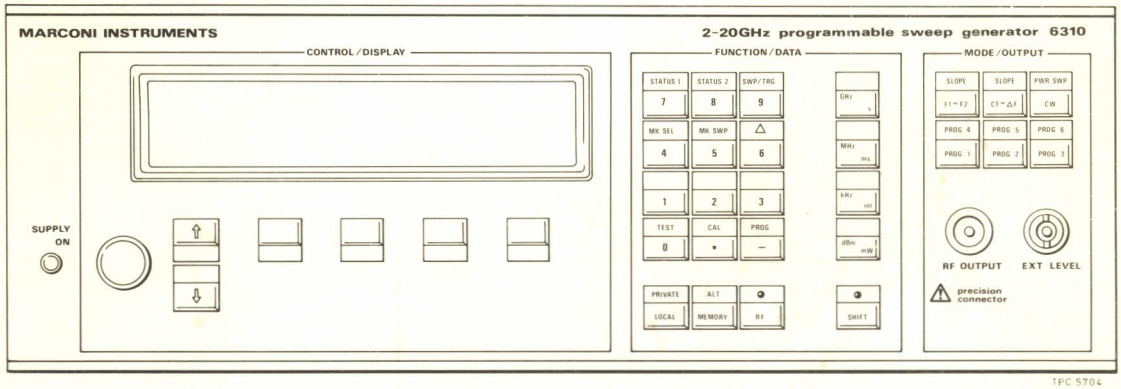
Marconi
Instruments

6310

2-20 GHz PROGRAMMABLE SWEEP GENERATOR



TPC 5704

Operating Manual

EQUIPMENT ... 6310

TITLE ..... Programmable Sweepp Generator

ACCOMPANYING
DOCUMENTS ... None

MANUAL CHANGE

Chap. 3-2, page 3-37, DISPLAY Editor (Level 2)

Second example display (showing area available for parameter display) is upside down.

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

EQUIPMENT ... 6310

TITLE ..... Programmable Sweep Generator

ACCOMPANYING
DOCUMENTS ... None

MANUAL CHANGE

This manual change note, which supersedes Change No. C1, details expanded facilities available when operating the 6310 Programmable Sweep Generator in an amplitude analysis system with the 6500 Automatic Amplitude Analyser. All changes are in Chapter 3-4. The changes apply to 6310 Firmware Issue 3 and higher, except where otherwise stated.

Page 3-47

Amend fifth paragraph to read:

6500 front panel settings are stored automatically in the sweeper's non-volatile memories whenever 6310 memory STORE operations are carried out. These may be recalled by 6310 memory RECALL operations or by means of the special alternate sweep facilities developed for use with the 6500.

Page 3-49

The following replaces the text under **MARKER and ΔF keys:**

If your 6500 contains Issue 5 Firmware the 6500 [MARKER] and [ΔF] keys are disabled. Use the marker and CF-ΔF facilities available from the sweeper front panel.

The following marker facilities apply to 6310 Issue 4/6500 Issue 6 Firmware:

Provision has been made for the electronically generated line markers available on 6500 to be assigned to and to track the 6310 markers.

Line markers are vertical lines similar in appearance to the brightline cursor. Issue 6 firmware provides a small highlight "pip" on the lower end of the brightline to distinguish it from the line markers.

Control of the line markers is achieved by means of a menu displayed on the 6500 screen. They may be displayed instead of or as well as the RF dip markers generated by the sweeper.

Marker control from the 6500 marker menu

Full control of the 6500 line marker facilities is obtained by selecting [SHIFT][MARKER].

The following information is displayed:

6310 Markers:	A	B	C	D	E
6500 Markers:	Off	Off	Off	Off	Off
Toggle using:	1	2	3	4	5

6 - All Off
7 - All On

8 - Marker Δ On/Off

9 - Marker Δ with ΔF On/Off

NORMAL - Exit

The upper two lines show which of the 6310 markers, A to E, have been assigned 6500 line markers.

Numeric keys 1 to 5 may be used to assign a line marker to a 6310 marker. These keys have a toggling action; the current assignments are shown as **Off** or **On**.

Numeric keys 6 and 7 may be used to switch all five line markers on or off together.

Option 8 toggles the Marker Δ display on or off. This shows the difference in amplitude between the measurement at the reference marker frequency and at the 6500 brightline frequency. Marker Δ information is updated at the same time as the other brightline related information - at the end of each measurement sweep and when the brightline is moved.

Option 9 performs the same function as option 8, but additionally displays the absolute value of the frequency difference between the reference marker and the brightline, in place of the usual brightline frequency. This is indicated by a Δ character displayed as part of the 6500's frequency axis annotation.

The Marker Δ display is switched on only when 6310 is in a swept frequency mode (i.e. not CW or power sweep), and when the Reference Marker is displayed as a line marker. The Marker Δ field is blanked if it is not possible to compute a valid amplitude difference value. The most likely reason for this is that the reference marker frequency lies outside the current F1-F2 frequency range.

Assigning the reference marker frequency using the 6500 brightline

The 6500's [MARKER] key sets the 6310 reference marker frequency from the 6500's current brightline frequency. This may be used to position a marker at a feature of interest on the new trace. At the same time as the reference marker is assigned the new frequency, the corresponding 6500 line marker is switched on. (This action is performed automatically, so that it is not necessary to select the marker menu - see above).

Brightline skip

The [ΔF] key on the 6500 has been re-assigned to provide a brightline skip facility.

When [ΔF] is pressed, the brightline skips to the first line marker it encounters at a frequency higher than its present position. If the brightline reaches the end of the sweep (F2) without finding a line marker, the search is resumed starting at the beginning of the sweep, (F1). A message is displayed at the lower right of the 6500 graticule area to identify the destination marker. For example,

BL -> B

means that the brightline has skipped to marker B.

Page 3-50

Delete **STO and RCL** paragraph and add:

Instrument settings stores and alternate sweep

The [STO] and [RCL] keys on 6500 are disabled when the instrument is used with the 6310. Instead, 6500 settings are stored in the 6310 at the same time that 6310 STORE and RECALL operations take place.

This provides two advantages. The number of stores available for holding 6500 instrument settings increases from 9 to 20, and the storage is non-volatile.

STORE and RECALL operations are transparent as far as the 6500 operator is concerned. When a STORE operation is initiated in the sweeper, a "snapshot" of the current settings of the 6500 is transferred via the private GPIB and stored together with the 6310 settings. The 6500 settings are transmitted back to the 6500 and are activated when the 6310 memory is recalled.

If the 6310 power-on condition is specified to be one of the memories (see under MEMORY FACILITIES, Chapter 3-1) the 6500 settings in that memory will also be recalled following power-on.

Alternate sweep with the 6500

The alternate sweep facility provides a means of switching between two complete analyzer and sweeper instrument settings with one key press. Refer to **Alternate sweep selection**, Chapter 3-1, page 3-25.

When the **altern** parameter is toggled from **off** to **man** a "snapshot" of the 6500 settings is taken - these are the **current** settings.

The **ALT_MEM** parameter specifies which of the twenty 6310/6500 settings memories will be used for alternate sweep.

The **man_alt** parameter toggles between the 6310/6500 **current** settings and those in the specified **memory**.

Notes ...

The analyzer **current** settings are updated only when the **altern** parameter undergoes a transition from **off** to **man**. You must remember to switch **altern** to **off** and then to **man** again if you change any parameter (such as DATUM, RANGE etc.) on the 6500. If you do not do this, the new 6500 settings will be overwritten by the "old" **current** settings the next time **man_alt** toggles from **memory** to **current**.

It is not possible to engage **auto** alternate sweep with a 6500. The **altern** parameter will not toggle to **auto** when an analyzer is present on the private bus.

Alternate sweep worked example

Here is a simple example to demonstrate the alternate sweep operation.

(1) Select the **ALT** configuration on the 6310 and ensure that the **altern** parameter is set to off and the **man_alt** parameter is set to **current**.

(2) Select channel A on the 6500 and set a DATUM level of 3.0 dBm. Store settings to Memory 3 using the 6310's memory facility.

(3) Set a new datum of 10 dBm on the 6500. In this way we have made a change to distinguish the analyzer's operation from that stored in Memory 3.

(4) Select the ALT configuration on the 6310 and set the **ALT_MEM** parameter to 3. This means that the system will alternate between the current settings and those in Memory 3.

Toggle the **altern** parameter from **off** to **man**. This causes the the 6500 current settings to be acquired.

Now use the **man_alt** key to alternate between the current settings and those in Memory 3.

Although, in this simple example, the only difference between the **current** and **memory** settings is the 6500 DATUM value, the principle of operation is demonstrated.

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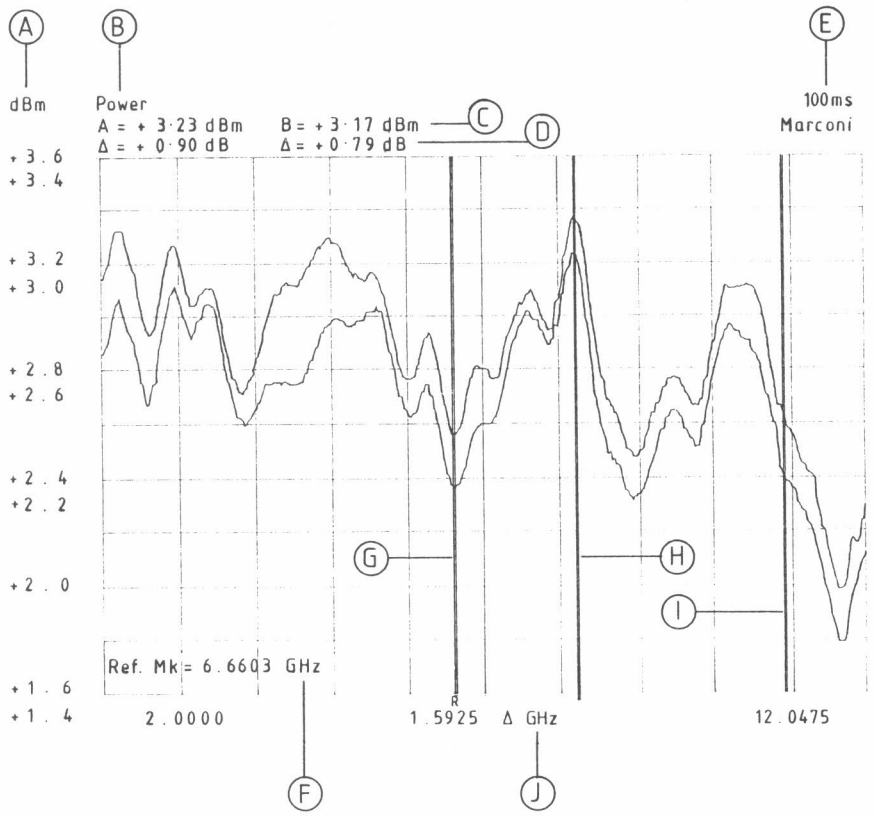
The following applies to 6310 Issue 4/6500 Issue 6 Firmware and higher:

Presentation of brightline and marker information on 6500 plots

The figure below illustrates the presentation of brightline and marker information on a digital plot of channels A and B. Option 9 (Marker Δ with ΔF) has been selected from the marker control menu, and the reference marker and one other marker are switched on.



A = Power scaling
B = Current measurement
C = Brightline power
D = Difference in power between brightline and reference marker
E = Sweep time
F = Reference marker frequency
G = Reference marker (identified by "R" at the bottom of the graticule)
H = Brightline
I = Marker
J = Difference in frequency between brightline and reference marker

6500 plot of channels A and B showing presentation of brightline and marker information

2 to 20 GHz
PROGRAMMABLE SWEEP GENERATOR
6310

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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 meaning of hazard symbols appearing on the equipment is as follows:–

Symbol	Nature of hazard	Reference in manual
⚠	Dangerous voltages	Page iv
⚠	Static sensitive components	Page iv
⚠	Precision connector	Page 3-2

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 amendment. Any changes subsequent to the latest amendment status are included on Manual Change sheets coded C1, C2 etc at front of the manual.

CONTENTS

ASSOCIATED PUBLICATIONS

GPIB Operating Manual, H 6310 Vol. 1A
Service Manual, H 6310 Vol. 2

OPERATING PRECAUTIONS

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, the precautions detailed in the WARNINGS below should be observed. To avoid damage to the equipment the precautions detailed in the CAUTIONS should be observed.

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 auto-transformer.

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 the internal supply fuse is in series with the live (brown) conductor of the supply lead. If connection is made to a 2-pin unpolarized supply socket it is possible for the fuse to become transposed to the neutral conductor, in which case parts of the equipment could remain at supply potential even after the fuse has ruptured.

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.

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.

This equipment has a **Lithium** battery which if incorrectly handled could cause a danger to health or safety – refer to the service manual for safe handling precautions.

CAUTION – LCD HANDLING

When usng this equipment take care not to depress the front or rear faces of the display module as this may damage the liquid crystal display elements.

CAUTION – STATIC SENSITIVE COMPONENTS

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

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Chapter 1

GENERAL INFORMATION

FEATURES

Performance

The 6310 is a programmable sweep generator with a range of 2 GHz to 20 GHz. It provides a combination of frequency and power sweeps with a typical accuracy of 3 MHz and 0·2 dB. When used with Marconi Instruments' 6500 Automatic Amplitude Analyser it forms a scalar measurement system with a private GPIB to enhance the performance of the 6500, as well as a system GPIB to allow operation as part of a complete automatic test system.

Control and display

Logically arranged keypads with step-up and step-down keys, and a continuously variable rotary control, allow rapid manual operation. A large, backlit LCD display shows operating status, current values of controlled parameters and the current functions of four 'soft' keys. The 6310 can also be fully controlled via the GPIB.

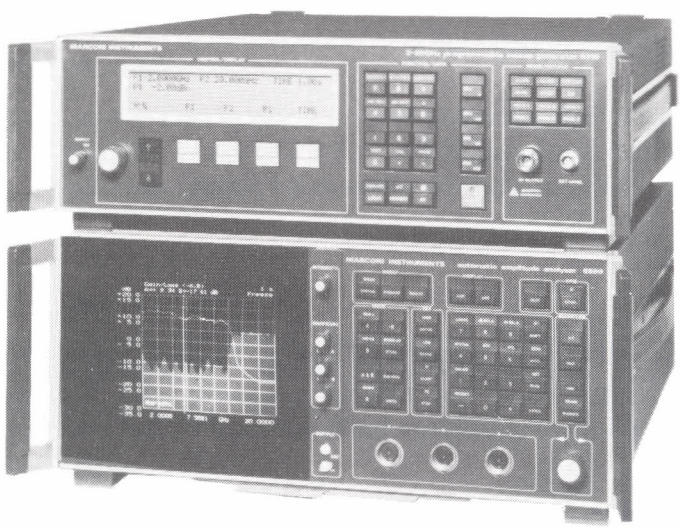


Fig. 1-1 6310 Programmable Sweep Generator with 6500 Automatic Amplitude Analyser

Soft keys and configuration keys

In normal operation, some or all of the four soft keys have one operating parameter assigned to each of them. Selection of a soft key allows the value or state of the parameter associated with it to be changed. Parameters are assigned to the soft keys according to which 'configuration' (group of parameters) has been selected.

There are fourteen pre-programmed configurations currently available on the 6310, including:

Configuration	Associated parameters
[F1 – F2]	Start frequency (**F1**), stop frequency (**F2**) power level (**P1**), sweep time (**TIME**).
[SWP/TRG]	Internal/external sweep (**sweep**), sweep trigger (**swp_tr**), single sweep initiation (**s_swp**), counter trigger (**cntr_tr**).

The pre-programmed configurations are accessed by labelled 'configuration keys'. Additionally, there are six 'user-programmable' keys, which allow you to store and access your own configurations to match a particular application (see 'User programming').

Operating mode/sweep configurations

There are four basic operating modes:

Frequency sweep at constant power.

Frequency sweep with power slope.

Constant frequency and power.

Constant frequency with power sweep.

The frequency sweep can be defined either between upper and lower limits (F1 – F2) or as a frequency span about a centre frequency (CF – △F). These two additional 'modes' give a total of six 'sweep configurations', each accessed by a labelled configuration key.

Markers

Up to five frequency 'markers' may be set within a sweep. These enable you, for example, to stop the sweep at some nominal frequency and accurately measure that frequency using a counter. Another application is the setting of secondary limits within the total sweep, to allow both in-band and out-of-band testing.

Memories

Twenty non-volatile memories can each store complete instrument settings. The contents of the memories can be reviewed one after the other using the step keys or rotary control. While reviewing the memories, the RF output is switched off to avoid any risk of damage to sensitive test pieces.

Any memory setting can be chosen as the power-up condition, so that repetitive testing can begin immediately after switch-on.

User programming

The PROG key enables you to make up and store (in non-volatile memory) up to six of your own configurations. These can then be accessed via the six 'user-programmable' configuration keys.

Applications of this facility include the ability to further simplify the front panel operation by masking non-critical parameters, or to overlay a real-time clock to allow the timing of a test procedure.

To maintain security, all frequency information may be removed from the screen.

User calibration

The output power and frequency of 6310 may be simply re-calibrated to enhance accuracy in specialized measurement systems. An example would be where a long cable intervenes between the 6310 and the test piece, or where there is a high ambient temperature.

