9

HEWLETT PACKARD

HP 37721A
Digital Transmission Analyzer
Calibration Manual

WIN AN HP CALCULATOR!

Fill in the Reader Comment Card supplied opposite; return it to HP and you could win an HP Calculator.

Every three months, all returned cards will be entered into a free prize draw for either an HP Scientific or HP Business Calculator.

Note

When you fill in the card, remember to tick the box showing which type of calculator you would prefer if you win.

Hewlett-Packard reserves the right to withdraw this offer at any time.

Reader Comment Card

HP Product No. **Manual Part No.**

We welcome your evaluation of this manual. Your comments and suggestions help us improve our publications.

Please circle one number for each.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
• The manual is well organized.	1	2	3	4	5
• I can find the information I want.	1	2	3	4	5
• The index is thorough.	1	2	3	4	5
• I can easily understand the instructions and procedures.	1	2	3	4	5
• The instructions are complete.	1	2	3	4	5
• The manual is clearly written.	1	2	3	4	5
• The concepts and vocabulary are easy to understand.	1	2	3	4	5
• The examples are clear and useful.	1	2	3	4	5
• The manual contains enough examples.	1	2	3	4	5
• The illustrations are clear and helpful.	1	2	3	4	5
• The manual contains enough illustrations.	1	2	3	4	5
• The layout and format enhance the manual's usefulness.	1	2	3	4	5
• The information in the manual is accurate.	1	2	3	4	5
• The manual, taken as a whole, is a good learning tool.	1	2	3	4	5
• The anticipated quality of the documentation influences my first time purchase decision.	1	2	3	4	5
• The quality of this manual would influence any repeat purchase decisions.	1	2	3	4	5
• This manual meets my overall expectations.	1	2	3	4	5

Please write additional comments, particularly if you disagree with a statement above. Use additional pages if you wish. The more specific your comments, the more useful they are to us.

Comments: _____

_____

_____

Name: _____ **Title:** _____

Company: _____

Address: _____

_____ **Postcode:** _____ **Phone:** _____

If I am successful in the free draw, please supply me with an:

☐ HP Business Calculator ☐ HP Scientific Calculator (Tick one)

Tape Here Please do not staple Tape Here

Fold Here

Affix
postage
stamp
here

Hewlett-Packard Ltd

Queensferry Telecommunications Division

South Queensferry

West Lothian

Scotland

EH30 9TG

ATTN: PRODUCT SUPPORT DEPT

HP 37721A Digital Transmission Analyzer

Calibration 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 relevant section of this manual.

HP Part No. 37721-90018
Microfiche Part No. 37721-90043
Printed in U.K. October 1992

WARRANTY

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environment specifications for the products, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility and to the calibration facilities or other International Standards Organization members.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

WARNING

READ THE FOLLOWING NOTES BEFORE INSTALLING OR SERVICING ANY INSTRUMENT.

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

Notice

The information contained in this document is subject to change without notice.

Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

Printing History

First Edition May 1991
Second Edition October 1992

Contents

Figures

Tables

1

General Information

This section contains general information concerning the HP 37721A Digital Transmission Analyzer.

On the title page of this manual, below the manual part number, is a Microfiche part number. This number can be used to order this manual in 4 × 6-inch microfilm transparencies, each transparency contains up to 96 photo-duplicates of the manual pages. The Microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

SPECIFICATIONS

SAFETY CONSIDERATIONS

INSTRUMENTS COVERED BY MANUAL

OPTIONS

ACCESSORIES

Specifications

The instrument specifications are given on pages 1-7 to 1-9. These specifications are the performance standard or limits, against which the instrument is tested.

The recommended Test Equipment required to carry out the Performance Tests is listed in Table 1-1.

Since the Service Manual is an Option, the Performance Tests are contained in Section 3 of this manual.

Safety Considerations

The HP 37721A Digital Transmission Analyzer is a Safety Class 1 (IEC) instrument. This instrument has been designed according to international safety standards. The instrument and manuals should be reviewed for safety markings and instructions before operation.

This manual contains information, cautions and warnings which must be followed by the user, to ensure safe operation and retain the instrument in a safe condition.

Refer To Service Manual : This symbol on the instrument means the user must refer to the instrument Service Manual to protect the instrument from damage.

Protective Earth Ground : Indicates protective earth ground terminal of the ac power source on the instrument. All exposed metal surfaces on the instrument must connect to a protective earth ground terminal.

Frame or Chassis Terminal : This symbol identifies a terminal that is normally common to all exposed metal surfaces on the instrument.

Warning

THE WARNING SIGN DENOTES A HAZARD TO THE OPERATOR. IT CALLS ATTENTION TO A PROCEDURE, PRACTICE, OR THE LIKE, WHICH IF NOT CORRECTLY PERFORMED OR ADHERED TO, COULD RESULT IN INJURY OR LOSS OF LIFE. DO NOT PROCEED BEYOND A WARNING SIGN UNTIL THE INDICATED CONDITIONS ARE FULLY UNDERSTOOD AND MET.

Caution

The CAUTION sign denotes a hazard to the instrument. It calls attention to an operating or maintenance procedure, practice, or the like, which if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Instruments Covered By Manual

Attached to the rear panel of the instrument is a serial number plate. The serial number plate has a four digit serial prefix, a reference letter denoting country of origin (U = United Kingdom) and a five digit serial number. The serial prefix is the same for all identical instruments, it changes only when a change is made to the instrument. The serial number is unique to each instrument and should be quoted in all correspondence with Hewlett-Packard, especially when ordering replacement parts.

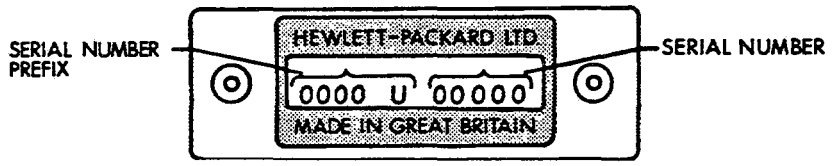

Figure 1-1. Serial Number Plate

Options

The Options available in the HP 37721A Digital Transmission Analyzer allow the instrument to be configured to fit a wide range of applications. The Options available are :-

Option 001	Remote Control :-Provides a Remote Control capability via HP-IB or RS-232-C interfaces.
Option 002	Multiple Outputs :- Provides an additional three data outputs phase delayed with respect to the SIGNAL OUT data, for multiplexer testing.
Option 003	Frequency Offset :- Permits a +ve or -ve Offset to be applied to each of the standard bit rates in the range ± 100 ppm for Clock Offset Tolerance testing.
Option 004	Binary Interfaces :-Provides binary interfaces at the standard bit rates of 704 kbit/s, 8448 kbit/s, 34368 kbit/s and 139264 kbit/s.

Option 005	Frame Analysis :- Provides detection of the Frame Alignment Signal (FAS errors) to provide basic in-service monitoring at the selected rate.
Option 910	Provides an additional set of Operating and Calibration manuals.
Option 915	Provides a Service manual.
Option 916	Provides an additional Remote Control Manual
Option H01	Includes Options 001 and 003. The Graphics capability is not fitted.

Accessories

The following accessories are supplied with the HP 37721A Digital Transmission Analyzer :-

Power Cable

Spare Roll of Printer Paper - 9270-1299

RS-232-C Loopback connectors (2 Off) - 5060-4462

The following accessories are available but are not supplied with the HP 37721A Digital Transmission Analyzer :-

Carrying Bag - HP 15910A

Transit Case - HP 15911A

Isolator - HP 15507A

Impedance Converter - HP 15508C

Cable - HP 15512A (0.9 m (3ft) test cable with two Siemens 3-pin male connectors.

Cable - HP 15525A (1.2m (4ft) coaxial test cable with two BNC unbalanced 75 ohm connectors.

Measurements

Out-of-Service performance analysis

Errors
Bit, code, error ratio

G.821 error analysis (including Annex D)
Severely errored seconds
Percent severely errored seconds
Errored seconds
Percent errored seconds
Error-free and percent error-free seconds
Unavailability and percent unavailability
Unavailable seconds
Degraded minutes
Percent degraded minutes
Code error seconds

Alarms
Alarms and LED display of:
AIS, signal loss, pattern sync loss, power fail (no LED)

LED display of:
Errors present, signal present, pattern sync gain

Received frequency
Offset from internal clock rate (ppm)

In-service frame error analysis (Optional)

Errors (all rates)
Frame bit error count and ratio
Code error count and ratio (not 140 Mb/s)
CRC4 (2 Mb/s only)
REBE (E-bits) count (2 Mb/s only)

G.821-type analysis
On frame bit errors (all rates)
On CRC errors (2 Mb/s only)

Spare bit display: At all rates

Alarms
All rates: frame loss, remote alarm;
2 Mb/s only: CAS multiframe loss, CRC multiframe loss, remote multiframe alarm.

All measurements are simultaneous.

HP 37721A Specifications

Bit rates: 704 kb/s, 2.048, 8.448, 34.368, 139.264 Mb/s.
Frequency offset: Up to ± 100 ppm (Option 003).
Interfaces: Meet CCITT G.703.
Connectors: BNC 75 ohm unbalanced, 3-pin Siemens 120 Ω balanced.

Test patterns

PRBS: 2^{15}-1 at 704, 2048 and 8448 kb/s; 2^{23}-1 at 34.368 and 139.264 Mb/s (CCITT O.151).
Word: User-defined 16-bit word; all-ones; all-zeros; 1010; 1000.

Test period: Manual; single fixed duration: 1 hour, 24 hours, 72 hours, 7 days; user-defined: 1 to 99 seconds, minutes, hours, days.
Delayed start: Single test period starts at a preset time.
Real- time clock: Date, time and elapsed test time.

Transmitter

Clock timing Internal: 2.048, 8.448, 34.368, 139.264 Mb/s.
Recovered (loop timed): From 704 or 2048 kb/s receiver input.
External: To 52 MHz (not CMI) (option 004).

Output
704 kb/s, 2.048 Mb/s: HDB3 or AMI balanced/unbalanced.
8.448 Mb/s: HDB3 or AMI unbalanced.
34.368 Mb/s: HDB3/RZ unbalanced.
139.264 Mb/s: CMI unbalanced.

Bit error add: 1 in 10^3 or single error.

Receiver

Input: 704 kb/s, 2.048, 8.448, 34.368 and 139.264 Mb/s ±100 ppm.
Line codes: As transmitter.
Autosetup: Bit rate, code, test pattern, and level of an incoming signal. Jitter tolerance: To CCITT Rec G.823.

