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1253A

Gain-Phase Analyzer

OPERATING MANUAL

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1253A

GAIN-PHASE ANALYZER

OPERATING MANUAL

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Solartron Analytical
5 Ashville Way, Molly Millars Lane,
Wokingham, Berkshire, RG41 2PL, UK
Tel +44 (0) 1252 556 800
E-mail parsolsr.support@ametek.com

Web: http://www.ameteksi.com

For details of our agents in other countries, please contact our UK office.

solartron
analytical

Solartron Analytical
5 Ashville Way, Molly Millars Lane,
Wokingham, Berkshire, RG41 2PL, UK
Tel +44 (0) 1252 556 800

DECLARATION OF CONFORMITY

CE

The directives covered by this declaration

73/23/EEC Low voltage Equipment Directive, amended by 93/68/EEC

89/336/EEC Electromagnetic Compatibility Directive, amended by 92/31/EEC & 93/68/EEC

Product(s)

1253A Gain-Phase Analyzer

Basis on which conformity is being declared

The product(s) identified above comply with the requirements of the EU directives by meeting the following standards:

EN50081-1:1992	Electromagnetic Compatibility – Generic Emission Standard Part 1:Residential, commercial and light industry.
EN50082-1:1992	Electromagnetic Compatibility – Generic Immunity Standard Part 1:Residential, commercial and light industry.
EN61010-1:1993	Safety requirements for electrical equipment for measurement, control and laboratory use.

Accordingly the CE mark has been applied to this product.

Signed

For and on behalf of Solartron Analytical, a division of Solartron Group Limited

Authority: **Engineering Manager**

Date: **December 1995**

GENERAL SAFETY PRECAUTIONS

The equipment described in this manual has been designed in accordance with EN61010 "Safety requirements for electrical equipment for measurement, control and laboratory use", and has been supplied in a safe condition. The equipment is intended for electrical measurements only. It should be used for no other purpose.

To avoid injury to an operator or service technician the safety precautions given below, and throughout the manual, must be strictly adhered to, whenever the equipment is operated, serviced or repaired. For specific safety details, please refer to the relevant sections within the manual.

Solartron accept no responsibility for accidents or damage resulting from any failure to comply with these precautions.

GROUNDING
To minimise the hazard of electrical shock, it is essential that the equipment be connected to a protective ground through the ac supply cable. The continuity of the ground connection should be checked periodically.

AC SUPPLY VOLTAGE
Never operate the equipment from a line voltage or frequency in excess of that specified. Otherwise, the insulation of internal components may break down and cause excessive leakage currents.

FUSES
Before switching on the equipment, you should check that fuses of the correct rating are fitted. The rating of the ac line fuse must accord with the voltage of the ac supply.

The fuses are accessible from the exterior of the equipment. Should any fuse continually blow, do not insert a fuse of a higher rating. Switch the equipment off, clearly label it "unserviceable" and inform a service technician.

EXPLOSIVE ATMOSPHERES
YOU MUST NEVER operate the equipment, or any sensors connected to the equipment, in a potentially explosive atmosphere. The equipment is NOT intrinsically safe and you could possibly cause an explosion.

SAFETY SYMBOL
For the guidance and protection of the user, the following safety symbol appear on the equipment:

Symbol	***Meaning***
	Refer to user guide for detailed instructions of use. In particular, note the maximum voltage permissible at the input sockets as detailed in the Specification.

Continued overleaf.

General Safety Precautions (*continued from previous page*)

NOTES, CAUTIONS AND WARNINGS

For the guidance and protection of the user, **Notes**, **Cautions** and **Warnings** appear throughout the manual. The significance of these is as follows:

NOTES	highlight important information for the reader's special attention.
CAUTIONS	guide the reader in avoiding damage to the equipment.
WARNINGS	guide the reader in avoiding a hazard that could cause injury or death.

AVOID UNSAFE EQUIPMENT

The equipment may be unsafe if any of the following statements apply:

- Equipment shows visible damage.
- Equipment has failed to perform an intended operation.
- Equipment has been stored in unfavourable conditions.
- Equipment has been subjected to severe physical stress.

If in any doubt as to the serviceability of the equipment, don't use it. Get it properly checked out by a qualified service technician.

LIVE CONDUCTORS

When the equipment is connected to its measurement inputs or supply, the opening of covers or removal of parts could expose live conductors. The equipment must be disconnected from all power and signal sources, before it is opened for any adjustment, replacement, maintenance or repair. Only qualified personnel, who should refer to the relevant maintenance documentation, must do adjustments, maintenance or repair.

EQUIPMENT MODIFICATION

To avoid introducing safety hazards, never install non-standard parts in the equipment, or make any unauthorised modification. To maintain safety, always return the equipment to Solartron for service and repair.

Contents

Chapter 1
Introduction

1 GENERAL

The 1253 Gain-Phase Analyzer stimulates a system and measures its frequency response

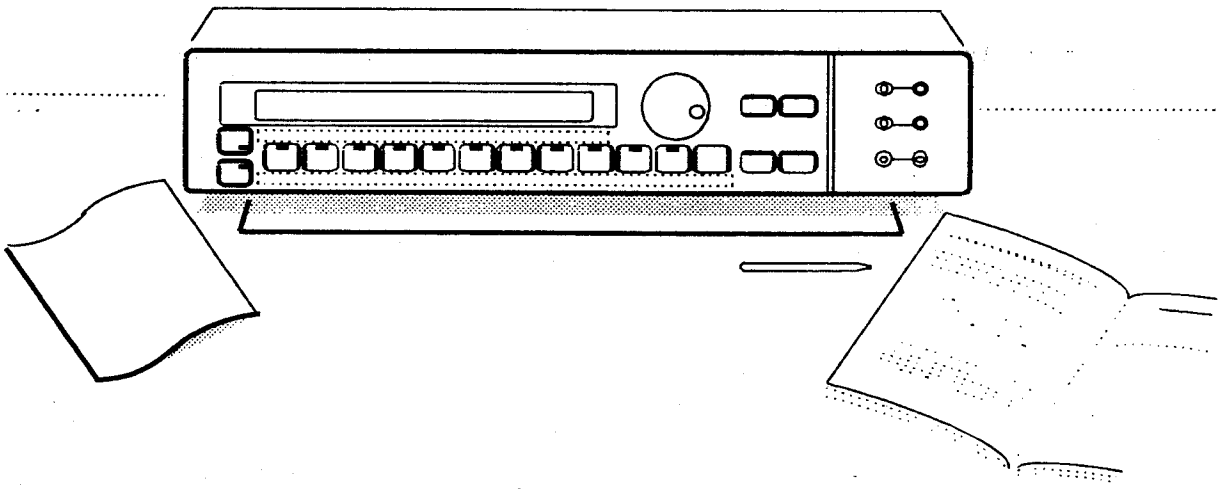


Fig. 1.1 *The 1253*

Full details of all 1253 facilities are given in this operating manual.

The 1253 is controlled via a menu system. A quick reference guide to the menus available is provided on a blue pull-out card. First time users are directed to the 'getting started' practical examples in Chapter 3.

2 INSTRUMENT ESSENTIALS

The three main components of the 1253 are:

(1) **The Generator**, used to produce sine waves for stimulating the system under test.

(2) **Two Analyzer Channels,** each of which is used to measure the response to the stimulus at different points in the system .

(3) **The Display**, used for menus and results (both gain and phase displayed simultaneously).

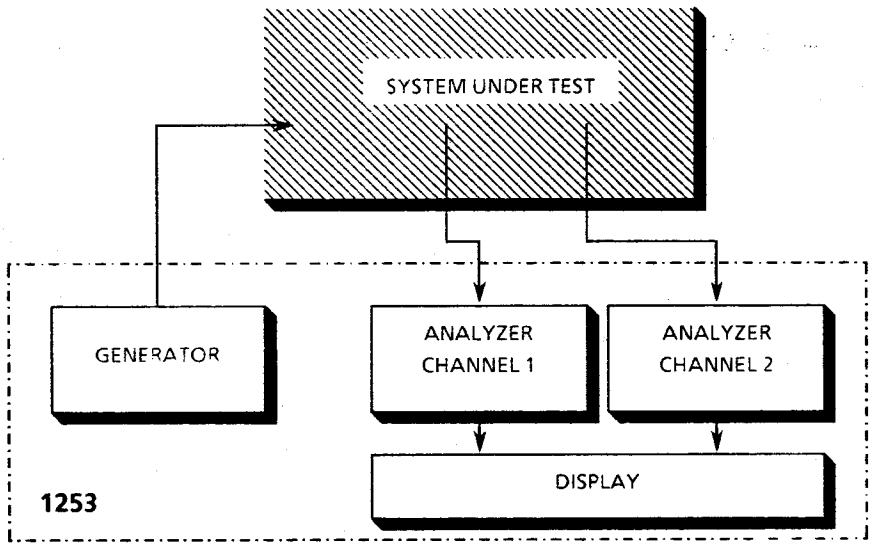


Fig. 1.2 *Instrument Essentials*

3 FACILITIES

- LED annunciated keyboard with bright 40-character vacuum fluorescent display
- Menu-driven hardware and processing control
- Learnt program facility
- Battery maintained memory, capable of storing learnt progra ms and menu settings for typically 1000 hours, with no mains power supply, at 20°C. This could be reduced at higher temperatures.
- Comprehensive self-test routines
- History file
- Comprehensive plotting facilities
- GPIB interface for remote control or driving external devices (plotters, printers etc.)
- RS423 interface for driving an external printer
- Mathematical processing and manipulation of data including display of results in Cartesian, polar or log polar form
- Synchronizer, used where the 1253 cannot stimulate the system under test. Instead, the reference signal used by the analyzer channels is synchronized to a suitable signal already in the system.
- Modulator/Demodulator, for making measurements on ac carrier systems

Chapter 2
Installation

1 ACCESSORIES

The 1253 accessories are supplied with the instrument. They comprise:

a. 2 fuses, 20mm × 5mm, T1.6A, for 220V or 240V supplies
b. 2 fuses, 20mm × 5mm, T3.15A, for 100V or 120V supplies
c. 4 fuses, 20mm × 5mm, 400mA, for the Generator output
d. 2 rack mounting brackets
e. 1 slide mounting bar, for telescopic slide rack mounting
f 4 screws, M4 × 12 countersunk, to fix item e
g. 3 twin 4mm to 4mm connecting leads for front panel connections

An ac supply lead, appropriate to the destination country, is packed with the instrument. If ordered with the 1253, a telescopic rack slide mounting kit (option 12535B) is also packed.

2 SAFETY

The 1253 is designed in accordance with the EN61010, 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use', and is supplied in a safe condition. This operating manual contains information and warnings that must be followed by the user to ensure safe operation and to keep the equipment in a safe condition.

The operating instructions include safety precautions where appropriate, but the principal ones are also listed below.

2.1 GENERAL SAFETY PRECAUTIONS

1. Before switching on, ensure that the mains lead is connected to the ac supply in accordance with the colour code.

2. Ensure that the mains voltage selector is correctly set.

3. Ensure that the mains plug is connected only to a mains outlet that has a protective earth (ground) contact. This applies equally if an extension lead is used: the lead must contain an earth conductor.

4. To effect earthing, the mains plug must he inserted before connections are made to measuring and control circuits. The mains plug or external earth (as appropriate) must remain connected until all measuring and control circuits have been disconnected.

5. Any interruption of the earth connection (inside or outside the 1253) is prohibited.

6. When the 1253 is connected to the ac supply, the opening of covers or removal of parts could expose live conductors. The 1253 should be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair. The user should not attempt adjustments, maintenance or repair of the 1253 when it is powered. If repairs are necessary, consult a Solartron Service Centre.

7. Ensure that fuses of the correct rating and of the specified type are fitted. Makeshift fuses, and short-circuiting of fuse holders, is prohibited.

8. Whenever it is likely that the safety of the 1253 has been impaired, it should be made inoperative and secured against any unintended operation. Safety could be impaired if the 1253:

   a. shows visible damage

   b. fails to perform intended measurements

   c. has been subjected to prolonged storage under unfavourable conditions

   d. has been subjected to severe transport stress.

9. The 'Δ' and '!' symbols on the 1253 mean 'Refer to Operating Manual' for detailed instructions or safety precautions. See Chapter 6 for further details.

   In particular note that the outer connections to the rear panel BNC plugs are **not** grounded. Always take care to ensure that no hazardous voltages are present on the connecting leads when plugging or unplugging them - always switch off all power to the system under test before disconnecting the leads.

2.2 EARTHING

For reasons of safety an earth connection is essential whenever measurement and control circuits are connected, even if the 1253 is switched off. The instrument is earthed by connecting it to a mains outlet or other suitable earthing point. This earth should be capable of carrying 25A and conform to the regulation in 'British Standard Code of Practice CP1013 1965, Earthing'.

3 ELECTROMAGNETIC COMPATIBILITY

When used as described in the manual, with the connecting leads supplied by Solartron, the instrument meets the requirement of the EMC Directive. (See Specification in Chapter 12.) If any other leads are used, the instrument may not remain compliant. If the 1253 needs to be repaired, any replacement components must be of the correct type (see the Maintenance Manual).

For best EMC compliancy, all connecting cables should be screened, with the screens properly connected to the ground terminal on the rear panel of the instrument.

4 CONNECTING THE AC MAINS

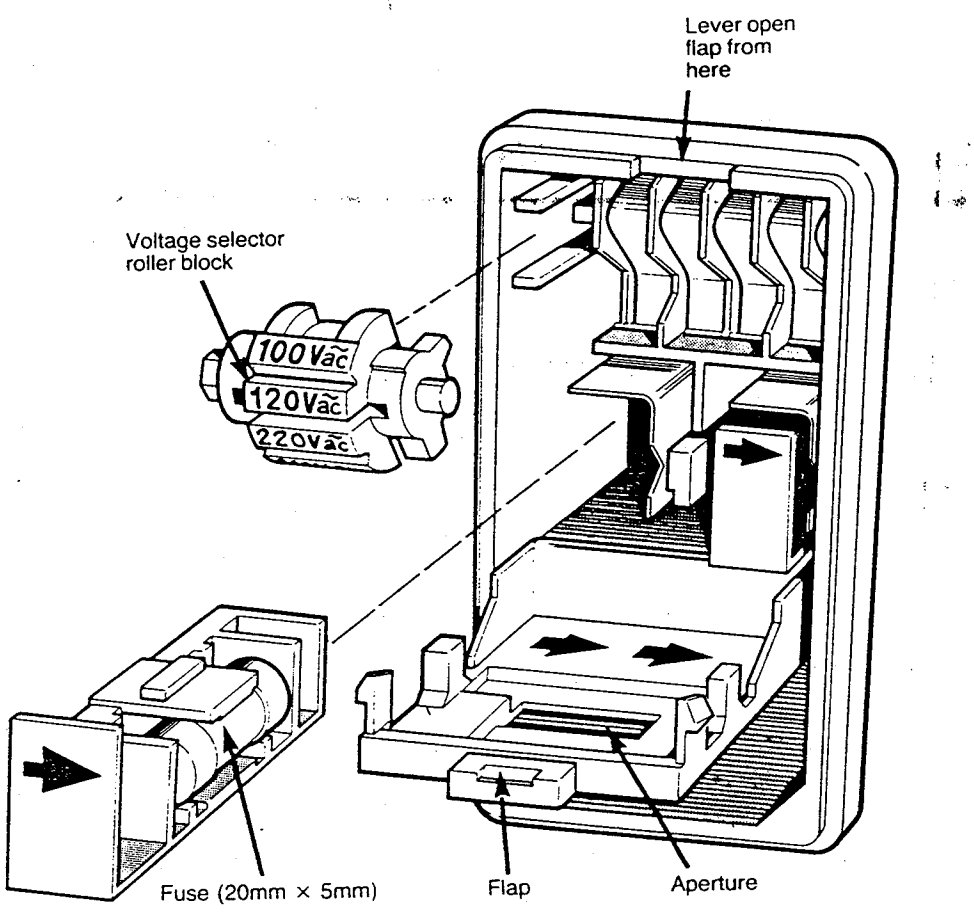


Fig. 2.1 *Mains input unit*

The 1253 is fitted with a mains unit (Fig.2 1) containing two mains fuses, and a voltage selector. These items cannot be accessed until the mains connector has been unplugged from the unit.

4.1 VOLTAGE SELECTOR

The following table gives the correct selector setting for different mains voltage ranges (nominal 50Hz or 60Hz):

Mains Voltage Variation Range	Voltage Selector Setting Required
90 - 110V	100V
108 - 132V	120V
198 - 242V	220V
216 - 264V	240V

In cases of doubt, set the voltage selector to the lower of the two closest possible values to ensure that all 1253 internal voltage levels are fully attained.

To change the selected voltage:

1. Unplug the mains connector from the unit.

2. Lever the hinged flap open with a screwdriver and lift out the voltage selector roller block.

3. Refit the block with the chosen voltage value facing outwards.

4. Check that the fuses fitted are of the correct value (Section 4.2 below) and, if necessary, change them.

5. Close the flap securely, checking that the correct value shows through the aperture.

6. Plug in the mains connector again.

4.2 MAINS FUSES

Live and Neutral are both fused in the 1253. Fig. 2.1 shows how these fuses are accessed, after the mains connector has been unplugged. The arrowheads marked on each fuseholder must align with those on the flap when the fuseholders are refitted.

The fuse values are:

T1.6A, for 220V or 240V setting

T3.15A, for 100V or 120V setting

Replacement fuses must be 20mm × 5mm cartridge type.

4.3 MAINS LEAD

An ac mains connector lead, complete with a mating socket for the IEC plug on the 1253 mains input unit, is supplied appropriate to the destination country.

This lead should be connected to the user's ac supply according to the following colour code:

BROWN	=LIVE
BLUE	=NEUTRAL
GREEN/YELLOW	=EARTH

An IEC socket and lead other than the one supplied may be used, but it must be correctly wired as shown in Fig 2.2.

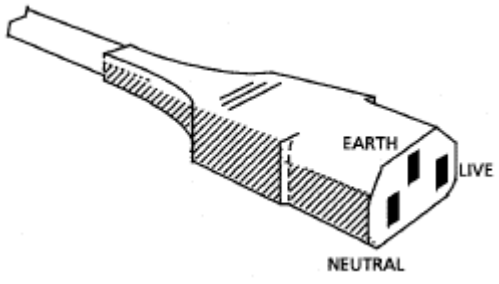


Fig 2.2 *IEC power socket connections.*

4.4 CONNECTION PROCEDURE

1. Before connecting the supply, ensure that the mains voltage selector on the rear panel is correctly set (Section 4.1), and that the fuses fitted in the mains input unit are correctly rated (Section 4.2).

2. Ensure that the power on/off switch is 'off'. This switch is located next to the mains input unit on the rear panel.

3. Connect the mains lead.

4. Switch the 1253 'on' at the rear panel.

5 REPLACING GENERATOR FUSES

Two 400mA fuses protect the 1253 Generator, one in series with the Hi output and one in series with the Lo. If the Generator appears to be inoperative, before inspecting or replacing these fuses, check the following points:

a. Is the Generator 'on'? If not, press SINGLE or RECYCLE.

b. Are all connections with the system under test OK?

c. Is the Generator menu set correctly, with the Amplitude parameter non-zero? Refer to Chapters 3 and 5 for procedure.

d. Is the START/STOP input on the rear panel being held low?

e. Disconnect the 1253 from the system under test. Set up a measurement and confirm the Generator is inoperative by monitoring the output with an oscilloscope or suitable voltmeter.

If none of these indicate a problem external to the Generator then one or more of the Generator fuses may have failed. This may be because the Generator output has been subjected to a large external voltage in the system under test. Refer to Chapter 12: Specifications, for Generator capabilities.

To replace or inspect the fuses follow the procedure described in Section 4.1.

5.1 TOP COVER REMOVAL

Before proceeding any further, disconnect both the mains power supply and all connections to the system under test.

a. Remove the 1253 from its racking (if fitted).

b. Remove the finishers and left hand side trim as indicated in Fig. 2.3. If a rack mounting kit is fitted only the rack ears need be removed.

c. Remove the 2 cover retaining screws at the back of the top cover, slide the cover backwards and remove.

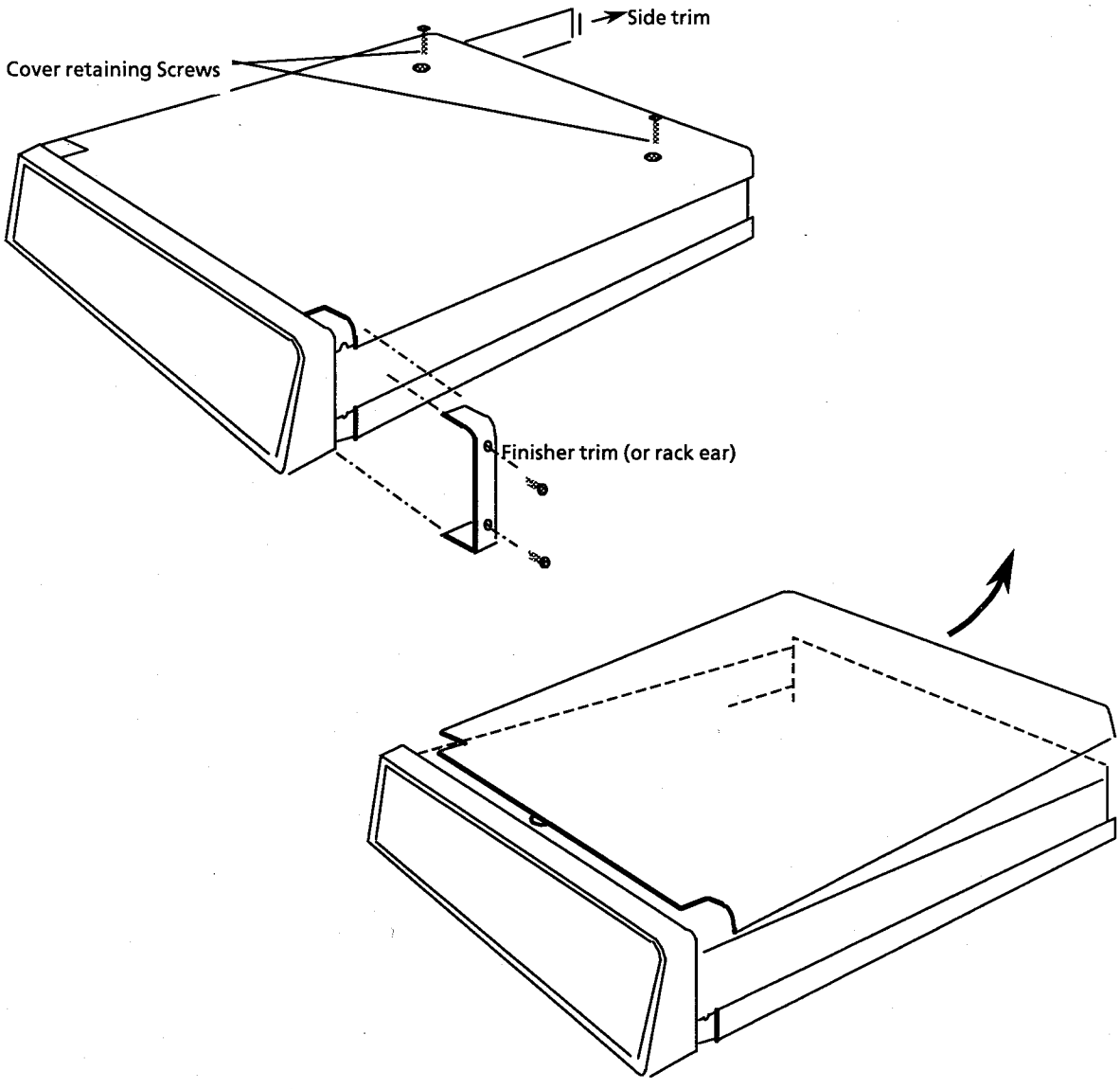


Fig. 2.3 *Top Cover Removal*

5.2 FUSE REPLACEMENT

Fuse positions are indicated in Fig. 2.4. Remove each fuse for inspection and replacement as necessary. Replacement fuses should be 20mm x 5mm, 400 mA cartridge types.

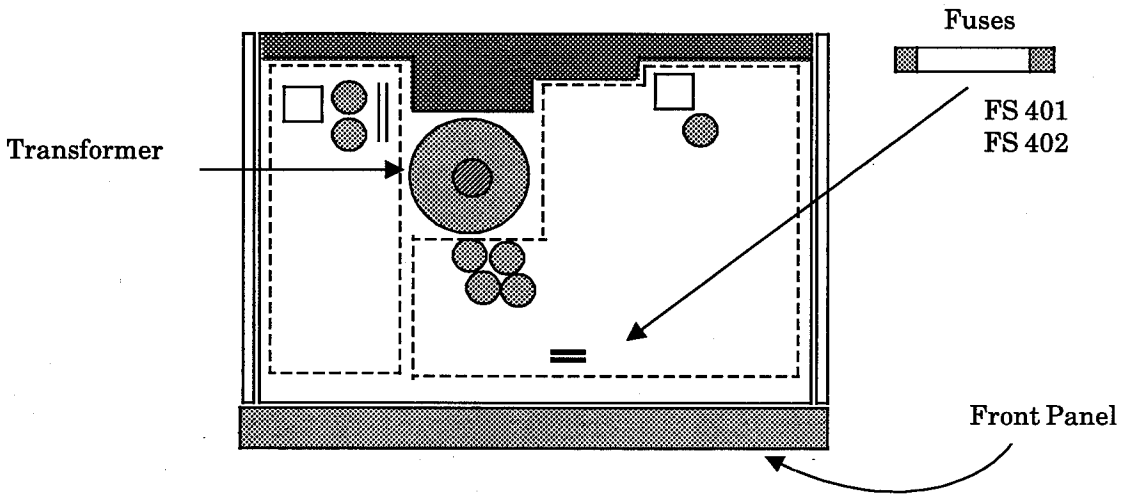


Fig. 2.4 *Generator Fuse Replacement*

Top cover replacement and refitting is a straightforward reversal of the removal procedure.

6 RACK MOUNTING

The 1253 can be rack mounted in two ways: either by using fixed rails in the rack to support the underside of the case, or by using telescopic slides to support the 1253 and allow easy withdrawal for servicing.

With either method, the pair of rack mounting ears included in the accessory kit is substituted for the finisher trims on the 1253. Screws inserted through the ears and into the rack keep the unit in place.

Note 1: The rack mounting ears must be used only to prevent the 1253 sliding out of the rack. They are not designed to support the whole weight of the instrument.

Note 2: When the 1253 is rack mounted on telescopic slides, ensure that the rack will not tip over when the slides are fully extended.

6.1 TELESCOPIC SLIDE MOUNTING KIT 12535B ACCURIDE, U.K.9

This slide mounting kit is available from Solartron as an optional accessory, and contains:

a. 1 telescopic slide kit, plus fixings
b. 12 screws, M4x6 panhead, to fix slide inner members to the mounting bars
c. 12 washers, M4 crinkle
d. 2 screws, M6 satin chrome, to fix front panel to rack
e. 2 washers, M6 plain
f. 2 caged nuts, M6, to fix front panel to rack

The kit is suitable only for 30 inch deep IMHOF IMRAK Series 80 or dimensionally similar cabinets.

6.2 RACK DIMENSIONS

The internal rack dimensions required for fitting the 1253 are:

610mm (24ins) deep x 485mm (19 ins) wide for fixed rail mounting, and

760mm (30 ins) deep x 485mm (19 ins) wide for telescopic slide mounting.

6.3 VENTILATION

In the 1253, warm air is expelled through the centre of the rear panel by a fan, and replacement cool air is drawn in through slots under the front panel.

Ensure that the rack in which a 1253 is mounted, and any adjacent racked instruments, do not block these two airways. If fitted, front doors on the rack must have vent holes.

6.4 FITTING TELESCOPIC SLIDE MOUNTING KIT 12535B

6.4.1 Remove the following items from the unit, as shown in Fig. 2.5:

a. **Finisher Trim** (two off)
Keep the four M4x16 panhead screws and M4 crinkle washers for securing the rack ears.

b. **Handle** and **Handle Trim**

c. **Side Trim**
Located on the opposite side to the handle, it is normally secured by a pip on the finisher trim, and slides out backwards.

d. **Feet** (four off) and **Tilt Bar**
The tilt bar is secured by the two front feet.

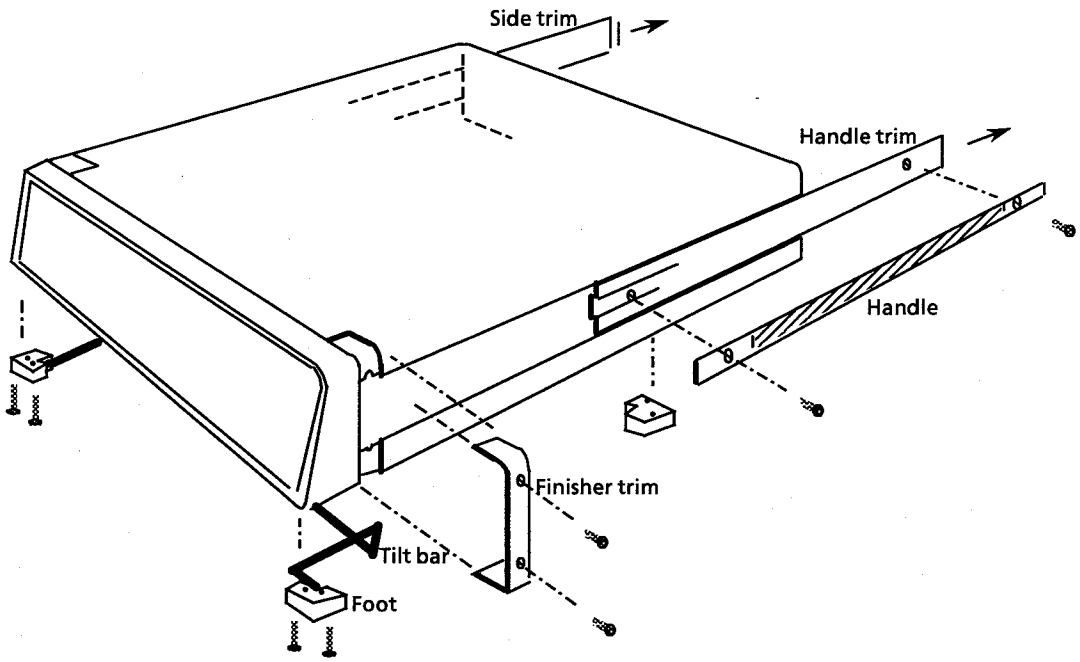


Fig. 2.5 *Removal of trims, handle, feet and tilt bar*

6.4.2 Fit the following items to the unit, as shown in Fig. 2.6:

a. **Rack Ears** (two off)
Fit rack ears in place of the finisher trim, using the same fixings.