Using Marconi Instruments 6960 RF Power Meter (with 6910 Sensor) and the 2440 20 GHz Microwave Counter connected to 6310's Private GPIB, re-calibration takes approximately 15 minutes. Certain non-Marconi power and frequency instruments may be used with the optional software support pack, which additionally allows a dump of performance results before and after calibration.

Two sets of user calibration data may be held in non-volatile store while the primary calibration is also retained.

Unauthorized re-calibration is made difficult by the necessity of entering special authorization codes (contained in a document which accompanies each instrument). The primary calibration is doubly protected in this way. All re-calibration may be disabled by the setting of an internal switch.

The display indicates whether primary or user calibration is in use.

Amplitude analysis

The 6310 with Marconi Instruments' 6500 Automatic Amplitude Analyser form a complete amplitude analysis system.

Measurements which can be made include:

Voltage standing wave ratio (VSWR)

Gain

Insertion loss

Gain compression

Absolute power

Connection between the 6310 and the 6500 via the Private GPIB allows intelligent interaction between the instruments which greatly enhances the performance of the 6500. Details of the operation of the 6310 with the 6500 are given in Chap. 3-4.

System GPIB operation

Over seventy commands allow full control via the system GPIB. In addition to those commands with equivalent front panel key operations, others allow fast data transfer, text display and other facilities.

RF generation

As it uses fundamental YIG tuned oscillators, the 6310 gives a very pure output having low harmonic and sub-harmonic components. All three oscillators are kept running while the instrument is switched on to increase stability and reduce band switching times. Switching between oscillators is by means of a PIN switch which gives a typical band switch delay of 0.5 μs. The levelling circuit uses a wide band coupler and detector diode.

Digital correction data for all significant frequency values and power levels are stored in memory, and applied to the sweep.

The FM input allows direct access to the YIG oscillators so that external frequency locking equipments may be used.

The RF on/off key has an integral LED to indicate whether or not the output is enabled, and the LCD gives an 'unlevelled' (UNLV) display if the output power is greater than the specified levelled maximum, or if the output is switched off.

PERFORMANCE DATA

Frequency

Range:	2 GHz to 20 GHz.
Resolution:	500 kHz displayed in all modes. 100 kHz displayed in CW vernier mode. 10 kHz increments manually and with GPIB control.
Accuracy at cal. temp.	
F1 and CW:	±10 MHz, ±3 MHz typical.
CW, F2, sweep modes at 100 ms sweep time:	±30 MHz, ±20 MHz typical.
Stability:	
With temperature:	1 MHz/°C typical.
With 10% supply voltage change:	10 kHz.
With 10 dB power level change:	±300 kHz.
With 30 dB power level change:	±500 kHz.
With 3:1 load VSWR	TBA.
With time at constant temp. after 1 h warm up:	±100 kHz/h.

Residual FM

(In 10 Hz to 10 kHz bandwidth, CW mode with Filter On)

2 to 8 GHz:	6 kHz peak typical, 10 kHz max.
8 to 12·4 GHz:	7·5 kHz peak typical, 10 kHz max.
12·4 to 20 GHz:	10 kHz peak.

Residual AM: −50 dBc (in 100 kHz bandwidth).

Sweep characteristics

Sweep time:	Selectable between 10 ms and 33·5 s.
Resolution:	1 ms.
Minimum sweep width:	500 kHz.
RF markers:	Up to 5 markers, any one of which can be designated 'Reference Marker'.
Accuracy:	±30 MHz, ±20 MHz typical.
Depth:	5 dB typical.

Spurious signals

Harmonics:	−40 dBc.
Spurious and sub-harmonics:	−60 dBc.

Output power

Maximum levelled power at 25°C ±5°C

2 to 18 GHz:	+10 dBm.
18 to 20 GHz:	+7 dBm.

Power level accuracy including flatness (from −5 dBm to +10 dBm at cal. temp. ±5°C in range 0 to 50°C)

Internally levelled:	±0.4 dB.
Externally levelled (excluding coupler and detector effects):	±0·2 dB, ±0·01 dB typical.
Settable power range:	−15 dBm to +20 dBm.
Dynamic range:	30 dB.
Resolution:	0·01 dB.

Power stability with temperature

0 to 20°C:	0·02 dB/°C.
20 to 40°C:	0.04 dB/°C.
40 to 50°C:	0.08 dB/°C.

Power sweep

Accuracy:	±0·4 dB.
Linearity:	0·1 dB.
Power sweep time:	As for frequency sweep.

Modulation

Internal square wave AM

Frequency range:	1·0 to 100 kHz.
Resolution:	Variable 0·1 to 1·2 kHz.
Depth:	−60 dBc from 2 to 18 GHz. −50 dBc from 18 to 20 GHz.
Rise and fall time: (10% to 90%)	0·5 μs.

External pulse AM

Depth:	As internal square wave AM.
Rise and fall time: (10% to 90%)	As internal square wave AM.
Frequency response:	DC to 100 kHz

External AM

Frequency response:	DC to 100 kHz.
Dynamic range:	30 dB for 0 to −10 V input.

External FM

Deviation:	50 MHz maximum, 25 MHz at 1 MHz rate.
Sensitivity:	−6 MHz/V.

General

Auxiliary outputs

1 V/GHz accuracy:	±10%.
Sweep out:	0 to 10 V ±2 mV.
Output connector:	Type N (female) precision, 50 Ω.

Reverse input power:	100 mW maximum.
GPIB interface:	System and private buses. All functions except supply switch are remotely programmable.
Capabilities	
SYSTEM:	Complies with sub-sets SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT0, C0 and E2 as defined by IEEE 488 – 1978 and IEC 625-1.
PRIVATE:	Complies with sub-sets SH1, AH1, T6, L4, SR1, RL1, PP0, DC0, DT0, C1,2, 3,4,5, E2.

Environmental

Safety:	Complies with IEC 348.
Rated range of use	
Temperature:	0 to 50°C.
Conditions of storage and transport	
Temperature:	−40 to 70°C.
Humidity:	Up to 90% RH.
Altitude:	Up to 2500 m (pressurized freight at 27 kPa differential, i.e. 3.9 lbf/in^2).
Power requirements	
Voltage ranges: (switchable)	105 to 120 V AC 210 to 240 V AC } ±10%
Frequency range:	45 to 400 Hz.
Consumption:	580 VA max., 300 W max.
Radio frequency interference:	Conforms to the requirements of EEC Directive 76/889.
Dimensions and weight (excluding handles and feet)	
Height:	133 mm (5·2 in)
Width:	433 mm (17·1 in)
Depth:	485 mm (19·1 in)
Weight:	15 kg (33 lb).

SUPPLIED ACCESSORIES

Part no.	
43129–071D	AC supply lead.
46881–365P	Operating manual (H 6310 Vol. 1)
46881–636X	GPIB operating manual (H 6310 Vol. 1A)
23411–063B	4·0 A time lag fuse for 115V mains application (2 off)

OPTIONAL ACCESSORIES

43129–189U	GPIB lead assembly.
46883–408K	GPIB adapter, IEEE male to IEC female.
43126–012S	BNC connection cable, 50 Ω, 1·5 m.
54311–094M	Adapter N(male) to SMA(fem).
54351–022X	Cable N(male) to N(male), 0·5 m, flexible.
54351–023M	Cable SMA(fem) to SMA(fem), 0·5 m, flexible.
46881–637M	Service manual, H 6310 Vol. 2.
6310–176	Cable/connector, D type, to 2440 Counter.
3964–732	Software support pack (SSP) with 3·5 in disc, external drive.
3964–733	Software support pack (SSP) with 5·25 in disc, optimized for use on the HP 9826 and 9836 with internal drive, but can be used with external drives.

AMPLITUDE ANALYSER SYSTEMS COMPOSITION

All systems include:

6310	Programmable Sweep Generator.
6500–001	Automatic Amplitude Analyser.
43129–189U	GPIB Lead Assembly.
43126–012S	BNC Connection Cable (Qty. 2).
3964–732	Software support pack (SSP) with 3·5 in disc, external drive.

The systems differ in the types of detectors supplied, as follows:–

System	Detectors
6500–501	Qty. 3 6511 N-type ·01–20 GHz detector.
6500–511	Qty. 3 6512 APC7 type ·01–20 GHz detector.
6500–541	Qty. 1 6511, Qty. 2 6512.
6500–551	Qty. 2 6511, Qty. 1 6512.

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 accordance with the general instructions below or with the more detailed information in the packing instruction note.

(1) Place mains lead in suitable plastic bag and tape it to the instrument 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 so that it locates in the cushion recess.

(6) Place the remaining 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 or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader; if the rear panel has guard plates or other projections a rear load spreader is also advisable.

RACK MOUNTING

The instrument may be mounted in a standard 19 inch rack using the kit 46883–506M available as an optional accessory. Fitting instructions are as follows:

(1) Remove both top and bottom outer covers. Detach and discard the front and rear feet on the bottom cover.

(2) Remove and discard the trim infills on each side of the front panel, together with their countersunk screws and screw cups.

(3) Fit the rack brackets in the front panel handles or side trim recesses using M4 x 16 pan head screws and washers. Finally refit the top and bottom covers.

SAFETY TESTING

Where safety tests on the AC supply input circuit are required, the following procedures can be applied. These comply with BS 4743 and IEC Publication 348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that AC supply input circuit components and wiring (including earthing) are safe.

(1) **Earth lead continuity test** from any part of the metal frame to the bared end of the flexible lead for the earth pin of the user's AC 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 earth.

Test limit : not less than 2 MΩ.

AC POWER SUPPLY

The instrument requires an AC supply of 105 to 120 V or 210 to 240 V, 50 to 400 Hz, 580 VA. The required supply fuses (time lag) are 4 A for 105 to 120 V or 2.5 A for 210 to 240 V. Before switching on, ensure that the rear panel voltage range switch is in its correct position as revealed by the cut-out in the locking place, and that the correct value fuses are fitted. To change the mains voltage setting, reverse the locking plate after setting the slide switch to its alternative position.

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

Earth (ground)	– Green/Yellow
Neutral	– Blue
Live (phase)	– Brown

When attaching the mains lead to a non-soldered plug it is recommended that the tinned ends of the lead are first cut off to avoid the danger of cold flow resulting in intermittent connection.

GPIB CONNECTOR CONTACT ASSIGNMENTS

The contact assignment of the GPIB lead assembly and the two device connectors is as shown in Fig. 2-1 below.

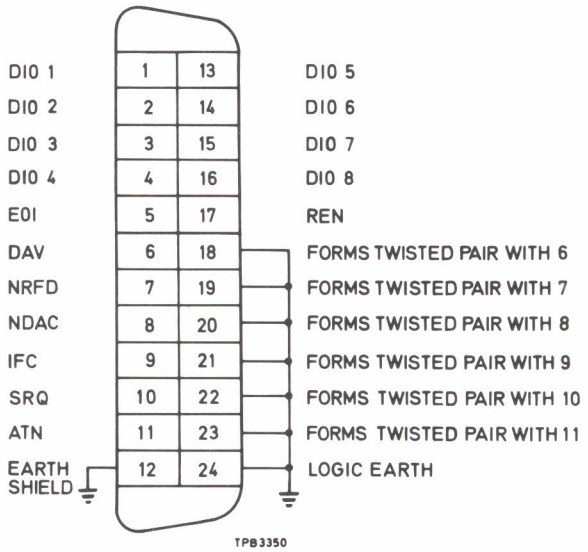


Fig. 2-1 GPIB connector contact assignments

Connection to other equipment which has a 24-way bus connector to IEEE Standard 488 can be made with the GPIB lead assembly 43129−189U, available as an optional accessory. An IEEE-to-IEC adapter 46883−408K is also available for interfacing with systems using a 25-way bus connector to IEC Recommendation 625 − see Fig. 2-2.

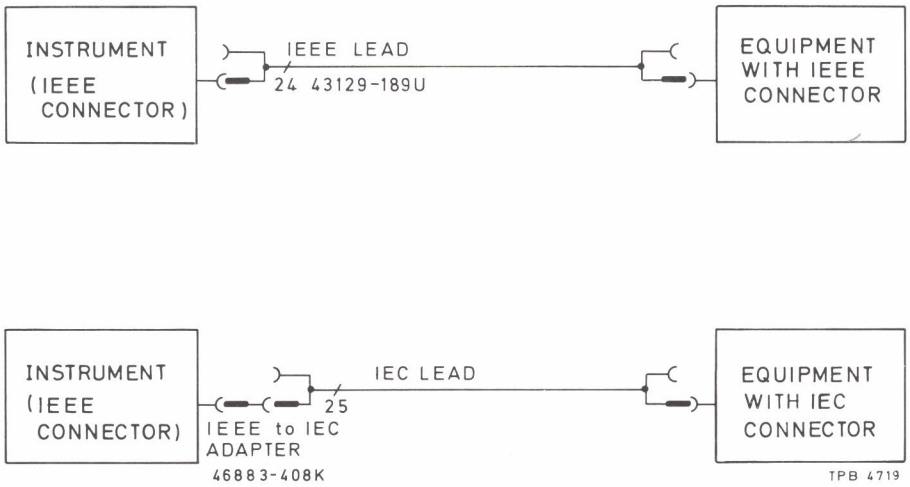


Fig. 2-2 GPIB interconnections

INTERFACE BUS LEAD CONNECTION

The leads 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 leads 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 lead 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.

Chapter 3-1

LOCAL OPERATION

FRONT PANEL CONTROLS

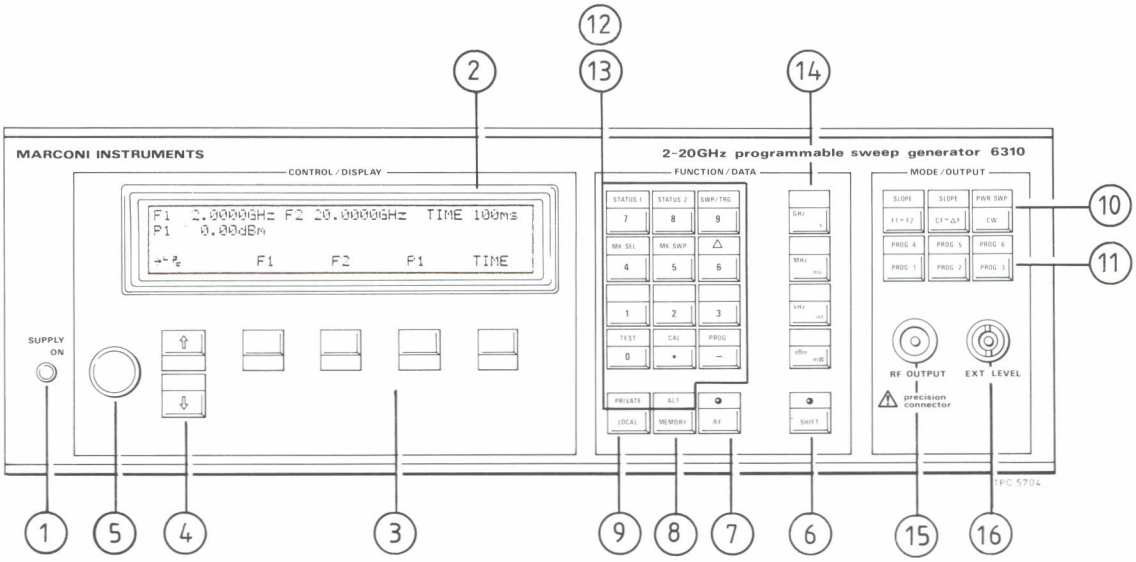


Fig. 3-1 : Front panel

① **SUPPLY ON.** Clockwise : ON Anti-clockwise : OFF.

② **LCD.** The liquid Crystal Display (LCD) can display four rows of forty alphanumeric characters. The display is fitted with an electro-luminescent backlight, and the contrast between the displayed characters and the background can be varied to suit viewing angle. Rows 1 to 4 are numbered from top to bottom.

③ **Soft keys.** The soft keys select parameters for modification. Parameters are assigned to the soft keys according to which 'configuration key' is selected. Row 4 of the LCD displays the soft key assignments. Selection of a soft key enables the value/state of the associated parameter to be changed.

④ **Step keys.** The step-up and step-down keys are used primarily for changing the value of a parameter by a preset amount. The step sizes for frequency, power and time can be set by the operator.

Note . . .

In operating procedures in this manual the following conventions are used to identify control functions:

Square brackets e.g. [PROG] indicates a front key title.

Bold face e.g. **TIME** indicates a soft key designation or a functional reference to an LCD parameter.

⑤ **Rotary control.** Fine adjustments may be made to a parameter value using the rotary control. The sensitivity of the control depends on the speed with which it rotates. The faster the control is turned, the greater is the change in value.

⑥ **SHIFT key.** Accesses the shifted functions, which are indicated in blue in the upper halves of certain keys. The SHIFT key remains active until another key is pressed, and this is indicated by the illumination of an integral LED.

⑦ **RF key.** Switches RF power on/off. The LED is illuminated when RF is on.

⑧ **MEMORY key.** Provides access to 20 non-volatile store/recall memories, each capable of storing complete instrument settings.

⑨ **LOCAL key.** Returns the instrument to front panel operation from GPIB control. This key can be disabled by the "local lockout" message from an external controller.

⑩ **Sweep configuration keys.** Select sweep modes and associated parameters for display and modification.

⑪ **User programmable configuration keys.** May be programmed with up to six user-defined configurations.

⑫ **Auxiliary configuration keys** (Shifted keys). Select auxiliary configurations such as step sizes, markers, GPIB addresses etc.

Notes . . .

