Errata

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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Agilent Technologies

HP 71600B Series of Gbit/s Testers

Operating Manual

SERIAL NUMBERS

This manual applies directly to:
HP 70841B 0.1-3 Gbit/s Pattern Generator with serial number(s) prefixed 3136U.
HP 70842B 0.1-3 Gbit/s Error Detector with serial number(s) prefixed 3136U. For important information about serial numbers, refer to SERIAL NUMBER INFORMATION in the HP 71600B Series Installation and Verification manual. Serial number information for other elements in the system is contained in the following manuals:
Display - see HP 70004A Installation and Verification Manual
Mainframe - see HP 70001A Installation and Verification Manual Clock Source - see HP 70311A/70312A Operating and Calibration Manual

HP Part No. 71600-90004
Microfiche Part No. 71600-90029
Printed in U.K. June 1992

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WARNING

READ THE FOLLOWING NOTES BEFORE INSTALLING OR SERVICING ANY INSTRUMENT.

1. IF THIS INSTRUMENT IS TO BE ENERGISED VIA AN AUTO-TRANSFORMER MAKE SURE THAT THE COMMON TERMINAL OF THE AUTO-TRANSFORMER IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.
2. THE INSTRUMENT MUST ONLY BE USED WITH THE MAINS CABLE PROVIDED. IF THIS IS NOT SUITABLE, CONTACT YOUR NEAREST HP SERVICE OFFICE. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).
3. BEFORE SWITCHING ON THIS INSTRUMENT:
   a. Make sure the instrument input voltage selector is set to the voltage of the power source.
   b. Ensure that all devices connected to this instrument are connected to the protective (earth) ground.
   c. Ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient).
   d. Check correct type and rating of the instrument fuse(s).

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Printing History

The Printing History shown below lists all Editions and Updates of this manual and the printing dates(s). The first printing of this manual is Edition 1. The Edition number increments by 1 whenever the manual is revised. Updates, which are issued between Editions, contain replacement pages to correct the current Edition of the manual. Updates are numbered sequentially starting with Update 1. When a new Edition is created, it contains all the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this printing page. Many product updates or revisions do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition 1 (71600-90004)	February 1992
Edition 2 (71600-90004)	June 1992

DECLARATION OF CONFORMITY

Manufacturer's Name: Hewlett-Packard Limited
Queensferry Telecommunications Division

Manufacturer's Address: South Queensferry
West Lothian
Scotland EH30 9TG

declares, that the product

Product Name : 3 GBit Error Performance Analyser

Model Number: 71603B

consisting of:
HP 70004A Display
HP 70001A Mainframe
HP 70841B Pattern Generator
HP 70842B Error Detector
HP 70311A Clock Source
HP 15680A Accessory Kit

conforms to the following Product Specifications:

Safety: IEC 348 (1978)
CSA Bulletin 556B (1973)

EMC: EN 55011 (1991) Group 1, Class A
EN 50082-1 (1991)

South Queensferry, Scotland	5 Mar 92	W R Pearson
Location	Date	W.R. Pearson/Quality Manager

5955-2395

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General Information

Documentation Description

The following manuals are provided with the HP 71600B Series Error Performance Analyzer and Pattern Generator Systems.

Operating Manual

This manual gives information on how to operate the Error Performance Analyzer System and Pattern Generator Systems. (Part number 71600-90004).

Installation and Verification Manual

Topics covered by this manual include installation, specifications, verification of instrument operation, and troubleshooting techniques. (Part number 71600-90005).

Programming Manual

Provides information to operate the HP 71600B Series Systems remotely. (Part number 71600-90006)

HP 70004A Graphics Display

Operating Manual (Part number 70004-90031)
Installation and Verification Manual (Part number 70004-90005)

HP 70001A Mainframe

Installation and Verification Manual (Part number 70001-90021)

How To Use This Manual

Introduction

This manual comprises eight self contained chapters providing all the information necessary to switch-on and confidently operate the HP 71600B Series Error Performance Analyzer and Pattern Generator Systems.

If you are new to the HP 71600B Series Systems and unfamiliar with their operating concept, you may wish to read Chapter 2 Getting Started, and key in the examples shown.

The following paragraphs describe each of the chapters and appendixes in this Operating Manual. Read through these paragraphs to acquaint yourself with the organization of the manual prior to using your new HP 71600B Series System.

Chapter 1: General Information

This chapter describes the various instruments/modules in the system and lists the documentation provided with each system.

Chapter 2: Getting Started

The Getting Started chapter is designed to help the first time user. This chapter describes how to turn-on the system, explains the softkey concept, using the display, and how to make your first measurement.

Chapter 3: Softkey Menu Maps

This chapter gives maps illustrating the softkey menus for all instrument functions.

Chapter 4: Softkey Menu Descriptions

This chapter is intended to be used as a reference chapter, as it lists all the user selectable functions/parameters that may be selected using the softkeys.

Chapter 5: Operating Features

This chapter explains many of the features of HP 71600B Series Systems and also includes some user applications.

Chapter 6: User Patterns and Disc Operation

This chapter explains how to load, edit and store user patterns. Information is also given on disc operation.

Chapter 7: Data Logging

This chapter explains how to log measurement results to an external printer.

Chapter 8: Front Panel Controls

This chapter explains the operation of user hardkeys, and front/rear panel controls and connectors.

Appendixes

These chapters include information on instrument preset configurations, measurement definitions, error messages, operating notes and display compatability.

HP 71600B Series of Error Performance Analyzers and Pattern Generators

Introduction

The HP 71600B Series modular 3 Gbit Error Performance Analyzer and Pattern Generator offers a new, flexible approach to high speed testing.

Two modular measurement products are offered:

The HP 71603B provides complete solutions for error performance analysis to 3 Gbit/s.

The HP 71604B is a high-performance pattern generator operating to 3 Gbit/s.

Both products include the HP 70004A color display and the HP 70001A mainframe.

The differences in the products are shown in the following table.

	Error Performance Analyzers	**Pattern Generators**
	HP 71603B 100 Mbit/s to 3 Gbit/s	**HP 71604B 100 Mbit/s to 3 Gbit/s**
Color Display	HP 70004A	HP 70004A
Mainframe	HP 70001A	HP 70001A
Pattern Generator Module	HP 70841B	HP 70841B
Error Detector Module	HP 70842B	-
Clock Source Module	HP 70311A	HP 70311A

Both HP 71600B Series products can be adapted by, for example, adding extra modules. A test solution can also be built which includes modules in almost any combination.

General Information

Remote Control

HP-IB Interface and Capability:

Operates according to IEEE standard 488.1 and 488.2, 1987. Also conforms, where appropriate, to the Standard Commands for Programmable Instruments (SCPI) standard 1990.0

Capability:

SH1,AH1, T6, TEO, L4, LEO, SR1, RL1, PP0, DC1, DT0, C1, C2, C3, C28.

Modes:

Addressable or Controller.

Addressable:

An external Controller has access to all the current results, status and alarms and can control all module functions except HP-IB, HP-MSIB addresses and power switch. An HP 71600B Series System cannot be configured as a Controller over HP-IB by a Controller.

Controller:

The HP 70842B error detector module can print results using an external printer over HP-IB without an external Controller.

Power Requirements

Voltage Range:

Selectable 100, 120, 220 and 240 V ac (±10%) nominal.

Frequency Range:

44 to 66 Hz and 400 Hz nominal.

Power Consumption:

HP 71604B or HP 71603B: 1000 VA max.
All module power requirements are supplied by the mainframe or display.

Environmental

Operating Temperature Range:

0°C to 45°C.

Storage Temperature Range:

-40°:C to +65°:C.

Humidity:

Operation 15% to 95% relative humidity at 40°C, non-condensing.

EMC:

Conducted and Radiated interference is in compliance with CISPR Pub 11, FTZ 526/1979, and MIL-STD 461B RE02/part 7.

Noise:

LpA < 70 dB	LpA < 70 dB
operator position	am Arbeitsplatz
normal operation	Normaler Betrieb
per ISO 7779	nach DIN 45635 T. 19

Calibration Interval:

Recommended one year.

Options

Option 100:	Delete HP 70311A or HP 70312A clock source module
Option 200:	Delete HP 15680A RF accessory kit.
Option 910:	One additional set of Operating, Verification and Installation manuals.
Option 908:	484 mm (19 in) rack mount kit for equipment without front handles fitted.
Option 913:	484 mm (19 in) rack mount kit for equipment with front handles fitted.
Option +W30:	Two years additional hardware support beyond the standard one year warranty.

Ordering Information

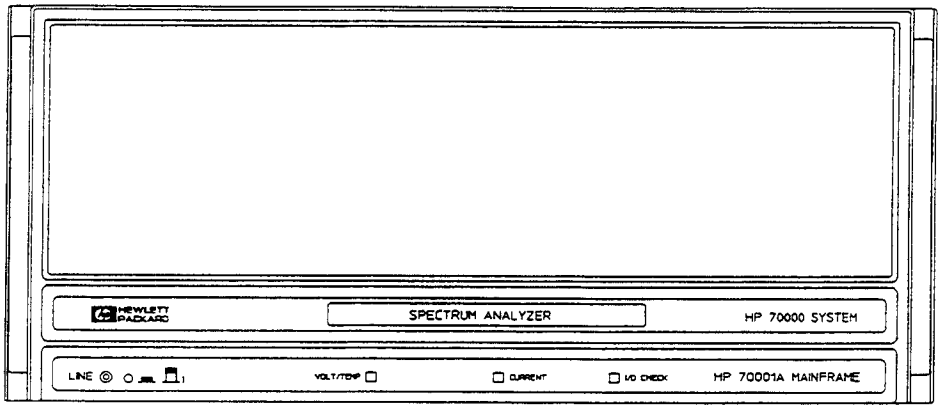
For advice on how to order individual instruments, modules, accessories or manuals refer to the HP 71600B Series Technical Data Sheet (HP Part number 5091-2911E).

Instrument and Module Descriptions

Introduction

An explanation is given here of the mainframe, display and modules that comprise an HP 71600B Series Error Performance Analyzer or Pattern Generator system. For detailed information on the HP 70001A mainframe and HP 70004A display refer to the Operating manuals provided with these instruments. The instruments and modules are described individually, rather than as part of a system.

HP 70001A Mainframe

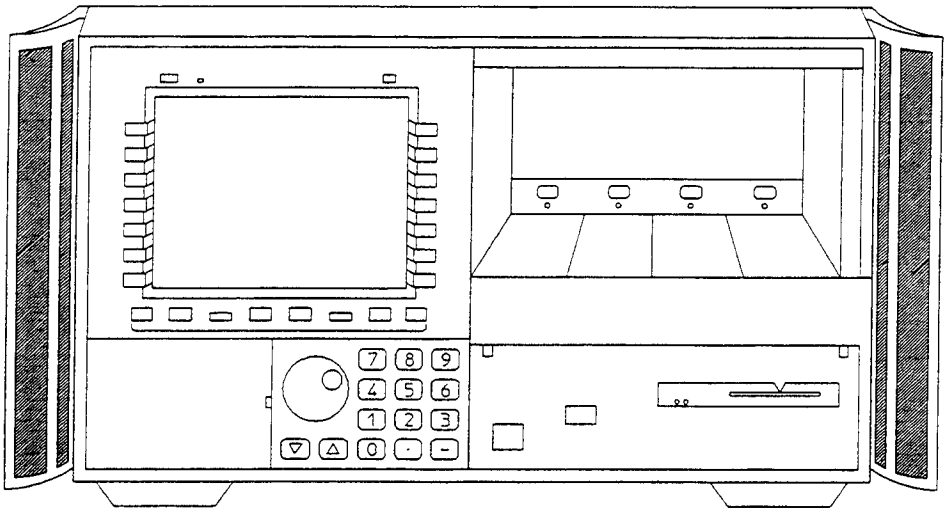


Description

The HP 70000 Modular Measurement System mainframe provides the structural environment for plug-in instrument modules along with cooling, power, and digital communication bus interface. It is compatible with 1/8, 1/4, 3/8 and 1/2 width modules and has a maximum capacity of eight one-section (1/8 width) modules. Rack compatibility is provided and benchtop use is facilitated with integral bails and optional handles.

Two digital control buses are provided: HP-IB for remote operation in automatic test applications, and a new high performance bus called (Module System Interface Bus) for intermodule communication. The mainframe has good EMC performance (MIL-STD 461B) and has been designed to withstand the rigors of tough, industrial environments. It provides a solid, reliable base around which error performance analyzer systems may be easily configured.

HP 70004A Graphics Display



Description

The HP 70004A display provides a graphic display and menu-driven interface for the HP 70000 Modular Measurement System. The display section of the HP 70004A fulfills the same function as the HP 70206A system graphics display or the HP 70205A graphics display module. The mainframe section of the display also provides the structural environment for plug-in instrument modules along with cooling, power, and digital communication interface buses.

The display shows system configuration information, measurement results, text, graphics, and built-in trace in up to 16 simultaneous colors (selectable from a palette of 4096 colors) at a resolution of 1024 horizontal by 400 vertical pixels. Menu keys are used to establish an interactive front panel for any modular instrument. A 7.5 inch diagonal display screen, menu keys, data and control keys, and a digital knob assist system operation. The display may be stacked or racked with the HP 70001A system mainframe or located remotely away from the rest of the system.

The displays mainframe can accommodate 1/8, 1/4, 3/8, and 1/2 width modules, and has a maximum capacity of four 1/8-width modules. Standard rack compatibility is provided, and bench-top use is enabled with retracting bails and built-in handles.

The HP-MSIB supports high-speed digital communications between modules within the display and instruments connected to the external HP-MSIB loop.

Every module in the display has access to the standard Hewlett-Packard Interface Bus (HP-IB). This bus provides a path of communication among controllers, other HP-IB instruments, and individual modules. The ac power input is switchable between several ranges.

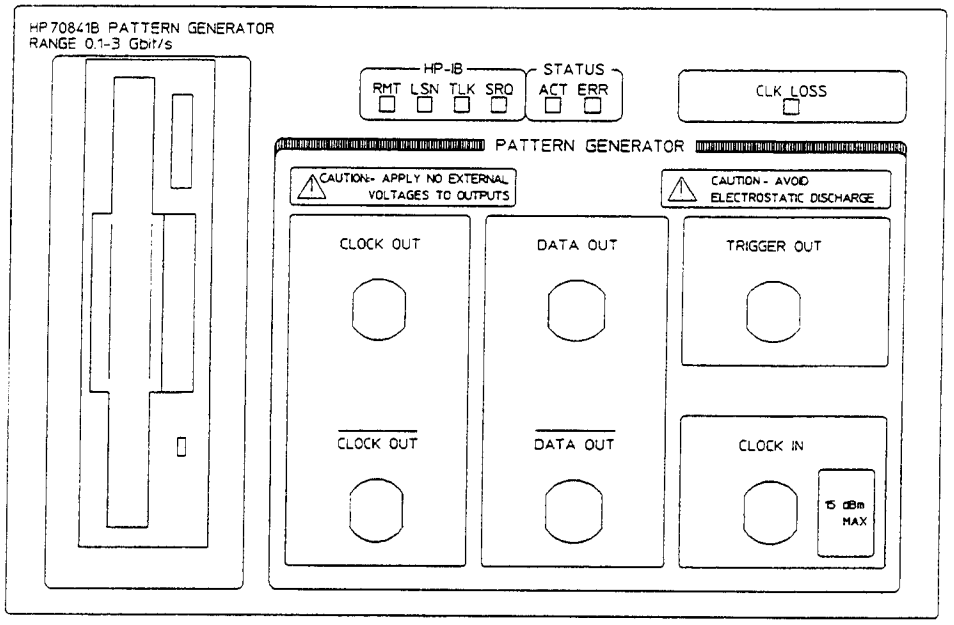
- 87-132V ac, 47-66 Hz
- 174-264 Vac, 47-66 Hz
- 87-132 V ac, 356-444 Hz

The display power supply processes the ac line power to produce regulated 40 kHz ac power for the modules, 5V dc for the HP-MSIB, dc power for the cooling fan, and a TTL-compatible line synchronization signal.

A fan provides cooling for both the display and up to four 1/8-width modules.

Note: The memory card shipped with the HP 70004A display can not be used with the HP 71600 Series Error Performance Analyzer or Pattern Generator systems.

HP 70841B Pattern Generator



Description

The HP 70841B pattern generator module in Hewlett-Packard's Modular Measurement System (MMS) occupies a 4/8 module slot and has eight Input/Output ports, six on the front panel and two on the rear panel. A floppy disc drive enables the user to store user defined patterns up to 4 Mbits in length.

Specifications

The following gives an abbreviated version of pattern generator module specifications; refer to the HP 71600B Series Installation and Verification manual for detailed specifications.

Operating Frequency Range

HP 70841B: 100Mbit/s to 3 Gbit/s

Patterns

The following test patterns are provided:

PRBS Test Patterns:

- 2^{31}-1, polynomial $D^{31}+ D^{28}+1=0$, inverted.
- 2^{23}-1, polynomial $D^{23}+ D^{18}+ 1=0$, inverted (as in CCITT Rec 0.151).
- 2^{15}-1, polynomial $D^{15}+ D^{14}+ 1=0$, inverted (as in CCITT Rec 0.151).
- 2^{10}-1, polynomial $D^{10}+ D^{7}+ 1=0$, inverted.
- 2^{7}-1, polynomial $D^{7}+ D^{6}+ 1=0$, inverted.

Zero Substitution/Variable Mark Density Test Patterns

- 8192 bits, based on 2^{13}-1 PRBS;
- 2048 bits, based on 2^{11}-1 PRBS;
- 1024 bits, based on 2^{10}-1 PRBS;
- 128 bits, based on 2^{7}-1 PRBS;

Zero Substitution

Zeros can be substituted for data to extend the longest run of zeros in the above patterns. The longest run can be extended to the pattern length, minus one. The bit after the substituted zeros is set to 1.

Variable Mark Density

The ratio of 1s to total bits in the above patterns can be set to 1/8, 1/4, 1/2, 3/4 and 7/8.

Word Test Patterns

Variable length user patterns from 1 to 4194304 bits are provided.
Resolution from:
1 to 32 kbits in 1-bit steps.
32 kbits to 64 kbits in 2 bit steps
64 kbits to 128 kbits in 4 bit steps
128 kbits to 256 kbits in 8 bit steps
256 kbits to 512 kbits in 16 bit steps
512 kbits to 1 Mbits in 32 bit steps
1 Mbits to 2 Mbits in 64 bit steps
2 Mbits to 4 Mbits in 128 bit steps

Pattern Stores

Four internal user pattern stores capable of holding up to 8192 bits, and eight disc pattern stores capable of storing up to 4 Mbits of data are provided.

Alternating Word Test Patterns

Alternate between two user-programmable 16-bit words under the control of the rear-panel Auxiliary input; changeover is synchronous with the end of the word.

Alternate Patterns

Switch between two patterns (A and B) with the switch occurring at the end of a pattern. There are two modes of operation as follows:

- Switch between two data patterns (A and B), for example from (A to B) or (B to A).
- Enable a single insertion of a number of instances of pattern B to be output. The number of *B* instances is equal to the smallest integral multiple of the pattern length, that divides exactly by 128.

Patterns A and B must be as follows:

- The same length.
- 1 bit to 2 Mbits in length.

Resolution

1 bit to 16 kbits in 1 bit steps
16 kbits to 32 kbits in 2 bit steps
32 kbits to 64 kbits in 4 bit steps
64 kbits to 128 kbits in 8 bit steps
128 kbits to 256 kbits in 16 bit steps
256 kbits to 512 kbits in 32 bit steps
512 kbits to 1 Mbits in 64 bit steps
1 Mbits to 2 Mbits in 128 bit steps

Add Errors

Single errors or fixed error rates from one error in 10^9 bits to one error in 10^3 bits may be added to the data. External errors may be input to the data via the rear panel ERROR INJECT port.

Error Inject

The rear panel ERROR INJECT input adds a single error to the data output for each rising edge (TTL levels) at the input.

Trigger Pulse

When a pure PRBS is selected (2^{n-1}), the TRIGGER OUTPUT produces a pulse which is either synchronized to the pattern (Pattern mode) or is the input clock divided by 32 (Clock/32 mode).

In PATTERN mode the trigger pattern that the user has entered is matched to the pattern being generated and a trigger pulse is output when the two correspond. If an alternating - word pattern is selected the trigger output pulse is either a regenerated version of the rear panel *AUX* input, which is used to switch between the words or the input clock divided by 32.

Trigger Pattern for Zerosub PRBS, Mark Density PRBS, or User Pattern

When either of the above patterns are selected the trigger pattern is selected with the `TRIGGER BIT` softkey, and can be set anywhere within the pattern.

Alternate Pattern Trigger

When an alternate pattern is selected, the user can select between a trigger pulse synchronized to the input or one pulse per pattern.

Frequency Measurement

Measure the incoming clock frequency to five significant digits. If an integral MMS clock source is used (for example HP 70311A or HP 70312A) then the frequency set up on this clock is displayed to ten significant digits.

Status Indicators

Front Panel LEDs:

Clock Loss: Indicates nominal low clock power at Clock Input.
HP-IB and HP-MSIB: Six LEDs indicate status.

Clock Input/Output and Data Output

Specifications for the Clock Input, Data Output and Clock Output ports, and Trigger Output are given in the HP 71600B Series Installation and Verification manual.

AUX INPUT

Introduction

The rear panel AUX INPUT port can be used to control alternate patterns, alternate words or inhibit data. The following paragraphs explain each mode of operation.

Auxiliary Input Control of Alternate Patterns

Path

(MENU) `select pattern` `user pattern` `ALT PAT CONTROL` `SOURCE AUX USR`

When `ALT PAT CONTROL` and `SOURCE AUX` are selected the instrument will output one of two patterns (A or B). The setting of the `OUTPUT ALT ONCE` softkey, and the signal at the rear panel AUX INPUT control which pattern is output in one of two modes as follows:

- `ALT` selected: The logic state of the signal at the AUX INPUT determines which pattern is output. A logic zero will output pattern A.
- `ONCE` selected: The rising edge of a signal (pulse width >100 ns) at the AUX INPUT causes a number of instances of pattern B to be output. The number of pattern B instances is equal to the smallest integral multiple of the pattern length that divides exactly by 128.

Note 

In both modes switching between patterns is at the end of a pattern and is hitless or error free.

Auxiliary Input Control of Alternate Words

Path

(MENU) select pattern, more 1 of 3, alt words

In Alternate Word mode two user-definable sixteen bit words, WORD 0 and WORD 1 are generated. The rear panel AUX input is used to switch between WORD 0 and WORD 1 at the end of either pattern. A TTL level signal is necessary at the AUX input to switch between words, TTL low selects WORD 0 and TTL high selects WORD 1.

If Alternate Word is selected and there is no input signal present at the AUX input, WORD 1 is selected. The following figure illustrates how the AUX input signal switches the Data Output between WORD 0 and WORD 1, and also gives the position of the Pattern Trigger Output pulse relative to the AUX input signal.

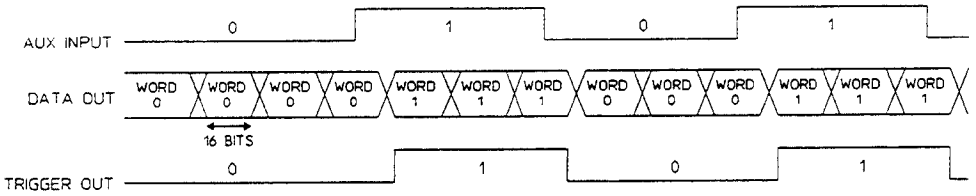


Figure 1-1. AUX Input Timing Diagram

Data Output Inhibit

If neither an alternate pattern nor an alternate word are selected, the data output pattern is gated to zero when the AUX INPUT signal is active (TTL low). See figure 1-2.

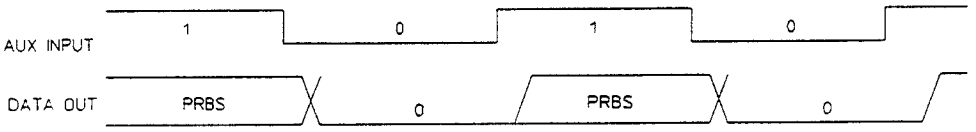
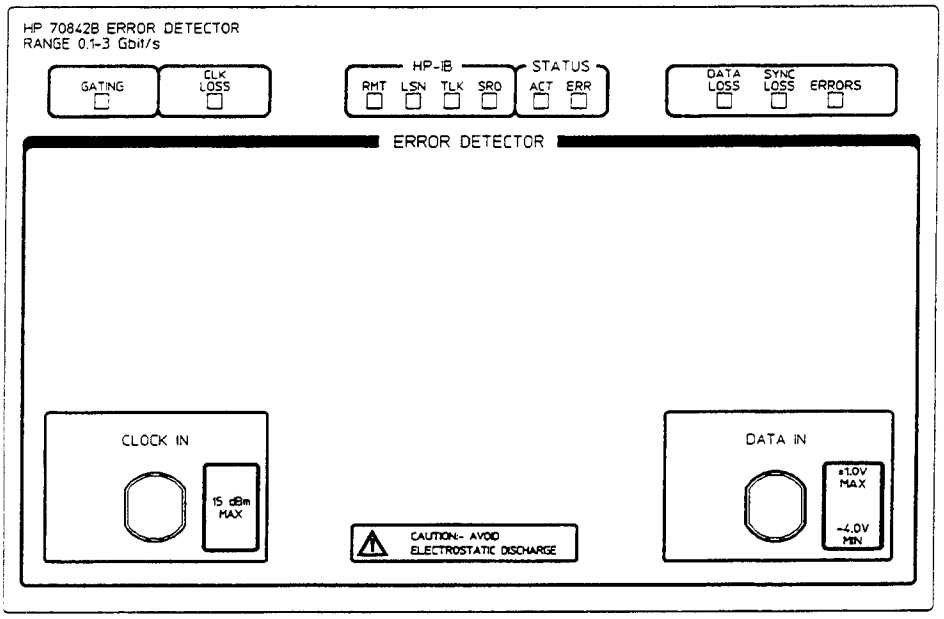


Figure 1-2. Data Output Inhibit

HP 70842B Error Detector



Description

The HP 70842B error detector module complements the pattern generator module.

The HP 70842B occupies 4/8 MMS module slot and has five Input/Output ports, two on the front panel and three on the rear panel.

Specifications

The following gives an abbreviated version of the error detector module specifications; refer to the HP 71600B Series Installation and Verification manual for detailed specifications.

Operating Frequency Range:

HP 70842B: 100Mbit/s to 3Gbit/s.

Patterns

PRBS, zero substitution/variable mark density test patterns, and word test patterns are as specified for pattern generator modules.

Error Measurements

The Error Detector counts bit errors by comparing the incoming data bit-by-bit with the internally generated reference pattern. All measurements run during the gating periods, with the exception of Delta Error Count and Delta Error Ratio which run continuously. The measurements performed are:

- Error Count
- Delta Error Count
- Error Ratio
- Delta Error Ratio
- Errored Intervals (second, decisecond, centisecond, millisecond)
- Error Free Intervals (second, decisecond, centisecond, millisecond)
- Error Count 0 → 1
- Error Count 1 → 0
- Error Ratio 0 → 1
- Error Ratio 1 → 0

Error Analysis

The error analysis measurements are based on CCITT Rec G.821 and derived from the bit error results.

- %Unavailability
- %Availability
- %Errored Seconds
- %Severely Errored Seconds
- %Degraded Minutes

Power-loss Seconds

Displayed as the number of seconds the error detector is not able to perform measurements during a gating period due to ac-power-loss. The gating continues to the end of the selected period following restoration of power.

Frequency Measurement

The incoming clock frequency is measured and displayed to five significant digits.

Measurement Definitions

Refer to Appendix B for definitions of measurements performed by HP 71600B Series Systems.

Measurement Period

Real-time Clock:

Provides time and date information for event logging. Battery back-up allows clock to continue running when the instrument is switched off or power fails.

Gating Periods:

There are three gating (measurement timing) modes: Manual, Single and Repeat.

Manual:

Gating period is controlled by the Run/Stop Gating keys. Accumulating results are displayed throughout the measurement and the end of measurement results are held until a new gating period is started.

Single:

Gating period is started by pressing the `RUN GATING` softkey and terminates at the end of the gating period set by the user or when the `STOP GATING` softkey is pressed. Accumulating results are displayed throughout the gating period and the end of gating results are held until a new gating period is started.

Repeat:

Similar to Single but when one timed gating period ends, a new identical period starts. This continues until the measurement is terminated by pressing the Stop Gating key. The measurement results displayed during any period can be the final results of the previous period or the accumulated results for the current period. There is no *deadtime* between consecutive periods.

Gating Period Format

The gating period format can be specified in one of three modes.

- A time period ranging from 1 second to 99 days, 23 hours, 59 minutes, 59 seconds, (resolution 1 second).
- The time for a number of errors to occur, (resolution 1 second). The number of errors can be 10, 100 or 1000.
- The time for a number of bits to be received, (resolution 1 second). The number of bits can be in the range 1E7 through 1E15 in decade steps.

Results summary can be logged to an external printer over HP-IB at the end of each consecutive period.

Gating after a Power Loss

On instruments configured for Master/Slave operation and with AUTO sync selected, gating will restart after a power loss in the following manner.

ON regaining power after a power loss the error detector will attempt to regain sync for approximately 25 seconds.

- If sync is regained within 25 seconds gating will restart immediately.
- If after 25 seconds has elapsed and sync has not been regained, gating is forced to start.

Gating Period Elapsed % Display

This display shows the percentage of gating period which has elapsed (time, errors or bits). When gating by errors or bits, it is a feature of the error detector that the displayed value can be greater than 100%. This arises because the gating period is only completed at 1 second boundaries. If the error or bit threshold is exceeded before the next 1 second boundary occurs then one of the following will be displayed:

Condition	Display
Threshold $\leq$ Count $<10 \times$ Threshold	100 to 999
Count $\geq 10 \times$ Threshold	*****

ERROR OUTPUT

The rear panel ERROR OUTPUT port produces an NRZ output pulse when errors occur.

Pattern Synchronization

Synchronization to the incoming pattern can be performed automatically or manually. In manual mode, the Sync Start key forces the error detector to attempt synchronization with the received pattern.

Sync Gain/Loss Criteria:

Synchronization is gained when the measured error rate is less than the set sync threshold. Synchronization loss occurs when the measured error rate exceeds the selected sync threshold. Selectable thresholds between 1×10^{-1} and 1×10^{-8} are provided.

Sync Gain Times

For most RAM based patterns synchronization should occur in approximately 2 to 3 seconds. However synchronization times are dependent on pattern length and pattern content, and will increase as pattern length increases. For very long patterns (for example 4 Mbits) times could be of a minute or more.

Clock and Data Inputs

Refer to the HP 71600B Series Installation and Verification manual for detailed specifications for these inputs.

ERROR COUNT INHIBIT (on rear panel)

An ECl (active high) signal present at the input will inhibit the error counting of errors in the instrument for a multiple of 16 clock periods.

TRIGGER OUTPUT (on rear panel)

The trigger output pulse is synchronous with the error detector reference pattern. For RAM based patterns the pulse position can change as follows following a resynchronization:

- The absolute position of the pulse can vary by 15 bits.
- The position of the trigger pulse relative to a pattern generator trigger can vary by a number of pattern lengths for patterns which are not a multiple of 128 bits.

Result Logging

Results can be logged to most standard HP-IB 80 column printers. There are two modes of operation; with and without an external controller.

With an external controller, information on results, status and alarms is provided for the controller.

Without an external controller, the error detector module can be set in controller mode to permit output of results, status and alarms to an external printer or other logging device.

Print Modes

Two modes are provided:

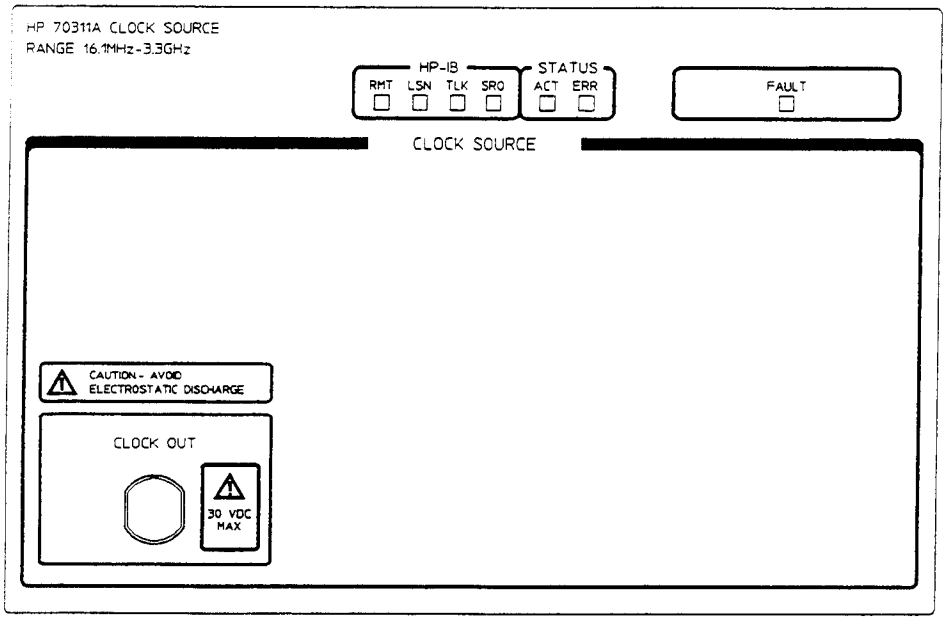
On-Demand:	Prints time-of-day and selected set of results when `Log On Demand` key is pressed.
Gating:	Logs time-stamped events during gating and/or a user selected summary of measured results and alarm durations at the end of each gating period. A conditional printing trigger can be set so that printing occurs only on errors or error ratios exceeding a value selected by the user.

Status Indicators

Front Panel LEDs:

Gating:	Signifies measurements in progress.
Clock Loss:	Indicates nominal low clock power at Clock Input.
Data Loss:	Indicates no transitions in the last decisecond. Under certain circumstances, this LED will not be illuminated when there is no signal connected to the DATA IN port. With no input, 'auto-threshold' sets the input 0/1 threshold to the mean of the idle input. Noise is seen as valid transitions around that threshold. The Data Loss indicator is operative when 'manual threshold' is selected and the 0/1 threshold level altered from the 'auto-threshold' mean value.
Sync Loss:	Illuminated in accordance with sync gain/loss criteria as specified.
Errors:	Indicates one or more data errors in the last decisecond.
HP-IB/MSIB:	Six LEDs indicate status.

HP 70311A/HP 70312A Clock Source Modules



Description

The HP 70311A and HP 70312A modules are synthesized clock sources designed to operate from 16 to 3300 MHz and 16 to 1500 MHz respectively. Both modules are part of the Hewlett-Packard Modular Measurement System (MMS) and may be used as a clock source for the HP 71600B Series of error performance analyzers and pattern generators, or any other MMS system with a suitable display (for example HP 70004A).

The clock source contains a non-volatile memory store which can be used to store and recall 10 user-definable instrument setups.

User Interface

The HP 70311A clock source does not itself have a display or keyboard capability. It formats information suitable for an MMS display and communicates with the display over the HP-MSIB interface. The HP 70312A clock source user interface is identical to the HP 70311A. The recommended display for use with the clock source is the HP 70004A.

Using Softkeys to Select User Functions

Clock source functions are set up using softkeys on either side of the display.

Specifications

The HP 70311A/HP 70312A clock source, Operating and Calibration manual (Part number 70311-90000) provides detailed information on specifications, installation and user operation.

2

GETTING STARTED

Getting Started

Introduction

The purpose of this chapter is to instruct first time users how to quickly become proficient at operating the HP 71600B Series error performance analyzers & pattern generators. The chapter is sub-divided to provide information for error performance analyzer and pattern generator systems configured for both master/slave and master/master operation. Save time by only referring to the sections in this chapter that apply to your system.

If You Have:

An HP 71603B error performance analyzer configured for master/slave operation; refer to pages 2-2 to 2-13.

If You Have:

An HP 71604B pattern generator system; refer to pages 2-2 to 2-7 and pages 2-15 to 2-18.

If You Have:

An HP 71603B error performance analyzer system; configured for master/master operation; refer to pages 2-2 to 2-7 and pages 2-14 to 2-19.

Note

Error performance analyzer systems are shipped from the factory configured for master/slave operation.

To Determine How Your System is Configured

Refer to Appendix D for information on how to determine how your system is configured.

Master/Master and Master/Slave Operation

Reference is made throughout this manual to master/master and master/slave operation; if this concept is new to you read the following brief explanation.

The HP 71600B Series error performance analyzers are normally configured for master/slave operation (error detector = master; pattern generator =submaster, clock source = slave). In certain applications it is desirable to configure the pattern generator and error detector as independent modules (masters). For example where you wish to set up different patterns in the pattern generator and error detector. In this case they would be configured in master/master mode.
Both pattern generator and error detector may be configured as a master, but only the pattern generator can be configured as a slave.

Master and Slave Elements

Master	An independent module having its own set of menus and softkeys.
Sub-Master	A module that can function as both master and slave at the same time. (Sub-masters are located at a Row Address other than 0, are controlled by another master, and may control a slave of their own.)
Slave	A module that is not independent; gives up its softkey menus and is controlled via a master module.
Master/Slave	One module is assigned as master and other modules in the system are considered as slaves. Modules are linked together to operate as one instrument, rather than separate modules.
Master/Master	Each module is an independent master and not controlled by any other module.

Note

Refer to the HP 71600B Series Installation and Verification Manual for information on how to configure modules for master/master or master/slave operation.

System Turn-On

Introduction

The getting started procedures assume that the HP 71600B series systems have been correctly installed and configured as described in the HP 71600B Series Installation and Verification Manual.

Warning

Before turning the system on, make sure it is grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact. Any interruption of the protective (grounding) conductor inside or outside the system, or disconnection of the protective earth terminal , can result in personal injury.

Caution

Do not turn on the HP 71600B Series Systems until they have been configured and fused for the available line voltage, and safely connected to the power line (115V or 230V).

Caution

Do not attempt to replace or remove modules while the HP 71600B Series Systems are powered up as it may damage modules. Switch off the HP 70004A Display and HP 70001A Mainframe before replacing or removing modules.

