

LOCAL OPERATION

Introduction

All operations of the signal generator are carried out from the front-panel keyboard which is color-coded. An extensive suite of utility menus make this a very versatile instrument. The built-in GPIB and RS-232 interfaces enable the instrument to be remotely operated.

Front-panel controls and connectors

Parameters are selected by means of keys which have their functions printed on them, a numerical key pad and a rotary control knob. The numerical keys are used to set parameters to specific values which can also be varied in steps of any size by using the [$\uparrow \div 10$] and [$\downarrow \times 10$] keys or the rotary control knob.

Connectors

The front-panel connectors are shown in Fig. 4-1 below:

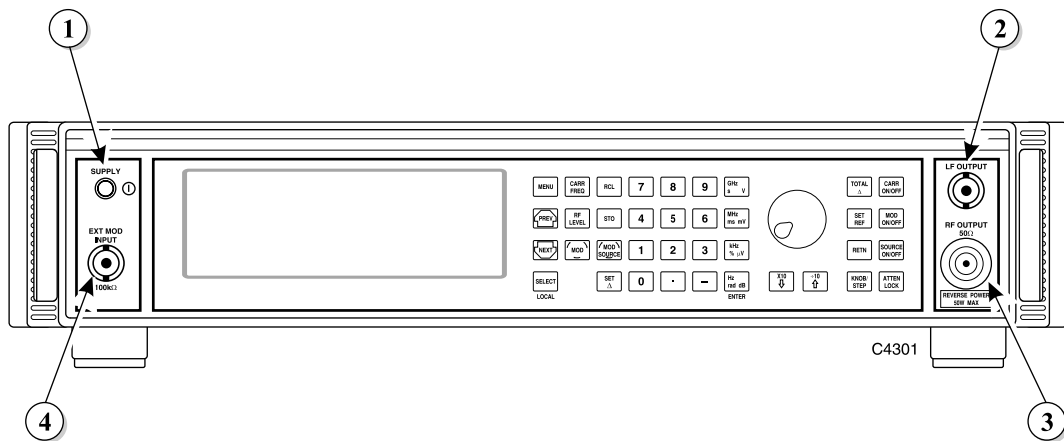


Fig. 4-1 2023/5 front panel showing SUPPLY switch and connectors

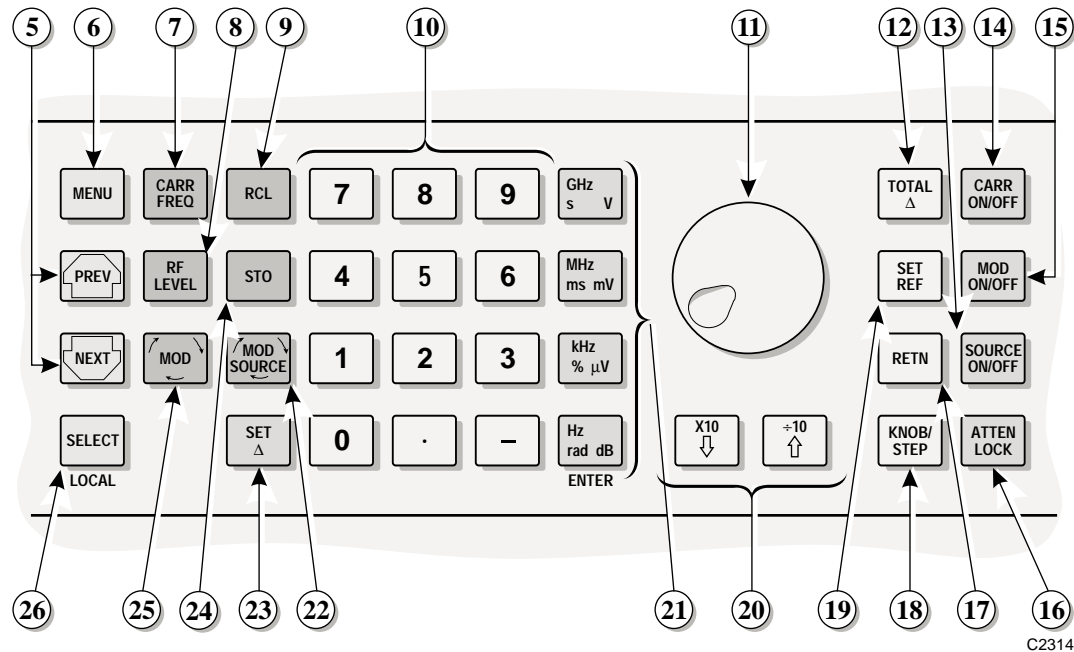
- | | | |
|-----|---------------|--|
| (1) | SUPPLY switch | Switches the supply on and off using a press on, press off action. |
| (2) | LF OUTPUT | 600 Ω BNC socket which monitors the modulation oscillator. With Option 5 this socket is fitted on the rear panel. |
| (3) | RF OUTPUT | 50 Ω N-type socket. Protected against the application of reverse power of up to 50 W. With Option 5 this socket is fitted on the rear panel. |
| (4) | EXT MOD INPUT | 100 k Ω BNC socket. An independent input which allows an external modulating signal to be applied. With Option 5 this socket is fitted on the rear panel. |

Note: connector positions differ for Option 7 and Option 11

Keyboard

The keyboard is functionally color-coded. The keys for the primary functions of carrier frequency, level and modulation are dark gray. Secondary functions such as unit selection and on/off keys are medium gray. Menu selection, which plays such a prominent part in this instrument, has keys which are colored blue.

The front-panel keyboard is shown in Fig. 4-2 below:



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Fig. 4-2 Instrument front panel showing keyboard

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|------|----------------------|---|
| (5) | [PREV]

[NEXT] | A key used to scrolls backwards through a menu list or the function list.

A menu key used to scroll forwards through a menu list or the function list. |
| (6) | [MENU] | Selects the main utility menu, or within utility menus steps back up through the menus. |
| (7) | [CARR FREQ] | Selects carrier frequency as the current function and causes the main screen to be displayed. |
| (8) | [RF LEVEL] | Selects RF level as the current function and causes the main screen to be displayed. |
| (9) | [RCL] | Used to recall a previously stored instrument setting from memory. |
| (10) | Numerical key pad | For entering the value of a selected parameter. Minus sign and decimal point are included. |
| (11) | Control knob | When enabled by the [KNOB/STEP] key, adjusts the value of the selected parameter. |
| (12) | [TOTAL Δ] | While the key is held down, displays the total shift from the keyed-in value. |
| (13) | [SOURCE ON/OFF] | Switches the current modulation source on and off. |
| (14) | [CARR ON/OFF] | Switches the carrier output on and off. |
| (15) | [MOD ON/OFF] | Switches ALL modulation on and off. |
| (16) | [ATTEN LOCK] | Holds the attenuator at the current setting with <i>Atten Lock</i> displayed. Allows the RF level to be decreased by a further 10 dB without the step attenuator operating. |

- | | | |
|------|---------------------------|--|
| (17) | [RETN] | After using the [$\uparrow+10$] or [$\downarrow\times 10$] keys or the control knob returns the setting of the function to the last keyed-in value. |
| (18) | [KNOB/STEP] | Switches between enabling the control knob and enabling the step operation. |
| (19) | [SET REF] | Transfers the current value as the keyed-in setting. |
| (20) | [$\uparrow+10$] | When KNOB is enabled, increases the knob resolution by a factor of 10. |
| | | When STEP is enabled, increments the current function by one step. |
| | [$\downarrow\times 10$] | When KNOB is enabled, decreases the knob resolution by a factor of 10. |
| | | When STEP is enabled, decrements the current function by one step. |
| (21) | [ENTER]/Units keys | Determine the units of the set parameters; also used to terminate a numerical entry. |
| (22) | [MOD SOURCE] | Selects modulation source as the current function and causes the main screen to be displayed. |
| | | For internal modulation repetitive pressing of this key cycles through the currently selected modulation sources while displaying the appropriate wave shape on the screen. |
| | | For external modulation it cycles through the currently selected external coupling modes. |
| (23) | [SET Δ] | Press to obtain the step setting display. To change the step size, press the relevant function key. |
| (24) | [STO] | Used to store the current instrument settings in memory. |
| (25) | [MOD] | Selects modulation as the current function and causes the main screen to be displayed. Repetitive pressing of this key cycles through each of the modulations of the current mode together with their source values. |
| (26) | [SELECT] | Selects an item highlighted on a utility menu. |
| | | With the main screen displayed selects the last utility accessed. |
| | | After power-up causes the software status to be displayed. |
| | [LOCAL] | Transfers control from the GPIB to the front panel (providing local lockout not asserted). |
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Rear-panel connectors

The rear-panel connectors are shown in Fig. 4-3 below.

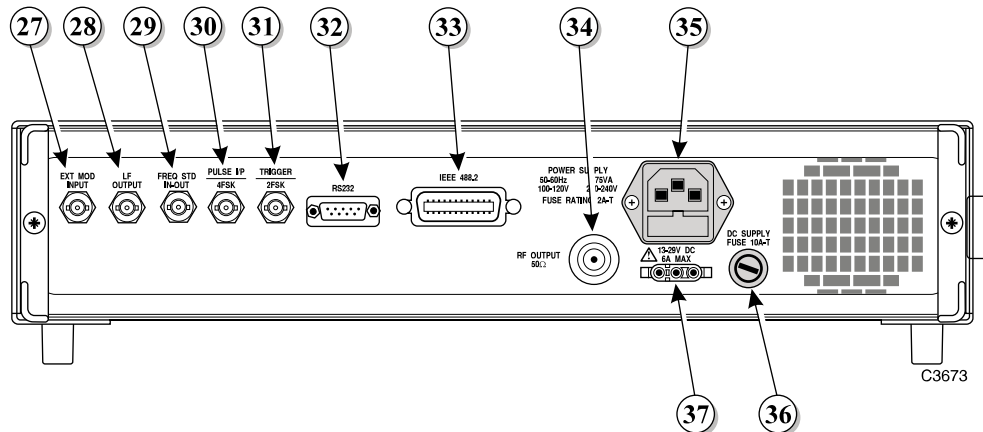


Fig. 4-3 Instrument rear panel showing connectors

- | | |
|--------------------------------|---|
| (27) EXT MOD INPUT (optional) | An Option 5 BNC socket which allows an external modulating signal to be applied. When fitted, replaces the front-panel socket. |
| (28) LF OUTPUT (optional) | An Option 5 BNC socket which monitors the modulation oscillator. When fitted, replaces the front-panel socket. |
| (29) FREQ STD IN-OUT | BNC socket for the input of external standard frequencies of either 1 MHz or 10 MHz. Can also supply a 10 MHz internal standard output. |
| (30) <u>PULSE I/P</u>
4FSK | 10 k Ω BNC socket which accepts a pulsed input. Also used as one logic input (the other is the TRIGGER input) for 4FSK modulation. |
| (31) <u>TRIGGER</u>
2FSK | BNC socket which has three uses; in priority order these are:
FSK logic input
Memory sequencing
Sweep trigger |
| (32) RS232 | 9-way RS-232 connector for remote control of the instrument. |
| (33) IEEE 488.2 | 24-pin socket accepts the standard GPIB connector to allow remote control of the instrument. |
| (34) RF OUTPUT (optional) | An Option 5 50 Ω N-type socket. When fitted, replaces the front-panel socket. |
| (35) POWER SUPPLY | 3-pin plug integral with fuse holder. Mates with AC supply lead socket. |
| (36) DC SUPPLY FUSE (optional) | When Option 2 fitted, fuses the DC input socket. |
| (37) DC input (optional) | When Option 2 fitted, the socket allows operation from an external 11 to 32 V DC source. |

FIRST-TIME USE

First-time users can quickly become familiar with the principles of control and display by carrying out the following exercise, which demonstrates how to set up a typical basic signal having the following parameters:

Carrier frequency:	100 MHz
Output level:	10 dBm
Frequency modulation:	100 kHz deviation at 500 Hz mod.

Switching on

Before switching the instrument on, check that the power supply is connected and ensure that no external signal sources are connected.

Switch on by means of the SUPPLY switch and check that the display is similar to that shown in Fig. 4-4, Fig. 4-5 or Fig. 4-6. This shows the main screen as it appears during normal operation.

If a default display as shown in Fig. 4-4, Fig. 4-5 or Fig. 4-6 is not obtained, a previous user may have set the instrument to switch on with one of the user memories recalled, rather than using the default factory settings.

To reset to the factory settings press the [RCL] hard key. RCL appears highlighted at the top right of the screen with the cursor blinking awaiting your entry. Enter 999 on the keyboard and press [ENTER]. (Note that any one of the units keys can be used to perform the [ENTER] function.) The *RESET* annunciator is shown and the factory settings are now recalled from memory location 999 and displayed on the screen.