The ears may be fitted as illustrated, or with their flanges facing the rear of the 1253, which causes the unit to stand out further in the rack, allowing use of racks too shallow for normal mounting.

b. **Slide Mounting Bar**
The slide mounting bar and fittings are provided with the 1253 accessories. Screw the bar to the chassis in the former position of the handle, using the four M4x12 countersunk screws provided. The bar fits correctly only one way round, with threaded holes nearest the front.

The corresponding mounting bar on the left-hand side of the unit is supplied already fitted behind the side trim; it is slightly narrower than the right-hand bar.

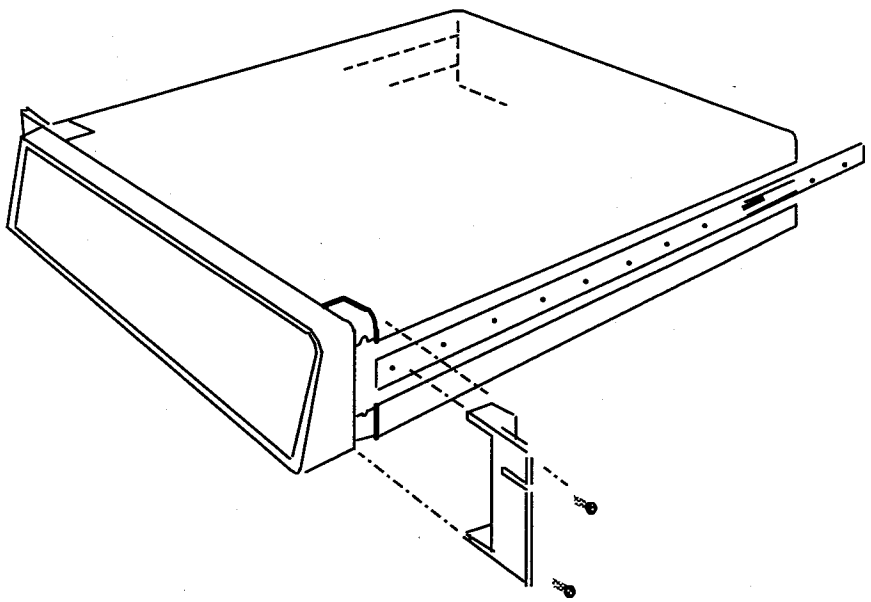


Fig. 2.6 *Fitting rack ears and telescopic slide inner members*

c. **Telescopic Slide Inner Members** (two off)
The telescopic slides are supplied with inner and outer members slotted together. Slide out the inner member as shown in Fig. 2.7, depressing the locking catch at the halfway point.

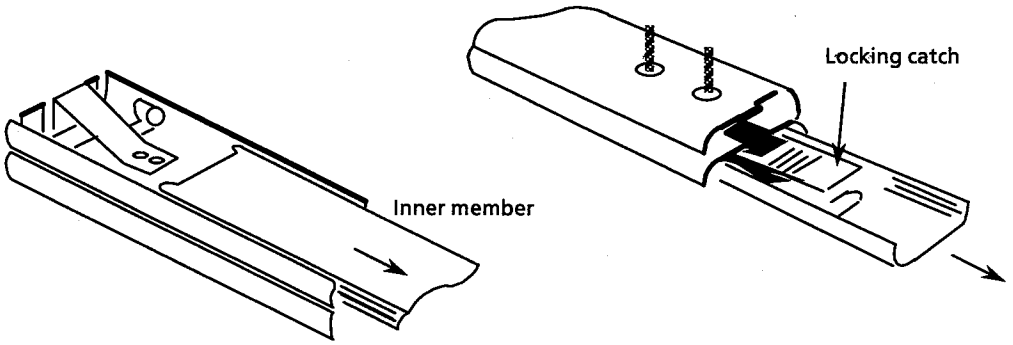


Fig. 2.7 *Separating the inner and outer slide members, prior to fixing*

Screw the slide inner members to the mounting bars, using the 12 M4 x 6 panhead screws supplied, 6 each side.

6.4.3 Fit the following items to the telescopic slide outer members, as shown in Figs. 2.8 and 2.9:

a. **Adjustable Rear Brackets** (two off)
Fit one rear bracket to each outer member, but do not fully tighten the screws until the 1253 is fitted into the rack (Section 5.4.6).

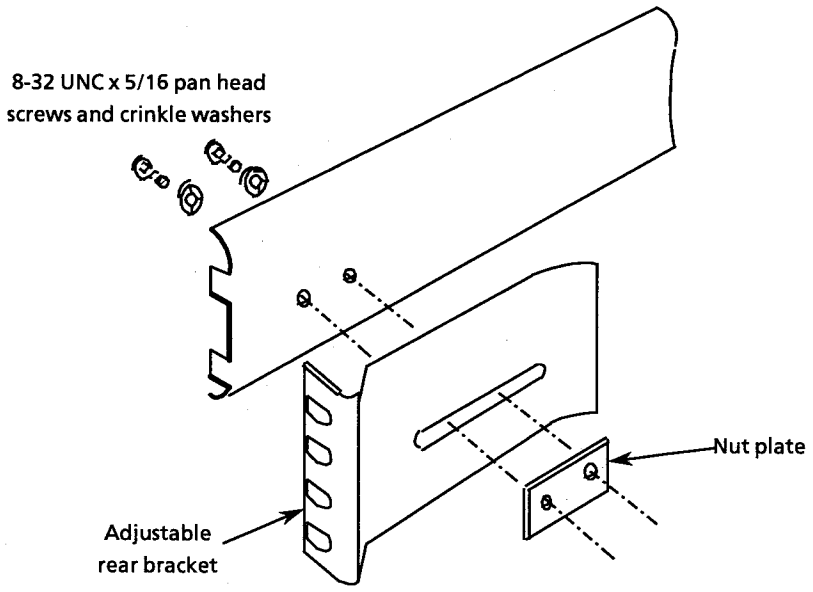


Fig. 2.8 *Fitting a rear bracket*

b. **Fixed Front Brackets** together with **Support Brackets** (two off each).

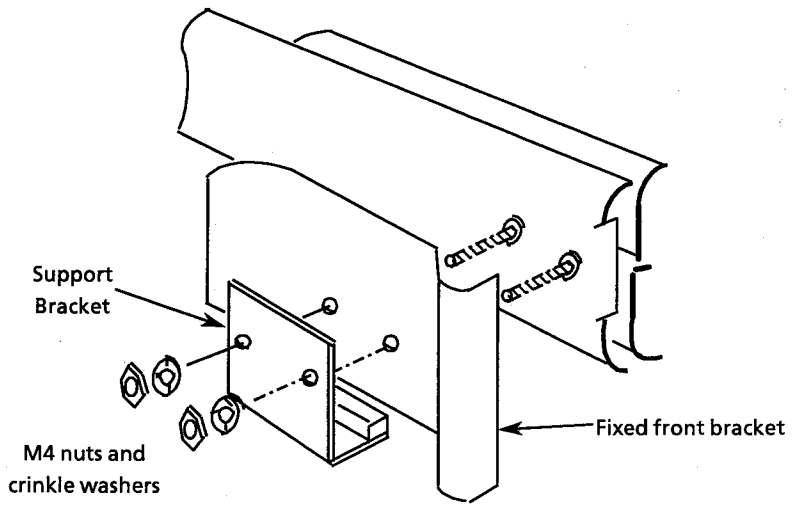


Fig. 2.9 *Fitting a front bracket and support bracket*

6.4.4 Fit the M6 caged nuts for outer slide member , rack slide member, and rack ear fixing into the rack, in the positions shown in Fig. 2.10. How to insert and remove caged nuts is shown in the figure detail.

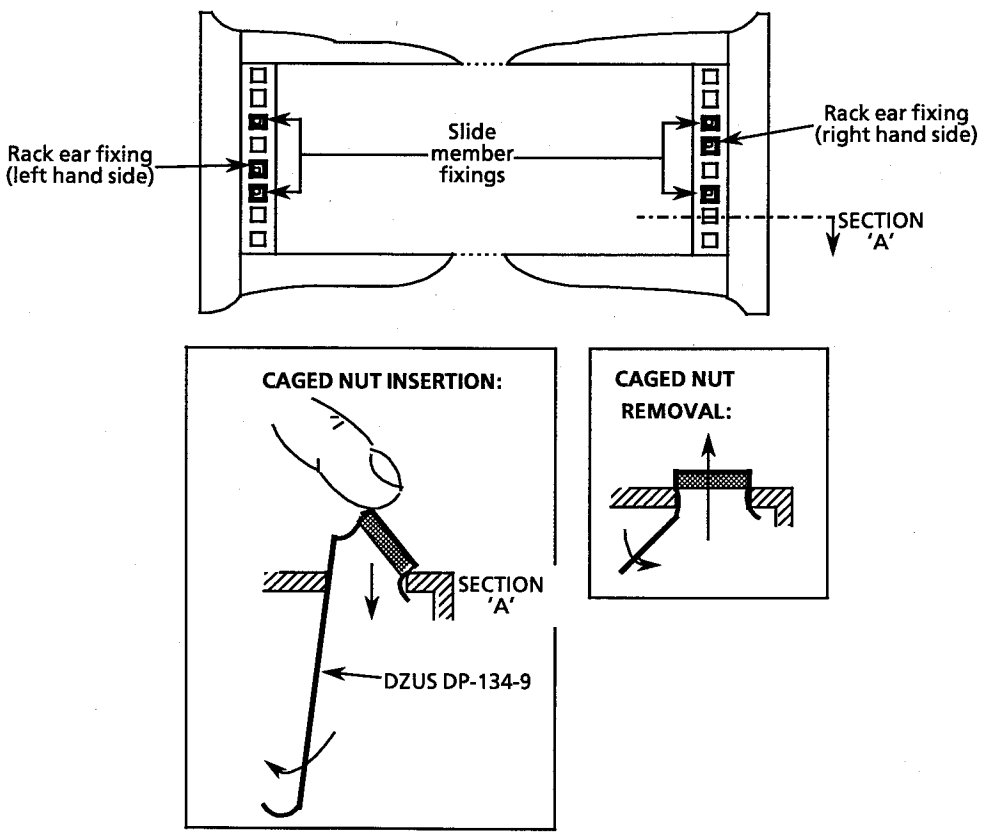


Fig. 2.10 *Caged nut insertion in Imrak Series 80 (and similar) cabinets*

6.4.5 Fit the **Outer Slide Members** (two off) to the rack as shown in Fig. 2.11.

Note that the tapped holes in the nut plate are positioned off-centre in order to provide maximum lateral adjustment. Fit the plates, as shown, with the holes offset towards the rack exterior.

Fitting one end of an outer member is made easier if the other end is supported, by hooking the bracket at the other end over an M5 screw pushed into the top caged nut.

Tighten the M5 screws securing each member until it is held moderately firmly in the rack, approximately in the centre of its travel. The members must, however, be free enough to take up any adjustment when the 1253 is first fitted into the rack.

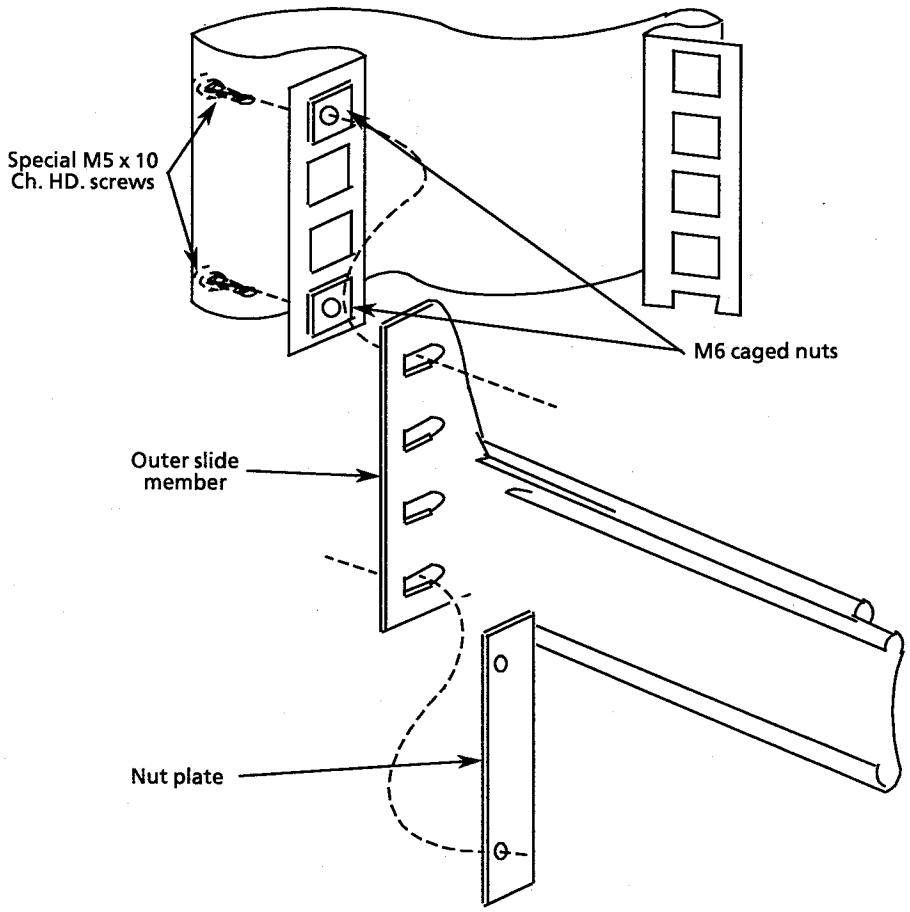


Fig. 2.11 *Fitting the outer slide members into the rack*

6.4.6 Finally, fit the 1253 into the rack, as follows:

a. Offer the 1253 up to the rack and feed the inner telescopic slide members into the outer members, pushing the unit into the rack until the locking catches engage and lock.

b. Depress both catches and push the unit fully into the rack, ensuring that no cables are trapped.

c. Tighten the screws on the outer slide members in the following order:

1. the M5 screws securing the rear bracket to the rack,

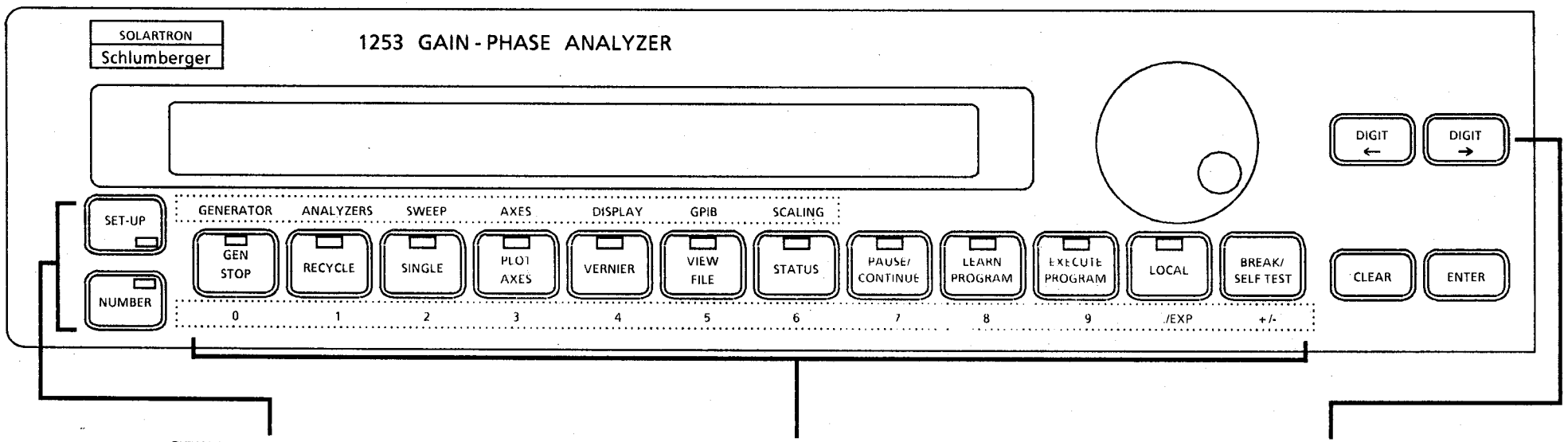
2. the M5 screws securing the front bracket to the rack,

3. the 8-32 UNC screws securing the rear bracket to the outer slide member.

Chapter 3
Getting Started

1 1253 KEYBOARD

There are three main groups of keys on the 1253 front panel:



SHIFT KEYS

These have a push-for-on (LED flashing), push-for-off (LED off) action. The shift keys alter the functions of the main keys to provide 3 front panel modes:

Normal Mode: with both shift keys 'off', the main keys act according to the label on each key face and are referred to as 'action keys'.
Menu Set-Up Mode: with the SETUP key'on' the main keys act according to the label above each key, allowing the user to select and set-up each menu.
Number Entry Mode: with the NUMBER key 'on' the main keys act as a number keypad according to the label below each key.

MAIN KEYS

These keys, operated in 'normal mode' (see SHIFT KEYS), have a push-for-on (LED on) action. The action will remain on until completed, or until some other action turns it off. A flashing LED indicates that the key operation is temporarily suspended (by another action for instance).

DIGIT KEYS / FRONT PANEL KNOB

The DIGIT keys are used to move the display cursors. They step once per press, but auto-repeat when held down.

The front panel knob :-

(i) Varies the number over the display cursor
(ii) Steps through [ ] bracket menu selections.

CLEAR is used to erase mis-keyed numeric entries and allow them to be re-keyed.

ENTER activates selected menu selections or menu parameter values, at the same time cancelling 'number entry' mode, if selected.

2 NORMAL MODE OPERATIONS

2.1 POWER-UP MESSAGES

"**POWER RESTORED**," indicates the 1253 unit has correctly remembered all existing menu settings, History File and Learnt Programs, after a mains supply interruption.

"**RESET**" indicates the 1253 has returned all menu settings to the default state, but left the History File and Learnt Programs as they were.

This happens if the 1253 unit detects a fault in its database {existing menu settings). This may occur (for example) if the unit has been without power for more than 1000hours, but not long enough to corrupt the history file and learnt programs 1 to 9. 1000hours is the time for which the internal battery is guaranteed to maintain the memory.

"**INITIALISED**" indicates menu settings have been returned to the default state, and the History File and battery maintained Learnt Programs (numbers 1 to 9) have been erased. This occurs if the 1253 unit has been switched off much longer than 1000 hours. Refer to Chapter 4, 1253 Menu Summary, for default values and parameter lists.

"**READY**" is displayed if the 1253 is no longer reset or initialised, but still has no measurement readings to display.

2.2 DISPLAY

In normal mode the display shows measurements as selected by the relevant menus. A measurement can be displayed, for instance, as:

1.106kHz +4.2172E+01 @ –3.65 deg

This is the default type of display, and shows a measurement frequency of 1.106kHz, a gain of 42.172 and a phase shift of –3.65 degrees.

To vary the content and convention of the display use the DISPLAY menu.

2.3 USING THE ACTION KEYS

Refer to the action key part of the menu summary (Chapter 4, Menu Summary).

Direct Acting Keys

Most of the action keys perform an immediate function, e.g. GEN STOP stops the Generator.

Indirect Acting keys

Some action keys (VIEW FILE, LEARN PROGRAM, and BREAK/SELF TEST) are pressed repeatedly to step through the list of selections until the one required is displayed. Press ENTER to activate the displayed selection. In the menu summary, these keys have selections in lower case letters within { } brackets e.g. {check}.

The STATUS key is used in conjunction with the front panel knob.

3 SETTING UP MENUS

Refer to Chapter 4, 1253 Menu Summary, for menu names and default parameters/values.

3.1 SELECTING THE MENU

To set up a menu press SET-UP followed by the main key corresponding to the required menu.

For example, press SET-UP, then SWEEP. The resulting display will be:

```
{ SWEEP  ENABLE   [off]        }
```

- the first of the SWEEP parameters (SWEEP ENABLE) and its current selection or value (e.g. [off]).

Menu selections and values are changed using the front panel knob and number entry mode.

3.2 SELECTING AND ENTERING PARAMETERS

In menu set-up mode the menu *parameter* and its selection/value are enclosed in { } brackets (e.g. SWEEP ENABLE..... above). Press the menu set-up key (e.g. SWEEP) to step to the next parameter in the menu (e.g {FR MIN }.

The *parameter values* or *selections* are enclosed in [ ] or ( ) brackets (e.g. [off] above) or shown as an existing number.

a. **[] brackets** indicate a *selection.* To change the current selection;

(i) Use the front panel knob to step through the selections (e.g. [up] instead of [off] above).
(ii) Press ENTER to activate the selection displayed. This either moves you on to the next menu item, or presents further [ ] or ( ) bracket choices eg. XMIN, XMAX in the AXES menu (see the plotting set-up example on page 3.15 and Chapter 4 'Menu Summary').

b. **An existing number** indicates a *numeric value.*

To enter a specific value:
(i) Press NUMBER.
(ii) () brackets will appear on the display, indicating 'number entry mode'.
(iii) Key in the required numeric value using the legends below each main key. This new value will appear between the () brackets.
(iv) To re-start entry press CLEAR.
(v) Press ENTER to activate the value displayed.
(vi) To move on to the next menu item press the menu key.

To enter a non-specific value or to vary the parameter continuously:
(i) A cursor appears under the right-hand digit of the number.
(ii) Vary the digit over the cursor by rotating the front panel knob.
(iii) Move the cursor on to each new/previous digit using the DIGIT⇆ keys. and repeat (ii) as necessary.
(iv) This method acts on the value immediately. If, for example, the Generator is 'on' then Generator parameters can be varied in order to see their effect on the system under test. Press the menu set-up key again, to move to the next parameter.

4 PRACTICAL EXAMPLES, SIMPLE MEASUREMENTS

This section presents the basic procedure for setting up a simple, single frequency, gain measurement on a circuit, extending this to a sweep (multiple frequency measurement), and then plotting the results. It is suggested that the first-time user follows this section through in order to gain familiarity with the 1253 menu system, at the same time referring to Chapter 4;Menu Summary. Chapter 5, Menu Terms, provides in-depth explanations of each menu term. As experience is gained, the user can modify the procedure to suit new tasks and more complex measurements. The example sequences and displays are taken from tests on a simple (first order) low pass filter with a cut-off point at a nominal 75Hz.

4.1 MEASUREMENT PREPARATION

IMPORTANT: Before using the 1253 refer to Chapter 2 for instructions on selecting mains voltage, mains fuses, and wiring the mains plug.

Figure 3.2 shows the connections to be made between the 1253 and the circuit under test. The Generator is connected to a point that will stimulate the circuit (e.g. the input to a filter), taking the place of the signal from another component in the system. One Analyzer Channel monitors the circuit input (Generator output) and the other monitors the output of the circuit.

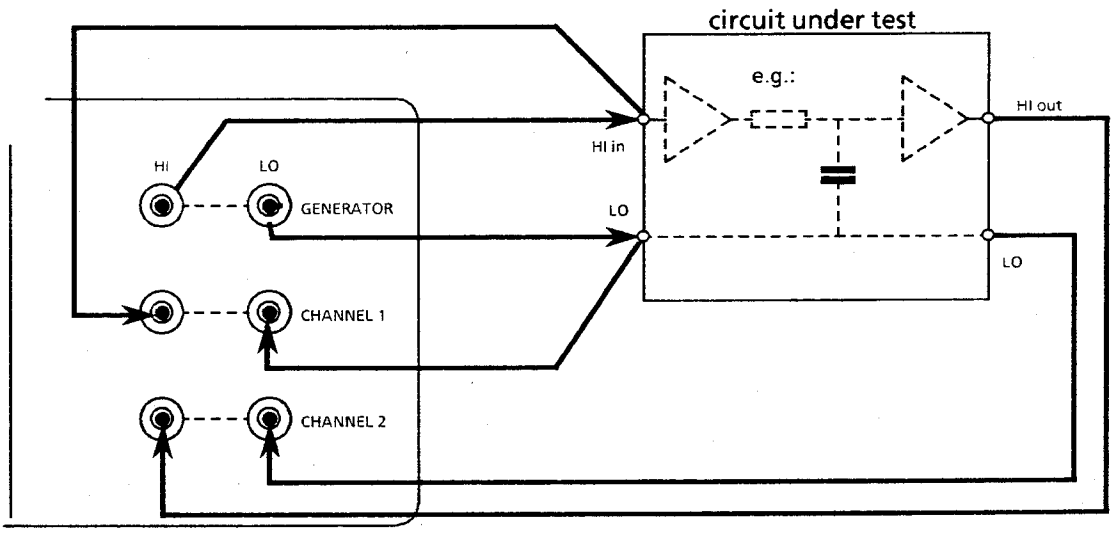
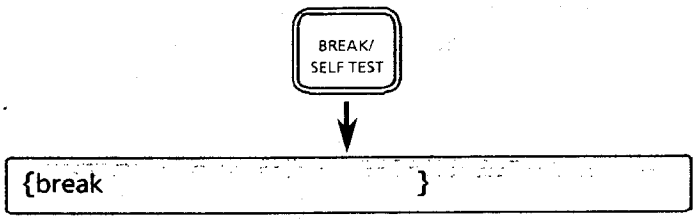


Fig. 3.2 *Connections for a Simple Gain/Phase Measurement*

4.2 KEY/DISPLAY SEQUENCES

The following examples are presented as a series of key/display sequences, showing the key-presses and resulting displays. Comments on operation are given alongside the sequence.

For example:



This means:
press the BREAK key,

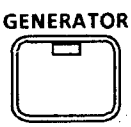
and the resulting display,

will change to: {break}.

As each main key has three different operations assigned to it (action key, menu key, and number key), to clarify its operation in these examples the keys are shown with the relevant label only For example, the GEN STOP key,

is shown as 

in 'normal' mode (both shift-keys 'off')

or as 

in 'menu set-up' mode (SET-UP shift-key 'on'),

or as 

in 'number entry' mode (NUMBER shift-key 'on').

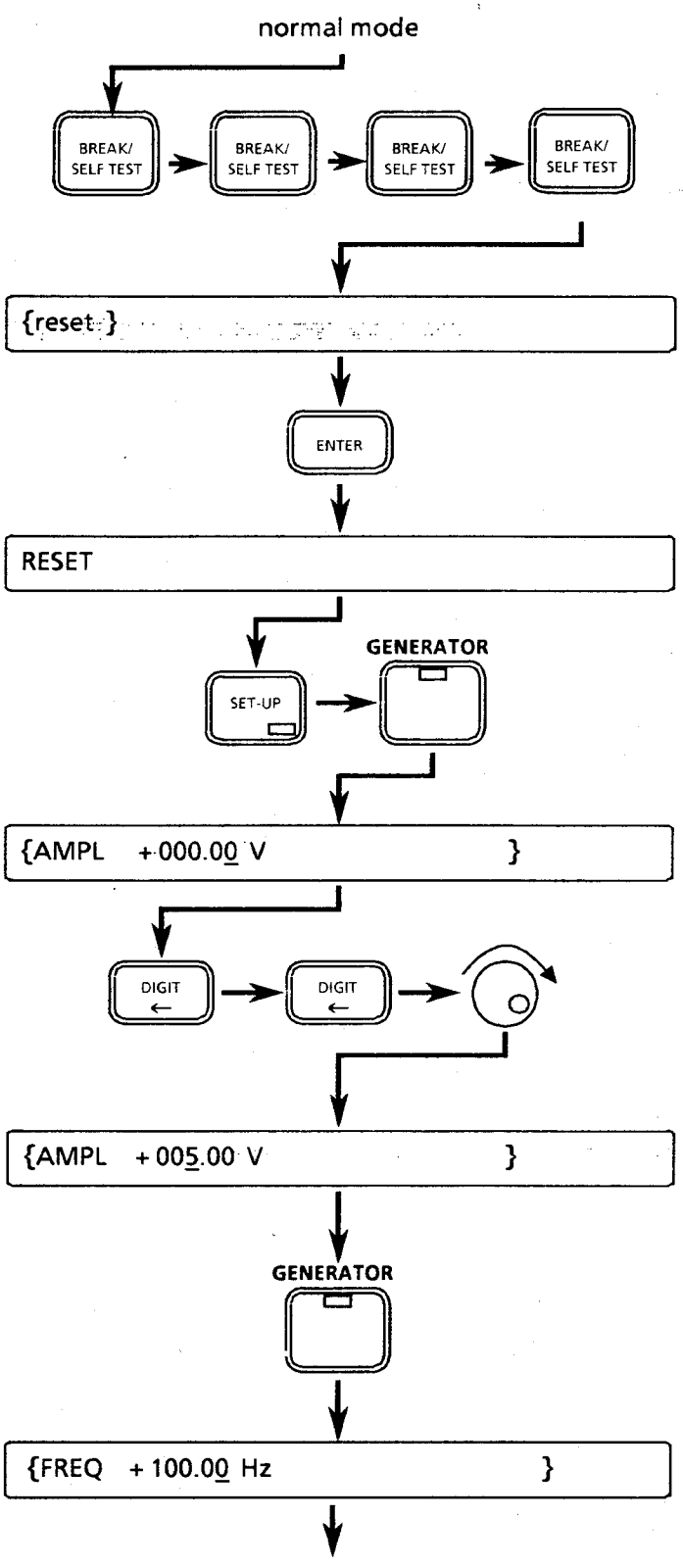
Lastly,  represents the front panel knob.

4.3 SIMPLE MEASUREMENT SET UP SEQUENCE: EXAMPLE

This sequence sets up a measurement with:

a measurement frequency of 200Hz,
a Generator Amplitude of 5 V,
display source of Ch2/Ch1 (i.e. voltage gain of the circuit under test),
display of results in decibels and degrees.

All other measurement parameters except the above are allowed to remain at their defaults (which are generally the most useful settings anyway).



Start in 'normal' mode, i.e. with both shift-keys 'off'.

The BREAK action key has several selections available. Skip through them by repeatedly pressing it until...

...{reset} is displayed. This selection will clear old menu settings.

Press ENTER to activate the displayed selection.

Change to 'menu set-up' mode and select the GENERATOR menu.

