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HP Part No. 37717-90435
Printed in U.K.

**Documentation Warranty**
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**WARNING**
For details of safety, see Safety information in this manual.
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Warranty

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<th>DURATION OF WARRANTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 37717C</td>
<td>3 years</td>
</tr>
</tbody>
</table>

1. HP warrants HP hardware, accessories and supplies against defects in materials and workmanship for the period specified above. If HP receives notice of such defects during the warranty period, HP will, at its option, either repair or replace products which prove to be defective. Replacement products may be either new or like-new.

2. HP warrants that HP software will not fail to execute its programming instructions, for the period specified above, due to defects in material and workmanship when properly installed and used. If HP receives notice of such defects during the warranty period, HP will replace software media which does not execute its programming instructions due to such defects.

3. HP does not warrant that the operation of HP products will be uninterrupted or error free. If HP is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product.

4. HP products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.

5. The warranty period begins on the date of delivery or on the date of installation if installed by HP. If customer schedules or delays HP installation more than 30 days after delivery, warranty begins on the 31st day from delivery.

6. Warranty does not apply to defects resulting from (a) improper or inadequate maintenance or calibration, (b) software, interfacing, parts or supplies not supplied by HP, (c) unauthorized modification or misuse, (d) operation outside of the published environmental specifications for the product, or (e) improper site preparation or maintenance.

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General Information

Warranty

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9 TO THE EXTENT ALLOWED BY LOCAL LAW, THE REMEDIES IN THIS WARRANTY STATEMENT ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. EXCEPT AS INDICATED ABOVE, IN NO EVENT WILL HP OR ITS SUPPLIERS BE LIABLE FOR LOSS OF DATA OR FOR DIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING LOST PROFIT OR DATA), OR OTHER DAMAGE, WHETHER BASED IN CONTRACT, TORT, OR OTHERWISE.

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Responsibilities of the Customer

The customer shall provide:

1 Access to the products during the specified periods of coverage to perform maintenance.

2 Adequate working space around the products for servicing by Hewlett-Packard personnel.

3 Access to and use of all information and facilities determined necessary by Hewlett-Packard to service and/or maintain the products. (Insofar as these items may contain proprietary or classified information, the customer shall assume full responsibility for safeguarding and protection from wrongful use.)

4 Routine operator maintenance and cleaning as specified in the Hewlett-Packard Operating and Service Manuals.

5 Consumables such as paper, disks, magnetic tapes, ribbons, inks, pens, gases, solvents, columns, syringes, lamps, septa, needles, filters, frits, fuses, seals, detector flow cell windows, etc.
General Information

Warranty

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 of other International Standards Organization members!

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

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Restricted Rights Legend
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General Information

Instruments Covered By Manual

Instruments Covered By Manual

Attached to the rear panel of the instrument is a serial number plate. The serial number plate has a two letter reference denoting country of origin (GB = Great Britain) and an eight digit serial number. The serial number is unique to each instrument and should be quoted in all correspondence with Hewlett-Packard, especially when ordering replacement parts.

Serial Number Plate

Storage and Shipment

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

Temperature  
-20° C to +70° C  
-15° C to +50° C with lid printer

Altitude  
Up to 15,200 meters (50,000 feet)

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

Repackaging for Shipment

Tagging for Service. If the instrument is being returned to Hewlett-Packard for service, please complete a repair tag and attach it to the instrument.
General Information

Weight and Dimensions

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.

Weight and Dimensions

Weight: 18 kg (40 lb) fully loaded
Dimensions: 190mm (7.5in) high, 340mm (14in) wide, 420mm (17in) deep (including cover).
General Information

Safety Precautions for the Operator

Safety Precautions for the Operator

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer’s failure to comply with these requirements.

In particular, the operator should note the following safety information:

• “Safety Symbols” on page 1-7
• “Connecting to the Power Supply” on page 2-4
• “Operating Environment” on page 2-2
• “Fuse Replacement” on page 2-3
• “Operators Maintenance” on page 1-8
• “Lifting/Carrying the HP 37717C” on page 1-6

DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

Lifting/Carrying the HP 37717C

Before attempting to lift or carry the instrument consider the following basic lifting techniques to help avoid personal injury.

Using both arms to lift instrument.

• Reach for the instrument - bend your knees and waist, and keep your back straight.
• GRASP the instrument firmly.
• LIFT with your legs.
• KEEP your shoulders level.
General Information

Safety Precautions for the Operator

Safety Symbols

The following symbols on the instrument and in the manual indicate precautions which must be taken to maintain safe operation of the instrument:

- The Instruction Documentation Symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the supplied documentation.
- Indicates the field wiring terminal that must be connected to earth ground before operating the equipment - protects against electrical shock in case of fault.
- Frame or chassis ground terminal - typically connects to the equipment's metal frame.
- Alternating current (AC)
- Direct current (DC)
- Indicates hazardous voltages

**WARNING**

Warning denotes a hazard. It calls attention to a procedure, which if not correctly performed or adhered to could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

**CAUTION**

Caution denotes a hazard. It calls attention to a procedure, which if not correctly performed or adhered to could result in damage to or destruction of the instrument. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

- Indicates that a laser is fitted. The user must refer to the manual for specific Warning or Caution information to avoid personal injury or damage to the product.
Warning

NO OPERATOR SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL. TO PREVENT ELECTRICAL SHOCK DO NOT REMOVE COVERS.

Maintenance appropriate for the operator is:

- Cabinet cleaning
- Optical Connector Cleaning
- Power supply fuse replacement

Cleaning

Cabinet Cleaning
Clean the cabinet using a dry cloth only.

Optical Connector Cleaning
It is recommended that the optical connectors be cleaned at regular intervals using the following materials:

<table>
<thead>
<tr>
<th>Description</th>
<th>HP Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blow Brush</td>
<td>9300-1131</td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>8500-5344</td>
</tr>
<tr>
<td>Lens Cleaning Paper</td>
<td>9300-0761</td>
</tr>
<tr>
<td>Adhesive Tape Kit</td>
<td>15475-68701</td>
</tr>
</tbody>
</table>

Caution

Do not insert any tool or object into the IN or OUT ports of the instrument as damage to or contamination of the optical fibre may result.

1. Recall Default settings (STORED SETTINGS 0) and remove the power from the HP 37717C.
General Information

Operators Maintenance

2 Remove the adapters from the IN and OUT ports.

3 Using the blow brush with the brush removed blow through the ferrule of the standard flexible connector and the adapter.

**CAUTION**
If the optical fibre of the fixed connector requires further cleaning this entails disassembly of the module which should only be carried out by suitably trained service personnel.

4 Apply some isopropyl alcohol to a piece of the cleaning paper and clean the barrel of the adapter. Using a new piece of cleaning paper, clean the face of the adapter. Repeat this operation, using a new piece of cleaning paper each time.

5 Lightly press the adhesive side of the tape provided against the front of the adapter, then remove it quickly - repeat twice. This removes any particles of cleaning paper which may be present.

6 Replace the adapters on the flexible connector.

Power Supply Fuse Replacement

See “Fuse Replacement” on page 2-3
Statement of Compliance

This instrument has been designed and tested in accordance with IEC Publication 1010-1 + A1:1992 Safety requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

The CE mark shows that the product complies with all relevant European legal Directives.

ISM 1-A

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

The CSA mark is a registered trademark of the Canadian Standards Association.

Australian EMC Regulations

The C-Tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Radiocommunications Act of 1992.

Noise Declaration (German)

LpA<70dB

am Arbeitsplatz (operator position)
normaler Betrieb (normal position)
nach DIN 45635 pt.19 (per ISO 7779)
General Information

Electromagnetic Compatibility

Electromagnetic Compatibility

This product has been designed to meet the protection requirements of the European Communities Electromagnetic Compatibility (EMC) directives:

EN55011:1991 (Group 1, Class A)
EN50082-1:1992
- IEC 1000-4-2 (1995) ESD
- IEC 1000-4-3 (1995) Radiated Susceptibility
- IEC 1000-4-4 (1995) EFT

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

Electrostatic Discharge

When an air discharge is applied to the HP37717C in accordance with IEC 801-2 (1991), degradation in performance may be observed in the form of occasional bit errors being counted.

See also “10 Base-T Lan Connection Radiated Emissions” on page 2-15
Declaration of Conformity
according to ISO/IEC Guide 22 and EN45014

Manufacturer's Name: Hewlett-Packard Ltd.
Manufacturer's Address: Telecomms Networks Test Division
South Queensferry
West Lothian, EH30 9TG
Scotland, United Kingdom

Declares that the product

Product Name: Communications Performance Analyzer
Model Numbers: HP 37717C
Product Options: This declaration covers all options of the above products as detailed in TCF A-5951-9852-01


Against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992
As Detailed in: Electromagnetic Compatibility (EMC)
Assessed by: Dti Appointed Competent Body
EMC Test Centre,
GEC-Marconi Avionics Ltd.,
Maxwell Building,
Donibristle Industrial Park,
KY11 5LB
Scotland, United Kingdom


Supplementary Information:
The product conforms to the following safety standards:
CSA-C22.2 No. 1010.1-92
CFR Ch.1 1040.10
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE-marking accordingly.

South Queensferry, Scotland 18 September 1997
Location Date W.R. Pearson / Quality Manager
Specifications

Except where otherwise stated, the following parameters are warranted performance specifications. Parameters described as “typical” or “nominal” are supplemental characteristics which provide a useful indication of typical but non-warranted performance characteristics.

Unframed PDH (Option UKK)

Transmitter

PDH Bit rates: 704 kb/s, 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264Mb/s

Frequency offset: Up to ±100 ppm

Interface: Meets ITU-T G.703

Connectors: BNC 75Ω unbalanced, 3 pin Siemens 120Ω balanced

Test patterns PRBS: $2^{15}-1$, $2^{23}-1$ at all rates (ITU-T O.151)

Word: User-defined 16 bit word, all ones, all zeros, 1010, 1000.

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 unbalanced.
139.264 Mb/s: CMI unbalanced.

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

Clock timing Internal: All rates Recovered (loop timed): From 704 kb/s or 2.048 Mb/s receiver input.

Receiver

Input:

704 kb/s, 2.048 Mb/s: ±100 ppm, balanced/unbalanced.
8.448 Mb/s: ±100 ppm, unbalanced.
34.368 Mb/s: ±100 ppm, unbalanced.
139.264 Mb/s: ±100 ppm, unbalanced.

Line codes: As transmitter.

Autosetup: Bit rate, test pattern, framing and level of an incoming signal.
General Information

Specifications

Jitter tolerance: To ITU-T Rec G.823.

Synchronization: Sync loss when BER $\geq 1:16$ over 100 ms. Sync gain when BER $< 1:16$.

Equalization: To ITU-T Rec G.703.

Monitor point compensation:
704 kb/s, 2.048 Mb/s, 8.448 Mb/s: 26 to 30 dB.
34.368, 139.264 Mb/s: 26 dB.

Frame Formats
2 Mb/s: PCM30 CAS with or without CRC4. PCM31 with or without CRC4
8 Mb/s, 34 Mb/s, 140 Mb/s: Framed.

Structured PDH (Options UKJ, UKL)
Option UKJ provides Structured PDH generation and measurement at standard bit rates. Option UKL provides measurement only at standard bit rates.

Transmitter (Option UKJ)

Interface Bit rates: 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s and 139.264 Mb/s.
Frequency offset: Up to $\pm 100$ ppm
Interface: Meets ITU-T G.703
Connectors: BNC 75$\Omega$ unbalanced, 3 pin Siemens 120$\Omega$ balanced

Test patterns
PRBS: $2^9-1, 2^{11}-1, 2^{15}-1, 2^{23}-1$ at all rates.
Word: User-defined 16 bit word, all ones, all zeros, 1010, 1000.

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

Bit error add: 1 in $10^3$, 1 in $10^4$, 1 in $10^5$, 1 in $10^6$, 1 in $10^7$ or single error
Frame error add: 1 in $10^3$, 1 in $10^4$, 1 in $10^5$, 1 in $10^6$, 1 in $10^7$ or error 1 to 4 consecutive frames
Code error add: (2, 8, 34 Mb/s) 1 in $10^3$, 1 in $10^4$, 1 in $10^5$, 1 in $10^6$, 1 in $10^7$ or single error

Clock timing Internal: All rates
Recovered (loop timed): From 2.048 Mb/s receiver input.
General Information

Specifications

Test signal rates: N X 64 kb/s, 64 kb/s, 2.048 Mb/s, 8.448 Mb/s, 34.368 and 139.264 Mb/s.

Frame Formats

All Rates: Unframed, Framed or Structured.

2 Mb/s, and 64 kb/s Framing: PCM30 CAS with or without CRC4, PCM31 with or without CRC4. As ITU-T Rec. G.704

8 Mb/s Framing: As ITU-T Rec. G.742

34 Mb/s Framing: As ITU-T Rec. G.751

140 Mb/s Framing: As ITU-T Rec. G.751

Background Patterns: Unframed 2^9-1 PRBS, AIS or same pattern as test signal.

External 2 Mb/s Mux I/P: Meets ITU-T Rec. G.703, unbalanced HDB3 signal only.

Receiver (Option UKJ, UKL)

Interface bit rate:

2.048 Mb/s: ±100 ppm balanced/unbalanced.
8.448 Mb/s: ±100 ppm unbalanced.
34.368 Mb/s: ±100 ppm unbalanced.
139.264 Mb/s: ±100 ppm unbalanced.

Line codes: As transmitter.

Autosetup: Bit rate, test pattern, framing and level of an incoming signal.

Synchronization: Sync loss when BER ≥ 20% over 100 ms for PRBS or ≥ 4% over 100 ms for word patterns. Sync gain when 32 consecutive error free bits received.

Equalization at f/2: 2.048 Mb/s, 8.448 Mb/s: 34.368 Mb/s, 139.264 Mb/s: 6 dB

Monitor point compensation: 2.048 Mb/s, 8.448 Mb/s: 20 dB, 6.448 Mb/s: 26 dB or 30 dB, 3.436, 139.264 Mb/s: 20 dB or 26 dB.

Frame Formats: As transmitter.

Frame Alignment 2 Mb/s: As ITU-T Rec. G.706


Frame Alignment 8 Mb/s: As ITU-T Rec. G.742.

Frame Alignment 34 Mb/s: As ITU-T Rec. G.751.

Frame Alignment 140 Mb/s: As ITU-T Rec. G.751.

Frame Gain 2 Mb/s: 1 correct sequence of FAS-NFAS-FAS.

Frame Loss 2 Mb/s: 3 consecutive incorrect FAS or NFAS words.

Frame Gain 2 Mb/s CAS: 1 correct CAS multiframe and the previous CAS word is not 0000.

Frame Loss 2 Mb/s CAS: 2 consecutive errored CAS multiframe patterns or 16 frames with CAS word 0000.

PDH Binary Interfaces (Option UH3)

Option UH3. Provides binary interfaces for the PDH modules (Options UKK and UKJ)

Transmitter

Binary Data Output

Data rates: 700 kb/s to 50 Mb/s (TTL),
General Information
Specifications

700 kb/s to 170 Mb/s (ECL)
Format: NRZ
Source impedance: Nominal TTL into 75 Ω to ground or nominal ECL into 75 Ω to -2V
Return loss: Typically >15 dB, 500 kHz to 100 MHz (TTL)

Binary Clock Output
Clock rates: 700 kb/s to 50 Mb/s (TTL), 700 kb/s to 170 Mb/s (ECL)
Format: Nominal squarewave 60/40 to 40/60 duty cycle.
Source impedance: Nominal TTL into 75 Ω to ground or nominal ECL into 75 Ω to -2V
Return loss: Typically >10 dB, 500 kHz to 100 MHz (TTL)

External Clock Input
Clock rates: 700 kb/s to 50 Mb/s (TTL), 700 kb/s to 170 Mb/s (ECL)
Logic threshold: 1.5V (TTL), -1.3V (ECL), ground (0V), signal mean level.
Termination: Nominal TTL into 75 Ω to ground or nominal ECL into 75 Ω to -2V
Format: Nominal squarewave 60/40 to 40/60 duty cycle.
Return loss: Typically >15 dB, 500 kHz to 200 MHz (TTL)

Receiver
Binary Data Input
Data rates: 700 kb/s to 50 Mb/s (TTL), 700 kb/s to 170 Mb/s (ECL)
Logic threshold: 1.5V (TTL), -1.3V (ECL), ground (0V).
Format: NRZ
Termination: Nominal TTL into 75 Ω to ground or nominal ECL into 75 Ω to -2V

Return loss: Typically >15 dB, 500 kHz to 200 MHz (TTL)

Binary Clock Input
Clock rates: 700 kb/s to 50 Mb/s (TTL), 700 kb/s to 170 Mb/s (ECL)
Logic threshold: 1.5V (TTL), -1.3V (ECL), ground (0V), signal mean level.
Format: Nominal squarewave 60/40 to 40/60 duty cycle.
Termination: Nominal TTL into 75 Ω to ground or nominal ECL into 75 Ω to -2V
Return loss: Typically >15 dB, 500 kHz to 100 MHz (TTL)

Binary interface rates: 2, 8, 34 and 140 Mb/s if Option UKJ is fitted. 0.7, 2, 8, 34 and 140 Mb/s if Option UKK is fitted.
Frequency measurement: On external clock input and binary clock input.