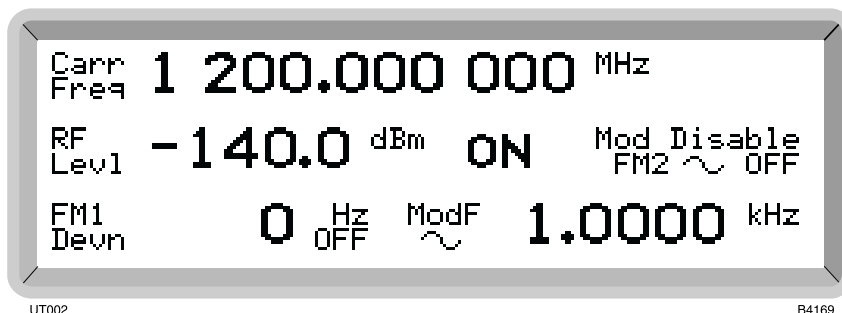


Fig. 4-4 2023A main screen in normal operation showing default display

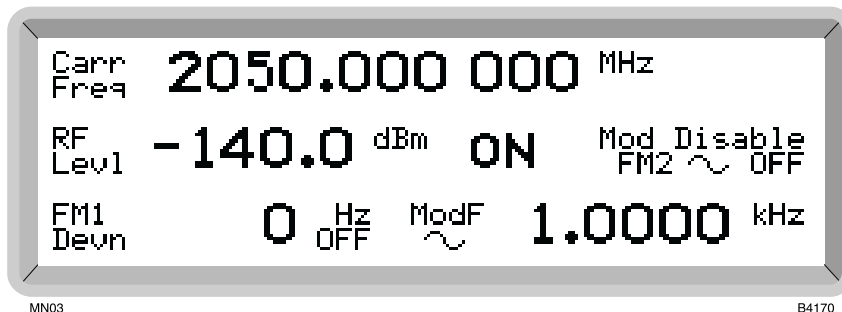


Fig. 4-5 2023B main screen in normal operation showing default display

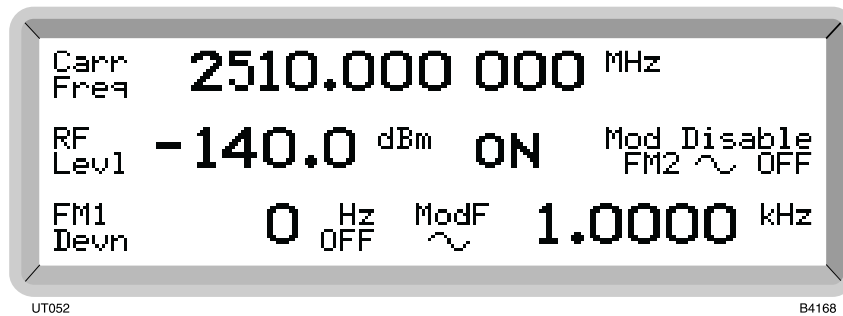


Fig. 4-6 2025 main screen in normal operation showing default display

Display

Before entering any parameters it is useful to look at the effect that pressing various keys has on the display. The display is divided into a number of fields as shown in Fig. 4-7.

Carrier frequency field

When you press [CARR FREQ] it causes *Carr Freq* to be highlighted and your data entry is recognized as a frequency setting. *Ext* is displayed when the instrument is locked to an external standard.

Memory field

When you press the [STO] or [RCL] key it causes *STO* or *RCL* to be highlighted respectively. Your data entry is recognized as a memory location number. The type of recall – *FREQ*, *FULL* or *RAM* (or sequence number for memory sequencing) – is also shown.

Error message field

Error messages are displayed when, for example, you exceed a parameter limit. A list of error messages is given at the end of this chapter.

RF level field

When you press [RF LEVEL] it causes *RF Level* to be highlighted and your data entry is recognized as a level setting. Units and unit type are displayed together with the carrier *ON* or *OFF* state. When selected, *Atten Lock* is displayed unless overwritten by *Offs* when an RF level offset has been enabled. This field is also used to display the SINAD measurement and weighting filter used.

Modulation field

When you press [MOD] it causes the currently selected type of modulation to be highlighted and your data entry is recognized as a modulation depth or deviation setting. Modulation *ON* or *OFF* is also shown.

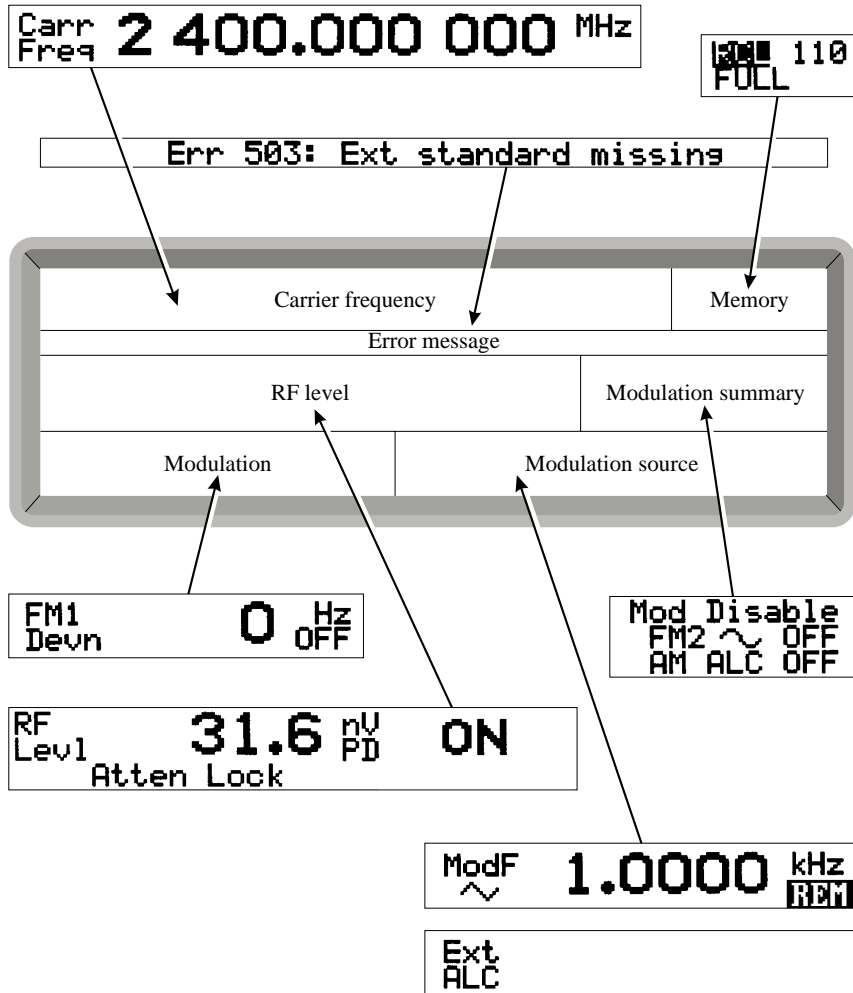
Modulation source field

When you press [MOD SOURCE] it causes the currently selected internal modulation source or external coupling to be highlighted. For an internal source a sine, triangle or square wave symbol is shown. Your data entry is recognized as a modulating frequency. For an external source *AC*, *DC* or *ALC* coupling is shown.

When the instrument is operating under remote control *REM* is displayed.

Modulation summary field

In this field are shown your other selected modulation sources. All your settings – types of modulation, waveforms, current *ON* or *OFF* states, as well as modulation enabled or disabled – are shown.



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Fig. 4-7 Division of the display into fields

Selecting functions and keyboard entry

Whenever one of the main functions – carrier frequency, RF level, modulation, modulation source – is highlighted on the main screen, making any terminated numerical entry will be accepted as being a changed parameter for that function. This enables you to enter, for example, a sequence of carrier frequencies without having to re-press the [CARR FREQ] function key for each entry.

Carrier frequency

- (1) Press [CARR FREQ] to select carrier frequency as the current function. *Carr Freq* is highlighted on the screen.
- (2) Using the numerical key pad, enter 100 MHz by entering 100 on the key pad and terminate with [MHz]. Observe that the *Carr Freq* display changes to *100.000 000 MHz*.

If you make an error when keying in, press the function key again and key in the correct value. If this causes an error message (e.g. *Err 100: Carrier limit*) to be displayed, it can be canceled by a correct entry (e.g. by entering a value which is within limits).

RF level

- (3) Press [RF LEVEL] to select RF level as the current function. *RF Levl:* is now highlighted on the screen.
- (4) Using the numerical key pad, enter 10 dBm by entering 10 on the key pad and terminate with [dB]. Observe that the *RF Levl* display changes to *+10.0 dBm*.
- (5) Press [CARR ON/OFF]. Repeated pressing toggles between the on and off states as shown by *ON* and *OFF* at the centre of the screen. Select *ON*. A 100 MHz, 10 dBm carrier is now being generated from the RF OUTPUT socket.

Modulation

- (6) Press [MOD] which highlights *FM Devn*. Repeated pressing of the key alternates between FM1 and FM2. Select *FM1 Devn*. Enter 100 on the key pad and terminate with [kHz]. *100 kHz* is displayed.
- (7) Press [MOD ON/OFF]. Repeated pressing toggles between the off state (when *Mod Disable* is displayed) and the on state. Select *ON*.
- (8) Press [MOD SOURCE] which highlights *ModF* with a waveform displayed. Repeated pressing of the key cycles through sine, triangle and square waveforms. Select sine wave. Enter 500 on the key pad and terminate with Hz. *500.00 Hz* is displayed.
- (9) Press [SOURCE ON/OFF]. Repeated pressing toggles between the on and off states. Select *ON*. A 100 MHz, 10 dBm carrier is now being generated at a 100 kHz deviation, modulated at 500 Hz, from the RF OUTPUT socket.

Using [NEXT] and [PREV] to select a function

The operating example above was carried out by pressing the four function keys in turn in order to enter the parameter values. Another method is to repeatedly press either the [NEXT] or [PREV] key. This enables you to access each of the four functions CARR FREQ, RF LEVEL, MOD, MOD SOURCE in either forward or reverse rotation.

Using the [$\uparrow \div 10$] and [$\downarrow \times 10$] keys

When you have entered a parameter value using the numerical key pad, you can adjust its value either in single steps or continuous steps.

As an example of its use we will adjust the carrier frequency using the knob for continuous adjustment as well as in selected increments/decrements using single steps.

- (1) Press [CARR FREQ] to select carrier frequency as the current function. Note that the frequency is displayed as *100.000 000 MHz*. The number of digits behind the decimal point shows the maximum resolution and indicates that the frequency can be changed in 1 Hz steps.

With the control knob

- (2) Select the control knob for adjustment by toggling the [KNOB/STEP] key so that the carrier frequency is displayed underlined by a bracket. With the bracket displayed the control knob is enabled and its sensitivity can be set.
- (3) Adjust the control knob sensitivity by pressing either the [$\uparrow \div 10$] key or the [$\downarrow \times 10$] key. Pressing the [$\uparrow \div 10$] key increases the bracket length by one decimal place. Pressing the [$\downarrow \times 10$] key shortens the bracket length by one decimal place. In this way the resolution of the control knob is respectively increased or decreased by a factor of ten.
- (4) Move the control knob in either direction and note how the displayed carrier frequency changes by the desired amount.
- (5) To check the current amount of offset from the reference carrier frequency press and hold [TOTAL Δ]. For the duration of the key-press the offset is displayed as either a negative or positive value.
- (6) You can return at any time to the reference carrier frequency by pressing [RETN]. *100.000 000 MHz* is displayed.
- (7) Alternatively, you can make the currently displayed frequency the reference carrier frequency by pressing [SET REF]. Subsequently pressing [RETN] will then return you to this frequency.

With steps

- (8) Press [KNOB/STEP] to disable the control knob (as indicated by the bracket no longer being displayed).
 - (9) Press [SET Δ]. The screen changes to display the default step settings for frequency, level and modulation as shown in Fig. 4-8.
 - (10) Press [CARR FREQ]. *Freq Step* is highlighted. Enter the step value on the key pad and terminate with the [MHz], [kHz] or [Hz] key.
 - (11) Press [CARR FREQ] again to return to the main screen.
Note that pressing one of the function keys at any time will at once return you to the main screen.
 - (12) Now repeatedly press the [$\uparrow \div 10$] and [$\downarrow \times 10$] keys and note how the displayed carrier frequency changes in steps of the desired amount. Holding either of these keys pressed provides continuous stepping.
 - (13) As for control knob operation, you can check the current amount of offset from the reference carrier frequency by pressing and holding [TOTAL Δ].
 - (14) As for control knob operation, pressing [RETN] returns you to the reference carrier frequency; pressing [SET REF] selects the currently displayed frequency as the reference frequency.
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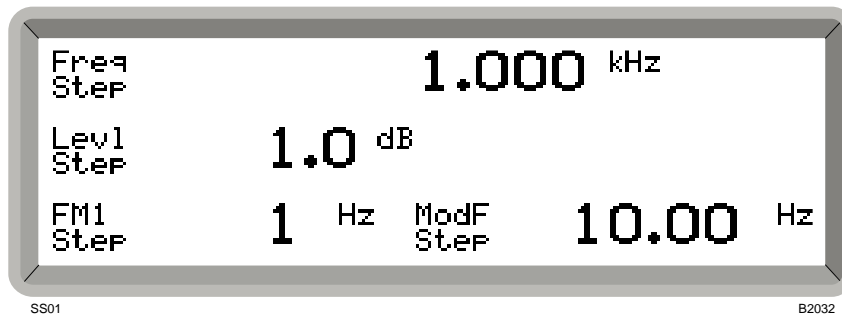


Fig. 4-8 Step setting display showing default settings

Using the utility menus

As an exercise in the use of the utility menus we will perform the operation of selecting an alternative frequency standard.

- (1) Press [CARR FREQ] followed by [MENU] to display the *Utility Group Menu* shown in Fig. 4-9. This is the top level menu of a 3-tier menu chain. Since the [CARR FREQ] function key preceded the [MENU] key, the required *Frequency/Sweep* group is already highlighted on the menu.

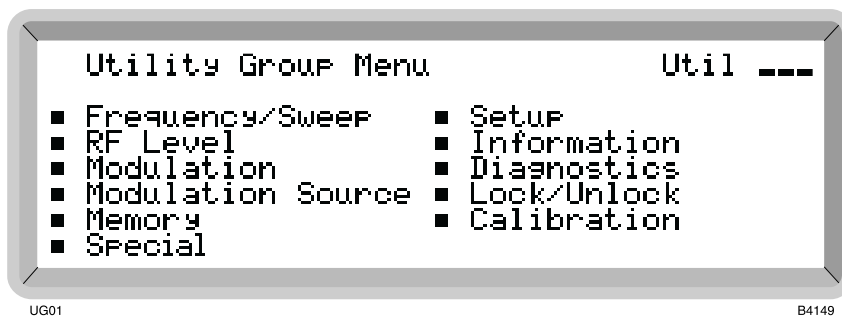


Fig. 4-9 Utility group menu

- (2) Use the [NEXT] and [PREV] keys to move around the menu.
- (3) Highlight *Frequency/Sweep* again and press [SELECT]. This causes the 2nd-level *Frequency/Sweep Menu* shown in Fig. 4-10 to be displayed.

