HP 37721A Digital Transmission Analyzer

Operating Manual

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 3243U. For additional important information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL in the HP 37721A Calibration manual.

HEWLETT PACKARD

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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).

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 : Digital Transmission Analyser

Model Number(s): HP 37721A

Product Options: This declaration covers all options of the above product.

conforms to the following Product Specifications:

Safety: IEC 348 (1978)
CSA - C22.2 No. 231 Series - M89

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

South Queensferry, Scotland	24 Feb 92	WR Pea
Location	Date	W.R. Pearson/Quality Manager

5955-2395

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Getting Started

About this manual

This Operating manual describes control of the HP 37721A using the front panel Keys and is arranged in three sections :

Getting Started

Making Measurements

Reference

Note

Remote Control details (Option 001) are contained in the Remote Control manual.

This Getting Started section explains the following :

- How to obtain the required Display using the display select keys, [SETTINGS]; [RESULTS]; [PRINTER]; [OTHER].
- How to modify the display information, using [⇧] [⇩] and the Display Softkeys
- How to use the other front panel keys
- How to interpret the Status indicators

The Making Measurements section describes in detail how to test with the HP 37721A.

The Reference section contains definitions of terminology and measurements where necessary.

About the HP 37721A

The HP 37721A is a multi-rate bit error measuring instrument. It can generate and receive a range of data patterns, and provide analysis of received errors to G.821 requirements.

Standard bit rates of 704 kbit/s, 2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s and 139.264 Mbit/s are provided. At 704 kbit/s and 2.048 Mbit/s the generator timing can be recovered from the received data.

Clock offset capability of ±100 ppm about the standard rates is available as Option 003.

Multiple Outputs (four in total) is provided with option 002.

75 Ω unbalanced data interfaces are provided at all data rates. In addition 120 Ω balanced data Interfaces are provided at 704 kbit/s and 2.048 Mbit/s. AMI, HDB3 or CMI coding is used depending on the selected rate.

Accurate error measurements can still be made in the presence of half-rate cable loss of up to 12 dB, and at protected monitor points.

Option 004 provides binary interfaces at the standard bit rates of 704 kbit/s, 2048 kbit/s, 8448 kbit/s, 34368 kbit/s and 139264 kbit/s. In addition with an input binary clock, rates in the range 700 kbit/s to 168.5 Mbit/s are available. The binary interfaces consist of receiver clock and data input, transmitter external clock input and transmitter clock and data output. These interfaces are provided by connectors on the HP 37721A rear panel.
Inputs and outputs are at TTL levels for frequencies up to 50 MHz and ECL for frequencies up to the maximum specified.

Option 005 provides detection of the Frame Alignment Signal (FAS errors) to provide basic in-service monitoring at the selected data rate. FAS monitoring is also available with receiver binary data and clock input.

Power Requirements

The HP 37721A Digital Transmission Analyzer requires a power source of 115 V (+10% -22%) or 230 V (+10% -18%) at a frequency between 48 Hz and 66 Hz.

Caution

Before connecting this instrument to a power outlet, ensure that the voltage selector is correctly set for the voltage of the power source, and a fuse of the correct rating is fitted.

Line Voltage Selection

The Line Voltage is selected by the rear panel switch labelled 115 V, 230 V. Fuse rating of 3 A 250 V (Time Delay) is applicable for both power source settings, HP Part Number 2110-0029.

Obtaining and Modifying the HP 37721A Displays

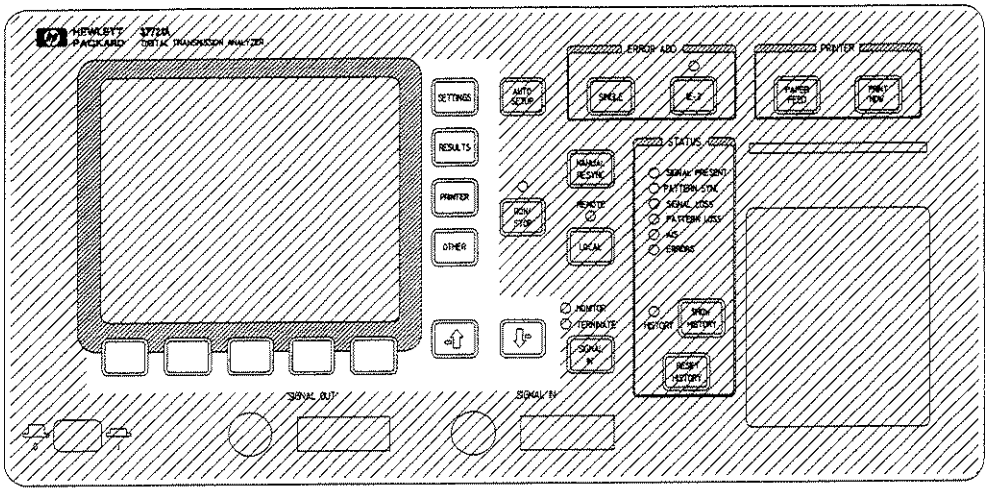


Figure 1-1. HP 37721A Front Panel

The operator interface is provided by the display and the front panel keys.

Four different display areas are obtainable using the four keys, [SETTINGS] [RESULTS] [PRINTER] and [OTHER], immediately to the right of the display :

[SETTINGS] Allows control of Bit Rate, Interface, Clock Source, Pattern, Termination, and Code for both generator and receiver. On option 003 instruments Tx Clock Offset is available. On option 005 instruments the instrument measurement application can be selected from OUT-OF-SERVICE TESTING or IN-SERVICE-MONITORING.

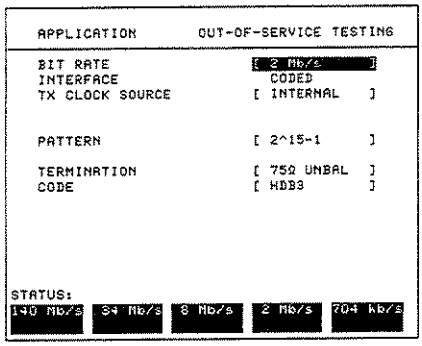
[RESULTS] Allows control of the Test Period and displays the selected measurement results.

[PRINTER] Allows control of the selected printer and the frequency of printing of the selected measurement results.

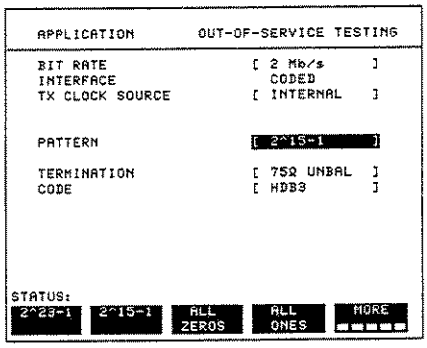
OTHER

Allows control of Time & Date, Keyboard Lock, Beep On Error, Stored Settings, Resynchronisation Mode, Analysis Control, Self Test, Calibration, an Option key to view the options fitted and, if Option 001 is fitted, Remote Control.

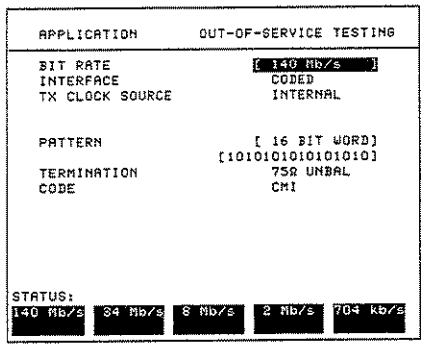
1. In each of the display areas the field currently able to be changed is marked by a "highlighted cursor".



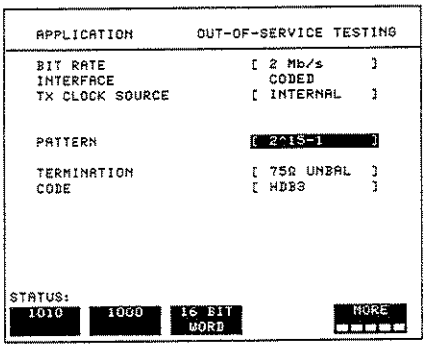
2. The "highlighted cursor" is moved around the display using ⇩ and ⇧.



3. The menu of selections available, for the highlighted field, appears at the bottom of the display (`140 Mb/s` `34 Mb/s` `8 Mb/s` `2 Mb/s` `704 kb/s`). The choice from the menu is made using the display softkeys situated immediately below the display.



4. When a field has more than 5 choices, as in PATTERN above, a softkey labelled `MORE` is provided. When `MORE` is chosen the remainder of the menu is revealed as shown below.



5. When the setting within a field is not enclosed in [ ], as in TERMINATION and CODE above, the field cannot be highlighted as no choice is allowed.

Other Front Panel Keys

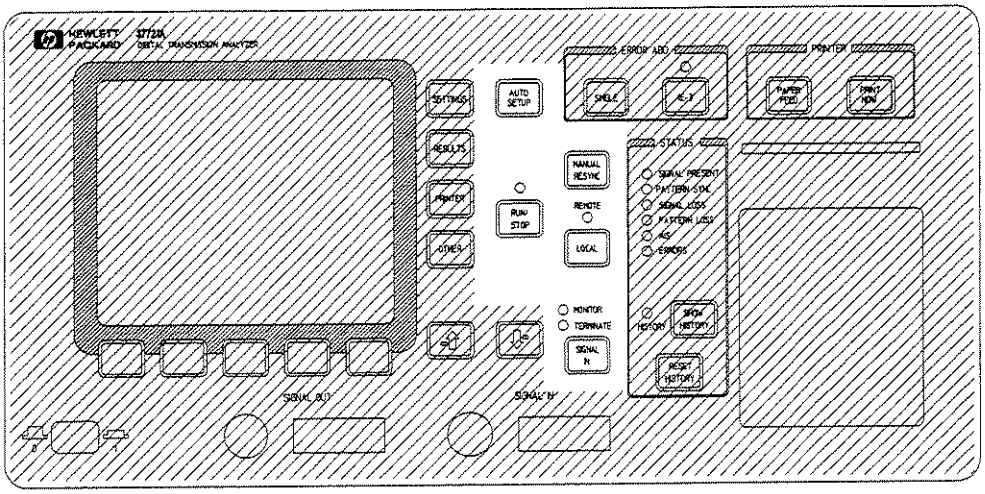


Figure 1-2. Front Panel Keys

- [SIGNAL IN] determines whether the SIGNAL IN port functions as a Terminated input or as a Monitor input. Monitor allows accurate error measurement at the line equipment protected monitor point. The appropriate indicator, situated above the key, is lit to signify which type of input is selected.
- [AUTO SETUP] causes the instrument to attempt to match the settings of Rate, Pattern, Termination and Code to the signal present at the SIGNAL IN port.
- [RUN/ STOP] starts the test period. If a test period is in progress this can be used to stop the test period. The indicator above the key is lit when a test period is in progress.
- [MANUAL RESYNC] controls pattern synchronization when RESYNCHRONISATION [MANUAL] is selected on the [OTHER] display.
- [LOCAL] used to return the instrument from remote operation to keyboard (Local) operation when Option 001, Remote Control, is fitted. The indicator above the key is lit when the instrument is under Remote Control.

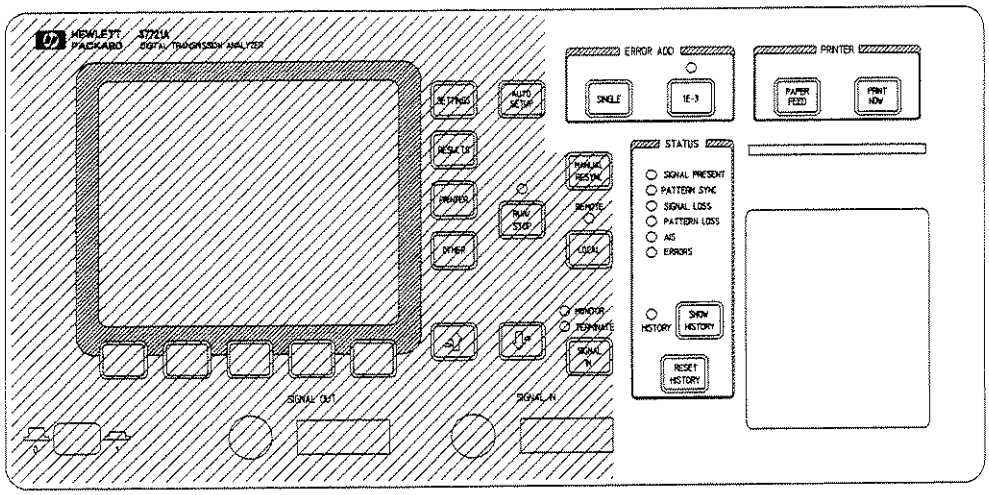


Figure 1-3. Front Panel Keys

- (SINGLE) adds a single bit error to the output data pattern each time the key is pressed.
- (1E-3) adds bit errors to the output data pattern at a rate of 1 error every 1000 clock periods. This continues until the key is pressed again. The indicator above the key is lit when errors are being added.
- (PRINT NOW) causes the selected measurement results to be logged, immediately, on the selected printer.
- (PAPER FEED) causes the paper in the Internal printer to roll up.

Caution

Do not press (PAPER FEED) while attempting to load a new roll of paper in the Printer. It could result in a paper jam and disable the Printer. Wait until the paper is fed through the Printer rollers before pressing (PAPER FEED).

- (SHOW HISTORY) when pressed and held causes the Status indicators to display any alarms which have been set during the current Test Period (Signal Loss, Pattern Loss, AIS, Errors). This continues until (SHOW HISTORY) is released at which time the current status is displayed. The indicator alongside the key is lit to signify that an alarm has occurred during the current Test Period.

- (RESET HISTORY) resets the history store such that the historical and present status are the same. This can also be achieved by starting a new Test Period.

Status Indicators

The 6 Status indicators on the front panel convey information regarding the measurement in progress. If an alarm has occurred during the current Test Period the indicator alongside (SHOW HISTORY) is lit. To view which alarms have occurred press and hold (SHOW HISTORY). When (SHOW HISTORY) is released the status indicators return to displaying the current status.
Note the status indicator labels in italics indicate the label for an option instrument.

Signal Present	Indicates that data transitions are present at the SIGNAL IN port.
Signal/Clock In (option 004)	Indicates that: **a.** When a BINARY INTERFACE is selected, clock transitions are present at the rear panel RX CLOCK IN port. (option 004 instruments only) **b.** When a CODED (Ternary) INTERFACE is selected, clock/data transitions are present at the front panel SIGNAL IN port. (option 004 or 005 instruments)
Pattern Sync	Indicates that the received data is in synchronisation with the internally generated reference data.
Ext Clock In (option 004)	Replaces Pattern Sync when option 004 is fitted. Indicates that clock transitions are present at the rear panel TX EXT CLOCK input. On instruments fitted with option 005, but without option 004, the *Ext Clock In* LED is available but is non-functional.
Signal Loss	Indicates that data transitions are not present at the SIGNAL IN port.
Pattern Loss	Indicates that the received data is not in synchronisation with the internally generated reference data.

Pattern/Frame (option 005)	Replaces Pattern Loss when option 004 or 005 is fitted. When an Out-of-Service Application is selected the LED indicates that the received pattern is not in synchronisation with the internally generated reference pattern. For an In-Service Application the LED indicates that frame loss has occurred.
AIS	Indicates that the signal present at the SIGNAL IN port meets the ALL ONES AIS criterion.
Errors	Indicates that an error (Bit or Frame (option 005)) has been detected. The indicator will remain lit for at least 100 ms.

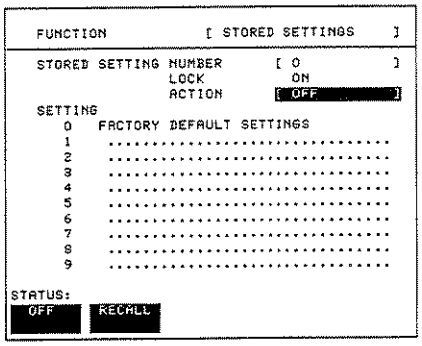
Basic Error Measurement Demonstration

This simple illustrated procedure explains how to perform the following :

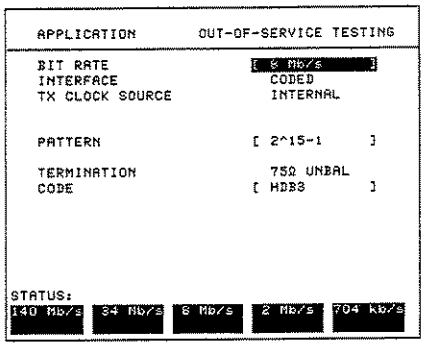
- Recall the factory default settings using the STORED SETTINGS function.
- Set up a short term error measurement of error count and error ratio .
- Start the measurement and monitor the results.
- Add Bit errors to the generated PRBS data.
- Log results on the internal printer.

1. Set up the STORED SETTINGS function on the (OTHER) display as shown opposite.

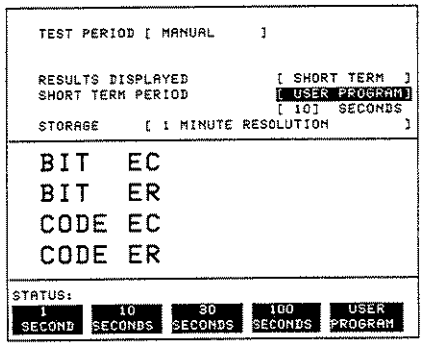
Select RECALL to recall the factory default settings.



