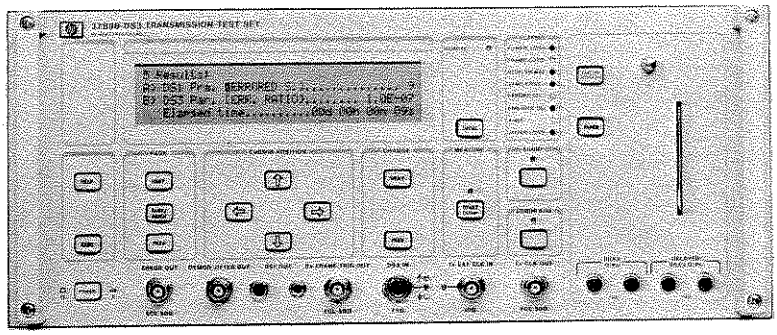
QUICK OPERATING GUIDE

Master

# HP 3789B

## DS3 TRANSMISSION TEST SET



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## OPERATING INFORMATION

# HP 3789B
# DS3 TRANSMISSION TEST SET

### SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2638U.



Manual Part Number: 03789-90001
Microfiche Part Number: 03789-90026

Printed: January 1987

# Contents

## Contents (continued)



## Figure or Table

**Page**

# Introduction To The HP3789B DS3 Transmission Test Set

# 1

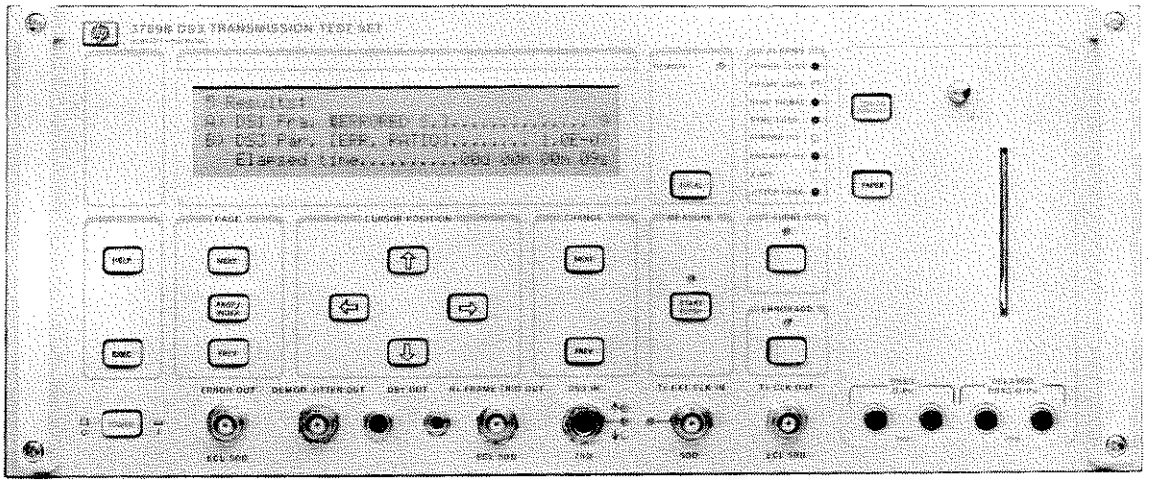


**Figure 1-1 HP3789B DS3 Transmission Test Set**

## Description

The HP3789B DS3 Transmission Test Set offers comprehensive error measuring capability for the Digital Transmission hierarchy at DS3 level (44.736Mb/s). It allows on-line non-intrusive monitoring of live digital traffic in a PCM transmission system, and with DS3 data generation its applications also include commissioning, field trials and maintenance of DS3 transmission terminals and link equipment.

The unit is designed to monitor B3ZS coded data for bit, frame, parity and code errors at DS3 level and to detect bit, frame and CRC errors at DS1 level. With optional DS1 and DS3 jitter measurement it provides comprehensive error and analytical real time measurements to assess the performance of a transmission system.

The HP3789B is microprocessor based and is compatible with the Hewlett-Packard Interface Bus (HP-IB). (HP-IB is Hewlett-Packard's implementation of IEEE Standard 488-1978). It may also be controlled via an RS-232 port. Results can be logged to an external printer or either an internal printer or internal disc drive.

The HP3789B enables live traffic to be monitored for framing errors at DS3, DS2 or DS1 levels by testing the F and M bit sequences within the incoming data. The B3ZS coded DS3 input data is checked for correct parity and to ensure it complies with the B3ZS coding rules. Bit errors are detected by comparison between a compatible 15-stage Quasi-random or 8-bit word pattern and the internally generated reference pattern. DS1 bit errors are detected in the selected digroup by comparison with a 20-stage Quasi-random or 8-bit word pattern. In addition CRC error measurement is available with Fe (extended frame) DS1 framing.

# Getting Started 2

## Introduction

The purpose of this section is to instruct first time users how to turn on the HP3789B and quickly become proficient operating the instrument. The section contains the following items:

**Instrument Turn On** - Detailed instructions on how to configure the HP3789B for the available line voltage and safely connect to the power line.

**Operating The HP3789B** - Simple, easy to understand instructions on the operation of the HP3789B, with practical examples of how to make a measurement.

## Instrument Turn On

**CAUTION**

**Do not turn on the HP3789B until it has been configured and fused for the available line voltage and safely connected to the power line.**

### Introduction

The HP3789B was designed such that it can be operated from either an AC or (optionally) DC supply. The DC capability is available with option 005.

### Before Connecting Power To The HP3789B:

a. Set the rear panel AC/DC switch to the desired line input supply.

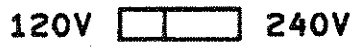
b. Refer to the appropriate instructions for the line input supply you have selected.

Table 2-1. Fuses

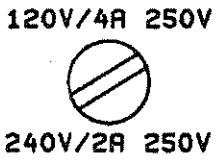
| Voltage Selector | Fuse Type | HP Part Number |
|---|---|---|
| 120V | 4A | 2110-0365 |
| 240V | 2A | 2110-0303 |
| DC - OPTION 005 | 10A | 2110-0051 |

## AC Operation

1. Set the rear panel Voltage Selector switch to the position that corresponds to the power line voltage to be used.




2. Verify that the proper fuse is installed in the rear panel fuse holder.




**WARNING**

**To avoid serious injury, disconnect the ac power cord before removing the ac line fuse.**

3. Set the front panel POWER switch to the OFF position.

4. Connect the ac power cord to the rear panel Line Input connector. Plug the other end of the power cord into a three-terminal grounded power outlet. Proceed to step 5.

## DC Operation (Option 005)

1. Verify that the proper fuse is installed in the rear panel fuse holder (part number 2110-0051).


2. Set the front panel POWER switch to the OFF position.

3. Connect the DC power cord to the rear panel DC SUPPLY POSITIVE, NEGATIVE and GROUND terminals. DC power input 22V to 57V.

**WARNING**

**Ensure the ground connection is made independently of the POSITIVE and NEGATIVE terminals, otherwise power may be conducted via the front panel signal connections.**

Note : The HP3789B must only be used on a positive grounded supply. See the Installation Section (8) of the main Operating Manual for further details.

4. Set the rear panel POWER SUPPLY switch to DC.

5. Turn on the power to the instrument by setting the POWER switch to ON. Verify that the following events occur at switch-on.

* The audible alarm beeps twice.

* All front panel leds illuminate simultaneously for approximately 1 second.

* The LCD display light illuminates and a complete set of characters is displayed momentarily.

* After initial switch-on the HP3789B display will give an "Index" or a "Page" of information. The display is dependent on the current configuration before the last power down. It can be either 1 of 3 Indexes or 1 of 16 information "Pages".

# Operating the HP3789B

INTRODUCTION

The HP3789B is controlled by means of a liquid crystal display (LCD) and a simple "keyboard". Information on instrument status, configuration and results etc, is displayed to the operator in "Pages" of information which may be accessed for viewing or change via the keyboard. The information "Pages" are organized into an Index which lists all the pages in numerical order, indicating the information content of each page. There are 3 Indexes and 16 information Pages. The 3 Indexes listing all the Pages are as follows:

```
Index 1  (In a fix ? Push the HELP key.)
Preset Panel..... 1  Tx Setup......... 4
Rx Setup (A)..... 2  Results.......... 5
Rx Setup (B)..... 3  Gating Period.... 6
```

```
Index 2  (In a fix ? Push the HELP key.)
Events & Alarms.. 7  Output Port..... 10
Data Logging..... 8  Disc Control.... 11
Remote Cont Port. 9  Access Switch... 12
```

```
Index 3  (In a fix ? Push the HELP key.)
Analysis........ 13  Self Test....... 16
Time/Date Set... 14
DS1 Output...... 15
```

Pages 3 and 11 relate specifically to options. If the option is not fitted the HP3789B display will indicate "Option not fitted" when the relevant page is selected.

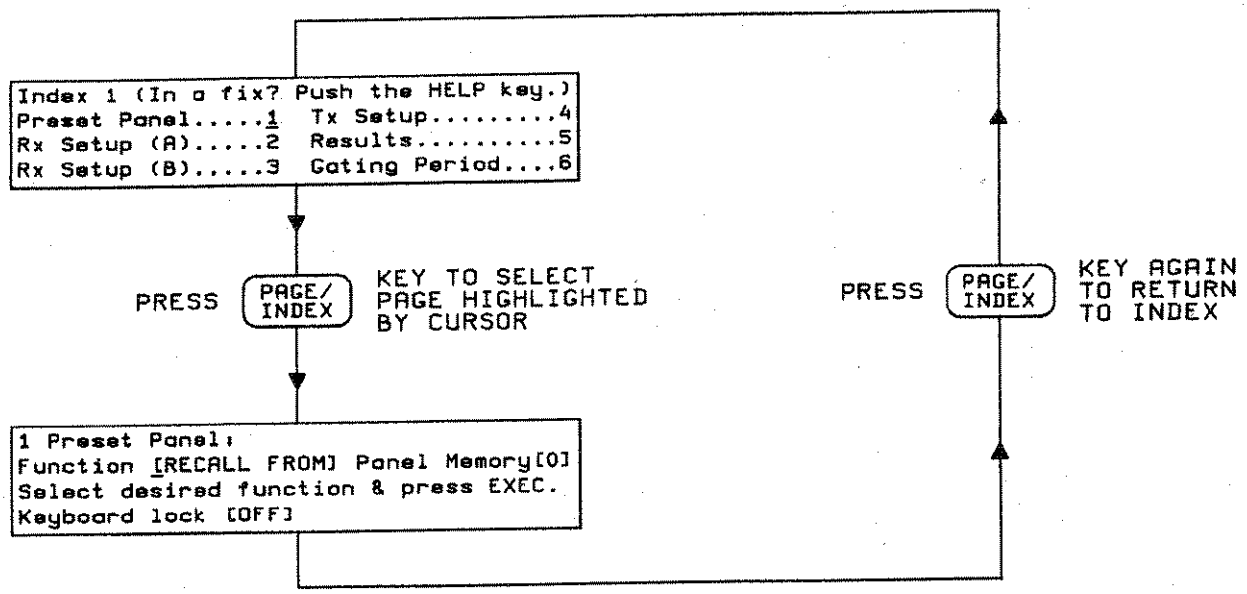
A simple "cursor" system used in conjunction with the PAGE and CHANGE keys allows access to both Pages and Index, and also the selection of various functions/parameters within each page.