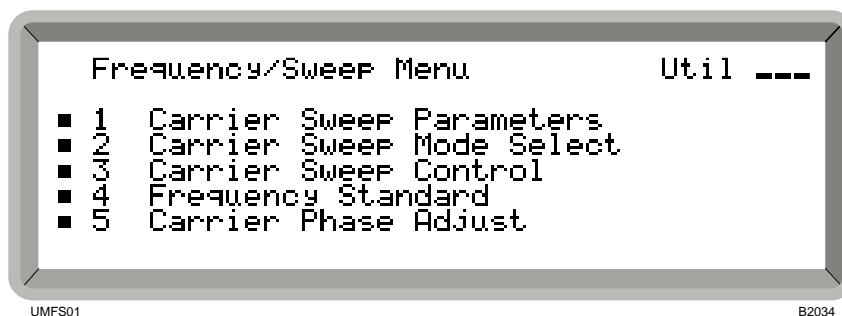


Fig. 4-10 Frequency/sweep menu

- (4) Highlight utility 4 *Frequency Standard* and press [SELECT]. This displays the 3rd-level menu used for internal and external standard selection shown in Fig. 4-11. A flashing cursor awaiting entry is shown against the current selection.

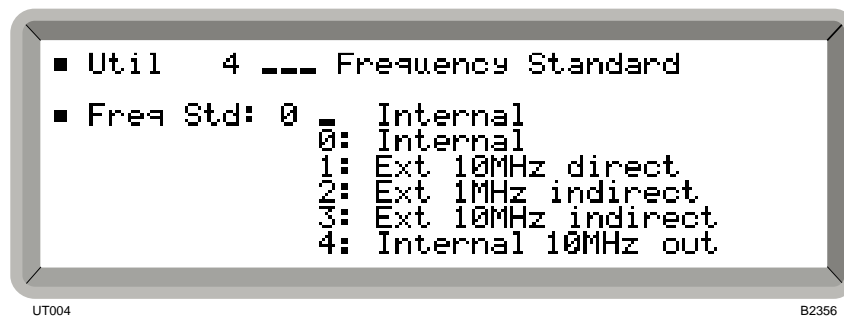


Fig. 4-11 Frequency standard menu

- (5) Step through the selections using the [$\uparrow+10$] and [$\downarrow\times 10$] keys or by direct entry on the key pad. Each time, the highlighted selection becomes the current selection (no terminator is required).

Since no external standard is connected, the message *Err 503: Ext standard missing* is displayed every time you select an external standard.

- (6) Select *0: Internal* to restore the instrument to normal operation. *Internal* is displayed as the current selection.
- (7) Press any function key which returns you again to the main display. Pressing [SELECT] at any time from now on will always return you to your last selected utility menu.

Short cut

Note that for the top and 2nd-level menus *Util* is shown each time at the top right. This allows you to use a short cut. Since you now know the utility number for the *Frequency Standard* utility, enter 4 on the key pad for this menu followed by [ENTER] which takes you straight to the requested menu.

Moving within the menus

When you are using the menus, pressing [SELECT] will take you down the menu chain, pressing [MENU] will take you back up.

Looking through the list of menus

To see what utilities are available to you, display the top level menu then press [SELECT] to display the numbered list of menus. Now you can use the [NEXT] and [PREV] keys to browse through the complete list.

Menu conventions

The following simple conventions apply to the menus:

- A filled-in square indicates an unprotected function.
- An open, unfilled, square indicates a protected function.
- An ellipsis (...) indicates a continuation to another screen.

Additionally, the following are used for memory operation:

- A dash (–) indicates an unprotected memory store.
- A lower-case **p** indicates a protected memory store.

DETAILED OPERATION

Selecting carrier frequency

Carrier frequency can be entered in the range 9 kHz to 1.2 GHz (2023A), 9 kHz to 2.05 GHz (2023B) or 9 kHz to 2.51 GHz (2025) to a resolution of 1 Hz.

- (1) Press [CARR FREQ] to select carrier frequency as the current function. *Carr Freq:* is highlighted on the screen.
- (2) Enter the required value using the numerical key pad. Terminate using the [Hz], [kHz], [MHz] or [GHz] key.
- (3) The frequency can then be adjusted either in steps or by using the control knob for continuous adjustment. The default increment/decrement is 1 kHz.
- (4) You can check the current amount of offset from the reference carrier frequency by pressing and holding [TOTAL Δ].
- (5) Pressing [RETN] returns you to the reference carrier frequency; pressing [SET REF] selects the currently displayed frequency as the reference frequency.

Carrier on/off

The carrier may be switched *ON* or *OFF* at any time via the [CARR ON/OFF] key. This effectively switches the output on and off, retaining the 50 Ω output impedance.

Carrier sweep operation

The sweep capability allows the comprehensive testing of systems, since measurements at single points will not necessarily give an overall indication of the performance. Sweep operation is carried out in this instrument by means of three utility menus.

Sweep parameters

Carrier start and stop frequencies together with step size and time are set as follows:

- (1) Select the *Util 1: Carrier Sweep Parameters* menu. This shows the currently selected parameter values (see Fig. 4-12) as well as the currently selected mode.
- (2) Enter the sweep start and stop frequencies.
- (3) Enter the step size. For linear sweeps enter the step size in the range 1 Hz to the instrument maximum frequency to a resolution of 1 Hz.

For log sweeps enter the step size in the range 0.01% to 50.00% to a resolution of 0.01%. Enter step time in the range 50 ms to 10 s (5 s when Option 100 fitted).

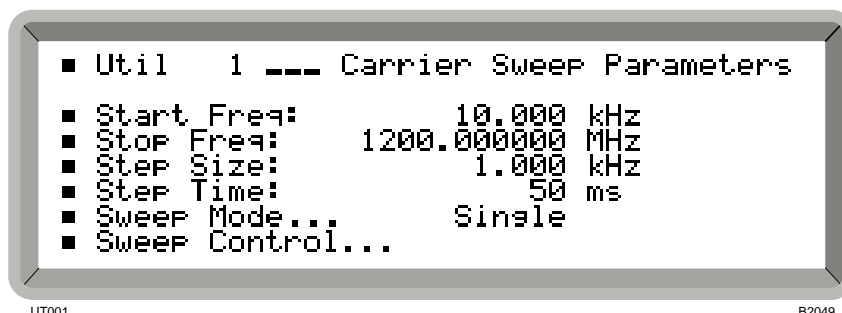


Fig. 4-12 Carrier sweep parameters menu

- (4) To change the mode of sweeping, highlight *Sweep Mode...* and press [SELECT]. This gives you immediate access to the *Util 2: Carrier Sweep Mode Select* menu shown below.
- (5) To carry out the sweeping operation, highlight *Sweep Control...* and press [SELECT]. This gives you immediate access to the *Util 3: Carrier Sweep Control* menu shown below.

Sweep mode

The following menu allows you to set the carrier sweep mode to either single shot or continuous sweep, to logarithmic or linear sweep and to select the mode of external triggering. For external operation, connect a TTL trigger signal to the rear-panel TRIGGER connector. Ensure however, that this socket is not disabled by a higher priority mode having been selected. The order of priority is as follows:

FSK logic input
Memory recall
Sweep trigger.

All three modes of operation may be enabled at the same time, but only one mode will be active, the one with the highest priority. Therefore ensure that FSK and memory recall are not enabled, otherwise selecting sweep triggering will have no effect. Sweep mode selection is as follows:

- (1) Select the *Util 2: Carrier Sweep Mode Select* menu. This shows the currently selected sweep mode (See Fig. 4-13).

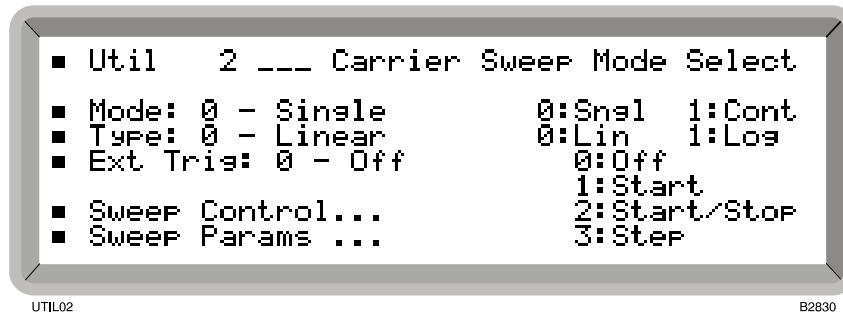


Fig. 4-13 Carrier sweep mode select menu

- (2) Select the required sweep mode by setting *Mode* to either *1* for continuous sweep or *0* for single shot.
- (3) Select the required sweep type by setting *Type* to either *1* for logarithmic sweep or *0* for linear sweep.
- (4) For external triggering set *Ext Trig* to *0* to inhibit the external trigger, or to *1*, *2*, or *3* to select one of the following triggering modes:

Start: The first trigger input causes the carrier sweep to commence sweeping. Any other trigger inputs whilst sweeping are ignored. Only at the end of each sweep is the trigger latch reset ready for the next input.

Start/Stop: The first trigger input starts the carrier sweep and the following trigger input pauses it, so that the user can investigate a particular point of interest. The next trigger input continues the sweep from where it was paused. At the start of each sweep the trigger latch is reset ready for the next input.

Step: Each trigger input steps the sweep on by one frequency step. The trigger latch is reset after each step ready for the next step.

- (5) To carry out the sweeping operation highlight *Sweep Control...* and press [SELECT] to access the *Util 3: Carrier Sweep Control* menu.
- (6) To return to the *Carrier Sweep Parameters* menu, highlight *Sweep Params...* and press [SELECT].

Sweep control

Control of the sweep: start, stop, reset and continue is performed as follows:

- (1) Select the *Util 3: Carrier Sweep Control* menu. Initially this shows *Start Sweep* and the start *Carr Freq:* value together with the currently selected *Freq Mode:* (see Fig. 4-14).

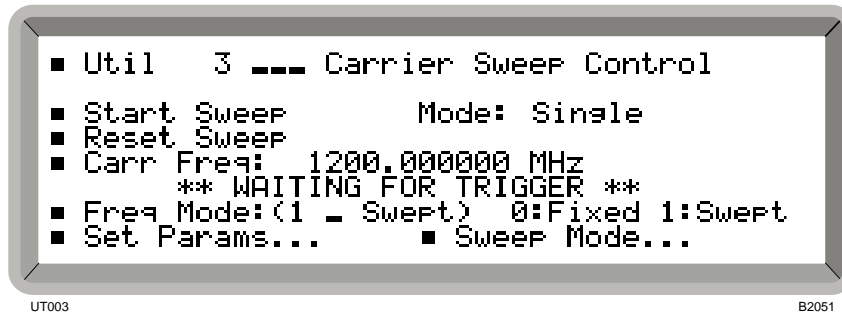


Fig. 4-14 Carrier sweep control menu (shown with sweep enabled)

- (2) Enable the sweep operation by setting *Freq Mode:* to 1 (no terminator is necessary). **** WAITING FOR TRIGGER **** is displayed.
- (3) To start the sweep, select *Start Sweep*. The selection changes to *Stop Sweep*, the frequency is shown changing and **** SWEEPING **** is displayed.
- (4) During the sweep, *Reset Sweep* may be selected to discontinue the sweep and reset it to the start frequency. Note that during the sweep all of the function keys are still accessible.
- (5) Selecting *Stop Sweep* causes the selection to change to *Continue Sweep* and **** PAUSED **** is displayed.
- (6) Selecting *Continue Sweep* allows the sweep to continue. At the end of a single sweep, the stop frequency is shown and the selection changes to *Restart Sweep* with **** COMPLETE **** displayed. For continuous sweep, the sweep automatically recommences from the start frequency.
- (7) To change the sweep parameters, highlight *Set Parameters...* and press [SELECT] to return to the *Carrier Sweep Parameters* menu.
- (8) To change the sweep mode, highlight *Sweep Mode...* and press [SELECT] to return to the *Carrier Sweep Mode Select* menu.

Carrier phase adjustment

The phase offset of the carrier can be adjusted in degrees as follows:

- (1) Select the *Util 5: Carrier Phase Adjust* menu. This shows the currently selected phase shift setting (see Fig. 4-15).

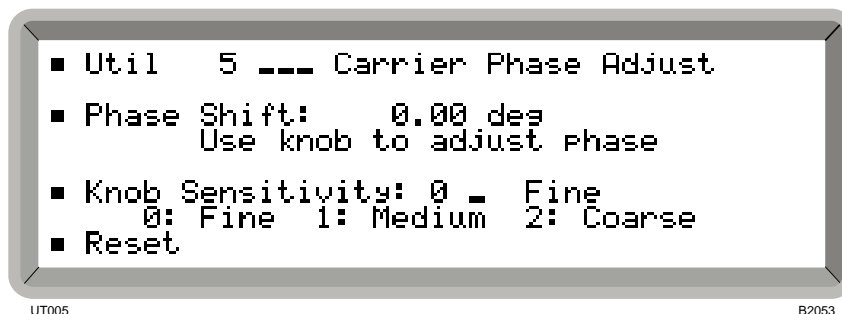


Fig. 4-15 Carrier phase adjust menu

- (2) Select the required control knob sensitivity between *Fine* (0.09°), *Medium* (0.9°) and *Coarse* (2.7°).
- (3) Highlight *Phase Shift* and adjust the phase using the control knob. Adjustment is in the range -359.91° to $+359.91^\circ$ (fine sensitivity). Note that if you have set the carrier phase and subsequently adjusted the carrier frequency, the menu *Phase Shift* value will be blanked. This is because the value will then be indeterminate due to the adjustment.
- (4) To establish a reference the displayed phase shift can be reset to 0° by highlighting *Reset* and pressing [SELECT].

