marconi instruments

# 2382/2380

## 100Hz-400MHz SPECTRUM ANALYZER AND DISPLAY

## Operating Manual

PROVISIONAL

Operating Manual

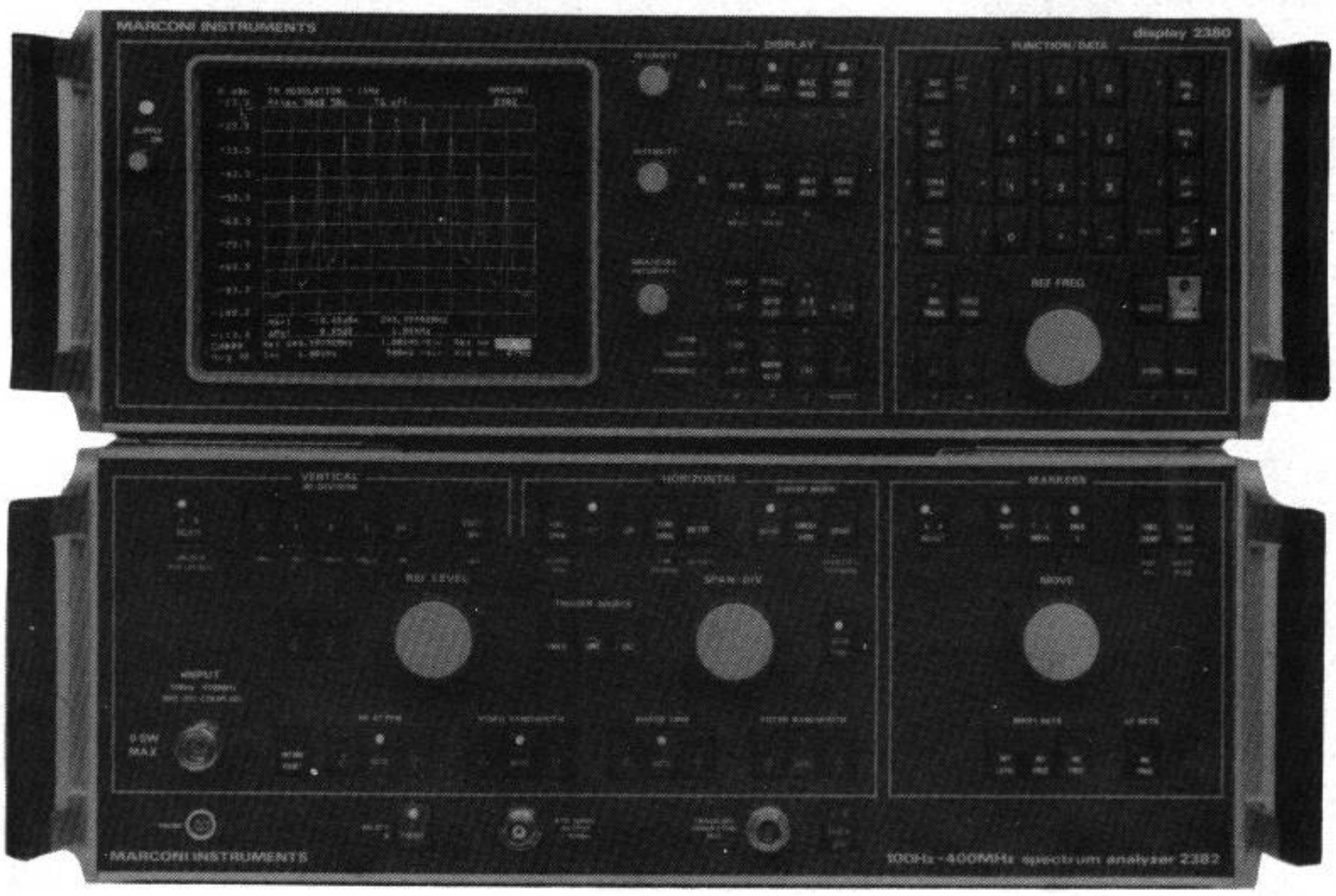
H 52382-900A
Vol. 1

# 100 Hz - 400 MHz SPECTRUM ANALYZER and DISPLAY

## 2382/2380

Comprising:

**100 Hz - 400 MHz Spectrum Analyzer Type 2382**
(Code No. 52382-900A)
and
**Display Type 2380**
(Code No. 52380-900E)





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## CONTENTS

**PRELIMINARIES**



**CHAPTERS**



These chapters are contained in a separate volume available as an optional accessory.

**HAZARD WARNING SYMBOLS**

The following symbols appear on the equipment:

| Symbol | Type of hazard | Reference in manual |
|---|---|---|
| ⚠ | Static sensitive device | Page (iv) |
| ⚠ | Dangerous voltages present | Page (iii) |
| ⚠ | Supply voltage | Page (iii) |

Note ...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am. 2 etc.). The title page always shows the amendment status of the manual. New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus ▶.....◀ to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

# NOTES AND CAUTIONS

## ELECTRICAL SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class 1. It has been designed and tested according to IEC Publication 348, ´Safety Requirements for Electronic Measuring Apparatus´, and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

### Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

### Removal of covers ⚠

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be allowed to discharge through the bleed resistors fitted for the purpose; do not attempt to remove the safety covers from the power supply until the lamp under the top cover stops blinking. Should the unit be reconnected to the supply with the safety covers removed and then disconnected, do not attempt to discharge the power supply unit´s main reservoir capacitors using a shorting link as the equipment may be damaged. Discharge should always be allowed to occur gradually.

Note also that the 12 kV e.h.t. circuit for the cathode ray tube retains its charge for a considerable time after switch off. Therefore before any handling is carried out in the vicinity of the cathode ray tube or e.h.t. unit it is essential that the supply is disconnected from the instrument and the final anode lead is shorted to the chassis several times immediately after unplugging. The residual charge on the c.r.t. itself must also be removed by shorting the anode connection to ground.

### AC supply plug ⚠

The supply plug shall only be inserted in a socket outlet provided with a protective ground contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous.

**Fuses - primary and secondary**

Note that there is a supply fuse in both the line and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

A number of secondary fuses are fitted to boards in the upper and lower units. For details of both primary and secondary fuses refer to Performance data - Chap. 1.

**CAUTION: STATIC SENSITIVE COMPONENTS**

Components identified with the symbol ⚠ on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by yellow discs, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disc or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with a grounded conductive surface.

Metallic tools grounded either permanently or by repeated discharges.

A low-voltage grounded soldering iron.

A grounded wrist strap and a conductive grounded seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

(4) If using a freezer aerosol in fault finding, take care not to spray programmable ICs as this may affect their contents.

**WARNING: HANDLING HAZARDS**

This equipment is formed from metal pressings and, although every endeavour has been made to remove sharp points and edges, care should be taken, particularly when servicing the equipment, to avoid minor cuts.

**Cathode ray tube:** When exposing or handling the cathode ray tube care must be taken to prevent implosion and possible scattering of glass fragments. Handling should only be carried out by experienced personnel and the use of safety mask and gloves is recommended. A defective tube should be disposed of in a safe manner by an authorized waste contractor.

**WARNING: TOXIC HAZARD**

Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should therefore be taken in the disposal of these items.

# Chapter 1

## GENERAL INFORMATION

CONTENTS

CONTENTS (continued)



## FEATURES

### General

1. The 2382 Fig. 1 is an exceptionally versatile general purpose spectrum analyzer for use from 100 Hz up to 400 MHz. Although simple to operate it has many functions which make it an indispensable tool in research, development, production, installation, commissioning and maintenance. It analyzes signals by separating them into their frequency components and the power or voltage level of each is displayed as a function of frequency, on a c.r.t. Further facilities such as the display of a modulated signal, the recovery of a modulating signal, the provision of a tracking generator etc. are also available.