Synchronization: Sync loss when BER ≥ 1:16 over 100 ms. Sync gain when BER < 1:16 or when manual resync key pressed.

Equalization: To CCITT Rec G.703.
Monitor point compensation:
704 kb/s, 2.048, 8.448 Mb/s: 26 to 30 dB; 34.368, 139.264 Mb/s: 26 dB.

Graphics and printing

Graphic display or printout
Barchart (results versus 60 time periods) for current or stored measurement period. Showing: bit error count, error seconds; power fail, signal loss and AIS alarms (optional code, frame bit, and CRC errors; in-service alarms).
Bar resolution: 1, 15, 60 minutes.

Printer and remote control
Internal: 24-column thermal printer.
External: 80-column HP ThinkJet (RS-232-C) printer (or HP-IB with option 001).
Connector: 25-pin female RS-232-C.
Printing: Results, time, date and instrument control settings.
Print triggers: Power up, manual, start of test period, turning printer on in test period, end of print period, any alarm or error second, start of new day.
Print period: 5 minutes, 1 hour, 24 hours, 15 minutes nested; user-defined (2 to 99 min or 2 to 99 hours).

General

Dimensions mm (inch): 190 (7.5) high, 365 (14.5) wide, 355 (14.9) deep including front panel cover.
Weight: 8.0 kg (17.6 lb).
Supply: 90 to 260 Vac, 60 VA, 48 to 66 Hz.
Temperature: 0 to +50°C operating, -20 to +70°C storage.

Options

Remote control (Option 001)

HP-IB or full duplex RS-232-C remote control via a terminal or a computer; results printed on external HP ThinkJet (HP-IB) printer.

Multiple outputs (Option 002)

Provides three additional output signals on back panel (BNC connectors). Specifications same as for unbalanced signal output. Bit delay: Relative to main output:

Rate (kb/s)	Output		
	#2	#3	#4
704, 2048, 8448, 34368	4	8	12
139264	0	0	0

Frequency offset (Option 003)

Provides a variable positive or negative frequency offset from the standard bit rates.

User-defined: Maximum ± 100 ppm at all rates (1 ppm resolution).
Fixed: CCITT G.703.

Binary interfaces (Option 004)

Bit rates
Internal: 704 kb/s, 2.048, 8.448, 34.368 and 139.264 Mb/s.
External: 1 kb/s to 168.5 Mb/s (using transmitter external clock input).

External clock input threshold:
TTL, ECL, ground, auto.
Level: Nominal TTL (50 MHz max); ECL (168.5 MHz max).
Connectors: 75 ohm unbalanced BNC.

Transmitter

Binary clock and data outputs
Rate: 20 kb/s to 168.5 Mb/s (with external clock input).
Impedance: 75 ohms (TTL); nominal low, unbalanced to ground (ECL).
External load: 75 ohm to ground (TTL); -2V (ECL).
External clock input: 168.5 MHz (max).

Receiver

Binary clock and data inputs
Rate: 20 kb/s to 168.5 Mb/s
Impedance: 75 ohm to ground (TTL); -2V (ECL) unbalanced.
Threshold: TTL, ECL, ground, auto (clock only).

Option 004 cannot be used with 002.

Frame analysis (Option 005)

Framing
2 Mb/s: Meets CCITT Rec. G.704: no multiframe, CAS multiframe, CRC4 multiframe, CAS and CRC4 multiframe.
8 Mb/s: Meets CCITT G.742. **34 and 140 Mb/s:** Meets CCITT G.751.

Option 005 cannot be used with 002.

Hewlett-Packard manufactures the HP 37721A under a quality system approved to the international standard ISO 9002 (BSI Registration Certificate No FM 10987).

Table 1-1. List Of Recommended Test Equipment

Instrument Type	Critical Specification	Suggested Model	Use
Oscilloscope	Bandwidth 275 MHz; Dual Channel; 1 MΩ and 50 Ω I/P Termination	HP 1725A	T
Oscilloscope	Bandwidth 1 GHz; 50 Ω I/P Termination	HP 54100D	P,A,T,O
Frequency Counter	DC to 170 MHz with Time Interval capability	HP 5316A	P,T,O
Digital Voltmeter	1mV Resolution; DC	HP 3435A	P,T
Signature Analyzer	Unique	HP 5005A	T
Bal/Unbal Converter	120 Ω to 75 Ω	HP 15508C	P
Cable	Impedance 75 Ω	HP 15525A	P
Cable	Impedance 120 Ω	HP 15521A	P
Cable	Impedance 75 Ω (90 meters of)		P
Termination	Impedance 75 Ω	HP15522A	P
Transmission Analyzer	Unique	HP 3784A	P
Function Generator	1 kHz to 50 MHz	HP 8116A	P
Signal Generator	20 kHz to 170 MHz	HP 8642A/B	P
Frame Generator	Unique	HP 37729A	P
Blocking Capacitor	0.18 μF	HP 10240B	P

Note

P = Performance Test A = Adjustment T = Troubleshooting
O = Operation Verification

2

Installation

This section contains information and instructions required to prepare the HP 37721A Digital Transmission Analyzer for use. Included in this section are the initial inspection procedures, power and grounding requirements, fuse selection procedure, installation information, operators maintenance and instructions on repackaging for shipment.

INITIAL INSPECTION

PREPARATION FOR USE

OPERATORS MAINTENANCE

HEWLETT-PACKARD INTERFACE BUS

OPERATING ENVIRONMENT

STORAGE and SHIPMENT

Initial Inspection

Warning

TO AVOID HAZARDOUS ELECTRICAL SHOCK, DO NOT PERFORM ELECTRICAL TESTS WHEN THERE ARE SIGNS OF SHIPPING DAMAGE TO ANY PORTION OF THE OUTER ENCLOSURE (COVERS, PANELS, METERS).

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked both mechanically and electrically. Procedures for checking electrical operation are given in Section 3 of this manual. If the contents of the shipment are incomplete, if there is mechanical damage or defect, notify the nearest Hewlett-Packard Office. If the instrument does not pass the electrical performance tests given in Section 3, notify the nearest Hewlett-Packard office. If the shipping container is also damaged, or the cushioning material shows signs of stress, notify the carrier as well as the nearest Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The Hewlett-Packard office will arrange for repair or replacement without waiting for claim settlement.

Preparation For Use

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.

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.

Total power consumption is approximately 360 VA.

Line Voltage Selection

The Line Voltage is selected by the rear panel switch labelled 115 V, 230 V.

Fuse ratings for the two power source settings are given in Table 2-1.

Table 2-1. Fuses

Line Voltage	Fuse Rating	HP Part Number
115V (+10% -22%)	5 A 250 V (Time Delay)	2110-0367
230 V (+10% -18%)	2.5 A 250 V (Time Delay)	2110-0380

Power Cord

The power cord supplied with each instrument varies with the country of destination. Figure 2-1 illustrates the standard power plug and cord configurations that are commonly used. The part number shown beneath each plug is the part number of the appropriate power cord and plug. If the appropriate power cord is not included with the instrument notify the nearest Hewlett-Packard office and a replacement will be provided.

Warning

TO AVOID THE POSSIBILITY OF INJURY OR DEATH, THE FOLLOWING PRECAUTIONS MUST BE FOLLOWED BEFORE THE INSTRUMENT IS SWITCHED ON :-

(a) Note that the protection provided by grounding the instrument cabinet may be lost if any power cable other than the three-pronged type is used to couple the ac line voltage to the instrument.

(b) If this instrument is to be energized via an auto-transformer to reduce or increase the line voltage, make sure that the common terminal is connected to the neutral pole of the power source.

(c) The power cable plug shall only be inserted into a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor (grounding).

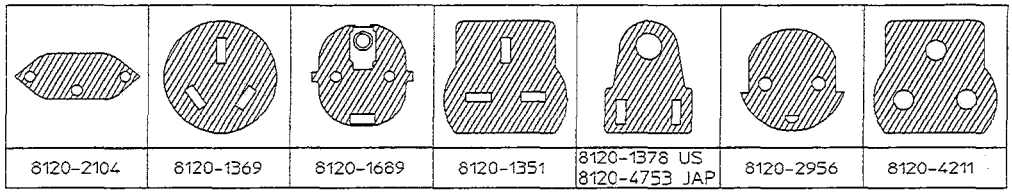

Figure 2-1. Power Cord Part Numbers

Operators Maintenance

Operators maintenance consists of cleaning the air filter associated with the instrument fan. The operator may also replace any defective ac line fuses.

Air Filter

The air filter is attached to the fan from the outside of instrument, for ease of cleaning and replacement. The filter should be removed and cleaned at approximately one monthly intervals, depending upon the operating environment.

To remove the filter; remove the four screws which secure the filter to the rear panel of the instrument.

Wash the air filter mesh in clean soapy water, rinse well and dry before refitting. If the air filter is damaged replace with HP Part Number 03782-60057.

Warning

THE INSTRUMENT SHOULD NOT BE OPERATED WITH THE AIR FILTER REMOVED AND THE FAN BLADES EXPOSED.

Fuse Replacement

Only the ac line fuse located at the rear of the instrument may be replaced by the operator.

Warning

ALL OTHER FUSE REPLACEMENT SHOULD ONLY BE CARRIED OUT BY SUITABLY TRAINED SERVICE PERSONNEL AWARE OF THE HAZARDS INVOLVED.

BEFORE REMOVING THE FUSE THE AC LINE POWER CORD SHOULD BE DISCONNECTED FROM THE POWER SOURCE AND THE OTHER END DISCONNECTED FROM THE INSTRUMENT.

The fuse is removed by inserting a suitable flat bladed tool into the slot in the fuse cap and turning anti-clockwise. The cap and the fuse can then be removed and the fuse changed for another of the correct rating. The fuse ratings and HP part numbers are listed in Table 2-1.

Hewlett-Packard Interface Bus (Option 001 Only)

If Option 001 is fitted, the HP 37721A Digital Transmission Analyzer is connected to the HP-IB by means of an appropriate HP-IB cable.The HP-IB interconnecting cables available are listed in Table 2-2.

Table 2-2. HP-IB Interconnecting Cables

Length	Accessory Number
1 meter	10833A
2 meters	10833B
4 meters	10833C
0.5 meter	10833D

To achieve interface design performance standards, restrictions are placed on the HP-IB system cable lengths. These restrictions allow the bus interface electronics to maintain correct line voltage levels and timing relationships.

When connecting an HP-IB system the following rules should be observed :-

The total HP-IB cable length used must be less than or equal to 20 meters (65.6 feet).

The total HP-IB cable length used must be less than or equal to 2 meters (6 feet) × the total number of devices connected to the bus.