2. Set up the (SETTINGS) display as shown below.



3. Set up the (RESULTS) display as shown below.



4. Connect the 75 Ω Signal In to 75 Ω Signal Out.

5. Press (RUN/STOP) to start the measurement and monitor the (RESULTS) display.

6. Press ERROR ADD (SINGLE) or (1E-3) and check that the BIT EC and BIT ER results change.

7. Select RESULTS DISPLAYED [CUMULATIVE] to view the results accumulated since the beginning of the test period.

8. Press (PRINT NOW) to obtain a printout of the instrument set up and the cumulative results.

2

Making Measurements

This chapter contains a series of application orientated measurements and instrument tasks associated with the measurements.

The following measurements are described :

- End-to-End Testing (Installation/Commissioning)
- Loopback Testing (Fault Location)
- Frequency Offset Tolerance (Option 003 Only)
- In-Service Monitoring (Option 005)
- Multiple Channel Outputs (Option 002 Only)
- Binary Interface Testing (Option 004)
- Frequency Measurement

Each measurement includes an explanation of the measurement, how and where to connect the instrument, how to configure the instrument, and how to obtain the relevant results.

The instrument tasks associated with the measurements are :

- Logging Results
- Connecting an HP ThinkJet Printer
- Internal Printer Changing Paper
- Graphics
- Stored Settings
- Keyboard Lock
- Beep On Error
- Time and Date Setting
- Resynchronization Mode
- Analysis Control

End-to-End Testing

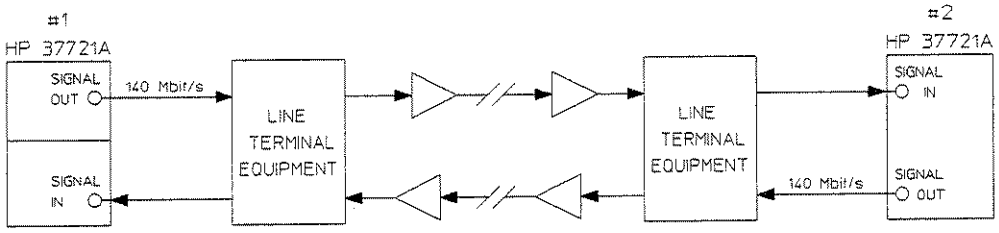
Application

A transmission system must be specified for its overall error performance, measured over a period of time. Conformance to these specifications ensures that an installed system will meet the requirements of an Integrated Digital Network (IDN).

After troubleshooting, or during installation or commissioning, it is necessary to check that the transmission link meets this error performance.

Error performance measurements are made on an end-to-end basis testing the Go and Return paths separately but simultaneously. The measurements are often performed unattended and the results and other events, alarms for example, logged on a printer and timed by a real time clock facility.

Two HP 37721A's are required for this measurement, one at each end of the link.



140 Mb/s End-to-End Test

Default (Known State) Settings

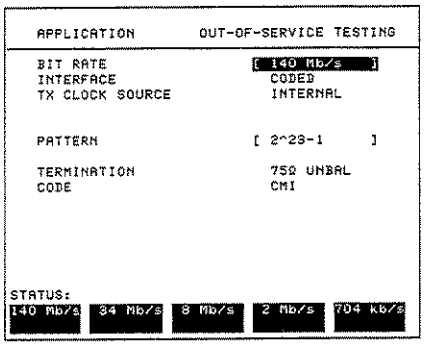
It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (140 Mb/s End-to-End Test)

This setup procedure is based on 140 Mb/s, CMI, PRBS test data terminated at 75 Ω. A SINGLE test period of 24 HOURS is used and use of the internal printer for recording of results and alarms is included. A graphical record of the results can be viewed on the HP 37721A (RESULTS) display at the end of the test period. If a hard copy is required the graphical record can be logged on an external HP ThinkJet printer at the end of the test period.

HP 37721A #1

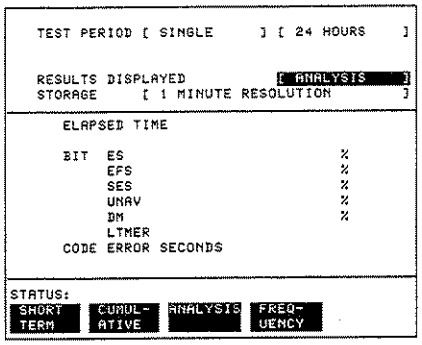
1. Connect the HP 37721A to the CMI code interface of the line terminal equipment and set up the (SETTINGS) display as shown opposite.



2. Set up the (RESULTS) display as shown opposite.

The RESULTS DISPLAYED selection can be changed during the test period without interrupting the test.

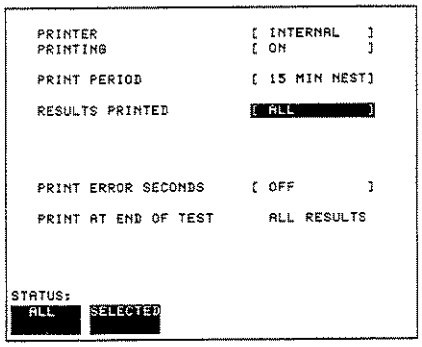
If ANALYSIS or CUMULATIVE is selected the Elapsed Time of the test period is displayed.



3. Set up the (PRINTER) display as shown opposite.

A PRINT PERIOD selection of [15 MIN NEST] provides the following :

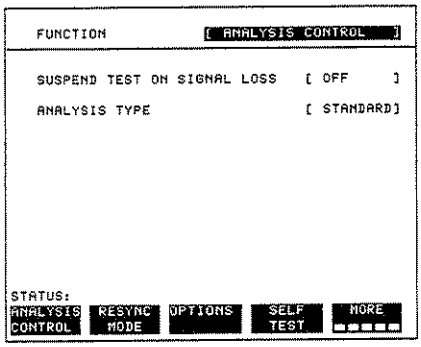
A complete set of period and a complete set of cumulative results logged on the printer every 15 minutes.
A complete set of period results logged on the printer at 1 hour and 24 hour intervals.
A complete set of cumulative results logged on the printer at the end of the test period.



4. The default state of SUSPEND TEST ON SIGNAL LOSS on the (OTHER) display is OFF. This means that any period of Signal Loss will be included in the results.

If it is desirable to exclude periods of Signal Loss from the Analysis results select ON.

The ANALYSIS TYPE default is STANDARD which means that standard G.821 Analysis is used.

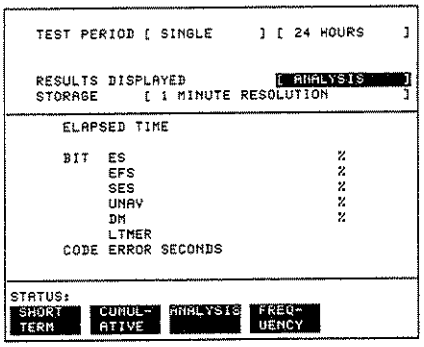


HP 37721A #2

1. Set up the (RESULTS) display as shown opposite.

The RESULTS DISPLAYED selection can be changed during the test period without interrupting the test.

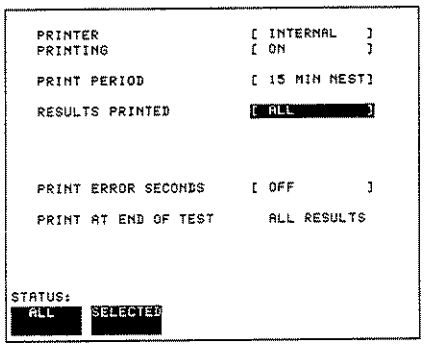
If ANALYSIS or CUMULATIVE is selected the Elapsed Time of the test period is displayed.



2. Set up the (PRINTER) display as shown opposite.

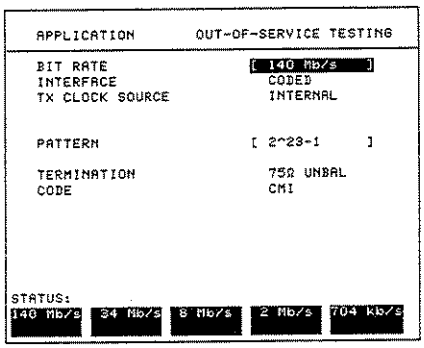
A PRINT PERIOD selection of [15 MIN NEST] provides the following :

A complete set of period and a complete set of cumulative results logged on the printer every 15 minutes.
A complete set of period results logged on the printer at 1 hour and 24 hour intervals.
A complete set of cumulative results logged on the printer at the end of the test period.



3. Connect the HP 37721A #2 to the CMI code interface of the line terminal equipment and press (AUTO SETUP).

The HP 37721A will match the settings of RATE; PATTERN; CODE; and Termination signal level to the signal present at the SIGNAL IN port.

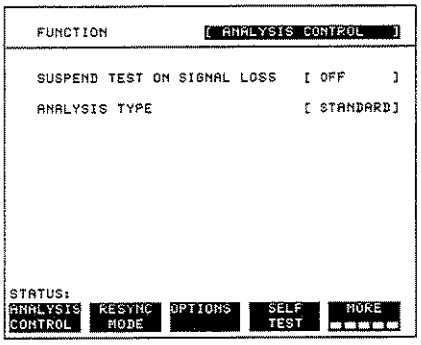


4. The default state of SUSPEND TEST ON SIGNAL LOSS on the (OTHER) display is OFF.

This means that any period of Signal Loss will be included in the results.

If it is desirable to suspend the test during periods of Signal Loss select ON.

For ANALYSIS TYPE the default setting is STANDARD which means that standard G.821 Analysis is used.



Run the Test (140 Mb/s End-to-End)

1. Press (RUN/STOP) on both the HP 37721A's.

The Date and Time the test started and the instrument setup are logged on the printer.

Any alarms which occur during the test period, Pattern Loss; Signal Loss; AIS and Power Failure, will be logged on the printer.

All results are logged on the printer at 15 minute intervals.

Period results are logged on the printer at 1 Hour and 24 Hour intervals.

The test can be halted at any time by pressing (RUN/STOP).

At the End of the Test (140 Mb/s End-to-End)

At the end of the test period a complete set of cumulative results are logged on the printer.

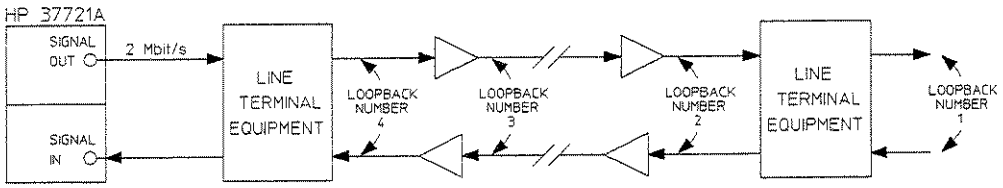
A graphical record of the results during the whole test period or the results during a selected part of the test period can be viewed on the (RESULTS) display or logged on an external printer. See *Graphics* and *External HP ThinkJet Printer*.

Loopback Testing

Application

Loopback testing is used for fault location to a particular piece of line terminal equipment or a repeater. The loopback is normally made at the outermost point of the link for the first test and then moved nearer to the test instrument until the faulty area is located. In circuits where more than one network operator is involved, loopback testing can be used at boundaries to identify which operator needs to check for an impairment.

Testing generally entails the insertion of errors to test path continuity.



2 Mb/s Loopback Test

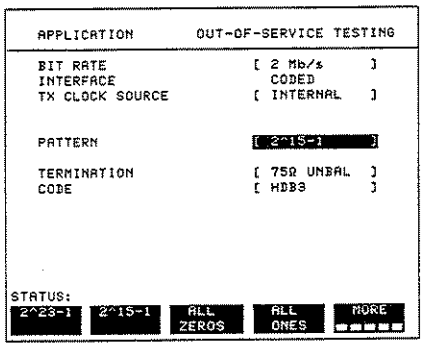
Default (Known State) Settings

It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (2 Mb/s Loopback)

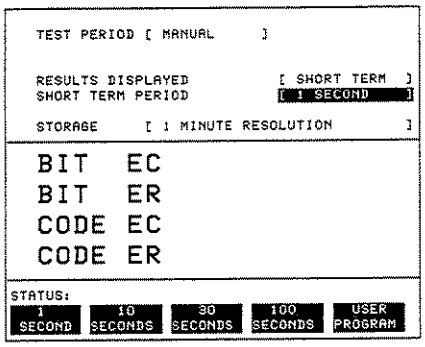
This setup procedure is based on 2 Mb/s, HDB3, PRBS test data interfaced at 75 Ω. Errors are added to the generated data and the SHORT TERM results of Error Count and Error Ratio are displayed.

1. Connect the HP 37721A to the HDB3 code interface of the line terminal equipment and set up the (SETTINGS) display as shown opposite.

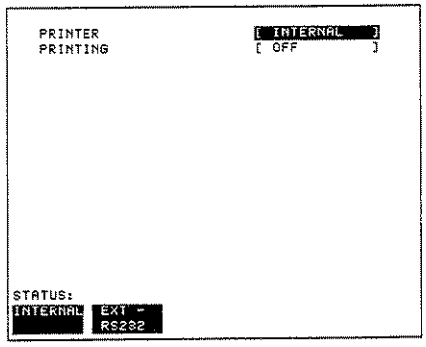


2. Set up the (RESULTS) display as shown below.

The displayed results are updated according to the SHORT TERM PERIOD selection.



3. Set up the (PRINTER) display as shown below.



Start the Test (2 Mb/s Loopback)

1. Connect a loopback at the desired point on the line terminal equipment and press (RUN/STOP) on the HP 37721A.

The test can be halted at any time by pressing (RUN/STOP).

2. Add bit errors to the generated data and check that the errors are measured as Bit Error Count and Bit Error Ratio.

Bit Errors can be added in one of two ways :

(SINGLE) Adds a single bit error each time the key is pressed.

(1E-3) Adds bit errors at a rate of 1 error every 1000 clock periods. This continues until the key is pressed again. The indicator above the key is lit to indicate errors are being added at the required rate.

3. Move the loopback and add errors until the faulty section is located.

At the End of the Test (2 Mb/s Loopback)

1. Halt the test by pressing (RUN/STOP), and disconnect the HP 37721A.

2. Remove the loopback, repair or replace the faulty equipment, and return the line terminal equipment to service.

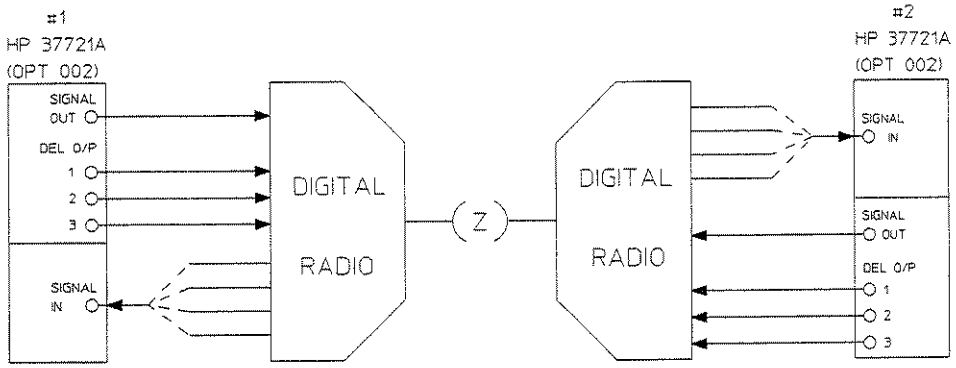
Commissioning Multiplexers

Application

To commission multiplexers at line rates up to 565 Mb/s, all four input tributaries of the system need to be loaded. The multiple output option (002) on the HP 37721A allows this in-service condition to be simulated.

Error performance measurements are made on an end-to-end basis testing the Go and Return paths simultaneously but separately.

Two HP 37721A's with Option 002, Multiple Outputs, fitted are required for this measurement, one at each end of the link.



Commissioning Multiplexers

Default (Known State) Settings

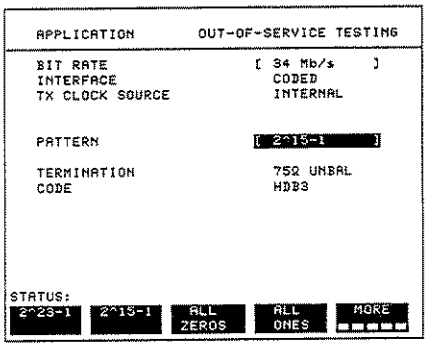
It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (Commissioning Multiplexers)

This setup procedure is based on 34 Mb/s, HDB3, PRBS test data terminated at 75 Ω. A SINGLE test period of 24 HOURS is used. No results are logged during the test period but a complete set of results is logged at the end of the test period. A graphical record of the results can be viewed on the HP 37721A (RESULTS) display at the end of the test period. If a hard copy is required the graphical record can be logged on an external HP ThinkJet printer at the end of the test period.

HP 37721A #1

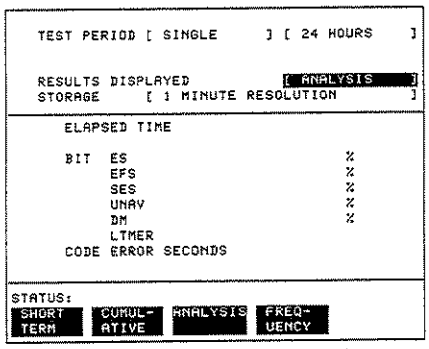
1. Connect the HP 37721A to the HDB3 code interface of the multiplexer and set up the (SETTINGS) display as shown opposite.



2. Set up the (RESULTS) display as shown opposite.

The RESULTS DISPLAYED selection can be changed during the test period without interrupting the test.

