SELECTIVE LEVEL METER 200 Hz to 1.62 MHz

SPM-33

Description and operating manual

BN 2033/02 series B ...

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Glossary

FOREWORD

A hand-held selective level meter is something maintenance and service technicians have always wanted. The logical application of new technologies has now made this possible. The SPM-33, which has a frequency range from 200 Hz to 1.62 MHz, will fit into a briefcase, weighs about 1 kg and will operate for a day on one battery pack.

For performance the compact SPM-33 can be compared with larger and heavier bench and lab equipment. The SPM-33 is the culmination of many years of experience in the development, production and quality assurance of level test sets.

The SPM-33 uses the latest technologies: SMD on pcbs, high scale integration, gate arrays and compact low-weight quartz crystals. Special circuits were developed to reduce power consumption – the SPM-33 operates on just two 9 V batteries.

In spite of its small size, the SPM-33 has stable synthesiser tuning, an AFC, and frequency search capability. The results are shown on a large digital LCD display; the resolution is 0.1 dB. The display is supplemented by means of a fast, quasi-analog bargraph which shows result trends. The SPM-33 has all the usual bandwidths and impedances used in CF systems. A demodulator with an integral loudspeaker can be used to monitor the input signal.

All parameters are entered by means of function keys, a digital keypad, or up/down keys. A facility for storing up to 100 complete setups or fixed frequencies takes the tedium out of repetitive measurements.

Main topics

Chapter 1: The technical data for the SPM-33, order numbers for options and accessories.

Chapter 2: Display contrast 2-1
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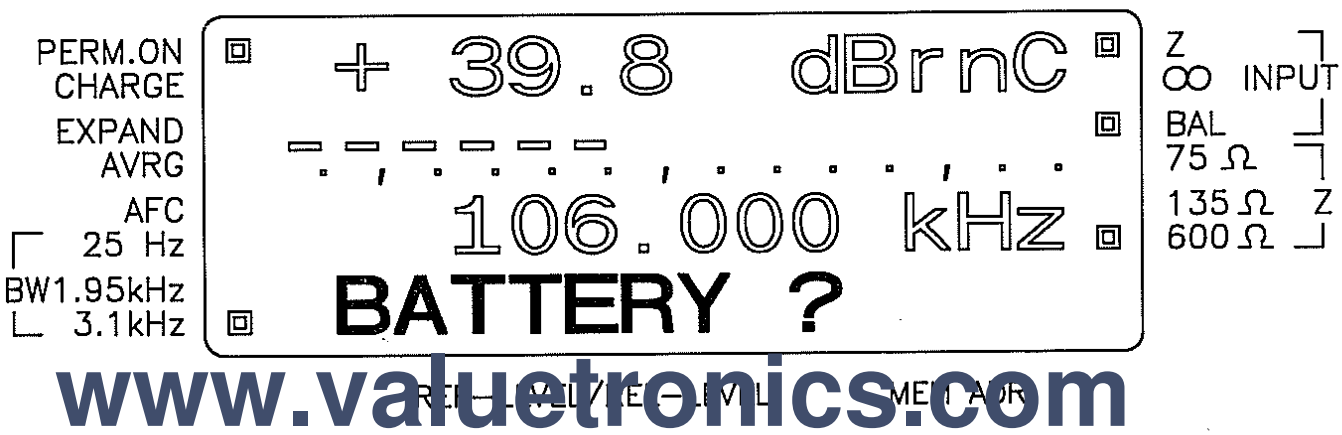
A key-word glossary at the end of the manual will help you to find particular references quickly.

Notes on the display

The displays have been illustrated using a computer and all essential features of the display have been shown. However the relevant lettering in the illustrations is shown in bold characters for the sake of clarity. The actual display does not, of course, make these distinctions.

Example: in this figure "BATTERY?" is written in bold script as this aspect of the SPM-33 is being discussed.



1 TECHNICAL DATA

Unless otherwise stated, this data applies to the nominal range of use of the ambient conditions after the instrument has been calibrated.

1.1 Inputs

Coaxial input* . . . . . Versacon® 9 Universal Connector
is compatible with all common connector systems
Input impedance, selectable . . . . . 75 Ω, high impedance
Return loss . . . . . ≧40 dB

Balanced input[1] . . . . . 2-pole CF connector
135 Ω connector is compatible with WECO 241A
600 Ω connector is compatible with WECO 310
Input impedance,
selectable . . . . . 75 Ω, 135 Ω, 600 Ω, high impedance
Return loss at f = 10 kHz . . . . . ≧40 dB
Signal balance ratio to CCITT O.121,
f ≦620 kHz . . . . . ≧40 dB
f >620 kHz . . . . . ≧30 dB
Maximum load for both inputs
(as input signal and common mode signal)
Input level . . . . . +30 dBm
D.C. input voltage . . . . . 60 V from Z_{out} ≧600 Ω

1.2 Frequency

Frequency range . . . . . 200 Hz to 1.62 MHz

Frequency setting
– manual via keypad, resolution . . . . . 1 Hz
– AFC
Accuracy . . . . . ±1 Hz ±1 % of bandwidth
Capture range, B = 25 Hz . . . . . ±50 Hz

Capture range, B ≦ 100 Hz [1] . . . . . ±100 Hz
Capture range, B ≧ 100 Hz . . . . . ±1.5 kHz
– automatic frequency search,
adjustable level threshold,
at B ≦ 100 Hz . . . . . ≦40 dB down on wideband level
at B > 100 Hz . . . . . ≦60 dB down on wideband level

Frequency display . . . . . 7 digits, resolution 1 Hz
Frequency error limits including
1 year ageing . . . . . $\pm 3 \times 10^{-6} \pm 1$ Hz

1) Option BN 2033/00.52

1.3 Level measurements

Measured quantities
Power level (dBm) referred to . . . . . 1 mW
Voltage level (dB) referred to . . . . . 0.775 V
Level difference in . . . . . dB
Level in dBm0
Relative level . . . . . dBr
or noise in . . . . . dBrnC, dBrnC0
MAX. LEVEL . . . . . displays the max. rms value
aid for use with keyed signals

Level display
Digital display, max. resolution . . . . . 0.01 dB
Quasi-analog bar graph as trend display
Scale, selectable . . . . . 140 dB/10 dB ±2 dB
Resolution, expanded display . . . . . 0.1 dB

Display range

From intrinsic spurious noise to max. test level (dBm)

Input		Selective	Wideband
Coaxial	75 Ω	<−120 [1] to +20 dBm	<−50 to +20 dBm
Bal-anced	75 to 135 Ω	<−105 [1] to +20 dBm	<−50 to +20 dBm
	600 Ω	<−110 [1] to +10 dBm	<−60 to +10 dBm

1) For a bandwidth of 25 Hz, f ≧ 2 kHz; bal. 75 Ω: −100 dBm

1.4 Error limits of the level display

for $Z_{in} = Z_{out} = Z_o$, after calibration, with display averaging (AVRG), MAX. LEVEL off, battery mode, includes rounding errors and the signal balance ratio of test item ≧20 dB

Intrinsic error and variation with level

at 10 kHz and (73 ±3) °F (table values in dB)

Bal., all bandwidths		±0.4				±0.9	—
Co-axial	Bandwidth >100 Hz						
	100 Hz bandwidth	±0.3	±0.1	±0.3	±0.4		±0.6
	25 Hz bandwidth				±0.4		
Level range/dBm (75/135 Ω)		+20	0	0	−70	−80	−90	−100
Level range/dBm, dB (600 Ω)		+10			−80	−90	−100	−110

Variation of level display with frequency

referred to 10 kHz, the input level being ≧40 dB above the intrinsic noise level

Coaxial	$Z_o = 75\ \Omega$	±0.3 dB	±0.5 dB
Balanced	$Z_o = 75$ or 135 Ω	±0.3 dB	±0.5 dB
	$Z_o = 600\ \Omega$	±0.4 dB	±0.6 dB
Frequency range	20 Hz		320 kHz	1.62 MHz

Total error
(the total of all previously listed errors)

Error limits (selective) [1]	f = 200 Hz to 620 kHz	±0.7 dB	
	f = 200 Hz to 1.62 MHz	±0.9 dB	
Error limits (wideband) [2]	f = 200 Hz to 620 kHz	±0.8 dB	—
	f = 200 Hz to 1.62 MHz	±1 dB	—

Level range/dBm (75/135 Ω)	+20	−40	−80
Level range/dBm (600 Ω)	+10	−50	−90

1) rms measurements
2) For average sinusoidal voltage measurement, rms display

1.5 **Selectivity,** bandwidth selectable

Nominal value	Effective noise bandwidth	Bandwidth for attenuation <3 dB	Centre frequency ± Δf for attenuation >60 dB
25 Hz	—	24 Hz	±250 Hz
100 Hz [1]	—	80 Hz	±400 Hz
1.95 kHz	1.95 kHz ±10 %	1650 Hz	±2 kHz
3.1 kHz	3.1 kHz ±15 %	2.7 kHz	±2 kHz

1) Option, replaces 25 Hz. Values for +50 to +95 °F

Image frequency and IF attenuation . . . . . >60 dB

1.6 **Harmonic ratio a_{k_2}, a_{k_3}**

for fundamentals ≧2 kHz . . . . . >60 dB

1.7 **Demodulator**

Single sideband demodulation,
selectable . . . . . upper or lower sideband

Integral loudspeaker volume adjustable

100 setups can be stored and recalled. The setups are cleared by being overwritten

1.9 General specifications

Power supply

Battery mode . . . . . 9 V
Manganese batteries (two) . . . . . IEC 6LF22 or 6LR61
Operating time . . . . . approx. 8 h
Rechargeable batteries
with charger contact (two) . . . . . same size as IEC 6LF22
Operating time . . . . . approx. 2 h
Mains power . . . . . 14 to 15 V, approx. 100 mA
See ordering information for suitable a.c. adaptor/charger.
The batteries can be charged when the SPM-33 is making measurements.

Ambient conditions

Ambient temperature
Nominal range of use . . . . . +32 to +131 °F
Limits operating range . . . . . +14 to +131 °F
Limits range for transit and storage . . . . . −40 to +158 °F
Relative air humidity (to 104 °F) . . . . . 5 to 95 %
Not suitable for continuous operation in warm humid conditions.
Occasional condensation will not affect the instrument.

Dimensions (w × h × d) in mm . . . . . 110 × 200 × 60
Weight (with batteries) . . . . . approx. 1 kg

1.10 Ordering information

Level Meter SPM-33* (CF connector)	**BN 2033/01**
Level Meter SPM-33*	**BN 2033/02**
Like BN 2033/01, but with noise measurements in dBrnC, WECO connectors	
Level Meter SPM-33*	**BN 2033/03**
like BN 2033/01, but with I-214 bal. connectors [1]	

Supplied accessories: two dry batteries, carrying strap

Options (no extra charge)

124 Ω [2] instead of 135 Ω	BN 2033/00.60
140 Ω [2] instead of 135 Ω	BN 2033/00.62

Option (charged extra)

100 Hz bandwidth [2] instead of the 25 Hz bandwidth	BN 2033/00.52

Accessories (charged extra)

Nicads (two required)	BN 820/00.50
A.C. charger/adaptor with European mains connector (193 to 242 V, 47.5 to 63 Hz)	BN 964/00.02
U.S. mains connector (105 to 132 V, 47.5 to 63 Hz)	BN 964/00.03
U.K. mains connector (211 to 264 V, 47.5 to 63 Hz)	BN 964/00.04
Australian mains connector (211 to 264 V, 47.5 to 63 Hz)	BN 964/00.05
Balanced Attenuator SDG-40 (40 dB) for SPM-33, BN 2033/01	BN 608/00.01
Leather carrying case for the SPM-33 for a.c. adaptor/charger, SDG-40, adaptor, cables	BN 926/15

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* Fitted with the Versacon® 9 75 Ω basic connector and BNC insert. Other types of insert – see Versacon® 9 data sheet – should be ordered with the SPM-33

1) If required cable K 438 I-214 (m) CF, 1 m, K 474 2×I-214 (m), 1.5 m

2) To be ordered together with the SPM-33 (can only be factory fitted)

2 GENERAL INFORMATION FOR THE USER

2.1 Display contrast

Like all modern pocket calculators, the SPM-33 has an LCD display. The display contrast depends on:
– the light incident on the display
– the viewing angle (fig. 2-1)

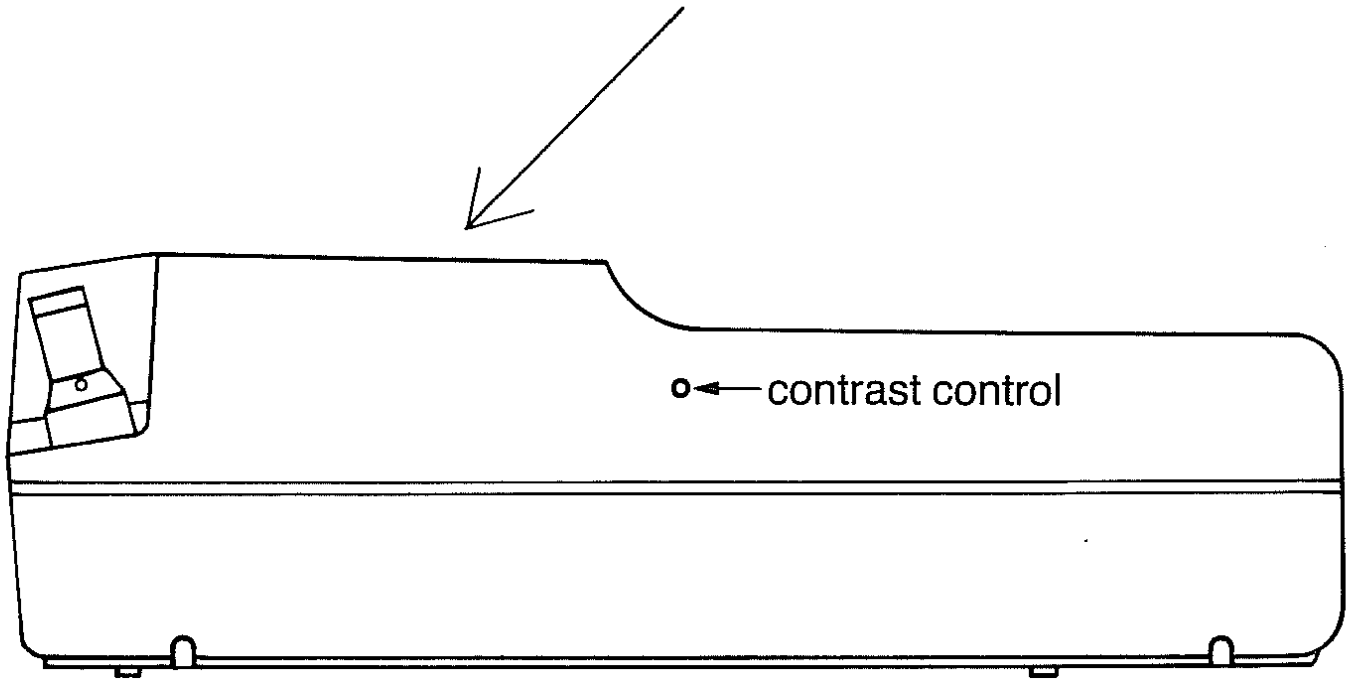


Fig. 2-1 Normal viewing angle. The contrast can be adjusted by means of the contrast control (in hole in side of set).

