Reference

Menu Overview

A wide range of "auxiliary" setup functions is provided in the GB1400 Generator and Analyzer Menu systems. To enter the Generator or Analyzer Menu system, simply press the instrument's F1 key. At this point the format of the display will change to show the first page of the top level Menu. The top level Menu in both the Generator and Analyzer contains other Menus and various setup parameters. Once inside the Menu system, you use the functions keys, F1 ... F4, to navigate to any Menu function, and to make selections within each Menu function.

Functions Common to Generator (TX) and Analyzer (RX)

AC Power

The GB1400 Generator and Analyzer are both AC powered. The power switch of both instruments is located on the front panel.

Selecting 115 VAC or 230 VAC Operation

Both the GB1400 Generator and Analyzer are equipped with an auto-ranging AC power supply. This supply will operate over a voltage range of 90 to 250 VAC, and a frequency range of 47 to 63 Hz. Thus, no setup change is required to operate from 115 VAC at 60 Hz or 230 VAC at 50 Hz.

Turning Instrument Power ON/OFF

The Generator and Analyzer are equipped with AC power switches on the front panel.

LCD Viewing Angle

The optimum viewing angle of the GB1400 Generator or Analyzer LCD display may be adjusted using the VIEW ANGLE control. Each press of the VIEW ANGLE key will raise the optimum view angle until the highest angle is reached. The next press of VIEW ANGLE will return optimum viewing angle to its lowest angle, and so on.

Recalling the Default Setup

The default setup of the Generator and Analyzer are shown in the Appendix. To return the Generator or Analyzer to this setup, use the following procedure:

1. Turn instrument power off.
2. While holding down the VIEW ANGLE, MSB 1, and (PATTERN) CLEAR keys simultaneously, turn instrument power back on.
3. *After* you see the message **Default Settings** appear in the display, release the three keys. In a few seconds the normal display format will appear and the instrument will be in its default setup.

Locking the Front Panel

The instrument's front panel may be "locked" or "unlocked" using the PANEL LOCK control. When the front panel is locked, all keys that can cause a setup change are disabled. It is often useful to lock the front panel during a long or critical test to prevent accidental loss of test results. Note that the LED in the PANEL LOCK control indicates whether the front panel is locked (LED on) or unlocked (LED off).

Simply press the PANEL LOCK control to toggle between the locked (LED on) and unlocked (LED off) state.

Selecting a Pattern

The following section defines the patterns that can be generated and analyzed by the GB1400 and how to set up the Generator and Analyzer to use a particular pattern. Note that the Generator and Analyzer are compatible with the same suite of test patterns and use the same setup procedures.

Pattern Definitions

The GB1400 can generate and analyze Pseudo-random bit sequence (PRBS) and WORD test patterns. Each type has its own set of advantages and uses.

PRBS Patterns

Pseudo-random bit sequence (PRBS) patterns are designed to simulate "live traffic" and have been standardized by the telecommunications and computer industries. As a result they are often used to characterize or qualify new devices or systems. Two key characteristics of a PRBS are its overall length in bits and maximum number of contiguous 0s. The length of a PRBS pattern has the form 2^n-1. For example a 2^{23}-1 PRBS contains 8,388,607 bits. The maximum number of contiguous 0s in a PRBS pattern is n-1, for example 22 in a 2^{23}-1 PRBS.

The PRBS patterns generated and analyzed by the GB1400 are listed below.

Table 3-1. PRBS (2^n-1) Test Patterns

n	Label Used in Generator and Analyzer Displays	Length (2^n-1 bits)	Maximum Number of Contiguous 0s
7	PN 7	127	6
15	PN 15	32767	14
17	PN 17	131,071	16
20	PN 20	1048575	19
23	PN 23	8388607	22

Word Patterns

Word patterns are programmable by the user. Word patterns can be designed to cause specific stress characteristics, such as maximum jitter, or to simulate framed patterns like SONET, SDH, or FDDI. The standard GB1400 Generator and Analyzer will allow you to create and save up to ten 16-bit (two-byte) WORD patterns in battery-backed memory. Or, with the 1-Mbit Option installed, you can create and save up to ten 64 kbit WORD patterns (depends on buffer settings) in battery backed memory. Note that the standard and 1-Mbit instruments also store the current WORD pattern in battery-backed memory.

Selecting the Active Pattern

In this User's Guide, the pattern currently being generated by the Generator or analyzed by the Analyzer is called the *active* pattern. Procedures to make a selected PRBS, WORD, or mark density the current active pattern are provided below.

Selecting PRBS Patterns

To select a PRBS pattern:

Press the PRBS key. The instrument will now be in the PRBS pattern mode.

Press the pattern up/down keys until the name of the desired PRBS pattern is displayed. Available PRBS patterns are:

PN 7

PN 15

PN 17

PN 20

PN 23

The displayed PRBS pattern becomes the active pattern immediately.

Selecting the Current Word Pattern

To make the current WORD pattern the active pattern, simply press WORD key.

Selecting (RECALLing) a Saved Word Pattern

You can recall a WORD pattern using the Generator or Analyzer RECALL function:

8/16 bit WORD patterns are available on all instruments. Long-WORD (>16-bits) are available only in units equipped with the 1-Mbit Option.

Use the following procedure to select (recall) a WORD pattern:

Press the RECALL key.

Press the pattern up/down keys until the desired WORD or desired mark density pattern is displayed. Available selections are:

WORD 0

WORD 1

WORD 7

The displayed Word pattern becomes the active pattern immediately.

Word Patterns

This section explains how to create, edit, save, and recall WORD patterns using front panel controls or the Menu system.

Basics

You may create and save up to eight WORD patterns in battery-backed memory locations WORD 0 through WORD 7. In addition, the current WORD pattern is stored in battery-backed memory. In standard units, each of the saved WORDs and the current WORD can contain up to 16 bits. In Generators and Analyzers equipped with the 1-Mbit Option, which provides additional battery-backed memory, each of the saved WORDs and the current WORD can contain up to 1-Mbit.

There are three ways to create GB1400 WORD patterns:

Using front panel controls. This is usually the quickest way to create and edit short patterns. It also can be a practical way to edit a few bytes in long patterns if these bytes are located near to each other.

Using the Menu system. Because it provides direct byte addressing, this is often the best method for editing a few widely scattered bytes in long WORD patterns. The Menu system also provides the FILL function, used to load a user-specified 8-bit pattern into all bytes, and the ORDER function, used to set the bit-order in each byte to MSB or LSB first. Thus you can use the Menu system to create long WORDs with simple bit patterns using its byte fill, order, and editing capabilities.

Downloading: This is the best way to create long WORDs with complex patterns. Long WORD patterns may be created on an external controller, using a text editor or specialized software, and downloaded via the instrument's GPIB or RS-232 ports. Downloading is the only practical way to create simulations of SONET, SDH, FDDI or other framed signals.

Creating Word Patterns Using Front Panel Controls

Standard Instruments

Use the following procedure to create WORD patterns using front panel controls in standard instruments, that is Analyzers and Generators **not** equipped with the 1-Mbit Option:

1. If you are using a previously saved pattern as the basis for the new pattern, recall this pattern from memory. (See Recalling Word Patterns).
2. Press the WORD key. The LED in the WORD key will turn on (indicating that the instrument is in the WORD editing mode) and the display will show the bit sequence of the current WORD pattern in binary format. The WORD may contain either one or two bytes, that is 8 or 16 bits. Word length (8 or 16) is displayed after the WORD's bit sequence.

3. If you need to change WORD length, press the WORD LENGTH key and then the pattern up or down key to toggle WORD length between 8 and 16 bits. When the desired WORD length is displayed, press the WORD key to return to the WORD editing mode.
4. To select the first or second byte in a 16-bit pattern, press the up or down key. The selected byte will be indicated in the display by an arrow located between the two bytes. Byte selection is not required for 8-bit patterns because the first byte is always selected.
5. To edit the selected byte, press the 1 (MSB) through 8 (LSB) bit keys to toggle individual bits between 0 (LED off) and 1 (LED on).
6. If you need to edit the other byte in a 16-bit pattern, repeat steps 4. and 5.

Instruments Equipped with 1-Mbit Option

Use the following procedure to create WORD patterns using front panel controls in instruments that are equipped with the 1-Mbit Option:

1. If you are using a previously saved pattern as the basis for the new pattern, recall this pattern from memory. (See Recalling Word Patterns).
2. Press the WORD key. The LED in the WORD key will turn on to indicate that the instrument is in the WORD editing mode. The selected byte in the current pattern will be displayed in the form AAAAA HH, where AAAAA is the byte's location or "address" within the current WORD in decimal, and HH is the value of the selected byte in hexadecimal. Byte address will be in the range 0, 1, ..., 16383.
3. If you need to change WORD length, press the WORD LENGTH key and then the pattern up/down keys. Pattern lengths of 2048 bytes or less will be displayed in terms of M bytes plus N bits. Pattern lengths above 2048 bytes will be displayed in terms of bytes only. When the desired WORD length is displayed, press the WORD key to return to the WORD editing mode.
4. To select a byte within the current pattern, use the pattern up/down keys to increment or decrement the displayed byte address.
5. To edit the selected byte, press the 1 (MSB) through 8 (LSB) bit keys to toggle individual bits. Note that the LED in each bit key indicates whether the associated bit equals 0 (LED off) or 1 (LED on).
6. Repeat steps 4. and 5. until the WORD has been edited as required.

You have now created a new WORD pattern and may use it to perform tests. The current pattern is automatically stored in battery-backed memory. However if the new pattern is important, be sure to save it before creating or RECALLing another pattern.

See an additional list of remote commands in the Appendix that support the 1-Mbit Programmable Word option.

Creating Word Patterns Using Menus

The Menu functions used to create or edit WORD patterns are:

LENGTH

FILL

EDIT and

ORDER.

These functions are located in the WORD Menu. Note that ORDER is a standard function while the LENGTH, FILL, and EDIT functions are added to the WORD Menu as part of the 1-Mbit Option. Therefore in standard units, all WORD editing procedures, except for bit order, are performed using front panel controls. However in instruments equipped with the 1-Mbit Option, WORD editing may be performed using either front panel controls or the Menu system, depending on which approach is more convenient in a given situation.

Note that the WORD Menu also includes the Pattern Sync and SYNC functions. If you are trying to observe the Data output of the Generator, or the Monitor Data output of the Analyzer, you may want to use the Pattern Sync Menu to select the byte location of the pattern synchronization pulse generated by the rear-panel Pattern Sync output. The SYNC Menu, which appears on the same page of the Analyzer Menu system, is not directly involved in creating or editing WORD patterns. Rather, it is used to set the Analyzer pattern synchronization threshold in terms of BER.

A detailed explanation for each function in the WORD Menu may be found later in this chapter.

In addition, the general procedure for creating WORD patterns in a Generator or Analyzer equipped with the 1-Mbit Option is given below:

1. Use the current pattern or recall a previously saved pattern as the basis for the new pattern. (See Recalling Word Patterns).
2. Press the F1 key to enter the Menu system.
3. If you need to change current WORD length, select the LENGTH Menu by pressing F3. Enter a new value for length using the F2, F3, and pattern up/down keys. Then exit the LENGTH Menu by pressing either F4 to set this new length or F1 to "escape" without making any setup changes.
4. If you want to fill a pattern, select the FILL Menu by pressing F4. Edit the fill byte using the individual bit keys, 1 (MSB) through 7 (LSB). When done, exit the FILL Menu by pressing either F4 to automatically load this eight bit pattern into every byte of the current WORD or F1 to "escape" without making any setup changes.
5. To edit the current WORD, press F2 to enter the EDIT Menu. Use the F2, F3, and pattern up/down keys to select a byte within the current WORD. Next, use the bit keys to edit the displayed byte. Repeat for each byte to be edited. When done, exit the EDIT Menu by pressing either F4 to lock in these changes or F1 to "escape" without making any setup changes.

6. You now may want to access the ORDER and Pattern Sync Menus by pressing F1 (MORE). The ORDER Menu determines the bit transmission/analysis order of each byte in the pattern, that is MSB or LSB first. The Pattern Sync Menu determines the byte location of the pattern sync pulse in long WORD patterns. When done with these Menus, press the F1 key until the normal display format appears.

You have now created a new WORD pattern and may use it to perform tests. As noted earlier, the current pattern is automatically stored in battery-backed memory. However if the new pattern is important, be sure to save it before creating or recalling another pattern.

Creating Word Patterns Under Remote Control

The third way to create WORD patterns is by remote control.

There are two sets of WORD editing commands: "WORD" and "byte". Word commands, also known as "short WORD" commands, are part of the standard command set and are used to perform 8 and 16 bit editing functions.

Byte or "long-WORD" commands, which are added to the GB1400 Generator or Analyzer command as part of the 1-Mbit Option, are used to perform editing functions on WORDs of any allowed length up to 16384 bytes. Note that most WORD commands will function normally in instruments equipped with the 1-Mbit Option.

This allows instruments equipped with the 1-Mbit Option to operate in automated test applications designed around the 8/16-bit WORD command set. However only byte commands may be used to edit long WORD patterns—that is WORDs that are more than 16 bits long. Therefore a GB1400 Generator or Analyzer must be equipped with the 1-Mbit Option to function in automated test applications designed around the byte command set.