A standard HP-IB connector is provided on the instrument rear panel. The connections and HP-IB logic levels are shown in Figure 2-2. The Mating connector part number is HP 1251-0293 or Amphenol 57-30240.

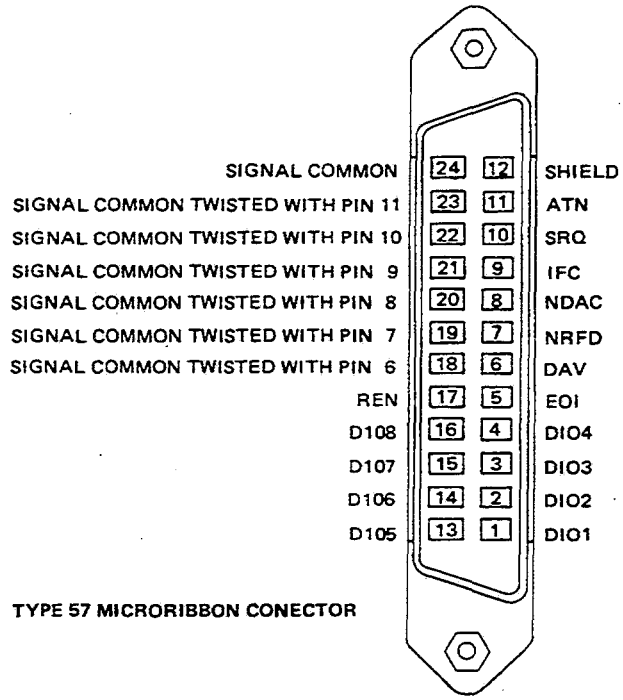

Figure 2-2. HP-IB Connections and Logic Levels

HP-IB Address Selection (Option 001 Only)

The HP 37721A HP-IB address is accessed on the (OTHER) display under the REMOTE CONTROL function using ▢ and ▢.

The address can be set to any value between 0 and 30 inclusive using the display softkeys.

Operating Environment

The instrument may be operated in temperatures within the range 0 degrees to +50 degrees centigrade at altitudes up to 4,500 meters (15,000 feet). At all times the instrument should be protected from temperature extremes and environments which cause condensation within the instrument.

Storage and Shipment

The instrument may be stored or shipped in environments within the following limits :-

Temperature	-40°C to +65°C
Altitude	Up to 15,200 meters (50,000 feet)

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

Repackaging For Shipment

Tagging For Service. If the instrument is being returned to Hewlett- Packard for service, please complete one of the blue repair tags located at the beginning of the Service Manual and attach it to the instrument. **Original Packaging.** Containers and materials identical to those used in factory packaging are available from Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, Model number, and full Serial number. Mark the container FRAGILE to ensure careful handling.

In any correspondence, refer to the instrument by Model number and full Serial number.

Other Packaging. The following general instructions should be followed when repackaging with commercially available materials :-

Wrap instrument in heavy paper or plastic. If the instrument is being shipped to Hewlett-Packard, attach a tag indicating the type of service required, return address, Model number and full Serial number.

Use a strong shipping container. A double wall carton made of 350 pound test material is adequate.

Use a layer of shock absorbing material 70 to 100 mm (3 to 4 inch) thick, around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the Front Panel controls and Rear Panel connectors with cardboard.

Seal shipping container securely.

Mark shipping container FRAGILE to ensure careful handling.

In any correspondence, refer to instrument by Model number and full Serial number.

3

Performance Tests

Introduction

The procedures given in this Section, test the HP 37721A electrical performance using the Specifications listed in Section 1, General Information, as performance standards. Each test is self contained and, therefore, may be performed as a stand-alone test or as part of full instrument calibration.

Equipment Required

Equipment, required for the Performance Tests, is listed in Table 3-1, Recommended Test Equipment. Any equipment which meets or exceeds the critical specification of the equipment listed, may be substituted.

Table 3-1. Recommended Test Equipment

Instrument	Critical Specification	Model Number
Oscilloscope	Bandwidth 1 GHz; 50 Ω I/P Termination	HP 54100D
Frequency Counter	DC to 170 MHz with Time Interval capability	HP 5316A
Digital Voltmeter	1 mV Resolution; DC	HP 3435A
Bal/Unbal Convertor	120 Ω to 75 Ω	HP 15508C
75 Ω/50 Ω Matching Pad	Insertion Loss 5.7dB	HP 11852B
Cable	Impedance 75 Ω	HP 15525A
Cable	Impedance 120 Ω	HP 15521A

Table 3-1. Recommended Test Equipment (continued)

Instrument	Critical Specification	Model Number
Cable	Impedance 75 Ω 90 meters long	STC 091204B
Termination:	Impedance 75 Ω	HP 15522A
Transmission Analyzer	Unique	HP 3784A
Function Generator	1 kHz to 50 MHz	HP 8116A
Signal Generator	20 kHz to 170 MHz	HP 8642A/B
Frame Generator	Unique	HP 37729A
Blocking Capacitor	0.18 μF	HP 10240B

Performance Test Record

The results of the Performance Tests may be recorded on the Performance Test Record at the end of this Section. The Performance Test Record lists all the tested specifications and the acceptable limits. The results recorded at incoming inspection may be used for comparison during periodic maintenance, troubleshooting or after repair or adjustment.

Calibration Cycle

This instrument requires periodic verification of performance. Depending on use and environmental conditions, the instrument should be checked approximately once a year, using these Performance Tests.

Factory Default Settings

The Performance Test procedures require the HP 37721A to be set to its Factory Default Settings. This ensures that the instrument is set to a pre-defined state at the beginning of each test. The Factory Default Settings are located in STORED SETTING NUMBER 0 and are listed in Appendix A.

Transmitter Clock

Specification

Bit Rate

Bit Rate	Specification
140 Mb/s	139.264000 MHz ± 700 Hz
34 Mb/s	34.368000 MHz ± 171 Hz
8 Mb/s	8.448000 MHz ± 42 Hz
2 Mb/s	2.048000 MHz ± 10 Hz
704 kb/s	704.000 kHz ± 3.5 Hz

Offset Bit Rate (Option 003 Only)

Bit Rate	Frequency Offset	Specification
140 Mb/s	+15 ppm	139.266089 MHz ± 700 Hz
140 Mb/s	-15 ppm	139.261911 MHz ± 700 Hz
34 Mb/s	+20 ppm	34.368690 MHz ± 171 Hz
34 Mb/s	-20 ppm	34.367310 MHz ± 171 Hz
8 Mb/s	+30 ppm	8.448250 MHz ± 42 Hz
8 Mb/s	-30 ppm	8.447750 MHz ± 42 Hz
2 Mb/s	+50 ppm	2.048100 MHz ± 10 Hz
2 Mb/s	-50 ppm	2.047900 MHz ± 10 Hz
704 kb/s	+50 ppm	704.035 kHz ± 3.5 Hz
704 kb/s	-50 ppm	703.965 kHz ± 3.5 Hz

Description

The Bit Rates are measured by connecting a Frequency Counter to the 75 Ω unbalanced SIGNAL OUT. 34 Mb/s, 8 Mb/s, 2 Mb/s and 704 kb/s are measured on a ternary coded signal (AMI or HDB3). The Frequency Counter is set to trigger on the positive pulses only and therefore the Frequency Counter will read half the bit rate. 140 Mb/s is measured on a CMI coded signal.

Equipment

Frequency Counter	HP 5316A
DC Voltmeter	HP 3456A
75 Ω Termination	HP 15522C

Procedure

1. Select STORED SETTINGS NUMBER 0 on the (OTHER) display. (Factory Default Settings).
2. Select PATTERN: [ALL ONES] on the (SETTINGS) display.
3. Connect the equipment as shown in Figure 3-1.

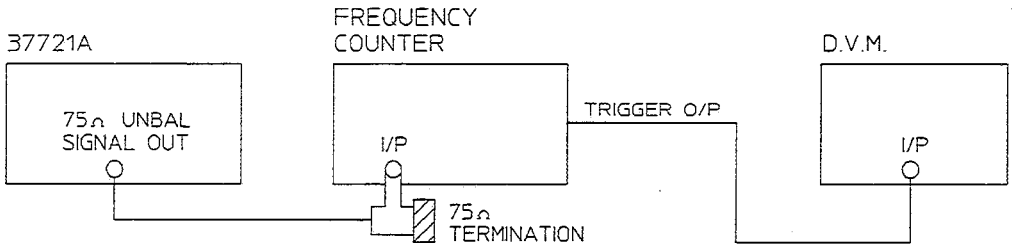

Figure 3-1. Test Hook-up

4. Set the Frequency Counter function to FREQ A and set the trigger level to give a reading of approximately +800 mV on the DC Voltmeter.
5. Check that the reading on the Frequency Counter is 1.024000 MHz ± 5 Hz.
6. Select BIT RATE: [704 kb/s], [8 Mb/s] and [34 Mb/s] in turn and check the readings are as follows :-

Bit Rate	Counter Reading
704 kb/s	352.000 kHz ± 1.75 Hz
8 Mb/s	4.224000 MHz ± 21 Hz
34 Mb/s	17.184000 MHz ± 86 Hz

7. Select BIT RATE: [140 Mb/s] and PATTERN: [ALL ZEROS]. (CODE: [CMI] is selected automatically).
8. Check that the reading is 139.264000 MHz ± 700 Hz.

Note

Set the frequency counter Trigger level to 0 V. The Gate Time may have to be adjusted.

Frequency Offset Bit Rates (Option 003 Only)

9. Select BIT RATE: [140 Mb/s] and TX CLOCK OFFSET: [+15 ppm] and check that the frequency reading is 139.266089 MHz ± 700 Hz.
10. Select TX CLOCK OFFSET: [-15 ppm] and check that the frequency reading is 139.261911 MHz ± 700 Hz.
11. Select TX CLOCK OFFSET: [USER PROGRM] [+100 ppm] and check that the frequency reading is 139.277926 MHz ± 700 Hz.
12. Select TX CLOCK OFFSET: [-100 ppm] and check that the frequency reading is 139.250073 MHz ± 700 Hz.
13. Select BIT RATE: [34 Mb/s], PATTERN: [ALL ONES]. (CODE: [HDB3] is selected automatically).

Note

The Trigger level and Gate Time on the frequency counter will have to be adjusted as detailed in Step 4.