Jitter generation: Simultaneous jitter of binary clock and binary data outputs if Option UHK or A3K (2, 8, 34 & 140 Mb/s) is fitted.
Jitter measurement: Jitter measurement of binary clock input if Option UHN, A1M, A1N, A1P, A3L, A3V or A3N (2, 8, 34 & 140 Mb/s ±100 ppm) is fitted.
General Information
Specifications

**DS1/DS3/E1/E3 structured test interfaces (Option 110)**

**OUT and IN ports** (used for transmit and receive)

**Type:** Electrical: To ANSI T1.102-1993; ITU-T O.171, G.703.

**Connectors:**
- DS1 (1.554 Mb/s): WECO bantam, 100 Ω balanced. DS3 (44.736 Mb/s): BNC, 75 Ω, unbalanced.
- E1 (2.048 Mb/s): BNC, 75 Ω, unbalanced and WECO bantam, 120 Ω balanced.
- E3 (34.368 Mb/s): BNC, 75 Ω, unbalanced.

**Rate:** 1.544, 2.048, 34.368, 44.736 Mb/s.

**DSn/PDH transmitter**

**Clock timing:** Internal: All rates; Recovered by the receiver.

**Frequency offset generation:**
Up to 100 ppm in 1 ppm steps.

**Clock output:** Selected transmitter clock (internal or looped receiver clock) used to generated DS1/DS3/E1/E3 test output signal. (BNC connector, externally terminated 50 Ω to ground).

**Line coding:**
- DS1: B8ZS, AMI.

**Output level:**
- DS1: DSX-1, DS1-LO.
- DS3: DS3-HI, DSX-3, DS3-900'

N x 64 kb/s and N x 56 kb/s structured for DS1 and DS3.

**Test pattern:**
- PRBS: $2^9-1, 2^{11}-1, 2^{15}-1, 2^{20}-1, 2^{23}-1$.
- QRSS (DS1 only).
- 3-in-24 stress pattern (DS1 only).
- Word: 1010, 1000, 16 bit user word, all ones, all zeros. The PRBS polarity of patterns is user selectable.

**Error add:**
- DS1: Bit, FAS (Frame Alignment Signal), BPV/code, CRC-6, EXZ (excess zeros).
- DS3: Bit, FAS, MFAS (MultiFrame Alignment Signal), BPV/code, parity (P bits), CP (path parity), FEBE, EXZ (excess zeros).
- E1: Bit, FAS, BPV/code, CRC-4, REBE.
- E3: Bit, FAS, BPV/code.

**Error insertion rate:** Single. 1.0E-3, 1.1E-3, 1.0E-4 to 9.9E-9. Mantissa step size 0.1, exponent step size 1.

**Alarm generation:**
- DS1: Loss of signal (LOS); Out of frame (OOF); alarm indication signal (AIS); remote alarm indication (RAI).
- DS3: LOS; LOF; AIS; RAI; far end alarm and control (FEAC): As per T1.107-1995.
- E1: LOS, LOF, AIS, RAI.
- E3: LOS, LOF, AIS, RAI.
FEAC code generation: With C-Bit parity framing loopback and alarm/status codes as per ANSI T1.107-1995 can be generated. Loopback codes: A single burst of N loopback codes and M messages where N and M are in the range 1 through 15.
Alarm/status codes: Any ANSI T1.107-1995 message or any 0xxxxxx011111111 message where x is selectable may be transmitted either in a single burst of 1 to 15 times or continuously.

Spare bits generation: The following spare bits can be modified:
34 Mb/s: FAS bit 12
2 Mb/s Si bits (international bits): Timeslot 0 bit 1 in both FAS and NFAS frames.
2 Mb/s E bits: CRC4 frames 13 and 15; timeslot 0 bit 1.
2 Mb/s Sa bit (national bits): NFAS timeslot bits 4 to 8.
2 Mb/s Sa bit sequences: An 8 bit sequence may be transmitted in any selected NFAS Sa bit when CRC4 framing has been selected. The sequence appears in odd-numbered CRC4 frames, starting at frame 1.
2 Mb/s CAS multiframe: MFAS timeslot bits 5, 7 and 8.

Signaling bits generation: DS1: User selectable Signaling ON or OFF. When ON user selectable AB bits for SF, ABCD for ESF and AB bits for SLC-96 framing.

Background patterns: Unframed $2^9-1$ PRBS, AIS or same as test pattern as foreground test signal.

Ext DS1 mux input: Weco bantam connector, AMI or B8ZS.
Ext 2 Mb/s mux input: BNC to ITU-T G.703, AMI or B8ZS.

DSn/PDH receiver
Type, connectors, rates, line code and framing: As for DSn/PDH transmitter.

Jitter tolerance: To Bellcore TR-TSY-000009 (DS1/DS3) and ITU-T O.171.

Operating level (terminate):
User selectable as follows:
DS1 (balanced): DSX-1 to DS1-LO levels.
DS3 (unbalanced): DS3-HI, DSX-3 and DS3-900 levels.
E1 (balanced): 3.0 V ± 20% for cable lengths as per ITU-T G.703.
E1 (unbalanced): 2.37 V ± 20% for cable lengths as per ITU-T G.703.
E3 (unbalanced): 1.0 V ± 20% with automatic equalization for cable lengths as per ITU-T G.703.

Monitor point compensation:
DS1 (balanced), E1 (balanced and unbalanced): 20, 26 or 30 dB gain relative to terminate mode. E1 (balanced) is restricted to half cable length with respect to ITU-T G.703 for 26 and 30 dB gains.
DS3 and E3: 20 or 26 dB gain relative to terminate mode.

Framing: All rates: Unframed, framed and structured. DS1: ESF (D4).
DS1: ESF to ANSI T1.403-1989, Bellcore TR-TSY-000499 and ITU-T G.704; the ESF data link (DL) defaults to repetition of idle code (01111110); DS3: M13 to ANSI T1.107-1995.
General Information

Specifications

DS3: C-bit parity to ANSI T1.107a-1990. E1: To ITU-T G.706/G.732
E3: To ITU-T G.751
N x 64 kb/s structured to ITU-T G.704
for E1, E3
N x 64 kb/s and N x 56 kb/s structured
for DS1 and DS3.

SDH MODULE: Option US1

Adds SDH STM-1 electrical transmit
and receive capability, frequency offset
capability, and error and alarm
generation.

SDH Transmit and Receive

SDH rate: 155.52 Mb/s
Frequency Offset: up to ±999 ppm.
Interface: Meets ITU-T G.703.
Connector: BNC, 75 unbalanced.

Payload:
140 Mb/s: Unframed, mapped into VC-4
according to ITU-T G.709 Figures 5.2 and 5.3.

34 Mb/s: Unframed, mapped into VC-3
according to ITU-T G.709 Figure 5.5.
Mapping route is C3-VC-3-TU-3-TUG3-VC-4.
The TU-3 pointer value is 0 with
normal New Data Flag in all TU-3’s.
SS bits “10”. Background TU pointers
are the same as the foreground.
The two background VC-3’s are filled
with a fixed byte value 10101010

2 Mb/s: Unframed, mapped into VC-12
according to ITU-T G.709 Figure 5.8.
Mapping route is C12-VC-12-TU-12-TUG2-TUG3-VC-4.
All background TU-12’s have mapped
2^9 -1 PRBS payload and the same
overhead values as the foreground.

Test patterns:
PRBS: 2^{15} -1, 2^{23} -1 at all payload rates
(SIU-T T.151).
Word: User-defined 16 bit word, all
ones, all zeros, 1010, 1000.

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

Clock timing: Internal or recovered or
external MTS.
Recovered: From received SDH signal.
EXT MTS: Data or clock format as
ITU-T G.811.

TX Overhead

Regenerator section overhead:
A1A2 contains pattern F628
(hexadecimal)
Cl is set to “00000001”.
B1 is the BIP-8 parity (using even
parity) calculated over the entire
previous frame, after scrambling.
E1 is transmitted as all zeros.
F1 is transmitted as all zeros.
D1-D3 are transmitted as all zeros.
All other bytes are all zero’s.

Multiplexer section overhead:
H1,H2 - H2 and the 2 least significant
bits of H1 indicate an in-range pointer
value. The 4 most significant bits of H1
are set to 0110 indicating normal New
Data Flag. The SS bits are set to 10.
H3 is transmitted as all zeros.
B2 is the BIP-24 parity (using even
parity) calculated over the MSOH bytes
and the VC-4 capacity.
K1,K2 are transmitted as all zeros.
D4 - D12 are transmitted as all zeros.
Z1,Z2 are transmitted as all zeros.
E2 is transmitted as all zeros.
All other bytes are all zero’s.
General Information

Specifications

User programmable
K1,K2 - Can only program 1 byte at a time i.e. K1 or K2.
S1 - Bits 5 - 8 only.

VC-4 path overhead:
J1 - a unique ASCII message is transmitted: “HP37717C
COMMUNICATIONS
PERFORMANCE ANALYZER,
GB00000000”’. Terminated by CR,LF.
B3 is the BIP-8 parity (using even parity) calculated over the previous
VC-4,before scrambling.
C2 is transmitted as Hexadecimal 12
(140 Mb/s Mapping) or 02 (2 Mb/s &
34 Mb/s Mapping).
G1 is transmitted as all zeros.
F2 is transmitted as all zeros.
H4 is transmitted as all zeros unless a
TU-12 payload is selected, in which
case the reduced H4 sequence defined
in ITU-T Rec. G.709 is transmitted.
Z3 - Z5 are transmitted as all zeros.
All other bytes are all zeros.

VC-3 path overhead:
J1 - a unique ASCII message is transmitted: “HP37717C
COMMUNICATIONS
PERFORMANCE ANALYZER,
GB00000000”’. Terminated by CR,LF.
B3 is the BIP-8 parity (using even parity) calculated over the previous
VC-3,before scrambling.
C2 is transmitted as Hexadecimal 04
(34 Mb/s mapping).
G1 is transmitted as all zeros.
F2 is transmitted as all zeros.
H4 is transmitted as all zeros.
Z3 - Z5 are transmitted as all zeros.
All other bytes are all zeros.

TU-12 overhead: V1,V2 - V2 and the
2 least significant bits of V1 are 0
indicating a pointer value of 0. The 4
most significant bits of V1 are 0110
indicating normal New Data Flag. The
SS bits are 10 indicating TU-12
payload. \nV5 - Bits 1 and 2 are the BIP-2 parity of
the previous VC-12 including V5 but
excluding V1 - V4. The VC-12 spans 4
frames.
Bits 5 - 7 are set to 010 indicating
Async mapping. All other bits are set to
0.

Pointer detection
AU-4 pointer value, TU-3 pointer value and TU-12 pointer
value.

Alarm generation
Loss of frame (LOF) STM-1 Only,
AU-4 Loss Of Pointer (AU-4 LOP),
Multiplexer Section (MS AIS),
Multiplexer Section FERF (MS FERF),
AU-4 Path AIS,
AU-4 Path FERF,
TU-3 Path AIS,
TU-3 Path FERF,
TU-3 LOP,
TU-12 Path AIS,
TU-12 Path FERF and
TU-12 LOP.

Equalization: Automatic for cable loss
up to 12 dB at half the bit rate.

Monitor point compensation: 20 dB
General Information

Specifications

<table>
<thead>
<tr>
<th>Error Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Error type</strong></td>
</tr>
<tr>
<td>Frame A1A2</td>
</tr>
<tr>
<td>B1</td>
</tr>
<tr>
<td>B2</td>
</tr>
<tr>
<td>B3</td>
</tr>
<tr>
<td>Path FEBE</td>
</tr>
<tr>
<td>VC-3 Path BIP</td>
</tr>
<tr>
<td>VC-3 Path FEBE</td>
</tr>
<tr>
<td>V5 BIP-2</td>
</tr>
<tr>
<td>V5 FEBE</td>
</tr>
<tr>
<td>Payload Bit</td>
</tr>
</tbody>
</table>

**Option A3R**

**OUT and IN ports**
(used for transmit)

**Type:** Electrical: To ITU-T G.703.

**Connectors:** BNC, 75 Ω, unbalanced.
(Small Siemens 75 Ω unbalanced option available.)

**Rate:** 155.52 Mb/s, 51.84 Mb/s.

**Line code:** 155.52 Mb/s: CMI. 51.84 Mb/s: B3ZS.

**Output level:** 155.52 Mb/s: ±0.5 V ±10%. 51.84 Mb/s: Output level is user configurable.
STM-0 X CON: 530 mV peak nominal.
STM-0 HI: 1.1 V peak nominal.
STM-0 LOW: 350m V peak nominal.

**Error output:** B3 error output pulse on receipt of STM-0 and STM-1 signals.
TTL pulse termination 75 Ω or 10 kΩ.

**Simultaneous STM-1e/STM-1e and STM-1o:** When used in conjunction with the appropriate optical interfaces, transmit STM-1 electrical output signal simultaneously with optical output signal.

**Transmitter**

**Clock timing:** Internal: All rates.
Recovered: From SDH input (CMI or NRZ electrical or optical).
Ext MTS: 64 kb/s conforming to ITU-T G.703, 2 Mb/s conforming to ITU-T G.811. BNC, 75 Ω, unbalanced or Siemens (3-pin), 120 Ω, balanced.
(Siemens (3-pin) connector is present on option A3R. Option 120 replaces this connector with a Bantam connector).
General Information

Specifications

**Frequency offset generation:**
Up to ±999 ppm in 0.1 ppm steps.

**Error addition:**

<table>
<thead>
<tr>
<th>Error type</th>
<th>Single</th>
<th>Rate (10^{-N})</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame A1A2</td>
<td>*</td>
<td></td>
<td>N in 4 frame words</td>
</tr>
<tr>
<td>B1</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>MS REI</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>AU-4 path BIP-8 (B3)</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>AU-4 path REI</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>AU-4 path IEC</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>AU-3 path BIP-8 (B3)</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>AU-3 path REI</td>
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<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>AU-3 path IEC</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-3 path BIP-8 (B3)</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-3 path REI</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-2 path BIP (V5)</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-2 path REI</td>
<td>*</td>
<td>5 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-12 path BIP (V5)</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-12 path REI</td>
<td>*</td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-11 path BIP</td>
<td></td>
<td>3 - 9</td>
<td></td>
</tr>
<tr>
<td>TU-11 path REI</td>
<td></td>
<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>Bit error *</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
</tbody>
</table>

\(\dagger\) MSP threshold \(N\) errors in \(T\) ms where \(0 \leq N \leq 1920\) (STM-1) and \(10\) ms \(\leq T \leq 10000\) s, in decade steps.