A general discussion of GB1400 remote control functions and an explanation of each remote command may be found in the Appendix. In addition, the general procedure for using byte commands to create and edit WORD patterns is given below:

1. All long-WORD editing procedures must start with an EDIT_BEGIN command, which may have an argument from -1 to +7. An argument of -1 tells the instrument to copy the current WORD pattern into "scratchpad" memory, while arguments of 0 through 7 tell the instrument to copy the indicated saved WORD pattern into scratchpad memory.
2. The core of a long-WORD editing procedure is constructed from byte commands such as BYTE_BLOCK, BYTE_FILL, BYTE_INSERT, BYTE_EDIT, and BYTE_DELETE. These commands may be used to download a new pattern into scratchpad memory, or to modify a pattern previously copied or downloaded into scratchpad memory.
3. All long-WORD (byte) editing procedures must end with an EDIT_END command. This command may have an argument from -2 to +7. An argument of -2 tells the instrument to discard the pattern in scratchpad memory and not to update the front panel. An argument of -1 tells the instrument to copy the pattern in scratchpad memory to the current WORD

memory location and to update the front panel. Arguments 0 to +7 tell the instrument to copy the pattern in scratchpad memory to the indicated (save) memory location without updating the front panel.

Note that a WORD or byte editing session in a GB1400 Generator or Analyzer can be started locally from the front panel or remotely via the instrument's RS-232 or GPIB remote ports. However the instrument will allow only one editing session to be in-progress at any given time.

Saving Word Patterns

You can save the current WORD pattern to one of eight WORD memory locations (WORD 0 to WORD 7), using the following procedure:

1. Press the SAVE key. The LED in the SAVE key should flash to indicate that you are in the save mode.
2. Press the pattern up/down keys to select a WORD memory location. Note that the WORD previously stored in this location will be overwritten.
3. Press the SAVE key again to save the current WORD into the selected location. At this point the SAVE LED will turn off.

Recalling Word Patterns

To recall a previously saved WORD pattern, use the following procedure:

1. Press RECALL to enter the recall mode. Note that the LED in the RECALL key turns on.

   NOTE: If the current WORD is important and has not been previously saved, you must save it before pressing RECALL. The recalled pattern will overwrite the current pattern.

2. Select a WORD pattern memory location by pressing the pattern up/down keys. The eight possible WORD memory selections are WORD 0 through WORD 7. In addition, if the 1-Mbit Option is installed, you will see the following five mark density pattern selections: MRK 1/8, MRK 1/4, MRK 1/2, MRK 3/4, and MRK 7/8. The selected WORD becomes the current WORD immediately. In other WORDs, the current WORD is over-written each time you press the up or down key.

You can now use the recalled WORD to perform tests. Note that if you want to edit the recalled WORD, you must press the WORD key again.

Generator (TX) Functions

This section defines key functions of the GB1400 Generator and how to set up these functions using front panel controls.

Clock Source and Frequency

The Generator can operate using its internal clock, or an external clock source. The CLOCK section of the Generator front panel is used to select clock mode (internal or external), set internal clock frequency, and store or recall user-defined frequencies. In addition, the CLOCK section contains an input for an external clock source. When using the internal clock, you may set frequency directly, or recall one of 10 previously saved frequencies from memory. The frequency save/recall feature is especially useful if you often switch back and forth between a limited number of different frequencies.

External Clock Input

When the Generator is in external clock mode, a clock source must be connected to the connector labeled INPUT in the CLOCK section of the Generator's front panel. The operating bit rate of the Generator will then be determined by the frequency of this source. However, when the Generator is set to internal clock mode, any signal applied to this input will be ignored.

External Clock Input Termination

The termination of the external clock input may be set to -2 , AC, or ground as follows:

3. Press the F1 key to enter the Generator Menu system.
4. Press F1 (MORE).
5. Press F2 (CLOCK).
6. Use the up/down keys in the PATTERN section to select one of the following:

   GND (ground), -2 V, or AC
7. Press F4 to set or F1 to exit without change.
8. Press F1 to exit the Menu system.

The input switching threshold of the external clock input depends on the selected termination, as shown below.

Table 3-2. External Clock Input Specifications vs. Termination

Termination	Switching Threshold	Amplitude Range*
50 Ω to ground	Ground ± 50 mV	500 mV to 2 V peak-to-peak, centered on ground.
50 Ω to -2 V	-1.3 V ± 50 mV	500 mV to 1.4 V peak-to-peak, centered on -1.3 V.

* These peak-to-peak amplitude limits are based on the requirement that signals applied to the external clock input must cross the decision threshold by at least 200 mV, but at the same time not exceed overall limits of -2 V to +2 VDC.

Clock Source

Generator clock source may be set to internal or external using the EXT key in the CLOCK section. When the LED in the EXT key is off, then clock source is internal. If the LED is on, the clock source is external and an external source must be connected to the external clock input (INPUT).

Press the EXT key to toggle clock source between internal and external.

Step Size and Frequency

The frequency of the Generator internal clock may be set using the FREQUENCY, STEP, and CLOCK section up/down keys. First select a step size. Then adjust current frequency using this step size. The complete setup procedure follows:

1. Select a step size. Do this by pressing the STEP key one or more times until the underscore in the frequency field is under the desired digit. Note that the underscore moves right one digit for each key press. The selected digit indicates step size. For example if the current frequency is 622.950 MHz, and the underscore is under the "5" , then current step size is 10 kHz. Or, if the underscore is under the "9" then the current step size is 100 kHz, etc.
2. Press the FREQUENCY key. Verify that the FREQUENCY key LED turns on.
3. Press the clock section up/down keys to increment or decrement the current frequency using the previously selected step size. Note that the underscore position indicates a step size, not which digit will be edited. For example if displayed frequency is 622.950, and the cursor is under the "9", then step size is 100 kHz and pressing the up (↑) key one time will change frequency to 623.050 MHz.

Saving a Frequency

You may save the current Generator frequency into one of 10 frequency memory locations as follows:

1. Press the clock SAVE key. Verify that the SAVE LED is flashing.
2. Press the clock section up/down keys to select the desired memory location . Note that frequency memory location is displayed in the bottom left field of the display as FREQ x, where x = 0, 1, ..., 9.
3. Then press SAVE a second time to save the current frequency into this location. Verify that the clock SAVE key LED turns off.

Recalling a Frequency

You can recall a previously saved frequency as follows:

1. Press the clock RECALL key and verify that the RECALL LED turns on.
2. Press the clock up/down keys until the display shows the desired frequency (top left) and frequency memory location (bottom left).

NOTE: The displayed frequency becomes the current frequency immediately. That is, you do not have to hit RECALL again.

Data and Clock Outputs

This section explains how to set up the Generator's clock and data outputs as well as related pattern sync. and clock/4 outputs.

Overview

The OUTPUT section of the Generator front panel contains the instrument's main NRZ (clock + data) outputs:

DATA

DATA-BAR

CLOCK

CLOCK-BAR

Note: The same term can be expressed three different ways.

$\overline{\text{clock}}$ **= clock bar = NOT clock**

$\overline{\text{DATA}}$ **= DATA BAR = NOT DATA**

DATA and CLOCK are the non-inverted test pattern outputs of the GB1400 Generator. DATA is a non-return to zero (NRZ) data signal and CLOCK is its corresponding clock signal. DATA-BAR and CLOCK-BAR are complementary outputs to DATA and CLOCK respectively. Thus the GB1400 can drive single-ended or differential inputs.

The amplitude and baseline offset of the CLOCK and DATA outputs are adjustable. This insures compatibility with a wide range of input circuit designs. The selected clock amplitude applies to both CLOCK and CLOCK-BAR and the selected data amplitude applies to both DATA and DATA-BAR.

Similarly the selected clock baseline offsets becomes the bottom (negative peak voltage) of both the CLOCK and CLOCK-BAR outputs and the selected data baseline offset becomes the bottom voltage of the DATA and DATA-BAR outputs.

The nominal waveform and phase relationship of the four output signals is shown in the figure below. An equivalent circuit model for these four outputs is shown in the second figure.

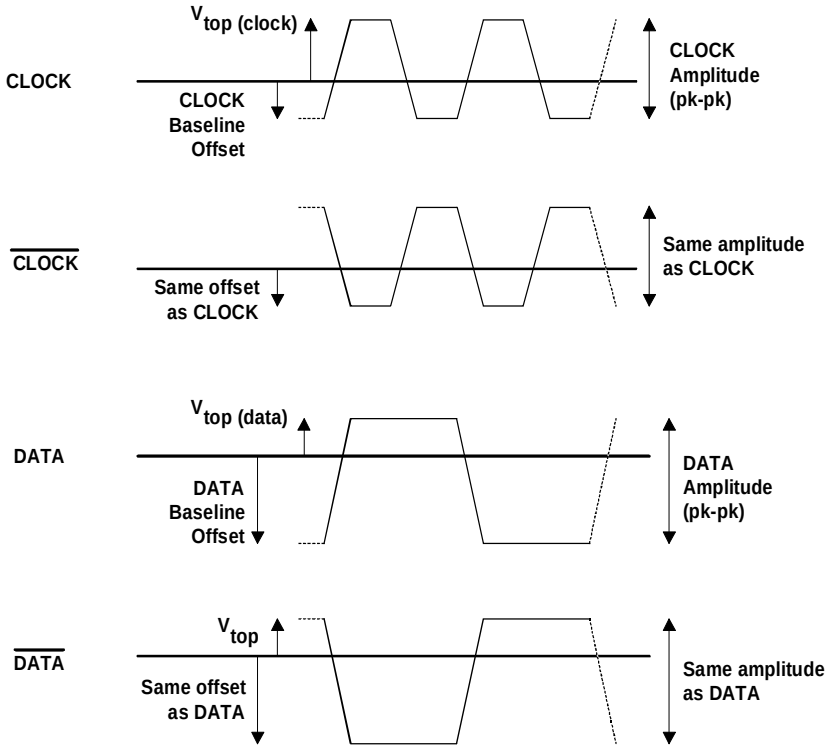


Figure 3-1. Nominal Generator Clock and Data Waveforms Showing Amplitude, Baseline Offset, and V_{top}.

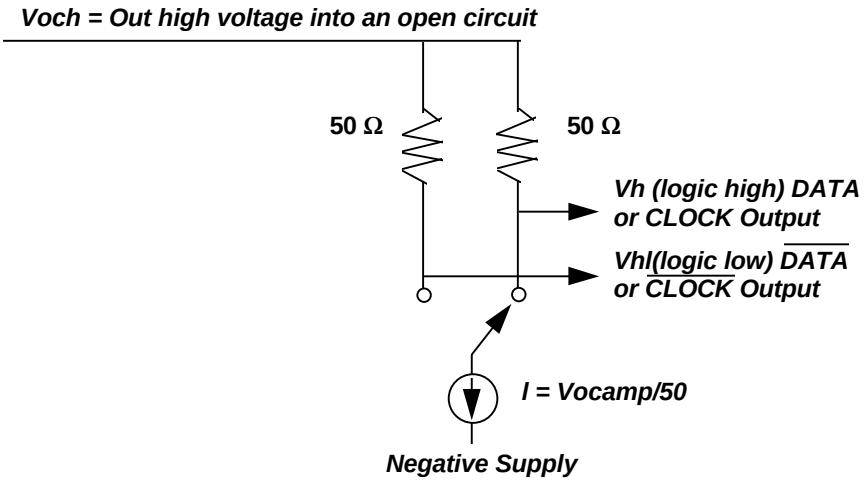


Figure 3-2. Generator Clock and Data Output Equivalent Circuits

Amplitude and Baseline Offset

The rules governing the setup of clock and data amplitude and baseline offset are as follows:

RULE 1: When terminated by 50 Ohms to ground, the amplitude adjustment range of clock and data outputs is **0 to 2 V peak-to-peak**. However, the absolute voltage of the **pulse top cannot exceed +2.8 VDC**, that is:

$$V_{amplitude\ p\text{-}p} + V_{offset} \leq 2.8\ VDC$$

RULE 2: When left unterminated (termination impedance > 2 kΩ) the amplitude adjustment range of clock and data outputs is **0 to 4 V peak-to-peak** with a pulse top limit of +5.6 VDC, that is:

$$V_{amplitude\ p\text{-}p} + V_{offset} \leq 5.6\ VDC$$

RULE 3: Displayed amplitude and baseline offset are calibrated for a termination of 50 Ohms to ground. Any variation of termination impedance or voltage will cause actual amplitude and offset to differ from the values shown in the Generator display.

These rules are summarized in the table below.

Table 3-3. Output Setup Rules vs. Termination Impedance

Termination	Amplitude Limit (V p-p)	Pulse Top Limit (VDC)	Actual Amplitude	Actual Baseline Offset (VDC)
50 Ω to ground	0 - 2	+2.8	as displayed	as displayed
50 Ω to -2 VDC	0 - 2	+2.8	as displayed	displayed value - 1.0 V
AC (50 Ω to AC)	0 - 2	+2.8	as displayed	unspecified
Open Circuit	0 - 4	+ 5.6	2 x displayed	as displayed

The following controls are used to set clock and data output amplitude and baseline offset:

CLOCK:

DATA:

AMPLITUDE (↑, ↓):

BASELINE OFFSET (↑, ↓):

Note that when the CLOCK key is pressed, its LED turns on and the display shows clock output amplitude and offset. Similarly, when the DATA key is pressed, its LED will turn on and the display shows data output amplitude and offset. The general procedure for setting data and clock output amplitude and baseline offset is shown below.