(i) TEST and CAL are considered separately from the configuration keys. See Appendix D, Self Test and Chap. 3-5, Calibration.

(ii) PROG is considered with the user programmable configuration keys (Chap. 3-2).

⑬ **Numeric keys** (Unshifted keys). Used for entering values of numeric parameters, and other number entries.

⑭ **Units keys.** Define units of numeric parameters. Terminate numeric entry.

⑮ **RF OUTPUT** (Precision type N connector).

CAUTION . . .

This connector may be damaged if mated with a non-precision type N plug.

⑯ **EXT LEVEL** (BNC). Input for external levelling signal.

REAR PANEL CONNECTIONS

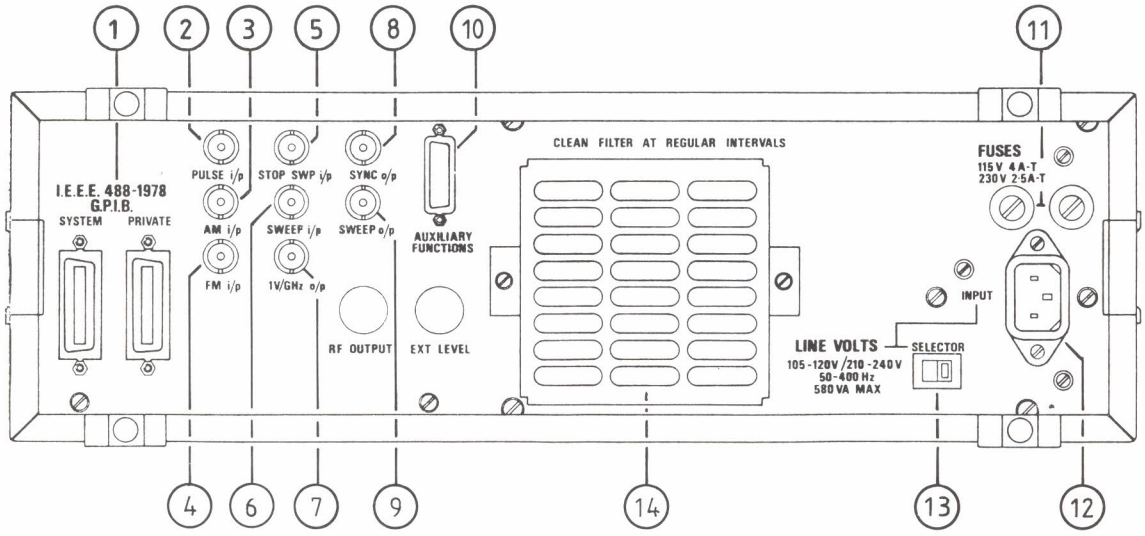


Fig. 3-2 Rear panel

① **GPIB connectors.** The sweeper has two GPIB interfaces: The SYSTEM GPIB allows remote programming using an external controller; the PRIVATE GPIB allows the sweeper to control a counter and power meter during auto-calibration or a 6500 Automatic Analyser and plotter to form a scalar measurement system.

CAUTION – GPIB INTERFACES

There are two GPIB interfaces located on the rear panel of this equipment. The SYSTEM GPIB interface is intended for connection to an external controller. Under no circumstances should a GPIB controller be connected to the PRIVATE GPIB interface, otherwise damage might result to both controller and sweeper.

② **PULSE i/p** (BNC). TTL compatible pulse modulation input. '0' = RF off, '1' = RF on.

③ **AM i/p** (BNC). Amplitude modulation input.

④ **FM i/p** (BNC). Frequency modulation input.

⑤ **STOP SWP i/p** (BNC). A TTL compatible logical '0' applied to this input causes the forward sweep to pause. The sweep resumes when a logical '1' (or open-circuit) is applied.

⑥ **SWEEP i/p** (BNC). Accepts 0 to +10 V tuning voltage when the instrument is set to operate with external sweep.

⑦ **1 V/GHz o/p** (BNC). Voltage proportional to output frequency.

⑧ **SYNC o/p** (BNC). Synchronization signal for use with 6500 Automatic Amplitude Analyser.

⑨ **SWEEP o/p** (BNC). Outputs an 0 to +10 V signal proportional to the swept or CW RF output. 0 V corresponds to the lower (F1) and 10 V to the upper (F2) frequency limit.

⑩ **AUXILIARY FUNCTIONS connector.** 15-way 'D' type.

Pin	Function	
1	STOP SWP i/p	(Also available on BNC connector)
2	GND	
3	+5 V	(Programmable outputs)
4	PROG 1	
5	PROG 3	
6	PROG 5	
7	GND	
8	GND	
9	SYNC o/p	(Also available on BNC connector)
10	PULSE i/p	(Also available on BNC connector)
11	EXT TRIG i/p	
12	PROG 2	
13	PROG 4	
14	CTR TRIG o/p	(Counter trigger)
15	GND	

The EXT TRIG i/p is TTL compatible. When external sweep trigger mode is selected, the sweep is triggered by a high-to-low transition applied to this input.

The CTR TRIG o/p provides a trigger pulse to a counter to initiate a frequency measurement. Appendix C describes interfacing suitable counters, including the Marconi Instruments type 2440.

⑪ **FUSES.** For protection of live and neutral lines of the supply input. See Chap. 2, Installation, for details.

⑫ **LINE VOLTS INPUT plug.** Accepts AC supply voltage input via lead No. 43129–071D.

⑬ **LINE VOLTS SELECTOR.** Selects AC supply voltage range. See Chap. 2, Installation, for details.

⑭ **FILTER inlet.** Do not obstruct. See Service Manual for cleaning instructions.

AMPLITUDE ANALYSIS : GETTING STARTED

6500 users who are impatient to begin testing may start here.

(1) The 6500 and 6310 should be connected as shown in Fig. 3-3 below. If a plot of 6500 results is required, an HP-GL (Hewlett-Packard Graphics Language) compatible digital plotter should also be connected as indicated.

(2) Ensure that the 6500 GPIB address is set to 8, and the plotter address to 5.

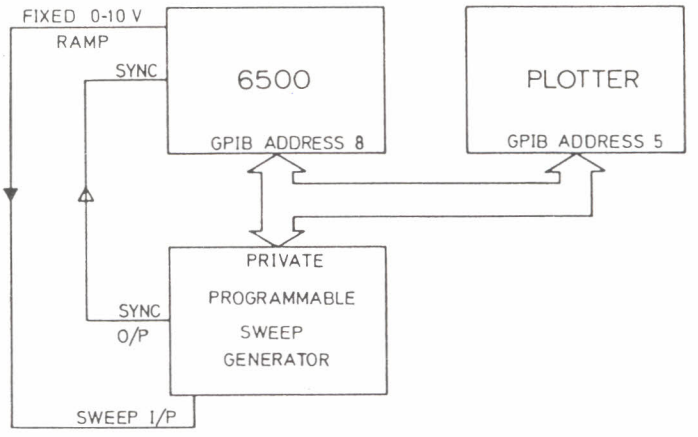


Fig. 3-3 Connections to 6500 and plotter

(3) Switch on the 6500 and plotter *before* the Sweeper. Devices connected to the Sweeper's PRIVATE GPIB are initialized when the sweeper is switched on. Initialization of the 6500 takes approximately 8 seconds including automatic detector zero.

(4) Press the SLOPE / F1-F2 key on the sweeper to define the sweep range for both sweeper and 6500. The display should be as shown.

```
F1   2.00000GHz F2 20.00000GHz  TIME 100ms
P1    0.00dBm

→└ PE          F1       F2       P1       TIME
```

To change F1 (Start Frequency), F2 (Stop Frequency), P1 (RF Power Level) or TIME (sweep time) press the appropriate soft key and use the rotary control, step keys or numeric keys (with appropriate units terminator) to adjust the value.

(5) Press O / RF on the 6310 to switch on the RF power.

(6) Readers who are not familiar with the normalization procedures required to prepare the 6500 to make measurements should refer to Chap. 3-4. "Operation with 6500 automatic amplitude analyser", and/or the 6500 Operating Manual.

SWITCH-ON CONDITIONS

When the sweeper is first switched on the display briefly shows the software issue number in the top left-hand corner, and an equivalent part code in the top right hand corner.

This is followed by a display showing the results of a check on the integrity of the data stored in all sections of the non-volatile memory. If all sections check out correctly the following message is momentarily displayed:

```
*** MEMORY TEST ***
[-----------------------------------]
NO FAULTS DETECTED
```

If any memory sections are found to have been corrupted a message of the form shown below is (permanently) displayed:

```
*** MEMORY TEST ***
[-----FGHI----------------a----f---]
 FAULT(S) DETECTED : REFER TO MANUAL
PRESS ANY CONFIGURATION KEY TO CONTINUE
```

For interpretation of a fault message see Appendix D : Self Test.

After the memory test has been completed, the instrument will normally set itself to the PRESET operating conditions:

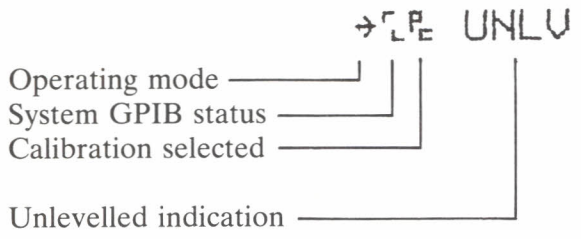
```
F1  2.00000GHz F2 20.00000GHz  TIME 100ms
P1    0.00dBm

→└ PE          F1       F2       P1       TIME
```

Any newly delivered instrument should set itself to these conditions. It is possible, however, to cause the instrument to have other settings at switch-on (see Chap. 3-1, Memory Facilities), so a deviation from the PRESET conditions does not necessarily imply that there is a fault.

RF power is normally off at switch-on, but this again can be changed by use of the memories (see Chap. 3-1). The state of the output (on or off) is indicated by the illumination or non-illumination of the integral LED in the RF key.

DISPLAY STATUS FIELD

During normal operation of the sweeper, the status field is displayed at the left hand side of row 4 of the LCD. There are four components of the status field:



Operating mode

The symbol indicates one of four possible operating modes:

- ⊥ CW operation
- Swept operation (Levelled output power)
- Swept operation (Power slope)
- Power sweep

System GPIB status

The character cell is divided into two halves. The upper character indicates Local or Remote and the lower character indicates whether the sweeper is addressed to listen, addressed to talk, or unaddressed.

- Local operation
- Remote operation (Unaddressed)
- Remote operation (Addressed to listen)
- Remote operation (Addressed to talk)

Calibration selection

The character indicates whether the Primary calibration or a User calibration is selected. Refer to Chap. 3-5.

- Primary calibration selected
- User calibration selected (Cal 1)
- User calibration selected (Cal 2)

Unlevelled indication

When the output power is calibrated the field of four characters is blank. If an output power outside the levelled range is set, UNLV is displayed. UNLV is also displayed when RF is switched off.

PARAMETERS AND CONFIGURATIONS (GENERAL)

Parameters

The operating parameters of the 6310 are the settings of the instrument which the operator can change (in value or state) to define its operation*. Examples include Start Frequency (**F1**), Sweep Time (**TIME**), System GPIB address (**S_ADDR**) and Stop Marker (**mk_stp**).

Parameters are either 'numeric' or 'non-numeric'. A full list of the 6310's parameters is given in Appendix A.

Numeric parameters

Numeric parameters are those which take a numerical value. Examples include Start Frequency (**F1**), Private GPIB Address (**P_ADDR**) and Start Power Level (**P1**).

Numeric parameters are shown in upper-case letters on the display.

Non-numeric parameters

Non-numeric parameters may take up one of a few defined states. Examples include CW Filter (**filter**) which can be either '**on**' or '**off**'; and Sweep Trigger (**swp_tr**) which has the states '**int**', '**ext**', '**line**' and '**single**'.

Non-numeric parameters are shown in lower case letters on the display.

Configurations

Configurations are groups of related parameters which together define some aspect(s) of the instrument's operation. They are selected by the 'configuration keys' which are shown in Fig. 3-4 below. The configuration keys may be sub-divided into three groups:

Those in the top row of the MODE/OUTPUT section of the front panel are the 'Sweep Configuration' keys.

Those in the FUNCTION/DATA section are the 'Auxiliary Configuration' keys.

Those in the second row of the MODE/OUTPUT section are the 'User Programmable Configuration' keys.

* *There are in addition certain 'display-only', 'soft key only' and 'diagnostic' parameters. See 'STATUS 2'and 'PRIVATE' (this chapter) and also Appendix A.*

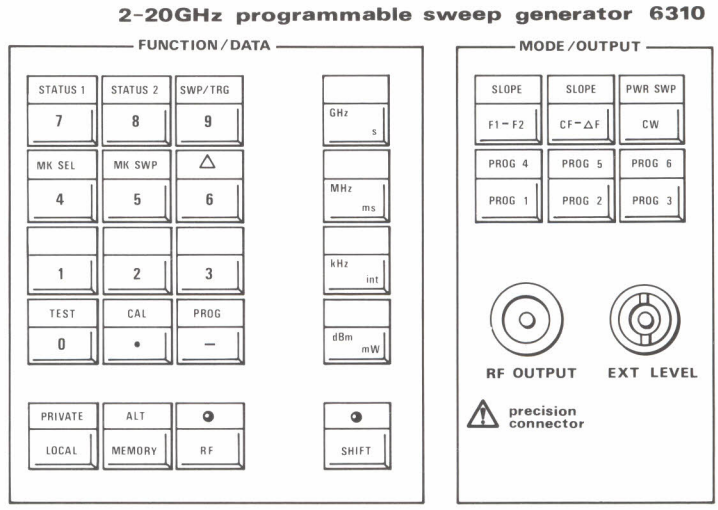
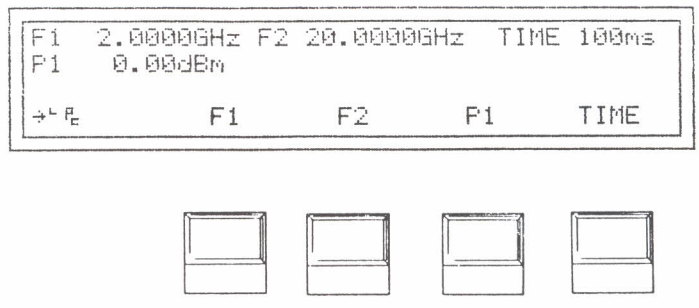


Fig. 3-4 Configuration keys

Configuration selection and display

When a configuration key is pressed, the current values/states of its associated parameters are displayed in rows 1, 2 and 3 of the display.

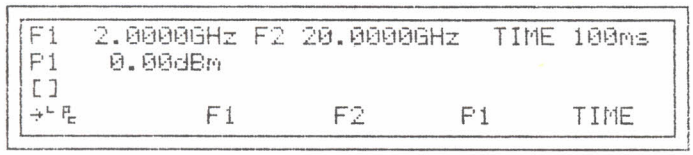
In row 4 the symbol of each (changeable) parameter is displayed above a 'soft' key. For example, selecting the F1-F2 key should give a display like this:



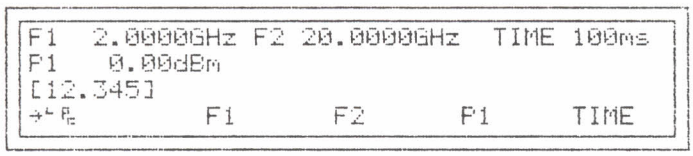
A parameter's value or state can then be changed by first selecting the soft key to which it has been assigned.

Changing numeric parameter values

When a soft key assigned to a numeric parameter is pressed, the soft key label flashes to indicate that numeric entry is enabled for that parameter. A numeric entry field prompt '[ ]' appears on the left of row 3.

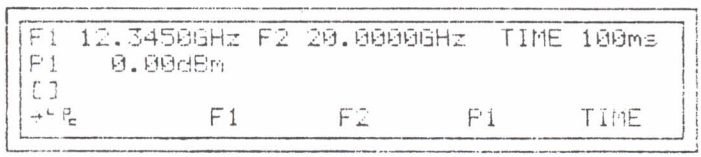


As digits are entered they are displayed in the numeric entry field:–



Numeric entry terminators

Numeric entries are terminated using a units key appropriate to the parameter. Frequency input is terminated using the [GHz], [MHz] or [kHz] keys; power input using the [dBm]/[mW] key; sweep time input using the [s] or [ms] keys. The [int] terminator is used when entering integer values such as a GPIB address. When the numeric input is terminated the new value is assigned the parameter and the numeric entry field is cleared. The soft key label continues to flash, indicating that a further numeric entry may be started.



Step keys and rotary control

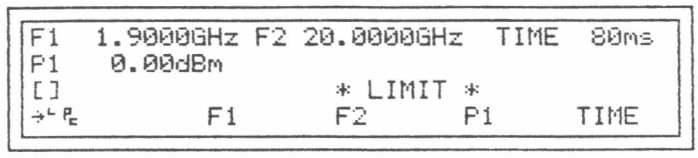
The step keys and rotary control may be used whenever numeric entry is enabled. The step size is definable for each type of numeric parameter: for frequency, power (dBm), power (mW), and time, using the △ configuration. When a step key is pressed, the value of the parameter is incremented or decremented as appropriate. If a step key is held down it repeats automatically.

The rotary control sensitivity depends on the speed of rotation. A rapid twist to the control results in a large change to the parameter. Slow rotation allows fine adjustments to be made.

Operating the rotary control or step keys has no effect on any pending numeric entry displayed in the numeric entry field.