2. The design of the 2382 incorporates many original and sophisticated features. This extends its application in areas such as :

- Testing of h.f. and v.h.f. transmitters and receivers
- Interference monitoring

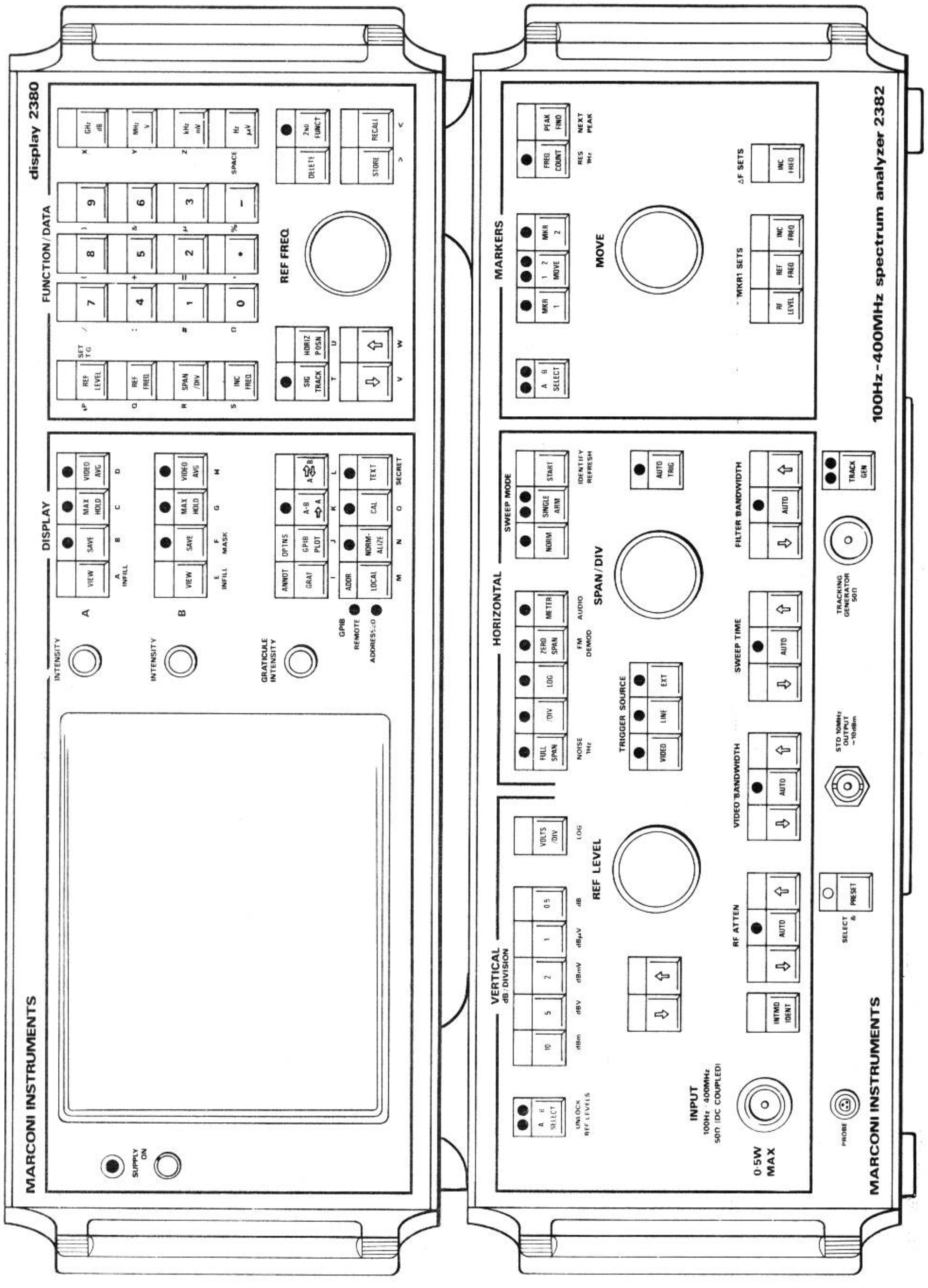


Fig. 1 The 100 Hz - 400 MHz Spectrum Analyzer

- Surveillance
- Signal source purity measurements
- Commissioning communication systems
- PCM and FDM system measurements
- Measurements on CW, FM, and AM signals including :

  non-linear modulation
  hum sidebands
  spurious FM on AM
  carrier frequency
  modulation frequency
  deviation/modulation depth

- Displaying the characteristics of active and passive networks - filters, amplifiers etc.

3. The instrument is a microprocessor controlled swept tuned analyzer of the superheterodyne type. It comprises a lower unit (2382) containing a frequency synthesizer and swept receiver, and an upper unit (2380) containing the display, digital processing and power supply. The c.r.t. has a viewing area of 140 mm x 110 mm. A minimum of multifunction front panel controls have been used for simplicity and ease of operation.

4. The display is scaled in both frequency and amplitude for absolute and relative measurement - advanced circuit design, digital error correction and automatic self calibration give a reference level accuracy of ±1 dB.

5. For optimum control the operator may set the reference frequency, span, and reference level using either a keypad or dedicated rotary controls. Full GPIB talk and listen facilities are also provided.

## The display

6. Two memory stores designated A and B record the display, and the content of either or both stores refreshes the horizontally scanned TV type raster. The graticule, having 10 x 10 major divisions and five vertical and horizontal minor sub-divisions, is electronically generated and the A and B traces can be displayed against this background. The two traces A and B, and the graticule, have separate brightness controls to highlight one trace against the other or against the graticule lines. In addition each trace may be infilled or outlined, according to user preference, to clarify the picture when the signal is particularly complex. All these ensure that the display is clear and easy to interpret and if the 'Options' board is fitted it can be shown in colour on an RGB video monitor by coupling this into a socket at the rear of the 2380.

7. The A and B traces have independently variable reference levels and vertical scales. The levels relating to each are displayed adjacent to the major graticule lines; those for the A trace are on the left hand side of the screen and those for the B trace on the right hand side. Main control settings are indicated as screen annotations not only for ease of operation but also to provide an unambiguous photographic record if required. The display can be protected from being overwritten by using the 'SAVE' mode. Additional information can be typed into a text area at the top of the screen

using the Display keys. When appropriate, readout of numerical keypad entries, menu selections, prompts, warnings and error messages are also displayed.

**The ´preset´ mode**

8. A feature which is especially helpful to first time users is the ´preset´ mode. When this mode is selected certain keys are automatically set to produce an ´initial´ display. These keys are identifiable on the front panel; they have green lettering. The instrument can however be set to switch on in any chosen setting according to operator preference. This is a feature of the store/recall mode.

**The six mode horizontal scale**

9. The frequency scale of the display can be viewed in six different modes - full, per div., meter, log, zero span and FM DEMOD. The full span mode is used to identify signals. By rotating the REF FREQ control a dashed vertical line on the screen can be moved to locate a required spectral line and the frequency of that signal is then displayed at the bottom of the graticule area. The ´per div.´ mode can be used to ´zoom´ into that signal for a more detailed inspection. It can be displayed at the centre, at the left or at the right hand side of the screen as required. When METER is selected the signal is displayed at the centre of the screen in the form of a vertical bar-chart readout.

10. In ´log´ mode, frequency is displayed on a logarithmic scale. One to seven decades are available ranging from 100 Hz to 1 GHz.

11. The ´zero span´ mode is used for recovering modulating signals or real time monitoring of a single signal - for settling times etc. In this mode the analyzer acts as a fixed tuned receiver with selectable bandwidths. Amplitude demodulated signals can therefore be displayed on the screen against a time axis. The signals can also be heard by using the integral loudspeaker or by plugging headphones into a connector at the rear of the RF unit. A second function of ´zero span´ enables FM deviation to be displayed and measured against a time axis in the same way.

12. For ease of operation, in the ´auto´ mode, filter bandwidth, sweep time and video bandwidth are set automatically to give optimum resolution at each choice of frequency span. Span can be varied from a full 400 MHz down to 100 Hz; 200 MHz to 100 Hz in a 1,2,5 sequence. Resolution bandwidths are available from 1 MHz down to 3 Hz in a 1,3,10 sequence. The minimum bandwidth 3 Hz filter with a shape factor of less than 11:1 ensures that line related sidebands may be resolved without being masked by the limitation of the filter.

**Amplitude measurements**

13. High sensitivity is achieved by careful r.f. and i.f. amplifier design, the measurement range being from -150 dBm to +30 dBm with an accuracy of ±1 dB at any frequency and at all levels. The vertical scale is switchable in 1,2,5 steps from 10 dB/div. (a 100 dB display) down to 0.5 dB/div. and amplitudes can be resolved to 0.01 dB.

14. Facilities have been included to measure signal levels with respect to 1 mW, 1 V, 1 mV and 1 µV by changing the vertical scale from its preset mode of dBm to dBV, dBmV, or dBµV. In addition relative measurements in dB can be

made. Frequency response is ±0.4 dB for r.f. attenuation of 10 dB or more on all displayed ranges.

15. Voltage ranges are available on a linear or a logarithmic display. Linear ranges extend from 100 nV/div. to 500 mV/div. in a 1,2,5 sequence on a 10 division graticule; log. ranges from 100 nV to 10 V (top of scale) in a 1,10,100 sequence on a two and a half decade graticule.

**Markers**

16. Using a rotary control on the front panel, markers can be steered across the trace, providing amplitude and frequency readouts on either the A or B display. Alternatively, by key control, a marker can be immediately directed to the peak of the largest signal on the display, and then to subsequent peaks as required. The amplitude and frequency of each peak is clearly displayed.