1. Press DATA. The display will show data output amplitude and offset.
2. Press the BASELINE OFFSET up/down keys to set the desired data signal baseline offset.
3. Then press the AMPLITUDE up/down keys to set the desired data signal amplitude.
4. Press CLOCK. The display will now show clock output amplitude and offset.
5. Press the BASELINE OFFSET up/down keys to set the desired clock signal baseline offset.
6. Then press the AMPLITUDE up/down keys to set the desired clock signal amplitude.

Logically Inverting Output Data (D-INV)

The INVERT DATA key may be used to logically invert the output data pattern, that is change all 1s to 0s and 0s to 1s. If the INVERT DATA LED is off, then the output data pattern is not inverted. However if the INVERT DATA LED is on, the output data pattern is logically inverted. You can toggle the INVERT DATA function on and off by pressing the INVERT DATA key. Note that logically inverting the output pattern is the same as swapping the connections to the DATA and DATA-BAR outputs.

To toggle output data inversion on or off, press the INVERT DATA key.

Single-ended or Differential Operation

DATA-BAR and CLOCK-BAR are complimentary outputs to DATA and CLOCK respectively. Therefore, to drive a single-ended clock or data input simply connect appropriate true output (CLOCK or DATA) while terminating its compliment (CLOCK-BAR or DATA-BAR) with 50 Ohms to ground. Or, to drive a differential clock or data input, connect the appropriate true output (CLOCK or DATA) to the non-inverting input and the complimentary output (CLOCK-BAR or DATA-BAR) to the inverting input. No other setup is required to configure the Generator for singled-ended or differential operation.

Procedure for Single-ended Operation (TX only)

1. For singled-ended operation, connect Generator CLOCK and DATA outputs to singled-ended inputs on the DUT.
2. Terminate the CLOCK-BAR and DATA-BAR outputs with 50 Ohms to ground.

Procedure for Differential Operation (TX only)

1. Connect CLOCK and CLOCK-BAR outputs of the Generator to the true and complimentary clock inputs on the DUT.
2. Connect DATA and DATA-BAR outputs of the Generator to the true and complimentary data inputs on the DUT.

Pattern Sync and CLOCK/4 Outputs

The OUTPUT section of the Generator front panel contains two additional outputs that may be useful when observing the Generator output with an oscilloscope. The first is the Pattern Sync or output which generates one pulse per pattern frame. This signal may be used to trigger an oscilloscope at the beginning of the output data pattern. The second is the CLOCK/4 output, which is a clock signal at one quarter the frequency of CLOCK. This signal is particularly useful when viewing the output of the Generator using an oscilloscope that doesn't have sufficient bandwidth to trigger on the CLOCK signal.

Both the Pattern Sync and CLOCK/4 outputs have a fixed amplitude of 200 mV pk-pk, centered around ground, when terminated by 50 Ohms to ground. The phase relationship of CLOCK/4 and CLOCK is also fixed, with the nominal location of CLOCK/4 transitions occurring on the falling edge of CLOCK.

The width and location of the Pattern Sync pulse depends on which pattern type is currently active. For PRBS patterns, the Pattern Sync pulse has a width equal to one bit time slot, at a fixed position not adjustable by the user. For short-WORD patterns (1-Mbit Option not installed) the Pattern Sync waveform is a nominal square wave that is high during the first byte of a 16-bit WORD, and low for the second. For long-WORD patterns (1-Mbit Option installed), the Pattern Sync pulse is one byte wide that occurs at the beginning of the frame.

Error Injection

The GB1400 Generator can inject bit errors, also known as logic errors, into the output data pattern. One use of error generation is to self-test the GB1400 Generator/Analyzer system. Or, when generating WORD patterns containing simulated framed signals, for example a SONET signal, error generation can be used to determine the ability of the terminal under test to detect errors or to stay in-frame in the presence of high error rates.

The available internal error injection rates are 10^{-n}, where n = 7, 6, 5, 4, or 3. In other WORDs, injected BER can be set to integer powers of 10 from 10^{-7} to 10^{-3}. Using the external error inject mode, errors can be injected at any rate up to 10^{-3}. There is no lower limit on external error injection BER.

Selecting an Error Inject Mode

The controls that determine the error injection mode of the Generator are:

RATE (key)

SINGLE (key)

When the LED on the RATE key is off, the Generator is in the single error inject mode. In this mode, no errors are generated except when the SINGLE error key is pressed. That is, each press of the SINGLE key will cause a single, isolated bit error to be injected. However, when the RATE key is on, the instrument is either generating an error rate internally, or under external error generation control. You can determine which by observing the bottom, middle field of the display.

If an error rate is displayed (e.g. ERR 1E-09) then the Generator is in the internal error inject mode. If the message EXT ERR is displayed, then the external error inject mode has been selected indicating that the signal appearing at the rear-panel EXTERNAL ERROR INJECT input will control error injection rate. One error will be generated for each negative-to-positive transition in this signal. In all other error inject modes, the signal appearing at this input will be ignored.

NOTE: In all error injection modes, the ERROR LED will flash each time an error is injected.

Procedure to Control Error Injection Mode

1. Press the RATE key one or more times to select the desired error injection mode. Note that the LED in the RATE key will turn on except when mode is set to ERR OFF. Available selections are:

   ERR OFF: Single inject mode.

   ERR $1E^{-7}$: Internal rate of 10^{-7}.

   ERR $1E^{-6}$: Internal rate of 10^{-6}.

   ERR $1E^{-5}$: Internal rate of 10^{-5}.

   ERR $1E^{-4}$: Internal rate of 10^{-4}.

   ERR $1E^{-3}$: Internal rate of 10^{-3}.

   ERR EXT: External error inject mode.

2. Once you have selected an internal error rate, or the external mode, you can turn this error rate off and on by alternately pressing the SINGLE key and RATE key. Do not press the RATE key two or more times in a row unless you want to change the current error injection mode. However, while the current error rate is off, you can press the SINGLE key as many times as you wish to inject single errors.

3. To return to the single injection mode, press RATE one or more times until ERR OFF is selected.

ERROR INJECT Input

The ERROR INJECT input is a BNC (female) connector located on the rear-panel of the Generator. When the error injection mode is set to ERR EXT, one bit error will be generated for each rising edge in the signal applied to this input.

Setup - The ERROR INJECT is a 50 Ohm, ECL input. No hardware setup is required.

Data Inhibit - The DATA INHIBIT input is located on the rear-panel of the Analyzer. A signal applied to this input may be used to gate off and on the Generator DATA output signal. The logic of the DATA INHIBIT function is shown in the following table. The DATA INHIBIT function is not bit or frame synchronized with the DATA output signal. Therefore, the gating action caused by the DATA INHIBIT input may occur anywhere within a DATA output bit time slot and anywhere within a pattern frame. DATA INHIBIT is a standard 50 Ohm ECL input and does not require any threshold or delay setup.

Table 3-4. Data Inhibit Logic

Logic Level Applied to DATA INHIBIT INPUT	Action
OPEN or LOW	DATA output operates normally.
HIGH	DATA output is disabled, that is forced LOW.

Analyzer (RX) Functions

This section explains how to enable or disable Analyzer automatic synchronization functions. It further shows how to manually set Analyzer input parameters and error detection functions, and how to start tests, view results, and print results. The section also defines all results calculated by the Analyzer.

Automatic Setup Functions (SYNC)

This section explains how to use the following "SYNC" controls and indicator in the ERROR DETECTION section:

AUTO SEARCH key.

DISABLE key.

LOCK indicator.

AUTO SEARCH Key

The AUTO SEARCH key is used to enable or disable the auto-search feature. When auto-search is enabled, the Analyzer will automatically attempt to set the following parameters each time pattern synchronization is lost:

1. clock and data input threshold,
2. data input delay,
3. PRBS pattern,
4. pattern polarity, and
5. pattern alignment.

In addition, auto-search will clear (turn off) the BIT and PHASE history indicators once pattern sync. is regained. Thus, AUTO SEARCH can greatly simplify Analyzer setup and operation, especially when the input clock and data phase relationship and amplitudes are not known.

DISABLE Key

The DISABLE key is used to *disable* automatic pattern realignment. When automatic pattern realignment is enabled (DISABLE off) the Analyzer will attempt to resynchronize its pattern detector each time BER goes above the pattern synchronization threshold *by looking for a new pattern alignment*. A change of pattern alignment will occur, for example, if a buffer over flows or under flows in the DUT. A change of pattern alignment will also normally occur if the CLOCK input to the Analyzer is momentarily disconnected.

On the other hand, with pattern realignment disabled (DISABLE on), the Analyzer will not attempt to find a new pattern alignment—*even if BER goes above the synchronization threshold*—until the start of a new test interval. This allows the analyzer to measure BER and count errors on signals with very high error rates.

LOCK Indicator and Actions Taken by the Analyzer if Synchronization (Lock) is Lost

The LOCK LED indicates whether or not BER is above or below the current synchronization threshold. The LOCK indicator will turn on while BER is below the current synchronization threshold, and off while BER is above this threshold. The setup actions taken by the Analyzer when BER crosses the synchronization threshold will depend on the state of the AUTO SEARCH and DISABLE keys, as shown in the table below.

Table 3-5. Actions Taken by Analyzer when Synchronization is Lost

AUTO SEARCH	DISABLE	Action when synchronization is lost (LOCK LED turns off)
on	off	Analyzer will attempt to find new pattern alignment, input level, input delay, PRBS pattern and pattern polarity
off	off	Analyzer will attempt to find new pattern alignment.
off	on	No setup change—Analyzer will continue to measure BER and count errors.
on	on	(this combination not allowed)

AUTO SEARCH With PRBS Patterns

When using a PRBS pattern you can enable the AUTO SEARCH feature as follows:

1. Set up the Generator to transmit a PRBS pattern.
2. Set up the Analyzer as follows:

   EXT (ref. data input control), off

   SYNC DISABLE, off

   AUTO SEARCH, on

After you perform this procedure, the auto-search feature will be enabled and the instrument will immediately attempt to re-synchronize with the received test signal. Once lock is achieved—that is once BER goes below the synchronization threshold—the BIT and PHASE history indicators will be cleared (turned off) and all current error counts will be reset to zero. The SYNC LOSS indicator will remain on, however, until cleared by the user.

NOTE: The AUTO SEARCH feature will work over a wide range of conditions. Therefore if you have set up the Generator to generate a standard PRBS, enabled the AUTO SEARCH feature on the Analyzer, but the Analyzer LOCK LED still fails to turn on, then it is likely that a problem exists in the device under test or your patch cord connections.

AUTO SEARCH with "Non-PRBS" Patterns

In cases where you need to use a WORD or other type pattern for testing, you can still use AUTO SEARCH to set DATA and CLOCK threshold, and DATA input delay and threshold as follows:

1. Set up the Generator to transmit a PRBS pattern.
2. Enable Analyzer AUTO SEARCH as follows:

   EXT (ref. data input control), off

   SYNC DISABLE, off

   AUTO SEARCH, on
3. After the Analyzer LOCK LED turns on, disable AUTO SEARCH by pressing the AUTO SEARCH key. Verify that the LED in the AUTO SEARCH key turns off.
4. Change the pattern setup of the Generator and Analyzer as desired. For example, to perform a test using a WORD pattern stored in memory: press the Analyzer pattern RECALL key and up/down keys to select the WORD pattern. Repeat these steps on the Generator to select the same WORD pattern. At this point the SYNC LOCK LED should turn on again indicating that the Analyzer has regained synchronization. You may now start a new test interval by clearing previous results (PRESS ERROR DETECTION CLEAR key) and history indicators (PRESS HISTORY CLEAR key).

How to DISABLE Automatic Pattern Resynchronization

The pattern resynchronization disable feature is turned on or off as follows:

Press the DISABLE key to toggle automatic pattern resynchronization on or off. When the DISABLE LED is on, pattern resynchronization is *disabled*. When the DISABLE LED is off, pattern resynchronization is *enabled*.

Relationship between AUTO SEARCH and DISABLE

Turning AUTO SEARCH on automatically turns DISABLE off. Similarly, turning DISABLE on automatically turns AUTO SEARCH off. That is, AUTO SEARCH and DISABLE cannot be on at the same time. However you may turn both functions off. There are, therefore, three possible levels of Analyzer synchronization:

1. AUTO SEARCH on: This is the most automated mode.
2. AUTO SEARCH off and DISABLE off: This is a partially automated mode with AUTO SEARCH functions disabled but auto-pattern resynchronization still enabled.
3. DISABLE on: This is the "fully manual" mode in which all AUTO SEARCH functions and the auto-pattern resynchronization function, are disabled.