14. Select the BIT RATE and TX CLOCK OFFSET listed and check that the frequency counter readings are as listed.

BIT RATE	TX CLOCK OFFSET	Counter Reading
34 Mb/s	+20 ppm	17.184345 MHz ± 86 Hz
34 Mb/s	-20 ppm	17.183655 Hz ± 86 Hz
8 Mb/s	+30 ppm	4.224125 MHz ± 21 Hz
8 Mb/s	-30 ppm	4.223875 MHz ± 21 Hz
2 Mb/s	+50 ppm	1.024050 MHz ± 5 Hz
2 Mb/s	-50 ppm	1.023950 MHz ± 5 Hz
704 kb/s	+50 ppm	352.018 kHz ± 1.75 Hz
704 kb/s	-50 ppm	351.982 kHz ± 1.75 Hz

Signal Out Amplitude

Specification

75 Ω Unbalanced Output

Bit Rate	Code	Amplitude
140 Mb/s	CMI	± 0.5 V peak ± 10%
34 Mb/s	HDB3	± 1.0 V peak ± 10%
8 Mb/s	AMI/HDB3	± 2.37 V peak ± 10%
2 Mb/s	AMI/HDB3	± 2.37 V peak ± 10%
704 kb/s	AMI/HDB3	± 2.37 V peak ± 10%

120 Ohm Balanced Output

Bit Rate	Code	Amplitude
2 Mb/s	AMI/HDB3	± 3.0 V peak ± 10%
704 kb/s	AMI/HDB3	± 3.0 V peak ± 10%

Description

The amplitude and duty cycle of the data are checked by connecting the SIGNAL OUT port to a 50 Ω terminated Oscilloscope, via the 75 Ω/50 Ω Matching Pad. The 120 Ω Balanced SIGNAL OUT is connected to the Oscilloscope via a 120/75 Ω Balanced/Unbalanced Convertor and the 75 Ω/50 Ω Matching Pad.

Equipment

Oscilloscope	HP 54100D
Balanced/Unbalanced Convertor 120/75 Ω	HP 15508C
75 Ω/50 Ω Matching Pad	HP 11852B

Procedure

1. Select STORED SETTINGS NUMBER 0 on the (OTHER) display. (Factory Default Settings).
2. Select PATTERN: [ALL ONES] on the (SETTINGS) display.

75 Ohm Unbalanced Output

3. Connect the 75 Ω Unbalanced SIGNAL OUT to the 50 Ω input of the Oscilloscope via the 75 Ω/50 Ω Matching Pad.
4. Check that the Amplitude of the positive pulse is 1.0 V peak ± 0.10 V. (Equivalent to 2.37 V peak ± 0.237 V when terminated in 75 Ω).
5. Check that the Amplitude of the negative pulse is 1.0 V peak ± 0.10 V. (Equivalent to 2.37 V peak ± 0.237 V when terminated in 75 Ω).
6. Select BIT RATE: [704 kb/s] and repeat steps 4 and 5.
7. Select BIT RATE: [8 Mb/s] and repeat steps 4 and 5.
8. Select BIT RATE: [34 Mb/s].
9. Check that the Amplitude of the positive pulse is 420 mV peak ± 42 mV. (Equivalent to 1.0 V peak ± 100 mV when terminated in 75 Ω).
10. Check that the Amplitude of the negative pulse is 420 mV peak ± 42 mV. (Equivalent to 1.0 V peak ± 100 mV when terminated in 75 Ω).
11. Select BIT RATE: [140 Mb/s]. (CODE: [CMI] is selected automatically).
12. Check that the Amplitude is 420 mV pk-pk ± 42 mV. (Equivalent to 1 V pk-pk ± 100 mV when terminated in 75 Ω).
13. Check that the duty cycle of the waveform is between 44:56 and 56:44.

120 Ω Balanced Output

14. Select BIT RATE: [2 Mb/s]; INTERFACE: [120 Ω BAL] and CODE: [HDB3].
15. Connect the 120 Ω balanced SIGNAL OUT, via the 120/75 Ω Bal/Unbal Convertor and the 75 Ω/50 Ω Matching Pad, to the 50 Ω input of the Oscilloscope.
16. Check that the Amplitude of the positive pulse is 1.0 V peak ± 0.10 V. (Equivalent to 3.0 V peak ± 0.3 V when terminated in 120 Ω).
17. Check that the Amplitude of the negative pulse is 1.0 V peak ± 0.10 V. (Equivalent to 3.0 V peak ± 0.3 V when terminated in 120 Ω).
18. Select BIT RATE: [704 kb/s] and repeat steps 16 and 17.

Patterns

Specification

PRBS	2^{23}-1 as per CCITT Recommendation O.151
	2^{15}-1 as per CCITT Recommendation O.151
WORD	ALL 1's, ALL 0's, 0101, 1000 and programmable 16 bit WORD

Description

The 2^{23}-1 and 2^{15}-1 PRBS patterns are checked by connecting the 75 Ω SIGNAL OUT to an HP 3784A Transmission Analyzer and checking that the patterns synchronize. The WORD patterns are checked by setting up a known pattern and checking the result on the Frequency Counter.

Equipment

Transmission Analyzer	HP 3784A
Frequency Counter	HP 5316A

Procedure

PRBS

1. Select STORED SETTINGS NUMBER 0 on the [OTHER] display (Factory Default Settings.
2. Connect the 75 Ohm unbalanced SIGNAL OUT to the 3784A RX TERNARY DATA IN.
3. Using the Page/Index key, select Display Page 3 on the 3784A.
4. Using the Update/Next keys select Rx Setup [AUTO] on the 3784A and then press EXEC.

5. Check that after several seconds, the 3784A synchronizes to the input signal from the 37721A (i.e. no ALARMS are set on the 3784A) and that the 3784A displays PATTERN: [PRBS]-[15].

Note

The 3784A will also display the CODE, INTERFACE and CLOCK RATE.

---

6. Select BIT RATE: [34Mb/s] on the 37721A. PATTERN: [2^23-1] is selected automatically.
7. Select Rx Setup [AUTO] on the 3784A and then press EXEC.
8. Check that after several seconds, the 3784A synchronizes to the input signal from the 37721A (i.e. no ALARMS are set on the 3784A) and that the 3784A displays PATTERN: [PRBS]-[23].

WORD

9. Select STORED SETTINGS NUMBER 0 on the (OTHER) display (Factory Default Settings.
10. Connect the equipment as shown in Figure 3-1. Set the Frequency Counter function to FREQ A and set the Trigger Level to give a reading of approximately +800 mV on the DC Voltmeter.
11. Select PATTERN: [16 BIT WORD] [1010101010101010] on the (SETTINGS) display.
12. Check that the reading on the Frequency Counter is 512.000 kHz ± 3 Hz.
13. Select PATTERN: [16 BIT WORD] [0101010101010101] on the (SETTINGS) display.
14. Check that the reading on the Frequency Counter is 512.000 kHz ± 3 Hz.
15. Disconnect the test equipment.

Error Add

Specification

SINGLE	Adds a Bit error each time the key is pressed.
1E-3	Adds Bit errors at a rate of 1 error in 1000 clock periods.

Description

The Error Add capability is checked by connecting a Frequency Counter to the 75 Ω unbalanced SIGNAL OUT and then injecting binary (bit) errors into a 2 Mb/s, ALL ZEROS, AMI coded data pattern. Each error is shown as a data 1 in the ALL ZEROS data pattern. The errors may be added either as a SINGLE error or at a rate of 1E-3.

The Frequency Counter is set to trigger on the positive pulses only and therefore the Frequency Counter will read half the expected rate.

Equipment

Frequency Counter	HP 5316A
DC Voltmeter	HP 3456A
75 Ω Termination	HP 15522C

Procedure

1. Select the STORED SETTINGS NUMBER 0 on the [OTHER] display. (Factory Default Settings).
2. Select PATTERN: [ALL ZEROS] and CODE: [AMI] on the [SETTINGS] display.
3. Connect the equipment as shown in Figure 3-1.
4. Set the Frequency Counter function to FREQ A and set the trigger level to give a reading of +800 mV on the DC Voltmeter.

5. Select ERROR ADD: [1E-3] and check that the reading on the Frequency Counter is 1.024 kHz.
6. Deselect ERROR ADD: [1E-3].
7. Set the Frequency Counter function to TOT START (to measure absolute count).
8. Press the ERROR ADD SINGLE 6 times and check that the Frequency Counter reads 3.
9. Disconnect all the test equipment.

Receiver

Specification

SIGNAL IN	75 Ω unbalanced at 140 Mbit/s, 34 Mbit/s, 8 Mbit/s, 2 Mbit/s, 704 kbit/s 120 Ω balanced at 2 Mbit/s, 704 kbit/s
Format	CMI at 140 Mbit/s HDB3/RZ at 34 Mbit/s HDB3/RZ and AMI/RZ at 8 Mbit/s, 2 Mbit/s, 704 kbit/s
Equalization	12 db at half bit rate 140 Mbit/s and 34 Mbit/s 6 db at half bit rate 8 Mbit/s, 2 Mbit/s, and 704 kbit/s
Monitor Mode Additional gain	26 db at 140 Mbit/s and 34 Mbit/s 26 to 30 db at 8 Mbit/s, 2 Mbit/s and 704 kbit/s

Description

The following back-to-back tests check out the 37721A Receiver using the 37721A Generator. The tests use the 75 Ω unbalanced and 120 Ω balanced SIGNAL IN ports at different bit rates to perform the Equalization and Monitor tests. The validity of the generated PRBS patterns is also checked using the back-to-back tests.

Equipment

Attenuator	HP 3750A
Long Cable	90 Meters Coaxial Cable

Procedure

Signal In

1. Select STORED SETTINGS NUMBER 0 on the (OTHER) display (Factory Default Settings).

2. Connect the 75 Ω unbalanced SIGNAL OUT to the 75 Ω unbalanced SIGNAL IN.
3. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit and the ERRORS indicator is unlit.
4. Connect the 120 Ω balanced SIGNAL OUT to the 120 Ω balanced SIGNAL IN.
5. Select INTERFACE: [120Ω BAL].
6. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit and the ERRORS indicator is unlit.

Signal Input Conditioning - Terminated

7. Select BIT RATE [140 Mb/s] and PATTERN [2^23-1]. INTERFACE [75Ω UNBAL] and CODE [CMI] are automatically selected.
8. Disconnect the cable between the 75 Ω unbalanced SIGNAL OUT and 75 Ω unbalanced SIGNAL IN and replace with the long cable.
9. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit and the ERRORS indicator is unlit.
10. Select BIT RATE: [2Mb/s].
11. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit and the ERRORS indicator is unlit.