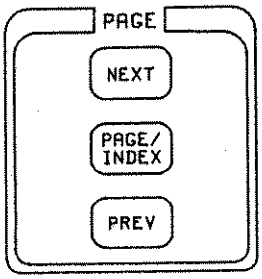
## HP3789B Display at Switch-On

At switch-on, the display presented to the user is dependent on the last selection made by the previous user. Built-in Nonvolatile Memory stores the current HP3789B settings and recalls them on the next power-up after a power-down or power loss. Because of this feature it is impossible for a new user to know what will be displayed on an HP3789B at switch-on.

## How to select an Index or Page

The example below illustrates the key action to select a Page from the Index and then return to the Index.




**To Select an Index** - press the PAGE/INDEX key, then use the PAGE PREV and PAGE NEXT keys to step between the three Indexes. If an Index is already displayed when you switch on, then you need only use the PAGE PREV or PAGE NEXT keys to display the required Index.

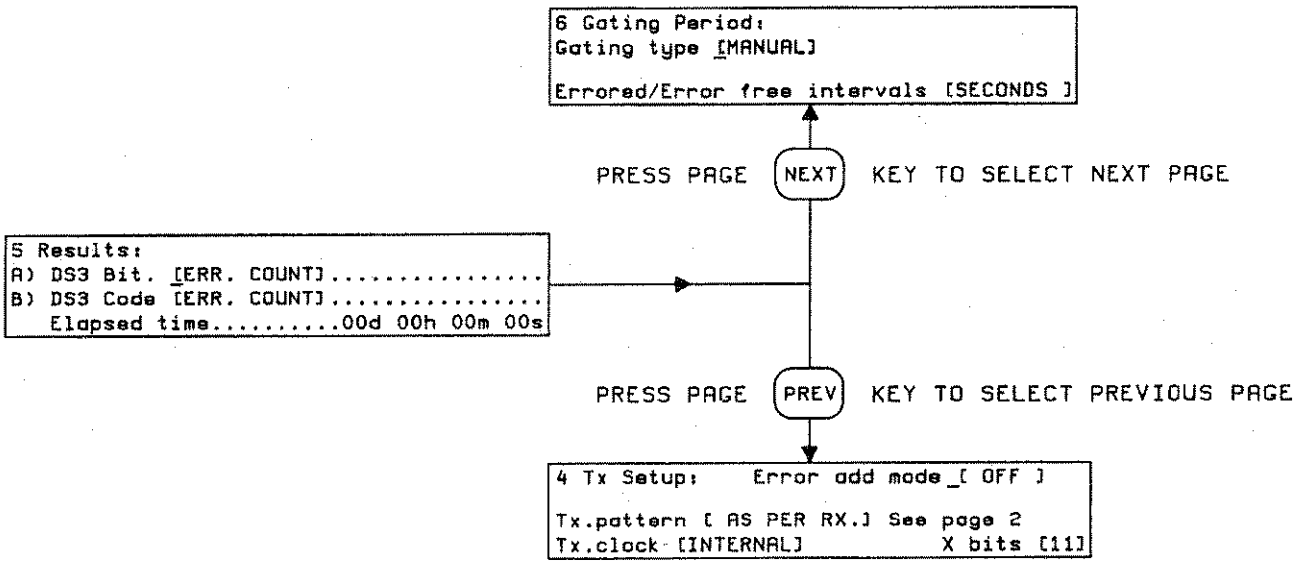
Repeated pressing of the PAGE/INDEX key will alternate the display between the Index, and the page on the Index list which is highlighted by the flashing cursor (flashing black square).

## Page Next/Page Prev

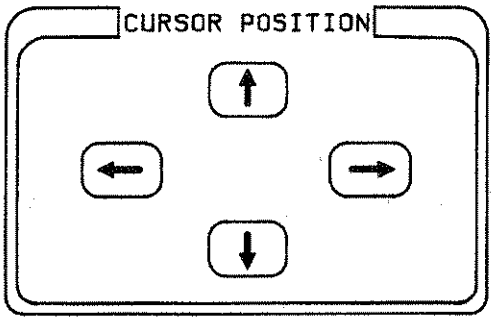
**To select a PAGE** - select an Index then using the CURSOR POSITION keys, move the flashing cursor (flashing black square) to the page number you require and press the PAGE/INDEX key.

If a Page is already displayed, use the PAGE PREV and PAGE NEXT keys to step backwards and forwards through the Pages.

The PAGE NEXT and PAGE PREV keys are also used to step backwards and forwards through the Indexes (when an Index is displayed). The following example illustrates PAGE NEXT /PAGE PREV key operation when Page 5 is currently displayed.



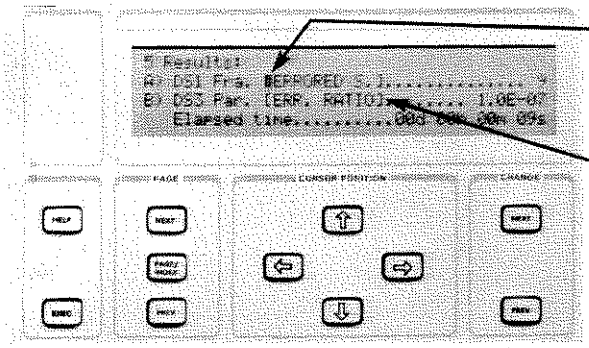

## Controlling the Cursor




These four keys, each marked with an appropriate direction-indicating arrow, enable the user to position the cursor on an appropriate display field, for example a page number in the Index or a measurement parameter on a page. User selectable fields are bracketed [-].

## Changing User Selectable Functions/Parameters

When the cursor has been positioned on a display field the CHANGE [NEXT] and CHANGE [PREV] keys are used to select from the various choices available in that field. The following example illustrates how the CURSOR POSITION and CHANGE keys control the selection of functions/parameters within each display field.



Flashing cursor: movement controlled by CURSOR POSITION keys. Indicates that the choices within that field can be selected using the CHANGE keys.

Areas within square brackets are display fields which offer various user selectable choices. Position the cursor on the field of your choice, then use the CHANGE keys to select from the choices available.

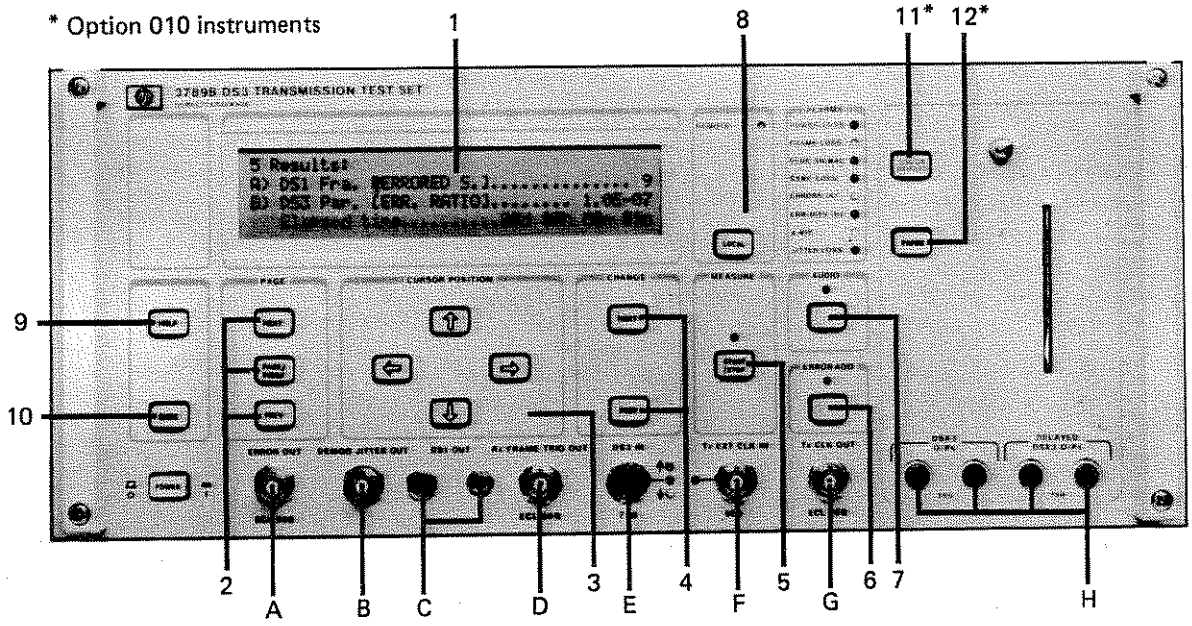
If the item within the field is descriptive (ie. functional) the field is effectively a continuous loop. The CHANGE [NEXT] key steps through the selections in one direction, while the CHANGE [PREV] key steps through in the opposite direction.

Where the display field is numeric the CHANGE [NEXT] key will increase the parameter to the next available value. Similarly the CHANGE [PREV] key will decrease the parameter value. The numeric fields have end stops at minimum and maximum values; indicated by an audible beep.

The CHANGE keys are inoperative when an Index is displayed.

Note: Only relevant choices are presented to the user. For example on Page 2 the Pattern field will only be shown if the Measure A field is set for a Bit Errors measurement.

# Front Panel Operating Features




1. The HP3789B is menu-driven, i.e. information on instrument status, configuration, results, functions etc. is displayed to the operator via pages on the LCD display. The selection of these pages and functions within the pages are controlled by the PAGE, CURSOR POSITION and CHANGE keys.

   The HP3789B is also measurement-driven. For each measurement selected on Page 2 Rx Setup, or Page 3 Rx Setup (option 003) the HP3789B automatically presents a set of functions/parameters that the user must set.