If you are viewing the SPM-33 at a different angle, adjust the contrast accordingly.

You will find the contrast control in the hole in the lefthand side of the set. You can adjust the control with a thin screwdriver. Set the contrast so that
– the lettering is clear and
– the background dot can scarcely be seen

2.2 Power supply

The SPM-33 can use one of three types of power supply:
– an a.c. adaptor/charger
– two 9 V dry batteries
– two rechargeable batteries (Ni-Cd)

2.2.1 Mains power

The **BN 964/00.02 a.c. adaptor/charger** is ideal for powering the SPM-33. Charging will only take place if rechargeable batteries with a charger contact are used (see 2.2.2).

- Push the adaptor's jack-plug into the connector on the right-hand side of the instrument.
- If there are batteries in the SPM-33, the jack-plug can be inserted or removed without interrupting the power supply. When the adaptor is connected, it alone supplies power.
- If you use the mains adaptor without any batteries in the SPM-33, the set will still work but anything stored in memory will be lost if there is a power failure. For this reason, it is best to use both.

  If there are no batteries in the SPM-33, or the batteries are low, the message "BATTERY ?" is displayed – even if the mains adaptor is connected (see section on low batteries).

2.2.2 Battery power

Two 9 V dry batteries or two rechargeable batteries are required. The following are suitable:
– Manganese/sal ammoniac batteries (IEC 6LF22 or 6LR61), give an operating time of about 8 hours, or
– Rechargeable Ni-Cds (same size as 6LF22), give an operating time of about 2 hours.
  Wandel & Goltermann supply suitable rechargeable batteries with charger contact – order code BN 982/00.50.

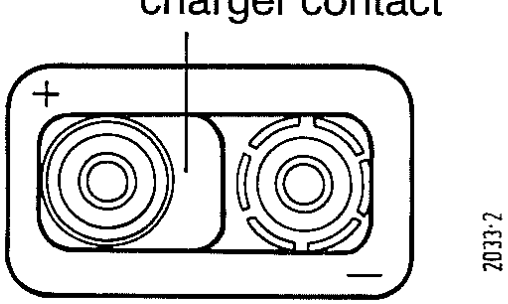


Fig. 2-2 Terminals of 9 V rechargeable battery with charger contact

Low batteries

If the batteries are low,
– "BATTERY ?" is displayed, and
– the SPM-33 is switched off automatically after 1 to 3 minutes.

In general, one can say that the batteries will be able to backup stored data for at least a few more days.

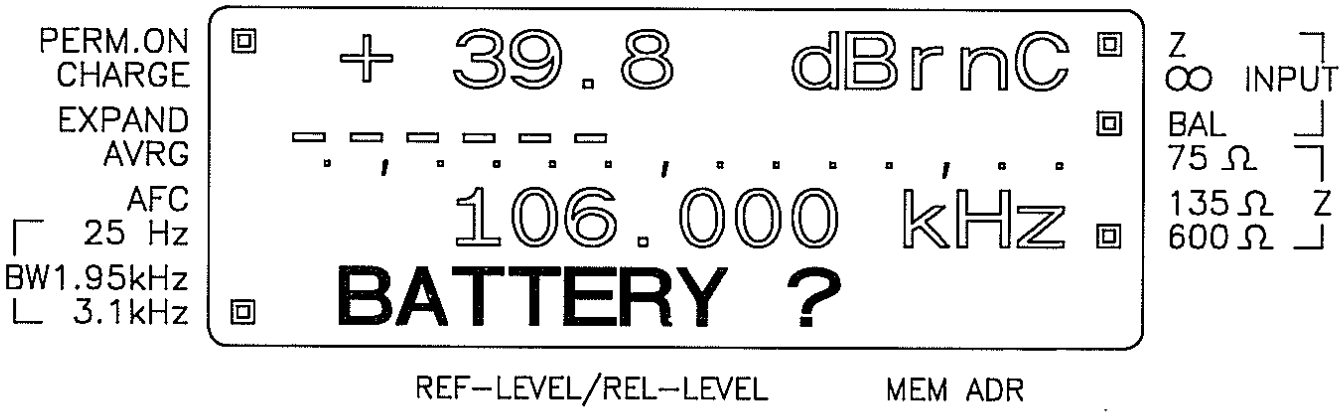


Fig. 2-3 Battery low warning

- The battery low warning "BATTERY ?" is temporarily cleared when you press a function key. It will however reappear after about a minute because the battery voltage is measured at minute intervals.
- The warning will also be displayed when the SPM-33 is powered by the mains adaptor and there are no batteries in the set.

Changing the batteries

Only replace one battery at a time, otherwise you will lose any data that you have stored.

The batteries are changed in the following way:

- Turn the SPM-33 so that the back panel faces upwards
- Slide the catch in the battery compartment lid downwards, and remove the lid.
- Holding the SPM-33 in one hand shake out the batteries into your other hand taking care not to disconnect them.
- Replace one battery at a time so that you do not lose any data which you may have stored.

The SPM-33 will not be damaged if you try to connect a battery the wrong way round.

- Replace the new batteries as shown in the diagram below (fig. 2-4). The flat cable must be below the batteries and must not be twisted.

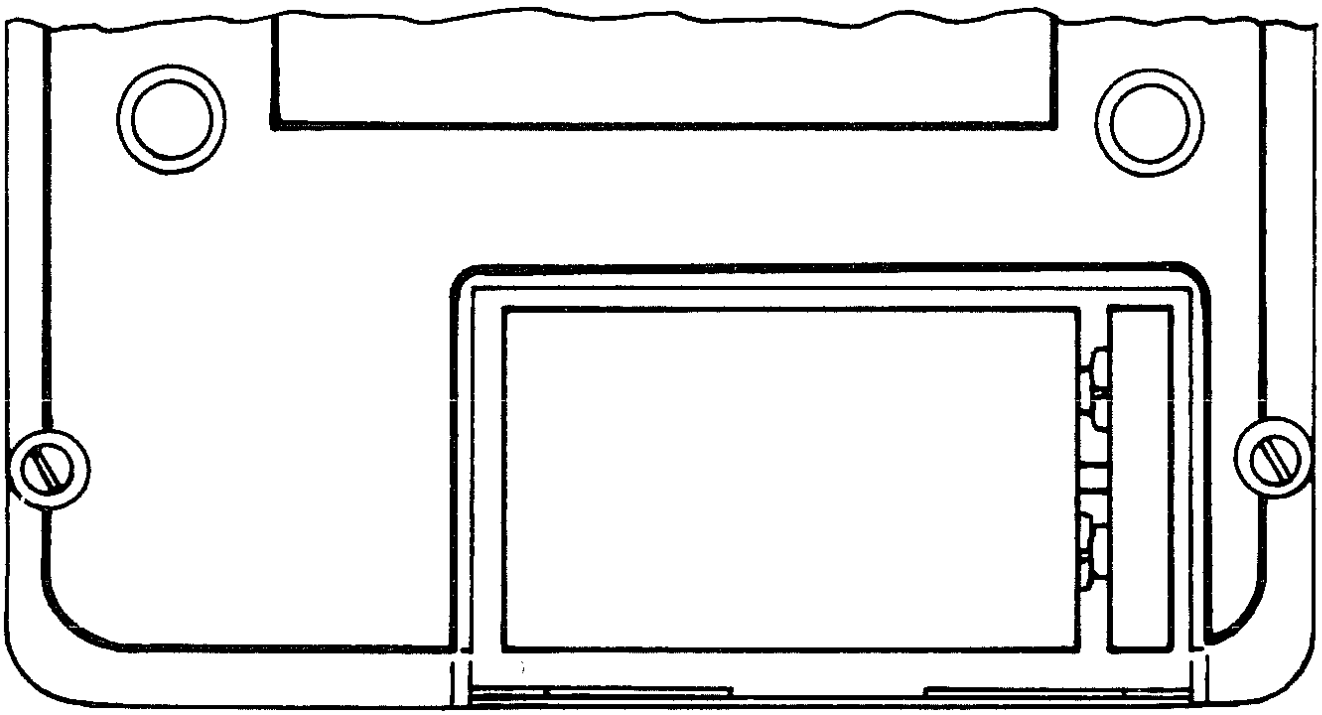


Fig. 2-4 How to replace the batteries in the battery compartment.

catch upwards.
If the lid does not fit properly, do not use force, the flat cable under the batteries may be twisted.

Charging the batteries

When the mains adaptor is connected, the rechargeable batteries are trickle-charged.

If the warning "BATTERY ?" is displayed, the batteries must be charged.

- Connect the mains adaptor
- Switch on the SPM-33

[ON/OFF] (1st row, blue key)

- Wait until the test is over (approx. 6 s)
- Set the SPM-33 to PERM ON mode (no auto-off)

[*] [ON/OFF]
PERM.ON

- Select the charge mode by entering the following keystrokes:

[*] [ON/OFF]
CHARGE

"PERM ON" and "CHARGE" should now appear in the display (fig. 2-5).

If the mains voltage is too low, the warning "LINE POWER ?" is displayed. This warning disappears within 1 minute when the correct charging voltage is applied.

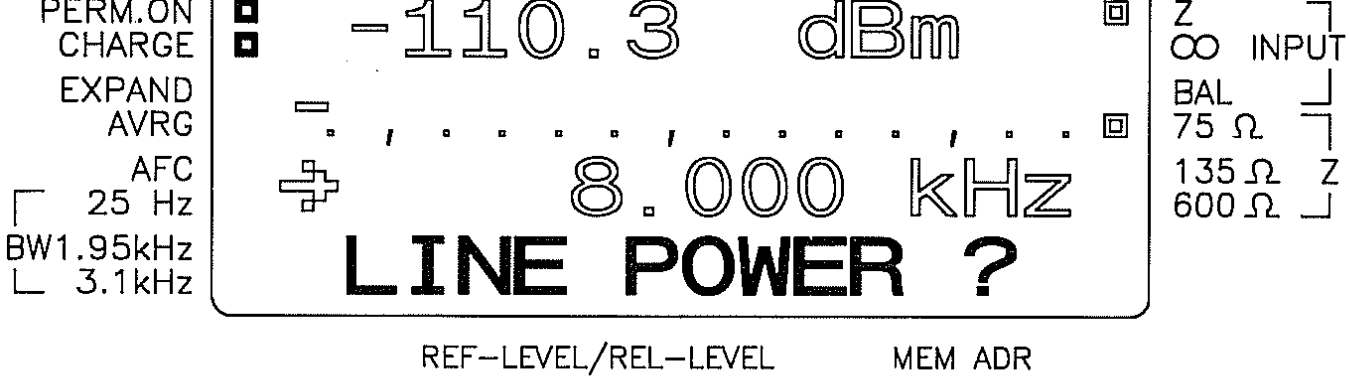


Fig. 2-5 The SPM-33 has been set to charge mode, but there is no mains voltage.

- Charging is timed and takes 14 hours
- You can make measurements while the batteries are being charged.
- If there are dry batteries in the SPM-33, and you select charge mode, the SPM-33 will confirm that charge mode has been selected but the batteries will not be charged as they do not have a charger contact.

2.3 Switching on the SPM-33

ON/OFF (1st row, blue key)

This key is used to switch the SPM-33 on or off. When the SPM-33 is switched on a selftest is run, this checks the microprocessor. The test lasts about 6 seconds. The following text is displayed when the test is in progress

SPM-33 TEST

The SPM-33 is then automatically calibrated. Calibration involves all subassemblies and lasts about 9 s. The following text is displayed when calibration is in progress:

CAL

ments. The current setting is the same as the setting at switch-off.

You can also call up the calibration routine during measurements.

*	ENTER	(row 6)
	CAL	

It is a good idea to calibrate at intervals of 30 min to take changes in ambient temperature into account, or to use the full accuracy of the set.

If the power to the RAM is interrupted, e.g. the batteries are flat, the following text is displayed during the test phase:

CLEAR ALL

If "CLEAR ALL" is displayed, the SPM-33 is set to the standard setting: selective measurement mode, f = 8 kHz.
If you enter "RCL" plus address number and no setup has been stored at the address, the standard setting is used.

The SPM-33 switches itself off automatically to save power if no keystroke is entered for 15 min. The auto-off facility can be disabled by entering:

*	ON/OFF
	PERM.ON

The SPM-33 will now stay on permanently. A little square appears next to "PERM. ON" (top left of display). This mode can only be cancelled by switching the SPM-33 off then on again.

The charge mode can be selected by entering the key sequence [*], [ON/OFF] again.

3 OPERATION

3.1 Overview

Fig. 3-1 shows the input connectors and the display. Fig. 3-2 shows the keypad. Both pictures can be folded out and are to be found at the back of the manual.

3.1.1 Connectors and keys

Explanation of symbols used:

[X]	..... Description of the function selected when [X] is pressed.
[*] [X]	"Y" Description of function Y which is selected when the key sequence [*] (shift) [X] is entered.