Synchronization (LOCK) Threshold

The current synchronization threshold depends on pattern, and the setup of the SYNC Menu, as summarized in the table below:

Table 3-6. Synchronization Threshold

Pattern Type	Threshold	How to Set
PRBS	1,024 errors in 4,096 bits (BER = 2.5 E-01)	Fixed
All WORD patterns (up to 16 bits) when 1-Mbit Option **not** installed.	256 errors in 4,096 bits (BER = 6.3 E-02)	Fixed
All WORD, mark density, or other ROM patterns with 1-Mbit Option installed.	Based on 256 errors in a rolling window of x bits. Nine BER levels available: **1:** 3.1 E-02 **2:** 7.8 E-03 **3:** 1.9 E-04 **4:** 9.7E-04 **5:** 4.8 E-04 **6:** 2.4 E-04 **7:** 1.2 E-04 **8:** 6.1 E-05 **9:** 3.0 E-05	Use **SYNC** Menu to select a synchronization level from 1 to 9.

You can change the synchronization threshold for (long) WORD, mark density, and ROM patterns using the SYNC Menu as follows:

Procedure to Set SYNC Threshold

1. Press the F1 key to enter the Menu system.
2. Press F4 (MORE) **two** times.
3. Press F2 (SYNC).
4. Use the pattern up/down keys to select a synchronization threshold level from 1 to 9.
5. When done, press F4 to enter your choice.
6. Press F1 multiple times until you have exited the Menu system.

NOTE: See later in this chapter for a further explanation of the SYNC Menu.

Clock, Data, and Reference Data Inputs

This section explains how to set up Analyzer clock, data, and reference data inputs using front panel controls and Menus.

Overview

The Analyzer CLOCK, DATA, and REF DATA inputs are designed to accommodate a wide range of output logic levels and circuit designs. An equivalent circuit diagram of the Analyzer input section is shown in the following figure.

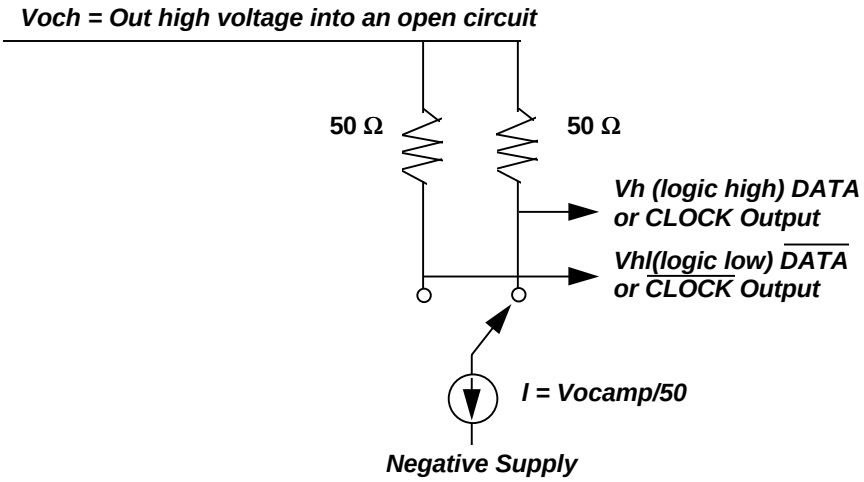


Figure 3-3. Analyzer Clock and Data Input Equivalent Circuits

Input Parameters

The following input parameters may be set manually by the user or automatically by the AUTO SEARCH function:

Decision threshold (CLOCK, DATA, and REF DATA)

Delay (DATA and REF DATA)

Inverted or non-inverted data (DATA).

In addition, there are two parameters that can be selected only by the user:

Termination (CLOCK, DATA, and REF DATA)

Single-ended or differential operation (CLOCK, DATA)

Note that user or manual control functions may be executed locally, via front panel controls or Menus, or remotely via the instrument's RS-232 or GPIB ports.

Controls

The INPUT section controls that are used to set up input parameters are:

DELAY key

V-TERM key

V-THRESH key

INPUT (↑, ↓) Keys

D-INV key

In addition, the state of the F2 and F3 function keys determines the action of the INPUT up/down keys as shown in the table below. Note that this function of the F2 and F3 keys does not apply while the Analyzer is in the Menu mode.

Table 3-7. How F2 and F3 Determine Which Input Can be Set Up

F2	F3	Input that can be adjusted using (↑, ↓) Keys
off	off	DATA
on	off	CLOCK
off	on	REF DATA
on	on	not allowed

Use of the Display

The Analyzer display will normally show the currently selected delay parameter (DATA or REF DATA) in the bottom left field and the currently selected threshold parameter (CLOCK, DATA, or REF DATA) in the bottom right field. In addition the bottom middle field will show whether or not input data inversion is enabled. Specifically, if the INVERT DATA key is on, then the message INV will appear after the name of the current pattern, for example PN 23 INV.

Input Data Delay

Up to 4 ns of delay can be added to the DATA and REF DATA inputs to adjust their phase alignment with the input clock signal. A different amount of delay may be added to each of these inputs so that the Analyzer can accommodate different phase relationships between DATA, REF DATA, and CLOCK.

Procedure to Add Delay

1. Select either the DATA or REF DATA inputs using the F2 and F3 keys.
2. Press the DELAY key. Verify that its LED turns on.
3. Press the input up/down keys while observing the amount of added delay in the bottom left field of the display. Delay may be set in the range 0 to 4 ns, in 20 pS steps.

The delay value shown in the display is in effect immediately. In other WORDs, delay is changed each time you press the up or down key. Note that delay is an AUTO SEARCH parameter. Therefore, you should normally turn off AUTO SEARCH if you want to fix delay at a specific value.

Input Termination

The input termination can be independently selected for the CLOCK, DATA, and REF DATA inputs. Note that the termination selected for CLOCK and DATA also applies to the CLOCK-BAR and DATA-BAR inputs. Available input terminations are shown in table below.

Table 3-8. Input Terminations for CLOCK, DATA, and REF DATA

Label	Termination
GND	50 Ohms to ground.
- 2 V	50 Ohms to -2 VDC.
AC	50 Ohms, via 0.01 µF capacitor, to ground.

Procedure for Selecting Input Termination

1. Select the DATA, CLOCK, or REF DATA inputs using the F2 and F3 keys.
2. Press the TERM key. Verify that its LED turns on.
3. Press the input up/down keys while observing the selected termination in the display. Available terminations are: GND, -2V, and AC.

The displayed termination becomes effective immediately. In other WORDs, termination is changed each time you press the up or down key.

Low-Frequency Effects of AC Termination on Single-ended Operation

Because the single-ended AC termination is AC-coupled to ground, input impedance will deviate from the nominal 50 Ohm value at low frequencies. As a practical matter, for any PRBS pattern analyzed by the GB1400, frequency effects will not be noticed until the peak energy frequency is less than about 10 MHz, which for PRBS patterns will occur only when bit rate is less than about 20 Mb/s. However, for WORD patterns with long strings of contiguous zeros, effects may be noticed at higher bit rates.

Note that when the AC termination is used with differential operation, the input termination is not "AC-coupled". Therefore, the above low-frequency limit on use of the AC termination does not apply when operating the CLOCK or DATA inputs in the differential mode. Specifically, when the Analyzer clock or data inputs are set up for differential operation, the AC termination may be used over the entire bit rate operating range of the Analyzer.

Input Decision Threshold

The input decision thresholds of the CLOCK, DATA, and REF DATA inputs can be independently adjusted. However, it is important to note that input threshold adjustment applies only for *single-ended operation*. When operating Analyzer clock or data inputs in the differential mode, their input decision threshold effectively becomes the average of the positive peak and negative peak voltage levels and is not adjustable by the user.

Procedure to Adjust (Single-ended) Input Decision Threshold:

1. Verify that the selected input is set up for singled-ended operation.
2. Select either the DATA, CLOCK, or REF DATA input using the F2 and F3 keys.
3. Press the THRESH key. Verify that its LED turns on.
4. Press the input up/down keys while observing selected threshold value in the bottom, right field of the display. Decision threshold setup range is a function of input termination as shown in table below.

Table 3-9. Input Threshold Range as a Function of Termination

Selected Termination	Threshold Setup Range
GND	- 2.00 to + 4.00 VDC, 50 mV steps
- 2 V	- 3.00 to + 3.00 VDC, 50 mV steps
AC	- 2.00 to + 2.00 VDC, 50 mV steps

The displayed threshold takes effect immediately. In other WORDs, threshold is incremented or decremented each time you press the up or down key. Note that threshold is an AUTO SEARCH parameter. So be sure turn off AUTO SEARCH if you want to fix delay at a specific value.

Logically Inverting Input Data

The INPUT section INVERT key may be used to logically invert the input data pattern, that is change all 1s to 0s and 0s to 1s. If the INVERT key is off, then the input data pattern is not inverted. However if the INVERT key is on, the input data pattern is logically inverted. You can toggle input data inversion on or off by pressing the INVERT DATA key. Note that logically inverting the input pattern is equivalent to swapping the connections to the DATA and DATA-BAR inputs.

To toggle input data inversion on or off, press the INVERT key.

Singled-ended or Differential Operation

Analyzer clock and data inputs can be operated in a singled-ended or differential mode. Differential operation provides greater immunity to ground noise and EMI. Note that threshold setup applies to the clock and data inputs only when they are operated in the singled-ended mode. When the clock or data input is operated in the differential mode, its input threshold effectively becomes the average of the positive peak and negative peak voltage of the received true and complement signals.

Procedure to Configure CLOCK or DATA Inputs for Single-Ended Operation

1. Connect Clock signal to CLOCK input.
2. Connect Data signal to DATA input.
3. Connect cable from rear panel DATA THRESHOLD output to front panel DATA BAR input.

Selecting the Reference Data Mode

In most testing applications, the Analyzer is set up to compare the received data pattern with a data pattern generated internally by the Analyzer. However you may also set up the Analyzer to compare two externally generated patterns. This makes it possible to analyze framed or proprietary signals that cannot easily be simulated as long WORD patterns.

To configure the Analyzer for reference data testing, the primary or *test signal* must be connected to the Analyzer data input (which may be set up for singled-ended or differential operation) while the *reference signal* is connected to the REF DATA input. Then the Reference Data mode must be selected using the EXT key. Note that the reference signal must be generated by a singled-ended output.

Procedure for Selecting the Reference Data Mode

1. Connect a test signal to the Analyzer data input and a reference signal to the REF input.
2. Press the Analyzer EXT key to toggle the reference mode on. Verify that the EXT key turns on.
3. To de-select the reference mode, press the EXT key again. Verify that the EXT key turns off.

Monitor Outputs

The MONITOR CLOCK and DATA outputs are provided so that you can monitor the test signal as seen by the Analyzer. This allows you to attach an error logging device, for example, to record the exact times that errors occur. Or, you may attach another type of instrument to make specialized calculations.

MONITOR DATA is an NRZ output signal with the same bit sequence as that recovered by the Analyzer front end circuit. MONITOR CLOCK is the corresponding clock signal. Because the MONITOR output is a regenerated version of the received test signal, bit errors reported by the Analyzer—due to noise on the received data (or clock) signals—will be present in the MONITOR DATA output bit sequence.

Output Setup

All three MONITOR ports (CLOCK, DATA, and Pattern Sync) are 50 Ohm, ECL, single-ended outputs.

Error Detection Set Up

Overview

The GB1400 Analyzer calculates error results using three different methods: **Window**, **Test**, and **Totalize.** These three methods are independent of each other and can operate simultaneously. Window results are used to view current or "real-time" performance. Totalize results are generally used to view performance over long intervals. Test results are used to measure error performance over specified time intervals.

Two results are calculated for all three methods:

BER

Bit Errors

In addition, Test results include the following network performance parameters and event counts:

Test seconds

Total bits monitored

Errored seconds

Severely errored seconds

Unavailable seconds

Threshold errored seconds

Error-free seconds

Degraded minutes

Signal loss seconds

Pattern Synchronization loss seconds

Phase error seconds

For explanations of these results see **Result Definitions** later in this chapter.

How TOTALIZE Results are Measured

Totalize results are measured continuously by the Analyzer. Totalize results can be cleared by the user (by pressing the CLEAR key when Totalize results are displayed). However, Totalize result accumulation is a continuous background process of the Analyzer and cannot be suspended by the user. The Totalize measurement process is illustrated in the figure below.

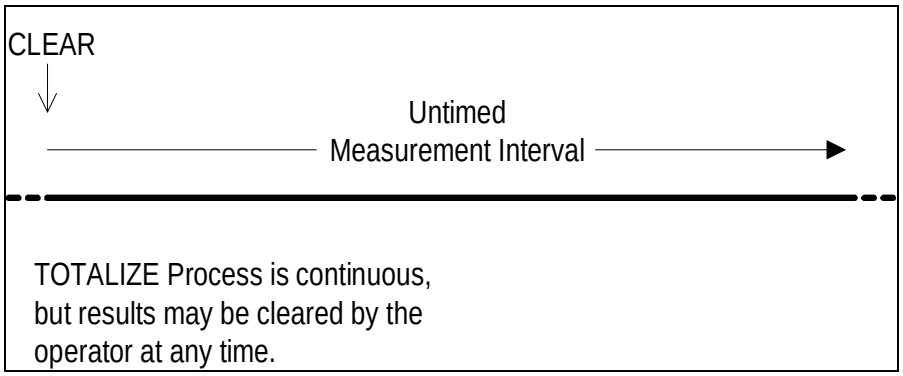


Figure 3-4. The TOTALIZE Measurement Process

How WINDOW Results Are Measured

Window Mode results are calculated over an sliding window whose length is defined by the user. Window results can be cleared at any time by pressing the CLEAR key when Window Mode results are displayed. But as in the case of Totalize results, the Window measurement process cannot be suspended by the user.