Note

The HP 71600B Series Systems will not function correctly unless each instrument in the system is cabled correctly for HP-MSIB operation, and each instrument is powered up. Refer to the HP 71600B Series Installation and Verification Manual for information on cabling.

Operating the HP 71600B Series Error Performance Analyzers & Pattern Generators

Using the HP 70004A Display

The HP 70004A display serves as the *front panel* for instruments in the HP 71600B Series Systems, and as your window for viewing current system configuration and measurement results. The HP 70004A display has fourteen **softkeys**, (seven on each side of the screen) and a number of [FIXED LABEL] keys above and below the screen.

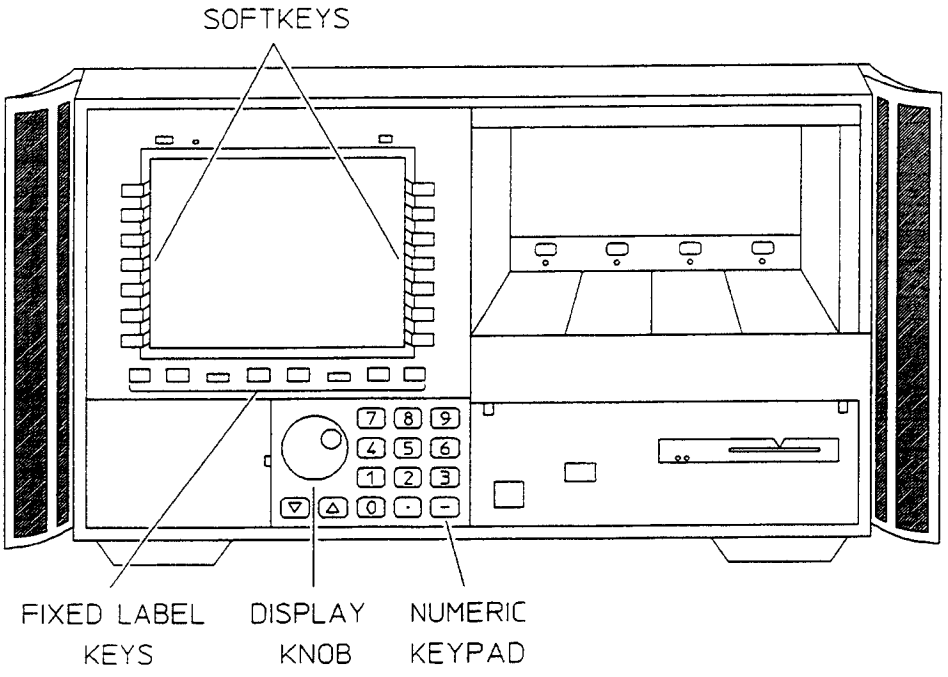


Figure 2-1. HP 70004A Display

Key Notation

Throughout this manual **softkey** indicates softkey labels and [FIXED LABEL] indicates fixed label keys.

Instrument Softkeys

The following description refers to instrument (pattern generator and error detector module) softkeys, refer to the HP 70004A Display Operating Manual for an explanation of display softkeys.

The fourteen softkeys are split into two columns of seven keys referred to as the left-menu and the right-menu. The keys in the left-menu are the *top level* keys and are used to select major functions or groups of functions. When a left-menu key is selected it is underlined. The right-menu keys are subordinate to the currently selected (underlined) left-menu key, and are used to select functions or parameters relevant to the left-menu selection. For example, if the left-menu **select pattern** softkey is selected, the right- menu softkeys enable the user to select from a choice of PRBS or user defined patterns.

Multi-State Functions

Some softkeys switch between two states, such as `LOGGING OFF ON` and `SYNC AUTO/MAN`. An underline on the key labels indicates which keys and conditions are selected.

Fixed Label Keys

Fixed Label keys select major system functions such as PRINT, PLOT, INSTR PRESET, DISPLAY or MENU. The two most important keys (DISPLAY) and (MENU), are explained in the following paragraphs. Refer to the HP 70004A display Operation Manual for detailed information on Fixed Label Keys.

Display Knob

Use the knob to change parameters and select other operating values.

Numeric Keypad

Use the numeric keypad to enter numeric values.

To Set Up the Display

To configure the system correctly it is important to first set up the display, and then configure the display to show instrument or module status. System functions are therefore split into two groups as follows:

- Display Functions
- Instrument Functions

These functions are explained in the following paragraphs.

Display Functions

Display functions are accessed using the (DISPLAY) fixed label key. Pressing the (DISPLAY) key provides the softkeys on the left and right of the display as shown below, enabling display functions to be set up. Refer to the HP 70004A display Operation Manual for detailed information on display operation softkeys.

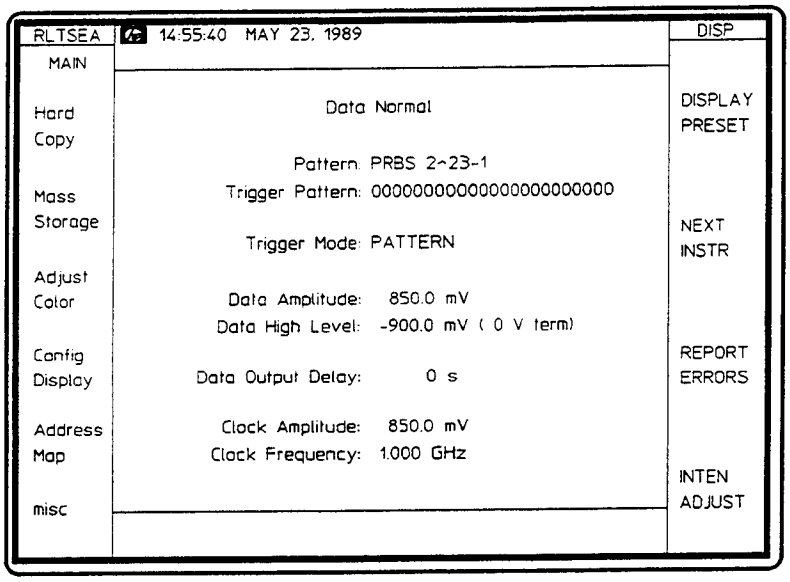


Figure 2-2. Display Softkeys

Instrument Functions

Instrument functions are accessed via the (MENU) fixed label key. Pressing the (MENU) key enables softkeys which give access to all instrument or module functions, as shown in the following figure for the error detector module selection.

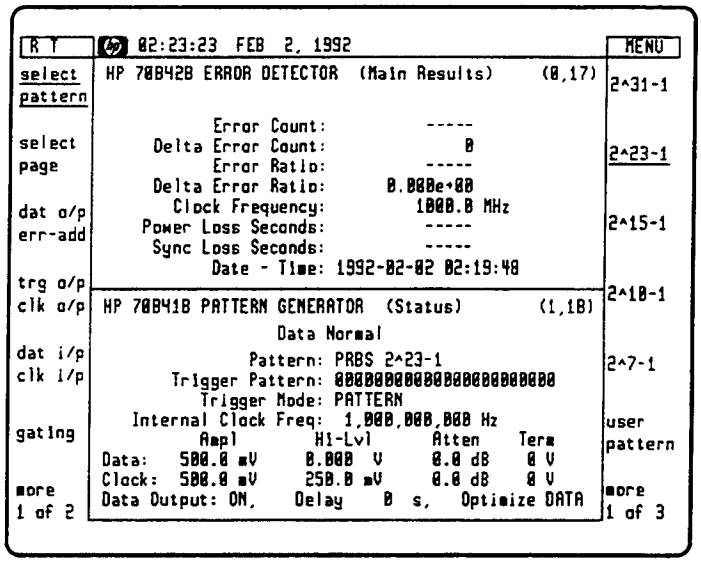


Figure 2-3. Instrument Softkeys for Master/Slave Operation

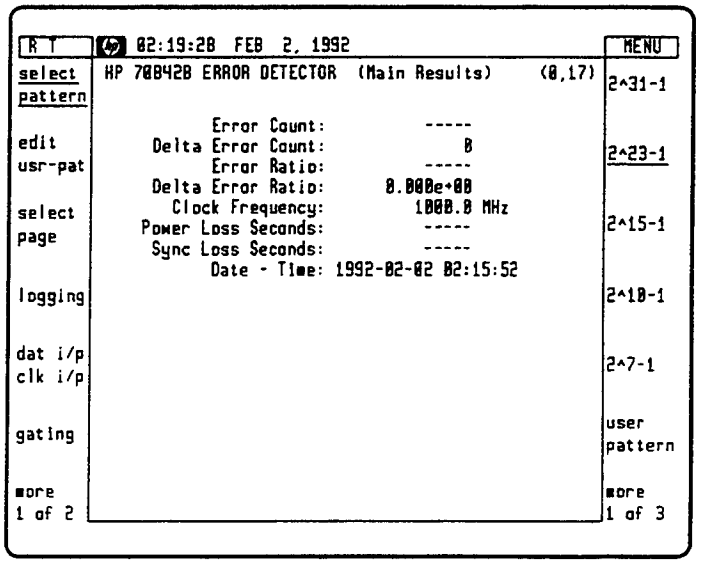


Figure 2-4. Instrument Softkeys for Master/Master Operation

Making Your First Measurement

Introduction

The following procedure is designed to give you confidence in using the Display (Fixed Label) keys and **Softkeys** by performing a simple error measurement. It shows you how to cable the system and set up the pattern generator and error detector modules to perform a simple back-to-back error measurement. The procedure also introduces you to many of the instrument operating features.

Note

It is assumed that the system is configured for master/slave operation. If your system is configured for master/master operation refer to the master/master procedure on page 2-14.

Procedure

Ensure that 50 ohm cables are used to connect the module IN/OUT ports. All the cables, adapters and terminations you need are contained in the HP 15680A RF Accessory Kit.

1. Connect the HP 70311A or HP 70312A clock source CLOCK OUT port to the pattern generator CLOCK IN port. Refer to the HP 70311A and HP 70312A Clock Sources Operating and Calibrating manual for advice on setting clock frequency. If you are not using an HP 70311A/HP 70312A clock source, connect a suitable external clock source to the CLOCK IN port.
2. Connect the pattern generator DATA OUT and CLOCK OUT ports to the error detector DATA IN and CLOCK IN ports respectively. Terminate any unused ports with 50 ohm terminations (HP part number 1250-2153). See figure 2-5. Ensure the HP 70001A mainframe and HP 70004A display rear-panel HP-MSIB ports are connected. Information on HP-MSIB cabling is given in the HP 71600B Series Installation and Verification manual.

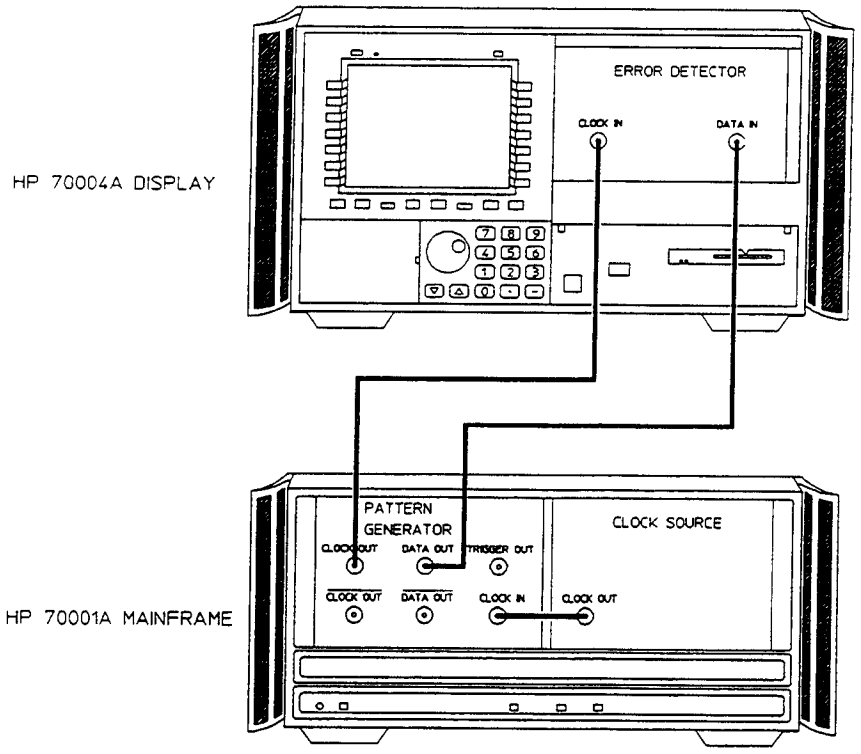


Figure 2-5. System Back-to-Back Connection

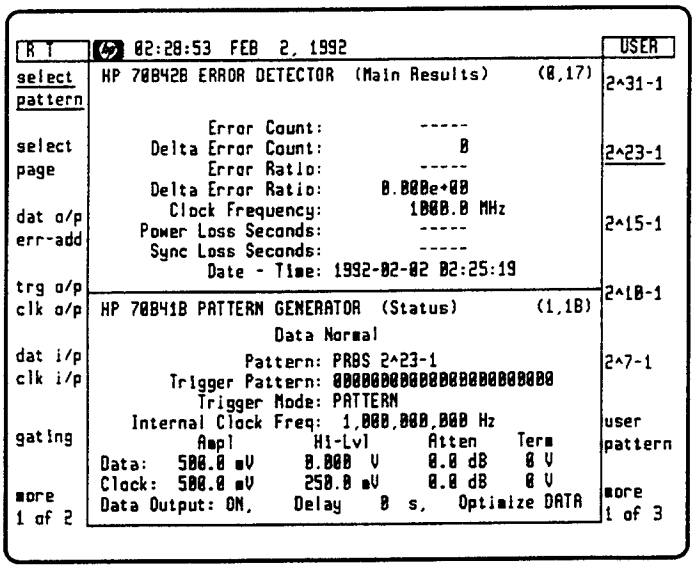
Initial Switch-On

3 Switch on power to the HP 70001A mainframe and the HP 70004A display. The mainframe I/O led and all display LEDS will illuminate and then extinguish after a few seconds. The display will cycle through a range of colors, give a display indicating *HP 70004A DISPLAY* and a message stating *For instrument display press DISPLAY then NEXT INSTR*, and finally display the status of the module selected before the last power down. The ACT LED on the module selected will be illuminated. Wait until the display settles to indicate module status before continuing with this procedure. If module status is not displayed press (DISPLAY) then **NEXT INSTR**.

Note Softkeys that are selected are displayed in inverse video or are underlined.

Setting the system to a known (default) state

4. Press the (MENU) key, then the green (INSTR PRESET) key. This sets the pattern generator and error detector modules to their default values. A list of default settings is given in Appendix A. The display should be as follows:



Automatic Clock-to-Data Alignment

This feature aligns the clock and data inputs such that the error detector samples in the middle of the *eye* (in the time axis). See page 5-23 for a more detailed explanation of clock-to-data alignment.

5. Press the left-menu `dat i/p clk i/p` softkey.

6. Press the right-menu `CLK-DAT ALIGN` softkeys. If clock-to-data alignment is successful a message *Clk-Data Aligned, Eye Width=***ps* is displayed at the bottom of the display.

To Select a Measurement Gating Period

7. Press the left-menu `gating` softkey. The gating mode currently selected is MANUAL (see right-menu), try selecting a 10 second SINGLE gating period.

8. Press `SINGLE` then `GATING PERIOD`, use the numeric keypad and `SECONDS` softkey to select a 10 second gating period. Proceed to step 9, or read the following note for alternative gating choices.

Note

The instrument is currently set to gate by time; two other gating period choices are also provided, they are: *gate by errors* and *gate by bits*. To select either of these gating choices select the following softkeys in the order given.

- Select the `more 2 of 2` right-menu, and select `GATE BY ERRS` or `GATE BY BITS`.
- Select the `more 1 of 2` right-menu and press `GATING PERIOD`.

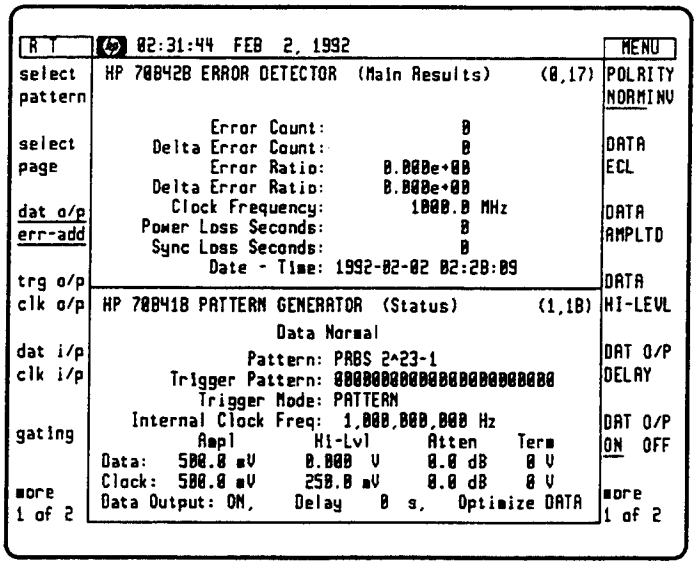
- Select the appropriate **ERRORS** or **BITS** softkey and press **EXIT**.

To Start a Measurement

9. Press the right-menu **RUN GATING** softkey. Note the illuminated *Gating* LED on the error detector module front panel and the *Gating* flag at the top left of the screen.

Viewing Results and Introducing Errors into the System.

10. Since there were no errors introduced into the system there are no errors measured. To introduce errors into the system and obtain a meaningful result proceed as follows:
11. Select the **dat o/p, err-add** left-menu softkey, the right-menu softkeys will change to the following:



12. Select the **more 2 of 2** right-menu, then press the **error add** softkey. Note that a new right-menu providing error add softkeys is displayed.

To Add Single Errors to the Data

13. Press the **ERR-ADD SINGLE** softkey.

To Select a Fixed Error Rate

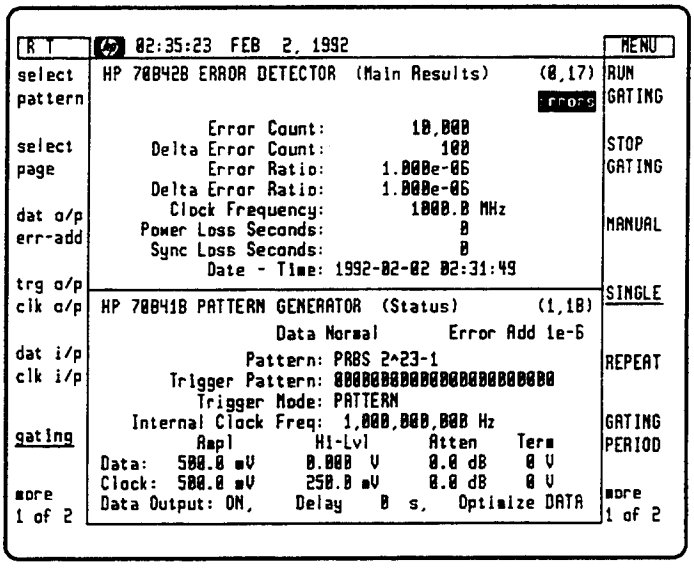
14. Select **ERR-ADD FIXED**, then **fixed rate** from the right-menu.
15. Select a fixed error rate from the menu displayed using the appropriate softkey. Press **EXIT**, then **EXIT** again to return to the main menu. The error rate selected will be displayed at the top right of the pattern generator display, and the error detector will have an Errors flag at the top right of the display.

To Add External Errors

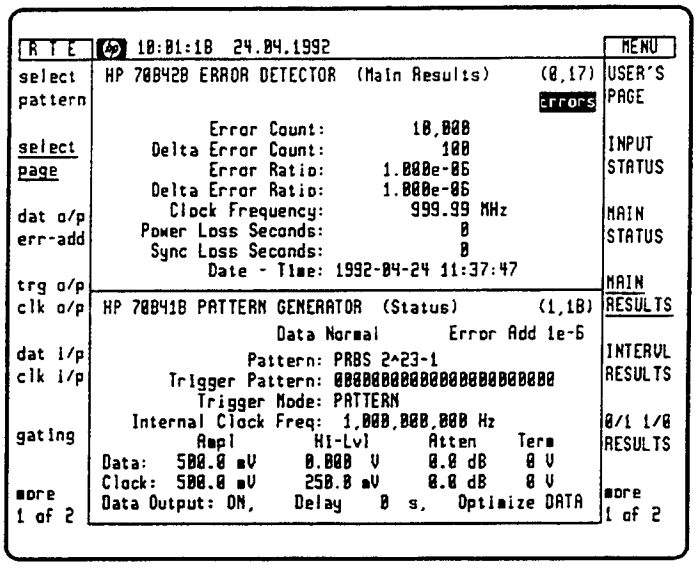
16. Connect an external error signal source to the pattern generator rear panel ERROR INJECT input. A single error is added to the data output for each rising edge at the input.

To Begin a New Measurement

17. Select the left-menu **gating** softkey, then press the right-menu **RUN GATING** softkey. Check the error detector (Main Results) at the end of the gating period. A typical results display is given in the following figure.



18. The error detector (Main Results) are displayed; this is only one of seven pages you may select to view error detector status or configuration. Press **select page**; note that the menu on the right of the display changes to the following:



19. Try selecting each of the right-menu softkeys and view the error detector display for each page.

This concludes your first measurement using an HP 71600B Series System.

Master/Master Configuration

Introduction

In certain applications it is desirable to configure the HP 71600B Series error detector and pattern generator as independent modules (HP-MSIB masters). For example where you wish to setup different patterns in the pattern generator and error detector.

Note

Full instructions on how to configure a module for master or master/slave operation is given in the HP 71600B Series Installation and Verification Manual.

Master/Master Softkeys

Only softkeys relevant to the module status currently shown are displayed.

The right-hand menus corresponding to a left-hand menu selection are unchanged from those in master/slave operation, except that in the error detector the alternate word pattern is not available from within the `select pattern` softkey.

Refer to Chapter 4 for a detailed description of pattern generator and error detector softkeys.

To Set Up an HP 71604B Pattern Generator

Introduction

All modules in the HP 71600B series systems are set up and configured using the seven softkeys on each side of the display screen. The following procedure explains how to use these softkeys to first display pattern generator status and then setup or configure the pattern generator. It is assumed that the module HP-MSIB and HP-IB addresses have already been set. Refer to the HP 71600B Series Installation and Verification manual for advice on setting addresses.

Note It is assumed that the pattern generator is configured for master/master operation.

Procedure

To Display Pattern Generator Status

1. View the Display screen. Is the pattern generator status displayed?

NO: Press the (DISPLAY) key, then the **NEXT INSTR** softkey. The display will cycle through the column address until the next instrument is enabled and displayed. Continue to press the **NEXT INSTR** key until the pattern generator status is displayed. Press the (MENU) key to display the pattern generator softkeys.

YES: Press the (MENU) key. The left-menu now displays the pattern generator softkeys. The right-menu gives the choices offered for the left-menu softkey that is selected (underlined).

2. Set the pattern generator to its default setting by pressing the green (INSTR PRESET) key. Check the display is similar to the following:

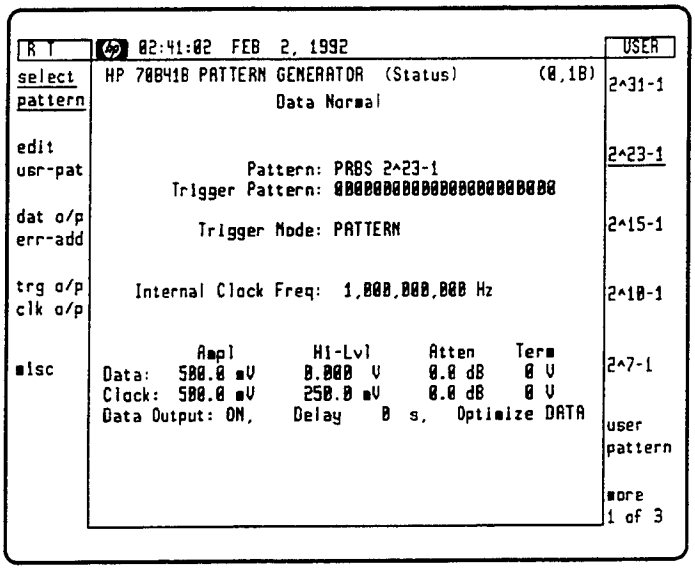


Figure 2-6. Pattern Generator Default Status

To Select a Pattern

1. Press the **select pattern** left-menu softkey. The right-menu softkeys displayed enable the user to select from one of the following:

- A PRBS of 2^31-1, 2^23-1, 2^15-1, 2^10-1 or 2^7-1
- A user defined pattern; pressing the **user pattern** key accesses twelve user patterns stores, (four internal and eight disc pattern stores), and via the **ALT PAT CONTROL** softkey a sub-menu of softkeys to select the control and format of alternate patterns. Information on how to edit and store user patterns is given in Chapter 6 User Patterns and Disc Operation.
- Select the **more 2 of 3** right-menu softkey to access ZEROSUB PRBS's of 2^13, 2^11, 2^10 or 2^7, and alt words.
- alt words: Provides two 16 bit user definable words (WORD A and WORD B); pressing the key a second time enables the words to be edited.
- Select the **more 3 of 3** right-menu softkey to access MARKDEN PRBS's of 2^13, 2^11, 2^10 or 2^7.

To Set Up Data Amplitude and Error Add

1. Press the **dat o/p, err-add** left-menu softkey.

2. Press the **DATA AMPLTD** and **DATA HI-LEVL** softkeys (displayed in inverse video when ON) and set the required Data Amplitude and Data Hi-Level values using the display knob or numeric keypad. If you use the numeric keypad to enter the Data Amplitude or Data Hi-Level values, the right-menu changes to reveal softkeys of **mV**, **V** and **CLEAR**. Press the appropriate key when you have finished entering the value.

Inject Errors Into the Data Output

3. Select the `more 2 of 2` right-menu and press `error add`.

4. Use the `ERR-ADD SINGLE` softkey to inject single errors into the data.

5. For a fixed error rate from 1e-3 to 1e-9 select `ERR-ADD FIXED`, then `fixed rate`, and select an error rate from the seven right-menu softkeys.
   Press `EXIT` then `EXIT` again to return to the main menu. Note that the error rate selected is now displayed at the top right of the pattern generator screen.

Polarity, Data Output and Termination Settings

6. Set the `POLRITY NORMINV`, `DATA ECL`, `DAT O/P DELAY` and `DAT TRM 0V/-2V` softkeys as required.

To Optimize Data Eye Crossing Points

7. Select the `more 2 of 2` right-menu, and set the `OPTMIZE D D+D/` softkey as required.

To Set Up the Pattern Generator Trigger and Clock Output

1. Press the left-menu `trg o/p, clk o/p` softkey. Set `TRIGGER PAT CLK` to `PAT`.
   Note: when the TRIGGER is set to `CLK` the Trigger Mode is set to Clock/32.

2. To set up a trigger pattern press `TRIGGER PATTERN` (*trig pat:* appears at the bottom of the screen), then use the '1' and '0' keys on the numeric keypad to select a trigger pattern. Press `ENTER` when you finish selecting a trigger pattern.

Note

The `TRIGGER PATTERN` softkey will change to read `TRIGGER BIT` (if a user pattern is selected) or `TRIG ON A-B PAT` (if an alternate pattern is selected)

To Set Up Clock Amplitude

3. Press the `CLOCK AMPLTD` softkey (displayed in inverse video when ON). Use the display knob or numeric keypad to set the Clock Amplitude. To set the clock amplitude via the numeric keypad, enter the value using the keypad, then select the `mV` or `V` right-menu softkey.

   The pattern generator is now set up.

To Set Up Clock Frequency

If you have an HP 70311A or HP 70312A clock source installed in your system as a slave to the pattern generator, there will be two additional softkeys of `CLOCK FREQ` and `FREQ STEP` displayed (on the `more 1 of 2` right- menu). If these keys are not present, your clock source is configured as a master. Instructions on how to setup clock frequency for each configuration is given in the HP 70311A/HP 70312A Clock Sources Operating and Calibration Manual.

To Switch off the Data Output

1. Select the `dat o/p err-add` left menu softkey.
2. Select the `more 1 of 2` right-menu and set the `DAT O/P ON OFF` softkey to `OFF`.

To Set Up an HP 70842B Error Detector

Introduction

The following information applies to an error detector configured for master/ master operation.

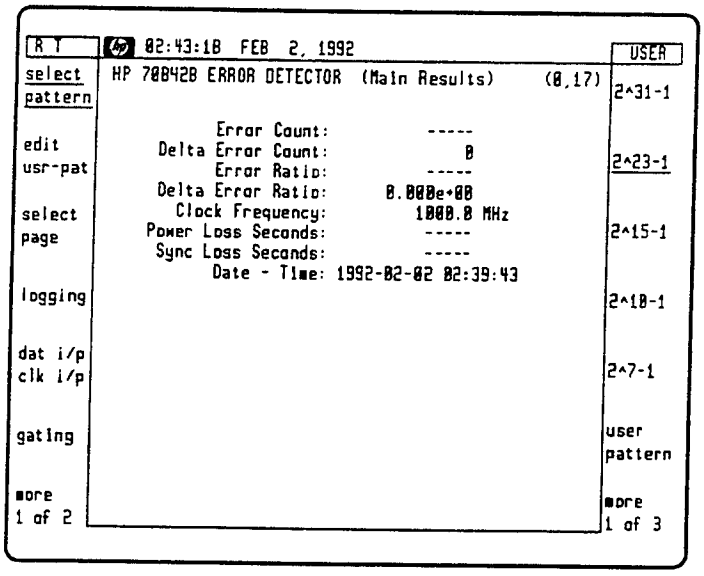
To Display Error Detector Status

View the display screen. Is the error detector status displayed?

NO: Press the (DISPLAY) key, then the `NEXT INSTR` softkey. The Display will cycle through the column address until the next module is enabled and displayed. Continue to press the `NEXT INSTR` key until the error detector status is displayed. Press the (MENU) key.

YES: Press the (MENU) key.The left-menu now displays the functions or parameters relevant to the error detector. The right-menu gives the choices offered for the left-menu softkey that is selected (underlined).

To configure the error detector simply select from the left-menu softkeys displayed. As you select a left-menu softkey the right-menu will change to provide user-selectable functions relevant to the left-menu softkey you have selected. The following figure illustrates the right-menu softkeys when the `select pattern` left-menu is selected.



To Set Up the Error Detector to Perform a Measurement

The procedure is identical to the error detector procedure given in the *Making Your First Measurement* section on pages 2-8 to 2-13.

3

SOFTKEY MENU MAP

Introduction

The following softkey menus are accessed by the (MENU) key and the softkeys located at the left side of the display. The menus are divided into pages. Press the more softkeys to access additional pages.

Each softkey menu map illustrates the function or groups of functions that may be accessed, and selected or edited when a particular left-menu *primary* softkey is selected.

The boxes shown on the charts represent actual key presses and illustrate the sequence of key presses necessary to perform individual functions.

Softkey Notation

The softkeys shown in the following menu maps are referred to as *PRIMARY* and *SECONDARY* softkeys, an explanation of each is given below:

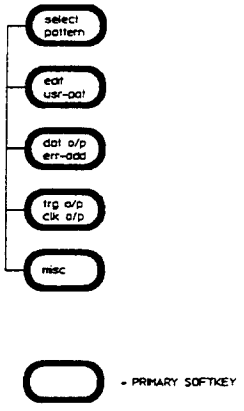
- PRIMARY softkey:-softkeys from the left-menu which are used to select major functions or groups of functions. Also known as the *top level* keys.
- SECONDARY softkey:-softkeys from the right-menu, used to select functions or parameters relevant to the PRIMARY key currently selected.

Left-Menu Softkey Map

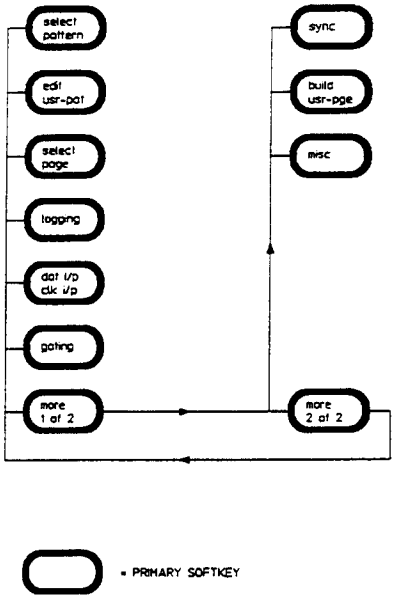
The following maps illustrate the left-menu softkeys for Master/Slave and Master/Master operation.

MASTER/MASTER OPERATION

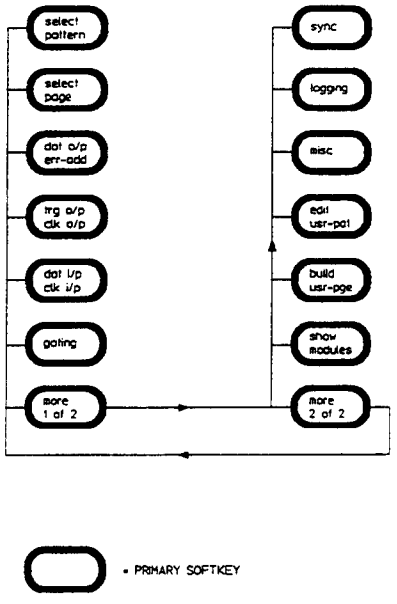
PATTERN GENERATOR



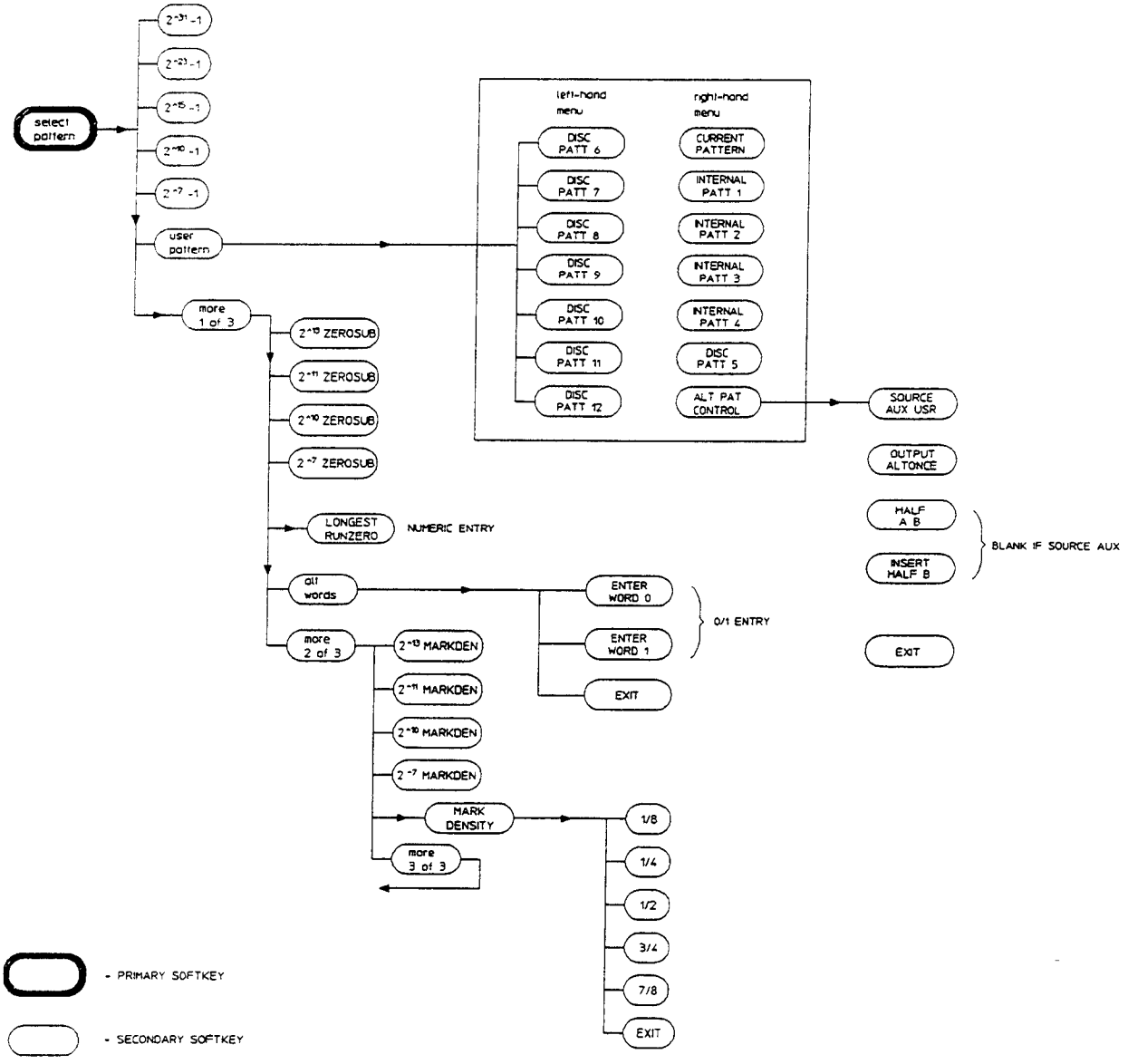
ERROR DETECTOR



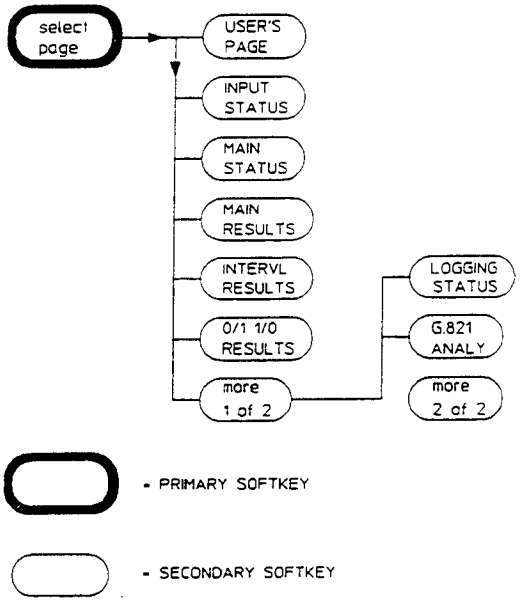
MASTER/SLAVE OPERATION



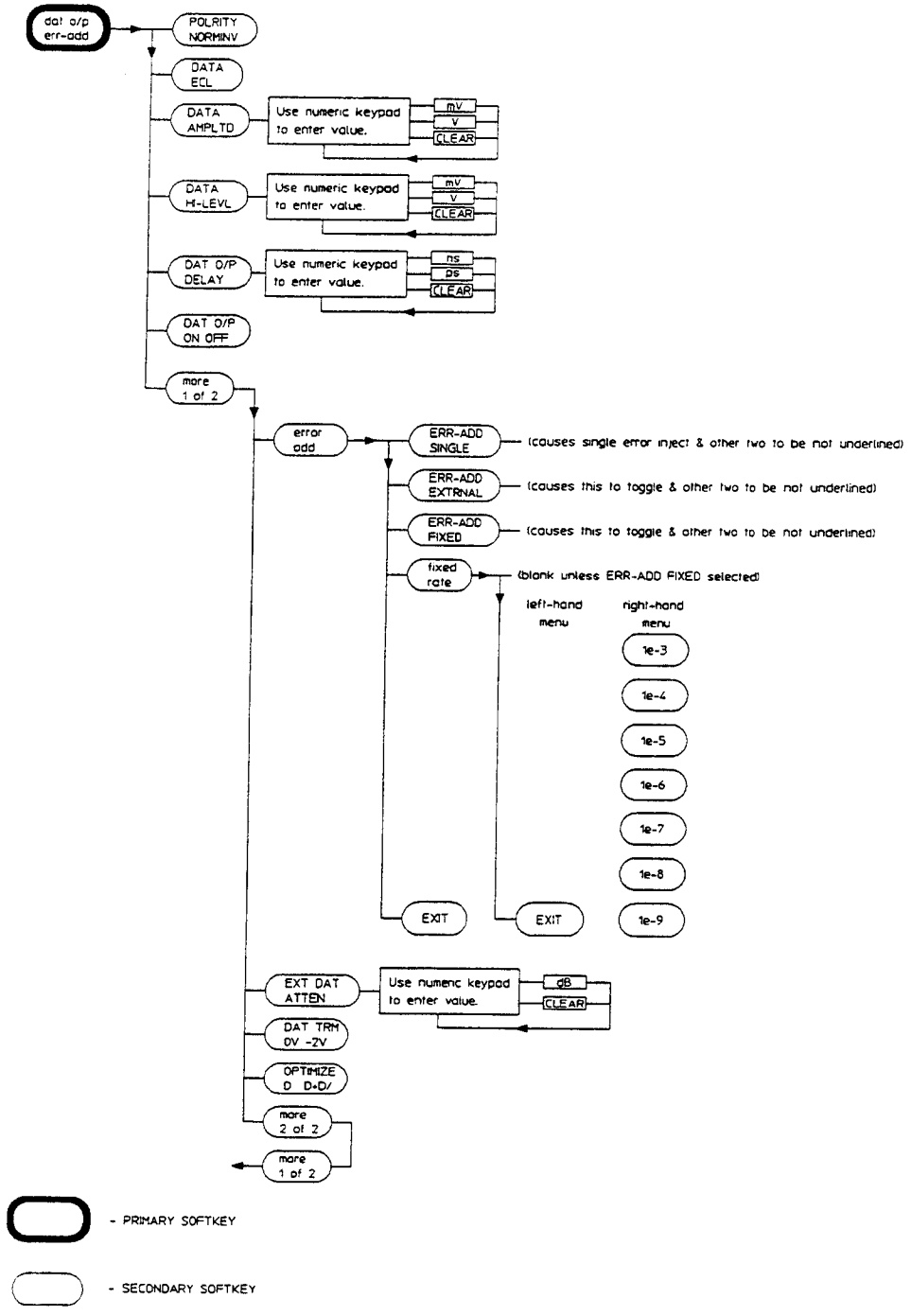
Select Pattern Menu Map (Pattern Generator)