Selecting RF level

RF level can be entered in the range -140 to +13 dBm (or to +25 dBm for the High Power Option).

- (1) Select the RF level from the main screen by pressing [RF LEVEL]. *RF Levl:* is highlighted on the screen.
- (2) Enter the required value using the numerical key pad.
- (3) For voltage terminate using the [μ V], [mV] or [V] key. For dBm terminate using the [dB] key. RF levels in linear (PD or EMF) and logarithmic units are selected from the utilities.
- (4) The level can then be adjusted either in steps or by using the control knob for continuous adjustment. The default increment/decrement is 1 dB.
- (5) You can check the current amount of offset from the reference level by pressing and holding [TOTAL Δ].
- (6) Pressing [RETN] returns you to the reference level; pressing [SET REF] selects the currently displayed level as the reference level.
- (7) The RF output level may be toggled on and off by means of the [CARR ON/OFF] key.

Choice of units

Conversion can be made between dB and V by pressing the appropriate units key. Selection of linear and logarithmic units is made using Util 10 and Util 11 respectively (see below).

Attenuator hold

Pressing the [ATTEN LOCK] key inhibits operation of the step attenuator from the level at which the key is enabled. This is usable for a level reduction of at least 10 dB. Whilst in operation the display shows *Atten Lock*.

Reverse power protection

Accidental application of power to the RF OUTPUT socket trips the reverse power protection (RPP) circuit (unless Option 1: No Attenuator is fitted, which has no protection) and causes Fig. 4-16 to be displayed.

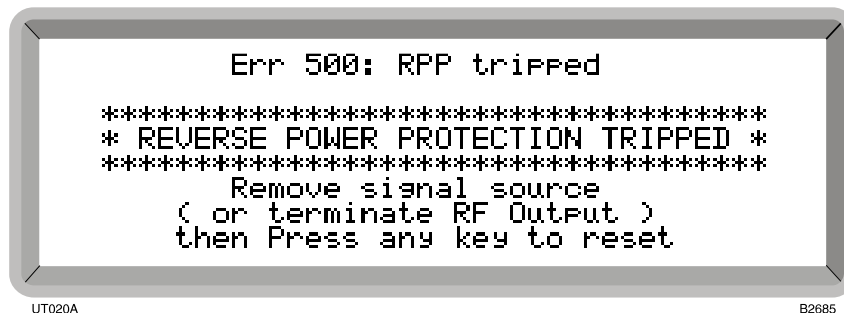


Fig. 4-16 RPP tripped display

The protection circuit can be reset by pressing any key after having removed the power source. The display then returns to the menu in use at the time that the RPP was tripped.

Note that the protection circuit may be activated when the generator is set to a high level and the RF OUTPUT socket has no terminating load.

RF level linear units

You can set the RF level in linear units of volts PD or volts EMF as follows:

- (1) Select the *Util 10: RF Level Linear Unit* menu. This shows the currently selected linear unit (see Fig. 4-17).

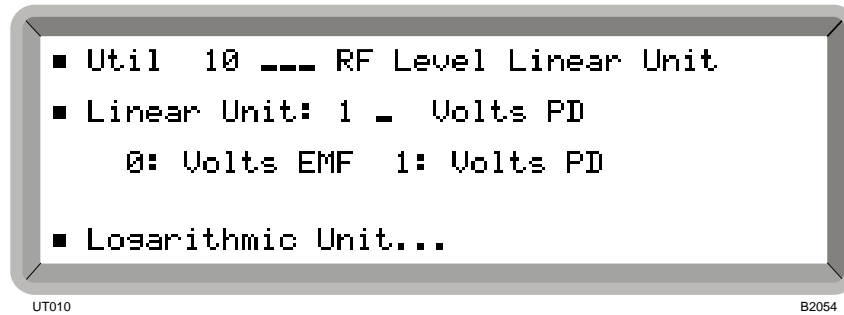


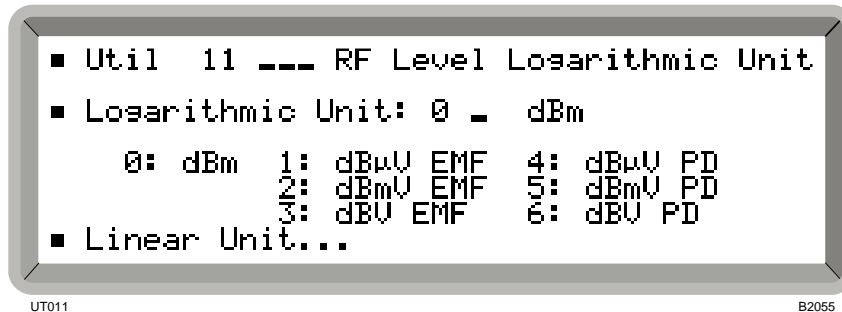
Fig. 4-17 RF level linear units menu

- (2) Enter *1* for *Volts PD* or *0* for *Volts EMF* (no terminator is necessary).
- (3) To select a logarithmic unit, highlight *Logarithmic Unit...* and press [SELECT]. This gives you immediate access to the *Util 11: RF Level Logarithmic Unit* menu shown below.

RF level logarithmic units

You can set the RF level in logarithmic units as follows:

- (1) Select the *Util 11: RF Level Logarithmic Unit* menu. This shows the currently selected logarithmic unit (see Fig. 4-18).



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Fig. 4-18 RF level logarithmic units menu

- (2) Enter a number in the range 0 to 6 (no terminator is necessary) to select between volts (dBV), millivolts (dBmV), microvolts (dB μ V) – in EMF or PD – and 1 milliwatt into 50 Ω (dBm).
- (3) To select a linear unit, highlight *Linear Unit...* and press [SELECT]. This gives you immediate access to the *Util 10: RF Level Linear Unit* menu shown above.

Modulation modes

The EXT MOD INPUT socket allows an external modulation signal to be summed with the signals from the internal oscillator. This allows up to three modulations to be available: for example, external FM with a combined internal AM1 and AM2.

Modulation source can be internal or external. If internal, the modulation can be the sum of two signals – AM1 + AM2, FM1 + FM2 or Φ M1 + Φ M2 – each of which can have its own depth/deviation and modulation frequency.

The common carrier wave can be modulated by two different types of modulation, where one uses an internal source and the other an external source. The internal source may be composed of two signals. Allowed combinations are:

internal AM + external FM ; internal FM + external AM
 internal AM + external Φ M ; internal Φ M + external AM

Note that pulse modulation may be selected in addition to any normal modulation combination.

Mode selection

Modulation mode may be selected as follows:

- (1) Select the *Util 20: Modulation Mode (Normal)* menu. This shows the currently selected modulation mode against *Mod Mode:*. If pulse modulation is enabled this will also be displayed.
- (2) From the menu select the desired modulation mode by highlighting the item and then pressing [SELECT]. The current modulation mode changes accordingly. Select single on the first menu page (shown in Fig. 4-19) or dual on the second (shown in Fig. 4-20).

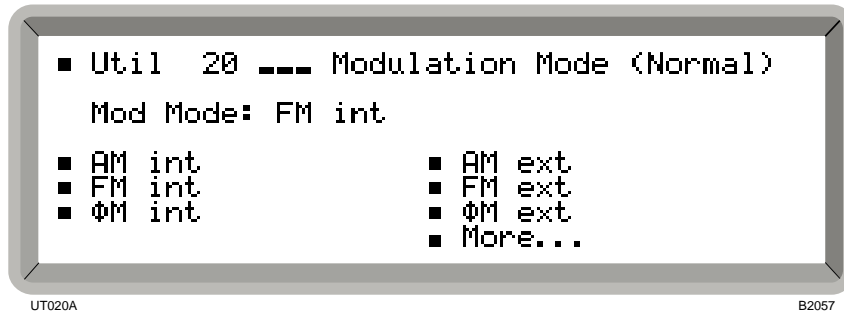


Fig. 4-19 Modulation mode menu – first page

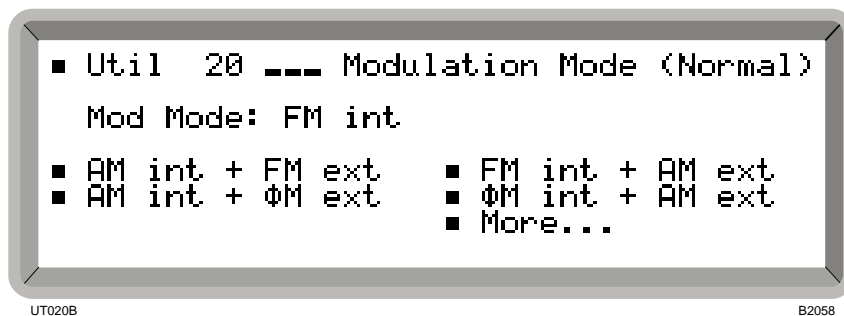


Fig. 4-20 Modulation mode menu – second page

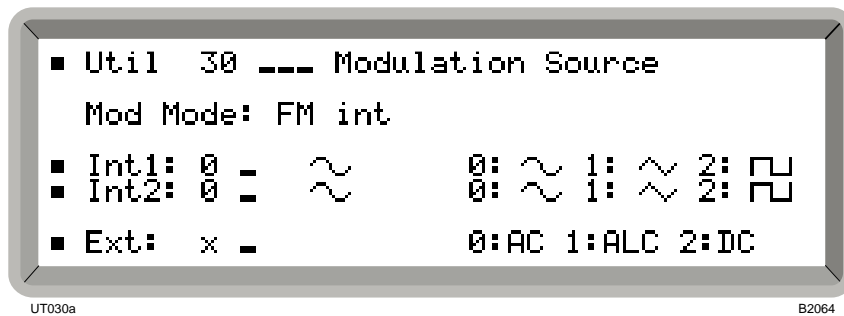
- (3) Press [MOD] to return to the main screen. Repeatedly pressing [MOD] will now step through each modulation of your selected modulation mode.

Source selection – internal

Having previously selected internal modulation from the *Util 20: Modulation Mode* menu, select the waveform and modulating frequency as follows:

- (1) Press [MOD SOURCE] to highlight the current modulation source selection.
- (2) Repeatedly press [MOD SOURCE] to cycle through and select a sine, square or triangular waveform.
- (3) Enter the required modulating frequency on the keypad and terminate with the [Hz] or [kHz] key. If the modulation requested exceeds 20 kHz the modulation is set to the maximum value.

The output waveform can be switched in a different sequence to that allowed by the [MOD SOURCE] key. For instance it may be required to switch from sine to square wave without the necessity of switching via the triangular wave. For this requirement, use the *Util 30: Modulation Source* menu shown in Fig. 4-21.



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Fig. 4-21 Modulation source menu

Source selection – external

AC or DC coupling or automatic leveling control (ALC) can be used in conjunction with an external source. Having previously selected external modulation from the *Util 20 Modulation Mode* menu continue as follows:

- (1) Press [MOD SOURCE] for modulation source selection.
- (2) Repeatedly press [MOD SOURCE] to cycle through the selections *Ext DC*, *Ext AC* and *Ext ALC*.
- (3) Apply a signal to the EXT MOD INPUT socket. Note that on switch-on this socket is disabled.
- (4) If *EXT ALC* has been selected and the error message *Err 511: ALC too high* or *Err 512: ALC too low* is displayed the signal input is outside the 0.75 to 1.25 V RMS ALC range of the instrument.
- (5) If *EXT DC* has been selected, note that a DCFM nulling facility is available (refer to ‘DCFM nulling’ in the ‘General’ section below).

External source selection may also be made by means of the *Util 30: Modulation Source* menu shown in Fig. 4-22.

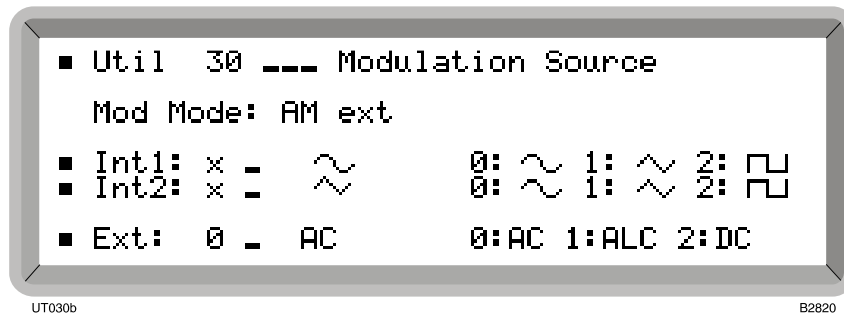


Fig. 4-22 Modulation source menu – shown with an external source selected

Modulation enable/disable

[SOURCE ON/OFF] switches the current modulation channel on or off. To switch all modulation on or off press [MOD ON/OFF]; this function is mainly used when more than one modulation source is enabled. Switching all modulation off causes *Mod Disable* to appear on the main screen.

Modulation source phase adjustment

The phase difference of the modulation oscillator channel 2 relative to channel 1 can be adjusted in degrees as follows:

- (1) Select the *Util 31: Modulation Source Phase* menu. This shows the currently selected phase difference setting (see Fig. 4-23).

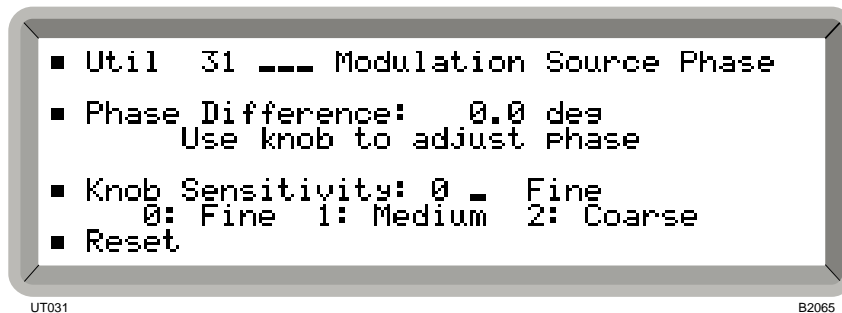


Fig. 4-23 Modulation source phase menu

- (2) Select the required control knob sensitivity between *Fine* (0.1°), *Medium* (1°) and *Coarse* (3°).
- (3) Highlight *Phase Difference* and adjust the phase using the control knob. Adjustment is in the range -359.9° to $+359.9^\circ$ (fine sensitivity). Note that if you have set the source phase and subsequently adjusted the source frequency or changed the waveform, the menu *Phase Difference* value will be blanked. This is because the value will then be indeterminate due to the adjustment or changed waveform.
- (4) To establish a reference the displayed phase shift can be reset to 0° by highlighting *Reset* and pressing [SELECT].