2. **PAGE keys:**

   **PAGE NEXT/ PAGE PREV:** Use these keys to step backwards and forwards through the pages, i.e. if Page 4 is displayed; pressing PAGE [NEXT] will display Page 5, whereas pressing PAGE [PREV] will display Page 3.

   **PAGE/INDEX:** Repeated pressing of the [PAGE/INDEX] key alternates the display between an Index page and the page on the Index highlighted by the flashing cursor.

3. **CURSOR POSITION:** Use these keys to position the cursor (flashing black square) on items to be selected/changed within the page displayed.

4. **CHANGE:** These keys are used to select/change functions or parameters within each information Page. The keys are disabled when an Index page is displayed.

5. **START/STOP:** Initiates a new measurement or stops a current one. Gating period (Page 6) can be selected from Manual, Single, Repetitive or 2.2 sec. Repetitive. The led above the key is illuminated during gating.

6. **ERROR ADD:** Single, Burst or Variable Ratio errors may be added to the Transmitter output data. To inject Single or Burst errors into the Transmitter output data it is necessary to select either of these functions in the "Error add mode" field on Page 4, and then depress the ERROR ADD key. When either Single or Burst mode is selected the led above the ERROR ADD key is illuminated to warn that it has been enabled.

7. **AUDIO:** When the AUDIO key is enabled (led above key illuminates) an audible tone sounds each time errors occur. The pitch of the tone varies with the error rate of the received signal. On Option 003 instruments which include the second measurement, "Measurement B", it is necessary to select on (Page 7 - Events and Alarms) whether the audible tone occurs on Measure A or Measure B. When Measure B is selected, jitter hits can also trigger the audio tone.

8. **LOCAL:** Returns the instrument to local control after Remote operation.

9. **HELP:** Pressing and holding down the [HELP] key gives a display of useful information for the Page currently selected.

10. **EXEC:** The [EXEC] key is operative when pages 1, 2, 11, 12, 14 or 16 are displayed, and is used to initiate functions within these pages.

11. **LOG ON DEMAND:** Pressing this key will initiate logging when not otherwise called for. Its action is dependent on various conditions and is explained in detail in the main Operating Manual.

12. **PAPER:** (Option 010 instruments). Pressing this key causes the Printer to feed paper. If held down, continuous paper feeding occurs.

## Front Panel Input/Output Ports

A. **ERROR OUT:** Provides one pulse for each error recorded by Measure A. Measure A is selected on Page 2 Rx Setup. If sync loss occurs during Bit Error measurements the ERROR OUT port will provide one pulse per clock period. In Bit Error and Code measurements if signal is lost the ERROR OUT port will show a continuous error stream. Can be used to trigger external devices such as Counters, Loggers, Analyzers, etc. Level - nominal ECL output.

B. **DEMOD JITTER OUT:** Provides an analog output of the demodulated jitter prior to the application of measurement filtering.

| | |
|---|---|
| **Scaling** : | 500 mv/UI |
| **Frequency Range** : | Range : 10Hz to 300kHz |

May be used with a Spectrum Analyzer to check individual frequency components or with an Oscilloscope to examine the shape of the demodulated jitter.

C. **DS1 OUT:** Provides an output of the selected demultiplexed DS1 digroup from the DS3 input stream.
**Level/Impedance/Slope** : As per Bell Compatibility Bulletin No. 119 for the DS1 cross connect.
**Coding** : AMI or B8ZS selectable on Page 15 DS1 OUTPUT.

May be connected to equipment providing further demultiplexing to voice channels or data traffic.

D. **Rx FRAME TRIG OUT:** Provides an ECL level pulse 85 clock periods wide. Trailing edge synchronous with start of M1 bit (i.e. first multiframe alignment bit). Useful for looking at the occurrence of errors or other events within the DS3 frame.
Nominal ECL output of DS3 level frame trigger.

E. **DS3 IN:** Six levels of DS3 input signal are catered for and may be selected on Page 2 `Rx Setup`; they are as follows:

**Level :** DS3-HI : 0.91 volts peak nominal - tolerance +3db/-6db

DS3-LO : as for HI but with 13.8dB of additional gain
(i.e. 185mV peak nominal)

DSX3 : as for DS3-HI but with cable equalization for 450ft of 728A cable
(i.e. 560mV peak nominal)

DSX3-LO : as for DSX3 but with 20dB of additional gain
(i.e. 56mV peak nominal)

900' : as for DS3-HI but with cable equalization for 900ft of 728A cable
(i.e. 300mV peak nominal)

900' LO : as for 900' but with 20dB of additional gain
(i.e. 30mV peak nominal)

**Format** : Ternary B3ZS encoded

**DS3 IN PORT LEDs:** The green led adjacent to the DS3 IN port illuminates on input signal transitions. The upper yellow led indicates the presence of high input signals, and has a threshold of nominally +4dB. The lower yellow led indicates the presence of low input signals and has a threshold of nominally -4dB, both relative to the mean signal level. The following examples illustrate **DS3 IN** port operation.

☼
☼ Transitions detected but signal level >4db above selected input level.
•

•
☼ Transitions detected. Input signal level within +/-4db of selected input level.
•

•
☼ Transitions detected but input signal level >4db below selected input level.
☼

•
• No Transitions detected, i.e. Signal Loss flagged.
☼

F. **Tx EXT CLK IN:** The frequency of an external clock source should be 44.736MHz±2%. The input is compatible with ECL or TTL signals. The led adjacent to the port illuminates if clock transitions are detected.

G. **Tx CLOCK OUT:** Nominal ECL output of the internal Transmitter clock output (internal Transmitter setup on Page 4 Tx Setup).

H. **DSX3 O/P's:** Six DSX3 outputs are provided, four of the outputs are delayed by 2 bits with respect to the others. A set of four on the front panel provide two straight and two delayed, the other two delayed ports being on the rear panel.

### HP3789B Display Backlight

The HP3789B display backlight is enabled when any front panel key is pressed. If no key is pressed within fifteen minutes the light is switched off.

## Alarms

**POWER LOSS:** The POWER LOSS led illuminates when power is restored after a power loss, when the instrument is gating. The led will not illuminate following a power loss when the instrument is not gating. If the power loss led is illuminated it will remain so until a new gating (measurement) period is initiated via the START/STOP key.

**FRAME LOSS:** For DS3 measurements - the frame loss led is disabled if the DS3 Frame field on Page 2 Rx Setup is set to [OFF]. If set to [ON] the led will illuminate when the following occurs:

F Bits 3 out of 15 errored
M Bits 2 out of 3 "010" sequences errored

For measurements requiring DS2 framing:
The FRAME LOSS led is illuminated in one or both of the levels DS3, DS2 when any of the following occur:

DS3 - F Bits 3 out of 15 errored
M Bits 2 out of 3 "010" sequences errored

DS2 - F Bits 3 out of 15 errored
M Bits 2 out of 3 "010" sequences errored

For measurements requiring DS1 Framing:
The FRAME LOSS led is illuminated when any of the following occur:

DS3 - errors as listed for DS3 measurements

DS2 - errors listed as for DS2 measurements

DS1 - Ft Bits 3 out of 8 errored

**BLUE SIGNAL:** The BLUE SIGNAL led illuminates when correct DS3 Framing is received and information bits in each block between frame bits alternate 1010 - with each block starting with logic "1".

**SYNC LOSS:** The SYNC LOSS (Pattern sync loss) led illuminates when a BIT ERROR measurement is selected (DS3 BIT ERRORS or DS1 BIT ERRORS) on Page 2 Rx **Setup**, and the criteria for sync loss is met, i.e. Threshold value in the range 1 in 64 to 4 in 64 bits in error depending on distribution. Refer to the Specifications given in the HP3789B Service Manual or Specification Document (Part No. 5954-7936) for detailed information on Sync loss/gain criteria.

**ERRORS (A):** Illuminates on the occurrence of errors. The category of errors is selected from the "Measure A" field on Page 2 Rx **Setup**.

**ERR/HITS (B) - Option 003:** Illuminates on the occurrence of errors or hits detected by the measurements selected from the "Measure B" field on Page 3 Rx **Setup**.

**X-BIT:** Illuminates when M1 and M2 bits in the DS3 frame structure are both received as a logic "0". An internal link on the A11 Assembly enables the alarm to be set to occur when M1 and M2 bits are logic "1".

**JITTER LOSS:** Indicates when the jitter measurement has lost the reference against which it measures.

# Making Measurements With The HP3789B

# 3

## Introduction

This section gives a list, definition and method of computation for each of the measurements provided by the HP3789B. Also included is information on how to store or recall measurement configurations from memory, and individual measurement procedures.

## Principal Measurements

The principal measurements performed by the HP3789B are selected and configured on Page 2 Rx Setup. The measurements provided are listed in this manual under the heading **What Measurements does the HP3789B Perform?** When the user selects a particular measurement from this list the HP3789B responds by selecting parameters which are obligatory, thus relieving the user of the need to set necessary parameters. For example if a measurement of Parity Errors is required then the HP3789B will ensure that DS3 Framing is selected to be ON. The remaining parameters are those whose setting is necessary but are left to the user to select.

**AUTO Setup:** When DS1 AUTO or DS3 AUTO is selected the HP3789B automatically selects the most appropriate error measurement available for the signal provided at the Receiver DS3 IN port. In addition to selecting the measurement the HP3789B will also configure all the obligatory parameters on Page 2 Rx Setup. For example, if the signal present at the DS3 input contains a repeating pattern, then bit by bit error detection on that pattern will provide the most accurate overall measure of the error performance and the HP3789B will select a "BIT ERROR" measurement with the correct pattern framing, and input level. When DS1 AUTO is selected the user must specify which digroup he wants to make measurements on.

**Note:** The HP3789B is only configured automatically when the "Auto Setup" is executed (i.e. when Auto setup is selected and the [EXEC] key pressed). It will not thereafter reconfigure itself unless directed to do so by the user. If no frame or recognizable pattern is found at DS1, the HP3789B will look for frame at DS2 and failing that will revert to the DS3 AUTO set routine. *If non standard waveforms are applied at the DS3 IN port then the Auto Setup interpretation of the input level may not correspond with expectation.*

## Second Measurement (Option 003)

On instruments fitted with option 003 a second measurement can be performed simultaneously with the measurement selected from Measure A and both sets of results are displayed simultaneously (on Display Page 5). This measurement is configured on Page 3 Rx Setup B.