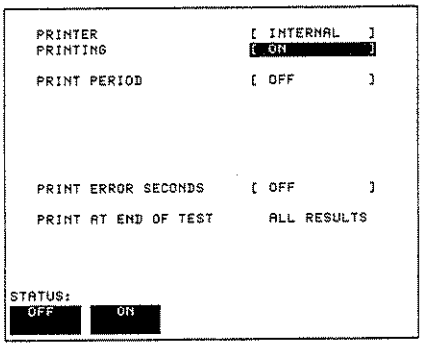
If ANALYSIS or CUMULATIVE is selected the Elapsed Time of the test period is displayed.



3. Set up the (PRINTER) display as shown opposite.

PRINT PERIOD [OFF] results in a complete set of results being logged at the end of the test period.

A complete set of up to date results can be obtained at any time during the test period by pressing (PRINT NOW).

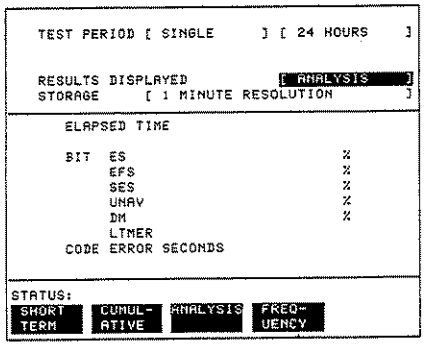


HP 37721A #2

1. Set up the (RESULTS) display as shown opposite.

The RESULTS DISPLAYED selection can be changed during the test period without interrupting the test.

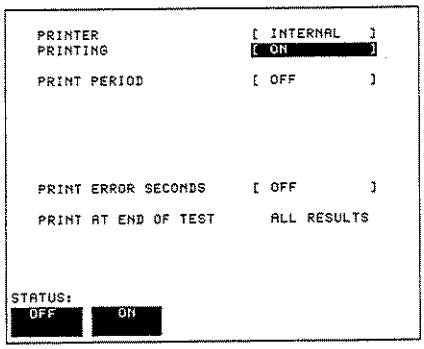
If ANALYSIS or CUMULATIVE is selected the Elapsed Time of the test period is displayed.



2. Set up the (PRINTER) display as shown opposite.

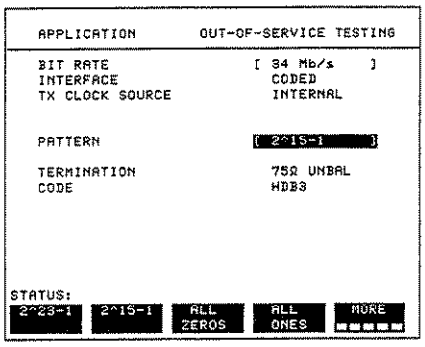
PRINT PERIOD [OFF] results in a complete set of results being logged at the end of the test period.

A complete set of up to date results can be obtained at any time during the test period by pressing (PRINT NOW).



3. Connect the HP 37721A #2 to the HDB3 code interface of the line terminal equipment and press (AUTO SETUP).

The HP 37721A will match the settings of RATE; PATTERN; CODE; and Interface signal level to the signal present at the SIGNAL IN port.



Run the Test (Commissioning Multiplexers)

1. Press (RUN/STOP) on both the HP 37721A's.

The Date and Time the test started and the instrument setup are logged on the printer.

Any alarms occurring during the test period, Pattern Loss; Signal Loss; AIS and Power Failure, are logged on the printer.

The test can be halted at any time by pressing (RUN/STOP).

At the End of the Test (Commissioning Multiplexers)

At the end of the test period a complete set of results is logged on the printer.

A graphical record of the results during the whole test period or the results during a selected part of the test period can be viewed on the (RESULTS) display or logged on an external HP ThinkJet printer. See *Graphics* and *External HP ThinkJet Printer*

Frequency Offset Tolerance

Application

Most network equipment recovers clock from the incoming bit stream. As a minimum requirement network equipment must provide reliable clock recovery over the CCITT tolerance range. Failure to reliably recover the clock can result in high error rates.

The capability of the network equipment to reliably recover the clock is tested by varying the clock rate of the generated data and checking for the occurrence of transmission errors.

The measurement is made via a loopback and is generally of short duration.

The CCITT G.703 Recommendation for Clock Tolerance :

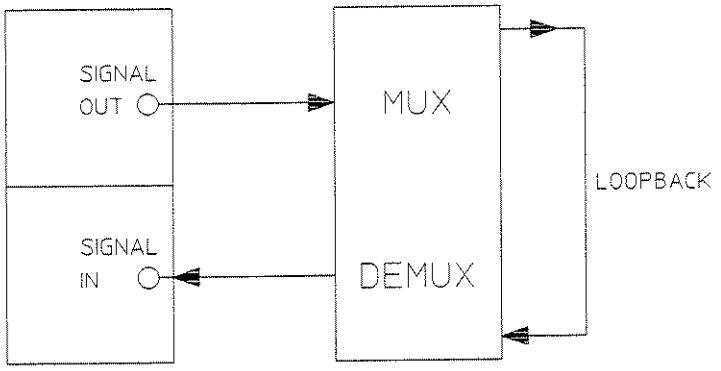
2048 kbit/s ± 50 ppm

8448 kbit/s ± 30 ppm

34368 kbit/s ± 20 ppm

139264 kbit/s ± 15 ppm

An HP 37721A with Option 003, Frequency Offset, fitted is required for this measurement.



Frequency Offset Tolerance

Default (Known State) Settings

It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (Frequency Offset Tolerance)

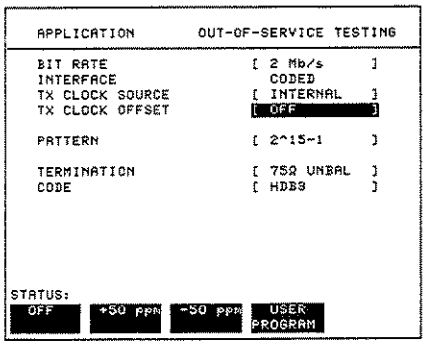
This setup procedure tests the clock recovery capability of the line terminal equipment at 8 Mb/s using a PRBS pattern connected to the 75 Ω interface. The frequency of the generated data is offset using the Frequency Offset capability (Option 003). The data is looped back and monitored for errors.

Note

2 Mb/s; 34 Mb/s and 140 Mb/s can be checked in the same manner using a PRBS pattern.

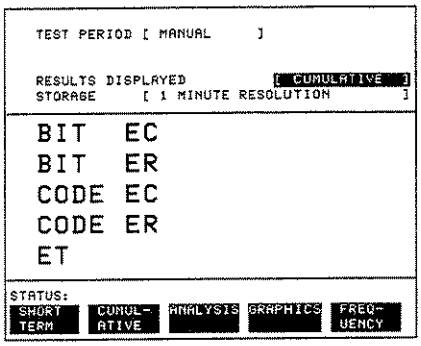
1. Connect the HP 37721A to the 75 Ω interface of the multiplexer and set up the (SETTINGS) display as shown opposite.

TX CLOCK OFFSET is set to [OFF] until the test is started.



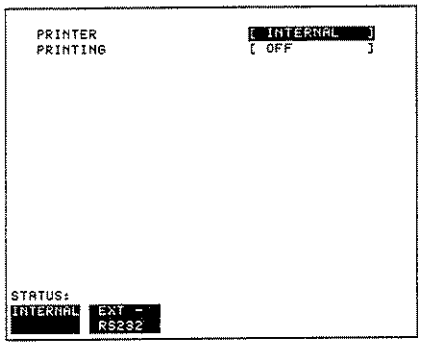
2. Set up the (RESULTS) display as shown opposite.

The Elapsed Time (ET) in the test period appears on the display.



3. Set up the (PRINTER) display as shown opposite.

PRINTING [OFF] disables the printer.



Run the Test (Frequency Offset Tolerance)

1. Connect a loopback at the desired point on the line terminal equipment and press (RUN/STOP) on the HP 37721A.

The test can be halted at any time by pressing (RUN/STOP).

2. Select TX CLOCK OFFSET [+30ppm] and check that the Error Count and Error Ratio results are unchanged.

3. Select TX CLOCK OFFSET [-30ppm] and check that the Error Count and Error Ratio results are unchanged.

Note

The OFFSET values used above conform to CCITT G.703 Recommendation. If different values are required selection of [USER PROGRM] allows offsets of up to ±100 ppm to be used.

At the End of the Test (Frequency Offset Tolerance)

1. Halt the test by pressing (RUN/STOP), and disconnect the HP 37721A.

2. Remove the loopback, repair or replace the faulty equipment, and return the line terminal equipment to service.

In-Service Monitoring

Application

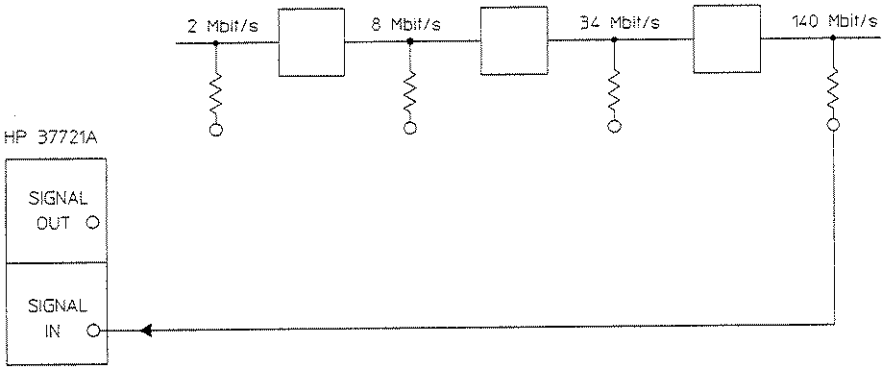
In-service monitoring allows the error performance of a link to be tested without disturbing traffic and losing valuable revenue.

In-service tests allow indentification of the following:

- Deterioration in circuit performance before the service is seriously affected.
- In-service troubleshooting allows detections of problems which only occur at certain times of day, or when certain line traffic conditions exist.

Such problems can be detected by the occurrence of Frame Alignment Signal (FAS) errors.

Using the HP 37721A (option 005) in a *receive only* mode, FAS errors can be measured and viewed on the (RESULTS) display. In addition, the results can be logged on a Printer for examination later.



In-Service Monitoring

Default (Known State) Settings

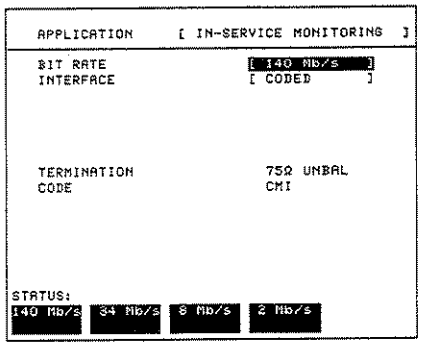
It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (In-Service Monitoring)

This setup procedure is based on 140 Mb/s, line traffic interfaced at the line equipment Monitor point. The instrument is used in a receive only mode to measure FAS Errors. A Timed Start test period is used which allows the measurement to be started at a time of interest when the user would not normally be available. Alarms are logged in real time on the internal printer.

Error Count; Error Seconds; Error Ratio and Analysis results are logged on the printer at the end of the test period. When live traffic is being monitored, FAS Bit Errors will be measured.

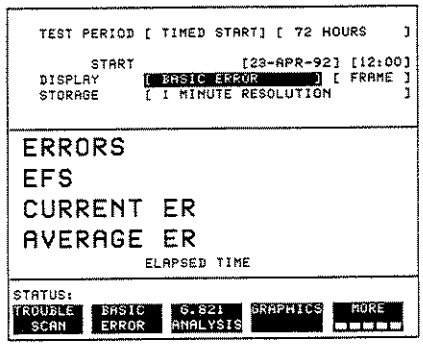
1. Connect the HP 37721A to the line terminal equipment Monitor point and set up the (SETTINGS) display as shown opposite.



2. Set up the (RESULTS) display as shown opposite.

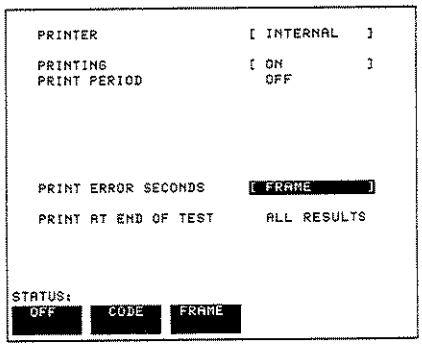
Select your own START time.

Analysis results are also calculated during the test period, and can be viewed by setting the DISPLAY field to [G.821 ANALYSIS].



3. Set up the (PRINTER) display as shown opposite.

A complete set of up to date results can be obtained at any time during the test period by pressing (PRINT NOW).



Run the Test (In-Service Monitoring)

1. Press (SIGNAL IN) until the MONITOR indicator is lit.

The test period will begin at the START time selected on the (RESULTS) display.

The Date and Time the test started and the instrument setup are logged on the printer.

Any occurrence of Alarms or FAS Errors during the test period are logged on the printer.

The test can be halted at any time by pressing (RUN/STOP).

At the End of the Test (In-Service Monitoring)

At the end of the test period Cumulative results of Error Count; Error Ratio; Error Seconds and Analysis results are logged on the printer.

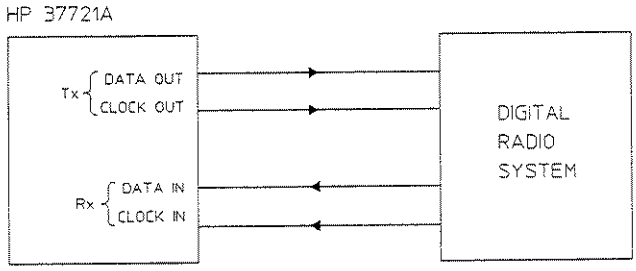
Binary Interface Testing (Option 004)

Application

In many test applications, such as digital radio, line coded interfaces may not be available. In such situations it is necessary to use Binary clock and data signals to interface to the system.

Error performance measurements are made on an end-to-end basis; testing the *GO* and *RETURN* paths of the Digital Radio system.

An HP 37721A digital transmission analyzer with option 004, Binary interfaces fitted is required for this measurement.



Binary Interface Testing

Default (Known State) Settings

It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (Binary Interface Testing)

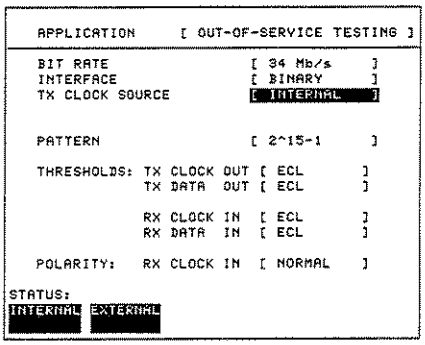
This setup procedure is based on testing a digital radio system at the binary interface, and operating at 34 Mb/s. A single test period of 24 hours is used and use of the internal printer for recording results and alarms is included. A graphical record of the measurement can also be obtained.

1. Connect the TX and RX DATA and CLOCK ports to the system under test.

2. Press the SETTINGS key and select an OUT-OF-SERVICE APPLICATION.

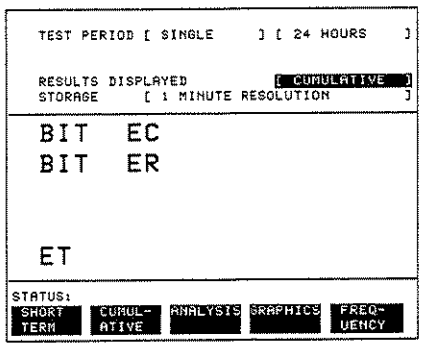
Set the BIT RATE to [34 Mb/s], the INTERFACE to [BINARY] and the TX CLOCK SOURCE to [INTERNAL].

Set all other settings as shown opposite, or as required to suit your own application.



3. Setup the (RESULTS) display as shown opposite:

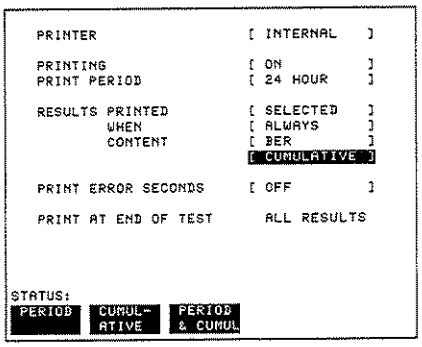
Analysis results are also calculated during the test period, and can be viewed by setting the RESULTS DISPLAYED field to [ANALYSIS], or logged by setting the CONTENT field on the PRINTER page to [ANALYSIS] or [BER & ANAL].



To Print Measurement Results on the Internal Printer

4. Setup the (PRINTER) display as shown opposite.

A complete set of up to date results can be obtained at any time during the test by pressing (PRINT NOW).



Run the Test (Binary Interface)

Press (RUN/STOP) on the HP 37721A to begin the measurement test period.

The Date and Time the test started and the instrument setup are logged on the printer.

Any occurrence of Alarms or FAS Errors during the test period are logged on the printer.

Error Count and Error Ratio results are logged on the printer at 24 Hour intervals.

The test can be halted at any time by pressing (RUN/STOP).