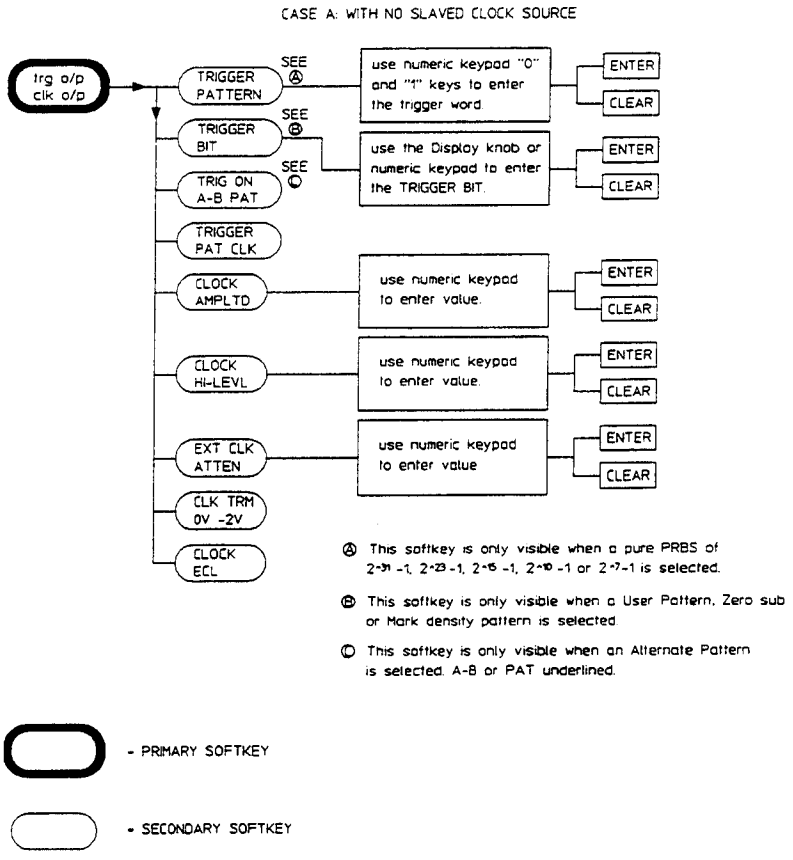
Select Page Menu Map



Data Output/Error Add Menu Map



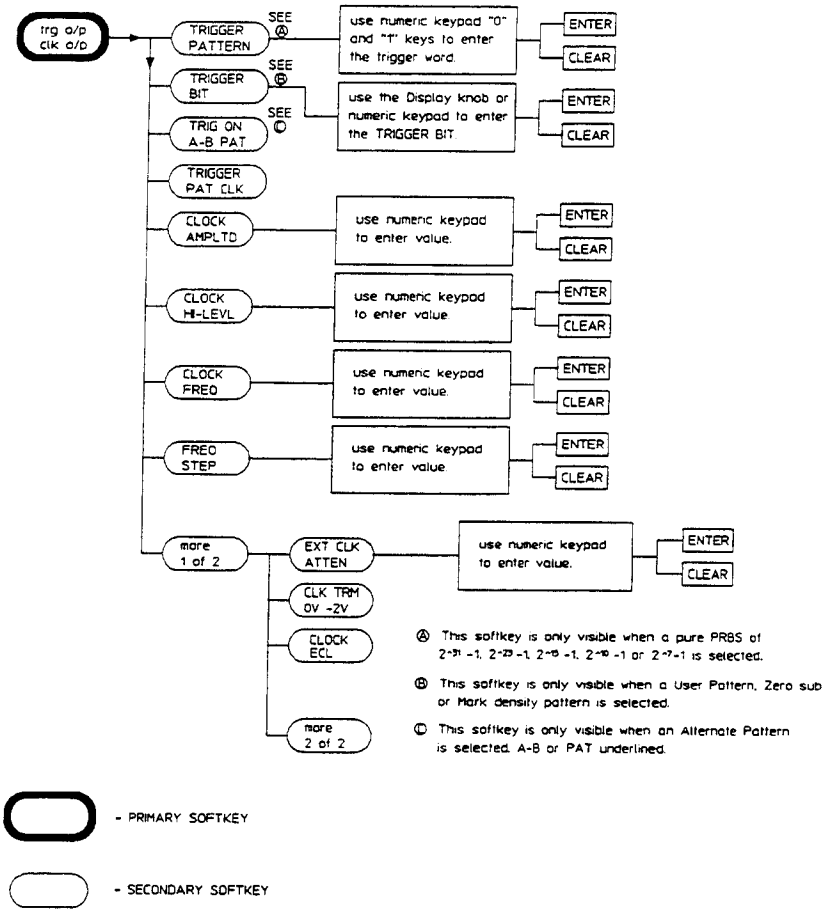
Trigger Output/Clock Output Menu Map



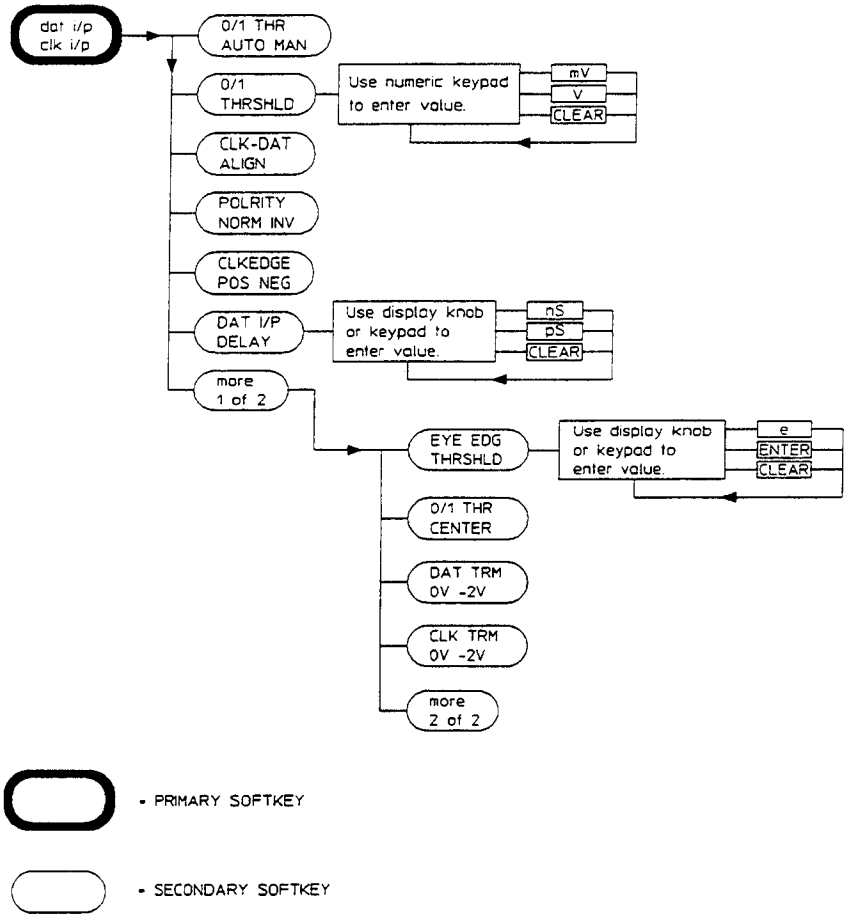
See next page for Case B with a slaved clock source.

The following menu is available when a slaved clock source is used.

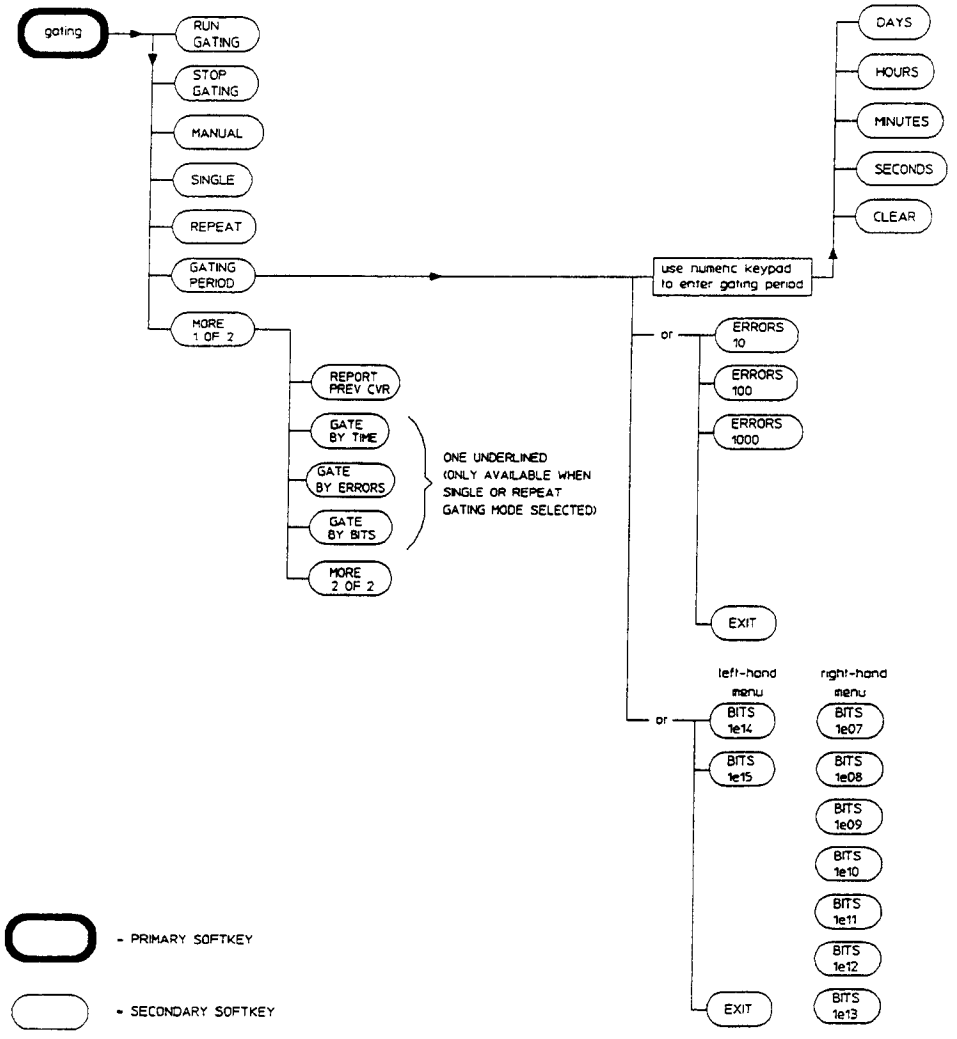
CASE B: WITH A SLAVED CLOCK SOURCE



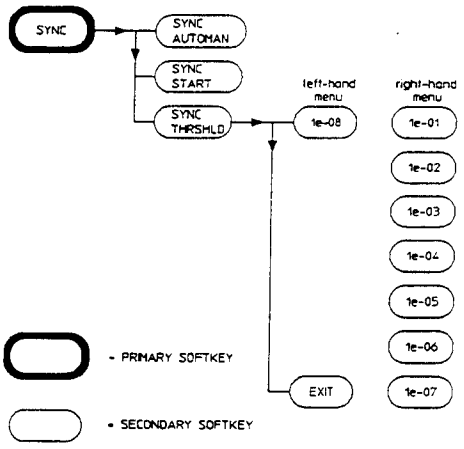
Data Input/Clock Input Menu Map



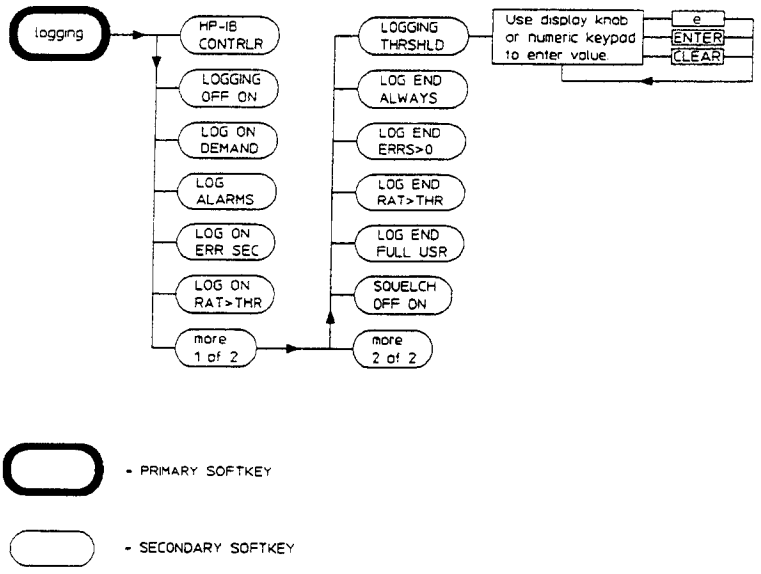
Gating Menu Map



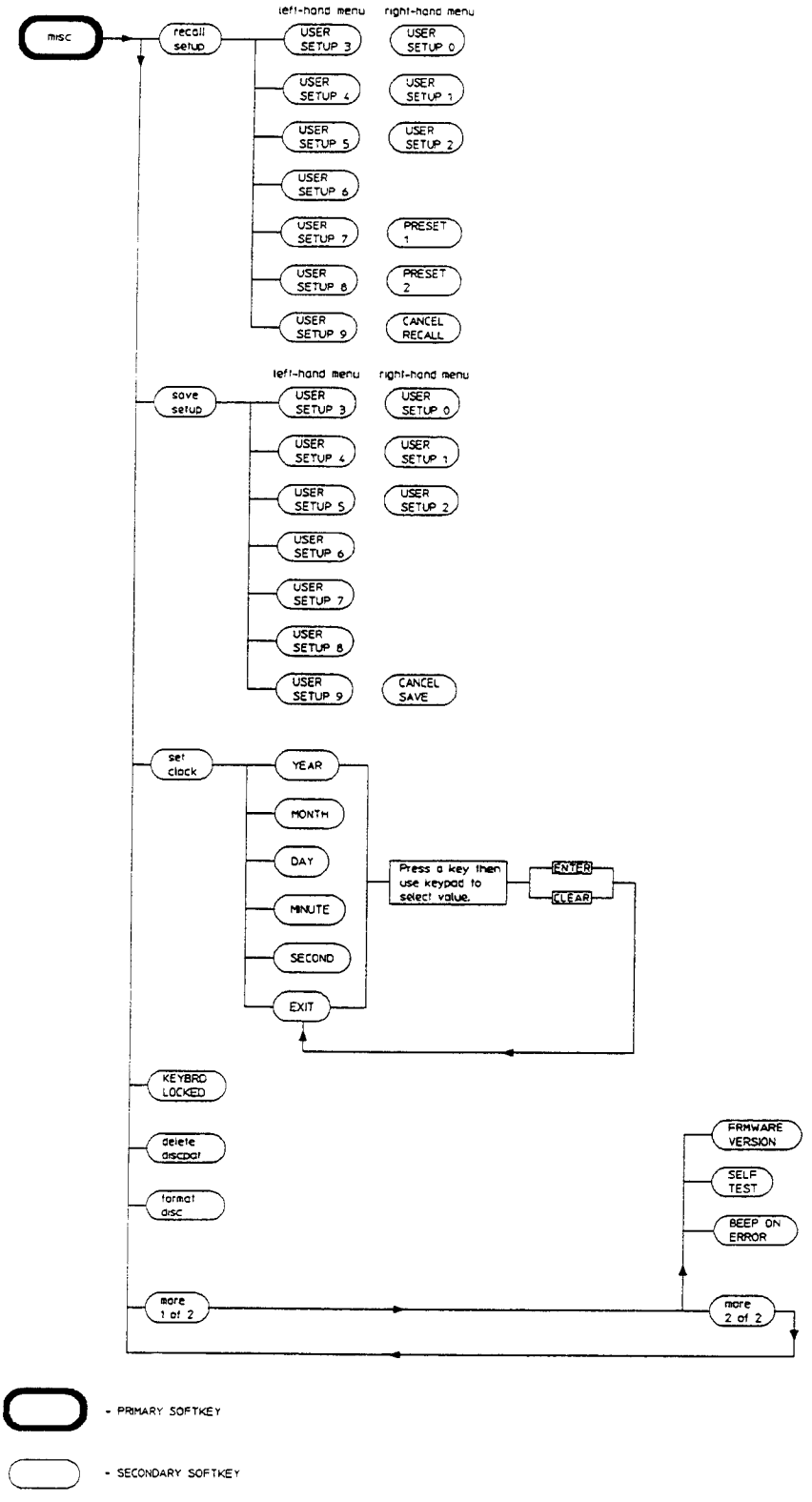
Synchronization Menu Map



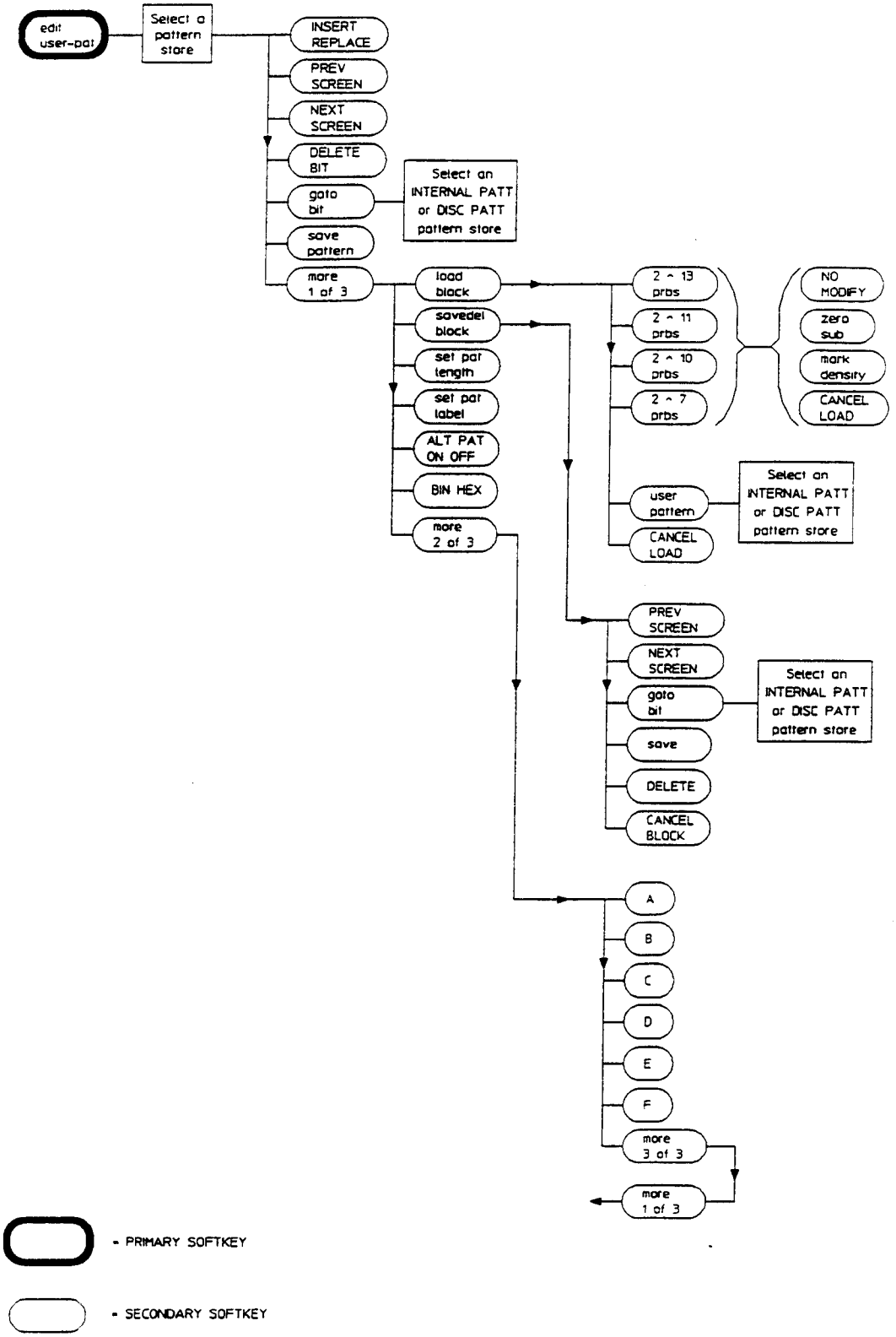
Logging Menu Map



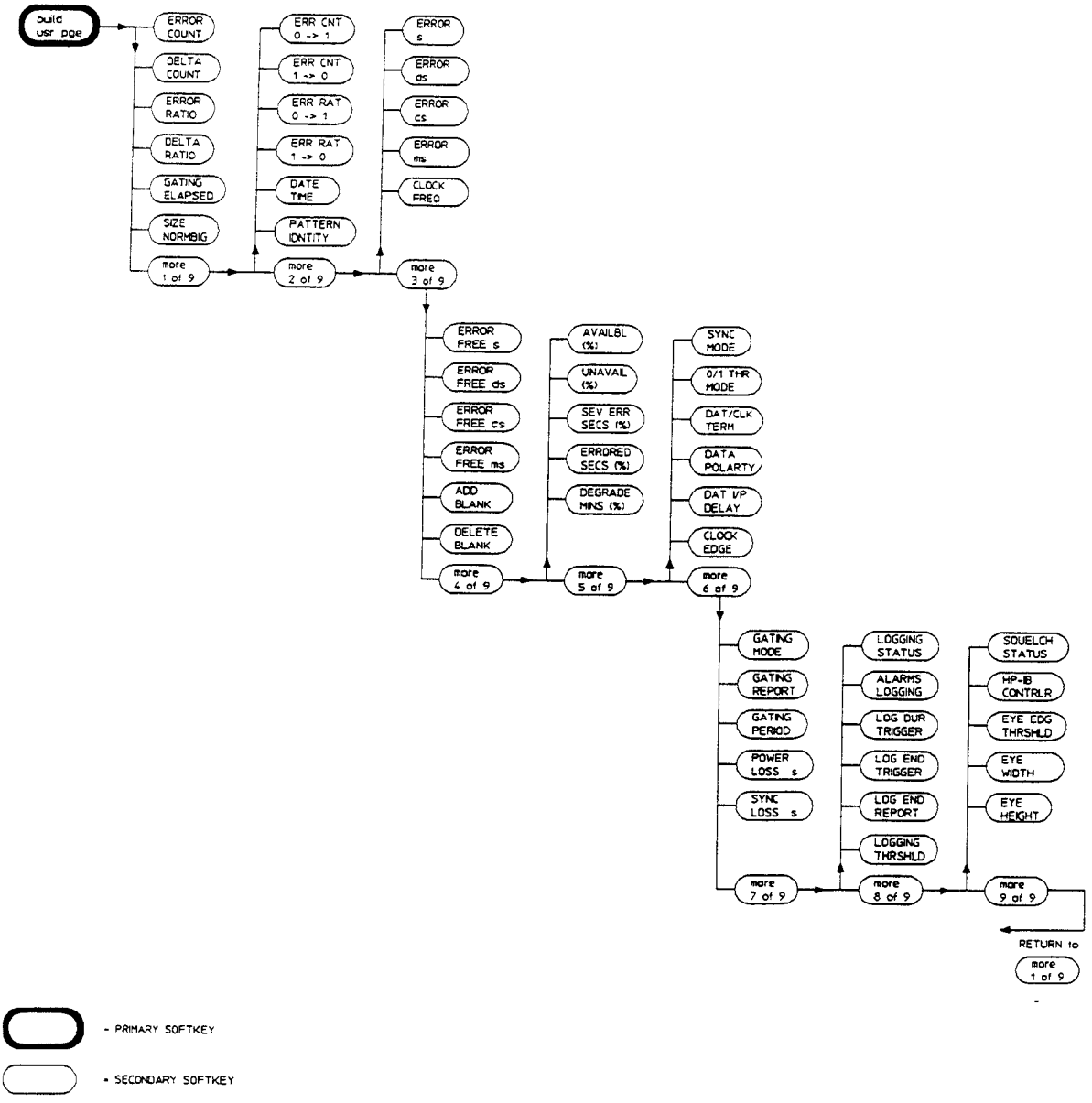
Miscellaneous Menu Map



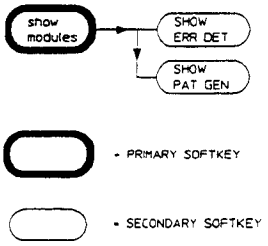
Edit User Pattern Menu Map



Build User Page Menu Map



Show Modules Menu Map



4

SOFTKEY MENU DESCRIPTIONS

SoftKey Menu Descriptions

Introduction

This section gives a brief introduction to using softkeys, explains how master/slave or master/master operation effects softkey menus and gives detailed descriptions of each softkey.

Softkey Menus

In HP 71600B Series error performance analyzer systems the fourteen display softkeys are split into two columns of seven each, which are referred to as the left-menu and the right-menu. The keys in the left-menu are the *primary level* keys and are usually present on the display: they are used to select major functions or groups of functions. When a left-menu is selected it is underlined. The keys in the right-menu are subordinate to the left-menu that is currently selected (underlined), and are used to select minor attributes of the left-key's function group or to access a lower level of right-hand menu.

Menus with greater than seven entries

Some of the menus that appear on either the left or right of the display have more than seven entries. When this is the case the bottom key in the column is labelled *more* and gives access to more options plus a further *more* key. Menus that use *more* are circular so that the user can easily find all the available options.

Softkeys requiring numeric entry

These keys which require the entry of a numeric value will usually have subordinate keys, which specify the units of the parameter being set as well as a *CLEAR* function, which allows the user to leave the value unchanged.

Key Labelling

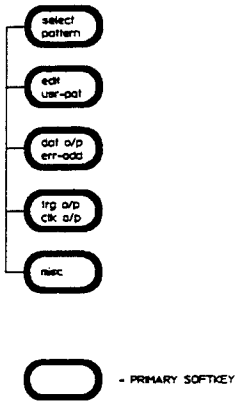
The key labelling follows the convention that lower-case indicates that the key is a *navigation* key, giving access to a lower-level menu; whilst upper-case is used for a *configuration* key which allows the configuration to be changed.

Softkey Menus in Master/Slave or Master/Master Operation

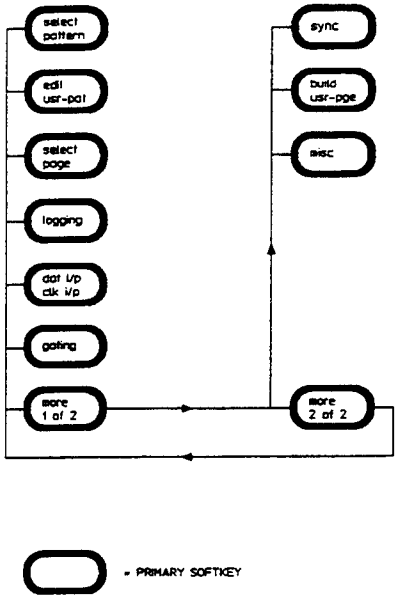
The softkey menus displayed and available to the user differ depending on whether the instrument is configured for master/slave or master/master operation. Please refer to the HP 71600B Series Installation and Verification manual for information on how to configure the instrument for master or master/slave operation. The following figures illustrate the differences in left-menu softkeys presented to the user for each mode of operation.

MASTER/MASTER OPERATION

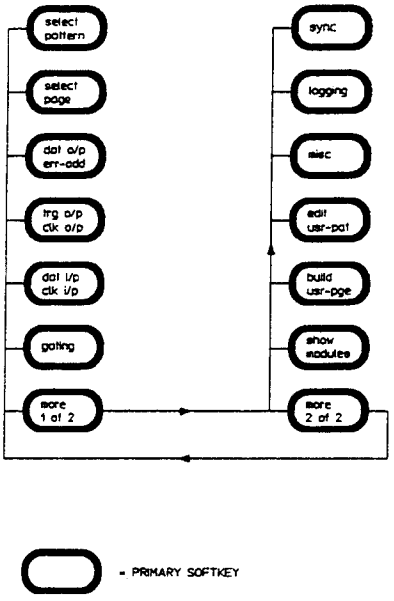
PATTERN GENERATOR



ERROR DETECTOR



MASTER/SLAVE OPERATION



Pattern Generator Softkey Menus

Introduction

The left-hand menu of the pattern generator contains five softkeys, (in master/master configuration) which are visible when the pattern generator has control of the keyboard. These keys and their subordinate right-menu keys are described in detail in the following paragraphs. Menu maps illustrating the subordinate right menus for each key are given in Chapter 3.

In HP 71600B Series Systems configured for master/slave operation the pattern generator and error detector primary softkeys are combined in two left-menu pages, joined by a `more` key. The order in which these keys are presented to the user differs from that given here for master/master operation. The operation of left-menu softkeys and their corresponding right-menu softkeys is however identical for both master/master and master/slave operation.

Select Pattern Menu

Path

(MENU) `select pattern`

Description

The `select pattern` softkey gives access to a selection of patterns in the right-menu; the currently selected pattern is underlined. This menu uses three pages joined by `more` keys. The right-menu softkeys subordinate to the `select pattern` softkey are as follows:

`2^31-1` `2^23-1` `2^15-1` `2^10-1` `2^7-1`	Enables the user to select one of five pure Pseudo Random Binary Sequences. The expressions represent the lengths of the patterns, in bits.
`user pattern`	Selects a pattern (up to 4194304 bits long) that can be edited using the pattern editor. The choice of patterns are four RAM based patterns (numbers 1 to 4) of length up to 8192 bits, eight floppy disc based patterns (numbers 5 to 12) and the CURRENT PATTERN.

Note

If you select a *user pattern* ensure that the sync threshold is compatible with the pattern being generated. Failure to set the correct sync threshold may result in incorrect synchronization.

Incorrect synchronization results in errors and may cause clock-to-data alignment failure.

ALT PAT CONTROL This key is part of the **user pattern** menu of softkeys, and provides a sub-menu from the **user pattern** menu which gives access to the control of alternate patterns. When pressed the **ALT PAT CONTROL** softkey gives the following menu.

SOURCE AUX USR: When **AUX** is selected, the source of control for the Alternate Patterns is the rear-panel AUX INPUT port. When **USR** is selected, the source of control is from the front-panel or over HP-IB. Refer to chapter 1 General Information for an explanation of the AUX INPUT operation.

OUTPUT ALTONCE: This controls how the alternate pattern is output; either each half of the pattern is output alternately (controlled by **HALF A B** softkey) or a single insertion of a number of instances half *B* half is inserted between repetitions of half A.

HALF A B: This key is labelled this way only if the **OUTPUT ALTONCE** is set to **ALT**. It selects whether the *A* or *B* half of the pattern is output. It is blank if **SOURCE AUX USR** is set to **AUX**.

INSERT HALF B: This key is labelled this way only if **OUTPUT ALTONCE** is set to **ONCE**. When pressed it causes the single insertion of a number of instances of half *B* to be inserted between repetitions of half A. The number of half *B* instances is equal to the smallest integral multiple of the pattern length that divides exactly by 128. It is blank if **SOURCE AUX USR** is set to **AUX**.

more 1 of 3 Selects the next page of softkey selections.

2^13 ZEROSUB
2^11 ZEROSUB
2^10 ZEROSUB
2^7 ZEROSUB

Select from one of four *modified* PRBS which are Pseudo- Random Binary Sequences with an extra zero added to the longest run of zeros, and with a run of zeros (Zero Substitution) being substituted for the normal bits that follow the longest run of zeros in the pattern.

LONGEST RUNZERO Enables the user to set the total length of the longest run of zeros. The longest run can be extended to the pattern length, minus 1. The bit after the substituted zeros is set to 1.

alt words Selects a pattern that comprises two, 16-bit words, between which the pattern generator switches under the control of the *AUX* input. See page 1-13 for an explanation of the rear panel **AUX** input port. The pattern is selected by pressing the key once. Pressing it a second time allows the user to select which pattern is to be entered, and then to key in the pattern selected using the numeric keypad 0 and 1 keys.

more 2 of 3 Selects the next page of softkey selections.

`2^13 MARKDEN`
`2^11 MARKDEN`
`2^10 MARKDEN`
`2^7 MARKDEN`
	Select from one of four *modified* Pseudo-Random Binary Sequences which have an extra zero added to the longest run of zeros, and with a modified Mark Density.

`MARK DENSITY`	Enables the user to set the value of the Mark Density by selecting a value from the menu that appears; the values offered are 1/8, 1/4, 1/2, 3/4 and 7/8. These represent the ratio of marks to the number of bits in the pattern.
`more 3 of 3`	Returns to the first page of softkey selections.

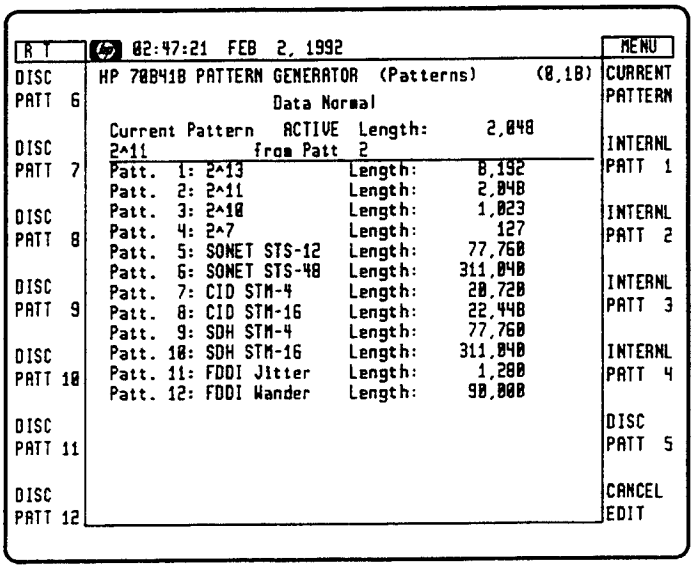
Edit User Pattern Menu

Path

(MENU) `edit usr-pat`

Description

The `edit usr-pat` softkey accesses the editor used to modify the user-defined patterns. When the `edit usr-pat` softkey is pressed the contents of the user pattern stores (including labels and lengths) are displayed as shown in the following example: If one of the user patterns is the pattern currently being output, the display indicates *Current Pattern ACTIVE*



To enter the editor and gain access to the editor softkeys select an **INTERNL PATT** or **DISK PATT** store. The contents of the pattern store selected are loaded into the user pattern memory and can now be edited. The **CURRENT PATTERN** softkey enables the user to access the pattern currently loaded in user pattern memory.

The editor right-menu softkeys are as follows:

INSERT REPLACE — Switches the edit mode between **INSERT REPLACE**. Position the cursor on the point in the pattern to be changed, then use the numeric keypad keys to insert or replace bits.