* For SDH stand-alone operation, bulk-filled payloads and DS1, DS3 mapped payloads only. For bit error rates supported with other payloads refer to the PDH test option for details.
General Information
Specifications

Alarm generation:
LOS, LOF, OOF, MS AIS, MS RDI,

Payload capability

STM-1/STM-4 payload mappings (to ITU-T G.707):
139.264 Mb/s into a VC-4 and VC-4 bulk-filled mappings. 34.368 Mb/s into VC-3 and VC-3 bulk-filled mappings. 2.048 Mb/s (async and fl. byte sync) into VC-12 and VC-12 bulk-filled mappings.
DS3 (44.736 Mb/s) into VC-3 and VC-3 bulk-filled mappings
DS1 (1.544 Mb/s) async into VC11†.
VC-3 - TU-3 - TUG-3 - VC-4 - AU-4 - AUG; VC-3 - AU-3 - AUG.
VC-2 bulk filled mapping and TU-2-Nc (for N = 2 to 6): VC-2 - TU-2 - TUG-2 - TUG-3 - VC-4 - AU-4 - AUG
VC-2 - TU-2 - TUG-2 - VC-3 - AU-3 - AUG.
VC-12 - TU-12 - TUG-2 - TUG-3 - VC-4 - AU-4, VC-12 - TU-12 - TUG-2 - TUG-3 - VC-3 - AU-3 - AUG.
VC-11 - TU-11 - TUG-2 - TUG-3 - VC-4 - AU-4 - AUG, VC-11 - TU-11 - TUG-2 - TUG-3 - AU-3 - AUG

† DS1 and DS3 mappings require PDH options UKJ, UKN or 110 to be fitted.

Payload data: The following unframed patterns can be generated: (Framed and structured signals are available in conjunction with the PDH/DSn option UKJ/UKN/110).
PRBS: 2⁰-1 (O.150), 2¹¹-1 (O.152), 2¹⁵-1 (O.151) and 2²³-1 (O.151)
QRSS (2²⁰-1, 14 zero limited)†
Word: User-defined 16-bit word, all ones, all zeros, 1010, 1000. All PRBS patterns can be set to inverted or non-inverted.

† Applicable to DS1 mappings only.

Payload framing: 139.264, 34.368 and 2.048 Mb/s: Unframed.
139.264, 34.368 and 2.048 Mb/s: Framed and structured.†
DS3† payloads: Unframed, C-Bit parity (to ANSI T1.107a-1990) M13 (to ANSI T1.107-1988).
† Only available in conjunction with the PDH/DSn option UKJ/UKN/110.

Drop/insert: 139.264 Mb/s: Drop/insert via Tx/Rx on options UKJ/UKN.
45.736 (DS3): Drop/insert via Tx/Rx on option 110.
34.368 Mb/s: Drop/insert via Tx/Rx on options UKJ/UKN/110.
2.048 Mb/s: Drop/insert via drop/insert ports on options UKJ/UKN/110.
General Information
Specifications

1.544 Mb/s: Drop/insert via drop/insert ports on option 110.

**Pointer adjustment generation**

Increment/decrement/alternating:
Provides a burst, selectable between 1 and 10 pointer adjustments (between 1 and 5 for TU-12 or TU-11 pointer).

New pointer value: The AU-4, AU-3, TU-3, TU-2, TU-12 or TU-11 moves to a selectable new location in a single jump, with or without an accompanying new data flag (NDF).

Frequency offset (and 87:3):
Pointer sequences are generated by offsetting the frequencies of the AU-4, AU-3 (in these modes the 87:3 sequence is generated to ITU-T G.783) or TU-3, TU-2, TU-12, TU-11 and the line rate relative to each other.
Range: ±100 ppm in 0.1 ppm steps.

**ITU-T G.783 sequences:** Bursts of periodic single adjustments with added or canceled adjustments. Polarity is selectable. Bursts of periodic double adjustments with pairs alternating in polarity. In all cases the interval between adjustments or pairs of adjustments is programmable. On starting to run any of the pointer sequences an initialization sequence followed by a cool down period may be run prior to the chosen sequence.

**Transmit overhead**

**Overhead:** Default selection: Standard overhead values to ITU-T G.707.

SOH user-settable bytes: SOH can be set in binary or HEX. RSOH: A1, A2, J0, E1, F1, D1 to D3. J0 path trace:

User-defined/predefined 16-byte ITU-T E.164 sequence. MSOH: K1, K2, D4 to D12, S1, M1, Z1+, Z2+, E2 (and access to bytes reserved for national use plus all bytes reserved for future international standardization). VC-4 and VC-3 POH: J1, C2, G1, F2, H4, F3, K3, N1, J1 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence or 64-byte sequence. VC-2, VC-12, VC-11 POH: V5, J2, N2, K4. J2 path trace: User defined/predefined 16-byte ITU-T E.164 sequence.

† Z1 and Z2 are not present in STM-0 mode.

**Overhead sequence generation:**
A single or multi-byte overhead channel is overwritten with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames.

RSOH:
6-byte channel A1A2
3-byte channel D1 to D3
Single byte channels: C1, E1, F1.

MSOH:
9-byte channel D4 to D12
2-byte channel K1K2.
Single byte channels: S1, M1, Z1+, Z2+, E2.

† Z1 and Z2 are not present in STM-0 mode.

**Overhead BER test:** Any RSOH, MSOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a
property of the content. Some of the text is as follows:

**General Information**

**Specifications**

BER measurement is performed using a $2^9-1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern.

**MSP message generation:**
Messages are displayed in text form as per ITU-T G.783 for linear architecture and to ITU-T G.841 for ring architectures (MSP-ring). User programmed sequences (K1K2).

**DCC drop/insert:** The data supplied to the DCC port can be inserted into either the regenerator section or multiplexer section data communications channel. Similarly, data can be dropped from either channel. The data may be dropped/inserted MSB or LSB first. The data rate for access is: 192 kb/s (RSOH DCC), 576 kb/s (MSOH DCC).

**Optical interface stress test:** 2 to 259 bytes of the payload are overwritten with a block of zeros or ones after scrambling. Alternatively the ITU-T G.958 CID (consecutive identical digits) test can be selected.

**Tributary scan:** Automatically test BER on each SDH tributary for error free operation. Rx setup is used to determine tributary structure and test pattern. Alarms: Pattern loss. Test time: Fully user selectable. User selectable bit error threshold: Off, > 0, ≥ 10-3, ≥ 10-6.

**Mixed payloads:** Backgrounds can be individually configured to have TU-11, TU-12 or TU-3 independently for foreground testing channel.

**Keep alive signals:** PDH: Transmit last configured SDH signal while transmitting a PDH signal.

**SDH:** With structured PDH options transmit unframed fixed word PDH signal while transmitting a SDH signal.

**SDH:** Using unstructured PDH option transmit last configured PDH signal while transmitting an SDH signal.

**Thru mode**

**Transparent thru mode:** The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.

**Overhead overwrite thru mode:** In addition to the above, the test features associated with the SOH and POH can be enabled to control one single- or multi-byte overhead channel (i.e. errors and alarms, optical stress test, overhead sequences, MSP messages, DCC insert, overhead BER. Full Rx functionality also available).

**AU-4/AU-3 overwrite thru mode:** In addition to both of the above, overwrite the complete AU-4/AU3 with the internally generated payload. This enables the SOH to be looped through while a new payload is inserted. All of the test features which affect the VC-4/VC-3 and/or the POH are enabled (i.e. errors and alarms, adjust pointer, overhead sequences, MSP messages, overhead BER. Full Rx functionality also available).

**Tributary overwrite thru mode:**

When the payload passing through the instrument contains a TU structure, thru mode it will be possible to choose a
single TU to be overwritten, as opposed to the complete payload. All of the test features which affect the TU and/or the POH are enabled (i.e. errors and alarms, adjust pointer. Full Rx functionality also available).

**STM-1e and STM-0/STM-1e receiver functions**

**STM-1 receive input**

*Equalization:* Automatic for cable loss up to 12 dB at half the bit rate.

*Monitor point compensation:* Monitor mode conforms to ITU-T G.772. Monitor gain 20 to 26 dB.

**STM-0 receive input**

*Operating level:* Receiver mode is user selectable.
- STM-0 XCON: 530 mV peak nominal
- STM-0 HI: 1.1 V peak nominal, equalization up to 450 ft.
- STM-0 LOW: 1.1 V peak nominal, equalization from 450 to 900 ft.

*Monitor point compensation:* Monitor mode conforms to ITU-T G.772. Monitor gain 20 to 26 dB.

**STS-3/STM-1e and STM-0/STM-1e test and interfacing (Option 120)**

(for SDH specification see A3R)

**OUT and IN ports** (used for transmit)

*Type:* Electrical: To ITU-T G.703.

*Connectors:* BNC, 75 Ω, unbalanced.

*Rate:* 155.52 Mb/s, 51.84 Mb/s.

**Line code:**
- 155.52 Mb/s: CMI.
- 51.84 Mb/s: B3ZS.

**Output level:**
- 155.52 Mb/s: ±0.5 V ±10%.
- 51.84 Mb/s: Output level is user configurable.
- STS-1 X CON: 530 mV peak nominal.
- STS-1 HI: 1.1 V peak nominal.
- STS-1 LOW: 350m V peak nominal.

**Error output:** B3 error output pulse on receipt of STS-1 and STS-3 signals.

TTL pulse termination 75 Ω or 10 k Ω.

**Simultaneous STS-3 and OC-3:**
When used in conjunction with the appropriate optical interfaces, transmit STS-3 electrical output signal simultaneously with OC-3 optical output signal.

**Transmitter**

*Clock timing:* Internal: All rates.

Recovered: From SONET input (CMI or NRZ electrical or optical)

Bits: 1.544Mb/s DS1 timing reference as per TA-TSY-000378 Bantam, 100 Ω nominal, unbalanced

Ext MTS: 64kb/s conforming to ITU-T G.703, Bantam, 120 Ω balanced*

2 Mb/s conforming to ITU-T G.811, BNC 75 Ω unbalanced,*

Bantam 120 Ω balanced.*

*Available when instrument in SDH mode.

**Frequency offset generation:**

Up to ±999 ppm in 0.1 ppm steps.

**Error addition:**
General Information

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<table>
<thead>
<tr>
<th>Error type</th>
<th>Single</th>
<th>Rate 10^N</th>
<th>Comments</th>
</tr>
</thead>
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<tr>
<td>Frame A1A2</td>
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<td>N in 4 frame words</td>
</tr>
<tr>
<td>CV-S (B1)</td>
<td>*</td>
<td>4 - 9</td>
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</tr>
<tr>
<td>CV-2 (B2)</td>
<td>*</td>
<td>3 - 9</td>
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</tr>
<tr>
<td>REI-L</td>
<td>*</td>
<td>3 - 9</td>
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</tr>
<tr>
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<td>4 - 9</td>
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<tr>
<td>STS-3c SPE REI-P</td>
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<td>4 - 9</td>
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</tr>
<tr>
<td>STS-3c SPE IEC-P</td>
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<td>4 - 9</td>
<td></td>
</tr>
<tr>
<td>STS-1 SPE CV-P (B3)</td>
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<td>4 - 9</td>
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</tr>
<tr>
<td>STS-1 SPE REI-P</td>
<td>*</td>
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</tr>
<tr>
<td>STS-1 SPE IEC-P</td>
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</tr>
<tr>
<td>VT6 CV-P (V5)</td>
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<tr>
<td>VT6 REI-P</td>
<td>*</td>
<td>5 - 9</td>
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<tr>
<td>VT2 CV-P (V5)</td>
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<tr>
<td>VT2 REI-P</td>
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<td>4 - 9</td>
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</tr>
<tr>
<td>VT1.5 CV-P</td>
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<td>3 - 9</td>
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</tr>
<tr>
<td>VT1.5 REI-P</td>
<td>*</td>
<td>4 - 9</td>
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</tr>
<tr>
<td>Bit error *</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
</tbody>
</table>

† APS threshold \(N\) errors in \(T\) ms where \(0 \leq N \leq 1920\) (STM-3) and \(10\) ms \(\leq T \leq 10000\) s, in decade steps.

* For SONET stand-alone operation, bulk-filled payloads and DS1, DS3 mapped payloads only.

For bit error rates supported with other payloads refer to the DSn/PDH test option for details.

Alarm generation: LOS, LOF, SEF, AIS-L, RDI-L.
STS-3c SPE AIS-P, STS-3c SPE RDI-P, STS-3c SPE LOP, STS-3c SPE path unequipped.
VT6 path AIS, VT6 RDI-V, VT6 LOP, VT6 path unequipped, VT6 H4 LOM (loss of multiframe).
VT2 path AIS, VT2 RDI-V, VT2 LOP, VT2 path unequipped.
General Information

Specifications

VT2 H4 LOM (loss of multiframe).
VT1.5 path AIS, VT1.5 RDI-V, VT1.5
LOP, VT1.5 path unequipped
VT1.5 H4 LOM (loss of multiframe).

Payload capability

Payload mappings
(to Bellcore GR-253-CORE):
OC-12/OC-12c/OC-3/OC-3c
capability when optical module fitted.
DS3 (44.736 Mb/s) into STS-1 SPE and
STS-1 SPE bulk filled mappings:
DS1 (1.544 Mb/s) async into VT1.5.
139.264 Mb/s into a STS-3c SPE and
STS-3c SPE bulk-filled mappings.
2.048 Mb/s (async and fl. byte sync)
into VT2 SPE and VT2 SPE bulk filled
mappings:
34.368 Mb/s, into STS-1 SPE and STS-
1 SPE bulk filled mappings:
VT6 SPE bulk filled mapping and VT6
-Nc (for N = 2 to 6):
† DS1, DS3 mappings require DSn/
PDH option UKJ, UKN or 110 to be
fitted.

Payload data: The following unframed
patterns can be generated: (Framed and
structured signals are available in
conjunction with the PDH/DSn options
UKJ/UKN/110).
PRBS: 2^9-1 (O.150), 2^11-1 (O.152),
2^15-1 (O.151) and 2^23-1 (O.151)
QRSS (2^20-1, 14 zero limited)†
Word: User-defined 16-bit word, all
ones, all zeros, 1010, 1000. All PRBS
patterns can be set to be inverted or
non-inverted.
† Applicable to DS1 mappings only.

Payload framing: 139.264, 34.368 and
2.048 Mb/s: Unframed.
139.264, 34.368 and 2.048 Mb/s:
Framed and structured signals†
DS3 payloads: Unframed, C-Bit parity
(to ANSI T1.107a-1990)†
M13 (to ANSI T1.107-1988).
VT6: Unframed. DS1 payloads:
Unframed, SF (D4), ESF (to ANSI
T1.403-1989). TR-TSY-000499 and
ITU-T G.704), SLC-96†.
† Only available in conjunction with
the PDH/DSn option UKJ/UKN/110.

Drop/insert: 139.264 Mb/s: Drop/insert
via Tx/Rx on options UKJ/UKN.
45.736 (DS3): Drop/insert via Tx/Rx
on option 110.
34.368 Mb/s: Drop/insert via Tx/Rx on
options UKJ/UKN/110.
2.048 Mb/s: Drop/insert via drop/insert
ports on options UKJ/UKN/110.
1.544 Mb/s (DS1): Drop/insert via
drop/insert ports on option 110.

Pointer adjustment generation

Increment/decrement/alternating:
Provides a burst, selectable between 1
and 10 pointer adjustments (between 1
and 5 for VT6, VT2 and VT1.5
pointer).

New pointer value: The STS-3c SPE,
STS-1 SPE, VT6, VT2 or VT1.5 moves
to a selectable new location in a single
jump, with or without an accompanying
new data flag (NDF).

Frequency offset (and 87:3): Pointer
sequences are generated by
offsetting the frequencies of the STS-3c
SPE, STS-1 SPE (in these modes the
87:3 sequence is generated to Bellcore
GR-253-CORE/ANSI T1.105.03) or
VT6, VT2, VT1.5 and the line rate
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relative to each other.
Range: ±100 ppm in 0.1 ppm steps.

Bellcore GR-253-CORE and
ANSI T1.105.03: Bursts of periodic single adjustments with added or canceled adjustments. Polarity is selectable. Bursts of periodic double adjustments with pairs alternating in polarity. In all cases the interval between adjustments or pairs of adjustments is programmable. On starting to run any of the pointer sequences an initialization sequenced followed by a cool down period may be run prior to running the chosen sequence.

Transmit overhead

Overhead: Default selection: Standard overhead values to Bellcore GR-253-CORE and ANSI T1.05

STS-3/STS-1 user-settable bytes:
TOH can be set in binary or HEX. SOH: A1, A2, J0, E1, F1, D1 to D3. J0 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence.
LOH: K1, K2, D4 to D12, S1, M1, E2 (and access to bytes reserved for national use plus all unmarked bytes reserved for future international standardization).
STS-1 SPE POH: J1, C2, G1, F2, H4, Z3, Z4,N1.
J1 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence or 64-byte sequence.
VT6 SPE, VT2 SPE, VT1.5 SPE POH: V5, J2, Z6, Z7.
J2 path trace: User defined/predefined 16-byte ITU-T E.164 sequence.