Window results may be thought of as a series of snapshots of the received signal performance. Each snapshot indicates BER and total bit errors over the most recent interval T, where T is the value of the Window length set by the user. The amount of "slide" between snapshots is effectively determined by the display update rate which is about five times per second. Therefore the Window slide between display updates is about 200 ms. Note that End-of-Window reports are generated once per second so the effective window slide in printed results is one second. The Window measurement process is illustrated in following figure.

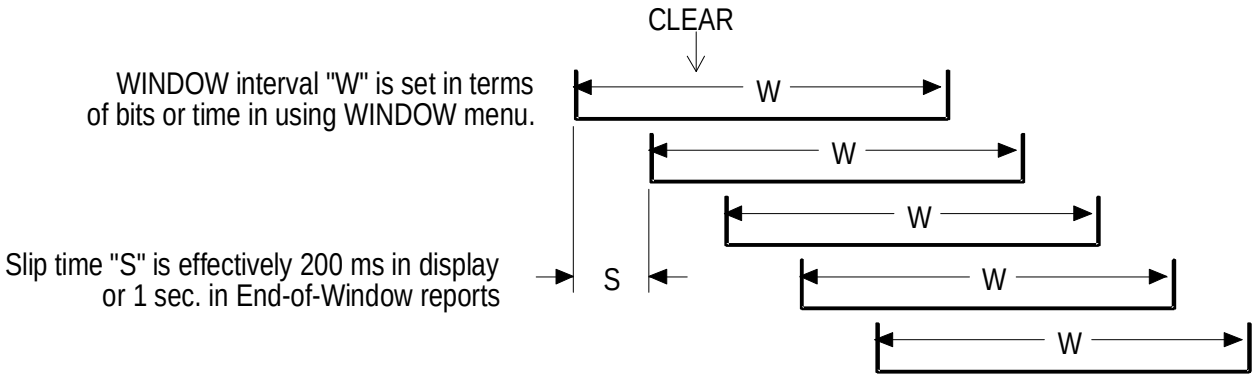


Figure 3-5. The WINDOW Measurement Process

How TEST Results Are Measured

Unlike Totalize and Window results, the accumulation of Test results can be started or stopped by pressing the CLEAR key. That is, the CLEAR key in effect becomes a test start/stop key. While a test is "stopped", all current Test results are frozen. When the CLEAR key is pressed to start a new test, all current Test results are saved as previous Test results before current result registers are cleared.

As shown in the next figure, Test results may be calculated using one of three timing modes: Timed, Untimed, or Repeat.

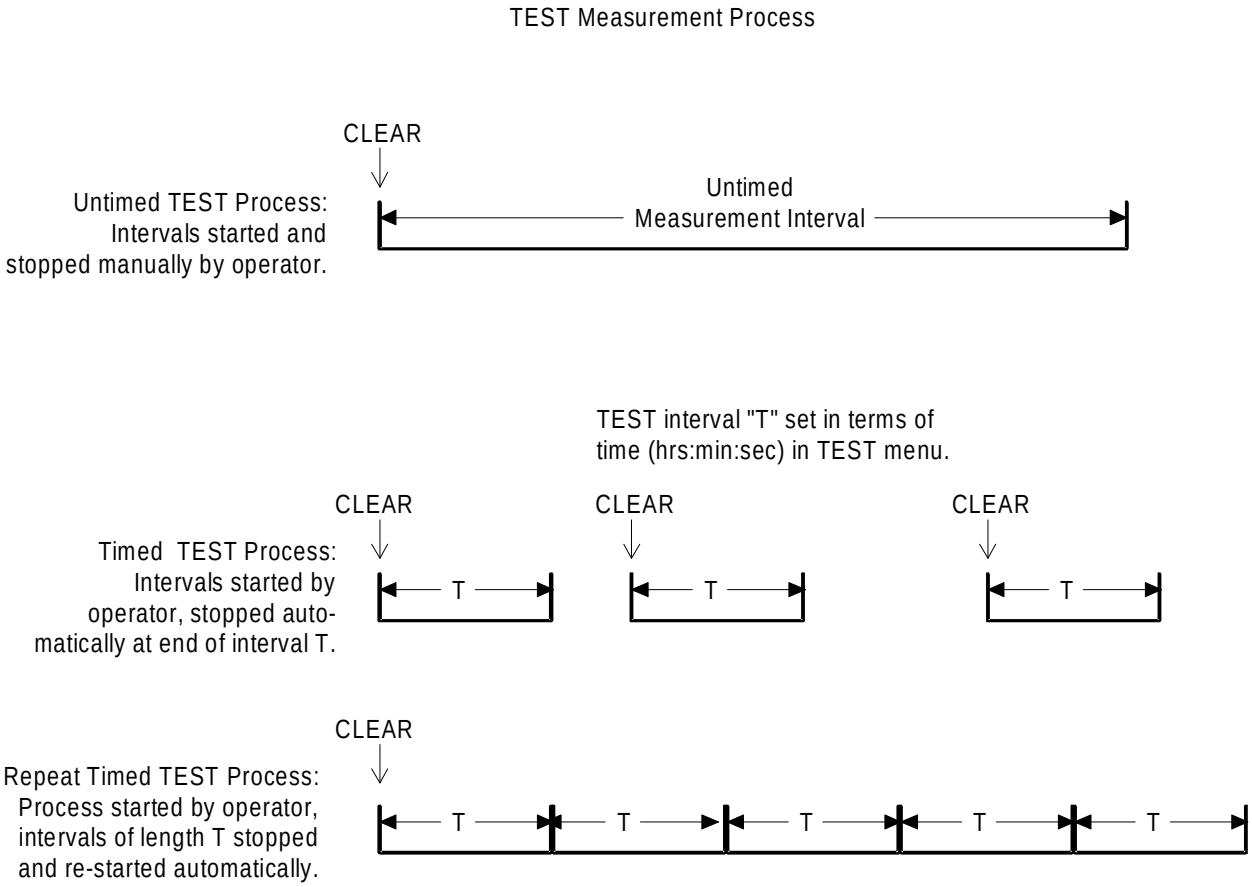


Figure 3-6. The TEST Measurement Process

Timed Tests. When the *Timed* mode is selected, the Analyzer will automatically stop accumulating Test results after the test interval (specified by the user) has elapsed. All Test results will be frozen until the CLEAR key is pressed to begin a new test.

Repeat (Timed) Tests. When the *Repeat* mode is selected, the Analyzer will automatically stop and then restart a test after a user specified test length has elapsed. This process will continue until the user presses the CLEAR key to manually stop Test result accumulation.

Untimed Tests. When the *Untimed* mode is selected, the Analyzer will continue to collect Test results until the CLEAR key is pressed. At this point Test results will remain frozen until the CLEAR key is pressed again to start a new test.

Display Mode: Totalize, Window, or Test

When the Analyzer is not in the Menu mode, you can select a display mode using the SELECT DISPLAY key. The display mode determines which BER and Bit Error results are shown in the main display. BER results are shown in the top, middle field of the display, while Bit Error results are shown in the top right field. Display mode also determines which results will be cleared when you press the ERROR DETECTION CLEAR key.

Procedure to Select a Results Display Mode

Press the DISPLAY SELECT key to select a different display mode. Selections are: **Totalize**, **Window**, or **Test**

The selected display mode will be indicated by the character in front of the BER result, as explained in the table below. Note that there are three possible Test display mode characters (T, U, and R) which further indicate which Test timing mode (Timed, Untimed, or Repeat) has been set up. Note that MODE is a parameter in the TEST Menu.

Table 3-10. How to Tell Which Display Mode is Active

Character In Front of BER Result	Indicated Result Display Mode
no character (blank)	Window
the infinity symbol (∞)	Totalize
T, U, or R	Test: T = Timed mode. U = Untimed mode R = Repeat mode

Clearing Results and Starting Tests

To do this:

1. Press DISPLAY SELECT until the Totalize Mode results are displayed (infinity character in front of the BER result).
2. Press the CLEAR key in the ERROR DETECTION section to clear Totalize BER and Bit Error results.

Totalize Process Set Up

The Totalize measurement process is active all the time and requires no explicit setup by the operator.

Window Process Set Up

The Window measurement process may be configured using the four parameters in the WINDOW Menu:

MODE: Defines window length in terms of "bits" or "seconds".

BITS: Window length in bits.

SECOND: Window length in terms of hours, minutes, and seconds.

REPORT: Turns end-of-window reports on or off.

If you want to measure Window results, you must set the MODE parameter, and depending on your MODE selection, either the BITS or SECOND parameter. In addition, if you want to generate end-of-window reports you must also set the REPORT parameter to on.

Procedure

1. Press F1 to enter the Menu system.
2. Select the WINDOW Menu (F3).
3. Within the WINDOW Menu, set up:

a. MODE (F2) and

b. either BITS (F3) or SECOND (F4).

4. Press MORE (F1) to see the next page of the WINDOW Menu.
5. If you are using a printer, set the REPORT parameter (F2) to on or off as required.
6. When WINDOW Menu setup is complete, press F1 multiple times to exit the Menu system.

See later in the this chapter for more information on setting up the WINDOW Menu.

Test Process Set Up

The TEST Menu contains the following six selections:

LENGTH: Test length: hours, minutes, seconds.

MODE: Test timing mode: Timed, Untimed, or Repeat.

REPORT: Test reporting mode: None, Print On Error, or Both.

THRESH: Threshold for the TES (threshold errored second) result.

SQUEL: On Error report squelch after 10 consecutive seconds: yes or no.

PRINT: Use this function to print current Test results immediately.

If you want to collect TEST results, you must set LENGTH and MODE before you begin a test. And if you are using a printer you should set the REPORT parameter as desired. Note that On Error reports can generate a lot of paper, so select On Error or Both with caution. Setup of the other parameters in the TEST Menu are optional.

Procedure

1. Press F1 to access the Menu system.
2. Select the TEST Menu (F2).
3. Within the TEST Menu, set up:

a. LENGTH (F2) and

b. MODE (F3).

4. And, if you are using a printer, set up the REPORT parameter (F4).
5. Press MORE (F1) to see the next page of the TEST Menu. Review the setup of the THRES (F2) and SQUEL (F3) parameters. Change if necessary.

NOTE: Setting SQUEL (squelch) to ON is recommended.

6. Press the F1 key multiple times to exit the Menu system.

See later in this chapter for more information of setting up the TEST Menu.

Viewing Results

BER and bit error results are shown in the normal display mode. However to view the complete list of Test results, you must use the TEST Menu VIEW-CUR or VIEW-PRE functions.

BER and Bit Errors

The Analyzer calculates BER and bit errors using all three measurement methods (Totalize, Window, and Test). The current display mode determines which BER/bit error result pair is shown in the display. Note that BER is shown in the top, middle field while the bit error result is shown in the top, right field.

Procedure to View Desired BER and Bit Error Results

Press the DISPLAY SELECT key to select the appropriate display mode.

As noted earlier, the character in front of the BER result will indicate the current display mode. The infinity symbol (∞) indicates Totalize; a blank character indicates Window; and the T, U, or R characters indicate Test results which have been measured using the timed, untimed, or repeat timing modes respectively.

All Other Results (Test Process only)

To view the complete set of Test results, select the VIEW-CUR or VIEW-PRE functions from the TEST Menu. VIEW-CUR will show partial results if a timed test is in progress, or results from the last completed test. VIEW-PRE will show results saved in the "previous" test registers. These results are over-written with the contents of the current registers each time a test is completed.

Procedure

1. Press F1 to enter the Menu system.
2. Select the TEST Menu (F2).
3. Press MORE (F1) twice to view the third page of the TEST Menu.
4. Select either VIEW-CUR or VIEW-PRE to view all current or previous Test results respectively. Once inside either the VIEW-CUR or VIEW-PRE function, use the pattern up/down keys to scroll through the results list.
5. When done, press F1 multiple times to exit the Menu system.

See later in this chapter for more information on the TEST Menu. Also see **Measurement Definitions**, later in this chapter.

Printing Results (Reports)

A serial or parallel printer may be connected to the Analyzer's RS-232-C or PRINTER ports respectively. Note that you cannot connect a GPIB printer directly to the GPIB port; but you may "print" results to a GPIB controller, which can store reports for later viewing or printing.

Basic Report Setup Procedure

The following initial setup procedure must be performed in order to generate any type of Analyzer report.

1. Connect your printer to the Analyzer RS-232 or PRINTER ports as appropriate. (See Chapter 6 for details).
2. Press F1 to enter the Menu system.
3. Select MORE (F1) to view the second page of the main Menu.
4. Set up the appropriate hardware port as follows:
    a. If you are using a serial printer, select RS232 (F2) to set up the serial port.
    b. If you are "printing" to a GPIB controller, select GPIB (F3) to set up the GPIB port

NOTE: The Analyzer PRINTER port is a standard PC-type parallel port which requires no hardware setup.

5. Next, select the PRINT parameter (F4).
    a. Set the PORT parameter to Parallel, GPIB, or Serial.
    b. Set the ON/OFF parameter to ON to enable reports.

NOTE: The PRINT ON/OFF parameter must be set to ON to print any type of report.