**Note:** If the second measurement option is fitted then the measurement selected on Page 3, under the heading Measure B, can influence the selection of "necessary" parameters (on Page 2). For example, if Measure A is set to DS3 CODE ERRORS then Digroup selection would not normally be offered, but if Measure B has DS1 Jitter selected then Digroup becomes a necessary parameter and will be displayed on Page 2. Parameters are always located in the same position and in the same Page regardless of the setup.

## What Measurements does the HP3789B perform?

The HP3789B performs both in-service and out-of-service measurements. Four TTL and four voltage measurement inputs on the rear panel EVENTS INPUT are provided to enable system alarms, AGC voltages etc. to be monitored and recorded. Analysis measurements are provided, and are selected on Page 13 `Analysis`.

For systems carrying live traffic the following Error measurements can be performed.

### In-Service Measurements

**Measurement A** - selected on Page 2 `Rx Setup`

1. DS3 Parity Errors
2. DS3 Frame Errors
3. DS3 Code Errors (Bipolar Violations)
4. DS2 Frame Errors
5. DS1 Frame Errors (normal D4 framing)
6. DS1 Frame Errors (Extended Frame Format)
7. DS1 CRC Errors

```
2 Rx Setup:  Setup [ MANUAL ]
             Measure A [DS3 PARITY ERRS]

                    Input level [ DSX3  ]
```

**Measurement B** - selected on Page 3 `Rx Setup` (Option 003 instruments)

8. DS3 Parity Errors
9. DS3 Code Errors (Bipolar Violations)
10. DS1 Jitter
11. DS3 Jitter

```
3 Rx Setup:  Measure B [ DS3 CODE ERRS ]
```

### Out-of-Service Measurements

All of the measurements listed for in-service measurements can also be used for out-of-service measurements where the output DS3 signal is framed. The following measurements involve the replacement of live traffic with repeating Word/PRBS Patterns. Two such measurements are provided, both of which may be performed on framed or unframed signals, they are:

**Measurement A** - selected on Page 2 `Rx Setup.`

1. DS3 Bit Error Measurement
2. DS1 Bit Error Measurement....(The DS1 Transmitter function is not included in the HP3789B)

### Event and Alarm Measurements

In addition to the Error and Jitter measurements listed previously, four TTL events inputs and four voltage inputs (on rear panel EVENT INPUTS connector) enable system alarms and voltages to be monitored and recorded. Page 7 **Events & Alarms** gives a display of these TTL levels and the selected voltage input, and also the duration of the selected alarm occurring during the overall gating period.

```
7 Events & Alarms:      Audio [MEASURE A]
TTL Events.......................... 1111
Duration of [POWER LOSS ].........0 Secs
Voltage [1]....................... +0.1 V
```

**Alarms Durations**: The HP3789B totalizes the time in seconds when each of the following conditions exist: POWER LOSS, SIGNAL LOSS, FRAME LOSS, PATTERN SYNC LOSS, BLUE SIGNAL, X-BIT= alarm state, or JITTER LOSS.

Alarm flags on the instrument front panel indicate current alarm conditions (except Power Loss which is latched).

### Analysis of Error Results

Errors from any of the error measurements selected from the **Measure A** field on Page 2 **Rx Setup** may be analyzed to give the following:

% Availability
% Unavailability
% Errored Seconds
% Severely Errored Seconds
% Degraded Minutes
Asynchronous Error Seconds
Error Bursts

Each of the analysis measurements (selected on Page 13 **Analysis**) can be performed against a user selectable threshold which is compared with the measurement result. (Individual result threshold set to [YES]). If the result of any Analysis measurement falls below the users preset "PASS" threshold, then the **Overall** and **Individual Result** fields on Page 13 will register a "FAIL". The "PASS" condition for each measurement is deemed to be when the result is better than or equal to the threshold value. Refer to Appendix A of the main Operating Manual for a definition of each Analysis measurement. An example of a typical Analysis page is shown below.

**Note:** If more than one Analysis "Individual result threshold" has been set, then ALL the individual results must pass for the "Overall" field to register a "PASS".

```
13 Analysis: (Res.A only)
Result [AVAILABILITY ].............%
Individual result thres. [NO ]
Overall: ----    Individual Result: ----
```

## Measurement Results

```
5 Results:
A) DS3 Bit. [ERR. COUNT].................
B) DS3 Code [ERR. COUNT].................
   Elapsed time.........00d 00h 00m 00s
```

The results of measurements selected on Page 2 or Page 3 are displayed on Page 5 **Results**. For each of the measurements the user is offered a choice of result formats (on Page 5), which can be selected at any time, irrespective of gating. In the case of DS3 Jitter measurements the result type (ie. Hit, Hit Bit or Max Peak) is selected prior to starting a measurement, and the choice of result format limited to those for the result type selected. The following table indicates the choice of result formats displayed for each measurement. Detailed definitions of each measurement performed by the HP3789B are given in Appendix A of the main Operating Manual.

**Table 3-1. Measurement Result Formats**

| Measurement | Result Format |
|---|---|
| **Measurement A**<br>Error measurements 1 to 7 as listed for In-Service Measurements, plus DS3, DS1 Bit Error Measurements | Error Ratio<br>Errored Seconds... (Synchronous)<br>Error Free Seconds...(Asynchronous)<br>Error Count |
| **Measurement B** (option 003)<br>DS3 Code Errors<br>DS3 Parity Errors | Error Ratio<br>Errored Seconds...(Synchronous)<br>Error Free Seconds...(Asynchronous)<br>Error Count |
| DS1 Jitter (option 003) | Hit Count<br>Pk-Pk Amplitude<br>Hit Seconds...(Asynchronous)<br>Hit Free Seconds...(Asynchronous)<br>Maximum Positive Peak<br>Maximum Negative Peak |
| DS3 Jitter (option 003) | Maximum Peak<br>Hit Bit Count<br>Hit Bit Ratio<br>Hit Seconds...(Asynchronous)<br>Hit Free Seconds...(Asynchronous)<br>Hit Count |

## Store Measurement Configurations in memory and recall on demand

An important feature of the HP3789B is the ability to store up to 9 complete measurement configurations in nonvolatile memory (NVM) and recall on demand. This saves time when a number of measurements are performed repeatedly, and when stored in advance simplifies operation for first time users. This function is implemented on Page 1 **Preset Panel**. Measurement configurations are stored in Preset Panels 1 to 9; Preset Panel 0 is in ROM and contains a set of default values which cannot be changed by the user.

Example: To Store the current measurement configuration in Preset Panel 4.

1. Select Page 1 **Preset Panel**

2. Set the Function to [SAVE IN] and Panel Memory to [4]

```
1 Preset Panel:
Function [  SAVE IN  ]  Panel Memory [4]
Select desired function & press EXEC.
Keyboard lock [OFF]
```

3. Press the [EXEC] key the display will show as follows:

```
1 Preset Panel:
Function [RECALL FROM]  Panel Memory [0]
Select desired function & press EXEC.
Keyboard lock [OFF]
```

Example: To Recall measurement setup from Panel Memory.

1. Select Page 1 **Preset Panel**.

2. Set the Function to [RECALL FROM] and Panel Memory to [4].

3. Press the [EXEC] key, the display will blank momentarily then show as follows:

```
1 Preset Panel:
Function [RECALL FROM]  Panel Memory [4]
Select desired function & press EXEC.
Keyboard lock [OFF]
```

# Measurement Examples

**Note:** Parameter changes are normally performed when the instrument is not gating. An audible "beep" warns of disallowed parameter selection/change.

## Automatic Measurement Setup

The HP3789B provides an "Auto Setup" mode which when selected, automatically selects the most suitable error measurement available for the signal provided at the Receiver **DS3 IN** port.

There are two Auto Setups available DS1 AUTO and DS3 AUTO, both are selected in Page 2 Rx Setup.

**How to configure the HP3789B automatically.**

1. Switch-on the HP3789B.
2. Connect the DS3 signal to be measured to the HP3789B **DS3 IN** port.
3. Select Page 2 Rx Setup .....use the PAGE and CURSOR POSITION keys.
4. Position the flashing cursor on Setup and using the CHANGE keys select DS1 AUTO or DS3 AUTO as required. One of the following displays should be obtained:

```
2 Rx Setup:  Setup [DS1 AUTO]
Connect DS3 test signal..
         .. select required Digroup [ 1]
Then hit EXEC. key for correct setup.
```

OR

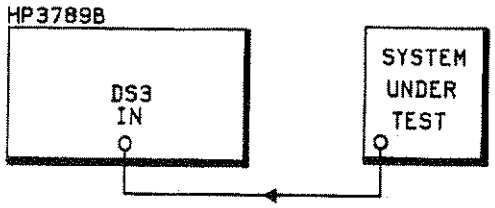
```
2 Rx Setup:  Setup [DS3 AUTO]
Connect DS3 test signal..

Then hit EXEC. key for correct setup.
```

5. For DS1 AUTO select the Digroup of interest.
6. Press the [EXEC] key. The HP3789B will now select each of its six input levels in turn, gathering framing and pattern recognition information and monitoring for errors. From the information it has gathered, a selection will be made of the most likely input level, framing and pattern conditions present.
7. All that is required now is for the operator to set the measurement gating period (Page 6) and initiate the measurement by pressing the [START/STOP] key.

# Measure Parity Errors (In-Service)

**Procedure**

Configure the HP3789B to perform a Parity Error measurement over a single 4 second Measurement Period.




1. Switch-on the HP3789B.
2. Connect the DS3 signal to be measured to the HP3789B **DS3 IN** port.
3. Select Page 1 **Preset Panel** and set the HP3789B to the default settings by setting the **Function** field to [RECALL], **Panel Memory** to [0] and then press the [EXEC] key.
4. Select Page 2 **Rx Setup** .....use the PAGE and CURSOR POSITION keys as necessary.
5. Position the flashing cursor on **Measure A** and using the CHANGE keys change the display to the following:

```
2 Rx Setup:  Setup [ MANUAL ]
             Measure A [DS3 PARITY ERRS]

                    Input level [ DSX3  ]
```

6. Position the flashing cursor on the Receiver **Input level**, and using the CHANGE keys select the correct Input level for the signal at the Receiver **DS3 IN** port. The leds adjacent to the Receiver **DS3 IN** port indicate the level of the DS3 input signal. The upper yellow LED indicating a signal larger than the nominal level and the lower LED a signal smaller than the nominal. The green LED illuminates on input signal transitions. Refer to the Front Panel Operating Features section (Page 2-7) for an explanation of Receiver input levels.