Monitor

12. Disconnect the long cable and connect the Attenuator between the 75 Ω unbalanced SIGNAL OUT and the 75 Ω unbalanced SIGNAL IN.
13. Set the Attenuator to 26 db attenuation.
14. Select SIGNAL IN: MONITOR.
15. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit and the ERRORS indicator is unlit.
16. Select BIT RATE: [140Mb/s].
17. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit and the ERRORS indicator is unlit.
18. Disconnect all test equipment.

Error Measurement

Specification

Bit Errors	Result from bit by bit comparison of the received data with the reference data.
CMI Code Errors	Result from two consecutive marks of the same polarity or a bit period coded as two half bits 01.
HDB3 Code Errors	Result from violations of the coding scheme.
AMI Code Errors	Result from violations of the alternate mark inversion rule.

Description

Bit Errors are measured by connecting the 37721A back to back and then adding a known number of Bit Errors into the transmitted data pattern. Code Errors are measured by connecting an HP 3784A Transmission Analyzer to the 75 Ω unbalanced SIGNAL IN. Code Errors are then injected into the data pattern and measured on the 37721A.

Equipment

Transmission Analyzer	HP 3784A

Procedure

Bit Errors

1. Select STORED SETTINGS NUMBER 0 on the (OTHER) display. (Factory Default Settings).
2. Connect the 75 Ω unbalanced SIGNAL OUT to 75 Ω unbalanced SIGNAL IN.

3. Select the following parameters on the (RESULTS) display :-

TEST TIMING	[SINGLE]
DURATION	[USER PROGRAM] [10] [SECS]
RESULTS DISPLAYED	[SHORT TERM]
SHORT TERM PERIOD	[10 SECONDS]

4. Press (RUN/STOP).
5. Press ERROR ADD (SINGLE) three times during the test.
6. Check that each time the key is pressed, the ERRORS indicator flashes and at the end of the test, the BIT EC (bit error count) is 3.
7. Press ERROR ADD (1E-3).
8. Press (RUN/STOP).
9. Check that at the end of the test, the BIT EC is 20480.

Code Errors

10. Connect the 3784A TX DATA OUT to the 75 Ω unbalanced SIGNAL IN.
11. Using the Page/Index key, select Page 2 on the 3784A.
12. Select the following parameters on the 3784A :-

DATA OUT	[75TERM] [HDB3]
CLOCK	[STD RATE] [2MHz]
OFFSET	[+0]ppm
PATTERN	[PRBS]-[15]
ZERO SUB	[000]
ER ADD	[CODE] [RATE]-[3]

13. Press (RUN/STOP).
14. Check that at the end of the test, the CODE EC (code error count) is 20480. (Ignore the BIT EC reading.)
15. Disconnect the test equipment.

Receiver Clock

Specification

Rates	139 Mb/s, 34 Mb/s, 8 Mb/s, 2 Mb/s, 704 kb/s
Range	±100 ppm at all rates

Description

The 37721A is connected back to back and the RECEIVER CLOCK recovered from the input data. The operating range of each clock recovery circuit is checked by offsetting the frequency of the input signal. The BIT EC (bit error count) is then monitored to ensure that the 37721A RECEIVER remains error-free over the operating range.

Equipment

None required.

Procedure

1. Select STORED SETTINGS NUMBER 0 on the (OTHER) display (Factory Default Settings).
2. Connect the 75 Ω unbalanced SIGNAL OUT to the 75 Ω unbalanced SIGNAL IN.
3. Select the following parameters on the [RESULTS] display :-

TEST TIMING	[SINGLE]
DURATION	[USER PROGRAM] [10] [SECS]
RESULTS DISPLAYED	[SHORT TERM]
SHORT TERM PERIOD	[10 SECONDS]

4. Press (RUN/STOP).

5. Check that the SIGNAL PRESENT and PATTERN SYNC indicators are lit but the ERRORS indicator is not lit and the BIT EC is 0.
6. Select TX CLOCK OFFSET: [USER PROGRAM] [+100 ppm] on the [SETTINGS] display and repeat steps 3 to 5.
7. Select TX CLOCK OFFSET: [USER PROGRAM] [-100 ppm] and repeat steps 3 to 5.
8. Select BIT RATES: [704 kb/s], [8 Mb/s], [34 Mb/s] and [140 Mb/s] with OFFSETS : [0ppm], [+100 ppm] and [-100 ppm] and repeat steps 3 to 5.

Multiple Outputs (Option 002)

Specification

Amplitude

Bit Rate Selection	Code	Amplitude Specification
140M	CMI	± 0.5 V peak ±10%
34M	HDB3	± 1.0 V peak ±10%
8M	AMI/HDB3	± 2.37V peak ±10%
2M	AMI/HDB3	± 2.37V peak ±10%
704k	AMI/HDB3	± 2.37V peak ±10%

Nominal Delay

Bit Rate	Signal Out		
	#1	#2	#3
139M	0	0	0
34M, 8M, 2M, 704k	4	8	12

Description

The amplitude levels of the rear panel SIGNAL OUT 2, SIGNAL OUT 3 and SIGNAL OUT 4 are checked by connecting the ports to a 50 Ω terminated Oscilloscope, via a 75/50 Ω Matching Pad. The nominal delays in the data are measured by comparing each port with the front panel 75 Ω unbalanced SIGNAL OUT on the Oscilloscope.

Equipment

Oscilloscope	HP 54100D
75/50 Ω Matching Pad	HP 11542B

Procedure

Amplitude

1. Select STORED SETTINGS NUMBER [0] on the [OTHER] display. (Factory Default Settings.)
2. Select PATTERN: [ALL ONES] on the [SETTINGS] display.
3. Connect the rear panel SIGNAL OUT 2 to the 50 Ω input of the Oscilloscope, via the 75/50 Ω matching pad.
4. Check that the Amplitude of the positive pulse is 1.0V peak ±0.10V. (Equivalent to 2.37V peak ±0.237V when terminated in 75 Ω.)
5. Check that the Amplitude of the negative pulse is 1.0V peak ±0.10V. (Equivalent to 2.37V peak ±0.237V when terminated in 75 Ω.)
6. Select BIT RATE: [704kb/s] and repeat steps 4 and 5.
7. Select BIT RATE: [8Mb/s] and repeat steps 4 and 5.
8. Select BIT RATE: [34Mb/s].
9. Check that the Amplitude of the positive pulse is 420mV peak ±42mV. (Equivalent to 1.0V peak ±100mV when terminated in 75 Ω.)
10. Check that the Amplitude of the negative pulse is 420mV peak ±42mV. (Equivalent to 1.0V peak ±100mV when terminated in 75 Ω.)
11. Select BIT RATE: [140Mb/s]. CODE: [CMI] is selected automatically.
12. Check that the Amplitude is 420mV p-p ±42mV. (Equivalent to 1V p-p ±100mV when terminated in 75 Ω.)
13. Check that the duty cycle of the waveform is 44:56 to 56:44.
14. Repeat steps 1 to 13 for SIGNAL OUT 3 and SIGNAL OUT 4.

140 Mb/s Delay Measurement

15. Select BIT RATE: [140Mb/s]; PATTERN: [16 BIT WORD] [1000000000000000].
16. Connect the 75 Ω Unbalanced SIGNAL OUT to the 50 Ω, Channel A input of the Oscilloscope, via a 75/50 Ω matching pad.
17. Connect the rear panel SIGNAL OUT 2 port to the 50 Ω, Channel B input of the Oscilloscope, via a 75/50 Ω matching pad.
18. Check that the signal on Channel A is in phase with the signal on Channel B.
19. Disconnect the SIGNAL OUT 2 port and connect the SIGNAL OUT 3 port to the 50 Ω, Channel B input of the Oscilloscope, via the 75/50 Ω matching pad.
20. Check that the signal on Channel A is in phase with the signal on Channel B.
21. Disconnect the SIGNAL OUT 3 port and connect the SIGNAL OUT 4 port to the 50 Ω, Channel B input of the Oscilloscope, via the 75/50 Ω matching pad.
22. Check that the signal on Channel A is in phase with the signal on Channel B.

34M, 8M, 2M, 704kbit/s Delay Measurement

23. Select BIT RATE: [2Mb/s] and PATTERN: [16 BIT WORD][1000000000000000].
24. Connect the 75 Ω Unbalanced SIGNAL OUT to the 50 Ω, Channel A input of the Oscilloscope, via a 75/50 Ω matching pad.
25. Connect the rear panel SIGNAL OUT 2 port to the 50 Ω, Channel B input of the Oscilloscope, via a 75/50 Ω matching pad.
26. Check that the signal on Channel B is 4 bits delayed with respect to the signal on Channel A.
27. Disconnect the SIGNAL OUT 2 port and connect the SIGNAL OUT 3 port to the 50 Ω, Channel B input of the Oscilloscope, via the 75/50 Ω matching pad.
28. Check that the signal on Channel B is 8 bits delayed with respect to the signal on Channel A.
29. Disconnect the SIGNAL OUT 3 port and connect the SIGNAL OUT 4 port to the 50 Ω, Channel B input of the Oscilloscope, via the 75/50 Ω matching pad.
30. Check that the signal on Channel B is 12 bits delayed with respect to the signal on Channel A.
31. Disconnect the test equipment.

Binary Interface (Option 004 Only)

Specification

TX EXT CLK

Rate:	1 kb/s to 168.5 Mb/s
Level:	Nominal TTL to 50 Mb/s Nominal ECL to 168.5 Mb/s
Impedances:	75 Ω to GND (TTL), dc coupled 75 Ω to -2V (ECL), dc coupled
Thresholds:	TTL, ECL, GND and AUTO

TX CLK OUT

Rate:	20 kb/s to 168.5 Mb/s
Level:	Nominal TTL to 50 Mb/s Nominal ECL to 168.5 Mb/s

TX DATA OUT

Rate:	20kb/s to 168.5 Mb/s
Level:	Nominal TTL to 50 Mb/s Nominal ECL to 168.5 Mb/s

RX CLOCK IN

Rate:	20 kb/s to 168.5 Mb/s
Level:	Nominal TTL to 50 Mb/s Nominal ECL to 168.5 Mb/s
Polarity:	Normal or Inverted
Thresholds:	TTL, ECL, GND and AUTO

RX DATA IN

Rate:	20 kb/s to 168.5 Mb/s
Level:	Nominal TTL to 50 Mb/s Nominal ECL to 168.5 Mb/s
Thresholds:	TTL, ECL and GND

Equipment

Function Generator	HP 8116A
Signal Generator	HP 8642A/B
Blocking Capacitor 0.18uF	HP 10240B

Description

The Binary Interface tests check the following rear panel binary inputs and outputs; TX EXT CLK (Transmitter External Clock Input); CLK TX OUT (Transmitter Clock Output); DATA TX OUT (Transmitter Data Output); CLK RX IN (Receiver Clock Input); DATA RX IN (Receiver Data Input)

The input threshold levels of the TX EXT CLK and CLK RX IN are checked using a Function Generator. The frequency range of the Binary Interfaces are then checked by connnecting the CLK TX OUT/ CLK RX IN and DATA TX OUT/DATA RX IN back to back and then applying a signal from a Function Generator, and then a Signal Generator, to the TX EXT CLK input.