PREV SCREEN
NEXT SCREEN — If the Pattern length is greater than 576 (192 for a half size window) it is split between two or more screens. Where this is the case the **PREV SCREEN** and **NEXT SCREEN** softkeys enable the user to skip between screens to examine or edit the pattern.

DELETE BIT — Deletes the bit highlighted by the cursor.

goto bit — Enables the user to quickly position the cursor on any bit in the pattern.

save pattern — Enables the user to store the contents of the user pattern memory to a pattern store. The label, pattern type and binary contents of the user pattern memory are all saved.

more 1 of 3 — Selects the next page of softkey selections.

load block — Pressing this key produces a sub-menu of softkeys, which enable the user to load a fixed PRBS of 2^7, 2^10, 2^11 or 2^13, or a user pattern into the user pattern memory at the current cursor position. The current setting of the **INSERT REPLACE** softkey controls how the pattern is loaded. See chapter 6 for more detailed information on **load block**.

savedel block — Pressing this key produces a sub-menu of softkeys, which enable the user to save or delete a block of data; they operate as follows:

save: The user can define a block of bits within the user pattern memory, then save this block to any pattern store large enough to hold the pattern.

DELETE: Use this key to delete a block of bits in the pattern currently in user pattern memory. To delete a block of bits: position the cursor at the start of the block, select **savedel**, set the cursor to the end of the block and press **DELETE**.

set pat length — Enables the pattern length to be selected using the numeric keypad. If the user pattern is active the length chosen must match the appropriate resolution (see page 5-10).

set pat label — Enables the user to assign a name or label to a pattern.

When the **set pat label** softkey is pressed the right-menu changes to give softkeys of **EXIT**, **FINISH ENTRY**, **CLEAR LABEL** and **ENTER CHAR**. To select a pattern label use the display knob to set the cursor on the first letter or digit of the label and press the **ENTER CHAR** softkey. Continue moving the cursor to the next character and pressing **ENTER CHAR** until the label is finished. Press the **FINISH ENTRY** softkey when you have finished entering the label. The **CLEAR LABEL** key erases the label currently being edited. **EXIT** returns the user to the **edit-usr pat** right-menu.

BINARY HEX

Enables the user to select between binary and hexadecimal displays. In hexadecimal mode, the contents of the pattern are shown in hexadecimal. All other fields remain in decimal.
The data is displayed in lines, where each line contains eight 4 character fields. Each field represents sixteen bits as four hexadecimal digits.
When the length of a pattern is not a multiple of 16, the last four-digit hex number is truncated such that only digits required to display the pattern are shown. Truncation takes place from the least significant digit. When the length of the pattern is not a multiple of 4, the lower bits of the digit which exceeds the pattern length are ignored and considered to be zeros.
The hexadecimal digits A through F are input via the **more 3 of 3** menu.

The hexadecimal ordering is such that hex digits from left to right represent contiguous nibbles of the binary data from first bit to last bit. The left most bit of a nibble is represented by the most significant bit of the hexadecimal value. As an example, the bit pattern 101000011100 is represented by the string A1C.

ALT PAT ON OFF

When **ALT PATT ON** is selected the pattern in the user pattern memory is split into two patterns (A and B) with the switch between patterns occurring at the end of a pattern. Toggling the **ALT PAT** key ON/OFF will set the pattern length to 1. Patterns A and B can be a maximum of 2 Mbits in length. Refer to chapter 5 Operating Features or the Installation and Verification manual for detailed alternate pattern specifications.
The switch either:
Inserts a single insertion of a number of instances of half B between repetitions of A - or - makes a switch from pattern A to B (or B to A). Control of the pattern switch can be from the front panel, HP-IB or the rear panel AUX INPUT.

The softkeys which control which of these modes is employed are `ALT PAT CONTROL` and `SOURCE AUX USR`; part of the `select pattern, user pattern` menu of softkeys. Refer to chapter 6 User Patterns and Disc Operation for a procedure for selecting alternate patterns.

`EXIT`	Returns to the `more 2 of 3` menu.
`more 2 of 3`	Selects the next page of softkey selections.
	The `more 3 of 3` menu comprises the hexadecimal digits A through F.
`more 3 of 3`	Returns the user to the first page of softkeys.

Data Output, Error Add Menu

Path

(MENU) `dat o/p, err-add`

Description

The `dat o/p, err-add` softkey gives access to a selection of right-menu keys which set the level of the data and inverted-data outputs, and permit data errors to be added to the data output. The attenuator setting allows the user to specify the level referenced to the far (that is non-pattern generator) side of an external attenuator. The `dat o/p, err-add` right-menu softkeys are as follows:

`POLRITY NORMINV`	Toggles the data outputs to be either normal or inverted in sense.
`DATA ECL`	Sets the data outputs to use Emitter Coupled Logic levels. It also resets the Data Amplitude and Data HI-Level to default values.(Data Amplitude +850mV; Data Hi-Level -900.0mV)
`DATA AMPLTD`	Enables the peak-to-peak amplitude of the data outputs to be entered in units of volts or millivolts.
`DATA HI-LEVL`	Enables the entry of the value for the data high output level in units of volts or millivolts.
`DAT O/P DELAY`	Enables the entry of a time delay by which the data output should lag the clock output. The delay is entered in picoseconds and may be negative (in which case the data leads the clock). The entry is rounded to the nearest picosecond.
`DAT O/P ON OFF`	Permits the data output signal to be switched off. When off the data output is set to 0V.
`more 1 of 2`	Selects the next page of softkey selections.

`error add`

Pressing this key brings up a second-level menu that permits the control of errors added to the data stream. The error add softkeys are as follows:

`ERR-ADD SINGLE`: Forces a single error in one bit each time the key is pressed. This key also turns off both the fixed error addition and external error addition.

`ERR-ADD EXTRNAL`: Pulses input to the rear panel ERROR I/P port result in data errors injected into the data stream. This key also turns off the fixed error addition.

`ERROR-ADD FIXED`: Permits errors to be added at a fixed rate. This key also turns off the external error addition. The fixed rate can be varied by using the `fixed rate` key which provides a sub-menu of fixed rate softkeys.

`fixed rate`: Permits the rate of constant error addition to be varied in powers of ten between the limits of 1e-3 and 1e-9. This key is blank unless `ERR-ADD FIXED` is selected.

`EXT DATA ATTEN`

Enables the user to enter the value of an external data attenuator in decibels and read from the display the data amplitude value at the far end of the attenuator (non pattern generator). Changing the value also resets the Data Amplitude and Data High-Level to default values (250mV and 0V respectively).

`DAT TRM 0V/-2V`

Sets the instrument to the data termination voltage selected by the user. This also causes the Data High-Level to be reset and modifies the permissible range of the Data HI-Level.

`OPTMIZE D D+D/`

Enables a choice to be made for the optimization criterion of the data *eye* crossing points. When `D` is selected, the crossing point is optimized for just the data signal. When `D+D` is selected, the crossing point is optimized as a compromise between the data and inverted data signals.

`more 2 of 2`

Returns the user to the first page of softkey selections.

Trigger Output and Clock Output Menu

Path

(MENU) `trg o/p, clk o/p`

Description

The `trg o/p, clk o/p` softkey gives access to a selection of right-menu keys which set the configuration of the Trigger Output, and set the levels of the clock and inverted-clock outputs. The attenuator setting allows the user to specify the level referenced to the far (that is non-pattern generator) side of an external attenuator.

The Trigger Output produces a pulse which is either synchronized to the pattern (PATTERN mode) or is the input clock divided by 32 (CLOCK/32 mode). In PATTERN mode the trigger pattern that the user has entered is matched to the pattern being generated and a trigger pulse is produced when the two correspond. For a 2^n-1 pattern the length of the trigger pattern is *n* bits, which ensures that the pattern will be unique.

The behavior of the Trigger Output changes when the pattern being generated is the alternating-word pattern; in this case the output is either a regenerated version of the *AUX* input, which is used to switch between the words, or the input clock divided by 32.

When a zero-substitution PRBS, a mark-density PRBS or a user-defined pattern is selected, then the trigger pattern is selectable with the `TRIGGER BIT` softkey. It can be set anywhere within the pattern.

When an alternate pattern is selected, the user can select between a trigger pulse synchronized to the input or one pulse per pattern.

Note

The first softkey in the right-menu can be labelled in one of three ways: `TRIGGER PATTERN`, `TRIGGER BIT` or `TRIG ON I/P PAT`

The `trg o/p, clk o/p` right-menu softkeys are as follows:

`TRIGGER PATTERN` — The first key on the right-menu is labelled `TRIGGER PATTERN` when the Pattern selected is a *pure* PRBS of 2^31-1, 2^23-1, 2^15-1, 2^10-1, or 2^7-1.
Enables entry of a bit pattern for triggering, of length 7,10,15, 23 or 31 bits, depending on the current setting of the *pure* PRBS. An all-ones pattern is disallowed.

OR

`TRIGGER BIT` — The first key on the right-menu is labelled `TRIGGER BIT` when the Pattern selected is a User Pattern, Zerosub or Markden pattern.
It enables the position of the trigger bit to be varied. This is an active parameter. If a user-defined pattern is selected, this key controls the trigger bit position of the pattern currently in the edit buffer. It does

not affect the trigger bit position of the stored patterns. If the current pattern is saved, the trigger bit is saved with the pattern contents.

OR

TRIG ON A-B PAT	The first key of the right-menu is labelled TRIG ON A-B PAT whenever an alternate user-defined pattern is selected. Either the A-B or the PAT is underlined. If the A-B is selected, then the trigger pulse occurs synchronously as alternate pattern halves are selected. If PAT is selected, then the trigger pulse is synchronised to the first bit of the pattern.
TRIGGER PAT CLK	Toggles between *PATTERN* mode, in which the occurrence of a user-entered pattern in the output stream, is the condition which causes a trigger pulse to be output; and CLOCK/32 mode, in which the Trigger Output is the input clock divided by 32. If a modified PRBS or a User Pattern is selected, then the trigger bit position appears in parentheses.
CLOCK AMPLTD	Enables the peak-to-peak amplitude of the Clock Outputs to be entered in units of volts or millivolts.
CLOCK HI-LEVL	Enables the entry of the value for the clock high output level in units of volts or millivolts.
CLOCK FREQ	If a slaved clock source or signal generator is connected, this key permits the frequency of this source to be set up. Otherwise, this key is blank.
FREQ STEP	If a slaved clock source or signal generator is connected, this key permits the value of the frequency step to be set up, using the display knob or ▲ ▼ keys. Otherwise, this key is blank. Enter the desired frequency step using the large display knob, or the numeric keypad. If you use the keypad the right-menu changes to give softkeys of GHz, MHz, kHz and Hz. Set the step value then select the appropriate softkey. Select the CLOCK FREQ softkey. Use the ▲ ▼ keys on the numeric-keypad to increase or decrease the frequency by the step value selected.
more 1 of 2	Selects the next page of softkey selections.
EXT CLK ATTEN	Enables the user to enter the value of an external attenuator in decibels, and read from the display the clock amplitude at the far end of the attenuator (input to device under test).
CLK TRM 0V/-2V	Sets the clock termination voltage to 0 volts or -2 volts. This also causes the Clock High-Level to be reset and modifies the permissable range of the Clock High-Level.
CLOCK ECL	Sets the clock outputs to use emitter coupled logic levels. It also resets the Clock Amplitude and Clock High-Level to default values.
more 2 of 2	Returns the user to the first page of softkeys.

Misc Menu

Path

(MENU) misc

Description

The misc softkey allows miscellaneous user functions to be selected via the right-menu softkeys. The recall setup and save setup keys are used to recall and save the module's current configuration. The misc right menu softkeys are as follows:

recall setup	Enables a lower-level menu from which a module configuration can be recalled. The choices are from ten *USER SETUPS* and two *PRESETS*. Each *USER SETUP* permits the user to store an entire module configuration, and each *PRESET* holds a pre-defined module configuration. See Appendix A for a list of *PRESET* configurations.
save setup	Enables a choice from ten *USER SETUPS* into which the user may store an entire module configuration.
KEYBRD LOCKED	Toggles between the locked and unlocked state. When locked the user can not modify any of the instrument's configuration parameters, only display parameters. Keyboard is locked when the softkey is underlined.
FRMWARE VERSION	Shows the firmware version code, in the form X.nn.nn. If an MMS signal generator is slaved to the pattern generator, then its firmware version is appended to that of the pattern generator, for example. "F/W: Pat Gen B.01.00, Clk Src A.01.20"
SELF TEST	Enables the instrument to self-test the processor ROM and RAM. Instrument settings are not affected by this self-test.
delete discpat	Permits a disc-based pattern to be deleted from a disc.
format disc	Permits a 3.5in floppy disc to be formatted.

Error Detector Softkey Menus

Introduction

The error detector left-hand menu comprises two pages of softkeys, accessible via the `more` key. These left-menu softkeys and their subordinate right-menu keys are explained in the following pages, in the order in which they are displayed when the error detector does not have a slave.

In HP 71600B Series Systems configured in master/slave operation the pattern generator and error detector primary softkeys are combined in two left-menu pages joined by a *more* key. The order in which these keys are presented to the user differs from that given here for master/master operation. The operation of left-menu softkeys and their corresponding right-menu softkeys is however identical for both master/master and master/slave operation.

When operated in master/slave format the pattern selections are the same as available for the pattern generator. When operated as an independant master, the alternate word and alternate patterns selections are not available.

Select Pattern Menu

Path

(MENU) `select pattern`

Description

The `select pattern` softkey gives access to a selection of patterns in the right-menu; the currently selected pattern is underlined. This menu uses three pages joined by *more* keys. The `select pattern` right-menu softkeys are as follows:

`2^31-1` , `2^23-1` `2^15-1` `2^10-1` `2^7-1`

Enables the user to select one of five Pseudo Random Binary Sequences. The expressions represent the lengths of the patterns, in bits.

`user pattern`

Selects a pattern (up to 4194304 bits long) that can be edited using the pattern editor. The choice of patterns are four RAM based patterns (numbers 1 to 4) of length up to 8192 bits, eight floppy disc based patterns (numbers 5 to 12) and the CURRENT PATTERN.

Note

If you select a *user pattern* ensure that the sync threshold is compatible with the pattern being generated. Failure to set the correct sync threshold may result in incorrect synchronisation.

Incorrect synchronisation results in errors and may cause clock-to-data alignment failure.

`more 1 of 3`	Selects the next page of softkey selections.

`2^13 ZEROSUB`
`2^11 ZEROSUB`
`2^10 ZEROSUB`
`2^7 ZEROSUB`
	Select from one of four *modified* PRBS which are Pseudo- Random Binary Sequences with an extra zero added to the longest run of zeros, and with a run of zeros (Zero Substitution) being substituted for the normal bits that follow the longest run of zeros in the pattern.

`LONGEST RUNZERO`	Enables the user to set the total length of the longest run of zeros. The longest run can be extended to the pattern length, minus 1. The bit after the substituted zeros is set to 1.
`more 2 of 3`	Selects the next page of softkey selections.

`2^13 MARKDEN`
`2^11 MARKDEN`
`2^10 MARKDEN`
`2^7 MARKDEN`
	Select from one of four *modified* Pseudo-Random Binary Sequences which have an extra zero added to the longest run of zeros, and with a modified Mark Density.

`MARK DENSITY`	Enables the user to set the value of the Mark Density by selecting a value from the menu that appears; the values offered are 1/8, 1/4, 1/2, 3/4 and 7/8. These represent the ratio of marks to the number of bits in the pattern.
`more 3 of 3`	Returns to the first page of softkey selections.

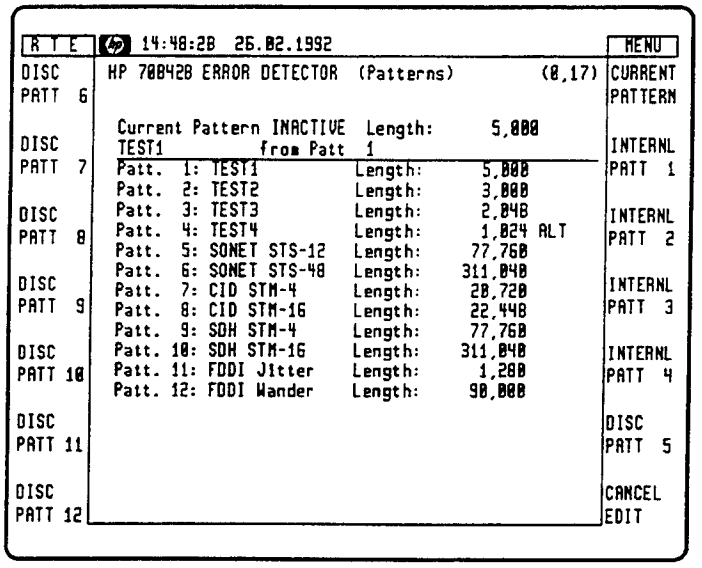
Edit User Pattern Menu

Path

(MENU) `edit usr-pat` `PATTERN`

Description

The `edit usr-pat` softkey accesses the editor used to modify the user-defined patterns. When the `edit usr-pat` softkey is pressed the *user patterns* (including labels and lengths) are displayed as shown in the example below: If one of the *user patterns* is the pattern currently being output, the display indicates *Current Pattern ACTIVE*.



To enter the editor and gain access to the editor softkeys select an **INTERNL PATT** or **DISK PATT** store. The contents of the pattern store selected are loaded into the user pattern memory and can now be edited.

The editor right-menu softkeys are as follows:

INSERT REPLACE — Switches the edit mode between **INSERT REPLACE**. Position the cursor on the point in the pattern to be changed, then use the numeric keypad keys to insert or replace bits.

PREV SCREEN
NEXT SCREEN — If the Pattern length is greater than 576 (192 for a half size window) it is split between two or more screens. Where this is the case the **PREV SCREEN** and **NEXT SCREEN** softkeys enable the user to skip between screens to examine or edit the pattern.

DELETE BIT — Deletes the bit highlighted by the cursor.

goto bit — Enables the user to quickly position the cursor on any bit in the pattern.

save pattern — Enables the user to store the contents of the user pattern memory to a pattern store. The label, pattern type and binary contents of the user pattern memory are all saved.

more 1 of 3 — Selects the next page of softkey selections.

load block — Pressing this key produces a sub-menu of softkeys, which enable the user to load a fixed PRBS of 2^7, 2^10, 2^11 or 2^13, or a user pattern into the user pattern memory at the current cursor position. The current setting of the **INSERT REPLACE** softkey controls how the

pattern is loaded. See chapter 6 for more detailed information on `load block`.

`savedel block` — Pressing this key produces a sub-menu of softkeys, which enable the user to save or delete a block of data; they operate as follows:

`save`: The user can define a block of bits within the user pattern memory, then save this block to any pattern store large enough to hold the pattern.

`DELETE`: Use this key to delete a block of bits in the pattern currently in user pattern memory. To delete a block of bits: position the cursor at the start of the block, select `savedel`, set the cursor to the end of the block and press `DELETE`.

`set pat length` — Enables the pattern length to be selected using the numeric keypad. If the user pattern is active the length chosen must match the appropriate resolution (see page 5-10).

`set pat label` — Enables the user to assign a name or label to a pattern.
When the `set pat label` softkey is pressed the right-menu changes to give softkeys of `EXIT`, `FINISH ENTRY`, `CLEAR LABEL` and `ENTER CHAR`. To select a pattern label use the display knob to set the cursor on the first letter or digit of the label and press the `ENTER CHAR` softkey. Continue moving the cursor to the next character and pressing `ENTER CHAR` until the label is finished. Press the `FINISH ENTRY` softkey when you have finished entering the label. The `CLEAR LABEL` key erases the label currently being edited. `EXIT` returns the user to the `edit-usr pat` right-menu.

`BINARY HEX` — Enables the user to select between binary and hexadecimal displays. In hexadecimal mode, the contents of the pattern are shown in hexadecimal. All other fields remain in decimal.
The data is displayed in lines, where each line contains eight 4 character fields. Each field represents sixteen bits as four hexadecimal digits.
When the length of a pattern is not a multiple of 16, the last four-digit hex number is truncated such that only digits required to display the pattern are shown. Truncation takes place from the least significant digit. When the length of the pattern is not a multiple of 4, the lower bits of the digit which exceeds the pattern length are ignored and considered to be zeros.
The hexadecimal digits A through F are input via the `more 3 of 3` menu.

The hexadecimal ordering is such that hex digits from left to right represent contiguous nibbles of the binary data from first bit to last bit. The left most bit of a nibble is represented by the most significant bit of the hexadecimal value. As an example, the bit pattern 101000011100 is represented by the string A1C.

EXIT	Returns to the more 2 of 3 menu.
more 2 of 3	Selects the next page of softkey selections. The more 3 of 3 menu comprises the hexadecimal digits A through F.
more 3 of 3	Returns the user to the first page of softkey selections.

Select Page Menu

Path

(MENU) select page

Description

There are six pages displaying instrument status and results that are available to the user. The select page softkey enables the user to select and view these pages; they are as follows:

USER'S PAGE	Provides a user-definable page into which the user can put any of the results or status lines that appear on any of the other pages.
INPUT STATUS	Displays the termination, polarity, 0/1 threshold status, input delay and eye width measurement settings.
MAIN STATUS	Gives a description of the pattern currently selected, and displays the current synchronization, gating and HP-IB Controller status.
MAIN RESULTS	Displays the accumulated error count, delta error count, error ratio, delta error ratio, clock input frequency and the counts of seconds during which power or synchronisation was lost.
INTRVL RESULTS	Displays counts of time intervals (s, ds, cs, ms) containing errors, and intervals containing no errors.
0/1 1/0 RESULTS	Shows the amount of data zeros detected as ones, and the count of data ones detected as data zeros.
more 1 of 2	Selects the next page of softkey selections.
LOGGING STATUS	Gives a detailed statement of the current logging configuration.
G.821 ANALY	Provides G.821 measurements of Availability/Unavailability plus Errored and Severely Errored Seconds and Degraded Minutes.
more 2 of 2	Returns the user to the first page of softkey selections.

Logging Menu

Path

(MENU) logging

Description

The logging softkey enables two right-menus, (selected by a more key) which allow error detector data logging functions to be set up.

The logging right-menu softkeys are as follows:

HP-IB CONTRLR — When this key is active (underlined) the HP 71600B Series System is configured as a Controller, enables data logging to an external printer and can not be controlled remotely. If the key is not active then the system may be controlled via an external Controller. When in this mode, the system will SRQ when it has a line of text to output. The Controller can then ask for this line of text. Note that when the HP-IB CONTRLR key is not active, the instrument expects to find a printer at the fixed address 0.

LOGGING OFF ON — Switches logging OFF or ON. When OFF, the logging is totally suppressed.

LOG ON DEMAND — Logs a single snapshot of the current results at the instant the key is pressed, irrespective of whether the system is gating or not, and whether logging is enabled or disabled. Current results are time stamped with the date and time at which the results were valid. The output logged is dependent on the current state of the instrument, and is defined as follows:

- LOGGING ON, Gating ON:-.... .results only logged
- LOGGING OFF, Gating ON:-.... header and results logged
- LOGGING ON or OFF, Gating OFF:-.... header and results logged

Note The keys marked with an * cannot be changed when logging.

LOG ALARMS* — Logs the time that the following alarms :Clock Loss, Data Loss and Sync Loss start and end. Power Loss and Power Recovery are always logged regardless of whether the LOG ALARMS key is enabled or not.

The following two keys are mutually exclusive. If you press a key that is currently selected (underlined) it will deselect both keys

LOG ON ERR SEC* — Logs events during gating when an errored second occurs. The set of results logged when an errored second occurs is *Error Count* and *Error Ratio* for the second before the trigger occurred.

`LOG ON RAT>THR*` Logs events during gating, when the error ratio for the last second exceeds a user defined threshold. The threshold is in the range 1.0 to 1.0E-20 inclusive. Error count and error ratio for the last second are logged.

`more 1 of 2` Selects the next page of softkey selections.

`LOGGING THRSHLD*` Enables the user to select a logging threshold in the range 1.0 to 1.0E-20 using the numeric keypad. The logging threshold is compared against one second error ratio values to determine when results are logged.
For example, to enter a threshold of 1.50E-02 press the `LOGGING THRSHLD` key, enter 1.50 using the numeric keypad, then press the `e` right-menu softkey. Finish entering the number (02) using the numeric keypad then press `ENTER`.

The next three keys are mutually exclusive. If you press a key that is currently selected (underlined) it will deselect all three keys.

`LOG END ALWAYS*` Sets the instrument to *Always* log results at the end of a measurement period. Cannot be changed during logging. The contents of the output are controlled by the `LOG END FULL USR` key.

`LOG END ERRS>0*` Sets the instrument to log results at the end of the measurement period if the Error Count >0. Cannot be changed during logging. The contents of the output are controlled by the `LOG END FULL USR` key.

`LOG END RAT>THR*` Set the instrument to log results at the end of the measurement period when the Error Ratio exceeds a preset threshold. Cannot be changed during logging. The contents of the output are controlled by the `LOG END FULL USR` key.

`LOG END FULL USR*` Provides the user with the choice of selecting from two sets of results at the end of the measurement period. Note: If you select `LOG END USR` the list of results/status items depends on the size of display screen currently allocated to the error detector. This is because there are two User's Page lists (one for a half screen display and one for a full screen).

`SQUELCH OFF/ON` When SQUELCH is ON, logging is inhibited if logging is triggered for ten consecutive seconds, thus preventing excessive use of paper. The trigger for logging may be an error second or the error ratio exceeding a preset threshold. Squelch can be over-ridden by the LOG ON DEMAND key. Squelch does not effect end of period logging. Logging is resumed after one trigger free second.

- FULL: Logs Main Results, Interval Results and G.821 Analysis
- USR: Logs the results currently part of the Users Page

`more 2 of 2` Returns to the first page of softkey selections.

Data Input, Clock Input Menu

Path

(MENU) dat i/p clk i/p

Description

The dat i/p clk i/p softkey gives access to a selection of right-menu softkeys which enable the setting up of the error detector Data Input and Clock Input electrical characteristics, including the level at which the transition between a mark and a space is recognized (the 0/1 threshold level). The *active* clock edge is the direction of clock transition relative to which the data input is sampled. The dat i/p clk i/p right-menu softkeys are as follows:

0/1 THR AUTO/MAN	Toggles the selection of the zero-to-one threshold level between manual and automatic.
0/1 THRSHLD	Allows entry of the level at which the zero-to-one discrimination will be performed, can be set in units of volts or millivolts. This forces the 0/1 threshold mode into MANUAL.
CLK DAT ALIGN	Initiates an attempt to align the data input delay so that the Error Detector samples in the center of the data input eye. While alignment is in progress the right-menu changes to give an ABORT ALIGN softkey. The user may press this key at any time and the alignment will abort and return the instrument to its original state. During the alignment procedure, various messages are displayed to the user at the bottom of the display. The full list of these is given in Chapter 5 Operating Features.
POLRITY NORMINV	Toggles the polarity of the input data pattern
CLKEDGE POS NEG	Toggles the *active* clock edge between positive-going and negative-going edges. This nominally gives 180 degree phase inversion to the time point in the eye at which the bit decision is made.
DAT I/P DELAY	Sets the time delay from the *active* clock edge to the time at which the data is actually sampled. The value is entered in picoseconds and may be negative, in which case the data is sampled before the nominated clock edge. The entry is rounded to the nearest picosecond.
more 1 of 2	Selects the next page of softkey selections.
EYE EDG THRSHLD	Sets the threshold used by the clock/data align feature in the search for the edges of the data eye. The range of valid values is 1.0E-1 through 1.0E-7. For example to enter a BER threshold of 1.5E-02: Press the EYE EDG THRSHLD softkey. Enter 1.5 using the numeric keypad, then

press the e right-menu softkey. Finish entering the number (2) using the numeric keypad then press ENTER.

The Eye Edge Threshold is used by the clock-to-data align and 0/1 threshold center functions to define the edges of the data input *eye*.

0/1 THR CENTER	Initiates an attempt to set the zero-to-one threshold to the mid-point of the incoming data eye on the vertical, voltage axis.
DAT TRM 0V/-2V	Toggles the data input termination level between ground and -2 volts.
CLK TRM 0V/-2V	Toggles the clock input termination between ground and -2 volts.
more 2 of 2	Returns to the first page of softkey selections.

Gating Menu

Path

(MENU) gating

Description

The gating softkey gives access to a selection of right-menu softkeys which control the error detector measurement (gating) period. The three gating modes (MANUAL, SINGLE and REPEAT) are a one-of-three selection.

Gating after a Power Loss

On instruments configured for master/slave operation and with AUTO sync selected, gating will restart after a power loss in the following manner.

After a power loss the error detector will attempt to regain sync for approximately 25 seconds.

- If sync is regained within 25 seconds gating will restart immediately.
- If after 25 seconds has elapsed sync has not been regained, gating is forced to start.

The Power Loss Seconds result displayed is the overall time that gating was lost, and thus the time that the system was unable to make a measurement.

Note Neither the gating mode, nor the gating period may be changed while gating is active.

The gating right-menu softkeys are as follows:

RUN GATING	Starts the error detector gating, or stops the current gating action and begins a new gating period.
STOP GATING	Stops the current gating action.

The next three keys are mutually exclusive.

MANUAL	Configures the error detector to make measurements over a gating period controlled by the user.
SINGLE	Configures the error detector to make measurements over one gating period and then stop.
REPEAT	Configures the error detector to make repetitive measurements whereby one gating period follows another immediately. There is no *deadtime* between the end of one period and the start of the next.
GATING PERIOD	The user may elect to gate *by time, by errors,* or *by bits*, selectable using the **gating** more 2 of 2 right-menu of softkeys. Note: if MANUAL gating is selected only gating *by time* is available. If the gating period is set to gate *by time*, then this key sets the duration of the gating period. The avaliable units are days, hours, minutes or seconds. The input value must not exceed the maximum period of 99 days, nor be less than 1 second. If the gating period is set to gate *by errors*, then this key permits the user to set the number of errors over which the gating will occur. Choices of 10, 100, and 1000 are available. If the gating period is set to gate *by bits*, then this key permits the user to set the number of bits over which the gating will occur. Choices of 1E7 through 1E15 in decade steps are available.
more 1 of 2	Selects the next page of softkey selections.
REPORT PREVCUR	Configures the error detector to display the results from the previous complete gating period or the results currently being accumulated. This selection is effective in REPEAT mode only.

Note

The next three keys are mutually exclusive; they cannot be changed whilst the instrument is gating

GATE BY TIME	Configures the error detector to perform SINGLE and REPETITIVE gating periods that are controlled by elapsed time. When the selected time has accumulated, the gating period ends. This key is blank whenever MANUAL gating is selected.
GATE BY ERRS	Configures the error detector to perform SINGLE and REPETITIVE gating periods that are controlled by the accumulation of bit errors. When the selected number of bit errors have been accumulated, the

gating period ends. This key is blank whenever MANUAL gating is selected

GATE BY BITS	Configures the error detector to perform SINGLE and REPETITIVE gating periods that are controlled by the accumulation of clock bits. When the selected number of clock periods have been accumulated, the gatine period ends. This key is blank whenever MANUAL gating is selected.
more 2 of 2	Returns to the first page of softkey selections.

Sync Menu

Path

(MENU) sync

Description

The sync softkey gives access to a set of softkeys that control how the error detector searches for synchronization (that is, tries to align the incoming pattern with the internal pattern that the user has selected). The patterns are deemed to be synchronized when the measured error rate is less than the set sync threshold; a user-defined value. The sync right-menu softkeys are as follows

SYNC AUTO/MAN	Toggles between the error detector automatically initiating re-synchronization whenever synchronization is lost (AUTOMATIC), and requiring the user to initiate re-synchronisation by hand (MANUAL).
SYNC START	Forces the error detector to initiate a re-synchronization.
SYNC THRSHLD	Allows the selection of a new synchronization threshold. This is selected from a sub-menu containing the values 1e-01 through 1e-08 in decade steps. See page D-4 of Appendix D Operating Notes. When a sync-start is initiated, the message *Trying to gain sync* is displayed on the prompt line. If, after trying all possible reference pattern alignments, sync is still not gained then the message *Sync attempt failed, retrying* is displayed.

Build User Page Menu

Path

(MENU) build usr-pge

Description

The **build usr-pge** softkey gives access to a list of results and status items for the user to add to or remove from the *USER'S PAGE*. This key also makes the *USER'S PAGE* the current page selection. The right-menu displayed gives a softkey for each of the result or status lines that may be inserted into the *USER'S PAGE*.

These keys are all toggle-type keys; when not underlined pressing one adds the appropriate line (or lines) into the *USER'S PAGE* in the first (starting at the top of the page) available line (or lines). If there is no space available for the line, an error is reported. If a softkey label is underlined, pressing the key will remove the appropriate line (or lines) from the display.

Because of the large number of results and status lines that are available to be put into the *USER'S PAGE* they are organized into nine pages, linked by **more** keys.

User Page Lists

There are two USER'S PAGE lists as follows:

a. When the error detector is allocated the full display.

b. When the error detector is allocated only half the display.

If you select **build usr-pge** and configure the USER'S PAGE with the error detector allocated a full display you will create list a.

The **build usr-pge** right-menu softkeys are as follows:

ERROR COUNT Displays the error count accumulated since the start of the gating period, displayed in either normal or extra large characters. Extra large characters are selected using the **size normbig** softkey.

Note

When extra large characters are selected, the selection takes up four lines of display.

DELTA COUNT Displays the error count accumulated in the last decisecond, displayed in either normal or extra large characters. This display is updated even when not currently gating.

ERROR RATIO Displays the ratio of the number of errors to the number of clock pulses, since the start of the gating period, displayed in either normal or extra large characters.

DELTA RATIO	Displays the ratio of the number of errors to the number of clock pulses in the last decisecond, displayed in either normal or extra large characters. This display is updated even when not currently gating.
GATING ELAPSED	Displays the time that has elapsed in the current gating period in either normal or extra large characters.
SIZE NORMBIG	Key selection toggles between NORM and BIG. When BIG is selected and one of the upper five softkeys on this menu is selected, that item will appear on the display in extra large characters.
more 1 of 9	Selects the next page of softkey selections.

ERR CNT 0 → 1	Displays the number of data *zeros* detected in error as a data *one* accumulated since the start of the gating period.
ERR CNT 1 → 0	Displays the number of data *ones* detected in error as data *zeros* since the start of the gating period.
ERR RAT 0 → 1	Displays the number of data *zeros* detected in error as a data *one* divided by the number of clock periods since the start of the gating period.
ERR RAT 1 → 0	Displays the number of data *ones* detected in error as a data *zero* divided by the number of clock periods since the start of the gating period.
DATE TIME	Displays the current date and time of the real clock within the error detector module.
PATTERN IDNTITY	Displays two lines that identify the pattern selected. Note: this selection reserves two adjacent lines of the display even for pure PRBS selections, where only one line is needed.
more 2 of 9	Selects the next page of softkey selections.
ERROR s	Displays the number of one second intervals (since the start of the gating period) in which one or more errors were detected.
ERROR ds	Displays the number of one decisecond intervals (since the start of the gating period) in which one or more errors were detected.
ERROR cs	Displays the number of one centisecond intervals (since the start of the gating period) in which one or more errors were detected.
ERROR ms	Displays the number of one millisecond intervals (since the start of the gating period) in which one or more errors were detected.
CLOCK FREQ	Displays the frequency of the incoming clock.
more 3 of 9	Selects the next page of softkey selections.

ERORR FREE s	Displays the number of one second intervals (since the start of the gating period) in which no errors were detected.

ERROR FREE ds	Displays the number of one decisecond intervals (since the start of the gating period) in which no errors were detected.
ERROR FREE cs	Displays the number of one centisecond intervals (since the start of the gating period) in which no errors were detected.
ERROR FREE ms	Displays the number of one millisecond intervals (since the start of the gating period) in which no errors were detected.
ADD BLANK	Inserts a blank line into the screen. The blank line is highlighted by a colon (:) at the extreme left of the screen.
DELETE BLANK	Deletes a blank line on the display. If more than one *blank line* currently exists, the one nearest the bottom of the display is deleted.
more 4 of 9	Selects the next page of softkey selections.

AVAILBL (%)	Displays G.821 *availability* measurement.
UNAVAIL (%)	Displays G.821 *unavailability* measurement.
SEV ERR SECS (%)	Displays G.821 *Severely Errored Seconds* measurement.
ERRORED SECS (%)	Displays G.821 *Errored Seconds* measurement.
DEGRADE MINS (%)	the G.821 *Degraded Minutes* measurement.
more 5 of 9	Selects the next page of softkey selections.

SYNC	Displays the synchronization (MANUAL or AUTOMATIC) and the error ratio threshold above which automatic re-synchronization is initiated.
0/1 THR	Displays the method of determining the data input discrimination level (MANUAL or AUTOMATIC) and the value of the current 0/1 threshold level.
DAT CLK TERM	Displays the data input termination level.
DATA POLRITY	Displays data input polarity (NORMAL or INVERTED).
DAT I/P DELAY	Displays the time delay between the active edge of the clock and the act of sampling the data input.
CLOCK EDGE	Displays the direction of the active clock edge (positive or negative).
more 6 of 9	Selects the next page of softkey selections.

GATING MODE	Displays selected gating mode (MANUAL, SINGLE or REPETITIVE).
GATING REPORT	Displays results from the PREVIOUS or CURRENT gating interval.

GATING PERIOD	Displays gating period length.
POWER LOSS s	Displays the number of one second intervals (since the start of the gating period) for which power to the error detector was lost.
SYNC LOSS s	Displays the number of one second intervals (since the start of the gating period) for which the incoming and internal patterns were out of synchronisation.
more 7 of 9	Selects the next page of softkey selections.

LOGGING STATUS	Indicates whether LOGGING is ON or OFF.
ALARMS LOGGING	Indicates whether the LOG ALARMS softkey is enabled or disabled.
LOG DUR TRIGGER	Displays the trigger which, when it occurs will initiate logging during the gating period. The selection is between log on error seconds and log on the error ratio greater than a set threshold.
LOG END TRIGGER	Displays the trigger which will initiate logging at the end of the gating period. The selection is between always, error count non-zero and error ratio greater than a set threshold.
LOG END REPORT	Displays whether a *Full Report* or the *User's Page* results selections are logged at the end of the measurement period.
LOGGING THRSHLD	Displays the current selection of the user - threshold that is used to determine when output is logged.
more 8 of 9	Selects the next page of softkeys.