7. Select Page 6 **Gating Period** ..... use the PAGE [NEXT] key.

   Set the display to the following:....use CURSOR POSITION and CHANGE keys.

```
6 Gating Period:
Gating type [SINGLE]
Period [ 0]d [ 0]h [ 0]m [ 4]s
Errored/Error free intervals [SECONDS ]
```

8. Select Page 5 **Results** ..... use the PAGE keys.

   Set the display to the following:

```
5 Results:
A) DS3 Bit. [ERR. COUNT].................
B) DS3 Code [ERR. COUNT].................
   Elapsed time.........00d 00h 00m 00s
```

9. Start a measurement by pressing the [START/STOP] key.

   * The MEASURE LED will illuminate for the period of the measurement (4 seconds).

   * After 4 seconds the HP3789B display will indicate the result of the DS3 PARITY ERROR measurement, i.e. "0" if no error add enabled.

# Measure DS3 Bit Error Ratio (Out-of-Service)

Perform an out-of-service measurement where live traffic is replaced with a repeating pattern. The HP3789B provides two such measurements, DS3 BIT ERRORS and DS1 BIT ERRORS. To perform either of these measurements it is necessary to have a suitable pattern source. The HP3789B built-in DS3 Transmitter offers this facility for DS3 Bit Errors.

Example: Configure the HP3789B to perform a DS3 Bit Error Ratio measurement over a single 5 second measurement period and log the results on the internal Printer (option 010) or internal Disc Drive (option 011 instruments). To perform the following procedure it is necessary to have an HP3789B option 010 or 011 instrument.

**Procedure**

1. In a practical situation one would connect the HP3789B as shown in Figure A, for the purpose of this example, connect the HP3789B back-to-back as shown in Figure B.

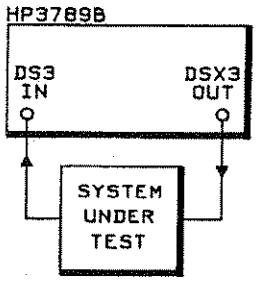



**Figure A**

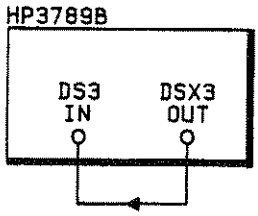



**Figure B**

2. Switch on the HP3789B

3. Set the HP3789B to the Default settings by selecting Page 1 `Preset Panel` and recalling Panel Memory 0.

4. Select and display Page 2 Rx `Setup` ....use the PAGE and CURSOR POSITION keys as necessary.

5. Change the display to the following .... use the CURSOR POSITION and CHANGE keys.
   Note the Quasi 15 stage Pattern is a 2E15-1 PRBS with no zero limiting.

```
2 Rx Setup:  Setup [ MANUAL ]
             Measure A [ DS3 BIT ERRS  ]
Pattern [QUASI] 15 stage
DS3 Frame [ON ]    Input level [ DSX3  ]
```

6. Select Page 6 **Gating Period** .... use the PAGE [NEXT] key.
   Set the display to the following:

```
6 Gating Period:
Gating type [SINGLE]
Period [ 0]d [ 0]h [ 0]m [ 5]s
Errored/Error free intervals [SECONDS ]
```

7. Select Page 8 **Data Log** .... use the PAGE [NEXT] key.
   Set the **Device** field to [3789B].

   The **Occurrence** field has two choices [DURING GATING] and [END OF PERIOD SUMMARY]. For this example we only require a print of Result A as a summary at the end of the measurement period, and do not require a print during gating, (other than Events and Alarms). The Occurrence selections are therefore selected and set as follows:

```
8 Data Log: Device [3789B]
Occurrence [END OF PERIOD SUMMARY]
Log [ A ]  Anlyss [NO ]  Alrm Dur. [NO ]
Trigger [   ALWAYS   ]
```

```
8 Data Log: Device [3789B]
Occurrence [    DURING GATING    ]
Log [ALARMS ONLY]
```

10. If your instrument has a disc drive fitted and you are inserting a new disc, it will be necessary to initialize the disc before data can be logged. Display Page 11 and set the **Function** field to [FORMAT NEW SINGLE SIDE DISC] or [FORMAT NEW DOUBLE SIDE DISC] as required - insert the new disc then press the [EXEC] key.

9. Select Page 4 **Tx Setup**.
   Set the display to the following:

```
4 Tx Setup:      Error add mode [RATIO ]
Error type [BIT/PAR]   Ratio 1.0E-[ 2.0]
Tx.pattern [ AS PER RX.] See page 2
Tx.clock [INTERNAL]          X bits [11]
```

10. Select Page 5 Results.

11. Press the (START/STOP) key to initiate the measurement. Check the MEASURE LED illuminates at the start of gating and extinguishes at the end.

12. Observe the measurement results in the Results display at the end of gating, and check that the Printer prints a summary of the DS3 Bit Error result. The results of this measurement and an example printout is given below.

[ERR. RATIO].....1.000E- 02
[ERRORED S.].....5
[ER. FREE S].....0
[ERR. COUNT].....2210512

} Note: Only one result displayed at one time

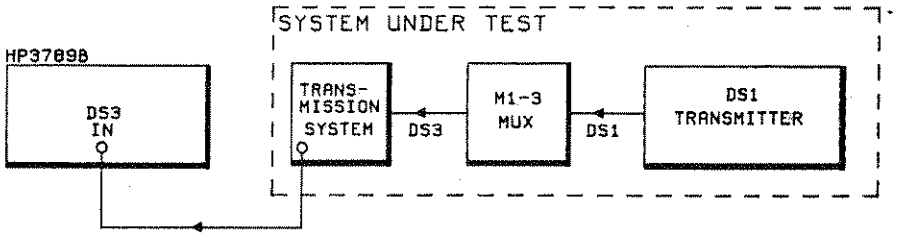
**Note:** The Error Count result you may obtain may not be identical to the value given above; this is due to the following.
a. The accuracy of the Tx clock (i.e. +/-20ppm) and.
b. The accuracy of the 5 second gating period, which in turn is dependent on the accuracy of the HP3789B real time clock.
Taking these factors into account gives an Error Count result within the limits 2207822 to 2215348; your result should fall within these limits.

```
**************************
Hewlett-Packard     3789B
15:42:25  12/15/86 START
Event inputs....... 1111
Alarms and Events Only

15:42:31  12/15/86  STOP

SUMMARY
DS3 Bit Error Result
Er.Ratio...... 1.000E-02
```

If your instrument is fitted with a Disc Drive, measurement results will be stored on disc - provided a disc is loaded and initialized. The contents of the disc may be copied to an external Printer via the HP-IB or RS232 ports. Refer to the Data Logging section of the main Operating Manual for complete Disc Drive operating features.

# Measure DS1 Bit Error Ratio

For the HP3789B this is a receive function only. The HP3789B can demultiplex out a DS1 stream from a DS3 signal and perform bit by bit error detection on patterns. It also generates an output pattern with the correct DS3 framing bits. This measurement therefore requires a DS3 signal fully multiplexed up from DS1, with a test pattern in a Digroup. The procedure for measuring DS1 Bit Error Ratio is as follows:




**Procedure**

1. Switch-on the HP3789B.
2. Connect the system or item to be tested to the HP3789B **DS3 IN** port.
3. Select the Default settings by selecting Page 1 **Preset Panel** and recalling Panel Memory 0.
4. Select Page 2 **Rx Setup** ....use the PAGE and CURSOR POSITION keys.
5. Set the **Measure A** field to [DS1 BIT ERRS]. The display shown below is for example only, select the Pattern, Digroup fields etc. to suit your own application.
   Note: a Quasi 20 stage pattern is a QRSS (Quasi Random Signal Source ) of 2E20-1 (14 zero limited).

```
2 Rx Setup:  Setup [ MANUAL ]
             Measure A [ DS1 BIT ERRS  ]
Pattern [QUASI] 20 stage    Digroup [ 1]
DS1 Frame [OFF]    Input level [ DSX3  ]
```

6. Error detection can be performed on unframed patterns or on patterns framed with normal framing (D4) or extended framing (FE). Set the framing as required in the **DS1 Frame** field.
7. Set the **Input level** field to the correct level for the signal at the HP3789B **DS3 IN** port.
8. Select Page 6 **Gating Period** and set the required measurement gating period.
9. Select Page 5 **Results** - select the required result format for Result A), i.e. [ERR. COUNT], [ERR. RATIO] etc.
10. If Manual or Repeat gating periods are used it will be necessary to use the (START/STOP) key to initiate and terminate the measurement; with SINGLE gating periods the measurement is initiated using the (START/STOP) key and will stop automatically at the end of the selected gating period.
11. Observe the measurement result in the HP3789B display at the end of the measurement gating period.

# Jitter Measurements (Option 003)

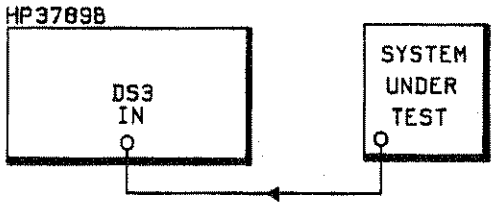
Jitter measurements are provided in the HP3789B at DS1 and DS3 levels (option 003 instruments). There are three types of jitter measurement at DS3 as follows:

**DS3 Jitter Measurements**

1. DS3 Hit Bit Count, DS3 Hit Bit Ratio.
2. DS3 Hit Count, Hit Seconds, Hit Free Seconds.
3. DS3 Maximum Peak value of Jitter.

Note, that not all DS3 Jitter measurements are available simultaneously. For example if a Hit Bit result is selected then only Hit Bit results are given, similarly if a Hit measurement (i.e. Hit Count, Hit Secs etc) is selected then only Hit results are given. Because of this it is necessary when performing DS3 Jitter measurements to select the type of result on the Results page (Page 5) prior to the start of the measurement. This is quite different to Error or DS1 Jitter measurements where the result type may be selected at the end of the measurement. Results can be interrogated during the gating period only within the selected groups above, i.e. if MAX PEAK was selected only that result is available during gating, but if any result from group 2 had been initially selected all three results may be viewed during gating.
See Appendix A in the main Operating Manual for a definition of Jitter Measurements.

## Measure DS3 Jitter (Option 003)




**Procedure**

1. Connect the monitor point of the system or item under test to the HP3789B DS3 IN port.
2. Set the HP3789B to the Default settings by selecting Page 1 `Preset Panel` and recalling Panel Memory 0.
3. Select Page 2 `Rx Setup (A)`.
   Set the `Input level` field to correspond to the DS3 input signal at the HP3789B DS3 IN port.
4. Select Page 3 `Rx Setup (B)`.
   Set the `Measure B` field to [DS3 JITTER]
5. Select Page 5 `Results`.
   Set `Result B` to the DS3 Jitter result format required (i.e. Hit, Hit Bit or Max Peak).