Inputs

⊙	Coaxial input, 75 Ω or high impedance (∞)
○ ○	Balanced input, 75 Ω, 135 Ω, 600 Ω or high impedance (∞) (Different versions of the SPM-33 fitted with 124 or 140 Ω are available) The input is selected automatically when the input impedance (Z) is selected (see "Z/Ω")

[*]	Shift key (yellow) ● When a key sequence having the form [*] [X] is entered, the function in yellow lettering below [X] is selected.

flashes in the top line of the display.
- If you press the shift key by mistake, you can cancel the entry by pressing [CLEAR].

POWER

[ON/OFF]

For switching the SPM-33 on or off. If no keystroke is entered for 15 min, the SPM-33 switches itself off automatically.

[*] [ON/OFF]

PERM.ON, CHARGE: Each time this key sequence is entered, the following sequence of functions is selected:

- PERM.ON. The auto-off facility is disabled
- Charge mode on (14 hours)
- Charge mode off
- Charge mode on (14 hours)
- Charge mode off etc

FREQ

[TUNE]

To enter a new frequency press [TUNE] then:

- Enter the frequency via numeric keypad (entry taken as kHz) and terminate with [ENTER]
- The frequency can be entered in steps using the four up/down keys (coarse, fine); the step widths are fixed.

[*] [TUNE]

Selects or cancels AFC. No effect when [DEMOD], [WIDE] or [MAX.LEVEL] have been selected.

SEARCH

To start frequency search, press [TUNE]:

- search starts at tuning frequency
  - Increase frequency by pressing [↑] or [↑↑]
  - Decrease frequency by pressing [↓] or [↓↓]
- The search stops
  - when the result > REF or
  - when the upper or lower frequency limit has been reached
- The search can be stopped by pressing: [TUNE] or [STEP]

(The search function cannot be selected if DEMOD, WIDE or MAX. LEVEL have been selected.)

STEP

To enter a new frequency or to alter the frequency press [STEP] then:

- Enter the frequency by means of the numeric keypad (entry taken as kHz), terminate with [ENTER].
- The frequency can be incremented or decremented by means of the 4 up/down keys, the stepwidth is Δf. Δf can be set to any integral frequency between 0 Hz and 1.65 MHz.

* STEP

By entering this key sequence (Δf) you can alter the stepwidth:

- Enter Δf (kHz) via keypad and terminate with [ENTER]
- The up/down keys can also be used to alter Δf.

ABS	Displays the absolute power level in dBm or noise level in dBrnC. Toggle between dBrnC and dBm "dBrnC/dBm" by entering the key sequence [*], [–].
* ABS	"REF", using this key sequence you can alter the reference level (–120 dBm to +20 dBm): ● Enter value by means of keypad, terminate entry with [ENTER] ● The up/down keys can be used to increment or decrement "REF".
ABS-REF	Shows the difference between the measured level (dBm) and the stored reference level "REF".
* ABS-REF	"ABS → REF": by entering this key sequence, the measured level is stored as the new reference level.
dBm0	Displays dBm – dBr. The relative level can be entered by pressing [*] [dBm0]
* dBm0	"REL (dBr)": allows you to modify the relative level. ● Enter value by means of keypad and terminate with [ENTER]. ● "REL" can be incremented or decremented using the up/down keys.
DEMOD	Demodulates single sideband signals. You can toggle between LSB and USB demodulation by pressing this key. The built-

demodulated signal.

- It is a good idea to select the 3.1 kHz filter and to tune to the centre of the bandwidth
- The volume can be adjusted with the up/down keys.

*	DEMOD	"MAX.LEVEL": displays the max. level reached by keyed signals (carrier telegraphy).

SCALE

*	7	"EXPAND": expands bargraph display: 1 dB/div (on/off). Unexpanded display 10 dB/div.
*	8	"AVRG": result averaging (slow) on/off.

CLEAR	• Clears any entry which has not been terminated with [ENTER] • Cancels the shift key, [*]

BANDW/Hz

*	4	"25": selective measurement, 25 Hz bandwidth ("100": sel. measurement with 100 Hz bandwidth)
*	5	"1.95 k": sel. measurement using the 1.95 kHz bandwidth
*	6	"3.1 k": sel. measurement using the 3.1 kHz bandwidth

WIDE		Wideband measurements

Z/Ω

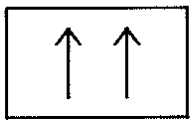
*	1	The input impedance, Z, = 75 Ω
*	2	The input impedance, Z, = 135 Ω (or 124 or 140 Ω depending on the version)
*	3	The input impedance, Z, = 600 Ω

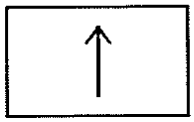
INPUT

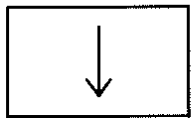
Z/∞		Toggles between the selected input impedance Z and high input impedance (∞)
*	Z/∞	With this key sequence you can toggle between the balanced (BAL) and the coaxial input (UNBAL).

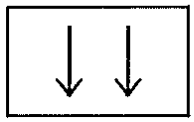
*	0	"TEST/CONFIG": This key sequence calls up the test and service programs (s. service manual). The software version and the option that have been fitted are shown in the display. You can leave this mode by pressing [CLEAR] or [*] (takes a few seconds) or by switching the SPM-33 on and then off.
ENTER		For terminating entries.

*	ENTER	"CAL": calls up the calibration routine







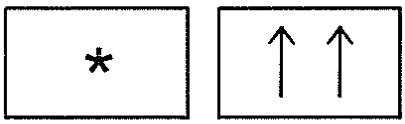


Using the up/down keys, you can increase or decrease the frequency, the level or the address no. in steps. If you hold any of the keys down, the repeat function is activated.

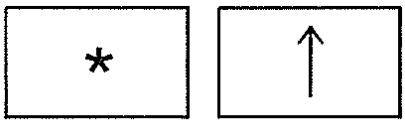
- [TUNE]: Increases or decreases the tuning frequency. The coarse step width depends on bandwidth, the fine step width is 1 Hz.
- [SEARCH]: Starts the search function.
- [STEP]: Increases or decreases the tuning frequency by Δf (adjustable step-width). Δf is entered by entering the key sequence [*], [STEP].
- After the key sequence [*], [STEP] has been entered, Δf can be increased or decreased in steps of 10 Hz or 1 Hz.
- After the key sequence [*], [ABS] (= REF) has been entered, the stored reference level can be incremented or decremented by 1 dB or 0.1 dB.
- After the key sequence [*], [dBm0] (= "REL (dBr)") has been entered, the stored reference level can be incremented or decremented by 1 dB or 0.1 dB.

volume in steps of 6 dB (or 2 dB)

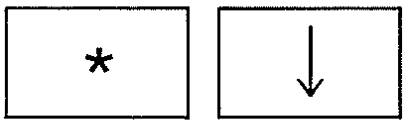
- [MEM]: the address number is increased or decreased by 5 or 1.



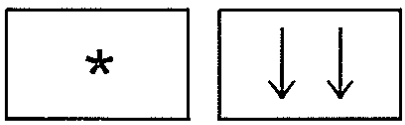
"RCL MEM": for recalling setups. first of all, the address which was last set is displayed. The address no. can then be altered with the up/down keys or reset (0 to 99); the entry is terminated with [ENTER].



"STO MEM": stores the current setup and result at an address between 0 and 99 (see RCL MEM).



"DISPLAY MEM": displays a setup that has been stored. The last value that was measured before the setup was stored is also displayed. It is not possible to make measurements when the setup is being displayed. The display is cleared by pressing [*], [↓↓] or any key in the FREQ or MODE groups.
For more on addresses see "RCL MEM".



"MEM OFF": Cancels the memory mode, addresses are no longer displayed.

3.1.2 Display

The SPM-33's display is split up into 4 rows and 16 columns (see fig. 3-1 at back of operating manual). Various device parameters are marked around the edge of the display; squares in the display indicate which parameters have been selected.

From now on, the rows will be designated by the letters A to D and the columns with the numbers 1 to 16. (B/15) means the character in the 2nd row and 15th column.

- Row A shows
  - The measured level is shown when [ABS], [ABS-REF], [dBm0] or [MAX. LEVEL] are entered
  - USB or LSB is indicated when [DEMOD] is entered
- Row B shows
  - The result is shown in terms of a bargraph (coarse)
  - "MAX. LEVEL" when [*] [DEMOD] (max level) is selected
  - "FREE" if there is nothing stored at the address when DISPLAY MEM is entered
- Row C shows
  - The receive frequency when [TUNE], [SEARCH] or [STEP] are pressed
  - "WIDEBAND" is displayed when [WIDE] is pressed
- Row D shows
  - The reference level when [REF] is pressed
  - The relative level when [REL(dBr)] is pressed
  - Various symbols and the address in memory mode

Meaning of symbols

* (flashes)	(A2), the yellow shift key has been pressed. Clear with [CLEAR].
→	The value indicated by the arrow may be altered. The arrow flashes when an entry has been started but not terminated.

! (briefly)	(D2), when [*], [ABS-REF] is pressed, the measured level is stored as the reference level. (D13), storing or recalling (STO, RCL) a set-up.
?	(A2), the input level is too high, or when wide-band measurements are being made, too low.
→ Δ	(C2,3), when the key sequence [*], [STEP] is entered you can change the frequency stepwidth Δf.
S	(C3), when you press [STEP], the tuning frequency can be incremented or decre-mented by Δf.
▲ ▼	(C3), when [SEARCH] has been pressed, search mode has been selected but not started.
▲	(C3), [SEARCH] and then [↑] have been pressed; starts the search, the frequency is increasing.
▼	(C3), [SEARCH] and [↓] have been pressed; starts the search, the frequency is de-creasing.
BATTERY ?	(D), the battery voltage is too low (see 2.2.2)
BATT.? POWER?	(D), the errors designated by "BATTERY ?" and "LINE POWER?" have both occurred.
CAL	(A), SPM-33 is being calibrated (after switch-on or after pressing [*] [ENTER]).
DEM. LOWER SB	(A), when [DEMOD] is pressed twice the LSB of the CF signal is demodulated and out-put via the internal loudspeaker.

DEM. CF LSB	(A), which [DEMOD] is pressed, the USB of the CF signal is demodulated and output via the integral loudspeaker.
DSP	(D14), when [*] and [↓] are pressed, "DSP" and an address are displayed alternately. The memory contents at this address are shown but the SPM-33 is not set to this setup.
MAX. LEVEL	(B), when [*], [DEMOD] is pressed, the rms level of a keyed carrier frequency telegraphy signal is shown.
LINE POWER ?	(D), the SPM-33 has been set to the charge mode. The voltage delivered by the charger is however too low.
STO	(D14..), appears after [*] and [↑] have been entered; "STO" and an address are displayed alternately. By pressing [ENTER] you can store the current setup and result at the address shown in the display.
WIDEBAND	(C), appears when [WIDE] is pressed. Measurements are performed using the wideband receiver.

Display marker (□)

This marker is used to indicate with function has been selected; the possibilities are marked on the right- and lefthand edges of the display.

AFC	
AVRG	Display averaging (slow); the resolution of the level display is 0.01 dB.
BW	Shows which bandwidth has been selected
CHARGE	Batteries are charging

EXPAND	Bargraph is expanded
INPUT: Z	Either 75 Ω, 135 Ω or 600 Ω has been selected as an input impedance
INPUT: ∞	High input impedance
INPUT: BAL	The balanced input has been selected
PERM. ON	The auto-off function is disabled

3.2.1 Operating modes

The SPM-33 has 3 operating modes:

- Selective level measurements (indicated by "meas." in table 3-1)
- Demodulating SSB signals – output by means of integral loud-speaker. (indicated by "monitor" in table 3-1).
- Wideband level measurements

Table 3-1 is a summary of the functions in each operating mode. AFC can only be selected in the selective level measurement mode.

Function (selected with keypad)	Wideband receiver	Selective receiver	
		Meas.	Monitor
Wideband meas.	WIDE		
Receive frequency		TUNE, STEP	
Search		SEARCH	
AFC		AFC	
Level reference	ABS, ABS-REF, dBm0		
Bandwidths		25/100 Hz to 3.1 kHz	
Demodulation			DEMOD

Table 3-1 Summary of the SPM-33's functions

3.2.1 Selective level measurements

How to set the SPM-33 for selective measurements:

- Select input and input impedance:

  Use the keys in the group marked "Z/Ω" and the shift key: [*] [1], [*] [2] or [*] [3]
  → see 3.2.2

- Setting the receive frequency:

  Use [TUNE], [STEP] or [SEARCH] (frequency search)
  → see 3.2.3

- Absolute power level, level difference or level in dBm0:

  Use [ABS], [ABS-REF] or [dBm0]
  → see 3.2.5

- Select one of the three bandwidths: 25 Hz (100 Hz) to 3.1 kHz:

  Use the keys in the group marked "BANDW/Hz" and the shift key: [*] [4], [*] [5] or [*] [6]
  Use the 25 Hz (100 Hz) bandwidth to make measurements below 4 kHz.
  → see 3.2.4

Reading the display in the selective level mode

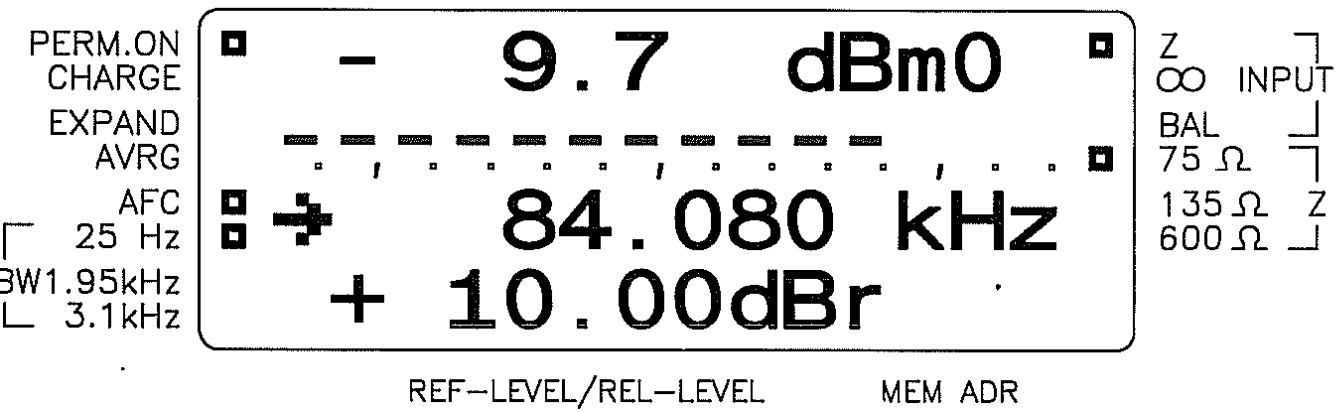


Fig. 3-3 Typical selective level display

facility.