At the End of the Test (Binary Interface)

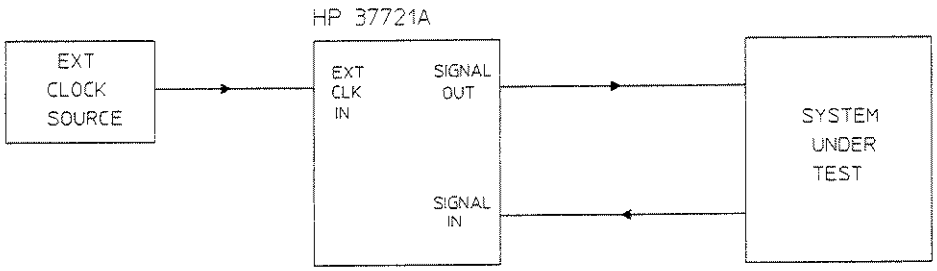
At the end of the test period Cumulative results of Error Count and Error Ratio are logged on the printer.

External Clock Input (Option 004)

Application

On instruments fitted with option 004 (Binary) the external clock capability enables tests to be performed at non standard rate interfaces, and can also be used to produce binary outputs.

The following figure illustrates an external clock source being input to the HP 37721A rear panel EXT CLK IN port, and a coded (Ternary) signal output from the front panel SIGNAL OUT port to a system under test.



Using an External Clock Source

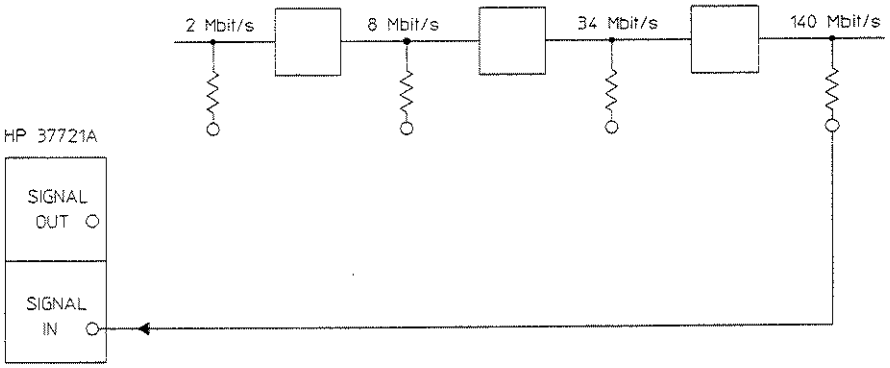
Frequency Measurement

Application

Most network equipment recovers clock from the incoming bit stream. As a minimum requirement network equipment must provide reliable clock recovery. Failure to reliably recover the clock, can result in high error rates.

The clock frequency and the amount of offset from the CCITT standard rate can be measured as an indication of probability of errors.

The measurement can be made in monitor mode and is generally of short duration.



Frequency Measurement

Default (Known State) Settings

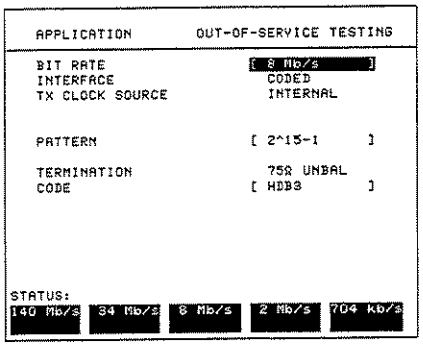
It can be advisable to set the HP 37721A to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (Frequency Measurement)

The measurement is interfaced at the line terminal equipment Monitor point. The HP 37721A is used in a receive only mode to measure the SIGNAL IN frequency. The SIGNAL IN frequency is measured and compared with the internal CCITT standard frequency selected.

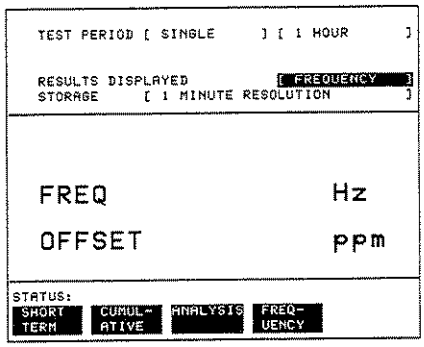
1. Select RATE [8 Mb/s].

For frequency measurement PATTERN; TERMINATION and CODE are not relevant.



2. Select RESULTS DISPLAYED [FREQUENCY].

For frequency measurement TEST TIMING and DURATION are not relevant.



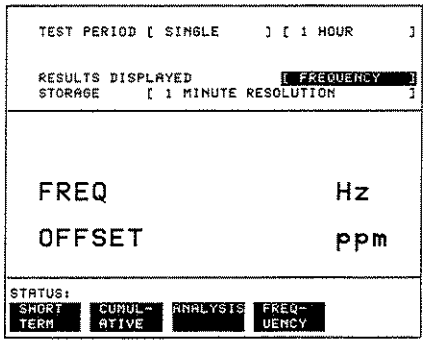
Run the Test (Frequency Measurement)

1. Press (SIGNAL IN) until the Monitor indicator, above the key, is lit.
2. Connect the SIGNAL IN port to the line terminal equipment monitor point.

The measured frequency and amount of offset from the internal standard is displayed.

If the SIGNAL IN frequency is different from the selected BIT RATE the error message **Unable to recover clock** appears on the display. A FREQ reading is displayed but this should be ignored.

Offset is not applicable in Binary mode, or when using an external clock.



At the End of the Test (Frequency Measurement)

Disconnect the HP 37721A from the line terminal equipment.

Logging Results

The results obtained during a test are retained in memory until they are overwritten by the next set of results. The results can be logged on a printer at any time during or after the test.

Any Alarm occurrence results in a timed and dated message being logged on the printer.

BER and Analysis results are available. The analysis results are only calculated for Bit errors :

BER	Bit and Code Errors : Error Count; Error Ratio; Error Seconds
Analysis	Bit Errors Only (not code errors):Errored Seconds (ES) and % Errored Seconds; Error Free Seconds (EFS) and % Error Free Seconds; Severely Errored Seconds (SES) and % Severely Errored Seconds; Unavailable Seconds (US) and % Unavailable Seconds; Degraded Minutes (DM) and % Degraded Minutes.

Cumulative and Period versions of the results can be calculated :

Period	The results obtained over a set period of time during the test. The Period is defined by the PRINT PERIOD selection.
Cumulative	The results obtained over the time elapsed since the start of the test.

The user can choose whether to record BER or Analysis results or both and choose whether the results will be Cumulative or Period or both.
Note: With option 005 fitted frame related logging results are also presented.

Test Period Logging

If degradations in system performance can be observed at an early stage, then the appropriate remedial action can be taken to maximize circuit availability and avoid system crashes. Period logging allows you to monitor the Code error performance of your circuit. At the end of the test period the selected results are logged on the printer. If desired, results can be logged at regular intervals during the test period by selecting a PRINT PERIOD of shorter duration than the test period.

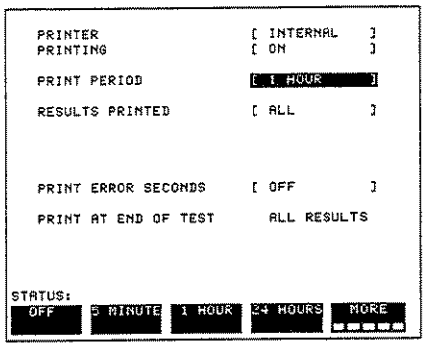
Without affecting the test in progress an instant summary of the results can be demanded by pressing (PRINT NOW).

PRINTING [ON] enables the printing of ALARM conditions.

The selection made under PRINT PERIOD determines how regularly the results are logged.

A complete set of, Cumulative, BER and Analysis results are logged on the printer at the end of the test period.

Each time (PRINT NOW) is pressed the Cumulative BER and Analysis results are logged on the selected printer.



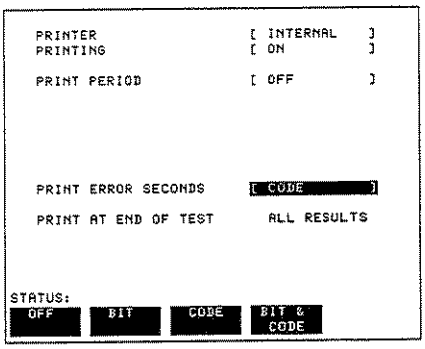
Error Event Logging

Manual tracing of intermittent faults is time consuming. Error event logging allows you to carry out unattended long term monitoring of the circuit. Each occurrence of the selected error event is logged on the printer.

Alarm conditions (Signal Loss; Power Loss; Pattern Loss and AIS) are logged automatically.

1. PRINT ERROR SECONDS [CODE] determines that each time a code error second is detected, a timed and dated message will be logged on the printer.

A complete set of, cumulative, BER and Analysis results are logged on the printer at the end of the test period.

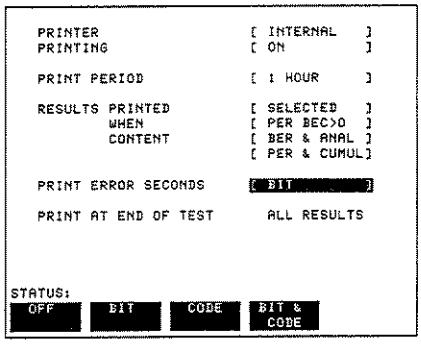


When making long term out-of-service bit error measurements it is often desirable only to log results when an error has occurred.

2. WHEN [PER BEC>0] determines the action taken at the end of the PRINT PERIOD. If the bit error count during a Print Period is greater than 0 then at the end of the Print Period a set of BER and Analysis results, for that period only, are logged. If the bit error count is 0 then the message *NO BIT ERRORS* is logged at the end of the Print Period.

PRINT ERROR SECONDS [BIT] determines that each time a bit error is detected, a timed and dated message will be logged on the printer.

A complete set of, Cumulative, BER and Analysis results are logged on the printer at the end of the test period.



External HP ThinkJet Printer

The HP 37721A has the capability of interfacing with an RS-232-C HP ThinkJet printer via the rear panel RS232 printer port. If Option 001, Remote Control, is fitted the HP 37721A has the capability of interfacing with an HP-IB HP ThinkJet printer via the rear panel HP-IB port. The choice between internal and external printer is available on the (PRINTER) display.

Connecting an RS-232-C ThinkJet Printer

1. Connect the HP 37721A rear panel RS232 printer port to the ThinkJet RS-232-C port.

2. Set the ThinkJet Mode switches to 0 (All switches down).

3. Set the ThinkJet RS-232-C switch to match the HP 37721A settings of PRINTER BAUD RATE, PARITY and HANDSHAKE.

ThinkJet RS-232-C Switch Settings

Handshake	Parity	Baud Rate
Bit 1=0 = Xon/Xoff	Bit 2=0 Bit 3=0 = 0's	Bit 4=0 Bit 5=0 =9600
Bit 1=1 = DTR *	Bit 2=0 Bit 3=1 = ODD	Bit 4=0 Bit 5=1 =19200 *
	Bit 2=1 Bit 3=0 = EVEN	Bit 4=1 Bit 5=0 = 2400
	Bit 2=1 Bit 3=1 = 1's	Bit 4=1 Bit 5=1 = 1200

Note

Items marked with an * cannot be matched on the HP 37721A.

Normal settings 9600 Baud, 0's Parity and Xon/Xoff is achieved when all Bits of the ThinkJet RS-232-C switch are set to 0.

Connecting an HP-IB ThinkJet Printer (Option 001 Only)

1. Connect the HP 37721A (Option 001) rear panel HP-IB port to the ThinkJet HP-IB port.

2. Set the ThinkJet Mode switch to LISTEN ALWAYS.

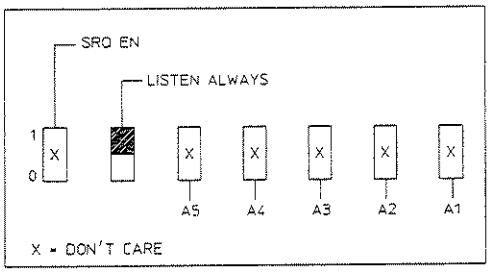


Figure 2-1. ThinkJet Listen Always

Internal Printer Changing Paper

The internal printer is housed in a compartment, beneath [PAPER FEED] and [PRINT NOW] which is accessible from the front panel. A plastic cover is fitted to prohibit dust from the printer mechanism and retain the printer paper.

Caution 

Do not press [PAPER FEED] while attempting to feed the paper into the Printer.

To change the internal printer paper proceed as follows :

1. Remove the printer compartment cover by pushing the cover catch upwards and lifting the cover off.
2. Remove any paper remaining from the old roll by gently pulling.
3. Undo the new roll of paper and place in the printer compartment such that the paper feeds up the open end of the compartment (See Figure 2-2).
4. Using scissors cut the first 2 inches of the paper as shown in Figure 2-2.
5. Feed the paper into the slot behind the cylindrical printer head located at the top of the compartment and keep feeding until the point of the paper appears between the tear-off "teeth".
6. Pull the paper through until a full width of paper appears and then tear-off as required.

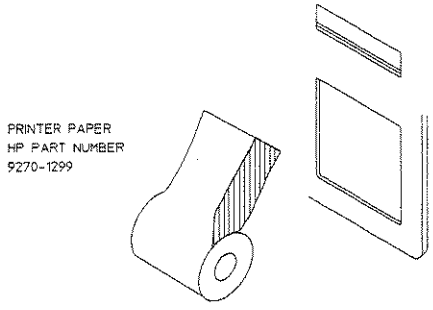


Figure 2-2. Paper Feed Direction

Graphics

The Graphics function provides the following :

- a bar graph display of the results obtained during the test period,
- a display of the instrument setup and results during the test period,
- a display of the Graphics Store, content and capacity.

Each of these displays can be viewed in the (RESULTS) display. The bar graph display and the instrument setup and results can be logged on an external HP ThinkJet printer.

Note

The internal printer is not suitable for recording the Graphics displays.

Up to 10 sets of bar graphs, associated results and setups, and the status of the stored results can be stored in non volatile memory.

The total graphics store capacity is determined by the selection made under STORAGE on the (RESULTS) display:

1 MINS RESOLUTION	3 Days and 6 Hours
15 MINS RESOLUTION	45 Days
1 HOUR RESOLUTION	99 Days

The resolution selected affects the ZOOM capability when viewing the bar graphs. If 15 MINS is selected only 15 MINS/BAR and 60 MINS/BAR are available. If 1 HOUR is selected only 60 MINS/BAR is available.

Up to 10 sets of graphical results can be stored. If an attempt is made to store more than 10 sets of results, then a first in first out policy is operated. If graphics are enabled and a test is run which exceeds the remaining storage capacity, then some previously stored graphical results will be discarded.

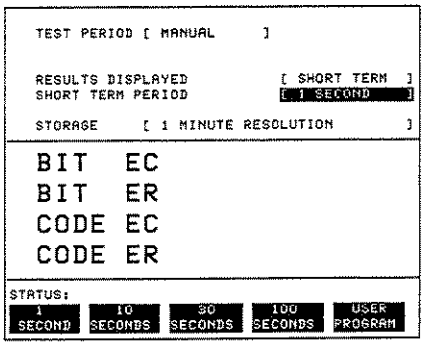
To prevent accidental overwriting of graphics data the graphics capability should be disabled when graphical results are not required. To disable the graphics capability select STORAGE [OFF] on the (RESULTS) display.

Obtaining Graphics Results

To obtain graphical results enable the graphics by selecting STORAGE [1 MIN RESOLUTION] or [15 MINS RESOLUTION] or [1 HOUR RESOLUTION] on the (RESULTS) display.

STORAGE [1 MINUTE RESOLUTION]

enables the graphics and allows storage of the measurement results for a maximum of 3 Days 6 Hours.



Bar Graphs of Bit Error Count; Bit Error Seconds and Alarms are available; only two of the three are displayed at any one time.

With option 005 fitted Frame bit error count and ratio; CRC4 (2 Mb/s only) and REBE (E-bits) count (at 2 Mb/s) can be displayed.

Note

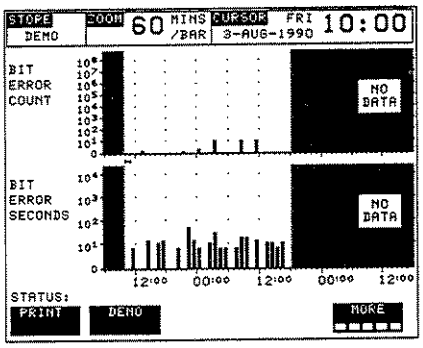
A softkey labelled DEMO is provided to allow a demonstration set of bar graphs to be constructed as an operators "training" aid. The demonstration bar graphs have been utilized in the illustration of the following procedure.

Viewing the Bar Graph Display

1. Select RESULTS DISPLAYED [GRAPHICS] on the (RESULTS) display.

Select MORE then DEMO to obtain the demonstration bar graphs.

The bar graph construction takes approximately 20 s.



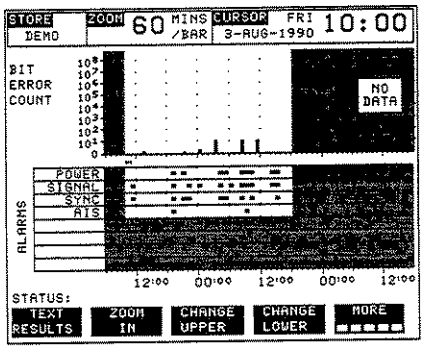
The top row of the display comprises three fields :

Store — Memory location in which the displayed bar graph data is stored. Store can only be changed when the status of stored results is displayed. Select TEXT RESULTS and then STORE STATUS and move the highlighted cursor, to the STORE location desired, using (↑) and (↓).

Zoom — The width, in Minutes, of each "bar" in the bar graph, controlled by ZOOM IN / ZOOM OUT.