Overhead sequence generation:
A single or multi-byte overhead channel is overwritten with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames.

SOH:
6-byte channel A1A2
3-byte channel D1 to D3
Single byte channels: C1, E1, F1.

LOH:
9-byte channel D4 to D12
2-byte channel K1K2
Single byte channels: S1, M1, Z1†, Z2†, E2.
† Z1 and Z2 are not present in STS-1 mode.

High order POH:
Single byte channels: J1, C2, G1, F2, H4, Z3, Z4, N1.

Overhead BER test: Any SOH, LOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a 2⁹⁻¹ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern.

APS message generation: Messages are displayed in text form as per Bellcore GR-253-CORE for linear architecture and to Bellcore GR-1230-CORE for ring architectures (BLSR). User programmed sequences (K1K2).

DCC drop/insert: The data supplied to the DCC port can be inserted into either the regenerator section or multiplexer section data communications channel. Similarly, data can be dropped from
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either channel. The data may be dropped/inserted MSB or LSB first. The data rate for access is: 192 kb/s (SOH DCC), 576 kb/s (LOH DCC).

Optical interface stress test:
2 to 259 bytes of the payload are overwritten with a block of zeros or ones after scrambling. Alternatively the ITU-T G.958 CID (consecutive identical digits) test can be selected.

Tributary scan: Automatically test BER on each SONET tributary for error free operation. Rx setup is used to determine tributary structure and test pattern. Alarms: Pattern loss. Test time: Fully user selectable. User selectable bit error threshold: Off, > 0, ≥10-3, ≥10-6.

Mixed payloads: Each STS-1 SPE within an STS-3 can be independently configured to contain a STS-1 SPE user word, VT2 or VT1.5 structure.

Keep alive signals: DSn/PDH: Transmit last configured SONET signal while transmitting a DSn/PDH signal.

Thru mode

Transparent thru mode:
The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.

Overhead overwrite thru mode:
In addition to the above, the test features associated with the TOH and POH can be enabled to control one single- or multi-byte overhead channel (i.e. errors and alrams, optical stress test, overhead sequences, APS messages, DCC insert, overhead BER. Full Rx functionality also available).

STS-3c/STS-1 SPE overwrite thru mode: In addition to both of the above, overwrite the complete SPE with the internally generated payload. This enables the TOH to be looped through while a new payload is inserted. All of the test features which affect the SPE and/or the POH are enabled (i.e. errors and alarms, adjust pointer, overhead sequences, APS messages, overhead BER. Full Rx functionality also available).

Tributary overwrite thru mode:
When the payload passing through the instrument contains a VT structure, thru mode it will be possible to choose a single VT to be overwritten, as opposed to the complete payload. All of the test features which affect the VT and/or the POH are enabled (i.e. errors and alarms, adjust pointer. Full Rx functionality also available).

STS-3 and STS-1 receiver functions

STS-3 receive input

Equalization: Automatic for cable loss up to 12 dB at half the bit rate.

Monitor point compensation: Monitor mode conforms to ITU-T G.772. Monitor gain 20 to 26dB.

STS-1 receive input
General Information

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**Operating level:**
Receiver mode is user selectable.
STS-1 XCON: 530 mV peak nominal.
STS-1 HI: 1.1 V peak nominal, equalization up to 450 ft.
STS-1 LOW: 1.1 V peak nominal, equalization from 450 to 900 ft.

**Monitor point compensation:**
Monitor mode conforms to ITU-T G.772. Monitor gain 20 to 26 dB.

**OVERHEAD and STRESS TEST**
**SDH MODULE:**
Option A1T.

Adds SDH STM-1 electrical transmit and receive capability, frequency offset capability, error and alarm generation, pointer sequence generation and overhead access.

**SDH Transmit and Receive**

**SDH rate:** 155.52 Mb/s
**Frequency Offset:** up to 999 ppm.
**Interface:** Meets ITU-T G.703
**Connector:** BNC, 75Ω unbalanced.
**Clock timing:** Internal or recovered or external MTS.

**Recovered:** From received SDH signal.

**EXT MTS:** Data or clock format as ITU-T G.811.

**Payload capability:**

**Payload mappings:** 139.264 Mb/s mapped into VC-4 according to ITU-T G.709.
34.368 Mb/s mapped into VC-3 according to ITU-T G.709.
2.048 Mb/s (asynchronous) mapped into VC-12 according to ITU-T G.709.
2.048 Mb/s (Floating byte synchronous) mapped into VC-12 according to ITU-T G.709.
VC-2 bulk loaded and mapped into TU-2 and TU-2-Nc (for N = 2-6) according to ITU-T G.709.

**Payload Data:**
**PRBS:** $2^5-1$, $2^{11}-1$, $2^{15}-1$, $2^{23}-1$ (ITU-T O.151).
**Word:** User-defined 16 bit word, all ones, all zeros, 1010, 1000.
Framed and structured payloads are available in conjunction with the Structured PDH option UKJ/UKN.

**Payload framing:** 139.264, 34.368, and 2.048 Mb/s and TU-2 Unframed.
139.264, 34.368, and 2.048 Mb/s framed and structured signals are available in conjunction with the Structured PDH option UKJ/UKN.

**External payload data:** 139.264 and 34.368 Mb/s data may be inserted and dropped via the IN/OUT ports of the Structured PDH option UKJ/UKN.
2.048 Mb/s data may be inserted and dropped via the 2 Mb/s drop/insert ports of the Structured PDH option UKJ/UKN.

**TX Overhead User programmable bytes:**
RSOH: A1,A2, C1, E1, F1, D1 to D3 and access to bytes reserved for national use plus all unmarked bytes reserved for future international standardization.
MSOH: K1, K2, D4 to D12, S1, M1, Z1, Z2, E2 and access to bytes reserved for national use plus all unmarked bytes reserved for future international standardization.
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VC-4 and VC-3 POH: J1, C2, G1, F2, H4, Z3 to Z5.
J1 Path Trace: 64 byte or 16 byte, ITU-T E.164 sequence or user defined byte.
VC-12 POH: J2, V5 signal label.
J2 Path Trace: 16 byte ITU-T E.164 sequence or user defined byte.

**Pointer adjustment generation:**
**Increment/Decrement:** The adjust pointer key provides a burst selectable between 1 and 10 pointer adjustments (between 1 and 5 for TU-12 and TU-2 pointer).
**Frequency offset:** these 87:3 pointer sequences are generated by offsetting the frequencies of the AU-4 (or TU-3, TU-12, TU-2) and the line rate relative to each other. Range: 100 ppm in 0.1 ppm steps.

**New pointer value:** The AU-4, TU-3, TU-12 or TU-2 moves to a selectable new location in a single jump, with or without an accompanying new data flag (NDF).

**ITU-T G.783 sequences:** Bursts of periodic single adjustments with added or cancelled adjustments. Polarity is selectable.
Bursts of periodic double adjustments with pairs alternating in polarity.
In all cases the interval between adjustments or pairs of adjustments is programmable.

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<thead>
<tr>
<th>Error type</th>
<th>Single</th>
<th>Rate 10^-N</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame A1A2</td>
<td>*</td>
<td></td>
<td>N in 4 frame words (STM-1 Only)</td>
</tr>
<tr>
<td>B1</td>
<td>*</td>
<td>4 - 9</td>
<td>STM-1 Only</td>
</tr>
<tr>
<td>B2</td>
<td>*</td>
<td>3 - 9</td>
<td>STM-1 Only</td>
</tr>
<tr>
<td>AU-4 Path BIP-8</td>
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<tr>
<td>MS FEBE</td>
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<td>TU-12 BIP</td>
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</tr>
<tr>
<td>Payload Bit</td>
<td>*</td>
<td>3 - 9</td>
<td></td>
</tr>
</tbody>
</table>

**Alarm generation** Loss of signal (LOS), Loss of frame (LOF) STM-1 Only, Out of frame (OOF), AU-4 Loss Of Pointer (AU-4 LOP), AU-4 path unequipped, AU-4 Path AIS, AU-4 Path FERF, Multiplexer Section AIS (MS AIS), Multiplexer Section FERF (MS FERF), TU-3 Path AIS, TU-3 path unequipped, TU-3 Path FERF, TU-3 LOP, TU-2 path AIS, TU-2 path FERF, TU-2 LOP, TU-2 path unequipped, TU-12 path unequipped, TU-12 Path AIS, TU-12 Path FERF and TU-12 LOP.

**Overhead sequence generation:** A single overhead channel is overwritten with a single or repeated sequence of programmed values. Alternatively a BER test can be performed on a selected byte of regenerator, multiplexer section or path overhead.

**MSP message generation:** Messages are displayed in text form as per ITU-T G.783. Also user programmed sequences.

**DCC insert/drop:** Data supplied to the DCC port can be inserted into either the regenerator section (192 kb/s) or multiplexer section (576 kb/s) communications channel. Similarly, data can be dropped from either. Data may be inserted/dropped MSB or LSB first.

**STM-1 optical interface stress test:** 2 to 259 bytes of the payload are overwritten with a block of zeros (or ones for NRZ systems) after scrambling. Alternatively the ITU-T G.958 test can be selected.

**STM-1 thru mode:**

- **Transparent mode:** The signal is passed through the instrument unaltered.
- **Overhead overwrite mode:** The test features associated with MSOH and POH can be enabled in order to control one single or multi byte overhead channel.
- **AU-4 overwrite mode:** Overwrite the complete AU-4 with the internally generated payload. This enables the SOH to be looped through while a new payload is inserted. All of the test features which affect the VC-4 and/or the POH are enabled.

**Equalization:** Automatic for cable loss up to 12 dB at half the bit rate.

**Monitor point compensation:** 20 or 26 dB

**Pointer detection:** AU-4, TU-3 and TU-12 pointer values.
General Information

Specifications

STM-1 OPTICAL INTERFACE:
Option UH1.
Rate: 155.52 Mb/s
Line code: NRZ
Connectors: Adaptors to which a range of interfaces can be attached.
Transmit:
Wavelength: 1280 - 1330 nm
Fibre power output: nominal -9 dBm
Safety classification: Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825
Receive:
Wavelength: 1200 - 1600 nm
Sensitivity: -28 dB minimum (with 1300 nm wavelength, 100% modulation depth, BER of 10^{-10} and 2^{23} PRBS)
Maximum input power: -8 dBm (for BER of 10^{-10})
Alarms detected: Loss of optical signal.

STM-1/STM-4 OPTICAL INTERFACE: Option UH2.
Rate: 155.52 Mb/s, 622.08 Mb/s
Line code: NRZ
Connectors: Adaptors to which a range of interfaces can be attached.
Transmit:
Wavelength: 1280 - 1330 nm
Fibre power output: nominal -10 dBm
Safety classification: Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825
Receive:
Wavelength: 1200 - 1600 nm
Sensitivity: -26 dB minimum (with 1300 nm wavelength, 100% modulation depth, BER of 10^{-10} and 2^{23} PRBS)
Maximum input power: -8 dBm (for BER of 10^{-10})
Alarms detected: Loss of optical signal.

STM-1/STM-4 OPTICAL INTERFACE: Option UH2.
Rate: 155.52 Mb/s, 622.08 Mb/s
Line code: NRZ
Connectors: Adaptors to which a range of interfaces can be attached.
Transmit:
Wavelength: 1520 - 1565 nm
Fibre power output: nominal -1 dBm
Safety classification: Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825
Receive:
Wavelength: 1200 - 1600 nm
Sensitivity: -26 dB minimum (with 1300 nm wavelength, 100% modulation depth, BER of 10^{-10} and 2^{23} PRBS)
Maximum input power: -8 dBm (for BER of 10^{-10})
Alarms detected: Loss of optical signal.
General Information

Specifications

Background STM-1 overhead:
A1,A2 contains pattern F628 (hexadecimal)
C1 - 00000001 to 00000100
Unused C1 bytes - AA (hexadecimal)
B1 - Correct BIP-8 parity H1,H2 - 6A and 0A (hexadecimal), Y=93 (hexadecimal)
B2 - Correct BIP-24 parity
B3 - Correct BIP-8 parity
H4 is transmitted as all zeroes unless a TU-12 payload is selected, in which case the reduced H4 sequence defined in ITU-T Rec. G.709 is transmitted. All other overhead bytes are transmitted as all zero’s.

Protected monitor point input:
Level: nominal 150 mV to 800 mV pk-pk

STM-1/STM-4 OPTICAL INTERFACE (1310 nm) with STM-4 Overhead Option UKT

Rate: 155.52 Mb/s, 622.08 Mb/s
Line code: NRZ
Connectors: Adaptors to which a range of interfaces can be attached.

Transmit:
Wavelength: 1280 - 1330 nm
Spectral width: 2.5 nm rms nominal
Extinction ratio: <8.2dB nominal
Fibre power output: -10dBm nominal
Safety classification: Class 3A, FDA 21 CFR Ch.1 1040.10 and EN 60825

Clock timing: Internal, recovered from received STM-1 or STM-4 optical signal, recovered from received STM-1 electrical signal, external MTS - data or clock format (as ITU-T G.811)

Frequency offset generation: Up to ±999 ppm in 0.1 ppm steps

STM-4 error add (Not available if SDH option is US1): Frame - single and N in 4 frame words, MS B2 BIP - 10^{-4} to 10^{-9}
STM-4 alarm generation: Loss of signal (requires A1T), loss of frame (requires A1T), multiplexer section AIS, multiplexer section FERF.
STM-4 thru mode: The STM-4 signal is passed through the HP 37717C without being altered for monitoring purposes where no protected monitor point is available.
STM-4 Tx Overhead: Standard overhead values to ITU-T G.70X

User programmable bytes (Not available if SDH option is US1):
RSOH: A1, A2, C1, E1, F1, D1-D3
MSOH: H1 (SS bits only), K1, K2, D4-D12, S1, Z2 (column 4), Z1 & Z2 (for STM-1 under test), M1 (when STM-1 number 3 selected for test)

STM-4 sequence generation (Not available if SDH option is US1): A single or multi-byte overhead channel is overwritten with a single or repeating sequence of programmed values. The sequence can contain up to 5 different values each being transmitted for up to 64,000 frames.
RSOH: D1-D3, E1, F1, C1 (for STM-1 under test), D4-D12, K1-K2, S1, E2, Z1 & Z2 (for STM-1 under test), M1 (when STM-1 number 3 selected for test)

High order POH: J1, C2, G1, F2, H4, Z3, Z4, Z5 (for STM-1 under test)
STM-4 overhead BER test (Not available if SDH option is US1): Any
General Information

Specifications

overhead channel listed under STM-4 sequence generation (except Z1, Z2) can have a \(2^9\)-1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern and a BER measurement performed.

**STM-4 MSP message generation:**
Messages are displayed in text form as ITU-T G.783.
User programmed sequences (Not available if SDH option is US1).

**Receive:**
- **Wavelength:** 1200 - 1600 nm
- **Sensitivity:** STM-1 -34dBm minimum, STM-4 -28 dB minimum (with 1300 nm wavelength, 100% modulation depth, BER of \(10^{-10}\) and \(2^{23}\) PRBS)
- **Maximum input power:** -8 dBm (for BER of \(10^{-10}\)). Damage level +10 dBm
- **Protected monitor point:**
  - **Input level:** nominal 150 mV to 1000 mV pk-pk
  - **Line code:** NRZ
  - **Impedance:** Nominal 50Ω AC coupled
- **Optical power measurement:** Range 0 to -30dBm, Accuracy ±1dB
- **STM-4 error results:** RS B1, MS B2
- **STM-4 alarms detected:** Loss of signal, loss of frame, out of frame, multiplexer section AIS, multiplexer section FERF, clock loss, K1/K2 change, (Not available if SDH option is US1).
- **STM-4 overhead sequence capture:** A single or multibyte overhead channel can be monitored. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

**RSOH:** A1A2, E1, F1, C1, (for STM-1 under test), D1-D3
**MSOH:** H1H2, K1K2, D4-D12, S1, E2, Z1 & Z2 (for STM-1 under test), M1 (when STM-1 number3 selected for test)
**High order POH:** J1, C2, G1, F2, H4, Z3, Z4, Z5 (for STM-1 under test)
**STM-4 overhead BER measurement (Not available if SDH option is US1):** Any RSOH, MSOH or POH channel listed under STM-4 overhead sequence capture can be selected and a BER measurement using the \(2^9\)-1 PRBS provided by the transmit overhead BER test function. Error count, error ratio, error free seconds, percentage error free seconds and pattern loss seconds are calculated.