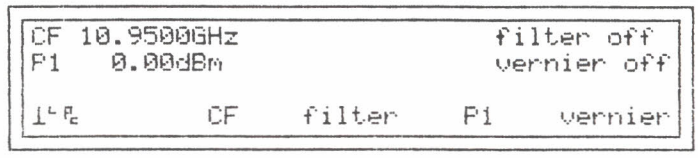
Limits

Every numeric parameter has a maximum and minimum permitted value. If an attempt is made to enter a value outside this range, a **LIMIT** message is displayed momentarily on row 3 of the LCD and the parameter is set to the nearest allowed value, either maximum or minimum as appropriate.

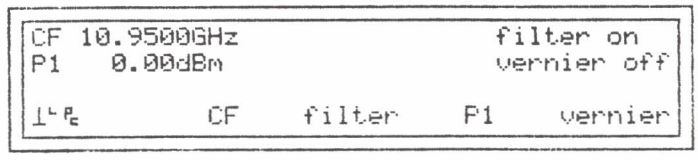


Changing non-numeric parameters

When a soft key assigned to a non-numeric parameter is pressed, the value of the parameter changes to another state, as shown below. If the key is pressed repeatedly, the parameter cycles through all its possible states.



Effect of pressing the filter soft key:



Changes to non-numeric parameters have no effect on any pending entry displayed in the numeric entry field.

Programmable keys

The three programmable keys [PROG 1] to [PROG 3] (with shifted functions [PROG 4] to [PROG 6]) belong to the class of configuration keys. In these cases, however, the configurations are defined by the operator. Refer to Chap. 3-2.

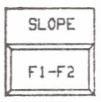
SWEEP CONFIGURATIONS

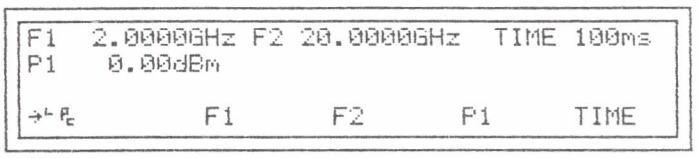
Changes between sweep configurations involve changes in operating mode, except where the configurations differ only in the definition of the frequency sweep: (F1-F2) or (CF-△F).

When a sweep configuration key that involves frequency or power sweeping (i.e. all except CW) is pressed you will notice a momentary pause in the sweep. This is due to the digital correction values for the sweep being recalculated.

The sweep is also halted momentarily when new parameter values are entered.

Swept operation (Levelled output power) (F1-F2)





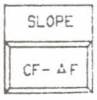
F1	Start frequency	(Minimum 1·9 GHz)
F2	Stop frequency	(Maximum 20·1 GHz)
P1	Power level (dBm)	(Range −15 dBm to +20 dBm)
TIME	Forward sweep time	(Range 10 ms to 33·5 s)

RF output sweeps from F1 to F2

Note . . .

Sweeps from high to low frequency are not permitted. If F1 is set to a higher frequency than F2, or F2 to a lower frequency than F1, both F1 and F2 are adjusted to the last entered frequency.

Swept operation (Levelled output power) (CF-△F)




```
CF 11.0000GHz ΔF 18.0000GHz  TIME  80ms
P1   0.00dBm

→└ PL          CF       ΔF       P1       TIME
```

CF	Centre frequency	(Range 1·9 to 20·1 GHz)
△F	Frequency span	(Maximum 18·2 GHz)
P1	Power level (dBm)	(Range −15 to +20 dBm)
TIME	Forward sweep time	(Range 10 ms to 33·5 s)

RF output sweeps from CF − △F/2 to CF + △F/2.

Note . . .

The values of CF, △F, F1 and F2 are interdependent. Changes in the value of any of these will cause changes in the others, in accordance with these equations:

$$CF = (F2 - F1)/2 + F1$$

$$\triangle F = F2 - F1$$

If the centre frequency is adjusted past a point where either F1 reaches its lower limit or F2 reaches its upper limit, the value of △F is reduced to maintain a symmetrical sweep.

If CF is subsequently moved away from the band edge, △F increases towards its 'remembered' original value. Note that the 'remembered' △F value is lost if either a new configuration is selected or an explicit change is made to △F.

CW operation


```
CF 11.0000GHz                    filter off
P1   0.00dBm                     vernier off

↵                CF     filter     P1     vernier
```

CF RF output frequency

filter CW filter

- **off** Filter off
- **on** Filter on

P1 Power level (dBm)

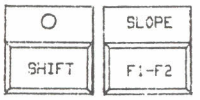
vernier: Frequency vernier control

- **off** Vernier off
- **on** Vernier on

Note . . .

Frequency parameters may be set to a resolution of 500 kHz during normal operation. When the vernier is enabled, CF, F1 or F2 may be set to a resolution of 10 kHz.

Swept operation (Power slope) (F1-F2)




```
F1  2.0000GHz F2 20.0000GHz  TIME 100ms
P1    0.00dBm  SLP    0.00dB/GHz

↗↘E          F1       F2       SLP     TIME
```

F1 Start frequency

F2 Stop frequency

SLP Power slope (dB/GHz)

TIME Forward sweep time

P1 Start power (Power level at F1)

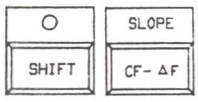
Note . . .

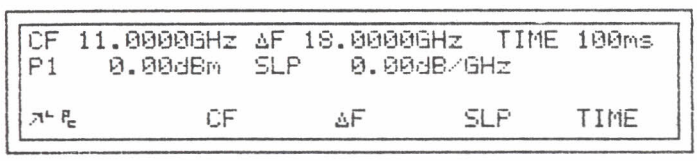
In power slope mode the RF output power increases with frequency, a typical use for which is to compensate for high frequency losses in RF cables.

The start power P1 should be set using the corresponding levelled sweep configuration.

The **SLP** setting is terminated with the dBm key.

Swept operation (Power slope) (CF-△F)





CF Centre frequency

△F Frequency span

SLP Power slope (dB/GHz)

TIME Forward sweep time

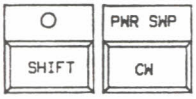
P1 Start power (Power level at F1)

Note . . .

In power slope mode the RF output power increases with frequency, a typical use for which is to compensate for high frequency losses in RF cables.

The start power P1 should be set using the corresponding levelled sweep configuration.

Power sweep




```
CF 11.0000GHz filter off      TIME 100ms
P1   0.00dBm  P2  +5.00dBm

↑ᴸ P₂          CF       P1       P2       TIME
```

CF RF output frequency

P1 Start power (dBm)

P2 Stop power (dBm)

TIME Sweep time

filter CW filter

- **off** Filter off
- **on** Filter on

Note . . .

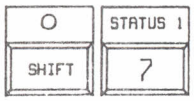
The filter should be selected using the corresponding CW configuration.

AUXILIARY CONFIGURATIONS

No change to the operating mode occurs when an auxiliary configuration is selected.

Status 1 display

States of the non-numeric parameters are selected by successive presses of the soft keys.




```
blank off                    alc int
am off                       AM_FREQ   1.0kHz

→└ P₂        blank     alc      am     AM_FREQ
```

blank Selects RF blanking

off	No RF blanking
retrace	RF blanking during sweep retrace

alc Selects internal or external RF power levelling

int	Internal levelling selected
ext+	External detector (positive output)
ext−	External detector (negative output)
mtr	Power meter levelling

am Selects internal square wave amplitude modulation

off	Amplitude modulation off
on	Amplitude modulation on

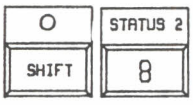
AM_FREQ Amplitude modulation frequency

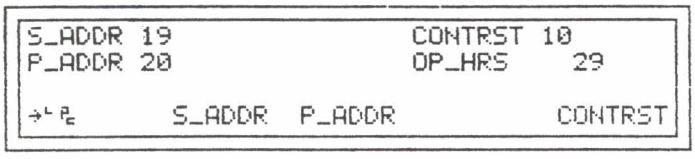
Note . . .

Retrace blanking is not permitted when external sweep is selected.

Note that the RF output is calibrated only when internal levelling is selected. When using external levelling the detector or power meter should be connected to the EXT LEVEL socket adjacent to the RF OUTPUT connector.

Status 2 display





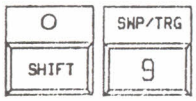
S_ADDR System GPIB address. Refer to GPIB operating manual.

P_ADDR Private GPIB pass through address. Refer to GPIB operating manual.

CONTRST Adjusts LCD contrast to suit operator viewing angle

OP_HRS Total instrument operating hours

Sweep/Trigger selection




```
sweep ext                  swp_tr int
s_swp inactive             cntr_tr off

↵ R        sweep   s_swp  swp_tr  cntr_tr
```

sweep Selects internal or external sweep

- **int** Internal sweep selected. TIME parameter determines sweep time.
- **ext** External sweep selected. Rear panel SWEEP i/p connector accepts 0 to +10 V tuning voltage.

swp_tr Selects method of sweep triggering

- **int** Internal triggering.
- **ext** External triggering. Sweep triggered by logical 1 to logical 0 transition applied to EXT TRIG (pin 11 of rear panel AUXILIARY FUNCTIONS connector)
- **line** Trigger synchronized to power line frequency
- **single** Sweep initiated by pressing soft key assigned to the **s_swp** parameter

s_swp Initiates sweep when single sweep triggering selected

- **inactive** Single sweep triggering disabled
- **ready** Sweep may be initiated by pressing soft key
- **sweeping** Sweep in progress

cntr_tr Selects counter trigger option for use with an external frequency counter

- **off** Counter trigger off
- **f1** Counter triggered at start frequency
- **f2** Counter triggered at stop frequency
- **mk** Counter triggered at reference marker frequency

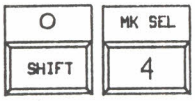
Note . . .

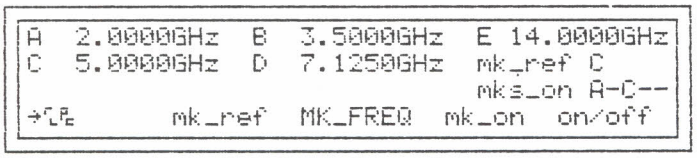
If **ext**ernal sweep is selected (e.g. for use with 6500) it is not possible to select **ext**ernal, **line** or **single** triggering. Conversely, if **ext**ernal, **line** or **single** triggering is selected it is not possible to select **ext**ernal sweep.

The counter trigger facility allows frequency measurements to be made while operating in a swept frequency mode. At a point in the sweep specified by the **cnt_tr** parameter, the sweeper generates a trigger pulse. The counter responds by generating a STOP SWP signal of sufficient duration for a count to be acquired. **The counter trigger operates only when internal sweep is selected.**

Appendix C describes counter interfacing.

Marker select





Soft keys

mk_ref Selects one of the 5 markers, A,B,C,D or E to be the reference marker, thereby enabling its frequency to be changed. The reference marker is shown at right of row 2.

MK_FREQ When selected (flashing) the frequency of the reference marker can be changed.

mk_on Switches the reference marker on/off

on/off Switches all markers on/off

Displays

A,B,C,D,E Marker labels. The current frequency of each marker is shown adjacent to its label.

mks_on Displays the on/off status of all 5 markers. The presence of the marker label indicates that the marker is on; a hyphen indicates the marker is off

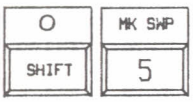
Note . . .

This configuration allows the five markers to be switched on or off and their frequencies set. To change the frequency of a particular marker, or switch it on, it must first be made the reference marker.

The reference marker frequency is the start point for the marker sweep.

An 'on' marker appears as a dip of approximately 5 dB in the RF output power at the marker frequency.

Marker sweep




```
A  2.0000GHz  B  3.5000GHz  Δ  1.5000GHz
C  5.0000GHz  D  7.1250GHz  mk_ref C
              mk_swp off    mk_stp B
→CF      mk_ref  mk_stp  mk_swp  transfr
```

mk_ref Selects one of the 5 markers, A,B,C,D or E to be the reference marker

mk_stp Selects one of the 5 markers, A,B,C,D or E to be the stop marker during marker sweeps

mk_swp Activates frequency sweep between the reference and stop markers.

on	Marker sweep on
off	Marker sweep off

transfr Makes the marker sweep permanent by assigning the current reference and stop marker frequencies to F1 and F2

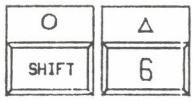
△ Indicates the frequency difference between the reference and stop markers

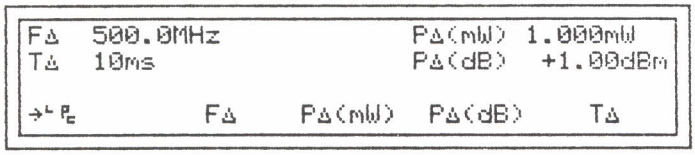
Note . . .

Although it is not displayed in this configuration, marker E may be the reference or stop marker.

A non-numeric parameter is available for setting the centre frequency CF to the reference marker frequency. If this facility is required, a programmable key configuration should be created in which the 'cf=ref' parameter is assigned to one of the soft keys. Refer to Chap. 3-2.

Parameter step size selection





F△ Frequency step

P△(mW) Power step (mW)

P△(dB) Power step (dB)

T△ Time step

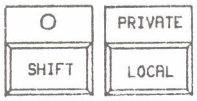
Note . . .

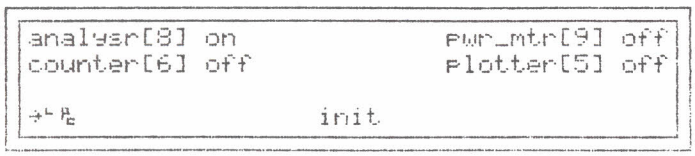
This configuration is used to program the step size for each type of numeric parameter.

The step size for the 'integer' parameters (GPIB address, LCD contrast, etc.) may also be changed from its default setting of 1. To do this it is necessary to use the programmable keys. Refer to Chap. 3-2.

P△(mW) allows the step size of the Power (mW) parameters to be changed. The Power (mW) parameters are not found in any of the standard configurations but may be employed in a user defined configuration assigned to one of the programmable keys. Refer to Chap. 3-2.

Private GPIB status





Soft key

init Initialize private GPIB

Displays

device[X] indicates the expected address of a device connected to the Private GPIB, thus:

analysr[8] 6500 Automatic Amplitude Analyser expected at address 8

counter[6] Counter expected at address 6

pwr_mtr[9] Power meter expected at address 9

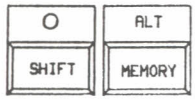
plotter[5] Plotter expected at address 5

on Device present at expected address
off Device not present at expeted address

Note . . .

At power on or following a private GPIB reset command, the sweeper determines which devices are present on the private GPIB and sets **analysr[8], counter[6], pwr_mtr[9]** and **plotter[5]** on or off accordingly.

Alternate sweep selection




```
ALT_MEM  1                altern off
                          man_alt current

                ALT_MEM            altern  man_alt
```

This configuration provides alternate sweep facilities.

ALT_MEM Specifies the instrument setting memory to be used for alternate sweep

altern Selects alternate sweep

- **off** Alternate sweep disabled
- **man** Alternation between current instrument settings and those in the specified memory is actioned manually by pressing a soft key assigned to the **man_alt** parameter
- **auto** Alternation between current instrument settings and those in the specified memory occurs automatically at the end of each sweep

man_alt allows manual switching between current instrument settings and those in the specified memory

- **current** Sweeper operates using current instrument settings
- **memory** Sweeper operates using instrument settings stored in the memory specified by **ALT_MEM**

Note . . .

Automatic alternate sweep is not permitted when the instrument is set for external sweep. Manually switched alternate sweep is primarily intended for use with the 6500 Automatic Amplitude Analyser.

MEMORY FACILITIES

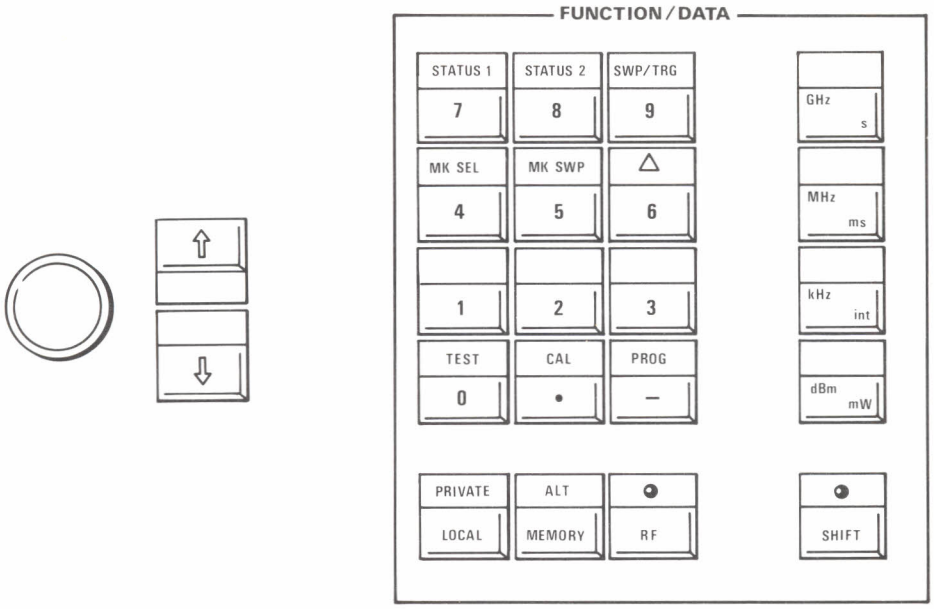


Fig. 3-5 Location of MEMORY key and associated controls

Twenty non-volatile memories are available, each capable of storing complete instrument settings. The [MEMORY] key provides access to the memories, allowing their contents to be reviewed, stored and recalled. In addition, it is possible to specify the instrument state at power-on. Following selection of the [MEMORY] key, the LCD appears as below. RF power is switched off as a safety precaution, but if you need to store sweeper settings with RF on (when setting up a power-on default memory, for example) you may operate the RF key in the usual way.

```
F1  2.0000GHz F2 20.0000GHz  TIME 100ms
P1   0.00dBm
[]
→ MEM 1   STORE  RECALL  POWER-ON  EXIT
```

The display shows the current contents of one of the twenty memories. The memory number is located on row 4 directly above the step keys, and to its left the operating mode associated with the memory is displayed symbolically. The contents of all the memories may be reviewed (i.e. examined without changing the state of the instrument) by operating the step keys or rotary control, or by entering the memory number directly via the numeric keys. The [kHz/int] key is used to terminate numeric memory number entry.