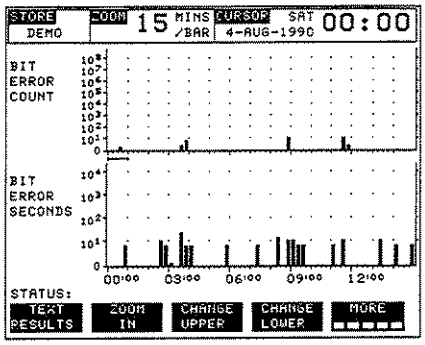
Cursor — The cursor position in terms of Time and Date, controlled by (↑) and (↓). The cursor is physically located between the two graphs.

2. The bar graphs displayed can be changed using CHANGE UPPER and CHANGE LOWER. The effect of CHANGE UPPER and CHANGE LOWER is shown opposite.



3. Position the cursor centrally within the time of interest using ⇦ and ⇩ . Select ZOOM IN to reduce the time axis of the bar graph for more detailed inspection as shown opposite.

If required, position the cursor centrally within the time of interest and select ZOOM IN once more to reduce the time axis to 01 MINS/BAR.

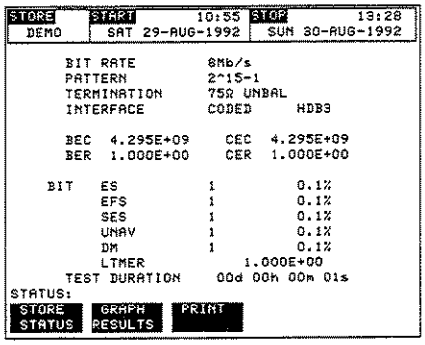


Viewing the Instrument Setup and Results

4. Select TEXT RESULTS. The instrument setup and some analysis results are displayed as shown opposite.

Selection of GRAPH RESULTS accesses the bar graph display.

Selection of STORE STATUS accesses the display of the stored results status.



The top row of the display comprises three fields :

Store — Memory location in which the displayed bar graph data is stored. Store can only be changed when the status of stored results is displayed. Select STORE STATUS and move the highlighted cursor, to the STORE location desired, using ⇦ and ⇩.

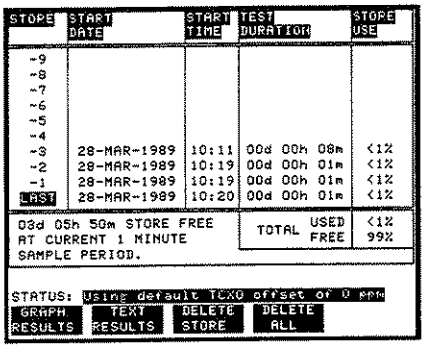
Start — The start time and date of the test, which produced the displayed results.

Stop — The stop time and date of the test, which produced the displayed results.

Viewing the Stored Results Status

1. If currently viewing the bar graph display, select `TEXT RESULTS` then `STORE STATUS`. If currently viewing the setup and results display, select `STORE STATUS`.

`DELETE STORE` allows the results in the store marked by the highlighted cursor to be deleted.



`DELETE ALL` allows all the results in all of the stores to be deleted. If `DELETE ALL` is selected, a `CONFIRM DELETE` or `ABORT DELETE` choice is provided to prevent accidental deletion of stored results.

The top row of the display comprises five fields :

Store	Memory location in which the displayed bar graph data is stored. Move the highlighted cursor, to the STORE location desired, using ⇧ and ⇩.
Start Date	The start date of the test, which produced the stored results.
Start Time	The start time of the test, which produced the stored results.
Test Duration	The duration of the test, which produced the stored results. The storage capacity of the graphics capability is expressed in Days, Hours and Minutes. The total amount of storage capacity used and the amount still available for use is given at the bottom of the TEST DURATION column under TOTAL USED and FREE respectively.
Store Use	The percentage of the overall storage capacity occupied by each set of stored results. The percentage used and the percentage still available is provided at the bottom of the STORE USE column.

Printing Graphics Displays

The following graphics displays can be logged on an external HP ThinkJet printer :

- Bar Graph display
- Setup and results display

Note

1. Graphics displays can not be logged on the internal printer.
2. Graphics displays can not be logged to an external printer when testing is in progress.

To print a graphics display on an external HP ThinkJet printer :

1. Connect an external RS-232-C HP ThinkJet printer to the HP 37721A rear panel RS232 Printer port. If Option 001, Remote Control, is fitted an external HP-IB HP ThinkJet printer can be connected to the HP 37721A rear panel HP-IB port. See *External HP ThinkJet Printer*.
2. Make the required PRINTER selection on the (PRINTER) display, [EXT - HPIB] or [EXT - RS232], and select PRINTING [ON].
3. Obtain the graphics display required and select PRINT.

   If PRINT is selected on the bar graph display, the bar graphs and the instrument setup and results will be logged on the printer.

   If PRINT is selected on the Setup and Results display only the instrument setup and results are logged on the printer.

Stored Settings

It is often desirable to store measurement settings which are used regularly and be able to recall those settings at a moments notice. This capability is provided on the HP 37721A by the STORED SETTINGS function on the (OTHER) display.

One preset store is provided which cannot be overwritten, STORED SETTING NUMBER [0], and is used to set the HP 37721A to a known state. The known state is the FACTORY DEFAULT SETTINGS.

Factory Default Settings

Bit Rate	2 Mb/s	Print Period	1 Hour
TX Clock Source	Internal	User Print Period	10 Mins
TX Clock Offset	Off	Results Printed	All
User Offset	+0 ppm	When	Always
Pattern	PRBS 2^15	Content	BER & Anal
Termination	75Ω Unbal		Per & Cum
Code	HDB3	Print Error Seconds	Off
Test Timing	Single	Printer Baud Rate	9600
Duration	1 Hour	Stored Setting Lock	On
User Duration	10 Secs	Stored Setting Number	0
Short Term Period	1 Sec	Resync Mode	Automatic
User Period	10 Secs	Suspend Test on Sig Loss	Off
Start	01 Jan 89 12.00	Keyboard Lock	Off
Printer	Internal	Beep On error	Off
Printing	Off	Error Add	Off
Storage	On 1 Min Res		

Option 004/005 Default Settings

The following settings apply to option 005 instruments unless otherwise noted. All other settings are as listed for standard instruments in the previous table.

Option 004/005 Default Settings

Application	Out-of-Service Testing
Interface	Coded
Thresholds (option 004)	All TX and RX ports set to TTL
Frame Type	CAS MFM (when In-Service and 2 Mb/s bit rate selected)
Display	Trouble Scan (when In-Service Application selected)
Analysis Type	Standard

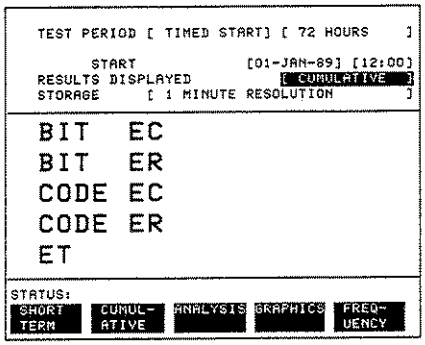
The use of the STORED SETTINGS function is illustrated by carrying out the following tasks :

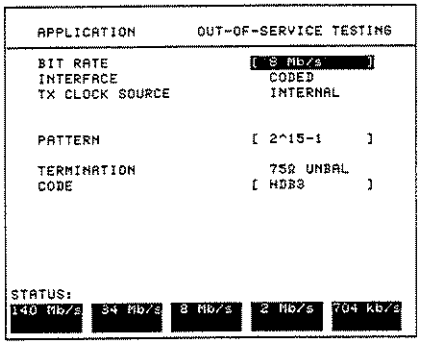
- Select the settings used in the system monitoring application
- TITLE the settings as System Monitoring
- SAVE the settings as Stored Setting Number [1]
- RECALL the Factory Default Settings from Stored Setting Number [0]
- RECALL the system monitoring settings from Stored Setting Number [1]

Select Settings to be Stored

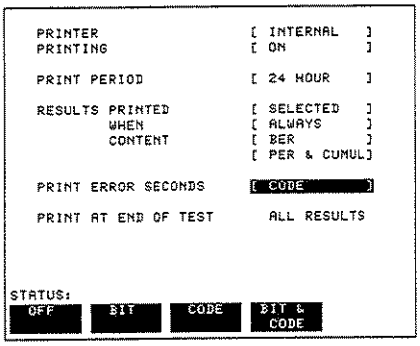
1. Set up the (SETTINGS) display as shown opposite.

2. Set up the (RESULTS) display as shown below.





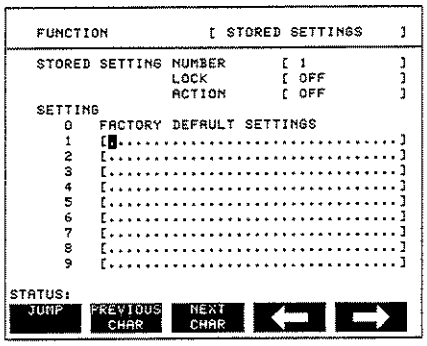
3. Set up the (PRINTER) display as shown below.



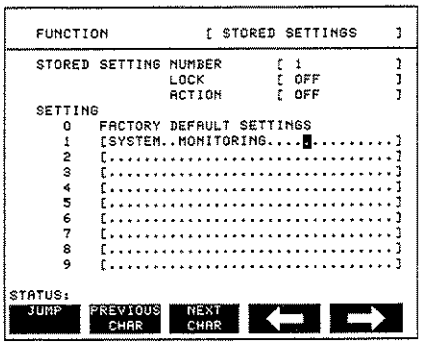
Title the Settings

1. Select the STORED SETTINGS function on the (OTHER) display and set up the display as shown opposite.

To Title settings LOCK [OFF] must be selected.



2. Using JUMP; PREVIOUS CHAR; NEXT CHAR; ▶ and ◀ title the settings as shown below.

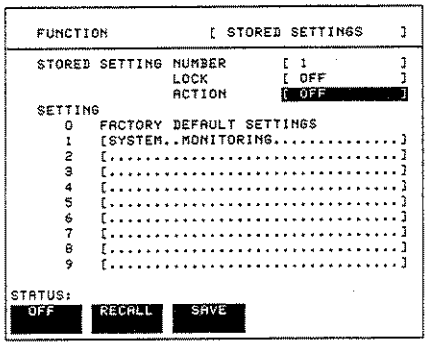


Save the Settings

1. Set up the display as shown opposite and select ACTION [SAVE].

To SAVE settings LOCK [OFF] must be selected.

The system monitoring settings are now stored in STORED SETTING NUMBER [1].

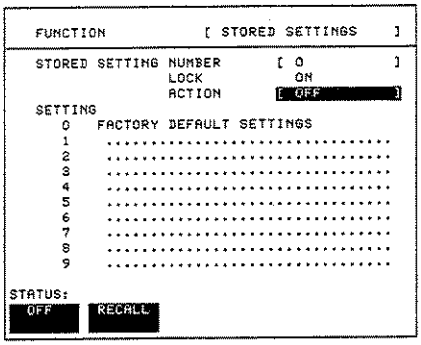


Recall Default Settings

1. Set up the display as shown opposite and select ACTION [RECALL].

To verify that the instrument has adopted the Factory Default Settings, view the (SETTINGS); (RESULTS) and (PRINTER) displays.

Settings can be recalled when LOCK [ON] is selected but to save settings or title settings LOCK [OFF] must be selected.

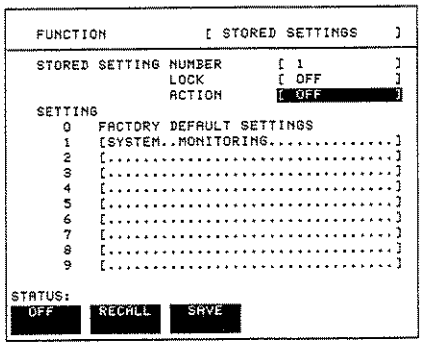


Recall Previously Stored Settings (System Monitoring)

1. Set up the display as shown opposite and select ACTION [RECALL].

To verify that the instrument has adopted the system monitoring settings, view the (SETTINGS); (RESULTS) and (PRINTER) displays.

Settings can be recalled when LOCK [ON] is selected but to save settings or title settings LOCK [OFF] must be selected.



Keyboard Lock

It is often desirable to protect the measurement settings from interference, during a test. This facility is provided on the HP 37721A under the heading KEYBOARD LOCK on the (OTHER) display.

The following keys are not affected by Keyboard Lock :

- Display keys (SETTINGS); (RESULTS); (PRINTER); (OTHER)
- cursor keys (↑); (↓)
- (SHOW HISTORY)
- (PAPER FEED)

The following display functions are not affected by Keyboard Lock :

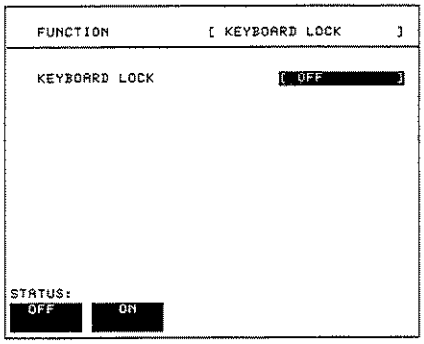
- RESULTS DISPLAYED on the results display
- KEYBOARD LOCK on the other display

Lock/Unlock the Keyboard

1. Set up the (OTHER) display as shown opposite.

To Lock the keyboard select [ON].

To Unlock the keyboard select [OFF].



Beep On Error

It is sometimes desirable to have an audible indication of an error particularly when the display on the test set is hidden from view. This function is provided on the HP 37721A under the heading BEEP ON ERROR on the (OTHER) display.

Enable/Disable Beep On Error

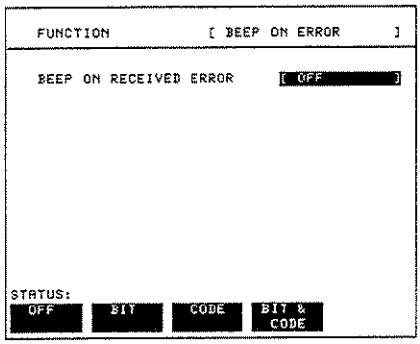
1. Set up the (OTHER) display as shown opposite.

To Beep when a Bit error occurs select `BIT`.

To Beep when a Code error occurs select `CODE`.

To Beep when a Bit or a Code error occurs select `BIT & CODE`.

For In-Service applications on Option 005 instruments the following additional choices are available: `FRAME`, or when a 2Mb/s Bit Rate and `CRC MFM` Frame Type is selected; `CRC`, `REBE`, `FRM_CRC`, `FRM_REBE`, `FRM_CRC_REBE` or `CRC_REBE`



Time & Date

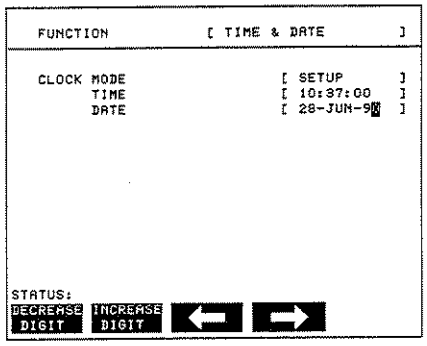
When making Bit error measurements and recording results it is desirable to have certain events timed chronologically for example, Alarms ; Error Seconds.

The capability to set the Time and Date is provided on the OTHER display under the TIME & DATE function.

Setting Time and Date

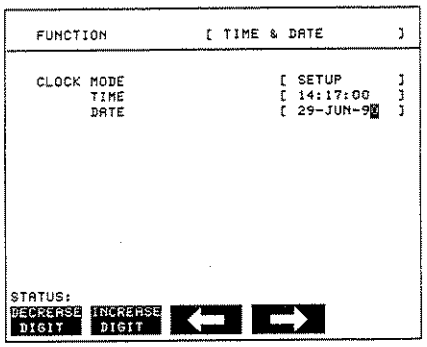
1. Set up the OTHER display as shown opposite.

Set the Time and Date as required using ↑; ↓; ◀; ▶; INCREASE DIGIT; DECREASE DIGIT.



2. Using ↑ and ↓ move the highlighted bar to [SETUP] as shown opposite.

Select RUN to complete the setting of Time and Date.



Resynchronization Mode

When making bit error measurements it is essential that the data pattern at SIGNAL IN is in synchronization with the internally generated data pattern. If synchronization is lost during testing, then resynchronization is necessary.

Two types of resynchronization are provided :

Automatic — Whenever synchronization is lost the HP 37721A will detect Sync Loss and automatically compare the two patterns until synchronization is regained. All the data received during the Sync Loss/Sync Gain period will be counted as bit errors.

Manual — The HP 37721A will only attempt to gain synchronization when the (MANUAL RESYNC) key is pressed. When synchronization has been achieved the measurement will continue irrespective of the measured Bit error rate.

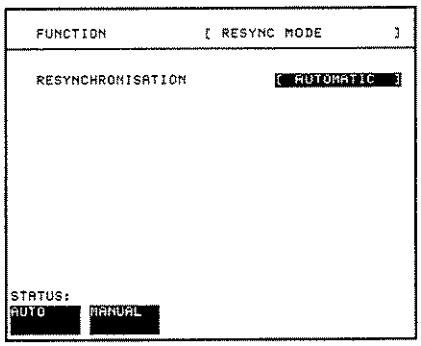
This function is provided on the HP 37721A under the heading RESYNC MODE on the (OTHER) display.

For In-Service Measurements (option 005) RESYNCHRONISATION is fixed at AUTOMATIC.

Resynchronization Mode

1. Set up the (OTHER) display as shown opposite.

Select AUTOMATIC or MANUAL as required.