Procedure

1. Select STORED SETTINGS NUMBER 0 on the OTHER display (Factory Default Settings). Set the cursor to ACTION and select RECALL STATUS.
2. Select the following parameters on the SETTINGS display;

   INTERFACE [BINARY]

   TX CLOCK SOURCE [EXTERNAL]

   PATTERN [2^15-1]

   THRESHOLDS
3. Set the TX EXT CLOCK threshold to [ECL].
4. Connect a Function Generator to the TX EXT CLK input.
5. Set the Function Generator to output a 1kHz, 1V p-p, ECL squarewave.
6. Check that the EXT CLOCK IN Status LED is on.
7. Set the TX EXT CLOCK threshold to [TTL].
8. Set the Function Generator output level to TTL level and check that the EXT CLOCK IN Status LED is on.
9. Set the TX EXT CLOCK threshold to [GROUND].
10. Set the Function Generator output level to 300mV p-p about ground and check that the EXT CLOCK IN Status LED is on.
11. Set the TX EXT CLK threshold to [AUTO].
12. Set the Function Generator output level to 300mV p-p with a +2V dc offset and check that the EXT CLOCK IN status LED is on.

    Reset the Function Generator offset to zero.
13. Disconnect the Function Generator from the TX EXT CLK input and connect to the CLK RX IN.
14. Set the RX CLOCK IN threshold to [ECL].
15. Set the Function Generator to output a 20kHz, 1V p-p ECL squarewave.

16. Check that the SIGNAL/CLOCK IN LED is on.
17. Set the RX CLOCK IN threshold to [TTL].
18. Set the Function Generator output level TTL level and check that the SIGNAL/CLOCK IN LED is on.
19. Set the RX CLOCK IN threshold to [GROUND].
20. Set the Function Generator output level to 300mV p-p about ground and check that the SIGNAL/CLOCK IN LED is on.
21. Set the RX CLOCK IN threshold to [AUTO].
22. Set the Function Generator output level to 300mV p-p with a +2V dc offset and check that the SIGNAL/CLOCK IN LED is on.

    Reset the Function Generator offset to zero.

    BACK-BACK CHECKS

23. Set the threshold levels as follows;

TX CLOCK OUT	[TTL]
TX DATA OUT	[TTL]
TX EXT CLOCK	[AUTO]
RX CLOCK IN	[TTL]
RX DATA IN	[TTL]

24. Connect the Function Generator to the TX EXT CLK input.
25. Set the Function Generator to output a 20kHz, 300mV p-p squarewave.
26. Connect the CLK TX OUT to the CLK RX IN and the DATA TX OUT to the DATA RX IN.
27. Check that the SIGNAL/CLOCK IN and EXT CLOCK IN status LEDS are both on and that the SIGNAL LOSS, PATTERN/FRAME and ERRORS status LEDS are all off.
28. Set the Function Generator frequency to 50MHz and check that the results are the same as in step 27.
29. Set the TX CLOCK OUT, TX DATA OUT, RX CLOCK IN and RX DATA IN threshold levels to [ECL].

30. Check that the results are the same as in step 27.
31. Disconnect the Function Generator from the TX EXT CLK input.
32. Connect a Signal Generator, set to output a 168.5MHz, 300mV p-p signal to the TX EXT CLOCK input.
33. Check that the results are the same as in step 27.
34. Disconnect the test equipment.

Frame Alignment Signals (Option 005 Only)

Specification

Frame Analysis conforms to CCITT Recommendation G.704 at 2Mb/s

Frame Analysis conforms to CCITT Recommendation G.742 at 8Mb/s

Frame Anlaysis conforms to CCITT Recommendation G.751 at 34Mb/s

Frame Analysis conforms to CCITT Recommendation G.751 at 139Mb/s

Equipment

Frame Generator HP 37729A

Description

A Frame Generator is used to generate the appropriate Frame Alignment Signals (FAS), to provide basic In-Service Frame Error Analysis at the selected bit rate. The FAS signals are detected by the HP 37721A to check for the following In-Service events:

2Mbit/s: Selection of CAS Multiframe; CRC4 Multiframe; CAS and CRC4 Multiframe; no Multiframe.

Frame Bit Errors; Code Errors; Cyclic Redundancy; Check (CRC4) Bit Errors; Remote End Block Errors (REBE); Remote Alarms; Remote Multiframe Alarms; Spare Bits.

8Mbit/s: Frame Bit Errors; Code Errors; Remote Alarms; Spare Bits.

34Mbit/s: Frame Bit Errors; Code Errors; Remote Alarms; Spare Bits.

139Mbit/s: Frame Bit Errors; Code Errors; Remote Alarms; Spare Bits.

Procedure

1. Set the HP 37721A to its default settings by recalling STORED SETTINGS NUMBER 0 on the (OTHER) display.
2. Select APPLICATION : IN-SERVICE on the (SETTINGS) display.
3. Select FRAME TYPE: [CAS, CRC4 MFM].
4. Ensure [TROUBLE SCAN] is selected on the (RESULTS) display.

2 Mb/s Frame Analysis

5. Steps 6 to 11 set up the parameters on the HP 37729A Frame Generator.
6. Set the HP 37729A Frame Generator OUTPUT parameters as follows:

   FREQ [2]

   CODE [HDB3]
7. Press the [MENU] key to select the MENU display.
8. Use the ▲ and ▼ keys to select [ALIGNMENT].
9. Press [ENTER] to select the ALIGNMENT parameters.
10. Use the [PAGE UP] and [PAGE DOWN] keys to select ALIGNMENT: [2M].
11. Set the FAS and NFAS parameters as follows;

    NFAS 01011111

    FAS 10011011
12. Press the SELECT key until all the 2048 Kbit/s LEDS are OFF.
13. Connect the Frame Generator AMI/HDB3 output to the HP 37721A 75 Ω SIGNAL IN port.

14. Press the HP 37721A (RUN/STOP) key to start a measurement and check that the display is blank, the SIGNAL/CLOCK IN LED is on and that all other STATUS LEDS are OFF.

15. Press the Frame Generator 2048 Kbit/s (SELECT) key until the CAS MFL LED is flashing.

CAS Multiframe

16. Press the Frame Generator 2048 Kbit/s (ON/OFF) key and check that the HP 37721A displays STATUS ALARM; the status line message displays [CAS MFM LOSS OCCURRED] and the PATTERN/FRAME LED is ON.

17. Press the Frame Generator 2048 Kbit/s (ON/OFF) key and check that the status line message disappears and the PATTERN/FRAME LED is now OFF. (The STATUS ALARM will still remain displayed until a new measurement is started.)

18. Press the HP 37721A (RUN/STOP) key twice to start a new measurement, and check that the HP 37721A display is blank.

CRC4 Multiframe

19. Use the Frame Generator (SELECT) and (ON/OFF) keys to select and enable CRC MFL.

20. Check that the HP 37721A displays a CRC errors count and that the ERRORS LED is ON.

21. Check that after several seconds, the HP 37721A displays STATUS ALARM, the CRC error count stops, the status line message displays [FRAME LOSS OCCURRED] and the PATTERN/FRAME LED is ON.

22. Press the Frame Generator 2048 Kbit/s (ON/OFF) key and check that the status line message disappears and the PATTERN/FRAME and ERRORS LEDS are now OFF.

23. Press the HP 37721A [RUN/STOP] key twice to start a new measurement and check that the HP 37721A display is blank.

Error Detection

24. Use the Frame Generator 2048 Kbit/s [SELECT] and [ON/OFF] keys to select and enable BIT ERROR 2Mb.
25. Check that the HP 37721A counts FRAME, CRC and REBE errors and displays STATUS ALARM. The status line message [FRAME LOSS OCCURRED] and PATTERN/FRAME LED should be flashing and the ERRORS LED should be ON.
26. Press the Frame Generator [ON/OFF] key and check that the FRAME, CRC and REBE error counts stop, the status line message disappears, and the PATTERN/FRAME and ERRORS LEDS are now OFF.
27. Press the HP 37721A [RUN/STOP] key twice to start a new measurement and check that the HP 37721A display is blank.

Alarm Detection

28. Use the Frame Generator 2048 Kbit/s [SELECT] and [ON/OFF] keys to select and enable DF (Remote Alarm) and check that the HP 37721A displays STATUS ALARM.
29. Press the Frame Generator [ON/OFF] key.
30. Press the HP 37721A [RUN/STOP] key twice to start a new measurement and check that the HP 37721A is blank.
31. Use the Frame Generator 2048 Kbit/s [SELECT] and [ON/OFF] keys to select and enable DMF (Remote Multiframe Alarm) and check that the HP 37721A displays STATUS ALARM.
32. Press the Frame Generator 2048 Kbit/s [ON/OFF] key.
33. Press the [RUN/STOP] key twice to start a new measurement and check that the HP 37721A is blank.

Spare Bits Detection

34. Select DISPLAY: [SPARE BITS] on the HP 37721A (RESULTS) display.
35. Check that the HP 37721A displays:

    NFAS ?1011111

    CAS 00001011
36. Change the Frame Generator NFAS parameters to the following:

    NFAS 01000000
37. Check that the HP 37721A now displays the following NFAS parameters:

    NFAS ?1000000
38. Press the (RUN/STOP) key once to stop the measurement.

8 Mb/s Frame Analysis

39. Select BIT RATE: [8 Mb/s] on the HP 37721A (SETTINGS) display.
40. Select DISPLAY: [TROUBLE SCAN] on the HP 37721A (RESULTS) display.
41. Set the following parameters on the Frame Generator:

OUTPUT	[FREQ] [8]
	[CODE] [HDB3]
ALIGNMENT	[8M]
SB	[00]
FAS	[1111010000]

42. Press the (SELECT) key until all 8448 Kbit/s ERROR and AIS LEDS are OFF.
43. Press the (RUN/STOP) key to start a measurement and check the HP 37721A display is blank, the SIGNAL/CLOCK IN LED is ON and that all other STATUS LEDS are OFF.