6. When you have completed all desired setup changes, press F1 multiple times to exit the Menu system.

Analyzer Setup Report

Press the F4 key at any time to print an immediate report listing the current setup of the Analyzer. This function is not available while the Analyzer is in the Menu mode. An example Setup Report is shown below.

Example Analyzer Setup Report

```
**** Tektronix, Inc. GB-1400 Jun/14/99 02:14:29
AUTO_SET AUTO
DATA_DELAY 1.800E-9
DATA_THRES 0.05
RDATA_DELAY 0.000E-9
RDATA_THRES -1.50
DATA_TERM GND
CLOCK_TERM GND
RDATA_TERM GND
TEST_LENGTH "00:00:30"
TEST_MODE TIMED
TEST_PREV PRE
TEST_REP ON_ERR
TEST_STATE STOP
TEST_SQUELCH OFF
TEST_THRES OFF
WIN_MODE SEC
WIN_PREV CUR
WIN_REP OFF
WIN_BIT_LEN 09
WIN_SEC_LEN "00:00:01"
PRINT_ENABLE ON
PRINT_PORT PARALLEL
AUDIO_VOL 0
AUDIO_RATE 3
PRBS_LENGTH 23
WORD_BITS 16, #HAA, #H55
DATA_PATTERN WORD
DATA_INVERT ON
WORD_MEMORY 0, 16, #HAA, #H55
WORD_MEMORY 1, 16, #HAA, #H55
WORD_MEMORY 2, 16, #HAA, #H55
WORD_MEMORY 3, 16, #HAA, #H55
WORD_MEMORY 4, 16, #HAA, #H55
WORD_MEMORY 5, 16, #HAA, #H55
WORD_MEMORY 6, 16, #HAA, #H55
WORD_MEMORY 7, 16, #HAA, #H55
WORD_MEMORY 8, 16, #HAA, #H55
WORD_MEMORY 9, 16, #HAA, #H55
VIEW_ANGLE 0
GPIB_ADDRESS 14
GPIB_BUS OFF_BUS
```

End-of-Test Reports

When End-of-Test reports are enabled, one End-of-Test report will be generated each time the end of a Test interval is reached. This can occur automatically, when timing mode is set to Timed or Repeat, or manually when the user stops an Untimed test by pressing the CLEAR key. Use the REPORT parameter in the TEST Menu to enable or disable End-of-Test reports. An example End-of-Test report is shown below.

Example End-of-Test Report

```
-------------------------------------------------------------------------------------------
Tektronix, Inc. GB-1400 TEST SUMMARY       Jun/14/99  02:42:48

TEST MODE:      TIMED                      FREQ:    100.0 MHz          ERROR THRES: E-05

          TIME                                ALARMS                          PERFORMANCE
START   Jun/14/99  02:43:26          SIG LOSS          OS  US  0 0.0%
STOP  Jun/14/99  0s:43:31         SYNC LOSS   OS  SES  0 0.0%
ELAPSED  000-00:00:05      PHASE ERR    OS TES  5  100.0%
                      ES  5  100.0%
          ERRORS/BITS      EFS  0  0.0%
TOTAL ERRS      000050000          AVG RATE         1.0E-04  DM  0  0.0%
TOTAL BITS      500002816          CUR RATE         1.0E-04
-------------------------------------------------------------------------------------------
```

You can set up the Analyzer to generate End-of-Test Reports as follows:

Procedure to Enable or Disable End-of-Test Reports

1. Complete the basic report setup procedure.
2. Press F1 to enter the Menu system.
3. Select the TEST Menu (F2).
4. Select the REPORT parameter (F4).
5. You may now either **enable** End-of-Test reports by selecting END OF TEST or EOT/ERROR; or **disable** End-of-Test reports, by selecting NONE.
6. Press F4 to lock in you selection.
7. Press F1 multiple times until you have exited the Menu system.

End-of-Window Reports

When enabled, an End-of-Window report will occur once every second. The results of an End-of-Window report are based on a sliding interval T, where T is set in terms of bits or time (hours:minutes:seconds). Use the REPORT parameter in the WINDOW Menu to enable or disable End-of-Window reports. Use the MODE, BITS, and SECOND parameters in the WINDOW Menu to set window length T. An example End-of-Window report is shown below.

Example End-of-Window Report

Date: Jun/14/99	Time: 02:42:34.46		
Bits= 5.00E+08	Errs= 5000	Err rate= 1.0E-04	Freq= 100.00 MHz
Pattern= AA55	Data los= 0	Sync Los= 0	Phase Err= 0

Procedure to Enable or Disable End-of-Window Reports

1. Complete the Basic Report Setup Procedure.
2. Press F1 to enter the Menu system.
3. Select the WINDOW Menu (F3).
4. Press F1 to see the second page of the WINDOW Menu.
5. Select the REPORT parameter (F2).
6. Set the REPORT parameter to ON. Press F4 to lock in this choice.
7. Exit the Menu system by pressing F1 multiple times until the normal display format appears.

On-Error Reports

When enabled, On-Error reports are generated for each second in which error rate is above the current THRES threshold. Note that On-Error reports can be squelched after reports are generated on 10 consecutive seconds, by enabling the SQUEL feature. This is recommended for unattended operation since On-Error reports can generate a lot of paper. An example On-Error report is shown below.

Example On-Error Report

```
-------------------------------------------------------------------------------------------------------------
Tektronix, Inc.      GB-1400 TEST START      Jun/14/99 02:42:48

TIME: 02:42:48            ERRORS:  10000            RATE:    1.00e-004
TIME: 02:42:49            ERRORS:  10000            RATE:    1.00e-004          SynLos
TIME: 02:42:50     ERRORS:  10000              RATE:  1.00e-004
-------------------------------------------------------------------------------------------------------------
```

Procedure to Enable On-Error Reports

1. Complete the basic report setup procedure.
2. Press F1 to enter the Menu system.
3. Select the TEST Menu (F2).
4. Select the REPORT parameter (F4).
5. You may now either enable or disable End-of-Window reports by setting the WINDOW REPORT parameter to ON or OFF.
6. Press F4 to lock in your selection.
7. `Press F1 multiple times to exit the Menu system.

On-Demand Test Reports

You can generate a test summary report on demand using the PRINT function in the TEST Menu. While a test is in progress, the PRINT function will generate a summary report based results from the current test interval. This report will have the same basic format as an End-of-Test report. If a test is not in progress, the PRINT function will generate an End-of-Test Report based on previous results, that is results from the most recently completed test interval.

1. Procedure to Generate an On-Demand Test Summary Report

1. Make sure the Basic Report Setup Procedure has been completed.
2. Press F1 to enter the Menu system.
3. Select the TEST Menu (F2).
4. Press F1 to see the second page of the TEST Menu.
5. Select the PRINT parameter to generate an immediate Test report
6. Press F1 multiple times to exit the Menu system.

Result Definitions

The following section defines all results calculated by the Analyzer.

BER and Bit Errors

The following two results are calculated by all three Analyzer measurement processes (Totalize, Window, and Test):

Bit Errors: The total number of bit (logic) errors counted in the measurement interval. May be based on Totalize, Window, or Test measurement intervals.

Bit Error Rate (BER): Also known as "bit error ratio". May be based on Totalize, Window, or Test measurement intervals. Equals the number of bit errors divided by the total number of bits in the measurement interval:

BER = TE / TB

where: TE = total number of bit errors in the interval
TB = total number of bits in the interval

Note that BER results, when included in End-of-Test or Immediate Test Reports, are identified as follows:

AVE RATE: BER calculated over the entire TEST interval.

CUR RATE: BER calculated over the latest WINDOW interval.

All Other Results (Test Intervals Only)

The following results are calculated over Test intervals only. You can view all Test results using the VIEW-CUR and VIEW-PRE functions in the TEST Menu. Or, you can print all Test results at the end of Test intervals or immediately, using the REPORT or PRINT functions respectively in the TEST Menu.

SIG LOSS: The number of 20 ms intervals in which the Analyzer input activity detector sees no transitions on the input CLOCK signal for 20 ms.

SYNC LOSS: The number of 20 ms intervals in which pattern synchronization (lock) is lost.

PHASE ERR: The number of 20 ms intervals in which a phase error event is detected. The Analyzer will report a phase error when the active clock edge moves too close to the data waveform transition point, thus violating the input circuit setup or hold time.

Errored Seconds (ES): The number of seconds in the measurement interval containing one or more errors. The GB1400 measures a*synchronous* errored seconds—that is one second intervals based on the instrument's internal clock rather than the detection of an error. Errored seconds are not counted during unavailable time (see below). However, the errored second count does include both severely errored seconds and non-severely errored seconds.

ES = TSE - US

TSE = total seconds in the current measurement interval with one or more errors.

US = unavailable seconds in the current interval

% Errored Seconds (%ES): Errored seconds as a percentage of the total number of seconds in the measurement interval:

%ES = (ES / TS) * 100%

ES = errored seconds in the measurement interval

TS = total seconds in the measurement interval

Error Free Seconds (EFS): The number of seconds that contain no errors and are not unavailable.

EFS = (TS - ES - US)

TS = total seconds in the measurement interval

ES = errored seconds in the measurement interval

US = unavailable seconds in the measurement interval

%**EFS**: Percentage Error-free Seconds. Error-free seconds as a percentage of the total number of seconds in the measurement interval.

% EFS = (EFS / TS) * 100%

EFS = error-free seconds in the measurement interval

TS = total seconds in the measurement interval

Severely Errored Seconds (SES): The number of errored seconds in the measurement interval which BER is greater than or equal to 1E-03, excluding unavailable seconds. For example, on a 100 Mb/s test signal, this would include all available, synchronous errored seconds with 100,000 or more errors.

SES = (seconds with BER ≥ 1E-03) - US

US = unavailable seconds in the current interval

TES: Threshold Errored Seconds: The number of seconds in the measurement interval in which BER exceeds the threshold set by the THRES parameter in the TEST Menu, minus the number of unavailable seconds. Available threshold values are 1E-n, where n = 2, 3, ... 16.

TES = (seconds with BER ≥ Threshold) - US

US = unavailable seconds in the current interval

Degraded Minutes (DM): The number of 60 second intervals in the current interval in which the BER exceeds the current test threshold (THRES).

Percentage Degraded Minutes (%DM): The number of degraded minutes expressed as a percentage of the total number of minutes in the measurement interval.

% DM = (DM / TM) * 100%

DM = degraded minutes in the measurement interval

TM = total minutes in the measurement interval

Unavailable Seconds (US): The number of seconds in unavailable intervals. Unavailable intervals start upon the detection of 10 contiguous severely errored seconds (SES), and end upon the detection of 10 non-severely errored seconds.

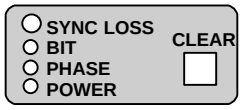
Percentage Unavailable Seconds (%US): The number of unavailable seconds expressed as a percentage of total seconds in the measurement interval.

% US = (US / TS) * 100%

US = unavailable seconds in the measurement interval

TS = total seconds in the measurement interval

Error History Indicators



The Analyzer (performance) history indicators are located in the ERROR HISTORY section of the front panel. These indicators will latch on when the indicated event occurs, and can be cleared by the user.

SYNC LOSS: This indicator will turn on if the LOCK LED turns off; that is if the BER rises above the current synchronization threshold (See Synchronization (LOCK) Threshold in Chapter 4)

BIT: Will turn on if a bit error is detected.

PHASE: Will turn on if a phase error is detected. The Analyzer will report a phase error when the active clock edge moves too close to the data waveform transition point thus violating the input circuit setup or hold time.

POWER: Will turn on after a power loss has occurred.

CLEAR Control

Pressing the CLEAR key will reset all active history indicators. Note that when you start a test, you must clear test results and history indicators by pressing the ERROR DETECTION CLEAR and ERROR HISTORY CLEAR keys respectively.

Audio (Beeper) Function

The Analyzer may be set up to "beep" each time a second is detected in which BER is above a specified threshold. The AUDIO VOL and RATE controls are used to configure this function.

Procedure To Set Up the Audio Alert Function

1. Press the AUDIO RATE up or down keys to increment or decrement the current audio alert BER threshold. The current value of the AUDIO RATE will be displayed in the bottom, right field of the display for about seven seconds after the last key press. Available selections are 1E-x, where x = 2, 3, ... 16
2. Press the AUDIO VOL up or down keys to increment or decrement the current audio alert volume. There are four volume levels. The minimum value is "OFF". Except when volume is set to the minimum level, a beep will occur each time you press an AUDIO VOL up or down key to indicate the current volume.

Analyzer Error Messages

When abnormal input conditions are detected, the Analyzer will display various error messages to indicate an unusual condition. These are explained below.

NO CLOCK: This message will appear in the frequency field (top, left) if no activity is detected at the CLOCK input for 20 ms.

NO DATA: This message will appear in the BER field (top, middle) if no activity is detected at the data (or clock) input for 20 ms.

LOW AMP: May appear when no signal or a low-signal is applied to the CLOCK or DATA input and AUTO_SEARCH is enabled

Starting and Stopping Measurements

The following section explains how to start and stop TEST measurements, and how to initialize or "re-start" WINDOW and TOTALIZE measurements.