Analysis Control

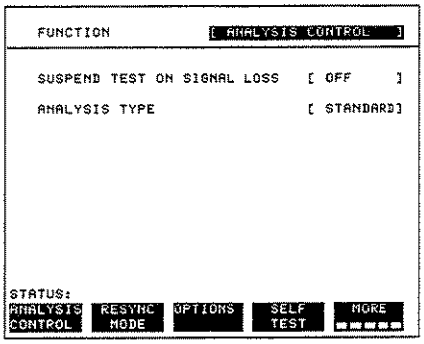
When testing it may be desirable to halt the test during periods of Signal Loss and resume the test when the Signal Loss condition is cleared. This function is provided under ANALYSIS CONTROL on the (OTHER) display.

1. Set up the (OTHER) display as shown opposite.

To include periods of Signal Loss in the Test period select [OFF].

To exclude periods of Signal Loss from the Test period select [ON].

The ANALYSIS TYPE field provides a choice of STANDARD G.821 Analysis or G.821 ANNEX D Analysis.



Self Test

Before using the HP 37721A to make measurements it may be desirable to run Self Test to ascertain the integrity of the HP 37721A. These tests take approximately 15 minutes to complete.

Before activating Self Test both the 75Ω and 120Ω Signal In ports must be connected to the corresponding Signal Out ports. An RS-232-C loopback connector (HP Part Number 5060-4462) must be connected to the rear panel RS232 Printer Port and if Option 001, Remote Control, is fitted, to the rear panel RS232 Remote Port.

If option 004 (Binary) is fitted the rear panel TX CLK/DATA OUT ports must be connected to the RX CLK/DATA IN ports.

Note

If any or all of these connections are not made the HP 37721A will FAIL Self Test.

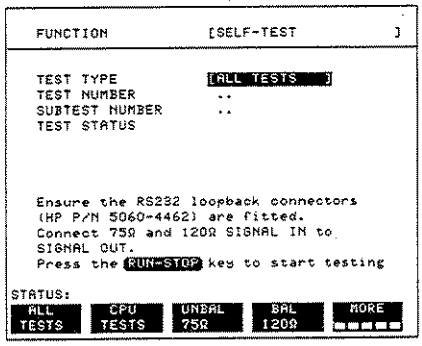
1. Set up the (OTHER) display as shown opposite using (OTHER), MORE and SELF TEST.

2. Connect 75Ω Signal In to 75Ω Signal Out.

3. Connect 120Ω Signal In to 120Ω Signal Out.

4. Connect an RS-232-C Loopback connector (HP Part Number 5060-4462) to the rear panel RS232 Printer port.

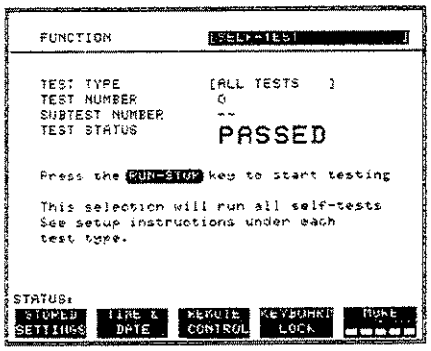
5. If Option 001, Remote Control, is fitted connect an RS-232-C Loopback connector (HP Part Number 5060-4462) to the rear panel RS232 Remote port.



1. Press (RUN/STOP) to activate the Self Test. TEST STATUS [RUNNING] will be displayed. The information pertaining to TEST TYPE, TEST NUMBER and SUBTEST NUMBER will change as the Self Test progresses

If the HP 37721A is functioning correctly, after approximately 15 minutes, TEST STATUS [PASSED] is displayed.

If TEST STATUS [FAIL nnn] is displayed the HP 37721A should be returned to a service office for repair.



Note

1. FAIL Error Numbers are listed and defined in the HP 37721A Service Manual (HP part number 37721-90000) and are intended for use by Service personnel.

2. On some instruments below Serial Number 3123U00621 the information regarding connecting Signal In to Signal Out and RS-232-C Loopback connectors does not appear on the display. If the Self Test is run without these connections being made then FAIL 51 (RS232 Printer port test failure) will be displayed. If Option 001, Remote Control, is fitted then FAIL 50 (RS232 Remote port test failure) will be displayed.

3

Reference

This Reference section contains a detailed description of all HP 37721A keys, indicators, functions, measurement results and connectors. These are arranged in the following order :

Front Panel

Rear Panel

(SETTINGS) Display

(RESULTS) Display

(PRINTER) Display

(OTHER) Display

Front Panel

SIGNAL IN PORT	Allows the connection of 75 Ω BNC unbalanced (all bit rates), and 120 Ω balanced (704 kb/s and 2 Mb/s only) data signals for error measurement.
SIGNAL OUT PORT	Provides 75 Ω BNC unbalanced (all bit rates) and 120 Ω balanced (704 kb/s and 2 Mb/s Only) data outputs to be used as a stimulus to line equipment.
(SETTINGS)	Displays the settings associated with the measurement set-up. (⇧) and (⇩) move the highlighted bar between fields. The selection from the menu is made using the display softkeys.
(RESULTS)	Displays the settings associated with the measurement results. (⇧) and (⇩) move the highlighted bar between

fields. The selection from the menu is made using the display softkeys.

PRINTER — Displays the settings associated with the printer set-up. ⇧ and ⇩ move the highlighted bar between fields. The selection from the menu is made using the display softkeys.

OTHER — Displays the settings associated with one of the following functions : STORED SETTINGS; TIME & DATE; REMOTE CONTROL (Option 001 Only); KEYBOARD LOCK; BEEP ON ERROR; ANALYSIS CONTROL; RESYNC MODE; OPTIONS; SELF TEST; and CALIBRATION. The desired function is selected using the display softkeys. ⇧ and ⇩ move the highlighted bar between fields. The selection from the menu is made using the display softkeys.

⇧ — Moves the highlighted cursor around the display in an upward or left direction.

⇩ — Moves the highlighted cursor around the display in a downward or right direction.

Display Softkeys — Allow the settings within the highlighted cursor to be changed and are situated immediately below the display. The softkey labels appear on the bottom of the display and change according to the highlighted cursor position.

SIGNAL IN — Allows selection between TERMINATE and MONITOR. The data on which the error measurement is to be made is presented at the SIGNAL IN port. If this data is derived from the line equipment Monitor port it will be at a low level and require amplification before accurate Error measurements can be made.

Terminate — The data present at the SIGNAL IN port is unmodified and the terminate indicator above the key is lit.

Monitor — An amplifier is connected in the input circuitry to compensate for the low level of the line equipment Monitor port. 30 dB of amplification is provided at 8 Mb/s, 2 Mb/s and 704 kb/s. 26 dB of amplification is provided at 140 Mb/s and 34 Mb/s. When Monitor is selected the monitor indicator above the key is lit.

AUTO SETUP — Attempts to match the HP 37721A settings of BIT RATE; PATTERN; CODE and TERMINATION signal level to the signal present at the SIGNAL IN port. If this is not possible, standard settings are chosen and the Status Message **Autosetup failed** is displayed. Standard settings are as follows :

Bit Rate : 2 Mb/s
Tx Clock source : Internal
Pattern : PRBS 2^15
Interface : 75 Ω Unbal
Code : HDB3

Option 004: Autosetup will not attempt to check binary operation as a valid setup, or switch the instrument out of binary mode. A message *AUTOSETUP NOT AVAILABLE IN BINARY* will be displayed.
Option 005: Autosetup will not attempt to check IN-SERVICE MONITORING as a valid setup, or switch the instrument out of IN-SERVICE mode. A message *AUTOSETUP NOT AVAILABLE* will be displayed.

RUN/ STOP — Starts a SINGLE or MANUAL test period. A TIMED START test period is started by the real time clock. Any type of test period can be stopped using RUN/ STOP. The indicator above the key is lit when a test period is in progress and extinguished when the test period ends.

When a test period is in progress only certain display settings can be altered :

(RESULTS) RESULTS DISPLAYED

(PRINTER) PRINTER; PRINTING; PRINTER BAUD RATE (EXT-RS232 only).

(OTHER) KEYBOARD LOCK; BEEP ON ERROR; REMOTE CONTROL; and SELF TEST.

If an attempt is made to change any other settings during a test period the Status Message **Press STOP, then change selection** is displayed.

ERROR ADD

Adds bit errors to the generated data during a test period in two possible ways :

(SINGLE) Each time the key is pressed one bit error is added to the generated data stream.

(1E-3) When the key is pressed bit errors at a rate of 1 error every 1000 clock periods are added to the data stream. This rate of error addition continues until the key is pressed again. The indicator above the key is lit to indicate that errors are being added at the prescribed rate.

(MANUAL RESYNC) Causes a synchronization search to be carried out when RESYNCHRONIZATION [MANUAL] is chosen on the (OTHER) display. If RESYNCHRONIZATION [AUTOMATIC] is selected the key is disabled.

PRINTER

Controls the printer using 2 keys :

(PAPER FEED) Causes the paper in the internal printer to roll up.

(PRINT NOW) Cumulative measurement results of Bit : Error Count, Error Ratio, Error Seconds and Code : Error Count, Error Ratio, Error Seconds are immediately logged on the selected printer, irrespective of

the PRINT PERIOD selection on the (PRINTER) display. For IN-SERVICE measurements (option 005) Error Count, Error Ratio and Analysis results are printed for Frame , CRC4 and REBE results. Code results are also logged on the Printer irrespective of the print period selection on the (PRINTER) display. Code errors are not printed if a Binary Interface is selected (option 004).

STATUS

Allows the current and past status of the HP 37721A to be viewed. The Status field contains 2 Status indicators, 4 Alarm indicators, 2 keys and 1 further indicator.

(SHOW HISTORY)

When an alarm occurs during the test period the indicator alongside the key is lit. To determine which alarm has occurred press and hold (SHOW HISTORY). The status indicators will now display those alarms that have occurred during the test period. When (SHOW HISTORY) is released the status indicators display the current status.

(RESET HISTORY)

Resets the history store. The reset function can also be achieved by starting a new Test Period.

Signal Present

Indicates that data transitions are present at the SIGNAL IN port.

Signal/Clock In

Indicates that:

a. When a BINARY INTERFACE is selected, clock transitions are present at the rear panel RX CLOCK IN port (option 004 only).

b. When a CODED (Ternary) INTERFACE is selected clock/data transitions are present at the front panel

	SIGNAL IN port (option 004 or 005 instruments).
Pattern Sync	Indicates that the received data is in synchronization with the internally generated reference data.
Ext Clock In (option 004)	Replaces Pattern Sync when option 004 is fitted. Indicates that clock transitions are present at the rear panel TX EXT CLOCK input. On instruments fitted with option 005, but without option 004, the *Ext Clock In* LED is available but is non-functional.
Signal Loss	Indicates that data transitions are not present at the SIGNAL IN port.
Pattern Loss	Indicates that the received data is not in synchronization with the internally generated reference data.
Pattern/Frame	Replaces Pattern Loss when option 004 or 005 is fitted. When an Out-of-Service Application is selected the LED indicates that the received pattern is not in synchronisation with the internally generated reference pattern. For an In-Service Application the LED indicates that frame loss has occurred.
AIS	Indicates that the signal present at the SIGNAL IN port meets the All ONES AIS criteria. The All ONES AIS signal will be detectable in the presence of a 1 X 10^{-3} Error Rate. A framed signal with all bits except the Frame Alignment signal in the "1" state will not be mistaken for AIS.
Errors	Indicates that an error (Bit or Frame (option 005)) has been detected. The indicator will remain lit for at least 100 ms.

(LOCAL)

Allows the HP 37721A to be returned to local (keyboard) control from remote control provided, Option 001 Remote Control is fitted, and remote control Local Lockout is not set. The indicator above the key, when lit, indicates that the HP 37721A is under remote control. When under remote control the selected settings are protected from unauthorized or accidental alteration by operation of the front panel keys. Only certain display settings may be changed from the front panel whilst under Remote Control :

(RESULTS) RESULTS DISPLAYED
Display

(OTHER) REMOTE CONTROL
Display

(LOCAL) ; (SHOW HISTORY) and (PAPER FEED) are not affected.

Rear Panel

RS232 Printer Port	Allows connection of an RS-232-C HP ThinkJet printer when PRINTER [EXT-RS232] is selected on the (PRINTER) display.
HP-IB Port (Option 001 only)	Allows connection of an HP-IB printer to record the measurement results when PRINTER [EXT-HPIB] is selected on the (PRINTER) display or connection of an HP-IB controller when REMOTE CONTROL PORT [HPIB] is selected within the REMOTE CONTROL function on the (OTHER) display.
RS232 Modem Port (Option 001 only)	Allows connection of an RS-232-C controller when REMOTE CONTROL PORT [RS232] is selected within the REMOTE CONTROL function on the (OTHER) display. The connection can be made directly, CONNECTION [HARDWIRED] selected within the REMOTE CONTROL function, or via a Modem, CONNECTION [MODEM] selected within the REMOTE CONTROL function.
RX IN: CLK/DATA (option 004 only)	Used to provide binary clock and data signals to the HP 37721A receiver. Inputs are binary NRZ at TTL levels up to 50 MHz and ECL levels at frequencies up to the maximum specified. Rate; 700 kbit/s to 168.5 Mbit/s. Level: Nominal TTL to 50 MHz, ECL to 168.5 MHz. Impedance: 75 ohms to ground (TTL) or -2V (ECL) unbalanced.
TX OUT: CLK/DATA (option 004 only)	Used to provide binary clock and data output signals from the HP 37721A transmitter. Rate: 700 kbit/s to 168.5 Mbit/s (with external clock input). Level: nominal TTL to 50 MHz, ECL to 168.5 MHz. Impedance: Nominal low, unbalanced to ground (ECL), 75 ohms (TTL).
TX EXT CLK (option 004 only)	Used to provide the clock to the HP 37721A transmitter. Maximum clock rate: 52 MHz for ternary data, 168.5 MHz for binary data clocking.

(SETTINGS) Display

APPLICATION

Instrument Application is fixed at [OUT-OF-SERVICE TESTING] unless option 005 is fitted. On option 005 instruments the user is offered the choice of selecting [IN-SERVICE MONITORING] or [OUT-OF-SERVICE TESTING]. Refer to page 1-6 of the HP 37721A Calibration manual for a list of measurements for each application.

BIT RATE

Determines the frequency of the internally generated clock. Selection between [140 Mb/s]; [34 Mb/s]; [8 Mb/s]; [2 Mb/s] and [704 kb/s] is available.

140 Mb/s	139.264 Mb/s
34 Mb/s	34.368 Mb/s
8 Mb/s	8.448 Mb/s
2 Mb/s	2.048 Mb/s
704 kb/s	704 kb/s

INTERFACE

Selects between BINARY and CODED operation when option 004 is fitted, otherwise only CODED is available.

TX CLOCK SOURCE

Only displayed if 704 kb/s or 2 Mb/s is selected. At these Bit rates the clock can be recovered from the received data. Selection between [INTERNAL] and [RECOVERED] is available. At all other Bit rates the clock is internally generated.

Option 004: When a BINARY INTERFACE is selected the STATUS selections are INTERNAL or EXTERNAL at all bit rates.

When CODED INTERFACE is selected the TX CLOCK SOURCE field is displayed for all bit rates.

At 140 Mbit/s, 34 Mbit/s and 8 Mbit/s only INTERNAL and EXTERNAL are available; at 2Mbit/s and 704 kbit/s INTERNAL, EXTERNAL and RECOVERED are available.

TX CLOCK OFFSET (Option 003 only)

Allows the clock to be offset in frequency for Frequency Offset Tolerance testing. Selection of +ve and -ve Preset (CCITT) values or User defined values is available.

Off	Offsets are disabled.	
+ve Preset	Positive Offset as defined by CCITT :	
	140 Mb/s	+15 ppm (parts per million)
	34 Mb/s	+20 ppm (parts per million)
	8 Mb/s	+30 ppm (parts per million)
	2 Mb/s	+50 ppm (parts per million)
	704 kb/s	+50 ppm (parts per million)
-ve Preset	Negative Offset as defined by CCITT :	
	140 Mb/s	-15 ppm (parts per million)
	34 Mb/s	-20 ppm (parts per million)
	8 Mb/s	-30 ppm (parts per million)
	2 Mb/s	-50 ppm (parts per million)
	704 kb/s	-50 ppm (parts per million)
User	User defined Offset in the range ±100 ppm (parts per million).	

PATTERN

Determines the pattern adopted by the generated data and the receiver reference data. Selection between [2^23-1]; [2^15-1]; [ALL ZEROS]; [ALL ONES]; [1010]; [1000] and [16 BIT WORD] is available.

FRAME TYPE

Frame Type is only available with option 005 instruments and when a 2 Mb/s Bit Rate is selected. The choices offered to the user are: [CAS MFM], [NO MFM], [CAS CRC4 MFM] and [CRC4 MFM].

TERMINATION

Determines the Signal In and Signal Out termination to the line terminal equipment. If 704 kb/s or 2 Mb/s is selected, termination selection between [75Ω UNBAL] and [120Ω BAL] is available. If 8 Mb/s; 34 Mb/s or 140 Mb/s is selected the termination is fixed at [75Ω UNBAL].

CODE

Determines the line code of the generated data. Selection between [CMI]; [AMI] and [HDB3] is available but is dependant upon the bit rate selected :

140 Mb/s	CMI only
34 Mb/s	HDB3 only
8 Mb/s	HDB3 or AMI
2 Mb/s	HDB3 or AMI
704 kb/s	HDB3 or AMI

(RESULTS) Display

TEST PERIOD

Determines the type of test period during which the requested measurements are made. Selection between [SINGLE]; [MANUAL] and [TIMED START] is available.

