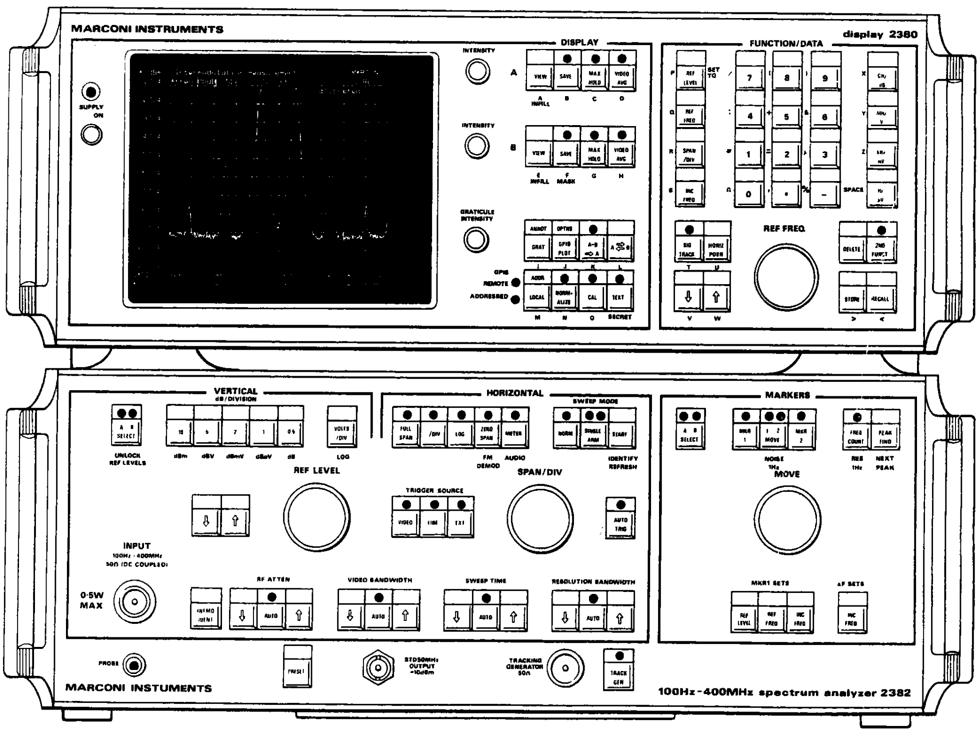
Marconi
Instruments

2382/2380

100 Hz–400 MHz
SPECTRUM ANALYZER and DISPLAY



Operating Manual

100 Hz - 400 MHz SPECTRUM ANALYZER and DISPLAY 2382/2380

Comprising:

100 Hz - 400 MHz Spectrum Analyzer type 2382
(Part no. 52382-900A)
and
Display type 2380
(Part no. 52380-900E)

Printed in the UK

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GPIB Operating Manual (H 52382-900A Vol. 1A)	46881-583Y
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PREFACE

WARNINGS, CAUTIONS AND NOTES

These terms have specific meanings in this manual:-

WARNINGS contain information to prevent personal injury.
CAUTIONS contain information to prevent damage to the equipment.
Notes contain important general information.

HAZARD SYMBOLS

The meanings of hazard symbols appearing on the equipment are as follows:-

Symbol	Nature of hazard	Reference in manual
	Dangerous voltages	Page iv
	Static sensitive components	Page iv

MANUAL AMENDMENT STATUS

Each page in this manual bears the date of its original issue or, if it has been amended, the date and status number of the latest amendment. Any changes subsequent to the latest amendment status are included on Manual Change sheets coded C1, C2 etc. at the front of the manual.

This product has been designed and tested in accordance with IEC Publication 348 – 'Safety Requirements for Electronic Measuring Apparatus'. To keep it in a safe condition and avoid risk of injury, observe the following **WARNING** notices. To avoid damage to the equipment, observe the **CAUTION** notices.

WARNING – ELECTRICAL HAZARDS

AC supply voltage. This equipment conforms with IEC Safety Class 1, meaning that it is provided with a protective earthing lead. To maintain this protection the mains supply lead must always be connected to the source of supply via a socket with an earthing contact. Make sure that the earth protection is not interrupted if the supply is connected through an extension lead or an autotransformer.

Before fitting a non–soldered plug to the mains lead cut off the tinned end of the wires, otherwise cold flowing of the solder could cause intermittent contact.

Do not use the equipment if it is likely that its protection has been impaired as a result of damage.

Fuses. Note that there is a supply fuse in both the live 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.

Make sure that only fuses of the correct rating and type are used for replacement. Do not use mended fuses or short–circuited fuse holders.

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

Removal of covers. Disconnect the supply before removing the covers so as to avoid the risk of exposing high voltage parts. If any internal adjustment or servicing has to be carried out with the supply on, it must only be performed by a skilled person who is aware of the hazard involved.

Remember that capacitors inside the equipment, including any supply filter capacitors, may still be charged after disconnection of the supply. Those connected to high voltage points should be discharged before carrying out work inside the equipment. This applies particularly to the EHT circuit for the cathode ray tube which must be discharged by repeatedly shorting the final anode lead to chassis, or by using a bleed resistor. The residual charge on the CRT itself should also be removed by shorting the anode connector to chassis.

WARNING – OTHER HAZARDS

Parts of this equipment are made from metal pressings, therefore it should be handled with due care to avoid the risk of cuts or scratches.

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

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

CAUTION – STATIC SENSITIVE COMPONENTS

This equipment contains static sensitive components which may be damaged by handling – refer to the Service Manual for handling precautions.

CAUTION - INTEGRITY SEALS

If, during the warranty period of this product, an integrity seal is broken, by removing the covers for example, the warranty may be invalidated.

Similarly, if a module with a broken seal is returned on an exchange basis, it will not be acceptable under the terms and conditions of the exchange service.

CAUTION - FAN FILTER CLEANING

The display and RF units are both cooled by fans whose filters are fabricated from wire gauze. These must be cleaned periodically. Clean with a suction cleaner and, if necessary, with hot soapy water. Do not use a solvent cleaner.

CAUTION - VDU SCREEN CLEANING

Clean the Display Unit screen using a lint-free cloth damped with alcohol or else use an anti-static cleaner. Under no circumstances should an arklone-based cleaner be used.

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Chapter 1
GENERAL INFORMATION

FEATURES

General

The 2382 Fig. 1–1 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 CRT screen. Facilities such as the display of a modulated signal, the recovery of a modulating signal and the provision of an integral tracking generator for swept frequency measurements further enhance its capabilities.

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

- Testing of HF and VHF transmitters and receivers
- Interference monitoring
- Surveillance
- Signal source purity measurements
- Commissioning communication and radar systems
- 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 swept frequency characteristics of active and passive networks – filters, amplifiers etc.

The instrument is a microprocessor controlled swept tuned analyzer of the super-heterodyne type. It comprises a lower unit (2382) containing frequency synthesizers, the swept receiver and tracking generator, and an upper unit (2380) containing the display, digital processing and power supply. The CRT has a viewing area of 140 mm x 110 mm.

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.

For optimum control the operator may set the reference frequency, span, and reference level using either a keypad or dedicated rotary controls. RF attenuation, video bandwidth, sweep time and resolution bandwidth are set automatically but settings may be simply overridden using dedicated increment keys. Full GPIB talk and listen facilities are also provided.

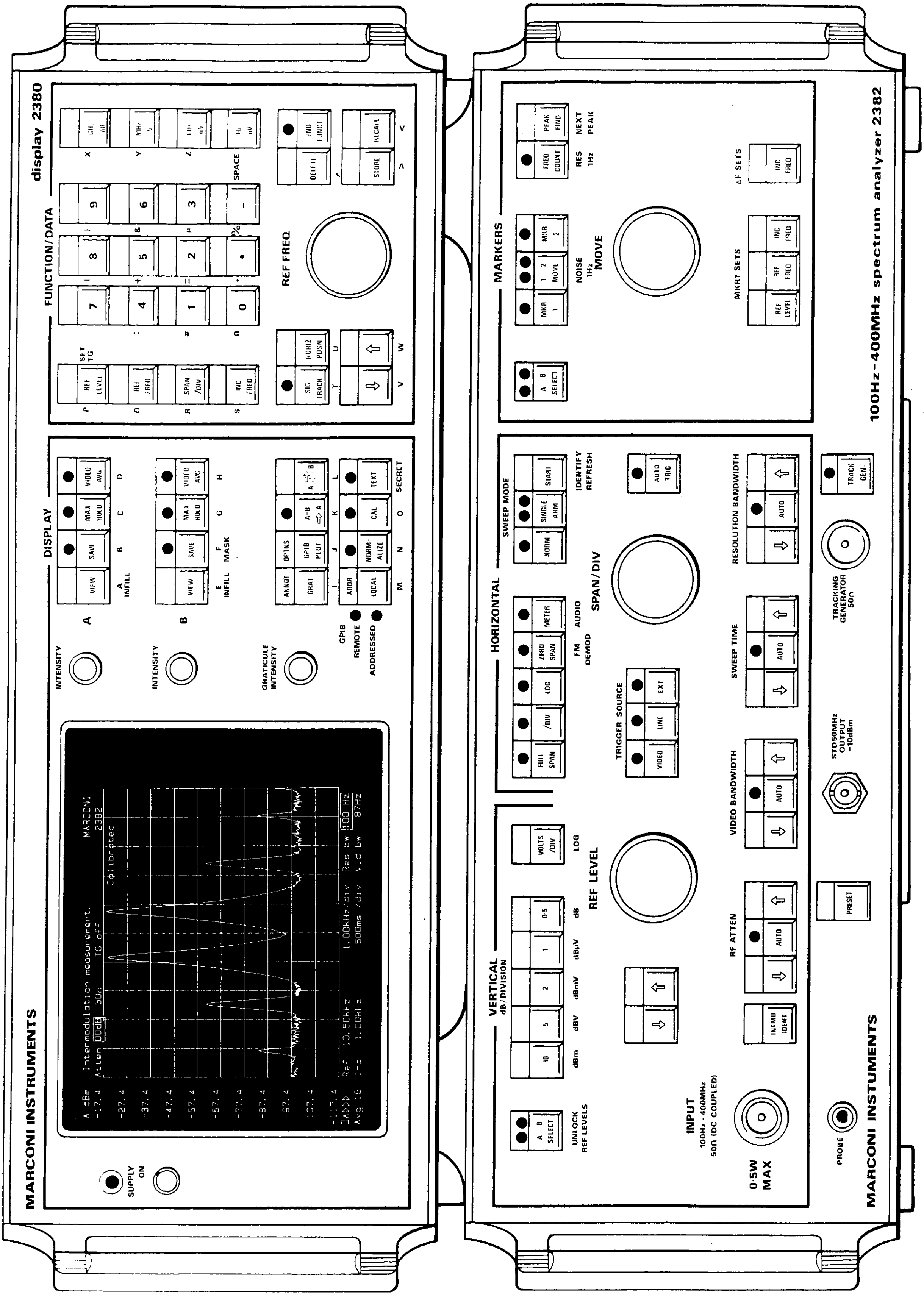


Fig. 1–1   The 2382 Spectrum Analyzer with 2380 Display

The display

Two memory stores designated A and B record the trace data, 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 A and B traces and the graticule have separate intensity 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 features 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 the OPTIONS socket at the rear of the 2380.

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 unambiguous hard copies or photographic records if required. The display can be protected from being overwritten by using the SAVE mode. An operator generated caption can be displayed at the top of the screen to identify displays with titles, serial numbers and dates. Marker values, user prompts, menus and error messages are also displayed.

The PRESET mode

A feature which is especially helpful to first time users is the PRESET mode. When this mode is selected by pressing the PRESET key the instrument sets itself to a logical starting condition, overriding all previous settings except for any text at the top of the screen. The functions activated are indicated on the front panel keys by green lettering.

The six mode horizontal scale

The display can be viewed in six different modes - FULL SPAN, /DIV, METER, LOG, ZERO SPAN and FM DEMOD. The FULL SPAN mode is used to display the entire input spectrum and is useful in the initial identification of 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 /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 the right-hand side of the screen as required. When METER mode is selected the spectrum analyzer acts as a fixed tuned receiver and the level of the signal at the marker frequency is displayed at the centre of the screen in the form of a vertical bar chart with digital readout.

For ease of operation, in the AUTO mode, resolution bandwidth, sweep time and video bandwidth are set automatically to give optimum resolution at each choice of frequency span. In /DIV mode 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.

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

The ZERO SPAN mode is used for recovering modulating signals or for real time monitoring of a single signal and to measure 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 (FM DEMOD) enables FM deviation to be displayed and measured against a time axis in the same way.

Amplitude measurements

High sensitivity is achieved by careful RF and IF amplifier design, the measurement range being from −150 dBm to +30 dBm. 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.

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 respectively. In addition relative measurements in dB can be made.

Voltage ranges are available on a linear or a logarithmic display. Linear ranges extend from 0.1 µV/div to 0.5 V/div in a 1,2,5 sequence on a 10 division graticule. Log voltage ranges are from 100 nV to 10 V (top of scale) in a 1,10,100 sequence on a two and a half decade graticule.

Markers

Using a rotary control on the front panel, two 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 (PEAK FIND), and then to subsequent peaks as required (NEXT PEAK). The amplitude and frequency of each peak is clearly displayed.

For closer inspection, an identified peak 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).

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

Further highlights

Although information is provided in much greater detail in Chap. 3 – 'Control Functions' there follows a very brief description of some of the more significant features of the 2380/2382 not yet mentioned.

Store/recall. Nine sets of instrument mode settings or limit masks can be permanently stored and subsequently recalled as required. The 2382 automatically powers up in store 1 condition (if it is set).

Low level signals. Low level signals which can be obscured by random noise can be detected more easily by increasing the degree of video filtering, applying video averaging and/or by reducing input attenuation. The former requires a very slow sweep to achieve results but by 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.

In an unscreened environment the CRT 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.

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. Masks can be stored using the STORE key.

Tracking generator. The integral tracking generator produces a swept signal whose frequency precisely tracks the spectrum analyzer tuning in all span modes. The frequency range of the tracking generator is 100 Hz to 400 MHz, and is set to the same accuracy as the tuned frequency.

The tracking generator can be used to provide the sweeping signal for measuring the frequency response of both active and passive devices. 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.

Intermodulation products. Normally, in the AUTO mode, the RF 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 RF attenuator is controlled manually however overloading can occur and distortion products can be produced.

A simple key operation (INTMD IDENT) identifies these products quickly and easily thereby giving increased confidence in measurements.

Overload protection. The maximum input signal level which can be applied continuously 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 continues to provide protection when 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 is emitted from a beeper. Providing the overload is no longer present the latching relay can be reset by pressing the INTMD IDENT key on the front panel.

More detail

Complete information on all the features of the 2382 are in Chap. 3, 'Control Functions'. Some of these functions are listed below.

- Max hold
- Incremental keys
- Trace exchange
- Trace arithmetic (A – B)
- GPIB plot
- Noise measurement
- Identify refresh
- Secret key
- Single shot
- Triggering

External standard, setting internal standard, probe, and standard 10 MHz output are covered in Chap. 3, 'Inputs and Outputs'.

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

FREQUENCY

Measurement range

100 Hz to 400 MHz in 1 Hz 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, 40 MHz/div selected by means of keypad or dedicated rotary switch. Displayed accuracy ±1% of separation frequency, ±2% of total span.

LOG

1 to 7 decade logarithmic display. User selects Start and Stop frequencies (decade values only) and instrument selects resolution bandwidths and sweep speeds for each decade for optimum display. For optimum display refresh, the highest frequency decade is swept first. Displayed accuracy ±5N% 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 is better than ±2 parts in 10^6 over 0 to 50°C. Ageing rate is 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 inverse video on the display when the internal standard has been adjusted.

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 of the nominal input frequency for the system to lock. The annotation 'Ext std' is shown on the display when lock is achieved.

Input connector

50 Ω BNC type 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

The 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 times Ref freq/10 MHz) + 2% of selected sweep span + oscillator drift]. 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 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, LOG, /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: Frequency standard error ±2 times resolution.
Restrictions are that the resolution bandwidth must be greater than 0.2% of 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	Sets the reference frequency to that of the Marker 1 frequency.
MKR1 SETS INC FREQ	Sets the incremental frequency step to that of the Marker 1 frequency.
ΔF SET INC FREQ	Sets the incremental frequency step to the difference between Marker 1 and Marker 2 frequencies.

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. 1-2.
Accuracy	3 dB points within ±20% of their nominal value apart from the 1 MHz filter which is +0% −30%.
Shape factor	All filters 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. The 1 MHz filter shape factor is less than 5:1.

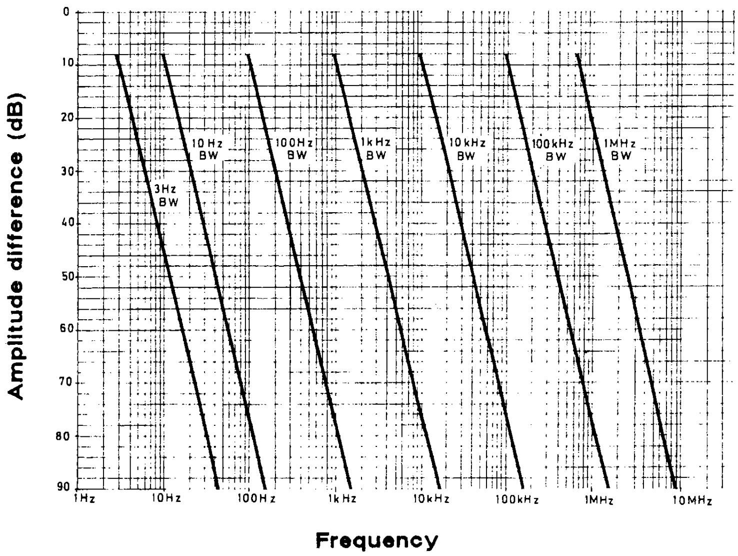


Fig. 1–2 Typical spectrum analyzer resolution

Stability

Residual FM

Less than 1.5 Hz p–p 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 oscillator drift rate is as follows:

<10 Hz/min at 10 Hz/div increasing to
<20 Hz/min at 2 kHz/div.

<1 kHz/min at 5 kHz/div increasing to
<2 kHz/min at 200 kHz/div.

<50 kHz/min at 500 kHz/div increasing to
<100 kHz/min at 40 MHz/div.

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

Hum (line related) sidebands:
Better than -80 dBc using 3 Hz filter.

Displayed noise sidebands

Offset from carrier	Displayed noise (normalized to 1 Hz bandwidth at 100 MHz)
100 Hz	<–90 dBc
300 Hz	<–100 dBc
20 kHz	<–105 dBc

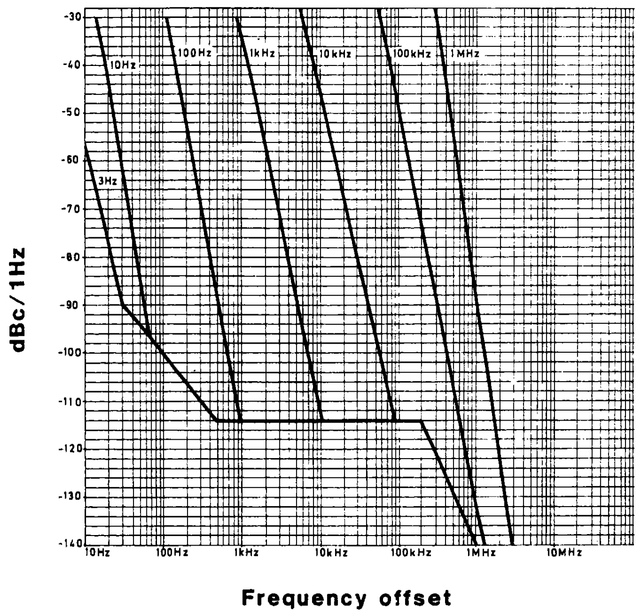


Fig. 1–3 Typical SSB noise vs offset from carrier

AMPLITUDE

Measurement range

–150 dBm to +30 dBm; 0.1 µV/div to 0.5 V/div.

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.

Overload protection

Overload protected to +47 dBm (50 W) by means of a latching relay which can be reset using the INTMD IDENT key.

Input protection may be overridden if required by means of an unlabelled second function for use on pulsed RF signals. Input is protected when instrument is switched off.

Displayed range

dB/DIVISION

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

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.

Selection of the above is by means of dedicated keys and can be made on 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
LOG VOLTS/DIV

Linearity of display less than ±2% FSD.

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. The dB relative mode sets the top of the 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, IF gain setting, RF attenuator setting and resolution bandwidth provided that the 'sweep uncal' message is not displayed.

VOLTS/DIV	0.1 µV/div to 0.5 V/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 IF gain setting, RF attenuator setting and at any permitted filter selection but ±25% at other frequencies. The CAL key must have been pressed at the reference frequency prior to making a measure ment.
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, IF gain setting, RF attenuator setting and at any permitted filter se- lection.
Frequency response	On all displayed ranges, the frequency response is ±0.4 dB for RF attenuations of 10 dB or more, and ±0.5 dB for RF attenuation of 0 dB. Typically -3 dB at 50 Hz.
RF Input	
Connector	50 Ω N-type female to MIL-C-39012C, DC coupled.
Return loss	>20 dB return loss for RF attenuator settings of 10 dB or more. >15 dB return loss for RF attenuator setting of 0 dB.
Local oscillator leak	Typically better than -85 dBm at any frequency and any RF attenuator setting..
Markers	Markers measure the amplitude of points on the display in all horizontal modes except for FM DEMOD.
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 is 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 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 MARKERS 1 2 MOVE)	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 is greater than 80 dB down on the fundamental. Refer to Fig. 1-4 for other levels.
Non-harmonic distortion	With a sinusoidal signal at -42 dBm at the input mixer*, any internally generated non-harmonic distortion products are more than 75 dB down on this signal.
Display	100 dB.
Third order intermodulation	-95 dBc for on-screen signals using the 3 Hz filter at -42 dBm at the input mixer.* Refer to Fig. 1-4 for other levels.

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

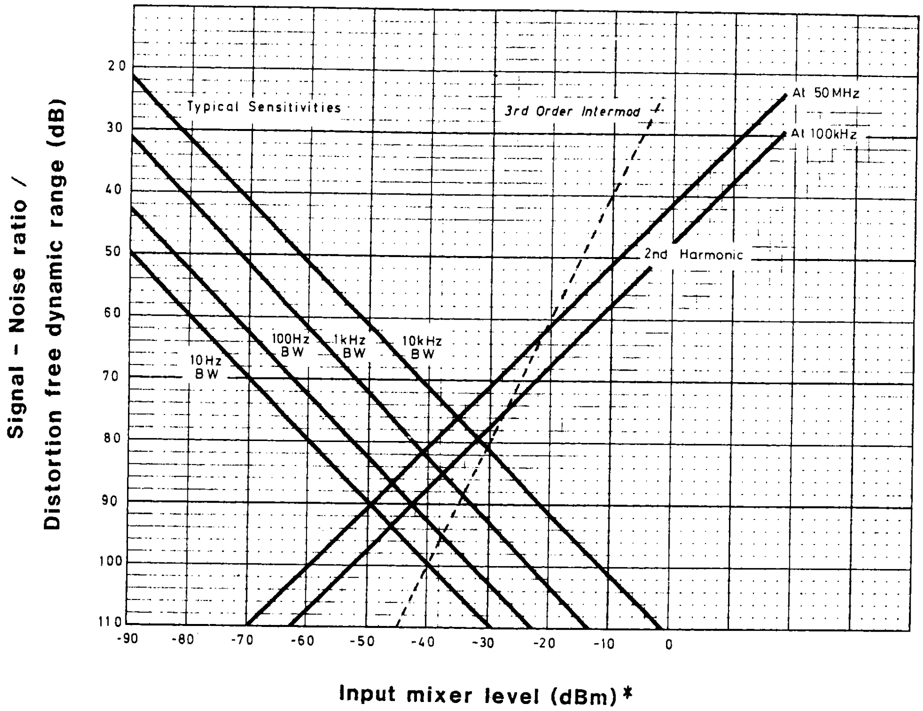


Fig. 1–4 Optimum dynamic range

Residual responses	Better than –115 dBm (typically –120 dBm) at 0 dB RF attenuation.
Equivalent input noise sensitivity	Better than –135 dBm (typically –145 dBm) using 3 Hz resolution bandwidth for reference frequencies greater than 150 kHz. Refer to Fig. 1–5 for other filter bandwidths.

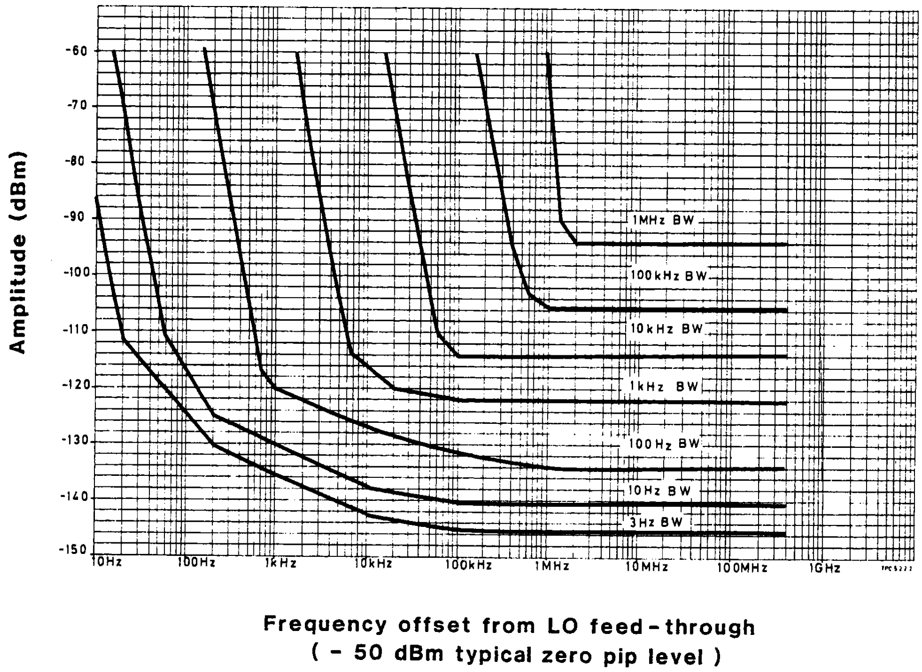


Fig. 1–5 Typical sensitivity vs input frequency

Tracking generator cross-coupling

With the tracking generator switched on and both the input and the tracking generator output terminated in 50 Ω the displayed noise level in a 3 Hz bandwidth is better 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.

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 p-p 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 p-p 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 pk-pk to 100 V pk-pk from 10 Hz to 100 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.

If EXT TRIGGER SOURCE and AUTO mode are selected with no external signal applied, the sweep will run immediately on pressing the START key.

Sweep time

[/DIV]

AUTO or ↓↑ keys select sweep times of 10 ms/div to 20 s/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 RESOLUTION BANDWIDTH ↓↑ keys.
Display accuracy	Deviation accuracy at zero deviation rate ±20% FSD ±1 Hz. Bandwidth depends on selected filter. The deviation sensitivity and modulation frequency response is a function of the selected resolution bandwidth. Since this relationship depends upon Bessel functions it is non-linear and dependent on the deviation magnitude. The sensitivity quoted is for low modulation frequencies i.e. less than 5% of the selected resolution bandwidth.
Markers	Markers measure time and time difference for points on the display in ZERO SPAN and FM DEMOD modes.
Resolution & accuracy	Resolution 0.2% of sweep span time. Accuracy as for 'Frequency Standard'.

TRACKING GENERATOR

Frequency Range	100 Hz to 400 Hz.
Accuracy	±1 Hz referred to the tuned frequency.
Amplitude setting	-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 better than 30 dB down on the fundamental signal.
Non-harmonic distortion	All spurious signals are better than 30 dB down on the fundamental signal.
Residual signals	All residual signals are less than -70 dBm with the tracking generator off.

Tracking generator output

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

DISPLAY

Display size	140 mm x 110 mm.
Trace	Two 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 (15664 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.
[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. In dB/DIV 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.
All the resolution filters are adjusted to set their centre frequencies and gains. Each step of the RF attenuator and the overall frequency response is measured and stored for error correction of all subsequent measurements.

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 modes, 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.

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 (1004 byte block data 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.

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 RF attenuation and adds 3 dB more IF 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.

PRESET

Operation of this key sets the instrument to a standard starting condition. If the input has been overloaded, operation of this key will clear the latched protective state unless the overload is still present.

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.

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 type female.

47.4 MHz output (IF output)

Centre frequency	47.4 MHz.
Bandwidth	Typically 3 MHz.
Amplitude	Proportional to the signal level at the first mixer. Nominally 7 dB greater than the RF input signal for 0 dB RF attenuation.
Connector	50 Ω BNC type female.

Phones (demodulated output)

Frequency range	Nominally 50 Hz to 50 kHz.
Amplitude	Dependent on vertical scale range, modulation depth and volume control setting. The pk-pk output level corresponding to a full screen step is nominally:

1's volts/div ranges	9.4 V pk-pk
2's volts/div ranges	18.8 V pk-pk
5's volts/div ranges	9.4 V pk-pk

Connector	6.35 mm standard jack socket.

Probe supply

Supply available at the front panel socket to power 1 GHz Active Probe 2388 and Zero Loss Probe 2374.

Radio frequency interference

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

Complies with VDE 0871, limit value class B, as specified in General Licence Vfg 1046/1984. (Applies to 2382 RF units from serial number 152062-001 onwards when used with 2380 Display Units from serial number 152055/001 onwards.)

Safety

Complies with IEC 348.

Conditions of storage and transport

Temperature	−40°C to +70°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).

Rated range of use (over which full specification is met)

Temperature	0°C to 50°C.
Humidity	0°C to 35°C at 90% relative humidity.

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 live 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).

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 6.1 in	418 mm 16.5 in	575 m 22.5 in	13 kg 28.5 lb
2382	155 mm 6.1 in	418 mm 16.5 in	575 mm 22.5 in	17.3 kg 38 lb
Rack mounted				
2380 and 2382	356 mm 14.0 in	418 mm 16.5 in	575 mm 22.5 in	

OPTIONS

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

OPTNS (2nd FUNCT 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:- 1 Error 2 End of sweep 3 Overload
Analogue Pen plot	Permits direct copy of A trace, B trace and major graticule lines onto paper using X-Y 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 axes. Short circuit protected. 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 p-p, positive-going 300 mV sync pulses 700 mV video level. Used to drive auxiliary TV display or a video plotter.
Connector	75 Ω BNC type female.
RGB Outputs	Three video drives at nominally 1 V p-p positive-going, into 75 Ω DC coupled. Sync drive, 1 V p-p negative-going, into 75 Ω AC coupled. This option allows an RGB video 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 selec table via the OPTNS menu.

Note ...

The RGB colour monitor for use with this option should be capable of accepting a 250% over-drive 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 15.664 kHz. Vertical sync frequency 48.2 Hz non-interlaced.

Connector

15-way D-type socket. Option also includes RGB monitor connecting lead.

Note ...

The above performance data is only applicable if the measurement is made within 10 minutes of the CAL key being pressed, the 'sweep uncal' message is not displayed (sweeps faster than AUTO) and connections are made directly to the front panel N-type connectors.

VERSIONS

When ordering please quote the eight-digit ordering numbers.

Version		Ordering numbers
Display		
2380	Display. No options fitted.	52380-900E
2380	Display with Conversion kit fitted (Beeper, Analogue Pen Plot, Monochrome and RGB Video Outputs).	52380-900E plus 46883-735V
100 Hz - 400 MHz Spectrum Analyzer		
2382	Standard 50 Ω version with tracking generator	52382-900A
2382	Version with 3 MHz/div frequency span	52382-301W
2382/1	Version with 75 Ω input/output impedance	52382-901Z

ACCESSORIES

Supplied accessories - 2380 Display

	Ordering numbers
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
2380 series Operating Summary booklet (2 copies)	46881-816K
Cable Assembly (Power)*	43130-369S
Cable Assembly (Data)*	43130-082H

* To interconnect 2382 to 2380

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 Cable (double screened)	46883-962H
IEEE/IEC Adapter Block for GPIB Socket	46883-408K
Conversion Kit. Beeper, Analogue 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
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, N-type 50 Ω 1000 mm long	54311-095C
20 W 20 dB Attenuator	54431-021B
1 GHz Active Probe 2388	52388-900D
Zero Loss Probe 2374 (200 MHz)	52374-900C
Coaxial Adapter N-type male to BNC female	54311-092P
Support 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 to 600 kHz	54481-042M
10 MHz - 4.2 GHz Amplifier	54432-010A
Stowage Cover Kit. Provides stowage for leads etc. Fitted to front of instrument.	46884-486X

Chapter 2

INSTALLATION

UNPACKING AND REPACKING

Retain the container, packing material and the packing instruction note (if included) in case it is necessary to reship the instrument.

If the instrument is to be returned for servicing attach a label indicating the service required, type or model number (on rear label), serial number and your return address. Pack the instrument in its original container using the materials supplied and in accordance with the packing instruction note. If an instruction note has not been included the method of packing is probably self evident because of the shape of the materials used. In general the procedure will be as follows:

(1) Place supply lead in suitable plastic bag and tape it to the instrument's rear panel.

(2) Place the instrument within its plastic cover.

(3) Ensure that the padded fitting is in place within the inner carton and slide the instrument in, rear panel first, leaving the front panel exposed at the open end.

(4) Fit the separate front panel protecting cover over the panel and close and seal the inner carton.

(5) Place one of the moulded plastic cushions in the bottom of the outer carton and insert the inner carton to locate in the cushion recess.

(6) Place the other plastic cushion over the other end of the inner carton and close and seal the outer carton.

(7) Wrap the container in waterproof paper and secure with adhesive tape.

(8) Mark the package FRAGILE to encourage careful handling.

Note ...

If the original container and/or materials are not available split the instruments into two units and use a strong double-wall carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of each one to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader; a rear load spreader is also advisable.

MOUNTING ARRANGEMENTS

Excessive temperatures may affect the instrument's performance; therefore, completely remove the plastic cover, if one is supplied over the case. Ensure that the fan air vent and other ventilation holes are not obstructed otherwise the maximum temperature specification is reduced resulting in imperfect operation. Avoid standing the instrument in the vicinity of large transformers or other possible magnetic fields or where X-rays are present. If the source of such fields cannot be isolated Mumetal shields should be used to provide the necessary screening.

RACK MOUNTING

The instruments are normally supplied ready for bench mounting. A rack mounting kit, consisting essentially of two pairs of mounting brackets a front panel and a front panel support, is available as an optional accessory (Part No. 54127–305R). Fitting instructions are provided with the kit. Generally the brackets are fitted as follows:

(1) Temporarily remove the bottom cover of the instrument and remove the feet.

(2) Replace the bottom cover.

(3) Remove the trim strip in the recess of each of the front panel handles.

(4) Fit the brackets in these recesses and secure by fitting the M4 screws provided into the tapped holes.

Slides or runners must be fitted to give support to the rear of the instrument. By removing the carrying straps M4 tapped holes are revealed which can be used for fixing an adapter plate to which runners may be secured.

SAFETY TESTING

Where safety tests on the AC supply input circuit are required, the following procedures can be applied. These comply with BS4743 and IEC Publication 348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that input circuit components and wiring (including ground connections) are safe.

(1) Ground lead continuity test from any part of the metal frame to the bared end of the flexible lead for the ground pin of the user's supply plug. Preferably a heavy current (about 25 A) should be applied for not more than 5 seconds.

Test limit : not greater than 0.5 Ω.

(2) 500 V DC insulation test from the AC supply circuit to ground.

Test limit : not less than 2 MΩ.

CONNECTING TO SUPPLY

Before connecting the instrument to the AC supply check the position of the voltage selector switch. The range selected can be seen on the side of the switch situated on the rear panel (refer to Chap. 3, Fig. 3–2). The instrument is normally dispatched set to the 210–240 V range. To select the 105–120 V range operate the LINE VOLTS SELECTOR switch and change the value of the AC supply fuses to that shown below:

110 V range 4 A–T (4 amp time lag)
230 V range 2.5 A–T (2.5 amp time lag)

Fuses are 20 mm x 5 mm cartridge type.

The AC supply cable is fitted at one end with a female plug which mates with a connector at the rear of the instrument. When fitting a power plug ensure that conductors are connected as follows:

Ground (Earth)	-	Green/Yellow
Neutral	-	Blue
Line	-	Brown

Any interruption of the ground conductor is liable to make the equipment dangerous.

GENERAL PURPOSE INTERFACE BUS (GPIB)

The GPIB interface built into the 2380 enables the spectrum analyzer to be remotely controlled enabling it to form part of a automatic measuring system.

GPIB cable connection

Connection to other equipment which has a 24-way connector to IEEE Standard 488 is made using the 2380's rear panel GPIB socket. For this purpose the GPIB cable assembly available as an optional accessory (see Chap. 1 'Accessories') may be used.

GPIB connector contact assignments

The contact assignments of the GPIB cable connector and the device connector are as shown in Fig. 2-1.

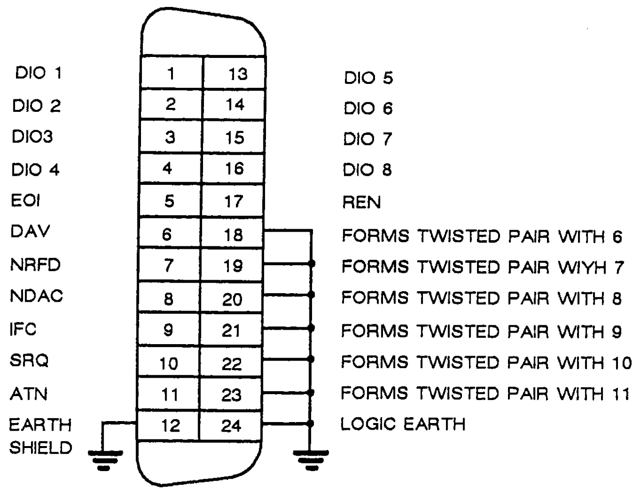


Fig. 2-1 GPIB connector contact assignments

IEEE to IEC conversion

An optional IEEE-to-IEC adapter is also available (see Chap. 1 'Accessories') for interfacing with systems using a 25-way bus connector to IEC Recommendation 625. The method of use is shown in Fig. 2-2.