17. For closer inspection of an identified peak, it can be positioned at the dashed reference frequency line and at the top of scale reference level ready for further analysis by use of the MKR 1 SETS, REF FREQ and REF LEVEL keys. Frequency can be measured to an enhanced resolution of ±1 Hz if required by using RES 1 Hz (2ND FUNCT then FREQ COUNT). The 'signal track' mode is useful in this instance as it maintains the signal at the centre of the screen against the effects of possible drift - intermediate sweeps are taken in order to achieve stability.

18. A second marker enables the difference in level and frequency between two signals to be measured, for example when displaying modulation sidebands, intermodulation products or harmonic distortion.

**Further highlights**

19. Although information is provided in much greater detail in Chap. 3 - 'Front panel control functions' there follows a very brief description of some of the more significant features of the 2380/2382 not yet discussed.

20. **Store/recall.** Nine sets of instrument mode settings can be permanently stored and recalled as required.

21. **Small signals.** Low level signals which are often obscured by noise can be measured very effectively by either video filtering, video averaging or by reducing input attenuation. The former requires a very slow sweep to achieve results but when using video averaging, changes in noise smoothing can be seen almost immediately enabling the low level signals to be identified and measured with speed and accuracy.

22. In an unscreened environment the c.r.t. can be switched off entirely whilst a sweep is taken and stored. This reduces electro-magnetic radiation to a minimum and enables a low level signal measurement to be made more accurately. Subsequently the display can be switched on again to observe the readings.

23. **Limit mask.** Using the data keypad and terminator keys, upper and lower limit boundaries can be entered into the 'B' store and displayed on the screen to provide a go/no go limit mask. This can be employed to check the frequency response of a filter, for example, against upper and lower limits overlaid upon it.

24. **Tracking generator.** The integral tracking generator produces a signal whose frequency precisely tracks the spectrum analyzer tuning in all scan modes. On full span the frequency range is therefore 100 Hz to 400 MHz, accurate to within ±1 Hz of the tuned frequency.

25. The tracking generator can be used to provide the sweeping signal for measuring the response of a filter or crystal etc. Output level is controllable from -9.7 to -20.3 dBm in 0.1 dB steps and a 'normalize' feature is provided to compensate for frequency response errors introduced by the test fixture, connecting leads and the analyzer itself.

26. **Intermodulation products.** Normally, in the 'auto' mode, the r.f. attenuator is set to give optimum dynamic range by maintaining the signal level at the input to the first mixer such that internally generated intermodulation or distortion products, produced by the non-linear behaviour of the input mixer, do not appear greater than the noise level. When the r.f. attenuator is controlled manually however overloading can occur and distortion products can be produced.

27. A simple key operation (INTMD IDENT) identifies these products quickly and easily thereby giving increased confidence in measurements. If the amplitude of some of the displayed peaks changes when the key is operated these are the intermodulation or distortion products. If amplitudes do not change there is no distortion present.

28. **Overload protection.** The maximum input signal level which can be applied without fear of damage is +27 dBm (0.5 W) but the instrument is protected against accidental application of overload power up to +47 dBm (50 W) by means of a latching relay which operates even if the instrument is turned off. An indication that an overload has occurred is given by the word 'OVERLOAD' appearing on the screen and, if the 'OPTIONS' board is fitted, an audible sound being emitted from a beeper. Providing the overload is no longer present the latching relay can be reset by pressing a specific key on the front panel.

## More detail

29. Complete information on all the features of the 2382, some of which are listed below, are in Chap. 3, Front panel control functions.

- Max hold
- Incremental keys
- Trace exchange
- Trace arithmetic
- The pen plot option
- Meter mode
- Identify refresh
- Secret key

- Single shot
- Triggering

30. External standard, setting internal standard, probe, and standard 10 MHz output are covered in the introductory paragraphs of Chap. 3.

31. One of the most important features of this analyzer is that it can be operated remotely via the GPIB, full details of this facility are given in the GPIB Operating manual (H 52382-900A Vol. 1A).

## PERFORMANCE DATA

### 32. FREQUENCY

**Measurement range**

100 Hz to 400 MHz in 1Hz steps set by means of keypad, dedicated rotary control or dedicated REF FREQ keys. Usable down to 50 Hz.

**Frequency span**

| | |
|---|---|
| FULL SPAN | 0 to 400 MHz spanning the 10 division display, selected by FULL SPAN key. |
| /DIV | 10 Hz/div to 20 MHz/div in a 1,2,5 sequence and 40 MHz/div selected by means of keypad or dedicated rotary switch. Displayed accuracy ±1% of separation frequency, ±1% of full span. |
| LOG | 1 to 7 decade logarithmic display. User selects Start and Stop frequencies (decade values only) and instrument selects filter bandwidths and sweep speeds for each decade for optimum display. For optimum display refresh, the highest frequency decade is swept first. Displayed accuracy ±5 N% where N is the number of decades selected. |
| ZERO SPAN | Displays the amplitude modulation of any signal at the current reference frequency against a time axis. See Sweep section for specification. |
| METER | Selection of this mode executes a single sweep and leaves a 'bar chart' type display at the screen centre, whose amplitude indicates the instantaneous signal level at that frequency. Measurement frequency changed with MARKERS MOVE control. For frequency accuracy, see Marker section. |
| FM DEMOD [2nd FUNCT ZERO SPAN] | Displays the instantaneous frequency deviation of a single sinusoid against a time axis. This signal must be free from significant amplitude modulation since filter slope detection is used as the discriminator. See Sweep section for specification. |

**Frequency standard**

| | |
|---|---|
| Internal standard | The internal standard is a TCXO type with zero warm-up time. |
| Temperature stability | Better than ±2 parts in $10^6$ over $0^0$C to $50^0$C. |
| Aging rate | Less than ±1 part in $10^6$ per year. |
| External adjustment | The Internal standard can be adjusted by means of a rear panel preset (SET INT STD). The annotation INT STD is shown in reverse video on the display when the internal standard has been adjusted. |

para. 32 (continued)

External standard input
EXT STD

System will automatically switch to an external standard if a signal of 1,2,5 or 10 MHz is applied at a level of between -15 dBm and +15 dBm. The frequency must be within ±1 part in $10^6$ for the system to lock. The annotation EXT STD is shown on the display when lock is achieved.

Input connector

50 Ω BNC female.

**Reference frequency**

FULL SPAN

A dashed vertical line may be moved across the display by operation of the keypad, REF FREQ rotary control or ↓↑ keys. The frequency of any signal on the display can be read to a resolution of better than 1 MHz. This facility permits signal selection made in this mode to be displayed at the reference frequency in any subsequent /DIV selection.

/DIV

Reference frequency can be positioned at the centre, left hand or right hand side of the display by operation of the HORIZ POSN key, the appropriate vertical graticule line being dashed to indicate this state. The value of the reference frequency can be read from the screen annotation to a resolution of ±0.2% of span and to an accuracy of ±[(Freq. std. error x Ref. freq./10 MHz) +2% of selected sweep span + oscillator drift] Hz. See 'Stability' for oscillator drift figures. This mode is also selected by operation of the PRESET key.

LOG

The reference frequency rotary control is inoperative in this mode.

ZERO SPAN, METER & FM DEMOD

Frequency accuracy as for /DIV mode but no allowance is needed for oscillator drift.

SIG TRACK

A signal at the reference frequency of the display is tracked. The tuning of the instrument is adjusted after every sweep to cancel out any drift in the signal being analyzed. The only restrictions are that the signal must be positioned sufficiently far up the skirt of the response to ensure capture and that the signal drift is not so fast that the response drifts off the display in one sweep interval. Operates only in HORIZ POSN centre mode.

If the frequency span is rapidly reduced a single sweep will be taken at appropriate intermediate values so as not to lose track of the signal.

## Markers

Markers measure the frequencies of points on the display in FULL SPAN, /DIV and METER horizontal modes.

[A B SELECT] — Key toggles to place the markers on either the A or B trace.

[MKR1], [1 2 MOVE] & [MKR2] — A dedicated rotary control permits a marker to be positioned anywhere on the selected A or B trace. The screen annotation displays the frequency of the marker to the resolution and accuracy of the reference frequency above. If both Marker 1 and Marker 2 are displayed, additional screen annotation shows the value of frequency difference between them to the same accuracy as in the Frequency Span /DIV mode.

[FREQ COUNT] — The frequency of any spectral line viewed on the screen may be measured by moving the marker to the signal of interest. The resolution of the screen readout is ±10 kHz on spans greater than 200 kHz/division, ±1 Hz on spans of less than 200 Hz/division and ±100 Hz for all other spans. Accuracy as for Frequency Standard. Restrictions are that the selected filter must have a 3 dB bandwidth greater than 0.2% span; that only one signal is present in this bandwidth and that the marker must be at least 20 dB out of the noise up the filter skirt.

[RES 1HZ] (2nd FUNCT FREQ COUNT) — As for FREQ COUNT except resolution is 1 Hz for all spans.