Manual	The test period starts when (RUN/STOP) is pressed and stops when (RUN/STOP) is next pressed.
Single	The test period starts when (RUN/STOP) is pressed and stops when the user specified PERIOD is completed. The test can be stopped at any time by pressing (RUN/STOP).
Timed Start	The test period starts at a user defined START date and time and stops when the user specified DURATION is completed. The test can be stopped at any time by pressing (RUN/STOP).

If a SINGLE or TIMED START is selected. Selection between [1 HOUR]; [24 HOURS]; [72 HOURS]; [7 DAYS] and [USER PROGRAM] is available. [USER PROGRAM] allows the PERIOD to be set in the range 1 to 99 Seconds; 1 to 99 Minutes; 1 to 99 Hours or 1 to 99 Days.

START

Determines the Date and Time at which a TIMED START test begins, in Day, Month, Year, Hour, Minute format.

STORAGE

To enable graphical results and determine the total graphics store capacity select from the following:

OFF - graphics storage is disabled.

[1 MIN RESOL'N] - store capacity is 3 days and 6 hours.

[15 MIN RESOL'N] - store capacity is 45 days.

[1 HOUR RESOL'N] - store capacity is 99 days.

RESULTS DISPLAYED

Determines whether measurement results or the recovered clock frequency is displayed. Selection between [SHORT TERM]; [CUMULATIVE]; [ANALYSIS]; [GRAPHICS] and [FREQUENCY] is available.

DISPLAY (option 005)

When IN-SERVICE MONITORING is selected on instruments fitted with option 005, the RESULTS DISPLAYED field is changed to *DISPLAY*. The following additional results can be displayed when option 005 is fitted, and IN-SERVICE MONITORING is selected: [TROUBLE SCAN]; [BASIC ERROR]; [G.821 ANALYSIS]; [GRAPHICS];[ALARM SECONDS]; [FREQUENCY] and [SPARE BITS]. The following paragraphs list the measurement results displayed for each RESULTS DISPLAYED and DISPLAY selection.

Cumulative — Bit Error Count; Bit Error Ratio; Code Error Count; Code Error Ratio and Elapsed Time results are displayed and continuously updated during the test period.

Analysis — Elapsed Time; Errored Seconds (ES); % Errored Seconds; Error Free Seconds (EFS); % Error Free Seconds; Severely Errored Seconds (SES); % Severely Errored Seconds; Unavailable Seconds (UNAV); % Unavailability; Degraded Minutes (DM); % Degraded Minutes; Code Errored Seconds and LTMER are displayed.

Short Term — Bit Error Count; Bit Error Ratio; Code Error Count and Code Error Ratio results are displayed. When Short Term is selected the results displayed are calculated and updated according to the setting made for SHORT TERM

	PERIOD. A Bar Meter type display gives an indication of the time elapsed since the results were updated. The Bar Meter update rate varies according to the SHORT TERM PERIOD setting.
Short Term Period	Determines the measurement interval and the display update rate. Selection between [1 SECS]; [10 SECS]; [30 SECS]; [100 SECS] and [USER PROGRAM] is available. When [USER PROGRAM] is selected SHORT TERM PERIOD can be set in the range 1 to 100 seconds.
Elapsed Time	ET : The time passed since the start of the test period.
Bit Error Count	BIT EC : Total number of bit errors counted during the measurement interval.
Code Error Count	CODE EC : Total number of code errors counted during the measurement interval.
Bit Error Ratio	BIT ER : Ratio of counted bit errors to the number of clock periods in the measurement interval.
Code Error Ratio	CODE ER : Ratio of counted code errors to the number of clock periods in the measurement interval.
Unavailability	UNAV Seconds : The number of 1 second intervals during which the system was considered "Unavailable". A period of "Unavailability" begins when the Bit Error Ratio in each second is worse than 1×10^{-3} for 10 consecutive seconds. Those 10 seconds are considered "Unavailable". The period of "Unavailability" terminates when the Bit Error Ratio in each second is better than 1×10^{-3} for 10 consecutive seconds. Those 10 seconds are considered "Available". % UNAV : The ratio of 1 second intervals when the system was considered "Unavailable" to the total second count during the test period.

The user can choose to halt the test during periods of signal loss and resume the test when the Signal Loss condition has cleared. SUSPEND TEST ON SIGNAL LOSS is available within the ANALYSIS CONTROL function on the (OTHER) display. Selection of [ON] halts the test during periods of Signal Loss.

Errored Seconds

ES : The number of 1 second intervals containing at least 1 bit error during the "Available" time.

% ES : The ratio of 1 second intervals containing at least 1 bit error during the "Available" time to the total "Available" second count within the measurement interval.

The user can choose to halt the test during periods of signal loss and resume the test when the Signal Loss condition has cleared. SUSPEND TEST ON SIGNAL LOSS is available within the ANALYSIS CONTROL function on the (OTHER) display. Selection of [ON] halts the test during periods of Signal Loss.

Error Free Seconds

EFS : The number of 1 second intervals containing no bit errors during the "Available" time.

% EFS : The ratio of 1 second intervals containing no bit errors during the "Available" time to the total "Available" second count within the measurement interval.

The user can choose to halt the test during periods of signal loss and resume the test when the Signal Loss condition has cleared. SUSPEND TEST ON SIGNAL LOSS is available within the ANALYSIS CONTROL function on the (OTHER) display. Selection of [ON] halts the test during periods of Signal Loss.

Severely Errored Seconds

SES : The number of 1 second intervals having a BER worse than 1×10^{-3} during the "Available" time.

% SES : the ratio of 1 second intervals having a Bit Error Ratio worse than 1×10^{-3} during the

"Available" period to the total "Available" second count within the measurement interval.

The user can choose to halt the test during periods of signal loss and resume the test when the Signal Loss condition has cleared. SUSPEND TEST ON SIGNAL LOSS is available within the ANALYSIS CONTROL function on the (OTHER) display. Selection of [ON] halts the test during periods of Signal Loss.

Degraded Minutes

DM : The number of "Packaged Minutes" having a Bit Error Ratio worse than 1×10^{-6}

A "Packaged Minute" is a grouping of 60 seconds which does not include Severely Errored seconds or periods of Unavailability.

% DM : The ratio of "Packaged Minutes" exhibiting a Bit Error Ratio worse than 1×10^{-6} to the total "Packaged Minute" count within the measurement interval.

The user can choose to halt the test during periods of signal loss and resume the test when the Signal Loss condition has cleared. SUSPEND TEST ON SIGNAL LOSS is available within the ANALYSIS CONTROL function on the (OTHER) display. Selection of [ON] halts the test during periods of Signal Loss.

Code Error Seconds

The number of 1 second intervals containing at least 1 code error.

LTMER

Long Term Mean Error Ratio: The error ratio in available time, not including errors occurring in severely errored seconds.

OPTION 005 ONLY

The following results can be displayed when option 005 is fitted and IN-SERVICE MONITORING selected.

DISPLAY

Trouble Scan	Provides an immediate display in large letters of CODE, FRAME, CRC or REBE

error count, plus STATUS alarms that occur during the current test period. The cumulative error count is displayed at the end of the test period. CRC and REBE error count are only available (at 2 Mb/s) when CRC4 MFM is selected on the SETTINGS page.

Basic Errors

Offers the user the choice of displaying error results for one of the following: [FRAME], [CRC4], [REBE] and [CODE]. [CRC4] and [REBE] are only available if CRC4 MFM Frame Type is selected and [CODE] when a Binary Interface is not selected. The results displayed are as follows:

ERRORS:The number of errors counted in the test period.

EFS: The number of 1 second intervals containing no bit errors during the current test period.

CURRENT ER: Displays the error ratio calculated over the last second.

AVERAGE ER: Displays the cumulative error ratio over the test period.

G.821 Analysis

Provides a complete set of analysis results for FRAME, CRC4 and REBE measurements.

Elapsed Time; Errored Seconds (ES); % Errored Seconds; Error Free Seconds (EFS); % Error Free Seconds; Severely Errored Seconds (SES); % Severely Errored Seconds; Unavailable Seconds (UNAV); % Unavailability; Degraded Minutes (DM); % Degraded Minutes;

	Code Errored Seconds and LTMER are displayed.
ALARM SECONDS	Displays the duration in seconds that the following alarms occur during the test period.
All rates	SIGNAL LOSS, AIS, FRAME LOSS and REMOTE ALARM.
2 Mb/s only	With CAS MFM Frame Type selected on the [SETTINGS] page the following alarms are displayed: CAS MFRAME LOSS, REMOTE MFRAME ALARM, CRC MFRAME LOSS.
Frequency	The recovered clock frequency (FREQ) and the amount the measured frequency is OFFSET from the standard bit rate are displayed. A Bar Meter type display gives an indication of the time elapsed since the frequency measurement was updated. The Bar Meter takes 16 s to complete.
SPARE BITS	Provides a display of NFAS and CAS spare bits (at 2 Mb/s).

GRAPHICS

Provides a graphical display of Bit Error Count versus Time; Error Seconds versus Time or Alarms versus Time. On option 005 instruments Code Error Count; FAS Bit Error Count; CRC4 Error Count; REBE Error Count or Alarms versus time can be displayed. Any two of these can be displayed at one time.

Selection between [TEXT RESULTS]; [ZOOM IN]; [CHANGE UPPER]; [CHANGE LOWER]; [PRINT] and [DEMO] is available.

Note: If you wish to store/plot text or graphics ensure the STORAGE field on the SETTINGS page is set to a resolution of 1MIN, 15MINs or 1 HOUR.

Demo	Produces a demonstration graph as an aid to user understanding.
Change Upper	Allows the upper graph type to be selected.
Change Lower	Allows the lower graph type to be selected.
Print	The graphics display, and a summary of instrument set up and results, are logged on an external HP ThinkJet printer.
Zoom In/Out	Expands or contracts the scale of the graph base. The cursor is moved along the graph base line to the point of interest, using ⇧ and ⇩. When the point of interest is reached, Zoom In/Out is used for more detailed examination of the area of interest.
Text Results	Provides a display of the instrument set-up and a summary of Analysis results. Selection between [STORE STATUS]; [GRAPH RESULTS] and [PRINT] is available.
Graph Results	Returns to the Bar Graph display.
Print	The Text Results display is logged on an external HP ThinkJet printer.
Store Status	Allows the storage of up to nine sets of results. The results can be recalled at a later date by moving the cursor to the required store, using ⇩ and ⇧.
Graph Results	Returns to the bar graph display. The bar graph displayed is constructed from the results in the store marked by the cursor.

Text Results	Refer to the previous description of Text Results given on page 3-19.
Delete Store	Deletes the results in the store marked by the cursor.
Delete All	Prepares for deletion of, the results in all stores. Requires a confirmation [CONFIRM DELETE] before deletion occurs.
Confirm Delete	Completes the deletion started by Delete All.
Abort Delete	Prevents the deletion from taking place if Delete All was selected in error.

Frequency

The recovered clock frequency (FREQ) and the amount the measured frequency is OFFSET from the standard bit rate are displayed. A Bar Meter type display gives an indication of the time elapsed since the frequency measurement was updated. The Bar Meter takes 16 s to complete.

(PRINTER) Display

PRINTER

The measurement results can be logged on the internal printer or on an external RS-232-C Thinkjet printer connected to the rear panel RS232 PRINTER port. Selection between [EXT-RS232] and [INTERNAL] is available. If Option 001, Remote Control, is fitted the measurement results can also be logged on an HP ThinkJet external printer connected to the rear panel HP-IB port. An [EXT-HPIB] selection is added to the menu.
Note: If option V01 is fitted and [EXT-RS232] is selected, then additional choices of [HP-MODE] or [VRM] are given.

PRINTING

Disables or enables the logging of measurement results on the selected printer. Selection between [OFF] and [ON] is available.

- OFF — Results are only logged on the selected printer when (PRINT NOW) is pressed.
- ON — Results are logged on the selected printer on a regular basis defined by the PRINT PERIOD selection.

PRINT PERIOD

Determines when the measurement results are logged on the selected printer. Selection between [OFF]; [5 MINUTE]; [1 HOUR]; [24 HOURS]; [15 MIN NESTED] and [USER PROGRAM] is available.
Note: Print Period is fixed at OFF on option 005 instruments when an In-Service Monitoring Application is selected.

- 5 Minute — The results, determined by the RESULTS PRINTED selection, are logged at 5 minute intervals during the test period and a complete set of cumulative results are logged at the end of the test period.

	1 Hour	The results, determined by the RESULTS PRINTED selection, are logged at 1 hour intervals during the test period and a complete set of cumulative results are logged at the end of the test period.
	24 Hours	The results, determined by the RESULTS PRINTED selection, are logged at 24 hour intervals during the test period and a complete set of cumulative results are logged at the end of the test period.
	15 Min Nested	Cumulative and period results are logged at 15 minute intervals and a complete set of period results are logged at 1 hour intervals and 24 hour intervals. A complete set of cumulative results are logged at the end of the test period.
	User Program	The results, determined by the RESULTS PRINTED selection, are logged at intervals determined by the user in the range 2 to 99 Minutes or 2 to 99 Hours and a complete set of cumulative results are logged at the end of the test period.
RESULTS PRINTED	Determines which results are printed at the intervals determined by the PRINT PERIOD selection. Selection between [ALL] and [SELECTED] is available.	
	All	A complete set of cumulative and period results are logged on the selected printer at the end of each PRINT PERIOD during the test period and a complete set of cumulative results are logged at the end of the test period.
	Selected	Allows a choice of, conditions under which results are logged on the selected printer, the printed result content, and the form of the result.

WHEN

Determines the condition under which [SELECTED] results will be logged. Selection between [ALWAYS] and [BIT EC>0] is available.

Always	The [SELECTED] results are logged at intervals determined by the PRINT PERIOD selection.
Bit EC>0	Results are logged on the printer at intervals determined by the PRINT PERIOD. If the Bit Error Count is 0 during the PRINT PERIOD the **NO BIT ERRORS** message is printed. If the Bit Error Count is greater than 0 during the PRINT PERIOD the selected results are logged.

CONTENT

Provides the user with the choice of selecting the type of results logged, and whether the results logged are based on the PRINT PERIOD selection, or the total test period time or both.

The type of results that can be logged are; [BER]; [ANALYSIS] and [BER & ANALYSIS], they are as follows.

BER	Bit Error Ratio results are logged : Bit Error Count, Code Error Count, Bit Error Ratio, Code Error Ratio and Code Errored Seconds.
Analysis	A complete set of Analysis results are logged.
BER & ANAL	Bit Error Ratio and Analysis results are both logged.

The time interval selections over which logged results are based are as follows:[PERIOD], [CUMULATIVE] and [PER & CUMUL].

Period	The results logged are based on the PRINT PERIOD. At the end of each PRINT PERIOD the error counters are reset and a new measurement is started.
Cumulative	The results logged are based on the time elapsed since the start of the test period. At the end of each PRINT PERIOD the error counters are unmodified and the measurement continues. Any errors which occur within succeeding PRINT PERIOD's are added to the count.
PER & CUMUL	Both Period and Cumulative results are logged.

PRINT ERROR SECONDS

Allows the occurrence of each Error Second to be logged on the selected printer. Selection between [OFF]; [BIT]; [CODE] and [BIT & CODE] is available.

Off	Error seconds are not logged.
Bit	Each bit error second is logged on the printer. If 10 consecutive bit error seconds are received, logging will be inhibited until 10 consecutive bit error free seconds occur.
Code	Each code error second is logged on the printer. If 10 consecutive code error seconds are received, logging will be inhibited until 10 consecutive code error free seconds occur.
Bit & Code	Both bit error seconds and code error seconds are logged on the printer. If 10 consecutive error seconds are received, logging will be inhibited until 10 consecutive error free seconds occur.

Option 005 For option 005 instruments the following print error second choices are available:
In - Service Application at 140, 34 or 8 Mb/s: -[FRAME] or [CODE]
In - Service Application at 2 Mb/s and with [CRC MFM] Frame Type selected: [CODE], [FRAME], [CRC], [REBE], [FRM_CRC], [FRM_REBE], [FRM_CRC_REBE] and [CRC_REBE].

PRINT AT END OF TEST

ALL RESULTS are always logged at the end of the test period assuming the selected printer is enabled : PRINTING [ON].

PRINTER BAUD RATE

The Printer BAUD RATE and HANDSHAKE fields are displayed when the Printer field is set to [EXT-RS232]. Determines the rate of data transfer between the HP 37721A and the HP RS-232-C Thinkjet printer. This setting must match the setting on the HP Thinkjet printer. Selection between [1200 BAUD]; [2400 BAUD] and [9600 BAUD] is available.

HANDSHAKE

The HP Thinkjet printer handshake must be set to Xon/Xoff to ensure efficient transfer of data as the HP 37721A handshake is fixed at Xon/ Xoff. If the printer buffer is nearly full the Xoff signal is sent to the HP 37721A to halt data transfer. When the printer buffer is ready to accept more data the Xon signal is sent and data transfer will resume.