Modulation selection

The carrier can be frequency, amplitude or phase modulated from an internal or external source. Additionally pulse modulation is available from an external source. The internal modulation oscillator is capable of generating two tones simultaneously in one modulation channel and has a frequency range of 0.01 Hz to 20 kHz.

Amplitude modulation selection – internal

Having previously selected the modulation mode (see ‘Mode selection’ above) select amplitude modulation as follows:

- (1) Press [MOD] to display the main screen with *AM1 Depth* highlighted.
 - (2) Enter the required internal modulation depth via the numerical key pad and terminate with the [%] key. If you exceed the 99.9% modulation depth it is reset by default to the maximum value.
 - (3) If the internal modulation is to be the sum of two signals (selected from the *Util 30* menu), press the [MOD] key again to highlight *AM2 Depth*. Enter the required modulation depth for the second signal. If you exceed the (99.9% – AM1) modulation depth limit it is reset by default to the maximum allowed value.
-

Frequency modulation selection – internal

Having previously selected the modulation mode (see 'Mode selection' above) select frequency modulation as follows:

- (1) Press [MOD] to display the main screen with *FM1 Devn* highlighted.
 - (2) Enter the required internal FM deviation via the numerical key pad and terminate with the [Hz] or [kHz] key. If you exceed the 100 kHz deviation limit it is reset by default to the maximum value.
 - (3) If the internal modulation is to be the sum of two signals (selected from the *Util 30* menu), press the [MOD] key again to highlight *FM2 Devn*. Enter the required deviation for the second signal. If you exceed the (100 kHz – FM1) deviation limit it is reset by default to the maximum allowed value.
-

Phase modulation selection – internal

Having previously selected the modulation mode (see 'Mode selection' above) select phase modulation as follows:

- (1) Press [MOD] to display the main screen with $\Phi M1 Devn$ highlighted.
 - (2) Enter the required internal ΦM deviation via the numerical key pad and terminate with the [rad] key. If you exceed the 10 radians deviation limit it is reset by default to the maximum value.
 - (3) If the internal modulation is to be the sum of two signals, press the [MOD] key again to highlight $\Phi M2 Devn$. Enter the required deviation for the second signal. If you exceed the (10 rad – $\Phi M1$) deviation limit it is reset by default to the maximum allowed value.
-

Pulse modulation selection

Pulse modulation may be selected in addition to any other normal modulation modes. The source is external only from the rear-panel PULSE I/P socket. (Note that using this socket prevents 4FSK operation.) Selection may be made as follows:

- (1) Select the *Util 22: Pulse Modulation* menu. This shows the currently selected modulation mode against *Mod Mode*: (see Fig. 4-24).

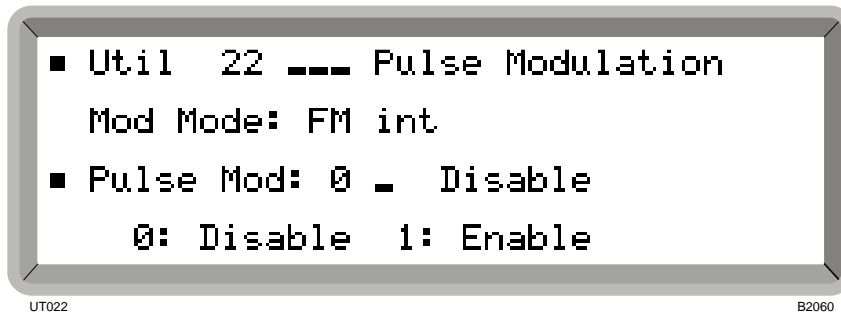


Fig. 4-24 Pulse modulation menu

- (2) Enter 1 on the key pad (no terminator is required) to *Enable* the external modulation. The display changes to show the current modulation plus *Pulse* (for example, *Mod Mode: AM int + FM ext + Pulse*).
- (3) Press [MOD] to return to the main screen with *Pulse* displayed together with its *ON* or *OFF* state.

When *ON* the carrier is controlled by the logic level applied to the PULSE I/P socket. A logical '1' (5 V) allows carrier output, a logical '0' (0 V) suppresses it. Turning pulse mod *OFF* effectively applies a logical '1', allowing carrier output.

FSK selection

The instrument accepts one or two logic level inputs to produce an FSK modulated output signal. The input data is sampled at 156 kHz and produces a 2 or 4 level shift waveform which is filtered by a 20 kHz Bessel filter and applied to the carrier. Frequency shift keying is selected as follows:

- (1) Select the *Util 21: Modulation Mode (Special)* menu. This shows the currently selected modulation mode against *Mod Mode:* (see Fig. 4-25).

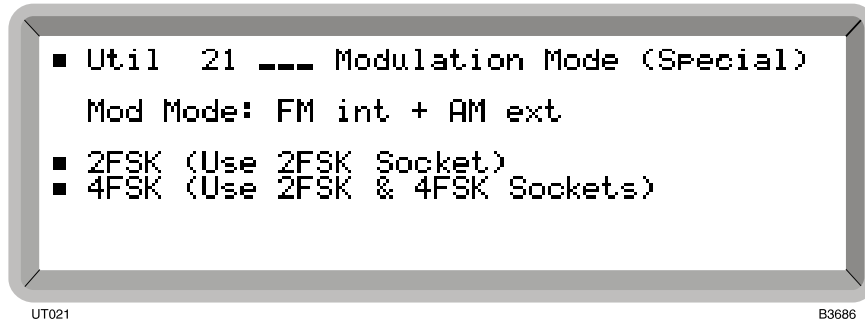


Fig. 4-25 Modulation mode (special) menu

- (2) Select the type of FSK. Either *2FSK* or *4FSK* is shown against *Mod Mode*.
- (3) For 2FSK apply a TTL signal to the 2FSK socket. For 4FSK apply the signals to the 2FSK and 4FSK sockets.
- (4) Press [MOD] to return to the main screen with *FM Devn* displayed. Enter the required deviation via the numerical key pad and terminate with the [Hz] or [kHz] key. If you exceed the 100 kHz deviation limit it is reset by default to the maximum value.
- (5) Either *2FSK Ext* or *4FSK Ext* is shown in the modulation source field. Note that for FSK operation pressing [MOD SOURCE] has no effect on the instrument.
- (6) If FSK is turned *OFF* no frequency shift is applied to the carrier.

The frequency shifts produced by the applied data are as follows:

2FSK		4FSK		
2FSK	SHIFT	2FSK	4FSK	SHIFT
1	+D	1	0	+D
0	-D	1	1	+D/3
		0	1	-D/3
		0	0	-D

Where D is the set deviation value.

Default settings

The instrument is reset to the factory default settings in the following cases:

- (1) At power-up.
- (2) Following execution of the RCL 999 command.
- (3) Following execution of the *RST command.

The default settings are shown in Table 4-1 .

Table 4-1 Instrument default settings

Carrier frequency	:	(Maximum available) 1.2 GHz/2.05 GHz/2.51 GHz
Step	:	1 kHz
RF level	:	-140 dBm (or -2 dBm with the No Attenuator option)
Step	:	1 dB Status: ON
Modulation mode	:	Internal FM, modulation disabled
Modulations	:	FM1 : Deviation: 0 Hz, OFF : Internal source, frequency: 1 kHz, sine
	:	FM2 : Deviation: 0 Hz, OFF : Internal source, frequency: 400 Hz, sine
	:	Φ M1 : Deviation: 0 rad, OFF : Internal source, frequency: 1 kHz, sine
	:	Φ M2 : Deviation: 0 rad, OFF : Internal source, frequency: 400 Hz, sine
	:	AM1 : Deviation: 0%, OFF : Internal source, frequency: 1 kHz, sine
	:	AM1 : Deviation: 0%, OFF : Internal source, frequency: 400 Hz, sine
	:	Pulse : OFF
	:	SINAD : OFF
Modulation steps	:	Δ FM 1 kHz, Δ Φ M 0.1 rad, Δ AM 1%
Mod frequency steps	:	10 Hz
Carrier sweep	:	
Freq mode	:	Fixed
Mode	:	Single sweep
Type	:	Linear
Ext trigger	:	Off
Start	:	9 kHz
Stop	:	(Maximum available)
Step size	:	1 kHz
Time	:	50 ms
SINAD	:	
Averages	:	5
Weighting filter	:	CMESS

MEMORY

Memory stores

There are three types of store: carrier, full and RAM. Both carrier and full stores are non-volatile. The contents of the RAM store are lost when the instrument is switched off.

Carrier store

The non-volatile carrier frequency store has 100 locations numbered 0 to 99 for the storage of carrier frequency only. This store can be used to apply a set of test conditions to a range of frequencies. For example, if you wish to use the same modulation at a variety of frequencies you can use the carrier store to set the instrument to each of the frequencies in turn. When a carrier store is used it will only replace the current carrier frequency – all the other settings will remain unchanged.

Full store

The non-volatile full store has 100 locations numbered 100 to 199 for the storage of instrument settings. This store is used to store those parameters which currently affect the RF output: carrier frequency, RF level, modulations in use, on/off and source information and the two modulation oscillator frequencies in use.

A full store contains the following information:

- Carrier frequency setting
- Carrier frequency step size
- RF level setting
- RF level step size
- All modulation settings
- All modulation step sizes
- Modulation mode and status
- The active modulation frequencies
- The modulation frequency step size
- All sweep settings.

RAM store

The volatile RAM store has locations numbered from 200 to 299 for the full storage of instrument settings. The parameters stored are the same as those for the full store. However, the RAM store has no long-term wear-out mechanism and is therefore recommended for use in ATE programs where all the settings to be used in a test sequence are initially declared and then recalled. This results in a reduction of the GPIB/RS-232 overhead.

Storing data

To store data, press the [STO] key and enter the location number on the key pad then press [ENTER]. Depending on which location range the number falls in, the display shows *FREQ* (for carrier store), *FULL* or *RAM*. If you make a mistake, and have not yet pressed [ENTER], press [STO] again and re-enter the location number.

Memory recall

There are three types of recall: carrier, full and RAM. Both carrier and full stores are non-volatile. The contents of the RAM store are lost when the instrument is switched off.

Carrier recall

The non-volatile carrier frequency store has 100 locations numbered 0 to 99 for carrier frequency only. These can be recalled and used in conjunction with full recall to apply a set of test conditions to a range of frequencies.

Full recall

The non-volatile full store has 100 locations numbered 100 to 199 for the storage of instrument settings. These stores may be recalled and used to reset the instrument's parameters to those which affect the RF output: carrier frequency, RF level, modulations in use, on/off and source information and the two modulation oscillator frequencies in use.

RAM recall

The volatile RAM store has locations numbered 200 onwards for the full storage of instrument settings. The parameters that are recalled are the same as those for full recall.

Recalling data

To recall data, press the [RCL] key and enter the location number on the key pad, then press [ENTER]. Depending on which location range the number falls in, the display shows *FREQ* (for carrier store), *FULL* or *RAM*. The [$\uparrow+10$] and [$\downarrow\times 10$] keys as well as the control knob can be used to recall the next and previous locations.

Recalling default settings

To recall the factory default settings, press the [RCL] key and enter 999 on the keypad, then press [ENTER]. The *RESET* annunciator is shown and the instrument is reset to the settings shown in Table 4-1.

Memory sequencing

You can step the memory up in a sequence from a start location using a TTL input connected to the rear-panel TRIGGER socket. Note that the triggering order of priority is as follows:

FSK logic input
Memory recall
Sweep trigger.

Therefore ensure that FSK is not enabled, otherwise selecting memory recall triggering will have no effect. The memory sequencing operation is as follows:

- (1) Select *Util 40: Memory Sequencing* to display the menu shown in Fig. 4-26.

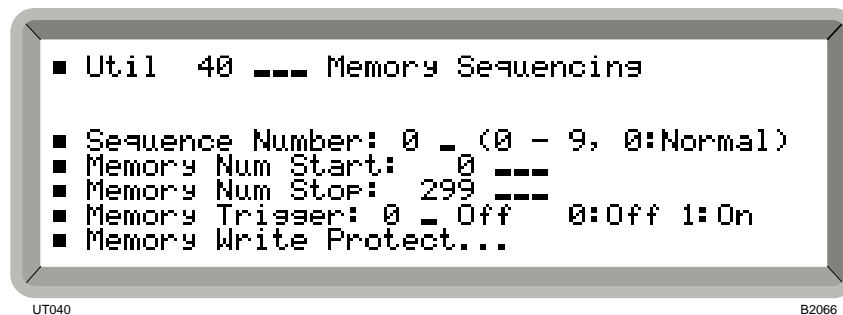


Fig. 4-26 Memory sequencing menu

- (2) Select one of up to 9 sequences by entering a number in the range 1 to 9. Select 0 to turn sequence off (normal mode).
- (3) Enter the *Memory Num Start* and *Mem Num Stop* store numbers for the selected sequence within the ranges:

0–99	Carrier store
100–199	Full store
200–299	RAM store.
- (4) To enable memory recall sequencing set *Memory Trigger* to 1. Each trigger will then recall the next memory store. When the end of the sequence is reached the carrier and full stores will wrap around to the start.
- (5) To protect your selected memory sequence against accidental overwriting, highlight *Memory Write Protect...* and press [SELECT]. This gives immediate access to the *Util 41: Memory Write Protect* menu shown below.