Error Detection

44. Use the Frame Generator 8448 Kbit/s (SELECT) and (ON/OFF) keys to select and enable BIT ERROR.
45. Check that the HP 37721A counts FRAME bit errors, displays STATUS ALARM and the ERRORS LED is ON.
46. Press the Frame Generator 8448 Kbit/s (ON/OFF) key and check that the FRAME bit error count stops and the ERRORS LED is now OFF.
47. Press the (RUN/STOP) key twice to start a new measurement and check that the HP 37721A display is blank.

Alarm Detection

48. Set the Frame Generator [SB] parameter to [10].
49. Check that the HP 37721A displays STATUS ALARM and the PATTERN/FRAME and ERRORS LEDS are OFF.
50. Reset the Frame Generator [SB] parameter to [00].
51. Press the (RUN/STOP) key twice to start a new measurement and check that the HP 37721A display is blank.

Spare Bit Detection

52. Select DISPLAY: [SPARE BITS] on the HP 37721A (RESULTS) display.
53. Check that the HP 37721A displays " 0 ".
54. Set the Frame Generator [SB] parameter to [01].
55. Check that the HP 37721A now displays a " 1 ".
56. Press the (RUN/STOP) key once to stop the measurement.

34 Mb/s Frame Analysis

57. Select BIT RATE: [34 Mb/s] on the HP 37721A (SETTINGS) display.
58. Select DISPLAY: [TROUBLE SCAN] on the HP 37721A (RESULTS) display.
59. Set the following parameters on the Frame Generator:

OUTPUT	[FREQ] [34]
	[CODE] [HDB3]
ALIGNMENT	[34M]
SB	[00]
FAS	[1111010000]

60. Press the 34368 Kbit/s (SELECT) key until all 34368 Kbit/s ERROR and AIS LEDS are OFF.

61. Repeat steps 43 to 56 and check that the results are the same as for 8Mb/s Frame Analysis.

140 Mb/s Frame Analysis

62. Select BIT RATE: [140 Mb/s] on the HP 37721A (SETTINGS) display.

63. Select DISPLAY: [TROUBLE SCAN] on the HP 37721A (RESULTS) display.

64. Set the following parameters on the Frame Generator:

OUTPUT	[FREQ] [139]
	[CODE] [CMI]
ALIGNMENT	[140M]
SB	[0000]
FAS	[111110100000]

65. Press the 139264 Kbit/s (SELECT) key until all the 139264 Kbit/s ERROR and AIS LEDS are OFF.

66. Connect the Frame Generator CMI/NRZ output to the HP 37721A 75 Ω SIGNAL IN port.

67. Press the (RUN/STOP) key to start a measurement and check that the HP 37721A display is blank, the SIGNAL/CLOCK IN LED is ON and all other STATUS LEDS are OFF.

Error Detection

68. Use the Frame Generator 139264 Kbit/s [SELECT] and [ON/OFF] keys to select and enable BIT ERROR.
69. Check that the HP 37721A counts FRAME and CODE errors, displays STATUS ALARM and the ERRORS LED is ON.
70. Press the Frame Generator [ON/OFF] key and check that the FRAME and CODE error count stops and the ERROR LED is OFF.
71. Press the [RUN/STOP] key twice to start a new measurement and check that the HP 37721A display is blank.

Alarm Detection

72. Set the Frame Generator [SB] parameter to [1000].
73. Check that the HP 37721A displays STATUS ALARM, but the PATTERN/FRAME and ERRORS LEDS are OFF.
74. Reset the Frame Generator [SB] parameter to [0000].
75. Press the [RUN/STOP] key twice to start a new measurement and check that the HP 37721A display is blank.

Spare Bits Detection

76. Select DISPLAY: [SPARE BITS] on the HP 37721A [RESULTS] display.
77. Check that the HP 37721A displays " 000 ".
78. Set the Frame Generator [SB] parameter to [0111].
79. Check that the HP 37721A now displays " 111 ".
80. Press the [RUN/STOP] key once to stop the measurement.
81. Disconnect the test equipment.

Performance Test Record

Hewlett-Packard Model 37721A Digital Transmission Analyzer	
Location:	*Serial No.:*
	Tested by:
Temperature:	*Certified by:*
Humidity:	*Date:*

Performance Test Record

Page No.	Test Description	Result		
	Transmitter Clock	*Min*	*Actual*	*Max*
3-5	Step 5: 2 Mb/s	1.023995 MHz		1.024005 MHz
	Step 6: 704 kb/s	351.99825 kHz		352.00175 kHz
	8 Mb/s	4.223979 MHz		4.224021 MHz
	34 Mb/s	17.183914 MHz		17.184086 MHz
	Step 8: 140 Mb/s	139.263300 MHz		139.264700 MHz
	Frequency Offset Bit Rates (Option 003 Only)			
	140 Mb/s			
	Step 9: + 15 ppm	139.265389 MHz		139.266789 MHz
	Step 10: - 15 ppm	139.261211 MHz		139.262611 MHz
	Step11: + 100 ppm	139.277226 MHz		139.278626 MHz
	Step 12: - 100 ppm	139.249373 MHz		139.250773 MHz

Performance Test Record (continued)

Page No.	Test Description		Result		
	Frequency Offset		*Min*	*Actual*	*Max*
		34 Mb/s			
3-6	Step 14:	+ 20 ppm	17.184259 MHz		17.184431 MHz
		- 20 ppm	17.183549 MHz		17.183741 MHz
		8 Mb/s			
		+ 30 ppm	4.224104 MHz		4.226146 MHz
		- 30 ppm	4.223854 MHz		4.223896 MHz
		2 Mb/s			
		+ 50 ppm	1.024045 MHz		1.024055 MHz
		- 50 ppm	1.023945 MHz		1.023955 MHz
		704 kb/s			
		+ 50 ppm	352.01625 kHz		352.01975 kHz
		- 50 ppm	351.980 kHz		351.984 kHz
	Signal Out : 75 Ω Unbal				
		2 Mb/s			
3-8	Step 4:	+ve Pulse Amp	0.90 V pk		1.10 V pk
	Step 5:	-ve Pulse Amp	0.90 V pk		1.10 V pk
		704 kb/s			
3-8	Step 6:	+ve Pulse Amp	0.90 V pk		1.10 V pk
		-ve Pulse Amp	0.90 V pk		1.10 V pk
		8 Mb/s			
3-8	Step 7:	+ve Pulse Amp	0.90 V pk		1.10 V pk
		-ve Pulse Amp	0.90 V pk		1.10 V pk
		34 Mb/s			

Performance Test Record (continued)

Page No.	Test Description		Result		
3-8	Step 9:	+ve Pulse Amp	378 mV pk		462 mV pk
	Step 10:	-ve Pulse Amp	378 mV pk		462 mV pk
	Signal Out : 75 Ω Unbal		*Min*	*Actual*	*Max*
		140 Mb/s			
3-8	Step 12:	Pulse Amp	378 mV p-p		462 mV p-p
	Step 13:	Duty Cycle	44 : 56		56 : 44
	Signal Out : 120 Ω Bal				
		2 Mb/s			
3-9	Step 16:	+ve Pulse Amp	0.90 V pk		1.10 V pk
	Step 17:	-ve Pulse Amp	0.90 V pk		1.10 V pk
		704 kb/s			
3-9	Step 18:	+ve Pulse Amp	0.90 V pk		1.10 V pk
		-ve Pulse Amp	0.90 V pk		1.10 V pk
	Patterns				
3-11	Step 5:	PRBS 2^{15}-1		Pass/Fail	
3-11	Step 8:	PRBS 2^{23}-1		Pass/Fail	
3-11	Step 12:	1010101010101010		Pass/Fail	
3-11	Step 14:	0101010101010101		Pass/Fail	
	Error Add				
3-13	Step 5:	(1E-3)		Pass/Fail	
	Step 8:	(SINGLE)		Pass/Fail	
	Receiver : Signal In 75 Ω				
3-15	Step 3:	Terminate		Pass/Fail	
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description		Result		
	Receiver : Signal In 120 Ω				
3-15	Step 6:	Terminate		Pass/Fail	
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
	Receiver : Terminated		*Min*	*Actual*	*Max*
		140 Mb/s			
3-15	Step 9:	Terminate		Pass/Fail	
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
		2 Mb/s			
3-15	Step 11:	Terminate		Pass/Fail	
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
	Receiver : Monitor 30 dB				
3-15	Step 15:	Monitor		Pass/Fail	
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
	Receiver : Monitor 26 dB				
3-15	Step 18:	Monitor		Pass/Fail	
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
	Error Measurement : Bit				
3-17	Step 6:	Error		Pass/Fail	
		Bit EC = 3		Pass/Fail	
	Step 9:	Bit EC = 20480		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description	Result		
	Error Measurement : Code			
	Step 9: Code EC = 20480		Pass/Fail	
	Receiver Clock : 2 Mb/s	*Min*	*Actual*	*Max*
3-19	Step 5: Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	+ 100 ppm			
	Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	- 100 ppm			
	Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	Receiver Clock : 704 kb/s			
3-19	Step 8: Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	+ 100 ppm			
	Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	- 100 ppm			
	Signal Present		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description	Result		
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	Receiver Clock : 8 Mb/s	*Min*	*Actual*	*Max*
3-19	Step 8: Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	+ 100 ppm			
	Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	- 100 ppm			
	Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	Receiver Clock : 34 Mb/s			
3-19	Step 8: Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	+ 100 ppm			
	Signal Present		Pass/Fail	
	Pattern Sync		Pass/Fail	
	Errors		Pass/Fail	
	Bit EC = 0		Pass/Fail	
	- 100 ppm			

Performance Test Record (continued)

Page No.	Test Description		Result		
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
		Bit EC = 0		Pass/Fail	
	Receiver Clock : 140 Mb/s		*Min*	*Actual*	*Max*
3-19	Step 8:	Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
		Bit EC = 0		Pass/Fail	
		+ 100 ppm			
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
		Bit EC = 0		Pass/Fail	
		- 100 ppm			
		Signal Present		Pass/Fail	
		Pattern Sync		Pass/Fail	
		Errors		Pass/Fail	
		Bit EC = 0		Pass/Fail	
	Multiple Outputs				
	Amplitude				
3-21		SIGNAL OUT 2			
	step 4	positive pulse	+0.9V		+1.1V
	step 5	negative pulse	-0.9V		-1.1V
	step 6	positive pulse	+0.9V		+1.1V
		negative pulse	-0.9V		-1.1V

Performance Test Record (continued)