[PEAK FIND] — Marker 1 positions itself on the peak of the largest signal on the display and annotation gives this frequency to /DIV accuracy. This value may be transferred to the reference frequency or the incremental frequency by use of the MKR1 SETS keys.

[NEXT PEAK] (2nd FUNCT PEAK FIND) — A similar function to PEAK FIND except that the marker moves to successively lower amplitude peaks up to a maximum of 9 peaks.

[MKR1 SETS REF FREQ] — Operation of this key sets the reference frequency to that of the Marker 1 frequency.

[MKR1 SETS INC FREQ] — Operation of this key sets the incremental frequency step to be that of the Marker 1 frequency.

[ΔF SETS INC FREQ] — Operation of this key sets the incremental frequency step to be that of the difference between Marker 1 and Marker 2 frequencies.

para. 32 (continued)

**Resolution**

| | |
|---|---|
| Resolution bandwidths | Twelve filters with 3 dB bandwidths of 3 Hz to 1 MHz in a 1,3,10 sequence. Optimally selected for chosen span in AUTO mode or manually selected by dedicated ↓↑ keys. Refer to Fig. 2. |
| Accuracy | 3 dB points within ±20% of their nominal value apart from the 1 MHz filter which is +0% -30%. |
| Shape factor | All bandwidths have a skirt selectivity for 60 dB/3 dB points of less than 11:1. All filters (apart from the 1 MHz filter) are synchronously tuned five pole Gaussian shaped filters.<br>1 MHz filter shape factor is less than 5:1. |

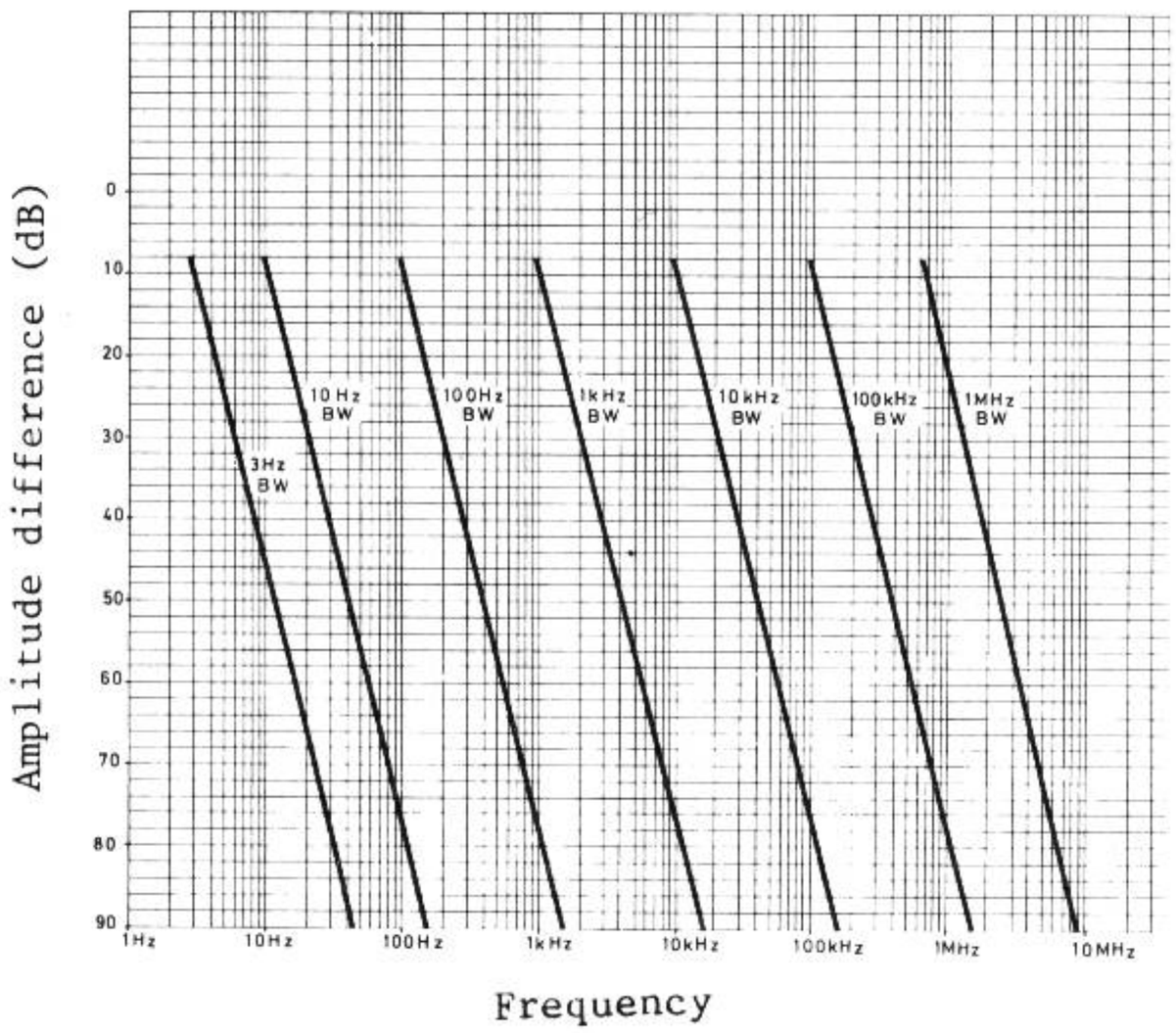


Fig. 2 Typical spectrum analyzer resolution

**Stability**

| | |
|---|---|
| Residual FM | Less than 1.5 Hz peak-to-peak during a 10 s period for spans narrower than 20 kHz, resolution bandwidth of 30 Hz or less and video bandwidth of 43 Hz or less. |
| Drift | After a 1 hour warm-up the LO drift rate is as follows:<br><br><10 Hz/min at 10 Hz/div. increasing to<br><20 Hz/min at 2 kHz/div.<br><500 Hz/min at 5 kHz/div. increasing to<br><1 kHz/min at 200 kHz/div.<br><50 kHz/min at 500 kHz/div. increasing to<br><100 kHz/min at 40 MHz/div. |

para. 32 (continued)

The drift is not cumulative; the oscillators are reset every 10 seconds or during each sweep retrace, whichever is the longer.

**Spectral purity**

Coherent sidebands — Better than -83 dBc using 3 Hz filter.
(** UNDER REVIEW**)

Displayed noise sidebands — At 100 MHz:

| Offset from carrier | Displayed noise (normalized to 1 Hz bandwidth) |
|---|---|
| 100 Hz | <-90 dBc |
| 300 Hz | <-95 dBc |
| 20 kHz | <-100 dBc |