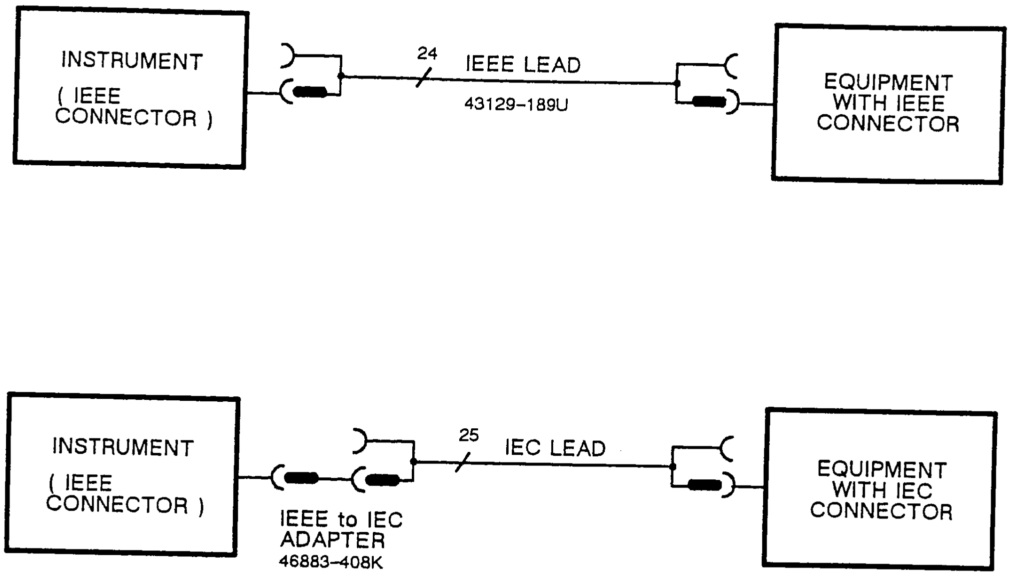


Fig. 2–2 IEEE to IEC conversion

Interface bus connection

The cables for the interface bus use special male–female connectors at both ends. This allows several connectors to be stacked one on top of another permitting several cables to be connected to the same source and secured by a lockscrew mechanism. Too large a stack however, may form a cantilevered structure which might cause damage and should be avoided. The piggyback arrangement permits star or linear interconnection between the devices forming a system with the restriction that the total cable length for the system must be :–

(1) No greater than 20 m (65 ft).

(2) No greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.

OPTIONS CONNECTOR

The contact numbering of the 15–way Options connector supplied with Conversion kit 46883–735V is shown in Fig. 2–3 as viewed from the back of the instrument. The functions of the contacts, which are all outputs, are given in Table 2–1. For information on voltages etc. see Chap. 1 'Options'.

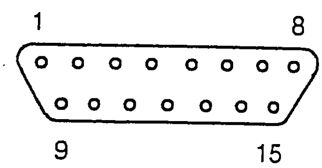


Fig. 2–3 Options connector
(contact numbering as viewed from the back of the instrument)

TABLE 2-1 OPTIONS CONNECTOR CONTACT ASSIGNMENTS

Contact	Function	Contact	Function
1	Ground	9	Red video
2	Ground	10	Green video
3	Ground	11	Blue video
4	Ground	12	Sync
5	Ground	13	Recorder Y-channel
6	Recorder pen-lift	14	Recorder X-channel
7	Recorder pen-lift	15	Not connected
8	Ground		

Chapter 3
OPERATION

PRINCIPLES OF CONTROL

An upper unit (2380) containing the display, power supply, GPIB interface, keyboard and digital processing is combined with the lower unit (2382) which contains the frequency synthesizer, swept receiver and tracking generator. All operations are carried out by using front panel controls or remotely via the GPIB. Operations are summarized in the Operator Guide and GPIB pull-out cards located under the front of the 2382. The controls and input/output connectors are divided basically into the following distinct groups :

Upper unit

SUPPLY ON	Indicating light shows the ON state.
DISPLAY	Control and display of A or B store information. GPIB mode indicator.
FUNCTION/DATA	Keypad, decrement/increment key and rotary control of reference frequency; keypad control of reference level, incremental frequency and span/div; store and recall of instrument mode settings.

Lower unit

INPUT	100 Hz - 400 MHz, DC coupled, 50 Ω, 0.5 W max. Overload protected to 50 W.
VERTICAL	Sensitivity controls, dB and VOLTS ranges, decrement/increment key and rotary control of reference level.
HORIZONTAL	Span selection keys; rotary control of sweep span from 10 Hz/DIV to 40 MHz/DIV. Sweep speed, resolution bandwidth and video bandwidth control.
MARKERS	Bright dot marker control for amplitude and frequency read-out.
SIGNAL OUTPUTS	Standard 10 MHz calibrator output. Tracking generator output. Probe supply.

Individual key functions within these groups are described in 'Control Functions'. Four colours have been used for marking front panel keys:

white	for first function keys
blue	for second function keys (2nd FUNCT key must be pressed first)
green	for functions becoming active on pressing the PRESET key
yellow	for alphanumeric and special characters available after the TEXT key is pressed.

INPUTS AND OUTPUTS

Front panel (refer to Fig. 3–1)

① **SUPPLY ON**

A rotary switch applies the AC supply voltage to both upper and lower units. A green indicator light shows the ON state. Refer to 'Connecting to Supply' in Chap. 2 for further information.

② **GPIB (General Purpose Interface Bus)**

Indicating lights show the mode in which the instrument is working :

Local	... ...	both lights OFF
Remote	... ...	REMOTE light ON
Addressed (addressed by controller)	...	ADDRESSED light ON

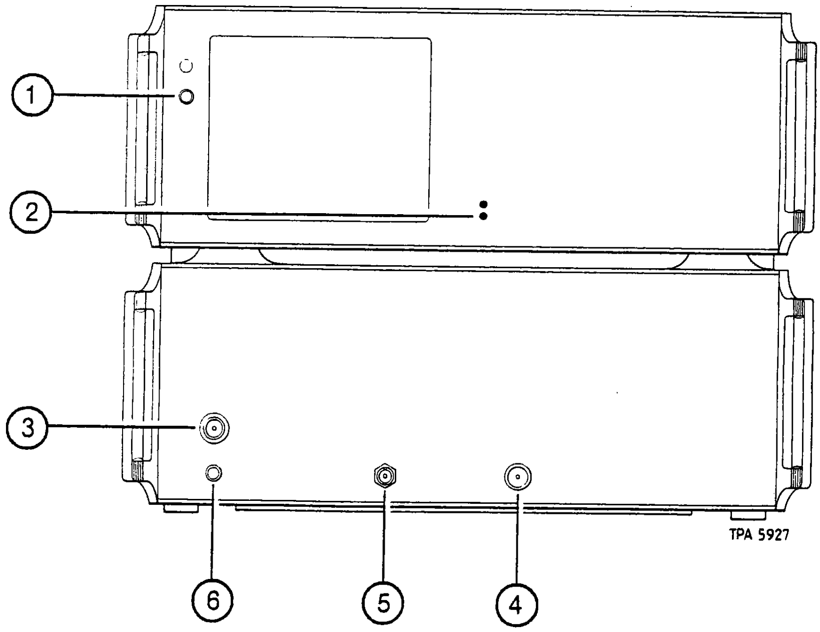


Fig. 3–1 Front panel inputs, outputs and indicating lights

③ **INPUT 50 Ω : DC 100 Hz–400 MHz, 0.5 W max.** An N–type socket for connection of input signals in the range 100 Hz – 400 MHz. Maximum input level is +27 dBm. Input circuitry is protected against accidental application of overload power up to +47 dBm (50 W) by means of a latching relay. The word 'OVERLOAD' appears on the screen if an input level of +27 dBm is exceeded and if an 'Options' board is fitted, it can be arranged that an audible warning is emitted. When the overload is no longer present the protective state and the screen annotation can be cleared by pressing the INTMD IDENT key (refer to '2382 Control Functions' [27]). For pulsed RF signals etc. the trip can be overridden [26].

Note : The locations of controls which are indicated by numbers in square brackets [ ] are shown in Fig. 3–30 at the end of this chapter.

(4) TRACKING GENERATOR 50 Ω

An N-type socket providing a swept frequency output synchronous with the internally generated input signal at 100 Hz - 400 MHz to within ±1 Hz. Output level from a 50 Ω source is initially -10 dBm, but can be adjusted from -9.7 to -20.3 dBm (refer to '2382 Control Functions' [35]).

(5) STD 10 MHz OUTPUT -10 dBm

A BNC type socket supplying a nominal 10 MHz square wave calibrator output at a level of -10 dBm from a 50 Ω source.

(6) PROBE

A sub-miniature 3-pin socket providing power for an active probe such as 1 GHz Active Probe 2388 or Zero Loss Probe 2374, or for the 10 MHz - 4.2 GHz Amplifier (see 'Optional Accessories').

Rear panel (refer to Fig. 3-2)

(1) FUSES

Supply input fuses are rated as follows :

230 V, 2.5 A time lag (20 mm x 5 mm cartridge),
110 V, 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.

(2) LINE VOLTS SELECTOR

The selector switch allows the instrument to be set to an appropriate supply voltage. The '230 V' setting covers supply voltages in the range 189 to 264 V and the '110 V' setting supply voltages between 95 and 132 V. Normally the instrument is despatched set for the 230 V supply. If the 110 V setting is to be used, the supply fuses must be changed to the appropriate rating.

(3) LINE VOLTS INPUT

Three pin AC supply power input connector. The ground pin is internally connected to the chassis. This male connector mates with the female socket fitted to the supply cable (43123-076Y).

(4) FAULT INDICATION

Four amber lights provide warnings of overload, over-voltage, low line input voltage and overheat or no RF unit.

(a) **Overload** light is ON when the internal power supply has shut down due to excessive load such as a short-circuited output.

(b) **Overvoltage** light is ON when there is a supply regulation fault which causes overvoltage.

(c) **Low line input voltage** light is ON to indicate there is or has been a low line input voltage or that a line drop-out exceeding 20 ms has occurred.

(d) **Overheat or no RF unit** light is ON when the instrument has shut down due to excessive internal temperature rise or if the display unit (2380) has been switched ON without the RF unit connected.

⑤ **POWER SUPPLY TO RF UNIT and SUPPLY INPUT** sockets, cable assembly 43130-369S. This cable and its two 37-pin connectors link the power supply from the upper display unit to the lower RF unit.

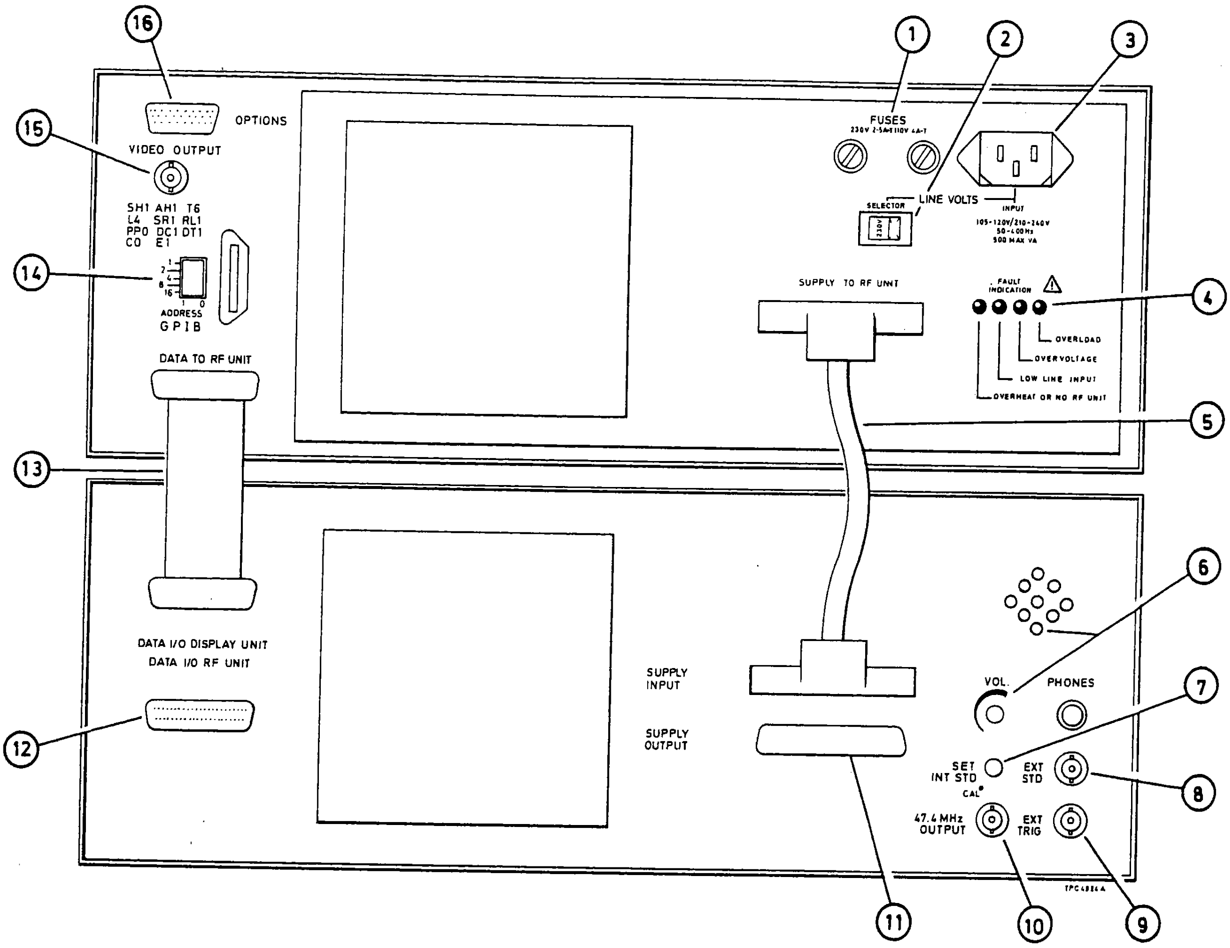


Fig. 3-2 Rear panel inputs, outputs and interfaces

⑥ **VOL, PHONES**

Audio monitoring of amplitude or frequency demodulated signals is provided using a loudspeaker fitted to the rear of the RF unit. As an alternative, this jack socket is provided for the use of earphones. The output from loudspeaker and phones is controlled using the adjacent VOL control. Selecting AUDIO on the front panel switches the drive ON and OFF. A 6.35 mm jack plug to BNC lead is available as an optional accessory.

⑦ **SET INT STD**

Normally in the CAL position. When moved off the CAL position this switched preset permits the frequency of the internal standard to be adjusted to a desired accuracy.

(8) EXT STD
A BNC socket is provided to enable an external standard to be connected if required. The internal 10 MHz frequency standard is locked to this signal or the appropriate harmonic of it. The external standard may have a frequency of 1, 2, 5 or 10 MHz, and a level of -15 dBm to +15 dBm into 50 Ω. The frequency must be within ±1 part in 10^6 for the system to lock.

(9) EXT TRIG
A BNC socket is provided to enable an external trigger to be applied to trigger the start of a sweep or to synchronize the display of a demodulated signal when zero span is used. Triggering can be applied over the range 50 mV p-p to 100 V p-p, at frequencies from 10 Hz to 300 kHz. Refer to '2382 Control Functions' [30].

(10) 47.4 MHz OUTPUT
The input signal after frequency translation to 47.4 MHz IF is connected to this BNC socket as an auxiliary 50 Ω output. The level is nominally 7 dB greater than the RF input signal for 0 dB RF attenuation, and the bandwidth is approximately 3 MHz.

(11) SUPPLY OUTPUT
This 37-way socket is used to extend the display unit's power supply to a further RF unit if required. The upper unit's supply will power up to two lower units, although only one can be selected at any one time.

(12) DATA I/O RF UNIT
This 25-way socket is used to extend data to and from further RF units if required.

(13) **DATA TO RF UNIT** and **DATA I/O DISPLAY UNIT** sockets, cable assembly 43130-082H. This cable and its two 25 pin connectors is used for the transmission of housekeeping and display data between the upper and lower unit.

(14) GPIB
All functions (apart from power ON, intensity controls and those related to the second marker) on both units are GPIB controllable via this 24-way socket. Indicator lights on the front panel show whether the instrument is in the 'local', 'remote' or 'remote addressed' modes, and the address slide switch is positioned on the left of the GPIB connector.

The 2380 can be set to talk directly to a GPIB plotter, via this socket, in order to obtain hard copy prints of traces, annotation and graticules.

(15) VIDEO OUTPUT
When Conversion kit 46883-735V is fitted this BNC socket provides the composite monochrome video signal to drive an auxiliary TV display or video plotter.

(16) OPTIONS
When Conversion kit 46883-735V is fitted this 15-way socket provides a pen recorder output comprising two analogue signals and a pen lift drive. It also provides the RGB and sync drives for a video colour monitor.

DISPLAY ANNOTATIONS

The display covers an area of 140 mm x 110 mm. The central 100 mm x 90 mm graticule area is used for the graphical display of the measured parameters and consists of ten major divisions horizontally and ten vertically.

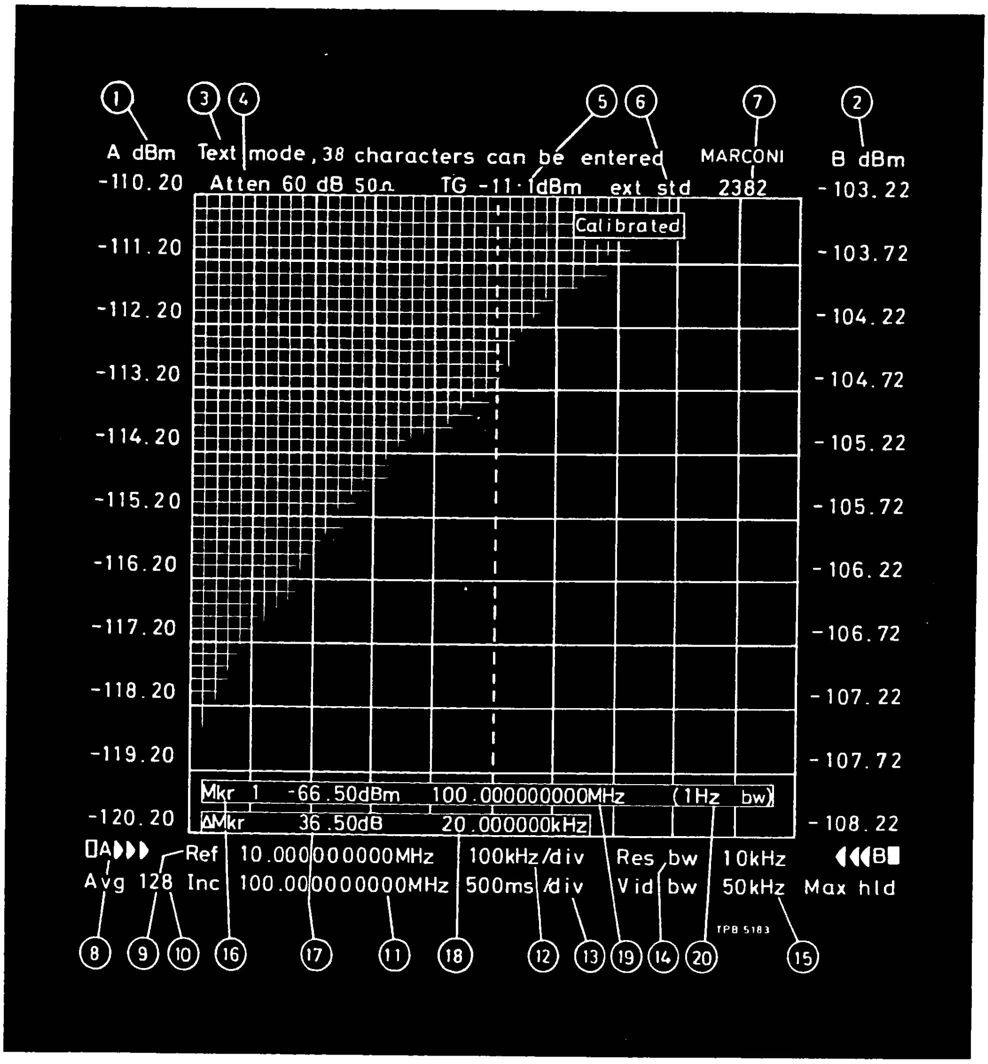


Fig. 3–3 CRT display annotations

Top of display

The top 10 mm of the display is used for the following dedicated information (refer to Fig. 3–3):

(1) 'A' scale units.

(2) 'B' scale units.

(3) Text. A caption of up to 38 characters can be input.

(4) RF attenuator in dB and input impedance in ohms.

(5) Tracking generator setting.

(6) Displays 'ext std' when an external standard frequency is in use. Displays 'int std' in inverse video when internal standard has been adjusted.

(7) The instrument type number.

Sides of display

Down each side of the graticule 20 mm strips nine characters wide are available for the display of vertical annotation on each major graticule division. 'A' scale annotations are down the left-hand side of the display and 'B' scale annotations down the right-hand side.

Data entry areas

Data entry areas towards the top of the graticule are used to display user prompts and standard error messages during normal use e.g. Invalid operation, Out of range and the 'calibrated' condition as shown in Fig. 3-3. Menus are also displayed superimposed on the trace to assist in the use of particular functions. If the trace interferes with the reading of a menu, it can be faded out using the appropriate intensity control.

Bottom of display

In FULL SPAN, /DIV and METER modes the bottom 10 mm of the screen is used for the following dedicated information (refer to Fig. 3-3):

(8) Whether the display is outlined (□) or infilled (■) and whether the above annotation refers to the 'A' or 'B' displays (indicated by A▶▶▶ or ◀◀◀B).

(9) Reference frequency value.

(10) Number of displays averaged when in VIDEO AVG mode. Alternatively 'Max hld' is displayed if the MAX HOLD function is ON.

(11) Incremental frequency value.

(12) Value of Span/div, Zero span or FM demod.*

(13) Value of Sweep Time.

(14) Value of resolution bandwidth.

(15) Value of video bandwidth.

*'Zero span' or 'FM demod' replaces the 'Span/div' annotation when the corresponding functions are selected.

The bottom 10 mm of the graticule area is used for the display of marker information.

(16) Level of Mkr 1 (in dBm, dBV, dBmV, dBµV, dB, nV, µV, mV or V as appropriate). In METER mode 'Mkr 1' is replaced by 'Meter'. Also refer to (20) below.

(17) Level difference between two markers in dB (in volts on VOLTS ranges).

(18) Frequency difference between two markers.

(19) Frequency of Mkr 1.

(20) Marker mode displays respectively 'Freq count', 'Res 1 Hz' and '(1 Hz bw)' when FREQ COUNT, RES 1 Hz and NOISE 1 Hz modes are selected.

CALIBRATION SEQUENCES

When the CAL key is pressed an automatic self-calibration routine is performed to optimize measurement accuracy and cancel any temperature drift. All the resolution filters are adjusted to set their centre frequencies and gains, and each step of the RF attenuator is measured. DC marker nulling is also performed and the level is displayed together with the two DAC values. The overall frequency response is measured and stored for error correction of all subsequent measurements. Note that calibration data are lost when the unit is switched off so that re-calibration is necessary following a warm-up period when the unit is switched back on. The calibration sequence takes about 50 seconds and disables the instrument during this time. This is an essential operation to perform whenever accurate measurements are to be made (refer to '2380 Control Functions' [9]).

OPERATING PROCEDURES

Preparation for use

If the two units have been disconnected for ease of transportation, mount the Display unit 2380 above the RF unit 2382 and lock into position using the clips at the front of the unit and the two toggle latches at the back.

With reference to Fig. 3–2 fit the power supply cable assembly 43130–369S (5) and data cable assembly 43130–082H (13).

Check that the rear panel supply fuses (1) are correctly rated for the supply in use and that the line volts selector switch (2) is set for the required supply voltage.

Fit the supply lead 43123–076Y into the power input connector (3), connect to supply and rotate the SUPPLY switch on the upper unit (refer to Fig. 3–1 (1)) until the green indicator light is ON.

Obtaining a display and use of basic controls

A full description of all front panel control functions is given in 'Control Functions'; refer to Fig. 3–30 or Table 3–4 for their location numbers.

Ensure that the INTENSITY controls [1, 2 and 3] are set to their mid–positions and press the PRESET key [36]. Functions becoming active upon operation of this key have green lettering. After a few seconds a display on the CRT should appear. Adjust GRATICULE INTENSITY as required. Press the CAL key [9] to carry out self-calibration.

Horizontal scale FULL SPAN

Adjust INTENSITY 'A' [1] until a display of noise can be seen. The average level of this noise, approx. -65 dBm, can be determined from the left–hand margin annotation of the screen graticule. The PRESET key [36] sets the vertical scale to dBm, 10 dB/div and the horizontal scale to /DIV, 40 MHz/div. The DC marker (zero pip) can be seen at the left–hand side of the graticule area.

Notice that the value of RF input attenuation (20 dB) is displayed and that the reference frequency, initially set at 200 MHz, is indicated by a dashed vertical line and marginal annotation. Incremental frequency (initially set at 40 MHz (one tenth of span)), sweep span (40 MHz/div), sweep time (10 ms/div) resolution bandwidth (1 MHz) and video bandwidth (11 kHz) are also marginally annotated. Typical CRT display annotations can be found in Fig. 3–3.

The top line of the graticule area is the reference level and this is initially set at 0 dBm. Press the FULL SPAN key [29].

Rotate the REF FREQ control [18] and observe that the dashed vertical line on the display can be repositioned over the entire spectral response. In FULL SPAN mode therefore, the reference frequency can be set to any value required over the range zero to 400 MHz, the marginal annotation indicating the actual value of the frequency selected.

In order to see a coherent signal display, connect a 50 Ω cable between the STD 10 MHz OUTPUT (Fig. 3-1 ⑤) and the INPUT (Fig. 3-1 ③). The screen should display vertical bright lines corresponding to the 10 MHz signal and its harmonics. The fundamental can be identified as the largest spectral line a quarter of a division from the left-hand side of the screen.

Position the dashed vertical line on the ninth harmonic using the REF FREQ rotary control [18]. The reference frequency annotation indicates that the value of the frequency at this point is approx. 90 MHz (refer to Fig. 3-4).

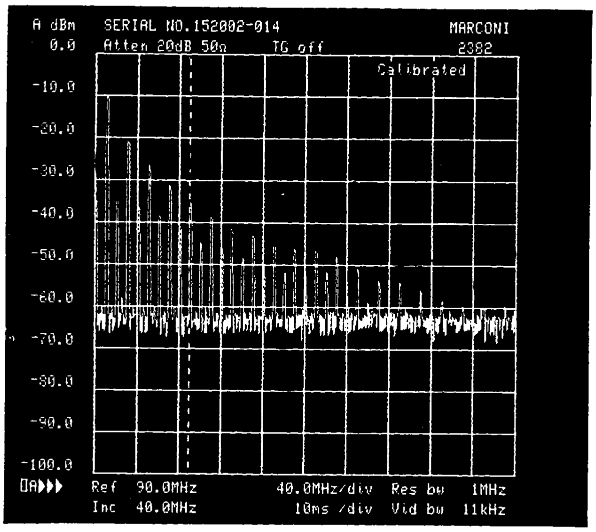


Fig. 3-4 Frequency spectrum for 10 MHz cal. sig. (FULL SPAN)

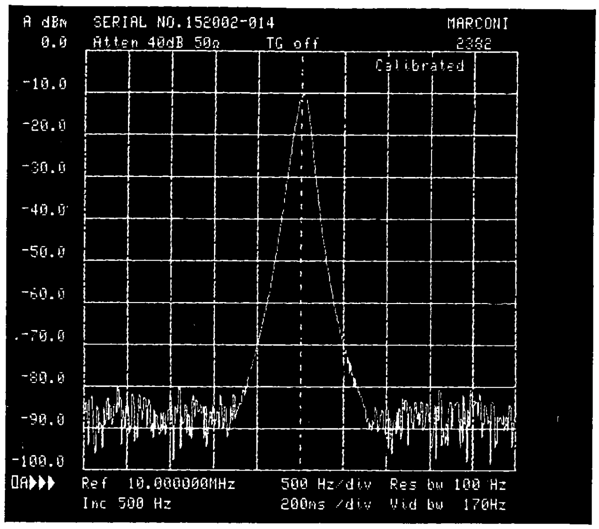


Fig. 3-5 Fundamental of 10 MHz cal. sig. (/DIV)

Horizontal scale /DIV

To obtain a display of say the 10 MHz fundamental at improved resolution, position the dashed line on to the fundamental and press the horizontal scale /DIV control [29]. The dashed vertical line will now appear at the centre of the screen, with the fundamental beneath it, the horizontal scale span/div resolution bandwidth, sweep time and video bandwidth being automatically set. Alternatively, instead of pressing FULL SPAN in the previous step press the REF FREQ key [12] and key in 10 MHz using the DATA keypad [19] and the MHz terminator [20]. In both cases it is the spectral display which moves, the dashed line remaining stationary. The reference frequency annotation now reads 10 MHz and the height of the fundamental should be one major division down from the top of the graticule area corresponding to -10 dBm.

Vary the setting of the SPAN/DIV 'click' control [29] and watch the displayed spectrum adjust to the new conditions. Anti-clockwise rotation decreases the Hz/div. At certain values of Hz/div RF attenuation, the resolution bandwidth, sweep time, video bandwidth and their annotations are adjusted automatically, sensitivity remaining unchanged. Notice that incremental frequency takes the same value as the span/div at each variation of the SPAN/DIV control. If necessary, the REF FREQ rotary control can be used to align the peak of the response with the dashed vertical line as the frequency span is reduced, or SIG TRACK [15] can be pressed to do this automatically (refer to Fig. 3-5).

The smallest value of frequency span possible using this control is 10 Hz/div. To increase the resolution further it is possible to override the AUTO resolution bandwidth selection by pressing the RESOLUTION BANDWIDTH ↓ control [33]. This selects the minimum resolution bandwidth of 3 Hz which is the best resolution that can be obtained. The sweep, controlled automatically during this time, is now very slow since narrow filters have long time constants and therefore require long scan times. It is possible to override this AUTO control by pressing the SWEEP TIME ↑ key [32] for an even slower sweep (maximum 20 s/div) with a lower video bandwidth, or the ↓ key for a faster sweep. The faster sweep however is in an uncalibrated condition and the ↓ key would only be used therefore to position the signal at the required reference position more quickly. To indicate this the message 'Sweep uncal' appears at the top of the screen. At faster sweeps the display shifts to the right and the amplitude is reduced. To restart the trace at any time press SWEEP MODE START [31].

Notice the 'bright up' vertical band moving across the screen. This appears whenever the sweep time is longer than 0.1 s/div and identifies the sweep refresh point. It can be switched off or on as required by pressing 2nd FUNCT then sweep mode START (IDENTIFY REFRESH) [31].* Return the controls to their original positions such that the 10 MHz fundamental is at the centre of the screen and is the reference frequency and that sweep time, resolution bandwidth and video bandwidth are all in AUTO settings. Set the span to 10 MHz/div using either SPAN/DIV rotary control [29], or the SPAN/DIV key [13] together with a keypad and terminator entry.

*** NOTE ON ALIASING**

The 2382/2380 sampling system digitizes the signal at the IF detector. To produce an accurate representation on the display at least two samples between the 0.1 dB points are required and therefore a minimum sampling rate of 10 µs (100 kHz) is necessary at the maximum sweep speeds used.

If a low repetition rate, narrow width pulse train is viewed on a wide bandwidth filter, e.g. 1 MHz or 300 kHz, this sampling rate may not satisfy the Nyquist Sampling Criteria and aliasing could result giving spurious shapes to the spectral envelope. If such effects are suspected, reduction of the resolution bandwidth to 100 kHz will eliminate the aliasing.

Reference frequency ↓ or ↑

Pressing the REF FREQ ↓ or ↑ key [17] in AUTO mode causes a decrease or increase in the reference frequency initially equal to one division of the current display. The actual value of the step is therefore equal to the SPAN/DIV control setting (in this instance 10 MHz). Subsequently if required the value of the 'decrease' or 'increase' can be changed using the INC FREQ key [14]. The display moves across the screen and the new reference frequency appears beneath the dashed vertical line, the marginal annotation indicating its value. Return the 10 MHz fundamental to the centre of the screen.

Incremental frequency (INC FREQ)

The decrement or increment produced when REF FREQ ↓ or ↑ is pressed may be set to any value from 1 Hz to 400 MHz with 1 Hz resolution using INC FREQ. Press the INC FREQ key [14]. The message 'Inc freq =' appears in the data entry area of the screen together with instructions for setting INC FREQ to its AUTO mode or new value. Enter 20 MHz using the DATA keypad and terminator and note the above message has been erased and 20 MHz incremental frequency appears in the marginal annotation area in inverse video. Press the REF FREQ ↑ key and the reference frequency annotation changes to 30 MHz. The 30 MHz component of the 10 MHz signal moves to the dashed vertical line at the centre of the display. Press the REF FREQ ↓ key to return to the 10 MHz reference.

The HORIZ POSN control

Initial operation of the PRESET key [36] automatically set the HORIZ POSN control [16] active in the centre reference mode and hence in the previous /DIV operations the reference frequency has been displayed by the dashed vertical line in the middle of the graticule area. Press the HORIZ POSN key [16]. The screen now displays the 10 MHz signal and dashed vertical line at the right-hand side of the graticule area. If HORIZ POSN is pressed again the 10 MHz signal and dashed vertical line are displayed at the left-hand side of the graticule area (refer to Fig. 3-6). Repeated operation of the key moves the 10 MHz signal and dashed vertical line sequentially through each of the three positions in turn. Select the left-hand reference position again. At a setting of 10 MHz/div frequency span the harmonics can be seen adjacent to every vertical graticule line to the right of the refe-rence frequency.

Vary the REF FREQ rotary control [18] and observe the change in the reference frequency annotation and how the new reference spectral line moves to the left-hand expand point. Vary the SPAN/DIV rotary control and note that the spectrum is expanded and compressed about the left-hand side of the screen. Return the control to its original position so that the reference frequency is 10 MHz and reset the HORIZ POSN key to the centre reference mode. Set the frequency span to 100 kHz/div and the incremental frequency to its AUTO mode. The AUTO mode is set by pressing INC FREQ and any terminator key e.g. Hz.

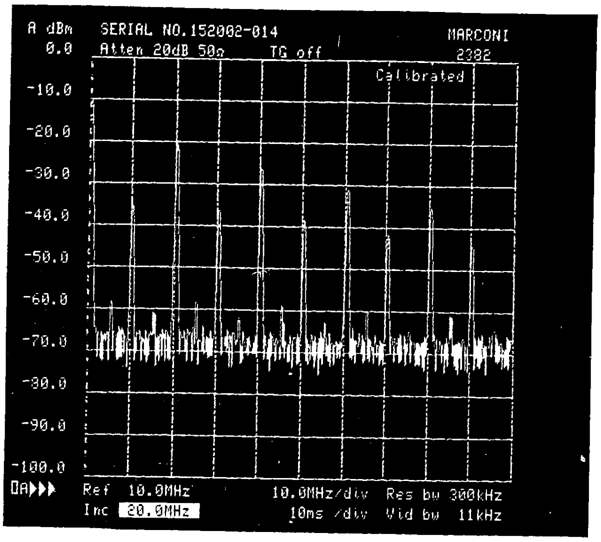


Fig. 3–6 The left–hand reference mode (/DIV)

Reference level and vertical scale controls

Initially the vertical scale [24] is set to 0 dBm, 10 dB/div and the REF LEVEL set to 0 dBm automatically by the operation of the PRESET key. In addition the A B SELECT control is in the 'A' state denoted by the green key–light being lit above the letter 'A'. The top of screen reference level is changed using the DATA keypad. Press the REF LEVEL key [11] and the message 'A&B Ref levels =' appears in the data entry area of the screen. Enter –15 dB using the keypad and terminator key and note that the message is erased and the required reference level of –15 dBm is displayed on the top line of the graticule, the display moving accordingly. Reset the top of screen reference level to 0 dBm using the same procedure.

Press the REF LEVEL ↑ key [25] and note that the vertical scale dB/div remains the same but the top of scale reference level changes by 10 dB. The REF LEVEL ↓ and ↑ keys change the reference level in 10 dB steps, the display moving accordingly as the sensitivity is either decreased or increased. Make the top of scale reference level –10 dBm to set the peak of the 10 MHz signal at the top of the screen. The 10 dB/div vertical scale setting gives minimum resolution.

Press the VERTICAL scale 5 dB/div key [24] to increase the vertical resolution, and observe that the top graticule line remains the same and indicates a reference level of –10 dBm but the left margin annotations change such that the bottom of the screen is now –60 dBm. Press the 2 dB/div key. The reference level remains the same again and the bottom of the screen is now –30 dBm. When the 1 dB/div key is pressed, the reference level is still –10 dBm but the vertical resolution is further increased and the scale annotations have an additional decimal place. Similarly the 0.5 dB/div scale annotations have two places of decimals. The extent of the scale is –20 dBm on the 1 dB/div range and –15 dBm on the 0.5 dB/div range.

Reference level (rotary control)

The top of screen reference level can also be changed using the rotary control [25]. This is a fine control however, whereas the reference level increment keys are coarse controls. Rotating the control anti-clockwise reduces the sensitivity, reference level increases and the trace moves down the screen. The reference level changes in steps which vary according to the selected vertical scale. For the 10 dB, 5 dB and 2 dB/div keys the steps are 0.1 dB. For the 1 dB and 0.5 dB/div keys the steps are 0.01 dB. Rotate the control clockwise and watch the trace moving up the screen in the same way and to the same extent as above. Refer to Fig. 3–7. The sensitivity increases when the control is moved in this direction and reference level increases. Notice the audible click as the control is rotated. This occurs whenever the input attenuator changes to optimise the dynamic range.