6. Select Page 3 `Rx Setup (B)`
   Select the high pass filter (HP1, HP2, or HP1 + HP2 for measurement over the whole mask) followed by the "Hit" threshold in the case of "Hit" and "Hit Bit" type measurements. Filter corner frequencies are as follows HP1:10Hz; HP2:60kHz. Note the "mask" referred to above is the Input Jitter Tolerance mask for a Digital Multiplexer, refer to Appendix D of the main Operating Manual for further information.

```
3 Rx Setup: Measure B [  DS3 JITTER    ]

Filter [ HP1 ]
Hit Threshold [2.50] UIP
```

7. Select Page 6 `Gating Period` and set the required measurement gating period. **Note:** The resolution of results displayed depends on the measurement gating period selected (see Table 3-2).

8. Select Page 5 `Results`

9. If Manual or Repeat gating is used it will be necessary to use the START/STOP key to initiate and terminate the measurement; with SINGLE gating periods the measurement is initiated using the START/STOP key and will stop automatically.

10. Observe the measurement results in the display at the end of gating.

**Note:** The "Max Peak" jitter measurement measures the maximum value of jitter recorded during the gating period. At any point in time the true value of jitter may be less than this value since the display "latches" the maximum measured value.

**Table 3-2. Display Resolution**

| Filter | Measurement Period | Increment Size |
|---|---|---|
| HP1 | 1 sec | 1.00 UI |
| | 2-3 sec | 0.50 UI |
| | 4-9 secs | 0.25 UI |
| | 10-49 secs | 0.05 UI |
| | >49 secs | 0.01 UI |
| HP2 | 1 sec | 0.05 UI |
| | >1 sec | 0.01 UI |
| HP1+HP2 | 1 sec | 25% mask |
| | 2-3 secs | 10% mask |
| | 4-19 secs | 5% mask |
| | >19 secs | 1% mask |

**Note:** For Manual gating periods the increment size is always set to the minimum ie 0.01 UI or 1% of mask.

## DS1 Jitter Measurement (Option 003)

### Introduction

This measurement allows jitter at the DS1 level to be measured even though access is only provided at the DS3 level. The DS1 jitter measurement reconstructs the jitter present on the selected DS1 Digroup by monitoring the justification control bits in the DS2 frame sequence. The measurement includes the waiting time jitter from the last multiplex. For convenience the justification jitter is removed from the peak and peak to peak results, although it can still be observed on the demodulated jitter signal. The effective reference for this measurement is the 6.312MHz clock in the last multiplex. (No reference connection to the HP3789B is required.)

### DS1 Jitter Setup

DS1 Jitter measurements are selected and setup on Page 3 Rx **Setup**; user selectable fields of **Range**, **Filter** and **Hit Threshold** are provided. An example of Page 3 Rx **Setup** with DS1 Jitter selected is given below.

```
3 Rx Setup:  Measure B [  DS1 JITTER   ]
Range [ 10UI]
Filter [ 10Hz ]  Lock-in app. 1 sec.
Hit Threshold [ 0.1] UIP
```

### Result Format

As with error type results, the jitter results can be displayed in various formats, the selection of output format is made on the **Results** page (Page 5) on the **Measure B** line.

```
5 Results:
A) DS1 Bit. [ERR. RATIO].............0
B) DS1 Jit. [ MAX PEAK ].........0.30UI
   Elapsed time.........00d 00h 00m 04s
```

### Types of DS1 Jitter Measurement

DS1 Jitter measurements are either Amplitude or Hit type measurements. The choice of measurements is as follows:

1. DS1 Jitter Pk-Pk Amplitude
2. DS1 Jitter Maximum Positive Peak
3. DS1 Jitter Maximum Negative Peak
4. DS1 Jitter Hit Free Seconds
5. DS1 Jitter Hit Seconds
6. DS1 Jitter Hit Count

For each of these measurements there is provided a choice of Filter (which also determines the time required to gain lock) and a Range value which also determines the scaling factor for the Demodulated Jitter Output. The `Hit Threshold` field applies to Hit type measurements only. If the **Range** field is incorrectly set, i.e. the input jitter is greater than the **Range** field selection, the Jitter Loss LED will be illuminated and DS1 Jitter measurement unavailable.

**Note:** For Manual or Single gating the DS1 Jitter Pk-Pk measurement provides a current result i.e. it tracks the jitter and continuously updates the result. In Repetitive gating the result shows the maximum value which has been measured since the (START/STOP) key was pressed. The result is updated at the end of every gating period so that the "current" display is the maximum value measured up to the end of the previous gating period. Measurement gating is selected on Page 6 `Gating Period`.

## Measure DS1 Jitter (Option 003)

### Procedure

1. Switch on the HP3789B.

2. Set the HP3789B to the Default settings by selecting Page 1 **Preset Panel** and recalling Panel Memory 0.

3. Connect the system or item to be tested to the HP3789B **DS3 IN** port.

4. Select Page 3 **Rx Setup**.
   Set **Measure B** to [DS1 JITTER].

5. Select Page 2 **Rx Setup**.
   Select the relevant Digroup in the Digroup field, and set the **Input level** field to suit the signal at the HP3789B **DS3 IN** port.

```
3 Rx Setup:  Measure B [  DS1 JITTER   ]
Range [ 10UI]
Filter [ 10Hz ]  Lock-in app. 1 sec.
Hit Threshold [ 0.1] UIP
```

6. Set the **Filter** field to one of the following high pass filters, [0.6mHz], [0.04Hz], [0.16Hz] or [10Hz]. Note that the time to gain lock depends on the filter selected. The nominal lock-in time for the filters is as follows;
   10Hz.....1 second
   0.16Hz.....56 seconds
   0.04Hz.....4.5 minutes
   0.6mHz.....7.5 hours

7. Set the **Range** field as necessary, and the **Hit Threshold** if a Hit type measurement is being performed.

8. Select Page 6 **Gating Period** and set the measurement gating period as required.

9. Select Page 5 **Results** and choose the desired result format for **Result B**. All result formats may be selected and viewed at the end of the measurement period if desired.

10. Press the (START/STOP) key to initiate the measurement. The **Measure** LED is illuminated during gating and extinguishes at the end of the measurement period.

11. Observe the measurement results in the HP3789B display at the end of the measurement period.

## Jitter Produced By Multiplex Equipment Using Justification Techniques

Multiplexers which use justification techniques (DS1-DS2) can insert jitter which arises as a consequence of the justification process. This process, together with the necessity of using a frame structure with justification control digits and a frame alignment signal, causes the demultiplexed output signal to exhibit a characteristic jitter. The following procedure is given as a guide for measuring this jitter.

1. Connect the relevant DS3 signal source from the Multiplexer to the HP3789B DS3 IN port.

2. Switch on the HP3789B.

3. Select Page 1 Preset Panel and recall Panel Memory 0.

4. Select Page 2 Rx Setup. Set the Input Level field to correspond to the level of the DS3 signal at the HP3789B DS3 in port.

5. Select Page 3 Rx Setup: Set Measure B to [DS1 JITTER].

6. Select a [10Hz] Filter, and set the Range to [10UI]. The 10Hz filter will be sufficient to pass the higher frequency justification jitter and waiting time jitter. However, if it is known or suspected that the jitter of interest is at a much lower frequency, then progressively select a filter with a lower cutoff frequency until the frequency of interest is passed by the filter.

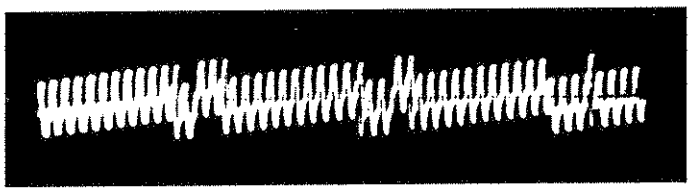
7. Select Page 6 Gating Period and select a [MANUAL] gating period.

8. Select Page 5 Results, set Results B format to [PK-PK AMP].

9. Select Page 2 Rx Setup and set the Digroup field as necessary.

10. Press the (START/STOP) key to initiate gating, and monitor the pk-pk Amplitude results on the Results page (Page 5), and the Demod Jitter output on an Oscilloscope if available.

Notes: If the jitter loss flag is extinguished then the HP3789B Receiver jitter circuitry has locked on. However it may be that there is no DS1 signal present and the Multiplexer is simply producing an idle code to which the HP3789B Receiver has locked on to. This is normally characterized by a reading of 0.0 UI p-p, which is not achievable in practice, or by a widely erratic jitter amplitude result. In either case a quick check on an Oscilloscope will yield the characteristic trace of a normal DS1 tributary (see following example).



If jitter lock is not achieved, then it may be due to the Range field on Page 3 being incorrectly set. Select Page 3 Rx Setup and increase the Range until lock is achieved. In normal circumstances, a Range of 1UI is adequate for a trouble free Multiplexer. However, if any excess jitter is present, then Range 10UI or 100UI may be necessary.

# Page Function Descriptions 4

## Introduction

This section gives a summary of the user-selectable functions on each of the pages listed in the HP3789B Indexes. A brief description of each function is given and practical examples of how to setup/perform selected functions. An example of a typical display for each Page and/or measurement is also given. Please refer to the HP3789B main Operating Manual (Part Number 03789-90000) for detailed lists/explanations of user-selectable functions.

## Store and Recall Measurement Configurations (Page 1)

This function is implemented on Page 1 `Preset Panel`

A Nonvolatile memory (NVM) consisting of RAM with battery backup allows up to 9 measurement configurations to be stored in memory (Preset Panels 1 to 9 inclusive) and recalled on demand. Preset Panel 0 is in ROM and contains a set of Default values which cannot be changed by the user. If the nonvolatile RAM memory is lost (eg. by the removal or failure of the back-up battery) the instrument will be returned to Preset Panel 0 at power-up.

```
1 Preset Panel:
Function [  SAVE IN  ]  Panel Memory [1]
Select desired function & press EXEC.
Keyboard lock [OFF]
```

Instruments fitted with a Disc Drive (option 011) have the additional facility of writing to or reading the 9 Preset Panels from the Disc Drive.