Page No.	Test Description		Result		
	step 7	positive pulse (8 Mb/s)	+0.9V		+1.1V
		negative pulse (8 Mb/s)	-0.9V		-1.1V
	step 9	positive pulse (34 Mb/s)	+378 mV		+462 mV
	step 10	negative pulse (34 Mb/s)	-378 mV		-462 mV
	step 12	pulse amplitude (140 Mb/s)	+378 mV		+462 mV
	step 13	waveform duty cycle	44.56		56.44
	step 14	steps 1 to 13 repeated for SIGNAL OUT 3 and SIGNAL OUT 4		Pass/Fail	
	140 Mb/s Delay				
3-22	step 18	channel A & B signals in phase		Pass/Fail	
	step 20	channel A & B signals in phase		Pass/Fail	
	step 22	channel A & B signals in phase		Pass/Fail	
	34 Mb/s, 8 Mb/s, 2 Mb/s, 704 kb/s Delay				
3-23	step 26	channel B signals 4 bits delayed wrt channel A signal		Pass/Fail	
	step 28	channel B signal 8 bits delayed wrt channel A signal		Pass/Fail	
	step 30	channel B signal 12 bits delayed wrt channel A signal		Pass/ Fail	
	Binary Interface				
3-24		*Thresholds*			
3-26	step 6	EXT CLOCK LED ON (ECL)		Pass/Fail	
	step 8	EXT CLOCK LED ON (TTL)		Pass/Fail	
	step 10	EXT CLOCK LED ON		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description		Result		
	step 12	EXT CLOCK LED ON		Pass/Fail	
3-27	step 16	SIGNAL/CLOCK IN LED ON		Pass/Fail	
	step 18	SIGNAL/CLOCK IN LED ON		Pass/Fail	
	step 20	SIGNAL/CLOCK IN LED ON		Pass/Fail	
	step 22	SIGNAL/CLOCK IN LED ON		Pass/Fail	
	step 27	SIGNAL/CLOCK IN LED ON		Pass/Fail	
		EXT CLOCK IN LED ON		Pass/Fail	
		SIGNAL LOSS LED OFF		Pass/Fail	
		PATTERN/FRAME LED OFF		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	
3-28	step 28	SIGNAL/CLOCK IN ON		Pass/Fail	
		EXT CLOCK IN LED ON		Pass/Fail	
		SIGNAL LOSS LED OFF		Pass/Fail	
		PATTERN/FRAME LED OFF		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	
	step 30	SIGNAL/CLOCK IN LED ON		Pass/Fail	
		EXT CLOCK IN LED ON		Pass/Fail	
		SIGNAL LOSS LED OFF		Pass/Fail	
		PATTERN/FRAME LED OFF		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description		Result		
3-28	step 33	SIGNAL/CLOCK IN LED ON		Pass/Fail	
		EXT CLOCK IN LEDS ON		Pass/Fail	
		SIGNAL LOSS LED ON		Pass/Fail	
		PATTERN/FRAME LED OFF		Pass/fail	
		ERRORS LED OFF		Pass/fail	
	FRAME ALIGNMENT				
	2 Mb/s Frame Analysis				
3-31	Step 14	SIGNAL/CLOCK IN LED ON		Pass/Fail	
	CAS Multiframe				
	Step 16	STATUS ALARM		Pass/Fail	
		CAS MFM LOSS OCCURRED		Pass/Fail	
		PATTERN/FRAME LED ON		Pass/Fail	
	Step 17	PATTERN/FRAME LED OFF		Pass/Fail	
	CRC4 Multiframe				
	Step 20	CRC error count		Pass/Fail	
		ERRORS LED ON		Pass/Fail	
	Step 21	STATUS ALARM		Pass/Fail	
		FRAME LOSS OCCURRED		Pass/Fail	
		PATTERN/FRAME LED ON		Pass/Fail	
	Step 22	PATTERN/FRAME LED OFF		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description		Result		
	Error Detection				
3-32	Step 25	FRAME bit error count		Pass/Fail	
		CRC error count		Pass/Fail	
		REBE count		Pass/Fail	
		FRAME LOSS OCCURRED		Pass/Fail	
		PATTERN/FRAME LED flashing		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	
	Step 26	PATTERN/FRAME LED OFF		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	
	Alarm Detection				
	Step 28	STATUS ALARM		Pass/Fail	
	Step 31	STATUS ALARM		Pass/Fail	
	Spare Bits Detection			Pass/Fail	
3-33	Step 35	NFAS ?1011111		Pass/Fail	
		CAS 00001011			
	Step 37	NFAS ?1000000		Pass/Fail	
	8 Mb/s Frame Analysis				
	Step 43	SIGNAL/CLOCK IN LED ON		Pass/Fail	
	Error Detection				
3-34	Step 45	FRAME bit error count		Pass/Fail	
		STATUS ALARM		Pass/Fail	
		ERRORS LED ON		Pass/Fail	
	Step 46	ERRORS LED OFF		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description	Result		
	Alarm Detection			
3-34	Step 49 STATUS ALARM		Pass/Fail	
	ERRORS LED OFF		Pass/Fail	
	Spare Bit Detection			
3-35	Step 53 HP 37721A displays 0		Pass/Fail	
	Step 55 HP 37721A displays 1		Pass/Fail	
	34 Mb/s Frame Analysis			
3-36	Step 61 SIGNAL/CLOCK IN LED ON		Pass/Fail	
	Error Detection			
	FRAME bit error count		Pass/Fail	
	STATUS ALARM		Pass/Fail	
	ERRORS LED ON		Pass/Fail	
	ERRORS LED OFF		Pass/Fail	
	Alarm Detection			
	STATUS ALARM		Pass/Fail	
	ERRORS LED OFF		Pass/Fail	
	Spare Bit Detection			
	HP 37721A displays 0		Pass/Fail	
	HP 37721A displays 1		Pass/Fail	
	140 Mb/s Frame Analysis			
	Step 67 SIGNAL/CLOCK IN LED ON		Pass/Fail	

Performance Test Record (continued)

Page No.	Test Description		Result		
	Error Detection				
3-37	Step 69	FRAME bit error count		Pass/Fail	
		CODE error count		Pass/Fail	
		STATUS ALARM		Pass/Fail	
		ERRORS LED ON		Pass/Fail	
	Alarm Detection				
	Step 73	STATUS ALARM		Pass/Fail	
		PATTERN/FRAME LED OFF		Pass/Fail	
		ERRORS LED OFF		Pass/Fail	
	Spare Bits Detection				
	Step 77	HP 37721A displays 000		Pass/Fail	
	Step 79	HP 37721A displays 111		Pass/Fail	

A

Factory Default Settings

In the event of a power failure the front panel settings are stored in Non-Volatile memory (NVM). When power is restored the instrument is returned to the pre power down state using the settings stored in NVM. If the power down sequence fails to operate properly and the front panel settings are lost then when power is restored the instrument is set to the Factory Default Settings.

These settings can be useful when you wish to set the instrument to a "known" state and can be accessed on the (OTHER) display under the STORED SETTINGS function :-

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

To verify that the instrument has adopted the Factory Default Settings, compare the (SETTINGS); (RESULTS) and (PRINTER) displays with the settings listed in Table A-1.

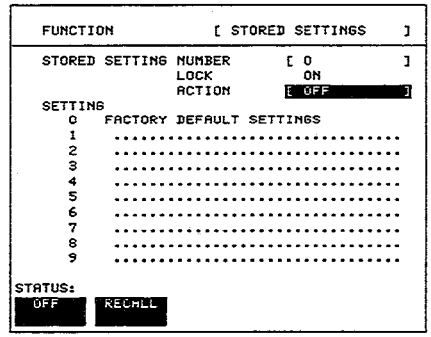

Table A-1. Factory Default Settings

Bit Rate	2 Mb/s	Print Period	Off
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
Interface	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	1MIN RESOL'N		

Option 005 Default Settings

The following settings apply to option 005 instruments unless otherwise noted. All other settings are as listed for standard instruments in Table A-1.

Table A-2. 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

Index

Hewlett-Packard Sales and Service Offices

US FIELD OPERATIONS HEADQUARTERS
Hewlett-Packard Company
19320 Pruneridge Avenue
Cupertino, CA 95014, USA
(800) 752-0900

California
Hewlett-Packard Co.
1421 South Manhattan Ave.
Fullerton, CA 92631
(714) 999-6700

Hewlett-Packard Co.
301 E. Evelyn
Mountain View, CA 94041
(415) 694-2000

Colorado
Hewlett-Packard Co.
24 Inverness Place, East
Englewood, CO 80112
(303) 649-5000

Georgia
Hewlett-Packard Co.
2000 South Park Place
Atlanta, GA 30339
(404) 955-1500

Illinois
Hewlett-Packard Co.
5201 Tollview Drive
Rolling Meadows, IL 60008
(708) 255-9800

New Jersey
Hewlett-Packard Co.
120 W. Century Road
Paramus, NJ 07653
(201) 599-5000

Texas
Hewlett-Packard Co.
930 E. Campbell Rd.
Richardson, TX 75081
(214) 231-6101

EUROPEAN OPERATIONS HEADQUARTERS
Hewlett-Packard S.A.
150, Route du Nant-d'Avril
1217 Meyrin 2\Geneva
Switzerland
(41 22) 780.8111

France
Hewlett-Packard France
1 Avenue Du Canada
Zone D'Activite De Courtaboeuf
F-91947 Les Ulis Cedex
France
(33 1) 69 82 60 60

Germany
Hewlett-Packard GmbH
Berner Strasse 117
60000 Frankfurt 56
West Germany
(49 69) 500006-0

Great Britain
Hewlett-Packard Ltd.
Eskdale Road,
Winnersh Triangle
Wokingham,
Berkshire RG11 5DZ
England
(44 734) 696622

INTERCON OPERATIONS HEADQUARTERS
Hewlett-Packard Company
3495 Deer Creek Rd.
Palo Alto, California 94304-1316
(415) 857-5027

Australia
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
(61 3) 895-2895

Canada
Hewlett-Packard (Canada) Ltd.
17500 South Service Road
Trans-Canada Highway
Kirkland, Quebec H9J 2X8
Canada
(514) 697-4232

Japan
Yokogawa-Hewlett-Packard Ltd.
1-27-15 Yabe, Sagamihara
Kanagawa 229, Japan
(81 427) 59-1311

China
China Hewlett-Packard, Co.
38 Bei San Huan X1 Road
Shuang Yu Shu
Hai Dian District
Beijing, China
(86 1) 256-6888

Singapore
Hewlett-Packard Singapore
Pte. Ltd.
1150 Depot Road
Singapore 0410
(65) 273 7388

Taiwan
Hewlett-Packard Taiwan
8th Floor, H-P Building
337 Fu Hsing North Road
Taipei, Taiwan
(886 2) 712-0404

HEWLETT PACKARD

Reorder No.
37721-90018

Manufacturing Part No. 37721-90018