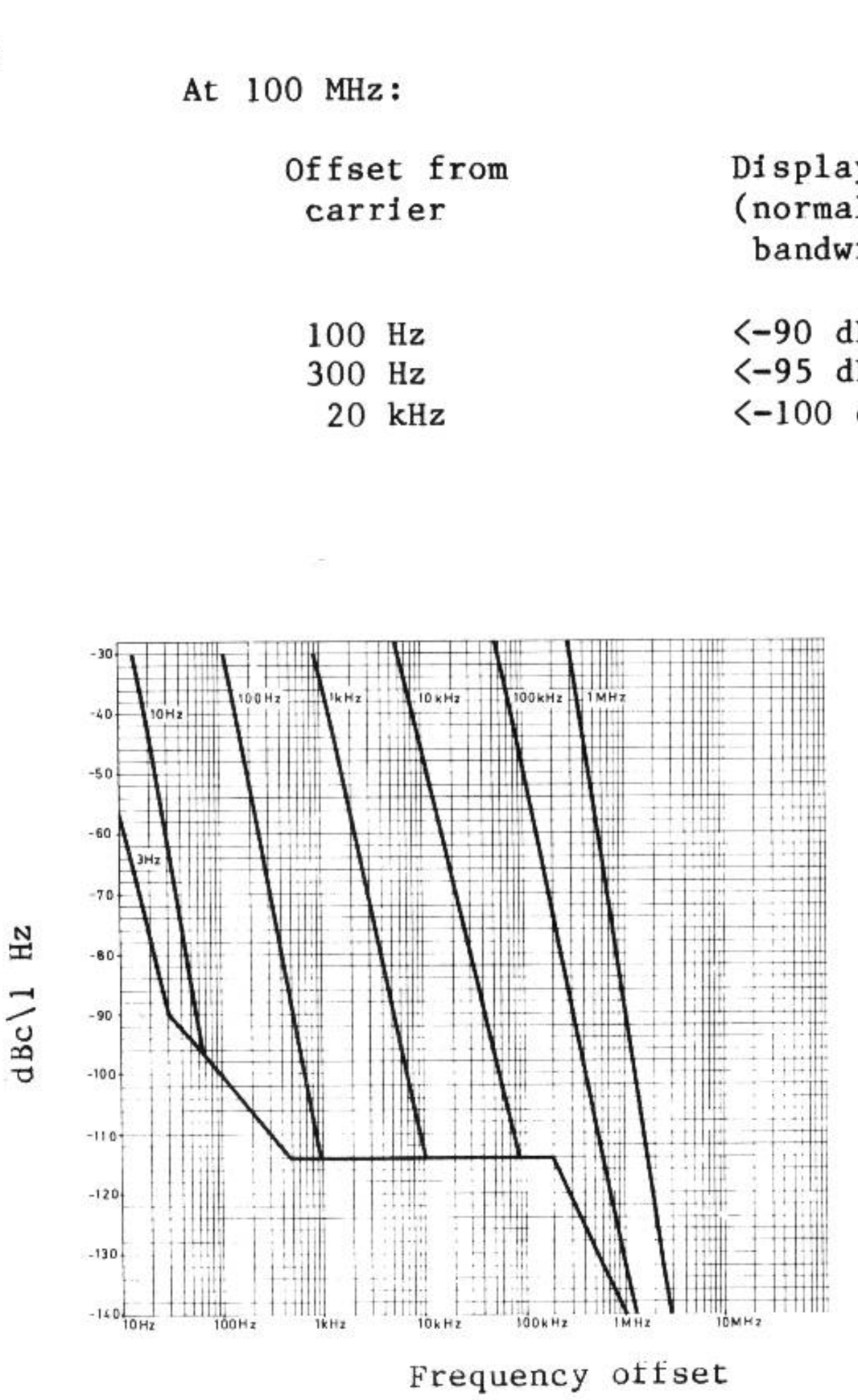


Fig. 3 Typical SSB noise vs offset from carrier

33. **AMPLITUDE**

**Measurement range** — -150 dBm to +30 dBm; 100 nV/div to 500 mV /div. Overload protected to +47 dBm (50W) by means of a latching relay which can be reset using INTMD IDENT key.

para. 33 (continued)

Input protection may be overridden if required by means of an unlabelled second function for use on pulsed r.f. signals. Input is protected when instrument is switched off.
Two channels of display, A and B, may be selected so that either can display any compatible range, at any reference level, with separate annotation down each side of the display.

**Displayed range**

The A and B displays can be independently set to give any of the ranges listed:

dB/DIVISION

| | |
|---|---|
| 100 dB at | 10 dB/div. |
| 50 dB at | 5 dB/div. |
| 20 dB at | 2 dB/div. |
| 10 dB at | 1 dB/div. |
| 5 dB at | 0.5 dB/div. |

Range selection is by means of dedicated keys and can be made on both live or stored displays. Expansion is around the reference level at the top of the graticule.

VOLTS/DIV

On stored displays, one vertical scale higher and one vertical scale lower may be recalled and displayed.

LOG VOLTS
(2nd FUNCT VOLTS/DIV)

Electronic graticule is changed to give two and a half decades of logarithmic display calibrated at each decade boundary in units of volts.

**Display fidelity**

dB/DIVISION

Departure from true logarithmic relationship less than 0.3 dB anywhere over the top 80 dB of the display.
Typically less than 0.05 dB per dB.

VOLTS/DIV

Linearity of display less than ±2% f.s.d.

LOG VOLTS

Departure from true logarithmic relationship less than ±3% of measured value anywhere over the display.

**Reference level**

dB/DIVISION

-150 dBm to +30 dBm in 0.025 dB (average) steps or equivalent in dBV, dBmV or dBµV. The level may be set with either the keypad, dedicated rotary control or the dedicated ↓↑ REF LEVEL keys. A dB relative mode sets the top of the

para. 33 (continued)

screen to a zero reference for measurements of relative amplitude. The reference is retained even when REF LEVEL or dB/DIVISION is changed. The A and B reference levels are normally locked together but they may be unlocked so that the reference levels may be independently set.

The REF LEVEL ↓↑ keys operate in 10 dB steps.

The rotary control operates in increments according to the dB/DIVISION scale selected; minimum resolution is 0.025 dB with 0.5 dB/DIVISION scale.

Accuracy — ±1 dB at any frequency, i.f. gain setting, r.f. attenuator setting and filter bandwith providing that the coupled control settings are not overridden.

VOLTS/DIV — 100 nV/div to 500 mV/div in a 1,2,5 sequence on a 10 division graticule, selected by means of the keypad or ↓↑ REF LEVEL keys.

Accuracy — ±12.5% at the selected reference frequency for any i.f. gain setting, r.f. attenuator setting and at any permitted filter selection but ±25% at other frequencies.

[CAL key pressed at the reference frequency prior to making a measurement].

LOG VOLTS/DIV — Two and a half decades of logarithmic display covering top of screen values of 100 nV to 10 V.

Accuracy — ±12.5% for any frequency, i.f. gain setting, r.f. attenuator setting and at any permitted filter selection.

**Frequency response** — On all displayed ranges, the frequency response is ±0.4 dB for r.f. attenuations of 10 dB or more and ±0.5 dB for 0 dB r.f. attenuation.
Typically -3 dB at 50 Hz.

**RF Input**

Connector — 50 Ω 'N' type female to MIL-C-39012C, d.c. coupled.

Reflection coefficient — Less than 0.10 (1.22 v.s.w.r., 20 dB return loss) for r.f. attenuator settings of 10 dB or more.

Less than 0.18 (1.44 v.s.w.r., 15 dB return loss) for r.f. attenuator setting of 0 dB.

para. 33 (continued)

Local oscillator leak — Typically less than -95 dBm at any frequency and any r.f. attenuator setting.

**Markers**

Markers measure the amplitude of points on the display in FULL SPAN, /DIV, LOG, ZERO SPAN and METER horizontal modes.

A B SELECT — Key toggles to place the marker on either the A or B trace.

MKR1, 1 2 MOVE & MKR2 — A dedicated rotary control permits a marker to be positioned anywhere on the selected A or B trace. The marker measures the amplitude at that point to a resolution of 0.025 dB and the annotation displays the value to two decimal places. Accuracy as specified in Reference Level above. If both Marker 1 and Marker 2 are displayed, additional screen annotation shows the value of the dB difference between them to an accuracy appropriate to the selected amplitude range.

MKR1 SETS REF LEVEL — Sets the reference level to be the same as the Marker 1 level, thus positioning the chosen response at the top of the display with the scale annotation altering appropriately.

PEAK FIND — The selected marker moves to the peak of the largest signal displayed on the selected A or B display. NEXT PEAK is also available, refer to Markers part of FREQUENCY section.

NOISE 1 Hz (2ND FUNCT FULL SPAN) — The displayed noise amplitude is corrected and normalized to a 1 Hz noise power bandwidth.

**Dynamic range**

Harmonic distortion — With a sinusoidal signal at -42 dBm at the input mixer*, any internally generated harmonic distortion product will be greater than 80 dB down on the fundamental. Refer to Fig. 4 for other levels.

* Press INTMD IDENT key to read input mixer level relative to reference level.

para. 33 (continued)

| | |
|---|---|
| Non-harmonic distortion | With a sinusoidal signal at -42 dBm at the input mixer*, any internally generated non-harmonic distortion products will be greater than 75 dB down on this signal. |
| Display | 100 dB. |
| Third order inter-modulation | -95 dBc for on-screen signals using the 3 Hz filter at -42 dBm at the input mixer.* Refer to Fig. 4 for other levels. |