Use the keys in the group marked "SCALE" and the shift key: [*] [7] or [*] [8]
→ see 3.2.6

Row 1: Level (rms)
Row 2: Bargraph
Row 3: Receiver frequency
Row 4: Relative level, reference level or memory function – otherwise this row is blank

- If no result is displayed, press [ABS], [ABS-REF] or [dBm0] (see 3.2.5).
- You cannot change the frequency shown in row 3 unless a flashing arrow appears before the entry; press [TUNE] or [STEP].
- If a "?" appears to the right of the level, the level is out of range.
- To check the total level, select the wideband receiver by pressing [WIDE]. Return to the selective mode by pressing [TUNE] or [STEP]; **the bandwidth is automatically set to 3.1 kHz.**
  – You can select any of the other two bandwidths, e.g.: 25 Hz (100 Hz) by entering [*] and [4]
- To demodulate a signal so that you can hear it press [DEMOD]. Return to level display by pressing [ABS], [ABS-REF] or [dBm0].

3.2.1.2 Wideband measurements

How to set the SPM-33 to measure levels with the wideband receiver:

- Select the input and the input impedance:

  Use the keys in the group marked "Z/Ω" and the shift key: [*] [1], [*] [2] or [*] [3].
  → see 3.2.2

BAND" appears in the 3rd row of the display.

- Select absolute power level, level difference or level in dBm0:

  Use [ABS], [ABS-REF] or [dBm0]
  → see 3.2.5

- If necessary: select expanded bargraph and the averaging facility:

  Use the keys in the group marked "SCALE": [*] [7] or [*] [8]
  → see 3.2.6

Reading the display in the wideband mode

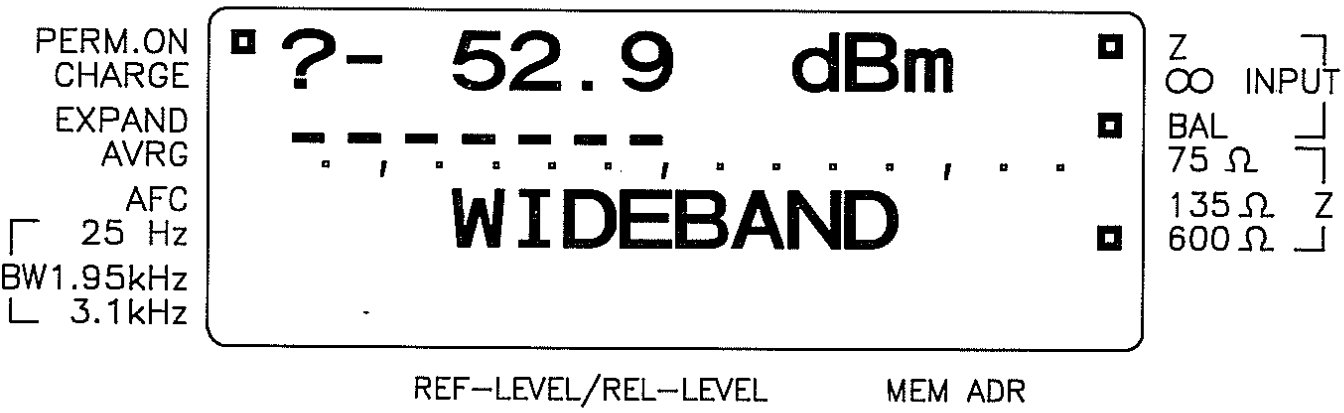


Fig. 3-4 Wideband mode display; the "?" in row A indicates that the input level is too small (in this case the input is open-circuited)

Row 1: Level (input open circuited)
Row 2: Bargraph
Row 3: "WIDEBAND"
Row 4: Relative level, reference level or memory function (or blank)

- The mean value is measured. The result shown is, however, the rms value of a sinusoidal signal with the same frequency.
- If no result is displayed, press [ABS], [ABS-REF] or [dBm0] (see 3.2.5).

– level out of range

3.2.1.3 SSB demodulation (DEMOD)

The SPM-33 can demodulate SSB signals. The signals can be checked, but cannot be measured. Telephone channels in the CF range are demodulated to the AF range (0.3 to 3.4 kHz), provided the SPM-33 is tuned to the centre of the channel.

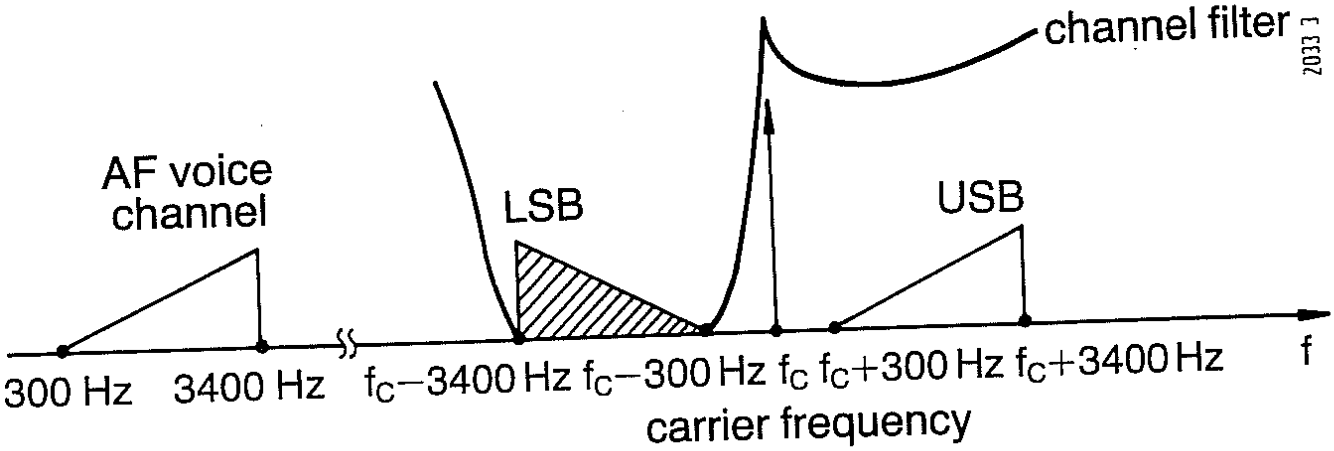


Fig. 3-5 SSB demodulation. The carrier and the USB have been suppressed.

Setting the SPM-33:

- Select the input and the input impedance:

  Use the keys in the group marked "Z/Ω" and shift: [*] [1], [*] [2] or [*] [3]
  → see 3.2.2

- Change the receive frequency:

  Use [TUNE] or [STEP]
  → see 3.2.3

  The centre of the band is converted to 2 kHz, provided the SPM-33 has been tuned to the centre of the channel. If the

frequency must be detuned to give correct reception, the correct offsets are given below:
LOWER SB −2 kHz
UPPER SB +2 kHz

- Select the sideband:
  By pressing [DEMOD] you can toggle between the LSB and USB (display "UPPER SB", "LOWER SB").

- Select the 3.1 kHz bandwidth

  Press [*] and [6]
  → see 3.2.4

  The 1.95 kHz and 25 Hz (100 Hz) bandwidths are only suitable for monitoring single tones.

- Adjust the volume using the up/down keys:

  – Volume up with [↑] or [↑↑] in 2 or 6 dB steps
  – Volume down with [↓] or [↓↓] in 2 or 6 dB steps.

  The loudspeaker volume can only be set if there is an arrow to the left of "DEMOD". If no arrow is displayed press [DEMOD].

  The frequency can be fine tuned by means of the up/down keys, [TUNE] or [STEP]

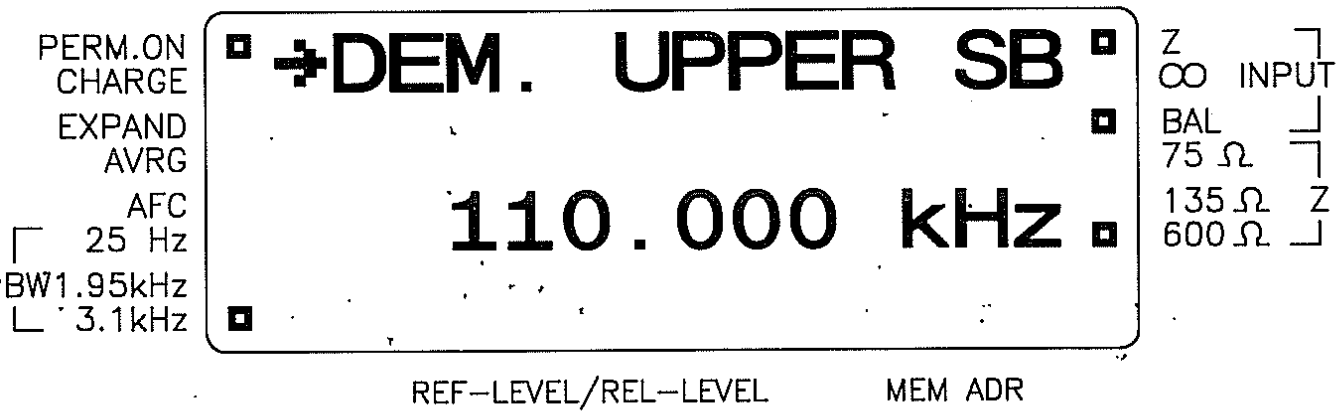


Fig. 3-6 Example showing the setting for single sideband demodulation. The SFM-33 is receiving the USB.

3.2.2 Inputs, input impedances (Z/Ω)

Note: the SPM-33 has various input impedance options; the 135 Ω input impedance can be replaced by impedances of 124 or 140 Ω. The following deals with the 135 Ω version of the SPM-33, but can be read mutando mutandis for the other versions.

With the SPM-33 you have the choice of 2 selectable inputs, (fold-out fig. 3-1):

- Coaxial input:
  Input impedances: 75 Ω or ∞ (>6.5 kΩ)
- Balanced input
  Input impedances: 75 Ω, 135 Ω, 600 Ω or ∞

Only one input can be selected at any one time.

> **»WARNING«**
>
> The input level (a.c. + d.c.)
> must not exceed
> **1 W** or **30 dBm**
>
> Max. d.c. input voltage =
> **60 V**
> from $Z_{out} \geqq 600\ \Omega$

Selecting the input and the input impedance

1	2	3	Z/∞	(row 5)
75	135	600	BAL/UNBAL	

The input and the input impedance are selected together:

– 75 Ω : coaxial input
– 135 or 600 Ω : balanced input (BAL)

Example: Input impedance of 600 Ω balanced input:

*	3

600

A small square next to the lettering on the righthand edge of the display shows which input impedance has been selected. A small square is also displayed next to "BAL".

Normally the input type and the input impedance are selected together, it is, however, possible to select them separately. The coaxial input can, therefore, have input impedances of 135 Ω or 600. There is no point doing this at high frequencies as the errors involved will be greater than those stated in the data sheet.

You can select the other input type by entering:

*	Z/∞

BAL/UNBAL

The input impedance remains the same.

The balanced input has been selected when a small square appears next to "BAL". If there is no square the coaxial input has been selected.

The following key is used to select the input impedance (75, 135, 600 Ω or ∞)

Z/∞

When this key is pressed the ohmic part of the input impedance is disconnected from the input connector leaving only the high impedance of the input amplifier (>6.5 kΩ).

"Z" or "∞" has been selected.

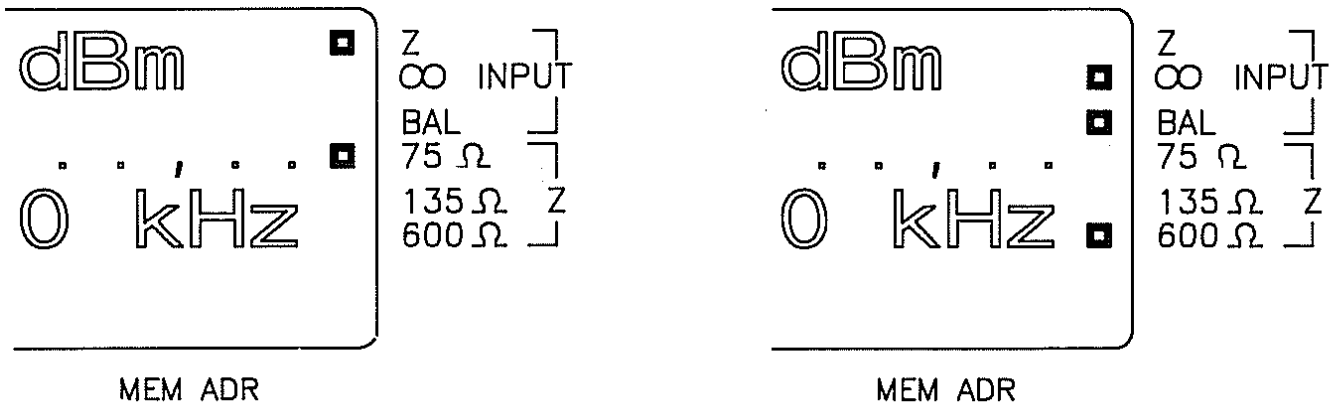


Fig. 3-7 Examples illustrating input selection

Left: Coaxial input, $Z_{in} = 75\ \Omega$
Right: Balanced input, high impedance (∞).

Power levels

Power levels (dBm) are referred to 1 mW. When a different input impedance is selected, a different level will be displayed by the SPM-33.

Z/Ω	50	75	124	135	140	150	600
L_p/dBm	10.8	9.03	6.85	6.48	6.32	6.02	0

Table 3-2 Power levels for 0.775 V into Z_{in}

Z/Ω	50	75	124	135	140	150	600
V_z/V	0.223	0.274	0.352	0.367	0.374	0.387	0.775

Table 3-3 Voltage for 0 dBm into Z_{in} ($P = 1$ mW)

3.2.3 Receive frequency (FREQ)

The three keys in the group marked "FREQ" are used to select the receive frequency of the selective receiver manually or automatically.