STM-1/STM-4 (1310/1550 nm) OPTICAL INTERFACE with STM-4 Overhead Option USN
- **Rate:** 155.52 Mb/s, 622.08 Mb/s
- **Line code:** NRZ
- **Connectors:** Adaptors to which a range of interfaces can be attached.

**Transmit:**
- **Wavelength:** 1280 - 1330 nm or 1520 - 1565 nm
- **Spectral width:** 2.5 nm rms nominal
- **Extinction ratio:** 1310 nm - <8.2dB nominal, 1550 nm - <10dB nominal
- **Fibre power output:** 1310 nm -10dBm nominal 1550 nm -1 dBm nominal
- **Safety classification:** Class 3A, FDA 21 CFR Ch.1 1040.10 and EN 60825
- **Clock timing:** Internal, recovered from received STM-1 or STM-4 optical signal, recovered from received STM-1
General Information
Specifications

- electrical signal, external MTS - data or clock format (as ITU-T G.811)
- **Frequency offset generation**: Up to ±999 ppm in 0.1 ppm steps
- **STM-4 error add (Not available if SDH option is US1)**: Frame - single and N in 4 frame words, MS B2 BIP - 10^-4 to 10^-9
- **STM-4 alarm generation**: Loss of signal (requires A1T), loss of frame (requires A1T), multiplexer section AIS, multiplexer section FERF.
- **STM-4 thru mode**: The STM-4 signal is passed through the HP 37717C without being altered for monitoring purposes where no protected monitor point is available.
- **STM-4 Tx Overhead**: Standard overhead values to ITU-T G.70X

User programmable bytes (Not available if SDH option is US1):
- RSOH: A1, A2, C1, E1, F1, D1-D3
- MSOH: H1 (S5 bits only), K1, K2, D4-D12, S1, Z2 (column 4), Z1 & Z2 (for STM-1 under test), M1 (when STM-1 number 3 selected for test)
- **STM-4 sequence generation (Not available if SDH option is US1)**: A single or multi-byte overhead channel is overwritten with a single or repeating sequence of programmed values. The sequence can contain up to 5 different values each being transmitted for up to 64,000 frames.
- RSOH: D1-D3, E1, F1, C1 (for STM-1 under test), D4-D12, K1-K2, S1, E2, Z1 & Z2 (for STM-1 under test), M1 (when STM-1 number 3 selected for test)

High order POH: J1, C2, G1, F2, H4, Z3, Z4, Z5 (for STM-1 under test)

**STM-4 overhead BER test** (Not available if SDH option is US1): Any overhead channel listed under STM-4 sequence generation (except Z1, Z2) can have a 2^31-1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern and a BER measurement performed.

**STM-4 MSP message generation**: Messages are displayed in text form as ITU-T G.783.

User programmed sequences (Not available if SDH option is US1).

**Receive**:
- **Wavelength**: 1200 - 1600 nm
- **Sensitivity**: STM-1 -34dBm minimum, STM-4 -28 dB minimum (with 1310 nm wavelength, 100% modulation depth, BER of 10^-10 and 2^23 PRBS)
- **Maximum input power**: -8 dBm (for BER of 10^-10). Damage level +10 dBm

**Protected monitor point**:
- **Input level**: nominal 150 mV to 1000 mV pk-pk
- **Line code**: NRZ
- **Impedance**: Nominal 50Ω, AC coupled

**Optical power measurement**: Range 0 to -30dBm, Accuracy ±1dB

**STM-4 error results**: RS B1 BIP, MS B2 BIP

**STM-4 alarms detected**: Loss of signal, loss of frame, out of frame, multiplexer section AIS, multiplexer section FERF, clock loss, K1/K2 change. (Not available if SDH option is US1).

**STM-4 overhead sequence capture**
General Information

Specifications

(Not available if SDH option is US1): A single or multibyte overhead channel can be monitored. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

**RSOH:** A1A2, E1, F1, C1, (for STM-1 under test), D1-D3

**MSOH:** H1H2, K1K2, D4-D12, S1, E2, Z1 & Z2 (for STM-1 under test), M1 (when STM-1 number 3 selected for test)

**High order POH:** J1, C2, G1, F2, H4, Z3, Z4, Z5 (for STM-1 under test)

**STM-4 overhead BER measurement**

(Not available if SDH option is US1): Any RSOH, MSOH or POH channel listed under STM-4 overhead sequence capture can be selected and a BER measurement performed using the $2^9-1$ PRBS provided by the transmit overhead BER test function.

Error count, error ratio, error free seconds, percentage error free seconds and pattern loss seconds are calculated.

**STM-0/STM-1/STM-4 OPTICAL INTERFACE (1310 nm) with STM-4c Overhead Option 131**

- **Rate:** 51.84 Mb/s, 155.52 Mb/s
- **Line code:** NRZ
- **Connectors:** Adaptors to which a range of interfaces can be attached.

**Transmit:**

- **Wavelength:** 1280 – 1330 nm
- **Spectral width:** 2.5 nm rms nominal
- **Extinction ratio:** <8.2dB nominal
- **Fibre power output:** -10dBm nominal

**Safety classification:** Class 3A, FDA 21 CFR Ch.1 1040.10 and EN 60825

**Clock timing:** Internal, recovered from received STM-0, STM-1 or STM-4 optical, electrical or binary signal, external MTS - data or clock format (as ITU-T G.811)

**Frequency offset generation:** Up to $\pm 999$ ppm in 0.1 ppm steps

**VC-4-4C error add:** B3 BIP, HP REI, HP IEC - $10^{-9}$ to $10^{-9}$, Bit - $10^{-3}$ to $10^{-9}$.

**VC-4-4C alarm generation:** AU-AIS, HP-RDI, AU-LOP, Path Unequipped

**STM-4 error add:** Frame - single and N in 4 frame words, B1 BIP - $10^{-4}$ to $10^{-9}$, B2 BIP and RS REI - $10^{-3}$ to $10^{-9}$.

**STM-4 alarm generation:** Loss of signal, loss of frame, out of frame, multiplexer section AIS, multiplexer section RDI.

**STM-4 thru mode:**

- **Transparent mode:** The STM-4 signal is passed through the HP 37717B without being altered. The BIP’s are not recalculated.

**Overhead overwrite STM-4 mode:** The test features associated with the section overhead can be enabled in order to control one single or multi byte overhead channel. The B1 and B2 bytes are recalculated.

**Overhead overwrite STM-4-4C mode:** The test features associated with the section overhead and path overhead can be enabled in order to control one single or multi byte overhead channel. The B1, B2 and B3 bytes are recalculated.

**AU-4 overwrite mode:** Overwrite the complete AU-4 with the internally generated payload. This enables the
SOH and the three background AU-4’s to be looped through while a new payload is inserted into the STM-1 under test. All of the test features which affect the VC-4 and/or the POH are enabled. The B1, B2 and B3 bytes are recalculated. The AU-4 under test is delayed by a greater amount than the three background AU-4’s.

Tributary overwrite: If the payload contains a TU structure a single TU can be overwritten. All of the test features which affect the tributary and/or the POH are enabled. The B1, B2, B3 and TU BIP bytes are recalculated.

**STM-4 Tx Overhead:** Standard overhead values to ITU-T G.707

**User programmable bytes:**
- **RSOH:** A1, A2, J0, Z0, E1, F1, D1-D3
- **MSOH:** H1 (SS bits only), K1, K2, D4-D12, S1, Z1 & Z2, M1.

**STM-4 sequence generation:** A single or multi-byte overhead channel is overwritten with a single or repeating sequence of programmed values. The sequence can contain up to 5 different values each being transmitted for up to 64,000 frames.

- **RSOH:** D1-D3, J0, E1, F1, Z0.
- **MSOH:** D4-D12, K1-K2, S1, E2, M1, Z1, Z2.

**High order POH:** J1, C2, G1, F2, H4, F3, K3, N1 (for STM-1 under test)

**STM-4 overhead BER test:** Any overhead channel listed under STM-4 sequence generation (except Z1, Z2) can have a $2^{23}$-1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern and a BER measurement performed.

**STM-4 MSP message generation:** Messages are displayed in text form as ITU-T G.783 (Linear) or ITU-T G.841 (Ring).

**Receive:**
- **Wavelength:** 1200 - 1600 nm
- **Sensitivity:** STM-0 and STM-1 - 34dBm minimum, STM-4 - 28 dB minimum (with 1300 nm wavelength, 100% modulation depth, BER of $10^{-10}$ and $2^{23}$ PRBS)
- **Maximum input power:** -8 dBm (for BER of $10^{-10}$). Damage level +10 dBm

**Protected monitor point:**
- **Input level:** nominal 150 mV to 1000 mV pk-pk
- **Line code:** NRZ
- **Impedance:** Nominal 50Ω, AC coupled

**Optical power measurement:** Range 0 to -30dBm, Accuracy ±1dB

**STM-4 error results:** Frame (A1A2), B1 BIP, B2 BIP, MS REI

**VC-4--4c error results:** B3 BIP, HP REI, HP IEC, Bit

**STM-4 alarms detected:** Loss of signal, loss of frame, out of frame, MS AIS, MS RDI, K1/K2 change.

**STM-4c alarms detected:** All STM-4 alarms and Loss of pointer, AU AIS, HP RDI, pattern sync loss

**STM-4 overhead sequence capture:** A single or multibyte overhead channel can be monitored. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

- **RSOH:** A1A2 for all four STM-1’s, J0 E1, F1, D1-D3, ZO.
- **MSOH:** H1H2, K1K2, D4-D12, S1, E2, Z1, Z2
General Information
Specifications

High order POH: J1, C2, G1, F2, H4, F3, K3, N1 for STM-1 under test)

Overhead BER measurement (STM-4): J0, Z0, E1, F1, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, K1, K2, S1, M1, E2, J1, C2, G1, F2, H4, F3, K3 & N1. A BER measurement can be performed on any of these bytes using the $2^9$-1 PRBS provided by the transmit overhead BER test function. Error count, error ratio, error free seconds, percentage error free seconds and pattern loss seconds are calculated.

STM-0/STM-1/STM-4 OPTICAL INTERFACE (1310/1550 nm) with STM-4c Overhead Option 130

Rate: 51.84 Mb/s, 155.52 Mb/s, 622.08 Mb/s
Line code: NRZ
Connectors: Adaptors to which a range of interfaces can be attached.

Transmit:
Wavelength: 1280 - 1330 nm and 1520 - 1565 nm.
Spectral width (3dB): 2.5 nm rms nominal (1310 nm)
Spectral width (20dB): 1 nm rms nominal (1550 nm)
Extinction ratio: <8.2dB nominal (1310 nm), <10 dBm nominal (1550 nm).
Fibre power output: -10dBm nominal (1310 nm), -1 dBm nominal (1550 nm).
Safety classification: Class 3A, FDA 21 CFR Ch.1 1040.10 and EN 60825
Clock timing: Internal, recovered from received STM-0, STM-1 or STM-4 optical, electrical or binary signal, external MTS - data or clock format (as ITU-T G.811)

Frequency offset generation: Up to ±999 ppm in 0.1 ppm steps

VC-4-4C error add: B3 BIP, HP REI, HP IEC - $10^{-4}$ to $10^{-9}$, Bit - $10^{-3}$ to $10^{-9}$.
VC-4-4C alarm generation: AU-AIS, HP-RDI, AU-LOP, Path Unequipped

STM-4 error add: Frame - single and N in 4 frame words, B1 BIP - $10^{-4}$ to $10^{-9}$, B2 BIP and RS REI - $10^{-3}$ to $10^{-9}$.

STM-4 alarm generation: Loss of signal, loss of frame, out of frame, multiplexer section AIS, multiplexer section RDI.

STM-4 thru mode:
Transparent mode: The STM-4 signal is passed through the HP 37717B without being altered. The BIP’s are not recalculated.

Overhead overwrite STM-4 mode:
The test features associated with the section overhead can be enabled in order to control one single or multi byte overhead channel. The B1 and B2 bytes are recalculated.

Overhead overwrite STM-4-4C mode: The test features associated with the section overhead and path overhead can be enabled in order to control one single or multi byte overhead channel. The B1, B2 and B3 bytes are recalculated.

AU-4 overwrite mode: Overwrite the complete AU-4 with the internally generated payload. This enables the SOH and the three background AU-4’s to be looped through while a new payload is inserted into the STM-1 under test. All of the test features which affect the VC-4 and/or the POH are
General Information

Specifications

enabled. The B1, B2 and B3 bytes are recalculated. The AU-4 under test is delayed by a greater amount than the three background AU-4’s.

Tributary overwrite: If the payload contains a TU structure a single TU can be overwritten. All of the test features which affect the tributary and/or the POH are enabled. The B1, B2, B3 and TU BIP bytes are recalculated.

STM-4 Tx Overhead: Standard overhead values to ITU-T G.707

User programmable bytes:
RSOH: A1, A2, J0, E1, F1, D1-D3
MSOH: H1 (SS bits only), K1, K2, D4-D12, S1, Z1 & Z2, M1.

STM-4 sequence generation: A single or multi-byte overhead channel is overwritten with a single or repeating sequence of programmed values. The sequence can contain up to 5 different values each being transmitted for up to 64,000 frames.

RSOH: D1-D3, J0, E1, F1, Z0.
MSOH: D4-D12, K1-K2, S1, E2, M1, Z1, Z2.

High order POH: J1, C2, G1, F2, H4, F3, K3, N1 (for STM-1 under test)

STM-4 overhead BER test: Any overhead channel listed under STM-4 sequence generation (except Z1, Z2) can have a 2^9-1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern and a BER measurement performed.

STM-4 MSP message generation: Messages are displayed in text form as ITU-T G.783 (Linear) or ITU-T G.841 (Ring).

Receive:
Wavelength: 1200 - 1600 nm
Sensitivity: STM-0 and STM-1 - 34dBm minimum, STM-4 -28 dB minimum (with 1300 nm wavelength,100% modulation depth, BER of 10^-10 and 2^23 PRBS)
Maximum input power: -8 dBm (for BER of 10^-10). Damage level +10 dBm

Protected monitor point:
Input level: nominal 150 mV to 1000 mV pk-pk
Line code: NRZ
Impedance: Nominal 50Ω, AC coupled

Optical power measurement: Range 0 to -30dBm, Accuracy ±1dB
STM-4 error results: Frame (A1A2), B1 BIP, B2 BIP, MS REI
VC-4--4c error results: B3 BIP, HP REI, HP IEC, Bit
STM-4 alarms detected: Loss of signal, loss of frame, out of frame, MS AIS, MS RDI, K1/K2 change.

STM-4c alarms detected: All STM-4 alarms and Loss of pointer, AU AIS, HP RDI, pattern sync loss

STM-4 overhead sequence capture: A single or multibyte overhead channel can be monitored. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

RSOH: A1A2 for all four STM-1’s, J0 E1, F1, D1-D3, ZO.
MSOH: H1H2, K1K2, D4-D12, S1, E2, Z1, Z2

High order POH: J1, C2, G1, F2, H4, F3, K3, N1 (for STM-1 under test)

Overhead BER measurement (STM-4): J0, Z0, E1, F1, D1, D2, D3, D4, D5,
General Information

Specifications

D6, D7, D8, D9, D10, D11, D12, K1, K2, S1, M1, E2, J1, C2, G1, F2, H4, F3, K3 & N1. A BER measurement can be performed on any of these bytes using the $2^9$-1 PRBS provided by the transmit overhead BER test function. Error count, error ratio, error free seconds, percentage error free seconds and pattern loss seconds are calculated.

SDH Binary Interface (Option 0YH)

Rate: 155.52 MHz
Clock & Data Polarity: Positive or inverted
Connectors: SMA
Data format: NRZ
Data level: ECL
Data termination: 50Ω to -2V

Transmit:
Clock duty cycle: 50% (nominal)
Clock to data timing: Clock edge nominally 800 ps before centre of data output.