Reference levels can also be set from the keyboard using the REF LEVEL key and the DATA keypad.

The above measurements have all been with respect to a reference of one milliwatt (dBm) but the procedures are the same when making measurements with respect to 1 V (dBV), 1 mV (dBmV) or 1 μV (dBμV). To select dBV press 2nd FUNCT [22] then 5 dB/div and to select dBmV press 2nd FUNCT then 2 dB/div etc.

Similarly, a dB vertical scale can be selected by pressing the 2nd FUNCT then 0.5 dB/div key. In this case the absolute value of the previously selected reference level (–10 dBm) is maintained, but the annotation changes to display a relative reference level with 0 dB at the top of the scale. The value of each major scale division from zero depends upon the setting of the vertical scale /div keys and is that number of dB with respect to the chosen reference level. Subsequent changes to the /div keys cause the picture and graticule annotations to change accordingly so that 0 dB is always at the reference level. The function is used to determine the dB difference between a reference at 0 dB and any other signal. The 0 dB reference is always retained even if the reference level is changed.

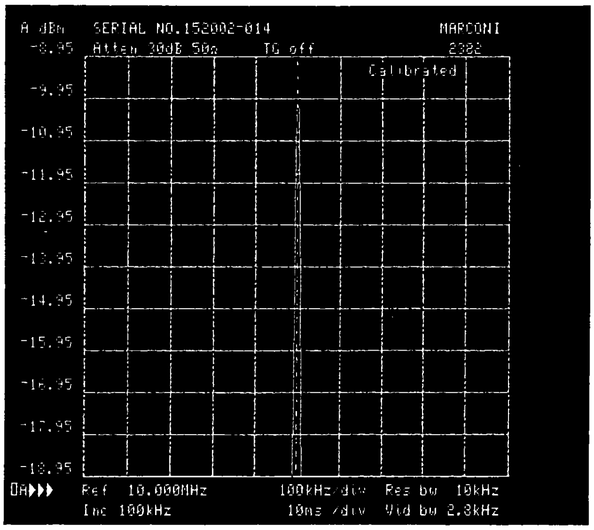


Fig. 3–7 Reference level – fine control display

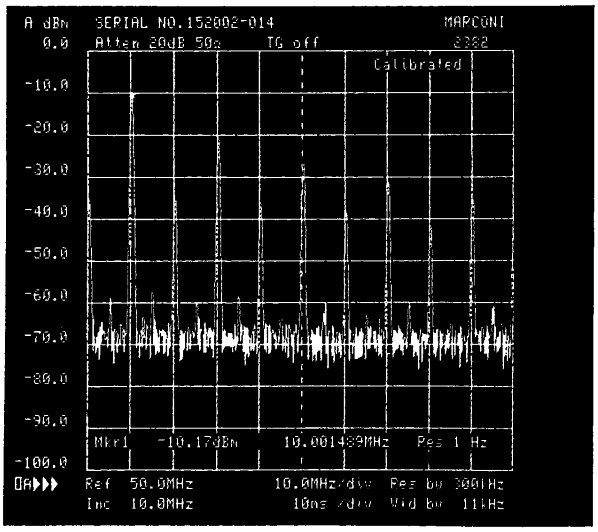


Fig. 3–8 Frequency measurements at 1 Hz resolution using MKR 1 and FREQ COUNT mode

The marker facilities

Display the 10 MHz calibrator signal as explained in the previous paragraphs with PRESET operated and with keys and controls set as follows :

SPAN/DIV [29] or [13]	10 MHz
REF FREQ [12]	50 MHz
REF LEVEL [25]	0 dBm

With markers A B SELECT key set to 'A' press MKR 1 [34]. A bright dot marker appears on the screen in the position occupied when the key was last selected. Adjust DISPLAY A and graticule intensities for best contrast. Display annotations for this marker can be seen on lines three and four from the bottom of the screen (refer to Fig. 3-3). They show the number of the marker in use (MKR 1 in this case) and the level and frequency of the signal indicated by it.

Press the 1 2 MOVE key. The green key-light indicates that marker 1 has been selected and the marker flashes on the screen to indicate that it can be moved. Using the markers MOVE rotary control move the marker to the left or right over the display. The marker follows the outline of the response and the marker annotations change accordingly.

Position the marker on the peak of one of the spectral lines and note the frequency recorded. To enhance the accuracy of the frequency measurement press FREQ COUNT. The annotation 'Freq count' appears at the bottom right-hand side of the screen and the frequency is now measured to a resolution of ±10 kHz. Press 2nd FUNCT then FREQ COUNT (RES 1 Hz). The frequency is now measured at ±1 Hz resolution (refer to Fig. 3-8). Press the FREQ COUNT key again to cancel the mode.

Vary the position of the marker and press PEAK FIND. The bright dot moves to the peak of the largest spectral line currently displayed. Press 2nd FUNCT then PEAK FIND (NEXT PEAK) and the bright dot moves to the next largest peak. Repeat as required. Pressing the 1 2 MOVE key again deselects the MOVE mode.

Press the MKR 2 key and set the 1 2 MOVE control to MKR 2. A key-light shows that MKR 2 is selected and the marker flashes on the screen. Using the rotary control move the dot to a signal peak and note that the screen annotations now show the level and frequency of this marker. In addition the difference in level and the difference in frequency between the two markers is shown (refer to Fig. 3-9). To avoid the continual movement of the display which may affect readability press SAVE A, this stores the display.

Switch off marker 2 by pressing the MKR 2 key again and set the 1 2 MOVE control back to MKR 1 and 'unsave' the A trace by pressing SAVE A again.

MKR 1 SETS REF FREQ. With the reference frequency set to 50 MHz, position marker 1 on to the peak of the 10 MHz spectral line and note that the annotated frequency is approx. 10 MHz. Press the MKR 1 SETS REF FREQ key. The reference frequency is now changed to that specified by the marker and this spectral line and marker now moves to the dashed vertical line at the centre of the screen.

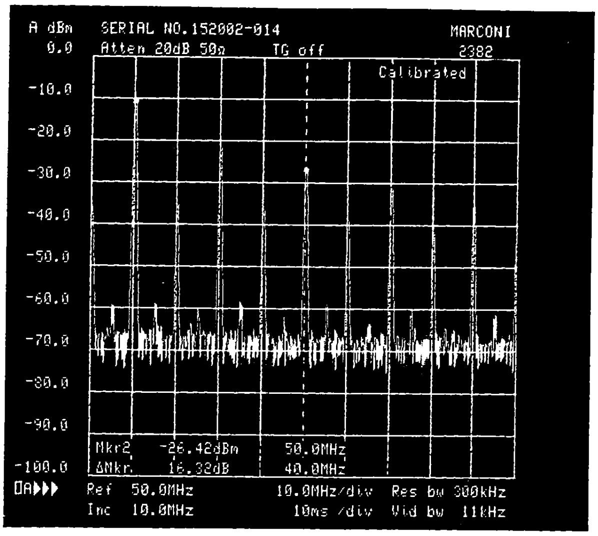


Fig. 3–9 Measurements using both markers

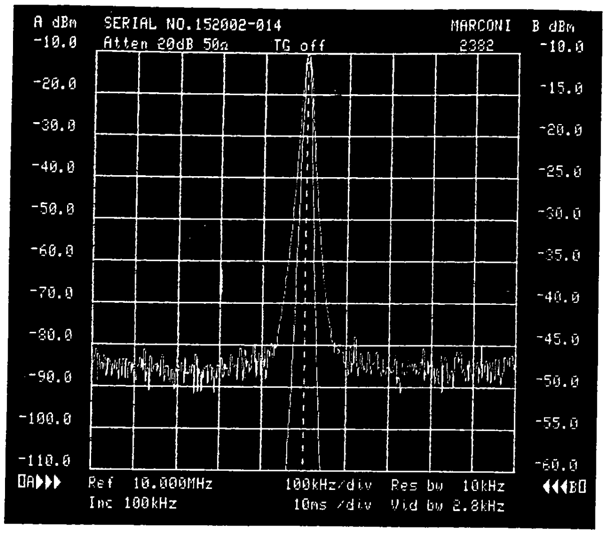


Fig. 3–10 Two signal display – different resolutions

MKR 1 SETS REF LEVEL. Pressing this key causes the reference level to change to that level indicated by the marker. The marker and response are therefore automatically repositioned at the top of the screen. Reset the REF LEVEL to 0 dBm.

MKR 1 SETS INC FREQ. Using this key the incremental frequency can be set to that indicated by the marker. At present, MKR 1 is positioned on the peak of the 10 MHz fundamental, this being the reference frequency displayed at the centre of the screen. Change the incremental frequency from 10 MHz to 20 MHz using the INC FREQ key [14], press the MKR 1 SETS INC FREQ key and note that the incremental frequency annotation is now back to the frequency of MKR 1 in inverse video. This may not be exactly 10 MHz and as the incremental frequency must be exactly 10 MHz for the next exercise, key in this value using INC FREQ. Subsequent operations of REF FREQ ↑ will now move the harmonics of the 10 MHz calibration signal successively to the dashed vertical line for measurement as required – these being themselves spaced at 10 MHz intervals. If INC FREQ is set to 20 MHz and the above procedure repeated, each time the REF FREQ ↑ key is operated the odd harmonics of the calibration signal will move successively to the dashed vertical line – these being spaced at 20 MHz intervals. Pressing the REF FREQ ↓ key successively will return the reference frequency to its original 10 MHz.

ΔF SETS INC FREQ. This key allows the incremental frequency to be set to the difference frequency between the two markers. Press MKR 2 and set the 1 2 MOVE control to MKR 2. Move marker 2 to the peak of the 20 MHz spectral line and note that the difference frequency annotation is approx. 10 MHz. Press the ΔF SETS INC FREQ key and note that the 'Inc' annotation is now the same as the 'Δ Mkr' frequency annotation. Set the display to a 10 MHz reference frequency and switch off the marker controls. Restore the INC FREQ setting to its AUTO value.

The display B and SAVE facilities

All the above operations can be repeated using the alternative channel – DISPLAY B [2]. For this exercise set the A B SELECT key [24] and the markers A B SELECT key [34] to 'B' and press VIEW A to deselect the A channel. Press VIEW B and adjust the INTENSITY B control until a display is obtained. Operate the keys as instructed in previous paragraphs using DISPLAY B controls and note that similar results are obtained except that the vertical marginal annotations are now at the right-hand side of the screen and the identifier at the bottom right of the display now indicates ◀◀◀B instead of A▶▶▶. The symbol '☐' signifies an outlined display. Press 2nd FUNCT then VIEW B to see an infilled one and note the change in marginal annotation (■).

Press PRESET to display the fundamental of the 10 MHz calibration signal on the A channel at the reference frequency and set the controls as follows:

SPAN/DIV [29] or [13]	100 kHz
REF FREQ [12]	10 MHz
REF LEVEL [11]	-10 dBm

Press the SAVE A control [1] and the display is stored in the digital memory. This can be demonstrated by disconnecting the input signal; the screen continues to show the stored display. Reconnect the input signal and press SAVE A again to deselect the mode and return to a 'live' display.

The same signal can now be shown at a different resolution using the DISPLAY B channel. Press VIEW A to deselect the A channel, set the vertical scale A B SELECT to the 'B' position and press VIEW B. Adjust the INTENSITY B control to give a satisfactory picture maintaining the key and control positions as for VIEW A. Press the VERTICAL scale 5 dB/div key to display the peak of the 10 MHz signal only. Now press VIEW A so that both channels are displayed on the screen and can be compared (refer to Fig. 3-10). Setting the A B SELECT control to either A or B allows the vertical scale for that view to be changed. Operating the REF LEVEL controls at this point however, changes the reference level on both displays. If independent control is required, operating 2nd FUNCT then A B SELECT [24] will unlock the reference levels allowing each to be adjusted separately. Under these circumstances the relevant key-light flashes, indicating the 'unlocked' condition. Repeating this operation restores the 'locked' condition and the relevant key-light ceases to flash. As the horizontal marginal annotations are common to both 'live' displays, both the arrowed annotations A▶▶▶ and ◀◀◀B appear.

In this situation if SAVE A is pressed a stored display A is shown against a 'live' display B. Alternatively, if SAVE B is pressed a stored display B is shown against a live display A. With SAVE B pressed operate the A B SELECT key [24]. With A B SELECT set at 'B' changes to the vertical scale can be made but if an attempt is made to adjust horizontal controls such as reference frequency, resolution bandwidth, or sweep time the 'A▶▶▶' annotation disappears and the displayed horizontal marginal annotations remain as they were i.e. those for the 'saved' trace. Trace B does not change but trace A is displayed in a new position relating to the changed horizontal controls. Switching AB SELECT to 'A' causes 'A▶▶▶' to reappear together with the new horizontal marginal annotations. The '◀◀◀B' annotation disappears. Switching A B SELECT to 'B' brings back the stored B display annotations. Return the horizontal controls to their previous positions. Press SAVE B again to deselect the mode and return to a live condition. Display view A and view B as in the previous paragraph.

Press SAVE A and SAVE B. Vertical controls can be used but again the horizontal marginal annotations are related to the stored displays. In the example being illustrated these are the same for both displays but this is not always the case and operating AB SELECT to either A or B would display each one independently as required. If an attempt is now made to adjust reference frequency, resolution bandwidth etc. the new values are set into the instrument but not displayed and traces A and B do not change.

Press SAVE A and SAVE B keys again to deselect these modes. The displays are now related to the changed horizontal control settings.

Voltage measurements

Press PRESET to display the fundamental of the 10 MHz calibrator signal on the 'A' channel at the reference frequency and set the controls as follows:

SPAN/DIV [29] or [13]	100 kHz
REF FREQ [12]	10 MHz
REF LEVEL [11]	0 dBm

To measure the voltage at the peak of this signal press the vertical scale VOLTS/DIV key. In this mode the signal is displayed against a linear ten division scale. The bottom graticule line shows zero and the top of scale annotation is 500 mV. This is an 'initial' value - if the voltage ranges have been used previously the top of screen annotation reverts to the value last used. To change the scale range for optimum sensitivity press the REF LEVEL ↓ or ↑ key. The ↑ key increases the top of scale annotation in a 1,2,5 sequence, decreasing the sensitivity of the instrument. The signal therefore appears to decrease in amplitude. Pressing the ↓ key increases the sensitivity in a similar way and the signal appears to increase in amplitude. For optimum sensitivity in this instance select 100 mV full-scale and determine the voltage at the signal peak. This should be approx. 70 mV RMS.

The vertical scale can also be set using the data keypad and terminator controls. After pressing VOLTS/DIV, press REF LEVEL [11], key in volts/div to give the required top of scale volts/div annotation (noting this must be in a 1,2,5 sequence) then press the appropriate terminator key V, mV or μV. Thus for a top of screen annotation of 1 V enter 100 mV/div. Notice that in the VOLTS/DIV mode rotation of the REF LEVEL rotary control has no effect and the message 'Invalid operation' appears on the screen.

Now press the 2nd FUNCT then VOLTS/DIV keys (LOG). This causes the horizontal lines of the vertical scale to appear in logarithmic form covering a range of two and a half decades. The top of scale annotation initially indicates 1 V and the other major decade boundaries 100 mV and 10 mV progressing towards the bottom of the display. Once again the voltage at the peak of the displayed signal can be assessed (70 mV) and the range can be changed using the REF LEVEL ↓↑ keys, in a 1,10,100 sequence (refer to Fig. 3-11).

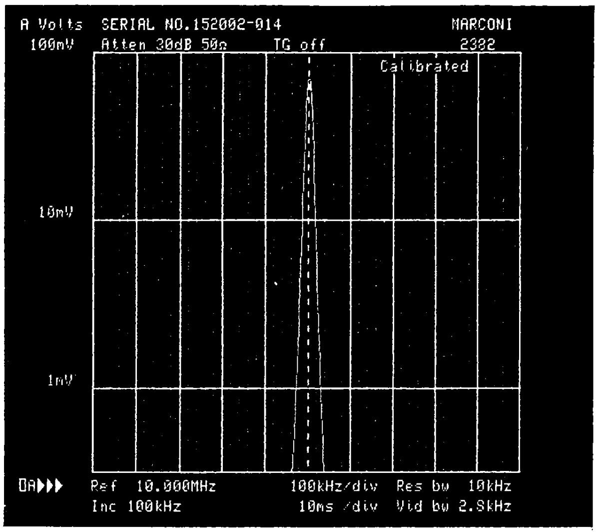


Fig. 3–11 LOG volts, vertical scale

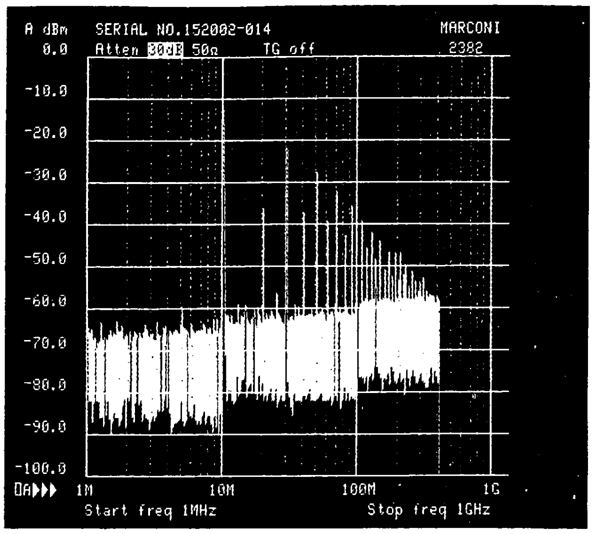


Fig. 3–12 Logarithmic frequency span

Horizontal scale LOG control

Press PRESET to display the 10 MHz calibration signal and its harmonics against a linear 400 MHz horizontal scale. Press horizontal scale LOG [29]. At first press, the logarithmic scale 10 kHz to 100 MHz appears on the screen. Press the LOG key a second time to change this.

At this second press, the prompt message 'Start freq =' appears near the top of the screen. Using the DATA keypad and terminator, key in 1 MHz. A second prompt message now appears – 'Stop freq ='. Enter 1 GHz in the same way. Note the request to enter decade values only.

Almost immediately after the terminator for this entry is pressed the prompt messages are erased and a three decade logarithmic scale is displayed horizontally along the bottom of the graticule area starting at 1 MHz and finishing at 1 GHz. Refer to Fig. 3–12. The frequency of any spectral line on this display can be determined by inspection of the graticule or by using a marker.

Signal track

Using this facility a slowly drifting signal can be automatically maintained at the centre of the display or an 'auto zoom' function can be initiated.

To demonstrate the capture and tracking of a signal press PRESET and select REF FREQ 10 MHz, SPAN/DIV 1 MHz. Using the REF FREQ rotary control offset the reference frequency slightly from the signal. Press SIG TRACK [15], which lights the amber key–light, and observing the display, note how the signal is drawn towards the centre of the screen while the displayed Ref freq is adjusted. Note also that moving the REF FREQ control has no effect since the signal is now in lock. Pressing SIG TRACK again deselects the function. Should, in practice, the signal be lost due to loss of signal strength or too rapid a frequency change the beeper will sound, if the 'Options' board is fitted, 'Lost Track' will be displayed in inverse video and the SIG TRACK key–light will go out.

The ability of the instrument to track a signal is used for the 'auto zoom' facility. To demonstrate this select PRESET and set the markers A B SELECT key to A, then press MKR 1 and position the marker on the required signal by pressing PEAK FIND or NEXT PEAK. Next press the MKR 1 SETS REF FREQ key to position the peak of the carrier on the dashed line. Select SPAN/DIV 40 MHz and press SIG TRACK. Now change SPAN/DIV to 10 Hz. 'Target span 10.0 Hz/div' is shown in inverse video and the instrument automatically steps through decreasing spans until the target span is reached, all the time keeping track of the signal. This operation may be single stepped by setting SWEEP MODE to SINGLE ARM [31] prior to 'auto zoom' and then repeatedly pressing the START key. Afterwards restore repetitive sweep by pres-sing the NORM key. Press MKR 1 to clear the marker from the screen.

Zero span

Using this control, signals may be amplitude demodulated, the modulating signal appearing against a horizontal time axis.

Press PRESET and connect a signal generator to the INPUT of the analyzer. Apply a signal of 30 MHz, amplitude modulated at 1 kHz (or as required e.g. from 1 to 10 kHz) to a modulation depth of approx. 70%. RF output level can be set to a approx. -20 dBm. Set the analyzer REF FREQ to 30 MHz and with the 30 MHz carrier and sidebands suitably displayed on the screen press ZERO SPAN. Set the vertical scale to VOLTS/DIV and operate the ↓↑ REF LEVEL keys to display the signal at maximum resolution. The SWEEP TIME and RESOLUTION BANDWIDTH ↓ and ↑ keys can now be pressed to obtain a satisfactory display (refer to Fig. 3–13).

When the input signal is an unknown amplitude modulated wave the above displays can be used to assess:

a) carrier frequency
b) modulating signal frequency
c) modulation depth
d) modulation distortion

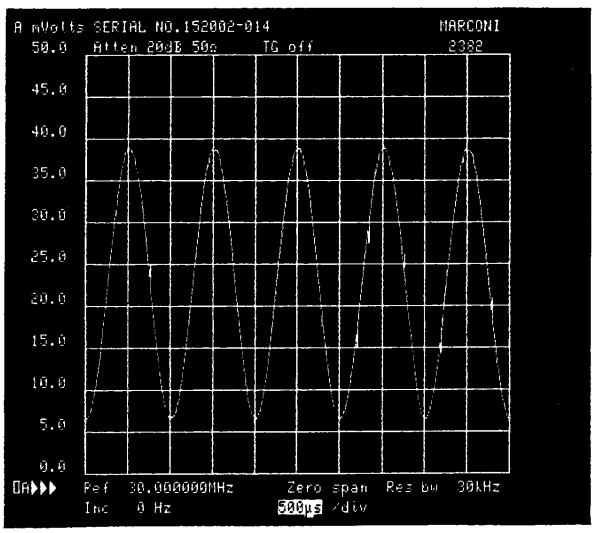


Fig. 3–13 An amplitude demodulated signal (ZERO SPAN)

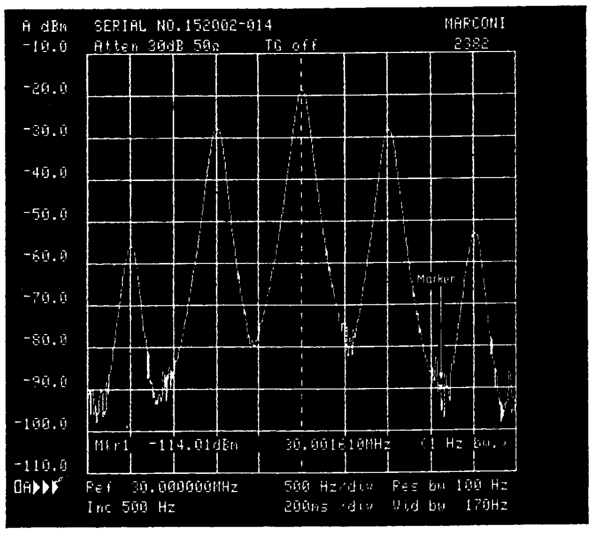


Fig. 3–14 Noise level measurement

The VIDEO TRIG mode is automatically selected for this display but external trigger, using the EXT TRIG socket on the rear panel, and the EXT trigger source key may provide a more satisfactory response. These modes normally provide positive-going edge triggering. Pressing 2nd FUNCT prior to selecting the trigger source gives negative-going edge triggering.

Noise level measurement

Press PRESET and using the signal generator, apply a 30 MHz, -20 dBm signal, amplitude modulated at 1 kHz and modulation depth 70% to the INPUT. Set the analyzer REF FREQ to 30 MHz and select SPAN/DIV 500 Hz and RESOLUTION BANDWIDTH 100 Hz. Set the markers A B SELECT key to A, press MKR 1 and set 1, 2 MOVE [34] to 1. Using the MOVE rotary control position marker 1 in the noise, well clear of the signal. Press 2nd FUNCT then 1, 2 MOVE (NOISE 1 Hz). Now press the display A VIDEO AVG key [1] and full information on the use of this function is displayed on the screen. Using the DATA keypad enter the number of sweeps to be averaged. The higher the number of sweeps the greater the smoothing but the time taken is longer. The maximum number of sweeps possible is 128 (2^7). The key-light flashes and as the sweeps are completed they are counted and shown in inverse video at the bottom of the screen. The reduced level of noise is apparent and upon completion the key-light changes to steady and the low level signal can be seen and measured as required (refer to Fig. 3-14). If VIDEO AVG has been selected in error it can be cleared by operating DATA key 0, otherwise to erase a completed or part completed entry, press the VIDEO AVG key again.

If a signal-to-noise measurement is required, press the 2nd FUNCT and 1, 2 MOVE keys again to deselect the NOISE mode and use MKR 1 to measure the power level of the signal concerned.

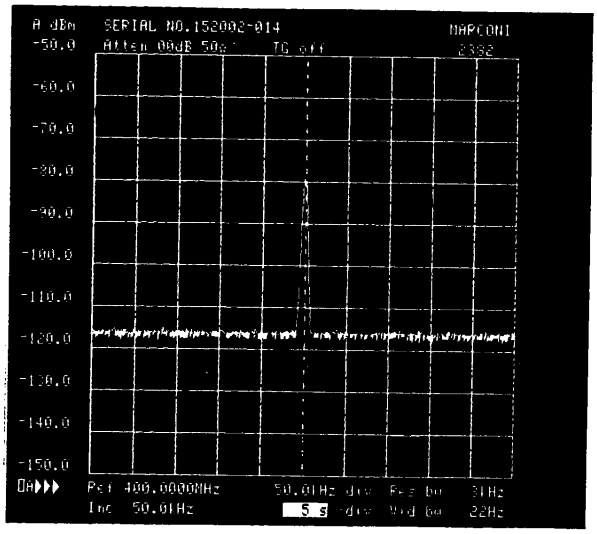


Fig. 3-15 Low level signal measurement by reducing video bandwidth

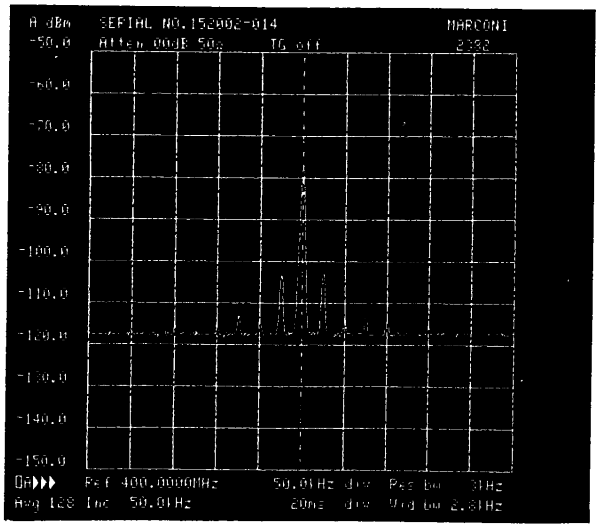


Fig. 3-16 Low level signal measurement by video averaging

Low level signal measurement

Low level signals near the noise level of the analyzer may be indiscernible from the noise. Detection of these signals can be facilitated by:

a) Reducing the resolution bandwidth
b) Decreasing the input attenuation
c) Increasing the noise filtering by reducing the video bandwidth
d) Video averaging

To demonstrate the third method connect the 10 MHz calibration signal to the analyzer INPUT and press the PRESET key. Set REF FREQ to 400 MHz (40th harmonic) and SPAN/DIV to 50 kHz and note that the level of noise is approx. 15 dB p-p. The 400 MHz harmonic is not visible as it is hidden in the noise. Video bandwidth at this point is 2.8 kHz. Increment SWEEP TIME to 5 s/div and observe that the level of noise has now been reduced to approx. 2 dB p-p. As the amplitude of the low level signal has not been similarly affected this can now be measured without difficulty. Adjust reference level and vertical scale dB/div for a satisfactory display (refer to Fig. 3-15). Video bandwidth under these circumstances is much reduced and is 22 Hz.

The above method for measuring low level signals requires a very slow sweep to achieve results. The second method using video averaging allows a more instantaneous display and changes in noise smoothing can be seen almost immediately. Set the analyzer controls so that REF LEVEL is 0 dBm, VERTICAL scale is 10 dB/div and RESOLUTION BANDWIDTH and SWEEP TIME are at AUTO. Press the display A VIDEO AVG key and full information on the use of this function is displayed on the screen. Using the DATA keypad, key into the instrument the number which gives the required sweeps to be averaged. The higher the number of sweeps the greater the smoothing but the time taken is longer. The maximum number of sweeps possible is 128 (2^7). The key-light flashes and as the sweeps are completed they are counted and shown in inverse video at the bottom of the screen. The reduced level of noise is apparent and upon completion the key-light changes to steady and the low level signal can be seen and measured as required (refer to Fig. 3-16). If VIDEO AVG has been selected in error it can be cleared by operating DATA key 0, otherwise to erase a completed or part completed entry, press the VIDEO AVG key again.

The store/recall function

To put the previous control or other settings into store as well as go/no-go limit masks (see below) press the STORE key [23], and the screen displays a menu of store operations. Press DATA key 1, the STORE SETTING mode, and then the DATA key corresponding to an empty or an unwanted unprotected store location. The current operational status of the instrument is now stored at this memory location and any unprotected data previously held here is overwritten. For identification the chosen location may be annotated by using the TEXT key [10] to add a suitable caption to the required display before performing the 'STORE' sequence. If no caption is present the reference frequency is automatically entered into the store location.

To verify that the current operational status has been stored, change the instrument settings and then press RECALL [23]. Key in the previously selected location using the DATA keypad and the original control status and display is returned to the screen. As an alternative, store the current operational status in location '1'. Now when the analyzer is switched OFF and then ON again the control settings are displayed at once without the necessity of having to recall them since the instrument powers up to STORE 1 settings.

To protect a stored display, press the STORE key to display the store operations and press DATA key 4. This selects the PROTECT mode and when the data key corresponding to the chosen location is pressed the location is then protected. The only way to overwrite this protected store in the future is to first unprotect it by pressing STORE, DATA key 5 and then the data key corresponding to the location to be unprotected. The normal overwriting procedure described previously can then be followed.

Disconnect the 10 MHz calibration signal from the analyzer INPUT.

Normalize using tracking generator

This facility compensates for frequency response errors incurred by the Spectrum Analyzer connecting cables and test fixtures when measuring the response of a filter, amplifier or other frequency-conscious device.

Press PRESET and key in the frequency span required by using the SPAN/DIV key [13] and the DATA keypad (1 MHz/div in this example). Press REF FREQ and key in the centre frequency to be used in the same way (9 MHz). Press TRACK GEN to select the tracking generator and if necessary reset its output level using the 2nd FUNCT then REF LEVEL (SET TG) keys and the data keypad; refer to '2382 Control Functions' [35]. Press NORMALIZE [6] causing the amber key-light to come on. The annotation 'Connect test fixture then press NORMALIZE' appears in the data entry area of the screen. As instructed, connect the test fixture or connecting leads between the TRACKING GENERATOR output (Fig. 3-1 ④) and the analyzer INPUT. The screen displays the frequency response of the test fixture and cables. Press NORMALIZE again. The displayed message changes to 'Normalized' and a single sweep at the bottom of the screen is executed. Connect the device to be tested (in this case a 10 MHz high-pass filter) into the test fixture. The resulting response is now that for the device only – the effects of the extraneous circuitry being nullified (refer to Fig. 3-17). But note that from now on the incoming signal is normalized to the tracking generator level (default -10 dBm). Clear down the function and return to normal operation by pressing NORMALIZE again causing the key-light to go out.

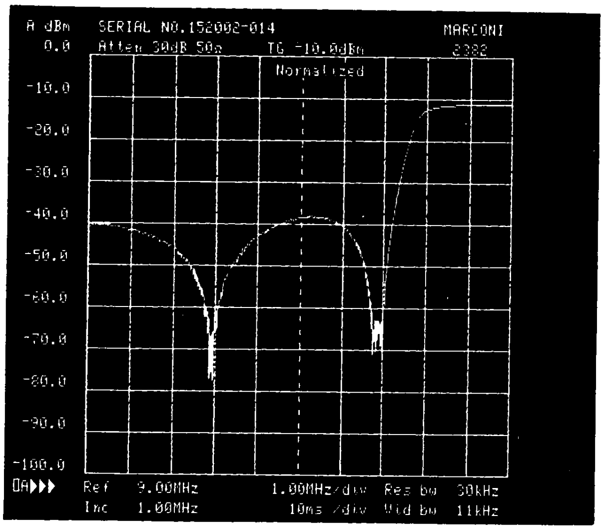


Fig. 3-17 Frequency response of a filter using the NORMALIZE facility

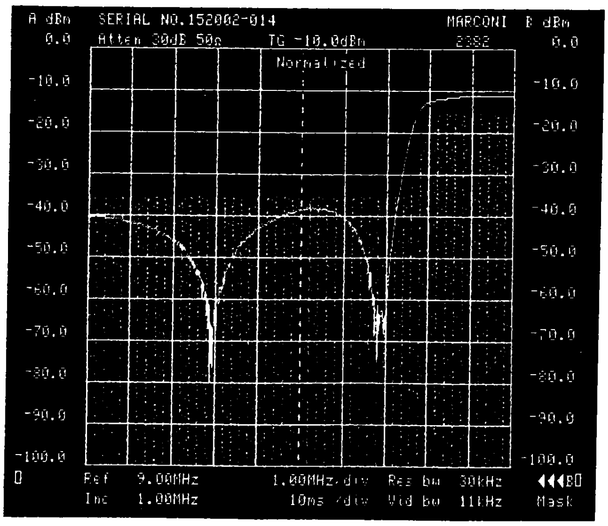


Fig. 3-18 Filter frequency response with limit mask

Limit mask

Using the data keypad, upper and lower limit boundaries can be entered into the 'B' store to provide a go/no-go limit mask. To demonstrate this the displayed frequency response of the filter previously tested can be checked against a limit mask entered in the following way.

Maintaining the control settings used above, press VIEW B, set the vertical scale AB SELECT key to B and the front panel controls as for display A. Press VIEW A and VIEW B to clear the displays from the screen. Press 2nd FUNCT then SAVE B keys (MASK). This displays a menu of mask operations on the screen. From this menu, to enter upper limit boundaries, press DATA key 1 and observe that the screen now displays a table into which a maximum of eight levels and eight corresponding frequencies can be inserted. After these have been entered press DATA key 0 to exit back to the mask menu.

For the lower limit boundaries press DATA key 2 and again a maximum of eight levels and eight frequencies can be inserted. As the levels and frequencies are keyed in, the upper and lower profiles of the mask appear on the screen. Exit from the menus and press VIEW A.

The frequency response of the filter can now be compared with the go/no-go limits which are overlaid upon it (refer to Fig. 3-18). Press 2nd FUNCT then VIEW A (INFILL) for an alternative display.

Mask values are retained in volatile memory. To save a mask use the STORE key. To modify part of the stored limit profile only, return to the menu by selecting MASK, choose the appropriate entry mode and key in the relevant ordinate changes. Alternatively the DELETE key can be used to remove a setting.

Once the mask is set up in this way, it is only necessary to substitute filters of the same type to rapidly check that each performs within specified limits.

Disconnect the test fixture and tracking generator signal from the input.

External standard input

To use this facility, apply a 1, 2, 5 or 10 MHz ±1 Hz signal at a level of -15 to +15 dBm to the EXT STD BNC socket at the rear of the RF unit. 'Ext std' is displayed on the screen to show that system lock has been achieved (Fig. 3-3 ⑥).

To demonstrate correct functioning, first connect the STD 10 MHz OUTPUT signal (Fig. 3-1 ⑤) to one channel of a dual trace oscilloscope, and the external standard signal to the other channel. If the oscilloscope is triggered by the external standard, the 10 MHz signal will drift across the oscilloscope screen because the two frequencies are not synchronously locked. If the external standard is now also fed to the EXT STD socket on the rear panel of the analyzer, the drift of the 10 MHz signal will cease, showing that system lock has been achieved.

Intermodulation testing

With the RF ATTEN [26] set at AUTO and a signal within the measurement range of the analyzer applied, the RF input attenuation is set to give the optimum trade-off between low noise and low intermodulation.The RF attenuator can be controlled manually however to operate in either a low noise or low intermodulation mode. Under these circumstances, if the value of the input attenuation is lower than its AUTO setting the mixer input may be overloaded. As a result, internally generated distortion products can be displayed which may appear to be input signals. It is necessary to be able to recognize these products and this can be done by pressing the INTMD IDENT key [27].

To demonstrate this, press PRESET and set REF FREQ to 10 MHz and REF LEVEL to 10 dBm. Connect a signal generator set to give a sinusoidal output of 10 MHz at +0 dBm to the input of the analyzer. Display the 10 MHz signal at the left-hand side of the screen and using the SPAN/DIV control decrease the frequency span to 5 MHz/div. Press the RF ATTEN ↓ control until the RF attenuation level shown on the screen in inverse video is 0 dB.

Note the 20 MHz and 30 MHz distortion products (refer to Fig. 3–19). Setting the INTMD IDENT key repeatedly ON and OFF will confirm whether these signals are internally generated, if their amplitude decreases and increases under these conditions then instrument-generated distortion is occurring. The amplitude of the fundamental remains almost unchanged. High level input signals causing distortion products such as these should be attenuated to eliminate this condition. Self-generated intermodulation products can also be produced by high level input signals. These can be identified in the same way. Set RF ATTEN to AUTO.

