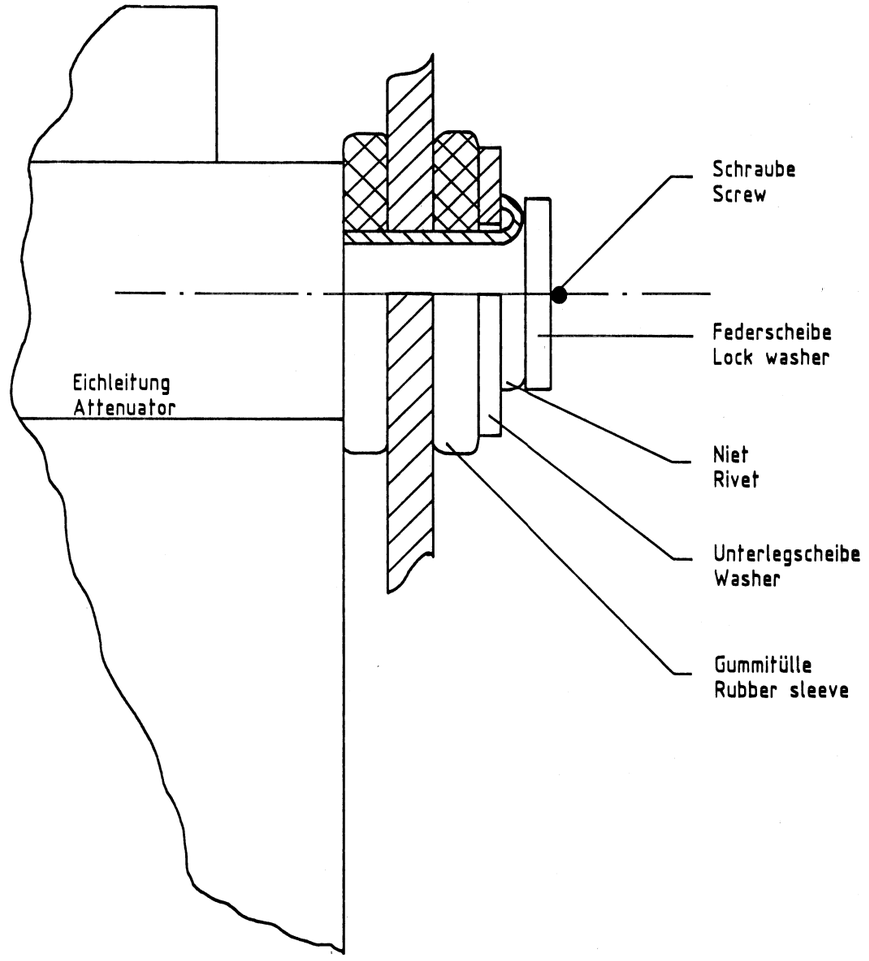


Bild 2-9 Befestigung der Eichleitung
Fig. 2-9 Mounting of attenuator