In addition to the twenty store/recall memories there is also a 'recall only' memory, designated PRESET. This can be used to place the instrument in a known state, and is particularly useful for overwriting the contents of the other memories at the end of an operating session should erasure be desirable for security reasons. The PRESET parameter values are listed in Appendix B.

Soft key assignments

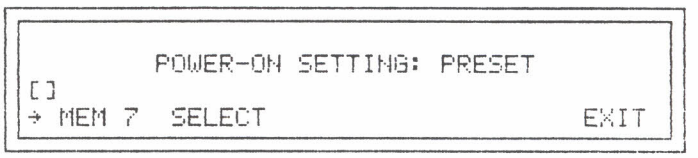
STORE Overwrites the displayed memory with the current instrument settings. It is not possible to overwrite the contents of the PRESET memory.

RECALL Recalls the displayed memory contents.

POWER-ON Specifies the instrument state following power on.

EXIT Leaves memory menu, returns to previous configuration.

Power-on



The instrument status following power-on may be set to one of the following three alternatives:

(i) The contents of one of the 20 memories

(ii) The **PRESET** state.

(iii) The **PWR-DOWN** state (the state immediately prior to power-down)

The rotary control, step keys or numeric keys allow the desired memory, **PRESET** or **PWR-DOWN** to be entered.

SELECT Assigns the power-on setting.

EXIT Returns to memory menu.

TEST AND CAL KEYS

The operation of the TEST key is described in Appendix D : Self Test.

The operation of the CAL key is described in Chap. 3-5 : Calibration.

Chapter 3-2
PROGRAMMABLE KEYS

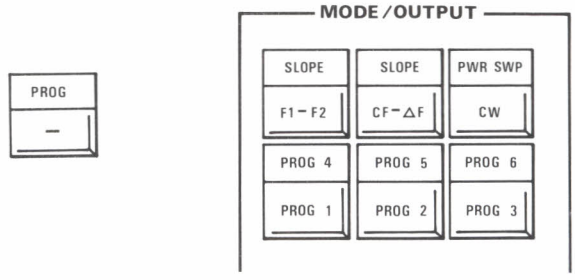


Fig. 3-6 PROG key and programmable keys

OVERVIEW

The programmable keys may be programmed with up to six operator defined configurations. The creation and modification of configurations is achieved using the [PROG] key in the FUNCTION/DATA keypad. Programmable key assignments are stored in non-volatile memory; once programmed a key retains its configuration until changed by the operator.

The keys described in Chap. 3-1 provide the configurations likely to be required for most applications. The programmable keys increase the options available to the operator by allowing new configurations to be created which can be accessed by a single key-press.

A configuration consists of: a display of the current values of a number of parameters; up to four soft key assignments; and the operating mode. The action of the PROG key is designed around these three components. Three Edit modes allow you to define a configuration by specifying:

(i) The parameters to be displayed and their positions.

(ii) The soft key assignments.

(iii) The operating mode.

The PROG key programmer in some ways resembles a word processor.
A word processor user:

(i) Either LOADS a document from a file into memory for editing or CLEARS the memory ready to start from scratch.

(ii) Performs various EDITING operations on the document.

(iii) STORES the resulting document to a file.

The PROG key provides similar facilities:

(i) LOADs an existing configuration into the 'edit memory'. This can be either one of the standard configurations (described in Chap. 3-1) or a previously created programmable key configuration. Alternatively, CLEARs the edit memory so that an entirely new configuration may be defined.

(ii) EDITs the configuration.

(iii) STOREs the new configuration to one of the programmable keys.

The PROG key accesses the main 'menu': LOAD, EDIT and STORE. Selection of any one of these gives rise to another menu of functions, and so on up to a maximum of three 'levels' below the main menu.

The complete structure of the user programming facility is shown in Fig. 3-7.

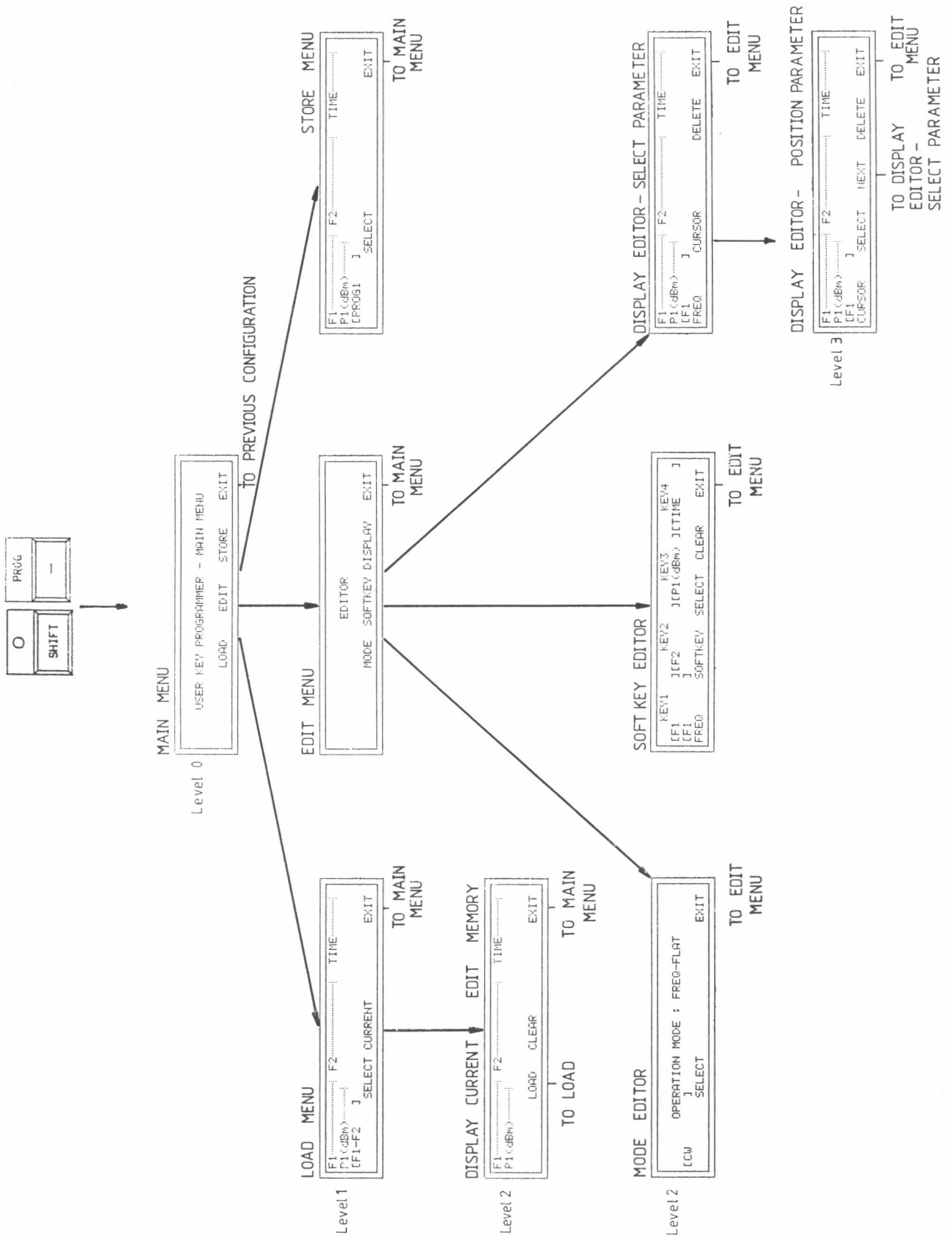
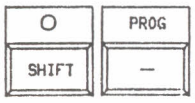


Fig. 3-7 Programmer overall structure

MENU DESCRIPTIONS

Apart from the Main Menu, menus are named according to the softkey labels which select them.

Main Menu (Level 0)



RF is switched off when the programmer is selected.

While editing is in progress, the configuration being created or modified is held in the 'edit memory'. Since the edit memory is not cleared every time the [PROG] key is pressed, it is permissible to leave the programmer at any time and resume the editing session later. The edit memory contents are not preserved, however, when power is removed. To save a configuration permanently it must be assigned to one of the programmable keys.

Soft key assignments

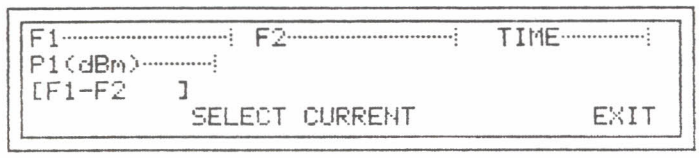
LOAD Loads a "built-in" (sweep or auxiliary) configuration, or a previously defined programmable key configuration, into the edit memory ready for editing.

EDIT Edits the configuration currently held in the edit memory. The editor allows displayed parameters, soft key assignments and the operating mode parameter associated with the configuration to be modified.

STORE Assigns current edit memory contents to one of the programmable keys.

EXIT Leaves the programmer and returns to previous configuration.

LOAD (Levels 1 and 2)



LOAD allows a standard configuration or a previously defined programmable key configuration to be copied into the edit memory.

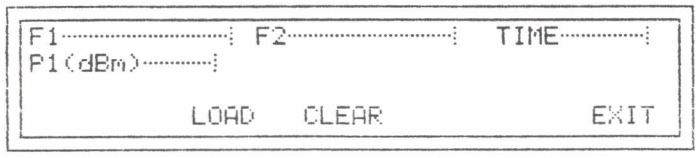
Soft key and rotary control assignments

ROTARY CONTROL — The configurations available to be loaded are displayed one after the other using the rotary control – first the sweep configurations, then the auxiliary configurations and finally the user-programable configurations. The configuration name (the same as the key legend) is displayed in parenthesis in row 3 and the associated parameters are shown in rows 1 and 2.

SELECT — The displayed configuration is loaded into the edit memory. This is indicated by 'SELECTED' being displayed at the left-hand side row 4.

EXIT — Returns to Main menu.

CURRENT — Displays the current contents of the edit memory. A new (Level 2) menu is displayed:

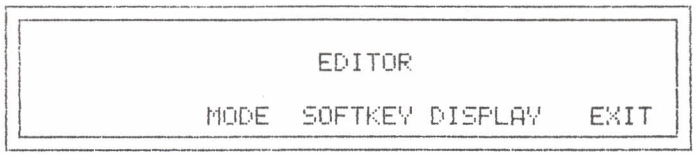


LOAD — Returns to LOAD menu.

CLEAR — Clears the edit memory to allow the creation of a new configuration, rather than the modification of an existing configuration.

EXIT — Returns to Main menu.

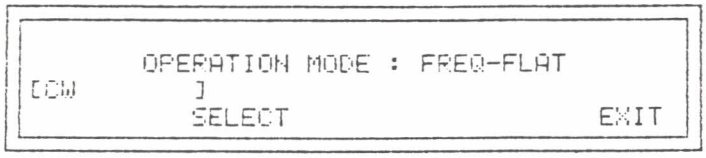
EDIT (Level 1)



Soft key assignments

MODE	When a configuration key is pressed, the operating mode may change. The editor allows the mode associated with a programmable key to be defined.
SOFTKEY	The soft key editor is used to assign parameters to the four soft keys.
DISPLAY	The display editor allows parameters to be selected for display and their positions on the LCD to be defined.
EXIT	Returns to programmer – main menu

MODE Editor (Level 2)



Row 2 of the display shows the current operating mode stored in the EDIT memory, which may be one of the following:

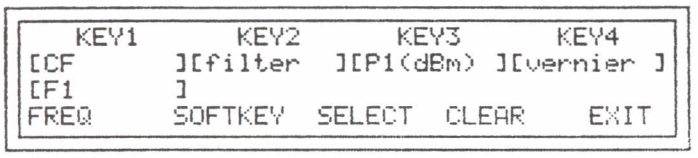
CW	(constant frequency and power)
FREQ-FLAT	(frequency sweep, levelled power)
FREQ-SLP	(frequency, power slope)
PWR-SWEEP	(constant frequency, power sweep)
NO-CHANGE	

The modes are also displayed after the other (by turning the rotary control) in row 3 of the display. This allows the operating mode of the new configuration to be selected. The NO-CHANGE option allows a configuration to be created which will not change the operating mode when selected. This is useful for status displays, and is in fact used in the built-in configurations STATUS 1 and SWP/TRG.

Rotary control and soft key assignments

ROTARY CONTROL	Used to view the four available modes and the 'NO CHANGE' option. The mode is displayed in parenthesis.
SELECT	Selects the mode currently displayed in parenthesis.
EXIT	Returns to the editor menu.

SOFTKEY Editor (Level 2)



The soft key editor is used to assign parameters to the four soft keys.

Row 1 of the LCD shows labels representing each of the four soft keys. Parameters currently assigned to these keys are shown in row 2.

Rotary control, step key and soft key assignments

STEP KEYS — Select a group of broadly related parameters. A label identifying the group is indicated above the step keys, on the left of row 4.

ROTARY CONTROL — Selects a parameter from within the group. The parameter label appears in parentheses on the left of row 3.

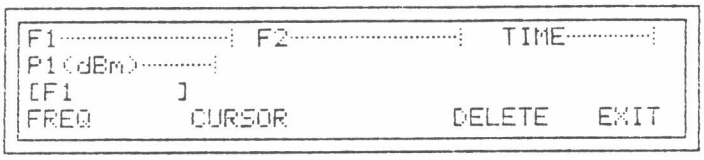
SOFTKEY — Selects one of the four soft keys. The corresponding label KEY1 to KEY4 flashes to indicate selection. Repeated key presses select each of KEY1 to KEY4 in turn.

SELECT — Assigns the parameter displayed in parentheses to the currently active soft key (indicated by the flashing label).

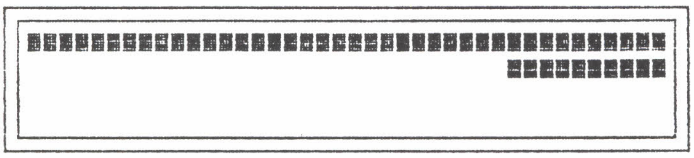
CLEAR — Removes any assigned parameter from the currently active soft key.

EXIT — Returns to the editor menu.

DISPLAY Editor (Level 2)



The display editor facilitates positioning of parameters on the LCD



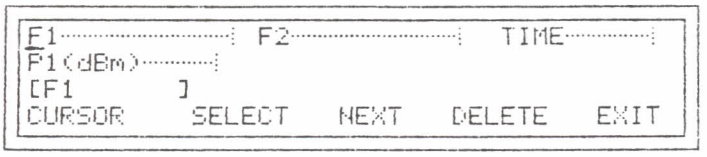
The blank area in the example display is the LCD area avilable for parameter display. Row 4 is reserved for status and soft key labels, and part of row 3 is required for the numeric entry field.

The LCD shows the total length of the character field occupied by each displayed parameter.

Rotary control, step key and soft key assignments

STEP KEYS	Select a group of broadly related parameters. A label identifying the group is indicated above the step keys.
ROTARY CONTROL	Selects a parameter from within the group. The parameter label appears in parentheses.
DELETE	If it is already present, the selected parameter is removed from the display
EXIT	Returns to editor menu.
CURSOR	Accesses a level 3 menu which allows re-positioning of parameters (see next page).

CURSOR (Level 3)



CURSOR — Changes the action of the step keys and rotary control to allow positioning of a cursor which in turn defines the position of the parameters on the display. The cursor appears as an underscore character.

ROTARY CONTROL — Clockwise – cursor right
Anticlockwise – cursor left

STEP KEYS — Cursor up/down

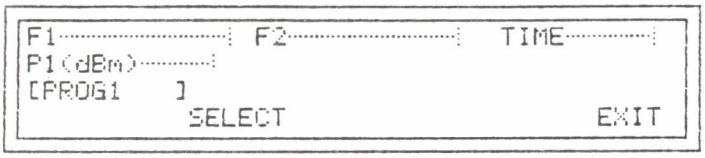
SELECT — Places parameter at position specified by the cursor.
If the parameter is already present elsewhere on the display it is automatically repositioned.
If the position is already occupied, or there is insufficient space, or if adding another parameter would cause the number displayed to exceed eleven (the maximum per configuration), an error message is displayed.
Existing parameters cannot be 'overwritten', but must be deleted (see DELETE).

NEXT — Returns to Display editor to allow the next parameter to be selected.