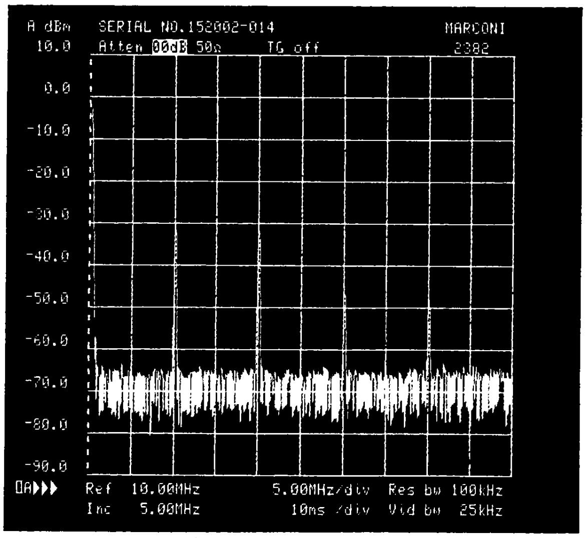


Fig. 3–19 Internally generated distortion products

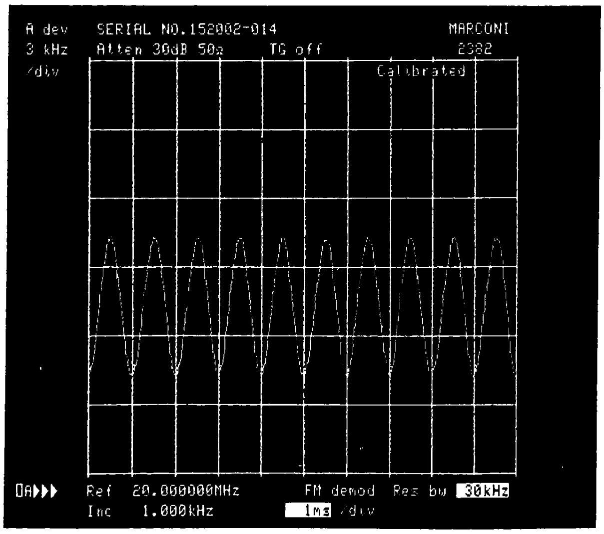


Fig. 3–20 A frequency demodulated signal (FM DEMOD)

Trace exchange (A↔B)

To demonstrate the use of this control and experience the display of amplitude modulated signals, adjust the signal generator to give a sinusoidal output of 100 MHz at −10 dBm to the input of the analyzer, and set keys and controls as follows:

PRESET	ON
REF FREQ	100 MHz
SPAN/DIV	10 kHz
REF LEVEL	−10 dBm

Display the signal at the centre of the screen and press 2nd FUNCT then VIEW A to 'infill' the trace and SAVE A to store it. Press VIEW A to delete the trace from the screen.

Press VIEW B and key in SPAN/DIV 500 Hz. Amplitude modulate the input signal at a frequency sufficient to show a good separation between the carrier and sidebands at a depth of about 50%. Press 2nd FUNCT then vertical scale A B SELECT to unlock the reference level. Set A B SELECT key to 'B' and key in a reference level of 0 dBm. Rotate the REF FREQ control to offset the displayed signal by approx. three graticule divisions. Press VIEW A to show both signals on the screen then press the A↔B key noting the change in the display.

It will be apparent that the contents of the A and B data stores have been interchanged. Press the VIEW keys alternately to prove the action. Note that the SAVE mode is automatically set when A↔B is pressed before the contents of the stores are interchanged.

Trace arithmetic (A−B→A)

To demonstrate the use of this control and experience the display of frequency modulated signals, change the input signal to 20 MHz and set keys and controls as follows:

PRESET	ON
REF FREQ	20 MHz
SPAN/DIV	1 kHz
REF LEVEL	0 dBm

Frequency modulate the input signal using a modulating signal of about 400 Hz and a deviation of 3 kHz and adjust the signal generator output to −10 dBm. Press SAVE A and VIEW A to store and delete the trace from the screen.

Press VIEW B and vary the deviation on the signal generator slightly to 4 kHz. Press VIEW A to bring back the stored image then press A−B→A. Press VIEW B.

The difference between the two displays can now be seen about a centrally placed horizontal axis, annotated 0 dB. By adjusting the signal generator deviation gradually back to 3 kHz this difference is steadily nullified. Press A−B→A again to cancel the function, then press VIEW B and the two displayed signals can be seen to be identical.

The main use of the A−B→A control is to compare the response curves of two filters which are almost the same.

FM DEMOD

This is set up in /DIV mode. Set the signal generator to 0 dBm at 20 MHz, frequency modulated at 1 kHz and deviation 30 kHz. Set REF FREQ to 20 MHz and adjust the REF LEVEL rotary control to position the largest signal at the top of the screen. Press 2nd FUNCT then ZERO SPAN (FM DEMOD). Operate the RESOLUTION BANDWIDTH ↓↑ keys to change the vertical scale (e.g. to 3 kHz) to display the signal at a reasonable amplitude. Use SWEEP TIME to change the horizontal scale (e.g. to 1 ms/div) to show the modulating signal more clearly. Finally, use the REF FREQ rotary control to move the trace vertically to a suitable position on the screen (refer to Fig. 3-20).

REMOTE OPERATION

The 2382/2380 can be remotely controlled over the GPIB. All functions (apart from power ON, A and B intensity controls, graticule intensity control and those related to the second marker) on both units are controllable via the 24-way socket on the rear panel (refer to Fig. 3-2 ⑭). This socket allows the instrument to be coupled to a suitable GPIB controller.

The analyzer responds to a remote command from the controller in the same way as it does to a local front panel command. Text and both A and B traces can therefore be displayed on the analyzer CRT by remote commands. General programming concepts and procedures are set out in IEEE Standard 488-1978 and IEC Publication 625-1. An introduction to the instrument bus, principles of operation, commands, data transfer etc. is given in 'The GPIB Manual' (H 54811-010P). In addition, the 'GPIB Operating Manual' (H 52382-900A) Vol. 1A, supplied with the instrument, gives full details of GPIB operation (refer to 'Accessories' in Chap. 1).

The 2382/2380 has talker, listener and talk only capabilities. One address is used for talk and listen and is initially set by means of the address switch which is positioned on the rear panel beside the GPIB connector (refer to Fig. 3-2 ⑭). The address is set as the sum of the numbers switched e.g. for address 12, the 8 and 4 switches are pressed to the left and all the others to the right. Addresses 0 to 30 are available; 31 puts the analyzer in talk only. At power up the instrument's internal address register is updated to the setting of this address switch and the address appears on the CRT display if the 2nd FUNCT key and then the LOCAL key are pressed. The status of the instrument's software etc. can be read over the GPIB and also displayed by pressing 2nd FUNCT then RECALL.

Capability codes to identify the interface functions applicable to the instrument are marked on the rear panel, just above the GPIB address switch. They are also listed below.

Indicating lights on the front panel (Fig. 3-2 ②) show when the instrument is under remote operation (REMOTE indicating light ON) and when it is being addressed by the controller (ADDRESSED indicating light ON). Under remote operation all front panel controls except LOCAL are disabled to guard against manual intervention. Pressing the LOCAL key restores manual control under these circumstances, but if the controller sends the local lock-out command the LOCAL key is disabled and to restore local operation a further command GTL - go to local - is necessary.

Available GPIB functions

The fundamental communication capabilities provided by the GPIB are as follows :

Source handshake (SH1)	– complete capability
Acceptor handshake (AH1)	– complete capability
Talker (T5)	– basic talker, serial poll, talk only, unaddress if MLA
Listener (L4)	– basic listener, unaddress if MTA
Service request (SR1)	– complete capability
Remote/local (RL1)	– complete capability, when in remote or local lock out, selected groups of keys can be enabled and disabled using commands sent over the bus
Device clear (DC1)	– complete capability, the instrument adopts its preset state
Device trigger (DT1)	– complete capability
Parallel poll (PP0)	– no capability
Controller (C0)	– no capability
Open collector devices (E1)	– as opposed to tristate devices.

CONTROL FUNCTIONS - 2380

A description of the function of each control key can be found by obtaining its location number from Fig. 3-30 or the Index of keys (Table 3-4) and relating it to the relevant part of this paragraph. A list of 'hidden' functions is also provided (Table 3-3). Where a group of controls is identified, an additional figure shows the keys covered by that particular location number. Functions becoming active upon operation of PRESET [36] have green lettering on their keys.

Note ...

If a key requiring data entry is pressed in error, the selected function can usually be cleared by pressing the DELETE key [21]. When this does not apply, the screen menu gives the information for clearing a function. The INTENSITY controls can be used to fade out the display if necessary while reading the menu.

1 DISPLAY A

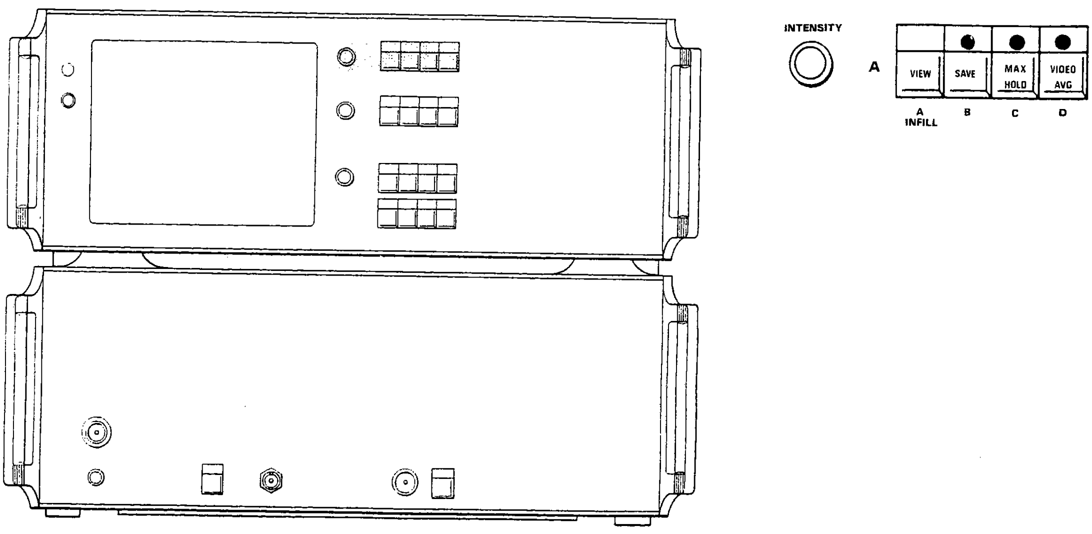


Fig. 3-21 Display A controls

VIEW (green letters)
Operation of this control continuously outputs the contents of the A display store to the CRT screen. Successive operations cause the function to interchange between the ON and the OFF state.

In the ON state the brightness of the display can be adjusted by means of the adjacent rotary INTENSITY control.

INFILL (2nd FUNCT then VIEW)
When the 2nd FUNCT key is operated followed by the VIEW key the display changes from the normal 'line draw' mode to an 'infill' mode. The display reverts to 'line draw' mode when the operation is repeated. The 'infill' mode presents information in a histogram type format whereas in the 'line draw' mode, an outline of the trace is displayed on the screen. An infilled or outlined square, as appropriate, is positioned next to the A▶▶▶ annotation.

SAVE

Successive operations of this key cause the function to be turned ON and OFF. A green key-light shows when the SAVE state is operative. In the ON state the signal is stored in the A channel digital memory. With VIEW A ON the contents of the store are displayed on the screen.

2nd FUNCT then SAVE A

These keys can be used to switch the screen's minor graticule lines OFF and ON.

MAX HOLD

When MAX HOLD is selected the maximum signal level recorded at each memory location is retained and displayed on the screen. Successive operations cause the function to interchange between the ON and OFF states. An amber key-light shows when the MAX HOLD condition is operative and the annotation 'Max hld' is displayed on the line immediately below 'A▶▶▶'. The MAX HOLD mode is automatically cleared down when video averaging is in use and is not available in ZERO SPAN and FM DEMOD.

VIDEO AVG

Operation of this key prepares for the signal averaging of a number of sweeps related to display A. The message 'A VIDEO AVERAGING' together with information on the use of a DATA key to select the number of sweeps to be averaged appears in the data entry area of the screen. The DATA key to be pressed is the exponent of 2 which gives that number of sweeps. For example, if 128 sweeps are to be averaged the digit 7 is keyed in ($2^7 = 128$). This average is a running average.

After a single DATA key is pressed, the screen message is replaced by an annotation at the bottom left-hand side of the display stating the number of sweeps to be averaged e.g. Avg 128. This in turn is replaced by the counted sweeps as they are completed. The key-light will flash while the process is running. Upon completion, the key-light will remain on steadily and the total number of sweeps averaged is shown until the mode is cancelled, or a second value is entered. If a VIDEO AVG key is selected in error, it can be cleared by operating DATA key 0. To erase a completed or part completed entry, press the VIDEO AVG key again.

In single sweep mode, repeated operation of the SINGLE ARM key is necessary to achieve the signal average of a set number of sweeps. Operation of the PRESET key sets the number of averages to 1 therefore no averaging occurs. The MAX HOLD mode is automatically cleared down when video averaging is in use.

[2] DISPLAY B

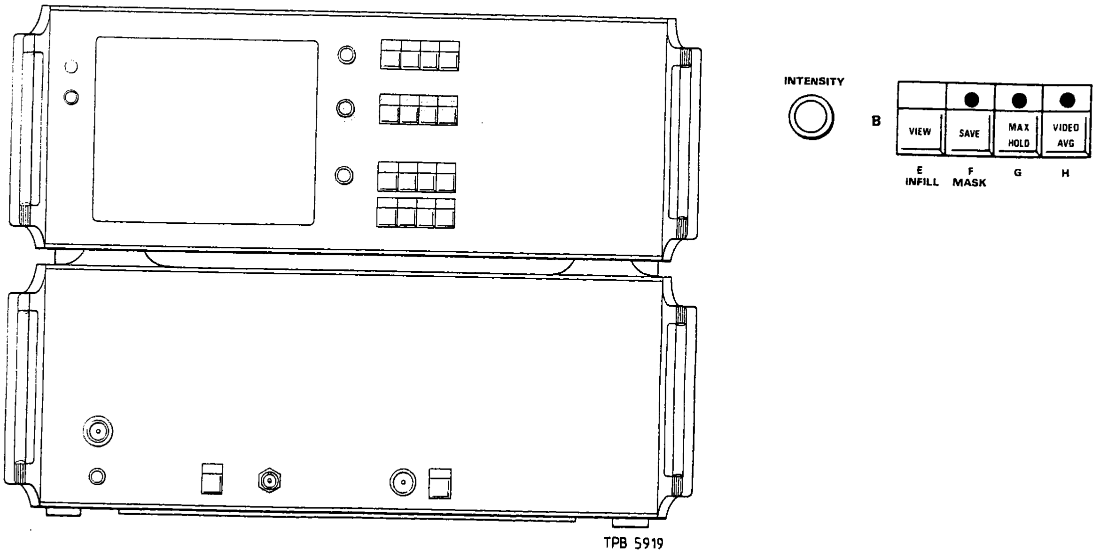


Fig. 3–22 Display B controls

VIEW, INFILL, SAVE, MAX HOLD, VIDEO AVG

Functions are the same as those for DISPLAY A, but read 'B' for 'A' where applicable e.g. B display store not A display store. Video averaging and max. hold marginal annotations are now on the right of the display.

MASK (2nd FUNCT then SAVE B)

If operation of the 2nd FUNCT key immediately precedes the operation of SAVE, upper and lower limit boundaries can be entered into the B store to provide a go/no-go limit mask. A menu of operations first appears on the screen from which it can be seen that by pressing certain DATA keys maximum and minimum levels and frequencies can be entered or cleared to define the limits of the mask. Instructions for entering the mask limits and a screen record of the entries are provided on pressing the relevant DATA keys. Pressing DATA key 0 switches the mode OFF. The limit mask appears on the screen as a bright band between the upper and lower limits when INFILL is not selected or as a pale band when INFILL is selected. In the latter case the display is bright below the lower limit and dark above the upper limit (refer to 'Operating Procedures - Limit Mask').

[3] GRAT (green letters)

Successive operations of this key cause the function to interchange between the ON and the OFF state, permitting the display or suppression of the graticule. In the ON state the brightness of the graticule can be adjusted by means of the adjacent rotary GRATICULE INTENSITY control. Pressing 2nd FUNCT and then GRAT suppresses the graticule annotations. Repeating this operation restores the annotations.

Except in the event of an overload, with VIEW A, VIEW B, and GRAT switched OFF, the EHT unit is switched OFF and the screen goes blank.

This may be used in an unscreened environment whilst a sweep is taken and stored. Electro-magnetic radiation is reduced to a minimum and very low level signal measurements can be made more accurately. Subsequently the display can be switched on again to observe the reading.

4

LOCAL

When under GPIB control, but not in 'local lock-out' mode, pressing this key returns the instrument to 'local' control and extinguishes the REMOTE indicator light. In 'local lock-out' mode, the LOCAL key is disabled.

ADDR (2nd FUNCT then LOCAL)
When this key is pressed the instrument's GPIB address is displayed on the screen for two seconds.

5

GPIB PLOT

This function enables a GPIB plotter to be driven via the GPIB socket at the rear of the instrument Fig. 3-2 (14). To execute a plot the GPIB address must be set to 31, using the GPIB switches at the rear of the instrument (Fig. 3-2 (14)). The message 'Warning: GPIB address is not 31' is flashed on the screen in inverse video if the address is not 31.

Note...

Early versions of the Hewlett Packard 7470A Graphics Plotter (Serial nos. up to and including 2250A 20800) may not work satisfactorily with the 2382/2380 Spectrum Analyzer.

When the GPIB PLOT key is pressed a menu is displayed listing the DATA keys to be used for further information.

DATA key 0 exits any of the secondary menus and displays the main GPIB PLOT menu.
DATA key 1 gives a detailed set of instructions on how to set up the instrument and obtain a plot.
DATA key 2 allows a choice of graticules i.e. major, minor, both or none; a choice of A and/or B trace; the annotations required i.e. A display, B display or general.
DATA key 3 allows pen numbers to be allocated for different parts of the display e.g. annotations, major and minor graticule lines etc.
DATA key 4 displays a secondary SET PEN SPEED menu allowing pen speeds to be set using data keys.
DATA key 5 automatically selects SAVE mode and executes the plot.

Pressing the DELETE key aborts the plot. All menus are automatically deleted during the plot and reappear again when plot execution is completed.

OPTIONS (2nd FUNCT then GPIB PLOT)
When these keys are pressed, an options menu is displayed. Standard options selected using DATA keys 1 to 3 are Beeper, Colour palette and Pen plot respectively but these are only available if Conversion kit 46883-735V is fitted. DATA key 0 is used to exit from the options mode and return the instrument to its previous setting. When DATA keys 1 to 3 are pressed a secondary menu is displayed appropriate to the option selected.

The secondary menu for the Beeper option shows that by pressing the respective DATA keys the beeper can be used to indicate an error, end of sweep or an overload. The selection can be turned ON or OFF by repeated pressings of the data key. To exit from the Beeper option back to the main menu, DATA key 0 is pressed.

With the colour palette selected, there is a choice available between normal and strong colours for use on a colour monitor. RGB and sync drives for the colour monitor are available from the OPTIONS socket on the rear panel. By pressing DATA key 1 normal colours are selected. This is a restful display suitable for continuous relaxed viewing. The following colours are used:

Normal colours:-

graticule - low luminance white (grey)
markers - high luminance white
A trace, annotations and text - low luminance red (orange)
B trace, annotations and text - low luminance blue
Top and bottom annotations (except text) - high luminance white or the A or B trace colours if selected.

DATA key 2 selects strong colours. These are for lectures or presentations etc. The following colours are used:

Strong colours :-

graticule - high luminance green
markers - high luminance white
A trace, annotations and text - high luminance red
B trace, annotations and text - high luminance blue
Top and bottom annotations (except text) - high luminance white or the A or B trace colours if selected.

DATA key 0 is used to exit back to the main menu.

In the pen plot mode a detailed secondary menu is displayed and using DATA keys 1 to 5 an X - Y plotter can be controlled via the OPTIONS socket. Facilities have been provided for setting graticule, bottom left, top right; plotting on major, minor, or major and minor graticule lines - or without graticule; choice of A, B, or both displays and actual plot execution - initially at 5 V/s but by using the ↓↑ FUNCTION/DATA keys plot speed can be increased or decreased in a 1, 2, 5 sequence from 1 V/s to 200 V/s. The DELETE key is used to abort the plot and DATA key 0 to exit back to main menu. All menus are deleted during plot execution and reappear after plot execution is completed.

6

NORMALIZE

Used in conjunction with the tracking generator output as the stimulus for passive or active frequency domain network analysis, the 'normalize' facility compensates for frequency response errors incurred by the spectrum analyzer test fixtures and leads. This permits the frequency response of the unit under test to be displayed with all external errors removed. The function may be selected on vertical scales dB/DIVISION or LOG VOLTS/DIV and horizontal scales FULL SPAN, /DIV and LOG modes only, for both A and B displays. First operation of this key causes the message 'Connect test fixture then press NORMALIZE' to appear in the data entry area of the screen and an amber key-light goes ON.
The next operation of the NORMALIZE key initiates a single sweep of the screen. If the sweep speed is relatively slow the displayed message changes to 'Normalizing' until the sweep has been executed then 'Normalized' appears. During normalizing several functions are rendered inoperative e.g. a previously selected vertical scale function, dB/division or volts/div cannot be changed. If the sweep speed is fast the message 'Normalized' appears almost instantaneously.
If NORMALIZE is pressed again, the function is cleared down, the amber key-light goes out, and the instrument is returned to normal operation.

7

A-B→A

Successive operations of this key cause the function to interchange between the ON and OFF states. An amber key-light shows when the function is ON.
When operative, the difference in level between the A and B displays is shown on the A display. The facility is therefore used for differential measurements (refer to 'Operating Procedures - Trace arithmetic'). It is not available on VOLTS modes. With VIEW A, VIEW B, SAVE B and SWEEP MODE NORM selected the screen shows the stored reference image 'B' superimposed on the live difference display. If the SAVE A function is selected in place of SAVE B the screen shows the live input signal 'B' superimposed on the live difference display.

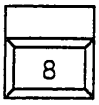
Display with a dB vertical scale

The difference is displayed in dB at the resolution selected for the A display. The horizontal centre line of the display is the difference between the A and B top of screen reference levels in dBs. Thus if the reference levels are the same the centre line is 0 dB with positive differences above and negative differences below this level.

Display with a logarithmic voltage vertical scale

If LOG mode has been selected (2nd FUNCT then VOLTS/DIV) and then A–B→A is pressed, the major horizontal lines of the logarithmic graticule are labelled 10, 1 and 0.1 starting at the top of the graticule. A zero difference is displayed on the graticule line annotated '1'.

A display on the graticule line annotated '10' indicates that signal A is greater than signal B by 1 unit of voltage (depends on scale selected). A display on graticule line 0.1 indicates that signal A is less than signal B by 1 unit of voltage (log ratio = 10:1 or 1:10 respectively). At the top of the scale the annotation 'A' scale units is replaced by the annotation 'RATIO'.



A↔B

Operation of this key causes the contents of the A and B data stores to be interchanged. The key is used mainly in conjunction with the A–B→A control and on single sweep displays when neither data store is being updated. If however the key is pressed when either or both sweeps are live then further processing of data from the input store is suspended, SAVE mode is automatically set and the contents of the stores are interchanged. Additionally, the A (or B) MAX HOLD & VIDEO AVG functions are made inoperative but an averaged or MAX HOLD trace is maintained if that mode has previously been selected.

The function is selected and data interchanged each time the key is pressed. An example on the use of this control is given in 'Operating Procedures - Trace exchange (A↔B)'.

CAL

When this key is pressed an automatic calibration routine is initiated (refer to 'Calibration Sequences' for further details).

When the control is ON and a calibration routine commences, the message 'Calibrating' is displayed on the screen and a calibrating signal replaces the signal at the receiver input. Whilst the calibrating routines are being carried out the display shows the progress and a 'Bad cal' message is displayed if an error is detected. After the routine is complete the input signal is restored and the messages are cleared from the display.

The green key-light shows when the instrument is in a calibrated state and the word 'Calibrated' is displayed at the top of the screen. This light and screen message are OFF when the instrument is in an uncalibrated state.

10

TEXT (yellow letters)

Operating this key selects the caption mode. An amber key–light shows when the function is ON. Successive operations turn the function ON and OFF. In the ON state the keys on the 2380 with yellow characters against them become alphanumeric entry keys and the Hz terminator a space key, enabling a caption of up to 38 characters to be entered on the top line of the display. A cursor indicates the data entry point and may be non–destructively positioned anywhere along this line using the REF FREQ rotary control.

The DELETE key erases the previous character in the caption area and pressing 2nd FUNCT then DELETE erases all characters in the caption area. Alphabetic characters are in yellow adjacent to their respective keys and numeric characters are displayed by pressing the appropriate keys on the DATA keypad. To obtain lower case characters or the non–numeric characters adjacent to the keypad symbols, the 2nd FUNCT key must be depressed before the appropriate character key. Whilst in this mode a message 'Enter annotation Press TEXT key to exit' is displayed in the data entry area of the screen. The instrument operational status cannot be changed whilst in the caption mode. A further operation of the TEXT key returns the 2380 keys to their normal operational functions.

SECRET (2nd FUNCT then TEXT)
When the 2nd FUNCT control key is pressed followed immediately by the TEXT key, annotations regarding reference frequency are erased. This is to prevent unauthorized reading of the frequency to which the instrument is set. Frequency annotations can be restored by repeating this operation.

FUNCTION/DATA

11

REF LEVEL

In the dB/division mode operation of this key changes the top of scale reference level. It is used in conjunction with the DATA keypad and appropriate terminator. Any unterminated keypad entry may be cancelled by operating REF LEVEL again or by repeated operations of the DELETE key.

When the key is pressed the message 'A&B Ref levels =' or 'A (or B) Ref level =' appears in the data entry area of the screen. The message appearing depends on the setting of the AB SELECT key and whether it is in locked or unlocked mode. Immediately after a level has been entered and a terminator pressed this message is erased and the required reference level is displayed on the top line of the graticule. Maximum reference level is +30 dBm, minimum is –160 dBm and data is displayed to 0.1 or 0.01 dB resolution, depending on the selected vertical scale (refer to location [25]).

It should be noted that reference level can also be altered by:–

Vertical scale	REF LEVEL	↓ or ↑
	REF LEVEL	rotary control
Markers	MKR 1 SETS	REF LEVEL

In the linear VOLTS/DIV mode the REF LEVEL key is used in a similar way to set the volts per division scaling in a 1,2,5 sequence. When the REF LEVEL key is pressed the message 'A&B volts/div =' or 'A (or B) volts/div =' appears on the screen. The message appearing depends on the setting of the A B SELECT key and whether it is in locked or unlocked mode. The required scaling is keyed in using the keypad and terminators as before. The scaling is displayed on the top line of the graticule after the terminator is pressed; maximum value is 0.5 V/div, minimum is 0.1 μV/div. Voltage scaling can also be changed using the REF LEVEL ↓↑ keys. Providing the keypad entry is acceptable a voltage terminator will force the lower unit into the VOLTS/DIV mode when previously set to dB/DIVISION and similarly a dB terminator will force the lower unit into the dB/DIVISION mode if previously set to VOLTS/DIV. Operation of the REF LEVEL key is ineffective in the LOG VOLTS/DIV mode; the REF LEVEL ↓↑ keys are used for scale changing.

SET TG (2nd FUNCT then REF LEVEL)

This second function of the REF LEVEL key is used to set the output level of the tracking generator and is associated with the TRACK GEN key (refer to '2382 Control Functions' [35]).

12

REF FREQ

This key is used to change the reference frequency. It is used in conjunction with the DATA keypad and an appropriate terminator to enter a desired reference frequency in the range 0–400 MHz to 1 Hz resolution.

Any unterminated keypad entry may be cancelled by operating REF FREQ again or by repeated operation of the DELETE key. When the key is pressed, the message 'Ref freq =' appears in the data entry area of the screen. Immediately after a frequency has been entered and a terminator pressed, this annotation is erased and the information is transferred to the appropriate margin annotation area.

If the horizontal scale /DIV mode is selected the new reference frequency is moved to the selected left–hand, right–hand or centre reference point depending on the setting of HORIZ POSN, the display moving accordingly. If however, horizontal scale FULL SPAN is selected then the dashed vertical line on the display is moved to the new reference frequency. Should a frequency be requested that exceeds the range of the lower unit, a message 'Out of range' is flashed in the display area for two seconds. The reference frequency remains at its previous value.

In the horizontal scale ZERO SPAN, FM DEMOD and METER modes the synthesizer is adjusted to tune the analyzer to the selected reference frequency. On horizontal scale LOG mode the function is inoperative.

It should be noted that the value of the reference frequency can also be altered by:

Function/data...................... SIGNAL TRACK, REF FREQ ↓ or ↑, REF FREQ rotary control.

Markers .... MKR 1 SETS REF FREQ.

13 SPAN/DIV

Whether in the /DIV or FULL SPAN mode the SPAN/DIV key in conjunction with the DATA keypad and appropriate terminator provides an alternative method for selecting the span required to that given by the horizontal scale SPAN/DIV 24-position rotary switch (refer to '2382 Control Functions' [29]). The ranges available are from 10 Hz/div to 20 MHz/div in a 1, 2, 5 ... sequence and 40 MHz/div. The value selected is indicated in the appropriate screen area.

When SPAN/DIV is pressed the message 'Span/div =' appears in the data entry area of the screen and two seconds after the required span has been entered the message is erased. Any unterminated keypad entry may be cancelled by operating the key again or by repeated operation of the DELETE key.

14 INC FREQ

This key is used in conjunction with the DATA keypad and appropriate terminator to define the magnitude of the frequency step to be applied to the reference frequency when either the REF FREQ ↓ or ↑ control is pressed. Initially in AUTO mode the incremental frequency is set so that this frequency step is one tenth of the frequency span for the FULL SPAN and /DIV controls, but the range available is from 1 Hz to 400 MHz. On ZERO SPAN and FM DEMOD modes the incremental frequency is set at 0 Hz.

Any unterminated keypad entry may be cancelled by repeated operation of the DELETE key.

Pressing the INC FREQ key causes the message 'Inc freq =' to appear in the data entry area of the screen together with brief 'setting up' instructions. After a frequency has been entered and a terminator pressed, this message is erased and the information is transferred to the appropriate margin annotation area. If INC FREQ is followed by the terminator key Hz with no numerical value entered the frequency step reverts to its initial or AUTO value.

It should be noted that the value of the incremental frequency can also be altered by:

Markers .... MKR 1 SETS INC FREQ and
ΔF SETS INC FREQ

15

SIG TRACK

Signals at the centre of the screen can be maintained in this position by pressing the SIG TRACK control even though the identified signal may drift. This mode is an automatic frequency controller, ensuring that the reference frequency of the analyzer is retuned to match the frequency of the input signal. The reference frequency is updated every sweep. Note that in this mode intermediate sweeps are taken as the span is decreased to avoid loss of signal and to provide an 'auto zoom' facility.

Successive operations of this key cause the function to interchange between the ON and OFF states, an amber key–light showing when the ON state is selected.

Operation of any of the following keys will automatically clear the function:

Horizontal scale ... FULL SPAN, LOG, METER, ZERO SPAN, FM DEMOD.

(Examples on the use of this control are given in 'Operating Procedures – Signal track').

16

HORIZ POSN

In the /DIV mode, successive operations of this key cause the reference frequency, indicated by a dashed vertical line, to be positioned at the centre, left–hand or right–hand side of the screen. The display then expands about the selected position as the frequency span is reduced. Since the reference frequency is unchanged the action of the key shifts the display to the left or right as required.
The HORIZ POSN function is inoperative in the FULL SPAN, LOG, ZERO SPAN, FM DEMOD and METER modes, its former setting being stored so that it can be recalled upon return to the /DIV mode. When SIG TRACK is operated the function is forced into the centre reference.

17

REF FREQ ↓ or ↑

Operation of these keys causes the reference frequency to be decremented or incremented in discrete steps. The magnitude of each step is either a value entered via the keypad using the INC FREQ key, a value entered using MKR 1 SETS INC FREQ or a specific AUTO value related to the horizontal scale FULL SPAN or /DIV controls.

If the horizontal scale /DIV mode is selected, the synthesizer moves the new reference frequency to the selected left-hand, right-hand or centre expand point, the display moving accordingly. If however, FULL SPAN is selected then the dashed vertical line is moved on the display to the new reference frequency. In ZERO SPAN, FM DEMOD and METER modes the synthesizer is adjusted to tune the analyzer to the selected reference frequency. On LOG mode this function has no meaning. If a frequency is requested that exceeds the range of the lower unit, a message 'Out of range' is flashed in the data entry area of the screen for two seconds. The reference frequency remains at its previous value.

18 REF FREQ rotary control

This control changes the value of the reference frequency, each new value being shown in the annotation area at the bottom of the screen. It also moves the cursor when in TEXT mode [10] and is used for vertical shift when in FM DEMOD mode. If horizontal scale FULL SPAN is selected, the dashed vertical reference line is moved on the display to that signal required as the new reference frequency. In the /DIV mode, providing the sweep speed is 10 ms/div or faster, rotating this control moves the spectrum across the display. For sweep speeds of 100 ms/div and slower in the /DIV mode, the dashed reference line is moved on the display. Once the line is placed over a chosen signal a new sweep is initiated and the signal is transferred to the selected left-hand, right-hand or centre expand point after only one sweep. The procedure is considerably quickened by using this method. In ZERO SPAN, FM DEMOD and METER modes the control tunes the analyzer to the selected reference frequency. In LOG mode the function is inoperative. If a frequency is requested that exceeds the range of the lower unit, a message 'Out of range' is flashed in the data entry area of the screen for two seconds.

19 DATA

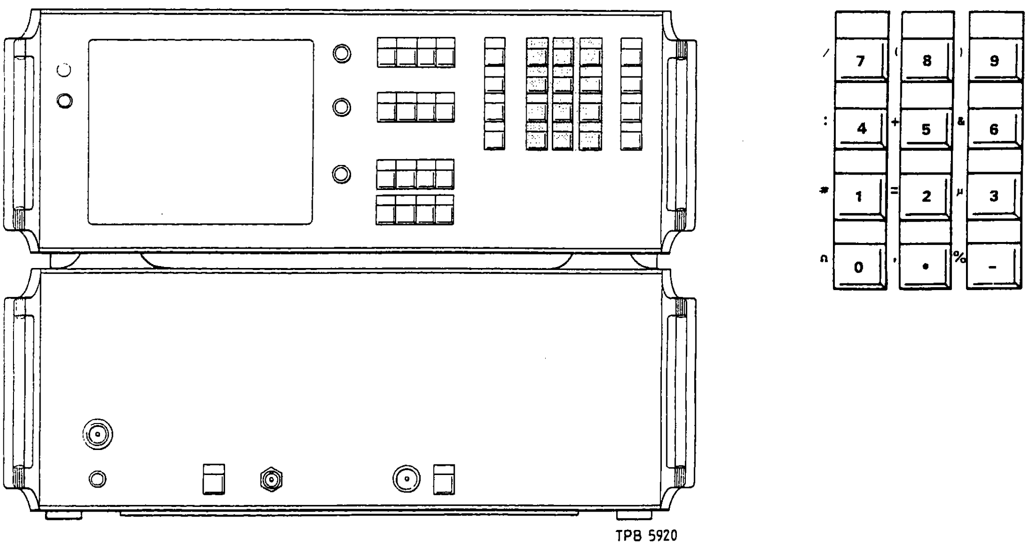


Fig. 3–23 Data controls

Keys 0 to 9, '.' and '–' are used in conjunction with instrument controls such as the REF LEVEL, REF FREQ, SPAN/DIV, INC FREQ and terminator keys to enter required numeric parameters. Prior to the operation of a terminator DELETE can be used to delete entries, one at a time, back to and including the initiator. In addition, when used with STORE, RECALL and A or B VIDEO AVG for example, keys 0 to 9 cause a numeric entry and initiate the respective mode. The 0 key is used to exit from a menu selection.

20 Terminators GHz/dB, MHz/V, kHz/mV, Hz/µV

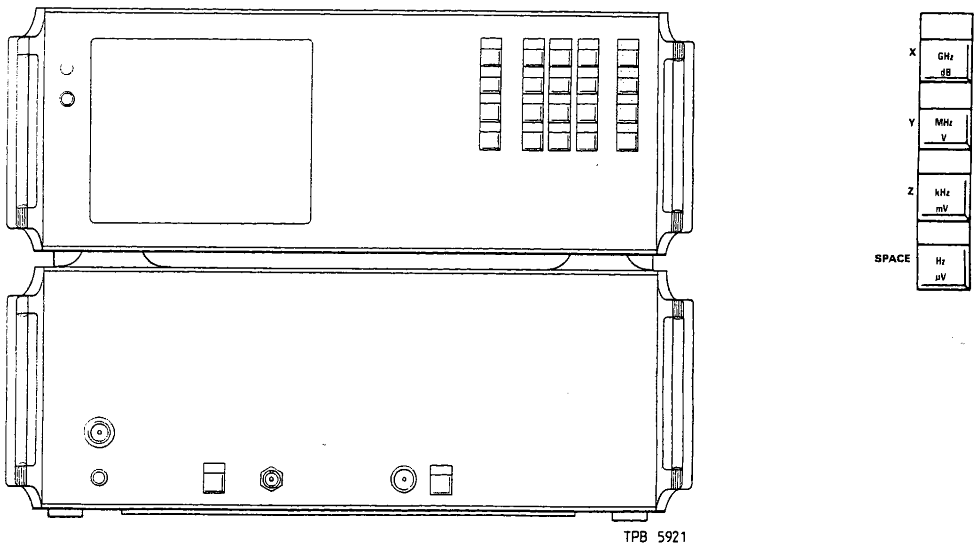


Fig. 3–24 Terminator controls

These keys are used in conjunction with REF LEVEL, REF FREQ etc. and the DATA keypad. They provide a selection of the units which can be specified, each one acting as a terminator to the entry.

21 DELETE

This key can be used to delete a function or unterminated data entered in error when using the FUNCTION/DATA keypad.

22 2nd FUNCT (coloured blue)

The 2nd FUNCT control allows certain keys a second function. These are generally printed on the front panel, adjacent to the key, in blue letters. The description of a key's second function, where applicable, is given with that for the key's primary function. Certain minor second functions are not annotated on the front panel. Refer to Table 3-3. To select a second function the 2nd FUNCT key is pressed, then the required function key. The key–light is ON when the 2nd FUNCT key is pressed, and OFF when the second function has been selected. If the second function has been selected in error, it can be cleared by pressing it a second time.