Receive:
Clock duty cycle: 50% ±10%
Input return loss: >15dB up to half rate
Data setup and hold time: 600 ps minimum

JITTER GENERATION:
Option UHK Adds Jitter generation at all standard PDH rates with the exception of 704 kb/s. If Option US1 or A1T is fitted adds Jitter generation at STM-1 and STM-4.

Data rates: 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264 Mb/s, 155.52 Mb/s (STM-1), 622.08 Mb/s (STM-4). At STM-1 and STM-4 a jittered 139.264 Mb/s clock is used to jitter the SDH clock. The UI transfer function is 1:1 at STM-1 and 1:4 at STM-4.

Jitter modulation
Frequency: 2 Hz to 4 MHz
Frequency accuracy: ±1%
Frequency resolution:
2 to 499 Hz in 1 Hz steps.
500 Hz to 4.99 kHz in 10 Hz steps
5 kHz to 49.9 kHz in 100 Hz steps
50 kHz to 499 kHz in 1 kHz steps
500 kHz to 990 kHz in 10 kHz steps
1 MHz to 4 MHz in 100 kHz steps.
The actual corner frequencies of the jitter generator will be beyond those in the ITU-T mask.

2.048 Mb/s: Corner frequency 13 kHz,
Cut-off frequency 102 kHz
8.448 Mb/s: Corner frequency 50 kHz,
Cut-off frequency 422 kHz
34.368 Mb/s: Corner frequency 210 kHz,
Cut-off frequency 840 kHz
139.264 Mb/s: Corner frequency 5 kHz,
Cut-off frequency 4 MHz

Amplitude: To ITU-T O.171
Amplitude ranges: 0.00 to 1.00 UI - Range 1
0.0 to 10.0 UI - Range 10
Range accuracy: Range 1 - 0.01 UI
Range 10 - 0.1 UI

Intrinsic jitter:
2.048 Mb/s - 0.02 UI
8.448 Mb/s - 0.02 UI
34.368 Mb/s - 0.03 UI
139.264 Mb/s - >10 kHz - 0.02 UI
5 kHz to 10 kHz - 0.05 UI
200 Hz to 5 kHz - 0.10 UI

Values are pk-pk jitter measured with HP1 filter present.
Amplitude accuracy: ±5% ± range accuracy ± intrinsic jitter.

Fixed jitter tolerance masks: 4 pre-programmed jitter tolerance masks with
pk-pk jitter amplitudes and modulating frequencies in accordance with ITU-T Rec. G.823 Table 2, covering low and high Q systems.

The masks can be used to measure tolerance to jitter amplitude at spot jitter frequencies or can be swept in 20% frequency increments. When generating an SDH signal the masks available are those specified in ITU-T Rec. G.958. A choice of type A or B masks is available at STM-1 and STM-4.

**Automatic jitter tolerance test:** The mask is swept in 20% frequency increments and at each frequency the jitter amplitude is increased until errors (of any type) are detected.

### JITTER and WANDER GENERATION (Options A3K [A3Q]) and EXTENDED JITTER GENERATION (Options 140 [141]):

- **A3K [A3Q]** Adds Jitter generation at all standard PDH rates with the exception of 704 kb/s. Adds Wander generation at 2.048 Mb/s. If Option US1 or A1T (SDH) is fitted adds Jitter and Wander generation at STM-1 and STM-4.
- **140 [141]** Adds Jitter generation at all standard PDH rates with the exception of 704 kb/s. If Option US1, A3R or A1T (SDH) is fitted adds Jitter generation at STM-1 and STM-4.

### Jitter Generation:

**Data rates:** 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264 Mb/s, 155.52 Mb/s (STM-1), 622.08 Mb/s (STM-4).

At STM-1 and STM-4 a jittered 139.264 Mb/s clock is used to jitter the SDH clock. The UI transfer function is 1:1 at STM-1 and 1:4 at STM-4.

### Jitter modulation

**Frequency:** 0.1 Hz to 5 MHz

**Frequency accuracy:** ±1% >3Hz, ±3% <3Hz

**Frequency resolution:** 1Hz (Ranges 1 & 10), 0.1Hz (ranges 50, 80 & 200)

The actual corner frequencies of the jitter generator will be beyond those in the ITU-T mask.

- **2.048 Mb/s:** Corner frequency 13 kHz, Cut-off frequency 102 kHz
- **8.448 Mb/s:** Corner frequency 50 kHz, Cut-off frequency 430 kHz
- **34.368 Mb/s:** Corner frequency 100 kHz, Cut-off frequency 840 kHz
- **139.264 Mb/s:** Corner frequency 5 kHz, Cut-off frequency 4 MHz
- **155.52 Mb/s:** Corner frequency 5 kHz, Cut-off frequency 4 MHz
- **622.08 Mb/s:** Corner frequency 5 kHz, Cut-off frequency 4 MHz

**Amplitude:** To ITU-T O.171

**Amplitude ranges:** 0.00 to 1.00 UI - Range 1
- 0.0 to 10.0 UI - Range 10
- 0.0 to 50.0 UI - Range 50
- 0.0 to 80.0 UI - Range 80
- 0.0 to 200.0 UI - Range 200
General Information

Specifications

**Range accuracy:** Range 1 - 0.01 UI  
Range 10 - 0.1 UI  
Range 50 - 0.5 UI  
Range 80 - 1.0 UI  
Range 200 - 2.0 UI

**Intrinsic jitter:**  
2.048 Mb/s - 0.02 UI  
8.448 Mb/s - 0.02 UI  
34.368 Mb/s - 0.03 UI  
139.264 Mb/s - >10 kHz - 0.02 UI<10 kHz - 0.04 UI  
STM-1 - >10kHz - 0.03 UI <10 kHz - 0.04 UI  
STM-4 - 0.10 UI Values are pk-pk jitter measured with HP1 filter present.

**High frequency inaccuracy:** STM-1  
Electrical >1.3 MHz  
<0.2 UI ±10%  
>0.2 UI ±20%

**Amplitude accuracy:**  
PDH rates: ±5% ± range accuracy ± intrinsic jitter.  
SDH rates: ±5% ± range accuracy ± intrinsic jitter ± high frequency inaccuracy

**Fixed jitter tolerance masks:** 6 pre-programmed jitter tolerance masks with pk-pk jitter amplitudes and modulating frequencies in accordance with ITU-T Rec. G.823 Table 2, covering low and high Q systems. The masks can be used to measure tolerance to jitter amplitude at spot jitter frequencies or can be swept in 20% frequency increments. When generating an SDH signal the masks available are those specified in ITU-T Rec. G.958. A choice of type A or B masks is available at STM-1 and STM-4.

**Automatic jitter tolerance test:** The mask is swept in 20% frequency increments and at each frequency the jitter amplitude is increased until errors (of any type) are detected.

**External jitter modulation input:**  
**Frequency range:** 2 Hz to 5 MHz.  
**Voltage response at 10 kHz:**  
10 UI range: 0.7V ±0.2V pk-pk/UI.  
2 UI range: 3V ±1V pk-pk/UI.  
**Maximum input level:** 6V peak AC/DC composite.

**Wander generation Options A3K [A3Q] only:**  
**Data rates:** 2.048 Mb/s, 155.52 Mb/s, 622.08 Mb/s.

**Wander modulation:**  
**Frequency:** 0.000010 Hz to 0.125000 Hz  
**Frequency accuracy:** ±1%.  
**Frequency resolution:** 1 µHz.  
**Amplitude range:**  
2 Mb/s: 0.5 to 80UI in 0.5UI steps.  
STM-1: 0.5 3600UI in 0.5UI steps.  
STM-4: 0.5 to 14400UI in 0.5UI steps.  
**Intrinsic jitter:** 0.1 UI  
**Rate inaccuracy:**  
2.048 Mb/s 1.0 UI  
155.52 Mb/s 0.5 UI  
622.08 Mb/s 0.5 UI

**Amplitude accuracy:** ±5% ± intrinsic jitter ± rate inaccuracy.  
Pre-programmed wander tolerance masks with pk-pk wander amplitudes. When 2.048 Mb/s is selected mask is in accordance with ITU-T Rec. G.823. When 155.52 Mb/s or 622.08 Mb/s is selected mask is in accordance with ITU-T Rec. G.958.

**Wander reference input:**  
**Rate:** 2.048 Mb/s ±100 ppm.  
**Format:** Clock or HDB3 Data.  
**Impedance:** Nominal; 75Ω
General Information

Specifications

unbalanced or 120Ω balanced.

**Peak Level:** 3V ±10% (balanced), 2.37V ±10% (unbalanced).


Option UHN adds PDH jitter measurement at all standard PDH rates with the exception of 704 kb/s. Adds Wander and Estimated slips measurements at 2.048 Mb/s.

Option A1M adds SDH Jitter measurement at 155.52 Mb/s (STM-1 electrical).

Option A1N adds SDH Jitter measurement at 155.52 Mb/s (STM-1 optical).

Option A1P adds SDH Jitter measurement at 155.52/622.08 Mb/s (STM-1/STM-4 optical).

Option A3L [A3M] Adds Pk-Pk jitter, RMS jitter and Auto Jitter Transfer measurement at STM-1 (electrical) rate and at all PDH rates except 704 kb/s. Adds Wander and Estimated Slips measurement at 2.048 Mb/s.


Option A3N [A3P] Adds Pk-Pk jitter, RMS jitter and Auto Jitter Transfer measurement at STM-4 (optical) rate, STM-1 (optical) rate, STM-1 (electrical) rate, and at all PDH rates except 704 kb/s Pk-Pk. Adds Wander and Estimated Slips measurement at 2.048 Mb/s.


**Jitter Data rates:** 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264 Mb/s, 155.52 Mb/s STM-1, 622.08 Mb/s STM-4.

**STM-1 Electrical Input**

**Line Code:** CMI

**Impedance:** 75Ω nominal, unbalanced

**Level:** Nominal 1 Volt peak to peak into 75Ω

**Equalization:** Automatic for cable loss up to 12 dB at half the bit rate.

**Monitor:** Equalization as above but with an extra 20 - 26dB of flat gain.

The receiver will compensate automatically for any combination of flat loss in the 20 -26dB range and cable loss up to 12dB.

**Connector:** BNC

**STM-1 Optical Receiver**

**Line Code:** NRZ

**Wavelength:** 1200 to 1600nm.

**Sensitivity:** -28 dBm minimum. This specification applies with 1300nm wavelength, 100% modulation depth, BER of 1.0E-10 and 2^23-1 PRBS data.

**Dynamic Range:** 20 dB minimum.

**Maximum Input Power:** -8 dBm. (For BER of 1.0E-10)

**Connector:** Customer Exchangeable System.

**STM-1/STM-4 Optical Receiver**

**Data Rate (nominal):** 155.52 Mb/s. or 622.08 Mb/s.

**Line Code:** NRZ

**Wavelength:** 1200 to 1600nm.

**Sensitivity:** -26 dBm minimum. This specification applies with 1300nm wavelength, 100% modulation depth, BER of 1.0E-10 and 2^23-1 PRBS
General Information

Specifications

data.

**Dynamic Range:** 18dB minimum.

**Maximum Input Power:** -8 dBm. (For BER of 1.0E-10). If > +3.0 dBm then damage may result.

**Connector:** Customer Exchangeable system.

**Alarms Detected:** Loss of Signal:
Loss of signal is detected in the optical receiver whenever the light level falls below approximately -30dBm ±3dBm.
To extinguish the alarm requires a light level approximately 1 - 2 dB higher than this threshold.

**General Jitter Receiver Specifications**

**Jitter measurement ranges:**
- Range 1.6 - 0 to 1.6 UI
- Range 16 - 0 to 16 UI

These ranges fulfill the measurement requirements of ITU-T Rec. O.171

**Range accuracy:**
- Range 1.6 - ±0.01 UI
- Range 16 - ±0.03 UI

**Intrinsic jitter:**
- Range 1.6 (2, 8, 34, 140 Mb/s):
  - Clock - ±0.02 UI
- Range 1.6 (2, 8, 34, 140, 155.52 Mb/s electrical):
  - PRBS - ±0.02 UI
- Range 1.6 (155.52 Mb/s optical):
  - PRBS - ±0.03 UI
- Range 1.6 (622.08 Mb/s optical):
  - PRBS - ±0.04 UI
- Range 16 (2, 8, 34, 140 Mb/s):
  - Clock - ±0.07 UI
- Range 16 (2, 8, 34, 140, 155.52 Mb/s):
  - PRBS - ±0.1 UI
- Range 16 (622.08 Mb/s):
  - PRBS - ±0.2 UI

Values are pk-pk jitter measured with HP1 filter present.

**Jitter Transfer Receiver Characteristics**

The value plotted is the Transfer Function, calculated using equation

$$20 \log \frac{J_{out}}{J_{in}} \text{dB}$$

**Measurement Bandwidth:** 10Hz

**Dynamic Range:** +5dB to -40dB

**Stability:** 0.02dB

The Measurement cycle must be started within 10 minutes of the completion of the Calibration cycle.

**Calibration:** 0.01dB

**Accuracy:** The figures quoted in the following table includes Stability & Calibration factors.

<table>
<thead>
<tr>
<th>Rx Jitter Amplitude UI</th>
<th>Accuracy dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 0.3</td>
<td>0.04</td>
</tr>
<tr>
<td>0.3 to 0.03</td>
<td>0.25</td>
</tr>
<tr>
<td>0.03 to 0.01</td>
<td>0.5</td>
</tr>
<tr>
<td>0.01 to 0.003</td>
<td>1</td>
</tr>
<tr>
<td>0.003 to 0.001</td>
<td>3</td>
</tr>
</tbody>
</table>

Examples:

Input 1.5UI, +0.5dB Transfer Function, output is 1.589UI. The accuracy will be 0.04dB.

Input 0.2UI, -19.5dB Transfer Function, then output is 0.0219UI. The accuracy will be 0.5dB.

Ideally there should be no coherent spurious signals generated by the UUT as any such signals close to measurement frequencies will degrade the instrument performance.

The input Line Rate should be within ±50 ppm of nominal to achieve Accuracy quoted.
General Information

Specifications

The HP 37717C must be connected back to back in order to perform a calibration cycle before making a Jitter Transfer measurement.
The HP 37717C must have been switched on for 1 hour before starting a calibration cycle.
The climatic conditions must remain stable from switch-on to end of measurement.

It is recommended that the maximum test period (start of calibration to end of measurement) does not exceed 90 minutes.
Test Period = Delay Time + Dwell Time + 5 Seconds X Number of Points X 2 (Calibration + Measurement).

Peak Jitter Measurement

These ranges cover the measurements range specified in O.171, Table3/O.171.

<table>
<thead>
<tr>
<th>Receiver Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
</tr>
<tr>
<td>1.6</td>
</tr>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

Note that the receiver will be able to handle transients of up to 24UI(peak) without losing lock, although the measurement will be out of range.

On Losing Lock the Jitter Loss LED is illuminated. If Lock is maintained but the measurement is out of range then a Status Message “Jitter Out of Range” is displayed on the Status Line.

<table>
<thead>
<tr>
<th>Peak Measurement Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Rate (Kb/s)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

** Meets ITU O.171 Table 4.
General Information

Specifications

Peak Measurement Accuracy

For 2Mb/s & 8Mb/s, the specification applies when HDB3 encoding is enabled.

<table>
<thead>
<tr>
<th>Range</th>
<th>Level</th>
<th>Accuracy peak</th>
<th>pk-pk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6UI</td>
<td>0 - 0.2 UI</td>
<td>±5% ±X ±Y ±Z</td>
<td>±5% ±2X ±Y ±2Z</td>
</tr>
<tr>
<td>1.6UI</td>
<td>0.21 - 1.6 UI</td>
<td>±5% ±X ±Y ±Z</td>
<td>±5% ±2X ±Y ±2Z</td>
</tr>
<tr>
<td>16UI</td>
<td>0 - 0.2 UI</td>
<td>±5% ±X ±Y Z*</td>
<td>±5% ±2X ±Y 2Z*</td>
</tr>
<tr>
<td>16UI</td>
<td>0.21 - 1.60 UI</td>
<td>±5% ±X ±Y Z*</td>
<td>±5% ±2X ±Y 2Z*</td>
</tr>
</tbody>
</table>

* Only has an effect for 2Mb/s operation.