SQUELCH STATUS	Indicates whether Squelch is ON or OFF.
HP-IB CONTRLR	Displays whether the error detector is configured as a controller (HP-IB CONTRLR set to ON), or controlled by a Controller in which case the key is set to OFF. The key is ON when it is underlined.
EYE EDG THRSHLD	Displays the current *eye edge threshold* value entered by the user.
EYE WIDTH	Displays the eye width measured during the last successful occurrence of the clock-to-data alignment, and the eye edge threshold value set when it was measured.
EYE HEIGHT	Displays the last measured value of the data input eye height.
more 9 of 9	Returns to the first page of softkey selections.

Misc Menu

Path

(MENU) misc

Description

The misc softkey allows miscellaneous user functions to be selected via the right-menu softkeys. The recall setup and save setup keys are used to recall and save the module's current configuration. The misc right menu softkeys are as follows:

recall setup Enables a lower-level menu from which a module configuration can be recalled. The choices are from ten *USER SETUPS* and two *PRESETS*. Each *USER SETUP* permits the user to store an entire module configuration, and each *PRESET* holds a pre-defined module configuration. See Appendix A for a list of *PRESET* configurations.

save setup Enables a choice from ten *USER SETUPS* into which the user may store an entire module configuration.

set clock Enables right-menu softkeys which allow the user to set up the error detector real-time clock. This is the clock that is used to time stamp logging.
On power-up, the error detector searches the HP-MSIB address space to its left (both on the same row and below) for a module with TIME capability. If it finds one and reads a valid time from it, the error detector deems that module to be the holder of the system time and will not let the user set the time in the error detector. The error detector will re-sync its time to the system time at power-on and every hour (when not gating).

If the error detector does not find another module with the time, it uses the time from its real-time clock as the system time. In this case the user can set the date and time as they wish.

Note The above algorithm specifically uses the HP-MSIB address and not the HP-IB address.

The range of the date and time is from the start of 1990 to the end of 2049.

When the user is setting the time the individual parameters (hours, minutes and seconds) are not coupled in any way and have the expected ranges.

When setting the date, there is a degree of coupling involved. If the user selects a YEAR which causes the current DAY setting to be

invalid, the day is changed by the minimum amount to make it valid, for example, 29 Feb 91 is changed to 28 Feb 91.

Similarly, if the user selects a MONTH which makes a day invalid, the DAY is again changed. When entering a DAY, only those days which are valid for the current month and year settings are allowed.

`delete discpat` Permits a disc-based pattern to be deleted from the disc of a slaved pattern generator. The key is blank if there is no slave.

`format disc` Permits a disc to be formatted. The key is blank if there is no slave.

`KEYBRD LOCKED` Toggles between the locked and unlocked state. When locked the user can not modify any of the instrument's configuration parameters, only display parameters. Keyboard is locked when the softkey is underlined.

`more 1 of 2` Selects the next page of softkey selections.

`FRMWARE VERSION` Shows the firmware version code, in the form X.nn.nn. For example: "F/W: Cntl Proc B.01.00, Meas Proc B.01.00"

If a pattern generator and/or a clock source is slaved to the error detector then another key selection permits the slaves firmware revision to be displayed, for example.

"F/W:Pat Gen B.00.15, Clk Src A.01.20"

`SELF TEST` Enables the instrument to self-test the processor ROM and RAM.

The instrument settings are not affected by this self-test. This command is not allowed during gating.

`BEEP ON ERROR` Toggles on or off an audible warning that bit errors have occurred. The repetition rate of the beep varies depending on the delta error ratio as shown in the following table:

The error detector must be allocated a window in the Display for the beep to sound.

Table 4-1. Beep Repetition Rate

delta BER	Beep Repetition Rate
1E-1	continuous beep
<1E-1 to >= 1E-3	short beep every 0.1 seconds
<1E-3 to >= 1E-5	short beep every 0.2 seconds
<1E-5 to >= 1E-7	short beep every 0.3 seconds
<1E-7 to >= 1E-9	short beep every 0.4 seconds

`more 2 of 2` Returns to the first page of softkey selections.

Show Modules (only valid for Master/Slave configuration)

Path

(MENU) show modules

Description

The show modules softkey only functions if the error detector has a pattern generator as a slave. If this is not the case then the error detector uses the whole window assigned to it for its own display; but when it does have a slave, there is the possibility that the window may be shared by both modules.

The show modules softkey right-menu has two toggle keys as follows:

SHOW ERR DET	Enables the display to show the error detector page.
SHOW PAT GEN	Enables the display to show the Pattern Generator page.

There are two possible cases to consider:

1. The error detector has been assigned a window that is at least half a screen but less than a full screen in size. In this case these two keys are mutually exclusive and either will toggle both when pressed. The window is given to whichever module is indicated by the currently active key.
2. The error detector has been assigned a window that is the size of the full screen. In this case the two keys toggle independently. If only one key is selected then the corresponding module will be allocated the whole screen. If both keys are selected the screen is split into two sub-windows and one is allocated to each module. The error detector will have the upper sub- window and the pattern generator the lower. The keys may not be selected to be both off together.

If the error detector does not have a pattern generator as a slave, and you wish to split the window into two to display both pattern generator and error detector status please refer to the *View Module Status in 1 or 2 Predefined Windows* section in chapter 5.

5

OPERATING FEATURES

Introduction

The chapter introduces you to some of the features incorporated in the HP 71600B Series error performance analyzers and pattern generators, and also how the instrument can be used in selected applications. All procedures refer to systems configured for master/slave operation unless otherwise noted.

To Store and Recall Measurement Configurations

Introduction

For some users, many different measurement setups and tests may be required. The ability to remember these configurations and recall them on demand is highly desirable, as it simplifies system operation and saves valuable test time. The HP 71600B Series error performance analyzer offers this feature by providing nonvolatile memory, allowing up to ten measurement configurations to be stored in memory and recalled on demand. Also included are two predefined fixed PRESET module configurations. Both types of store are explained in the following text.

- Recall one of two predefined PRESET module configurations. Refer to Appendix A for a list of PRESET settings.
- Store one of your own module configurations in memory for later recall.

To Recall One of Two PRESET Module Configurations

1. Press the (MENU) fixed label key.
2. Select the `more 2 of 2` left-menu and press the `misc` softkey.
3. Press the `recall setup` right-menu softkey.
4. Select one of the two PRESET right-menu softkeys. The module configuration stored in the PRESET softkey selected now becomes the current system or module configuration.

To Store and Recall User Defined Module Configurations

1. Press the (MENU) fixed label key.
2. Select the `more 2 of 2` left-menu.
3. Press the `misc` softkey.

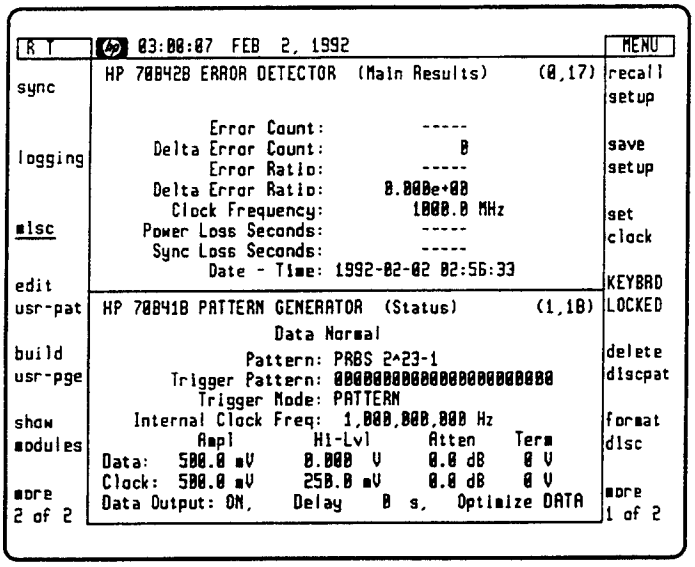


Figure 5-1. `misc` Right-Menu Softkeys

To Store User Defined Module Configurations

4. With the **`misc`** softkey still selected, press the **`save setup`** softkey. Select one of the ten USER SETUP softkeys in which to store your module configuration. When you press a **`USER SETUP`** softkey the current module configuration is automatically stored in that location.

To Recall User Defined Module Configurations

5. With the **`misc`** softkey still selected, press the right-menu **`recall setup`** and then select from the **`USER SETUP`** softkeys. The contents of the USER SETUP selected now become the current module configuration.

View Module Status in 1 or 2 Predefined Windows

The HP 70004A Display provides the user with the opportunity to display the status of modules in one or two predefined windows. The following example shows the pattern generator and error detector modules stacked in two windows.

Refer to the HP 70004A Display Operation manual for detailed information on the Build or Stack Window feature.

Note

It is assumed that both error detector and pattern generator are configured for master/master operation. That is both modules have an HP-MSIB Row address of '0'. If your system is configured for master/slave operation use the left- menu **show modules** softkey to select and display module status, and ignore this procedure.

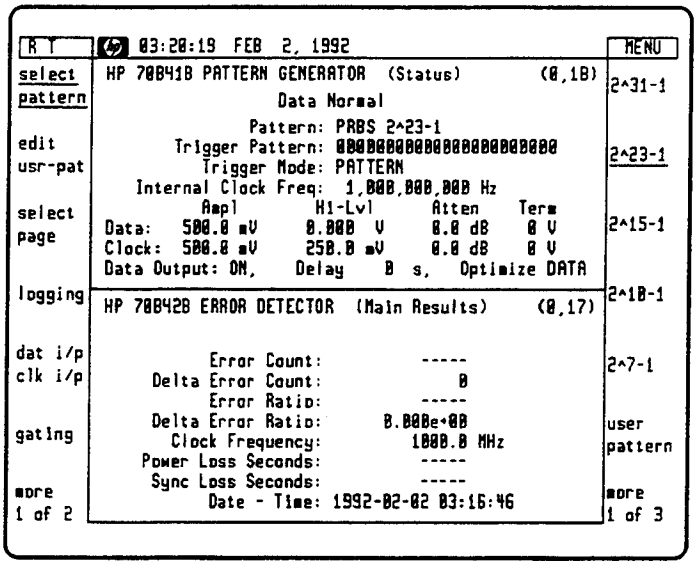


Figure 5-2. Stack two windows

Use the following flow chart to configure the display for one or two windows, or save a window configuration. The following notes are given as an aid to understanding the flow chart operation.

Assign Window Notes Use the Display knob to select window 1 or window 2 (see bottom of screen). The window to be assigned is highlighted by a green border.

HP-MSIB Notes. Once a window is assigned you must select the HP-MSIB column address of the module to be displayed. When the **HP-MSIB Column** key is pressed the HP-MSIB Column number is given at the bottom of the screen. As the display knob is varied the column number changes. Set the column number to that of the module you wish displayed (for example, pattern generator default address=18, error detector default address=17). Any module having an HP-MSIB Row Address of '0' is considered a master.

To Build or Stack 2 Windows

Use the following flow chart to build and assign the window of your choice.

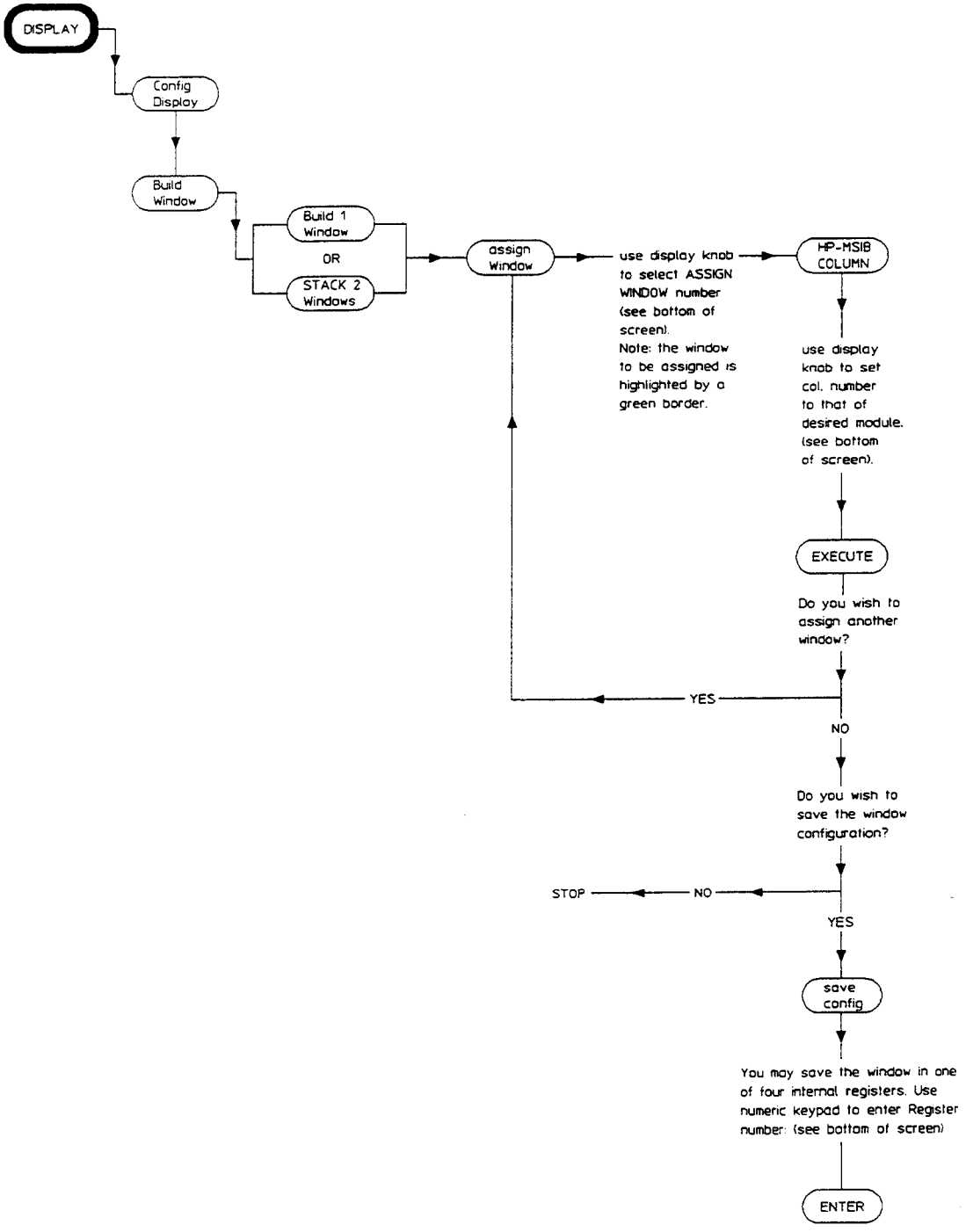


Figure 5-3. To Build or Stack 2 Windows

Save or Recall Windows

Once you have configured a window to display a module status (for example results or configuration), you may save that window in one of four internal registers, and then recall that window at any time. For example, you may wish to store pattern generator status in register 1, error detector status in register 2, and then stack 2 windows to display both modules, and store these in register 3.

To Save a Window

If for example the pattern generator status is currently displayed and you wish to store the window in register 2 proceed as follows:

a. Press the (Display) then `Config Display` keys.

b. Now press the `SAVE CONFIG` key. Note the message at the bottom of the screen asking you to save the screen configuration in one of the four internal registers.

c. Enter the value 2 using the keypad then press `ENTER`. The Pattern Generator window is now stored in register 2.

To Recall a Window

a. Press the (Display) then **Config Display** keys.

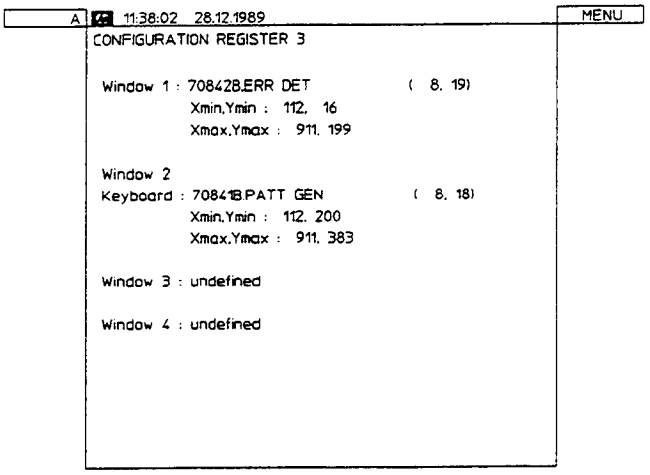
b. Press the **Recall Config** key.

c. Enter the number of the register you wish to recall using the keypad, then press the **ENTER** key.

View the Windows stored in the 4 internal registers

a. Press the (Display) ,**Config Display** then **SHOW CONFIG** keys.

b. Use the ▲ and ▼ keys on the display front panel to view the configuration of the four internal registers.

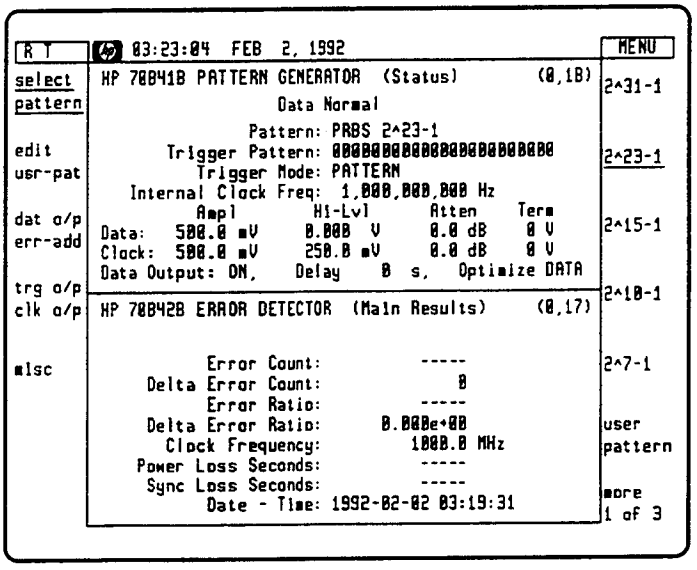


c. Press the (MENU) key to return to displaying module status.

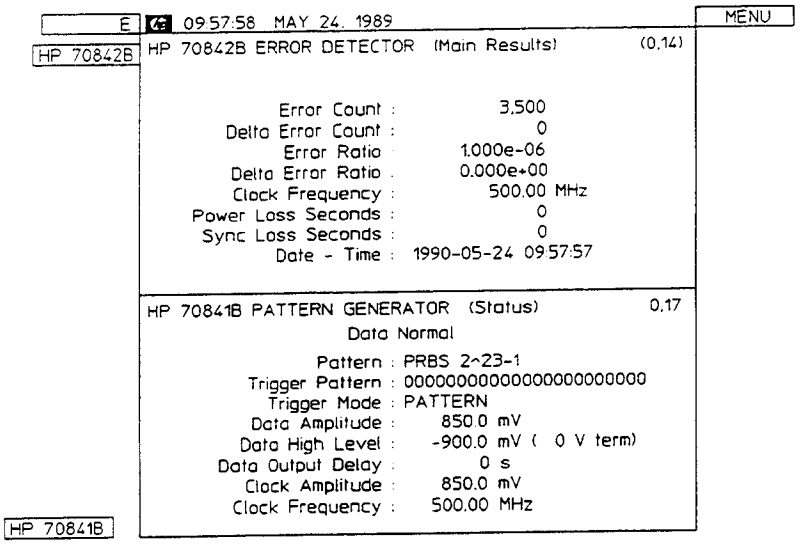
Display Module Status when two Windows are Assigned

Introduction

The following information applies to systems configured for master/master operation only. For a quick method of displaying module status when two *Windows* are assigned use the (INSTR) fixed label key. This key is used to transfer the keyboard between instruments on row 0 of the address map. An example of a display with two Windows assigned is given below.



When the (INSTR) fixed label key is pressed the display assigns colored borders to the Windows. Adjacent to the left-side of each Window is a softkey which, when pressed assigns the keyboard to that module, and also displays the softkeys for that module. Similar in action to when the (MENU) key is pressed. An example of a display when the (INSTR) key is pressed is shown on the following page.


E
09:57:58 MAY 24, 1989
MENU
HP 70842B
HP 70842B ERROR DETECTOR (Main Results) (0,14)
Error Count : 3,500
Delta Error Count : 0
Error Ratio : 1.000e-06
Delta Error Ratio : 0.000e+00
Clock Frequency : 500.00 MHz
Power Loss Seconds : 0
Sync Loss Seconds : 0
Date - Time : 1990-05-24 09:57:57
HP 70841B PATTERN GENERATOR (Status) 0,17
Data Normal
Pattern : PRBS 2^23-1
Trigger Pattern : 00000000000000000000
Trigger Mode : PATTERN
Data Amplitude : 850.0 mV
Data High Level : -900.0 mV (0 V term)
Data Output Delay : 0 s
Clock Amplitude : 850.0 mV
Clock Frequency : 500.00 MHz
HP 70841B

Pattern Generator Features

Patterns

The following test patterns are provided:

PRBS Test Patterns:

- 2^{31}-1, polynomial $D^{31}+ D^{28}+1=0$, inverted.
- 2^{23}-1, polynomial $D^{23}+ D^{18}+ 1=0$, inverted (as in CCITT Rec 0.151).
- 2^{15}-1, polynomial $D^{15}+ D^{14}+ 1=0$, inverted (as in CCITT Rec 0.151).
- 2^{10}-1, polynomial $D^{10}+ D^{7}+ 1=0$, inverted.
- 2^{7}-1, polynomial $D^{7}+ D^{6}+ 1=0$, inverted.

Zero Substitution/Variable Mark Density Test Patterns

- 8192 bits, based on 2^{13}-1 PRBS;
- 2048 bits, based on 2^{11}-1 PRBS;
- 1024 bits, based on 2^{10}-1 PRBS;
- 128 bits, based on 2^{7}-1 PRBS;

Zero Substitution

Zeros can be substituted for data to extend the longest run of zeros in the above patterns. The longest run can be extended to the pattern length, minus one. The bit after the substituted zeros is set to 1.

Variable Mark Density

The ratio of 1s to total bits in the above patterns can be set to 1/8, 1/4, 1/2, 3/4 and 7/8.

Word Test Patterns

Variable length user patterns from 1 to 4194304 bits are provided.
Resolution from:
1 to 32 kbits in 1-bit steps.
32 kbits to 64 kbits in 2 bit steps
64 kbits to 128 kbits in 4 bit steps
128 kbits to 256 kbits in 8 bit steps
256 kbits to 512 kbits in 16 bit steps
512 kbits to 1 Mbits in 32 bit steps
1 Mbits to 2 Mbits in 64 bit steps
2 Mbits to 4 Mbits in 128 bit steps

Pattern Stores

Four internal user pattern stores capable of holding up to 8192 bits, and eight disc pattern stores capable of storing up to 4 Mbits of data are provided.

Alternating Word Test Patterns

Alternate between two user-programmable 16-bit words under the control of the rear-panel Auxiliary input; changeover is synchronous with the end of the word. Refer to Chapter 1 for an explanation of the AUX INPUT operation.

Alternate Patterns

To configure the instrument to output an alternating pattern the user must consider three operations as follows:

- Selecting a source of control
- Selecting the format of the alternate pattern output
- Using the editor to setup an alternate pattern

The folowing paragraphs explain each of these operations, and the softkey menu chart on the following page illustrates the softkey selections and choices available to the user, when selecting the control and output format of alternate patterns.

1. Select a Source of Control

Determine how you wish to control alternate patterns and the format of the output. There are three sources of control as follows:

- From the front panel.
- Over HP-IB.
- The rear panel AUX INPUT port.

2. Select the Format of the Alternate Pattern Output

Switch between two patterns (A and B) with the switch occurring at the end of a pattern. There are two modes of operation as follows:

- `ALT` Switch between two data patterns (A and B), for example from (A to B) or (B to A).
- `ONCE` Insert a single occurrence of a number of instances of pattern B between repetitions of pattern A (see page 1-11 for further information).

Patterns A and B must be as follows:

- The same length.
- 1 bit to 2 Mbits in length.

Resolution

1 bit to 16 kbits in 1 bit steps
16 kbits to 32 kbits in 2 bit steps
32 kbits to 64 kbits in 4 bit steps
64 kbits to 128 kbits in 8 bit steps
128 kbits to 256 kbits in 16 bit steps
256 kbits to 512 kbits in 32 bit steps
512 kbits to 1 Mbits in 64 bit steps
1 Mbits to 2 Mbits in 128 bit steps

3. Use the Editor to Select and Generate an Alternate Pattern

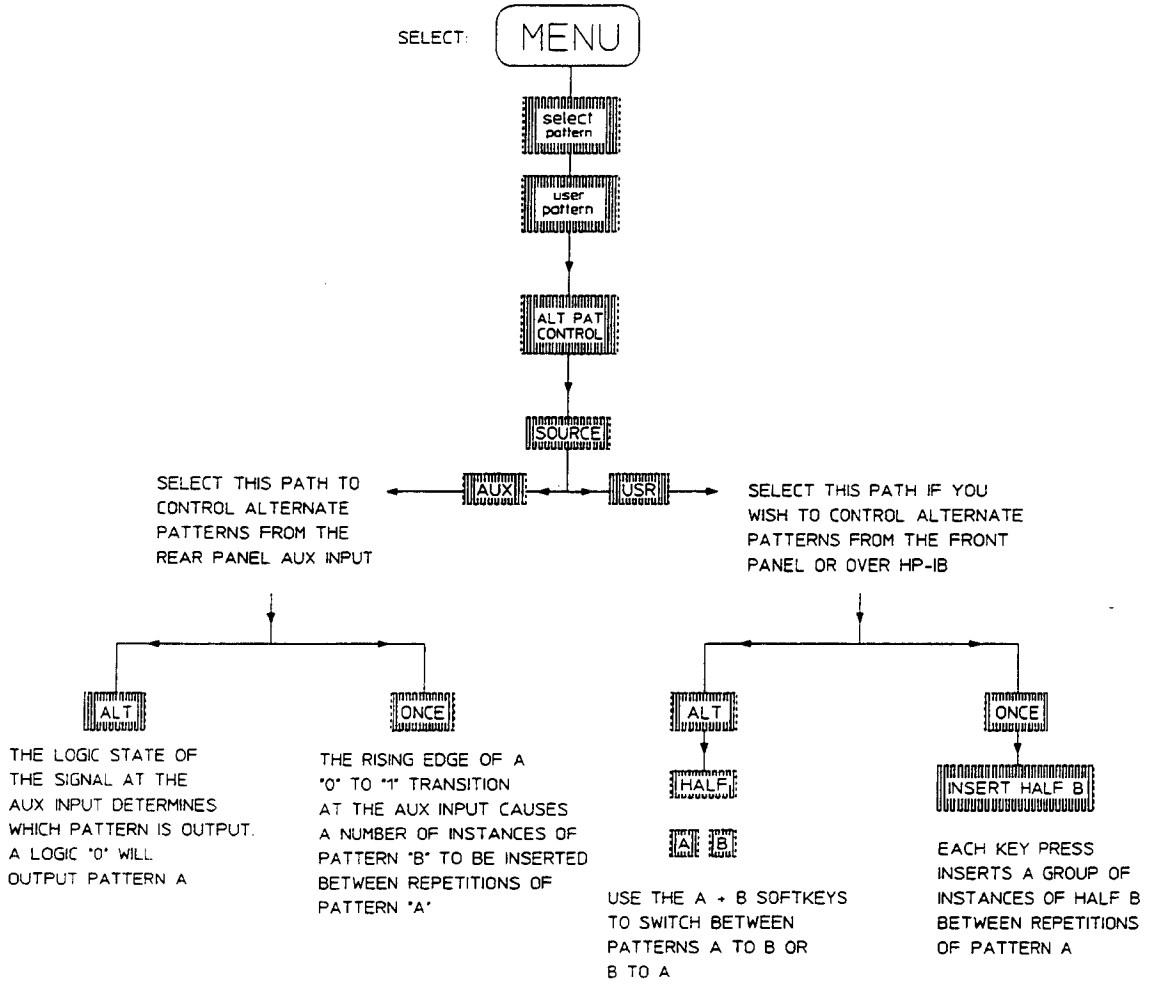
After selecting the source of control and output format for an alternate pattern, use the instrument editor to select the following:

- Select alternate pattern mode.
- Configure an alternate pattern using the editor softkeys.
- Save the alternate pattern to pattern store.

Procedures for performing the above tasks are given in chapter 6 User Patterns and Disc Operation.

Softkey Menu Chart for Alternate Pattern Control

The following chart illustrates the softkey selections when selecting alternate pattern control and output format.



Trigger Output

The TRIGGER OUT port provides a trigger pulse which is either synchronized to the pattern currently selected (PATTERN mode) or is the input clock divided by 32 (CLOCK/32 mode). This pulse can be used to trigger an oscilloscope or other test equipment. An explanation of each mode is given in the following text.

Pattern Mode

For all patterns except Alternate Word the trigger output is a single pulse synchronized to repetitions of the patterns. The rising edge of the pulse is the active edge. This mode is used to trigger an oscilloscope when a waveform display of random pulses is required. The trigger pulse synchronization point and repetition rate for each pattern in the HP 71600B Series pattern generators is given in Table 5-1. Note that the `TRIGGER PATTERN` softkey is only displayed when a standard (pure) PRBS is selected, and the `TRIGGER BIT` softkey when a User Pattern, Zerosub or Markden pattern selected.

Table 5-1. Trigger Pulse Synchronization Point

Pattern	Synchronization Point	Pulse Repetition Rate
Standard PRBS that is, one of the PRBS patterns of 2^7-1, 2^{10}-1, 2^{15}-1, 2^{23}-1 or 2^{31}-1 selected via the `select pattern` softkey.	The trigger pulse synchronization point occurs when the user defined *trigger pattern* (setup via the `trg o/p, clk o/p` , `TRIGGER PATTERN` softkeys) is matched with the same pattern in the PRBS currently selected.	One trigger pulse per 16 PRBS patterns, except for the 2^7-1 and 2^{10}-1 PRBS which is one pulse per 128 pattern repetitions.
All Other Patterns Includes ZEROSUB, MARKDEN and all other user defined patterns.	The trigger pulse synchronization point may be set by the user to any point in the pattern by using the `TRIGGER BIT` softkey. The `TRIGGER BIT` softkey is displayed when the left-menu `trg o/p, clk o/p` softkey is selected.	The pulse repetition rate depends on the pattern length (with the exception of alternate word patterns) and occurs at least every 128 repetitions of the pattern. The rising edge of the trigger pulse is active. See Table 5-2.
Alternate Word Selected via the `select pattern` softkey	The trigger output pulse is a regenerated version of the rear panel AUX input signal, which is used to switch between word 0 and word 1.	

Table 5-2. Trigger Pulse Repetition Rate

Pattern length divides exactly by:	Pattern repetitions between trigger pulses
128	1 (128/128=1)
64	2 (128/64=2)
32	4 (128/32=4)
16	8 (128/16=8)
8	16 (128/8=16)
4	32 (128/4=32)
2	64 (128/2=64)
1	128 (128/1=128)

Clock/32 Mode

The trigger output pulse is the pattern generator input clock divided by 32. This mode is used for eye diagram generation with oscilloscopes where the trigger bandwidth is significantly less than the data bandwidth.

To Display and Measure Data Waveforms

Introduction

The following procedure explains how the user may display and measure individual segments of a PRBS pattern. An HP 54120A digitizing oscilloscope is used in this procedure. If you are not using this type of oscilloscope ignore references to particular keys, and substitute them with those of your own oscilloscope. The basic procedure is however common to all oscilloscopes.

Procedure

1. Connect the HP 71600B Series pattern generator and clock source modules as shown in the following diagram.

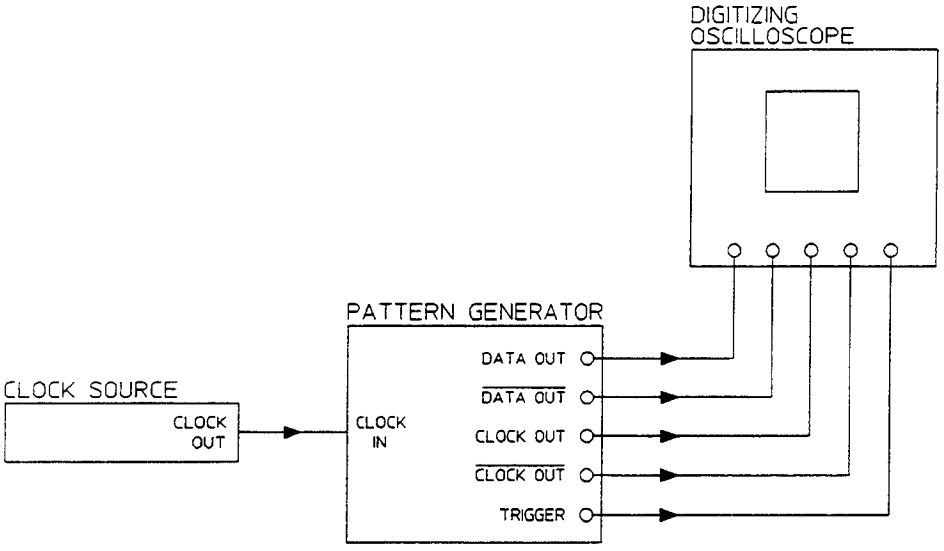


Figure 5-4. To Display and Measure Data Waveforms

To Set Up the Pattern Generator

To Display Only Pattern Generator Status

2. Press the (MENU) key. Set the pattern generator to its default settings by pressing the green (INSTR PRESET) key.

If your system is configured for master/master operation press the (DISPLAY) and **NEXT INSTR** keys until the pattern generator status is displayed.
If your system is configured for master/slave operation select the **more 2 of 2** left-menu. Press the **show modules** and **SHOW PAT GEN** softkeys. Press the **SHOW ERR DET** softkey to turn off the error detector.

To Set Up the Clock Frequency

If you are using an HP 70311A or HP 70312A clock source slaved to the pattern generator continue to step 3 if not, set your clock source to provide a -3dbm to +3dbm sinusoidal level and set to the desired frequency. In this example it is set to 1GHz.

3. Select the `more 1 of 2` left-menu.

4. Press the `trg o/p, clk o/p` left-menu softkey. Use the right-menu `CLOCK FREQ` and `FREQ STEP` softkeys to select the desired clock frequency (1GHz in this example).

Select a Pattern and Trigger

5. Press the left-menu `select pattern` softkey and select the desired pattern from the right-menu (`2^15-1` } for this example).

6. Press `trg o/p, clk o/p` and set the `TRIGGER PAT CLK` key to `PAT`.

Select Clock Amplitude

7. With the `trg o/p, clk o/p` menu still displayed press `CLOCK AMPLTD` and enter the desired pk-pk clock signal using the display knob, or numeric keypad. For this example the clock amplitude is set to 500mV.

Select Data Output Termination

8. Press `dat o/p, err-add`. Select the `more 2 of 2` right-menu and set the `TERM 0V -2V` softkey to `0V`.

Setting Up the Oscilloscope

If you are not using an HP 54120A oscilloscope use the equivalent keys on your oscilloscope to examine the pattern.

9. Press (AUTO-SCALE).

10. Press `Display` (bottom of screen), then set the Display Mode to `Averaged`.

11. Press `Timebase`. Adjust the `Sweep Speed` and `DELAY` as necessary to display the pattern of interest.

To Measure the Data

12. Press the oscilloscope **More** key (bottom right of screen). Press the oscilloscope **Measure** and **All** keys. An example of a typical data output waveform is given below.

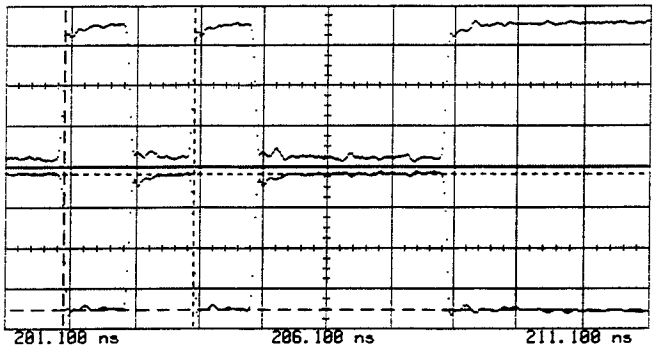


Figure 5-5. Data Output Waveform

Viewing a 2^23-1 PRBS

If you select a 2^23-1 PRBS it is possible that the oscilloscope may *timeout* during the Autoscale as triggering is infrequent. To overcome this the oscilloscope may be triggered manually, or Autoscale on a 2^15-1 PRBS and then select 2^23-1 PRBS.

To View Selected Segments of a PRBS

To view different segments of the PRBS pattern on the oscilloscope display, vary the oscilloscope timebase delay. If the segment of interest is out side the range of the oscilloscope delay, change the pattern generator Trigger Pulse position. To change the pattern generator Trigger Pulse position proceed as follows:

1. On the HP 71600B Series pattern generator select the **more 1 of 2** left- menu and press **trg o/p, clk o/p**.

2. Press the right-menu **TRIGGER PATTERN** softkey and then enter a trigger word pattern using the numeric keypad that corresponds to a similar word in an area of the pattern you wish to view.

3. Re-adjust the oscilloscope timebase and delay to display the pattern segment of interest.

For Zero-Substitution, Mark Density or User Patterns the method of positioning the pattern generator Trigger Pulse is different, see Table 5-1.

Measuring Input Sensitivity

Introduction

The following procedure illustrates how to check the input sensitivity of a device or system, using the pattern generator Data Outputs to stimulate the input to the device, and the error detector to monitor the output for errors. The input level to the device is varied until a point is found where the level just starts to introduce errors in the received data stream.

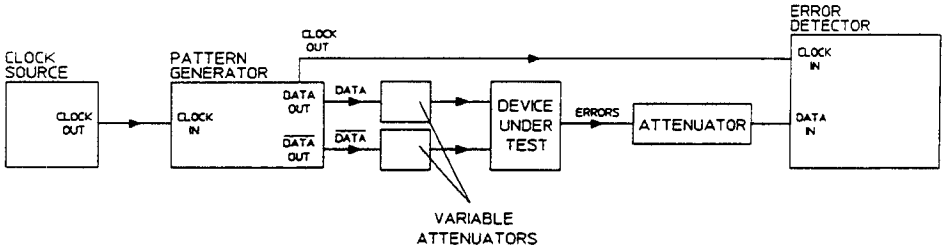


Figure 5-6. To Measure Input Sensitivity

Note It is assumed that the system is configured for master/slave operation.