The TEST measurement process has two states: started and stopped . In the started or active state, new "current" results are accumulated while all results from the previous TEST interval are saved in memory. In the stopped state, all current results are frozen so that in effect the results from the last two TEST intervals are saved in memory.

You can tell whether the current TEST process is started or stopped by observing the TEST character (T, U, or R) in the display. If the displayed TEST character (in front of the BER result) is blinking, then the TEST process is stopped and current results are frozen. On the other hand, if the TEST character is not blinking, that is if it is on steady, then the current TEST process is started and new results are accumulating.

You can start and stop TEST measurements as follows:

Procedure for Starting the TEST Measurement Process

1. Configure your Analyzer and Generator as desired. In particular, select a TEST timing mode: Timed, Untimed, or Repeat.
2. Use the DISPLAY SELECT key to set the display mode to TEST. Verify that the expected TEST character (T, U, or R) is shown.
3 If the TEST character is blinking, press the ERROR DETECTION CLEAR key to stop the TEST process.
3. At this point you may press the ERROR DETECTION CLEAR key to start a new TEST process at any time. After pressing CLEAR, verify that the displayed TEST character is no longer blinking. After starting a new TEST interval you may also reset the bit, phase, and power history indicators by pressing the ERROR HISTORY CLEAR key.

Regardless of the current TEST timing mode, you can stop an active TEST process as follows:

Procedure for Stopping the TEST Process

1. Use the DISPLAY SELECT key to set the display mode to TEST. Verify that the expected TEST character (T, U, or R) is shown.
2 Observe the TEST character.
    a. If the character is on steady, then you may stop the current TEST interval by pressing the ERROR DETECTION CLEAR key.
    b. However, if the character is blinking then the TEST process is already stopped and you should not press the CLEAR key until you want to start a new TEST interval.

Note that TEST measurement starting and stopping can be controlled manually or automatically, depending on the selected timing mode. When the Untimed

mode is selected, TEST intervals must be started and stopped manually by the user. When the Timed mode is selected, TEST intervals are started manually, but stopped automatically after an interval determined by the LENGTH parameter in the TEST Menu. When the Repeat timing mode is selected, once the TEST process has been started by the user, new TEST intervals are stopped and then re-started automatically, at intervals determined by the LENGTH parameter. However, even when the Repeat mode is selected, the overall TEST process can controlled by the user, that is started and stopped manually.

Starting New Totalize and Window Measurement Intervals

Unlike the TEST process, the Totalize and Window measurement processes are continuous background processes that cannot be stopped and started by the user. However you can clear all current results to start a new measurement interval as follows:

Procedure for Starting a New Totalize or Window Measurement Interval

1. Configure your Analyzer and Generator as desired.
2. Select the desired display mode (Totalize or Window).

At this point you may press the ERROR DETECTION CLEAR key at any time to zero all current results and start a new measurement interval. After starting a new TOTALIZE or WINDOW interval you may also reset the bit, phase, and power history indicators by pressing the ERROR HISTORY CLEAR key.

Menus

This chapter explains how to use the GB1400 Menu system. It includes basic rules, an overview of the Generator and Analyzer Menu structures, and a description of each Menu function.

Functions Performed Using the Menu System

The GB1400 Menu system is used to perform two types of functions: setup and immediate. Menu *setup* functions are used to set up instrument parameters such as test mode (untimed, timed, or repeat), of test duration, and window length. Setup functions are also used to configure remote ports and to enable or disable reports. Menu *immediate* functions are used to view or print results based on the "test in progress" or the last completed test. Immediate functions are also used to view the instrument's software version or a list of installed options.

Note that a few Menu functions can also be performed using front panel keys—for example setting WORD length. However most Menu functions do not have front panel equivalents.

Menu and Function "Pages"

Once you press the F1 key to enter the Menu system you will see two basic display or "page" formats: Menus and functions. *Menu* pages are used to pick a function or another Menu by pressing one of the function keys (F1 ... F4). *Function* pages are used to change one or more setup parameters (setup functions) or to perform specific actions (immediate functions).

An example setup procedure is presented next to illustrate the use of Menus and functions. The objectives of this example procedure will be to:

Set TEST length to 30 minutes.

Set TEST mode to TIMED.

Enable On-Error and End-of-Test reports.

Example Procedure Illustrating Menus and Functions:

1. Press F1 to enter the Analyzer Menu system. At this point you will see the first page of the Analyzer top level Menu:

```
F1    F2  F3    F4
MORE  TEST WINDOW WORD
```

2. Press F2 to enter the TEST Menu. You will now see the second page of the main Menu:

```
F1   F2  F3   F4
MORE LENGTH MODE REPORT
```

3. Press F2 and you will see the LENGTH function:

```
F1:ESC F2<- ->F3 F4:SET
TEST LENGTH = 01:00:00
```

NOTE: Your display may show a different value.

4. The TEST LENGTH function allows you to set the length of timed tests in terms of hours, minutes, and seconds. Notice that either the hours, minutes, or seconds field will be flashing. To change the value of the flashing field, press the pattern up/down keys. To change the value of another field, use the F2 or F3 key to select this field and then use the pattern up/down keys to change its value.

   In this example, we will change TEST LENGTH from 1 hour (as shown above) to 30 minutes, as shown below:

```
F1:ESC F2<- ->F3 F4:SET
TEST LENGTH = 00:30:00
```

5. Note that there are two ways to exit a function like TEST LENGTH. The normal way is to press F4 to lock in your changes and exit the function. However you can also exit most functions without making any setup change by pressing F1 to "escape". In this example we'll press F4 and see the following:

```
F1   F2  F3   F4
MORE LENGTH MODE REPORT
```

6. Notice that we've returned to the TEST Menu. Next press F3 to enter the MODE function and see the following:

```
F1:ESC       F4:SET
TEST MODE = UNTIMED
```

7. Note that the MODE function has only one field and therefore does not use the F2 and F3 direction keys. Press the pattern up key one time to select the timed test mode and see the following:

```
F1:ESC      F4:SET
TEST MODE = TIMED
```

8. As before, to lock in this setup change and return to the TEST Menu, press the F4 key and see:

```
 F1   F2  F3   F4
MORE LENGTH MODE REPORT
```

9. The last function we'll perform in this example is to enable End-of-Test and On-Error reports. To do this select the REPORT function by pressing F4 and see:

```
F1:ESC      F4:SET
REPORTS ON = NONE
```

10. Now press the pattern up key three times to select EOT/ERROR which will enable both End-of-Test and On-Error reports. The REPORT function should now look like the following:

```
F1:ESC      F4:SET
REPORTS ON = EOT/ERROR
```

11. To lock in this change and return to the TEST Menu, press F4:

```
F1   F2  F3   F4
MORE LENGTH MODE REPORT
```

12. Since all of the setup goals have been accomplished, we now want to exit the Analyzer Menu system. To do this from the TEST Menu, or from any Menu, *simply keep pressing the F1 key until the normal display appears*. In this example you would see the following:

a. Press F1 and see the second page of the TEST Menu .
b. Press F1 a second time and see the third page of the TEST Menu.
c. Press F1 a third time and see the first page of the main Menu again.
d. Press F1 a fourth time to see the second page of the main Menu.
e. Press F1 a fifth time and see the third page of the main Menu.
f. Press F1 a sixth time to exit the Menu system and see the normal Analyzer display format.

At this point you could perform a 30 minute timed test by:

1. Selecting the TEST display mode (press DISPLAY SELECT until a "T" appears in front of the BER field) and
2. Pressing the ERROR DETECTION CLEAR key to start a timed test interval.

General Rules for Using the Menu System

Operation of the GB1400 Analyzer and Generator Menu systems can be summed up by the following rules:

1. From the normal display mode, press F1 to enter the Menu system.
2. Navigate to a particular Menu function by pressing the appropriate "F" keys to select lower level Menus and finally the desired function.
3. In multi-field functions, use the F2 (move left) or F3 (move right) keys to select a field. Note that the selected field is indicated by its flashing mode: flashing = selected, not flashing = not selected.
4. Once a field is selected, use the pattern up/down keys to increment or decrement the value of the selected field.
5. To exit any setup function, press F4 to lock in all setup changes or F1 to "escape" without making any setup changes.
6. From any Menu, you can always exit the Menu system by pressing F1 key one or more times until the normal display format appears.

Menu Summaries

The GB1400 Generator and Analyzer Menu system may be thought of as a top level or "main" Menu plus a series of sub-Menus, with each sub-Menu containing a group of related functions. In this section you will find:

1. A brief description of each Menu found in the GB1400 Menu system.
2. An overall view of the Analyzer Menu system.
3. An overall view of the Generator Menu system.

Note that all Menu names in the following tables below are shown in bold type, and that all functions included only in instruments equipped with the 1-Mbit Option are marked with an asterisk (*). Once you have reviewed the summary tables in this section, please refer to the next section (**Menu Functions**) for a detailed description of each GB1400 Menu function.

Table 3-11. Menu Descriptions

Menu	Found In Which Instrument	Description
"Main"	Analyzer and Generator	Provides access to all other Menus. Also contains a few functions not part of any other Menu.
TEST	Analyzer only	Contains functions to set up the TEST measurement process including timing mode, End-of-Test reports, and the test threshold.
WINDOW	Analyzer only	Contains functions to set up the WINDOW measurement process including window length and End-of-Window reports.
WORD	Analyzer and Generator	Contains functions to create and edit WORD patterns.
RS-232	Analyzer and Generator	Contains functions to set up the RS-232C (serial) port.
PRINT	Analyzer only	Contains functions to select which port is used to print reports and to enable or disable all report printing.
UTIL	Analyzer and Generator	Contains functions to show which options are installed, and the current software version.

Table 3-12. Analyzer Menu System Overview

Menu	Page	F1	F2	F3	F4
"Main"	1 2 3	MORE MORE EXIT (*to Normal mode*)	TEST RS232 DATE	WINDOW GPIB TIME	WORD PRINT UTIL
TEST	1 2 3	MORE MORE ESC (*to MAIN Menu*)	LENGTH THRES VIEW-CUR	MODE SQUEL --	REPORT PRINT VIEW-PRE
WINDOW	1 2	MORE ESC (*to MAIN Menu*)	MODE REPORT	BITS --	SECOND --
WORD	1 2	MORE* ESC (*to MAIN Menu*)	EDIT* SYNC*	LENGTH* ORDER[3]	FILL* Pattern Sync*
RS232	1 2	MORE ESC (*to MAIN Menu*)	BAUD EOL	PARITY XON/XOFF	SIZE ECHO
PRINT	1	ESC (*to MAIN Menu*)	PORT	ON/OFF	--
UTIL	1	ESC (*to MAIN Menu*)	OPTION	VER	--

NOTES

1. Menu names appear in bold typeface.
2. Functions included only in instruments equipped with the 1-Mbit Option are marked with an asterisk (*).
3. The ORDER function appears under the F2 key in units **not** equipped with the 1-Mbit Option.

Table 3-13. Generator Menu System Overview

Menu	Page	F1	F2	F3	F4
MAIN	**1** **2**	MORE EXIT (*to Normal mode*)	**RS232**	GPIB CLOCK	**WORD** **UTIL**
RS232	**1** **2**	MORE ESC (*to MAIN Menu*)	BAUD EOL	PARITY XON/XOFF	SIZE ECHO
WORD	**1** **2**	MORE* ESC (*to MAIN Menu*)	EDIT* ORDER[3]	LENGTH*	FILL* --
UTIL	**1**	ESC (*to MAIN Menu*)	OPTION	VER	--

NOTES:

1. Menu names appear in bold typeface.
2. Functions included only in instruments equipped with the 1-Mbit Option are marked with an asterisk (*).
3. The ORDER function appears under the F2 key in units not equipped with the 1-Mbit Option.

Menu Function Definitions

This section describes each Menu function included in the GB1400 Menu system. For each function you will find the following information:

- Basic display format
- Menu in which it is located
- Function name used in the Menu system
- Whether it is found in the Analyzer, Generator, or both
- Which option(s) must be installed for this function to be available
- What this function is used for
- Parameters set using this function and their ranges
- Notes

Note that most of the following function descriptions are identified by a Menu name and a function name, for example **Test Length**. This is to clarify the application of the described function, and to differentiate functions that have the same name, for example Word Mode and Window Mode. Also note that function descriptions are grouped by Menu.

Word Edit (EDIT)

Format:

```
F1:ESC F2<- ->F3 F4:SET
WORD AT ddddd = bbbbbbbb
```

Menu: WORD

Function Name: EDIT

Instruments: Analyzer and Generator

Options: Requires the 1-Mbit Option.

Application: Use this function to create new WORD patterns or edit the current WORD pattern.

Parameters: Byte Location (ddddd): Set this parameter to the location (in decimal) of the byte you want to edit in the current WORD. May be set in the range: 00001 to M+1, where M the number of whole bytes in the current WORD. If WORD length is M bytes plus N bits, then the "byte" location of the last N bits is M+1.

Byte Value (bbbbbbbb): This is the binary representation of the selected byte. Edit this byte using the front panel "bit" keys, MSB 1 ... LSB 8.

Range: 00000000 to 11111111 (binary)

Notes: Use the WORD LENGTH function to set WORD length.

See an additional list of remote commands in the Appendix that support the 1-Mbit Programmable Word option.