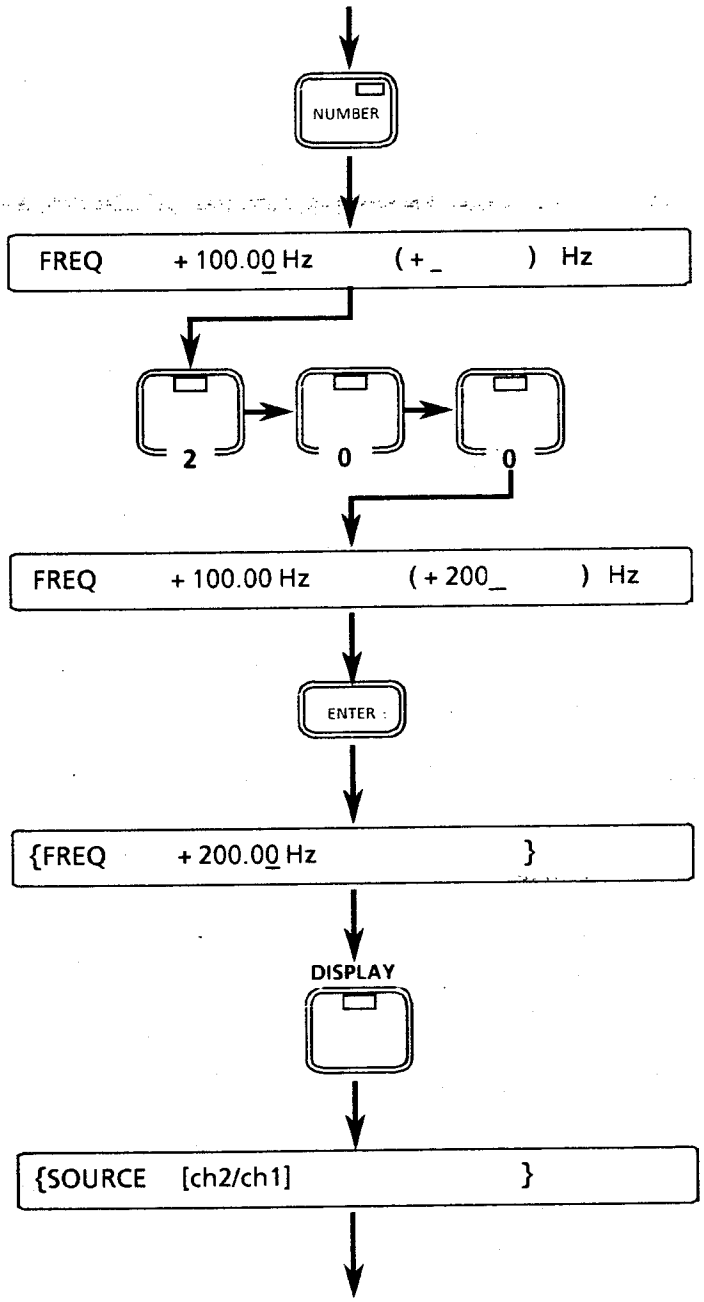
The first of the GENERATOR menu parameters, AMPL is displayed with its current value

Use the DIGIT keys to move the cursor and then turn the knob to vary the number over the cursor.

Input a value of 5.00

Press the GENERATOR key to move the display onto the next parameter.

The next GENERATOR parameter is FREQuency



Change to 'number entry' mode.

Number entry mode is indicated by the () brackets.

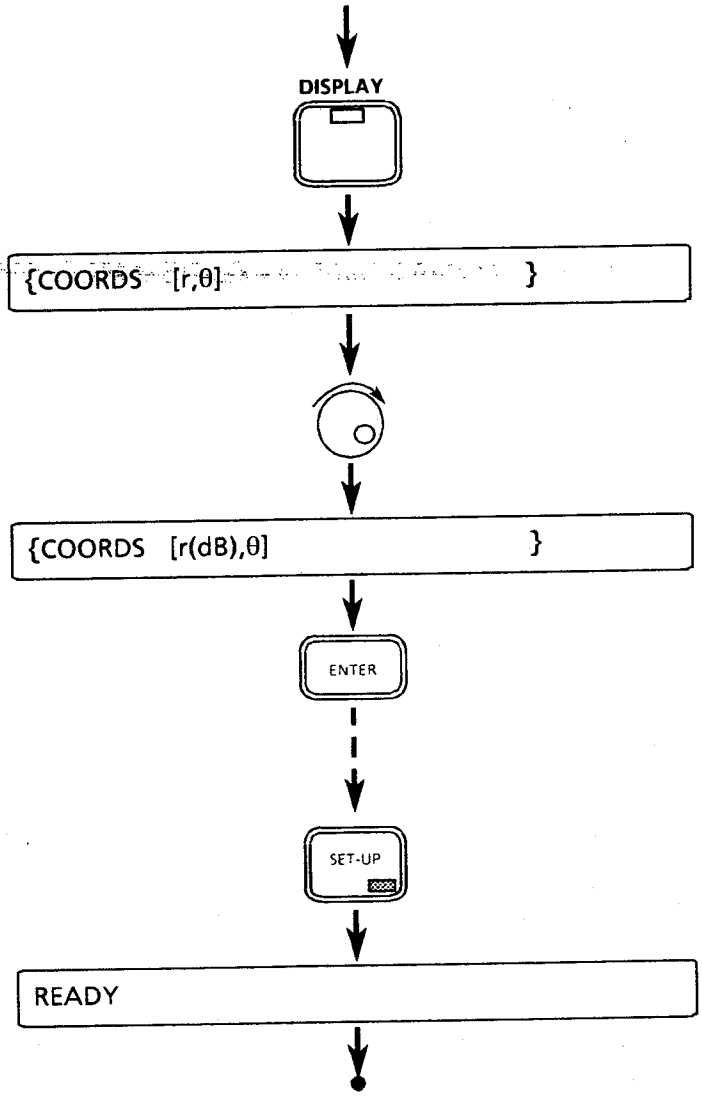
Key in the number (200 Hz)

ENTER this. The 1253 leaves 'number entry' mode ....

...and the new frequency is displayed.

Move on to the DISPLAY menu. (Other GENERATOR menu parameters will assume their default values e.g. BIAS (zero)).

The first parameter is SOURCE and the default selection is [ch2 / ch1]. This selection will calculate the gain of the circuit under test. This is the selection we require.



Press DISPLAY.

This moves you on to the next menu parameter COORDS. The default is polar, i.e. magnitude (r) and phase (θ).

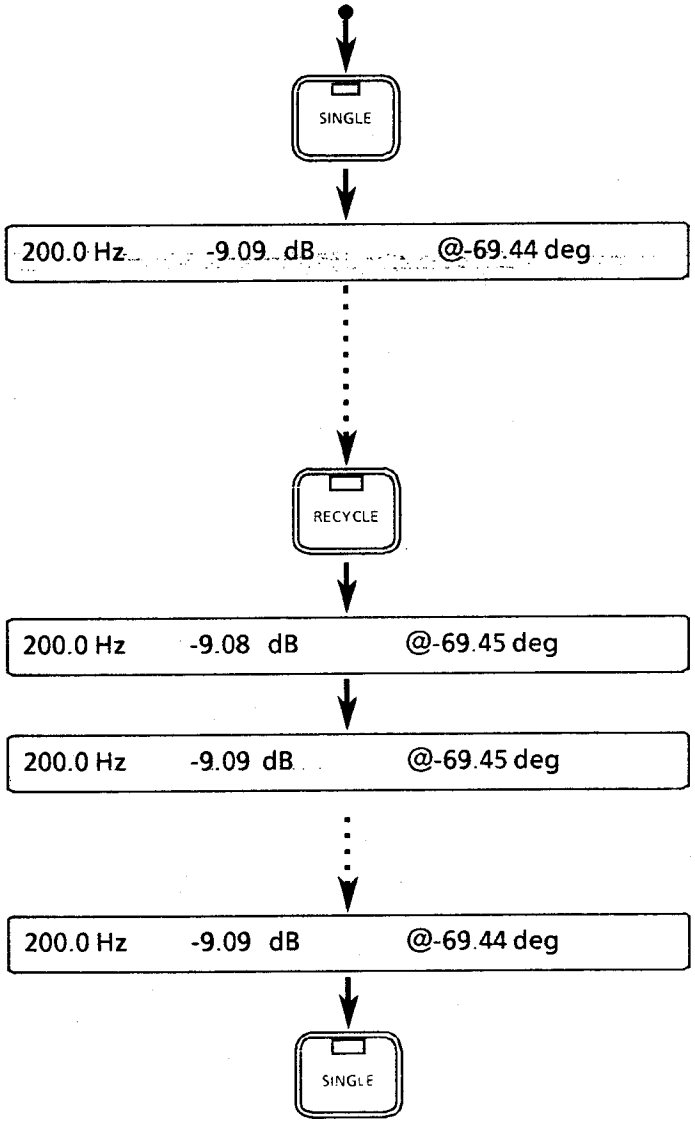
Use the front panel knob to select the..

...[r(dB),θ] option which will present results as a gain (r) in dB and phase (θ).

ENTER this.

Leave 'menu set-up' mode.

The 1253 is now ready to take a measurement.



Press SINGLE to start the GENERATOR and take a single measurement.

The result is displayed as the gain and phase of the circuit under test.

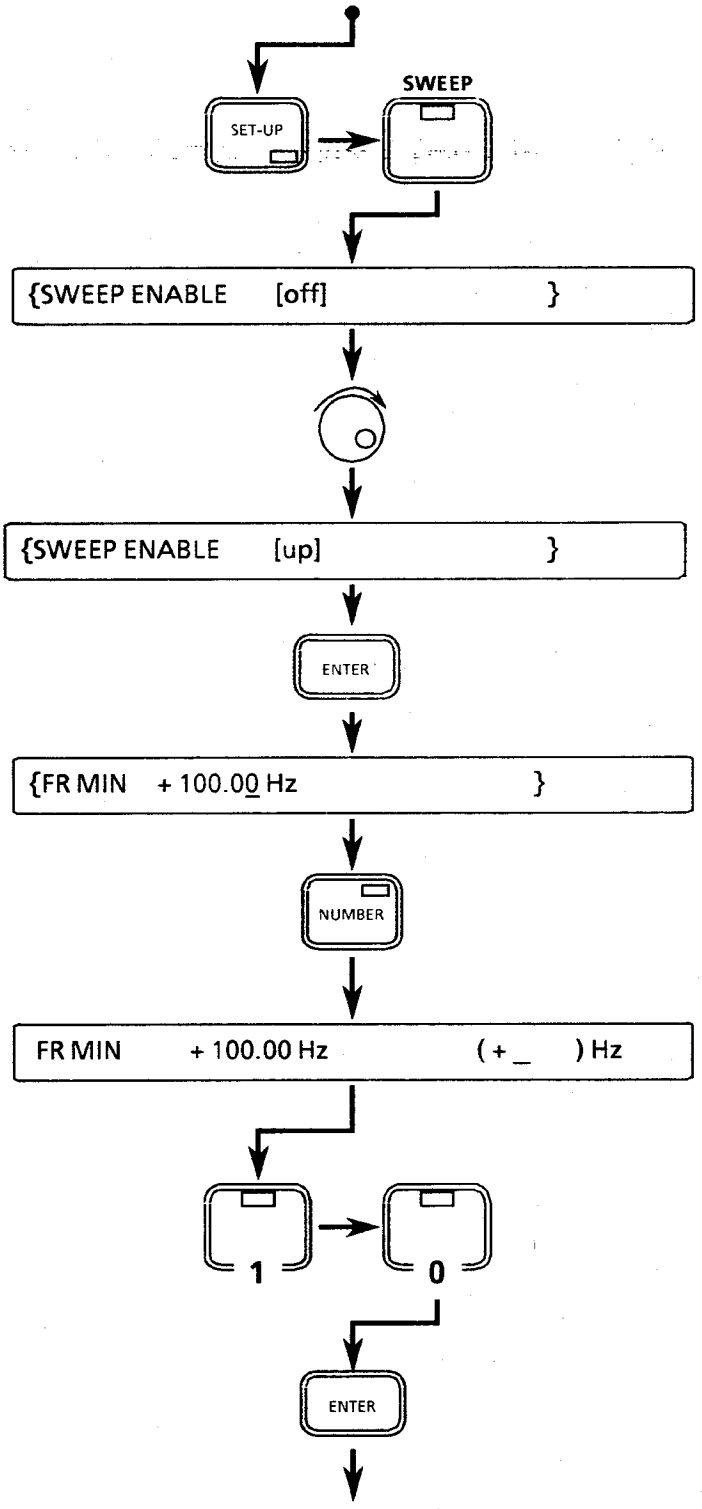
Use the RECYCLE key to update measurements continuously.

Use RECYCLE, SINGLE or GEN STOP to cancel RECYCLE.

4.4 SWEEP SET UP SEQUENCE: EXAMPLE

This sequence follows on from the previous example and sets up a sweep with:

a lower frequency of 10Hz,
an upper frequency of 1kHz,
9 points /sweep (logarithmic steps).



Start from 'normal mode' (both shift keys 'off').

Enter 'menu set-up' mode and select the SWEEP menu.

The first parameter is SWEEP ENABLE.

Set up the generator so that it sweeps upwards from FRMIN to FRMAX.

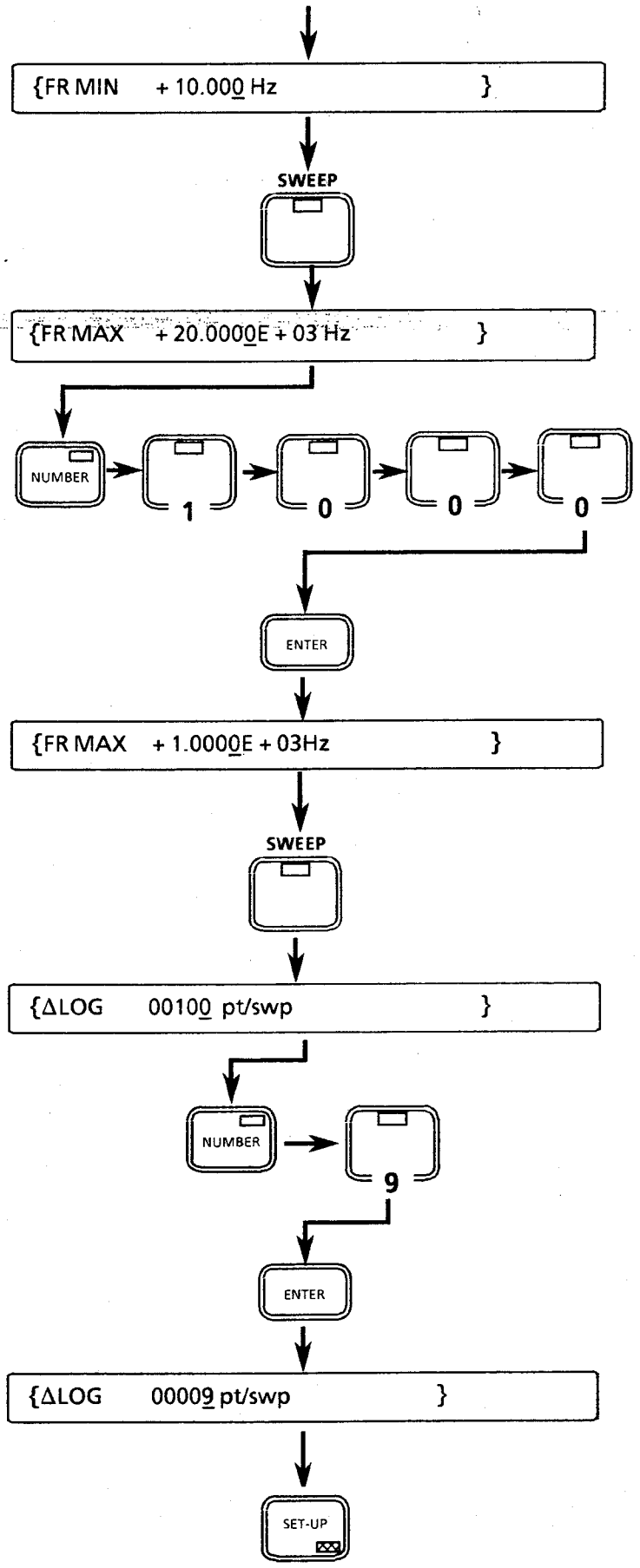
Enter this selection.

The next parameter is FR MIN. (The current value is the default 100Hz.)

Enter 'number entry mode'.

Type in the minimum frequency, 10 Hz.

ENTER this.



Move to the next menu parameter...

... FR MAX (the default is 2E4Hz)

Key-in the maximum frequency, 1000Hz using 'number entry mode'.

ENTER this.

Move to the next menu parameter.

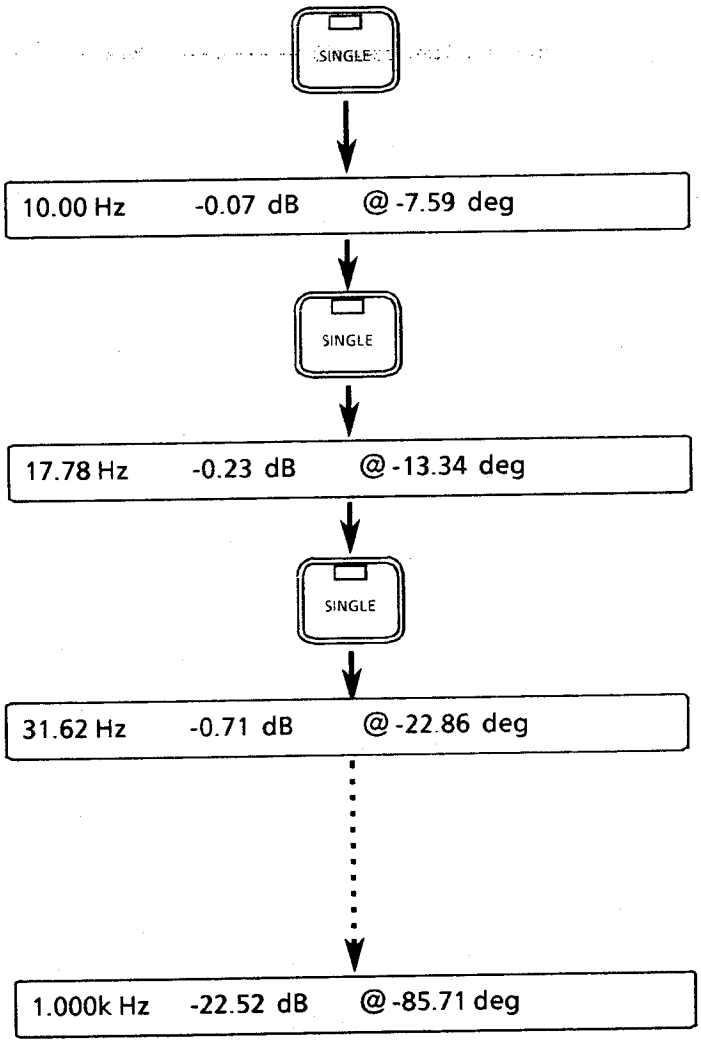
The next parameter, ΔLOG, is the increment used for logarithmically-stepped sweeps.

(The default is 100points/sweep)

Use number entry mode to key-in 9, the required value.

ENTER this.

Leave menu set up mode.



Use SINGLE to take the first of the SWEEP measurements...

...at FR MIN.

Press SINGLE each time a measurement is required. The 1253 automatically steps up by the frequency increment selected.

The sweep ends at 1kHz.

4.5 PLOTTING SET UP SEQUENCE: EXAMPLE

This sequence extends the previous example to plotting the results of the sweep on a GPIB plotter as an A4 size Bode magnitude plot (gain in dB versus frequency, on a logarithmic scale).

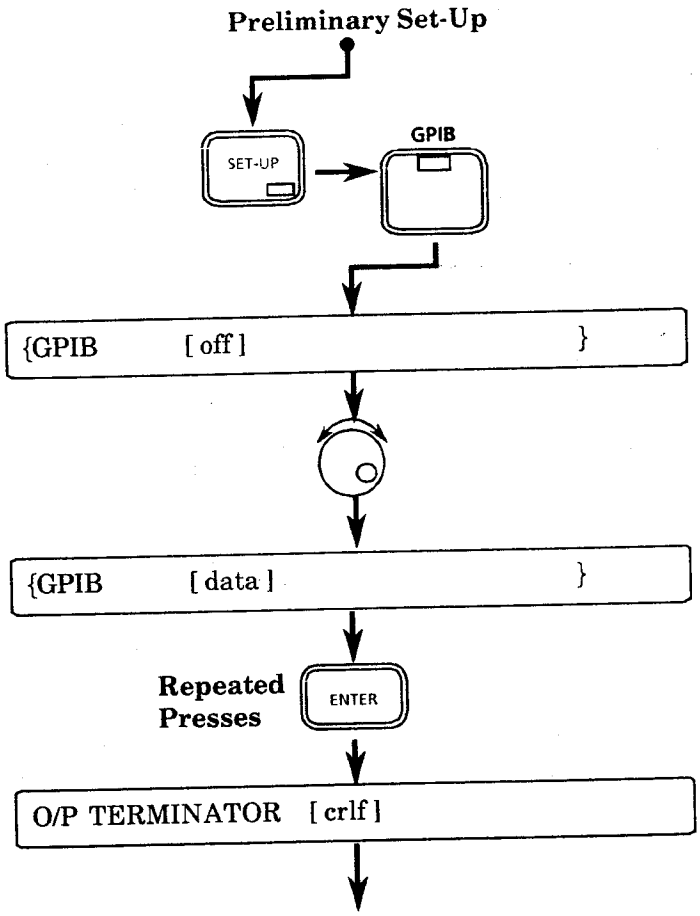
Connect an HPGL plotter to the 1253 via the rear panel connector. Before proceding with the key display sequence ensure that the plotter is set up correctly. i.e. :-

1. The 1253 rear panel Talk Only switch is set to 1.
2. The plotter is switched to listen only.

The GPIB menu default settings are-

Output separator [comma]
Output terminator [crlf]

If your plotter conforms to these settings, go straight to the main set-up sequence on page 3.17. If your plotter requires other separators and terminators, first follow the preliminary procedure below.



Select the GPIB menu.

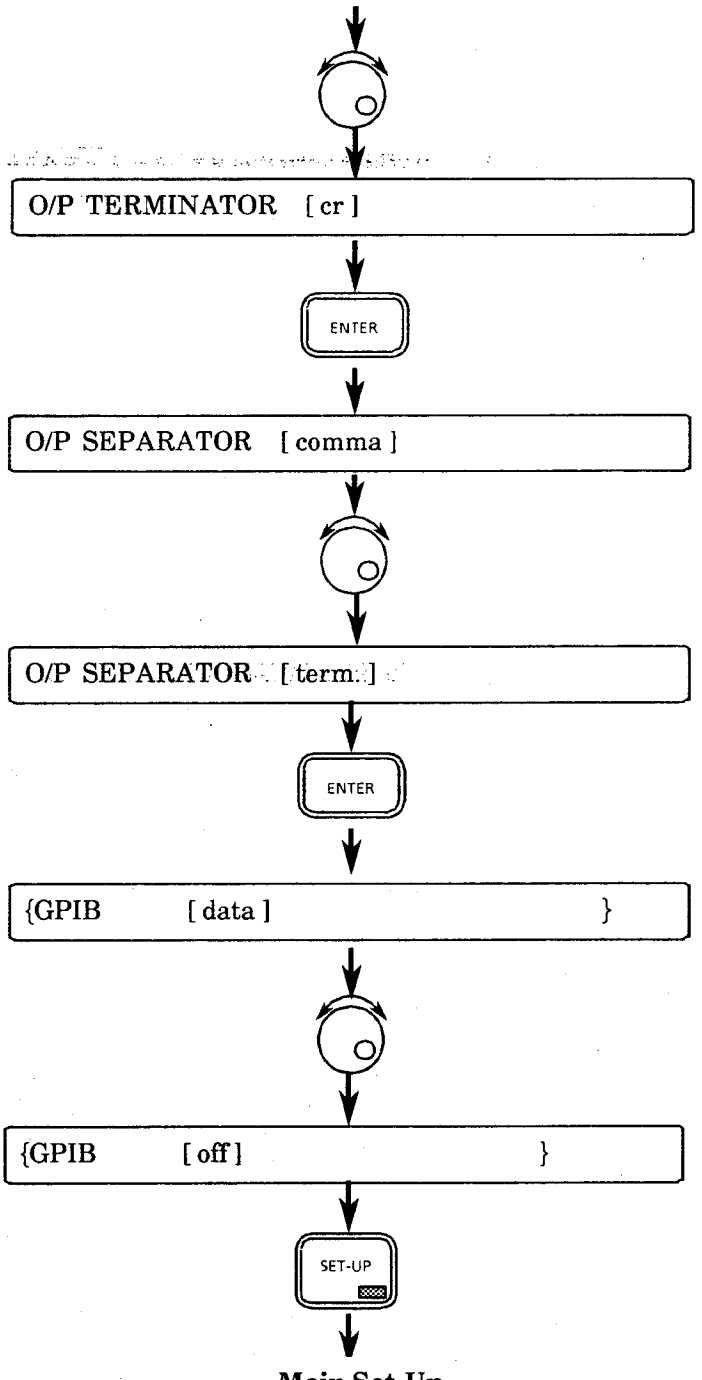
The GPIB selection needs to be changed to DATA.

Use the knob to make the selection

Press ENTER four times ....

.....until the O/P terminator is displayed. The default value is [crlf]

Preliminary Set-Up continued



Use the front panel knob to select the required terminator, [crlf], [crlf + EOI], [cr], or [cr + EOI]

for example, [cr]

ENTER this

Use the front panel knob to select the required separator- [comma], or the same as the terminator- [term.].

for example, [term.]

ENTER this

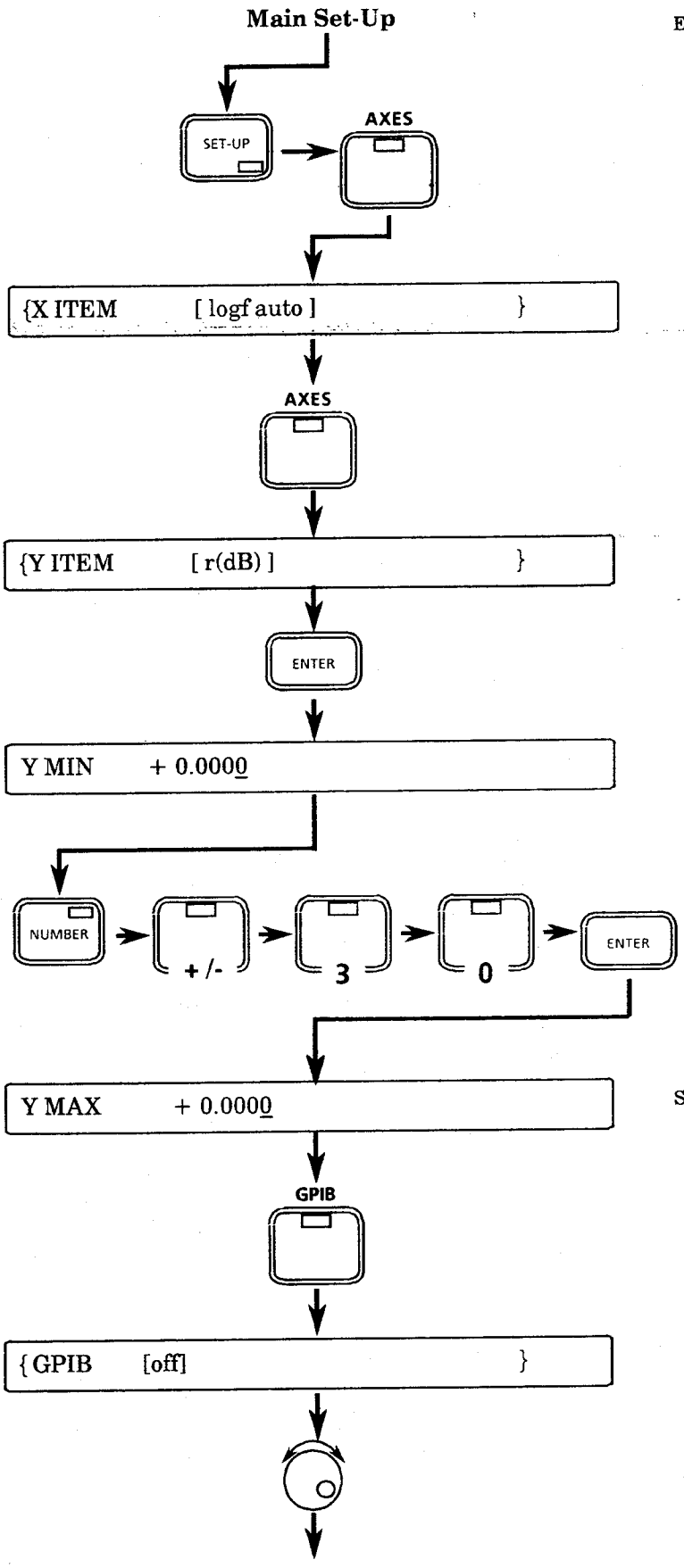
Change the GPIB selection back to OFF, to agree with the main plotting set-up example

Use the knob to make the selection

Leave menu set-up mode

Main Set-Up

You can now follow the plotting set-up routine on page 3.17



Ensure that the plotter and 1253 are set up as outlined on page 3.15 before commencing the plotting set-up sequence

Select the AXES menu.

The default selection is automatic logaritmmic scaling.

This is the selection required. Press AXES to move to the next parameter Y ITEM.

Select the default r(dB)

ENTER this

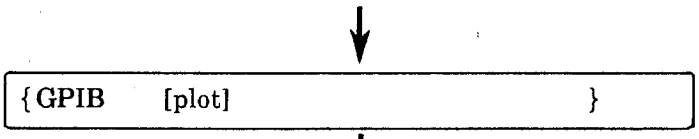
Key in a minimum y-axis value, -30dB and ENTER this.

Select the default for the maximum y-axis value.

Move on to the GPIB menu.

The GPIB selection needs to be changed to PLOT.

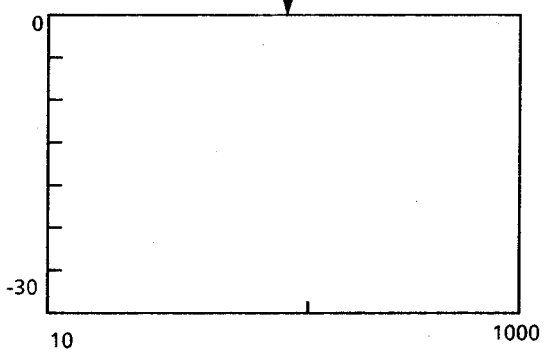
Use the knob to make the selection



ENTER this.

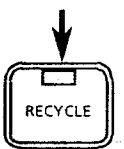
Leave menu set-up mode.

Press the PLOT AXES action key.



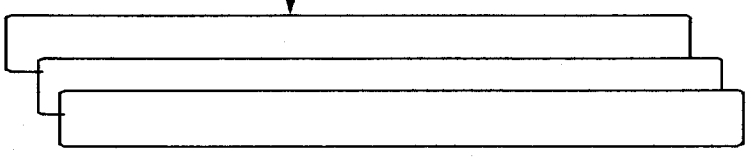
The axes and labels, are plotted.