TUNE	SEARCH	STEP	(1st row)
AFC		ΔF	

TUNE — The receive frequency can be entered via the decimal keypad or in steps (coarse/fine) using the up/down keys.

* TUNE — An AFC automatically adjusts the receive frequency to the frequency of the input signal.

SEARCH — Using this facility you can automatically search for signals in a certain frequency range that exceed a certain level threshold.

STEP — For changing the receive frequency via the decimal keypad, or in steps by means of the up/down keys (stepwidth ΔF). The stepwidth is fixed in the TUNE mode, but can be altered in the STEP mode (stepwidth 0 to 1.65 MHz).

* STEP — "ΔF": for entering the stepwidth when the STEP mode has been selected.

3.2.3.1 Frequency entry (TUNE: keypad or steps)

The selective receiver is selected by pressing:

TUNE

The receive frequency can be set in the following ways:
– Numerical entry via the decimal keypad
– In steps via the up/down keys

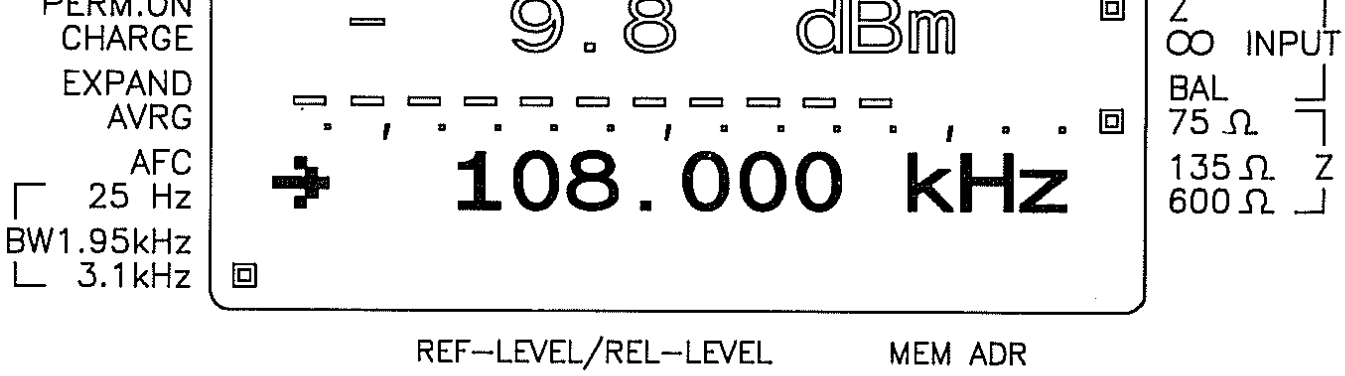


Fig. 3-8 Typical display in TUNE mode

Entering a frequency via the keypad

Example: 1.2345 MHz:

1	2	3	4	•	5	ENTER

N.B.: When you enter a number, the SPM-33 always takes it to be in kHz

Changing the frequency with the up/down keys

↑ ↑	Frequency is incremented by 10, 100 or 200 Hz (depends on bandwidth)
↑	Frequency is increased by 1 Hz
↓	Frequency is decreased by 1 Hz
↓ ↓	Frequency is decreased by 10, 100 or 200 Hz (depends on bandwidth)

- The repeat function comes into effect if you hold down any of up/down keys. The stepwidth for keys marked with one arrow is increased to 10 Hz when a bandwidth >25 (100) Hz is selected.

- When the TUNE mode has been selected, the up/down keys are a good way of fine tuning the SPM-33.

3.2.3.2 Frequency entry (STEP: keypad, adjustable stepwidth)

The selective receiver is selected when the following key is pressed.

STEP

The receive frequency can be altered in the following ways:
- Numerical entry via the digital keypad (like TUNE).
- In steps of ΔF using the up/down keys. The stepwidth, ΔF, can be adjusted.

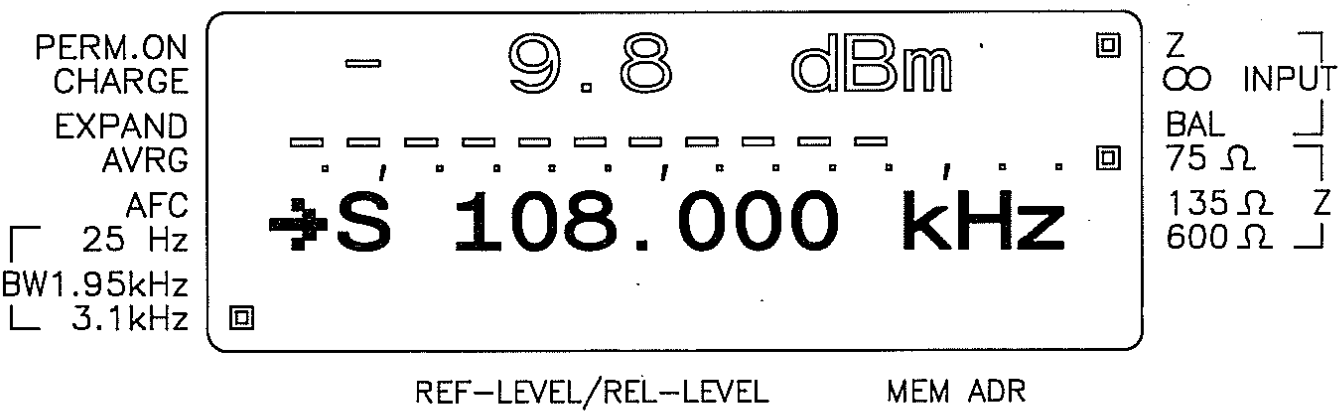


Fig. 3-9 Typical STEP mode display

Numerical frequency entry

Example: 1.2345 MHz:

1	2	3	4	•	5	ENTER

Always enter the frequency in kHz.

Frequency steps

By pressing

[↑] or [↑ ↑] the frequency is increased by ΔF

By pressing

[↓] or [↓ ↓] the frequency is decreased by ΔF

The previously stored value will be used unless altered.

Changing the stepwidth ΔF

The "change stepwidth mode" is selected by entering:

[*] [STEP]

ΔF

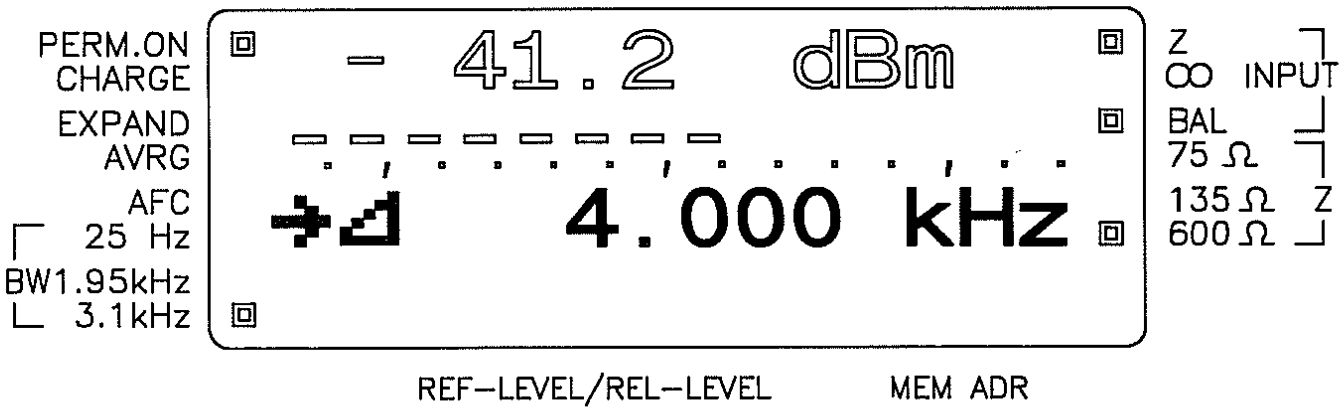


Fig. 3-10 Typical display before the entry of a new step width (ΔF). For new entry press [*] [STEP]

ΔF can now be changed
– using the up/down keys in steps of 1 Hz or 10 Hz, or
– by entering another value, e.g. 2.5 kHz:

[2] [•] [5] [ENTER] [STEP]

Always enter the frequency in kHz

When you press STEP, the SPM-33 will start to measure, the receive frequency can be incremented or decremented by the new frequency step.

3.2.3.3 SEARCH

When the SEARCH mode is selected, the SPM-33 searches automatically for signals that are greater than a threshold (adjustable). The receive frequency can be incremented or decremented starting at a selectable initial frequency. Because of the AFC the SPM-33 remains tuned to the first signal it encounters. If no signal is found the search will end at one or other of the frequency limits.

Unless the wideband level of a signal (measured with wideband receiver, WIDE) is not more than 60 dB above the reference level (40 dB for a bandwidth of 25 Hz (100 Hz)), it will not be found.

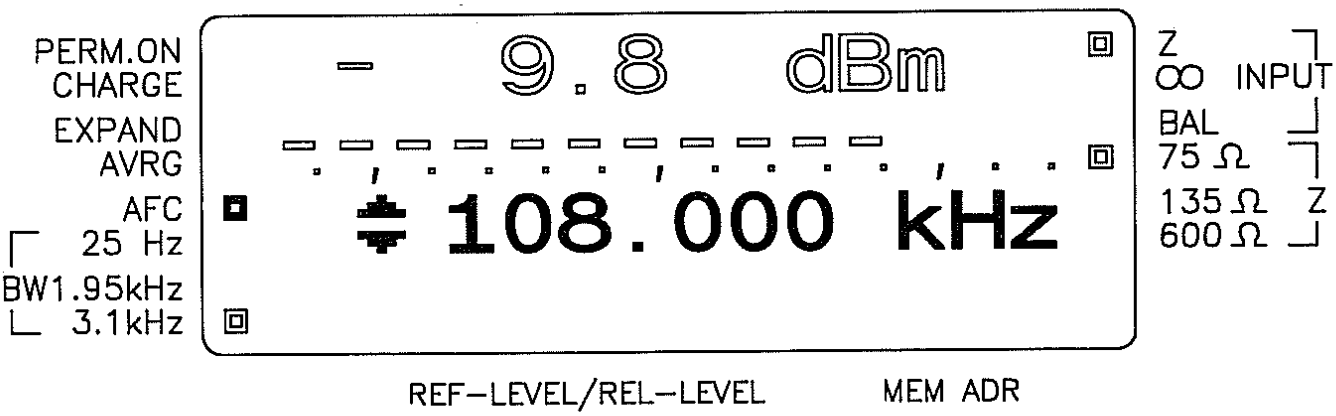


Fig. 3-11 A typical search display

Start frequency: equal to the current receive frequency. It can be entered as described in 3.2.3.1 (TUNE) and 3.2.3.2 (STEP).

Threshold (REF): The current value can be used or a new value can be entered.

- Changing the reference level, e.g. to −56 dBm

*	ABS REF	–	5	6	ENTER

- Select search mode:

SEARCH

- Start search:

↑ or ↑↑ frequency incremented

↓ or ↓↓ frequency decremented

An arrow to the right of the current frequency shows whether the frequency is being incremented or decremented. The search direction can be changed at any time.

- Stop the search temporarily by pressing

ABS or dBm0

- End the search by pressing

TUNE or STEP

Further notes

- The AFC is selected automatically
- If the signal level = threshold (REF) ± 1 dB it is not 100 % certain that the signal will be found.

Signal will be found

- always — REF + 1 dB
- sometimes — REF − 1 dB
- never

- When the SPM-33 finds a signal, its frequency is displayed. The result is subject to the following errors:
  - approx. ±1 Hz when a bandwidth of 25 Hz (100 Hz) has been selected,
  - approx. ±6 Hz when bandwidths of 1.95 or 3.1 kHz have been selected.
- The search speed depends on the bandwidth that has been selected, and whether the averaging facility (AVRG) has been selected.

[AVRG]	Bandwidth		
	25/100 Hz	1.95 kHz	3.1 kHz
on	80 Hz/s	2 kHz/s	3 kHz/s (9 min) *)
off	160 Hz/s	50 kHz/s (32 s) *)	100 kHz/s (16 s) *)

*) Time taken to search the whole frequency range

Table 3-4 Search speed as a function of bandwidth

3.2.3.4. AFC

The AFC adjusts the receive frequency to the input frequency. The AFC only comes into operation when selective measurements are being made and will only function properly if there is a discrete signal of sufficient amplitude in the passband of the selected filter.

AFC cannot be used when the DEMOD mode has been selected!

– you want to quickly tune the receiver to the centre of the filter,
– the signal frequency is fluctuating,
– you want to monitor a signal for a long time

AFC operating range

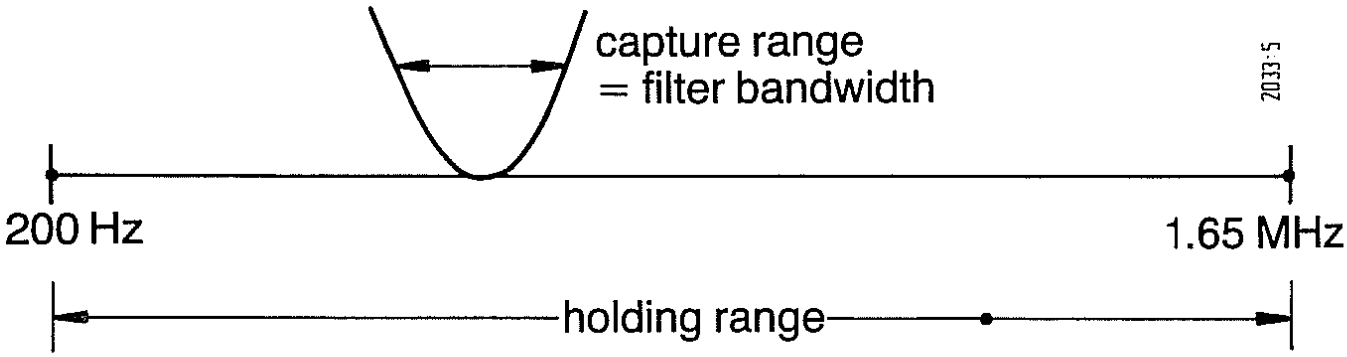
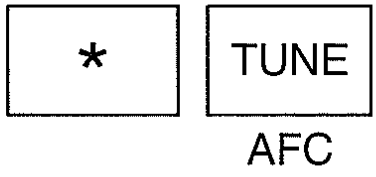


Fig. 3-12 Capture and holding range of the AFC

Switching on the AFC



- Tune the receiver so that the frequency of the signal is within the bandwidth of the filter
- The square beside "AFC" stops flashing when the AFC locks onto a frequency and the receiver is tuned to the signal frequency
- The square beside "AFC" flashes if the AFC has not locked because the signal frequency is outside the capture range
- The AFC will not lock if:
  – the signal frequency is fluctuating rapidly or there are large jumps in the signal frequency (select a larger bandwidth)
  – the signal level is too small

Switching on the AFC

*	TUNE	or
	AFC	

DEMOD	or	WIDE	or	*	DEMOD
					MAX.LEVEL

3.2.4 Bandwidths

Note: A 100 Hz filter option for the SPM-33 can be used to replace the 25 Hz filter (option BN 2033/00.52). The following on the 25 Hz filter applies, mutando mutandis, to the 100 Hz filter.