23

STORE, RECALL

These controls are used in conjunction with the DATA keypad. They permit the storage and recall of up to nine sets of instrument mode or limit mask settings. All nine sets are stored in non-volatile memory in the lower unit and are therefore retained even if the instrument is switched OFF. Store location 1 is the 'power up' state and settings stored here are displayed when the instrument is switched ON. Note that if 'store 1' is empty or contains a mask, the instrument will power up using 'preset' conditions.

STORE

To store the current operational status or current mask the STORE key is first pressed and the screen displays a menu of STORE OPERATIONS which can be selected using DATA keys 0 to 7. Using these keys, settings or masks can be stored, recalled, protected, unprotected and cleared as required.

DATA key 0 exits STORE OPERATIONS mode.

DATA key 1 - STORE SETTINGS MODE, or **DATA key 2** - STORE MASKS MODE list the store locations 1 to 9 and their contents. Location 1 is a 'power up' state. Protected stores are identified by an asterisk and these can only be erased by a deliberate sequence of key operations. Limit masks are identified by M in the first margin of the display. Unused locations are designated 'Empty' and to retain a display unprotected, it is only necessary to press the DATA key corresponding to an empty location. Alternatively, unprotected stores, settings or masks can be overwritten by pressing the DATA key corresponding to that store's location. For reference purposes, prior to storing, a suitable caption may be added to the setting or limit mask before using the TEXT key [10]. This caption will then appear against the chosen location in the list of stores. Failing this, by default, the reference frequency of the stored status or the 'start' and 'stop' frequencies if in LOG mode are displayed at the chosen location. Pressing DATA key 0 returns the display to the 'operations' menu.

DATA key 3 selects the RECALL MODE. Once again the list of locations is displayed and a required display is recalled by pressing the DATA key corresponding to its location in the list. Pressing DATA key 0 exits from the recall mode back to the 'operations' menu.

DATA key 4 selects the PROTECT MODE. The list of locations is displayed and to protect one of these the DATA key corresponding to that location is pressed. Note that even an empty store can be protected for use at a later date. DATA key 0 exits back to the 'operations' menu.

DATA key 5 displays the list of store locations in the UNPROTECT MODE. To unprotect a location, press the DATA key corresponding to the location to be unprotected. The asterisk adjacent to the location is erased. The store can now be cleared if necessary by returning to the 'operations' menu (DATA key 0) and pressing DATA key 6 (see below).

DATA key 6 of the operations list is for the CLEAR MODE. The list of locations is again displayed and subsequently pressing the data key corresponding to a chosen location will empty that store - provided it is unprotected. To clear protected stores they must first be unprotected as detailed in the paragraph above. Return to the 'operations' menu by pressing DATA key 0.

DATA key 7 clears all unprotected stores. DATA key 1 can be pressed to ascertain that the stores are now empty.

RECALL

Providing the store location is known a display can be recalled more quickly by pressing the RECALL key. The message 'Recall store=' appears on the screen and subsequently pressing the DATA key corresponding to the required store location produces the display.

2nd FUNCT then RECALL

This hidden function displays the status of the instrument's software for about ten seconds.

CONTROL FUNCTIONS - 2382

A description of the function of each control can be found by obtaining its location number from Fig. 3–30 or the Index of keys (Table 3–4) and relating it to the relevant part of this paragraph. A list of hidden functions is also provided (Table 3–3). Where a group of controls is identified, an additional figure shows the keys covered by that particular location number. Functions becoming active upon operation of PRESET [36] have green lettering on their keys.

Note ...

If a key requiring data entry is pressed in error, the selected function can usually be cleared by pressing the DELETE key [21]. When this does not apply, the screen menu gives the information for clearing a function. The INTENSITY controls can be used to fade out the display if necessary while reading the menu.

24 VERTICAL scale

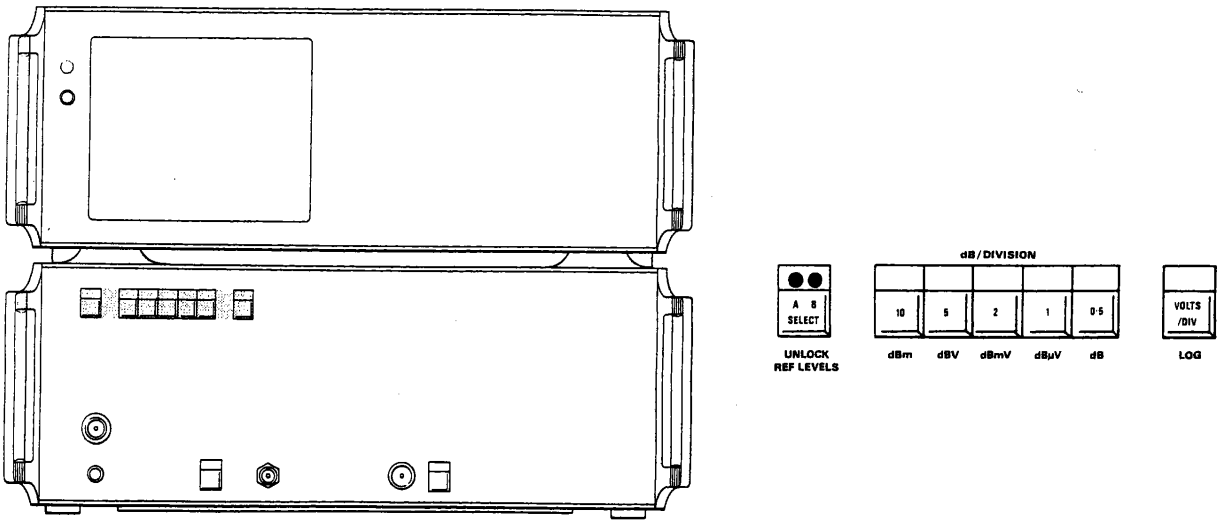


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Fig. 3–25 Vertical scale controls

10 (green figures)**,5,2,1,0.5 dB/DIVISION**
These keys are used in conjunction with the A B SELECT key to set the appropriate display scale. Operation of any of these controls will cause the vertical scale annotation to change to that number of dB per graticule division. The reference level remains unchanged.

2nd FUNCT then 10,5,2,1 or 0.5 dB/DIVISION key
This second function sets the A or B display scale to dBm, dBV, dBmV, dBμV or dB as required. In the latter case, the scale annotation is changed such that the selected reference level is annotated 0 dB. Subsequent increments or decrements of the reference level or scale expansion, cause the trace and graticule annotation to change accordingly so as to maintain 0 dB at the chosen dBm reference level.

VOLTS/DIV
This control key is used in conjunction with the A B SELECT key to select a voltage scale. The ↓↑ REF LEVEL keys or the REF LEVEL key and keypad are used to set the scale to a required voltage range. This is automatically set to 50 mV/div (500 mV top of scale) after using the PRESET key but otherwise the range selected is the one last used. In this mode the signal is displayed against a linear ten division scale.

LOG (2nd FUNCT then VOLTS/DIV)
This second function of the VOLTS/DIV key causes the horizontal lines of the scale to appear in logarithmic increments covering a range of two and a half decades. The major graticule lines, indicating decade boundaries, are annotated 1, 10 and 100 in units of voltage dependent upon the setting of the ↓↑ keys.

Graticule compatibility

A and B displays (both 'live'). Where both displays are live and unlocked:

(a) On VOLTS/DIV only two steps of sensitivity difference are possible.

(b) On FM DEMOD (2nd FUNCT then ZERO SPAN) the sensitivity must be the same on both scales.

(c) On ZERO SPAN the time axes must be the same but the Y axes can be different (limited to two steps on VOLTS/DIV).

The display is limited to having sweeps with compatible data for the A and B scales.

Displays such as log volts for the A display and dB/div for the B display are not possible simultaneously. Table 3–1 summarizes the various possibilities and whether the displays are compatible. On ranges where the displays are incompatible, the A B SELECT key determines the graticule format and the shared annotations.

A and B displays (one or both displays stored). Providing the displays are unlocked there is no limitation on the possible combinations of graticule format.

A B SELECT ('A' coloured green)
Used with the VERTICAL scale controls this key permits the independent setting of the vertical scale units for the two displays VIEW A and VIEW B (the horizontal marginal annotations and vertical reference levels are normally the same for both views). Successive operations of this key cause the function to interchange between the displays, a green key–light showing the one selected. Annotations A►►► and ◄◄◄B in the lower corners of the screen are both displayed when VIEW A and VIEW B are 'live'. The state of the control governs whether the A or B display scale units are changed when the appropriate keys are pressed.

When a stored and a live display are viewed together (e.g. SAVE B operated) and horizontal scale controls are changed, the horizontal marginal annotations can differ for views A and B therefore only one annotation A▶▶▶ or ◀◀◀B in the lower corner of the screen is displayed and this indicates which selection has been made. If A is selected and an attempt is made to adjust reference frequency, resolution bandwidth, sweep time or any parameters affecting the setting of the lower unit the ◀◀◀B arrowed annotation will disappear and the horizontal marginal annotations will be the ones currently being set into the instrument. View B, if displayed, will not change. Switching AB SELECT to 'B' brings back the stored B display annotations.

TABLE 3-1 GRATICULE COMPATIBILITY

B display	A Display				
	Volts/div	Log volts	dB	Zero span	FM demod
Volts/div	YES	NO	YES	YES	NO
Log volts	NO	YES	YES	NO	NO
dB	YES	YES	YES	YES	NO
Zero span	YES	NO	YES	YES	NO
FM demod	NO	NO	NO	NO	YES

When both SAVE A and SAVE B are selected with differing horizontal scale settings, annotation A▶▶▶ or ◀◀◀B indicates the display chosen by the position of the AB SELECT key. Vertical controls can be adjusted as required but if an attempt is made to adjust reference frequency, resolution bandwidth, sweep time etc., no visible change takes place. Nevertheless, new horizontal scale conditions are set into the instrument and when SAVE A and/or SAVE B are deselected the horizontal marginal annotations will show these new conditions.

UNLOCK REF LEVELS (2nd FUNCT then AB SELECT)

If independent settings of the reference levels for the two displays VIEW A and VIEW B are required, the 2nd FUNCT key must be operated, followed by the A B SELECT key. Successive operations of the A B SELECT key cause an interchange between the displays, a green flashing key-light showing the one selected.

25 REF LEVEL ↓↑ controls

dB measurements

When used with the vertical scale dB/DIVISION keys, unless the A B SELECT key is unlocked, these keys decrement or increment the reference level and scale annotation for both A and B displays in 10 dB steps. These also suitably adjust the RF attenuators and IF gain automatically in RF ATTEN AUTO mode. When the A B SELECT key is unlocked the A and B scale annotations can be changed independently.

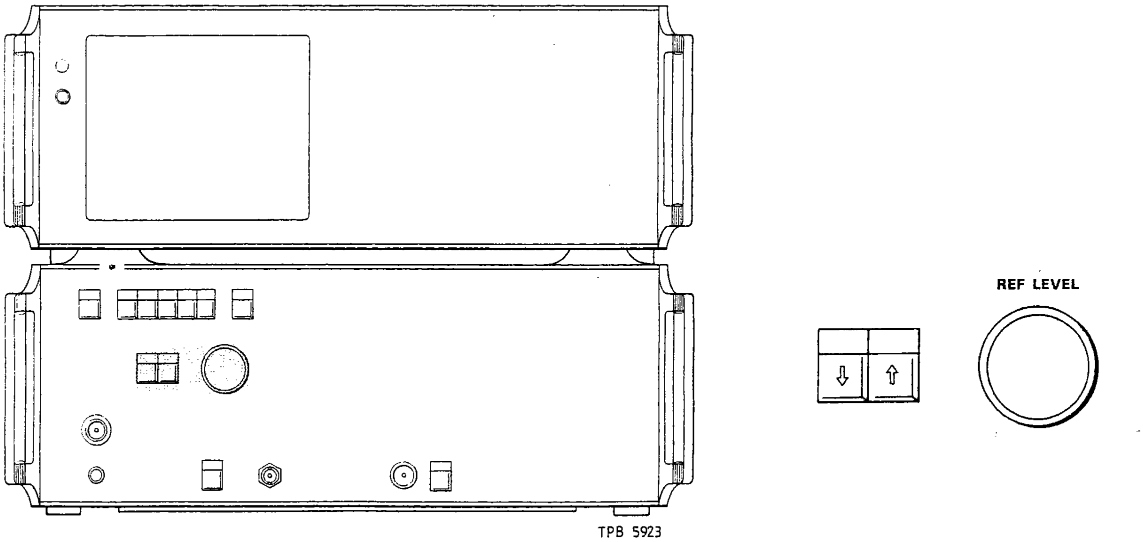

Fig. 3–26 Reference level controls

Voltage measurements

When used with the vertical scale A B SELECT and VOLTS/DIV keys these keys decrement or increment the scale sensitivity in a 1, 2, 5... sequence. The displayed scale annotation varies from 100 nV/div up to 500 mV/div on a 10 division graticule. With both VIEW A and VIEW B displays live and unlocked, difference in sensitivity is limited to two steps. When one (or both) display is saved sensitivity can be adjusted one step only on each side of the saved setting.

In LOG VOLTS mode, a two and a half decade logarithmic voltage scale is displayed and operation of the ↓↑ keys changes the range in a 1, 10, 100 ... sequence from nV up through μV and mV to V (min. 100 nV, max. 10 V top of scale).

Overload simulation (2nd FUNCT then REF LEVEL ↑)

This facility is used to demonstrate the operation of overload protection. Pressing these keys simulates the triggering of the overload circuit as if a high level signal had been applied at the INPUT socket. All characteristics of the overload state are retained, but the function does not test the operation of the latching relay. Press INTMD IDENT [27] to clear.

REF LEVEL rotary control

dB measurements

This control is used as an alternative to the REF LEVEL function/ data key or the ↓↑ REF LEVEL keys to change the appropriate top of screen reference level for both the A and B displays if the A B SELECT key is locked or for the A or B display if the A B SELECT key is unlocked.

The steps vary according to the selected vertical scale. For 0.5 dB and 1 dB/div, the steps are 0.01 dB. For 2 dB, 5 dB and 10 dB/div, the steps are 0.1 dB.

26

RF ATTEN

AUTO (green letters)

When in the AUTO mode, shown by the green key-light, the RF attenuators and IF gain will be set for the relevant display selected, in accordance with the REF LEVEL controls, resolution bandwidth settings and, when appropriate, the SAVE A and SAVE B keys.

Pressing the AUTO key when ON turns automatic selection OFF (fixing RF attenuation and IF gain at their current values). Pressing the key when OFF turns automatic selection ON again.

Care should be taken in the HORIZONTAL LOG mode however - refer to [29] LOG.

↓ and ↑

Operation of these keys causes the setting of the RF attenuator to be decremented or incremented in 10 dB steps from 10 dB to 60 dB. Normally to maintain sensitivity a compensating adjustment is automatically made to the IF gain but in the VOLTS/DIV mode it may be found that the maximum value of RF attenuation available has been reduced to ensure that automatic IF compensating gain can be achieved. In the ↓↑ mode, operation of any other front panel control affecting the overall instrument sensitivity changes the IF gain and not the RF attenuator.

Overload inhibit (2nd FUNCT then RF ATTEN ↑)

Although maximum input level is normally +27 dBm it is possible by pressing the 2nd FUNCT key followed by the RF ATTEN ↑ key, to override the overload trip when measuring signals which have a high peak power but a low mean power. If this is done the message 'No input protection' is displayed on the screen.

CAUTION

Overriding input protection can lead to damage and is not a practice to be encouraged. It should only be done when absolutely necessary. Restore the protection by pressing the 2nd FUNCT then RF ATTEN ↓ key again as soon as possible.

27 INTMD IDENT

The INTMD IDENT key enables any self-generated intermodulation or distortion products to be quickly and easily identified. Pressing this key adds 3 dB input attenuation and 3 dB IF gain, the overall sensitivity therefore remaining the same. If the display is unaltered when the key is pressed and released then any internally generated intermodulation is insignificant to the measurement. Signals which change in amplitude when the key is pressed are intermodulation or distortion products. The level of valid signals should remain the same but the noise floor will rise by 3 dB.

The facility can only be used on live displays. When the INTMD IDENT key is pressed, a new sweep starts and the initial input attenuation value is displayed and also the message:

'Input level of XXX.XXdBQ gives mixer level of YYY.YYdBQ'

where Q is the unit currently being displayed (dBm, dBV etc.), and XXX.XX is also the selected reference level being used. In the VOLTS/DIV mode the key is ineffective.

OVERLOAD CLEAR

The INTMD IDENT key may be pressed in an attempt to clear an 'OVERLOAD' annotation on the display. However, in the event of the overload still being present the annotation will be re-established.

28 VIDEO BANDWIDTH

This AUTO control (green letters), in horizontal scale FULL SPAN or /DIV mode, sets the video bandwidth in association with SWEEP TIME. Pressing AUTO when it is ON, indicated by the green key-light, will deselect AUTO and fix the video bandwidth at its current value. Pressing the AUTO key again deselects the automatic mode, fixes video bandwidth at its current value and turns OFF the green key-light. Manual override is possible by pressing the ↓ or ↑ key, the value of the video bandwidth being displayed on the bottom line of the screen in inverse video interlocked with sweep time. Only one of the two facilities may be under manual control at a time.

In the PRESET mode with FULL SPAN selected, video bandwidth is initially at 11 kHz. In the /DIV mode bandwidth depends upon the span selected. For both FULL SPAN and /DIV, operation of the ↓ or ↑ key approximately halves or doubles the bandwidth at each press to a minimum of 1 Hz and a maximum of 50 kHz. Video bandwidth controls are ineffective in the ZERO SPAN, FM DEMOD and LOG modes.

SWEEP TIME

With the AUTO key (green letters) pressed and the mode operative, in horizontal scale FULL SPAN or /DIV, sweep time is automatically set in association with VIDEO BANDWIDTH to its optimum value. A green key-light shows when AUTO mode is operative. Pressing the AUTO key again deselects the automatic mode, fixes sweep time at its current value and turns OFF the green key-light. Manual override occurs after pressing the ↓ or ↑ key, with the value displayed.

29 HORIZONTAL scale

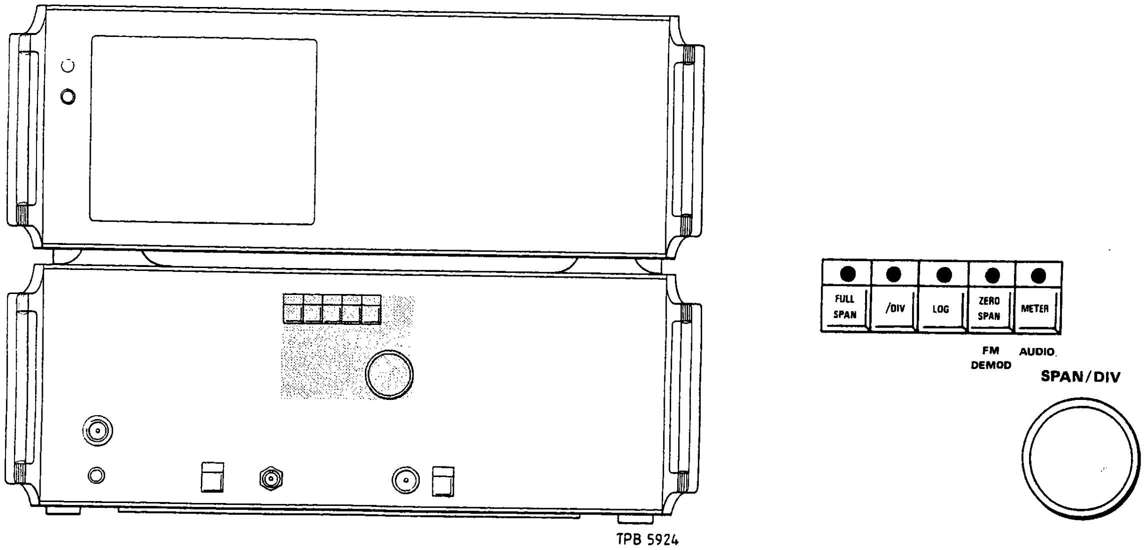

Fig. 3-27 Horizontal scale controls

Keys FULL SPAN, /DIV, LOG, ZERO SPAN and METER are mutually exclusive i.e. the operation of any one will not only enable that function and its green key-light, but will clear down and disable the other functions. The rotary switch control, SPAN/DIV, functions only when the /DIV or METER modes are selected.

FULL SPAN

This control sets the frequency span to the maximum value of 0 to 400 MHz. In this mode the dashed cursor line is positioned at that point on the display appropriate to the current value of the reference frequency. It can be re-positioned over the full display to select any reference frequency required using the REF FREQ rotary control.

/DIV (green letters) **and SPAN/DIV rotary switch**

When the /DIV mode is selected the horizontal scale Hz/div is set to its last used value. In AUTO mode resolution bandwidth, sweep time and video bandwidth are automatically set to produce the optimum display. Subsequently the SPAN/DIV rotary switch is used to select the span required. The value of the span selected is indicated by the displayed annotation in the appropriate screen area. The ranges available are from 10 Hz/div to 20 MHz/div in a 1,2,5 ... sequence and 40 MHz/div and on a 10 division graticule.

LOG

If already in LOG mode when this key is pressed, the prompt message 'Start freq =' appears at the top of the screen as an invitation to set the scale. Otherwise the logarithmic scale last used is shown on the screen. In the latter case if a change of scale is required, a second key press displays the prompt. Note that the request is to enter decade values only. Using the DATA keypad the desired start frequency and appropriate terminator are now keyed in, and a second prompt message appears, positioned below the first, saying 'Stop freq ='. The stop frequency is now similarly entered. As the terminator for this entry is pressed the prompt messages at the top of the screen are erased, and the bottom two lines of screen annotation are erased. The number of decades of frequency span required (which can range from 1 to 7) is evaluated and appears at the bottom of the screen, the required start and stop frequencies being at the left- and right-hand side of the display respectively. The available range is from 100 Hz to 1 GHz.

The sweep moves through the decades starting at the highest on the right and moving progressively to the lowest on the left, the complete spectrum being shown on the screen. The resolution bandwidth is automatically selected at each decade boundary. RF attenuation is normally fixed but if RF ATTEN AUTO is selected then attenuation is automatically optimized for each frequency decade according to the number of decades selected.

CAUTION

In AUTO RF ATTEN mode the RF attenuator can be switched many times during a sweep and continued sweeps may result in excessive attenuator wear.

The REF FREQ control is inoperative in this mode.

Table 3-2 below shows the filters which are selected when carrying out log sweeps. For example, in the range 10 kHz to 10 MHz there are 3 log decades. From the table for the case of 3 log decades displayed, the band-pass filters selected will be 300 Hz for 10 kHz to 100 kHz, 3 kHz for 100 kHz to 1 MHz, and 30 kHz for 1 MHz to 10 MHz.

TABLE 3-2 FILTERS RELATED TO LOG DECADES

Decade	Number of log decades displayed 1	2	3, 4 and 5	6, and 7
100 Hz - 1 kHz	10 Hz	10 Hz	10 Hz	10 Hz
1 kHz - 10 kHz	30 Hz	30 Hz	100 Hz	100 Hz
10 kHz - 100 kHz	100 Hz	300 Hz	300 Hz	1 kHz
100 kHz - 1 MHz	1 kHz	1 kHz	3 kHz	3 kHz
1 MHz - 10 MHz	10 kHz	10 kHz	30 kHz	30 kHz
10 MHz - 100 MHz	100 kHz	100 kHz	100 kHz	100 kHz
100 MHz - 1 GHz	1 MHz	1 MHz	1 MHz	1 MHz

ZERO SPAN
When this key is pressed, VIDEO trigger source is selected and the screen displays the input signal against a time axis. The Hz/div screen annotation changes to read 'Zero'. Sweep speed may be varied as required (refer to SWEEP TIME controls) and the VERTICAL scale controls are used to adjust the amplitude of the display. Real time sweeps occur for sweeps from 20 s/div to 10 ms/div. For 5 ms/div to 5 µs/div the sweeps are sampled and the displayed ordinates (vertical lines) are updated depending upon timebase selected.

FM DEMOD (2nd FUNCT then ZERO SPAN)
This second function of the ZERO SPAN key is used to display frequency demodulated information against a time axis, the vertical scale displaying frequency deviation. It should be noted that FM DEMOD will not function satisfactorily if a.m. is also present. When the keys are pressed, VIDEO trigger source is selected and the Hz/div screen annotation changes to read 'FM demod'. Marker controls are inoperative. Set up on /DIV mode. Using a resolution bandwidth which is 10 times the required kHz/division scale, position the carrier in the centre of the screen. Set REF LEVEL to position the largest signal at the top of the screen and select FM DEMOD. Use RESOLUTION BANDWIDTH ↓ or ↑ to change the vertical scale and use SWEEP TIME to change the horizontal scale. Use the REF FREQ rotary control to move the trace vertically.

METER
Operation of this key causes the display to present a real time readout of level variation in the form of a vertical bar chart at the centre reference frequency point on the display. The bar will normally be in outline but it may be filled in if INFILL is selected (refer to DISPLAY controls). MKR 1 and 1,2 MOVE are automatically

activated and the marker is directed to the peak of the bar. The signal level is thus also displayed. Meter mode uses a /DIV type display with centre reference. It can be used on both live and stored displays but the point to which the marker is tuned is live under all conditions. In this mode, sweep is set to SINGLE ARM but further single sweeps may be initiated by pressing any of the SWEEP MODE keys. Manual adjustment of the 1,2 MOVE control sets the marker at any required point on the display and the meter bar displays the level at that frequency.

AUDIO (2nd FUNCT then METER)

This operation provides audio monitoring of amplitude demodulated information using either the internal loudspeaker or earphones. A volume control and a jack socket for the phones are located on the rear panel (refer to Fig. 3–2). The VOLTS/DIV vertical scale should be used for optimum audio quality.

30

TRIGGER controls

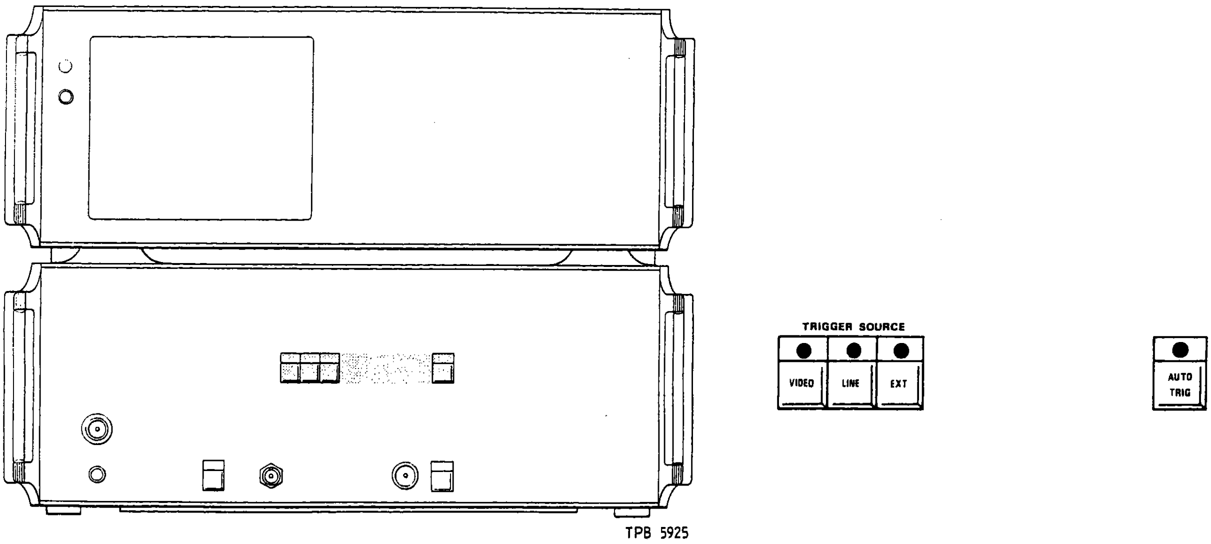

Fig. 3–28 Trigger controls

These controls select the desired trigger source both for frequency and time displays. All keys (except AUTO TRIG) are mutually exclusive, successive operations causing the function to interchange between the ON and OFF state. Operation of any of these keys lights its green key-light to show that it is in the ON state.

With VIDEO selected the sweep is triggered by the detected envelope of the input signal. With LINE or EXT selected the sweep is triggered from the power line or externally applied signal respectively. The above modes normally provide positive-going edge triggering. Pressing 2nd FUNCT prior to selecting the trigger source gives negative-going edge triggering.

AUTO TRIG (green letters)
Operation of this key initiates auto triggering whenever the triggering source falls below a certain level or frequency. A sweep therefore runs on trigger if a trigger source is present or free runs if a source is not present. As before the green key-light shows the function is in the ON state.

31 SWEEP MODE

NORM (green letters)
If this key is pressed, any sweep currently in operation will be terminated and the continuous sweep mode will be selected. In this mode at the end of a sweep the sweep circuit is rearmed so that the next trigger from the selected trigger source will start a further sweep. This process repeats indefinitely.

SINGLE ARM
Pressing the SINGLE ARM key lights the key-light, terminates any sweep currently in operation and permits the next trigger pulse from the selected trigger source or START key to initiate a single sweep. Each operation of the SINGLE ARM key produces a repetition of the above sequence, the amber key-light is ON from the time the sweep circuit is armed to the time the sweep has been completed.

START
Operation of this key during a sweep will abort that sweep and initiate a new sweep. If EXT source and AUTO TRIG are selected with no external signal applied, an 'artificial' trigger pulse is provided and the sweep will run immediately on pressing this START key.

IDENTIFY REFRESH (2nd FUNCT then START)
When this mode is selected a 'read in bright-up' vertical band moves across the screen to identify the sweep refresh point whenever the sweep time is longer than 0.1 s/div. Successive operations of these keys cause the function to interchange between the ON and OFF states but it should be noted that the ON state is initiated automatically on PRESET - refer to SWEEP TIME [32].

32 SWEEP TIME

These keys in conjunction with the horizontal scale FULL SPAN, /DIV or ZERO SPAN control enable the sweep time for the display to be set or automatically adjusted.

Pressing the AUTO key when ON, as shown by the green key-light, turns automatic selection OFF (fixing sweep time at its current value). Pressing this key when OFF turns automatic selection ON again.

Pressing the ↓ or ↑ key turns automatic selection OFF and manually sets the sweep time. When the sweep time is less than the AUTO value, the message 'Sweep uncal' may be displayed at the top of the display area. This indicates that the sweep through that particular filter is too fast. Increasing sweep time when in the AUTO video bandwidth mode will increase noise filtering and aid the identification of low level signals. When the selected sweep time is greater than 0.1 s/div a bright–up facility is activated. This can be deselected by pressing the 2nd FUNCT then START keys (IDENTIFY REFRESH).

The time/div annotation is displayed on the bottom line of the screen in inverse video when AUTO is not selected.

AUTO (with FULL SPAN)
In this mode, with the AUTO key pressed, sweep time is set at 10 ms/div.

AUTO (with /DIV)
When the AUTO key is pressed the current resolution bandwidth and horizontal scale dispersion selection are used and the correct sweep time for the display is produced automatically.

AUTO (with ZERO SPAN or FM DEMOD)
With the AUTO key pressed the sweep time is set at 10 ms/div.

↓,↑ (with FULL SPAN or /DIV)
On each operation of these keys, the sweep time is decremented or incremented by one step in a 1, 2, 5... sequence, to a minimum of 10 ms/div or a maximum of 20 s/div.

↓,↑ (with ZERO SPAN or FM DEMOD)
On each operation of these keys, the sweep time is decremented or incremented by one step in a 1,2,5... sequence as above, but to a minimum of 5 μs/div and a maximum of 20 s/div.

33

RESOLUTION BANDWIDTH

These controls, when pressed, select the resolution filter bandwidth. Pressing the AUTO key when ON, as shown by the green key-light, turns automatic selection OFF (fixing the resolution bandwidth at its current value). Pressing this key when OFF turns automatic selection ON again. Pressing the ↓ or ↑ key turns automatic selection OFF and manually sets the resolution bandwidth. The bandwidths available range from 3 Hz to 1 MHz in a 1,3,10 sequence and the selection made is annotated on the screen – in inverse video if AUTO is not operational.

AUTO (with FULL SPAN)
In this mode bandwidth is set at 1 MHz.

AUTO (with /DIV or METER)
When AUTO is pressed the optimum resolution bandwidth for the current frequency span (SPAN/DIV) is selected. The appropriate sweep time is also selected provided AUTO sweep time is active.

AUTO (with ZERO SPAN)
In this mode the resolution bandwidth in use depends upon the sweep time selected. With AUTO sweep time, bandwidth is 1 kHz.

AUTO (with FM DEMOD)
In this mode the resolution bandwidth is 1 kHz and the vertical scale annotation is 100 Hz/div on a nominal 6 division scale.

AUTO (with LOG)
Resolution bandwidth is selected automatically at each decade boundary.

↓,↑ (with FULL SPAN, /DIV or METER)
On each operation of these keys the resolution bandwidth is decremented or incremented by one step in a 1,3,10... sequence to a minimum of 3 Hz or a maximum of 1 MHz. New sweep times are set up accordingly when AUTO SWEEP TIME is selected.

↓,↑ (with ZERO SPAN)
The resolution bandwidth is decremented or incremented by one step in a 1,3,10...sequence within the range 3 Hz to 1 MHz as above.

↓,↑ (with FM DEMOD)
The resolution bandwidth is decremented or incremented as for the ZERO SPAN case and in addition the vertical graticule annotation is rescaled in accordance with the selected resolution bandwidth from 3 Hz/div to 300 kHz/div in a 1,3,10... sequence.

↓,↑ (with LOG)
These controls are ineffective in this mode.

34

MARKERS

A B SELECT
This key is used to select the display which is to carry the markers. Successive operations cause the function to interchange between VIEW A and VIEW B, a green key-light showing the one selected.

MKR 1, MKR 2
Successive operations of either of these controls cause the function to interchange between the ON and OFF state, a green key-light showing the ON state. Normally when the key is pressed, providing INTENSITY is not set too high, a flashing marker appears on the selected display in the same position it occupied when last selected. If however the METER mode is selected the marker is positioned on the top of the bar at the reference frequency. The display to carry the markers is that selected by the MARKERS A B SELECT control.

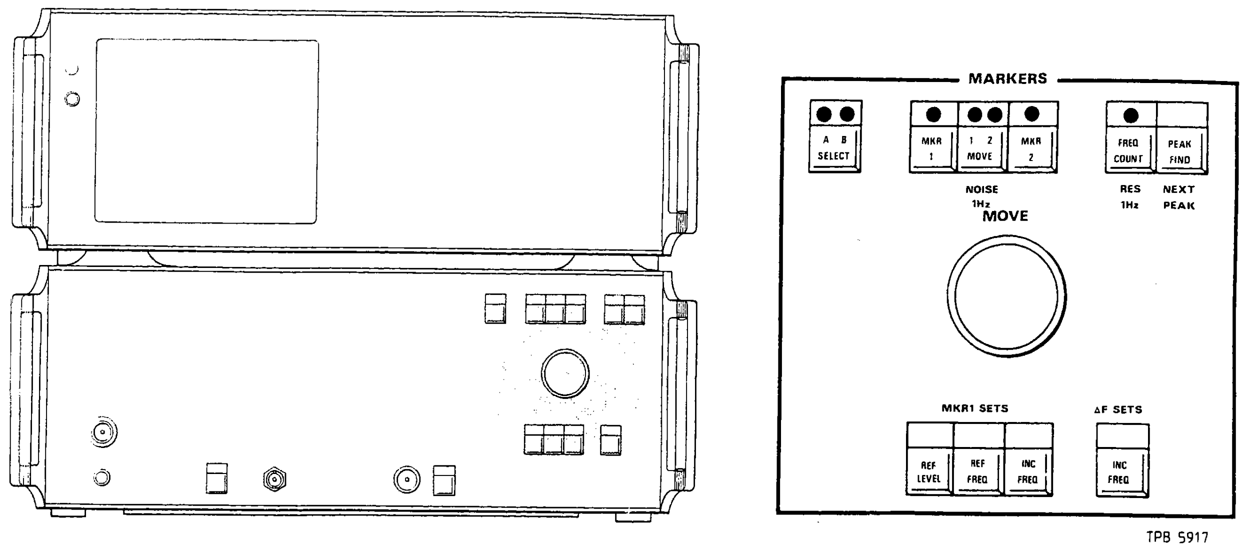

Fig. 3–29 Marker controls

Annotation of the display is in four zones on each of two lines as follows (refer to Fig. 3–3):

Zone 1 – line 1 (fourth line from bottom)
Marker identification, Mkr 1, Mkr 2, Meter.

Zone 2
Amplitude level in appropriate units, dB or VOLTS.

Zone 3
Marker frequency (no frequency annotation is given in the horizontal scale FM DEMOD mode).

Zone 4
The annotation '1 Hz bw' is displayed when the NOISE 1 Hz mode (2nd FUNCT then 1,2 MOVE) is in operation; 'Freq count' when FREQ COUNT mode is in use or 'Res 1 Hz' when RES 1 Hz (2nd FUNCT then FREQ COUNT) mode is in use.

Zone 1 – line 2 (third line from bottom)
The annotation 'Δ Mkr' is displayed on all occasions when MKR 1 and MKR 2 are operative. It is not displayed when in the METER mode.

Zone 2
The amplitude of the difference in level between the two markers is given when 'Δ Mkr' is displayed. All dB units (dBm, dBV, dBmV, dBμV) are reduced to a dB annotation.

Zone 3
The frequency difference between the two markers is given when 'Δ Mkr' is displayed and when frequency is displayed in Zone 3 line 1.

1,2 MOVE and MOVE rotary control
Operation of the 1,2 MOVE key permits the MARKERS MOVE control to move one marker horizontally following the outline of the spectral response. The marker being moved is indicated by one of the two green key-lights and also by that marker flashing on the display.