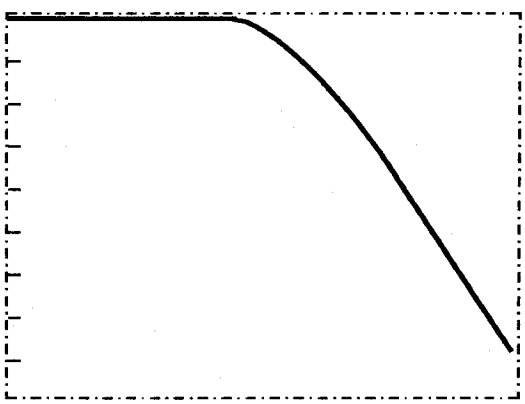
X-Ch2/Ch1 logf Hz
Y-Ch2/Ch1 r(dB)



Press RECYCLE.

The sweep runs automatically...





....plotting as it goes.

Chapter 4
1253 Menu Summary

1 MENU SUMMARY

The following tables summarise the1253 menus and action key operations.

Notes:

a. { } denote choice via repeated presses of the front panel keys, e.g. {BIAS} is obtained by pressing the GENERATOR Set Up key three times.

b. ( ) denote that a numerical entry is required, e.g. (0).

c. Limits are shown for each numerical entry.

d. [ ] denote choice via front panel knob, e.g, [auto].

e. **Bold** typeface is used to indicate default values.

SET UP MENU	PARAMETER	SELECTION		
GENERATOR	{AMPL}	**(0)** 0 to 10.23 V		
	{FREQ}	**(100)** 1E-3 to 2E4 Hz		
	{BIAS}	**(0)** -10.23 to 10.23 V		
	{MOD}	**[off]** [on]		
	{SYNC}	**[off]** [on]		
	{STOP MODE}	**[freeze]** [kill]		
ANALYZER	{∫ TIME}	**(0.1)** 0.1 to 1E5 secs		
	{INPUT}	**[front]** [rear]		
	{DEMOD 1}	**[off]** [on]		
	{DEMOD 2}	**[off]** [on]		
SWEEP	{SWEEP ENABLE}	**[off]** [up] [down]		
	(FR MIN}	**(100)** 1E-3 to 2E4 Hz		
	{FR MAX}	**(2E4)** 1E-3 to 2E4 Hz		
	{ΔLOG}	**(100)** 2 to 9999 points/sweep		
AXES	{X ITEM}	**[log f auto]**		
		[log f] [a]	X MIN **(100)** -1E9 to 1E9 *	
			X MAX **(20000)** -1E9 to 1E9 *	
	{Y ITEM}	**[r(dB)]** [r] [θ] [b]	Y MIN **(0)** -1E9 to 1E9	
			Y MAX **(0)** -1E9 to 1E9	
DISPLAY	{SOURCE}	[ch1] [ch2] **[ch2/ch1]**		
	{CO-ORDS}	[a,b] **[r,θ]** [r(dB),θ]		
	{ERROR δ}	**[on]** [off]		
GPIB	{GPIB}	[plot] **[off]**		
		[data] [dump]	SERIAL POLL **(0)** 0 to 255 integer	
			PARALLEL POLL **[0)** 0 to 8 integer	
			PAR. POLL SENSE **[true]** [false]	
			O/P TERMINATOR **[crlf]** [crlf + EOI] [cr] [cr + EOI]	
			O/P SEPARATOR **[comma]** [term.]	
SCALING	{DIVIDE BY}	**[unity]**		
		[r,θ]	SCALE r **(1)**	-1E9 to 1E9
			SCALE θ **(0)**	-180 to +180 degrees
		[last result] [last magnitude]		

ACTION KEY	FUNCTION/SELECTION	
GEN STOP	Generator <<stop>>	
RECYCLE**	Analyzer <<recycle (continuous)>> <<stop>>	
SINGLE**	Analyzer <<single cycle, then stop>> <<stop>>	
PLOT AXES	<<plots axes>>	
VERNIER	**{off}** {FREQ} {AMPL} {BIAS}	
VIEW FILE	{display file} select file entry using rotary knob and DIGIT ↔ keys	
	{list file}	
STATUS	[ ] display line selected by rotary knob	
PAUSE/CONTINUE	<<continue after programmed pause >>	
LEARN PROGRAM	{learn} ( ) integer 1 to 9	
	{edit} ( ) integer 1 to 9	Step through program lines using rotary knob then select from {delete}, {insert}, or {quit}
	{clear} ( ) integer 1 to 9	
	{copy} ( ) integer 1 to 9 to ( ) integer 1 to 9	
	{list} ( )integer 1 to 9	
EXEC. PROGRAM	execute program ( ) integer 0 to 9	
LOCAL.	<< return to local>> control (GPIB)	
BREAK/SELF TEST	{break} {drift correct} {initialise} {reset} {check} {test} {calibrate}***	
	{time}	HOURS ( ) 0 to 99 integer
		MINUTES ( ) 0 to 59 integer

<< >> Items marked thus are activated directly by action key.

{lower case} items are selected by repeated presses of the action key, then activated via ENTER.

* The number range for [log f] is restricted to positive numbers.

** RECYCLE and SINGLE keys cancel GEN STOP

*** This is part of the calibration procedure and normally should not appear. (See Technical Manual.)

Chapter 5
Menu Terms

1 GENERATOR

The GENERATOR menu sets up all steady-state Generator parameters.

1.1 {**AMPL**}

AMPLitude. This is the rms amplitude of the ac component of the Generator output, in the range 0V to 10.23Vrms* with a resolution of 10mV.

1.2 {**FREQ**}

FREQuency. The frequency can be set in the range ImHz to 20kHz with a maximum resolution of l in 4000. To step the frequency automatically use the SWEEP menu.

1.3 {**BIAS**}

BIAS. This is the steady dc offset of the Generator output, in the range –10.23Vdc* to +10.23Vdc*, with a resolution of 20mV. It is useful for setting a quiescent operating point in the system under test, or cancelling offsets in the system.

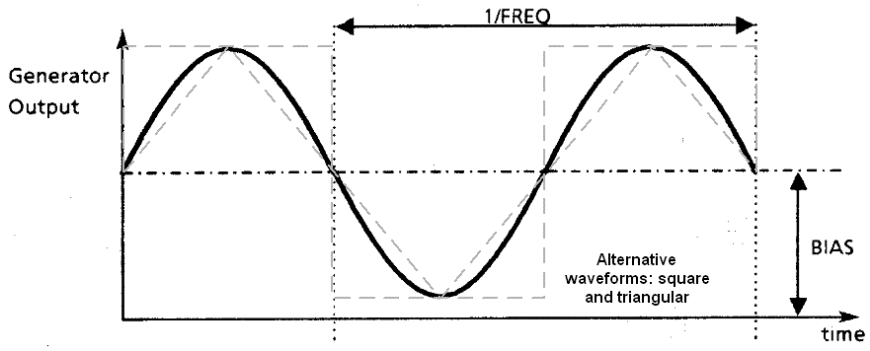


Fig. 5.1 *Generator BIAS and FREQ.*

***Note**: The peak output of the Generator, set by the combination of AMPL and BIAS, cannot exceed ±15V.

1.4 {**MOD**}

MODulation facility. The default setting is [off]. More information is in Chapter 10.

1.5 {**SYNC**}

SYNChronizer facility. The default setting is [off]. More information is in Chapter 10.

NOTE: In addition to the sine wave output of the generator, it is possible to select square wave or triangular wave. However, this can only be done by remote command. See Chapter 8, Section 5. The amplitude, frequency, and bias parameters are equally applicable to all three waveforms.

1.6 {STOP MODE}

The action the Generator takes when stopped via the front panel (GEN STOP key), rear panel (contact closure) or remote (SG) command. See Figs. 5.2 and 5.3.

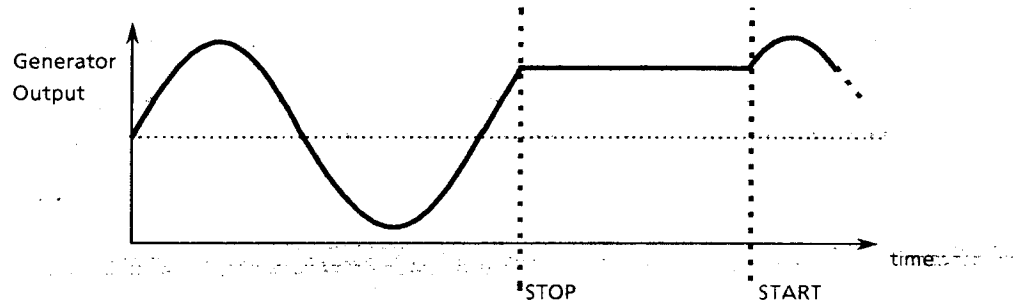


Fig 5.2 [freeze] *stops the Generator at the existing output level*

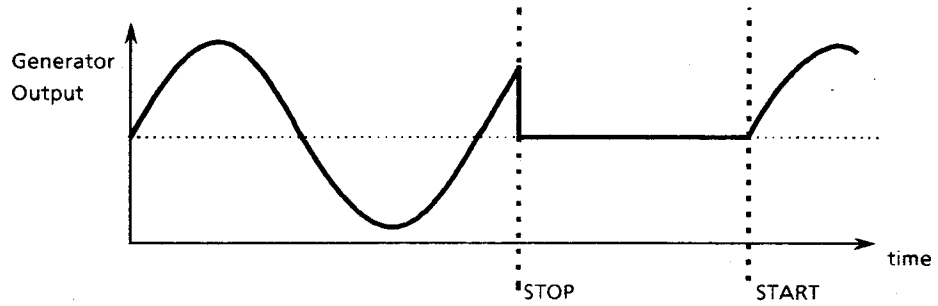


Fig 5.3 [kill] *sends the Generator to zero (Note: Bias will not be removed)*

2 ANALYZER

The ANALYZER menu sets up parameters common to both Analyzer Channels.

2.1 {∫ TIME}

The integration time to be used for measurements. In the range 0.1 to 1E5 sec, converted automatically to the nearest whole number of Generator cycles. If no ∫ TIME is specified or the user sets a time less than one cycle, the Analyzer assumes a value of 0.1 second or 1 cycle.

With noisy signals, the rms error in the readings due to the noise tends to zero as the integration time is increased. The longer the integration time used the closer the final reading will approach the true value of the wanted signal. The integration time has to be a compromise between speed of measurement and the acceptability of small errors in the reading.

The ability of the Analyzers to reject unwanted frequencies is illustrated in Fig. 5.4.

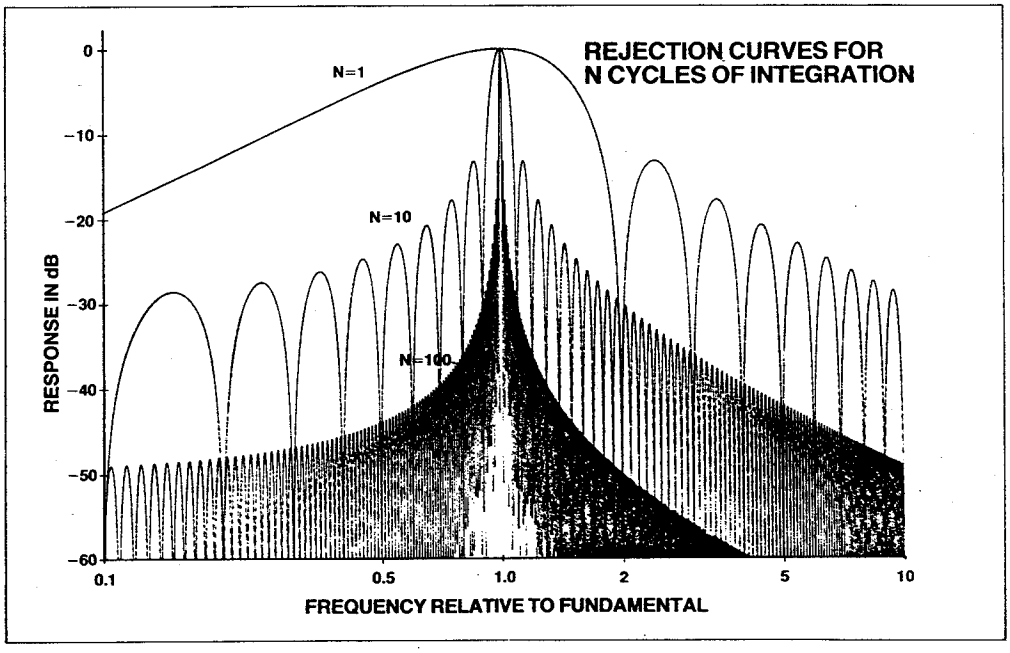


Fig. 5.4 *Rejection curves for n cycles of integration*

The curves indicate that one cycle of integration will give a reasonable reading where the signal contains little random noise.

For measurements where the random noise level is high, however, the number of cycles of integration and hence the integration time need to be increased, in order to improve the signal to noise ratio.

To evaluate the effect of different integration times observe the scatter on the displayed readings, with the Analyzer on RECYCLE. If the scatter is due to noise, or other spurious components, increasing the ∫ TIME value should cause a decrease in the scatter.

Note: The total measurement time depends upon the integration time and software delays.
eg. A typical ch2/ch1 measurement takes (2 x Integration Time + software delays.)

2.2 **{INPUT}**
INPUT terminals ; **[front]** or **[rear]** panel terminals can be selected. Both analyzers are switched together by this selection.

2.3 **{DEMOD 1}**
DEMODulation on Channel 1. The default is **[off]**. For more information see Chapter 10.

2.4 **{DEMOD 2}**
DEMODulation on Channel 2. The default is **[off]**. For more information see Chapter 10.

3 SWEEP

The SWEEP menu selects the parameters used by the 1253 to perform automatic sweeps from one frequency to another. One measurement is made at each frequency, the Generator stepping on to the next frequency after each complete measurement.

3.1 {SWEEP ENABLE}

a. [off]
No frequency sweep will occur.

b. [up]
The frequency is swept upwards according to the parameters entered in the rest of the sweep menu.

c. [down]
The frequency is swept downwards according to the parameters entered in the rest of the sweep menu.

3.2 {FR MIN}

Minimum sweep frequency. In the range 1mHz to 20kHz with a maximum resolution of 1 in 4000.

3.3 {FR MAX}

Maximum sweep frequency. In the range 1mHz to 20kHz with a maximum resolution of 1 in 4000.

3.4 {ΔLOG}

Logarithmic sweep increment.
The number of measurement points per sweep can be selected within the range 2 to 9999. The frequencies are spaced at equal intervals if plotted along a logarithmic base line. See Fig 5.5

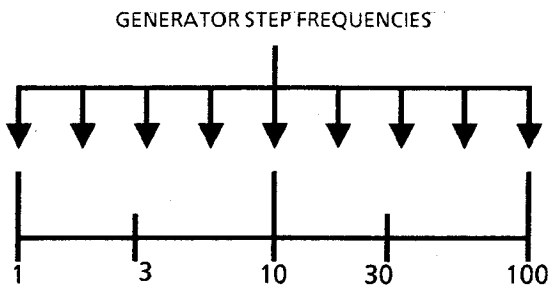


Fig. 5.5 *Example of Logarithmic Sweep at 9 points per sweep.*

If an increment of n points/sweep is selected, the step ratio is the (n-1) th root of FR MAX ÷ FR MIN

4 AXES

The AXES menu determines the form in which data are to be plotted. Fig.5.6 defines the terms described in the following paragraphs.

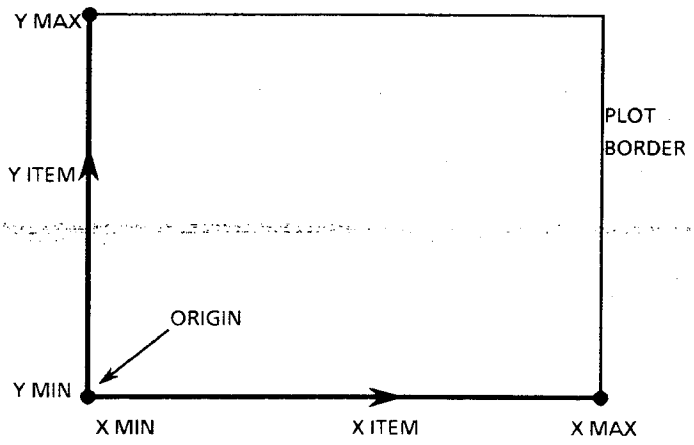


Fig. 5.6 *The plotting field.*

The alternative coordinate systems e.g. magnitude, phase; real, imaginary etc. are explained in more detail in section 5.2, page 5.10.

4.1 {X ITEM}

The quantity plotted on the X axis

a. [log f auto]
The X axis is scaled logarithmically from FR MIN to FR MAX, as defined by the sweep menu. The plot consists of points joined by lines (vectors).

b. [log f]
The X axis is scaled logarithmically. The minimum and maximum values of the X axis must be entered as **XMIN** and **XMAX**. Any number may be chosen in the range 1E–9 to 1E9. The plot consists of points joined by lines (vectors).

c. [a]
The real component of the result is plotted on the X axis. The minimum and maximum values of X must be entered separately as **XMIN** and **XMAX** (within the range –1E9 to 1E9). The plot consists of unconnected points.

The shape of plot is rectangular if X ITEM is set to [log f auto] or [log f], but square if set to [a].

4.2 {Y ITEM}

The Y axis of a plot can be chosen from the following forms

a. [r]
magnitude, polar coordinates. The Y axis is on the left hand side of the plot.

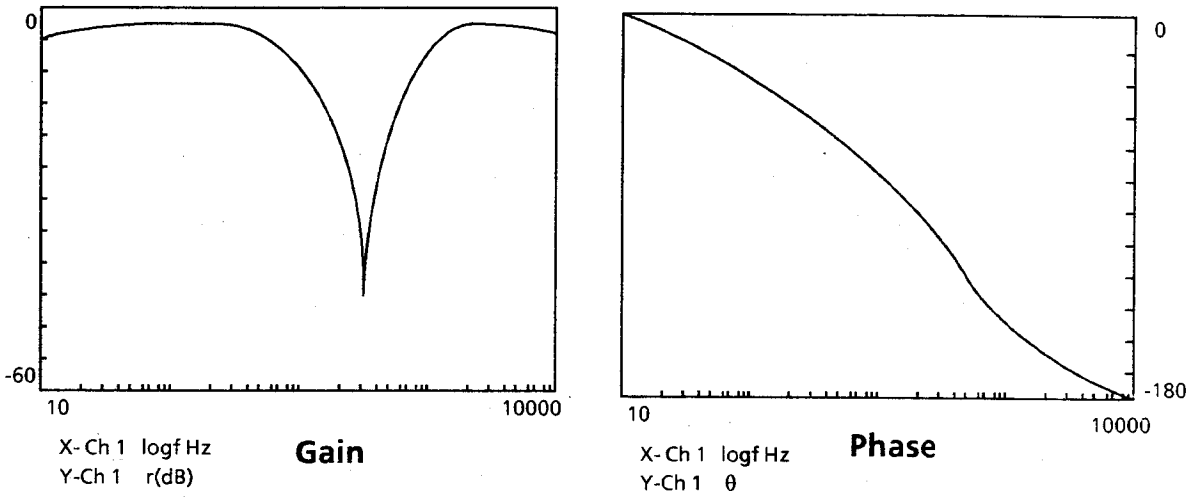
b. [r(dB)]
log magnitude,polar coordinates. The Y axis is on the left hand side of the plot.

c. **[θ]**
phase angle, polar coordinates. The Y axis is on the right hand side of the plot.

d. **[b]**
imaginary component, cartesian coordinates. The Y axis is on the left hand side of the plot.

The maximum and minimum values of Y must be entered as YMIN and YMAX (within the range -1E9 to 1E9).

Different plot types may be obtained by selecting appropriate items via the X ITEM and Y ITEM menus. The magnitude part of a **Bode** plot is obtained if X ITEM is selected as [log f] and Y ITEM is selected as [r(dB)]. The Bode plot has a rectangular format. A **Nyquist** plot is obtained if X ITEM is selected as [a] and Y ITEM as [b]. Typical Bode and Nyquist plots are shown in Fig. 5.7



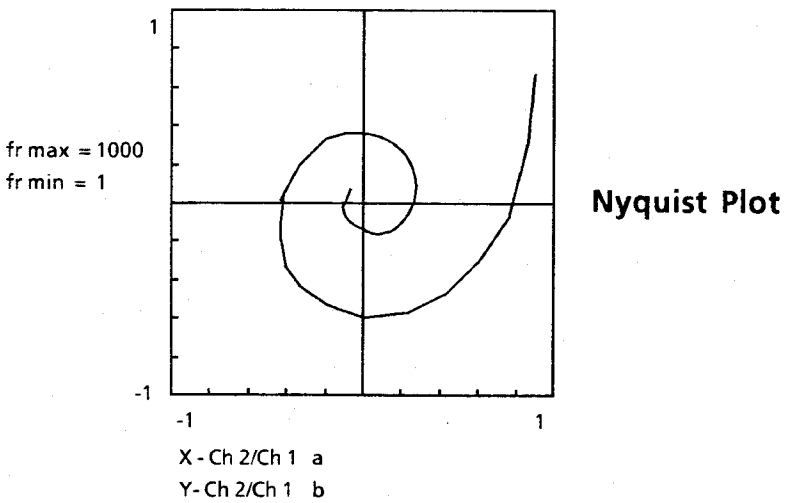


Fig. 5.7 *Bode and Nyquist plots.*

5 DISPLAY

The DISPLAY menu selects the source and form of displayed results, and the source of plotted results.
If {**SOURCE**} or {**CO-OORDS**} are changed, the heading of a plot is automatically updated.

5.1 {SOURCE}

Source of results. Specified as a single Analyzer Channel or a ratio of results from both Channels.

The three possible sources are:

a. **[ch 1]**, Channel 1 only (Note:any input to channel 2 is not measured).

b. **[ch 2]**, Channel 2 only (Note:any input to channel 1 is not measured).

c. **[ch 2/ch 1]**, Channel 2 divided by Channel 1.

Selections a. and b. provide results directly. Use these selections to monitor voltages, for example to check for an over-load.

Selection c. compares the two channels directly. Use this selection for transfer function measurements (Fig. 5.8).

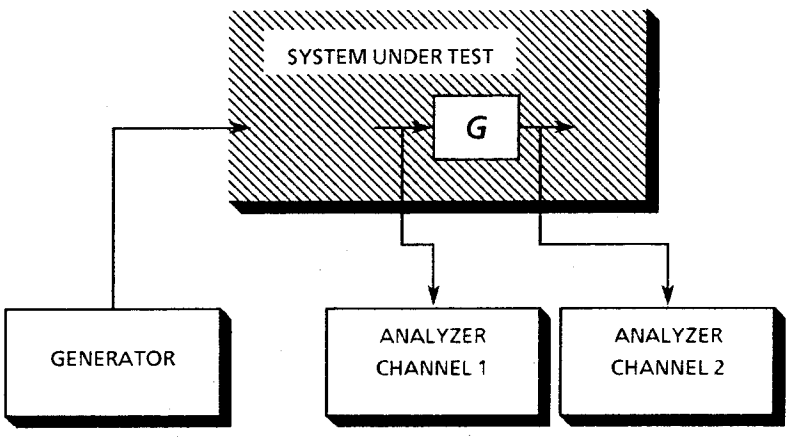


Fig. 5.8 *Example of measurement in-circuit. Input and output of a circuit are monitored by Analyzer Channels 1 and 2, respectively. Select [ch2/ch1] to find the transfer function G.*

5.2 **{CO-ORDS}**
CO-ORDINATE system used by the display. The three options are:

a. **[a , jb]**, cartesian, results are displayed as real part (or in phase component), a, and imaginary part (or quadrature component), b.

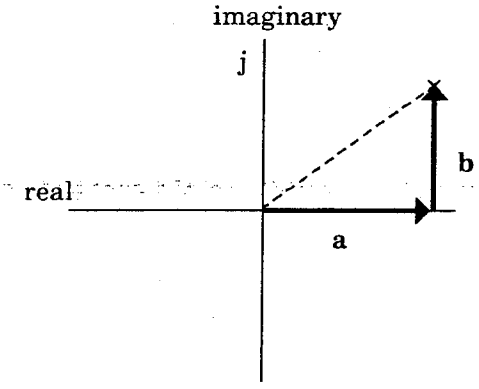


Fig. 5.9 *Cartesian coordinates*

b. **[r,θ]**, polar, results are displayed as magnitude, r, and phase, θ.

Note: $r = \sqrt{(a^2 + b^2)}$ and $\theta = \arctan(b/a)$

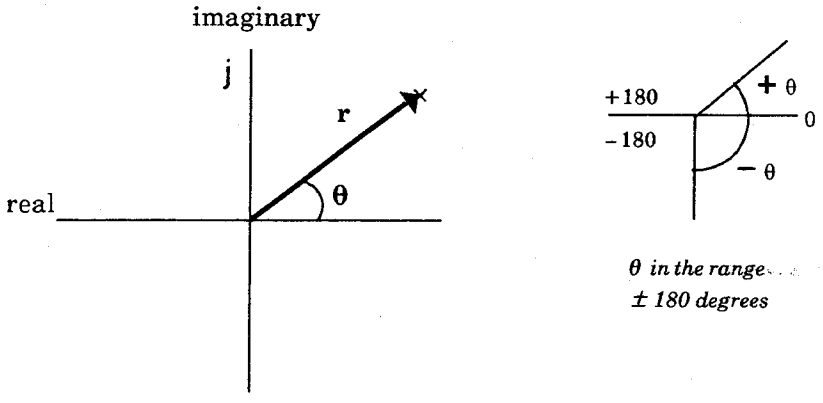


Fig. 5.10 *Polar coordinates*

c. **[r(dB),θ]**, log polar, results are displayed as in b. above except that r is expressed in decibels (Whenever [Ch1] or [Ch2] is selected, the dB reference is 1 volt.):

$$r(\text{dB}) = 20 \log \sqrt{(a^2 + b^2)}$$

5.3 **{ERROR BEEP}**
Error tone selection: **[off]** suppresses and **[on]** enables the 'error beep'.

6 GPIB

GPIB (IEEE 488) parallel interface

a. **[off]**
disables data output to the GPIB

b. **[plot]**
Allows a plotter to be operated from the GPIB port.

c. **[data]**
Enables output of data to the interface, in the form of ASCII characters.

d. **[dump]**
Enables output of data to the interface in the form of high speed binary data.

WARNING:

If GPIB devices are not connected always select [off]. Any other selection may cause the 1253 to stop measuring.

If [data] or [dump] are selected, five further selections are possible:

- ☐ **SERIAL POLL**
  An integer defining an event (or events) which will cause the 1253 to interrupt a GPIB controller.

- ☐ **PARALLEL POLL**
  An integer defining which of the eight GPIB data lines is to be used by the 1253 to give a parallel poll response, to indicate whether it is requesting service or not.

- ☐ **PP SENSE**
  Parallel poll sense:

  [true] signifies that when the data line selected carries a '1' the 1253 is requesting service.

  [false] signifies that when the line carries a '0' the 1253 is requesting service.

- ☐ **O/P TERMINATOR**
  Output Terminator. The character or action terminating each measurement result:

  [crlf], carriage return and line-feed
  [crlf + EOI], carriage return, line-feed, and the signal EOI (end or identify)
  [cr], carriage return
  [cr + EOI], carriage return plus end or identify

  If [dump] was selected above then no characters are generated as Output Terminators.

□ **O/P SEPARATOR**
Output Separator. The character separating the measurement result into fields. Selections are
[comma]
[term] selects the same character already selected as O/P TERMINATOR.

If [dump] is selected, then no characters are generated as Output Terminators. However, at the end of each measurement result the signal EOI is asserted, if [crlf + EOI] or [cr + EOI] is selected as the Output Terminator.

Refer to Chapter 8 for the implications of each selection.

7 SCALING

{DIVIDE BY}
Allows the result of a measurement to be divided by a vector. The following selections are possible:

a. **[unity]**, the result is unaffected
b. **[r,θ]**, a vector specified in polar coordinates. Enter the required magnitude (r), and phase angle (θ).
c. **[last result]**, used where relative, rather than absolute measurements are to be made. When this selection is ENTERed, the result currently on display is taken as the divisor for all future results.
d. **[last magnitude]**, acts in a similar way to **[last result]** with the divisor being the previous magnitude (ie. r in polar coordinates).

8 THE ACTION KEYS

8.1 GEN STOP

Stops the Generator.
The Generator can also be stopped by Remote Control or by connecting the rear panel START/STOP connector to ground. This, however, suspends SINGLE and RECYCLE measurements.
If GEN STOP is pressed, the Generator waveform will either remain at the level reached when the command was actioned, or drop to the bias voltage, depending on the selection made in the Generator {STOP MODE} menu.
The Generator can be restarted by pressing SINGLE or RECYCLE and the waveform will continue from wherever it had stopped.

Because of its immediate action, the GEN STOP key can be used as a 'Panic Switch' to stop the measurement if things seem to be getting out of control!

8.2 RECYCLE*

Allows the Analyzer to take a continuous series of measurements. The display is automatically updated as each measurement is completed.

If SWEEP has been enabled in the set-up menu, the 1253 automatically steps through the frequency range defined (see SWEEP set-up menu).

Pressing RECYCLE during a measurement cancels the measurement. The remote command RE, although generally equivalent to RECYCLE does not cancel previous RE commands.

Pressing RECYCLE has the effect of cancelling SINGLE.

8.3 SINGLE*

Allows the Analyzer to take a single measurement. Press the SINGLE key for each subsequent measurement required. The display is updated at the end of each measurement.

With SWEEP selected each press of SINGLE causes the 1253 to step on to the next frequency defined by the SWEEP menu. The display is updated at the end of each measurement.

Pressing SINGLE during a measurement cancels the measurement. The remote command SI, although generally equivalent to SINGLE does not cancel previous SI commands.

Pressing SINGLE has the effect of cancelling RECYCLE.

*** Note: A delay of at least 1 second occurs between pressing SINGLE or RECYCLE and the start of the first reading. This allows the test system to settle, after a change in input stimulus eg., after a large change in measurement frequency at the start of a sweep.**

8.4 VERNIER

Allows the user to display and vary one of the Generator parameters whilst still carrying out measurements. The required variable is displayed instead of the measurement frequency and updated after every measurement. The parameter selected is varied using the front panel knob and DIGIT ⇆ keys.

The selections are:-

a. {**FREQ**} Variable parameter is Generator FREQuency
b. {**AMPL**} Variable parameter is Generator AMPLitude
c. {**BIAS**} Variable parameter is Generator BIAS

8.5 PLOT AXES

A single press causes the axes of a graph to be drawn on a plotter, connected via the GPIB. The graph will be A4 in size and will be scaled according to the AXES Set-up Menu.

To draw the graph itself, ensure that the SWEEP menu is set up and enabled and that the GPIB menu is set to PLOT. Then press the RECYCLE action key.

8.6 VIEW FILE

Measurement data is automatically stored in a history file and is accessed via the VIEW FILE key. The following selections are possible:-

a. {**display file**} displays the first line (result) in the history file. Other lines are accessed by using the rotary knob and DIGIT ⇆ keys.

b. {**list file**} lists every line of the file in quick succession. The sequence is too fast to follow on the display. It is intended for plotting and listing the file to an external device via the GPIB (with the 1253 set to talk only) or RS423 port.
Do not enter another command until the listing is complete .