Procedure

1. Connect the HP 71600B Series error performance analyzer as shown above.
2. Select the data attenuators to match the device under test input range to the pattern generator output range.
3. Press the (MENU) key. Set the system to its default settings by pressing the green (INSTR PRESET) key.
4. Set the display to show both pattern generator and error detector status as follows: Press the left-menu `more 1 of 2` and `show modules` softkeys. Select `SHOW PAT GEN` and `SHOW ERR DET` softkeys (both underlined).
5. Select the `more 1 of 2` left-menu.
6. Press the `dat o/p,err-add` softkey and using the right-menu softkeys, set the Data Amplitude, Data Hi-Level and Data Termination to suit your application, or device under test. Use the `DATA AMPLTD`, `DATA HI-LEVL` and `TERM` softkeys.

Note When the `TERM 0V/-2V` softkey is set to `-2V` the Data Amplitude is set to 250mV. To increase the Data Amplitude press the `DATA AMP` softkey, and adjust the Data Amplitude using the display knob.

7. Press the `dat i/p, clk i/p` softkey, and select a suitable data input termination using the `TERM 0V/-2V` softkey.

8. Press the `gating` softkey and select a SINGLE or REPETITIVE gating period. Press the `GATING PERIOD` softkey and select the gating period. Select `RUN GATING`.

9. To view measurement results, press `select page` then `MAIN RESULTS`.

10. Adjust each external Variable Attenuator in turn until errors occur. This will indicate the performance of the device or system under test to varying levels of input voltage.

To determine the voltage at the output of the Attenuators you may use one of two methods as follows:

- Connect a suitable measuring instrument (for example an oscilloscope or voltmeter) to the output of the attenuators.
- Use the pattern generator `EXT DAT ATTEN` feature to calculate the attenuator output. (As described below)

External Attenuator Output Calculation

The HP 71600B Series pattern generator offers the user the opportunity to enter the value of an external attenuator in decibels, and then read from the display the calculated voltage at the attenuator output. From this you can establish the levels of input voltage which induce errors in the device under test. To do this proceed to step 11.

Note

The attenuator output voltage is calculated based on a voltage of 250mV at the pattern generator DATA OUT port.

---

11. Press the `dat o/p,err-add` softkey and then the right-menu `more 1 of 2` softkey.

12. Select `EXT DAT ATTEN`.

13. Enter the *data attenuation* value (the value of your external Attenuator) using the numeric keypad or display knob.

14. Check the Data Amplitude reading, it may not be what you expect; this is because when the `EXT DAT ATTEN` softkey is enabled, and an attenuation value selected, the voltage at the DATA OUT port is set to 250mV (see Note above). Therefore to determine at which point errors cease, increase the Data Amplitude as follows until errors stop.

15. Press the right-menu `more 2 of 2` softkey, then select `DATA AMPLTD`. Adjust the Data Amplitude using the large display knob, until errors just occur. This gives the correct input sensitivity of the device under test.

Measuring rms and pk-pk Jitter of a System Under Test

Introduction

In the following procedure an HP 71600B Series pattern generator is used to stimulate a system under test with a PRBS pattern. The output of the system under test is then checked on an oscilloscope for rms and p-p jitter. The oscilloscope used in the procedure is an HP 54120A digitizing oscilloscope. If you are not using this type of oscilloscope please ignore references to particular keys, and substitute them with those of your own oscilloscope. The basic procedure is however common to all oscilloscopes.

Note

It is assumed that both pattern generator and error detector are configured for master/slave operation. For example the error detector HP-MSIB Row Address is '0', and the pattern generator Row Address is '1'.

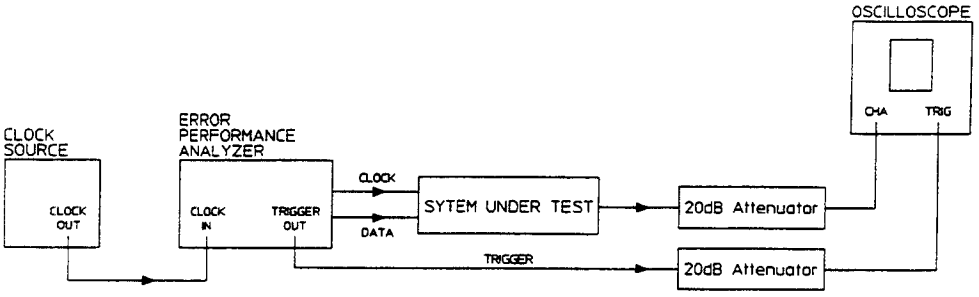


Figure 5-7. To Measure rms and pk-pk Jitter of a System Under Test

To Measure rms Jitter

Procedure

1. Connect the HP 71600B Series pattern generator TRIGGER OUT, CLOCK OUT and DATA OUT ports as shown in Figure 5-7.
2. Set the pattern generator to its default settings by pressing the green (INSTR PRESET) key.

To set up the Pattern Generator Clock Frequency

3. If you are not using an HP 70311A clock source as a slave to the pattern generator, set your clock source to the frequency you require and go to step 5, otherwise go to step 4. For this example the clock frequency is set to 2.5GHz.
4. Press the (MENU) and `trg o/p, clk o/p` keys. Use the right-menu `CLOCK FREQ` and `FREQ STEP` keys to set up a clock frequency of 2.5GHz.

Display Pattern Generator Status

5. Select the `more 2 of 2` left-menu and press `show modules` followed by the right-menu `SHOW PAT GEN` softkey. Press the `SHOW ERR DET` softkey to turn off the error detector.
6. Select the `more 1 of 2` left-menu, press the `select pattern` softkey and select a `2^23-1` PRBS.

7. Press the **trg o/p, clk o/p** softkey and set the TRIGGER to **CLK** (clock/32).

Setting up the Oscilloscope

8. Press **DISPLAY**, set the oscilloscope *Display Mode* to **Persist** then press AUTO SCALE.

9. Press **Timebase** and adjust the oscilloscope **Sweep Speed** using the large display knob to view a single *eye* on the screen (approximately 50ps at 2.5GHz). Adjust the oscilloscope **Delay** to give a single *crossover* point. Use the **DELAY** softkey and the large display knob to adjust the delay.

10. Press the **More** key on the oscilloscope.

11. Press **Histogram** then **Window**. Adjust **WINDOW MARKER 1** to the center of the eye *crossover* point. Press **WINDOW MARKER 2** and set to the same.

12. Select **Acquire**. Enter the number of samples (typically 1000 for user applications).

13. Press **Start Acquiring** wait until 100% complete (see top left of screen), then select **Results** and **Sigma**.

The **Sigma** result is the *rms* value of the jitter (displayed at bottom right of screen).
Continue to the next page for a procedure on how to measure pk-pk jitter.

To Measure Pk-Pk Jitter

Continue with the procedure at step 14.

14. Press the oscilloscope **UPPER DISTR LIMIT** key and adjust the dotted red vertical line to the outer (right) limit of the eye *crossover* point.

15. Press the **LOWER DISTR LIMIT** key and repeat the process, this time to the extreme left of the crossover point.

16. The Δ t (pk-pk) result at the bottom right of the screen is the pk-pk jitter result. The following figure gives an example of a typical eye diagram waveform.

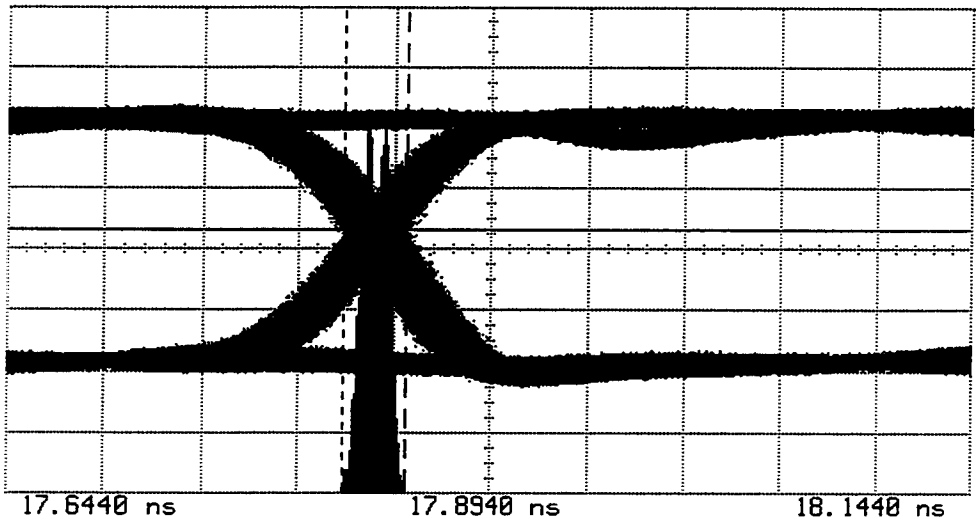


Figure 5-8. Eye Diagram Waveform

Error Detector Features

Automatic Clock-to-Data Alignment

Introduction

An important feature of the HP 70842B error detector is the ability to automatically align the clock and data inputs such that the error detector samples in the middle of the *eye* (in the time axis). This reduces setting-up time as it automatically compensates for delays in the clock/data paths, preventing unnecessary errors.
The delay point in the *eye* at which the error detector samples can also be set manually using the `DAT I/P DELAY` softkey (part of the left-menu `dat i/p, clk i/p` set of softkeys).

Definition

In order for the system to align the clock with the data (at the error detector input) it must find the edges of the data input *eye*. The *eye* edge is defined as a data input delay point where the Bit Error Ratio (BER) measured over a deci-second interval is less than or equal to a pre-defined threshold, and another adjacent point which is greater than the threshold. The *Eye Edge Threshold* can be set by the user to any value between 0.1 and 0 either via the `EYE EDG THRSHLD` softkey or remotely.

It is recommended that you perform the Clock-to-Data alignment procedure each time you configure an HP 71600B Series error performance analyzer. Normally this would be after setting-up instrument parameters such as Pattern, Data Output (Level, Polarity) and Data Input (0/1 threshold, polarity). The *Making Your First Measurement* procedure in Chapter 2 includes a clock-to-data alignment step.

Eye Width

Each time a successful clock-to-data alignment procedure is performed the eye width is calculated, and displayed at the bottom of the display. This result is also available on the INPUT STATUS page and can be added to the USER'S PAGE.

Note

The clock/data alignment process time is pattern dependent, and with some large user patterns alignment can take several minutes. If you wish to select a user pattern, it is recommended that you first peform clock/data alignment on a pure PRBS. This does not affect alignment accuracy, and can save you valuable time.

Note

Ensure that the clock frequency is stable before performing a clock-to-data alignment procedure.

Note The user must ensure that the instrument sync threshold is greater than or equal to the *eye edge threshold* to be used.

Clock/Data Alignment User Messages

The following messages may be displayed to the user at the bottom of the display during the clock-to-data alignment.

Table 5-3. Clock-to-Data Alignment User Messages

Message	Explanation
Cannot align data if gating	Alignment cannot be performed during gating as measurements are disrupted.
Clock to Data Alignment in Progress	Alignment in progress.
Clock to Data Alignment aborted	User pressed the *ABORT ALIGN* key.
No Point Worse Than Threshold Found	Could not find a data input delay point where BER exceeded the Eye Edge Threshold.
No Point Better Than Threshold Found	Could not find a data input delay point where BER was less than or equal to the Eye Edge Threshold.
Alignment Estimated from Right Hand Edge	Right hand edge only was found and eye center estimated from frequency. The data input delay point is set as close to estimated center of eye as possible.
Alignment Estimated from Left Hand Edge	Left hand edge only was found and eye center estimated from frequency. The data input delay point is set as close to estimated center of eye as possible.
Clock Edge Changed, Retrying Alignment	Could not find an edge so changing the data input clock edge and searching again.
Estimated Clk-Dat Alignment Failed	BER at estimated eye center was greater than threshold. Alignment exits and restores instrument to original state.
Clk-Dat Aligned, Eye Width=*** ps	Eye width calculated and data input delay set to center of the data input eye (in time axis).
Clk-Dat Alignment Failed	BER at calculated eye center was greater than threshold. Alignment exits and restores instrument to original state.
Alignment Failed, Frequency Unstable	The clock frequency changed significantly during the clock-to-data alignment making its results invalid. Ensure the clock frequency is not changing significantly during clock-to-data alignment.

Automatic 0/1 Threshold Center

The 0/1 THR CENTER softkey which is part of the left-menu dat i/p, clk i/p menu of softkeys enables the user to perform the following:

Set the 0/1 threshold midway between two points, top and bottom of the *eye*, where the bit error ratio is equal to a selectable threshold. The *eye* height is calculated and displayed. The BER selectable threshold is set using the EYE EDG THRSHLD key.

The 0/1 THR CENTER key may be used to determine the optimum sampling point for asymmetric *eyes*, or on patterns with an unequal mark-density.

Data Input 0/1 Threshold

Introduction

There are three methods of determining the 0/1 Threshold of input signals at the error detector data input; they are Manual, Automatic Track and Automatic Center.

If the signal at the error detector data input is a standard PRBS or a clean signal (no excessive noise or jitter) with a 1:1 mark density, use the Manual or Automatic Track Modes, otherwise use the Automatic Center mode.

Manual:	0/1 threshold can be set manually. Range:+1 to +4V nominal Resolution:10mV nominal
Automatic Track:	Tracks the mean dc level of the input signal. The 0/1 threshold calculated is displayed.
Automatic Center	The error detector sets the 0/1 threshold midway between two points, top and bottom of the *eye*, where the bit error ratio is equal to a selectable threshold. The *eye* height is calculated and displayed.

Selecting a 0/1 Threshold Method

To Select 0/1 Threshold Manual Mode

1. If your system is configured for master/master operation, press the (DISPLAY) then NEXT INSTR keys until the error detector is displayed. Press the (MENU) key to display the error detector softkeys. Proceed to step 2.

   If your system is configured for master/slave operation press the (MENU) key. If the error detector is not currently displayed, select the more 2 of 2 left-menu key then press the show modules and SHOW ERR DET softkeys.

2. Set the system to display error detector Input Status as follows:

Press the left-menu `select page` softkey, then select the right-menu `INPUT STATUS` softkey.

3. Press the left-menu `dat i/p, clk i/p` softkey. The right-menu will now change to show the `dat i/p, clk i/p` softkeys.

4. Press the right-menu `0/1 THRSHLD` softkey, (the key will be displayed in inverse video). Use the large Display knob or the Numeric Keypad to enter the desired 0/1 Threshold. The value selected is displayed at the bottom of the screen.

To Select Automatic Tracking

1. Select the error detector left-menu `dat i/p, clk i/p` softkey, then set the right-menu `0/1 THR AUTOMAN` softkey to `AUTO`, (`AUTO` is underlined when selected). If for example the pattern generator Data Amplitude were set to 500mV and the Data High Level to 0.0V, the Automatic 0/1 Threshold Mode value displayed will be -250mV.

To Select Automatic Center

In this mode it is recommended to first set the "EYE EDGE THRESHOLD " to a known BER (bit error ratio) threshold, perform a clock-to-data alignment and then select Automatic Center mode.

1. Select the error detector left-menu `dat i/p, clk i/p` softkey.

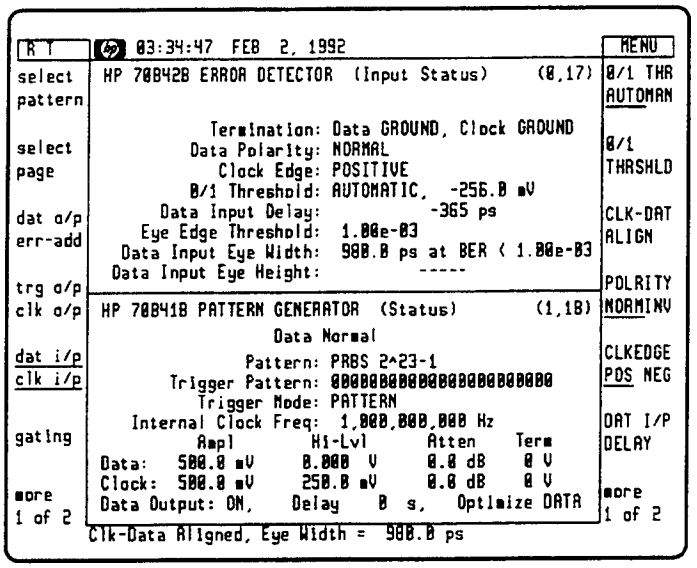
2. Press the right-menu `more 1 of 2` softkey.

Set the Eye Edge Threshold.

3. Press the right-menu `EYE EDG THRSHLD` softkey and select a BER threshold using the Numeric Keypad. For example, to select a BER of 1.00E-03; enter 1.00 using the keypad; then press the `e` softkey and enter 3 using the keypad, then press ENTER. The BER threshold is displayed at the bottom of the screen.

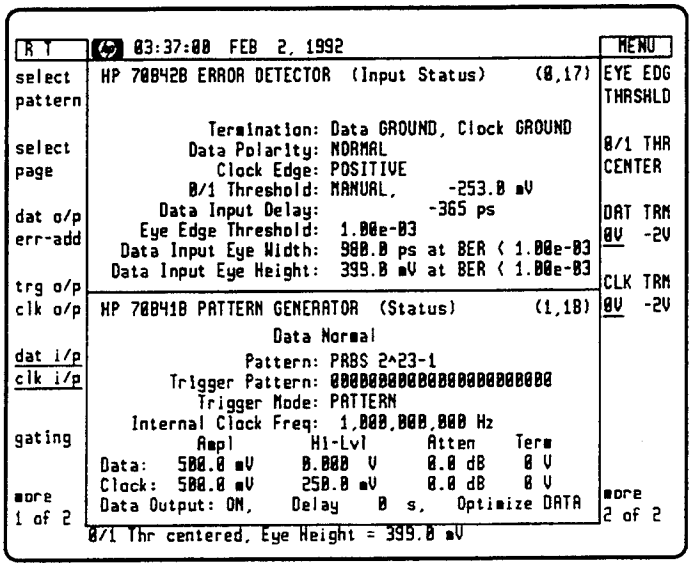
Perform Clock-to-Data Alignment.

4. Press the `CLK DAT ALIGN` softkey on the `more 1 of 2` right-menu. The *eye width* is displayed at the bottom of the screen.



To Perform Automatic Center.

5. Press the `0/1 THR CENTER` softkey on the `more 2 of 2` right-menu. The *eye height* is displayed at the bottom of the screen, and the 0/1 Manual Threshold value given with other parameters of the error detector Input Status, an example is given below.



Error Measurements

The error detector counts bit errors by comparing data bit-by-bit with the internally-generated reference pattern. All measurements run during the gating periods with the exception of Delta Error Count and Delta Error Ratio. These measurements run continuously to enable user adjustments for minimizing errors. The measurements are as follows, (refer to Appendix B for measurement definitions).

- Error Count
- Delta Error Count
- Error ratio
- Delta Error Ratio
- Errored Intervals
- Error Free Intervals

Error Analysis

The Error Analysis is based on CCITT Rec G.821 and is derived from the bit error results.

- %Unavailability
- %Availability
- %Errored Seconds
- %Severely Errored Seconds
- Degraded Minutes

Power-loss Seconds

Displayed as the number of seconds the error detector is not able to make measurements during a gating period due to ac-power-loss. The gating continues to the end of the selected period following a restoration of power.

Sync-loss Seconds

Displays the number of seconds the error detector lost pattern synchronization during a gating period.

Frequency Measurement

The incoming clock frequency is measured and displayed to five significant digits.

Result Logging

Refer to chapter 7 Data Logging for information on logging results.

To Set Up Your Own Display of Results or Status Information

The HP 71600B Series Systems gives you the opportunity to display on the screen a page containing results or status information important to you. This is called the *User's Page* and is setup as follows:

Note It is assumed that the system is configured for master/slave operation.

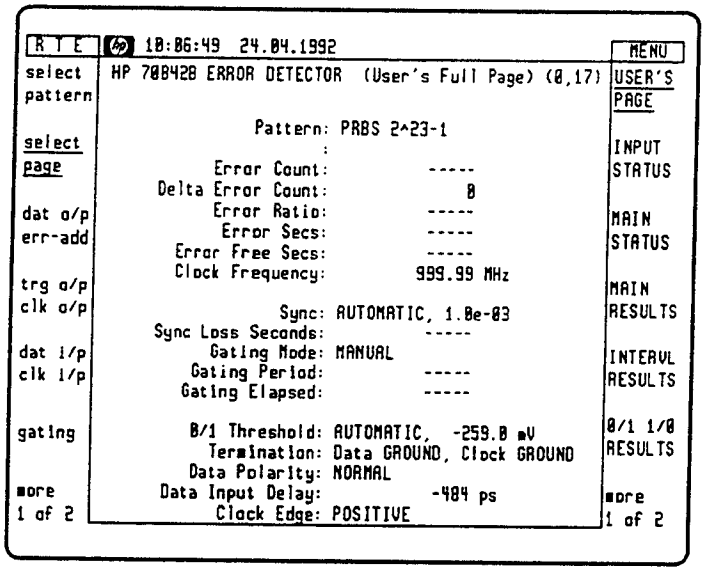
The following procedure shows you how to display and view the current *User's Page* selections, and edit (or build) the page to show your own choice of results or status information.
The process of editing the *User's Page* is referred to as *Building the User's Page*, and this is accomplished using the `build usr-pge` softkey.

Procedure

Select and View the User's Page

1. Press the (MENU) fixed label key.
2. Select the `more 2 of 2` left-menu.
3. Press the `show modules` left-menu softkey.
4. If the error detector status is not currently displayed, press the `SHOW ERR DET` right-menu softkey.
5. If the pattern generator status is also displayed , turn it off by pressing the `SHOW PAT GEN` right-menu softkey.
6. Select the `more 1 of 2` left-menu and press `select page`.
7. Press the right-menu `USER'S PAGE` softkey.

The *User's Page* is now displayed and shows the results or status information selected by the previous user. The following figure gives an example of a typical *User's Page*.



To Build Your Own User's Page

8. Select the **more 2 of 2** left-menu.

9. Press the **build usr-pge** softkey.

You may now select from the choices offered in the **build usr-pge** right- menu softkeys and build up the display to show the status or results information you wish. As you select a right-menu softkey the display will change to reflect your choice; the softkey selected is underlined. The build user's page menu comprises nine pages joined by **more** keys. Refer to the Build Users Page Menu Map in Chapter 3 for a chart of the selections offered.

Measuring Error Detector Eye Width and Height.

Introduction

The following procedure explains how to measure the width and height of the error detector eye.

Note It is assumed that the system is configured for master/slave operation.

Procedure

1. Connect the pattern generator DATA OUT and CLOCK OUT ports to the error detector DATA and CLOCK IN ports.
2. Connect an external clock source to the pattern generator CLOCK IN port. Set the clock source to a suitable frequency.
3. Set the instrument to its default settings by pressing the green (INSTR PRESET) key.
4. Set the display to show both pattern generator and error detector status as follows: Select the left-menu `more 2 of 2`, `show modules` softkeys. Select `SHOW PAT GEN` and `SHOW ERR DET` right-menu softkeys.
5. Press the left-menu `more 2 of 2` softkey.
6. Press `select pattern` and select `2^23-1` from the right-menu.
7. Press the `dat i/p, clk i/p` softkey.
8. Set the error detector `0/1 THR AUTO/MAN` to `AUTO`.
9. Press the `DAT I/P DELAY` softkey, and using the large display knob adjust the data delay in a positive direction until errors occur (note *errors* flashing on screen); note the delay. Now adjust the data delay in the opposite direction until errors occur. The difference between the two delay readings is the *eye* width.

To Measure Eye Height

Continue to step 10.

10. Press the `DAT I/P DELAY` softkey and using the display knob set the delay to the middle of the eye (the middle of the eye can be determined by halving the width result in step 9).
11. Set the error detector `0/1 THR AUTO/MAN` softkey to `MAN`, press the `0/1 THR` softkey.
12. Adjust the display knob in a positive direction until errors occur (note the 0/1 threshold value); repeat in a negative direction and again note the manual 0/1 threshold, the difference gives the height of the eye.

6

User Patterns and Disc Operation

Define, Edit and Store User Defined Patterns

Introduction

The HP 71600B Series Error Performance Analyzers and Pattern Generators offer

the user the ability to define and store their own patterns (*user patterns*) in up to twelve pattern stores. The contents of the pattern stores can be recalled and edited as necessary. The following paragraphs give a description of pattern editor operation, including a list of editor features, and procedures for editing patterns. Refer to chapter 4 for a description of editor softkeys.

Basic Editor Operation

There are three main functional blocks which together provide the capability to edit, store, and transmit a programmable user pattern. These are the editor, pattern stores, and the user pattern memory from which the instrument outputs a user pattern. The relationship between these three functional blocks is shown in the following figure:

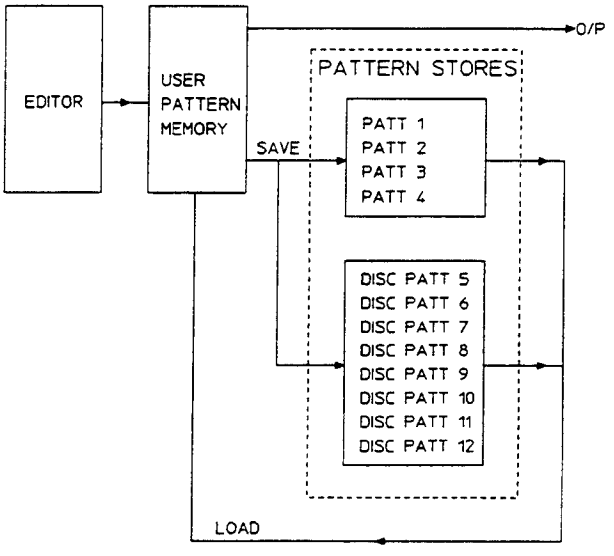


Figure 6-1. The Editor

The Editor

The editor always edits the contents of the user pattern memory. Thus if you wish to edit one of the twelve pattern stores, you must first load the pattern store into the user pattern memory, edit the pattern, then save the pattern back to the pattern store.

Editor Features

You can use the pattern editor to perform the following:

- Load into user pattern memory and edit/output one of four internal pattern stores or one of eight disc pattern stores.
- Load and edit one of four fixed PRBS patterns of 2^7, 2^10, 2^11 and 2^13.
- Copy the contents of one user pattern into another user pattern.
- Select between binary and hexadecimal displays.
- Save the contents of the user pattern memory (current pattern) to one of the four internal pattern stores or eight disc patterns.
- Load the contents of a pattern store to a precise point in the user pattern memory, highlighted by the display cursor.
- Define a block of bits within the user pattern memory and save to a pattern store large enough to hold the block.
- Delete a block of bits within the user pattern memory.

Pattern Stores

There are twelve pattern stores as follows:

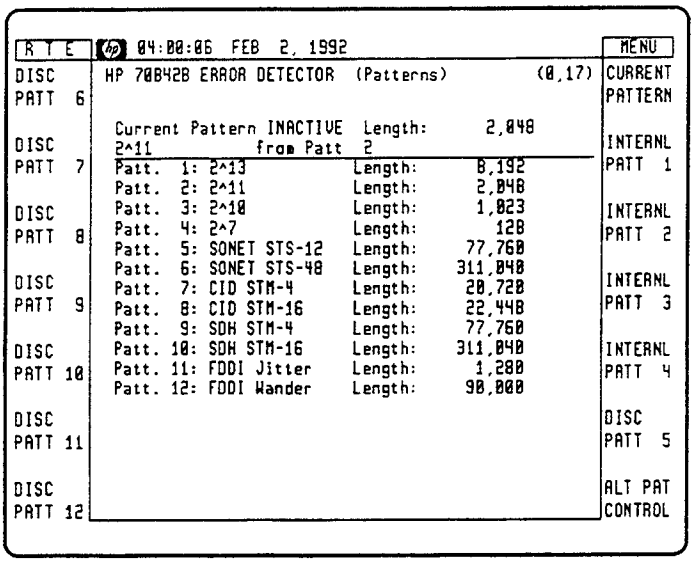
- Pattern Stores 1 to 4 can hold patterns up to 8 kbits in size. The data is held in non-volatile RAM.
- Patterns 5 to 12 are held on disc and can accomodate patterns of up to 4 Mbits in length, subject to a disc with sufficient free space being available. These patterns are held in separate files on the disc.

Current Pattern

The `CURRENT PATTERN` softkey enables the user to access the pattern currently stored in user pattern memory. This is the pattern that is output, when the user selects a User Pattern as the active output pattern.

Choosing a Pattern

On the occasions when a user has to choose a pattern store, a display similar to that in the following figure is shown.



Note Loading and saving large user patterns from or to a disc can take several minutes.

The information shown for patterns 5 to 12 directly reflects the state of the currently accessible disc. The user makes a choice by pressing the appropriate softkey.

The first line gives information on the contents of the user pattern memory, showing that the last pattern to be loaded into the memory was the contents of pattern store 2, that the user pattern memory is inactive (it is not the pattern currently being output), and the length in bits is 2048.

When operating in a half-window, all information after pattern store 5 is not visible by default. Pressing the ▼ key displays information on the remaining six pattern stores. Pressing the ▲ key returns the display to the original contents.

If the user changes the disc inserted in the drive, the display contents are regenerated to reflect the contents of the new disc.

If the disc is not accessible, the lines for pattern stores 5 to 12 are replaced with a single text message `no disk present`. If the instrument is unable to access a pattern store, an error message indicating the problem is displayed beside that stores entry.

User Pattern Memory

This is the 4 Mbit memory from which the instrument transmits any user pattern. The contents of a pattern store can be copied into the user pattern memory and edited, or the contents of the user pattern memory saved to a pattern store. The editor always edits the contents of this memory.

When no disc is accessible, the user pattern memory is the only memory capable of holding a pattern longer than 8 kbits. If the instrument is powered down its contents are lost. At power-on the user pattern memory is initialised to contain the following:

- A single zero:- if before power-down the user pattern memory contained a single pattern.

Exiting the Editor By Mistake

If you have just exited the editor by mistake, by perhaps pressing one of the top level softkeys, and wish to ensure that the pattern you were editing is not lost use the following short procedure.

Procedure

Select `edit usr-pat`, `CURRENT PATT` then `save pattern`. Now select the pattern store softkey in which you wish to save the edited pattern (`INTERN PATT` or `DISC PATT`).

How to Set Up and Edit Your Own User Pattern

Introduction

The HP 71600B Series Error Performance Analyzer and Pattern Generator offer the user the ability to define twelve *user patterns*. Any one of these patterns may be recalled and edited, for example:

- During a measurement when a pattern other than a user pattern is being output.
- During a measurement when the pattern to be edited is the *active* pattern (the pattern currently being output).

Note

It is assumed that both pattern generator and error detector are configured for master/slave operation. For example the error detector HP-MSIB row address is '0', and the pattern generator row address is '1'.

Note

If you select a *user pattern* ensure that the sync threshold is compatible with the pattern being generated. Failure to set the correct sync threshold may result in incorrect synchronisation.
Incorrect synchronisation results in errors and may cause clock-to-data alignment failure. See page 4-24.

To Edit User Patterns

Procedure

1. Press the (MENU) key to display module status, then select the `select pattern` softkey. Note that the `select pattern` softkey is underlined.

2. Select a pattern using the right-menu softkeys.

Note: If you select a user pattern this would then become the active (output) pattern, any edits you perform will therefore be on the output pattern.

3. Press the left-menu `more 1 of 2` softkey, and then the `edit usr-pat` softkey. The *user patterns* are now displayed, an example is shown in Figure 6-2.
   Note: In the following procedures the error detector is allocated a full screen. Use the `show modules` softkey on the `more 2 of 2` left-menu to assign the error detector a full screen.

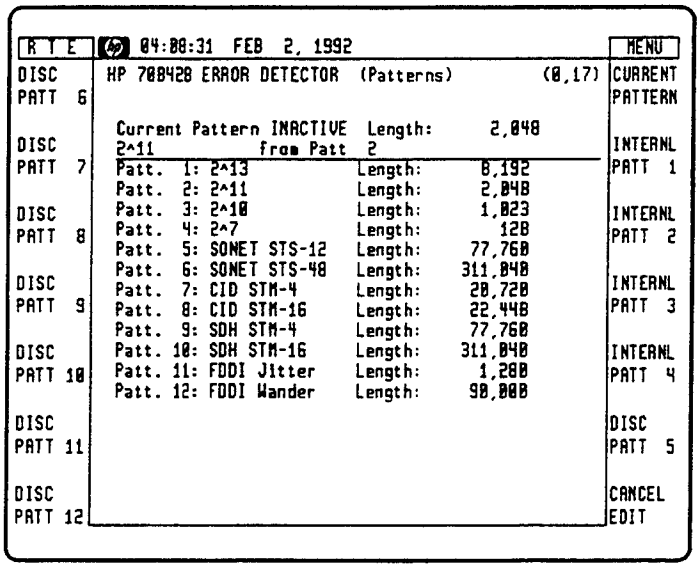


Figure 6-2. User Patterns

4. For this example let's edit `INTERNL PATT 1`.

5. Select `INTERNL PATT 1`.

6. The display now changes to show the current pattern in user pattern 1, and also gives a set of right-menu softkeys to enable you to edit and view the pattern. The contents of internal pattern 1 are now loaded into the *user pattern memory*, and you are now able to edit then save the contents of pattern 1 either back to `INTERNL PATT 1` or any other pattern store.

7. The following figure gives an example of a pattern loaded from `INTERNL PATT 1` and the right-menu edit softkeys.

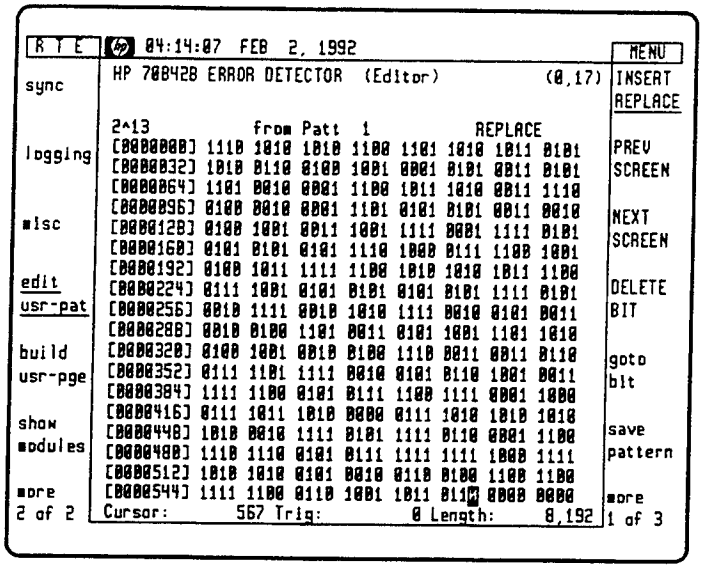


Figure 6-3. Edit Pattern 1

Note: The following steps explain how to perform individual edit functions. There is no need to complete the whole procedure; refer to each explanation as required. It is assumed that the user is currently working in the editor.

Set Pattern Length

1. Select the `more 2 of 3` right-menu.
2. Press the `set pat length` softkey - enter the pattern length using the numeric keypad and press the `ENTER` softkey.

Insert/Replace Bits in the Pattern

1. Select the `more 1 of 3` right-menu.
2. Press the `INSERT/REPLACE` softkey to select the function required. The key label underlined is the one selected.
   It may be that the part of the pattern in which you wish to insert or replace bits is not currently displayed. To view the part of the pattern containing the bits of interest you can use the `NEXT SCREEN`, `PREV SCREEN` or `goto bit` softkeys. For fast access to a bit in a large pattern use the `goto bit` softkey. Set the cursor address (at bottom of screen) to the number of the bit to be edited, then press `ENTER`. Use the numeric keypad 1 and 0 keys to insert or replace bits in the pattern.

Delete Bits

1. Select the `more 1 of 3` right-menu.
2. Use the display knob or `goto bit` softkey to set the cursor to the bit number of the bit to be deleted, then press `DELETE BIT`.

To Save a Pattern

When you have finished editing a pattern it must then be saved to a pattern store. This can be to a disc store or one of the four internal pattern stores. Use the following procedure to save an edited pattern to any pattern store.

Procedure

1. Select the **more 1 of 3** right-menu and press the **save pattern** softkey. The display will change to show the internal and disc pattern stores, an example is shown in the following figure.

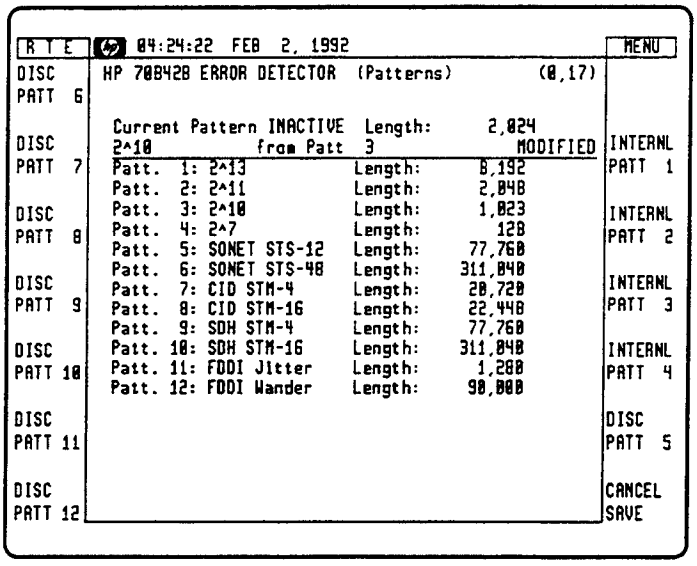


Figure 6-4. Pattern Stores Softkeys

2. Select the softkey indicating the pattern store into which you wish to store the edited pattern.

To Load a Pattern Store Into the Editor

The following procedure explains how to load the contents of a pattern store (INTERNL or DISC) into the editor when the user is not currently working in the editor.

Procedure

Use this procedure if you are not currently working in the editor.