There is a choice of 3 bandwidths when the selective mode has been selected. If you are in wideband mode you can switch to selective mode by selecting one of these bandwidths (see 3.2.1.1).

4	5	6	(4th row)
25	1.95 k	3.1 k	

To select a new bandwidth, e.g. 3.1 kHz, enter:

*	6
	3.1 k

3.1 kHz bandwidth

This is the same bandwidth as a telephone channel. Using this bandwidth you can measure the power and unweighted noise carried by single telephone channels (see fig. 3-13).

N.B. The 3.1 kHz and 1.95 kHz bandwidths should only be used when the receive frequency is greater than 2 kHz.

This filter corresponds to the 3.1 kHz channel filter, but has a smaller effective noise bandwidth. It is intended for measuring weighted noise. Its noise bandwidth is the same as that of the C-message weighting characteristic (see fig. 3-13).

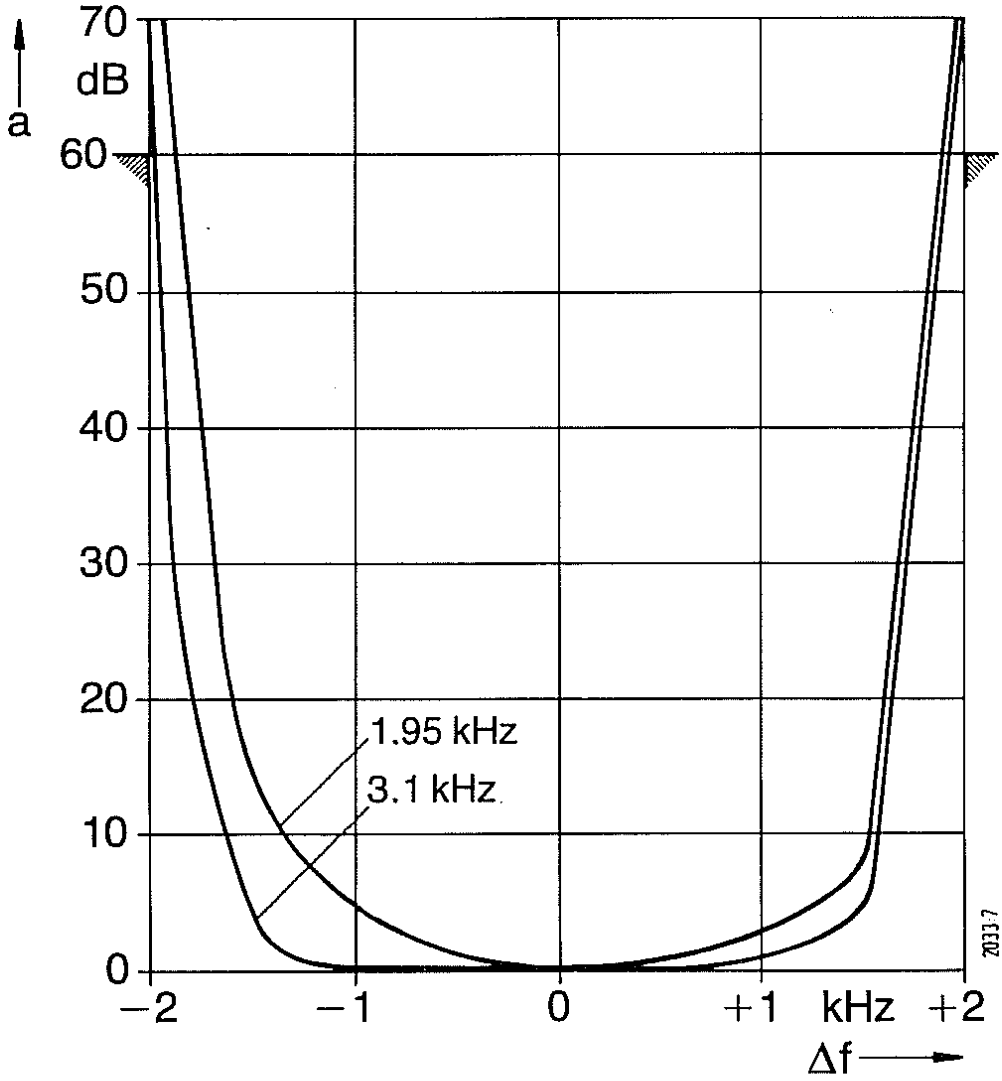


Fig. 3-13 Typical receiver selectivity for bandwidths of 1.95 kHz and 3.1 kHz

If white noise is measured using the 3.1 kHz bandwidth, the result goes down by 2 dB if the 1.95 kHz bandwidth is selected.

25 Hz bandwidth (100 Hz)

This narrow band filter is ideal for analysing signal components that are close together, or for making measurements on noisy signals (see fig. 3-14).

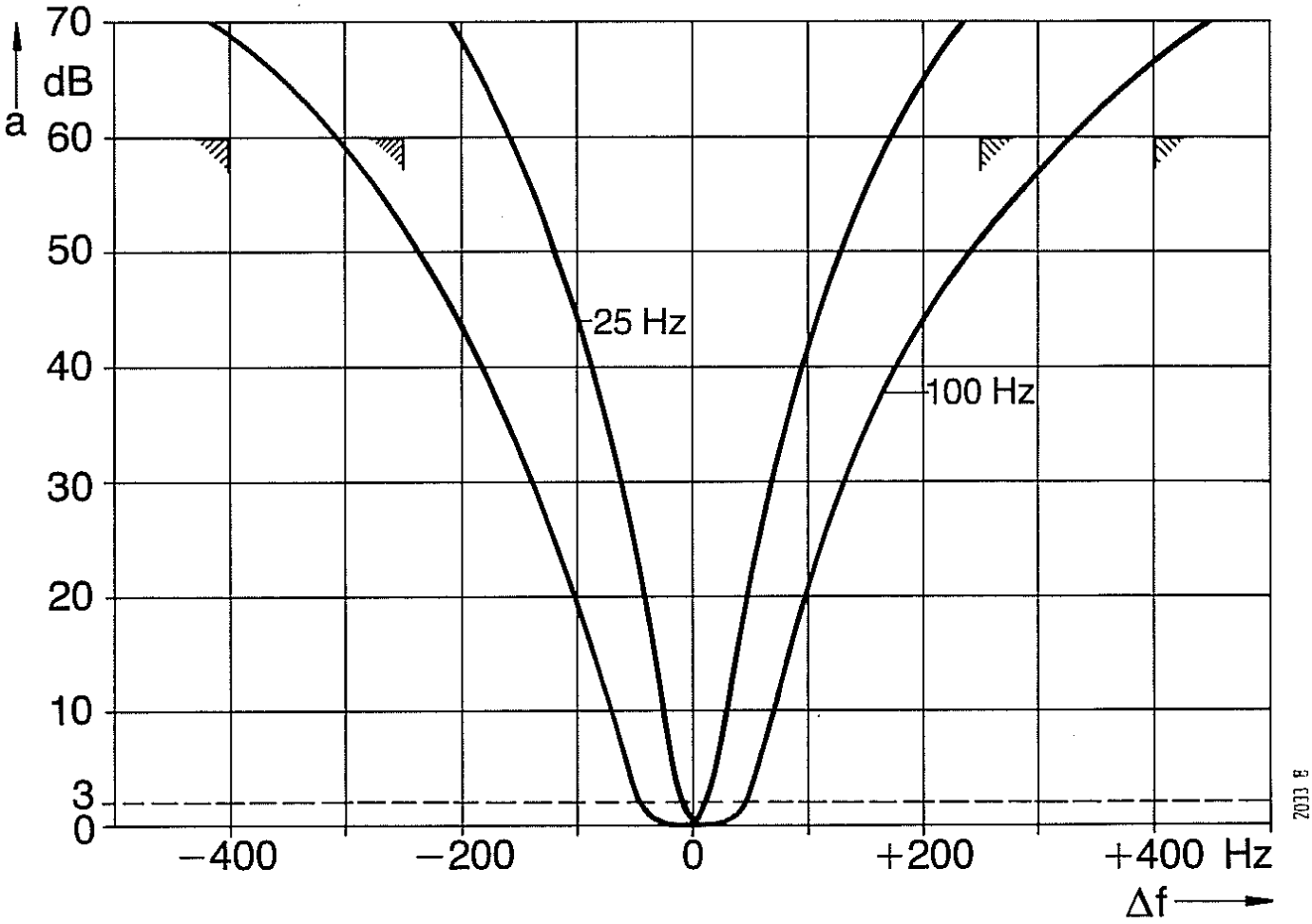
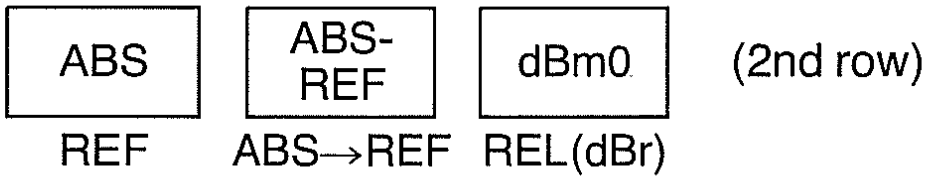


Fig. 3-14 Typical receiver selectivity for bandwidths of 25 Hz and 100 Hz.
(100 Hz instead of 25 Hz, option BN 2033/00.52)

3.2.5 Level mode

The SPM-33's results are shown in terms of an absolute level or a level difference.

quantity may be a reference, i.e. a certain power (dBm) and these are referred to as absolute levels. Relative levels are the difference between two levels.



The SPM-33 can measure the following:
- power levels (ABS) and noise levels
- level differences (ABS-REF)
- levels in dBm0

The following can be entered:
- reference level (REF)
- relative level (REL)

Designation	Result	Constants	Units
Abs. level	ABS		dBrnC/dBm
Level diff.	ABS-REF		dB
Ref. level [1]		REF	dBm
dBm0/dB0	dBm0 (ABS-REL)		dBrnC0/dBm0
Rel. level [1]		REL (dBr)	dBr

1) Constants which are not recalculated when dBrnC/dBm switchover takes place or when a new input impedance is selected.

Table 3-5 SPM-33 level measurements

3.2.3.7 Absolute level (ABS)

Absolute power level (dBm) is the log of a ratio of a power to a reference power (1 mW). When the input impedance is changed, the power dissipated and so the power level is different. The noise level (dBrnC): is the log of the ratio of the noise power to the reference power of 1 pW. The display in dBrnC = result in dBm + 90 dB. Measurement can only be performed using a bandwidth of 1.95 kHz.

The following can be measured,
– the absolute power level in dBm or
– the noise level in dBrnC after:

ABS

Selecting noise level or power level (dBrnC/dBm)

You can toggle between noise level (dBrnC) and power level (dBm) by pressing the following keys:

* –

dBrnC/dBm

- Switchover is only possible if a bandwidth of 1.95 kHz is selected.
- The reference level (REF) and the relative level (REL) are treated as constants and so are not adjusted when a different level mode (dBrnC/dBm) or a new input impedance are selected.

The level difference (ABS-REF) is the difference between the measured absolute level and a reference level (REF). The reference level can be entered as a constant. It is also possible to store a result and use it as the reference level.

The level difference can be measured when the following key is pressed:

ABS- REF

The reference level is shown in line D of the display.

The level difference (dB) = measured absolute level (dBm) – the stored reference level (dBm).

Example:			
	measured level	– 16.3 dBm	(ABS)
	– ref. level	– 26.0 dBm	(REF)
	level difference	+ 9.7 dB	(ABS-REF)

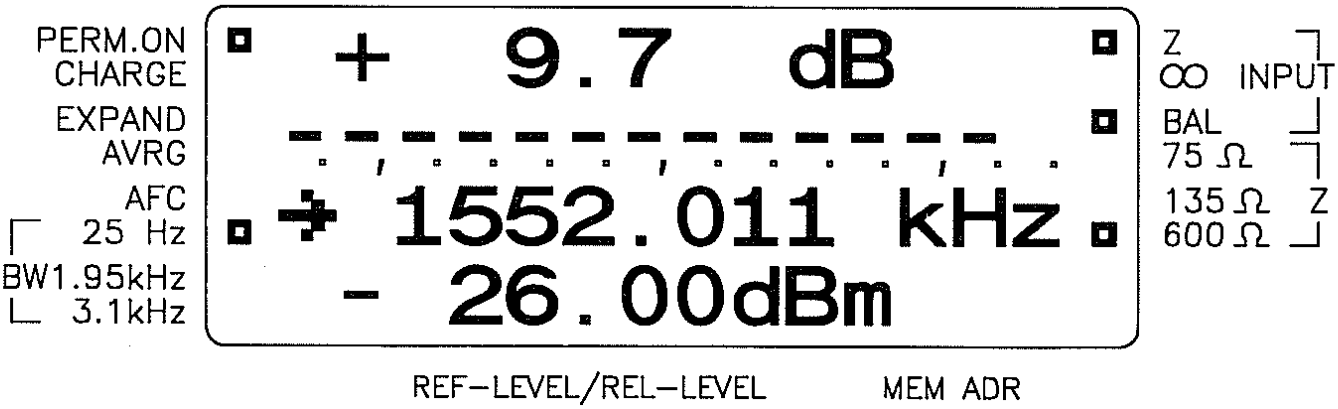


Fig. 3-15 Typical level difference display (ABS-REF), the selective measurement mode has been selected. The reference level is shown in row D of the display. The reference level can be entered after the key sequence [*] [ABS] has been entered. The SPM-33 is precisely tuned to the input signal by means of the up/down keys.