If only one marker is in use, successive operations of this key will cause the function to interchange between the ON and OFF state.

When both markers are in use successive operations of the key will cause the function to interchange between the two markers and the OFF state, the display being annotated appropriately. At all times the horizontal movement of the marker is limited to the display graticule area.

NOISE 1 Hz (2nd FUNCT then 1,2 MOVE)
On dB (dBm, dBV, dBmV, dBμV, dB), or VOLTS/LOG VOLTS vertical scales, on FULL SPAN, /DIV and METER modes, operation of these keys displays the noise normalized to a 1 Hz bandwidth.

MKR 1 and 1,2 MOVE functions are automatically activated and the noise is measured at the position of MKR 1. The equivalent noise in a 1 Hz bandwidth is displayed as an amplitude level annotation on the fourth line from the bottom of the screen. The annotation '1 Hz bw' is also displayed. Subsequent operations of these keys will clear the noise 1 Hz function. Markers are left to be cleared separately.

FREQ COUNT
Successive operations of this key cause the function to change between the ON and OFF states, the green key–light showing the ON state.

In the ON state this mode permits marker measurement of frequency to a resolution of 10 kHz on spans greater than 200 kHz/div, 1 Hz on spans less than 200 Hz/div and to 100 Hz for all other spans. Certain restrictions are applicable however – refer to 'Performance Data' in Chap. 1. The desired spectral line is identified by placing the displayed marker on it, and providing this position is 20 dB or more out of the noise the frequency at that point is measured and displayed in Zone 3 line 1, as detailed previously. The annotation 'Freq count' appears in Zone 4 line 1 when this function is selected.

RES 1 Hz (2nd FUNCT then FREQ COUNT)
This is similar to the above mode with the exception that the resulting measurement is displayed at 1 Hz resolution independent of the span selected. The annotation 'Res 1 Hz' appears in Zone 4 line 1.

PEAK FIND
This mode is operative when the horizontal scale FULL SPAN, /DIV or LOG keys are in use. Upon selection, MKR 1 moves to the peak of the largest spectral line on the currently selected display. If PEAK FIND is pressed when MKR 1 is OFF, then A B SELECT 'A' and MKR 1 are automatically selected. When 2nd FUNCT then PEAK FIND are pressed MKR 1 moves to the peak of the next largest spectral line. This feature is repeated for each successive operation of these two keys to a maximum of nine peaks.

MKR 1 SETS - REF LEVEL
This function operates only in the dB modes (dBm, dBV, dBmV, dBµV, dB) when MKR 1 is ON. When the key is pressed the operating reference level is changed to that indicated by the marker and the marker is automatically repositioned at the top of the display. If SIG TRACK mode is operational it must be reinstated after using this function.

MKR 1 SETS - REF FREQ
This key is operative only when MKR 1 is ON and the horizontal scale is set to FULL SPAN or /DIV. When pressed the reference frequency is changed to that frequency indicated by the marker. In the /DIV mode the new reference frequency and marker moves to the selected left-hand, right-hand or centre reference point, the display moving accordingly. If horizontal scale FULL SPAN is selected, the dashed vertical line is moved on the display to the new reference frequency indicated by the marker.

MKR 1 SETS - INC FREQ
With MKR 1 ON, and horizontal scale FULL SPAN or /DIV selected, when this key is operated the incremental frequency memory is loaded with the value of the frequency of MKR 1. The incremental frequency display annotation is changed accordingly (refer to the INC FREQ control for further information).

ΔF SETS - INC FREQ
Markers 1 and 2 must both be ON in this mode. Operation is similar to that above except that the frequency difference between marker 1 and marker 2 is loaded into the incremental frequency memory.

35

TRACK GEN

Operation of this key causes the tracking generator to be switched ON and OFF, a green key-light showing the ON condition. On PRESET the output of the tracking generator is fixed at -10 dBm, the range of frequencies swept being dependent upon the setting of the horizontal scale controls. The level can, however, be set by means of the keypad (refer to SET TG).

SET TG (2nd FUNCT then REF LEVEL)
When the 2nd FUNCT key followed by the REF LEVEL key is operated the message 'TG level=' is displayed on the screen and the tracking generator output can be varied from -9.7 dBm to -20.3 dBm in 0.1 dBm intervals using the DATA keypad. The selected output level is first displayed on the screen for two seconds after the terminator is pressed and then at the top of the screen (refer to Fig. 3-3). Any unterminated keypad entry may be cancelled by repeated operations of the DELETE key.

Note that even if the tracking generator has not been switched ON, entering a TG level will automatically turn it ON.

36 PRESET (coloured green)

Pressing this key activates the following control settings :

VERTICAL SCALE
AB SELECT in 'A' state, 10 dB/div, AUTO (RF ATTEN)

HORIZONTAL SCALE
/DIV, NORM (SWEEP MODE), IDENTIFY REFRESH, AUTO TRIG, AUTO (RESOLUTION BANDWIDTH), AUTO (SWEEP TIME), AUTO (VIDEO BANDWIDTH)

DISPLAY
VIEW A (in line draw state), GRAT

FUNCTION/DATA
HORIZ POSN in centre reference state

All other keys are OFF and marker functions are cleared down. The tracking generator although switched OFF remains ready for use at -10 dBm (refer to [35]). Key functions becoming active upon operation of PRESET have green lettering.

The following 'initial states' are set :

Vertical scale units to dBm

Volts/div sensitivity to 50 mV/div (500 mV top of scale)

REF LEVEL	0 dBm
REF FREQ	200 MHz
INC FREQ	10% of SPAN
SPAN/DIV	40 MHz
RF Atten (AUTO)	20 dB
Video Bandwidth (AUTO)	11 kHz
Sweep Time (AUTO)	10 ms/div
Resolution Bandwidth (AUTO)	1 MHz
Minor graticule	On
Overload protection	On

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TABLE 3–3 HIDDEN 2nd FUNCTIONS

Hidden function	Location (Fig. 3–30)	KEYS 2nd FUNCT and:
Minor graticule lines OFF/ON	1	SAVE A
Software information	23	RECALL
Overload simulation	25	REF LEVEL ↑
Overload inhibit	26	RF ATTEN ↑
Negative–going edge trigger	30	TRIGGER SOURCE

TABLE 3–4 INDEX OF KEYS AND FUNCTION LOCATIONS (see 'Control Functions')

Key	Location	Key	Location
AB Select – Markers	34	Ref Freq (rotary)	18
AB Select – Vertical	24	Ref Freq #	17
A↔B	8	Ref Freq ↑	17
A–B→A	7	Ref Level	11
Addr	4	Ref Level (rotary)	25
Annot	3	Ref Level ↓	25
Audio	29	Ref Level ↑	25
Auto Trig	30	Res 1 Hz	34
Cal	9	Resolution Bandwidth ↓	33
dB/Division (& 2nd functs)	24	Resolution Bandwidth AUTO	33
Delete	21	Resolution Bandwidth ↑	33
FM Demod	29	RF Atten ↓	26
Freq Count	34	RF Atten AUTO	26
Full Span	29	RF Atten ↑	26
Function/Data keypad	19	Save A	1
GHz/dB	20	Save B	2
GPIB Plot	5	Set TG	11
Grat	3	Sig Track	15
Horiz Posn	16	Span/div	13
Hz/μV	20	Store	23
Identify Refresh	31	Sweep Mode NORM	31
Inc Freq	34	Sweep Mode Single Arm	31
Intmd Ident	27	Sweep Mode Start	31
kHz/mV	20	Sweep Time ↓	32
Local	4	Sweep Time AUTO	32
Log (horizontal)	29	Sweep Time ↑	32
Log (vertical)	24	Text	10
Max Hold A	1	Track Gen	35
Max Hold B	2	Trigger Source Video	30
Meter	29	Trigger Source Line	30
MHz/V	20	Trigger Source Ext	30
MKR 1	34	Unlock Ref Levels	24
MKR 1 Sets Ref Level	34	Video Avg A	1
MKR 1 Sets Ref Freq	34	Video Avg B	2
MKR 1 Sets Inc Freq	34	Video Bandwidth ↓	28
MKR 2	34	Video Bandwidth AUTO	28
Next Peak	34	Video Bandwidth ↑	28
Noise 1 Hz	34	View A	1
Normalize	6	View B	2
Optns	5	Volts/div (& Log)	24
Peak Find	34	Zero Span	29
Preset	36	/Div	29
Recall	23	ΔF Sets Inc Freq	34
Ref Freq	12	1 2 Move	34
		2nd Funct	22

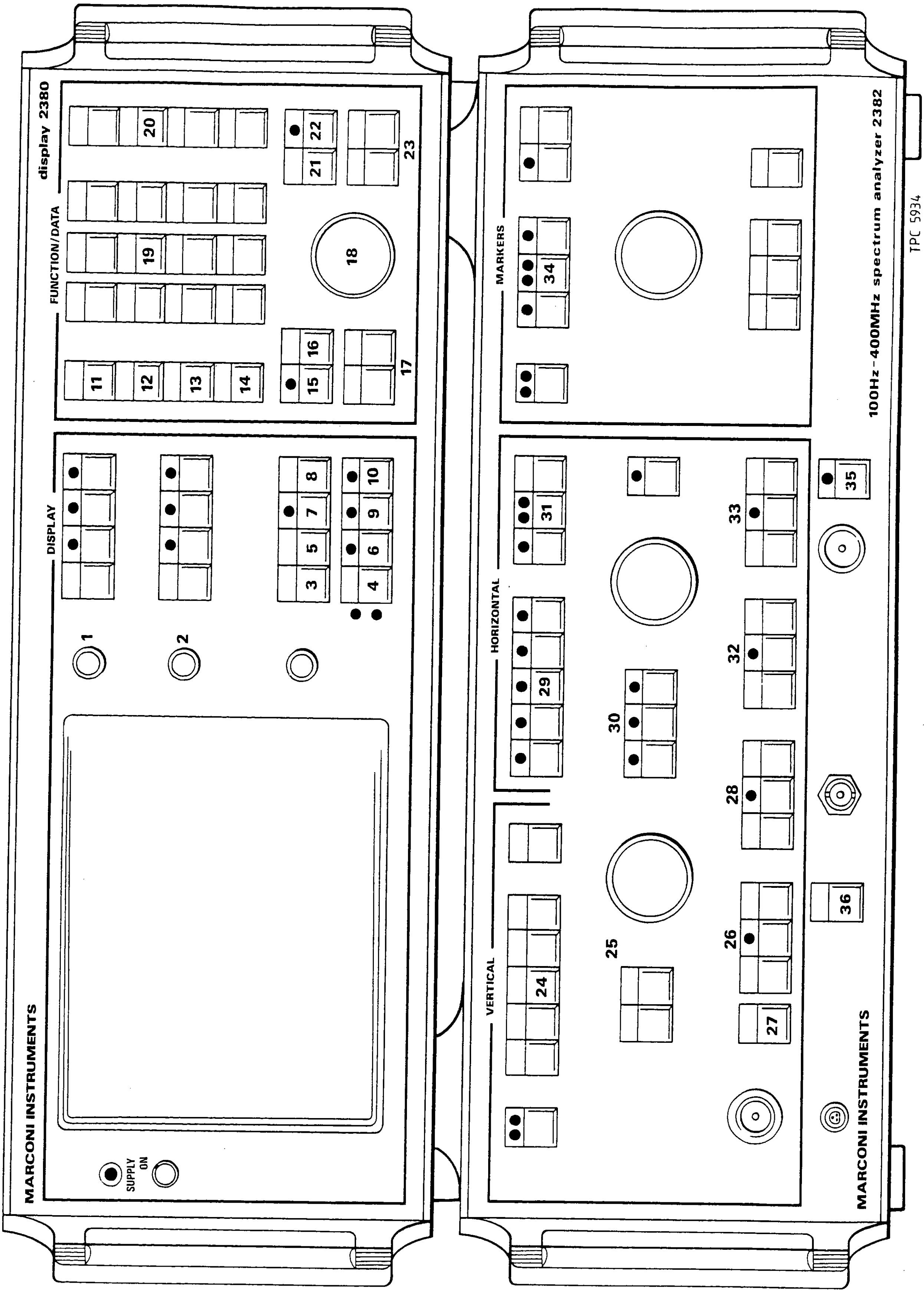

Fig. 3–30 Front panel control locations

Chapter 4–1

BRIEF TECHNICAL DESCRIPTION

INTRODUCTION

The following brief description should be read in conjunction with the appropriate diagrams in this chapter. A detailed description is given in the H 52382–900A Vol. 2 and H 52380–900E Vol. 2 Service Manuals.

The 2382/2380 Spectrum Analyzer comprises a lower unit (2382) containing RF signal processing plus an upper unit (2380) containing the display and power supply. Communication is via a two–way serial 9600 baud 20 mA current loop for housekeeping data and a one–way high speed serial link for the display data. The upper unit's power supply will power up to two lower units with only one selected at any one time. The lower unit is internally wired to be self–addressing and it may be controlled via the front panel or remotely via a single GPIB socket.

CIRCUIT SUMMARY

Signal path, data conversion and tracking generator

The 2382 RF unit has an integral tracking generator and forms with Display unit 2380 a swept tuned spectrum analyzer covering the range 100 Hz to 400 MHz. A block schematic of the 2382 is shown in Fig. 4–1. With reference to this diagram, the signal to be measured enters via the overload protection circuit. This is a latched change–over relay which is tripped out by any signals over 0.5 W and protects for overloads of up to 50 W. An appropriate annotation is displayed on the screen that this has occurred, and the tripped condition remains until it is cleared by means of a front panel key.

The signal is then processed via a conventional up–down multi–stage super-heterodyne configuration using a chain of phase coherent oscillators derived by phase locked loop synthesis techniques from the basic 10 MHz reference frequency oscillator. An additional phase coherent oscillator at 47.4 MHz provides the source signal for the tracking generator facility. This signal is frequency translated in a reverse, but otherwise identical, manner to the input signal by means of the second and first local oscillators.

The tracking generator signal is amplified by a broad band amplifier and amplitude levelled by an overall AGC loop and is then available for use internally for system calibration via an internal change–over switch, or externally as the stimulus for passive or active frequency domain network analysis.

After frequency translation, the input signal is resolved by either a switched bandwidth LC filter, or a switched bandwidth crystal filter, both at 2.6 MHz, depending on the bandwidth required. Bandwidths of 30 Hz and below require the signal to undergo a further down–up frequency translation to 100 kHz to enable the narrow bandwidths to be achieved.

The translated, filtered input signal is applied to a switched gain logarithmic amplifier system. This switches in extremely accurate attenuator sections to keep the output signal within a 12.8 dB range for an input variation of 89.6 dB. The seven possible values of attenuation needed to achieve this form a 3–bit code to indicate the instan–

taneous status of this setting. The remaining 12.8 dB of output is detected and A–D converted to an 11–bit word which is processed by a log/lin law PROM and overlapped with the previously mentioned 3-bits of data to form a 13–bit word describing the instantaneous signal level to a resolution of 0.025 dB in a dynamic range of 102.4 dB. A linear data table in the PROM is selected when the 'Volts' display mode is in use.

The trigger circuit can select either an internal, external or supply frequency source. The output triggers the sweep start for both frequency and time displays. This facility is essential on the 'Zero Span' mode where the demodulated signal is displayed instead of the frequency spectrum.

Finally, the 13–bit word is parallel–to–serial converted and transmitted to the display unit via a single lead at a 2.5 MHz bit rate. A sync out signal is also fed to the upper unit to synchronize the upper unit serial–to–parallel converter.

Microprocessor and control

The 2382 front panel controls and the serial link to the 2380 upper unit are serviced via microprocessor interrupt procedures organized by a software Real Time Executive residing in the main program. All system switching, control and flag reads are done via a two–way buffer on the microprocessor bus. In this way, the bus wiring in the receiver area is free from the continuous data train of pulses on the normal microprocessor bus thus reducing the possibility of interference to the analogue circuits.

Synthesizer

This is a major sub–system of the 2382 and comprises three master varactor controlled oscillators (see Fig. 4–2) whose outputs are offset one from the other by linking them via two slave varactor controlled oscillators in a phase locked loop configuration.

HF master oscillator

This covers the range 530 to 938 MHz and is swept for spans of 5 MHz to 400 MHz, or locked at 5 MHz intervals anywhere over this band. Its output is divided by 64 to enable a counter to monitor its frequency.

LF master oscillator

This covers the range of 26.9 to 34.1 MHz and can be swept for spans of 50 kHz to 2 MHz or locked at 100 kHz intervals anywhere over this band. Its output is directly counted to monitor its frequency.

HF slave oscillator

This oscillator combines with two masters to form a phase locked combination that synthesizes an output frequency range of 498.6 to 906.6 MHz.

Interpolation oscillator

This is a very stable free running varactor oscillator covering the range 28.46 to 32.4 MHz. Before being used as the fine offset frequency in the total system, the output is divided by 32 giving an operational range of 124 kHz at an offset frequency of 889 kHz. This oscillator is swept for spans of 100 Hz to 20 kHz and can be set to a final resolution of 1 Hz anywhere over its 124 kHz range. By counting its output frequency before division, the divided output can be measured to 1 Hz in a counter gate time of 31.25 ms instead of the 1 second gate required for direct measurement of the output.

LF slave oscillator

This oscillator is used to add the output of the interplation oscillator and the LF master oscillator into the other synthesized loop such that the overall system covers the range 502.6 to 902.6 MHz to a resolution of 1 Hz with sweep capability of 100 Hz to 400 MHz spans.

50 MHz VCXO

This is a high purity varactor controlled crystal oscillator used, after division, to drive the sampling gates which lock the LF and HF master oscillators to precise frequencies when they are not being swept. It is locked back to the 10 MHz reference frequency standard (either the internal or the external one, if connected) by means of another sampled feedback loop. The 50 MHz oscillator is also used to provide the time base gate period for the counter.

Control voltages

The microprocessor system, in conjunction with variable ratio dividers, a digital-to-analogue converter and a tracking integrator, provide a non-linear ramp. This has a magnitude and shape that will produce a linear frequency sweep from the chosen oscillator over the span and reference frequency currently being used.

By means of a further microprocessor controlled D/A converter each of the three controlled oscillators is refreshed with its correct tuning voltage during each sweep retrace, the value being retained during the subsequent sweep.

Signal path, display, pen plot and RGB video

The serial data input from the 2382 lower unit at the 2.5 MHz bit rate (see Fig. 4-3) is converted to 16-bit parallel data in the 2380 Display unit and is subjected to a running digital averaging process to simulate the customary video filter. A normal analogue RC network is inappropriate since, due to the inclusion of the high resolution switched gain logarithmic amplifier, no full range detected analogue signal exists anywhere in the system.

Since the final stored picture has a resolution of 500 slots across the displayed frequency span, it is necessary to ensure that any spectral responses less than one slot wide do not get missed or attenuated. The Resolution Stretcher is designed to do this whilst at the same time not exaggerating the noise level, as a simple peak hold circuit would do.

The processed data word is now transferred under Direct Memory Access (DMA) control to RAM space dedicated as Input Store or Error Store depending on whether the current sweep is a measurement scan or a calibration scan. The data in these two stores is now selectively subtracted (the data space in the Error Store permits correction over the range 100 Hz to 400 MHz) and loaded into the appropriate dedicated RAM spaces known as A Store and B Store under microprocessor control.

Each Display Store shift register contains 500 bytes representing the data for the currently displayed image. These data can be used to produce an infilled display or an outlined display depending on the option selected. On the completion of each horizontal scanning line (one complete recirculation of data in the shift register), the Clock Counter generates a DMA request. This results in a DMA transfer of a single display slot of data from the appropriate Display Store to the appropriate shift register. During this transfer the 16-bit word in the Display Store is added to the 16-bit word in the Shift Latch to arrive at the correct vertical display value and is then subject to the correct hardware multiplication to give the selected scaling factor before the 8 bits appropriate to the selected display range are loaded into the recirculating shift register. The output from the shift register is used to produce a solid (infilled) display or is subjected to further line draw processing to produce an outlined display. The resulting signal is then mixed with the graticule and character symbol data before being applied to the video amplifier and thence to the CRT.

The frequency graticule data and marker data are similarly refreshed, two bits being used for Graticule Brightness information and two bits being used for Steady or Flashing Markers.

The CRT controller chip organizes the display drive waveforms and also drives the character generator EPROM to annotate the graticule and display mode status information. The first character of each line is used as a control character and is suppressed, decoded and used to generate the amplitude graticule. Thus the graticule for both axes is under microprocessor control and may draw in any type of ruling to suit the needs of the display.

An optional board supplies the drives for the X and Y axes of a pen recorder, as well as RGB outputs for use with a colour monitor and a composite video output for a monochrome monitor. A beeper is also included on the board to warn against certain conditions.

Processor and control

The 2380 front panel controls are serviced via microprocessor interrupt procedures. Additionally, the processor shares the data and address buses with a DMA controller to allow direct memory access to selected peripherals. Housekeeping data between the processor and the RF unit is conveyed by the 20 mA current loop. The GPIB interface housed in the Display unit allows the spectrum analyzer to form part of a system acting under the direction of a controller.

Power supply

Besides powering the Display unit, the power supply can supply one RF unit on full power and a second on standby power. The switched mode power supply controller operates in synchronism with the associated RF unit's frequency standard. The controller shorts down to provide protection against overload, overvoltage or overheat conditions while rear panel lights illuminate to warn of overvoltage, undervoltage and overload as well as to indicate when no RF unit is connected.

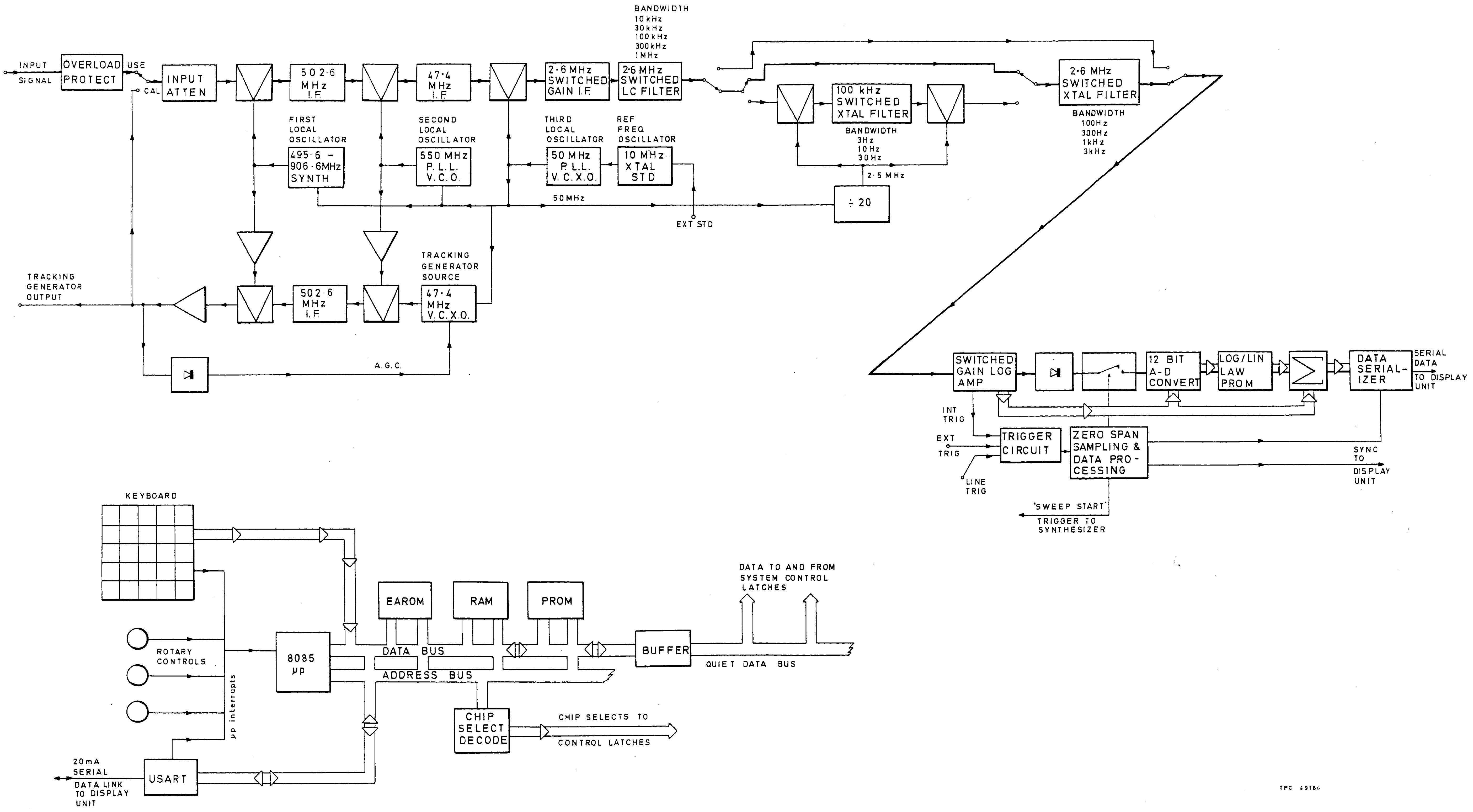

Fig. 4–1 Block schematic of 2382 system

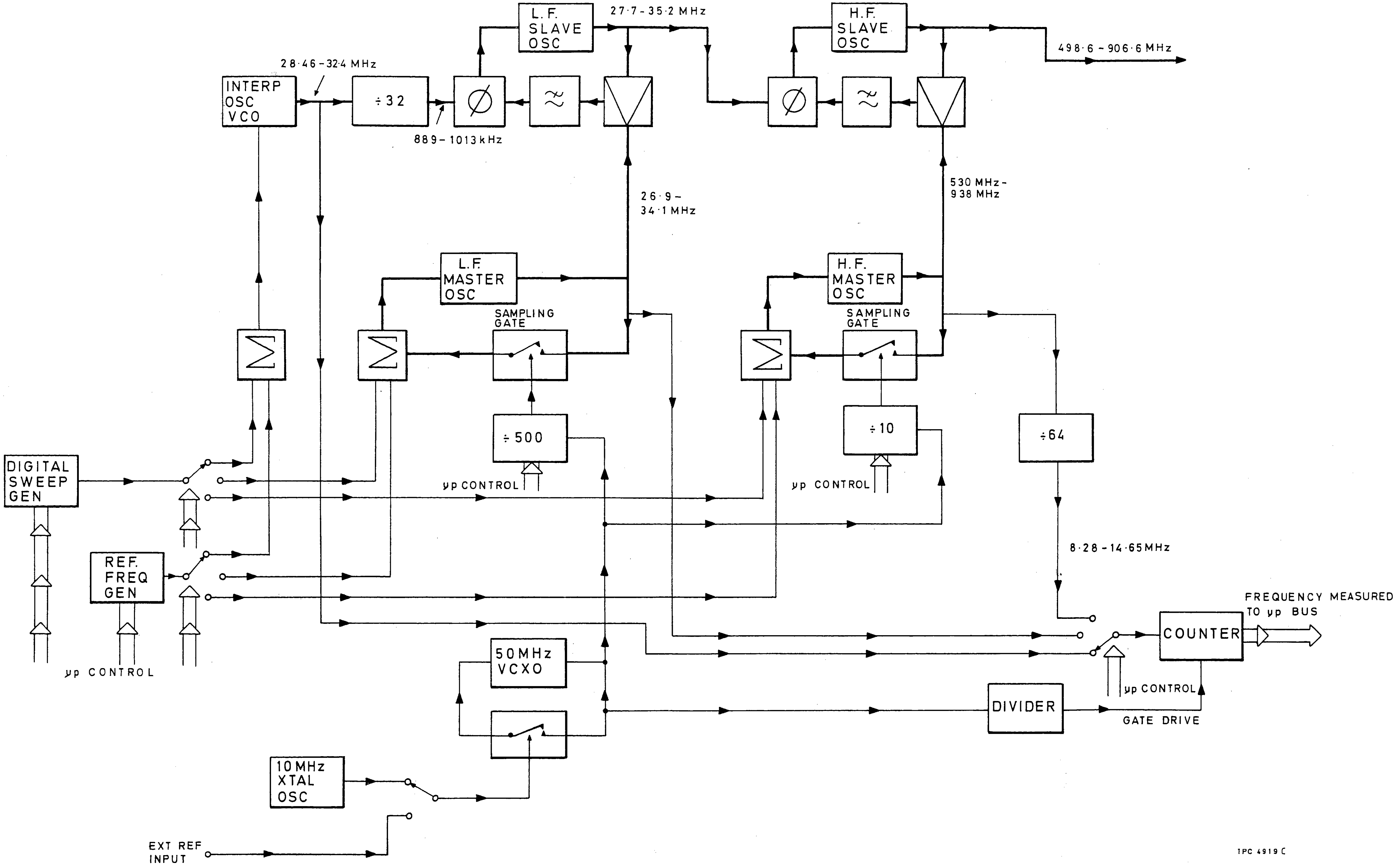

Fig. 4–2 Block schematic of 2382 synthesizer

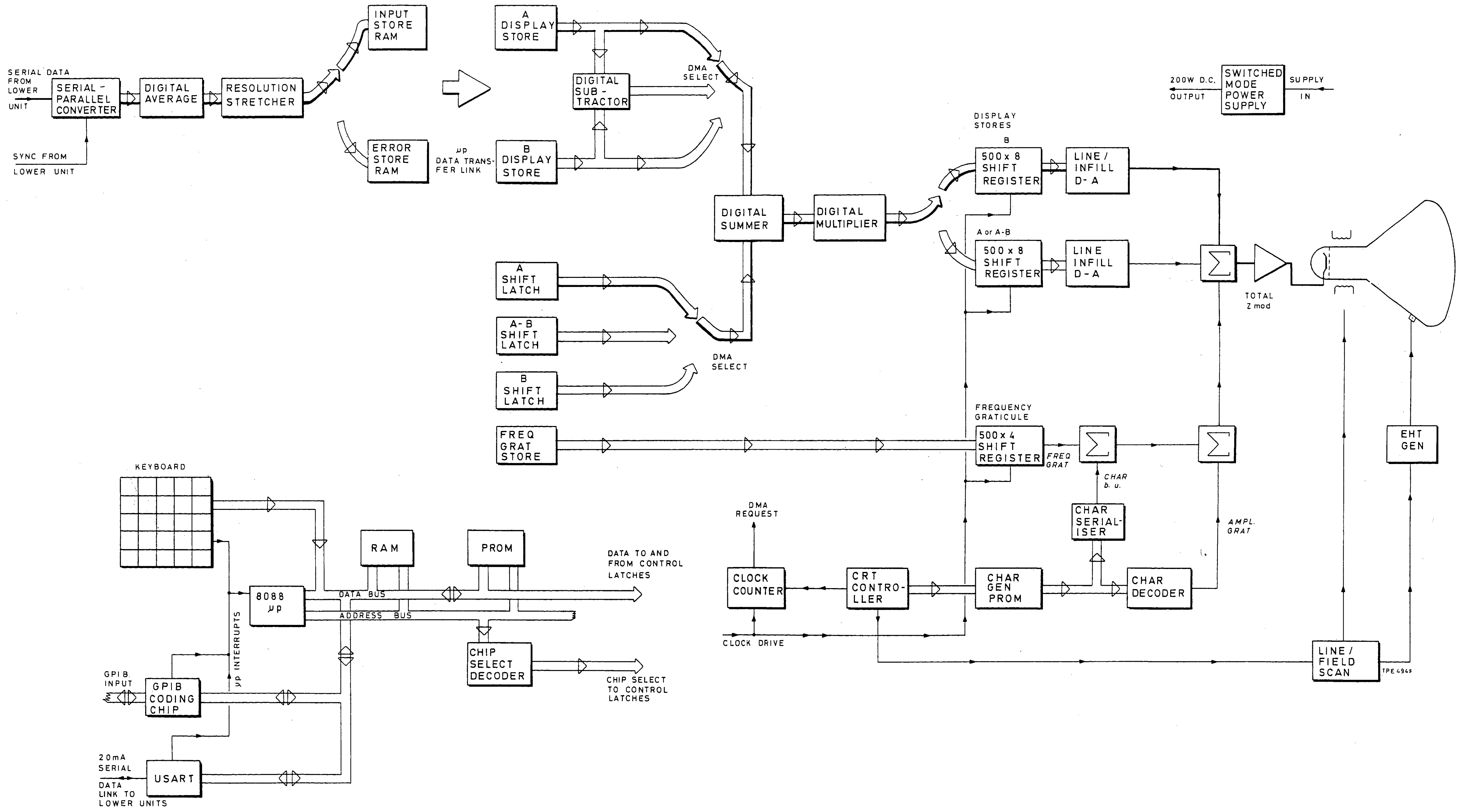

Fig. 4–3 Block schematic of 2380 system

Chapter 5

ACCEPTANCE TESTING

INTRODUCTION

1. The test procedures in this chapter enable you to verify that the electrical performance of the Spectrum Analyzer, together with its Display Unit, complies with the Performance Data given in Chap. 1. All tests may be performed with the covers in place and are intended to be carried out in the order given. For convenience, the test equipment and specification for each test are summarized before the test procedure.

TEST PRECAUTIONS

2. To ensure minimum errors and uncertainties when making measurements, it is important to observe the following precautions:-

(1) Always use recently calibrated test equipment, with any correction figures taken into account, so as to establish a known or traceable limit of performance uncertainty. This uncertainty must be allowed for in determining the accuracy of measurements. For example, if a parameter has a claimed accuracy of ±10% in the Performance Data, and you are checking this with a test equipment which has an uncertainty of ±5%, then the acceptance limit is the sum of the two unknowns, that is ±(10 + 5) = ±15%.

(2) A common external frequency standard, with an accuracy within ±1 part in 10^6, should be used for the analyzer and for the test generator and other frequency controlled test equipment.

(3) Use the shortest possible connecting leads; ideally the analyzer should be directly coupled to the test equipment.

(4) Allow a warm-up time of half an hour before commencing tests.

(5) Before each test select the 'preset' and 'calibrated' operating conditions of the analyzer by pressing the PRESET and CAL keys. Every subsequent 10 minutes the CAL key must be pressed again to maintain calibration.

RECOMMENDED TEST EQUIPMENT

The test equipment recommended for acceptance testing is shown in Table 5-1. Alternative equipment may be used provided it complies with the stated minimum specification.

TABLE 5-1 RECOMMENDED TEST EQUIPMENT

Description	Minimum specification		Example
Synthesized Generators	Frequency range: Output range: with auxiliary TTL output Frequency range: Output range:	5 Hz to 1 MHz −40 dBm to +10 dBm 1 MHz to 500 MHz −40 dBm to +10 dBm	Hewlett-Packard 3325A Marconi 2018A or 2019A
Oscillator (2 off)	Centre frequency: Output level: Phase noise: Short term stability:	100 MHz 0 dBm <−90 dBc/Hz at 1 kHz 1 part in 10^9	HCD Research 185R
Variable DC power supply	Range:	0 V to + 12 V DC	Marconi 2158
RF amplifier	Frequency range: Gain:	1 MHz to 500 MHz 40 dB	Marconi 2177
Power meter	Frequency range: Accuracy:	DC to 50 MHz ±0.01 dB	Wandel & Goltermann EPM1
Power meter (high frequency)	Frequency range: Accuracy:	30 kHz to 500 MHz ±0.02 dB	Marconi 6960 & 6912 sensor
Counter	Frequency range:	10 Hz to 500 MHz	Marconi 2432A
Digital multimeter	Functions:	DC volts, resistance	Solartron 7150
Oscilloscope	Frequency range:	DC to 100 MHz	Tektronix 2235
Spectrum analyzer	Frequency range: (with tracking generator facility)	100 Hz to 1 GHz	Marconi 2370 & 2373 extender
Step attenuator	60 dB in 10 dB steps		Hewlett-Packard 8495A
Attenuator pads (2 off)	10 dB, 50 Ω, type-N connectors		Marconi 6534/3
Power splitter	Frequency range: Impedance:	DC to 500 MHz 50 Ω	Weinschel 1870A

TABLE 5-1 RECOMMENDED TEST EQUIPMENT (continued)

Description	Minimum specification	Example
Combiner	Frequency: 100 MHz Impedance: 50 Ω	Mini-Circuits ZFSC-2-1
Low-pass filter	Cut-off frequency: 100 MHz Attenuation at 200 MHz: >50 dB	Telonic TCP 10048B
VSWR bridge	Frequency range: 10 MHz to 1 GHz Negative detector output	Wiltron 63N50
Termination (qty. 2)	Impedance: 50 Ω Type N connector	Weinschel 1404
Mismatch	470 Ω in series between type N connectors	–
Coaxial adapters	Type SMA male to N female, 50 Ω Type SMA female to N male, 50 Ω Signal injector assembly	Radiall R191327 Radiall R191329 Marconi 44990-810
Coaxial lead	1.5m long type-N connectors Impedance: 50 Ω	RG214
	1.0 m long type BNC connectors	Marconi 43126-012
Precision attenuator pads	3, 10, 20, 20, 30 dB (with correction figures at 50 MHz)	Texscan FP-50 series

-TEST PROCEDURES-

FREQUENCY SPAN, /DIV and LOG

3. This tests the display accuracy in the /DIV mode. If it is correct the less stringent display accuracy in LOG mode can be assumed to be correct also.

SPECIFICATION

Frequency span, /DIV:	±2% of full span >1% separation.
LOG:	±5N% where N = number of decades selected.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output range: -40 dBm to +10 dBm	Marconi 2019A

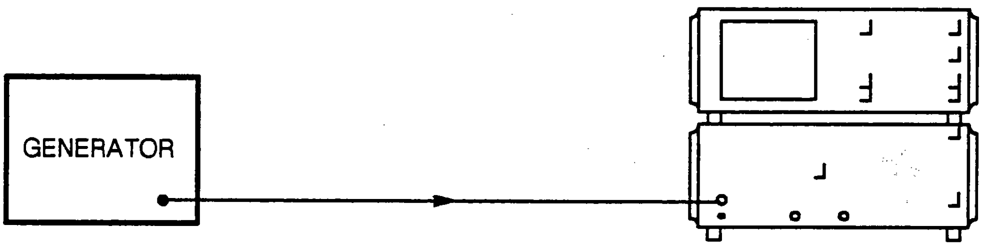

Fig. 5-1 Frequency span test set-up

Procedure

(1) Connect the generator output to the analyzer INPUT.