(OTHER) Display

STORED SETTINGS	Allows the storage in non-volatile memory of up to nine sets of front panel settings (1 to 9). Setting 0 is reserved for Factory Default Settings. Stored Settings can be recalled from settings 0 to 9 but storage is only allowed in settings 1 to 9.
STORED SETTING NUMBER	Allows selection of the settings number, 0 to 9.
LOCK	Prevents accidental corruption of the stored settings. Selection between [OFF] and [ON] is available. Off — Settings can be recalled, saved or titled. On — Settings can be recalled only.
ACTION	Determines the Stored Setting action desired. Selection between [OFF]; [RECALL] and [SAVE] is available.
TITLE	Allows each set of stored settings to be titled for easy identification using JUMP; NEXT CHARACTER; PREVIOUS CHARACTER; ◀ and ▶. To access these keys set the cursor on the ACTION field then press the (↵) key.
TIME & DATE	The Time and Date function clock, once set, provides all the HP 37721A timing and will continue to run even if the HP 37721A line voltage is removed. Time and Date information is used in the logging of certain occurrences on the printer, for example, Start of Test Period; Occurrence of Errored Second ; Pattern Loss.
CLOCK MODE	Allows the Time and Date settings to be altered if required. Selection between [RUN] and [SETUP] is available.
TIME	Displays the current time when CLOCK MODE [RUN] is selected. The displayed time is modified using the display softkeys when CLOCK MODE [SETUP] is selected and updated when [RUN] is next selected.

DATE

Displays the current date when CLOCK MODE [RUN] is selected. The displayed date is modified using the display softkeys when CLOCK MODE [SETUP] is selected and updated the next time [RUN] is selected.

KEYBOARD LOCK

Disables most front panel keys to prevent unauthorized or accidental alteration of the selected settings. Selection between [OFF] and [ON] is available. The following are not affected by KEYBOARD LOCK :

display keys (SETTINGS); (RESULTS); (PRINTER); (OTHER)

cursor keys (⇧); (⇩)

(SHOW HISTORY) (PAPER FEED)

RESULTS DISPLAYED on the results display

KEYBOARD LOCK on the other display

Any of the functions within the [OTHER] display can be viewed but cannot be modified until Keyboard Lock has been removed.

Any other key sequence will result in STATUS: **Change prevented by keyboard lock** appearing on the display.

BEEP ON ERROR

Makes an audible BEEP whenever an error is received. Selection between [OFF]; [BIT]; [CODE] and [BIT & CODE] is available.

Off	Occurrence of an error will not produce an audible BEEP.
Bit	Occurrence of a bit error will produce an audible BEEP.
Code	Occurrence of a code error will produce an audible BEEP.
Bit & Code	Occurrence of a bit error or a code error will produce an audible BEEP.
Option 005	For In-Service Applications an audible beep will occur when an error of the type

chosen from the following selection occurs, if that choice is currently selected.
[FRAME] or [CODE] at 140, 34 or 8 Mb/s.
At 2 Mb/s and with [CRC MFM] Frame Type selected; [CODE], [FRAME], [CRC] [REBE], [FRM_CRC], [FRM_REBE], [FRM_CRC_REBE] or [CRC_REBE].

ANALYSIS CONTROL

Allows the user to choose between continuing the test during periods of Signal Loss or halting the test during periods of Signal Loss and resuming the test when the Signal Loss condition has cleared.

Suspend Test On Signal Loss — When [OFF] is selected testing continues during periods of signal loss. When [ON] is selected testing is halted during periods of Signal Loss and testing resumes when the Signal Loss condition is cleared.

ANALYSIS TYPE — Allows the user to chose between [STANDARD] or [G.821 ANNEX D] analysis.

RESYNC MODE

When making error measurements it is necessary for the HP 37721A internally generated data pattern and the received data pattern to be in synchronization. If synchronization is lost during the test period then Resynchronization is necessary. Selection between [AUTOMATIC] and [MANUAL] is available.

On option 005 instruments if an In-Service Application is selected RESYNC is fixed at [AUTOMATIC].

Automatic — Sync Searches will be carried out until synchronization (Sync Gain) is achieved.

When Sync Gain has been achieved, < 6 errors in 96 bits, the Pattern Sync status indicator will be lit and the received data is monitored for Sync Loss, BER > 1/16 in 100 ms period (1s period for option

004 instruments operating at binary clock rates <10 kHz).

When Sync Loss is detected, a Sync Search is initiated, and Sync Loss indicated by extinguishing the Pattern Sync status indicator.

Sync Search will be repeated if necessary until Sync Gain is achieved. If a burst of errors sufficient to fulfil the Sync Loss criteria occurs, then all the data received during the Sync Loss/Sync Gain interval will be counted as bit errors and will be included in the measurement result.

Manual — When (MANUAL RESYNC) is pressed Sync Searches are carried out until Synchronization (Sync Gain) is achieved.

When Sync Gain is achieved the measurement will continue, irrespective of the measured Bit Error rate, until (MANUAL RESYNC) is pressed.

This is of benefit when making measurements on a system suffering irregular, long bursts of Errors.

`OPTIONS` — Lists the options available and indicates which, if any are, fitted to the instrument.

`SELF TEST` — This is a service tool. Refer to the HP 37721A Service Manual for detailed information.

`CALIBRATION` — This is a service tool only. Refer to the HP 37721A Service Manual for detailed information.

Warning

THE PROCEDURES CONTAINED WITHIN THE CALIBRATION FUNCTION SHOULD ONLY BE CARRIED OUT BY SUITABLY TRAINED SERVICE PERSONNEL AWARE OF THE HAZARDS INVOLVED.

REMOTE CONTROL (Option 001 Only)	Provides an HP-IB interface and an RS-232-C interface.
REMOTE CONTROL PORT	Determines which remote control port is active. Selection between [RS232] and [HPIB] is available.
HPIB	The HP 37721A can be controlled by an HP-IB controller connected to the rear panel HP-IB port.
RS232	The HP 37721A can be controlled by a RS-232-C controller connected to the rear panel RS-232-C Modem port.
ADDRESS	Allows the HP-IB address to be set in the range 0 to 30. The Address is factory preset to 05.
SRQ STATE	Indicates the SRQ state of the HP 37721A.
CONNECTION	Determines the type of connection between the RS-232-C controller and the HP 37721A. Selection between [HARDWIRED]; [MODEM] [HALF DUPLEX] and [MODEM] [FULL DUPLEX] is available.
Hardwired	Wire link between the terminal (controller) and the HP 37721A.
Modem Half Duplex	A Modem is connected between the terminal (controller) and the HP 37721A. Data can be transferred in both directions but in only one direction at a time. The modem and terminal settings must also be Half Duplex.
Modem Full Duplex	A modem is connected between the terminal (controller) and the HP 37721A. Data can be transferred in both directions at the same time. The modem and terminal settings must also be Full Duplex.

Xon/Xoff

To ensure efficient transfer of data the HP 37721A setting of Xon/Xoff must be the same as the modem setting. Xon/Xoff is part of the data transfer "protocol". Selection between [OFF]; [RX]; [TX] and [RX & TX] is available. Xon/Xoff is not applicable if [MODEM] [HALF DUPLEX] is selected.

ENQ/ACK

To ensure efficient transfer of data the HP 37721A setting of ENQ/ACK must be the same as the modem setting if Connection [MODEM] is selected or the same as the terminal (controller) if Connection [HARDWIRED] is selected. ENQ/ACK forms part of the data transfer protocol. Selection between [ON] and [OFF] is available.

SPEED

Determines the rate at which data is transferred between the HP 37721A and the RS-232-C terminal (controller) or modem. The terminal (controller) or modem must be set to the same baud rate setting. Selection between [300 Baud]; [600 Baud]; [1200 Baud]; [1800 Baud]; [2400 Baud]; [4800 Baud]; [9600 Baud] and [SELECTED BY MODEM] is available.

Selected By Modem

Some modems have the capability to operate at two baud rates. Normal operation is at the [HIGH] rate, say 2400 Baud. If the circuit quality is poor and causing errors the modem can be switched to the [LOW] rate, say 600 Baud. Although slower the LOW rate will be less error sensitive. Selection between [300 Baud]; [600 Baud]; [1200 Baud]; [1800 Baud]; [2400 Baud]; [4800 Baud]; and [9600 Baud] is available for HIGH and LOW but LOW can never be set greater than HIGH.

PARITY	Allows error detection and correction to take place on the data transferred between the HP 37721A and the terminal (controller) or modem. Each Byte of data contains 1 Start Bit; 7 Data Bits; and 1 or 2 Stop Bits. The Parity setting must match the setting on the terminal (controller) or modem. Selection between [ODD]; [EVEN]; [0's] and [1's]; is available.
STOP BITS	Each Byte of data contains a Start Bit; 7 Data Bits; and 1 or 2 Stop Bits. Selection between [1] and [2] Stop Bits is available.
ERROR NUMBER	If a remote control error occurs the relevant error number appears on the display. A display of +0 is normal.

A

Printer Messages

Internal Printer

Result Headers and Results are logged to the Internal printer when:

- (PRINT NOW) is pressed.
- a Test is started, during the Test and at the end of the Test, if Printer [INTERNAL] is selected on the (PRINTER) display.

Printed Headers		Meaning
Print Demanded 29 Sep 90	10:35:14	Header printed when (PRINT NOW) is pressed. Results are also printed.
Measurement Started 17 Oct 90	23:35:27	Start of Test period
Hewlett Packard HP 37721A Instrument Setup		
Application	Out-of-Service	(SETTINGS) display
BitRate	140 Mb/s	(SETTINGS) display
Frame Type	CAS CRC4	(SETTINGS) display (Opt 005 only)
Pattern	2^{23}-1	(SETTINGS) display
Tx Clk Offset	+50 ppm	(SETTINGS) display (Opt 003 only)
Termination	75 Ω Unbal	(SETTINGS) display
Interface	Coded	(SETTINGS) display
Code	CMI	(SETTINGS) display
Tx Clk Thrhld	ECL	(SETTINGS) display (option 004 only)
Tx Data Thrhd	ECL	(SETTINGS) display (option 004 only)
Rx Clk Thrhld	ECL	(SETTINGS) display (option 004 only)
Rx Data Thrhd	ECL	(SETTINGS) display (option 004 only)
Print Period	1 Hour	(PRINTER) display

Printed Headers		Meaning
Power Failure 17 Oct 90	23:37:44	Date and Time power failed
Power Restored 17 Oct 90	23:37:49	Date and Time power was restored
Date	18 Oct 90	Date change during the test
End of Period	00:35:27	End of print period
End of Test 18 Oct 90	11:35:27	Date and Time the test terminated
Cumulative Results :		Results accumulated since the start of the test
Period Results :	15 min	Results accumulated during the print period
Analysis		Analysis results - Bit Errors only

Printed Results		Meaning
Cumulative Results :		Results accumulated since the start of the test
Bit	Code	Bit Error and Code Error headings
EC n.nnnE+nn	n.nnnE+nn	Bit Error Count & Code Error Count
ER n.nnnE+nn	n.nnnE+nn	Bit Error Ratio & Code Error Ratio
ES -	n.nnnE+nn	Code Errored Seconds
Analysis		Analysis results - Bit Errors only
ES n.nnnE+nn	n.nnnE+nn%	Errored Seconds
EFS n.nnnE+nn	n.nnnE+nn%	Error Free Seconds
SES n.nnnE+nn	n.nnnE+nn%	Severely Errored Seconds
US n.nnnE+nn	n.nnnE+nn%	Unavailable Seconds
DM n.nnnE+nn	n.nnnE+nn%	Degraded Minutes
LTMER		Long Term Mean Error Ratio

Option 005 Printed Results

On option 005 instruments cumulative results of Frame CRC4 and REBE are printed. Refer to page A-9 for an example of the results printed.

Printed Results		Meaning
Signal LOSS	11:34:29	Signal Loss has occurred
Signal GAIN	11:34:31	Signal Loss has cleared
BES n	11:35:19	Bit Error Second containing n errors
BES n	11:35:20	Bit Error Second containing n errors
BES n	11:35:21	Bit Error Second containing n errors
BES n	11:35:22	Bit Error Second containing n errors
BES n	11:35:23	Bit Error Second containing n errors
BES n	11:35:24	Bit Error Second containing n errors
BES n	11:35:25	Bit Error Second containing n errors
BES n	11:35:26	Bit Error Second containing n errors
BES n	11:35:27	Bit Error Second containing n errors
BES n	11:35:28	Bit Error Second containing n errors
SQUELCHED	11:35:29	10 consecutive bit error seconds have occurred - no results will be printed until an error free second occurs
UNSQUELCHED	11:37:15	An error free second has occurred since Squelch condition occurred - normal printing of results will resume
Pattern LOSS	11:38:00	Pattern Sync has been lost
Pattern GAIN	11:38:22	Pattern Sync has been regained
AIS	11:41:58	AIS alarm condition has occurred
AIS CLEAR	11:42:01	AIS alarm condition has cleared
Frame LOSS		Frame has been lost (option 005 only)

External Printer

Result Headers and Results are logged to the External printer when :

- (PRINT NOW) is pressed.
- a Test is started, during the Test and at the end of the Test, if Printer [EXT - RS232] or [EXT - HPIB] (Option 001 only) is selected on the (PRINTER) display.

The header printed at the start of a test is shown below.

```
=========================================================================
                      Hewlett Packard HP37721A
                         Instrument Setup
 Link Identification :                        Bit Rate      : 2 Mb/s
 Generator Location  :                        Pattern       : 2^15-1
 Receiver  Location  :                        Tx Clk Offset : OFF
                                              Termination   : 75ohm Unbal
                                              Interface     : Coded
                                              Code          : HDB3
 MEASUREMENT STARTED : 28 Mar 89  10:14:38    Print Period  : 5 Min
-------------------------------------------------------------------------
  TIME    |  EVENT  | ALARM |                RESULTS
          |         | S A P |   Bit  EC     Bit  ER     Bit  ES    %Bit ES
          |         | i I a |-----------------------------------------------
          |         | g S t |   Code EC     Code ER     Code ES      LTMER
          |         | n   t |-----------------------------------------------
          |         | a   e |       EFS         SES         DM         UNAV
          |         | l   r |-----------------------------------------------
          |         |     n |      %EFS        %SES        %DM        %UNAV
=========================================================================
```

Other Result Headers are similar to those logged to the Internal printer :

- Print Demanded
- Power Failure
- Power Restored - Power Return
- Data Change
- End of Print Period
- End of Test - Measurement Complete

The Measurement Complete header and a set of Cumulative results are shown below.

MEASUREMENT COMPLETE : 28 Mar 89 10:18:17

	Cum Res		Bit EC	Bit ER	Bit ES	%Bit ES
			0	0	0	0.00000
			Code EC	Code ER	Code ES	LTMER
			0	0	0	0
			EFS	SES	DM	UNAV
			218	0	0	0
			%EFS	%SES	%DM	%UNAV
			100	0.00000	0.00000	0.00000

Other Results				Meaning
10:45:13	Alarm	P	Pattern Loss	
10:45:13	Alarm	S	Signal Loss	
10:45:14	Bit ES	S P	119765	Number of errors
10:45:15	Bit ES	S P	186789	Number of errors
10:45:15	Alarm	-	Signal Gain	
10:45:15	Alarm	-	Pattern Gain	
10:46:22	Bit ES	185		Number of errors
10:46:23	Bit ES	67		Number of errors
10:46:24	Bit ES	4284		Number of errors
10:46:25	Bit ES	15		Number of errors
10:46:26	Bit ES	892		Number of errors
10:46:27	Bit ES	309		Number of errors
10:46:28	Bit ES	185		Number of errors
10:46:29	Bit ES	85		Number of errors
10:46:30	Bit ES	23		Number of errors
10:46:31	Bit ES	10999		Number of errors
10:46:32	SQUELCH			10 consecutive Bit ES
10:46:41	UNSQUELCH		Errored Seconds : 9 Bit Errors : 10459	Error Free second

Option 005 Instruments External Printer Headers

The following figures give examples of the headers printed at the start and end of a test. The Measurement Complete header shows a set of cumulative results.

```
=============================================================================
                         Hewlett Packard HP37721A
                             Instrument Setup
 Link Identification :                              Bit Rate      : 2 Mb/s
 Generator Location  :                              Frame    : CAS MFM
                                                    Termination   : 75ohm Unbal
                                                    Interface     : Coded
                                                    Code          : HDB3
 MEASUREMENT STARTED : 28 Mar 89  10:34:53          Print Period  : OFF
-----------------------------------------------------------------------------
  TIME   |  EVENT  | ALARM |                   RESULTS
         |         | S A F |  Frame EC    Frame ER    Frame ES   %Frame ES
         |         | i I r |-------------------------------------------------
         |         | g S a |   Code EC     Code ER     Code ES       LTMER
         |         | n   m |-------------------------------------------------
         |         | a   e |       EFS         SES          DM        UNAV
         |         | l     |-------------------------------------------------
         |         |       |      %EFS        %SES         %DM       %UNAV
=============================================================================
```

MEASUREMENT COMPLETE : 28 Mar 89 10:45:32

	Frame Cum Res		Frame EC: 0	Frame ER: 0	Frame ES: 3	Frame %ES: 10.00000
			Code EC: 91	Code ER: 1.481E-06	Code EFS: 25	LTMER: 0
			EFS: 28	SES: 3	DM: 0	UNAV: 0
			%EFS: 10.00000	%SES: 10.00000	%DM: 0.00000	%UNAV: 0.00000
	CRC Cum Res		CRC EC: 0	CRC ER: 0	CRC ES: 3	CRC %ES: 10.00000
						LTMER: 0
			EFS: 28	SES: 3	DM: 0	UNAV: 0
			%EFS: 90.00000	%SES: 10.00000	%DM: 0.00000	%UNAV: 0.00000
	REBE Cum Res		REBE EC: 0	REBE ER: 0	REBE ES: 3	REBE %ES: 10.00000
						LTMER: 0
			EFS: 28	SES: 3	DM: 0	UNAV: 0
			%EFS: 90.00000	%SES: 10.00000	%DM: 0.00000	%UNAV: 0.00000

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