DELETE — If already present, the selected parameter is removed from the display.

EXIT — Returns to editor menu.

STORE (Level 1)



STORE enables the configuration held in the edit memory to be assigned to one of the programmable keys (PROG 1 to PROG 6).

Rotary control and soft key assignments

ROTARY CONTROL — Used to select a programmable key. The currently selected programmable key is displayed in parentheses.

SELECT — Programs the selected programmable key with the configuration held in the edit memory.

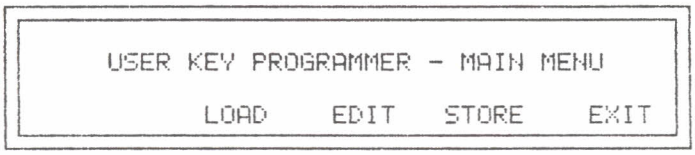
EXIT — Returns to the programmer main menu.

PROGRAMMABLE KEY WORKED EXAMPLE

The following worked example demonstrates most of the editing facilities. A good way to gain familiarity is to follow the example on the sweeper.

Suppose you wish to place the instrument in CW mode but display and enter the power level in mW rather than dBm. In this example PROG 3 is programmed with a modified version of the standard CW configuration

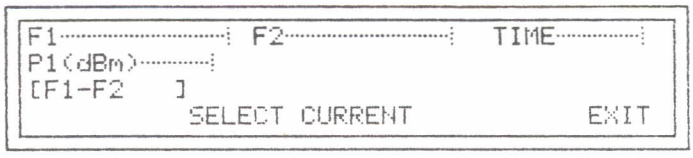
(1) Enter the programmable key programmer by selecting the [PROG] key.



Note . . .

As a safety precaution, RF power is switched off on selecting the [PROG] key.

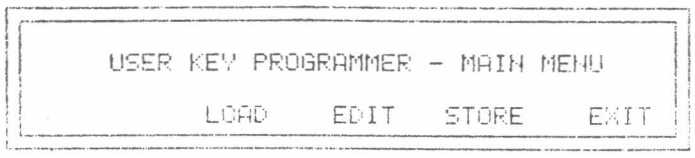
(2) As it is intended to modify an existing configuration, select the **LOAD** option.



(3) Rotate the rotary control to preview each of the standard and programmable key configurations. The label in parentheses above the rotary control indicates which configuration is displayed, and the LCD shows the displayed parameters for that configuration.

(4) Rotate the rotary control until the CW configuration is displayed, then press **SELECT** to load the configuration ready for editing.

(5) Press **EXIT** to return to the main menu.



(6) Press **EDIT** to obtain the edit menu.

```
                    EDITOR

          MODE  SOFTKEY DISPLAY   EXIT
```

The MODE editor allows you to change the mode associated with the configuration. Since the intention is to continue with CW mode, it is not necessary to use the MODE editor on this occasion.

(7) Select the **SOFTKEY** editor.

```
   KEY1       KEY2       KEY3       KEY4
[CF        ][filter   ][P1(dBm) ][vernier ]
[F1        ]
FREQ       SOFTKEY  SELECT  CLEAR     EXIT
```

The soft key editor allows you to assign parameters to the soft keys. On entering the soft key editor, KEY1 flashes to indicate that it is the currently active soft key. Pressing **SOFTKEY** selects KEY2 to KEY4 in turn.

(8) Press **SOFTKEY** twice to select KEY3.

The rotary control and step keys are used to select the parameter to be assigned to the soft key. The step keys select groups of broadly related parameters and the rotary control selects individual parameters within the group. Parameter groups are displayed on the left of row 4, and individual parameters are displayed (in parentheses) on the left of row 3.

(9) Press one of the step keys repeatedly until the PWR mW parameter group is selected.

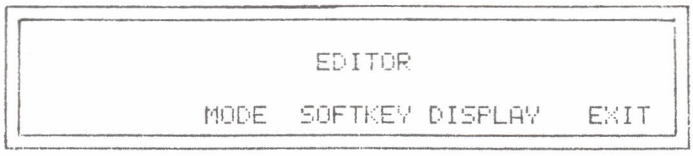
(10) Rotate the rotary control (if necessary) until the required parameter P1(mW) appears in the parentheses.

(11) Press **SELECT** to assign the parameter P1(mW) to KEY3.

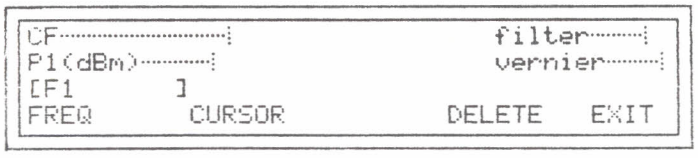
```
   KEY1       KEY2       KEY3       KEY4
[CF        ][filter   ][P1(mW)  ][vernier ]
[P1(mW)    ]
PWR mW     SOFTKEY  SELECT  CLEAR     EXIT
```

(12) Confirm that the desired parameter is assigned by checking for P1(mW) beneath the flashing KEY3 symbol.

(13) Soft key editing is now complete. Press **EXIT** to return to the EDITOR menu.

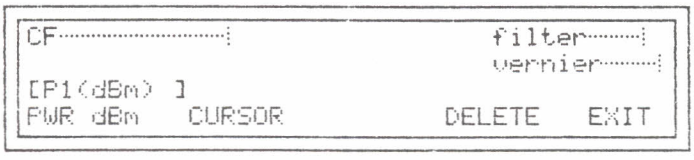


(14) Select **DISPLAY** to enter the display editor.



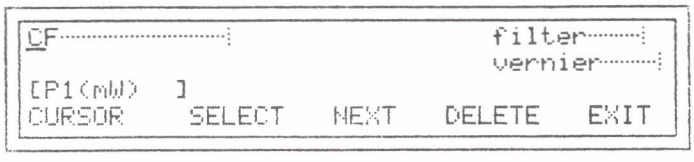
The displayed parameters are shown with bars indicating their field length. The task now is to delete the P1(dBm) parameter and replace it by P1(mW).

(15) As with the soft key editor, the step keys and rotary control are used to select a parameter. Select the P1(dBm) parameter, then press **DELETE.**



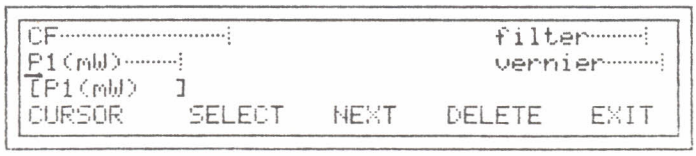
The P1(dBm) parameter has been deleted from the display.

(16) Use the step keys and rotary control to select the P1(mW) parameter. Press **CURSOR.**



(17) The cursor appears as an underscore character on the LCD. Using the step keys to move the cursor up and down, and the rotary control, to move it right (clockwise rotation) and left (anti-clockwise rotation), position the cursor in the parameter display area. The cursor may be positioned anywhere on the upper three rows of the LCD except the ten character field on row 3, which is reserved for numeric entry.

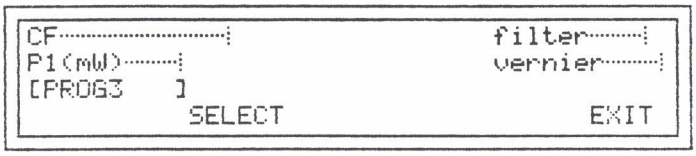
(18) Move the cursor to the position where the (dBm) parameter was formerly displayed, (the beginning of row 2) then press **SELECT.**



Modifications to the configuration are now complete.

(19) Press **EXIT** to return to the editor menu. Again press **EXIT** to return to the main menu.

(20) Press **STORE.**

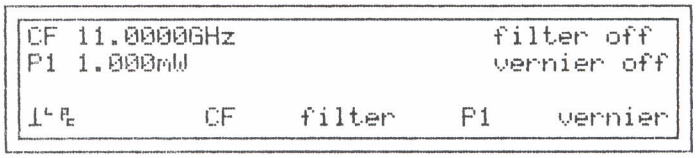


(21) The display shows the display configuration ready to be stored. The rotary control is used to select one of the programmable keys. Rotate the rotary control until PROG 3 appears in the parentheses.

(22) Press **SELECT** to program PROG SELECTED is displayed on the left of row 4.

(23) Press **EXIT** once to return to the main menu, and again to EXIT from the programmable key programmer.

(24) Press [PROG 3] to try the new configuration.



As required, it is now possible to enter power levels in mW instead of dBm.

Chapter 3-3

PRIVATE GPIB OPERATION

INTRODUCTION

The private GPIB enables the sweeper to control a Marconi Power Meter type 6960 and a Marconi Counter type 2440 during autocalibration.

It also provides an interface to an Automatic Amplitude Analyser type 6500 and, optionally, an HP-GL (Hewlett Packard Graphics Language) compatible plotter, to form a scalar measurement system.

CAUTION . . .

There are two GPIB interface connectors located on the rear panel of the sweeper. The SYSTEM GPIB interface is intended for remote programming of the sweeper. Under no circumstances should a GPIB controller be connected to the interface connector marked PRIVATE, or damage to the sweeper and GPIB controller might result.

ADDRESS ALLOCATIONS

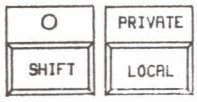
Private GPIB addresses are allocated as follows:

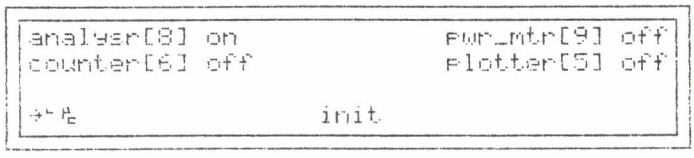
6500 Automatic Amplitude Analyser	8
Plotter	5
Power meter	9
Frequency counter	6

PRIVATE GPIB INITIALIZATION

At power-on, or in response to a Private Bus Initialize command from the keyboard or system GPIB, the sweeper checks the private GPIB addresses listed above to determine which instruments are installed. It is necessary to reinitialize the private GPIB should a device be added or removed. For this reason, it is strongly recommended that all instruments intended to be used on the private GPIB should be connected and switched on before the sweeper.

A status display showing the private GPIB configuration is obtained using:





Soft key

init Initialize private GPIB

Displays

device[X] indicates the expected address of a device connected to the Private GPIB, thus:

analysr[8] 6500 Automatic Amplitude Analyser expected at address 8

counter[6] Counter expected at address 6

pwr_mtr[9] Power meter expected at address 9

plotter[5] Plotter expected at address 5

on Device present at expected address

off Device not present at expected address

At power on or following a private GPIB reset command, the sweeper determines which devices are present on the private GPIB and sets **analysr[8], counter[6], pwr_mtr[9]** and **plotter[5] on** or **off** accordingly.

Power meter and counter operation

The power meter and counter are used for automatic calibration. Refer to Chap. 3-5.

Pass through facilities

A GPIB controller connected to the system GPIB may communicate with a device installed on the private GPIB. Refer to the GPIB operating manual.

Chapter 3-4

OPERATION WITH 6500 AUTOMATIC AMPLITUDE ANALYSER

SCALAR ANALYSIS SYSTEM

When used in conjunction with the sweeper, many enhancements are made to the operation of the 6500 Automatic Amplitude Analyser. The main additional facilities are as follows:

High resolution x-axis display. Units may be either GHz or dBm depending on the sweeper mode. Annotation is automatically updated whenever the 6310 frequency range or operating mode is changed.

If a calibration trace is stored and, subsequently, a measurement over a narrower frequency band is made, the sweeper expands and interpolates the data stored in 6500 to maintain a calibrated display.

If a digital plotter is installed, the sweeper controls plotting of 6500 measurements. A title may be entered via the 6500 keyboard and added to the plot. Plotting is implemented as a 'background task', allowing 6500 to make new measurements while plotting is in progress.

6500 front panel settings are stored automatically in the sweeper non-volatile memories.

RF power is switched off automatically during 6500 detector zero operation.

Compatibility

For correct operation, 6500 must have installed firmware Issue 5 or higher. 6500 firmware issue status may be determined at power-on. Refer to 6500 operating manual.

SYSTEM INTERCONNECTIONS

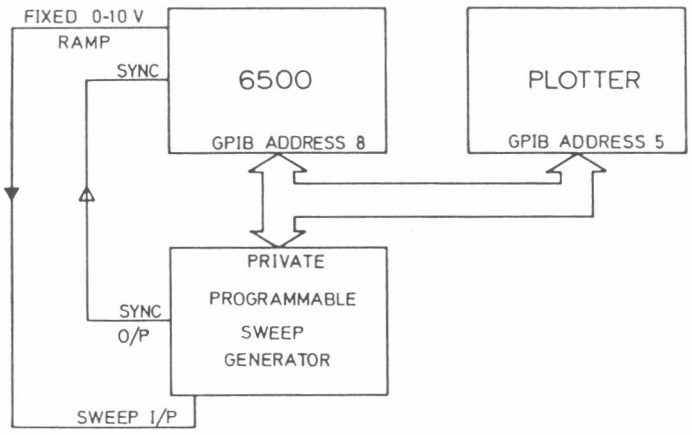


Fig. 3-8 Connections to 6500 and sweeper

In addition to the GPIB, two other connections are required between 6500 and the sweeper. The FIXED 0 – 10 V voltage ramp output from 6500 must be connected to SWEEP i/p, and the SYNC input of 6500 must be connected to the sweeper SYNC o/p.

INITIALIZATION

Following private GPIB initialization, certain operations specific to 6500 are carried out:

Instrument reset.

Transfer of 6500 front panel settings from sweeper non-volatile memory to 6500.

6500 detector zero.

High resolution x-axis annotation written to 6500.

In order to ensure that the sweeper and 6500 will operate correctly together, a number of sweeper parameters are preset. Amplitude modulation is switched off, and external sweep and internal sweep triggering are selected.

Alternate sweep must also be switched off, although it is possible to use this facility with 6500 provided that alternation between the current and memory settings is performed manually. Refer to the description of the ALT configuration in Chap. 3-1.

CHANGES TO 6500 OPERATION

If you are unfamiliar with 6500 operation you are advised to read this section in conjunction with the 6500 operating manual.

Warning and Status messages

Warning and status messages are written to the bottom line of the 6500 graticule area. Warnings indicate that the sweeper is operating in a way which is incompatible with 6500.

sweep? Warns that the sweeper is set for internal and not external sweep operation as required by 6500. Select the SWP/TRG configuration and ensure that the 'sweep' parameter is set to 'ext'.

am? Warns that amplitude modulation is switched on. Select the STATUS 1 configuration and ensure that the 'am' parameter is set to 'off'.

C Status message indicating that 6500 auto-renormalization (also known as adaptive calibration) is pending or in progress.

Frequency control

The most significant differences in the operation of 6500 when connected to the sweeper are concerned with frequency entry. The sweeper ensures that the x-axis annotation on 6500 is always correctly displayed; either frequency in GHz or power in dBm, depending on the sweeper operating mode.

Frequency or power data should be entered using the 6310 keyboard. Numeric frequency or power entry from the 6500 keyboard is not permitted, although it is possible to use the brightline to define either the beginning or end of a sweep.

If either [START] or [STOP] is selected on the 6500, the following prompt is displayed:

Position Brightline
Press [ENTER]

Use the 6500 spinwheel to position the brightline, then press [ENTER] to program the new sweep limit.

F1–F2 key

If the sweeper is operating in power sweep mode the effect of this key is to set a power sweep from −5 dBm to +10 dBm. For all other modes, F1 is set to 2·0 GHz and F2 to 20 GHz.

MARKER and △F keys

The 6500 [MARKER] and [△F] keys are disabled. Use the marker and CF-△F facilities available from the sweeper front panel.

STO and RCL

Instrument settings stored by 6500 using the [STO] key are transferred automatically to the sweeper where they are held in non-volatile memory. The 6500 stores are reprogrammed by the sweep during initialization.

ZERO

During 6500 detector zero RF power is switched off automatically.

STORE and SUB MEM keys

Whenever a trace is stored to one of the analyser memories, a copy is transferred to the sweeper. If a SUB MEM operation is initiated on 6500, the sweeper transfers the appropriate memory data back to 6500 after performing any necessary interpolation if the swept frequency range has changed. Warning messages are displayed on the sweeper LCD if it is not possible to interpolate the stored calibration data because either the sweeper operating mode has changed or the current sweep range encompasses frequencies for which no data was stored.

Changing 6500 sweep speed

A change to the 6500 sweep time causes the sweeper TIME parameter to be updated. Despite the fact that the sweeper operates in external sweep mode with 6500, the TIME parameter value is set to the 6500 nominal sweep speed to ensure that speed dependent error correction performed by the sweeper is properly applied.

Plot key

If a digital plotter is not connected, the 6500 displays the conventional analog X-Y recorder menu. If, however, a digital plotter is present the following menu is displayed together with any previously entered plot title.