(2) On the generator select:

Carrier frequency	9.5 MHz
Output level	-10 dBm
Incremental frequency	3.5 MHz

On the analyzer select:

PRESET	
CAL	
HORIZ POSN	left-hand reference
REF LEVEL	0 dB
SPAN/DIV	500 kHz
REF FREQ	9.5 MHz
PEAK FIND	

(3) The marker annotation (Mkr1) shows the frequency of the response, which should be 9.5 MHz ±100 kHz.

(4) Increment the generator frequency by 3.5 MHz, to give a frequency of 13.0 MHz, and press PEAK FIND on the analyzer. The response should move to a position at 70% of full span, as shown on line 1 of Table 5–1, and the Mkr frequency should read 13.0 MHz ±135 kHz, the limit being shown on the bottom line under the 70% column.

(5) On the analyzer select:

REF FREQ	14.5 MHz
(as in line 2 of the table)	
INC FREQ	5 MHz

Increment the signal generator frequency by a further 3.5 MHz, press PEAK FIND and check that the 16.5 MHz response is at 40% of full span and within 120 kHz.

(6) Step through each successive line of Table 1 by incrementing the analyzer reference frequency by 5 MHz and the generator by 3.5 MHz and check the response for correct position and frequency.

(7) On the generator select:

Carrier frequency	8.1 MHz

On the analyzer select:

SPAN/DIV	10 kHz
SWEEP TIME	50 ms/div
RESPONSE BANDWIDTH	1 kHz
REF FREQ	8.1 MHz
INC FREQ	500 kHz

(8) Step through each line of Table 5–2 by incrementing the generator frequency and analyzer reference frequencies to the values shown and check the response for correct position and frequency.

(9) On the generator select:

Carrier frequency	7.5 MHz

On the analyzer select:

SPAN/DIV	500 Hz
SWEEP TIME	2 s/div
RESPONSE BANDWIDTH	30 Hz
REF FREQ	7.5 MHz
INC FREQ	10 kHz

(10) Step through each line of Table 5–3 by incrementing the generator and analyzer reference frequencies and check the response for correct position and frequency.

TABLE 5-1 DISPLAY ACCURACY at 500 kHz/div (AUTO mode)

GENERATOR FREQUENCY (MHz) AS POSITION OF FULL SPAN

REF FREQ MHz	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
9.5	9.5							13.0		
14.5					16.5					
19.5		20.0							23.5	
24.5						27.0				
29.5			30.5							34.0
34.5							37.5			
39.5				41.0						
44.5	44.5							48.0		
49.5					51.5					
54.5		55.0							58.5	
59.5						62.0				
64.5			65.5							69.0
69.5							72.5			
74.5				76.0						
79.5	79.5							83.0		
84.5					86.5					
89.5		90.0							90.0	
94.5						97.0				
99.5			100.5							104.0
104.5							107.5			
109.5				111.0						
114.5	114.5							118.0		
119.5					121.5					
124.5		125.0							128.5	
129.5						132.0				
134.5			135.5							139.0
139.5							142.5			
144.5				146.0						
149.5	149.5							153.0		
154.5					156.5					
159.5		160.0							163.5	
164.5						167.0				
169.5			170.5							174.0
174.5							177.5			
179.5				181.0						
184.5	184.5							188.0		
189.5					191.5					
194.5		195.0							198.5	
199.5						202.0				
204.5			205.5							209.0
209.5							212.5			
214.5				216.0						
219.5	219.5							223.0		
224.5					226.5					
229.5		230.0							233.5	
234.5						237.0				
239.5			240.5							244.0
244.5							247.5			
249.5				251.0						
254.5	254.5							258.0		
259.5					261.5					
264.5		265.0								
269.5						272.0			268.5	
274.5			275.5							
279.5							282.5			279.0
284.5				286.0						
289.5	289.5							293.0		
294.5					296.5					
299.5		300.0								
304.5						307.0			303.5	
309.5			310.5							
314.5							317.5			314.0
319.5				321.0						
324.5	324.5							328.0		
329.5					331.5					
334.5		335.0								
339.5						342.0			338.5	
344.5			345.5							
349.5							352.5			349.0
354.5				356.0						
359.5	359.5							363.0		
364.5					366.5					
369.5		370.0								
374.5						377.0			373.5	
379.5			380.5							
384.5							387.5			384.0
389.5				391.0						
394.5	394.5							398.0		
399.5	399.5									
Limits +/-	100 kHz	105 kHz	110 kHz	115 kHz	120 kHz	125 kHz	130 kHz	135 kHz	140 kHz	145 kHz

TABLE 5-2 DISPLAY ACCURACY at 10 kHz/div (manual mode)

GENERATOR FREQUENCY (MHz) AS POSITION OF FULL SPAN

REF FREQ MHz	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
8.1	8.1	8.11								
8.6	8.6		8.62							
9.1	9.1			9.13						
9.6	9.6				9.64					
10.1	10.1					10.15				
10.6	10.6						10.66			
11.1	11.1							11.17		
11.6	11.6								11.68	
12.1	12.1	12.11								12.19
12.6	12.6		12.62							
13.1	13.1			13.13						
Limits +/-	2.0 kHz	2.1 kHz	2.2 kHz	2.3 kHz	2.4 kHz	2.5 kHz	2.6 kHz	2.7 kHz	2.8 kHz	2.9 kHz

TABLE 5-3 DISPLAY ACCURACY at 500 Hz/div (manual mode)

GENERATOR FREQUENCY (MHz) AS POSITION OF FULL SPAN

REF FREQ MHz	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%
7.50	7.50	7.5005								
7.51	7.51		7.5150							
7.52	7.52			7.5215						
7.53	7.53				7.5320					
7.54	7.54					7.5425				
7.55	7.55						7.5530			
7.56	7.56							7.5635		
7.57	7.57								7.5740	
7.58	7.58									7.5845
7.59	7.59	7.5905								
7.60	7.60			7.6010						
Limits +/-	100 Hz	105 Hz	110 Hz	115 Hz	120 Hz	125 Hz	130 Hz	135 Hz	140 Hz	145 Hz

EXTERNAL STANDARD INPUT

4. This tests the ability of the analyzer to lock to an external standard.

SPECIFICATION

Ext. standard input:	The system will lock to an external standard signal of 1, 2, 5 or 10 MHz at a level between -15 and +15 dBm. The frequency must be within ±1 part in 10^6 for the system to lock.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output level: -40 dBm to +10 dBm	Marconi 2019A
Power meter	Frequency range: 30 kHz to 500 MHz Accuracy: ±0.02 dBm	Marconi 6960 & 6912 sensor
RF power splitter	Frequency range: DC to 500 MHz Impedance: 50 Ω	Weinschel 1870A
RF amplifier	Frequency range: 1 MHz to 500 MHz Gain: 40 dB	Marconi 2177

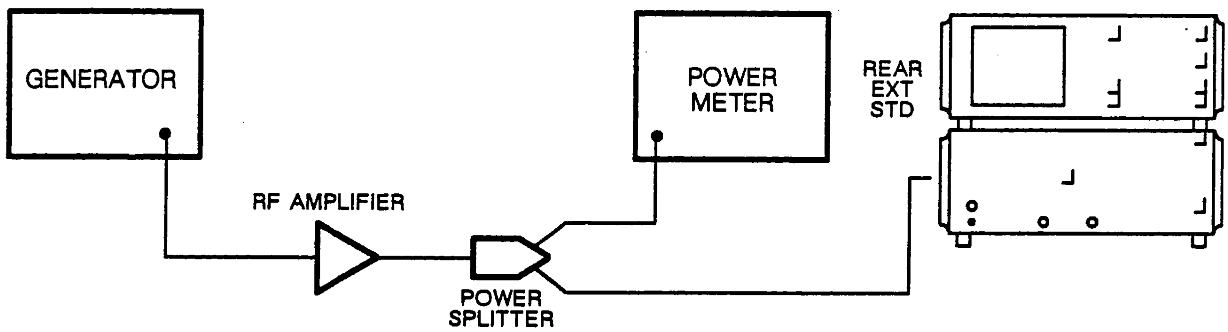

Fig. 5-2 External standard input test set-up

Procedure

(1) Connect the power meter sensor and the EXT STD input on the rear of the analyzer to the respective outputs of the power splitter.

(2) Set the generator frequency to precisely 1 MHz at an output level of -60 dBm. Connect the generator via the RF amplifier to the input of the power splitter. Adjust the generator level until the power meter reads +15 dBm.

External standard locking is indicated by the 'ext std' annotation on the screen; if lock is not achieved the annotation remains flashing.

(3) Check that the external standard locks for each of the values given in Table 5-4.

TABLE 5-4 EXTERNAL STANDARD LOCKING POINTS

EXT STD INPUT Freq (MHz)	Level (dBm)
10.0	+15
10.000050	0
9.999950	0
10.0	–15
1.0	–15

REFERENCE FREQUENCY, /DIV

5.

SPECIFICATION

Accuracy: >[(freq. std. error x ref. freq./10 MHz) +2% of selected sweep span + oscillator drift] Hz.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output range : –40 dBm to +10 dBm	Marconi 2019A

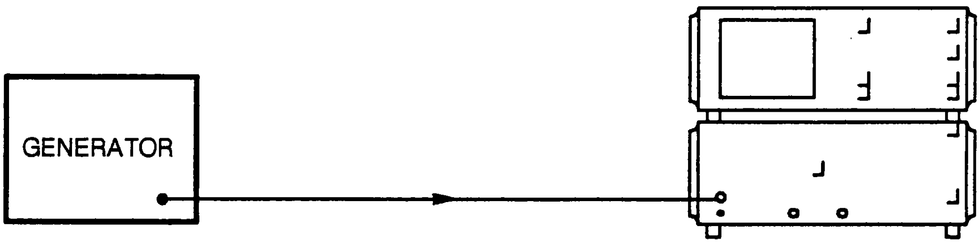

Fig. 5–3 Reference frequency test set-up

Procedure

(1) Connect the generator output to the analyzer INPUT.

(2) On the generator select 200 MHz at –10 dBm.

On the analyzer select:

PRESET	
CAL	
REF FREQ	200 MHz
REF LEVEL	0 dBm

(3) Set SPAN/DIV, SWEEP TIME and RESOLUTION BANDWIDTH as in line 1 of the table below and trigger a single sweep on the analyzer. Then press PEAK FIND and note that the response frequency shown by the Mkr1 annotation is 200 MHz ±8.05 MHz.

(4) Repeat step (3) for each set of values in Table 5–5 and check that the frequency is within the limits shown.

TABLE 5-5 REFERENCE FREQUENCY TEST POINTS

SPAN/DIV	RESOLUTION BANDWIDTH	SWEEP TIME/DIV	LIMITS (+)
40 MHz	100 kHz	50 ms	8.05 MHz
20 MHz	100 kHz	20 ms	4.05 MHz
10 MHz	100 kHz	10 ms	2.05 MHz
5 MHz	100 kHz	10 ms	1.05 MHz
2 MHz	100 kHz	10 ms	0.45 MHz
1 MHz	100 kHz	10 ms	0.25 MHz
0.5 MHz	100 kHz	10 ms	0.15 MHz
200 kHz	30 kHz	10 ms	40.05 kHz
100 kHz	10 kHz	10 ms	20.5 kHz
50 kHz	10 kHz	10 ms	10.5 kHz
20 kHz	3 kHz	10 ms	4.5 kHz
10 kHz	1 kHz	5 ms	2.5 kHz
5 kHz	1 kHz	2 ms	1.5 kHz
2 kHz	300 Hz	100 ms	410 Hz
1 kHz	100 Hz	500 ms	210 Hz
500 Hz	100 Hz	500 ms	110 Hz
200 Hz	30 Hz	2.0 s	50 Hz
100 Hz	10 Hz	1.0 s	30 Hz
50 Hz	10 Hz	2.0 s	20 Hz

FREQUENCY COUNT

6.

SPECIFICATION

Frequency count: Resolution of screen readout 10 kHz on spans >200 kHz/div,1 Hz on spans <200 Hz/div and 100 Hz on all other spans,with the marker at least 20 dB out of noise and 3 dB bandwidth >0.2% of span.

TEST EQUIPMENT

- none required -

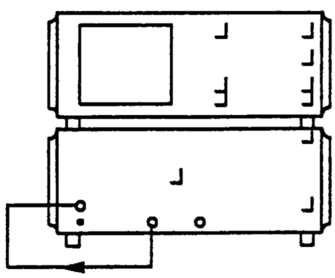

Fig. 5-4 Frequency count test set-up

Procedure

(1) Connect the STD 10 MHz OUTPUT to the INPUT.

Select:

PRESET
CAL

(2) Move Mkr1 so that it is positioned on the 10 MHz peak at least 20 dB out of the noise.

Select:

FREQ COUNT	
MKR1 SETS REF FREQ	
SPAN/DIV	10 kHz

Ensure that the response is within ±1 division from the reference frequency origin.

(3) Move Mkr1 onto the response at least 20 dB out of the noise.

Select:

MKR1 SETS REF FREQ	
SPAN/DIV	100 Hz

The response should be within 1 div of the reference frequency origin.

(4) Repeat with SPAN/DIV 10 Hz. Mkr1 should read 10 MHz ±1 Hz.

RESOLUTION 1 Hz

7.

SPECIFICATION

As for frequency count except resolution of 1 Hz for all spans.

TEST EQUIPMENT

- none required -

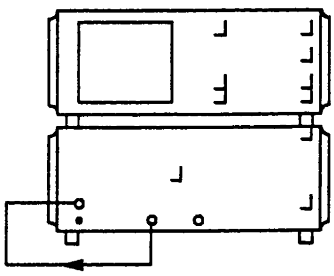

Fig. 5-5 Resolution 1 Hz test set-up

Procedure

(1) Connect the STD 10 MHz OUTPUT to the INPUT.

Select:

PRESET	
CAL	
REF FREQ	15 MHz
SPAN/DIV	2 MHz

(2) Move marker Mkr1 onto the 10 MHz response and 20 dB out of the noise. Select RES 1 Hz (2nd FUNCT - FREQ COUNT) and allow time for the reading to be taken. Centre the 10 MHz response using MKR1 SETS REF FREQ and deselect RES 1 Hz. Set SPAN/DIV to 10 Hz and check that the Ref frequency annotation reads 10 MHz ±1 Hz.

RESOLUTION BANDWIDTHS

8.

SPECIFICATION

3 dB bandwidth: ±20% of nominal value (+0% -30% for 1 MHz filter).
Shape factor : <11:1 (<5:1 for 1 MHz filter).

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz	Marconi 2019A

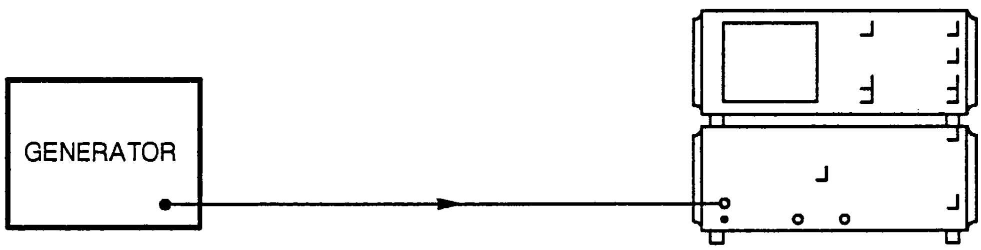

Fig. 5–6 Resolution bandwidths test set-up

Procedure

(1) Connect the generator output to the analyzer INPUT.

On the generator select:

Carrier frequency	10 MHz
Output level	0 dBm

On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
REF LEVEL	+2 dBm
dB/DIVISION	0.5 dB
RESOLUTION BANDWIDTH	1 MHz
SPAN/DIV	100 kHz
PEAK FIND	
MKR1 SETS REF LEVEL	
dB RELATIVE	
(2nd FUNCT - 0.5 dB VERTICAL/DIV)	
SWEEP MODE	SINGLE ARM

(2) Move Mkr1 to the lower frequency 3 dB point and Mkr2 to the upper frequency 3 dB point. The ΔF annotation will give the 3 dB bandwidth which should be equal to 1 MHz within the limits +0 and -300 kHz as shown in Table 5-6. Record the result for future reference.

TABLE 5-6 RESOLUTION BANDWIDTHS

RESOLUTION BANDWIDTH	A 3 dB SPAN/DIV	B 60 dB SPAN/DIV	3 dB BANDWIDTH LIMITS	SHAPE FACTOR
1 MHz	100 kHz	500 kHz	+0-300 kHz	<5:1
300 kHz	50 kHz	500 kHz	±60 kHz	<11:1
100 kHz	20 kHz	200 kHz	±20 kHz	<11:1
30 kHz	5 kHz	50 kHz	±6 kHz	<11:1
10 kHz	2 kHz	20 kHz	±2 kHz	<11:1
3 kHz	500 Hz	5 kHz	±600 Hz	<11:1
1 kHz	200 Hz	2 kHz	±200 Hz	<11:1
300 Hz	50 Hz	500 Hz	±60 Hz	<11:1
100 Hz	20 Hz	200 Hz	±20 Hz	<11:1
30 Hz	10 Hz	50 Hz	±6 Hz	<11:1
10 Hz	10 Hz	10 Hz	±2 Hz	<11:1
3 Hz	10 Hz	10 Hz	±1 Hz	<11:1

(3) Repeat (2) for each subsequent value of RESOLUTION BANDWIDTH and 3 dB SPAN/DIV (Column A) in the table and check that the 3 dB bandwidth is correct to within the limits shown.

(4) Change dB/DIVISION to 10 dB and measure the 60 dB bandwidth for each value of RESOLUTION BANDWIDTH and 60 dB SPAN/DIV (Column B) in the table. Record the result for future reference.

(5) For each filter calculate the shape factor $\left(= \frac{\text{60 dB bandwidth}}{\text{3 dB bandwidth}}\right)$ and check that it is within the limits shown.

RESIDUAL FM

9.

SPECIFICATION

Residual FM:	<1.5 Hz peak-to-peak during a 10 second period for spans <20 kHz, resolution bandwidths 30 kHz or less and video bandwidths of 43 Hz or less.

TEST EQUIPMENT

Description	Minimum specification	Example
Crystal oscillator	Output level: 0 dBm Output frequency: 100 MHz Phase noise: <-90 dBm at 100 Hz offset	HCD185R

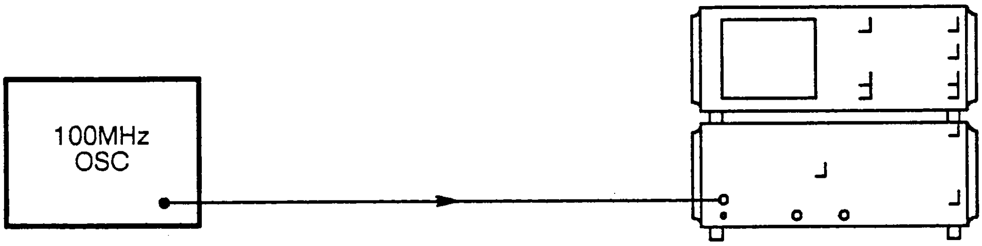

Fig. 5-7 Residual FM test set-up

Procedure

(1) Connect the crystal oscillator to the analyzer INPUT.

On the analyzer select:

PRESET	
CAL	
REF FREQ	100 MHz
SPAN/DIV	10 kHz

(2) Adjust the REF LEVEL until the response is in the top 2 dB of the screen.

Select:

FM DEMOD (2nd FUNCT - ZERO SPAN)	
SWEEP TIME	2 s/div
RESOLUTION BANDWIDTH	30 Hz

The displayed variation at any point should be less than 1.5 Hz.

DRIFT

10.

SPECIFICATION

Drift:	After a 1 hour warm-up	<10 Hz/min at 10 Hz/div increasing to <20 Hz/min at 2 kHz/div. <1 kHz/min at 5 kHz/div increasing to <2 kHz/min at 200 kHz/div. <50 kHz/min at 500 kHz/div increasing to <100 kHz/min at 40 MHz/div.

TEST EQUIPMENT

Description	Minimum specification	Example
Counter	Frequency range: 10 Hz to >500 MHz	Marconi 2432A

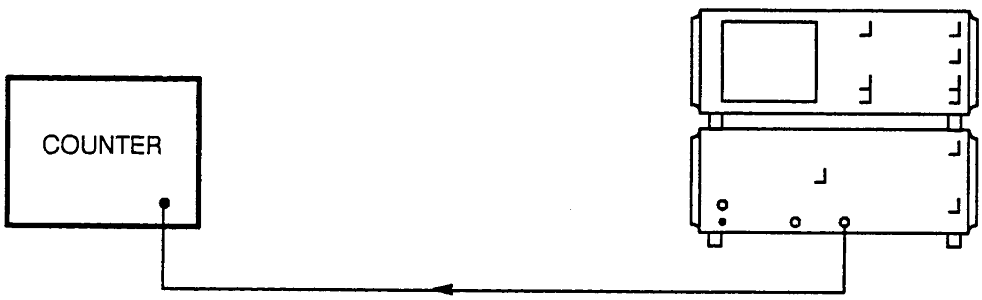

Fig. 5–8 Drift test set–up

Procedure

(1) Allow the analyzer to warm up for at least 1 hour. Connect the TRACKING GENERATOR output to the counter input.

(2) On the analyzer select:

PRESET	
CAL	
REF FREQ	95 MHz
SPAN/DIV	500 kHz
HORIZONTAL	METER
TRACK GEN	On

Note the counter reading, wait 1 minute and note the reading again. The drift should be <50 kHz.

(3) Repeat for SPAN/DIV 5 kHz and check that the drift is <1 kHz.

(4) Repeat again for SPAN/DIV 10 Hz and check that the drift is <10 Hz.

DISPLAYED NOISE SIDEBANDS

11.

SPECIFICATION

	Displacement from carrier	Displayed noise to 1 Hz bandwidth
Displayed noise sidebands:	100 Hz	<-90 dBc
	300 Hz	<-100 dBc
	20 kHz	<-105 dBc

TEST EQUIPMENT

Description	Minimum specification		Example
100 MHz oscillator	Phase noise at 100 Hz	: <-100 dBc/Hz	HCD185R
	at 1 kHz	; <-110 dBc/Hz	
	Output frequency	: 100 MHz	
	Output level	: 0 dBm	

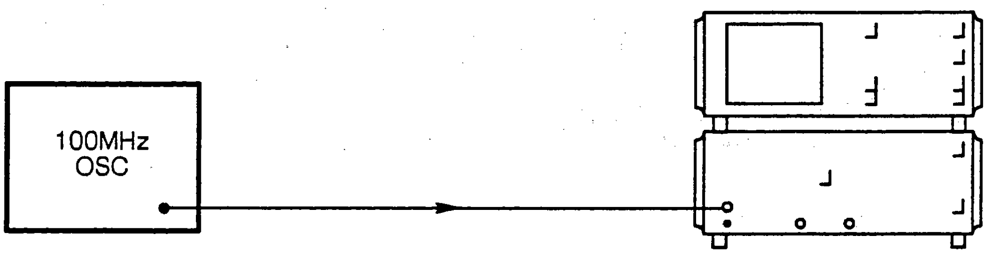

Fig. 5–9 Displayed noise sidebands test set–up

Procedure

(1) Connect the 100 MHz crystal oscillator to the analyzer INPUT and allow to stabilize.

(2) On the analyzer select:

PRESET	
CAL	
REF FREQ	100 MHz
SPAN/DIV	10 Hz
INC FREQ	100 Hz
PEAK FIND	
MKR 1 SETS REF LEVEL	
MKR 1 SETS REF FREQ	
dB RELATIVE (2nd FUNCT – 0.5 VERTICAL dB/DIVISION)	
REF FREQ	↑
REF LEVEL	↓
RESOLUTION BANDWIDTH	3 Hz

(3) Position marker at reference frequency origin.

Select NOISE 1 Hz (2nd FUNCT - MARKERS 1 2 MOVE)

The marker should read the equivalent of at least -90 dBc.

(4) Press REF FREQ ↑ twice

The marker should read the equivalent of -100 dBc.

(5) On the analyzer select:

REF FREQ	100.02 MHz

The marker should read the equivalent of -105 dBc.

OVERLOAD PROTECTION

12.

SPECIFICATION

Overload protected to +47 dBm.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output level: -40 dBm to +10 dBm	Marconi 2019A
RF amplifier	Frequency range: 1 MHz to 500 MHz Gain: +40 dB	Marconi 2177

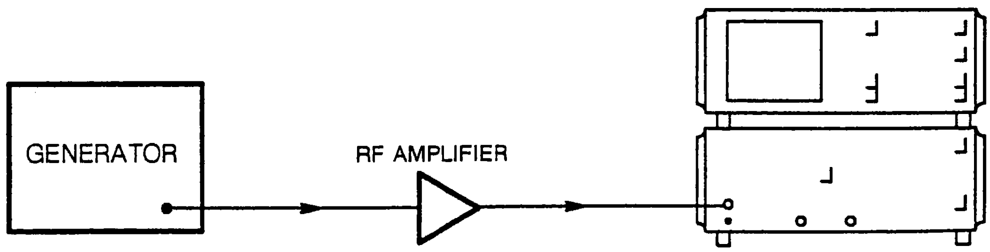

Fig. 5-10 Overload protection test set-up

Procedure

(1) Connect the 2177 RF amplifier output to the analyzer INPUT.

(2) On the 2019A generator select:

Carrier frequency	100 MHz
Output level	-30 dBm
Incremental level	1 dB

On the analyzer select:

REF LEVEL	+30 dBm
REF FREQ	100 MHz
SPAN/DIV	1 kHz

(3) Connect the 2019A generator output to the RF amplifier input.

(4) On the analyzer select:

PEAK FIND

(5) Increase the generator level to give a marker level of +22 dBm. The analyzer should not register an overload.

(6) Increase the generator output by +7 dBm and check that the 'Overload' annotation is displayed.

(7) Remove the input to the analyzer and press INTMD IDENT to remove the annotation and reset the overload protection.

DISPLAY FIDELITY, DB/DIV AND VOLTS/DIV

13.

SPECIFICATION

dB/DIV:	Departure from true logarithmic relationship less than 0.3 dB anywhere over the top 80 dB of display.
VOLTS/DIV:	Linearity better than >2% of full-scale.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output level : -40 dBm to +10 dBm	Marconi 2019A
Power meter	Frequency range: 30 kHz to 500 MHz Accuracy : >0.02 dBm	Marconi 6960 & 6912 sensor
RF amplifier	Frequency range: 1 MHz to 500 MHz Gain: +40 dB	Marconi 2177
RF attenuator	10 dB steps	HP 8495A
Power splitter	50 Ω, DC to 500 MHz	Weinschel 1870A

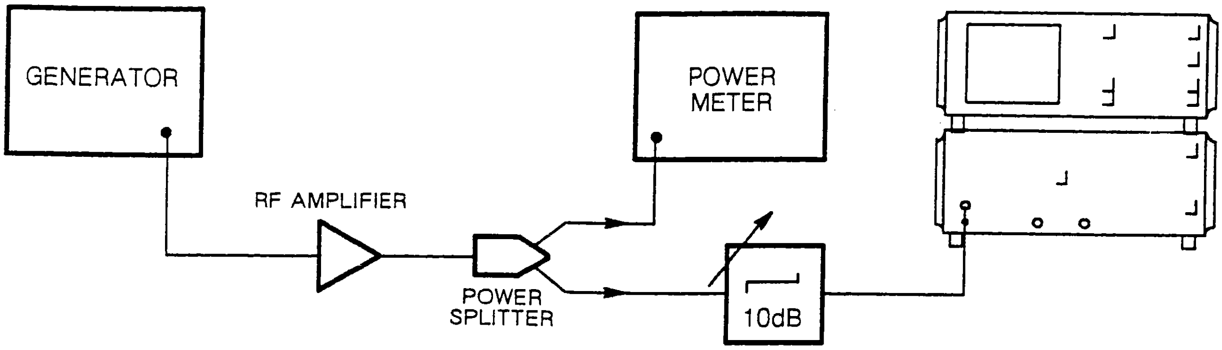

Fig. 5-11 Display fidelity test set-up

Procedure

(1) On the generator select a frequency of 10 MHz and an output level of -40 dB. Connect the generator via the amplifier to the power splitter input. Connect one output port on the power splitter to the power meter sensor, the other port to the analyzer INPUT via the 10 dB step attenuator.

(2) On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
REF LEVEL	+10 dBm
SPAN/DIV	10 Hz
HORIZONTAL	METER

(3) On the generator select a frequency of 10 MHz and adjust the output level to give +10 dBm on the screen. Note the power meter reading. Decrease the output level of the generator by 5 dB, checking correct reduction by use of the power meter. The readings should be -10 dBm ±0.3 dBm. Reduce the level in 5 dB steps to an input level of -10 dBm, noting marker readings at each step. All readings should be within ±0.3 dB of input level.

(4) Increase the output level of the generator to the original power meter reading. Introduce 20 dB of external attenuation. Repeat as above to an input level of -30 dBm.

(5) Increase the reference level of the generator to the initial power meter reading and introduce a further 20 dB of external attenuation. Repeat as previously to an input level of -50 dB.

(6) On the analyzer set input attenuation to 0 dB. Introduce a further 20 dB of external attenuation. Set generator level for marker reading equal to that recorded for the -50 dBm reading taken in step (5). Repeat as above to an input level on the screen of -70 dBm.

AMPLITUDE ACCURACY

14.

SPECIFICATION

dB/DIVISION accuracy:	±1 dB at any frequency, IF gain setting, RF attenuator setting and resolution bandwidth provided that the `sweep uncal' message is not displayed.

TEST EQUIPMENT

Description	Minimum specification	Example
Generators	Frequency range : 100 Hz to 1 MHz Output level : -40 dBm to +20 dBm	HP 3325
Generators	Frequency range : 1 MHz to 500 MHz Output level : -40 dBm to +10 dBm	Marconi 2019A
Power meter	Frequency range : DC to 50 MHz Accuracy : ±0.01 dB	W & G EPM1
	Frequency range : 30 kHz to 500 MHz Accuracy : ±0.02 dB	Marconi 6960 & 6912 sensor
Power splitter	50 Ω, DC to 500 MHz	Weinschel 1870A
RF attenuator	10 dB steps	HP 8495A

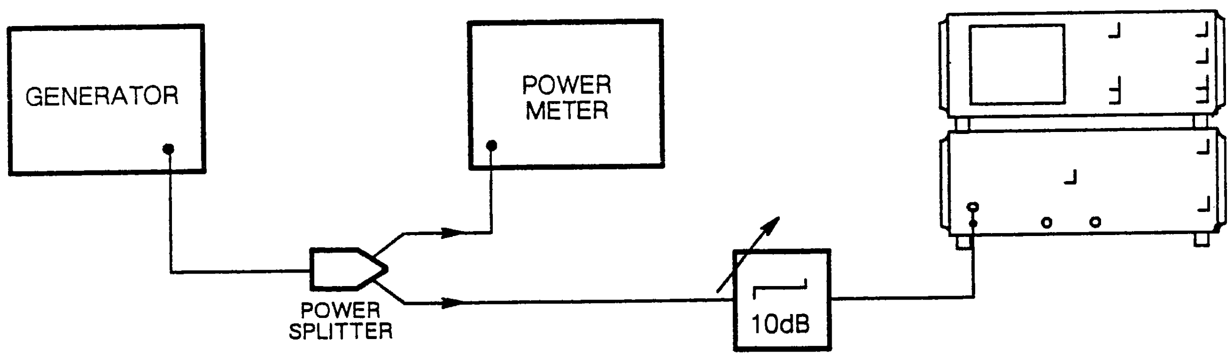

Fig. 5-12 Amplitude accuracy test set-up

Procedure

(1) Connect the STD 10 MHz OUTPUT to the INPUT.

(2) On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
REF LEVEL	-8 dBm
SPAN/DIV	10 Hz
dB/DIVISION	0.5 dB
B VIEW	On
VERTICAL A B SELECT	B
dB/DIVISION	0.5 dB
RESOLUTION BANDWIDTH	1 kHz
B SAVE	On

(3) Select each of the filters in turn and measure their amplitudes relative to the 1 kHz filter by use of MARKERS AB SELECT and PEAK FIND. Note each of the relative amplitudes. From these figures calculate the filter that has the greatest value relative to the 1 kHz filter and the one which has the least value relative to the 1 kHz filter.

(4) Connect the generator to the power splitter input. Connect the power meter to the output port and the attenuator onto the other output port of the power splitter. Attach the attenuator output onto the analyzer INPUT.

(5) On the generator select a carrier frequency of 100 Hz, levelled to 0 dBm.

(6) On the external attenuator select 20 dB attenuation.

On the analyzer select:

PRESET	
CAL	
REF FREQ	100 Hz
REF LEVEL	+10 dBm
SPAN/DIV	10 Hz

(7) Select the greatest filter and measure the response level using MKR1 and PEAK FIND. Repeat using the least filter. Both readings should be 20 dB ±1 dB.

(8) For each of the generator frequencies and the analyzer reference frequencies shown in Table 5-7 below, level the generator to 0 dBm using the power meter and measure the response level using the calculated filters.

TABLE 5-7 AMPLITUDE ACCURACY FREQUENCIES

GENERATOR and ANALYZER FREQUENCIES				
(Hz)	(kHz)	(MHz)	(MHz)	(MHz)
100	2	2	145.01	310.01
200	6	6	160.01	325.01
600	20	10.01	75.01	340.01
	60	25.01	190.01	255.01
	200	40.01	205.01	370.01
	600	55.01	220.01	385.01
		70.01	235.01	400.00
		85.01	250.01	
		100.01	295.01	
		115.01	280.01	
		130.01	295.01	

(9) Repeat the procedure for the reference levels and external attenuator settings shown in Table 5-8 below.

TABLE 5-8 AMPLITUDE ACCURACY REFERENCE LEVELS

ANALYZER REFERENCE LEVEL (dBm)	EXTERNAL ATTENUATOR (dB)	MARKER READING ±1 dB (dB)
+10	20	-20
0	20	-20
-10	30	-30
-20	30	-30
-30	40	-40
-40	40	-40

FREQUENCY RESPONSE

15.

SPECIFICATION

Frequency response:	±0.4 dB for RF attenuations of 10 dB or more. ±0.05 dB for RF attenuation of 0 dB.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 100 Hz to 1 MHz Output level : -40 dBm to +20 dBm	HP 3325
	Frequency range: 1 MHz to 500 MHz Output level : -40 dBm to +10 dBm	Marconi 2019A
Power splitter	50 Ω	Weinschel 1870A
Power meter	Frequency range: DC to 50 MHz	W & G EPM1
Power meter	Frequency range: 30 kHz to 500 MHz Accuracy : ±0.02 dB	Marconi 6960 & 6912 sensor

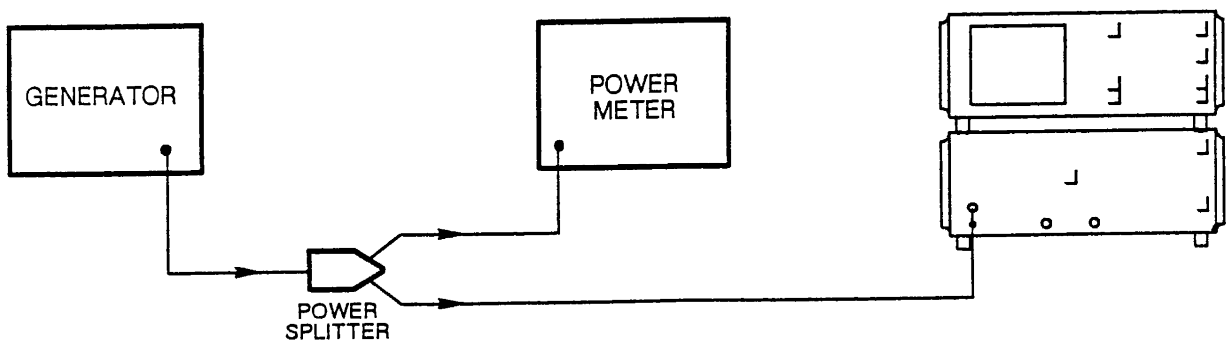

Fig. 5-13 Frequency response test set-up

Procedure

(1) Connect the generator as required to the power splitter input, and the power meter and analyzer to the power splitter outputs.

On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
REF LEVEL	-8 dBm
dB/DIVISION	0.5 dB
RF ATTEN	0 dB
SPAN/DIV	1 kHz

(2) On the generator select 10 MHz and adjust the output level until the response on the analyzer is -10 dBm. Note the power meter reading.

(3) For each of the generator and analyzer frequencies in Table 5-9 below, adjust the output so as to read the value for the 10 MHz level on the power meter as recorded in (2) above.

(4) On the analyzer use MKR1 and PEAK FIND to obtain the level at each frequency. This should be -10 dBm ±0.5 dB.

(5) Repeat for 20 dB of input attenuation. The levels should be -10 dBm ±0.4 dB.

TABLE 5-9 FREQUENCY RESPONSE TEST SETTINGS

GENERATOR and ANALYZER FREQUENCIES				
(Hz)	(kHz)	(MHz)	(MHz)	(MHz)
100	2	2	130.01	280.01
200	6	6	145.01	295.01
600	20	10.01	160.01	310.01
	60	25.01	185.01	325.01
	200	40.01	190.01	340.01
	600	55.01	205.01	355.01
		70.01	220.01	370.01
		85.01	235.01	385.01
		100.01	250.01	400.0
		115.01	265.01	

INPUT RETURN LOSS

16.

SPECIFICATION

Return loss (reflection coefficient):	±20 dB return loss for RF attenuator settings of 10 dB or more. ±15 dB return loss for RF attenuator setting of OdB.