1. Select the **more 2 of 2** left-menu.
2. Press **edit usr-pat** then select an **INTERNL PATT** or **DISC PATT**.

The pattern store selected is now displayed and you can edit that pattern using the right-menu softkeys.

The following two procedures explain how to load a PRBS or user pattern into the editor.

To Load a PRBS or User Pattern into the Editor

The editor load block function enables the user to load one of four fixed PRBS's, or the contents of a user pattern store into the *user pattern memory* at the current cursor position. The current setting of the INSERT/REPLACE softkey (on the more 1 of 3 right-menu) determines whether the contents of the PRBS or pattern store (the block) are inserted into, or replace bits in the pattern.

The number of block bits loaded from the PRBS or pattern store is tailored to fit between the cursor and pattern end. For example if the cursor is sitting on bit 500 of a 900 bit pattern, then when a block load is performed up to 400 bits can be inserted/replaced.

To Load a Block of Data (PRBS)

The following procedure explains how to load a fixed PRBS into the editor.

Procedure

1. Select edit usr-pat from the more 2 of 2 left menu.
2. Select the pattern store into which you wish to load a block of data. (for example INTERNL PATT 4).
3. Set the cursor to the bit in the pattern where you wish to insert/replace a block of data. Use the display knob or goto bit softkey.
4. Set the INSERT/REPLACE softkey to the desired mode.
5. Select the more 2 of 3 right-menu.
6. Select load block - the right-menu changes to give a sub-menu set of softkeys, offering the choice of selecting a fixed PRBS of 2^7, 2^10, 2^11 or 2^13, or a user pattern. For this procedure, select a PRBS.
7. When you select a PRBS the right-menu changes to give softkeys of NO MODIFY, zero sub, mark density and CANCEL LOAD.
   If you do not wish to edit zero substitution or mark density, press NO MODIFY then proceed to step 10.

To Edit Zero Substitution

8. Press the ZERO SUB softkey. Enter the value of the longest run of zeros using the numeric keypad (see bottom of screen), and then press ENTER.

To Edit Mark Density

9. Press the MARK DENSITY softkey. The right-menu changes to offer softkeys of 1/8, 1/4, 1/2, 3/4, 7/8 and CANCEL LOAD. select from the choices given or press CANCEL LOAD.

10. When you press **NO MODIFY** or finish editing zero sub or mark density the display returns to the main editing screen, with the PRBS selected loaded into the editor (user pattern memory) at the current cursor position.

11. To save the edited pattern, select the **more 1 of 3** right-menu, press **save pattern** then select a pattern store softkey.

To Load a User Pattern Into the Editor

The following procedure exlains how to load the contents of a user pattern store into the user pattern memory, at the current cursor position.

Procedure

1. Repeat steps 1 to 5 of the previous procedure (loading a PRBS).

2. Select **load block** - the right-menu changes to give a sub-menu set of softkeys, offering the choice of selecting a fixed PRBS of **2^7**,**2^10**, **2^11** or **2^13**, or a **user pattern**.

3. Select **user pattern** then the softkey of the pattern store **INTERNL PATT** or **DISC PATT** whose data you wish to load into the user pattern memory. Proceed to step 4.

Load Copies of User Patterns

When you select a user pattern you are offered the choice of loading more than one copy of the pattern. The number of copies you make is however limited by the length of the current pattern in the user pattern memory.

4. If you wish more than one copy, enter the number using the display numeric keypad, then press **ENTER**, if not press **ENTER**. The contents (block) of the pattern store selected in step 3 are now loaded into the editor at the point highlighted by the cursor.

5. You can now elect to save the contents of the user pattern memory to a pattern store, or edit further and then save to a pattern store. To save the block (pattern) you have loaded, select the **more 1 of 3** right-menu, press **save pattern**, then select a pattern store (INT or DISC PAT).

To Save a Block of Data

The user can define a block of bits within the current user pattern memory, then save the block to any pattern store large enough to hold the pattern. The current pattern store contents are overwritten by the new data being saved. The label of the pattern store is changed to that of the user pattern memory.

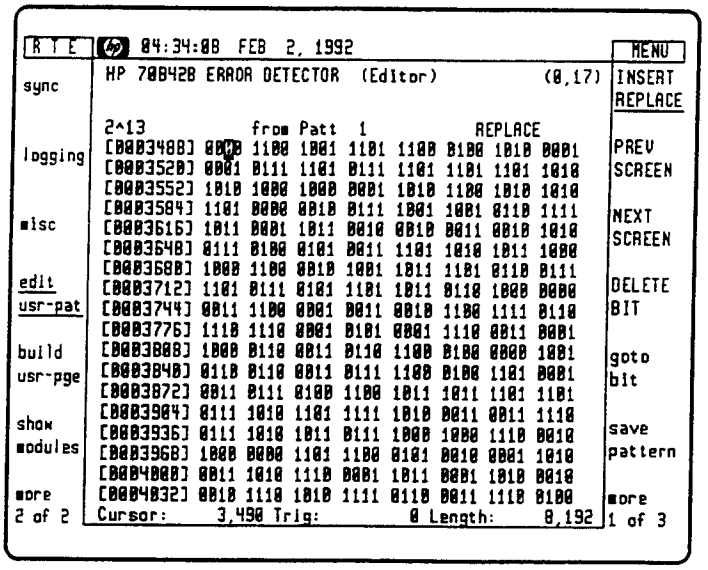
Procedure

The following procedure explains how to define a block of bits within a pattern in the user pattern memory, and then save the block to a user pattern store.

1. Select **edit usr-pat** from the **more 2 of 2** left-menu.

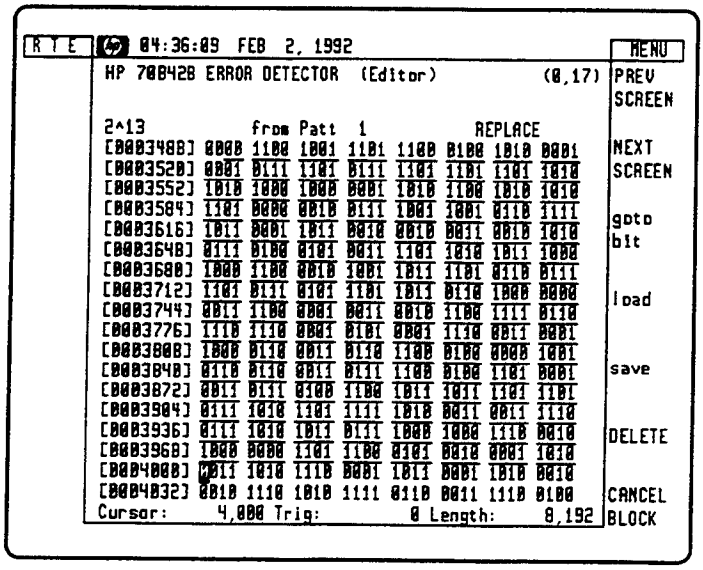
2. Call-in to the editor the pattern store containing the block of data you wish to save\delete (select an **INTERNL PATT** or **DISC PATT** store), or select a pattern store and create your own pattern.

3. Set the cursor on the first bit of the block of data to be saved\deleted, use the **goto bit** softkey or display knob. The following figure gives an example of a pattern loaded from pattern store 1, and with the cursor on bit 3490.



4. Select the **more 2 of 3** right-menu, and select **savedel block**.

5. Set the cursor on the last bit of the block of data to be saved\deleted. The block of data will be shown underlined. The following figure gives an example of a pattern where a block of bits from 3490 to 4000 is selected.



6. Press **save**, then select the **INTERNL PATT** or **DISC PATT** store into which you wish to store the block of data. The bottom left of the display now indicates *saved 511 bits to*

store **, while the display shows the original pattern store selected (the one you selected in step 2).

7. The block of data assigned in step 5 is now stored in the pattern store selected in step 6, and overwrites the data previously stored there.

To Delete a Block of Data

The user can define a block of bits within the current user pattern memory (CURRENT PATTERN), and then delete that block.

Procedure

1. Perform steps 1 to 5 of the previous (block save) procedure, then select the DELETE softkey. The display will indicate *Deleted 511 bits starting from bit 3490*.

Alternate Patterns

Use the following procedures to set the instrument to output two patterns A and B, and switch between patterns, or insert instances of pattern B into pattern A. The source of control for alternate patterns can be one of the following:

- From the instrument front panel.
- The rear panel AUX INPUT port.
- Over HP-IB.

Only the front panel and AUX INPUT mode of control is explained here.

To Select Alternate Pattern Control (front/rear panel)

Procedure

1. Select the following softkeys in the order given:

   `select pattern`, `user pattern`, `ALT PAT CONTROL`.

2. Set the `SOURCE AUX USR` softkey to `USR` for front panel control, or `AUX` for control via the rear panel AUX INPUT.
3. Set the `OUTPUT ALT ONCE` softkey to the mode you require. An explanation of the function of this key is given in chapter 1 (page 1-13) and chapter 4 (page 4-5).
4. Press the `EXIT` softkey to return to the main menu.

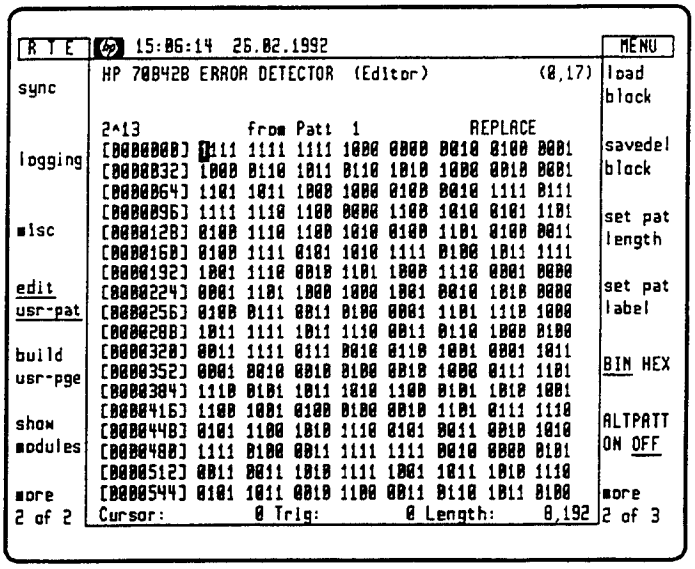
To Generate an Alternate Pattern

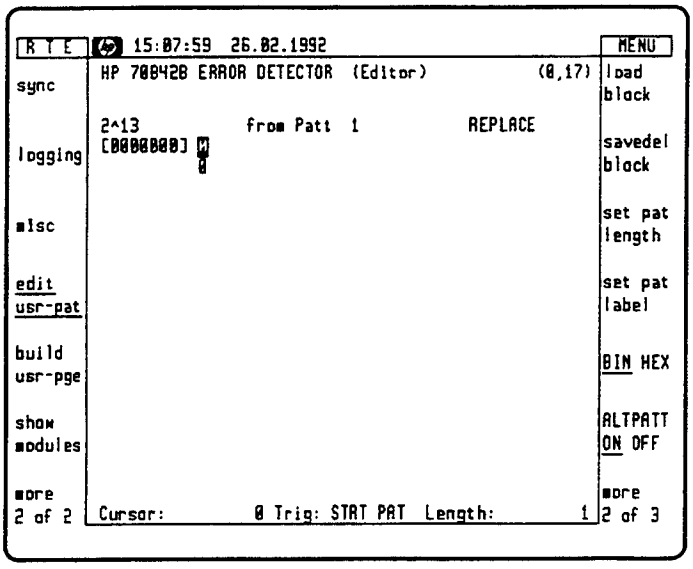
The following procedure explains how to generate an alternate pattern with an 2^7 PRBS loaded into pattern A (half A) and an 2^10 PRBS loaded into pattern B (half B).

Procedure

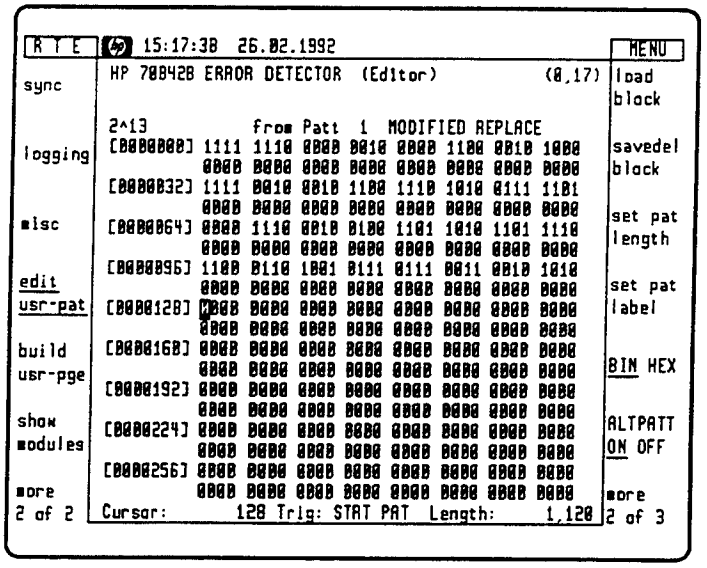
1. Press the (MENU) key to display module status, then select the `more 2 of 2` left-menu.
2. Select the `edit usr-pat` softkey.
3. Select an `INTERNL PATT` or `DISC PATT` store.
4. Select the `more 2 of 3` right-menu.
5. Set the `ALTPATT ON OFF` softkey to `ON`.

   When you switch the key from `OFF` to `ON` or `ON` to `OFF` the pattern that is currently in the user pattern memory is erased and a 0 is loaded into memory. The following figures give an example of the contents of the user pattern memory before and after `ALTPATT` is set to `ON`.



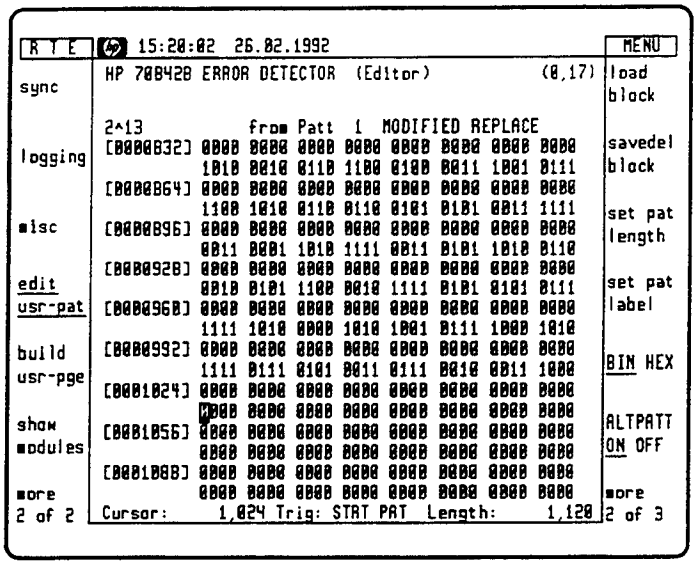


6. Select the **setpat length** softkey, and set the correct pattern length. You must ensure that you select a pattern length that is at least as large as the pattern to be loaded into the user pattern memory. For this example select a length of 3000 bits.
7. Select the **more 1 of 3** right-menu.
8. Position the cursor at the point in the pattern where you wish the block of data loaded (in this case a 2^7 PRBS) - use the **goto bit** softkey, and for this example set it to 0.
9. Select the **more 2 of 3** right-menu.
10. Select the **load block** softkey, then select a 2^7 PRBS. You may edit the PRBS zero substitution, or mark density or press **NO MODIFY**. When you exit this menu the 2^7 PRBS is loaded into the A half of the alternate pattern, as shown in the following figure.



To Load a 2^10 PRBS into Half B of the Alternate Pattern

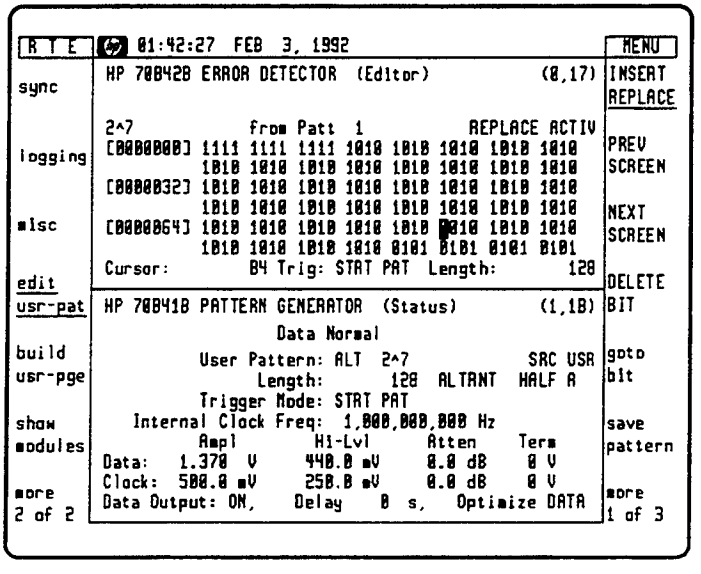
11. Select the **more 1 of 3** right-menu.
12. Use the display ▼ key to position the cursor on half B of the alternate word.
13. Position the cursor at the point in pattern B where you wish to load a 2^10 PRBS. Use the **goto bit** softkey - for this example select bit 0.
14. Select the **more 2 of 3** right-menu.
15. Select **load block** and select the 2^10 PRBS softkey.
16. Press **NO MODIFY** or edit further using the **zero sub**, **mark density** softkeys. The 2^10 PRBS is now loaded into the B half of the alternate pattern, as shown in the following figure.



To Save the Alternate Pattern

17. Select the **more 1 of 3** right-menu, and press the **save pattern** softkey. Select a pattern store in which to store the alternate pattern.
18. Select the **more 2 of 2** left-menu, press **edit usr-pat** and view the pattern list to check your pattern is saved correctly.

The following figure gives an example of an alternate pattern from *PATT 1* loaded into the editor. Note that the pattern generator display indicates that an alternate user pattern is selected, and alternate pattern control is via the front panel, (SRC USR is flagged).



Disc Operation

Introduction

The following provides information on the operation of the disc drive used in an HP 70841B pattern generator for the storage of user patterns.

Running out of Disc Space

When the contents of the user pattern memory is being stored to disc, there may not be enough room on the disc to hold the new pattern. When this occurs a message is displayed at the bottom of the display. To remedy this situation the user must make more disc space available, and resave his pattern while the pattern remains in the user pattern memory.

The two options available, either to insert a disc with more space, or to delete one of the other disc-based pattern stores to release more space on the same disc, are described in detail below:

An example of the first option is:

1. If there is a formatted, initialized disc available, insert it, and skip to step 4.
2. Enter the **misc** top-level function menu.
3. Insert a disc in the drive, and select the **format** function.
4. Re-enter the editor.
5. Perform a manual **save** operation to the original pattern store

and the second option:

1. Enter the **misc** top-level function menu.
2. Select the **delete discpat** softkey, and choose one of the disc-based patterns from the pattern selection window which is no longer required. The pattern selected is deleted from the disc, and its disc space is available for other patterns.
3. Re-enter the editor.
4. Perform a manual **save** operation to a pattern store.

Unable to write to disc

A similar problem to running out of disc space is that of being unable to write to the disc inserted in the drive. Possible reasons for this problem are:

1. There is no disc in the drive to write to.
2. The write-protect tab on the disk is set to prevent writing.
3. There is a hardware fault.

When a write operation fails within the editor, a simple error message is shown at the bottom of the screen and the user remains in the editor, with the pattern intact.

Disc Organization

Although DOS supports a hierarchical directory structure, the instrument only looks for pattern files in the topmost root directory.

The patterns are stored, one per file, in the root directory. A similar file is also present to store the data in the buffer used during `block save` and `block load`. The pattern files are named in some consistent manner, for example HPPATT01.DAT—HPPATT08.DAT.

On DOS there are no system-defined file types, but the files are tagged with one of the conventional suffixes, *DAT*, to indicate a data file.

The format of information held in a pattern or the buffer file is shown in Table 6-1. It should be noted that all integers are held in unsigned representation. The file containing the buffer data has a fixed label *Buffer*, and a pattern index of 0.

Table 6-1. Internal Format of Pattern/Buffer file

Offset	Type	Description
0	unsigned int	revision code
4	unsigned int	1= pattern file good - RESERVED
8	unsigned int	always 0 - RESERVED
12	unsigned int	always 0 - RESERVED
16	string (max 20 chars)	Header string
40	unsigned int	pattern index
44	unsigned int	pattern type. 0= single pattern. 1=alt pattern
48	unsigned int	pattern length
52	string (max 14 chars)	pattern label
70	unsigned int	trigger bit (alt patt =0)
74	unsigned int	trigger type (single patt=0), when alt patt, 0= A,B change, and 1= start of pattern.
78	pattern data	contents of pattern

The format of the three basic types of data stored on disc are detailed in Table 6-2, Table 6-3 and Table 6-4. Each field is described in detail in the following paragraphs.

Header String

A fixed string which must be present in a pattern file for that file to be considered valid. The suggested string is "HP Pattern".

Table 6-2. Disc Format of Unsigned Integer

Offset	Description
0	first byte of integer (least significant)
1	second byte of integer
2	third byte of integer
3	fourth byte of integer (most significant)

Table 6-3. Disc Format of String

Offset	Description
0	first byte of string length (least significant)
1	second byte of string length
2	third byte of string length
3	fourth byte of string length (most significant)
4	first 8-bit character of string
...	
string length + 3	last 8-bit character of string

Table 6-4. Pattern Data Format

Offset	Description
0	first byte of pattern data (most sig. bit first bit of pattern)
...	
roundup (pattern length/8)-1	last byte of pattern (lower (patt_size MOD 8) bits zero)

Revision Code

An unsigned integer specifying which format is used to record the pattern information in the file. This document specifies the first such format, revision 1, but this field allows future changes to be indicated. It is reasonable to expect a given firmware release to read all formats which pre-date it, but not those that postdate it.

Pattern Index

Matches the pattern number minus 4. The pattern in pattern store 9 is stored in file PATT05 and has an index of 1 in the pattern number field. Provides a further confidence check that the file is really the pattern file.

Pattern Label

The label given to the pattern store by the user. The label may contain any eight bit code. The characters represented by given codes are specified by the display. It is recommended that only ASCII character codes are used.

Pattern Length

For a straight pattern, this field holds the length of the pattern in bits. The minimum allowable length is 1. For an alternate pattern, this field holds the length of a pattern, and not the cumulative length of both patterns. Note: both patterns must have the same length.

Trigger Bit

The position of the trigger bit within the pattern. The position must be greater than, or equal to 0, and less than the pattern length.

Type of Pattern

This integer encodes the type of pattern held in the file. At present two types of pattern are defined:

- **Type 0**—straight pattern
- **Type 1**—alternate pattern

Pattern Contents

There are two cases to consider, storage of straight patterns and alternate patterns.
For straight patterns, the most significant bit of the first byte contains the first bit of the pattern. When the pattern length is not an exact multiple of 8, the lesser significant bits of the last byte are set to zero. The size in bytes of the pattern contents field is the value:

(pattern length ÷8) rounded up to the nearest integer

For alternate patterns, the two patterns are each stored in a format identical to that used for a straight pattern. The second pattern begins at the byte position after the last byte of the first pattern.

7

Data Logging

Data Logging

The HP 71603B error performance analyzer can log measurement results to an external printer. Results are logged in one of two modes as follows:

- Logs results in local mode via the rear panel HP-IB port to an external printer.
- When the HP 71603B error performance analyzer is controlled by an external controller, lines of text are returned when the appropriate command is received.

Note

The measurement period, that is the period over which a measurement starts and stops is referred to in this document as the *gating period*.

Recommended Printers

The following printers are recommended:

- HP ThinkJet Printer Model 2225A
- HP QuietJet Printer Model 2227A

Applications of Data Logging

Permanent Record of Results — Data logging to a printer is useful whenever a permanent record of results is required. For example, experimental records during development, and proof of conformance to error performance standards after system installation.

Time Stamped Logging — Time stamped logging is useful when analyzing time- varying error performance, since it allows measurements to be run over long periods unattended.

Note

The following procedures are written for systems configured for master/slave operation. The basic procedure is however similar for master/master operation, the difference is that you select error detector softkeys and status using the (DISPLAY) and `NEXT INSTR` keys, and the `logging` softkey is on the `more 1 of 2` left-menu.

Printer Address

The printer address is set permanently to 1, and cannot be changed by the user.

Selecting Logging Functions

All logging functions are found on the `logging` menu. Press `MENU` then select the `logging` softkey on the `more 2 of 2` left-menu. The following figure illustrates the logging softkeys available to the user.

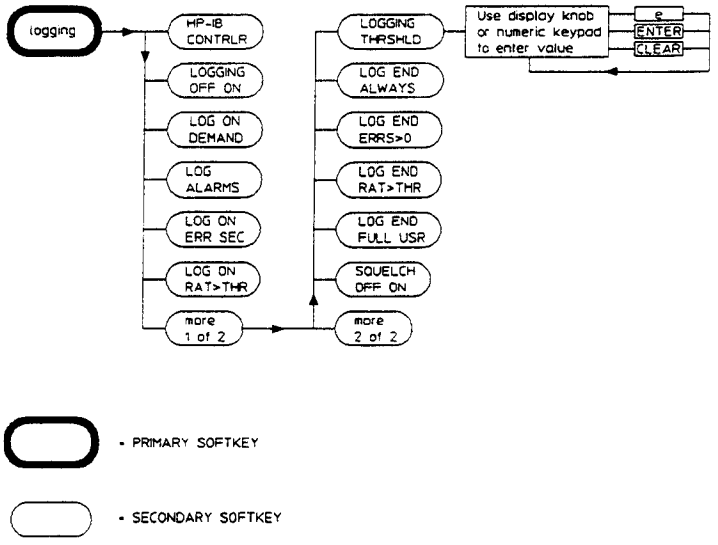


Figure 7-1. Data Logging Softkeys

To Log Results to an External Printer

Connecting a Printer

1. Connect a cable from the rear panel HP-IB port of the mainframe in which the HP 70842B error detector module is fitted to an external printer.

To Log Results

2. Press the (MENU) fixed label key.
3. Select the `more 2 of 2` left-menu.
4. Press the left-menu `logging` softkey.
5. Set the right-menu `LOGGING OFF ON` softkey to `OFF`.
6. Check the setting of the `HPIB CONTRLR` softkey.
   - When the key is active (underlined) the HP 71600B Series error detector is configured as a controller.
   - If the key is not active then the error detector may be controlled via an external controller.
7. Switch ON the `HPIB CONTRLR` softkey. The key is ON when it is underlined.
8. Select the type of logging you wish from the two pages of `logging` right-menu softkeys.

9. Set the LOGGING OFF ON softkey on the more 1 of 2 right-menu to ON.

The HP 71603B error performance analyzer is now configured to log results to an external printer.

To Output Results via HP-IB to a Controller

As an alternative to outputing results to a printer, it is also possible to return results to a controller; the following procedure explains how to do this.

Procedure

1. Press the (MENU) fixed label key.
2. Select the more 2 of 2 left-menu.
3. Select the left-menu logging softkey.
4. Set the right-menu LOGGING OFF ON softkey to OFF.
5. Switch OFF the HPIB CONTRLR softkey. The key is ON when it is underlined.
6. Set the right-menu LOGGING OFF ON softkey to ON.

The HP 71603B error performance analyzer is now configured to be controlled via a controller. Refer to the HP 71600B Series Remote Operation manual for detailed information on controller operation.

When Measurement Results can be Logged?

- Time stamped events during the measurement period (during gating).
- User selected or full results at the end of the measurement period.
- Current results at any time on demand.

Logging During Gating

The events (triggers) which cause logging during gating are:

- On an errored second
- On the error ratio exceeding a preset threshold

Note The two triggers listed above are mutually exclusive and cannot be changed while the `LOGGING OFF ON` softkey is set to `ON`.

Error Ratio Logging Trigger Threshold

The error ratio trigger threshold is in the range 1.0 to 1.0E-20 inclusive.

Results Logged During Gating

- Error Count for the last second.
- Error Ratio for the last second.

Each set of results is stamped with the date and time of day.

To Log Results During Gating

The following procedure explains how to configure an HP error performance analyzer system to log results during the gating period whenever the error ratio is >1.0E-07.

Procedure

1. Press the `MENU` fixed label key.
2. Select the `more 2 of 2` left-menu.
3. Select the left-menu `logging` softkey.
4. Set the right-menu `LOGGING OFF ON` softkey to `OFF`.
5. Switch ON the `HPIB CONTRLR` softkey (the softkey is underlined when ON).
6. Select `LOG ON RAT>THR` on the right-menu.
7. Select the `more 2 of 2` right-menu. Press `LOGGING THRSHLD`. Enter the desired logging threshold using the numeric keypad then press ENTER. To set a 1.00e-07 threshold, enter 1.00 using the keypad, press the `e` softkey, enter 07 and press `ENTER`.
8. Press the `more 2 of 2` right-menu softkey.
9. Set the `LOGGING OFF ON` softkey to ON.

The system is now configured to log results during gating whenever the error ratio is >1.00E-07.

The following figure gives an example of logging during gating when errors at a rate of 1.0e-06 are introduced into the system. The first five lines of the figure are known as the *header* and only appear once.

```
Hewlett-Packard                                                    708428

1990-10-17 13:39:09        START OF GATING

Gating Mode:  MANUAL UNTIMED

Logging Trigger (During): Error Ratio >  1.00e-07

Logging Trigger (Period): Error Count > 0

              Pattern: PRBS 2^23-1          Data Polarity: NORMAL


1990-10-17 13:39:10   Second Error Count:            100
                      Second Error Ratio:       1.00e-06
1990-10-17 13:39:11   Second Error Count:            100
                      Second Error Ratio:       1.00e-06
1990-10-17 13:39:12   Second Error Count:            100
                      Second Error Ratio:       1.00e-06
1990-10-17 13:39:13   Second Error Count:            100
                      Second Error Ratio:       1.00e-06
           Error Count:           400
           Error Ratio:     9.999e-07
1990-10-17 13:39:13       END OF MEASUREMENT
```

End of Measurement Period Logging

The following sets of results can be logged at the end of the measurement period: Selectable using the `LOG END FULL USR` softkey.

- `LOG END FULL` :Logs Main Results plus Interval Results plus G.821 Analysis OR
- `LOG END USR` :Logs the results currently part of the *Users Page*.

Note

There are separate User's Page lists for each of the full and half size screen displays. If you select `LOG END USR` the list of results logged will be those configured for the current size of screen display.

End of Measurement Logging Trigger

At the end of a measurement period the triggers to initiate logging are:

- Always
- Error Count >0
- Error Ratio > threshold (threshold range 1.0 to 1.0E-20)

Note

The three triggers are mutually exclusive and cannot be changed while the `LOGGING OFF ON` softkey is set to `ON`

To Log Results at the End of the Measurement Period

The following procedure explains how to configure the HP 71603A error performance analyzer to log results selected on the *Users Page*, at the end of the measurement period when the error count >0.

1. Press (MENU).
2. Configure the system to perform a measurement over a single or manual gating period.
3. Select the `more 2 of 2` left-menu.
4. Select the left-menu `logging` softkey.
5. Set the right-menu `LOGGING OFF ON` softkey to `OFF`.
6. Switch ON the `HPIB CONTRLR` softkey (the key is ON when it is underlined).
7. Select the `more 2 of 2` right-menu.
8. Select the `LOG END ERRS>0` right-menu softkey.
9. Set the `LOG END FULL USR` softkey to `USR`. This sets the error detector data logger to log all the results selected on the *Users Page* (see note on previous page).
10. Select the `more 1 of 2` right-menu.
11. Set the `LOGGING OFF ON` softkey to `ON`.

The error performance analyzer is now configured to log the *User Page* results if, at the end of the measurement period the error count is greater then zero.

The following figure gives an example of end of measurement period logging.

```
Hewlett-Packard                                                    70842B

1990-10-17 13:36:28        START OF GATING

Gating Mode:  MANUAL UNTIMED

Logging Trigger (During): Error Ratio >  1.00e-02

Logging Trigger (Period): Error Count > 0

              Pattern: PF PRBS 2^23-1        Data Polarity: NORMAL


           Error Count:              82
           Error Ratio:       3.416e-08
1990-10-17 13:36:53        END OF MEASUREMENT
```

Log On Demand

The LOG ON DEMAND softkey enables the user to log a single snapshot of the current results at the instant the key is pressed, irrespective of whether the system is gating or not, and whether logging is enabled or disabled. The output logged is dependent on the current state of the instrument, and is defined as follows:

- LOGGING ON ,GATING ON :.... results only logged
- LOGGING OFF ,GATING ON :.... header and results logged
- LOGGING ON or OFF , GATING OFF :.... header and results logged

Logging Alarms

When an alarm occurs and if the user has selected to have alarms printed, its cause (clock loss, data loss, sync loss), occurrence time and recovery time are printed. Power fail and recovery will always be printed regardless of whether alarms have been enabled or not. An example of Alarms logging is given below.

1990-04-23 23:10:04 ALARM: Power Failed
1990 04 23 23:10:14 Power Restored
1990 04 23 23:10:19 Gating Resumed

To Log Alarms

Select the left-menu logging softkey and turn ON the right-menu LOG ALARMS softkey. The LOG ALARMS softkey is ON when it is underlined.

Note

In the event of a power failure, any results which were stored prior to being sent to the Printer will be lost.

Logging Squelch

The Squelch feature is intended to save paper in situations where logging is being triggered over a long period of time. When Squelch is enabled logging is inhibited if triggered for ten consecutive seconds. When Squelch is active a message similar to the following is logged:

1990-04-23 23:10:03 Squelching Printing

To Squelch or not to Squelch

Only *during gating* triggers contribute to the decision on whether or not to squelch. Thus, the occurrence of *end of measurement periods* do not contribute, and are logged, if the user has indicated that they should, even when actively squelching.

Note that squelching status continues through an end of measurement period.

That is, if actively squelching when an end of measurement period occurs, then at the start of the next measurement period the instrument will continue to squelch. Logging is resumed after one trigger free second. A message similar to the following is logged at the end of squelching.

1990-04-23 23:11:04 End of Squelching Printing

When squelching terminates the error count and error ratio are logged.
Squelching has no effect when the `LOG ON DEMAND` softkey is used.

Results Storage

An internal buffer is used to store results when the volume of results is greater than the print speed. If additional results occur when the buffer is full, then new results are discarded. The following message is logged each time the results buffer becomes full.

1990-04-23 16:12:44 Printing Results Buffer Overflow - Results Lost

Once the results buffer begins to empty, new results are then stored. No message is logged when this occurs.

Results Storage when Logging is Switched On

When logging is switched ON the internal buffer used to store results is emptied. Disabling logging inhibits further storage of results but does not erase previously stored results.

8

Front Panel Controls

Front Panel Controls

Interpreting Front Panel Operation Indicators

If the HP-MSIB indicator lights (upper-left corner of the display, next to the [LCL] key), inspect the HP-MSIB cable connectors for tightness, then cycle power. If the HP-MSIB indicator remains on, refer to the *HP 70004A Installation and Verification Manual*

Front-Panel Controls

The HP 70004A Display serves as the "front panel" for instruments in the HP 71600B Series Modular Measurement System. It is possible to use one display with multiple measurement systems, one display for a single system, or even multiple displays for the same system.

The HP 70004A Display has one screen with 14 softkeys. The softkeys are labeled by either the display or the instrument that controls the keyboard. Softkeys are used for all manual instrument control functions.

All softkeys are organized into two groups which are accessed with the following front-panel keys:

- The [DISPLAY] key accesses all display functions.
- The [MENU] key accesses all instrument functions.

Fixed-Label Key Functions

For data entry, each display has a single knob and 24 labeled keys (such as 0 through 9, decimal point, minus sign, back-space, step-up, and step-down). In most cases, data can be entered with either the numeric keypad (0 through 9), the display knob, or the step keys. In addition, the following fixed-label keys exist on the display front-panel:

[INSTR] (Instrument) Use the [INSTR] key as the primary way of transferring the keyboard between instruments on row 0 of the address map. When the [INSTR] key is pressed, the display assigns colored borders to the currently defined windows. Near each window a softkey containing the first seven characters in the module's "label ID" (for example, the HP 70842B error detector) and module address (row and column) is displayed in inverse video in the same color as the module. If a labeled softkey is pressed, a keyboard link is offered to that window's instrument. If the instrument accepts the link, it will be

given the keyboard, and will put up its menu softkeys as though the [MENU] key had been pressed.

[LCL] (Local) This key returns all modules in the system from HP-IB remote to local control.

[INSTR PRESET] (Instrument Preset) When an instrument owns the keyboard, pressing [INSTR PRESET] will cause that instrument to preset all of its own operating parameters. This returns the instrument menu to the screen if the display menu is in use, but does *not* affect operation of the display except to terminate configuration functions.

[DISPLAY] This key accesses all of the system and display functions on the HP 71600B system. System functions such as the **Address Map**, **Config Display**, and **NEXT INSTR** softkeys control the addressing, communication, and configuration of the modules in the system. The [DISPLAY] key also accesses color editing, mass memory, multiple windows, printing, and plotting functions.

[MENU] This key brings up a menu of softkeys for pattern generator and/or error detector control. If the system is configured for master/slave operation, the softkeys displayed are for both modules. If configured for master/master individual module softkeys are displayed.

[USER] The operation of this key is identical to the [MENU] key for the pattern generator/error detector setup.

[HOLD] This key deactivates the knob, numeric keypad, and step keys (except in the [DISPLAY] and [INSTR] menus) until another function is accessed.

[◀] Use this key as a backspace key in a numeric entry, to return to the previous menu, and to return from the [USER] keys to the last set of [MENU] keys accessed.

[PRINT] This key starts a raster print output of the present display screen over HP-IB.

[PLOT] This key starts a vector plot HP-GL (Hewlett-Packard Graphics Language) output of the present display screen over HP-IB.

Key Functions

All functions are activated by pressing the keys around the perimeter of the display screen. The functions are organized in levels, called **softkey menus**. The [DISPLAY] and [MENU] keys access the top-level keys. This manual describes the softkeys accessed by the [MENU] key. The softkeys on the left-side of the Display are the *top level* or *primary* keys and select major functions or groups of functions. The right-menu softkeys are subordinate to the left-menu key that is currently selected, and are used to select functions or parameters relevant to the left-menu selection. The right-menu softkeys are referred to as *secondary* keys in this document.

Use the backspace [◀] key to return to the previously displayed level of keys.