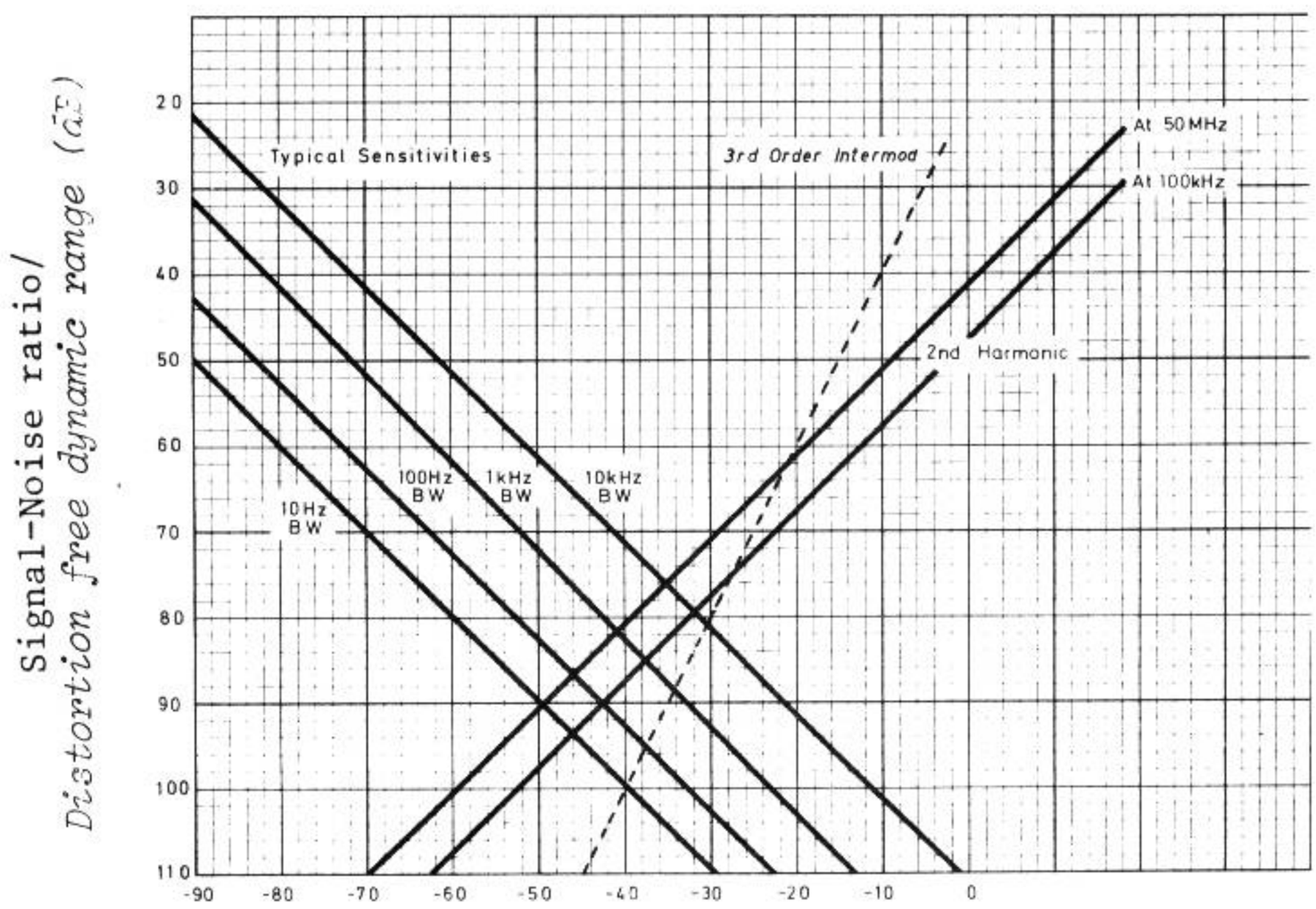


Fig. 4 Optimum dynamic range

| | |
|---|---|
| Residual responses | All residual responses, less than -120 dBm at 0 dB r.f. attenuation. |
| Equivalent input noise sensitivity | -135 dBm (typically -145 dBm) for reference frequencies greater than 150 kHz using 3 Hz filter. Refer to Fig. 5 for other filter bandwidths. |

*Press INTMD IDENT key to read input mixer level relative to reference level.

para. 33 (continued)

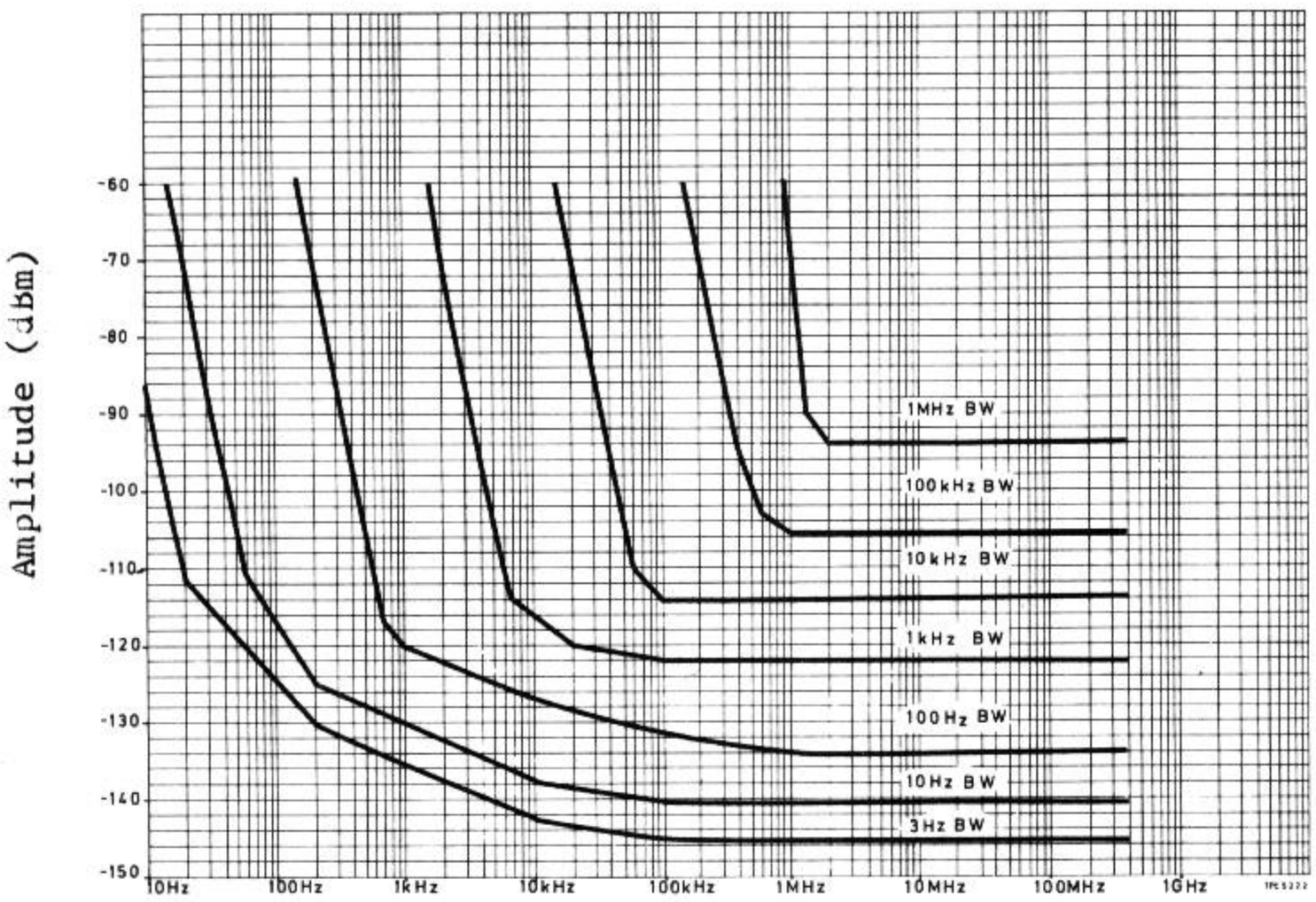


Fig. 5 Typical sensitivity vs input frequency

**Tracking generator cross-coupling**

With the Tracking Generator switched on and both the input and the Tracking Generator output terminated in 50 the displayed noise level in a 3 Hz bandwidth is not greater than -125 dBm from 150 kHz to 400 MHz.

VIDEO BANDWIDTH

When Auto mode is selected the detected signals are optimally digitally processed to give the equivalent of analogue video filtering to smooth the noise level; the equivalent video bandwidth is shown on the display. The bandwidth may be changed either by dedicated keys or by changing the Sweep Time if Auto mode is selected. The video bandwidth range is 1 Hz to 50 kHz.

VIDEO AVG

Two keys are used to select sweep-to-sweep averaging on either or both A and B traces. 2 to 128 sweeps (binary intervals) may be averaged; menu selection is used. The display indicates the number of sweeps elapsed since the mode was selected. Available on FULL SPAN and /DIV horizontal modes.

para. 33 (continued)

34. **SWEEP**

**Trigger source**

| | |
|---|---|
| VIDEO | Sweep is triggered by the detected envelope of the input signal within the frequency range 10 Hz to 300 kHz. Mark-to-space ratio to be in the range 10:1 to 1:10. Conditions for triggering depend on the VERTICAL scale selected. |
| dB/division | Detected signal must be within 20 dB of top of screen reference level and have a peak-to-peak displayed amplitude of at least 10 dB. |
| Volts/div. | Detected signal must occupy at least 1 major graticule division. |
| Log volts/div. | Detected signal must be above the first major graticule line, and have a peak-to-peak displayed amplitude of at least half a major division. |
| LINE | Sweep is triggered by power line frequency. |
| EXT | Sweep is triggered by external signals from the rear panel EXT TRIG BNC connector over the range 50 mV p-p up to 100 V p-p from 10 Hz to 300 kHz. Input impedance 3 MΩ shunted by 60 pF. |
| Polarity | Triggering is normally derived from the positive-going edge but negative-going edge triggering may be selected by pressing 2ND FUNCT prior to the trigger source key. |

**Trigger mode**

| | |
|---|---|
| AUTO TRIG | Sweep free runs in absence of a trigger. In the presence of trigger signals at a rate in excess of 10 Hz the sweep will trigger normally. |

**Sweep mode**

| | |
|---|---|
| NORM | Sweep re-arms after each retrace. Operation of the key during a sweep will abort that sweep and leave the sweep ready to be retriggered. |
| SINGLE ARM | Arms the sweep so that it runs on the next trigger and executes a single sweep. |
| START | Triggers a sweep; operation during a sweep will abort that sweep and start a new sweep.<br><br>If EXT TRIGGER SOURCE and AUTO mode is selected, with no external signal applied, the sweep will run immediately on pressing the START key. |

para. 34 (continued)

**Sweep time**

/DIV

AUTO or ↓↑ keys select sweep times of 10 ms/div. to 20s/div. in a 1,2,5,10.. sequence. Accuracy as for Frequency Standard.