Memory write protection

To use the memory protection utility first ensure that the instrument is unlocked to Level 1 using *Util 80: Protection Lock/Unlock*. Then you can either write protect a block of stores (or a single store) to prevent accidental overwriting or unprotect it as follows:

- (1) Select *Util 41: Memory Write Protect* to display the menu shown in Fig. 4-27.



Fig. 4-27 Memory write protection menu (showing stores 0 to 100 protected)

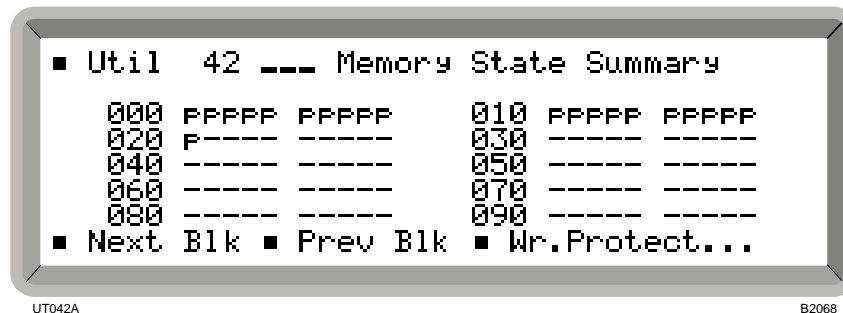
- (2) For a memory block enter the *Memory Num Start* and *Memory Num Stop* store numbers. For a single store make both numbers the same.
- (3) Select *Protect* or *Unprotect* as required. This action is acknowledged by the message *** Protected *** or *** Unprotected *** appearing respectively.
- (4) You can see which areas of the memory are protected by highlighting *Memory Store State Summary...* and pressing [SELECT]. This gives immediate access to the *Util 42: Memory State Summary* shown below.

Note that at power-on the volatile RAM stores are unprotected to allow immediate use.

Memory state summary

The memory state summary enables you to look at blocks of 100 stores at a time to see their protection states as follows:

- (1) Select *Util 42: Memory State Summary* to display the summary shown in Fig. 4-28.



```
■ Util 42 --- Memory State Summary
000 FFFFF FFFFF 010 FFFFF FFFFF
020 P----- 030 -----
040 ----- 050 -----
060 ----- 070 -----
080 ----- 090 -----
■ Next Blk ■ Prev Blk ■ Wr.Protect...
```

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Fig. 4-28 Memory state summary (showing carrier stores 0 to 20 protected)

- (2) Choose which of the three blocks you require by selecting *Next Blk* or *Prev Blk*.
- (3) An unprotected store is indicated by a dash, a protected store is indicated by a letter *p*. To change the protection status select *Wr.Protect...* This gives immediate access to the *Util 41: Memory Write Protect Blk* above.

Memory cloning

You can transfer the stored settings from one signal generator to another by using either the GPIB or the RS-232 interface. These stored settings are the full and carrier stores together with their currently protected states. This means that after cloning has been performed all of the non-protected memory stores on the receiving instrument will have been overwritten.

For GPIB operation the transmitting instrument is automatically configured as a talker sending to one or more automatically configured listeners. It does not matter which addresses the instruments are set to.

For RS-232 operation the transmitting instrument can only send to one receiving instrument. The settings of the serial ports of the two instruments do not matter except that data transfer will be at the higher baud rate.

To use this utility first of all ensure that the instrument is unlocked to Level 1 using *Util 80: Protection Lock/Unlock*. Then proceed as follows:

- (1) Ensure that the correct mode of operation, either GPIB or RS-232, has been selected for both instruments using *Util 50: Remote Operation Select*.
- (2) Select *Util 43: Memory Cloning* on transmitting and receiving instruments to display the menu shown in Fig. 4-29. Check that all instruments show the same remote mode – either *GPIB* or *RS232*.

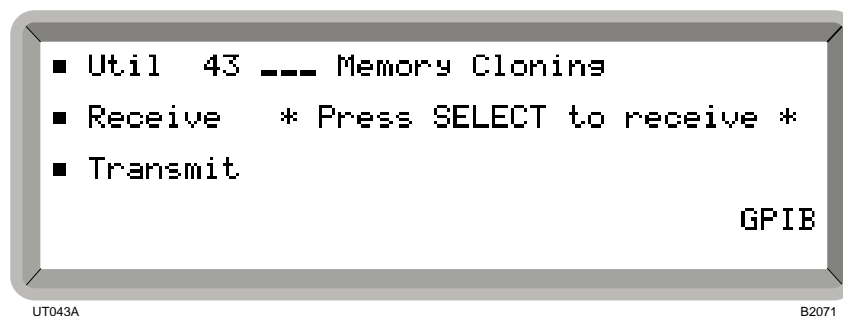


Fig. 4-29 Memory cloning menu (showing instrument ready to receive via the GPIB)

- (3) On the receiving instrument highlight *Receive* and press [SELECT]. The message ** Press SELECT to receive ** changes to ** Ready to receive ** and the instrument enters the remote mode (displays *REM*).
- (4) On the transmitting instrument highlight *Transmit* and press [SELECT]. The message ** Press SELECT ** changes to ** Transmitting **, *REM* is displayed and data transfer takes place. Cloning times via GPIB and RS-232 are approximately 4 s and 14 s respectively.
- (5) At the end of the data transfer process ** Transfer complete ** is displayed by all participating instruments.

GENERAL

Frequency standard selection

This utility enables you to select a 10 MHz output to provide a standard for use with associated equipment. It also enables you to select a standard (either external or internal) for use by the instrument. When an external standard is selected, the internal TCXO is locked to the external standard using a phase locked loop. In this case, the menu allows you to select between *direct* and *indirect*. When *direct* is selected the internal standard for the RF tray is provided directly from the external standard. When *indirect* is selected this standard is provided from the TCXO locked to the external standard. Frequency standard selection is as follows:

- (1) Select the *Util 4: Frequency Standard* menu shown in Fig. 4-30.

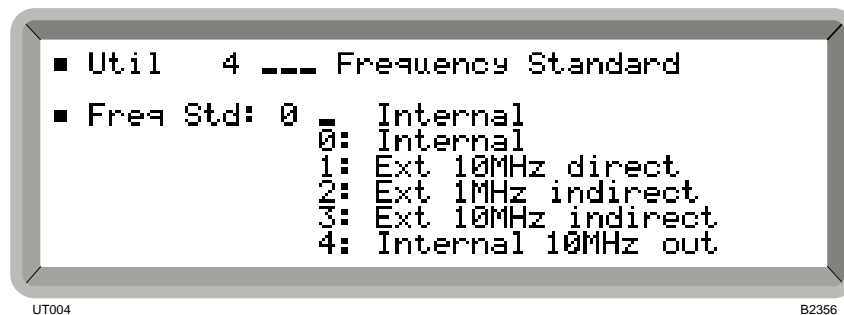


Fig. 4-30 Frequency standard menu

- (2) To select the standard for the instrument, choose between *Internal* or one of the three external standard selections. When an external standard is selected, *Ext* is displayed on the main screen.
- (3) To obtain an internally generated 10 MHz standard from the instrument's FREQ STD IN-OUT socket, select *Internal 10MHz out*.
- (4) To provide an externally generated 1 or 10 MHz standard for the instrument, connect the signal to the rear-panel FREQ STD IN-OUT socket. Then with an external standard selected, you can choose between *direct* and *indirect*. You should select *direct* if your provided standard is better than that fitted in the instrument.

50 Ω /75 Ω impedance selection

The performance specification of the instrument assumes operation into 50 Ω loads. By means of this menu in association with the 75 Ω adapter (see 'Versions and Accessories' in Data Sheet).

You can select operation into 75 Ω loads whilst maintaining correct voltage calibration.

It also enables the reverse power protection circuit to function correctly. But note that in the event of an overload the RPP will function but the adapter will NOT be protected. To use this utility ensure that the instrument is unlocked to Level 1 using *Util 80:Protection Lock/Unlock*. Then proceed as follows:

- (1) First of all connect the 50 Ω /75 Ω adapter to the front-panel RF OUTPUT socket.
- (2) Select the *Util 12: 50 Ohm/75 Ohm Calibration* menu. This shows the currently selected impedance (see Fig. 4-31).

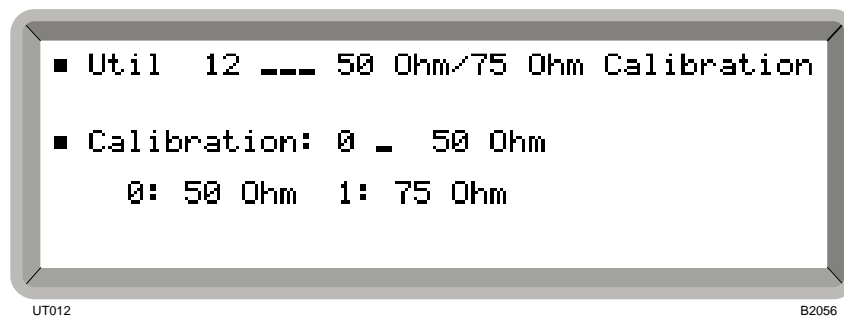


Fig. 4-31 50 Ω /75 Ω calibration menu

- (3) Select *1* for 75 Ω or *0* for 50 Ω (no terminator is necessary). When 75 Ω is selected, the value of the displayed output level is reduced by 5.7 dB to compensate for the 50 Ω /75 Ω adapter loss.

RF level limit

To use the RF level limit utility first ensure that the instrument is unlocked to Level 1 using *Util 80: Protection Lock/Unlock*. This utility enables you to set your own maximum output power limit which allows you to protect sensitive devices connected to the RF OUTPUT socket.

Proceed as follows:

- (1) Select the *Util 13: RF Level Limit* menu. This shows the currently selected RF level limit (see Fig. 4-32).

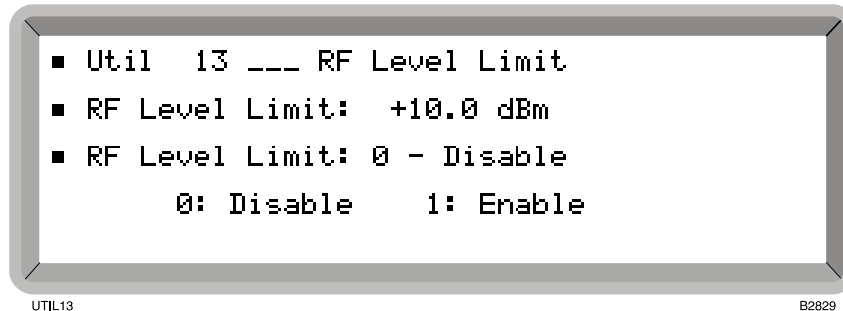


Fig. 4-32 RF level limit menu

- (2) Set the required *RF Level Limit* in the range -125 to $+13$ dBm to a resolution of 0.1 dB. For the High Power Option (Option 3), the maximum calibrated output level is $+25.1$ dBm up to 1.2 GHz and $+19$ dBm above this frequency. Above 1.2 GHz an uncalibrated level up to $+25.1$ dBm is allowed but an *RF Level Uncalibrated* message will be displayed.
- (3) Enter *0* to disable or *1* to enable the function.

The setting will be saved in non-volatile memory so that when subsequently the instrument is switched on again it will be set with your specified RF level limit.

RF level offsets

To use the RF level offsets utility first ensure that the instrument is unlocked to Level 1 using *Util 80: Protection Lock/Unlock*. This utility enables you to offset the RF output level to compensate for cable or switching losses, or to standardize a group of instruments so that they give identical measurements. The offsets do not change the displayed RF level but do change the RF output level. Setting a negative offset decreases the level from the RF OUTPUT socket.

One offset is allowed in each of the following frequency ranges (applicable to all instruments except where shown):

9 kHz	–	150 MHz
150 MHz	–	300 MHz
300 MHz	–	600 MHz
600 MHz	–	1.2 GHz
1.2 GHz	–	2.05 GHz (2023B only)
1.2 GHz	–	2.51 GHz (2025 only)

Proceed as follows:

- (1) Select the *Util 14: RF Level Offsets* menu. This shows the selected RF level offset for the currently selected carrier frequency (see Fig. 4-33).

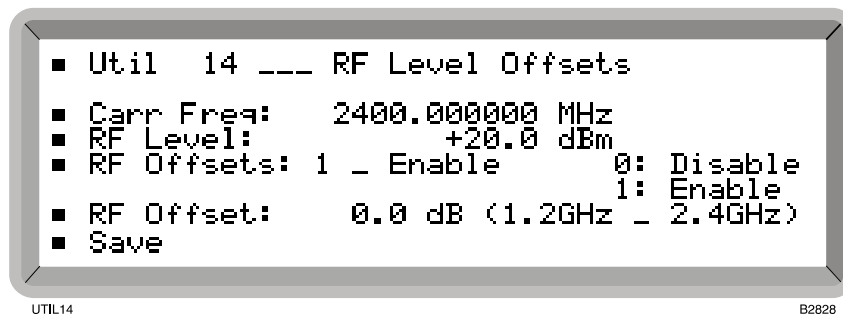


Fig. 4-33 RF level offsets menu

- (2) Enter the required carrier frequency (which automatically selects the appropriate frequency range).
- (3) Set the required positive or negative RF offset in the range 0 to 5.0 dB to a resolution of 0.1 dB using either the key pad or control knob. The applicable frequency range follows in brackets.
- (4) Repeat steps (2) and (3) above for each required additional range.
- (5) Enter 0 to disable or 1 to enable all ranges.
- (6) Select *Save* which causes ** Saved ** to be displayed. Now all your offsets are saved in non-volatile memory so that when subsequently the instrument is switched on again it will be set with your specified offsets.

Note that setting an RF level offset may cause the RF level displayed to decrease, so that the absolute limits of the instrument are not exceeded.