Filter AB123 27/9/85

Plotter Menu

0 – Plot All
1 – Plot Graticule
2 – Label Graticule
3 – Plot Trace Only

4 – Edit Title

5 – Abort Plot

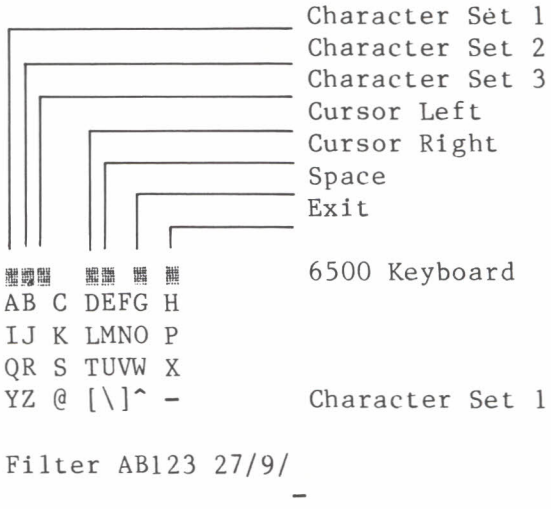
[NORMAL] – Exit

If menu items 0 to 3 are selected, the sweeper acquires the plotter command strings from 6500 and commences transmitting short HP-GL 'packets' to the plotter. Providing the plotter does not hold up the GPIB handshaking excessively, other bus commands may be interleaved between the HP-GL packets, allowing you to exit from the plot menu using the [NORMAL] key and make further measurements.

Menu option 5 causes any plot operation in progress to be aborted.

Plot title editor

A title of up to 33 characters may be added to a plot. Following selection of menu option 4, the 6500 keyboard is redefined. A pictorial representation of the new 6500 key assignments is displayed on the 6500 screen, together with the current plot title and the edit cursor (–).



The top row of 6500 keys provides edit functions and each of the remaining 32 keys is assigned a character.

Editor Function Keys

Character Set 1	Selects upper case alphabetic characters.
Character Set 2	Selects lower case alphabetic characters.
Character Set 3	Selects numeric and symbol characters.
Cursor Left	Moves cursor non-destructively one space left.
Cursor Right	Moves cursor non-destructively one space right.
Space	Inserts space character at cursor position and moves cursor one space right.
Exit	Returns to the plotter menu.

It should be noted that the characters plotted are a function of the plotter, not the sweeper or amplitude analyser, and may therefore differ slightly from those displayed on the 6500 screen.

Chapter 3-5

CALIBRATION

INTRODUCTION

The sweeper may be calibrated using a Marconi Instruments Microwave Counter type 2440 and a Marconi Instruments RF Power Meter type 6960 fitted with a Power Sensor type 6910. The calibration process is fully automatic and is controlled via the private GPIB.

PRIMARY AND USER CALIBRATION

Data for both frequency and power calibration is held within the sweeper. There are three independent calibration data stores: Primary, User 1 and User 2. The Primary calibration, created during factory calibration, is stored in EEPROM (Electrically Erasable Programmable Read Only Memory), and the User calibrations, which may be created by the operator, are stored in non-volatile memory. The calibration currently in use – Primary, User 1 or User 2 – is indicated by a symbol displayed in the status field.

Primary calibration selected

User 1 calibration selected

User 2 calibration selected

Provision is made to transfer calibration data from either User 1 or User 2 to the Primary calibration store.

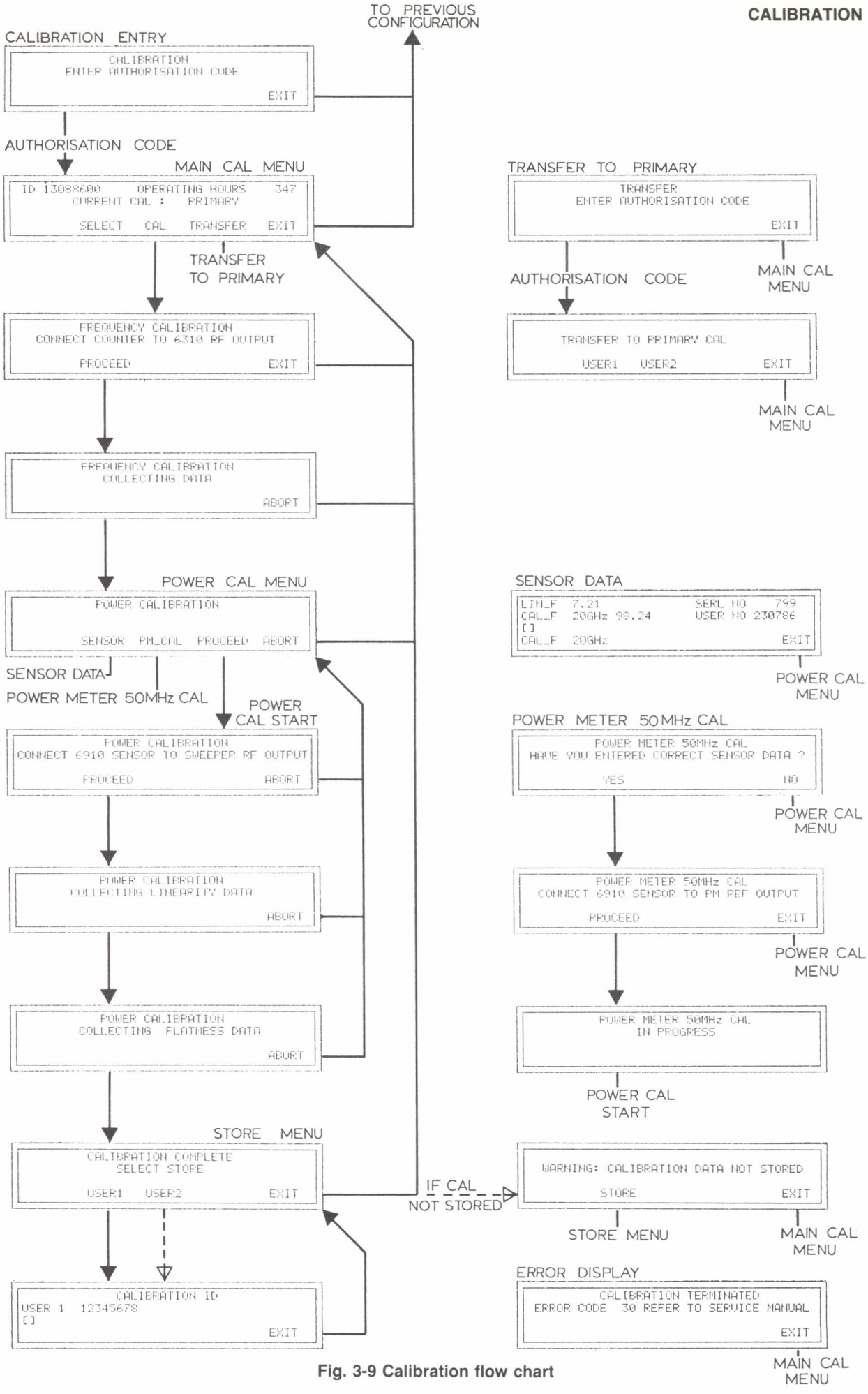


Fig. 3-9 Calibration flow chart

CALIBRATION INTEGRITY

There are three protection measures incorporated into the design to guard against unauthorized interference with the instrument calibration.

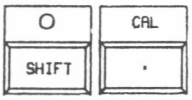
An internal switch disables the front panel calibration function. This prevents selection of the calibration menus. Access to the internal switch requires that the instrument covers be removed, and these may be sealed. During manufacture, the switch is preset to permit front panel calibration. Refer to the service manual for setting instructions.

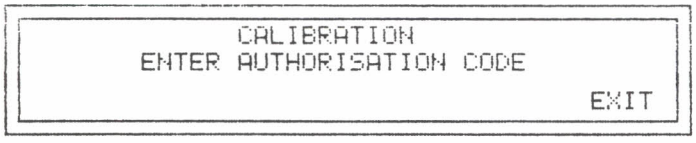
The operator is required to enter a six digit authorization code before a new calibration can be acquired or selected.

Transfer of data from either User 1 or User 2 to the Primary calibration store is protected by a second six digit authorization code.

CAL KEY OPERATION

Calibration facilities are selected using



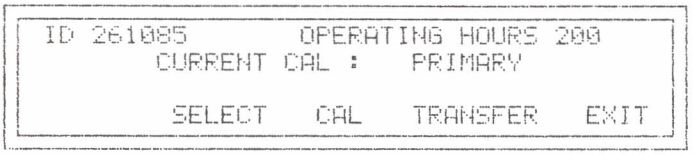


The correct sequence of six digits must be entered before access to the calibration main menu is permitted. The digits are not displayed as they are entered.

EXIT Exits from the calibration facility.

CALIBRATION – MAIN MENU

When the authorization code has been entered correctly, the display is as shown below.



CURRENT CAL Identifies the calibration currently in use.

OPERATING HOURS Operating hours since calibration data was stored.

ID Optional identification number. This may be used to show the date of calibration.

Soft key assignments

SELECT Selects Primary, User 1 or User 2 calibration. During subsequent operation, the selected calibration is displayed in the status field.

CAL Initiates acquisition of calibration data.

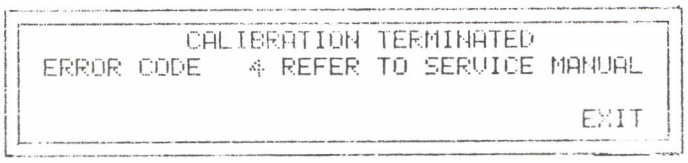
TRANSFER Transfers calibration data from User 1 or User 2 to the Primary calibration store. The Primary calibration is protected by a second authorization code.

EXIT Exits from the calibration facility.

A detailed description of the CAL option follows:

CAL – Initiate instrument calibration

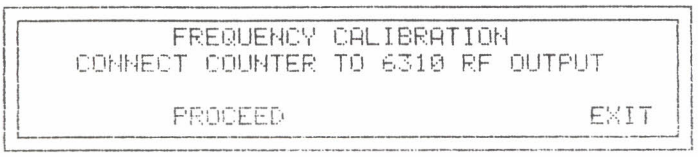
Error conditions. If an error condition arises during calibration, an error screen is displayed as shown below. An error condition encountered during calibration in general indicates a problem with the instrument hardware. The one exception is error 30 which indicates a GPIB instrumentation failure. If this error occurs, the private GPIB connections should be checked and the bus re-initialized. Refer to Chap. 3-3. All other fault conditions are described in the service manual.



EXIT Return to the calibration menu.

FREQUENCY CALIBRATION

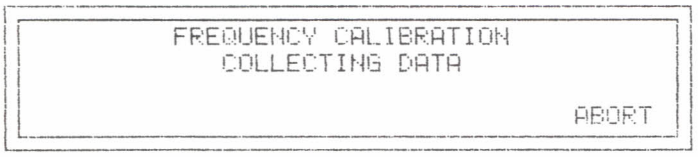
The instrument presents the following frequency calibration menu.



PROCEED Starts calibration data acquisition.

EXIT Returns to the calibration main menu without acquiring any calibration data.

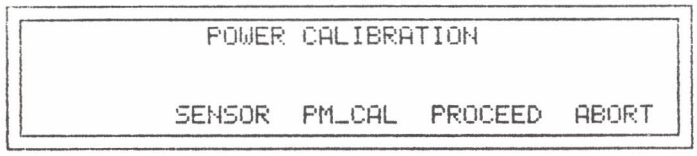
During calibration the instrument display is as below.



ABORT Aborts calibration and returns to the calibration main menu.

POWER CALIBRATION

Following successful acquisition of the frequency calibration data, the instrument presents the power calibration menu.



SENSOR This provides access to an editor allowing power meter sensor calibration data to be entered and stored in non-volatile memory.

PM_CAL Performs automatic power meter calibration at 50 MHz.

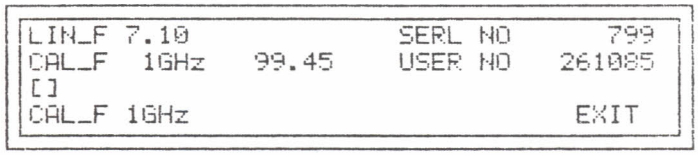
PROCEED Commences acquisition of power calibration data.

ABORT Aborts calibration and returns to the calibration main menu.

Detailed descriptions of the SENSOR, PM_CAL and PROCEED options follow.

SENSOR – Enter or modify 6910 Power Sensor calibration data

Before starting power calibration, it is important to ensure that the sweeper has been programmed with calibration information for the particular 6910 Power Sensor in use. The linearity factor and calibration factor data table should be entered from the calibration certificate supplied with the sensor. This information is stored within the sweeper's non-volatile memory.



The sensor data editor allows the following data to be entered.

LIN_F Linearity factor.

CAL_F Calibration factor. This is stored at 1 GHz intervals between 1 GHz and 20 GHz.

SERL NO 6910 serial number. This may be entered to remind you which sensor the linearity and Cal Factor data applies to.

USER NO An optional reference number which can be employed, for example, to show the power sensor calibration date.

Editing power sensor data

The rotary control or step keys are used to select a parameter for numeric entry. The current selection is displayed on row 4 of the LCD directly above the step keys. Numeric entry should be terminated using the [kHz/int] units key.

Permitted ranges of inputs are as follows:

CAL_F	70.00 –	100.00
LIN_F	0.10 –	14.99
SERL NO	0 –	999999
USER NO	0 –	999999

PM_CAL – Performs power meter 50 MHz calibration

Following selection, the sweeper displays a message reminding you to check that the power sensor data is correct.

NO Returns to the power calibration menu.

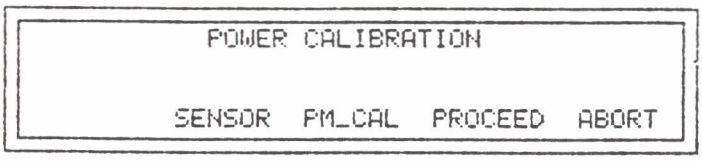
YES Continues power meter 50 MHz calibration.

EXIT Aborts power meter calibration and returns to the sweeper power calibration menu.

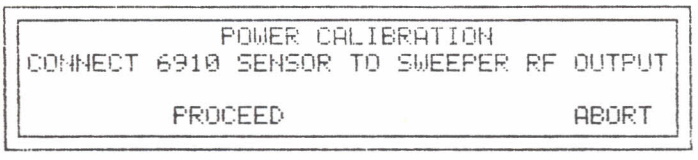
PROCEED Initiates power meter calibration.

Initiating power calibration

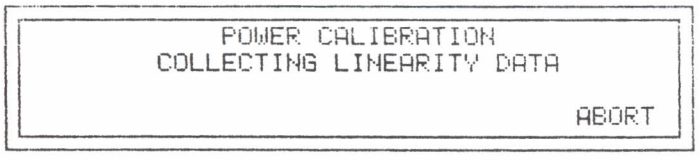
Approximately 25 s after initiating the 50 MHz calibration, the power calibration menu is again displayed.



PROCEED Starts calibration process



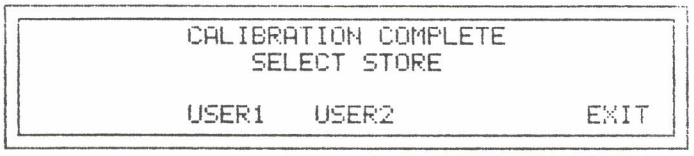
PROCEED Continues.



ABORT Returns to sweeper power calibration menu

STORING THE CALIBRATION

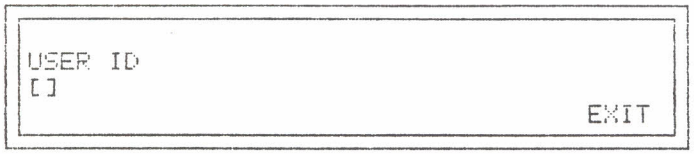
When calibration has been completed the data can be stored as follows:



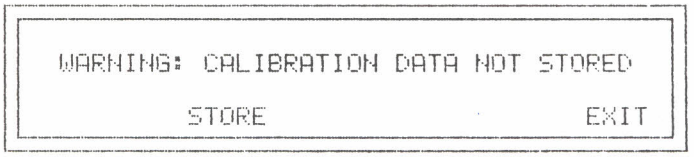
USER1 Assigns the newly acquired calibration data to the User 1 store.

USER2 Assigns the newly acquired calibration data to the User 2 store.

When the new calibration has been assigned to either User 1 or User 2 the sweeper prompts for an identification number of up to 8 digits.



EXIT Returns to the calibration main menu. Note that if the calibration data has not been stored, a warning is displayed. If EXIT is selected a second time, the new calibration is lost.

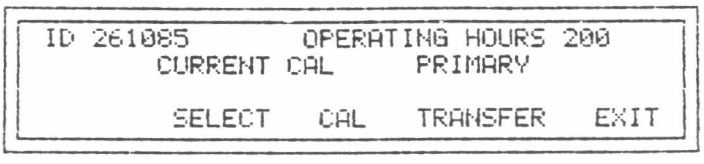


TRANSFER TO PRIMARY CALIBRATION

The calibration data in the user stores can be transferred to the primary calibration store.

CAUTION . . .

The transfer function overwrites the primary calibration. Access to this facility should be restricted to authorized personnel.



TRANSFER Selects transfer facility.

Transfer to the primary calibration store is protected by a second six digit authorization code.

If the authorization code is entered correctly, the display is as shown above.

USER1 Transfers from USER1 to the primary calibration

USER2 Transfers from USER2 to the primary calibration

EXIT Returns to the calibration main menu.

Appendix A

6310 SWEEPER PARAMETERS

FORMAT

The instrument is at present controlled by the parameters listed in the following tables. The format for presenting the parameter tables is as follows:

The parameter tables are divided into groups containing a number of related parameters. The group names correspond to those used in the programmable key programmer (Chap. 3-2).

For each numeric parameter its minimum and maximum permitted values are given. For non-numeric parameters each state is given.