ZERO SPAN

AUTO or ↓↑ keys select real time sweeps from 20 s/div to 10 ms/div and sampled sweeps from 5 ms/div to 5 µs/div.
Accuracy as for Frequency Standard, resolution is ±0.2% of full scale.

In ZERO SPAN, the vertical scale has the same units and range as the previous /DIV setting.

FM DEMOD
(2nd FUNCT
ZERO SPAN)

Filter skirt detection is employed to display six divisions of frequency deviation vertically against time horizontally.

Vertical sensitivity from 3 Hz/div. to 30 kHz/ /div. in a 1,3,10 sequence, set by FILTER BANDWIDTH ↓↑ keys.

Display accuracy

Deviation Accuracy at zero deviation rate ±20% f.s.d. ±1 Hz. Bandwidth depends on selected filter - refer to Fig. 6 for typical performance.

Fig. 6 (to be supplied)

## 35. TRACKING GENERATOR

| | |
|---|---|
| Frequency Range | 100 Hz to 400 MHz. |
| Accuracy | ±1 Hz referred to the tuned frequency. |
| Amplitude | -9.7 dBm to -20.3 dBm in 0.1 dB steps set from the keypad using SET TG [2ND FUNCT REF LEVEL]. |
| Accuracy | ±0.5 dB at -10 dBm at 10 MHz. |
| Frequency response | ±0.35 dB at -10 dBm. |
| Harmonic distortion | All harmonics are greater than 30 dB down on the fundamental signal. |
| Non-harmonic distortion | All spurious signals are greater than 30 dB down on main signal. |
| Residual signals | All residual signals are less than -70 dBm with Tracking Generator off. |

**Tracking generator output**

| | |
|---|---|
| Connector | 50 Ω N type female to MIL-C-39012C. |
| Reflection coefficient | Less than 0.10 (1.22 v.s.w.r., 20 dB return loss). |

## 36. DISPLAY

**Display size** — 140 mm x 110 mm.

**Trace** — Two memory stores (designated A and B) each having a horizontal resolution of 500 data points and a vertical resolution of 250 data points, record the trace data. The contents of either or both stores are used to refresh a scanned raster display (15,664 Hz line frequency, 48.2 Hz frame frequency) and are added to an annotated electronic graticule. Each of the facilities (A display, B display and graticule) have separate intensity controls and are available as monochrome or RGB colour drives for video monitors. (Video output is an additional option).

| | |
|---|---|
| [VIEW] | Displays the contents of the selected memory. |
| [SAVE] | Stops the selected memory from being refreshed. |
| [MAX HOLD] | Retains the maximum signal level recorded at each memory location for as long as it remains active. Not available in ZERO SPAN and FM DEMOD modes. |

para. 36 (continued)

| | |
|---|---|
| INFILL (2ND FUNCT VIEW) | Permits either or both displays to be infilled instead of the normal outline representation. This can be used to highlight the difference between the two traces on A and B displays. |
| GRAT | Key toggles to switch the electronic graticule off or on. |
| ANNOT (2ND FUNCT GRAT) | Key toggles to switch the annotation on the display off or on. |
| A-B→A | Takes the A and B channels and displays the difference as trace A.<br><br>In dB/DIVISION mode the annotation is changed so that the centre of the vertical scale is equal to the difference between the A and B reference levels. In LOG VOLTS/DIV the difference is displayed about the '1' graticule line. |
| A↔B | Exchanges A and B memory contents. |
| CAL | Starts an automatic self- calibration sequence to optimize measurement accuracy and cancel any temperature drift.<br>All the resolution filters are adjusted to set their centre frequency and gain. Each step of the r.f. attenuator and the overall frequency response is measured and stored for error correction of all subsequent measurements.<br>The calibration routine initially takes about 30 seconds and disables the instrument during this time. Subsequent calibration routines are faster depending on the degree of change since the last calibration occurred. A "calibrated" message appears on the screen when the instrument is in a calibrated state. To ensure quoted accuracy CAL should be pressed after the controls have been set. |
| NORMALIZE | When using the Tracking Generator, with FULL SPAN, /DIV and LOG horizontal mode, this facility permits the normalization of the display to allow for the loss or gain and frequency response in an external network as well as for that in the instrument. This allows for precise measurements of the device under test. Any network with a response within the displayed range of the instrument may be normalized. |

## 37. REMOTE OPERATION (GPIB)

Complies with the following subsets as defined by IEEE 488-1978 standard and IEC publication 625-1 : SH1,AH1,T5,L4,SR1,RL1,PP0,DC1,DT1,C0 and E1. All front panel facilities (except INTENSITY, SUPPLY and Marker 2 functions) are remotely programmable. Information can be written to or read from the display stores. REMOTE and ADDRESSED states are indicated by front panel lights.

**User accessible display**

Complete control of displayed text in two modes: text overlaying normal display in main screen mode; dedicated display giving full visual display unit facilities in alternative screen mode.

**Service requests**

The 2380 may be programmed to request service for the following conditions:
Error condition detected
Calibration state change
End of sweep
Any front panel key press on the display unit
Data available.

**Transfer formats**

Complies with IEEE 728-1982.

Trace data

ASCII : 502 point read of A or B trace using NR2 numeric data format.
Binary : 502 point read/write from/to A or B trace, read/write from/to instrument setting store and read/write from/to A or B trace (saved display store) using a block data format.

Display settings — Binary : 198 byte block transfer.

Instrument settings — Binary : 238 byte block transfer.

**Transfer times**

Trace data

ASCII : 1.5 s typical for 502 point transfer.
Binary : 600 ms typical for 502 point transfer.

Display settings — Binary : 100 ms typical for 198 byte block data transfer.

Instrument settings — Binary : 630 ms typical for 238 byte block data transfer.

These times are for an HP Series 200 controller using standard transfer techniques.

**GPIB PLOT**

The 2380 can be set to talk directly to an HP-GL compatible plotter to obtain a comprehensive hard copy print of traces with annotation. Both major and minor graticule lines may be plotted. Menu selection is used so that the user can select the parts of the display to be plotted, the pen colours to be used and the pen speed. The following

subset of HP-GL commands is used: DP,LB,LT,PA,PD,PR,PU,SC,SM,SP,SR,UC and VS.

## 38. OTHER FEATURES

**STORE**

Used with a single numeric key (1 to 9), this permits up to nine sets of front panel control settings to be stored in non-volatile memory for subsequent recall. Menu selection enables the titles of selected settings, entered with the TEXT key, to be shown. The title defaults to display the reference frequency if text is not added. Stores may also be protected to prevent accidental overwriting.

**RECALL**

Used with a single numeric key, this permits the instrument controls to be set to a previous configuration stored earlier at that location. Control settings stored in STORE 1 will be automatically recalled whenever the instrument is switched on.

**TEXT**

When this key is pressed the front panel keys become alphanumeric keys permitting a caption to be placed across the top of the display.

**SECRET** (2ND FUNCT TEXT)

Key toggles to remove the reference frequency annotations from the display to prevent unauthorized viewing of the operating frequencies.

**INTMD IDENT**

Used to identify any internally generated intermodulation or distortion when using the dB/DIVISION mode. Operation of this key applies 3 dB more r.f. attenuation and adds 3 dB more i.f. gain. It also causes the input mixer level relative to the selected reference level to be displayed. If the trace is unaltered when this key is pressed, then any intermodulation being generated in the instrument is not significant to the measurement.