DCFM nulling

For a DC-coupled external FM signal, small frequency offsets can be reduced by using the DCFM nulling facility. Operation is as follows:

- (1) First of all select external FM from *Util 20: Modulation Mode (Normal)*. Then select *DC* coupling from *Util 30: Modulation Source*.
- (2) Select the *Util 23: DCFM Nulling* utility shown in Fig. 4-34 below.

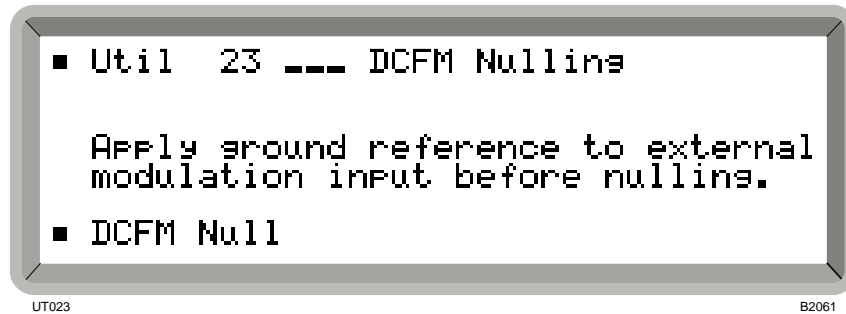


Fig. 4-34 DCFM nulling display

- (3) Follow the on-screen directions by connecting your ground reference to the EXT MOD INPUT socket.
- (4) With *DCFM Null* highlighted press [SELECT]. * *DCFM Nulling* * appears during the nulling process and when it disappears the process is completed.

SINAD measurement (Option 12)

When this option is fitted you may make measurements of the SINAD ratio on an audio frequency signal applied to the EXT MOD INPUT socket. Ensure that no external modulation mode has been selected from Util 20, since external modulation has priority over SINAD.

You can make the measurement in a flat bandwidth of 7 kHz or have it weighted according to the C-MESS or CCITT standards. You can select the amount of averaging so as to reduce variation in results and to control the update rate.

An automatic mode is available which uses a simple algorithm to adjust the RF output level of the signal generator until a target SINAD ratio is achieved.

The SINAD ratio is defined as:

$$10 \log_{10}[(\text{Signal} + \text{Noise} + \text{Distortion Power})/(\text{Noise} + \text{Distortion Power})]$$

The SINAD ratio provides a quantitative measure of signal quality, a noisy signal has a low SINAD ratio which increases as the signal quality improves. This measurement determines the RF signal level required to produce a given SINAD ratio at the receiver output. Typically SINAD ratio targets of 12 and 20 dB are used.

Proceed as follows:

- (1) First of all interconnect the receiver under test and the instrument as shown in Fig. 4-35 below.

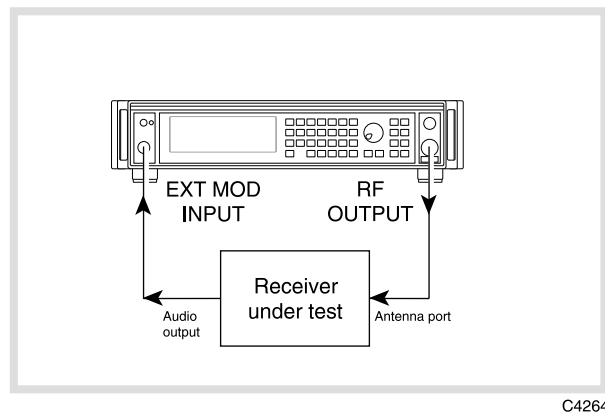


Fig. 4-35 SINAD measurement interconnections

- (2) Press [MENU] to display the *Utility Group Menu*. Then select *Special* to display the *Special Menu* shown in Fig. 4-36 below.

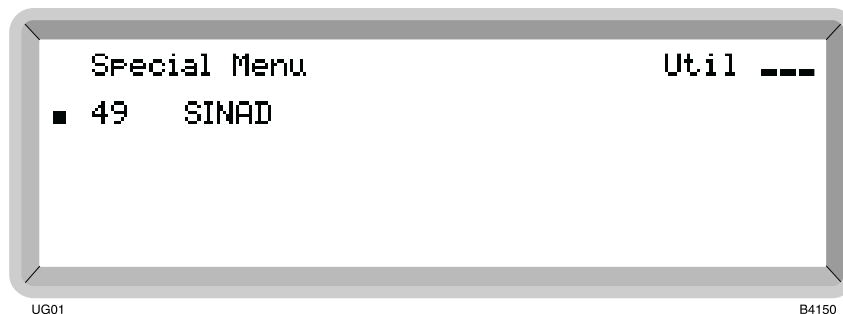
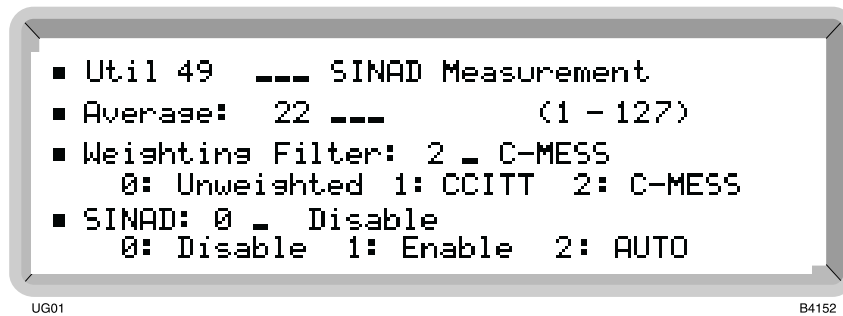


Fig. 4-36 Special menu

- (3) Highlight *Util 49: SINAD* and press [SELECT] to display the *Util 49: SINAD Measurement* menu shown in Fig. 4-37 below.



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Fig. 4-37 SINAD measurement menu

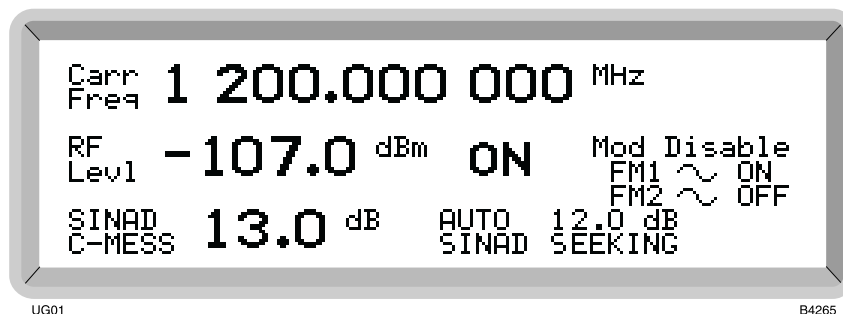
- (4) Select the number of samples to be averaged by highlighting *Average* and entering a number on the key pad in the range 1 to 127. But note that although a more accurate measurement results from selecting a high number, it also increases the measurement time.
- (5) Select the weighted filter between 1 for *CCITT* and 2 for *C-MESS*. 0 selects *Unweighted*. When no filter or averaging has been selected, by default the *C-MESS* filter is selected and 5 samples are averaged.
- (6) Enter 1 to enable manual SINAD or 2 to enable auto SINAD measurements.
- (7) Press [MOD] to return to the main screen. Repeatedly press this key until SINAD is displayed.

Manual SINAD

- (8) The measured SINAD is constantly updated and is proportional to the amount of RF level set. Adjust the RF level until the desired SINAD measurement is achieved.

Automatic SINAD

- (9) Set the target SINAD value by pressing [MOD SOURCE] and entering the target value in the range 6.0 to 60 dB.
- (10) Set the RF level so that the measured SINAD is several dBs greater than the target SINAD.
- (11) Start automatic leveling by pressing [SOURCE ON/OFF]. The RF level will decrement by the step size previously set (default 1 dB). During leveling the display will show *SEEKING* (as shown in Fig. 4-38) then *COMPLETE* when finished. The [SOURCE ON/OFF] key may be used to both pause and continue the process. At the conclusion pressing [SOURCE ON/OFF] will repeat the measurement.



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Fig. 4-38 Main screen during auto SINAD operation

SINAD set-up incorrect (Error 206) will be displayed if the first SINAD reading is lower than the target. The indicated RF level is unlikely to be correct. Probable causes are:

- Initial RF level set is too low.
- Radio is disconnected, incorrectly set up or malfunctioning.
- Signal generator [CARR ON/OFF] is OFF.
- Signal generator carrier is at the wrong frequency.

Signal generator carrier frequency is unmodulated, or modulation is not a 1 kHz sine wave.

[MOD ON/OFF] is OFF.

[SOURCE ON/OFF] is OFF.

If required, check that the correct CTCSS frequency, deviation and level are supplied to the unit under test.

Keyboard locking and display blanking

You may lock the keyboard to prevent unauthorized use of the instrument. Additionally you may blank the display to prevent sensitive data from being displayed. Selection is made as follows:

- (1) Unlock the protection by selecting *Util 80: Protection Lock/Unlock* and entering the 4-digit password for Level 1 using the keypad and pressing [ENTER].
- (2) Select the *Util 53: Key Lock/Display Blanking* menu shown in Fig. 4-39.



Fig. 4-39 Key lock/display blanking menu

Keyboard locking/unlocking

- (3) To lock the keyboard highlight *Lock Keyboard* and press [SELECT]. The instrument automatically returns to the main screen which indicates the locked status by displaying a key-shaped icon at the top right of the display. Now the keyboard is locked, although the instrument still responds to GPIB or RS-232 commands.
- (4) To unlock the keyboard enter the 4-digit password for Level 1 using the keypad and pressing [ENTER].

Display blanking

- (5) To blank the display highlight *Display Blanking* and press 1 [ENTER]. Press any function key to return to the main screen. Here it can be seen that the main parameters are blanked and replaced by dashes. This also applies to *Util 1: Carrier Sweep Parameters* where the start and stop frequencies are blanked, and to *Util 3: Carrier Sweep Control* where the carrier frequency is blanked.
- (6) To unblank the display re-enter *Util 53* and press 0 [ENTER].
- (7) You may lock the display in the blank state by using *Util 80* to enter an incorrect password.

Power-up options

The instrument can power-up in one of two states: with the factory settings or with the settings of your choice stored in one of the full memory locations. Selection is made as follows:

- (1) Select the *Util 54: Power Up Settings* menu. This shows the currently selected power-up choice (see Fig. 4-40).

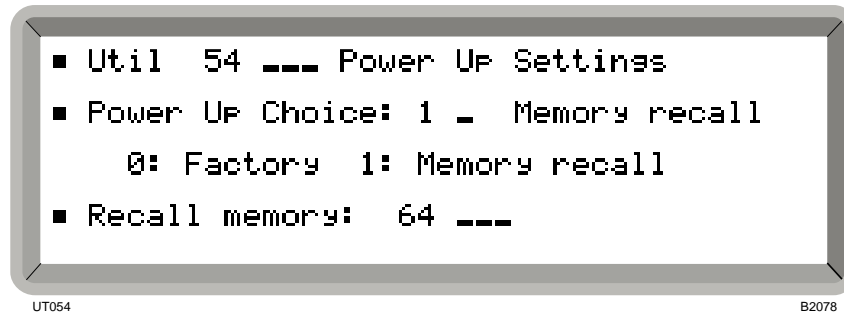


Fig. 4-40 Power-up settings menu

- (2) Enter 1 for *Memory Recall* or 0 for *Factory* (no terminator is necessary).
- (3) The current recall memory location is shown. To change, highlight *Recall Memory* and enter the required location number (in the range 0 to 199) and terminate with [ENTER].

Adjusting the display

Display contrast may be set to suit different lighting conditions and the setting saved in memory as follows:

- (1) Select the *Util 55: LCD Adjustment* menu. This shows the currently selected contrast setting (see Fig. 4-41).

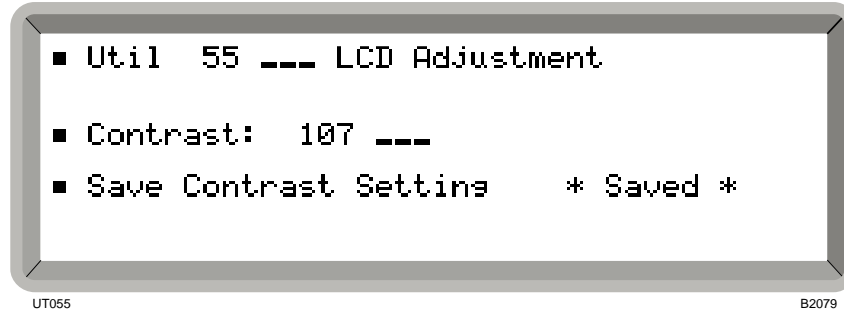


Fig. 4-41 LCD adjustment menu (with the setting saved for automatic recall at switch-on)

- (2) Enter a number in the low- to high-contrast range 0–255 (the default setting is 127). The setting can be adjusted by use of the [$\uparrow+10$] and [$\downarrow\times 10$] keys or the control knob.
- (3) If required, you can save the setting by selecting *Save Contrast Setting*. The instrument responds with **** SAVED **** and from now on whenever the instrument is switched on, the contrast will be at your individual setting.

Software information

You can obtain a description of the instrument's software by selecting *Util 60: Software Status*. This causes the software version and date as well as the programmed EPROM part number to be displayed (see Fig. 4-42).

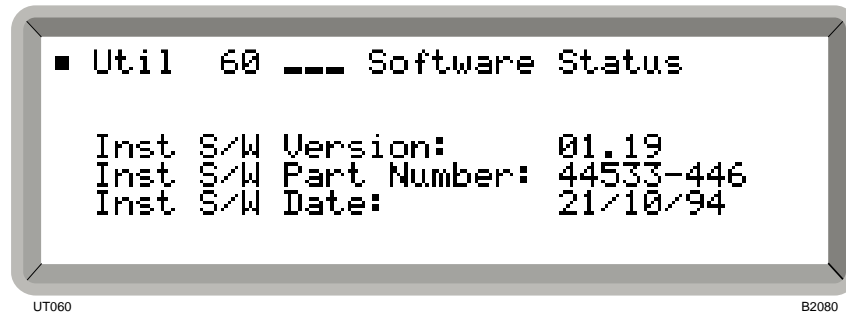


Fig. 4-42 Software status

Hardware information

You can obtain a description of the instrument's hardware by selecting *Util 61*. This causes the instrument type and serial number to be displayed (see Fig. 4-43).