Word Length (LENGTH)

Format:

```
F1:ESC F2<- ->F3 F4:SET
LEN:mmmmm BYTES + n BITS
```

Menu: WORD

Function Name: LENGTH

Instruments: Analyzer and Generator

Options: Requires the 1-Mbit Option.

Application: Use this function to set the length of the current WORD pattern.

Parameters:

Bytes (mmmmm): Set this parameter to the number of whole bytes in the pattern length. That is, if length is M bytes + N bits, set this parameter to M.

Range: 0 to 16,384

Bits(n): Set this parameter to the number of extra bits in the pattern length. That is, if length is M bytes + N bits, set this parameter to N.

Range: 0 to 7.

Notes: See an additional list of remote commands in the Appendix that support the 1-Mbit Programmable Word option.

Word Fill (FILL)

Format:

```
F1:ESC      F4:SET
FILL WORD MEMORY WITH:hh
```

Menu: WORD

Function Name: FILL

Instruments: Analyzer and Generator

Options: Requires the 1-Mbit Option.

Application: Use this function to fill all bytes in the current WORD with the same 8-bit pattern.

Parameters: Fill Byte (hh): Enter the hex value for the fill byte Range: 00 to FF.

Notes: You may use the fill function as the basis for a new WORD pattern, then edit individual bytes using the WORD EDIT function to create the exact pattern that you need.

See an additional list of remote commands in the Appendix that support the 1-Mbit Programmable Word option.

Word Order (ORDER)

Format:

```
F1:ESC      F4:SET
WORD ORDER = ccc FIRST
```

Menu: WORD

Function Name: ORDER

Instruments: Analyzer and Generator

Options: Requires the 1-Mbit Option.

Application: Use this function to change the transmit or analysis bit order (MSB first or LSB first) of the current WORD pattern.

Parameters: Word Order (ccc): May be set to LSB or MSB.

Note: Word order also applies to the fractional end-byte in patterns that do not contain an exact multiple of eight bits.

See an additional list of remote commands in the Appendix that support the 1-Mbit Programmable Word option.

Word Synchronization Threshold (SYNC)

Format:

```
F1:ESC      F4:SET
WORD SYNC THRES LEVEL= d
```

Menu: WORD

Function Name: SYNC

Instruments: Analyzer only

Options: Requires the 1-Mbit Option.

Application: This function is used to set the BER synchronization threshold used by the Analyzer for long WORD patterns. This function does not affect the sync. thresholds for PRBS or short WORD patterns, which are fixed.

Parameters: Long Word Synchronization Threshold Level (d): Set this parameter to a level from 1 to 9.

Notes: The long WORD synchronization threshold is always set to 256 errors in a rolling window of variable length. The length of this window is automatically set by the Analyzer, based on the selected threshold level, so that the nine threshold levels effectively correspond to the following bit error rates:

Level	BER
1	3.1 E-02
2	7.8 E-03
3	1.9 E-04
4	9.7E-04
5	4.8 E-04
6	2.4 E-04
7	1.2 E-04
8	6.1 E-05
9	3.0 E-05

See an additional list of remote commands in the Appendix that support the 1-Mbit Programmable Word option.

Test Length (LENGTH)

Format:

```
F1:ESC F2<- ->F3 F4:SET
TEST LENGTH = hh:mm:ss
```

Menu: TEST

Function Name: LENGTH

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to set the duration of timed tests and the repeat interval of repeat timed tests.

Parameters:
Hours (hh): Set from 00 to 23.
Minutes (mm): Set from 00 to 59.
Seconds (ss): Set from 00 to 59.

Notes: Test length does not affect untimed TEST intervals, or the TOTALIZE or WINDOW measurement processes.

Test Mode (MODE)

Format:

```
F1:ESC      F4:SET
TEST MODE = ccccccc
```

Menu: TEST

Function Name: MODE

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to select a test timing mode.

Parameters: Test Timing Mode (ccccccc): May be set to TIMED, REPEAT, or UNTIMED

Notes: This function applies only to the TEST measurement process and has no impact on either the TOTALIZE or WINDOW measurement processes.

Test Reports (REPORT)

Format:

```
F1:ESC      F4:SET
REPORTS ON = ccccccccc
```

Menu: TEST

Function Name: REPORT

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to enable or disable End-of-Test and On-Error reports.

Parameters: Reports On (ccccccccc): May be set to:
NONE: All test reports are disabled.
END OF TEST: Only EOT reports enabled.
ON ERROR: Only On Error reports enabled.
EOT/ERROR: Both EOT and On Error reports enabled.

Notes: If you want to generate reports, be sure the ON/OFF function in the PRINT Menu is set to ON.

Test Threshold (THRES)

Format:

```
F1:ESC        F4:SET
ERROR THRESHOLD = eeeee
```

Menu: TEST

Function Name: THRES

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to set the value of the test threshold.

Parameters: Test Threshold (eeeee): Set from 1E-03 to 1E-16.

Notes: The test threshold affects On-Error reports and the TES (threshold errored second) result.

Test Squelch (SQUEL)

Format:

```
F1:ESC      F4:SET
ON ERROR SQUELCH = ccc
```

Menu: TEST

Function Name: SQUEL

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to enable or disable squelching of On-Error reports.

Parameters: On Error Squelch (ccc): Set to ON or OFF

Notes: When On Error Squelch is ON, the analyzer will squelch (temporarily stop printing) On Error reports after ten consecutive reports, that is ten consecutive seconds in which BER exceeds the current test threshold. On Error reports will resume after 10 consecutive seconds in which the BER does not exceed the test threshold.

Test Print (PRINT)

Format:

```
F1:ESC      F4:SET
F4 TO PRINT TEST RESULTS
```

Menu: TEST

Function Name: PRINT

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to print a test summary report based on current test results (if a test is in progress) or previous test results (if a test is not in progress).

Parameters: None. This is an immediate function. Simply press F4 to generate a report or F1 to escape the function without generating a report.

Notes: Make sure the ON/OFF function in the PRINT Menu is ON if you want to generate a test summary report.

Test View Previous (VIEW-PRE)

Format:

```
F1:ESC      F4:SET
(result name)(count) (%)
```

Menu: TEST

Function Name: VIEW-PRE

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to view results from the last completed test.

Parameters: This is an immediate function. After selecting VIEW-PRE use the pattern up/down keys to scroll through the results shown below.

START (test start time), STOP (test stop time), ELAPSED (duration of test), TTL BIT (total number of bits in interval), TTL ERR (total number of bit errors counted), AVE ERROR RATE (BER of TEST interval), CUR ERROR RATE (BER of WINDOW interval), US (Unavailable Seconds), SES (Severely Errored Seconds), TES (Threshold Errored Seconds), ES (Errored Seconds), EFS (Error Free Seconds), DM (Degraded Minutes), SIG LOSS SEC (seconds in which a loss of signal has occurred), SYNC LOSS SEC (seconds in which a loss of pattern synchronization has occurred), PHASE ERR SEC (seconds in which a phase error has occurred).

Test View Current (VIEW-CUR)

Format:

```
F1:ESC      F4:SET
(result name)(count) (%)
```

Menu: TEST

Function Name: VIEW-CUR

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to view current test results. In effect this function takes a snap shot of the latest results from a test in progress.

Parameters: None. This is an immediate function. Use pattern up/down keys to scroll through results. Available results are the same as for VIEW-PRE except that STOP time is replaced by the message TEST IN PROGRESS

Notes: If the TEST process is currently stopped, this function will display the error message: NO TEST IN PROGRESS.

Window Mode (MODE)

Format:

```
F1:ESC      F4:SET
WINDOW MODE = ccccccc
```

Menu: WINDOW

Function Name: MODE

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to set window length equal to the number of bits specified by the WINDOW BITS function, or the time specified by the WINDOW SECOND function.

Parameters: Window Mode (ccccccc): May be set to BITS or SECONDS.

Window Interval in Bits (BITS)

Format:

```
F1:ESC      F4:SET
WINDOW LEN = 1.0eEE BITS
```

Menu: WINDOW

Function Name: BITS

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: When WINDOW MODE is set to BITS, use this function to set window duration in terms of bits.

Parameters: Window Length (EE): May be set from 1.0e08 to 1.0e16

Window Interval in Hrs:Min:Sec (SECOND)

Format:

```
F1:ESC F2<- ->F3 F4:SET
WINDOW LEN = hh:mm:ss
```

Menu: WINDOW

Function Name: SECOND

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: When WINDOW MODE is set to SECONDS, use this function to set window duration in terms of hours, minutes, and seconds.

Parameters: Window Length (hh:mm:ss):
hh: Set from 00 to 23
mm: Set from 00 to 59
ss: Set from 00 to 59

Window Reports (REPORT)

Format:

```
F1:ESC      F4:SET
END OF WINDOW PRINT = ccc
```

Menu: WINDOW

Function Name: REPORT

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to enable or disable End-of-Window reports.

Parameters: End-of-Window Print (ccc): May be set to ON or OFF.

Notes: To print End-of-Window reports, be sure ON/OFF parameter in PRINT Menu is set to ON.

RS-232 Baud Rate (BAUD)

Format:

```
F1:ESC        F4:SET
BAUD = dddd
```

Menu: RS232

Function Name: BAUD

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to set the baud rate of the serial (RS-232C) port.

Parameters: Baud rate (dddd): May be set to 300, 600, 1200, 2400, 4800, or 9600.

RS-232 Parity (PARITY)

Format:

```
F1:ESC      F4:SET
PARITY = cccc
```

Menu: RS-232

Function Name: PARITY

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to set parity for the serial port.

Parameters: Parity (cccc): May be set to ODD, EVEN, or NONE

RS-232 Data Bits (SIZE)

Format:

```
F1:ESC        F4:SET
SIZE =  d
```

Menu: RS232

Function Name: SIZE

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to set the number of data bits per character for the RS-232 (serial) port.

Parameters: Number of Data Bits (d): May be set to 7 or 8.

RS-232 End-of-Line Char. (EOL)

Format:

```
F1:ESC        F4:SET
EOL = ccccc
```

Menu: RS232

Function Name: EOL

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to select an end-of-line terminator. This character or pair of characters will be added to the end of every line in reports sent to the RS-232 port.

Parameters: End-of-Line Terminator (ccccc): May be set to CR/LF, LF/CR, CR, or LF.

RS-232 Xon/Xoff (XON/XOFF)

Format:

```
F1:ESC      F4:SET
XON/XOFF ENABLE = ccc
```

Menu: RS-232

Function Name: XON/XOFF

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to enable or disable Xon/Xoff flow control.

Parameters: Xon/Xoff Flow Control (ccc): May be set to ON (enabled) or OFF (disabled).

RS-232 Echo (ECHO)

Format:

```
F1:ESC        F4:SET
RS232 ECHO ENABLE = ccc
```

Menu: RS232

Function Name: ECHO

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to enable or disable character echo on the RS-232 port. When enabled, the instrument will "echo" (that is, transmit back to the controller) each character that it receives on the RS-232 port.

Parameters: RS-232 Echo Enable (ccc): May be set to ON or OFF.

GPIB

Format:

```
F1:ESC        F4:SET
TERMINATOR = cccccc
```

Menu: Selected from "main" Menu.

Function Name: GPIB

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use to select the GPIB end-of-line termination character or characters.

Parameters: GPIB End-of-Line Terminator (cccccc): May be set to EOI or EOI/LF.

External Clock Term. (CLOCK)

Format:

```
F1:ESC      F4:SET
EXT CLOCK TERM: ccc
```

Menu: Selected from the Generator main Menu.

Function Name: CLOCK

Instruments: Generator only

Options: None required. This is a standard feature.

Application: Use this function to select a termination for the Generator external clock (INPUT) input.

Parameters: External Clock Termination (ccc): May be set to GND or -2V

Utility Option (OPTION)

Format:	**F1 : ESC** **(options listed here)**
Menu:	UTIL
Function Name:	OPTION
Instruments:	Analyzer and Generator
Options:	None required. This is a standard feature.
Application:	Use this function to see which options are installed in your Analyzer or Generator.
Parameters:	None. This is an immediate function.

Utility Version (VER)

Format:

F1 : ESC
(software version listed here)

Menu: UTIL

Function Name: VER

Instruments: Analyzer and Generator

Options: None required. This is a standard feature.

Application: Use this function to see the software version installed in your unit.

Parameters: None. This is an immediate function.

Date (DATE)

Format:

```
F1:ESC F2<- ->F3 F4:SET
DATE = mmm dd yy
```

Menu: Selected from main Menu.

Function Name: DATE

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use to set the Analyzer's internal date function.

Parameters: Month (mmm): Set in range JAN, FEB, ..., DEC
Day (dd): Set in range 01, 02, ..., 31
Year (yy): Set in range 93, ..., 99

Notes: End-of-Test reports are date and time stamped.

Time (TIME)

Format:

```
F1:ESC F2<- ->F3 F4:SET
TIME = hh:mm:ss
```

Menu: Selected from main Menu.

Function Name: TIME

Instruments: Analyzer only

Options: None required. This is a standard feature.

Application: Use this function to set the instrument's 24-hour internal clock.

Parameters: Hours (hh): Set in range 00 - 23
Minutes (mm): Set in range 00 - 59
Seconds (ss): Set in range 00 - 59

Notes: The Analyzer clock uses a 24-hour format.