Results are scaled as required (set up in the SCALING menu) and stored in a + jb format. They are displayed (or output to external devices) in the form selected by the DISPLAY menu.

The file contains at least the last 100 results, unless it has recently been cleared.

The file is cleared automatically at the start of a sweep or learnt program

8.7 STATUS

Displays 17 lines of information on settings and 'status' of particular items. The information is updated every second. The first line will be displayed on the front panel and lines are accessed in either direction using the front panel knob.

All lines may be sent to the GPIB or RS423 output ports.

GPIB: Set the 1253 to talk only and the GPIB printer to listen only.
Press the STATUS key.
RS423: Press the STATUS key or send the remote command ST via the GPIB.

The following lines are available; words in brackets represent messages that may be displayed, or numbers (italics):

1	1253 GPA	(ready) (program) (busy) (pause) (remote)	TIME	(*hh:mm:ss*)
2	GENERATOR	(run) (kill) (freeze) (kill-ext) (Freeze-ext)	CARRIER	(off) (low) (on)
3	ANALYZERS	(stop) (run) (idle) (delay) (wait)	RANGE	(*analyzer 1 range*) (*analyzer 2 range*) (*analyzer 1/ analyzer 2 range*)
4	SWEEP	(stop) (idle) (run)	PLOTTER	(stop) (idle) (run)
5	SYNC	(off) (idle) (wait) (locked) (fault 1) (fault 2) (fault 3)	INPUT F	(*Value of input frequency*)
6	MIN F	(*min sync freq*)	MAX F	(*max sync freq*)
7	FILE SIZE	(*file size*)	LAST ERRORS	(*last three error codes*)
8	UPPER LIMIT	(*upper limit of last menu parameter entered*)		
9	LOWER LIMIT	(*lower limit of last menu parameter entered*)		
10	HISTORY FILE READINGS	(*number of readings taken*)	FILED	(*number of readings in file*)
11	PROGRAMS LEARNT	(*list of learnt programs 1-9*)		
12	RS-423 BAUD RATE	(*Baud rate 110 to 9600*)		
13	GPIB MODE	(talk only) (normal)	STATE	(idle) (maj TACS) (min TACS) (maj LACS) (min LACS)
			TACS = talker active state; min = minor LACS = listener active state; maj = major	
14	GPIB ADDRESS	(*major address/minor address*)	CONTROL	(local) (remote) (local + llo) (rem + llo)
			loc + llo = local + local lockout rem + llo = remote + local lockout	
15	GPIB STB	(serial poll byte, binary)	I/P TERM	(lf) (cr) (s-colon) (EOI)

8.8 PAUSE/CONTINUE

Inserts a pause when learning or editing programs. If a pre-programmed pause is reached during the execution of a program, the LED will flash on and off. Press the key to continue.

8.9 LEARN PROGRAM

Five options are available. Each option requires the entry of a program number. Use the number entry mode to enter the program number then press ENTER. The options are:

a. {learn} allows entry of a new program.
b. {edit} allows-editing .of aQexisting program.
c. {clear} clears a program-frommemory .
d. {copy} copies from one program to another.
e. {list} enables a program sequence to be listed via the RS423 or GPIB interfaces, to a printer.

For a detailed explanation see Chapter 11, Learnt Programs.

8.10 EXECUTE PROGRAM

Executes one of nine Learnt Programs (1 to 9). Use number entry mode to enter the program number then press ENTER.

8.11 LOCAL

Returns the 1253 to local control (i.e. via the front panel) from the remote state. That is, provided an external controller has not asserted local lockout.

8.12 BREAK/SELF TEST

Seven main selections are available:

a. {break} halts the present operation and transfers the 1253 to the ready state. {SYNC} is switced off if previously on.

b. {drift correct}, performs adrift correction on the next measurement. An automatic drift correction always occurs once per minute or once per integration time, whichever is the longer (for frequencies greater than 1 Hz). .

c. {initialise} clears the History file, any existing menu set-ups (returning all parameters to their default states) and battery maintained programs (1 to 9).

d. {reset} clears only the existing menu set-ups, returning all parameters to their default values. The history file and programs are not cleared.

e. {check} initiates a slmple self test, useful for checking the 1253 has no obvious faults. Check sums are performed on all the memories and basic circuit functions are verified. A satisfactory check results in a CHECK PASS message –together with the firmware issue, calibration date and an abreviated calibration location, e.g. the name of the service centre.

If a fault is detected the 1253 displays a message indicating the faulty area, e.g. “TIMER FAIL”. If a fault is indicated, switch the instrument off until the fault can be rectified. It is unlikely that the 1253 will be damaged if left on, but the readings may not be valid.

f. **{test}** implements a much more rigorous check. This checks reading/writing on all boards, measurement delays and watchdog timers. It carries out limited checks on communications interfaces. A series of checks on display elements and key functions is then carried out. The user presses ENTER at appropriate stages to move to the next group of checks. The display checks are as follows:

(i) All LEDS light and horizontal lines scroll up the display. Press ENTER.

(ii) Vertical lines run through and underline each character in turn. All LEDS light in sequence. Press ENTER.

(iii) All characters are displayed in sequence and scroll across the display. Press ENTER.

(iv) Key press test. The display records the number of key-presses and a 3 letter abbreviation of the key label. Turning the rotary knob varies the displayed number of key-presses. Press ENTER.

Failure of the 1253 at any point causes the routine to abort and display a 'FAIL' message indicating the cause of failure.

A successful check results in a 'PASS' message which also gives the firmware issue, calibration date and an abbreviated calibration location (e.g. The Solartron service centre).

g. **{time}**
The 1253 internal clock stops whenever the power is switched off and restarts from zero at every power-up, initialisation or reset. This selection allows the clock to be reset to a specific time :

(1) **{HOUR ( ) }**
Enter the required hour between the round brackets.

(2) **{HOUR** *hh* **MIN. ( )}**
Enter the required minute between the round brackets (the timing starts from zero seconds).

Chapter 6
Analog Connections

1 FRONT AND REAR PANEL CONNECTIONS

1.1 GENERAL

Always take care when connecting or disconnecting leads: hazardous voltages may be present at the leads. It is recommended that the system under test is powered down and the measuring leads isolated whenever altering the connections to the 1253. Where voltages are likely to be in excess of 30V rms or 60V dc, this becomes essential for safety.

The selection of front or rear panel Analyzer inputs is made via the ANALYZER {INPUT} menu; ensure that this choice is made *before* applying input voltages in excess of 125Vac rms.

1.2 FRONT PANEL CONNECTIONS

Fig. 6.1 shows the 1253 front panel connections.

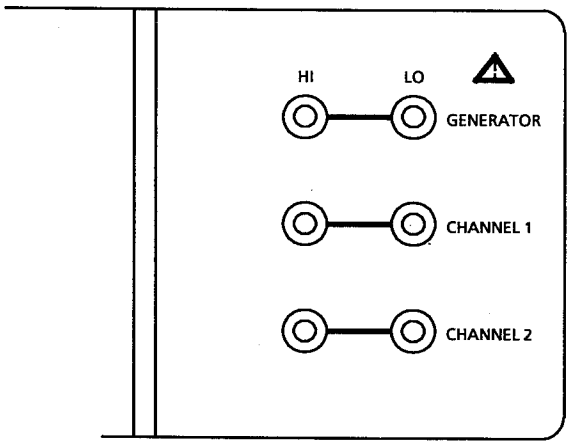


Fig. 6.1 *1253 Front Panel connections*

All connections are made by 4mm sockets. The Analyzer inputs are isolated from ground. The Generator output is also isolated from ground but the LO terminal should not be allowed to float above 15V from ground. A ground connection is available on the rear panel.

1.3 REAR PANEL CONNECTIONS

Fig. 6.2 shows the 1253 rear panel, BNC type, analog connections.All connectors are floating except START/STOP. This means that the outer part of the BNC connectors are not at ground potential.

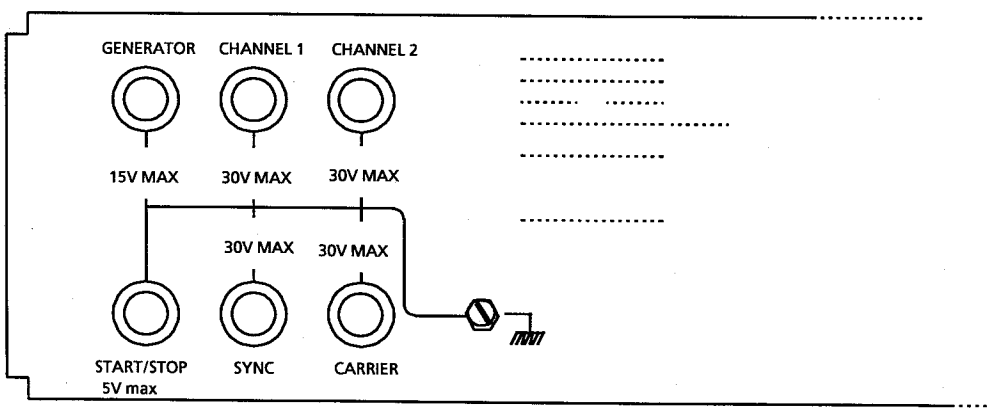
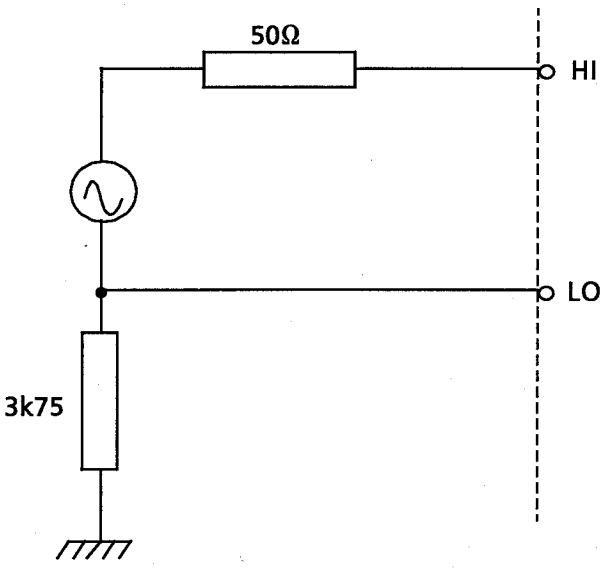


Fig. 6.2 *Rear Panel Analog Connections*

2 EQUIVALENT CIRCUITS

Fig. 6.3 shows the approximate equivalent circuits for the Generator Output and the Analyzer Inputs. They can be used to calculate loading effects on the system under test.

GENERATOR OUTPUT



ANALYZER INPUTS (CHANNEL 1 AND CHANNEL 2)

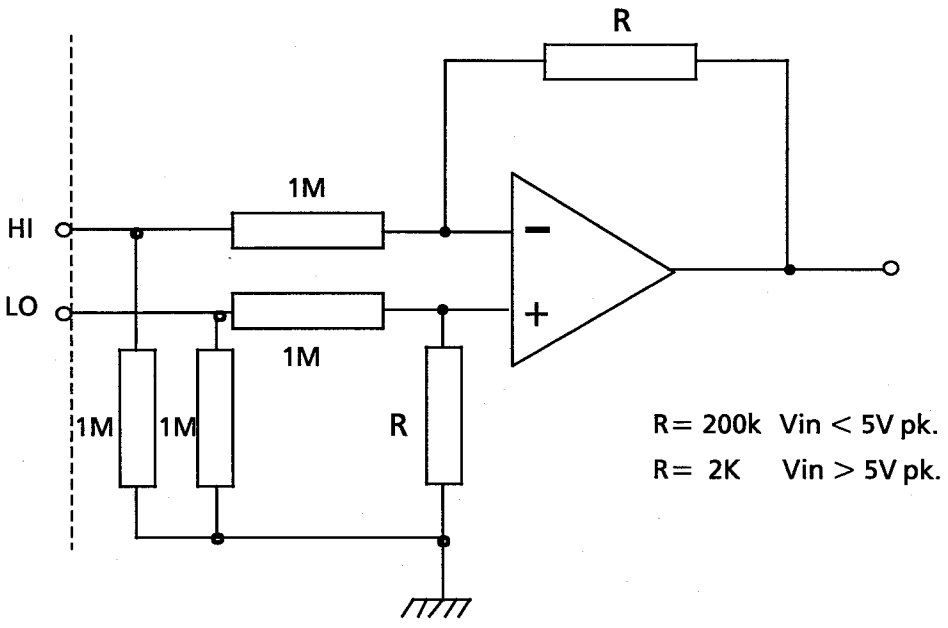


Fig 6.3 *Equivalent circuits*

3 TYPICAL CONNECTION DIAGRAM EXAMPLES

a) Connections to a typical system under test (SUT) –

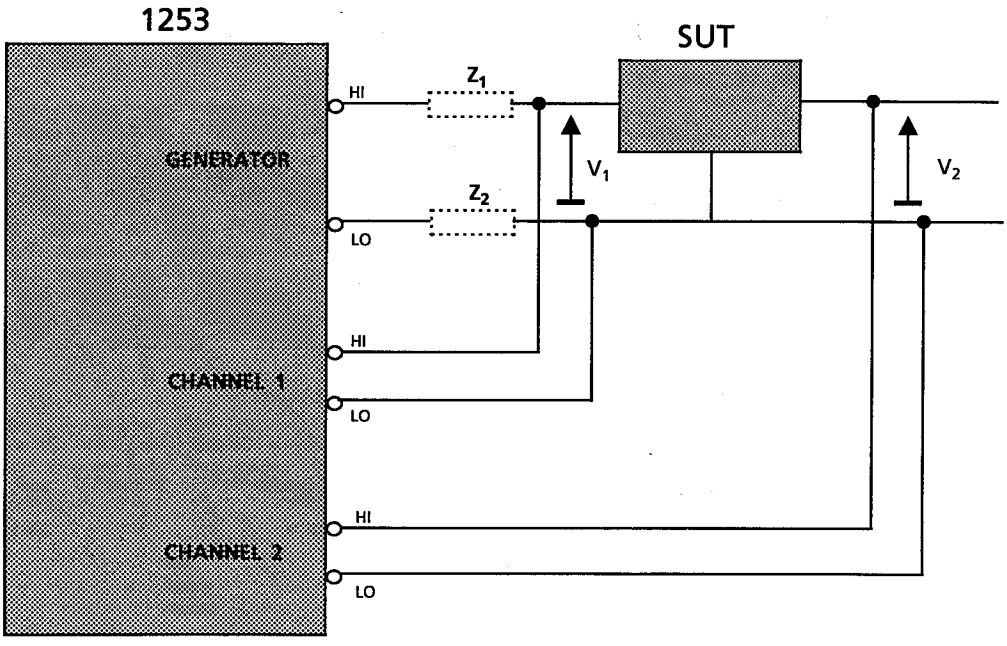


Fig. 6.4 *Connections to SUT*

Connect Channel 1 directly to the system under test and not to the Generator Output. This avoids errors due to the lead resistances Z_1 and Z_2.

b) Measuring the transfer function of part of a system under test –

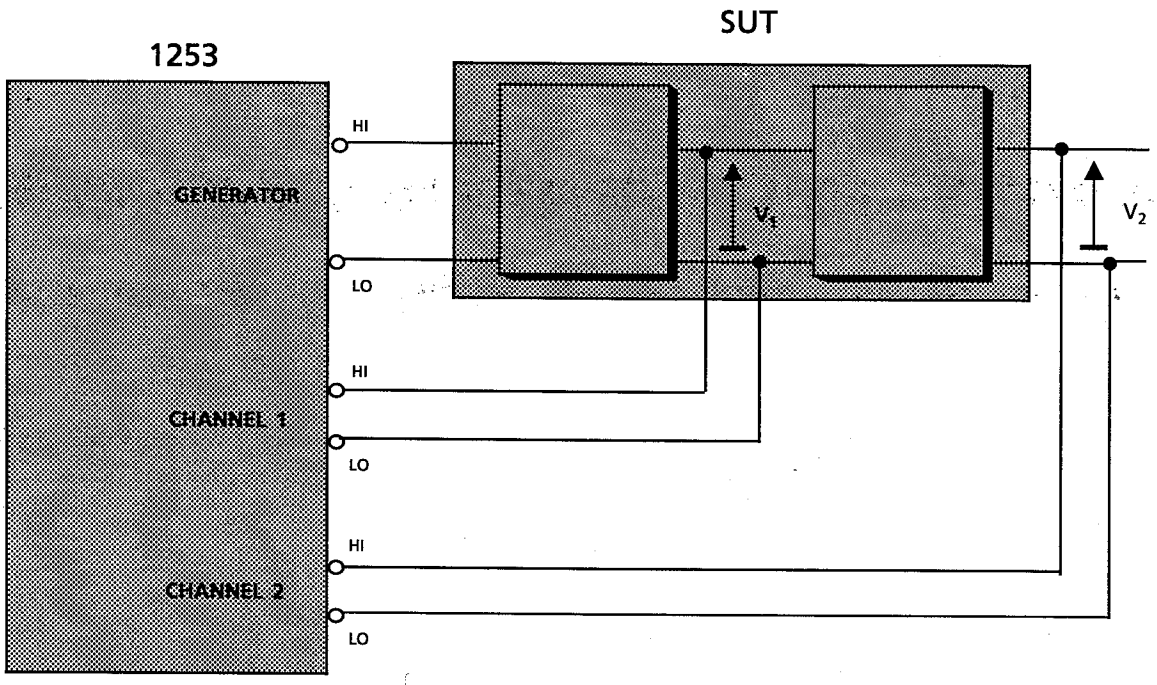


Fig. 6.5 *Measuring the transfer function of part of the SUT*

Chapter 7
RS423; Printer Interface

1 INTRODUCTION

An RS423 serial interface is provided on the rear panel. This is for data output to a printer and can be used for printing results, status information or learnt programs. The interface is always ON, allowing printing at anytime.

Remote control of the 1253 must be performed via the GPIB. See Chapter 8.

2 RS423 STANDARD

The RS423 Serial Interface is also compatible with RS232. Both these are Electronic Industries Association (EIA) standards, published by the Engineering Department under the titles:

> EIA Standard RS232C. Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange, August 1969.
>
> EIA Standard RS423. Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits, April 1975.

3 RS423 CONNECTIONS

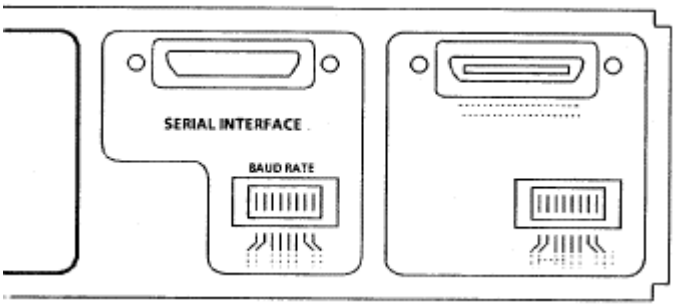


Fig 7.1 *RS423 connector and switches on the 1253 back panel.*

Connection to the RS423 Serial Interface port is made via the 25 way sub-miniature D-type connector on the rear panel. See Fig. 7.1. The pin connections are shown in Fig 7.2.

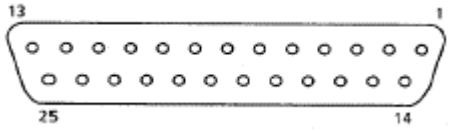


Fig 7.2 *RS423 Serial Interface connector, viewed from rear of 1253.*

pin 1 = Ground
pin 3 = Serial Data from 1253
pin 7 = Ground

pin 4 = RTS (Request to Send)
pin 5 = CTS (Clear to Send)
pin 6 = DSR (Data Set Ready)
pin 8 = DCD (Data Carrier Detect)
pin 20 = DTR (Data Terminal Ready)

4 Baud Rate

The baud rate can be set via the 8 way baud rate block on the rear panel. Choose a value from 110 to 9600.
Only one of the switches should be set in the down position, towards the required baud rate.

If the RS423 port is not in use, set the baud rate to 9600 to maximise the measurement speed.

5 ASCII Output to a Printer

The format of the results sent to the printer is as follows.

Headings :-

FREQUENCY (Hz) Note: this is the measurement frequency	REAL (V) *or* MAGNITUDE (V) or (dBV) no units for point-to point	IMAGINARY (V) *or* PHASE (DEG)	CHANNEL & RANGE *and* HISTORY FILE NO	TIME	STATUS

Results :-

frequency	real part	imaginary part	channel, range/file no	time	status
or;					
frequency	magnitude	phase angle	channel,range	time	status

Magnitude/phase or real/imaginary output is selected via the DISPLAY menu (see chapter 5).

The last result is automatically re-output when menu changes are made that would affect its presentation e.g. changing the DISPLAY from [r,θ] to [a,b], after the new heading.

The range code is as follows :
1 = 30 mV, 2 = 300 mV, 3 = 3 V, 4 = 30 V, 5 = 300 V.

6 Output of Status information

Press the status action key. All 17 lines of settings and status information will be printed out.

7 Printing Learnt Programs

Select {list} from the Learn Program menu, and press Enter. Alternatively, enter the remote command *P n (where n = program number), via the GPIB.

8 Printing the History File

Press the VIEW FILE action key twice, to obtain {list file}, and then ENTER.

Chapter 8
Remote Control- GPIB

1 INTRODUCTION AND STANDARDS

The 1253 can be remotely controlled via the General Purpose Interface Bus (GPIB) Interface. The 1253 can also be used in a system containing GPIB compatible devices (e.g. printers, plotters etc.).

The user will require the following documents to control the 1253 via the interface:

1. The Operating Manual of the external device.

2. The 1253 Operating Manual.

The GPIB Interface conforms to the IEEE 488,1978 standard. The IEEE the publishes complete standard, under the title: “IEEE Standard Digital Interface for Programmable Instrumentation”. A useful introduction to the theory of the GPIB is given in the Solartron monograph: “Plus Bus –the Solartron GPIB”.

1.1 GPIB CAPABILITY CODE

The GPIB Interface in the 1253 conforms to the following sub-functions within the standard, as listed on the rear panel:

SH1	Source Handshake
AHl	Acceptor Handshake
T5	Basic Talker, Serial Poll, Talk Only Selectable, unaddressed if MLA (My Listener Address)
TE0	No Extended Talker capability
L4	Basic Listener, no Listen Only mode, unaddressed if MTA (My Talker Address)
LE0	No Extended Listener capability
SRl	Complete Service Request capability
RL1	Complete Remote/Local capability, with Local Lock-Out
PP2	Parallel Poll with Local Configuration
DC1	Complete Device Clear capability, including Selective Device.Clear
C0	No Controller capability
DT0	No Device Trigger capability
E1	Open Collector Drivers

2 CONNECTIONS

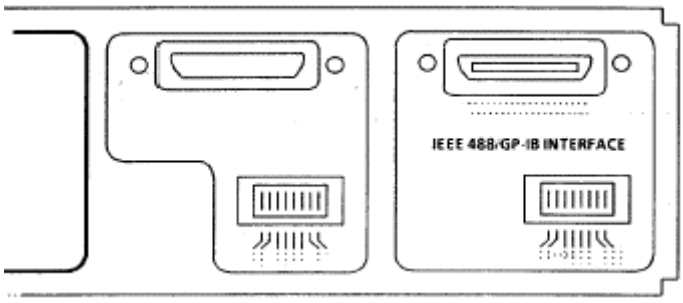


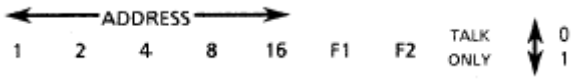
Fig 8.1 *GPIB connector and switches on the 1253 rear panel.*

Connection to the GPIB is made via the 24-way connector on the rear panel of the 1253. See Fig. 8.1. The pin connections conform to the IEEE 489, 1978 Standard.

3 SWITCHES

There are eight GPIB switches on the rear panel of the1253, as shown inFig.81. These switches must be set *before* the instrument can be used in a GPIB system

The eight switches are allocated as follows:



The first five switches select the GPIB address of the 1253. Switches Fl and F2 set up the command terminator characters. The last switch sets the GPIB mode of operation to Talk Only or normal Talker/Listener.

Once the switches have been set, the 1253 must 'read' them, so that their settings can be implemented. The switches are read automatically at 'power on' or when INITIALISE or BREAK are selected. If the switch settings have to be altered after the 1253 has been set up, selecting BREAK enables the new configuration to the read without disturbing any other data within the instrument, apart from the Serial Pall STATUS BYTE and those parameters listed in Chapter 5, Section 8.1.

3.1 ADDRESS SWITCHES

To eliminate problems associated with mixing binary and ASCII information, two GPIB ports are provided. One port is used for ASCII commands and data, the other for high-speed binary (DUMP) output. The same connector pins are used, but a different. address is assigned to each port.

The address of the ASCII input/output port is set up on the five address switches and is called the MAJOR address. It must always be an even number, so the left-hand "1" switch should always be in the up position . The address immediately following a MAJOR address is, of course, always an odd number, and is called the MINOR address. It is automatically assigned to the binary port, which is for high speed binary data (dump) output only.
For example, if the MAJOR address is chosen to be 16, the MINOR address is automatically 17.

3.2 INPUT COMMAND TERMINATOR CHARACTER SWITCHES

Switches F1 and F2 select the terminating character for the GPIB input commands to the 1253 as follows:

F1	F2	Meaning
0	0	= lf (Line Feed)
1	0	= cr (Carriage Return)
0	1	= ; (Semicolon)
1	1	= EOI (End or Identify) signal

Any command terminator other than the one selected is ignored by the Interface.

The choice of command terminator is usually determined by the type of controller used, and should be defined in the relevant controller handbook.

EOI is the title of one of the five GPIB Management Lines. Some controllers automatically assert EOI accompanied by a command terminator, set this to cr, lf or semicolon, to prevent the possibility of command data being lost or corrupted.

3.3 TALK ONLY SWITCH

The 1253 GPIB Interface is put into Talk Only mode when the Talk Only switch is in the down (1) position. The Talk Only mode is used for GPIB plotting and outputting data to a GPIB printer.

3.4 SWITCH EXAMPLE

If the switches are set to 00110010 (read from left to right as viewed from the rear of the 1253):

The MAJOR address is 12
The MINOR address is therefore 13
The Command Terminator is semicolon
The GPIB mode is normal Talker/Listener

4 REMOTE/LOCAL FACILITY

The REMOTE/LOCAL facility enables the 1253 to receive commands from either a REMOTE or a LOCAL source. The REMOTE facility is provided via the GPIB Interface and has priority over other devices. The Local source is the 1253 front panel.

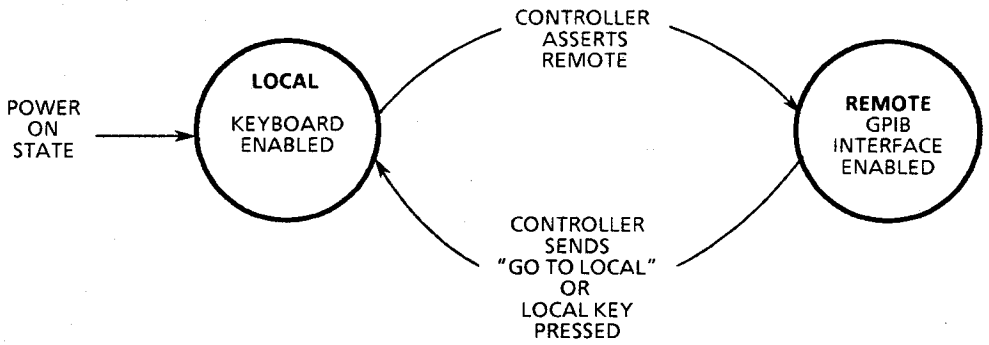


Fig. 8.2 *REMOTE/LOCAL state diagram*

The 1253 powers up in LOCAL mode. Fig. 8.2 indicates how control can be transferred from LOCAL to REMOTE and back again.
The full set of instructions for transfer from LOCAL to REMOTE and vice-versa is given in the IEEE Standard.

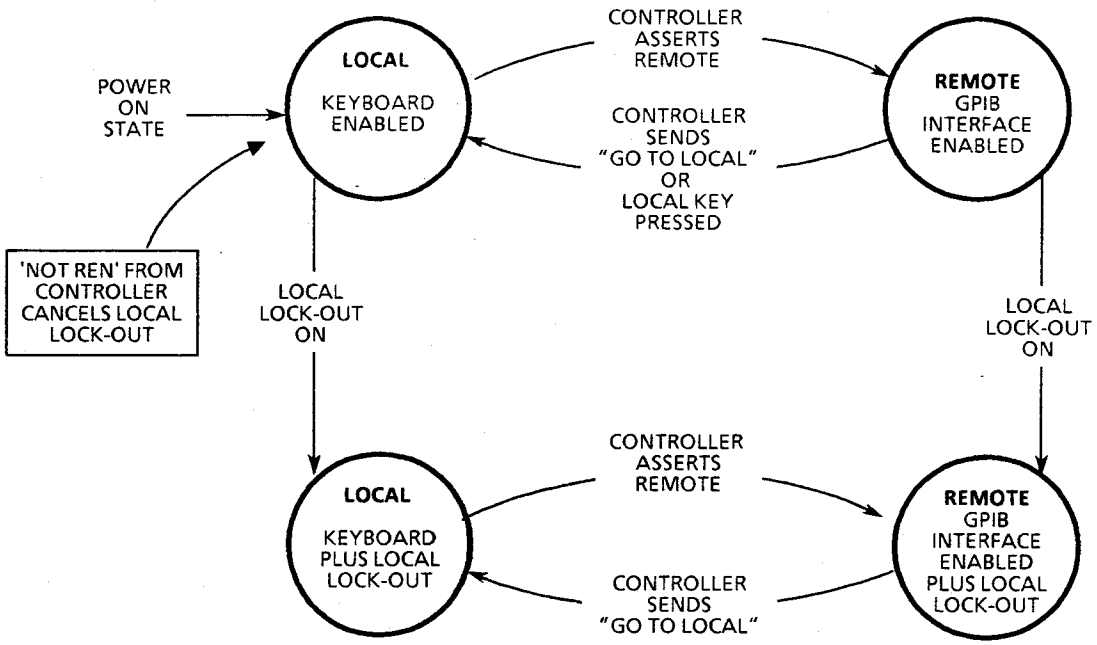


Fig. 8.3 *REMOTE/LOCAL state diagram with LOCAL LOCK-OUT*

4.1 LOCAL LOCK-OUT

The REMOTE/LOCAL facility described above can also have a LOCAL LOCK-OUT condition superimposed by a command from the controller. Once LOCAL LOCK-OUT is on, transfer of control from one device to another can be accomplished only by the GPIB controller.