X = 0.01 UI for range 1.6
0.03 UI for range 16,

Z = the amount of inaccuracy introduced at high frequency.

Y is intrinsic jitter.

Receiver Intrinsic Jitter

<table>
<thead>
<tr>
<th>Bit Rate (Kb/s)</th>
<th>Range 1.6 Intrinsic Jitter (UI)</th>
<th>Range 16 Intrinsic Jitter (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clock (all 1’s)</td>
<td>PRBS</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>2048</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>8448</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>34368</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>139264</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>155520 (electrical)</td>
<td>0.02</td>
<td>n/a</td>
</tr>
<tr>
<td>155520 (optical)</td>
<td>0.03</td>
<td>n/a</td>
</tr>
<tr>
<td>622080 (optical)</td>
<td>0.04</td>
<td>n/a</td>
</tr>
</tbody>
</table>

* Typical value after calibration is 0.05UI.
General Information

Specifications

---

### High Frequency Inaccuracy

<table>
<thead>
<tr>
<th>Bit Rate (Kb/s)</th>
<th>Selected Frequency</th>
<th>Z (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH Rates</td>
<td>All</td>
<td>0</td>
</tr>
<tr>
<td>2048</td>
<td>&gt;30KHz</td>
<td>(\frac{(f - 30)}{70}) \times 10 %*</td>
</tr>
<tr>
<td>8448</td>
<td>&gt;150KHz</td>
<td>(\frac{(f - 150)}{250}) \times 10 %*</td>
</tr>
<tr>
<td>34368, 139264</td>
<td>all</td>
<td>0</td>
</tr>
</tbody>
</table>

* Where \(f\) is the Modulation Frequency in KHz.

---

Note 1: Typically there will be an additional 0.01 UI when using monitor gain.

Note 2: Typically there will be an additional 0.01 UI when using equalisation.

Note 3: Typically there will be an additional 0.01 UI at STM-1 optical with light levels less than -22 dBm.

Note 4: Typically there will be an additional 0.01 UI at STM-4 with light levels less than -16 dBm.

Note 5: Typically there will be an additional 0.02 UI at STM-4 with light levels less than -22 dBm.

Note 6: Typically there will be an additional 0.01 UI due to temperature variation.

Note 7: When performing intrinsic measurements with the transmitter coupled to the receiver, the transmitter intrinsic must be included.

Values are peak to peak jitter in UI measured with HP1 filter present.

**Jitter Peak Results Resolution:**
Range 1.6 steps of 0.001 UI.
Range 16 steps of 0.01 UI.

**Jitter Hit Count:** The number of times in the jitter gating period that the received jitter amplitude exceeds a user set threshold. Counter capacity is 7,100,000 hits per second.

**Jitter Hit Threshold Resolution:**
Range 1.6 steps of 0.01 UI.
Range 16 steps of 0.1 UI.

Sensitivity >100 ns width to count typically.
Range 1.6 minimum threshold = 0.05UI.
Range 16 minimum threshold = 0.5UI.

**Jitter Hit Seconds:**
The number of seconds in which at least one jitter hit has occurred.

**Jitter Hit Free Seconds:**
The number of seconds in which no jitter hits have occurred.
General Information

Specifications

Internal Filters:  
A number of internal filters are available to band limit the demodulated jitter signal before jitter amplitude measurement. These filters are as specified in ITU O.171.

<table>
<thead>
<tr>
<th>Filter (kb/s)</th>
<th>HP1* (high pass) (Hz)</th>
<th>HP2* (high pass) (kHz)</th>
<th>LP** (low pass) (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048</td>
<td>20</td>
<td>18</td>
<td>100</td>
</tr>
<tr>
<td>8448</td>
<td>20</td>
<td>80</td>
<td>400</td>
</tr>
<tr>
<td>34368</td>
<td>100</td>
<td>10</td>
<td>800</td>
</tr>
<tr>
<td>139264</td>
<td>200</td>
<td>10</td>
<td>3500</td>
</tr>
<tr>
<td>155520</td>
<td>500</td>
<td>65**</td>
<td>1300</td>
</tr>
<tr>
<td>622080</td>
<td>1000</td>
<td>250***</td>
<td>5000</td>
</tr>
</tbody>
</table>

* Filter tested to be within 10% of nominal.
** Minimum frequency for the 3dB points.
*** Options A3L, A3V and A3N only.

For high pass filters the slope below the 3 dB point is 20 dB per decade. For the low pass filters the slope above the 3 dB point is 60 dB per decade.

The filters can be selected as follows

- OFF
- LP
- HP1
- HP2
- LP HP1
- LP + HP2
- 12 kHz

The 12 kHz filter is not characterised for pk-pk measurements, hence operation is not specified. (This filter is not recommended in any relevant ITU-T pk-pk measurement standard).

RMS Jitter Measurement (Options A3L, A3V and A3N only):

This measurement is available at all interface rates.

Filters: 12 kHz HP filter selectable. If HP1, HP2 and/or LP are enabled, then they will affect the jitter signal measured by the RMS receiver.

RMS Results Resolution: The RMS ranges are linked to the selection for Peak. No separate selection will exist.

Peak Range 1.6 UI: - RMS range 0.5, steps of 0.002 UI.
Peak Range 16 UI: - RMS Range 5, steps of 0.02 UI.
General Information

Specifications

RMS Measurement Accuracy:

<table>
<thead>
<tr>
<th>Range</th>
<th>Level (UIrms)</th>
<th>Accuracy</th>
<th>Additional factor &gt;3MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20Hz to 3MHz</td>
<td></td>
</tr>
<tr>
<td>0.5UI</td>
<td>0 - 0.1</td>
<td>± 5% ± V ± W ± Z</td>
<td>5%</td>
</tr>
<tr>
<td>0.5UI</td>
<td>0.11 - 0.5</td>
<td>± 5% ± V ± W ± Z</td>
<td>5%</td>
</tr>
<tr>
<td>5UI</td>
<td>0 - 0.1</td>
<td>± 5% ± V ± W ± Z*</td>
<td>5%</td>
</tr>
<tr>
<td>5UI</td>
<td>0.11 - 5.0</td>
<td>± 5% ± V ± W ± Z*</td>
<td>5%</td>
</tr>
</tbody>
</table>

* Only has an effect for 2Mb/s operation.

V = (display resolution)
0.002 UI for range 0.5
0.02 UI for range 5

W= the intrinsic jitter.

Z = the amount of inaccuracy introduced at high frequency.

<table>
<thead>
<tr>
<th>Bit Rate (kb/s)</th>
<th>Range 0.5 Intrinsic Jitter (UIrms)</th>
<th>Range 5 Intrinsic Jitter (UIrms)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clock (all 1’s)</td>
<td>PRBS</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>2048</td>
<td>0.004</td>
<td>0.03</td>
</tr>
<tr>
<td>8448</td>
<td>0.003</td>
<td>0.03</td>
</tr>
<tr>
<td>34368</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>139264</td>
<td>0.01</td>
<td>0.03</td>
</tr>
<tr>
<td>155520 (electrical)</td>
<td>0.006</td>
<td>n/a</td>
</tr>
<tr>
<td>155520 (optical)</td>
<td>0.015</td>
<td>n/a</td>
</tr>
<tr>
<td>622080 (optical)</td>
<td>0.02</td>
<td>n/a</td>
</tr>
</tbody>
</table>
### General Information

#### Specifications

<table>
<thead>
<tr>
<th>Bit Rate (Kb/s)</th>
<th>Selected Frequency</th>
<th>Z (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH Rates</td>
<td>All</td>
<td>0</td>
</tr>
<tr>
<td>2048</td>
<td>&gt;30KHz</td>
<td>$\frac{(f - 30)}{70} \times 6%$*</td>
</tr>
<tr>
<td>8448</td>
<td>&gt;150KHz</td>
<td>$\frac{(f - 150)}{250} \times 6%$*</td>
</tr>
<tr>
<td>34368, 139264</td>
<td>All</td>
<td>0</td>
</tr>
</tbody>
</table>

* Where $f$ is the Modulation Frequency in KHz.

Note 1: Typically there will be an additional 0.004 UI rms when using monitor gain.

Note 2: Typically there will be an additional 0.004 UI rms when using equalisation.

Note 3: Typically there will be an additional 0.004 UI rms at STM-1 optical with light levels less than -22 dBm.

Note 4: Typically there will be an additional 0.004 UI rms at STM-4 with light levels less than -16 dBm.

Note 5: Typically there will be an additional 0.008 UI rms at STM-4 with light levels less than -22 dBm.

Note 6: Typically there will be an additional 0.01 UI due to temperature variation.

Values are RMS jitter in UI rms measured with 12 kHz filter present.

**RMS Results Resolution:**

- **0.5UI Range:** Display format is 0.001UI rms
- **5UI Range:** Display format is 0.01UI rms

**Demodulated Jitter output:**
- Range 1.6 - 1.0 V/UI
- Range 16 - 0.1 V/UI
- Accuracy 10% nominal.

**Wander:**
- **Timing reference input:** External MTS clock as ITU-T Rec. G.811.
- **Bit rate:** 2.048 Mb/s
- **Format:** Clock or HDB3 data
- **Impedance:** 75Ω unbalanced (nominal) or 120Ω balanced (nominal).
- **Peak level:** 3V ±10% (balanced) 2.37V ±10% (unbalanced).
- **Connectors:** BNC (unbalanced). 3 pin Siemens audio (balanced).

**Wander measurement:**
- **Bandwidth:** Low pass response -3dB at 10Hz (nominal).
- **Resolution:** 0.125 UI
General Information
Specifications

**Range:** ±99999 UI. If no reference signal is present “NO REF” is displayed.
**Accuracy:** ±0.125 UI ±0.5% of reading. Valid up to 1 Hz wander frequency.

**ATM (Option UKN)**
Option UKN provides ATM generation and measurement at standard bit rates.

**ATM Transmitter:**
**Physical Interface Bit rates:** 2.048 Mb/s, 34.368 Mb/s, 139.264 Mb/s, 155.52 Mb/s and 622.08 Mb/s (not STM-4c).
**Physical Interface:** Meets ITU-T G.703
**Frequency offset (2.048 Mb/s, 34.368 Mb/s, 139.264 Mb/s):** Up to ±100 ppm

**Frequency offset (155.52 Mb/s, 622.08 Mb/s):** Up to ±999 ppm

**Connectors:** BNC 75Ω unbalanced
**Error add:** Bit, Single HEC or Double HEC - 1 in 10^3 or single error. Single or Double HEC in Bursts of up to 8 errors.
**Alarm generation:** Virtual path FERF, virtual path AIS, virtual channel FERF, virtual channel AIS, virtual channel continuity check

**Clock timing Internal:** All rates
**Recovered (loop timed):** 2.048 Mb/s only.
**External MTS:** 155.52 Mb/s, 622.08 Mb/s only.

**34.368 Mb/s Overhead:** As ITU-T Rec. G.832
Error Monitoring (EM) - correct BIP-8 Trail Trace (TR) - Test: “HP37717C” padded with spaces and the correct CRC added.
User - User defined.
Maintenance Adaptation (MA) - 011 hexadecimal.
Network Operator (NR) - All Zeroes General Communications (GC) - All Zeroes.

**155.52 Mb/s Overhead:** As SDH module Option US1, A3R or A1T.

**Frame Formats:**
2 Mb/s: As ITU-T Rec. G.804 with or without CRC4.
34.368 Mb/s, 139.264 Mb/s: As ITU-T Rec. G.804
155.52 Mb/s: As SDH module Option US1, A3R or A1T

**Cell layer modes:** UNI, NNI
**Cell layer headers:** VPI, VCI, GFC, PTI, CLP.

**Foreground cells:**
**2.048 Mb/s bandwidth:** 100 to 4528 cells/second.
**34.368 Mb/s bandwidth:** 100 to 80,000 cells/second.
**139.264,368 Mb/s bandwidth:** 100 to 326,037 cells/second.
**155.52 Mb/s bandwidth:** 100 to 353,207 cells/second.
**Distribution:** Periodic, Burst.
**Periodic:** A single cell is transmitted at regular intervals determined by the cell rate.Also allows a single burst of up to 2048 consecutive cells to be added.
**Burst:** User specified burst of up to 2048 consecutive cells added at intervals determined by the cell rate.
**General Information**

**Specifications**

**Payload:** Cross Cell PRBS, Single Cell PRBS, User Byte, Test Cell.

**Background cells:**
- Number of backgrounds: 3
- Background density: Individually settable from 0 to maximum after foreground allocation in 1% steps.
- Distribution: Periodic as for Constant Bit Rate service.
- Payload: Fixed byte.
- Fill cells: Idle or Unassigned. Payload GA (Hexadecimal)

**ATM Receiver**
- Interface bit rate: 2.048 Mb/s, 34.368 Mb/s, 139.264 Mb/s ±100 ppm unbalanced.
  - 155.52 Mb/s, 622.08 Mb/s ±999 ppm unbalanced.
- Pattern Synchronization:
  - **Sync loss:** BER ≥ 20% over 100 ms for PRBS or ≥ 4% over 100 ms for word patterns.
  - **Sync gain:** 32 consecutive error free bits received.
- **Equalization at f/2:** 12 dB
- **Monitor point compensation:**
  - 2.048 Mb/s: 20 dB, 26 dB or 30 dB.
  - 34.368 Mb/s, 139.264 Mb/s: 20 dB or 26 dB.
- **Frame Formats:** As transmitter.
- **Frame Alignment:** Out of Frame after 4 consecutive errored framing patterns. Frame regain after 2 consecutive error free framing patterns.
- **Loss Of Frame:** At detection of Out Of Frame a 3 ms window is started. If the system remains Out of Frame for the duration of the window then Loss Off Frame is activated. If in frame is detected during the 3 ms window the timer is reset.

**Cell layer modes:** UNI, NNI
**Cell layer headers:** VPI, VCI, GFC, PTI, CLP.
**Payload:** Cross Cell PRBS, Single Cell PRBS, User Byte, Test Cell, Live Traffic.
**Test cell synchronization:**
- **Sync loss:** 7 consecutive errored cells.
- **Sync gain:** 6 consecutive error free cells.

**REMOTE CONTROL:**
- HP-IB + RS-232-C option A3D.
- HP-IB + RS-232-C + LAN interface option A3B.
- Virtual Remote option UHE Distributed network Analyzer option USS

**PDH MULTIPLE OUTPUTS**
- (Option UHC): Provides three additional output signals (BNC connectors). Specifications same as for unbalanced signal output. Bit delay relative to main output:
  - 704 kb/s, 2 Mb/s, 8 Mb/s, 34 Mb/s:
    - O/P 2 - 4 bits
    - O/P 3 - 8 bits
    - O/P 4 - 12 bits
  - 140 Mb/s: No bit delay.

**MEASUREMENTS and ANALYSIS**

**Test timing:** Manual, single fixed, timed start
**Timed start:** Single test period starts at a preset time.
**Duration:** 1 hour, 24 hours, 72 hours, 7 days, user-defined
User-defined: 1 to 99 - seconds, minutes, hours, days
General Information
Specifications

Real-time clock: Date, time and elapsed test time.
Trouble Scan: Up to four prioritised non-zero error results are displayed in extra-large characters.
Received frequency: Frequency in Hz, resolution 1 Hz
Offset from internal clock rate (ppm), (Hz)

UNFRAMED PDH (Option UKK)
Out of Service analysis Errors:
Bit, Code - error count and ratio.
G.821 analysis: (including Annex D)
Severely errored seconds
Errored seconds
Percentage severely errored seconds
Error-free seconds
Percentage error-free seconds
Unavailability
Percentage unavailability
Unavailable seconds
Degraded minutes
Percentage degraded minutes
Code error seconds
Elapsed time
M.2100 error analysis: Same as G.821 (Bit errors only).
Alarm indication: AIS, signal loss, pattern sync loss, errors present.
Alarm seconds: All the above plus power loss.

G.821-type analysis: On frame bit errors (all rates) On CRC errors (2 Mb/s only) On REBE errors (2 Mb/s only)
Spare bit display: At all rates
M.2100 error analysis: Tx error seconds, Tx severely errored seconds, Rx error seconds, Rx severely errored seconds, Unavailability.
Alarm indication:
All rates: AIS, frame loss, signal loss, remote alarm, Errors present.
2 Mb/s only: CAS/CRC multiframe loss, remote multiframe alarm.
Alarm seconds: All the above plus power loss.