Reference level (REF)

When making level difference measurements the SPM-33 refers the measured absolute level to a reference level (ABS-REF).

The reference level can be set in the following ways:
- By entering a numerical value by means of the digital keypad or by incrementing or decrementing the level by means of the up/down keys.
- By storing a result and using it as the reference level.

Only one reference level can be defined at any one time. However, using the "STO MEM" facility up to 100 setups, and therefore, up to 100 reference levels can be stored.

Entering the reference level as a constant

You can change the reference level after you have entered the following key sequence:

*	ABS
	REF

The current value of the reference level is shown in row D of the display.

You can now enter a new reference level, e.g. −26 dBm:

−	2	6	ENTER

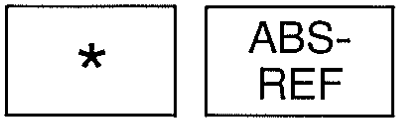
Changing the reference level in steps:

↑ ↑	The reference level is increased by 1 dB
↑	The reference level is increased by 0.1 dB
↓	The reference level is reduced by 0.1 dB

The reference level is reduced by 1 dB

Using a measured level as a reference level

A result is stored as a reference level by entering the following key sequence:



ABS→REF

An "!" appears as an acknowledgement (lower, lefthand corner of display)

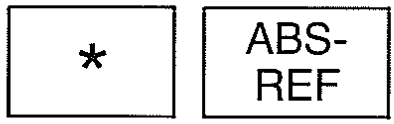
Example: attenuation of a channel filter at 4 kHz

The reference frequency is 1 kHz. One wants to find the difference between the levels measured at 1 kHz and 4 kHz.

- Tune the receiver to 1 kHz (reference frequency):

- Measure the level at 1 kHz

- Store the measured level as the reference



ABS→REF

- Tune the receiver to 4 kHz

- Measure the level difference

ABS-REF

3.2.5.3 Levels in dBm0, relative levels (REL)

Level in dBm0 = absolute level − level in dBr.

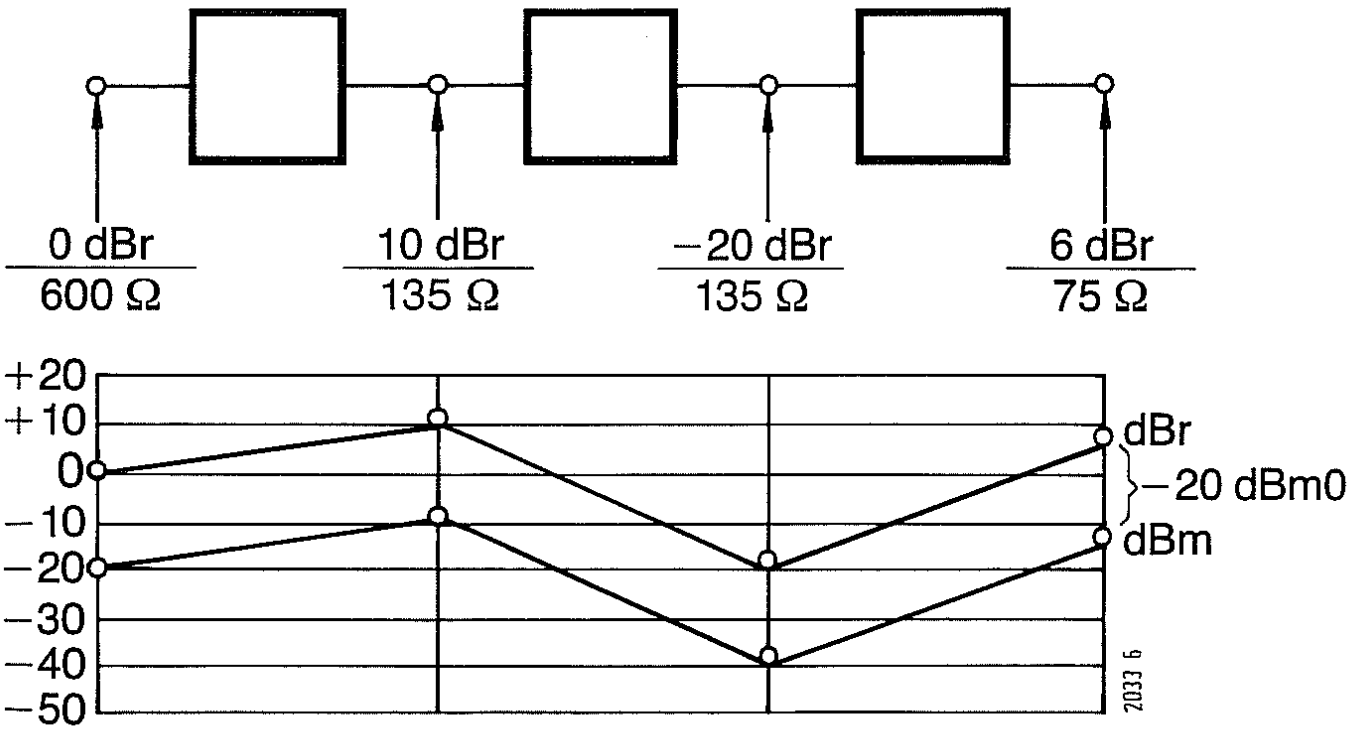


Fig. 3-16 Level plan for a transmission system

At the 0 TLP (0 dBr point) the level in dBm0 is equal to the absolute power level. For other points in the transmission system dBm0 = dBm − dBr. One must only ensure that the correct relative level and the correct input impedance are used for other test points.

The dBm0 mode is selected by entering:

dBm0

Example:			
	Measured level	−64.5 dBm	(ABS)
	− relative level	−15.0 dBr	(REL)
	Level in dBm0	−49.5 dBm0	

When you select "dBrnC" (instead of "dBm") the noise level referred to a 0 dBr point is measured (dB0). The stored reference level is not adjusted when "dBrnC" is selected.

Relative level (REL)

Unlike an absolute level, a relative level is, in fact, the difference in level between any point in a transmission system and the level at a reference point. At the reference point the relative level equals 0 dB (see fig. 3-16).

The relative level is determined by the level plan and so need not be measured. It is entered as a constant.

*	dBm0
	REL(dBr)

- The current value of the reference level is shown in row D of the display. The relative level can be set in the same way as the reference level, (see 3.2.5.2).
- It is only possible to define one relative level at any one time, however using "STO MEM" up to 100 different setups can be stored, thus making it possible to store up to 100 relative level values.

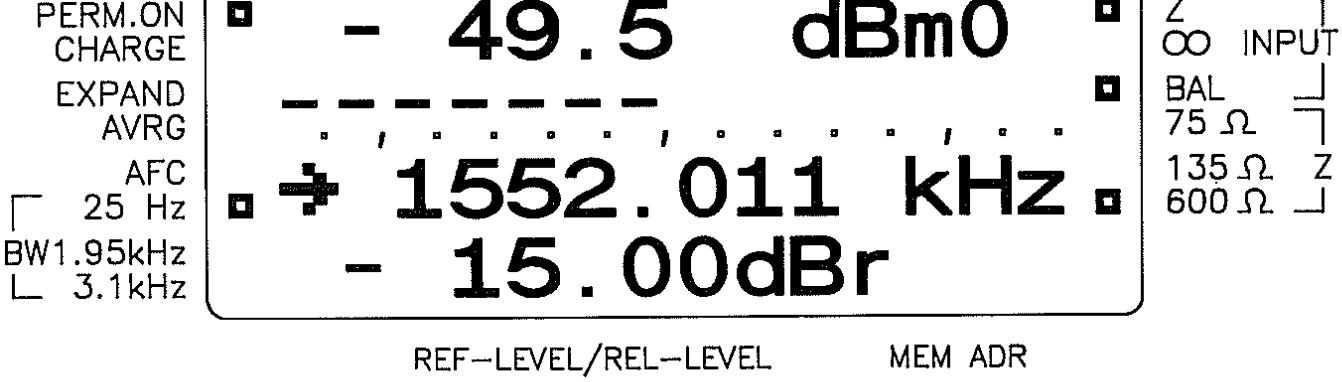


Fig. 3-17 Selective level measurement in dBm0. Row D shows the relative level in dBr (REL). It is entered by pressing [*] and [dBm0]. The receiver can be precisely tuned to the input frequency by means of the up/down keys.

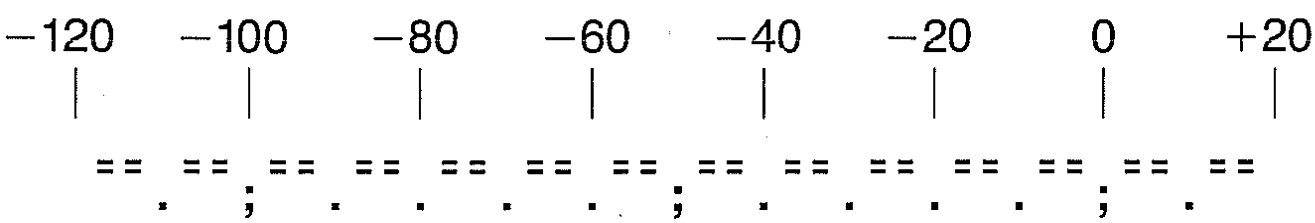
3.2.6 Bargraph, AVRG, MAX.LEVEL

3.2.6.1 Bargraph

The SPM-33 has a bargraph that has certain similarities with a meter display. The eye can interpret changes in the length of the line quicker than it can for a purely digital display.

Normal scale

Scale: 10 dB (or dBm or dBrnC) per division



Example: a display of −75 dBm:

Scale: 1 dB/div.

The expanded scale can be selected or cancelled by entering the sequence:

*	7	(3rd row)
	EXPAND	

The expanded scale is a relative scale and should be thought of as folding back onto itself. The display increases or decreases by ±10 dB at −11 dB or +1 dB (hysteresis to prevent display jitter at 0 or −10 dB). In other words, only the relevant section of an expanded display is shown.

n * 10 dB + ...

```
...  −10  −9  −8  −7  −6  −5  −4  −3  −2  −1   0  dB
       |   |   |   |   |   |   |   |   |   |   |
==  ==;==  ==  ==  ==  ==;==  ==  ==  ==  ==;==
  .   ;  .   .   .   .   ;  .   .   .   .   ;  .
```

Example: Result = −23.5 dB:

−20 dB −3.5 dB

```
==  ==;==  ==  ==  ==  ==;==  =
  .   ;  .   .   .   .   ;  .   .   .   .   ;  .
```

3.2.6.2 Display averaging (AVRG)

The SPM-33 has an averaging facility for rapidly fluctuating signals, it can be switched on and off by entering the following sequence:

*	8	(3rd row)
	AVRG	

The averaging facility has the following effects:

- The time constant of the rectifier is increased
- The current level shown by the display is calculated from the following formula:
  Display value = (7 * old value + new value) / 8
- The display resolution is increased from 0.1 dB to 0.01 dB.

3.2.6.3 MAX. LEVEL

The MAX.LEVEL facility is a special display with a very long decay time constant. It lets you measure the level of a keyed signal (fig. 3-18).

MAX.LEVEL can be selected or cancelled by entering the following key sequence:

*	DEMOD	(2nd row)
	MAX.LEVEL	

MAX.LEVEL can also be selected for level measurements.

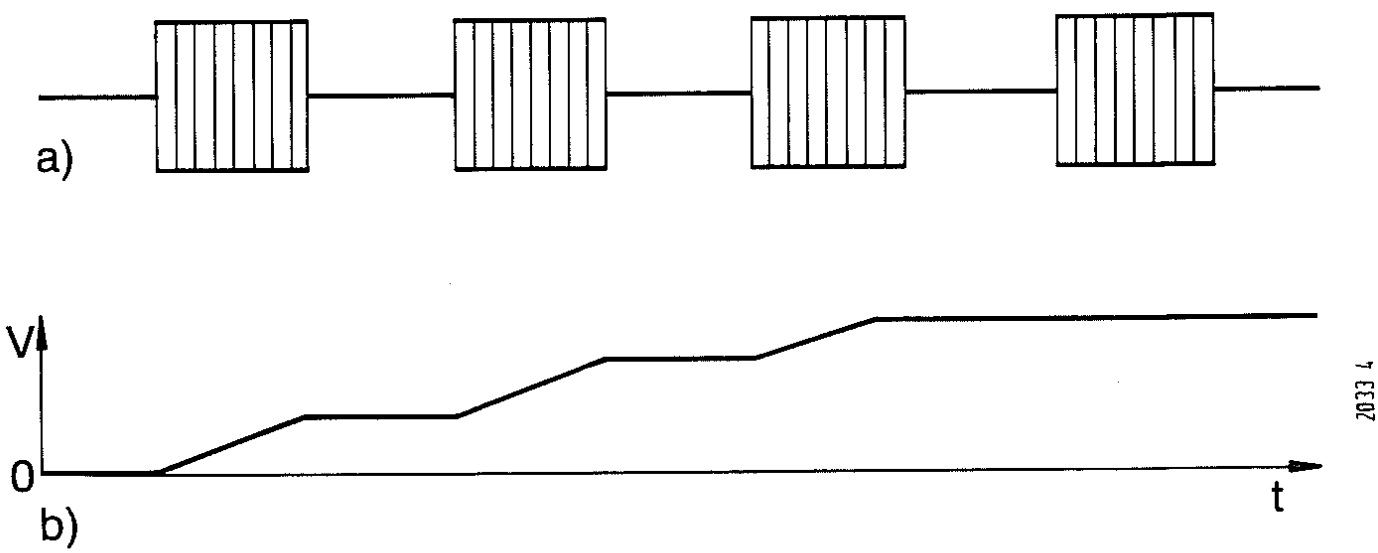


Fig. 3-18 Measuring the rms level of a keyed signal
a) signal, b) result

techniques are used.
– Single tone keying
– Double frequency shift keying

The latter method is used to-day.