This facility can be used, for example, to prevent unauthorised front panel manipulations affecting the settings of the 1253. Fig. 8.3 shows the relationship of the LOCAL LOCK-OUT feature to the REMOTE and LOCAL states previously shown in Fig. 8.2.

The LOCAL LOCK-OUT state is cancelled when the REMOTE ENABLE signal from the controller is false, i.e. the controller sends NOT REN.

As in Fig. 8.3, if the controller sends 'GO TO LOCAL', the LOCAL state which was previously in force is resumed.

4.2 COMBINATIONS OF RS423 AND GPIB DEVICES

The RS423 port is always ON, providing data output to a printer. It is unaffected by Remote/Local/Local Lock-out states.
It is therefore possible, to control the 1253 remotely using the GPIB and print out the measurement results via the RS423 interface.

5 1253 REMOTE COMMAND CODES

The 1253 command codes are based on front panel operations. Each command code consists of a simple ASCII-character string, often qualified by an argument (also in ASCII). Command codes are presented below as menu-commands that set menu parameters; instant -action commands that parallel the functions of the action keys; and additional commands that are used mainly to interrogate the 1253. Commands that are different to front panel operations are explained further in each section. For the detailed function of other commands refer to Chapter 5, Menu Terms. The majority of codes are qualified by a numerical argument. In the following lists:

F is a floating point number ± *n.nnnn E ±xx*
I is an integer of up to 2 digits
I, *I* are two integers of up to 2 digits each, separated by a comma
D is an integer of up to 4 digits

5.1 MENU-COMMANDS

	Parameter	Code & Argument		Argument Value/Range	Meaning/ Units
5.1.1	**GENERATOR**				
	AMPL	AM	*F*	0 to 10.23	V
	FREQ	FR	*F*	1E-3 to 100 to 2E4	Hz
	BIAS	BI	*F*	-10.23 to 0 to 10.23	V
	MOD	MO	*I*	0	**off**
				1	on
	(Waveform)	WV	*I*	0	**sine**
				1	square
				2	triangular
	SYNC	SY	*I*	0	**off**
				1	on
	STOP MODE	SM	*I*	0	**freeze**
				1	kill
5.1.2	**ANALYSERS**				
	∫TIME	IS	*F*	0.1 to 1E5	s
	INPUT	IP	*I*	0	**front**
		DE	*I,I*	1	rear
	DEMOD 1			1,0	**off**
		DE	*I,I*	1,1	on
	DEMOD 2			2,0	**off**
				2,1	on
5.1.3	**SWEEP**				
	SWEEP ENABLE	SE		0	**off**
				1	up
				2	down
	FR MIN	MI		1E-3 to 100 to 2E4	Hz
	FR MAX	MA		1E-3 to 2E4	Hz
	LOG INCREMENT	GS		2 to 100 to 9999	points/sweep

	Parameter	Code & Argument		Argument Value/Range	Meaning/ Units
5.1.4	**AXES**				
	X ITEM	XI	*I*	**0**	**log f auto**
				1	log f
				2	a
	X MIN	XL	*F*	-1E9 to **100** to 1E9	
	X MAX	XH	*F*	-1E9 to **20000** to 1E9	
	Y ITEM	YI	*I*	**0**	**r(dB)**
				1	r
				2	θ
				3	b
	Y MIN	YL	*F*	-1E9 to **0** to 1E9	
	Y MAX	YH	*F*	-1E9 to **0** to 1E9	
5.1.5	**DISPLAY**				
	SOURCE	SO	*D*	0100	ch1
				0200	ch2
				0201	**ch2/ch1**
	CO-ORDS	CO	*I*	0	(a,b)
				1	**(r,θ)**
				2	(r(dB),θ)
	ERROR BEEP	BP	*I*	**0**	**on**
				1	off
5.1.6	**GPIB**				
	GPIB	OP	*2,I*	**2,0**	**off**
				2,1	data
				2,2	dump
				2,3	plot
	SERIAL POLL	SV	*I*	**0** to 255	
	PARALLEL POLL	PP	*I*	**0** to 8	
	PAR. POLL SENSE	PS	*I*	0	false
				1	**true**
	O/P SEPARATOR	OS	*I*	**0**	comma
				1	terminator
	O/P TERMINATOR	OT	*I*	**0**	**crlf**
				1	crlf + EOI
				2	cr
				3	cr + EOI
5.1.7	**SCALING**				
	DIVIDE BY	FN	*I*	**0**	**unity**
				1	r,θ
				2	last result
				3	last magnitude
	SCALE r	RF	*F*	-1E9 to **1** to 1E9	
	SCALE θ	TF	*F*	-180 to **0** to 180	degrees

5.2 INSTANT-ACTION COMMANDS

	Function	Code & Argument		Argument Value/Range	Meaning/ Units
5.2.1	**GENERATOR**				
	STOP	SG			
5.2.2	**ANALYSERS**				
	SINGLE	SI			single
	RECYCLE	RE			recycle
		SA			stop
5.2.3	**PLOT AXES**				
	PLOT AXES	PA			
5.2.4	**VERNIER**				
	VERNIER	VA	*I*	0	off
				1	frequency
				2	amplitude
				3	bias
5.2.5	**VIEW FILE**				
	DISPLAY	UF	*D*	1 to approx 400*	output file number
	LIST	FO			
5.2.6	**PAUSE/CONTINUE**				
	PAUSE	CP			
5.2.7	**LEARN PROGRAM**				
	LEARN	*L	*I*	1 to 9	program no.
	EDIT	*E	*I*	1 to 9	program no.
	EDIT NEXT LINE	*F			
	EDIT PREVIOUS LINE	*B			
	DELETE LINE	*D			
	INSERT MODE	*I			
	EXIT	*Q			
	JUMP	JP	*I*	1 to 99	Jump to line
	CLEAR	*C	*I*	1 to 9	program no.
	COPY	*K	*I,I*	1 to 9, 1 to 9	prog. no. to prog. no.
	LIST	*P	*I*	1 to 9	program no.

Function	Code & Argument		Argument Value/Range	Meaning
5.2.8 STATUS				
STATUS	ST			
5.2.9 EXECUTE PROGRAM				
EXECUTE	EP	*I*	0 to 15	prog. no.
5.2.10 BREAK/SELF TEST				
BREAK	BK			
SELF TEST	TT	*I*	0	drift correct
			1	initialise
			2	reset
			3	check
			4	test
			5	calibrate**
TIME	TM	*I,I*	0 to 99,	hours
			0 to 59	minutes

* The maximum file size depends upon the memory set aside for learnt programs.
** This is part of the calibration procedure and should not normally appear (see Technical Manual).

5.3 ADDITIONAL COMMANDS

Menu	Parameter	Code & Argument	Response	Meaning
GENERATOR	SYNC STATUS*	?SN	*I*	0 off
				1 idle
				2 wait
				3 locked
				4 fault1
				5 fault 2
				6 fault 3
	SYNC FREQ.	?SF0	*F*	input freq.
		?SF1		max freq.
		?SF2		min freq.
		?SF3		start freq.
		?SF4		stop freq.
		?SF5		average freq.

Menu	Parameter	Code& Argument	Response	Meaning
ANALYZERS	CHANNEL 1 RANGE SELECTED	?AR *1*	*I*	1 30mV 2 300mV 3 3V 4 30V 5 300V
	CHANNEL 2 RANGE SELECTED	?AR *2*	*I*	as for ?AR1
VIEW FILE	FILE POPULATION	?FP *0*	*I*	no of results filed
	FILE POINTER	?FP *1*	*I*	present file no.
	FILE SIZE	?FS	*I*	100 to ~400**
PROGRAM	PROGRAM LENGTH	?PN *I****	*I*	no of blocks
BREAK/SELF TEST	SELF TEST RESULT	?TS *0*	*I*	0 pass 1 fail
MISCELLANEOUS	LAST ERROR	?ER		0 to 99 last error no.
	SOFTWARE VERSION	?VN	*I*	1 to 99 software version
	CLEAR LAST ERRORS	CE		clears last error indication
	REPEAT LAST RESULT	DO		

* The Sync Status codes are explained in Chapter 10 section 1.3
** The max. file size depends upon memory set aside for learnt programs
*** Enter program number

5.4 ALL COMMANDS (ALPHABETICAL ORDER)

CODE	MENU/KEY	PARAMETER/SELECTION
AM	GENERATOR	AMPL
BI	GENERATOR	BIAS
BK	BREAK/TEST	BREAK
BP	DISPLAY	ERROR BEEP
CE	MISCELLANEOUS	CLEAR LAST ERRORS
CO	DISPLAY	CO-ORDS
CP	PAUSE/CONT	PAUSE
DE	ANALYZERS	DEMOD
DO	MISCELLANEOUS	REPEAT LAST RESULT
EP	EXEC. PROGRAM	EXECUTE
FO	VIEW FILE	LIST
FN	SCALING	DIVIDE BY
FR	GENERATOR	FREQ
GS	SWEEP	LOG INCREMENT (points/sweep)
IP	ANALYZERS	INPUT
IS	ANALYZERS	∫ TIME
JP	PROGRAM	JUMP
MA	SWEEP	FR MAX
MI	SWEEP	FR MIN
MO	GENERATOR	MOD
OP 2,	GPIB	GPIB
OS	GPIB	O/P SEPARATOR
OT	GPIB	O/P TERM I NATOR
PA	PLOT AXES	PLOT AXES
PP	GPIB	PARALLEL POLL
PS	GPIB	PAR POLL. SENSE
RE	RECYCLE	START
RF	SCALING	SCALE *r*
SA	RECYCLE	STOP
SE	SWEEP	SWEEP ENABLE
SG	GENERATOR	STOP
SI	SINGLE	START
SM	GENERATOR	STOP MODE
SO	DISPLAY	SOURCE
ST	STATUS	STATUS
SV	GPIB	SERIAL POLL
SY	GENERATOR	SYNC
TF	SCALING	SCALE θ
TM	BREAK/TEST	TIME
TT	BREAK/TEST	SELF TEST
UF	VIEW FILE	VIEW
VA	VERNIER	VERNIER
WV	GENERATOR	Waveform (by remote command only)
XH	AXES	X MAX
XI	AXES	X ITEM
XL	AXES	X MIN
YH	AXES	Y MAX
YI	AXES	Y ITEM
YL	AXES	Y MIN
*B	PROGRAM	EDIT PREVIOUS LINE

CODE	MENU/KEY	PARAMETER/SELECTION
*C	PROGRAM	CLEAR
*D	PROGRAM	DELETE LINE
*E	PROGRAM	EDIT
*F	PROGRAM	EDIT NEXT LINE
*I	PROGRAM	INSERT MODE
*K	PROGRAM	COPY
*L	PROGRAM	LEARN
*P	PROGRAM	LIST
*Q	PROGRAM	EXIT
?AR	ANALYZERS	LAST RANGE USED
?ER	MISCELLANEOUS	LAST ERROR
?FP	VIEW FILE	FILE POP./POINTER
?FS	VIEW FILE	FILE SIZE
?NR	VIEW FILE	NO. OF READINGS
?PN	PROGRAM	LENGTH
?SF	GENERATOR	SYNC. FREQ
?SN	GENERATOR	SYNC. STATUS
?TS	BREAK/TEST	SELF TEST RESULT
?VN	MISCELLANEOUS	SOFTWARE VERSION

6 INTERROGATING PARAMETERS

Menu parameters can be interrogated by remote command. Simply prefix the code normally used to set up the parameter with a question mark. A number, *n*, is required in commands having more than one argument, e.g. ?TM0 will give the 'hours' value of time, and ?TM1 will give the 'minutes' value. If *n* is unspecified it defaults to zero.

7 MEASUREMENT OUTPUT

7.1 GPIB PORT

Output of results to the GPIB port is controlled by the GPIB menu; (Chapter 5, Section 6). Results can be output as ASCII characters (select [data]) or as binary data (select [dump]). The ASCII output can be tailored to suit either a printer or a controller. The binary data can only be interpreted by a controller.

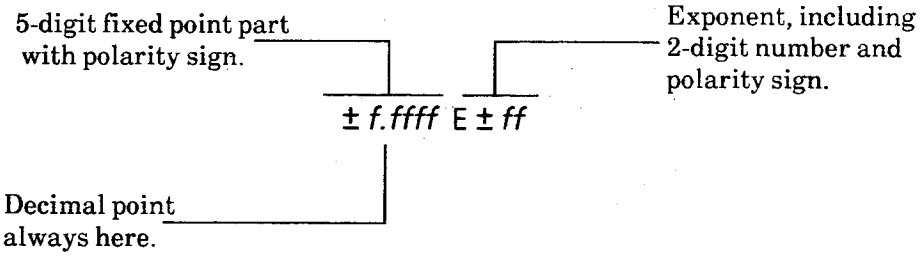
WARNING: If devices are not connected to the GPIB port always select [off]. Any other selection may cause the 1253 to stop measuring.

7.1.1 Output to a Printer (GPIB Talk Only)

This mode of presenting measurement results to the GPIB is selected by setting the TALK ONLY switch on the rear panel of the 1253 to ON. The 1253 then sends data to the GPIB ASCII port (major address) in a format suitable for GPIB-compatible printers. The format is the same as the RS423 output for a printer (chapter 7), but the Output Terminator and Separator are selected by the GPIB menu.

7.1.2 Normal Mode Output (Talker / Listener)

This mode of presenting measurement results is selected by setting the TALK ONLY switch on the rear panel of the 1253 to OFF and the GPIB menu selection to [data]. The data output is in compressed form, suitable for interpretation by a controller. The 1253 automatically allocates to each parameter a constant field width of 11 characters, containing a 5-digit fixed point part and a 2-digit exponent. For example, the frequency field is of the form:



A complete reading takes the form:

$$\pm f.fffffE \pm ff, \pm a.aaaaE \pm aa, \pm b.bbbbE \pm bb, ecr$$

frequency	a	b	error code
frequency	r	θ	error code
frequency	r(dB)	θ	error code

where *e* represents a 1-digit Error Code. Only the last digit of Group 8 Error Codes is reported. In this example, the Output Separator character is shown as a comma, and the Output Terminator is cr. i.e. Carriage Return.

The Output Separator and Terminator are selected by the GPIB menu.

No form of heading is available and the last result is not re-output after menu changes. Use the "DO" remote command to read the last result again (e.g. after changing the SCALING menu).

7.1.3 Dump Output

This mode provides the fastest means of outputting data from the 1253 and is selected by setting the TALK ONLY switch on the rear panel of the 1253 to OFF and the GPIB menu selection to [dump]. As the data is in binary form, however, it is suitable only for processing by a computer or for storage pending subsequent processing. Each reading is compressed into 12 bytes of binary information.

The format is:

aaaabbbbffff

which represents 3 × 4-byte floating point numbers, where:

aaaa	=	in phase data
bbbb	=	quadrature data
ffff	=	frequency

The floating point format used is explained in section 7.2 of this Chapter.

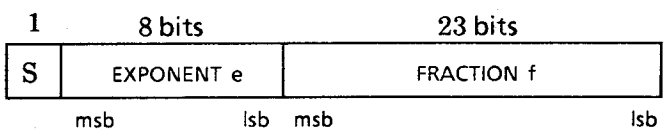
No separators or terminators are sent (as there is no way they can be distinguished from binary data), but if the Output Terminator, selected via the GPIB menu is either [cr + EOI] or [crlf + EOI], then EOI is asserted simultaneously with the 12th byte.

The output rate is approximately 1 byte per millisecond, as for the ASCII port, but the data is compressed into only 12 bytes compared with up to 40 bytes for ASCII. Also, in this mode, the 1253's internal computation time is much less.

No form of heading is available and the last result is not re-output after menu changes. Use the "DO" remote command to read the last result again (e.g. after changing the SCALING menu)..

7.2 FLOATING POINT FORMAT ('dump' data)

The floating point format conforms to the ANSI / IEEE Standard 754. It consists of a 4 byte (32 bit) floating point number, as shown below:



S = Sign bit
msb = most significant bit
lsb = least significant bit

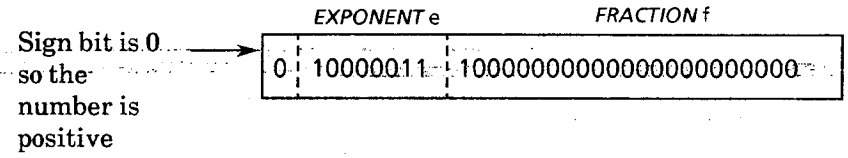
The value of the number is $(-1)^s 2^{e-127}(1.f)$ provided that $0<e<255$

NOTE:
1. A zero sign bit indicates a positive number, a 1 sign bit indicates a negative number.
2. If e = 0 and f = 0, the value of the floating point number is zero.
3. If e = 255 and f = 0, the value of the floating point number is $\pm\infty$

Example : To convert the following 4 byte binary number to decimal :-

Byte 1 contains	01000001_2	(most significant byte)
Byte 2 contains	11000000_2	
Byte 3 contains	00000000_2	
Byte 4 contains	00000000_2	(least significant byte)

The floating point number is arranged as follows :-



$e = 131_{10}$

The exponent represents $2^{131-127}$

$= 2^4$

$= 16_{10}$

The fraction part $= 1.f_2$

$= 1.10000000000000000000000_2$

$= 1.5_{10}$

The floating point number is therefore 1·5 x 16 = + 24

8 SERIAL POLL/PARALLEL POLL

The 1253 can be configured to interrupt other GPIB activities by asserting a Service Request (SRQ) when a particular event has occurred, e.g. End of Sweep, or Data Ready. When the controller detects that SRQ has been asserted it may 'poll' the bus to find out which device requires service. Polling can either be 'parallel', where all the devices on the bus are interrogated simultaneously, or 'serial', where each device is interrogated in turn.

8.1 SERIAL POLL

8.1.1 The Status Byte

The GPIB interface includes an 8-bit register which holds the STATUS BYTE (STB). The STB is interrogated when the controller initiates a serial poll, and contains the following status data:

128 DATA READY	64 RQS	32 END OF PROGRAM	16 END OF FILE	8 END OF PLOT	4 END OF SWEEP	2 END OF MEASURE	1 ERROR

When a particular condition exists, e.g. 'End of Plot', the corresponding bit is set to '1'.

The values of all the bits, except bit 1 and bit 64, continuously follow status changes: e.g. if the 1253 is on RECYCLE, bit 2 is set to '1' as each measurement is completed, then reset to '0' as a new measurement starts.

The RQS (Request for Service) bit 64 is set when the 1253 interface generates an SRQ (Service Request). A '1' in the RQS bit tells the controller that this device generated the SRQ. All 8 bits of the STB appear on the DI/O lines when the 1253 is interrogated.

The other seven bits identify which event(s) caused the SRQ. They are:

Bit 128, Data Ready. Set when data is available for ASCII or binary output to the GPIB.

Bits 32, 16, 8, 4 and 2. These indicate respectively the status of the program, the file, the plotter, the sweep and the present measurement. The 'End of File', bit 16, is set when either:

(a) The nth reading is stored in the file, where 'n' is the specified file size in blocks (100 minimum), or

(b) The final reading, whatever number this may be, is read from the file.

Bit 1, the Error bit. Set when a 1253 error or warning is detected.

To display the contents of the STB on the 1253 front panel, use the STATUS action key and select line 15: 'GPIB: STB, I/P terminator', which shows the STB bit values, updated every second.

NOTE : Once a status bit is set it remains set, until the function is no longer true for that bit eg. if the END OFSWEEP bit is set, it remains set until a new sweep is commanded.

8.1.2 Configuring the 1253 to Generate SRQ

Configure. The 1253 can be configured to generate a Request for Service (and set the RQS bit) when a single specified event occurs, or when any one of several specified events occur. Alternatively, if several of the STB bits must be monitored simultaneously, the controller can be programmed to serial poll at regular intervals without using SRQ at all.

To configure the 1253 to interrupt an event set the GPIB SERIAL POLL value to *n*,or send the remote command" SV*n*",where *n* is an integer from 1 to 255, representing the binary value of the STB with the specified event bit(s) set to '1'.

For example, $n=8$ (STB = 00001000) causes the 1253 to generate SRQ at the next End of Plot; $n=25$ (STB = 00011001) causes SRQ to be generated at whichever event occurs first of 'End of File', 'End of Plot', or 'Error' (i.e. bits 16 +8+1).

Once the 1253 has generated an interrupt, it must be reconfigured before it will generate another.

Unconfigure and Clear. Setting SERIAL POLL to zero or sending code SV0 unconfigures an existing interrupt and also clears bit 1 ('Error').

Pressing the BREAK/SELF TEST front panel key and entering {break} unconfigures an existing interrupt and also clears the whole STB. If the BREAK/SELF TEST key is used to enable the 1253 to read the GPIB switches, the STB must be reconfigured afterwards.

The RQS and Error bits are automatically cleared by any SV command, by entering BREAK, by initialising, resetting and by power off.

8.2 PARALLEL POLL

The 1253 can be configured to give a parallel poll, true/false response, on a selected GPIB data line, to indicate whether the 1253 is requesting service or not. The 1253 must first be configured for serial poll to define which event(s) shall assert SRQ (see 8.1.2 above).

To set up a parallel poll configuration set the GPIB PARALLEL POLL value to *n*, or send the remote command "PP*n*", where *n* is an integer from 1 to 8, defining which GPIB data line is to carry the response.

Setting PARALLEL POLL to zero or sending PP0 unconfigures parallel poll.

To select the sense of the parallel poll line set the GPIB PP SENSE value to *n* or send the remote command SE*n* where $n=1$ signifies 'true' and $n=0$ signifies 'false'.

The parallel poll response is also cleared by *any* change to the SERIAL POLL value, by any BREAK action-key selection and by power off.

Unlike serial poll, parallel poll need not be reconfigured after each interrupt.

9 GPIB PLOTTING

The Gain-Phase Analyzer can be connected to a plotter via the GPIB. Results are plotted as an A4 size graph.The 1253 can be connected to A3 plotters, but A4 graphs will still be drawn.

The 1253 is compatible only with plotters using Hewlett-Packard Graphics Language (HPGL). These plotters require that the 1253 plotter commands have a 'comma' as output separator and 'crlf' as output terminator. Both are the default characters.

If the GPIB plotter in use can be put into Listen Only mode, it can be driven directly from the 1253 without needing a controller on the bus. To operate in this way, ensure that the GPIB menu is set to [plot], so that only plotter commands are passed to the GPIB. Set the plotter to Listen Only, and the 1253 rear panel switch to Talk Only.

However, if the plotter has no Listen Only mode, a controller is necessary to instruct the plotter to 'listen' to the 1253. To operate using a controller on the GPIB, set both plotter and 1253 to normal Talker/Listener modes, and switch the GPIB menu to [plot]. Serial Poll can be used to signal the end of plotting, as described in Section 8.1 above. In this case, configure the 1253 to set bit 8 of the status byte at 'End of Plot'.

After a menu change affecting the measurement form, the previous result is not sent to the plotter again (results are re-output to the front panel display).

If the plotter is removed, return the GPIB menu to [off]. Failure to do this may cause the 1253 to stop measuring.

10 GPIB CONTROLLER : PROGRAM EXAMPLES

To clarify the use of GPIB port for remote control of the 1253, several examples are given of GPIB Controller programs. Each example is written as a series of abbreviated commands, including some BASIC programming language instructions. The programs are representational only and are not necessarily suitable for directly programming a Controller.

10.1 LANGUAGE USED IN PROGRAM EXAMPLES

The examples are intended to show the required sequence of events, as they affect the controls of the 1253. Other GPIB commands, such as Enable Signals and Addressing, are omitted. The most commonly used instructions are listed below, with a full explanation of their meaning.

Instruction	Meaning
OUTPUT " "	Send to the 1253 the string of characters within inverted commas, plus a Command Terminator.
INPUT	Receive data from the 1253.
INPUT A	Receive data from the 1253 and store it in Location A.
PRINT "FREQUENCY =",A	Print the statement: Frequency = "the value stored in location A".
DIM A$ (100)	The Controller is instructed to allocate sufficient temporary store space to accommodate a maximum of 100 character strings. A string could consist of a Learnt Program Command, a stored reading from the File etc. The store area is given the name A$.
FOR I = 1 to N INPUT A$ (I) NEXT I	This is a loop instruction telling the Controller to store each line of the 1253's output in area A$, from Line 1 to the final Line N. The loop instruction terminates when I = N.

This language is also used in Chapter 10 (Learnt Programs) to illustrate Remote Command Storage via the GPIB.

10.2 EXAMPLE 1 : OUTPUTTING READINGS TO GPIB

The use of comma as Separator and crlf as Terminator is assumed.

Instruction	Meaning
OUTPUT "CO0"	Select co-ordinates *a, b.*
OUTPUT "OP 2, 1"	Send all readings to the GPIB
OUTPUT "SI"	Make a Single measurement
INPUT F, A, B, E	Store the results of the measurement
PRINT "FREQ =", F	
PRINT "a =", A	
PRINT "b =", B	Print the results of the measurement
PRINT "error =", E	

Note that the results sent to the GPIB ASCII port are from the same Source Channel and are in the same co-ordinates as the results displayed on the Front Panel.

10.3 EXAMPLE 2 : OPERATING SEQUENCE FOR GPIB PLOTTER, USING A CONTROLLER

To perform a GPIB plot using a Controller, first set up the 1253 for the desired sweep and set the plotter controls. This preliminary setting up can either be performed using the Front Panel keys or remotely from the Controller.

The Controller program should now continue:

Instruction	Meaning
OUTPUT "SV8"	Configure SRQ for end of plot
OUPUT "RE"	Recycle

The Controller must now instruct the 1253 to "talk" and the plotter to "listen". Plotting will commence and continue until an interrupt is asserted by the 1253 to signal End of Plot. Alternatively, the controller can interrogate the STATUS BYTE continuously by Serial Polling, until it detects that the End of Plot bit has been set.

10.4 EXAMPLES 3 & 4: OUTPUTTING THE HISTORY FILE TO GPIB

There are two methods of transferring the contents of the History File to an external device via the GPIB port, depending on the rate at which the controller can handle data.

EXAMPLE 3: (Fast Method) Controller Program For Copying The History File To The GPIB Without Handshake

The 1253 transmits the History File contents at the rate of approximately one reading every 40ms (12ms for [dump]). Provided that the controller rate is faster than this, the 1253 merely has to 'list' the History File at its maximum speed.

Instruction	Meaning
DIM A$ (100)	Allocate temporary store space
OUTPUT "?FP0"	Query number of lines in File
INPUT N	N = number of lines in File
OUTPUT "OP2,1"	Output all readings to GPIB
OUTPUT "FO"	List File
FOR I = 1 to N	
INPUT A$ (I)	Store all readings from File until I = N
NEXT I	

EXAMPLE 4: (Slow Method) Controller Program For Copying The History File To The GPIB With Handshake

This method includes a 'handshake' routine to ensure that no data is lost.

Instruction	Meaning
DIM A$ (100)	Allocate temporary store space
OUTPUT "?FP0"	Query number of lines in File
INPUT N	N = number of lines in File
OUTPUT "OP2,1"	Output all readings to GPIB
FOR I = 1 to N	Keep sending UF to the 1253 and store
OUTPUT "UF";I	each reading until I = N
INPUT A$ (I)	Note the "handshake" effect of putting UF inside the
NEXT I	loop, compared with the previous example where FO is outside the loop.

Chapter 9
Error / Warning Codes

1 INTRODUCTION

Error and warning messages tell the user:

a. why the instrument has stopped or failed to respond to a command,
b. of an undesirable situation (e.g. overload),
c. of an internal fault.

Error messages are displayed as, for example, "ERROR 81". They are accompanied by a 'beep' (unless this is disabled by the DISPLAY {ERROR BEEP} menu). Messages may only be displayed briefly, but can be recalled using the STATUS menu (select line 6), or the ?ER remote command.

Error messages are assigned in 10 groups, determined by the first digit of the error number. Brief error explanations are given on the back of the blue pull-out 'menu summary' card. More detailed explanations of each error mesage are presented in section 2.

2 ERROR / WARNING CODE SUMMARY

2.1 GROUP 0: COMMAND STRUCTURE

These errors indicate when the user has incorrectly entered or specified a command.

CODE	*Explanation*
01	Unknown Command.
02	Argument mismatch. The wrong type, or number of arguments was used.
03	Argument out of range.
04	Floating point format error. A floating-point number was incorrectly entered, e.g. 1.2.5E2 instead of 1.25E2.
05	Illegal request for value. Some parameter modes cannot be interrogated. For example, it is meaningless to send '?SG' ('What is the value of Stop Generator').

2.2 GROUP 1: LEARNT PROGRAM

CODE	*Explanation*
11	Illegal edit command. After EDIT has been selected by remote control, only the commands DELETE (*D), INSERT (*I) or QUIT (*Q) can then be used.
12	Command cannot be learnt. Certain commands (e.g. {EDIT}) cannot be learnt.
13	Program does not exist with number specified.
14	Recursion attempted. Programs can only execute each other provided the program executed by the original program does not itself attempt to execute the program that executed it! Programs *can* execute themselves directly provided the 'execute program' instruction is the last instruction entered (before QUIT).
15	Attempt made to change a program whilst a program is running. Before attempting to change a. program, stop the running program using BREAK or EXECUTE PROGRAM 0.
16	Program checksum error. Learnt programs are stored in the 1253 memory; a check sum is calculated and stored with the program data. Before a stored program can be executed, a new checksum is calculated, and compared with the original. Disagreement of the two checksums indicates that the stored data are corrupted: the program is not executed and ERROR 16 is displayed.
17	Program already exists. Previously learnt programs must be cleared before they can be re-learnt.

2.3 GROUP 2: COMBINED PARAMETER

CODE	*Explanation*
22	The combination of AMPL, BIAS and MODULATION (if used) exceeds the maximum output voltage of 15V peak.
23	Sweep is not allowed when the synchronizer is switched on.
25	Either X MIN or Y MIN has been entered as greater than X MAX or Y MAX respectively.
26	*WARNING*: The selected number of points/sweep, is greater than the available file size. The sweep is still allowed to run, but some results will not be filed.
27	FRMAX < FRMIN. If SWEEP ENABLE is on it will be switched off.
28	When plotting, zero or negative values cannot be entered as limits for any axis selected to display *log r* values. For example if the X ITEM is chosen as [*log f*] then X MIN cannot be – 0.5.

2.4 GROUP 3: GENERATOR

CODE	*Explanation*
30	Generator stopped.
31	Carrier low
32	Carrier overload

2.5 GROUP 4: LEARNT PROGRAM / HISTORY FILE / VERNIER

CODE	*Explanation*
41	Line number not found. The line number specified in a JUMP command was not found. (Line numbers can only be assigned in remotely compiled programs).
42	JUMP has been commanded outside 'program learn' mode.
43	Attempt to step a VERNIER out of the allowed range (BIAS, AMPL or FREQ).
44	History file empty.
45	Illegal file access. It is illegal to display or list the History File whilst the Analyzer is running.
47	File pointer out of bounds. The user has attempted to read a History File entry that is outside the entries allocated to the file.