**SELECT & PRESET**

Operation of this key is equivalent to pressing all keys with green lettering so that it sets the instrument to 10 dB/div., 0 dBm reference level, 40 MHz/div., 200 MHz reference frequency, AUTO modes, Tracking Generator OFF etc. If the input has been overloaded, operation of this key will clear the latched protective state unless the overload is still present.

para. 38 (continued)

| | |
|---|---|
| [MASK] (2ND FUNCT SAVE B) | Enables user to enter upper and lower frequency and level limits from the keyboard into the B store, which can be overlaid upon the A display to produce a go/no go calibration.<br><br>A menu prompts the operator to enter the required limits for each corner of the mask. Up to 8 maximum levels and frequencies and 8 minimum levels and frequencies can be entered. |
| [AUDIO] (2ND FUNCT METER) | Toggles to switch loudspeaker mounted on rear panel on or off. Associated with VOL (volume) control on rear panel. |
| [IDENTIFY REFRESH] (2ND FUNCT START) | The display is progressively brightened up to identify where the trace is being refreshed. When enabled it will operate automatically for sweep speeds slower than 100 ms/division. |

**STD 10 MHz output**

| | |
|---|---|
| Frequency | 10 MHz ± Frequency Standard error. |
| Amplitude | -10 dBm ± 0.3 dB. |
| Connector | 50 Ω BNC female. |

**47.4 MHz output (i.f. output)**

| | |
|---|---|
| Centre frequency | 47.4 MHz. |
| Bandwidth | Typically 3 MHz. |
| Amplitude | Proportional to the signal level at the first mixer. Nominally 3 dB greater than the r.f. input signal for 0 dB r.f. attenuation. |
| Connector | 50 Ω BNC female. |

**Phones (Demodulated output)**

| | |
|---|---|
| Frequency range | Nominally 50 Hz to 50 kHz. |
| Amplitude | Dependent on vertical scale range, modulation depth and volume control setting. Signal level corresponding to a signal at the top of the screen is nominally:<br><br>10 to 0.5 dB/div. 6.5 volts<br>Linear 1 volt/div. 1.5 volts<br>2 volts/div. 2.0 volts<br>5 volts/div. 3.5 volts |
| Connector | 6.35 mm standard jack socket. |

para. 38 (continued)

**Probe supply**

Supply available at the front panel socket to power Zero Loss Probe 2374.

**Radio frequency interference**

Conforms with the requirements of EEC Directive 76/889 as to the limits of r.f. interference.

**Safety**

Complies with IEC 348.

**Rated range of use (over which full performance data is met)**

| | |
|---|---|
| Temperature | $0^0$C to $50^0$C. |
| Humidity | $0^0$C to $35^0$C at 95% relative humidity. |

**Conditions of storage and transport**

| | |
|---|---|
| Temperature | $-40^0$C to $+70^0$C. |
| Humidity | Up to 90% relative humidity. |
| Altitude | Up to 2500 m (pressurised freight at 27 kPa differential i.e. 3.9 lbf/in$^2$). |

**Power requirements**

AC supply

Switchable voltage ranges 105 to 120 V, 210 to 240 V, all ±10%
45 Hz to 440 Hz
Power taken by both units is approximately 180 W, 340 VA.

**Fuses**

Primary supply fuses

230 V - Two 2.5 A time lag (20 mm x 5 mm cartridge).
110 V - Two 4 A time lag (20 mm x 5 mm cartridge).

Note ...

The instrument employs double fusing, a fuse in both the line and neutral supply leads.

Secondary fuses (2380)

AC1 - Input and control of SMPS, output of D2
FS1(+170 V) 3.15 A Q/ACT (20 mm x 5 mm cartridge).
FS2(-170 V) 3.15 A Q/ACT (20 mm x 5 mm cartridge).

para. 38 (continued)

Secondary fuses (2382) AR2 Power supply interface, +5 V logic supply
FS1 3.15 A Q/ACT (20 mm x 5 mm cartridge).

| **Dimensions & weight** | Height | Width | Depth | Weight |
|---|---|---|---|---|
| 2380 | 155 mm<br>6.1 in | 418 mm<br>16.5 in | 575 mm<br>22.5 in | 13 kg<br>28.5 lb |
| 2382 | 155 mm<br>6.1 in | 418 mm<br>16.5 in | 575 mm<br>22.5 in | 17.3 kg<br>38 lb |
| Rack mounted | | | | |
| 2380 and 2382 | 356 mm<br>14.0 in | 418 mm<br>16.5 in | 575 mm<br>22.5 in | |

## 39. OPTIONS

The additional functions detailed below may be added to the standard 2380 by fitting Conversion Kit 46883-735V.

| | |
|---|---|
| OPTNS<br>(2ND FUNCT<br>GPIB PLOT) | Selecting this function causes the display to list the menu of options available which can be selected by pressing numeric keys. |
| **Beeper** | May be enabled or disabled for the following conditions, selected by menu.<br><br>1 Error<br>2 End of sweep<br>3 Overload |
| **Analog Pen plot** | Permits direct copy of A trace, B trace and major graticule lines onto paper using xy pen plotter. A menu is used which guides the operator through a setting-up procedure which includes setting the bottom left and top right extremities. |
| Output | 0 to +5 V ±10% into a load of 500 Ω for both x and y axis; short circuit protected.<br><br>The software limits the pen velocity for maximum writing speed consistent with good accuracy. |
| Connector | 15-way ´D´ type socket. |
| **Video output** | Composite monochrome video signal, nominally 1 V peak- to-peak, positive-going 300 mV sync pulses 700 mV video level. Used to drive auxiliary TV display or a video plotter. |
| Connector | 75 Ω BNC female. |

para. 39 (continued)

**RGB Outputs**

Three video drives at nominally 1 V peak-to-peak, positive-going, into 75 Ω d.c. coupled.
Sync. drive, 1 V peak-to-peak, negative-going, into 75 Ω a.c. coupled.
This option allows an RGB monitor to display the A store and annotation in one colour, the B store and annotation in a second colour and the graticule and common annotation in a third colour. Two colour palette sets are selectable via the OPTNS menu.
The RGB, colour monitor for use with this option should be capable of accepting a 250% overdrive on each RGB input without clipping and of displaying a minimum of 54 µs active horizontal line time to avoid loss of displayed information. Horizontal sync. frequency 15.625 kHz. Vertical sync. frequency 48.2 Hz non-interlaced.

Connector — 15-way ´D´ type socket.

## 40. VERSIONS

When ordering quote eight-digit code numbers.

| Versions | Ordering numbers |
|---|---|
| **2380 Display** | |
| Display. No options fitted. | 52380-900E |
| Display with Conversion kit fitted (Beeper, Analog Pen Plot, Monochrome and RGB Video Outputs). | 52380-900E plus 46883-735V |
| **2382 100 Hz-400 MHz Spectrum Analyzer** | |
| 100 Hz-400 MHz Spectrum Analyzer | 52382-900A |

## 41. ACCESSORIES

| Supplied accessories - 2380 Display | |
|---|---|
| AC supply lead | 43123-076Y |
| Operating precautions H 52380-900E Vol. 1 | 46881-576Z |
| **Supplied accessories - 2382 Spectrum Analyzer** | |
| Operating Manual H 52382-900A Vol. 1 | 46881-489W |
| GPIB Operating Manual H 52382-900A Vol. 1A | 46881-583Y |
| Operating Summary | 46881-646Z |
| Cable Assembly (Power)* | 43129-991G |
| Cable Assembly (Data)* | 43130-082H |

* To interconnect 2382 to 2380

para. 41 (continued)

**Optional accessories - 2380/2382**

| | |
|---|---|
| Service Manual for 2380. H 52380-900E Vol. 2 | 46881-488S |
| Service Manual for 2382. H 52382-900A Vol. 2 | 46881-490V |
| The GPIB Manual H 54811-010P - contains details of general GPIB protocols | 46881-365R |
| GPIB Lead | 43129-189U |
| IEEE/IEC Adapter Block for GPIB Socket | 46883-408K |
| Conversion Kit. Beeper, Analog Pen Plot, Monochrome and RGB Video Outputs. Includes RGB monitor connecting lead | 46883-735V |
| Carrying Case (two required for complete instrument) | 46662-088D |
| Camera Hood for Polaroid type camera | 46883-267B |
| Rack Mounting kit for 2380 and 2382 | 54127-305R |
| Viewing Hood (may be required outdoors in high ambient light conditions) | 54150-022P |
| 6.35 mm Standard Jack Plug BNC lead - for PHONES output socket | 43130-231J |
| RF Connecting Cable, 50 Ω BNC, 1520 mm long | 43126-012S |
| RF Connecting Cable, Type N 50 Ω 1000 mm long | 54311-095C |
| 20 W 20 dB Attenuator | 54431-021B |
| Zero Loss Probe 2374 (200 MHz) | 52374-900C |
| Coaxial Adapter Type N male to BNC female | 54311-092P |
| Maintenance Kit. Comprises 3 extender boards for 2380, extended Power and Data cable assemblies and coaxial cables | 54711-035Y |
| 50/600 Ω Transformer. Provides 600 Ω balanced input. Frequency range 300 Hz - 600 kHz | 54481-042M |

Note ...

All performance data is only applicable if the measurement is made within 10 minutes of the CAL key being pressed, all controls are set to AUTO and connections are made directly to the front panel N type connectors.