**Keyboard Lock**: The Keyboard Lock protects instrument setup from accidental disturbance.

## Receiver Setup (Page 2)

The principal measurements performed by the HP3789B are selected and configured on Page 2 `Rx Setup`. The measurements provided are selected from the choices offered in the "Measure A" display field. The "Setup" display field offers the user the choice of setting up the instrument Manually, or Automatically using the DS1 AUTO or DS3 AUTO selections. When DS1 AUTO or DS3 AUTO is selected the HP3789B automatically selects the most accurate error measurement available for the signal at the Receiver DS3 IN port. The following figures give an example of typical Page 2 displays for Manual and Auto Setup. The functions/parameters offered to the user for selection are dependent on the type of measurement selected.

```
2 Rx Setup:  Setup [ MANUAL ]
             Measure A [ DS1 BIT ERRS  ]
Pattern [QUASI] 20 stage    Digroup [ 1]
DS1 Frame [OFF]    Input level [ DSX3  ]
```

```
2 Rx Setup:  Setup [DS3 AUTO]
Connect DS3 test signal..

Then hit EXEC. key for correct setup.
```

## Second Measurement (Measure B) Setup (Page 3)

On instruments fitted with Option 003 a "Second Measurement" (Measure B) is provided. The Receiver is configured for this measurement on Page 3 **Rx Setup.**

```
3 Rx Setup:  Measure B [DS3 PARITY ERRS]
```

## DSX-3 Transmitter (Page 4)

The internal DSX-3 Transmitter is configured on Page 4 Tx Setup, an example of which is given below. The user selectable functions are Tx Pattern , Error Type/Add, X Bits and Tx Clock selection; these are explained in the following paragraphs.

```
4 Tx Setup:      Error add mode [RATIO ]
Error type [FRAME]     Ratio 1.0E-[ 2.0]
Tx.pattern [ AS PER RX.] See page 2
Tx.clock [INTERNAL]          X bits [11]
```

### Pattern Selection

The Transmitter provides patterns only at DS3 level (with or without DS3 framing bits) and hence will not operate back-to-back with the Receiver when set to measure at rates lower than DS3. When the Receiver Framing Control (on Page 2 **Rx Setup**) is set to [ON] the Transmitter output data will have the DS3 level framing and control bits added to it. When the Receiver is set to DS3 Frame [OFF] no frame or control bits are added to the Pattern.

Tx Pattern:

| | |
|---|---|
| [AS PER RX] | The Transmitter is automatically set to the same pattern as the Receiver. |
| [BLUE SIGNAL] | Continuous 1010 pattern with DS3 framing. Pattern commences with a logic "1" on the first data bit following a framing or control bit. |

| | |
|---|---|
| **Error Type:** | Errors may be added to the following: |
| [BIT/PAR] | To the data output signal after parity has been calculated but before framing is added. The errors are added only to the data bits of a framed signal. |
| [FRAME] | To the Frame Alignment signal (F bits) and Multiframe Alignment signal (M bits) in the DS3 framed output. |

**Error Add**

[SINGLE] When this function is selected single errors may be added via the ERROR ADD key on the instrument front panel. The LED above the key is illuminated when this function is enabled.

[BURST] Similar to SINGLE errors function but in this case a burst of errors may be added via the ERROR ADD key. The LED above the ERROR ADD key is illuminated when this function is enabled. Each time the key is pressed the burst of errors is added to the output data. The number of errors in the burst is user selectable from 1 to 150.

[RATIO] Errors may be added at a rate variable in the range 1.0E-2.0 to 1.0E-10.5 with a resolution of 1.0E-0.5 i.e. 18 different rates.

**Tx Clock**

[INTERNAL] Selects 44.736MHz internal clock.

[EXTERNAL] The Transmitter must be supplied with an external clock source of 44.736MHz +/-2% via the front panel TX EXT CLK IN port.

**X Bits**

[11] or [00] The X Bit function changes the logic sense of the M1 and M2 bits in the DS3 frame sequence:
When X Bit = 11, M1 M2 = 11
When X Bit = 00, M1 M2 = 00

## Measurement Results (Page 5)

Results of measurements configured on Page 2 Rx Setup (Measurement A) or Page 3 (Measurement B, if fitted) are displayed on Page 5 `Results`. Select Page 5 then use the CHANGE keys to select from the measurement results provided.

```
5 Results:
A) DS3 Bit. [ERR. COUNT].................
B) DS3 Code [ERR. COUNT].................
   Elapsed time.....00d 00h 00m 00s
```

**Elapsed Time:** In Manual and Single gating periods this shows the elapsed time since the measurement started, i.e. from the time when the START/STOP key was pressed. In Repetitive gating the display shows the elapsed time from the start of the current measurement interval.

## How to Control Measurement Gating (Page 6)

The HP3789B measurement gating period and type of gating is selected on Page 6 **Gating Period**. There are two types of gating provided in the HP3789B, Manual or Timed. There are three different timed modes, Single Shot, Repetitive and Repetitive 2.2 seconds. An example of a typical Gating Period page and an explanation of each gating type is as follows:

```
6 Gating Period:
Gating type [SINGLE]
Period [ 0]d [ 0]h [ 0]m [ 1]s
Errored/Error free intervals [SECONDS ]
```

**Gating type:**

[MANUAL] — The (START/STOP) key is used to initiate and terminate the overall gating period. The results display is updated continuously during gating. End of measurement results are held until a new gating period is initiated.

Timed [SINGLE] — The (START/STOP) key is used to initiate gating and the measurement terminates at the end of a user-selectable timed interval. The length of the timed interval is set by the user in the **Period** display fields on Page 6. This timed interval can be set in days, hours, minutes and seconds. Minimum timed interval is 1 second, while maximum is 99 days, 23 hours, 59 minutes, 59 seconds.

Timed [REPEAT] — The (START/STOP) key controls the total gating period over which Repetitive Measurements are made. The length of each individual timed interval is set by the user as for "SINGLE" mode. At the end of each timed interval the next interval is automatically started, and continues doing so until such times as the (START/STOP) key is pressed to terminate the gating period. Note: There is no "dead time" between consecutive intervals.

Timed [REPEAT] Interval 2.2 secs. — This is the same as "Timed Repeat" described previously but the timed intervals are fixed at 2.2 seconds. (This equivalent to approximately 10E8 clock periods at DS3)

## Events and Alarms (Page 7)

```
7 Events & Alarms:      Audio [MEASURE A]
TTL Events.......................... 1111
Duration of [POWER LOSS ].........0 Secs
Voltage [1]..................... +0.1 V
```

Four TTL event inputs and four analog voltage inputs on a multiway connector on the HP3789B rear panel enable system alarms and digital radio voltages to be monitored and recorded. Page 7 Events and Alarms gives a display of these TTL levels and voltage inputs and also the durations of alarms occurring during the overall gating period. The Alarm durations calculated are:

Power Loss
Signal Loss
Frame Loss
Pattern Sync Loss
Blue Signal
X Bits = 11 (or 00 depending on position of link 1 on A11)
Jitter Loss

**Option 003 Instruments:** If the "Audio" field on Page 7 is set to [MEASURE A] and the front panel AUDIO key enabled (LED above key illuminates) an audible tone will sound when ERRORS (A) occur. Similarly if the "Audio" field is set to [MEASURE B] then an audible tone will sound when ERRORS (B) occur.

The voltage thresholds for the events are:

Max. Low Threshold = 0.3volts (state 0)
Min. High Threshold = 2.0volts (state 1)

The voltage range for the Voltage Inputs is:

Range = +/- 12.5volts

There is a separate voltmeter for each of the four inputs and the voltage at any input can be viewed at any time. Only the selected input voltage will be logged however.

## Data logging (Page 8)

Results can be logged on the internal Printer (option 010) or Disc Drive (option 011) or to an external printer via HP-IB or RS232. Select Page 8 **Data Log:** in order to configure the HP3789B to print to internal or external devices. An explanation of the selections within the Device field is given below, refer to the main Operating Manual for complete descriptions of other fields on the Data Log page.

```
8 Data Log: Device [3789B]
Occurrence [    DURING GATING    ]
Log [ RESULT A  ]  Voltages [NO]
Trigger  [ERR. SECS (A)]   Squelch [OFF]
```

The Device field has three selections.

[HP3789B] Records data on the internal printer or disc drive.

[PORT] Records data on an external printer. To use this facility connect either an HP-IB printer to the HP-IB port or an RS232 printer to the RS232 PRINTER port. Display Page 10 and select the appropriate Output Port. Note: To select HP-IB it is necessary to deselect HP-IB remote control on Page 9.

[NONE] No data is recorded when this field is selected.

## Remote Control (Page 9)

The HP3789B offers full remote capability via HP-IB (IEEE 488) and RS232 interface buses. Measurement results may be output via rear panel HP-IB and RS232 ports to an external printer. An RS232 Modem port on the rear panel enables the HP3789B to be controlled remotely via a Modem. HP-IB or RS232 operation is selected and configured on Page 9 **Remote Operation.** A complete description of Remote Operation is given in the HP3789B main Operating Manual.

```
9 Remote Port: [RS232] Subpage [SETUP A]
Connection [  MODEM  ]     Duplex [FULL]
Enq/Ack [ON ]          Xon/Xoff [  OFF  ]
```

## Printer Output Port Selection (Page 10)

The Output Port selection which is set on Page 10 determines which port outputs data to an external Printer. To output data via the HP-IB port the Remote Port on Page 9 must be set to RS232. Since there are separate ports for RS232 Remote and Printer operation, RS232 Output Port may be selected irrespective of the settings on any other page.

```
10 Output Port: [RS232]
Speed [1200]                Parity [ 0's]
Stop Bits [1]               Enq/Ack [NO ]
Xon/Xoff [NO ]
```

## Disc Control (Page 11)

The disc drive (option 011) has a number of functions including data logging. These can be selected on Page 11 an example of which is given below. The user selectable functions within this page are also explained.

```
11 Disc Control:  Last File Created ....
Function [ COPY FILE TO THE OUTPUT PORT]
Press EXEC. to output file # [0000]
Status: ..............................
```

**Note:** Files are called: F3789Bnnnn - where "nnnn" is the number. When data logging to the internal disc drive has been initiated a new file is created each time the (START/STOP) key is pressed, and also each time the LOG ON DEMAND key is pressed after the HP3789B has stopped gating.

[STORE PRESET PANELS ON THE DISC]
Select this function and press the (EXEC) key to write the contents of the nine memories of the instrument panel setup onto the disc.

[RECALL PANELS FROM THE DISC]
Select this function and press the EXEC key to write the nine memories of the instrument panel setup from the disc into the instrument preset panel memory (page 1).

[COPY DIRECTORY TO OUTPUT PORT]
Select this function and press the EXEC key to write the disc directory onto an external Printer connected to the Output Port.