The set should be tuned to the centre of the channel; the 25 Hz bandwidth should be selected (option BN 2033/00.52: 100 Hz instead of 5 Hz). The spectrum is so wide that the channels can only be compared (qualitative measurement).

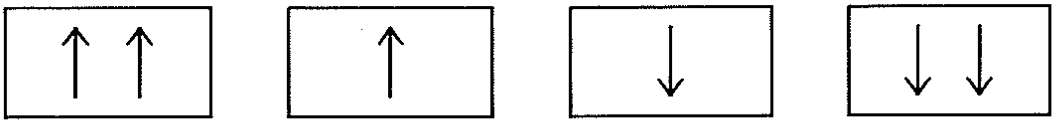
The max. rms power of the spectrum within the passband of the filter is shown. This rms value is of short duration under certain circumstances.

When normal data traffic is being carried (random signal distribution) the amplitude fluctuations are so large that MAX.LEVEL must be used to make the measurements. The 511 bit text to CCITT V.52 is a suitable pseudorandom signal for test purposes.

The MAX.LEVEL display mode is not suitable for measuring the rms value of signals whose amplitude fluctuates, e.g. noise. The AVRG facility should be used in such cases.

3.2.7 Storing setups (MEMORY)

The SPM-33 can store up to 100 complete setups which can be recalled when required. The current result is also stored when the setup is stored. As it is possible to display stored setups, without using them for measurements, the memory can also be used as an electronic notebook.



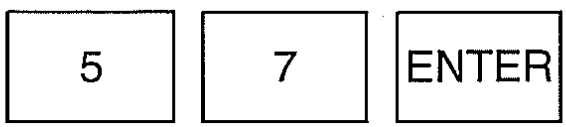
RCL MEM	Recalls stored setup
STO MEM	Stores current setup and latest result
DISPLAY MEM	Displays a setup stored in memory
MEM OFF	Cancels the current memory function

3.2.7.1 Addresses

Addresses, 0 to 99, are used to store setups. One setup can be stored at each address.

When STO MEM, RCL MEM or DISPLAY MEM are selected, an address number is displayed in the lower righthand corner of the display. The arrow to the right of the displayed address means that the address number can be altered.

- Entering an address number via the digital keyboard, e.g. 57



The ENTER key terminates the entry.

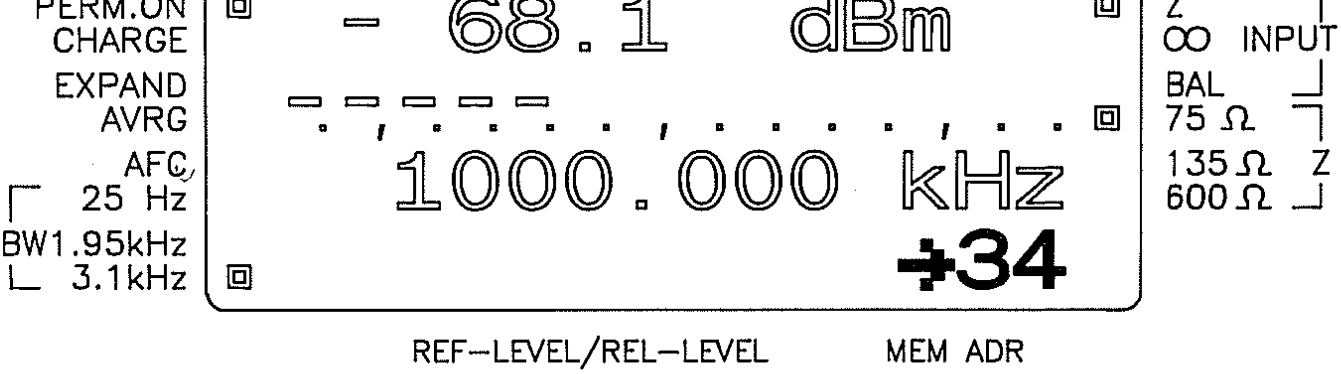


Fig. 3-19 Typical display when RCL MEM is selected. The address, in this case 34, can now be modified.

- Incrementing or decrementing the address number:

↑ ↑	Address is increased by 5
↑	Address is increased by 1
↓	Address is decreased by 1
↓ ↓	Address is decreased by 5

The repeat mode is selected if any of these keys are held down.

3.2.7.2 Storing a setup (STO)

Storing a setup, at address 25, for example.

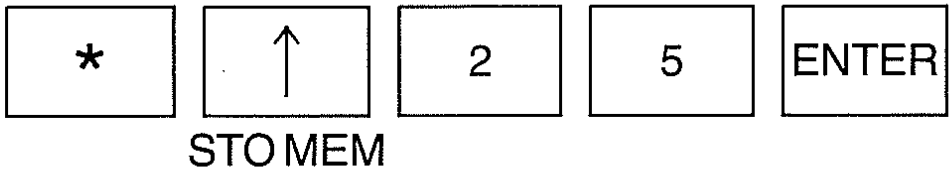
*	↑	2	5	ENTER
STO MEM				

- When STO MEM has been selected by pressing [*] and then [↑], "STO" and an address number are shown in the display (they flash on and off alternately)
- The address number can be modified using the up/down keys, or a new address can be entered via the digital keypad.
- When you press [ENTER] the setup and the current result are stored at the displayed address.
- Entry is acknowledged by "!STO" which appears in the lower righthand corner of the display.
- If you store a setup at an address where a setup has already been stored, the old setup will be overwritten. You can determine beforehand whether an address is free or not by using DISPLAY MEM (see 3.2.7.3).
- To quit the memory mode press [*] and then [↓↓], (MEMORY OFF).
  You can also quit the memory mode by pressing any function key, e.g. [TUNE] or [DEMOD].

Storing results

When a setup is stored, the current result is also stored. These results can be viewed later using the DISPLAY MEM function. In effect, the SPM-33 can be used as an electronic notebook, which not only tells you what settings you have used but also the results.

Example showing how three results are stored, the initial address is 25. The setup selected is always the same. The initial address is entered by means of the digital keypad. The address number can then be incremented by means of the [↑] key.

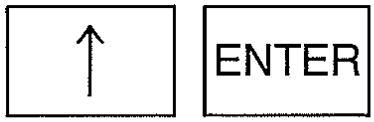


STO MEM

2nd result:

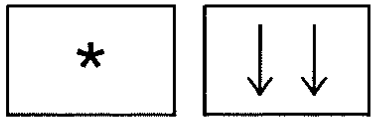
(address 26)

3rd result:



(address 27)

Quit the memory mode by entering:

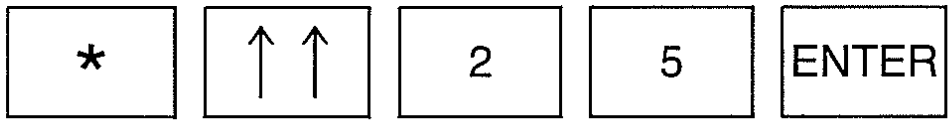


MEM OFF

3.2.7.3 Setup recall (RCL)

You can recall a stored setup as often as you want from memory. When you press [ENTER] the SPM-33 is set to the recalled setup and the measurement is started immediately.

Recalling a setup, e.g. stored at address 25



RCL MEM

- After selecting the RCL MEM mode by entering [*] and then [↑↑], an address number is displayed in the lower righthand corner of the display.

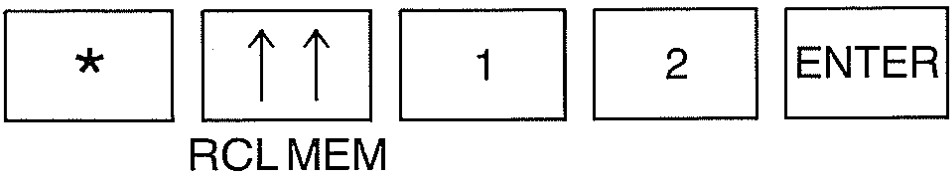
- The address number can be modified using the up/down keys or by entering a new address number via the digital keypad (as described in 3.2.7.1).
- When [ENTER] is pressed, the SPM-33 is set to the recalled setup and the instrument starts measuring.
- An exclamation mark to the left of the address number (e.g. "!25", acknowledges the previous procedure.
- You can quit the memory mode by pressing [*] and then [↓↓], "MEM OFF".
  You can also quit memory mode by pressing any other function, key, e.g. [TUNE] or [DEMOD].
- If you attempt to recall a setup at an address at which nothing has been stored, the standard setup is set (selective measurements at f = 8 kHz).

Calling up several setups

To recall a sequence of stored setups, you do not need to reselect the RCL MEM function each time.

Example: Recalling three setups, the initial address being 12. The first address is entered via the digital keypad. It is then possible to modify this address using [↑] (increment = 1).

1st setup



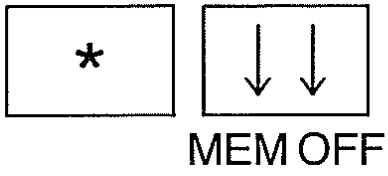
2nd setup:

(the address is increased by 1 to 13)

3rd setup:

(the address is increased by 1 to 14)

Quitting the memory mode

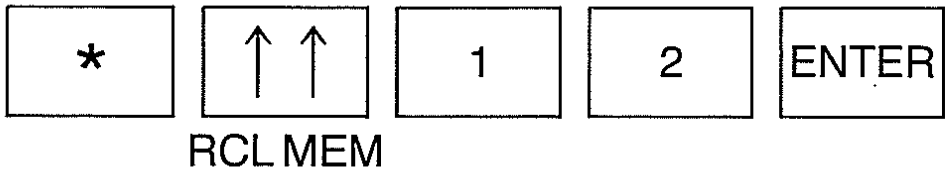


Bringing stored results up to date

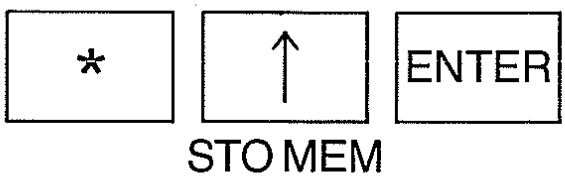
Stored results and setups can be updated by recalling the setup and storing it at the same address after a measurement has been made. The setup itself is unchanged. Later the new results can be viewed by means of DISPLAY MEM.

Example: updating results, starting at address 12:

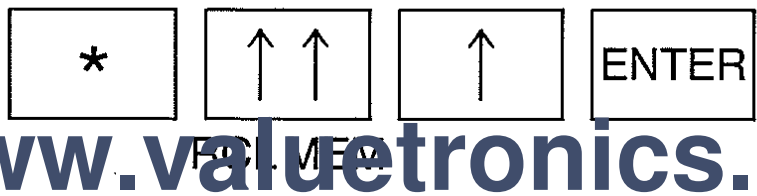
- Recall setup at address 12:



- Make measurement and then re-store:



- Increment address by 1 and recall setup:



or

RCL MEM

↑	*	↑ ↑	ENTER
		RCL MEM	

- etc.

3.2.7.4 DISPLAY

Stored setups can be viewed with the DISPLAY MEM function. This gives you

– an overview of the memory contents
– a way of reading off the results stored with the setups.

If nothing is stored at a particular address, "FREE" is shown in the display.

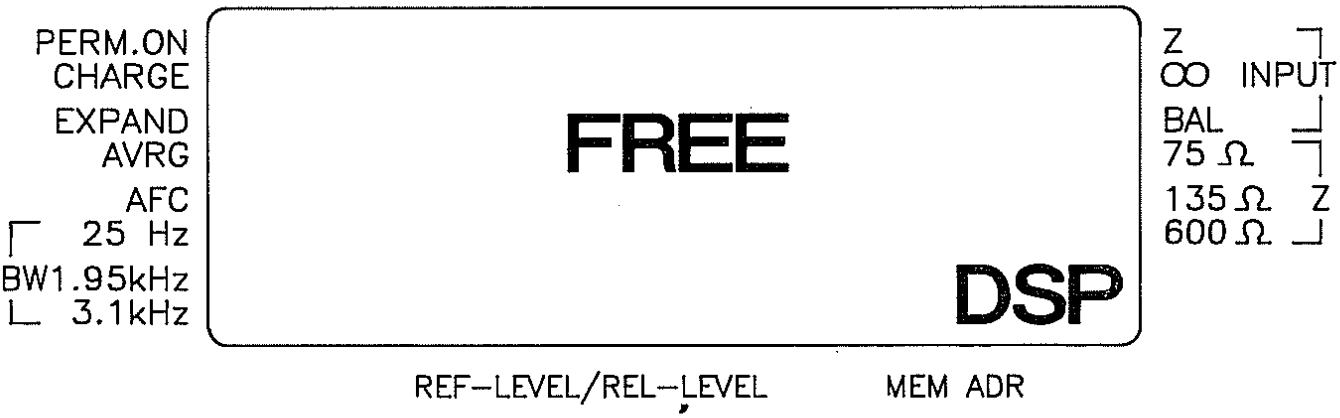


Fig. 3-20 DISPLY MEM display, address is unoccupied. "DSP" and the address number flash on and off alternately

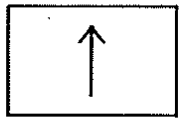
Example illustrating how to check what is stored at address 0:

1st setup:

*	↓	0	ENTER
DISPLAY MEM			

- After you have selected DISPLAY MEM by entering [*] and then [↓], "DSP" and "0", the address number, flash on and off alternately.
- If you alter the address number using the up/down keys, you do not need to press [ENTER], as this key is disabled.

2nd setup:



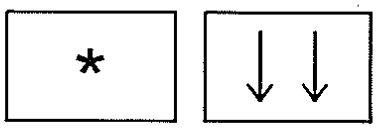
(address increased by 1 to 1)

3rd setup:

(address increased by 1 to 2)

The whole memory can be examined quickly in this way.

The display mode is switched off by entering:



MEM OFF

The SPM-33 is set to the last setup and starts measuring.

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