Some of the key functions are too numerous to display all at once, and for this reason are divided into pages. Press the **MORE** softkey to view additional pages.

Multi-State Functions

Some softkeys switch between two states, such as Logging OFF or ON LOGGING OFF ON and SYNC AUTOMAN. An underscore or inverse video on the key labels indicates which keys and conditions are selected.

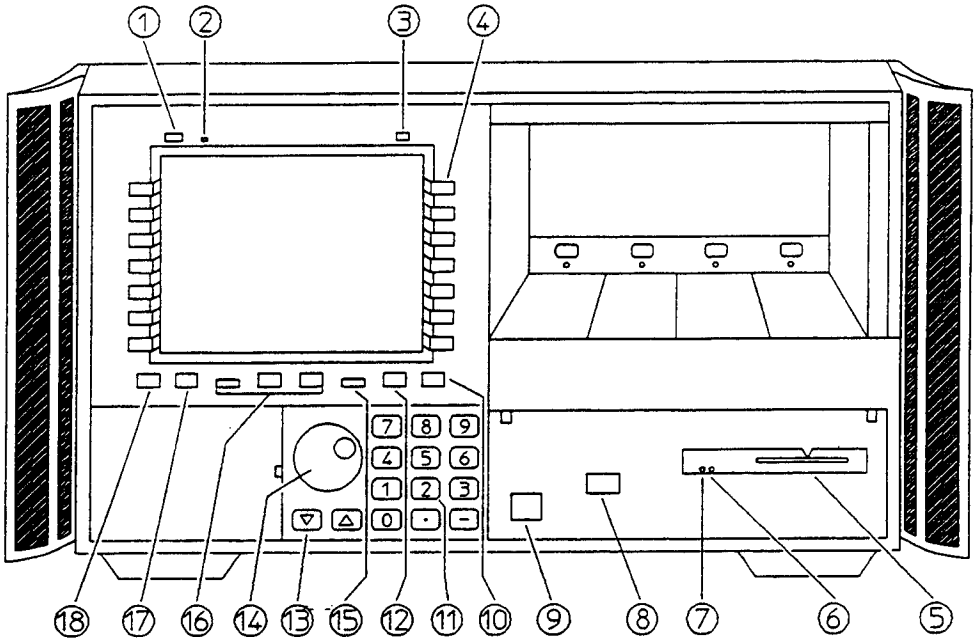


Figure 8-1. HP 70004A Display Front Panel

Front Panel Controls and Indicators

1. Use the [LCL] (Local) key to return the instrument from HP-IB remote control to local control.
2. The **HP-MSIB fault indicator light** indicates the status of the HP-MSIB. If the light is on, there is an HP-MSIB problem.
3. Use the [INSTR PRESET] (instrument preset) key to activate all the preset conditions of the instrument presently controlled by the keyboard. (The [DISPLAY PRESET] softkey in the [DISPLAY] menu performs a similar function.)
4. Use the **menu** keys to activate module and system control operations.
5. **Memory card slot**:-not used with HP 71600B Series error performance analyzer.
6. The **memory card access light** :-not used in HP 71600B Series Systems
7. The memory card **battery-low** light:- not used in HP 71600B Series Systems.
8. **HP-HIL** :-not used in HP 71600B Series Systems.
9. The [LINE] key switches the display on and off.
10. Use the [◀] (backspace) key to move from a lower level of menu keys to the previous level. Use the [◀] key to backspace the cursor while entering text or numbers.
11. Use the **numeric keypad** to enter numeric values.

12. Use the [HOLD] key to deactivate an active function to prevent further control setting changes.
13. Use the two [▲] [▼] (step) keys to change parameters up or down.
14. Use the Display **knob** to change parameters and select other operating values.
15. Use the [INSTR] (instrument) key to move the display keyboard between modules in the system that are on row address 0 of the address map.
16. Use the [DISPLAY], [USER], and [MENU] keys to call the top-level softkey menus to the screen.
17. Use the [PRINT] key to start a raster print output of the present display screen over HP-IB.
18. Use the [PLOT] key to start a vector plot output of the present display screen over HP-IB.

Input/Output Ports

Refer to the HP 71600B Series Installation and Verification manual for detailed specifications of the HP 70841A pattern generator and HP 70842A error detector input or output ports.

A

Preset Module Configurations

Preset Module Configurations

Introduction

This appendix lists the default settings for the three pre-defined PRESET module configurations; the four user PATTERNS, and the error detector *User's Page* settings when it is allocated a half and full screen.

PRESET Module Configurations

Within fixed memory there are stored three predefined, complete module configurations. The first is accessed with the (INSTR PRESET) key, and the other two are accessed with the `misc` , `recall setup` and `PRESET 1` and `PRESET 2` softkeys.

Table A-1 lists the HP 71600B Series pattern generator module configuration and Table A-2 the error detector module configurations when the green (INSTR PRESET) key is pressed.

Table A-1. Pattern Generator Module INSTR PRESET Settings

Function	Preset State
Pattern type	PRBS
PRBS pattern	2^23-1
alternate word	0101010101010101 0000000011111111
ZSUB pattern	ZERO SUB 2^13
zero substitution	13
MKDEN pattern	MARK DENSITY 2^13
mark density	4/8
user pattern	PATTERN 1
user pattern label	PRBS 2^23-1
user pattern 1 thru 12	not set to alternate pattern
alternate pattern source	Auxiliary Input
alternate pattern mode	alternate
alternate pattern half select	A half
external error add	OFF
internal error add	OFF
internal error add rate	1e-6
clock amplitude	500 mV
clock high-level	250 mV
clock attenuation	0 dB
clock termination	0 V
trigger pattern	all zeros
trigger mode	PATTERN SYNC
trigger control for alternate pattern	once per input change
data amplitude	500 mV
termination	0 V
data high level	0 V
data attenuation	0 dB
data polarity	NORMAL
data output control	ON
data optimisation	DATA
data ouput delay	0 ps
keyboard lock	OFF

Table A-1. Pattern Generator Module INSTR PRESET Settings (continued)

Function	Preset State
HP-IB format of packed data	
used for passing large patterns	1 bit per byte
internal MMS clock frequency	1 GHz
internal MMS clock frequency step	1 MHz
internal MMS clock amplitude	+3 dB
internal MMS clock output control	ON
trigger bit position	
zero-substitution PRBS 2^13-1	0
zero-substitution PRBS 2^11-1	0
zero-substitution PRBS 2^10-1	0
zero-substitution PRBS 2^7-1	0
mark-density PRBS 2^13-1	0
mark-density PRBS 2^11-1	0
mark-density PRBS 2^10-1	0
mark-density PRBS 2^7-1	0

PRESET 1 is defined as for (INSTR PRESET), but with the following exceptions:

- PRBS pattern..... 2^10-1
- clock amplitude..... .560 mV
- clock high level..... 280 mV
- data amplitude..... ..560 mV
- data high level..... .280 mV

PRESET 2 is defined as for (INSTR PRESET), but with the following exceptions:

- clock amplitude..... 560 mV
- clock high level..... ... 280 mV
- data amplitude..... .560 mV
- data high level..... 280 mV

Table A-2. Error Detector Module INSTR PRESET Settings

Function	Preset State
Pattern type	PRBS
PRBS pattern	2^23-1
ZSUB pattern	ZERO SUB 2^13
zero substitution	13
MKDEN pattern	MARK DENSITY 2^13
mark density	4/8
user pattern	PATTERN 1
user pattern label	"2^13"
data polarity	normal
keyboard lock	OFF
gating	OFF
gating control	by TIME
by TIME gating period	1 minute
by ERRORS gating period	100 errors
by BITS gating period	1e10 clock bits
measurement type	manual untimed
report mode	previous
0/1 THRESHOLD MODE	AUTOMATIC
0/1 THRESHOLD LEVEL	-1.3 Volts
data termination	0 Volts
data input delay	0 ps
clock edge	POSITIVE
clock termination	0 Volts
sync mode	AUTOMATIC
sync threshold	1e-3
current page	MAIN RESULTS
users page	see next table
size of items in first page	
of build-user page	normal height
beep on data error	OFF
show module config	full size window:show Edet & Pgen;
	half size window: show Edet

Table A-2. Error Detector Module INSTR PRESET Settings (continued)

Function	Preset State
LOGGING	OFF
SQUELCH	OFF
LOG ALARMS	OFF
LOG DURING TRIGGER	on errored second
LOGGING THRESHOLD	1.0e-3
LOG END TRIGGER	ALWAYS
LOGGING PERIOD REPORT	FULL
HPIB CONTRLR	OFF
EYE EDGE THRESHOLD	1.00e-3
HP-IB format of packed data	
used for passing large patterns	1 bit per byte

PRESET 1 is defined as for INSTR PRESET, but with the following exceptions:

- PRBS pattern..... .2^10-1
- current page..... .USER'S PAGE

PRESET 2 is defined as for INSTR PRESET, but with the following exceptions:

- gating period..... 30 seconds
- measurement type..... .timed single
- logging status..... ON
- alarms logging..... ON
- squelch status..... ON
- HP-IB controller..... ..ON

Error Detector User's Display Page Default Settings

The following two tables lists the default values of the error detector *User's Page* when allocated a half and full screen. The *User's Page* is accessed using the left-menu `select page` and right- menu `USER'S PAGE` softkeys.

Table A-3. User's Page Half Screen Settings

Line Number	INSTR PRESET	PRESET 1 & 2
Line 1	pattern, line #1	BIG error delta count
Line 2	pattern, line #2	BIG error delta count
Line 3	error count	BIG error delta count
Line 4	error ratio	BIG error delta count
Line 5	gating mode	error count
Line 6	gating period	0/1 threshold mode
Line 7	0/1 Threshold Mode	data input delay
Line 8	data input delay	gating elapsed

Table A-4. User's Page Full Screen Settings

Line Number	INSTR PRESET	PRESET 1 & PRESET 2
Line 1	pattern, line #1	BIG error delta count
Line 2	pattern, line #2	BIG error delta count
Line 3	error count	BIG error delta count
Line 4	delta error count	BIG error delta count
Line 5	error ratio	
Line 6	error seconds	BIG error count
Line 7	error free seconds	BIG error count
Line 8	clock frequency	BIG error count
Line 9		
Line 10	sync mode	
Line 11	sync loss seconds	0/1 threshold mode
Line 12	gating mode	data input delay
Line 13	gating period	eye width
Line 14	gating elapsed	clock frequency
Line 15		
Line 16	0/1 Threshold Mode	gating elapsed
Line 17	data termination	
Line 18	data polarity	error seconds
Line 19	data input delay	error milliseconds
Line 20	clock edge	sync loss seconds

User PATTERN Default Settings

Four PATTERNS are available to the user, numbered 1 through 4. They are initially set to the following, and are accessed via the left-menu `edit usr-pat` softkey. They are as follows:

Table A-5. User Pattern Default Settings

Pattern	Label	Length
PATTERN 1	2^13	8192
PATTERN 2	2^11	4096
PATTERN 3	2^10	2048
PATTERN 4	2^7	128

B

Measurement Definitions

Measurement Definitions

Introduction

Measurement definitions for the HP 71600B Series Error Performance Analyzer are given in this appendix.

Error Measurements:

The Error Detector counts bit errors by comparing the incoming data bit-by-bit with the internally-generated reference pattern. All measurements run during the gating periods are described with the exception of Delta Error Count and Delta Error Ratio.

Error Count:

The total number of errors during the gating period.

Delta Error Count:

The number of errors in successive decisecond intervals.

Error Ratio:

The ratio of counted errors to the number of bits in the selected gating period.

Delta Error Ratio:

The ratio of counted errors to the number of bits in successive decisecond intervals.

Errored Intervals:

Time intervals during which one or more errors occurred. These intervals are errored seconds, deciseconds, centiseconds or milliseconds.

Error Free Intervals:

Time intervals of seconds, deciseconds, centiseconds or milliseconds, during which no errors occurred.

Error Analysis

The error analysis is based on CCITT Rec G.821 and is derived from the bit error results.

%Unavailability:

The error ratio is calculated over 1 second timed intervals during the gating period. An unavailable period begins when the error ratio is worse than 1×10^{-3} for 10 consecutive seconds. These 10 seconds are considered part of the unavailable time. The unavailable period ends when the error ratio is better than 1×10^{-3} for 10 consecutive seconds. These 10 seconds are considered part of the available time. %Unavailability is the ratio of the unavailable seconds to the total gating period expressed as a percentage.

%Availability:

The ratio of the available seconds to the total gating period expressed as a percentage.

%Errored Seconds:

The ratio of the errored seconds in the available time to the total number of seconds in the available time, expressed as a percentage.

%Severely Errored Seconds:

The ratio of the total number of available seconds with an error ratio worse than 1×10^{-3} to the total number of available seconds, expressed as a percentage.

%Degraded Minutes:

Severely errored seconds are discarded from the available time and the remaining seconds are grouped into blocks of 60 seconds. Blocks which have an error ratio worse than 1×10^{-6} are called degraded minutes and %degraded minutes is the ratio of the total number of degraded minutes to the total number of 60 second blocks in the available time expressed as a percentage. Incomplete blocks of less than 60 seconds are treated as complete blocks of 60 seconds.

Power Loss Seconds:

Displayed as the number of seconds the Error Detector is not able to make measurements during a gating period owing to ac-power loss. The gating continues to the end of the selected period following restoration of power.

Sync-loss Seconds:

Displayed as the number of seconds the Error Detector losses pattern synchronization during a gating period.

C

Error Messages

Error Messages

Introduction

During operation of the HP 71600B Series pattern generator and error detector via the front panel, certain configurations, events and keystrokes are invalid and produce error messages. The messages are grouped into non-permanent and permanent errors. A permanent error is one (usually associated with a hardware failure) that persists indefinitely. Non-permanent errors are generally associated with incorrect user settings.

Notation

In the following Table, edet=error detector and pgen=pattern generator.

Non-permanent Errors

Error No.	Displayed Message	Description	Applicability*
101	Invalid set option		edet + pgen
102	Invalid query option		edet + pgen
103	Already gating	The instrument cannot be commanded to start gating while it is already gating.	edet
104	Already not gating	The instrument cannot be commanded to end gating while it is already not gating.	edet
105	Not while gating	This command is not permitted while the instrument is gating.	edet
106	Cannot gate while centering	This command is not permitted while the instrument is centering the eye height.	edet
107	Cannot gate while aligning	This command is not permitted while the instrument is aligning the eye width.	edet
108	Clock attenuator too large.		pgen
109	Keyboard locked	Commands that change the instrument's configuration are not permitted while the keyboard is locked.	edet + pgen
110	Window too small:		edet + pgen
111	Conflicts with run of zeros	The zero-substitution pattern requested is incompatible with the current setting of the run of zeros.	edet + pgen
112	Conflicts with zsub length	The run of zeros requested is incompatible with the current setting of the zero-substitution length.	edet + pgen
113	Conflicts with data high level	The data amplitude requested is incompatible with the current setting of the data high level.	pgen
114	Conflicts with data amplitude	The data high level requested is incompatible with the current setting of the data amplitude.	pgen
115	Need 2 adjacent locations	This item cannot be added to the User's Page because it needs two adjacent locations.	edet
116	Logging already enabled	The instrument cannot be commanded to start logging while logging is already enabled.	edet

Non-permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
117	Logging already disabled	The instrument cannot be commanded to end logging while logging is already disabled.	edet
118	Not while logging enabled	This command is not permitted while the instrument has logging enabled.	edet
119	Slave needs service	The slave module has detected an error and is requesting that its error queue be read to identify the cause.	edet + pgen
120	Data attenuator too large	The instrument cannot produce the defined ECL levels with the current value of attenuator.	pgen
121	Slave not present	The command can be executed only if a slave module exists.	edet + pgen
122	Need 4 adjacent locations	This item cannot be added to the User's Page because it needs four adjacent locations.	edet
123	Do not have system clock	The date or time cannot be set in this instrument as it is not the holder of the system date and time (ie there is another module from which it picked up the date and time at power up).	edet
124	Cannot align data if gating	A Clock to Data Align cannot be performed while we are gating as it interferes with the calculation of measurement results.	edet
125	Cannot center if gating	A 0/1 Threshold Center cannot be performed while we are gating as it interferes with the calculation of measurement results.	edet
126	Cannot align data if centering	A Clock to Data Align cannot be performed while we are performing a 0/1 threshold center operation.	edet
127	Cannot center data if aligning	A 0/1 threshold center operation cannot be performed while we are performing a Clock to Data Align operation.	edet
128	Already have external controller	The CONTROLLER capability cannot be used when an external HP-IB controller is already connected.	edet

Non-permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
129	Address conflicts with Err Det	Cannot set the printer address to that of the Error Detector.	edet
174	Non-volatile memory error	The non-volatile memory has failed causing the previous instrument setup to be lost.	edet + pgen
175	Results corrupted	The non-volatile memory has failed causing the measurement results to be lost.	edet
400	Pattern too large for store:		edet + pgen
401	Cursor position outside range:		edet + pgen
402	Invalid pattern length	The chosen length for the pattern cannot be generated by the instrument. The length must lie within the specified resolution. Only generated when the user pattern memory is active.	pgen + edet
403	Pattern length out of range	The pattern length is too large for the store.	pgen + edet
404	Invalid char(s) in label	A character in the label is not valid.	pgen + edet
405	Alternate patterns have no trigger bit	Alternate patterns do not have a trigger bit position. It is an error to try and set the trigger bit for a pattern store containing an alternate pattern.	pgen + edet
406	Straight patterns have no trigger mode	Straight patterns do not have a trigger mode. It is an error to try and set the trigger mode for a pattern store containing a straight pattern.	pgen + edet
407	Pattern store label too long	The label for the pattern store exceeds the maximum length allowed.	pgen + edet
408	Invalid pattern store	The pattern store number does not identify a valid store.	pgen + edet
409	Straight patterns have no half B	Attempt to perform an operation specific to an alternate pattern when the pattern store contains a straight pattern.	pgen + edet
410	Disk drive disabled	The disk drive has been internally disabled. The requested action on the disk drive can not be performed.	pgen

Non-permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
411	Disk pattern header invalid	An error has been detected in the information within the file holding the pattern store data. The file may be corrupted.	pgen
414	Disk pattern store invalid	The index field in the file containing the pattern store data is set to an illegal value. The file may be corrupted.	pgen
415	Disk pattern type invalid	The pattern type field in the file containing the pattern store data is set to an illegal value. The file may be corrupted.	pgen
416	Disk pattern label invalid	The pattern label in the file containing the pattern store data contains an illegal character. The file may be corrupted.	pgen
417	Internal disk error	Internal failure in disc system	pgen
418	Unrecognised disk error	An unrecognized error has occured whilst using the disk.	pgen
419	Directory overflow	Directory Overflow. Although there may be room on the media for the file, there is no room in the directory for another file name.	pgen
420	Pattern file not found	There is no file corresponding to the pattern store on the disc.	pgen
421	End of pattern file error	Operation caused the end of file to be reached. No data left whilst reading, or space left when writing to a pattern store.	pgen
422	Disk full	The disk is full. There is not enough free space for the specified size of pattern store.	pgen
423	Bad disk controller	There is a hardware problem with the floppy disk control electronics.	pgen
424	File open on disk	Operation not allowed on open file. May arise after changing the disk whilst an operation is in progress.	pgen
425	Media changed or not in drive	Disk changed or not in drive. Either there is no disc in the drive, or the eject button is pressed whilst the disk is being accessed.	pgen

Non-permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
426	Bad disk drive	Mass storage unit not present. A hardware problem.	pgen
427	Disc write protected	Write protected. Attempting to change the contents of a disk with it's write-protect tab set. Saving to a pattern store on disk, deleting a pattern store from the disk, or formatting a disk all generate this error if the disk is write-protected.	pgen
428	Disk media uninitialized	Media not initialized. The disk must be formatted before it is used to store pattern information.	pgen
429	Disk data read error	Read data error. The media is physically or magnetically damaged, and the data can not be read.	pgen
430	Disk check read error	Checkread error. An error was detected when reading the data just written. The media is probably damaged.	pgen
431	Corrupt disk	Disc may be corrupt.	pgen
435	Unable to reload edit buffer	During power-on, the user pattern memory could not be reloaded from the appropriate pattern store.	pgen

Permanent Errors

Error No.	Displayed Message	Description	Applicability*
	Error codes associated with interface 1 board		
130	Interface 1 board missing	The Interface 1 board is not present in the instrument.	edet + pgen
134	Too much calibration data	There is too much Phase Shifter (Vernier) calibration data to be held internally by the firmware. This must mean a bad calibration or that the calibration method has changed and this firmware is out of date.	edet + pgen
135	Vernier not calibrated	The calibration data for the Phase Shifter Vernier has been corrupted in the EEPROM.	edet + pgen
136	EEPROM sync-loss contents error	The calibration data for sync-loss detection has been corrupted in the EEPROM.	edet
137	EEPROM module ID error.	The calibration data for module identification has been corrupted in the EEPROM.	edet
	Error codes associated with interface 2 board		
140	Interface 2 board missing	The Interface 2 board is not present in the intrument.	pgen
143	Interface 2 freq meas error	The self-test firmware detected that a frequency measurement could not be started correctly.	pgen
144	EEPROM data contents error	The calibration data for the data amplifier has been corrupted in the EEPROM.	pgen
145	EEPROM clock contents error	The calibration data for the clock amplifier has been corrupted in the EEPROM.	pgen
146	EEPROM crc error:		edet + pgen
	Error codes associated with gate array board		
150	Gate array board missing	The Gate Array board is not present in the instrument.	edet + pgen
153 to 168	Gate array RAM (U3 - U18) error:	The self-test firmware detected a problem with writing to and reading from the ECL RAM CHIP U3 - U18 on the Gate Array board.	edet + pgen

Permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
170 to 173	Ram (U8 - U11) error:	The Self-test firmware detected a problem with writing reading from the RAM on the Control Processor Board U8 - U11.	pgen + edet
174		See the section on Non-Permanent errors	
175		See the section on Non-Permanent errors	
176		NV-RAM (U22) error:	
177		NV-RAM (U23) error:	
	Error codes associated with ROM		
180	ROM (U6) error	The self-test firmware detected an error during the CRC check of the Read Only Memory (ROM) on the Control Processor Board U6.	edet + pgen
181	ROM (U7) error	The self-test firmware detected an error during the CRC check of the Read Only Memory (ROM) on the Control Processor Board U7.	edet + pgen
185	PIT contents corrupt:	The Peripheral Interface/Timer (PI/T) device on the Control Processor board is not correctly retaining the values placed in it's Timer Preload Registers.	pgen + edet
186	PIT timer failure:	The Peripheral Interface/Timer (PI/T) device on the Control Processor board is not correctly counting time.	pgen + edet
	Error codes associated with HP-MSIB		
190	MSIB error	The internal self-test of the HP-MSIB bus has detected an error.	edet + pgen
191	Unrecognised slave found	An unrecognised MMS module has been found in this module's slave address space.	edet + pgen
192	Too many slaves found	More than the permitted number of slaves have been found in this module's slave address space.	edet + pgen

Permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
193	Slaved patt gen f/w incompatible	The firmware version of the slaved Pattern Generator is too old to be compatible.	edet
194	Slaved clock f/w incompatible	The firmware version of the slaved clock is too old to be compatible.	pgen
	Error codes associated with measurement processor		
200	Measurement board missing	The Measurement Processor board is not present in the instrument.	edet
201	DPRAM test error	The Self-test firmware detected a problem with writing to and reading from the Dual Port RAM (DPRAM) on the Control Processor Board U28.	edet
202	DPRAM exchange error	An error occurred in the firmware when we tried to create an exchange for processing results.	edet
203	DPRAM initialisation error	An error occurred in the firmware when trying to set up the firmware for processing of results from the DPRAM.	edet
204	DPRAM timeout error	The Control Processor firmware timed out while waiting for a response to a command sent to the Measurement Processor.	edet
205	Invalid DPRAM command	An invalid command has been sent via DPRAM to the Measurement Processor from the Control Processor.	edet
207	Results missed error	One or more sets of results from the Measurement Processor has been missed by the Control Processor.	edet
208	Measurement firmware incompatible	The firmware in the Measurement Processor is incompatible with the firmware in the control processor.	edet
210	Pattern type protocol error	An invalid pattern type command has been sent to the Measurement processor from the control processor.	edet
211	Pattern length protocol error #1	An invalid pattern length command has been sent to the Measurement processor from the control processor.	edet

Permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
212	Polarity protocol error	An invalid pattern polarity command has been sent to the Measurement processor from the control processor.	edet
213	Sync protocol error	An invalid sync command has been sent to the Measurement processor from the control processor.	edet
214	Threshold protocol error	An invalid sync threshold command has been sent to the Measurement processor from the control processor.	edet
215	Clock edge protocol error	An invalid clock edge command has been sent to the Measurement processor from the control processor.	edet
216	Pattern length protocol error #2	An invalid pattern length command has been sent to the Measurement processor from the control processor.	edet
217	Header protocol error	An invalid command has been sent to the Measurement processor from the control processor.	edet
218	Measurement board ROM (U3) error	The self-test firmware detected an error during the CRC check of the Read Only Memory (ROM) on the Measurement Processor Board U3.	edet
219	Measurement board ROM (U4) error	The self-test firmware detected an error during the CRC check of the Read Only Memory (ROM) on the Measurement Processor Board U4.	edet
220	Measurement board RAM (U5) error	The Self-test firmware detected a problem with writing to and reading from the RAM on the Measurement Processor Board U5.	edet
221	Measurement board RAM (U6) error	The Self-test firmware detected a problem with writing to and reading from the RAM on the Measurement Processor Board U6.	edet

Permanent Errors (continued)

Error No.	Displayed Message	Description	Applicability*
222	Measurement board PIT timer error	The Peripheral Interface / Timer (PI/T) device on the Measurement Processor board is not correctly counting time.	edet
223	Measurement board PIT contents error	The Peripheral Interface / Timer (PI/T) device on the Measurement Processor board is not correctly retaining the values placed in it's Timer Preload Registers.	edet
224	Pattern length protocol error #3	An invalid pattern length command has been sent to the Measurement processor from the control processor.	edet

*edet=Error Detector; pgen=Pattern Generator

D

Operating Notes

To Determine How Your System is Configured

This procedure assumes all modules are correctly installed and cabled.

1. Switch on the HP 70004A Display and HP 70001A Mainframe.
2. Press the (DISPLAY) fixed label key.
3. Press the **Address Map** left-menu softkey. Rotate the large display knob clockwise and observe the *Row* address of each module in your system.
   If each module (ERR DET, PAT GEN or SIG GEN) row address is '0', the system is configured for master/master operation, as shown below.

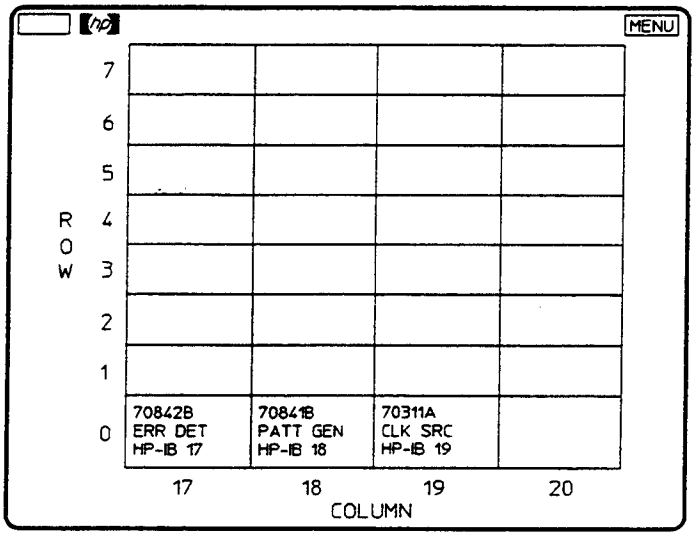


Figure D-1. Master/Master Address Setting

If the error detector module is the only module on Row '0' (except for the HP 70004A Display) the system is configured for master/slave operation. An example of master/slave address setup is as follows:

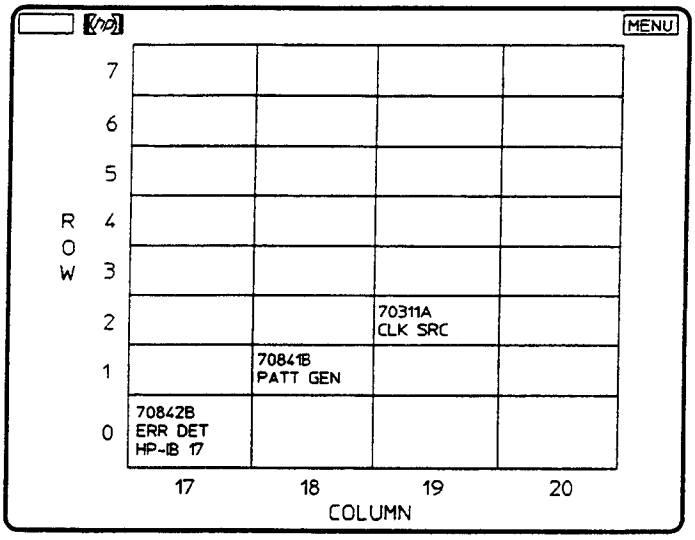


Figure D-2. Master/Slave Address Setting

An example where pattern generator and error detector are both configured as masters and the clock source as a slave is given below.

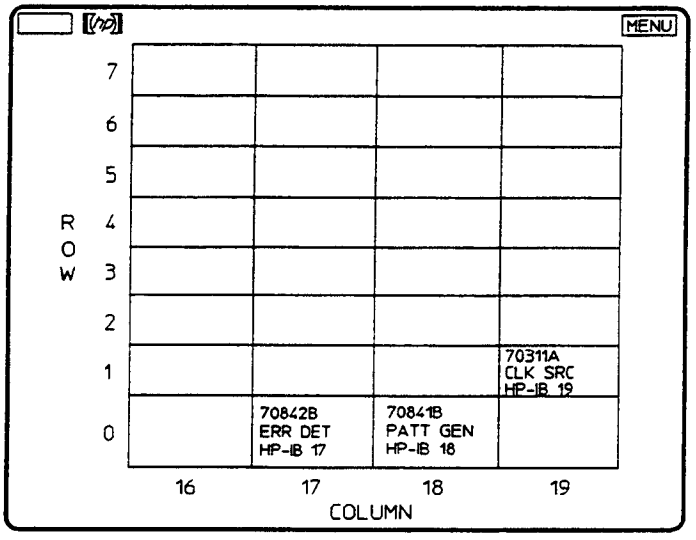


Figure D-3. Master/Master with Slaved Clock

Pattern Generator Data Output Termination Voltage/External Attenuation

Introduction

The following gives an explanation of how pattern generator data amplitude and data hi-level are affected by data output termination selection, and how the displayed data amplitude is calculated with external attenuation added.

- If you change the data output termination from 0V to -2V or vice versa, the data amplitude is set to 250mV and the data hi-level to -1V or 0V (0V for 0V termination). You can then select data amplitude and data hi-level as required.
- If you change the external attenuator value (using the **EXT DATA ATTEN** softkey) the data amplitude is set to the value calculated by multiplying 250mV by the attenuation factor (250mV x attenuation).

Note

When you use the **EXT DATA ATTEN** softkey to enter attenuation, the data amplitude displayed is the calculated voltage at the output of the attenuator, and not the voltage at the DATA OUT port.

A graphical example is given below of a pattern generator data output terminated to -2V and 20dB attenuation inserted between the DATA OUT port and the system under test. The displayed amplitude is 25mV and the DATA OUT port voltage 250mV.

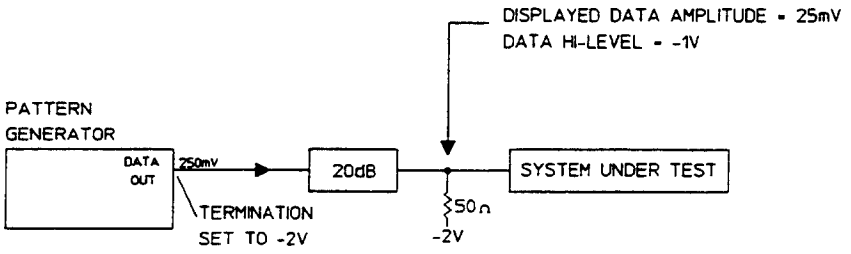


Figure D-4. Data Output Voltage with External Attenuation

Setting Error Detector Sync Thresholds

Introduction

The following paragraphs provide information on how to select the correct sync threshold for the current pattern. Failure to set the correct sync threshold may result in incorrect synchronisation, which may cause errors or clock-to-data alignment failure. Sync threshold is setup using the left-menu **SYNC** softkey (on more 2 of 2 left-menu) and the right-menu **SYNC THRSHLD** softkey.

Setting Sync Thresholds

To obtain accurate results you must choose a sync threshold which results in optimum alignment for the current pattern.

When using a PRBS pattern, loss of alignment with the incoming data will result in a nominal error rate of 50% due to the nature of PRBS data. Under these conditions, pattern misalignment will be detected no matter which sync threshold has been selected. Note: selecting a sync threshold of 1e01 allows the error detector to remain *in sync* over the widest range of system error rates.

For any pattern other than a PRBS pattern, the error rate caused by non-alignment with the incoming data is dependent on the data pattern. Here the sync threshold should be chosen so that only EXACT pattern alignment results in the error detector gaining sync. For example, consider a pattern of 1000 ones and 1000 zeros as shown in figure D-5. With *reference alignment 1* the patterns are totally out of phase and the error rate is 100%, but as the reference moves closer to optimum alignment the error rate drops gradually to zero. For exact alignment, the sync threshold must be set lower than the error rate caused by a 1 bit misalignment, that is lower than 1e03 in this example.

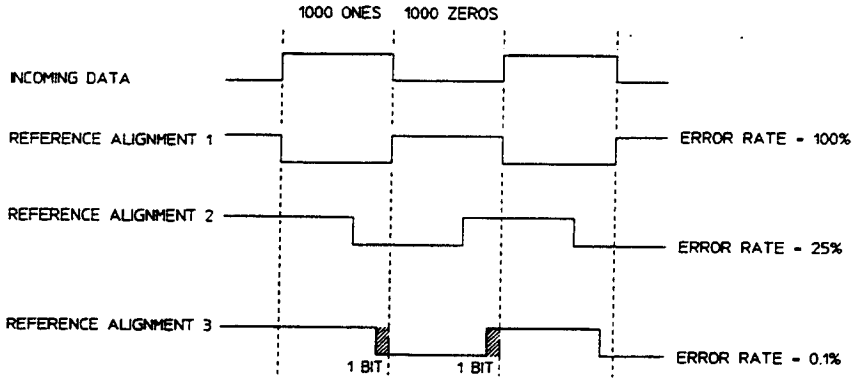


Figure D-5. Error rates due to pattern misalignment

In the general case, for an n bit pattern length the sync threshold should be set lower than 2/n if optimum alignment is to be achieved.

Clock-to-Data Alignment Failure

Are you experiencing a failure or intermittent failure when you perform clock-to-data alignment on a User Pattern? If so, check the sync threshold setting, it may be necessary to select a lower value (for example change from 1e01 to 1e02) and retry clock-to-data alignment. To select a new sync threshold press the left menu **SYNC** softkey then the right-menu **SYNC THRSHLD** softkey.

Note

On RAM based (USER) patterns the error detector may gain sync at a point in the pattern where the criteria for synchronisation (set by the Sync Threshold) is met; but is not the correct point where the internally generated reference pattern and the data input pattern match. When the error detector gains sync incorrectly errors occur and clock-to-data alignment may fail. If this occurs reset the sync threshold to a lower value and recheck the error rate and clock-to-data alignment.

Note

If you select a USER pattern ensure that the sync threshold is compatible with the pattern being generated. Failure to set the correct sync threshold may result in incorrect synchronisation.

Incorrect synchronisation results in errors and clock-to-data alignment failure.

Note

For most RAM based patterns synchronisation should occur in approximately 2 to 3 seconds. However synchronisation times are dependent on pattern length and pattern content, and will increase as pattern length increases. For very long patterns (for example 4 Mbits) times could be of a minute or more.

E

Compatibility with HP 70206A Graphics Display

Compatibility with HP 70206A Graphics Display

Introduction

The purpose of this appendix is to highlight some of the differences between using an HP 70004A Display and a HP 70206A Display in an HP 71600 Series Gbit/s Tester System.

HP 70206A Display Softkeys

The softkeys presented to the user when the fixed label [DISPLAY] key is pressed differ from those in an HP 70004A Display and are as follows:

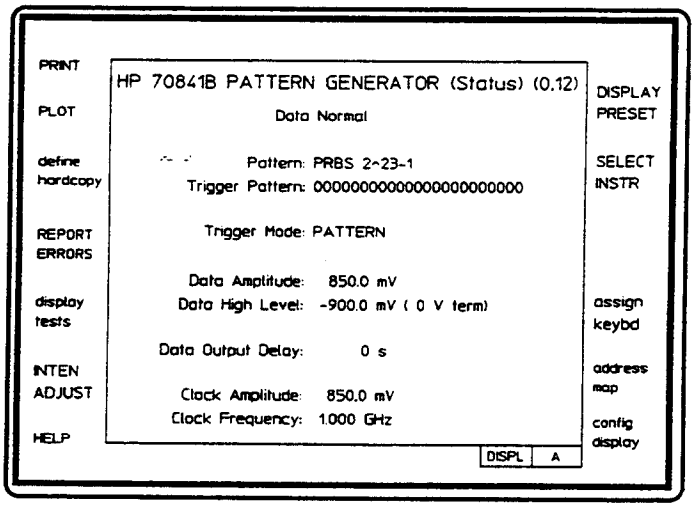


Figure E-1. HP 70206A Display Softkeys

Display Module Status When two Windows are Assigned

In HP 70004A Displays the (INSTR) fixed label key enables the user to quickly switch the keyboard between modules on row 0 of the address map.
The HP 70206A Display does not have an (INSTR) key, but it is possible to perform the same operation using the following procedure.

Note

The following procedure assumes the system has been configured for Master/Master operation and two windows are assigned.

---

a. Press the (DISPLAY) fixed label key.

b. Press the **assign keybd** right-menu softkey.

c. Use the Numeric Keypad ▲ and ▼ keys to select the widow required then press the (MENU) fixed label key. The window selected is highlighted by a green border.

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