[COPY FILE TO THE OUTPUT PORT]
Select this function and file #[nnnn], where nnnn is the selected file then press the EXEC key to write the contents of the file onto an external Printer connected to the Output Port.

[PURGE THE SELECTED FILE]
Select this function and file #[nnnn], where nnnn is the selected file then press the EXEC key to purge the selected file from the disc.

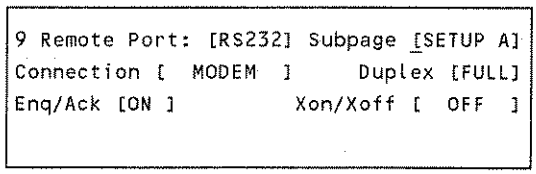
[PURGE ALL THE FILES ON THE DISC]
Select this function to purge ALL the files from the disc.

[FORMAT NEW SINGLE SIDE DISC]
Select this function and press the EXEC key to format a new single sided disc. !WARNING! THIS FUNCTION WILL PURGE ALL THE THE FILES ON A USED DISC AND REFORMAT IT.

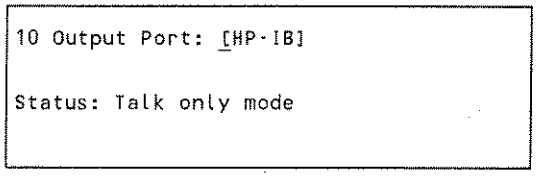
[FORMAT NEW DOUBLE SIDE DISC]
Select this function and press the EXEC key to format a new double sided disc. !WARNING! THIS FUNCTION WILL PURGE ALL THE FILES ON A USED DISC AND REFORMAT IT.

**Copy contents of Disc via HP-IB to an external Printer**

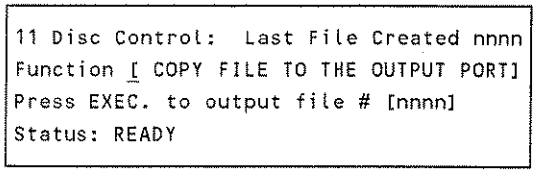
Display Page 9 **Remote Port**.....use the PAGE keys.
Set the "Remote Port" field to RS232 - ignore the other fields on this page.




Display Page 10 **Output Port**
Set the display to the following:




Display Page 11 **Disc Control**
Set the display to the following:



Select a file.
Press the [EXEC] key - the contents of the file selected are printed on the external Printer.
Note: The external Printer must be set to listen always if HP-IB is selected. If RS232 then all the appropriate Output Port settings to suit the RS232 Printer being used must be set on Page 10.

**Copy contents of Disc via RS232 to external Printer**
The procedure for copying the contents of the disc via RS232 to an external Printer is as follows:

Set the "Output Port" on Page 10 to "RS232".
The "Output Port" on Page 10 is automatically set to RS232. The other fields within Page 10 are user selectable and determined by the type of RS232 Printer being used. Set the fields to suit the Printer you are using.

Display Page 11 `Disc Control` and set the display as per the example given for HP-IB operation, on Page 4-7.
Press the [EXEC] key - the contents of the file selected are printed on the external Printer.

## Access Switch (Page 12)

A two wire connection on the HP3789B rear panel permits control of Access Switches which allow the monitoring of multiple DS3 signals. The built-in Access Switch Controller allows the user to select from a number of DS3 inputs. Switches can be "stacked" up to 3 deep to cater for up to 1000 inputs. Selection of the appropriate port is made when the `Mode` field is set to [NORMAL] (in Repetitive gating) or when the `Function` is set to [SET] [***] in Manual or Single gating.

Scan mode allows sequential measurements on each of several selected inputs and is available when the `Mode` field is set to [SCAN]. It is however only available when the gating period is set to [REPEAT].

Example:
To perform the same measurement sequentially on every one of 67 DS3 inputs.
Set Page 12 as follows:

```
12 Access Switch Control:  Mode [ SCAN ]
        Scan start........ [000]
        Step size......... [001]
        Steps per loop.... [067]
```

Press the [START/STOP] key to initiate the measurements. The HP3789B will then scan through each input sequentially, performing the measurements until the [START/STOP] key is pressed again.

Note: A 200uSec "dead time" is introduced between each measurement to allow for switching transients to decay.

## Analyze Measurement Results (Page 13)

An analysis of the results of each measurement selected from the "Measure A" field on Page 2 `Rx Setup` is provided on Page 13 `Analysis`. For each of the measurements selected on Page 2 there are seven analysis measurements.

Each of the analysis measurements can be performed against a user selectable threshold which is compared against the measurement result. If the result of the selected analysis measurement falls below the users preset "PASS" threshold, then the "Individual Result" field on Page 13 display will register a "FAIL". If more than one Analysis Threshold has been set, then all these results must pass before the **Overall** result is PASS.

Helpful information is provided for each of the Analysis measurements via the [HELP] key. The information given is only relevant to the measurement currently displayed.
An example of a typical Page 13 display and a brief explanation of each analysis measurement is as follows. For a more detailed definition of the Analysis measurements please refer to Appendix A in the main Operating Manual.

```
13 Analysis: (Res.A only)
Result [AVAILABILITY ].............%
Individual result thres. [NO ]
Overall: ----    Individual Result: ----
```

### Analysis Measurement Definition

All the percentage analysis measurements are based on the criterion of "Available" time during the measurement gating period. A period of available time is when the error ratio in each second is better than 1.0E-3 for a period of ten consecutive seconds. Similarly unavailability occurs when the error ratio is worse than 1.0E-3 in each second for a period of 10 consecutive seconds. These 10 second intervals are considered part of the unavailable or available time respectively.

If the HP3789B is flagging any of the following: Signal Loss, Frame Loss, Sync Loss, Blue Signal or if a Power Loss exists the HP3789B applies the same criteria as for error ratio (ER) exceeding the 1.10-3 threshold.

% Availability

The % Availability has 10 second hysteresis and is defined as the percentage of one second intervals when the ER was better than 1.10-3. The result is expressed as a percentage to the following decimal places:

N.NNN for 0 to 9.9999
NN.NNN for 10 to 99.999
NNN.NN for 100

% Unavailability

The % Unavailability has 10 second hysteresis and is the percentage of one second intervals when the ER is worse than 1.0E-3. This includes the loss conditions such as sync loss. The result displayed as follows:

N.NNNN for 0 to 9.9999
NN.NNN for 10 to 99.999
NNN.NN for 100

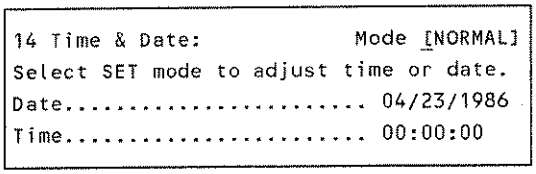
% Errored Seconds

Calculates the number of seconds containing errors during the "Available" time of the overall gating period and expresses this as a percentage of the total "Available" seconds. The percentage is derived by dividing the number of errored seconds by the number of available seconds and multiplying by 100.
Result expressed as NNN.NN - updated every second.

| | |
|---|---|
| % Severely Errored Seconds | Calculates the number of seconds during the "Available" time of the overall gating period that the error ratio (ER) is worse than the availability threshold (1.0E-3) and expresses the answer as a percentage of the total "Available" seconds. The percentage is derived by dividing the number of severely errored seconds by the number of available seconds and multiplying by 100.<br>Result expressed as NNN.NN - updated every second. |
| % Degraded Minutes | The number of 1 minute time intervals during "Available " time in the gating period when the error ratio was worse than 1.0E-6 (excluding severely errored seconds). |
| Error Bursts | Counts the number of error bursts with >100 errors. A burst is considered finished after 10 error-free time intervals (1 sec or 1 deci-sec, as selected.) (see Page 6 **Gating Period**) |
| Asyn.Err.Secs | An indication of error distribution for all errors irrespective of "Available " time in the gating period is provided. For asynchronous Error Seconds (or Error Deciseconds) a table of the number of seconds (or deci- seconds) containing N errors is given where N has the values 1, 2-10 or >10. The selection of seconds or deciseconds is made on Page 6 **Gating Period**. |

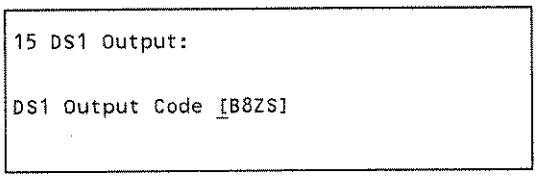
## Real Time Clock and Calendar (Page 14)

The HP3789B provides a 24 hour real-time clock and calendar which can be set or viewed on Page 14. The clock is used for date and time stamping results in the data logger. Battery back-up is provided for the clock therefore it is unaffected by AC line power hits. Also, the calendar is corrected for leap years.




## DS1 Output (Page 15)

A DSX1 1.544 Mb/sec output is available on the HP3789B front panel. The output data is selected to be either AMI or B8ZS encoded on Page 15. The DS1 data is one of the digroups demultiplexed from the DS3 input data, the digroup can be selected from any of the 28 DS1 digroups in the DS3 stream. Digroup selection is made on Page 2, once a DS1 measurement has been selected in the **Measure** A field (also on Page 2).



## Selftest (Page 16)

The HP3789B has the ability to perform internal tests to test the condition of its processor, measurement hardware, and peripherals such as the internal disc and printer. The test routines are accessed on Page 16. A comprehensive list of error codes is available in the HP3789B main Operating Manual.

```
16 Self Test: Function [TEST CPU & MEAS]
CPU.... ----        Tx..... ----
Rx..... ----
Press Exec. to run self-test.
```

```
16 Self Test: Function [ SHOW OPTIONS  ]
Options Fitted:
2nd Meas / DS1/3 Jit    Printer
DS1 Output              DS3 Transmitter
```

```
16 Self Test: Function [TEST PRINTER   ]
Internal Printer.......... ----

Press EXEC. to run self-test
```

```
16 Self Test: Function [TEST PRINT PORT]
RS232 printer port........ ----
Ensure loop-back plug is fitted to port
Press EXEC. to run self-test.
```

```
16 Self Test: Function [TEST MODEM PORT]
RS232 modem port.......... ----
Ensure loop-back plug is fitted to port
Press EXEC. to run self-test.
```

```
16 Self Test: Function [SHOW REV NUMBER]
Firmware revision Number(s):
Processor.... 0000  Jitter SMU..... 0000
Printer/Disc. 0000  Jitter JMU..... 0000
```