2.6 GROUP 6: ILLEGAL INPUT / OUTPUT MANIPULATION

CODE	*Explanation*
60	Attempt made to change input / output device during a learn sequence.
61	Attempt to change operating conditions from a non-enabled I/O device. For example, the keyboard attempts to send commands while the instrument is under 'local lock-out' GPIB control. For more information on states when various devices are enabled see Chapter 8, Remote Control.

2.7 GPOUP 7: SYSTEM

CODE	*Explanation*
70	Out of memory. No further memory is available for the operation attempted. Delete unwanted programs, or reduce program to make more room.
71	Power independent memory corrupted.
73	Calibration constants in error; l out of 3. One out of the three internal copies of the calibration constants is corrupted. The 1253 is still usable and measurements are valid, but contact a Solartron service facility.
74	Calibration constants in error; 3 out of 3. All of the three internal copies of the calibration constants are corrupted. The 1253 is still usable but measurement accuracy is not guaranteed. Contact a Solartron service facility immediately.
75	Commands not allowed if not in 'calibration mode'. The 1253 must be set internally before calibration commands can be used. See Technical Manual.
76	Offsets or multipliers out of range. Attempted calibration has failed. See Technical Manual.

2.8 GROUP 8: MEASUREMENT VALIDITY

CODE	*Explanation*
81	Overload

2.9 GROUP9: SYNCHRONIZER

CODE	*Explanation*
94	Synchronizer not ready or synchronizer fault 1, 2 or 3 has occurred. See Technical Manual.

Chapter 10
Synchronizer and Modulator / Demodulator

1 SYNCHRONIZER

1.1 INTRODUCTION

Some devices in a system under test cannot be stimulated by the 1253 Generator, for example the rotating shaft of a turbine. The Synchronizer monitors a suitable steady signal (measurement frequency) in the system and from this derives a suitable reference for the Analyzers.

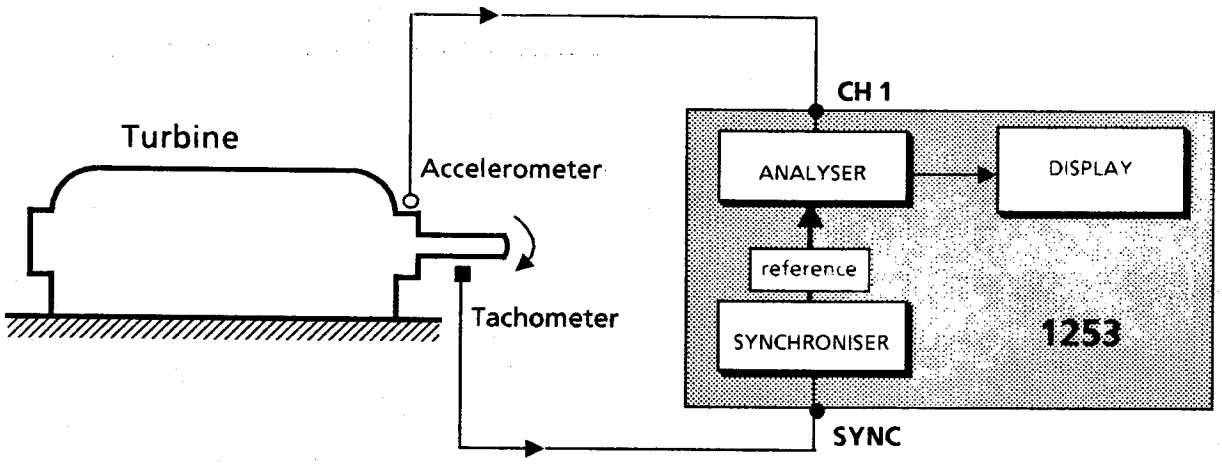


Fig. 10.1 *Example of synchronising. The reference frequency for the vibration analysis is derived from the rotating shaft.*

1.2 THE SYNCHRONISING SIGNAL

The synchronising signal can be any measurement frequency signal in the range 1 to 350V pk (250Vrms). The 1253 uses the positive going edges of the signal to determine the phase and frequency references.

The sharper the leading edges the more accurate the Synchronizer can operate, hence the ideal synchronising signal would be a square wave, or series of pulses. If either of these is used, no pulse width (positive or negative) should be less than 25μs. Sine waveforms can be used satisfactorily.

The normal trigger point is the positive zero-crossing of the signal between Hi and Lo inputs – the outer part of the BNC connector being Lo and the inner part Hi. Triggering on the negative edge of a waveform is achieved by interchanging Hi and Lo connections. Triggering at a voltage other than zero is achieved by biasing the Lo terminal (or Hi terminal for negative edges) to the required trigger voltage with respect to ground, and then applying the trigger signal between Hi (or Lo) and earth. Fig. 10.2 illustrates the arrangement with a TTL synchronizer signal.

Note: The maximum Lo to ground voltage is 30 Volts.

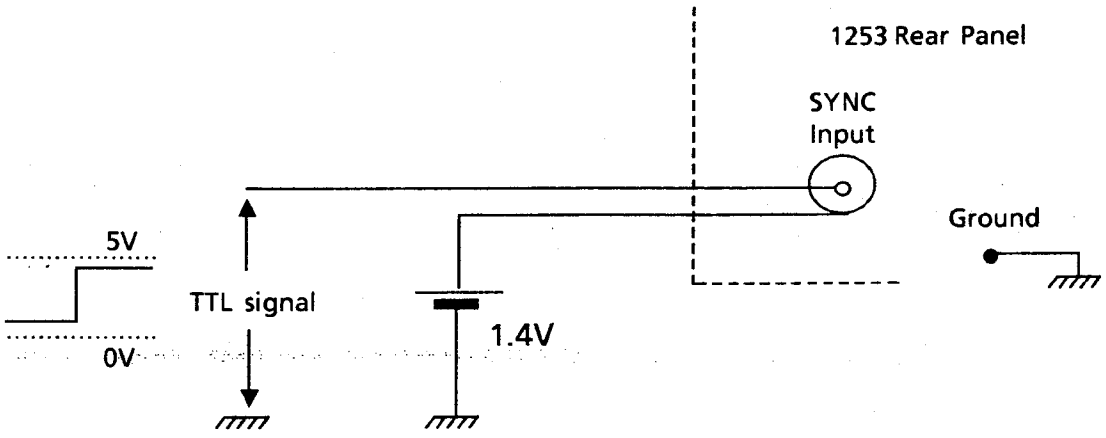


Fig. 10.2 *Adjusting the SYNC trigger level to suit a TTL signal*

1.3 OPERATION

The 1253 measures the period of the synchronising signal, adjusts the frequency of the internal reference (and Generator output) accordingly and then progressively corrects the phase of the reference. In the worst case, the Synchronizer takes the longer of 6 cycles or 500ms to synchronise with a steady signal. The accuracy of frequency measurements is limited by the normal frequency resolution at low frequencies, and by the period resolution at high frequencies.

Allow the Synchronizer to attain synchronism before commanding a measurement. If a measurement is commanded before the Synchronizer is ready, 'ERROR 94' will be displayed. 'ERROR 94' is also associated with a synchronizer fault. The type of fault is listed in the SYNC status information (see below).
To determine the state of the Synchronizer using the STATUS key, select STATUS line 5. The five possible messages displayed against 'SYNC' are:

'off', Synchronizer is off.

'idle', Synchronizer is on but has not yet detected the first two level changes in the synchronising signal.

'wait', Synchronizer is waiting for a stable signal.

'locked', Synchronizer has achieved satisfactory synchronism. Measurements can be taken.

'fault',
1 Frequency overflow. Input frequency > 20 kHz.
2 Time overflow. Input frequency < 1 mHz.
3 Signal unstable. If the input frequency varies by more than 0.1% noisy analyzer results are possible.

If the Analyzers are running, Faults 1 or 2 will cause the measurement to stop.
An attempt to run the Analyzers, while SYNC status is 'idle' or 'wait' will fail and gives ERROR 94.

2 MODULATOR / DEMODULATOR

2.1 INTRODUCTION

The Modulator/Demodulator enables measurements to be made on systems which require amplitude modulated carrier signals. To achieve the full specified accuracy when using Mod/Demod, particularly for carrier frequencies less than 400 Hz, the ratio between the carrier and input frequencies should be kept to integer values. If this cannot be achieved, longer integration times should be used.

2.2 THE CARRIER SIGNAL

The Carrier Signal must be in the range 48Hz to 10kHz and 6 to 250Vrms and is input via the rear panel 'carrier' socket (see Chapter 6, Analog Connections). See Chapter 12, Specfications, for other limits.

2.3 OPERATION

Modulation is enabled by setting the GENERATOR {MOD} parameter [on]. Fig. 10.3 outlines the operation when MOD is [on].

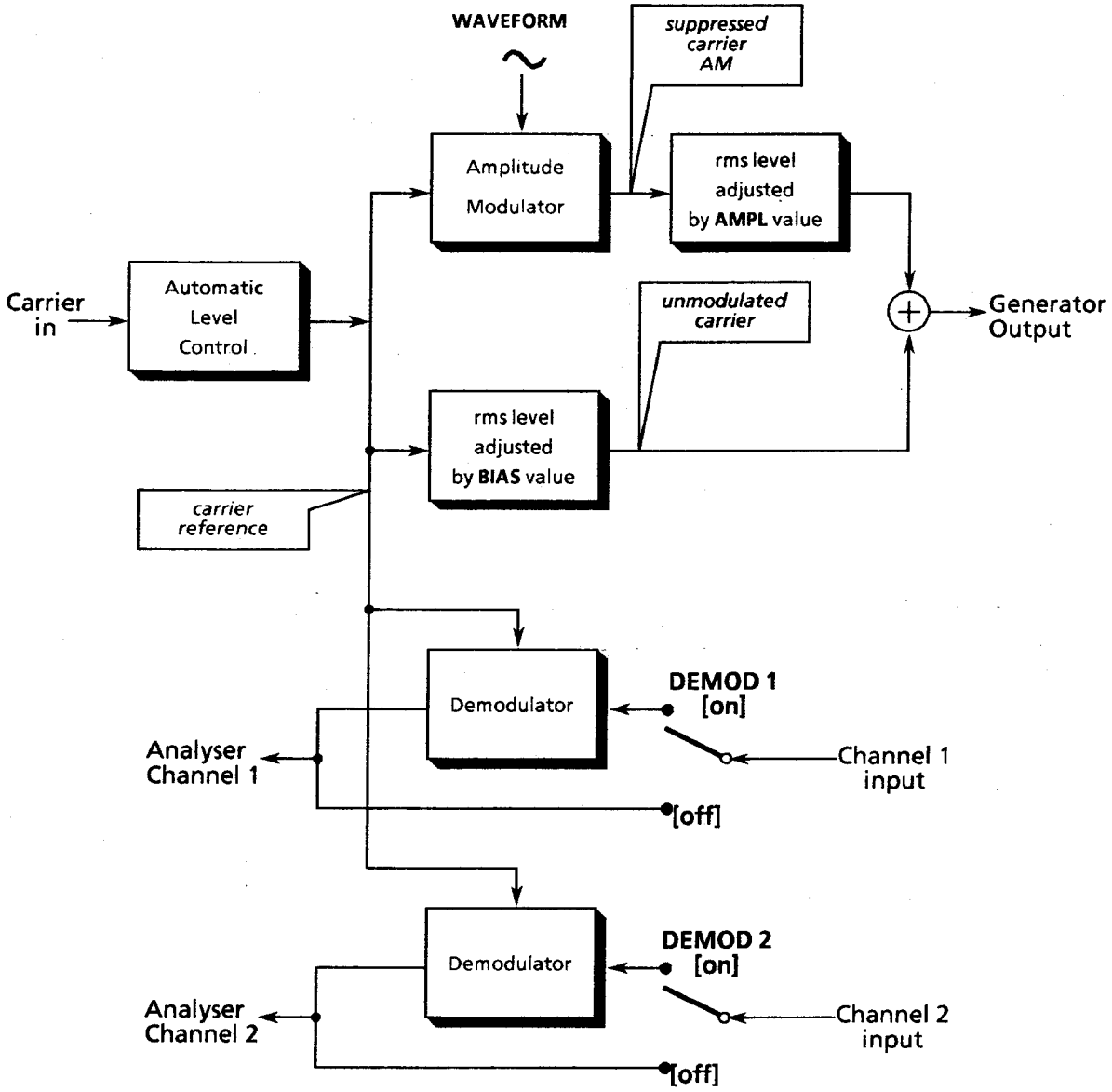


Fig. 10.3 *MOD/DEMOD operation, MOD [on]*

The 'depth' of modulation is set by the relative sizes of BIAS and AMPL

Either Channel can be demodulated by setting ANALYZER {DEMOD 1} menu and/or {DEMOD 2} to [on].

To determine the state of the Carrier using the STATUS page, select STATUS line 2. The three possible messages displayed against CARRIER are:

'off',	No carrier present.
'low',	Carrier is present, but at insufficient amplitude.
'on',	Output is modulated.

Chapter 11
Learnt Programs

1 LEARNT PROGRAM FACILITIES

The 1253 can store a sequence of measurement instructions for execution when required. These Learnt programs are useful where test sequences must be duplicated a number of times, for example in production testing.

One instruction is equivalent to a single menu selection. A typical comprehensive program uses less than 50 instructions, each instruction using one memory block.

Section 2 describes the programming facilities that are available. A simple example is given in Section 3, which provides a useful introduction to programming.

1.1 THE PROGRAM STORAGE AND SIZE

Up to 9 programs (numbered 1 to 9) can be stored in battery maintained memory along with the front panel (menu) settings.

These programs remain in memory for typically 1000 hours after the main supply is removed, but are 'refreshed' whenever mains power is re-applied. A full recharge takes up to 12 hours.

The maximum amount of memory that is available for storing learnt programs is approximately 300 blocks. The actual amount is determined by number of blocks allocated to the History file.

2 PROGRAMMING FROM THE FRONT PANEL

The learnt program facility uses the LEARN PROGRAM and EXECUTE PROGRAM keys. The function of these keys is discussed below.

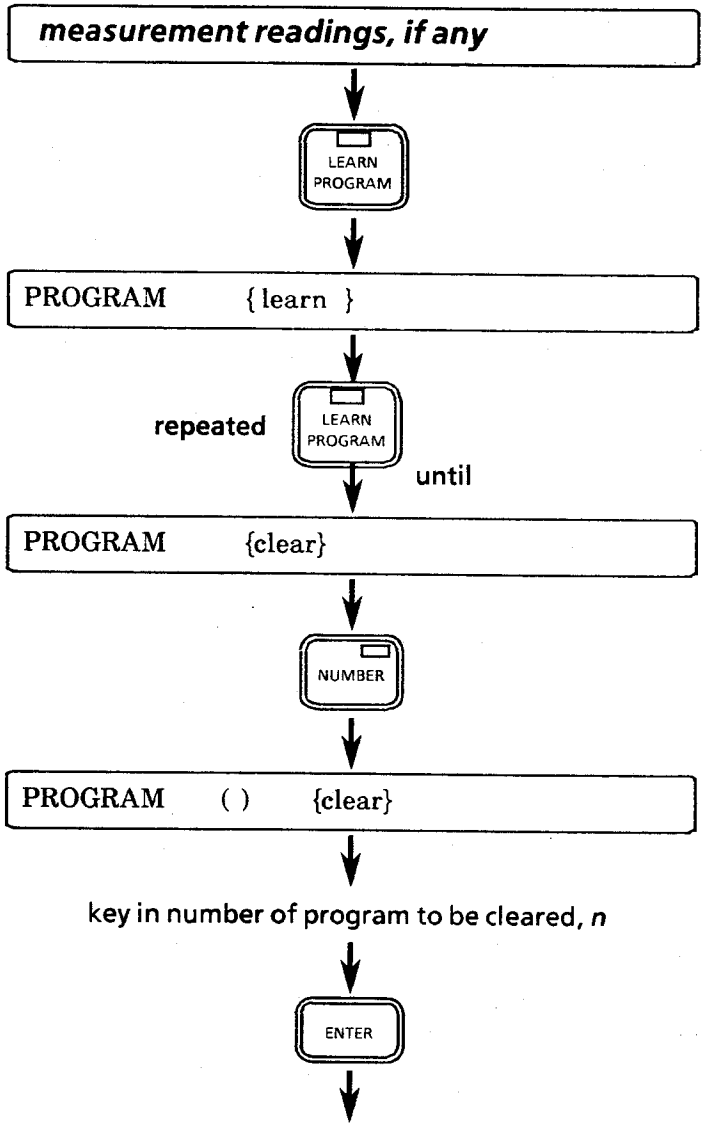
2.1 LEARN PROGRAM selections

Five programming actions are available from the LEARN PROGRAM key:
{clear}, {learn}, {edit}, {copy} and {list}.

These options are selected by repeated presses of the key. After choosing the option, enter the required program number.

2.2 {clear}

For security an existing program must be cleared before it is re-learnt or copied to, otherwise the 1253 returns 'ERROR 17'.Operation of the {clear} selection is outlined below.



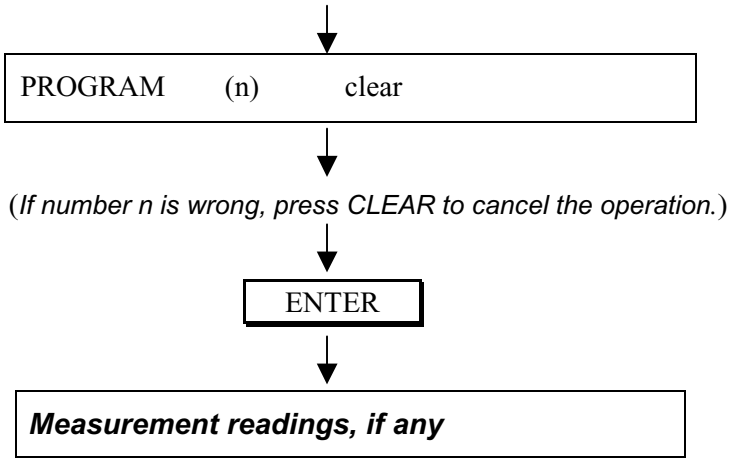
Start with both shift keys 'off'.

The {clear} selection

'Number entry mode' is indicated by the ( ) brackets.

Refer to numbers below each key.

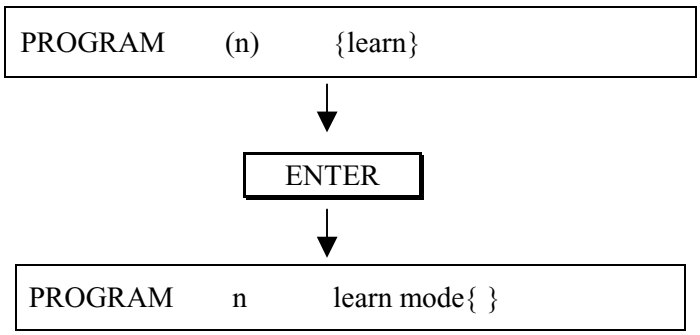
Each LEARN PROGRAM selection works in the same way up to this point.



To clear all menu settings and programs 1 to 9, use the BREAK {initialise} selection.

2.3 {learn}

To learn a new program, select the {learn} option and, using the number-entry key, input the number of the program to be learnt. Then enter the program 'learn' mode by following this sequence:



(*The learn mode is now active.*)

Enter a program by setting up menus in the normal way and pressing action keys when required. Instead of interpreting the set-ups or keys in the normal way, the 1253 interprets each entry as a program instruction and, when the program is executed, each instruction is executed in the order in which it was entered.

Pressing an action key will generally display the remote command code for that key on-display to confirm the entry. However, in the program 'learn' mode some action keys have functions that differ from their normal operation.

a. RECYCLE provides two options for the ANALYZER. These are selected by the repeated presses of the key and finally the ENTER key. {recycle} instructs the Analyzer to perform a series of pre-arranged measurements (generally a SWEEP) or to take measurements continuously. If the latter is selected, the measurements can be stopped only by front panel action (press RECYCLE). {STOP} is used to ensure the Analyzer is stopped before executing the next instruction.

b. **SINGLE** provides two options, selected by repeated presses of the key and then ENTERed:

(i) {single} ANALYZER instructs the Analyzer to perform a single pre-arranged measurement.

(ii) {STOP} ANALYZER is used to ensure the Analyzer is stopped before executing the next instruction.

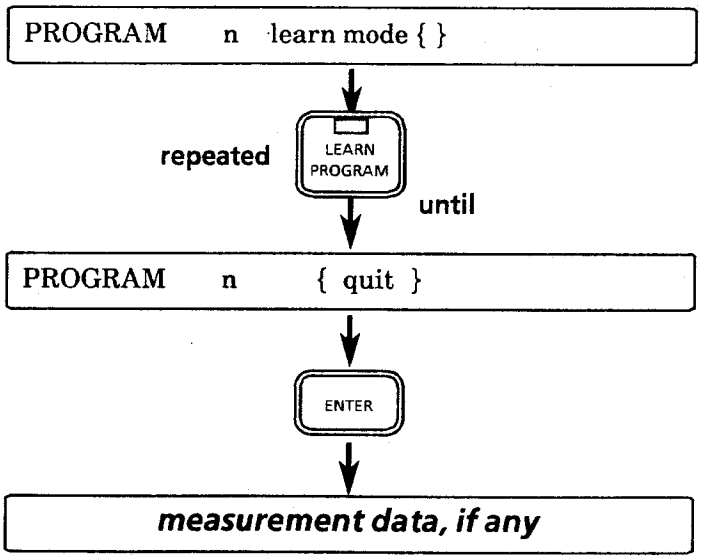
c. **VIEW FILE / STATUS** History file or status information is not shown on the front panel display, during the execution of a learnt program.The results are always sent via the RS423 interface and will be sent via the GPIB , if the 1253 is put into talk-only mode.
If {display file} is learnt via the front panel, only the first line of the history file is printed out.

d. **PAUSE/CONTINUE** inserts a pause (CP) instruction into the program This is used, for example, to adjust a parameter of the system under test, before the next instruction is performed. The PAUSE/CONTINUE LED flashes to indicate a pause, when the program is entered.

e. **EXECUTE PROGRAM** calls another program (use number entry mode to enter number, before pressing ENTER). Programs can execute each other provided any program called does not in its turn call the *original* program (recursion). Programs can call themselves (so looping continuously) provided the 'execute program' instruction is the last instruction entered in the program.

f. **BREAK** cannot be used in a program, other than to break the learning operation.

Once all the program has been learnt, quit the program by following this sequence:



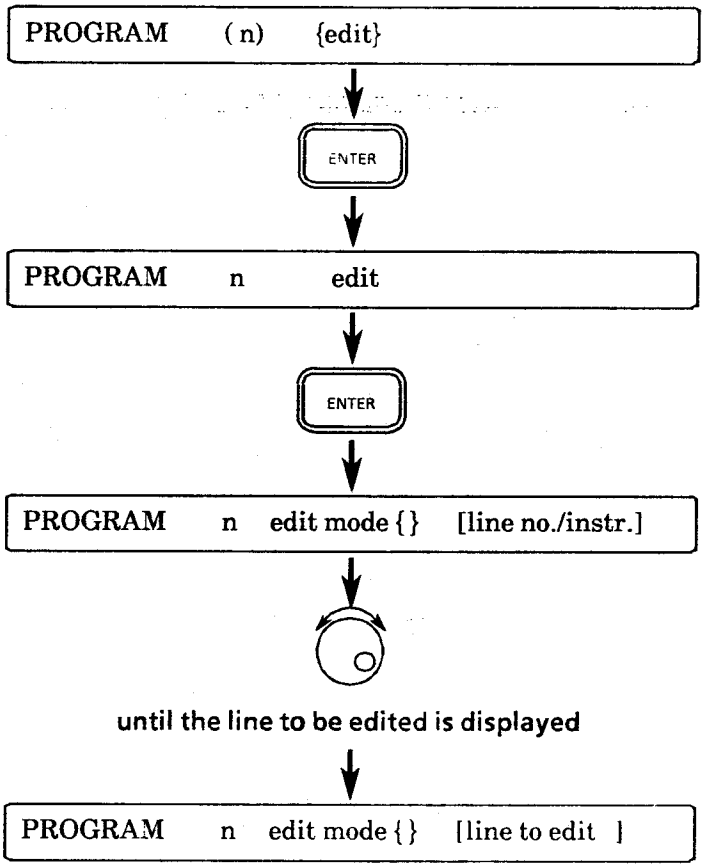
The {quit} selection

The program is now learnt.

2.4 {edit}

Editing is used to modify a Learnt Program by deleting or inserting program instructions (lines).

To edit a program select the {edit} option and key in the number of the program to be edited. Then follow this sequence:



The remote code and parameter value of the first line (instruction) of the program are displayed between [] brackets. Line numbers are also displayed if previously entered by remote control. Otherwise 00 is displayed

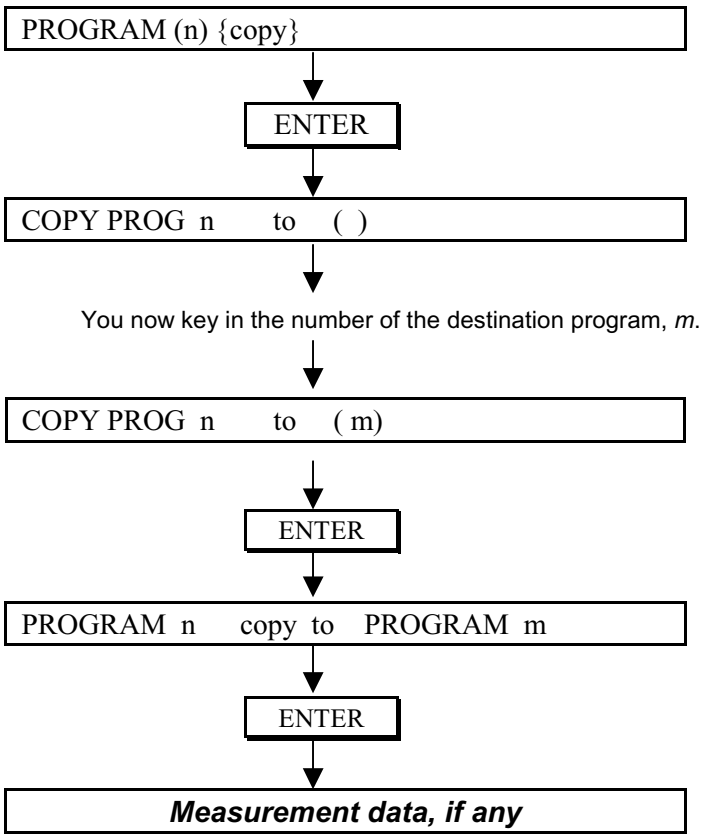
The line to be edited (start of new lines or line to be deleted).

Once the line to be edited is displayed, then it may either be deleted, or new instructions can be inserted *before* it. The options {delete}, {insert} or {quit} are selected by repeated presses of the LEARN PROGRAM key and the line to be edited can be changed by using the rotary knob.

2.5 {copy}

Copying is used to make duplicate copies of learnt programs.

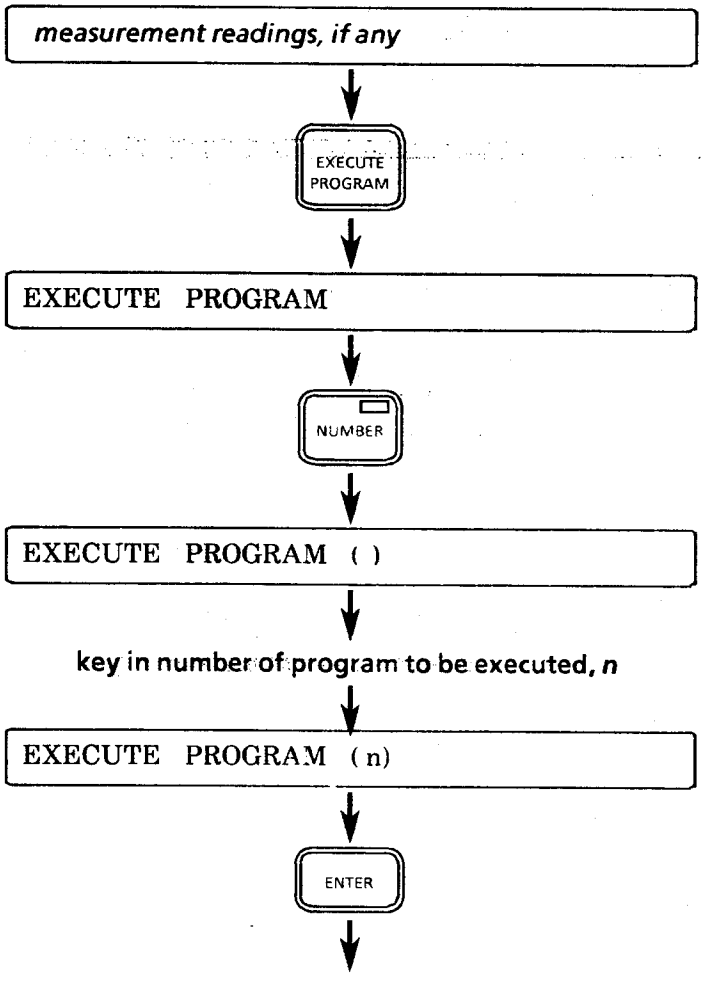
To copy a given (source) program to another (destination) program select the {copy} option and enter the number of the source program:



2.6 {list}
Enter **list n** to send program n to a printer connected via the RS423 interface or the GPIB.

2.7 **EXECUTE PROGRAM**

The EXECUTE PROGRAM action key is used to start any program running, for example:



Start from 'normal mode', i.e. with both shift keys 'off'.

'Number entry mode' is indicated by the ( ) brackets.

Refer to numbers below each key.

Program *n* will now run.

Before executing a program it is advisable to return all menu parameters to their default values, using the BREAK {reset} selection.

A program can be stopped during execution in two ways.

a Execute Program 0
This acts as a soft break, halting the program upon completion of the current instruction.
b Press BREAK key.
This interrupts the current instruction.

The program also halts when reaching a PAUSE instruction. The PAUSE/CONTINUE LED flashes and must be pressed to restart the program.

3 PROGRAM EXAMPLE

This section presents the basic procedure for setting up, executing and editing a simple program. The program measures the gain and phase of a circuit at two frequencies - 200Hz and 500Hz. After the first frequency the program pauses and must be restarted by the user.

The test circuit and connections are the same as those used in Chapter 3 - 'Getting Started'. i.e. A first order filter with a cut-off frequency of 75Hz.