TEST EQUIPMENT

Description	Minimum specification		Example
Spectrum analyzer	Frequency range	: 100 Hz to 1 GHz with tracking generator	Marconi 2370 & 2373 extender
Return loss bridge	Frequency range Impedance	: 10 MHz to 1 GHz : 50 Ω	Wiltron 62N50

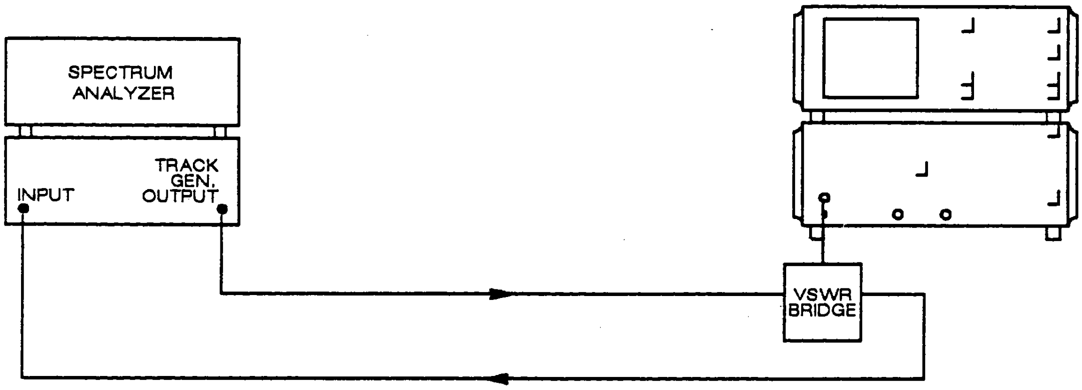

Fig. 5–14 Input return loss test set–up

Procedure

(1) Connect the test analyzer tracking generator output to the VSWR bridge input and the VSWR bridge output to the 2373 analyzer INPUT.

(2) On the test analyzer select:

Reference frequency	200 MHz
Horizontal scale	50 MHz/div
Reference level	0 dB
Vertical scale	10 dB/div

With the bridge test port open–circuited, save the level displayed on the test analyzer as a reference.

(3) Connect the VSWR bridge to the 2382 INPUT.

On the 2382 analyzer select:

REF FREQ	0 MHz
HORIZONTAL	ZERO SPAN
RF ATTEN	0 dB

The maximum level on the test analyzer up to 400 MHz should be 15 dB below the reference level stored.

(4) Repeat for 10 dB RF attenuation on the 2382. The reflected response should be 20 dB below the reference level.

LOCAL OSCILLATOR LEAKAGE

17.

SPECIFICATION

Leakage: Typically <-85 dBm at any frequency and any attenuator setting.

TEST EQUIPMENT

Description	Minimum specification	Example
Spectrum analyzer	Frequency range: 100 Hz to 1 GHz	Marconi 2370 & 2373 extender

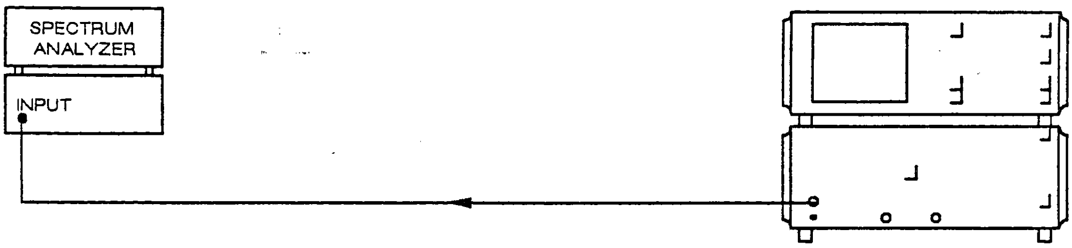

Fig. 5-15 Local oscillator leakage test set-up

Procedure

(1) Connect the 2382 analyzer INPUT to the test analyzer extender RF input.

On the 2382 select:

PRESET	
CAL	
REF FREQ	0 MHz
RF ATTEN	0 dB
HORIZONTAL	ZERO SPAN

(2) Tune the 2373 to 502.6 MHz and check that any signal at this frequency is below -85 dBm.

HARMONIC DISTORTION

18.

SPECIFICATION

Harmonic distortion: With a sinusoidal signal at -42 dBm at the input mixer any internally generated harmonic distortion products will be >80 dB down on the fundamental.

TEST EQUIPMENT

Description	Minimum specification		Example
100 MHz crystal oscillator	Harmonics	: >30 dB down on fundamental	HCD185R
100 MHz low-pass filter	Attenuation Cut-off frequency	: >50 dB at 200 MHz : 100 MHz	Telonic TCP100 48B

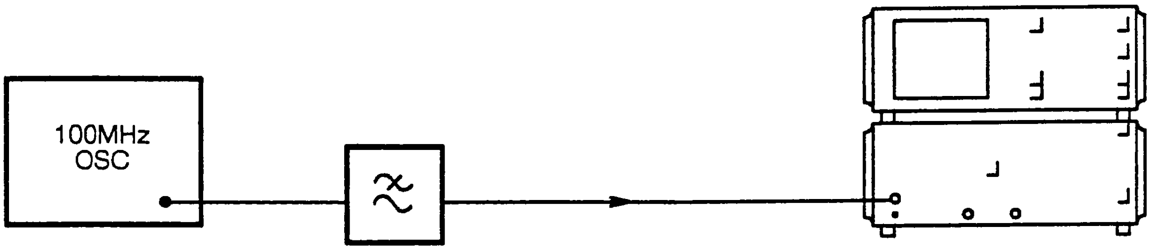

Fig. 5-16 Harmonic distortion test set-up

Procedure

(1) Connect the 100 MHz oscillator via the low-pass filter to the analyzer INPUT.

On the analyzer select:

PRESET	
CAL	
REF FREQ	100 MHz
REF LEVEL	-10 dB
SPAN/DIV	200 Hz
RF ATTEN	40 dB

(2) Adjust the oscillator output until it is at the top of the screen.

(3) On the analyzer select:

PEAK FIND	
MKR1 SETS REF FREQ	
MKR1 SETS INC FREQ	
REF FREQ	↑
SPAN/DIV	10 Hz

(4) Pressing INTMD IDENT should display 'input level of -10 dBm gives mixer level of -42 dBm'.

On the analyzer select:

SWEEP MODE	SINGLE ARM

After completion of the sweep press PEAK FIND.

(5) The marker reading should be at least 80 dB below the carrier (i.e. at least -90 dBm).

(6) On the analyzer select:

REF FREQ	↑
SWEEP MODE	SINGLE ARM

After completion of the sweep press PEAK FIND.

(7) The marker reading should again be at least -90 dBm.

(8) On the analyzer select:

REF FREQ	↑
SWEEP MODE	SINGLE ARM

After completion of the sweep press PEAK FIND.

(9) The marker reading again should be at least -90 dBm.

NON-HARMONIC DISTORTION

19.

SPECIFICATION

Non-harmonic distortion: With a sinusoidal signal at -42 dBm at the input mixer any internally generated non-harmonic distortion products will be >75 dB down on signal.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output level : -40 dBm to +10 dBm	Marconi 2019A

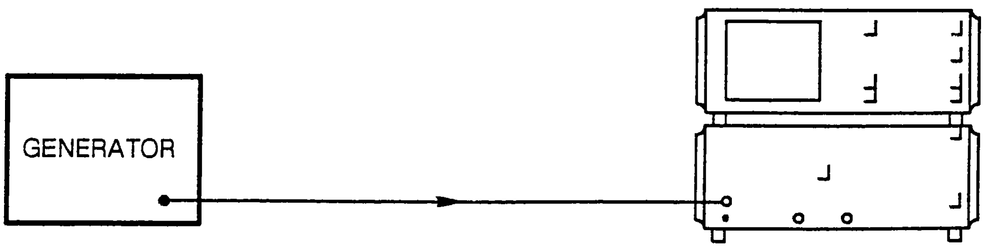

Fig. 5-17 Non-harmonic distortion test set-up

Procedure

(1) Connect the generator to the analyzer INPUT.

On the generator select:

Carrier frequency	260 MHz
Reference level	-10 dBm

(2) On the analyzer select:

PRESET	
CAL	
REF FREQ	8.7 MHz
REF LEVEL	-10 dB
SPAN/DIV	10 Hz
RF ATTEN	40 dB

(3) Adjust the generator so that the response is at −10 dBm on the screen. Pressing INTMD IDENT should display 'input level of −10 dBm gives mixer level of -42 dBm'.

(4) On the analyzer select:

RESOLUTION BANDWIDTH	3 Hz

After completion of the sweep press PEAK FIND.

(5) The response should be at least -85 dBm.

Repeat for generator frequencies and analyzer reference frequencies in Table 5-10 below.

TABLE 5-10 DISTORTION REFERENCE FREQUENCIES

GENERATOR FREQUENCY (MHz)	REFERENCE FREQUENCY (MHz)
300.0	48.7
350.0	98.7
400.0	147.7
9.919	104.719
109.919	104.719
356.919	104.719

THIRD ORDER INTERMODULATION

20.

SPECIFICATION

Third order intermodulation:	-95 dBc for on-screen signals using 3 Hz filter at -42 dBm at the input mixer (equivalent to third order intercept point of +5.5 dBm).

TEST EQUIPMENT

Description	Minimum specification	Example
100 MHz crystal oscillator (2)	Output level : 0 dBm Phase noise at 1 kHz: <-100 dBc	HCD 185R
Attenuators	1 x 3 dB, 2 x 20 dB BNC connectors	Texscan FP-50 series
Combiner	Frequency : 100 MHz Impedance : 50 Ω	Mini-Circuits ZFSC-2-1

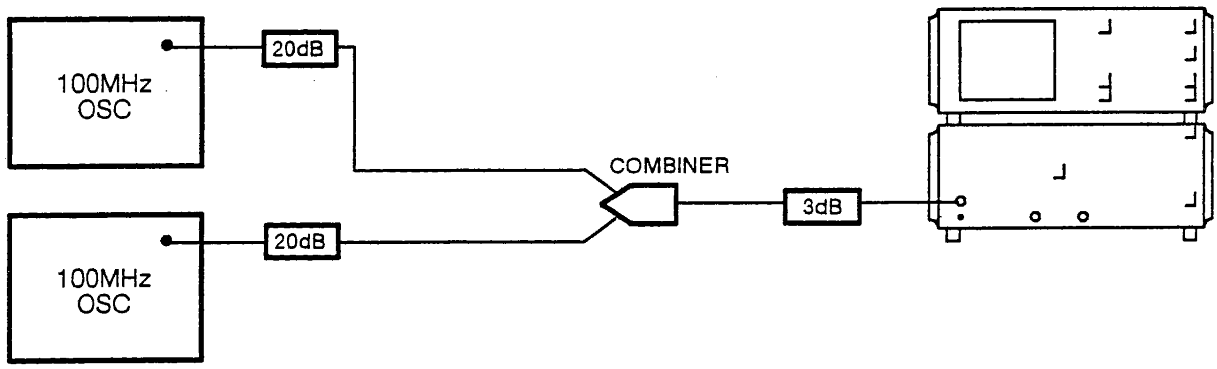

Fig. 5-18 Third order intermodulation test set-up

Procedure

(1) Connect a 20 dB pad to each input of the combiner, connect the output of the combiner via a 3 dB pad to the INPUT of the analyzer. Connect one crystal oscillator output to one of the 20 dB pads.

(2) On the analyzer select:

PRESET	
CAL	
REF FREQ	100 MHz
REF LEVEL	-20 dBm
SPAN/DIV	500 Hz

(3) Set the oscillator output level to the -20 dBm reference level.

(4) Connect the second oscillator to the other -20 dB pad input. Adjust its level and frequency to give a response at the reference level, 1 division to the left of the centred response.

(5) Adjust the analyzer attenuator so as to display the third order intermodulation products at least 10 dB out of the noise.

(6) Determine the difference N between the reference and the intermodulation levels as a positive number. (For an intermod of −120 dBm, N = 100.)

(7) Press INTMD IDENT to display the mixer level.

(8) Check that Mixer level + N/2 is equal or greater than 5.5 dBm.

RESIDUAL RESPONSES

21.

SPECIFICATION

Residual responses: <−115 dBm at 0 dB RF attenuation.

TEST EQUIPMENT

Description	Minimum specification	Example
Type-N termination	Impedance: 50 Ω	Weinschel 1404

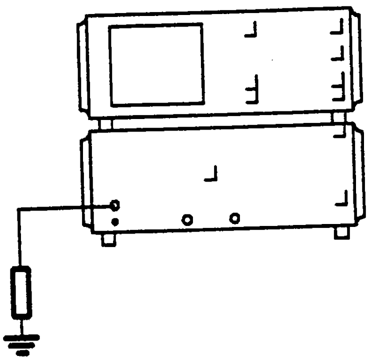

Fig. 5−19 Residual responses test set−up

Procedure

(1) Terminate the analyzer INPUT with the 50 Ω load.

Select:

PRESET	
CAL	
REF FREQ	5 MHz
REF LEVEL	−80 dB
SPAN/DIV	100 Hz
RESOLUTION BANDWIDTH	10 Hz
RF ATTEN	0 dB
SWEEP MODE	SINGLE ARM

After completion of the sweep press PEAK FIND.

(2) The response should be <−115 dBm.

(3) Repeat for the reference frequencies shown in Table 5−11 below:

TABLE 5-11 RESIDUAL RESPONSE FREQUENCIES

REFERENCE FREQUENCIES (MHz)

10.0	40
15.0	50
20.0	100
30.0	200
35.0	250
	300

INPUT NOISE SENSITIVITY

22.

SPECIFICATION

Sensitivity: <-135 dBm for reference frequencies greater than 150 kHz.

TEST EQUIPMENT

Description	Minimum specification	Example
Type-N termination	Impedance: 50 Ω	Weinschel 1404

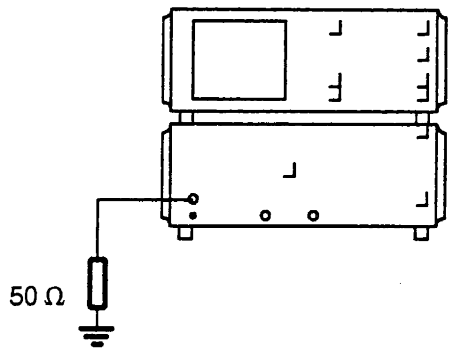

Fig. 5-20 Input noise sensitivity test set-up

Procedure

(1) Terminate the INPUT with a 50 Ω load.

Select:

PRESET	
CAL	
REF FREQ	151 kHz
REF LEVEL	-50 dBm
SPAN/DIV	10 Hz
RF ATTEN	0 dB
RESOLUTION BANDWIDTH	3 Hz
SWEEP MODE	SINGLE ARM

The average level of displayed noise should be <-135 dBm.

(2) Repeat using REF FREQ 200.01 MHz.

TRACKING GENERATOR CROSS-COUPLING

23.

SPECIFICATION

Cross-coupling:	With the tracking generator switched on and both the INPUT and the TRACKING GENERATOR output terminated in 50 Ω, the displayed noise level in a 3 Hz bandwidth is not >-125 dBm from 150 kHz to 400 MHz.

TEST EQUIPMENT

Description	Minimum specification	Example
2 x Type-N terminations	Impedance: 50 Ω	Weinschel 1404

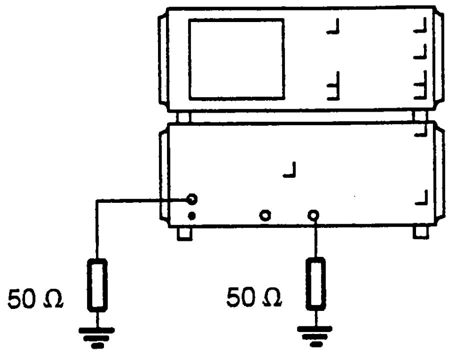

Fig. 5-21 Tracking generator cross-coupling test set-up

Procedure

(1) Terminate the INPUT and TRACKING GENERATOR output with 50 Ω.

Select:

PRESET	
CAL	
REF FREQ	0.15 MHz
REF LEVEL	-60 dBm
SPAN/DIV	10 Hz
RF ATTEN	0 dB
RESOLUTION BANDWIDTH	3 Hz
TRACK GEN	On
SWEEP MODE	SINGLE ARM

After completion of the sweep press PEAK FIND.

(2) The response should be at least -125 dBm.

(3) Repeat for the frequencies shown in Table 5-12 below.

TABLE 5-12 TG CROSS-COUPLING TEST SETTINGS

REFERENCE FREQUENCIES (MHz)
1.03
3.03
10.03
30.03
100.03
200.03
300.03
399.99

EXTERNAL TRIGGER SOURCE

24.

SPECIFICATION

External trigger source:	Sweep is triggered by external signals from the rear panel EXT TRIG BNC connector over the range 50 mV pk-pk to 100 V pk-pk from 10 Hz to 300 kHz.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 100 Hz to 1 MHz Output level : -40 dBm to +20 dBm	HP3325

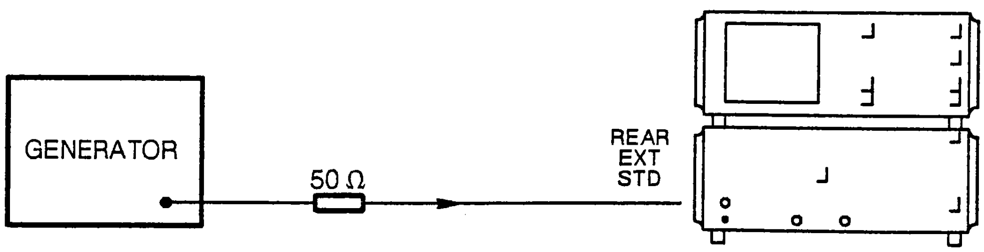

Fig. 5-22 External trigger source test set-up

Procedure

(1) On the analyzer select:

TRIGGER SOURCE	EXT
AUTO TRIGGER	Off

(2) Connect the trigger source via a 50 Ω load to the EXT TRIG input on the rear of the analyzer and check that the instrument sweeps continuously for each of the inputs shown in Table 5-13 below.

TABLE 5-13 EXTERNAL TRIGGER TEST SETTINGS

FREQUENCY	LEVEL
10 Hz	50 mV pk-pk
10 Hz	5 V pk-pk
6 kHz	50 mV pk-pk
6 kHz	5 V pk-pk
300 kHz	50 mV pk-pk
300 kHz	5 V pk-pk

FM DEMOD DISPLAY ACCURACY

25.

SPECIFICATION

Accuracy: Deviation accuracy at zero deviation rate is ±20% FSD ±1 Hz. Bandwidth depends upon selected filter.

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output level : -40 dBm to +10 dBm	Marconi 2019A

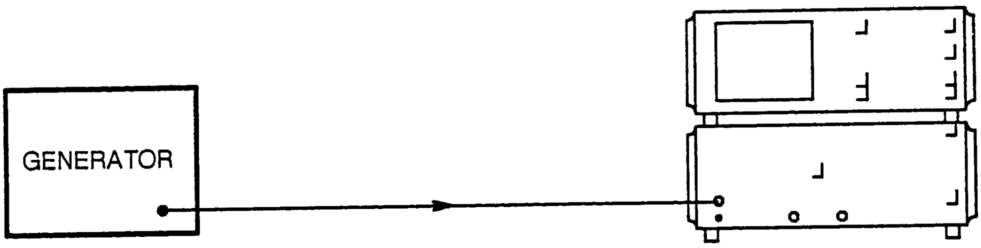

Fig. 5-23 FM demod display accuracy test set-up

Procedure

(1) Connect the generator output to the analyzer INPUT.

On the generator select:

Frequency	100 MHz
Output level	0 dBm

On the analyzer select:

PRESET	
CAL	
REF FREQ	100 MHz
SPAN/DIV	100 kHz

(2) Adjust the generator level until the response is within the top 2 dB of screen. On the analyzer select:

FM DEMOD (2nd FUNCT - ZERO SPAN)	
RESOLUTION BANDWIDTH	1 kHz

Note the reading, increase the generator frequency by 1 kHz and check that the reading on the analyzer is the original value +1 kHz ±120 Hz.

TRACKING GENERATOR FREQUENCY ACCURACY

26.

SPECIFICATION

Accuracy: +1 Hz referred to the tuned frequency.

TEST EQUIPMENT

\- None required -

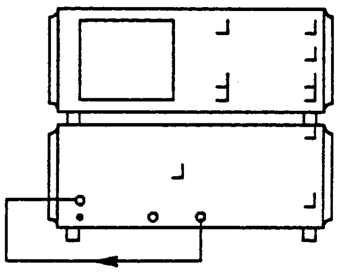

Fig. 5-24 Tracking generator frequency accuracy test set-up

Procedure

(1) Connect the TRACKING GENERATOR output to the INPUT.

On the analyzer select:

PRESET	
CAL	
REF FREQ	100 MHz
SPAN/DIV	10 Hz
RESOLUTION BANDWIDTH	30 Hz
TRACK GEN	On
SWEEP MODE	SINGLE ARM
START	
B VIEW	On
B SAVE	On
RESOLUTION BANDWIDTH	3 Hz
START	

(2) On commencement of sweep press MKR1 ON. Toggle marker between A and B traces using MARKERS AB SELECT and ensure that level readout does not change by >0.5 dBm.

TRACKING GENERATOR FREQUENCY RESPONSE

27.

SPECIFICATION

Amplitude accuracy:	±0.5 dB at −10 dBm at 10 MHz.
Frequency response:	±0.35 dB at −10 dBm.

TEST EQUIPMENT

Description	Minimum specification		Example
Power meter	Frequency : Accuracy :	30 kHz to 500 MHz ±0.02 dB	Marconi 6960 & 6912 sensor
Power meter	Frequency range: Accuracy :	DC to 50 MHz ±0.01 dB	W & G EPM1

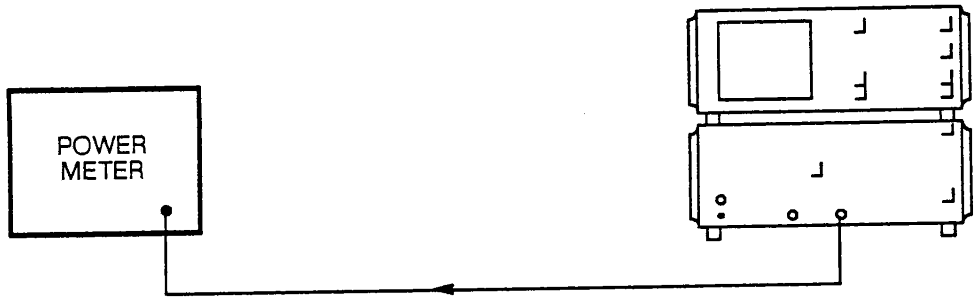

Fig. 5–25 Tracking generator frequency response test set–up

Procedure

(1) Connect the TRACKING GENERATOR output to the input of the appropriate power meter.

On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
TRACK GEN	On
HORIZONTAL	ZERO SPAN

The power meter reading should be −10 dBm ±0.5 dB.

(2) Select:

REF FREQ	200 Hz

The power meter should read the level at 10 MHz ±0.35 dB.

(3) Repeat for all of the frequencies in Table 5–14 below. Each reading should be within ±0.35 dB of the level at 10 MHz.

TABLE 5-14 TG FREQUENCY RESPONSE TEST SETTINGS

REFERENCE FREQUENCY			
(kHz)	(MHz)	(MHz)	(MHz)
0.5	2.0	130.0	280.0
2.0	5.0	145.0	295.0
5.0	10.0	160.0	310.0
20.0	25.0	175.0	325.0
50.0	40.0	190.0	340.0
200.0	55.0	205.0	355.0
500.0	70.0	220.0	370.0
	85.0	235.0	385.0
	100.0	250.0	400.0
	115.0	265.0	

TRACKING GENERATOR AMPLITUDE SETTING

28.

SPECIFICATION

Amplitude: -9.7 dBm to -20.3 dBm in 0.1 dB steps.

TEST EQUIPMENT

- None required -

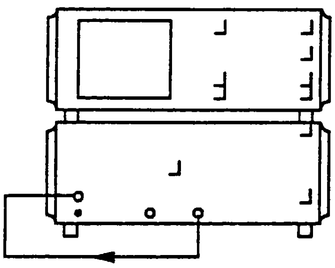

Fig. 5-26 Tracking generator amplitude test set-up

Procedure

(1) Connect the TRACKING GENERATOR output to the INPUT.

On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
SPAN/DIV	10 kHz
TRACK GEN	On
SET TG (2nd FUNCT - REF LEVEL)	-9.7 dBm
PEAK FIND	

The marker should read -9.7 dBm ±0.5 dB and the annotation at the top of the screen should read -9.7 dBm.

(2) Select a tracking generator level of -20.3 dBm. The marker should read -20.3 dBm ±0.5 dB and the associated annotation should read -20.3 dBm.

TRACKING GENERATOR DISTORTION

29.

SPECIFICATION

```
Harmonics            : all >30 dB down on the fundamental signal.
Non-harmonic signals: all >30 dB down on the fundamental signal.
Residual signals     : all <-70 dBm with the tracking generator off.
```

TEST EQUIPMENT

Description	Minimum specification	Example
Spectrum analyzer	Frequency range: 100 Hz to 1 GHz	Marconi 2370 & 2373 extender

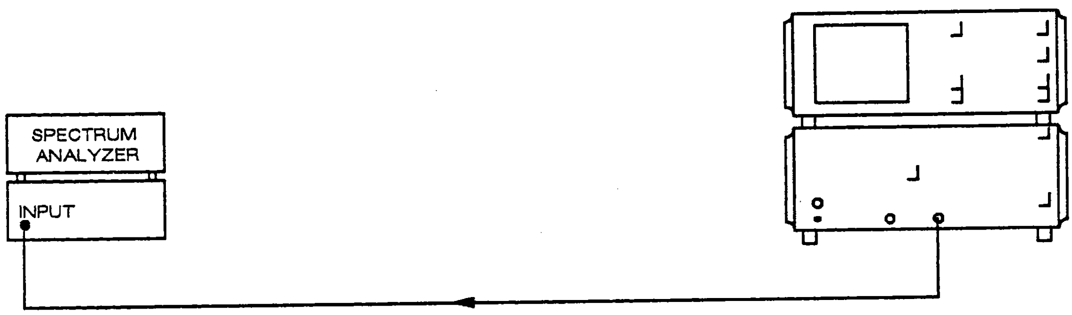

Fig. 5-27 Tracking generator distortion test set-up

Procedure

(1) Connect the TRACKING GENERATOR output to the test analyzer input.

On the test analyzer select:

Reference frequency	200 MHz
Horizontal scale	50 MHz/div
Top of screen	0 dBm
Vertical scale	10 dB/div

On the 2382 select:

PRESET	
CAL	
FULL SPAN	
TRACK GEN	On
SWEEP TIME	2 s/div

All harmonics and spurious signals should be >30 dB down on the fundamental.

Deselect TRACK GEN. Any residual signals should be <-70 dBm.

TRACKING GENERATOR RETURN LOSS

30.

SPECIFICATION

Return loss: 20 dB.

TEST EQUIPMENT

Description	Minimum specification	Example
Attenuators	N-type 10 dB attenuators (Qty. 2).	Marconi 6534/3
Mismatch	470 Ω resistor with N-type connectors.	-
Cable	1.5 m of N-type 50 Ω cable.	RG214

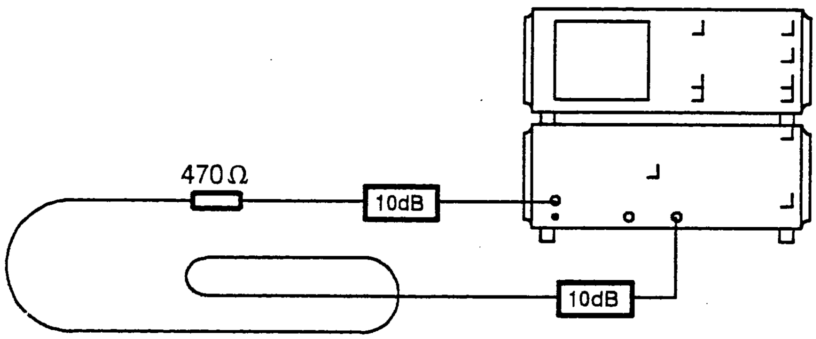

Fig. 5–28 Tracking generator return loss test set–up

Procedure

(1) Select:

PRESET	
CAL	
REF LEVEL	-42.5 dBm
SWEEP TIME	500 ms/div
TRACK GEN	On
SWEEP MODE	SINGLE ARM

(2) Press NORMALIZE once, then attach the assembly as shown and again press NORMALIZE. Press START.

Select:

dB/DIVISION	0.5 dB
REF LEVEL	2.5 dBm
SWEEP MODE	SINGLE ARM

Remove 10 dB pad from TG socket and press START. The maximum amplitude of the displayed signal should be 1 dB.

STANDARD 10 MHz OUTPUT FREQUENCY

31.

SPECIFICATION

Frequency: 10 MHz ± standard frequency error.

TEST EQUIPMENT

Description	Minimum specification	Example
Counter	Frequency range: 100 Hz to 500 MHz	Marconi 2432A

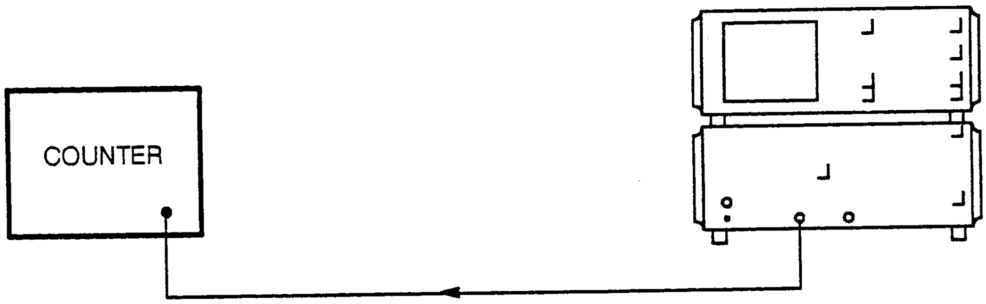

Fig. 5–29 Standard 10 MHz output frequency test set–up

Procedure

(1) Connect the STD 10 MHZ OUTPUT to the counter input. Remove any standard input connected to the analyzer EXT STD socket.

The counter should read 10 MHz ±20 Hz.

STANDARD 10 MHz OUTPUT AMPLITUDE

32.

SPECIFICATION

Amplitude: −10 dBm ±0.3 dB.

TEST EQUIPMENT

Description	Minimum specification	Example
Power meter	Frequency range: 30 kHz to 500 MHz Accuracy : ±0.02 dB	Marconi 6960 & 6912 Sensor
Generator	Frequency range: 1 MHz to 500 MHz Output level : −40 dBm to +10 dBm	Marconi 2019A

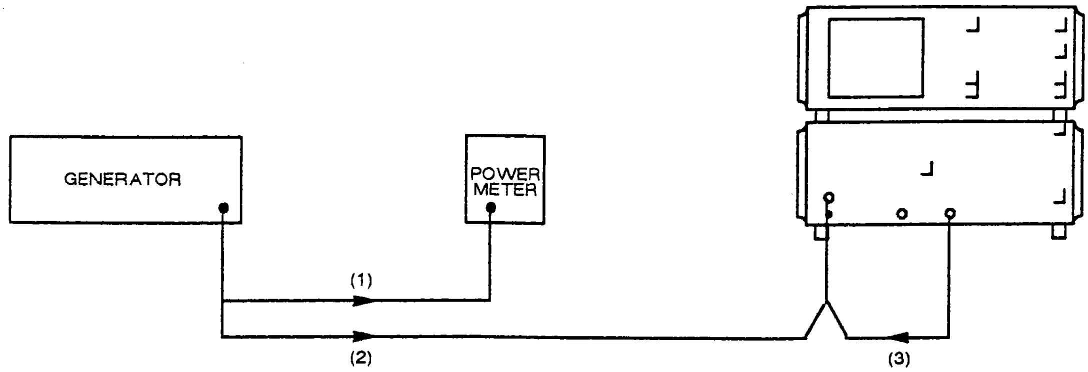

Fig. 5–30 Standard 10 MHz output amplitude test set–up

Procedure

(1) Connect the generator output to the power meter input.

On the generator select:

Carrier frequency	10 MHz
Output level	-10 dBm

Adjust the reference level until the power meter reads –10 dBm.

(2) Connect the generator output to the analyzer INPUT.

On the analyzer select:

PRESET	
CAL	
REF FREQ	10 MHz
REF LEVEL	-8 dBm
SPAN/DIV	10 kHz
dB/DIVISION	0.5 dB
A SAVE	

(3) Connect the STD 10 MHz OUTPUT to the INPUT.

On the analyzer select:

B VIEW	
VERTICAL A B SELECT	B
dB/DIVISION	0.5 dB

Using the markers the level of the 10 MHz standard should be within ±0.3 dB of the stored generator level.

47.4 MHz OUTPUT

33.

SPECIFICATION

Centre frequency:	47.4 MHz.
Bandwidth :	typically 3 MHz.
Amplitude :	nominally 3 dB greater than RF input signal for 0 dB RF attenuation +5 to 10 dB gain.

TEST EQUIPMENT

Description	Minimum specification	Example
Spectrum analyzer	Frequency range: 100 Hz to 1 GHz	Marconi 2370 & 2373 extender

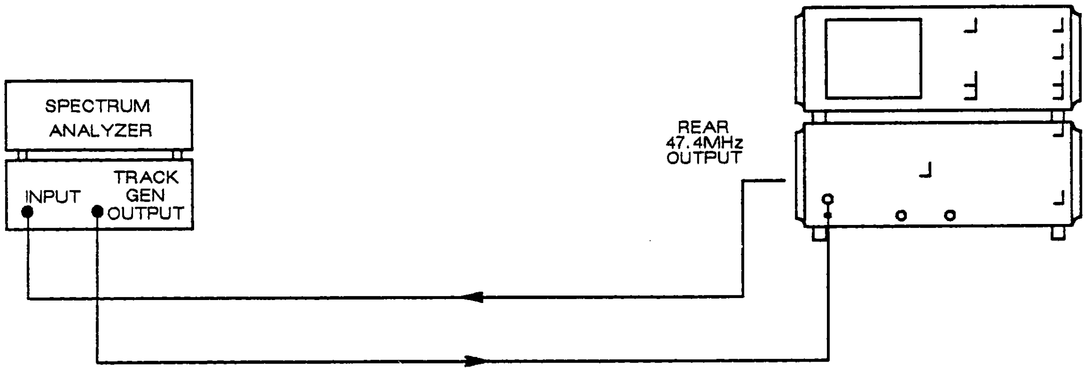

Fig. 5–31 47.4 MHz output test set–up

Procedure

(1) Connect the test analyzer tracking generator output to the 2382 INPUT. Connect the 47.4 MHz OUTPUT at the rear of the 2382 to the analyzer input.

(2) On the test analyzer select:

Reference frequency	47.4 MHz
Top of screen	+5 dB
Horizontal scale	1 MHz/div
Vertical scale	10 dB/div
Tracking generator	On

(3) On the 2382 select:

REF FREQ	47.4 MHz
RF ATTEN	0 dB
HORIZONTAL	ZERO SPAN

The response displayed on the test analyzer should be centred on 47.4 MHz with a bandwidth of nominally 3 MHz. The peak level should be between 5 and 10 dB greater than the test analyzer tracking generator output level.

DEMODULATED OUTPUT

34.

SPECIFICATION

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:

Linear	1 V/div	3.3 V
	2 V/div	3.3 V
	5 V/div	6.7 V

TEST EQUIPMENT

Description	Minimum specification	Example
Generator	Frequency range: 1 MHz to 500 MHz Output level : −40 dBm to +10 dBm	Marconi 2019A
Oscilloscope	Frequency range: DC to 100 MHz	Tektronix 2235

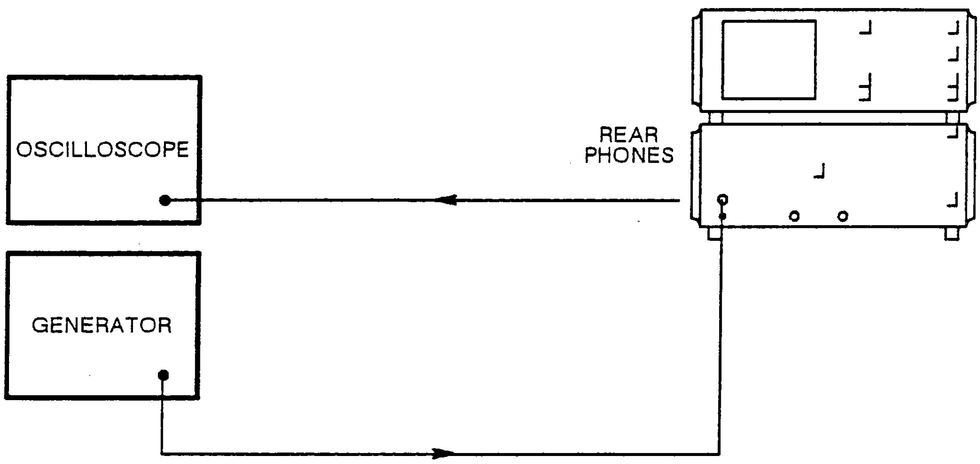

Fig. 5–32 Demodulated output test set–up

Procedure

(1) Connect the generator output to the analyzer INPUT. Connect the rear PHONES output to the oscilloscope.

(2) Lock the analyzer and the generator to an external standard.

(3) On the generator select:

Carrier frequency	100 MHz
AM depth	30 %
Modulation frequency	1 kHz
Modulation	Off
Output level	−10 dBm

(4) On the analyzer select:

REF FREQ	100 MHz
SPAN/DIV	20 kHz
VOLTS/DIV	100 mV full–scale
VOL control	Fully clockwise

(5) Adjust the RF level of the generator until the response is at 50 mV. Then switch the modulation on.

(6) On the analyzer select:

HORIZONTAL	ZERO SPAN
RESOLUTION BANDWIDTH	10 kHz
AUDIO (2nd FUNCT - METER)	On
SWEEP TIME	1 ms/div

(7) The demodulated signal will be displayed on the oscilloscope. Check that its amplitude is approximately 2 V pk-pk.

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LIST OF TABLES

LIST OF FIGURES