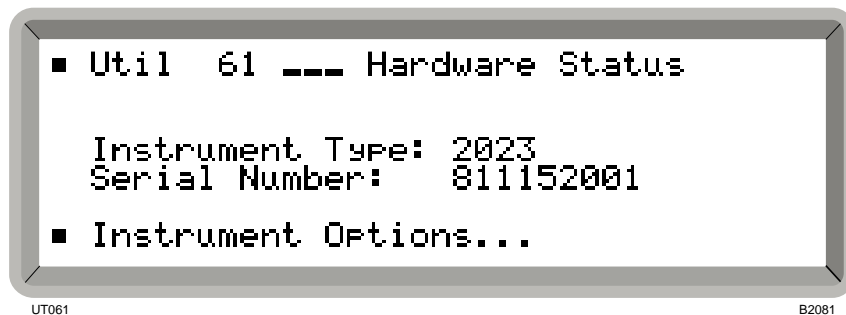


Fig. 4-43 Hardware status

- (1) Highlight *Instrument Options...* and press [SELECT]. This give you immediate access to the *Util 62: Instrument Options* display shown below.

Instrument options

You can obtain a list of the options fitted in the instrument by selecting *Util 62: Instrument Options* (see Fig. 4-44). For available options refer to 'Options' in Data Sheet.

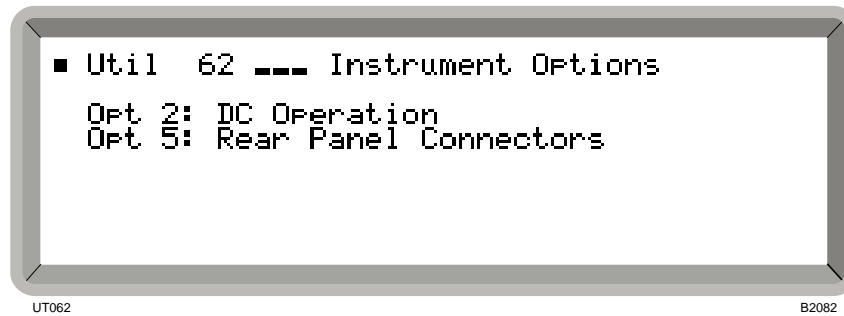


Fig. 4-44 Instrument options display

Note that if no attenuator is fitted reverse power protection is not provided.

Protection locking and unlocking.

To prevent accidental interference with the contents of internal memories, internal data is protected by secure key sequences. There are two levels of protection. The most secure, Level 2, used for servicing, is reserved for features such as altering the calibration data of the instrument. Level 1 protection is used for locking the keyboard, blanking the display and for memory protection. A filled-in square indicates an unprotected function. An open, unfilled square indicates a protected function.

To lock or unlock the protection select the *Util 80: Protection Lock/Unlock* menu shown in Fig. 4-45.

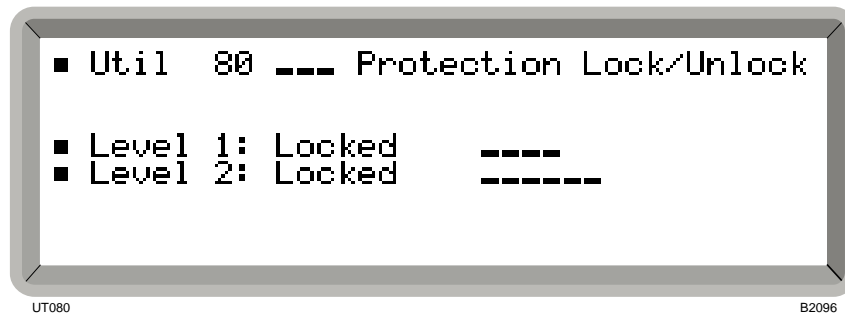


Fig. 4-45 Protection locking and unlocking

- (1) Highlight *Level 1*: and enter the 4-figure password on the keypad and press [ENTER]. *Locked* changes to *Unlocked*. The default password is 1234.
- (2) Highlight *Level 2*: and enter the 6-figure password on the keypad and press [ENTER]. *Locked* changes to *Unlocked*.
- (3) If the entered password is not recognized by the instrument the password will have been changed by operating personnel.
- (4) To lock the instrument, highlight either *Level 1*: or *Level 2*: and enter an incorrect password. Both levels will then become locked.

Changing the password

To change the password first ensure that the instrument is unlocked to Level 2 using *Util 80: Protection Lock/Unlock*. Then select the *Util 81: Password* menu shown in Fig. 4-46 and proceed as follows:



Fig. 4-46 Password selection menu

- (1) Highlight *Set Level 1 Password:* and enter a 4-figure password on the keypad then press [ENTER].
- (2) Highlight *Set Level 2 Password:* and enter a 6-figure password on the keypad and press [ENTER].

Keep a copy of your passwords in a safe place and remember to update the copy whenever the passwords are changed. In the event that you have forgotten your password(s) get in touch with your local Service Centre (for address refer to the end of this manual).

ERROR MESSAGES

Error handling

Error messages are divided into four groups:

- (1) Background errors – represent a condition of the instrument.
- (2) Foreground errors – generally caused by the user.
- (3) GPIB errors – generated by incorrect programming.
- (4) Fatal errors – caused by failure associated with the main RAM or the PROM. These errors may or may not be displayed according to the severity of the failure or corruption.

Background errors:

These are generated due to an incorrect operating condition within the instrument. These errors are generated automatically to warn the operator. For example if the reverse power protection circuit should trip the message: *Err 500: RPP tripped* will be displayed on the main screen. Background errors are listed in Table 4-2. Only one error will be displayed, that with the highest priority. To obtain a full list of errors occurring on your instrument in priority order, select *Util 75*:

Background Errors (see Fig. 4-47). Select *Down...* if the list is continued on a subsequent page.

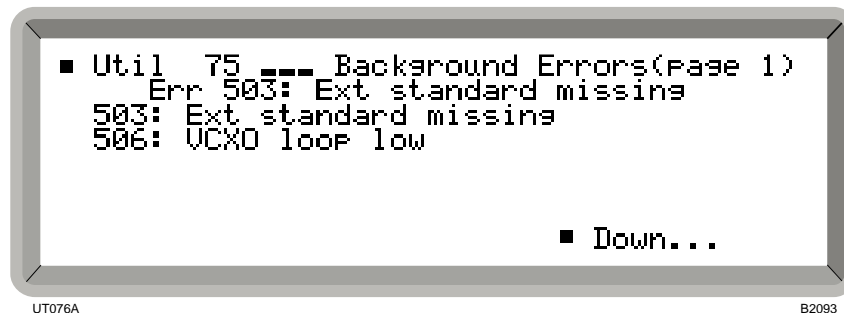


Fig. 4-47 Background errors display

Foreground errors:

These are typically generated when an entered parameter value is outside the valid range or for some other invalid operation. For example trying to set the carrier frequency above or below the specified range will display the following message *Err 100: Carrier limit* on the screen. The foreground errors are cleared upon function selection or by re-entering the parameter correctly. Foreground errors are listed in Table 4-3.

Error message priority:

A background error has a priority bit set which is used to determine which message needs to be displayed. A foreground error will temporarily overwrite the background error if currently displayed, but will return to displaying that error once the foreground error has been cleared.

GPIB errors

When an error occurs the error number is put into the error queue and the error message is displayed. Clearing the error message from the screen does not clear the error queue, which is only cleared by the GPIB command *ERROR?* query, which returns the error at the head of the queue, or by the **CLS* command which clears the whole error queue. GPIB errors are listed in Table 4-4.

The queue holds a maximum of 64 error message error numbers. If an error occurs while the queue is full the last error number is replaced with 399 to indicate that the queue is full. The ERROR? query returns a value of 399 for queue full and 0 for queue empty.

When an error number is written into the queue, a bit (<erb>) in the status byte register is set, and an appropriate bit in the standard event register is also set (one of <cme>, <exe>, <dde> or <qye>). These errors will also generate SRQ if the relevant bit in the status register is set. Many background errors are also reported in the Hardware and Coupling Status Registers.

Table 4-2 Background errors (500–599) in priority order

–	–	–	591	ftl	Main PROM faulty
590	ftl	Main RAM faulty	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
500	dde	RPP tripped	501	dde	Fractional-N loop low
502	dde	Fractional-N loop high	503	dde	Ext standard missing
504	dde	External std frequency low	505	dde	External std frequency high
506	dde	VCXO loop low	507	dde	VCXO loop high
508	dde	Amplitude modulator unlevelled	509	dde	Output unlevelled
510	dde	Power Amp Fail or Unterminated	511	dde	ALC too high
512	dde	ALC too low	513	dde	DSP not responding
514	dde	SINAD DSP not responding	515	dde	SINAD underrange
516	dde	SINAD overload	517	–	–
–	–	–	–	–	–
–	–	–	549	exe	RF level uncalibrated
550	exe	RF level limited by AM	551	exe	AM2 limited by AM1
552	exe	FM2 limited by FM1	553	exe	ΦM2 limited by ΦM1

Table 4-3 Foreground errors (0–399)

0	dde	No error	1	dde	EEPROM checksum
2	dde	Pad cal checksum	3	dde	RF cal checksum
4	dde	Freq std checksum	5	dde	Synthesizer cal checksum
6	dde	Mod ref checksum	7	dde	Mod offset checksum
8	dde	Mod amp checksum	9	dde	ALC cal checksum
10	dde	FM cal factor checksum	11	dde	FM tracking checksum
12	dde	ΦM cal factor checksum	13	dde	System cal checksum
14	dde	AM cal checksum	15	dde	Store checksum
16	dde	Image checksum	–	–	–
20	dde	Frac-N out of lock at <freq>	21	dde	VCO cal fail at <freq>
22	dde	VTF tune cal fail at <freq>	23	dde	FM tracking cal fail at <freq>
–	–	–	51	dde	Keyboard buffer overflow
52	dde	Display buffer overflow	53	dde	Display missing
–	–	–	–	–	–
100	exe	Carrier limit	101	exe	Carrier step limit
102	exe	RF level limit	103	exe	RF level step limit
104	exe	Invalid modulation mode	105	exe	AM limit
106	exe	AM2 limit	107	exe	AM step limit
108	exe	AM2 step limit	109	exe	FM limit

contd./...

Table 4-3 Foreground errors (0–399)(continued)

110	exe	FM2 limit	111	exe	FM step limit
112	exe	FM2 step limit	113	exe	ΦM limit
114	exe	ΦM2 limit	115	exe	ΦM step limit
116	exe	ΦM2 step limit	117	exe	Memory limit
118	exe	AM mod freq limit	119	exe	AM mod step limit
120	exe	AM2 mod freq limit	121	exe	AM2 mod step limit
122	exe	FM mod freq limit	123	exe	FM mod step limit
124	exe	FM2 mod freq limit	125	exe	FM2 mod step limit
126	exe	ΦM mod freq limit	127	exe	ΦM mod step limit
128	exe	ΦM2 mod freq limit	129	exe	ΦM2 mod step limit
130	exe	Return/Transfer not allowed	131	exe	Util limit
132	exe	Start freq limit	133	exe	Stop freq limit
134	exe	Sweep time limit	135	exe	Sweep mode disabled
136	exe	Carrier phase limit	137	exe	AM phase limit
138	exe	FM phase limit	139	exe	ΦM phase limit
140	exe	Memory store limit	141	exe	Memory recall limit
142	exe	Display blanking limit	143	exe	GPIB address limit
144	exe	Latch address limit	145	exe	Latch data limit
146	exe	Freq std carrier limit	147	exe	Freq std course adj limit
148	exe	Freq std fine adj limit	149	exe	Mod ref adj limit
170	exe	Util not available	171	exe	Entry outside limits
172	exe	Data out of range	173	exe	Units not valid
174	exe	Unlev fact limited by FM fact	175	exe	Invalid baud rate
176	exe	Data overrun	177	exe	Data parity
178	exe	Data framing	179	exe	Break in data
180	exe	Transmit buffer full	181	exe	Receiver not enabled
182	exe	Protected utility – Level 1	183	exe	Protected utility – Level 2
184	–	–	185	exe	This store is Read Only
186	–	–	187	–	–
188	exe	Pulse unavailable in 4FSK mode	189	exe	Pulse has been disabled
190	exe	No attenuator fitted	191	exe	No high power amp fitted
198	exe	No SINAD fitted	199	–	–
202	–	–	203	exe	SINAD unavailable with Ext Mod
204	exe	SINAD has been disabled	205	exe	RF level too low
206	exe	SINAD setup incorrect	207	–	–
398	–	–	399	exe	Error queue full

Table 4-4 GPIB errors (400–499)

400	cme	Syntax error	401	cme	Unrecognized mnemonic
402	cme	Numeric syntax	403	cme	Data expected
404	cme	Illegal data	405	cme	Too much data
406	cme	Incorrect data type	407	cme	Unrecognized character data
408	cme	Character data not unique	409	cme	Block definition
410	cme	Block size	411	cme	Missing quote
412	cme	Terminator expected	413	cme	Invalid unit
414	cme	Unit not expected	415	cme	No header match found
416	cme	Header not unique	417	cme	Illegal star command
418	cme	Sub-command not allowed	419	cme	Action not allowed with header
420	cme	Query not allowed with header	421	cme	Parser decode
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
450	qye	Query INTERRUPTED	451	qye	Query UNTERMINATED
452	qye	Query DEADLOCK	453	qye	Query lost after arbitrary char
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-