The example program is listed below. The instructions appear as Remote codes (see pages 8.7 to 8.13). This listing can be obtained via the RS432 port by selecting the {list} option in the LEARN PROGRAM menu:

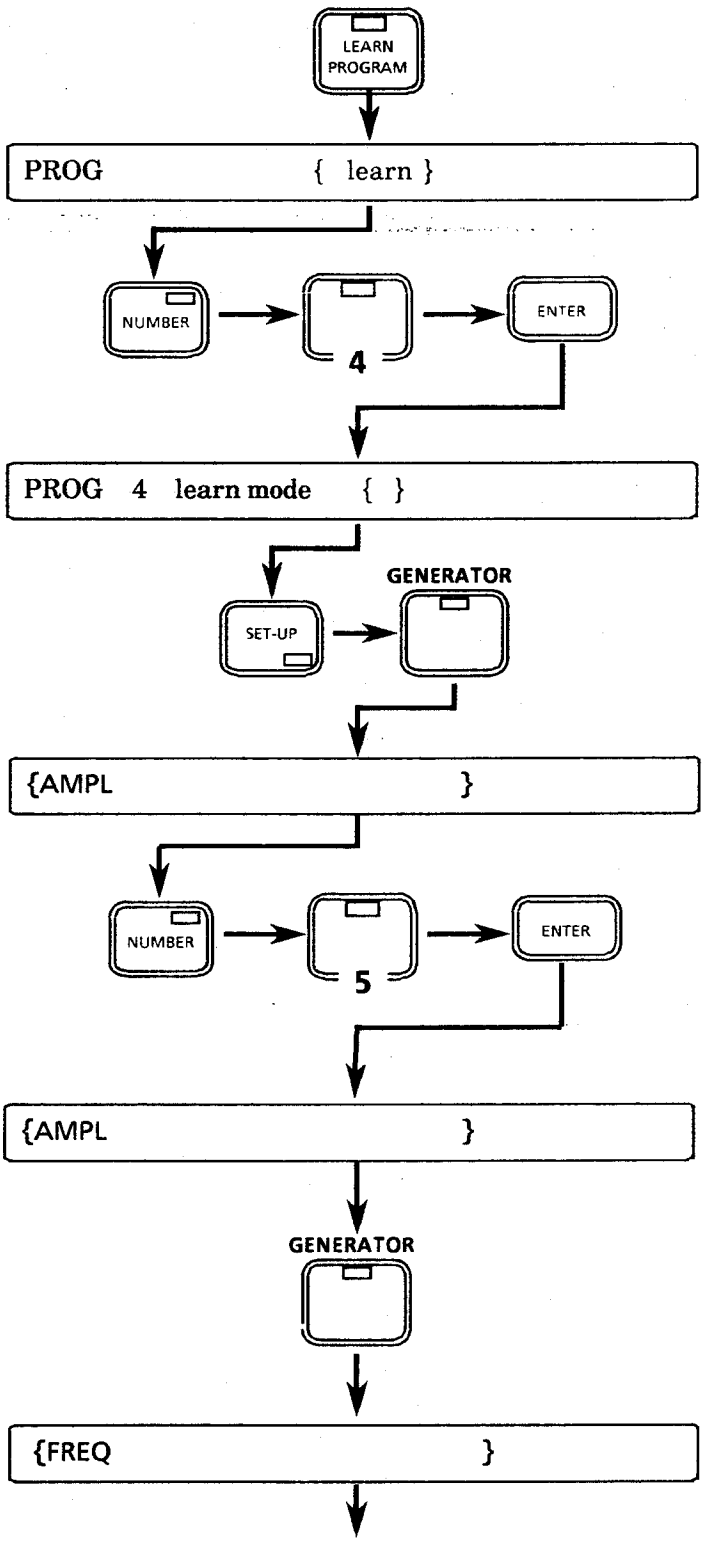
line no	*selection*	*Numeric value*	*comments*
00	AM	+5.0000E+00	Sets the Generator amplitude to 5 volts
00	FR	+2.0000E+02	Sets the Generator frequency to 200Hz
00	SI		SINGLE-takes a single measurement
00	CP		PAUSE/CONTINUE-Program halts
00	FR	+5.0000E+02	Sets Generator frequency to 500Hz
00	SI		SINGLE- takes a single measurement
99	*Q		End of program

NOTE:

All other parameters e.g. BIAS, COORDS etc. are set to their default values. Before entering a program, select {reset} from the BREAK menu, to ensure that all parameters return to their default values.

The progam line number is always zero (if the program has been entered from the front panel), except for the last line, which is always 99 *Q . Lines may be numbered remotely (see section 5.2).

3.1 LEARNING THE PROGRAM



Enter 'learn mode'

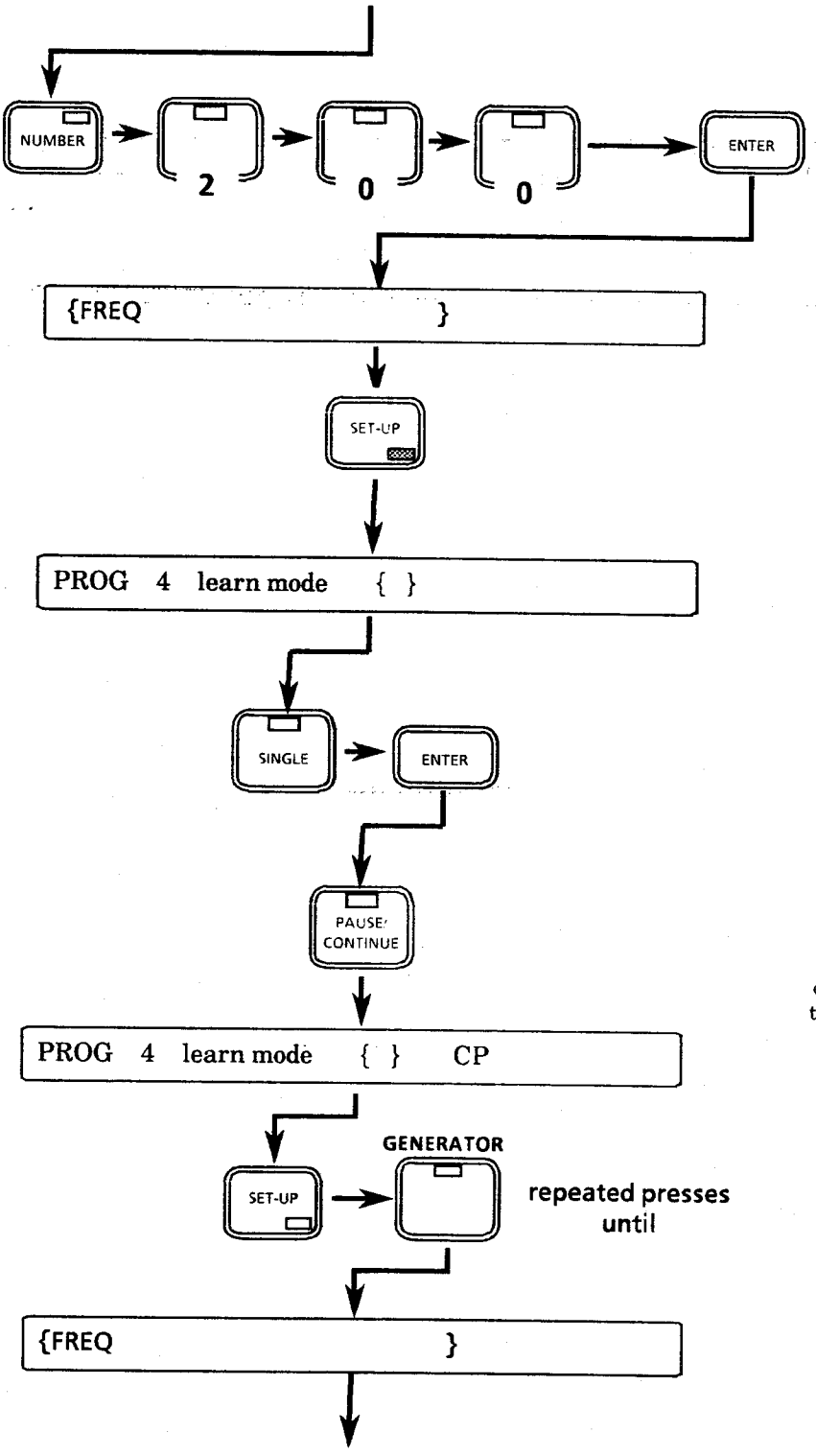
Enter the program number - 4

Set up a measurement in exactly the same way as described in chapter 3 - 'Getting Started'

Set the Generator amplitude to 5 volts

Note that the numerical entry does not appear on the display

Move to the next selection - frequency

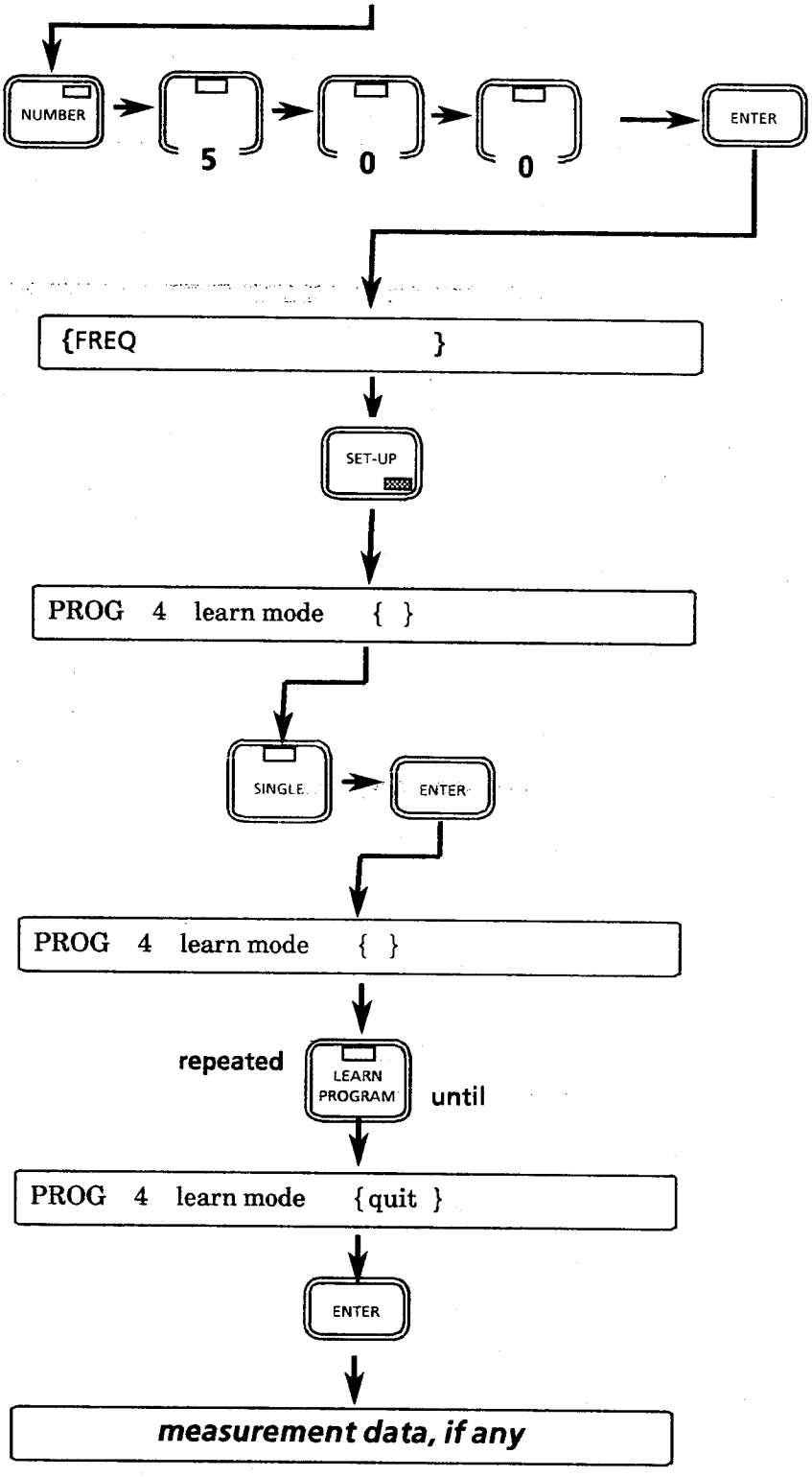


Set the Generator frequency to 200 Hz

Press 'SINGLE' and enter the choice. This key, within a program, instructs the 1253 to take a

Insert a pause into the program. The letters CP appear on the display. ENTER is not needed as there is no choice associated with PAUSE / CONTINUE

Set up the second measurement

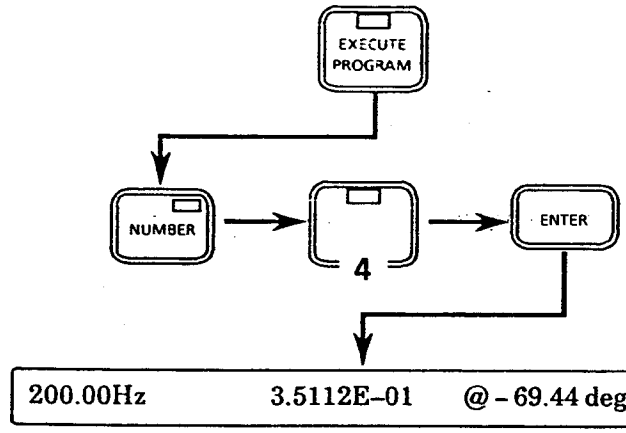


Set the Generator frequency to 500 Hz

Press SINGLE again. This instructs the program to take a single measurement at 500Hz.

Select {quit} and leave 'learn mode'

3.2 EXECUTING THE PROGRAM

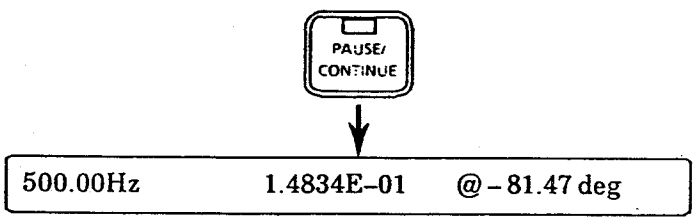


Execute program number - 4

The results are displayed in the default coordinates. - gain of 0.351 -phase lag of 69 degrees.

EXECUTION PAUSES

The PAUSE/CONTINUE LED flashes to indicate a pause in the program

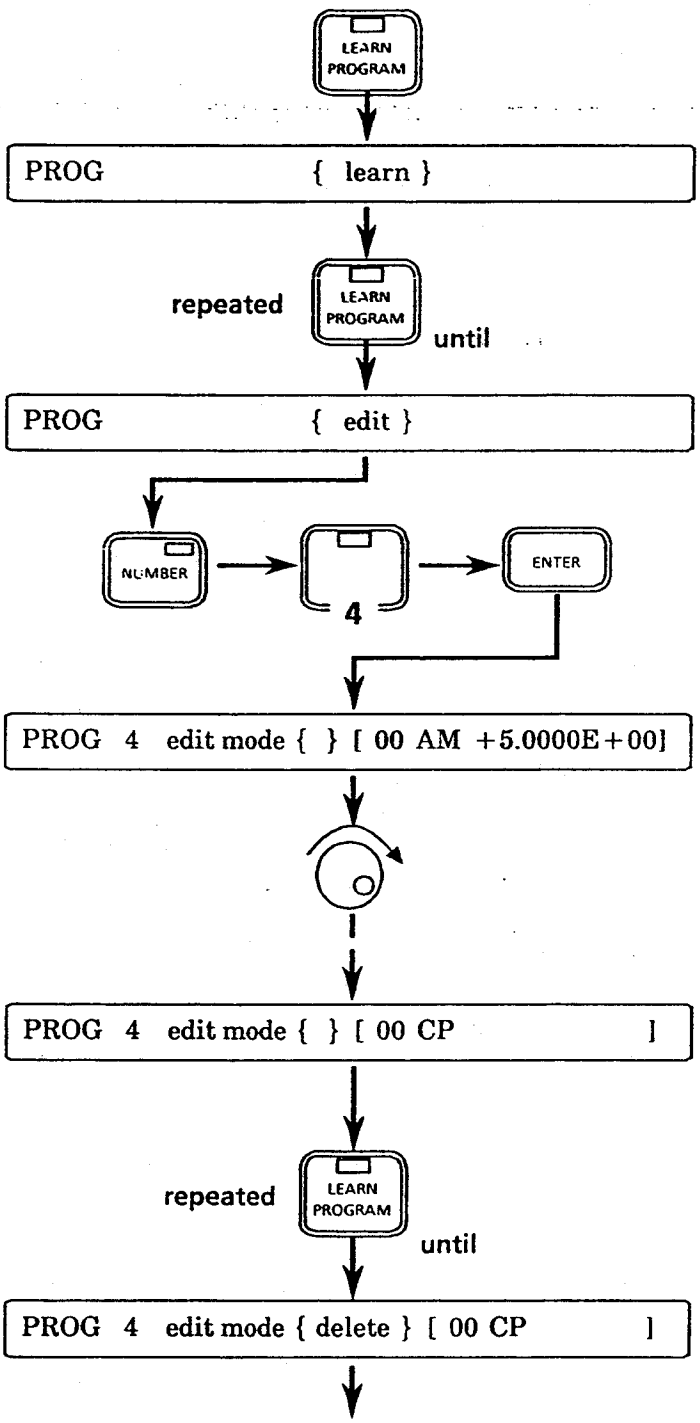


Press PAUSE/CONTINUE

The second measurement is taken.

3.3 EDITING THE PROGRAM

This sequence shows how our simple program can be edited. The PAUSE/CONTINUE command is deleted , so that on execution, two measurements are made without a break.



Enter 'edit mode'

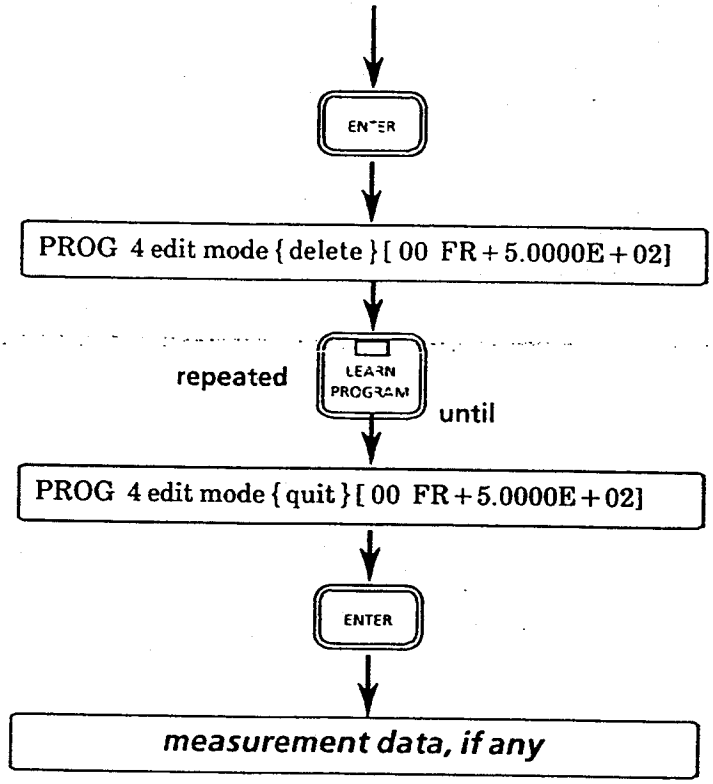
Enter the program number - 4

The first line of program 4 is displayed

Move through the program lines, by rotating the knob, ...

...until the pause line is reached (denoted by the remote code CP).

Select {delete}...



...and enter, to remove the PAUSE line. The program would now run without a break

The next line of the program is displayed

Leave edit mode by selecting {quit}

4 REMOTE PROGRAMMING

Remote control programming facilties parallel those available under front panel control. Additional facilities provided are line (instruction) numbering, JUMP instructions, and listing to remote device for external storage, etc.

All remote learnt program manipulations can be performed whilst the 1253 is making measurements, but Execute Program commands will not be implemented until the measurement is complete.

4.1 PROGRAMMING COMMANDS

The function of each command is explained below (in greater detail than Chapter 8).
Note: *n* or *m* repesent program numbers.

Code and Argument	Function
*L*n*	Enters 'program learn' mode for program *n* (1 to 9). All subsequent command codes (except *Q) are interpreted as program instructions and learnt in the order entered. Return to 'normal' mode by using *Q.
*E*n*	Enters 'program edit' mode for program *n* (1 to 9) at the first (line) instruction.
*F	Moves editing to next line.
*B	Moves editing to previous line.
*D	Deletes the line currently selected by the *E, *F or *B commands.
*I	Enters 'insert' mode. Subsequent command codes (except *Q) are interpreted as program instructions and inserted before the line currently selected by the *E, *F or *B commands. Return to 'program edit' mode with *F or *B .
*Q	Resumes 'normal' mode, after editing, ending the current programming operation.
*Cn	Clears program *n* (1 to 9). Programs must be cleared before being copied to or learnt.
*K*n*,*m*	Copies source program n (1 to 9) to destination program *m* (1 to 9).
JP*i*	Interpreted as 'jump' instruction to line *i* (integer 1 to 99). The destination line must be suitably numbered (see below).
*P*n*	Lists program *n* (1 to 9) to an external device for storage or examination.
EP*n*	Executes program *n* (0 to 9). (*n*=0 is equivalent to BREAK.)
?PN*n*	Interrogates the 1253 on the number of lines in program *n* (1 to 9).

4.2 LINE NUMBERING

Each learnt instruction can be numbered, for reference purposes or to enable the JP (jump) command to be used. When in 'program learn' mode or 'edit insert' mode you simply precede each command code by the required number (integer 1 to 98) e.g.

50 SG

Line 50 is then the 'Stop Generator' command

Line numbers always default to 00 (as seen in program edit mode when using the front panel display) except the last line of a program, which is always:

99 *Q

The line numbers have no effect on the order of execution of the program and programs must be learnt or edited into the order in which they are to be executed.

4.3 REMOTE COMMAND STORAGE: GPIB

There are two methods of transferring Learnt Programs to an external device via the GPIB port. The choice depends on the rate at which the Controller can handle data.

a. Fast Method. The Learnt Program is transmitted by the 1253 at the rate of approximately 1byte (i.e. one ASCII character) per millisecond. Provided that the Controller rate is faster than this, the required Program is listed by the 1253 at its maximum speed. An example Controller program for this method is shown below.

b. Slower Method. This method includes a 'handshake' routine to ensure that no data is lost. A typical Controller program is shown below.

Controller Programs. The most commonly used Controller program statements are defined in Chapter 8, the others are explained as they occur in the examples.

Note that the Learnt Program data fed to the GPIB will include an Output Terminator, as explained in Chapter 8.

Example I: CONTROLLER PROGRAM FOR TRANSFERRING LEARNT PROGRAM 2 FROM 1253 VIA GPIB PORT, WITHOUT HANDSHAKE

Instruction	Meaning
DIM A$ (100)	Allocate temporary store space.
OUTPUT "?PN2"	How many lines in Learnt Program 2?
INPUT N	N = number of lines in Learnt Program.
OUTPUT "*P1"	List Learnt Program 2 to the GPIB.
FOR I = 1 to N	Store all lines of Learnt Program until
INPUT A$ (I)	I=N.
NEXT I	

Example 2: CONTROLLER PROGRAM FOR TRANSFERRING LEARNT PROGRAM FROM 1253 VIA GPIB PORT, WITH HANDSHAKE

Instruction	Meaning
DIM A$ (100)	Allocate temporary store space.
OUTPUT "?PN2"	How many lines in Learnt Program 2?
INPUT N	N = number of lines in Learnt Program.
OUTPUT "*E2"	The command "Edit Learnt Program 2" sends Line 1 of the Program to GPIB.
INPUT A$ (I)	Store Line 1.
FOR 1 = 2 to N OUTPUT "*F"	Keep sending *F (Edit Next Line) to the 1253 and store all until I = N.
INPUT A$ (I)	Note the "handshake" effect of putting *F inside the loop, compared with Example 1, where *P is outside the loop.
NEXT I	
OUTPUT "*Q"	Quit program edit mode.

Example 3: RELOADING A LEARNT PROGRAM TO 1253 VIAGPIB

Learnt Programs which have been saved or compiled on an external device can be reloaded to the 1253 by using the Learn Program Command *L, as shown in this example for loading Program 1.

Instruction	Meaning
OUTPUT "*L1"	Instructs the 1253 to Learn Program 1.
FOR I = 1 to N	
OUTPUT A$ (1)	Send all lines of Learnt Program 1 to the 1253 until I = N.
NEXT I	

Note: The last line of the Learnt Program should be *Q. There is therefore no need to send a separate *Q instruction from the Controller to quit the 'Learn Program' mode.

Chapter 12
Specifications

1253 FREQUENCY RESPONSE ANALYZER

GENERATOR

Waveform: sinewave

Frequency

Range: 1mHz to 20kHz
Maximum Resolution: 1 in 4000
Sweep type: logarithmic, up or down
Points per sweep: 2 to 9999

Amplitude

Range: 10mV to 10.23V rms
Resolution: 10mV
Error (driving circuit): ±1% ±10mV
Distortion (@3V≤10MHz 1V>10MHz) <2%

Bias

Range: ±10.22V
Resolution: 20mV
Error (driving circuit): ±1% ±20mV
Maximum output, Hi to Lo (bias+ac) ±15V

Distortion: <2%
Output Impedance (Hi to Lo): 50Ω±10%
Maximum Voltage (Lo to grdn): ±15V
External stop input: contact closure or TTL logic 0 to kill or freeze

Connection

Front: floating, 4mm
Rear: floating, single BNC

Maximum current: 300mA
Output is short circuit proof

MODULATOR/DEMODULATOR

Input: differential, single BNC
Impedance, Hi or Lo to ground: >100kΩ <100pF

Maximum input

Hi to ground: ±350V peak 250V rms
Lo to ground: ±30V peak

Common Mode Rejection, up to 100Hz: >50dB
Carrier frequency range: 48Hz to 10kHz
Phase shift, carrier input to generator output

48Hz to 300Hz: <3°
300Hz to 1kHz: <1°
1kHz to 10kHz: <(1°+½°/kHz)

Additional analysis error when demodulating, mod frequency=0.05 carrier freq: <1%,<1°
Analyzer quadrature rejection: >26dB

ANALYZER

Two independent, autoranging input channels,with common analyzer.

Range	Sensitivity	Full Scale pk input	Com.mode rejection
30mV	1μV	45mV	30V
300mV	10μV	500mV	30V
3V	100μV	5V	30V
30V	1mV	50V	30V
300V	10mV	500V	30V

Maximum input

Hi to ground: ±500V peak, 300V rms
Lo to ground: ±30V peak

Coupling: dc
Connections

Front: differential, 4mm
Rear: differential, single BNC

Impedance, Hi to Lo (grounded): 1MΩ±2%
Capacitance

Front inputs, Hi to Lo (grounded) <70pF
Rear inputs, Hi to Lo (grounded) <100pF

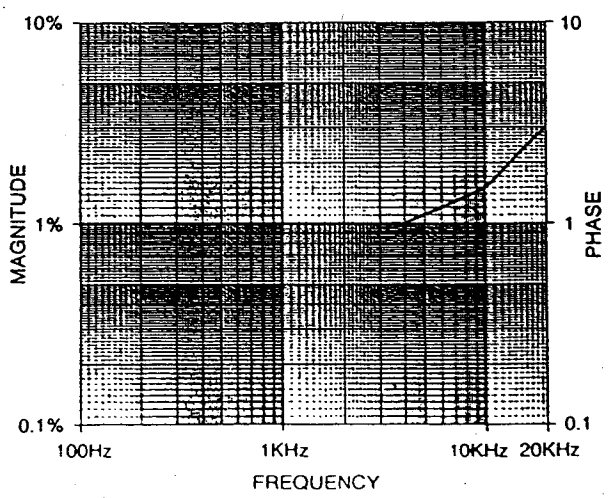
Common mode rejection, up to 100Hz: >60dB
Integration time

Range: 0.1 to 10^5

Cross channel isolation,<1kHz, 1kΩ across inputs, Lo grounded: >100dB

LIMIT OF ERROR

Warm up period 30mins:
Input >10% full scale
Integration time>200ms



SYNCHRONIZER

Connection: differential, BNC
Impedance, Hi or Lo to ground: >200kΩ <100pF
Maximum input
- Hi to ground: ±350V peak 250V rms
- Lo to ground: ±30V

Trigger point: positive zero crossing
Minimum signal to trigger (<1kHz): <- 0.6V to >+0.1V
Maximum time to synchronize:
- <12Hz 6 cycles
- >12Hz 500ms

Additional analyzer error (stable trigger signal), transfer function mode:
- Gain: 1% +0.2%/kHz
- Phase: 1°+0.2°/kHz

DATA PROCESSING

Scaling: division by vector (a+jb, rθ) division by last result, magnitude or vector
History file
- Maximum size: 400 results
- Minimum size: 100 results

Battery discharge time: Typically, >1000hrs

PROGRAM STORE

Type: battery backed RAM
- Maximum number of programs: 9
- Maximum number of program steps: 320

PLOTTING

Type: digital, compatible with Hewlett Packard Graphics Language
Parameters
- X-axis: a, linear scale f, linear or log scales
- Y-axis: b, r, r(dB), linear scale θ, degrees

Plot size: A4 or 8½" X 11"

INTERFACES

Serial output: suitable for use with printers and keyboards compatible with RS232 and RS423
- Selectable baud rates: 110 to 9600

GPIB: compatible with IEEE488 (1978)
Fully programmable Talker/ Listener
Switch selectable Talk only
Maximum data rate: 1000bytes/s
Fuctions implemented:
SH1, AH1, T5, TE0, LE0, SR1, RL1, PP2, DC1, C0, DT0

GENERAL

Power supply, switch selectable: 90 to 110V, 108 to 132V, 198 to 242V, 216 to 264V
Supply frequency: 48 to 65Hz
Consumption: approx.150VA
Dimensions:
- height: 108mm (4.25 in)
- width: 432mm (17in)
- depth: 472mm (18.5in)
- weight: 10kg (22lb)
- rack size: 19in, 2U

ENVIRONMENT

Temperature
- Operating: 0 to 50°C (32 to 122°F)
- Storage: -30 to 70°C (-22 to 158°F)
- Specification limits: 10 to 30°C (50 to 86°F)

Humidity, non-condensing: 95% at 40°C
Vibration: tested in accordance with IEC68 (BS2011)
Safety: complies with EN61010
Electromagnetic Compatibility: complies with EN50081-1 and EN50082-1

Solartron Analytical UK

Unit B1 Armstrong Mall,
Southwood Business Park,
Farnborough,
Hampshire,
GU14 0NR
Tel: +44 (0) 1252 556 800
Fax: +44 (0) 1252 556 899
E-mail info@solartronanalytical.com
E-mail for service issues
service@solartronanalytical.com
E-mail for customer support issues
support@solartronanalytical.com

Web: http://www.solartronanalytical.com

For details of our agents in other countries, please contact our Farnborough, UK, office.

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