Some parameters may not be assigned to soft keys. These 'dispay only' parameters are indicated by a 'D'. Similarly, a few parameters designated 'soft key only' are indicated by an 'S'.

TABLE A-1 FREQUENCY PARAMETERS

Name	Description	Minimum	Maximum	
F1	Start frequency	1·9 GHz	20·1 GHz	
F2	Stop frequency	1·9 GHz	20·1 GHz	
CF	Centre frequency	1·9 GHz	20·1 GHz	
△F	Frequency span	0.0 GHz	18·2 GHz	
A	Marker A	1·9 GHz	20·1 GHz	
B	Marker B	1·9 GHz	20·1 GHz	
C	Marker C	1·9 GHz	20·1 GHz	
D	Marker D	1·9 GHz	20·1 GHz	
E	Marker E	1·9 GHz	20·1 GHz	
MK_FREQ	Ref. marker frequency	1·9 GHz	20·1 GHz	
△	Marker sweep width	0.0 GHz	18·2 GHz	[D]
F△	Frequency increment	500 kHz	10·0 GHz	
AM_FREQ	AM frequency	1·0 kHz	100 kHz	

The reference marker frequency, MK_FREQ, is equal to the value of that marker (A to E) which is designated 'reference'. In the standard marker configurations A to E are manipulated indirectly. It is permissible to change the frequencies of markers directly if required.

TABLE A-2 POWER (dBm) PARAMETERS

Name	Description	Minimum	Maximum
P1	Power level	−15·0 dBm	+20·0 dBm
P2	Stop power	−15·0 dBm	+20·0 dBm
P△ (dB)	Power step	0·0 dB	5·0 dB
SLP	Power slope	0·0 dB/GHz	+20·0 dB/GHz

TABLE A-3 POWER (mW) PARAMETERS

Name	Description	Minimum	Maximum
P1	Power level	·0316 mW	100 mW
P2	Stop power	·0316 mW	100 mW
P△ (mW)	Power step	0·1 mW	20 mW

Although the units are different, P1 (dBm) and P2 (dBm) always have the same power values as P1 (mW) and P2 (mW).

TABLE A-4 TIME PARAMETERS

Name	Description	Minimum	Maximum
TIME	Forward sweep time	10 ms	33·5 s
T△	Time step	1 ms	10 s

TABLE A-5 INTEGER PARAMETERS

Name	Description	Minimum	Maximum	
H	Clock hours	0	23	
M	Clock minutes	0	59	
S	Clock seconds	0	59	
OP_HRS	Instrument operating hours	0	99999	[D]
USR_HRS	User settable operating hours	0	99999	
CONTRST	LCD contrast	1	20	
INT△	Integer step	1	10	
S_ADDR	System GPIB address	0	30	
P_ADDR	Private GPIB address	0	30	
RATE	Rotary control rate	0	1000	[D]
LAST_KEY	No. of last key pressed	0	65	[D]
mks_on	Marker on/off status	-----	ABCDE	[D]

TABLE A-6 DIAGNOSTIC PARAMETERS

Name	Description	Minimum	Maximum
RAMP	0 – 10 V ramp position	0	4095
OFFSET	OFFSET DAC	0	65535
LEVEL	Level DAC	0	65535
SCALE	Scale DAC	0	65535
VERN	Vernier DAC	0	4095
BAND	Frequency band	0	2
CONTROL		0	65535
CNTRL_A		0	255
CNTRL_B		0	255
PROG		0	15

Diagnostic parameters are used during calibration and service. Refer to service manual.

TABLE A-7 NON-NUMERIC PARAMETERS

Name	Description	States	
cntr_tr	Counter trigger	off, f1, f2, mk	
filter	CW filter	off, on	
swp_tr	Sweep trigger	int, ext, line, single	
alc	Automatic level control	int, ext+, ext−, mtr	
sweep	Sweep select	int, ext	
am	Amplitude modulation	off, on	
blank	Retrace blanking	off, retrace	
mk_on	Marker on/off	on/off	[S]
analysr[8]	6500 on/off indicator	off, on	[D]
pwr_mtr[9]	6960 on/off indicator	off, on	[D]
counter[6]	2440 on/off indicator	off, on	[D]
plotter[5]	Plotter on/off indicator	off, on	[D]
mk_swp	Marker sweep	off, on	
altern	Alternate sweep select	off, man, auto	
man_alt	Alt. sweep indicator	current, memory	
vernier	Vernier select	off, on	
mk_ref	Reference marker	A,B,C,D,E	
mk_stp	Stop marker	A,B,C,D,E	
on/off	All markers on/off		[S]
s_swp	Initiate single sweep	ready, sweeping, inactive	

TABLE A-8 NON-NUMERIC 'ACTION PARAMETERS'

Name	Description	
init	Initiate private GPIB	[S]
cf=ref	Assign CF from reference marker	[S]
transfr	Make the current marker sweep permanent	[S]

Action parameters have no states. When a soft key assigned to one is pressed the appropriate action is initiated immediately.

Appendix B
SWEEPER MEMORY FACILITIES

TABLE B-1 Parameters not stored in the sweeper's memories and therefore not affected by recall operations.

Parameter	Description
H	Clock hours
M	Clock minutes
S	Clock seconds
OP_HRS	Total instrument operating hours
USR_HRS	User settable operating hours
CONTRST	LCD contrast
S_ADDR	System GPIB address
P_ADDR	Private GPIB address
RATE	Rotary control rate
LAST KEY	No. of last key pressed
analysr[8]	6500 on/off indicator
pwr_mtr[9]	6960 on/off indicator
counter[6]	2440 on/off indicator
plotter[5]	plotter on/off indicator

TABLE B-2 Parameters which are set to a default value whenever a memory recall operation occurs

Parameter	Default value
ALT_MEM	0 (current)
RAMP	0
OFFSET	0
LEVEL	0
SCALE	0
VERN	0
BAND	0
CONTROL	0
CNTRL_A	0
CNTRL_B	0
PRO G	0
mk_swp	off
altern	off
man_alt	current

TABLE B-3 Default settings of the 6310 contained in the PRESET instrument memory

Parameter	Value	Units
F1	2·0	GHz
F2	20·0	GHz
CF	11·0	GHz
△F	18·0	GHz
A	11·0	GHz
B	11·0	GHz
C	11·0	GHz
D	11·0	GHz
E	11·0	GHz
MK_FREQ	11·0	GHz
△	0	GHz
F△	500	MHz
AM_FREQ	1·0	kHz
P1 (dBm)	0	dBm
P2 (dBm)	0	dBm
P△	1·0	dB
SLP	0	dB/GHz
P1 (mW)	1·0	mW
P2 (mW)	1·0	mW
P△	1·0	mW
TIME	100	ms
T△	10	ms
INT	1	
ALT_MEM	0	
mks_on	–––––	(all markers off)

Diagnostic parameter	Value	Non-numeric parameter	State
RAMP	0	**cntr_tr**	off
OFFSET	0	**filter**	on
LEVEL	0	**swp_tr**	int
SCALE	0	**alc**	int
VERN	0	**sweep**	int
BAND	0	**am**	off
CONTROL	0	**blank**	retrace
CNTRL_A	0	**mk_swp**	off
CNTRL_B	0	**altern**	off
PROG	0	**man_alt**	current
		vernier	off
		mk_ref	A
		mk_stp	B
		s_swp	inactive

Note . . .

(1) The PRESET configuration is [F1–F2].

(2) When the PRESET memory is recalled, RF power is switched off.

Appendix C
COUNTER INTERFACE

USE OF COUNTER

A frequency counter such as the Marconi Instruments 2440 20 GHz Microwave Counter may be used with the sweeper operating in a swept frequency mode.

The **cntr_tr** non-numeric parameter (page 3-20) specifies the point at which the sweep will be halted temporarily for a frequency measurement to be made. This may be at F1, F2 or the reference marker frequency.

At the appropriate point in the sweep, the sweeper asserts the signal CTR TRIG L on pin 14 of the rear panel AUXILIARY FUNCTIONS connector. The forward sweep is halted for up to 40 μs, during which time the counter must respond by asserting STOP FWD SWP L (pin 1 of the AUXILIARY FUNCTIONS connector) to halt the forward sweep for as long as is necessary for the counter to perform a frequency measurement.

It should be noted that if a frequency reading is taken at the reference marker and the reference marker is **on** then the RF output at the marker frequency dips appreciably and the counter may have difficulty in acquiring a reading. It is therefore advisable to ensure that the reference marker is switched off during frequency measurements.

Internal amplitude modulation is disabled automatically while the counter is making a frequency measurement.

Marconi 20 GHz Microwave Counter 2440

Connect instruments as shown in the following diagram.

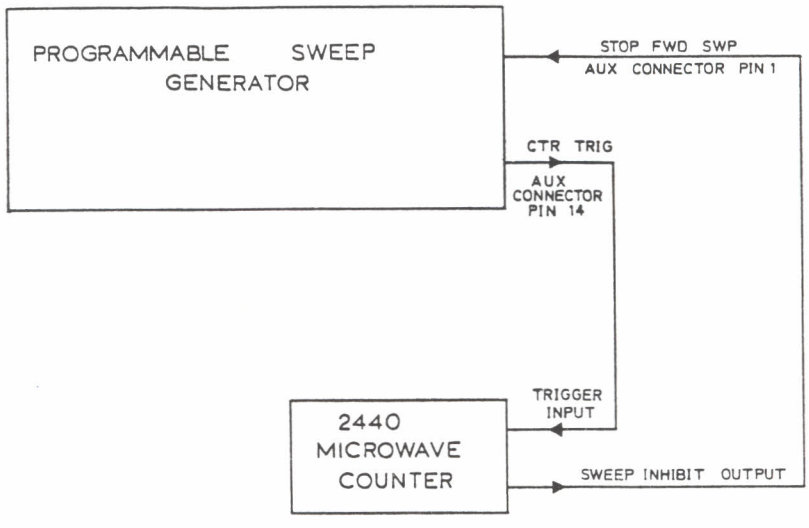


Fig. C-1 Connections to Marconi 2440 Counter

Set the 2440 to Test Mode B – External trigger mode by pressing its RESET key followed by the channel C selector button. The 2440 displays 'trig on' momentarily. Measurements are triggered by the negative-going CTR TRIG pulse from the sweeper. The external trigger mode may be switched off by repeating the above procedure.

Hewlett Packard 5343A Microwave Frequency Counter

Connect instruments as shown in the following diagram

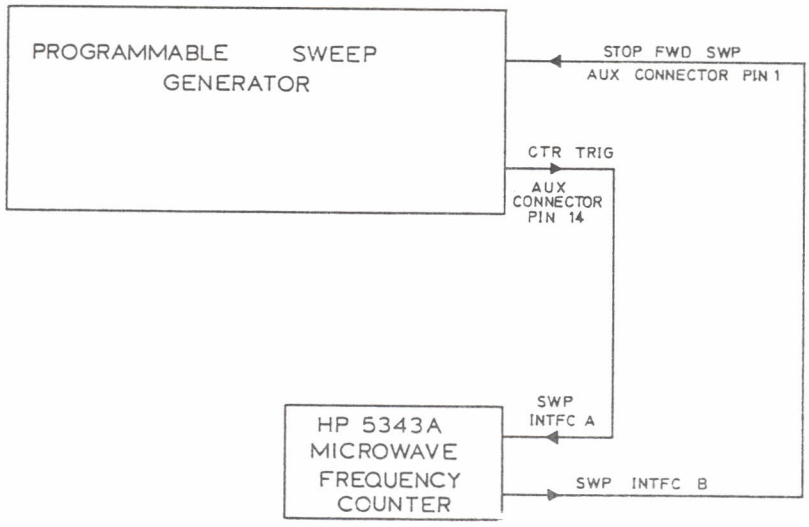


Fig. C-2 Connections to HP 5343A Counter

Set HP 5343A to AUTO, SWP M and set the desired frequency resolution. Set the ACQ TIME switch on the rear panel of the counter to MED.

Appendix D
SELF TEST

MEMORY TEST

At power-on or in response to selection of the [TEST] key, the sweeper performs a memory test to ensure the integrity of the data stored in the non-volatile memories. If all is well, the LCD displays the following message momentarily.

```
*** MEMORY TEST ***
[-------------------------------------]
NO FAULTS DETECTED
```

If the sweeper discovers that parts of the memory have been corrupted, a permanent message is displayed as shown below.

```
*** MEMORY TEST ***
[------FGHI-----------------a----f---]
 FAULT(S) DETECTED : REFER TO MANUAL.
PRESS ANY CONFIGURATION KEY TO CONTINUE
```

The sweeper's non-volatile memory is divided into a number of independent sections which, for convenience, are labelled with the alphabetic characters A to Z and a to i. The display shows which sections have been corrupted. In the above example faults have been discovered in sections F,G,H,I,a and f.

If a section of non-volatile memory is found to contain bad data, the sweeper attempts recovery action by overwriting the affected memory with suitable default data. This process is initiated when you press a configuration key such as [F1-F2].

The following table lists the memory sections and the default data employed for recovery. It should be noted that the design of the sweeper's non-volatile memories incorporates a number of measures to ensure integrity of the stored data. Persistent memory test failures should therefore be regarded as indicating a hardware fault which should be referred to your nearest Marconi Instruments service centre.

TABLE D-1 Memory sections and default data

Section	Description	Default
A	Programmable key configurations	[F1-F2] configuration
B	User defined LCD characters	Block characters
C	OP_HRS, USER_HRS and cal. times	0 hours
D	GPIB addresses	System 19, Private 18
E	Instrument power up state	PRESET
F	Memory 1	PRESET
G	Memory 2	PRESET
H	Memory 3	PRESET
I	Memory 4	PRESET
J	Memory 5	PRESET
K	Memory 6	PRESET
L	Memory 7	PRESET
M	Memory 8	PRESET
N	Memory 9	PRESET
O	Memory 10	PRESET
P	Memory 11	PRESET
Q	Memory 12	PRESET
R	Memory 13	PRESET
S	Memory 14	PRESET
T	Memory 15	PRESET
U	Memory 16	PRESET
V	Memory 17	PRESET
W	Memory 18	PRESET
X	Memory 19	PRESET
Y	Memory 20	PRESET
Z	Power down state	PRESET
a	6500 Analyser instrument settings	6500 Power on state
b	Primary Cal (CMOS RAM)	Primary cal EEPROM
c	User Cal 1	Primary cal EEPROM
d	User Cal 2	Primary cal EEPROM
e	6910 Sensor data	Default sensor data
f	Primary Cal (EEPROM)	Approximate cal data
g	Calibration ID numbers	0
h	Sweeper serial number	0
i	Yig lag correction constants	0

Appendix E
ERROR MESSAGES

Error messages are displayed momentarily on the sweeper's LCD.

★ ERROR 1 ★
NUMERIC ENTRY OVERFLOW

Entered number exceeds 214783647 during front panel numeric entry. The parameter value remains unchanged.

★ ERROR 2 ★
NO ROOM TO INSERT PARAMETER

When using the User Key Programmer display editor, this error occurs if an attempt is made to insert a parameter which would overwrite an existing parameter or overflow the edge of the LCD.

★ ERROR 3 ★
MAXIMUM NUMBER OF PARAMETERS EXCEEDED

When using the User Key Programmer display editor, this error occurs if an attempt is made to insert more than eleven parameters on the LCD.

★ WARNING 4 ★
POWER SUPPLY OVERHEATING

Ensure ventilation slots are clear of obstructions and that rear panel filter is clean. If warning persists, switch off and refer to service engineer.

★ LIMIT ★

Indicates attempt to set value of parameter outside its specified limits. Parameter is set automatically to the nearest permitted value (i.e. its maximum or minimum value, as appropriate).

★ ERROR 6 ★
EXTERNAL SWEEP CURRENTLY SELECTED

When external sweep is selected (e.g. for use with a 6500 Automatic Amplitude Analyser) it is not possible to change the values of certain non-numeric parameters.

These are:	cntr_tr	(must be 'off')
	swp_tr	(must be 'int')
	altern	(must be 'off' or 'man')

★ ERROR 7 ★
COUNTER TRIGGER CURRENTLY SELECTED

It is not permitted to select external sweep when counter trigger is enabled.

⋆ ERROR 8 ⋆
INTERNAL TRIGGER NOT SELECTED

It is not permitted to select external sweep unless internal sweep triggering is enabled.

⋆ ERROR 9 ⋆
ALTERNATE SWEEP CURRENTLY SELECTED

It is not permitted to select external sweep when the alternate sweep parameter, altern is set to 'auto'.

ERRORS 11 to 19 are related to GPIB operation. Refer to the GPIB operating manual.

⋆ ERROR 20 ⋆
CANNOT OVERWRITE PRESET SETTINGS

It is not possible to write instrument settings to the PRESET memory.

⋆ ERROR 21 ⋆
CORRUPT DATA : PRESET SETTINGS RECALLED

Data stored in the instrument's non-volatile memory has been corrupted. The sweeper attempts recovery action by over-writing the damaged memory with PRESET settings. If this error persists, refer to service engineer.

⋆ ERROR 22 ⋆
CANNOT INTERPOLATE 6500 MEMORY

Interpolation of 6500 channel memory contents has failed for one or more of the following reasons.

i) The sweeper mode has changed

ii) Current F1 < Stored F1

iii) Current F2 > Stored F2

⋆ ERROR 23 ⋆
MARKER SWEEP CURRENTLY SELECTED

It is not permitted to change a frequency parameter (F1, F2, CF, DF) while marker sweep is selected.

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