STRUCTURED PDH (Option UKJ or UKL)
Errors: Bit, Code, Frame, CRC, REBE - error count and ratio
G.821 analysis - Bit, Frame, CRC REBE
Error count
Severely errored seconds
Percentage severely errored seconds
Errored seconds
Errored seconds Annex D (Bit errors only)
Percentage errored seconds
Error-free seconds
Percentage error-free seconds
Unavailability
Percentage unavailability
Unavailable seconds
Degraded minutes
Percentage degraded minutes
Code error seconds
Elapsed time
M.2100 error analysis: TX Error seconds, RX error seconds. TX severely errored seconds, RX severely errored seconds, TX unavailability, RX unavailability.
General Information
Specifications

PDH M.2110 error analysis: 2 hour BIS result, 24 hour BIS result, 7 day BIS result.


Alarm indication: AIS, signal loss, pattern sync loss, frame loss, remote alarm, multiframe loss, errors present.

Error analysis per ITU-T G.826: Errored seconds, Severely errored seconds, Unavailable seconds, Path unavailable seconds, Errored second ratio, Severely errored second ratio.

In addition Errored blocks and Background block error ratio if 2 Mb/s is selected. If framed all above for NEAR end and FAR end.

Alarm indication: Signal loss, pattern loss, AIS, frame loss, multiframe loss remote alarm/FERF, remote multiframe alarm.

Alarm seconds: Power loss, AIS, signal loss, pattern loss, 140 Mb/s frame loss, 34 Mb/s frame loss, 8 Mb/s frame loss, 2 Mb/s frame loss, RAI, multiframe loss, remote multiframe alarm.

Alarm Scan: The interface rate and all lower levels in the hierarchy are scanned for occurrences of AIS, frame loss and RAI. Any occurrence of these alarms is displayed in graphical form.

Round trip delay: Measures up to 2 seconds delay between transmit and receive.

Resolution: - 10 s

Option 110 Results

Frequency measurement: Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.

Error results: DS1 (counts & ratios): Bit, B8ZS/AMI code violations, frame errors, CRC6 errors.

DS3 (counts & ratios): Bit, B3ZS code violations, frame errors, P-parity, CP-parity, FEBE.

E1 (counts & ratios): Bit, HDB3/AMI code violations, frame errors, CRC4, REBE.

E3 (counts & ratios): Bit, HDB3 code violations, frame error.

Alarm indication: DS1: LOS, pattern loss, AIS, OOF, Multiframe Loss, RAI, EXZ, Idle

DS3: LOS, Pattern Loss, AIS, OOF, Multiframe Loss, RAI, EXZ, Idle

E1: LOS, Pattern Loss, AIS, LOF, RAI, RMFAI, CASMFL

E3: LOS, Pattern Loss, AIS, LOF, RAI

FEAC code indication: With C-Bit parity framing loopback and alarm/status codes are decoded and displayed. Displays shows current and last active FEAC message.

G.826 analysis: Errored blocks (EB), errored seconds (ES), severely errored seconds (SES), unavailability seconds (UAS), error second ratio (ESR), severely errored second ratio (ESR), background block error ratio (BBER), path unavailable seconds (PUAS).

G.821 analysis (not DS1 and DS3): EC, SES, %SES, ES, %ES, EFS, %EFS, unavailability, %unavailability, degraded minutes, (%) degraded
General Information
 Specifications

minutes, code error seconds, elapsed (including Annex D for bit errors)

M.2100, M.2101, M.2110 and M2120 analysis: Tx ES, Tx SES, Rx ES,Rx SES, unavailability

M.2110 bringing into service test:
2 hour, 24 hour and 7 day PASS/-FAIL indication. Run a 24 hour out-of-service test using a PRBS. After 24
hours the instrument compares ES, SES and UAS results against the S1 and S2 thresholds derived from the path
location and flags either PASS/-FAIL. The 7 day test is then performed on uncertain paths (-?) during the 24
hour test, i.e. run continuously for a further 6 days.

M.2120 in-service test for maintenance: Contiguous 15 minute (T1) and 24 hour (T2) periods with
TR1 and TR2 threshold reports. Based on the user entered path allocation and maintenance factors, the T1-ES, T1-
SES, T2-ES and T2-SES thresholds are calculated. A single threshold report (TR1 for 15 minute, TR2 for 24 hour) is
generated when any of the relevant thresholds are exceeded within each 15 minute or 24 hour period.

Signaling monitor: DS1: Signaling bit state is displayed. ABCD format for ESF and AB for SF/SLC-96. SLC-96
can display one of three states; 0, 1 or alternating. E1: Graphical display, simultaneously showing the ABCD
signalling status of all 30 channels is available.

Alarm scan: Alarms at the Interface Rate and at all lower levels in the hierarchy are scanned continuously. A
graphical picture of the hierarchy is shown which displays the alarm state for all streams.

SDH (Option US1)
Error results: RSOH BIP-8 (B1),
MSOH BIP-24 (B2), POH BIP-8 (B3),
Path FEBE, VC-3 Path BIP, VC-3
FEBE, VC-5 BIP-2, VC-5 FEBE, Bit
(PDH Payload), Frame (A1,A2), MS
FEBE, AU-4 path IEC, TU-2 path
FEBE, TU-2 path BIP.
Error analysis per ITU-T G.826: For all the errors listed above. Errored seconds, Errored seconds ratio,
Severely errored seconds, Errored blocks, Unavailable seconds, Block error count, Severely errored seconds ratio, background block error ratio.
(G.821 and M.2100/M.2110/M.2120
for PDH payload)
Alarm indication: Loss of signal
(LOS), loss of frame (LOF), loss of
pointer (LOP), MS and path AIS,
pattern loss, MS FERF, Path FERF, TU
path AIS, TU path FERF, clock loss
and errors (any type).
Alarm seconds: Loss of power, Loss of Signal, Loss of frame, Out of frame,
Loss of pointer, MS and path AIS, K1/
K2 change, MS and path FERF, H4
multiframe, TU loss of pointer, TU path
AIS, TU path FERF.
Pointer results: AU pointer value,
NDF seconds, Missing NDF seconds,
+ve Adjustment count, +ve
Adjustment seconds, -ve Adjustment count, -ve Adjustment seconds, Implied
offset; for both AU and TU.
Overhead BER measurement: Error
count, error ratio, error free seconds and% error free seconds.
General Information
Specifications

Option A1T

Error results: B1, B2, AU-4 path BIP-8 (B3), AU-4 path FEBE, TU-3 path BIP-8 (B3), TU-3 path FEBE, TU-12 path FEBE, TU-12 path BIP (V5), bit errors (PDH payload), Frame (A1A2), MS FEBE, AU-4 path IEC, TU-2 path FEBE, TU-2 path BIP (V5).

Error analysis: To ITU-T G.826 (G.821 and M.2100/2110/2120 for PDH payload).

Pointer results: AU pointer value, AU NDF seconds, AU missing NDF seconds, AU +ve adjustment count seconds, AU -ve adjustment count/seconds, implied VC-4 offset, TU pointer value, TU NDF seconds, TU missing NDF seconds, TU +ve adjustment count/seconds, TU -ve adjustment count/seconds.

Alarm indication: LOS, LOF, OOF, LOP (AU-4, TU-3, TU-12), MS AIS, MS FERF, path AIS (AU-4), path FERF (AU-4), TU path AIS (TU-3, TU-12), TU path FERF (TU-3, TU-12), pattern sync loss, clock loss and errors (any type).

Alarm seconds: As for alarm indication, plus power loss, NDF and missing NDF, and except clock loss.

Frequency measurement: Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.

Received overhead snapshot: SOH and POH of a received STM-1 signal. Text message displayed for signal label (C2 and V5) and sync status (S1) decoded.

Overhead sequence capture: Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

AU-4 pointer location graph: A graphical display that shows the variation with time of the pointer location. Up to four days of pointer location activity can be monitored. Implied VC offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean VC offset calculated from this total.

Overhead BER measurement: Any RSOH, MSOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a 2^9-1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds, % error free seconds and pattern loss seconds are measured.

Option A3R Results

Error results: Frame (A1A2), B1, B2, MS REI, AU-4 path BIP (B3), AU-4 path REI, AU-4 path IEC, AU-3 path BIP (B3), AU-3 path REI, AU-3 path IEC, TU-3 path BIP (B3), TU-3 path REI,
General Information

Specifications

TU-2 path BIP (V5), TU-2 path REI, TU-12 path BIP (V5), TU-12 path REI, TU-11 path BIP (V5), TU-11 path REI, bit errors (bulk filled, PDH payload).
AU-3 path BIP (B3), AU-3 path REI, AU-3 path IEC.

DS1/DS3 error results:
Frame error, CRC6 error (DS1 ESF), P-bit parity (DS3), C-bit Parity (DS3 CBP framing), REI (DS3 CBP framing). Bit errors (DS1 and DS3).

Error analysis: To ITU-T G.826 (G.821 and M.2100/2110/2120 for PDH payload).

Alarm indication: LOS, LOF, OOF, MS AIS, MS RDI, K1K2 change AU-3 path AIS, AU-3 path RDI, AU-3 LOP, AU-3 pointer adj AU-4 path AIS, AU-4 path RDI, AU-4 LOP, AU-4 pointer adj TU-3 path AIS, TU-3 path RDI, TU-3 LOP, TU-3 pointer adj TU-2 path AIS, TU-2 path RDI, TU-2 LOP, TU-2 pointer adj TU-12 path AIS, TU-12 path RDI, TU-12 LOP, TU-12 pointer adj TU-11 path AIS, TU-11 path RDI, TU-11 LOP, TU-11 pointer adj H4 multiframe sync loss, pattern sync loss, clock loss, power loss and errors (any type).
DS1/DS3 alarm indication: AIS, frame loss, RDI.

Alarm seconds: As for alarm indication, plus NDF, missing NDF and except clock loss.

AlarmScan plus alarm and BIP scan: Automatically scans the SDH network hierarchy for alarms and BIP errors or alarms only with a graphical display of the network hierarchy’s status including the indication of unequipped channels. Alarms: LOP, path AIS, path RDI, H4 LOM†, TU LOP*, TU path AIS*, TU path RDI.*
† For TU-11, TU-12 and TU-2 structures.
* If applicable.

BIP errors:
AU-4 payloads: VC-4 B3.
AU-3 payloads: VC-3 B3.
TU-3 payloads: VC-4 B3 and VC-3 B3.
User selectable BIP error threshold: Off, > 0, > 10⁻³, > 10⁻⁶.

Protection switch times:
Service disruption test measures error burst length for measurement of protection switch times†.
Accuracy: < 50 ms.
Results: Longest burst length, shortest burst length, last burst length.
Resolution: 1 ms.
† Service disruption test requires PDH/DSn option UKJ, UKN or 110 to be fitted.

Pointer results: AU pointer value, AU NDF seconds, AU missing NDF seconds,
AU +ve adjustment count/seconds, AU -ve adjustment count/seconds, TU pointer value, TU NDF seconds, TU missing NDF seconds, TU +ve adjustment count/seconds, TU -ve adjustment count/seconds, implied VC-4, VC-3, VC-2, VC-12, VC-11 offer.
General Information

Specifications

**Frequency measurement:** Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.

**Received overhead snapshot:**
SOH can be set in binary or HEX. SOH and POH of a received STM-1 signal.
SOH and POH of a received STM-0 signal.
Text message displayed for signal label (C2 and V5) and sync status (S1) decoded.

**Overhead sequence capture:**
Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

**Pointer location graph:** A graphical display that shows the variation with time of the AU-n and TU-n pointer location. Up to four days of pointer location activity can be monitored. Implied VC offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean VC offset calculated from this total.

**Overhead BER measurement:**
Any RSOH, MSOH or PH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a 29 - 1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds, % error free seconds and pattern loss seconds are measured.

**Option 120 Results** (for SDH results see A3R)

**Error results STS-3c SPE:**

**DS1/DS3 error results:** Frame error, CRC6 error (DS1 ESF), P-bit parity (DS3), C-bit Parity (DS3 CBP framing), FEBE (DS3 CBP framing). Bit errors (DS1 and DS3).

**Error analysis:** To ITU-T G.826 (G.821 and M.2100/M.2101/2110/2120 for DSn/PDH payload).

**Alarm indication:** LOS, LOF, SEF, AIS-L, RDI-L, K1K2 change STS-3c SPE path AIS, STS-3c SPE RDI-P, STS-3c SPE LOP, STS-3c SPE pointer adj STS-1 SPE path AIS, STS-1 SPE RDI-P, STS-1 SPE LOP, STS-1 SPE pointer adj VT6 path AIS, VT6 RDI-V, VT6 LOP, VT6 pointer adj VT2 path AIS, VT2 RDI-V, VT2 LOP, VT2 pointer adj VT1.5 path AIS, VT1.5 RDI-V, VT1.5 LOP, VT1.5 pointer adj H4 multiframe sync loss, pattern sync loss, clock loss, power loss and errors (any type).

DS1/DS3 alarm indication: AIS, frame loss, RDI.

**Alarm seconds:** As for alarm indication, plus NDF, missing NDF and except clock loss.
General Information

Specifications

**AlarmScan plus alarm and BIP scan:**
Automatically scans the SONET network hierarchy for alarms and BIP errors or alarms only with a graphical display of the network hierarchy’s status including the indication of unequipped channels. Alarms: LOP, path AIS, RDI-P, H4 LOM†, VT LOP*, AIS-V*, RDI-V.*

† For VT6, VT2 AND VT1.5 structures.
* If applicable.

BIP errors:
STS-3c SPE payloads: STS-3c SPE CV-P (B3).
STS-1 SPE payloads: STS-1 SPE CV-P (B3).
VT6 /VT2 /VT1.5 payloads: STS-3c SPE/STS-1 SPE B3 and CV-V (V5).

User selectable BIP error threshold:
Off, > 0, > 10^-3, > 10^-6.

**Protection switch times:** Service disruption test measures error burst length for measurement of protection switch times†. Accuracy: < 50 ms.
Results: Longest burst length, shortest burst length, last burst length.
Resolution: 1 ms.

† Service disruption test requires PDH/DSn option UKJ, UKN or 110 to be fitted.

**Pointer results:** STS Path pointer value, NDF-P seconds, STS Path missing pointer, NDF seconds, STS Path +ve adjustment count/seconds, STS Path -ve adjustment count/seconds, VT pointer value, NDF-V seconds, VT pointer missing NDF -V seconds, VT +ve adjustment count/seconds, VT -ve adjustment count/seconds, implied STS-3c SPE, STS-1 SPE, VT6 SPE, VT2 SPE offset.

**Frequency measurement:** Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.

**Received overhead snapshot:**
TOH can be set in binary or HEX. TOH and POH of a received STM-1 signal. TOH and POH of a received STS-1 signal. Text message displayed for signal label (C2 and V5) and sync status (S1) decoded.

**Overhead sequence capture:**
Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.

**Pointer location graph:** A graphical display that shows the variation with time of the STS Path and VT pointer location. Up to four days of pointer location activity can be monitored.
Implied SPE offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean SPE offset calculated from this total.

**Overhead BER measurement:** Any SOH, LOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a 2^9-1 PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds, % error free seconds and pattern loss seconds are measured.
General Information
Specifications


**Results:** Jitter hit count, Jitter hit seconds, Jitter hit free seconds, +ve peak amplitude, -ve peak amplitude, peak-peak amplitude. Additional Results with Options A3L, A3V and A3N. Jitter Transfer and RMS Jitter.

**Jitter Autotolerance:** After a swept jitter tolerance measurement (using Option UHK or A3K, Jitter Generation) the results are presented graphically to show measured jitter against the ITU-T mask.

**Jitter Transfer (option A3L, A3V, A3N only):** After a Jitter Transfer measurement (using Option UHK or A3K, Jitter Generation) the results are presented in Graph form to show Jitter Gain against the ITU-T Pass mask and in text form to show the result at each frequency and amplitude point.

**Alarm indication:** Jitter unlock and Jitter hits

**WANDER**

**Results:** +ve peak amplitude, -ve peak amplitude, peak-peak amplitude 15 minutes, peak-peak amplitude 24 hours, Time interval error, Estimated frame slips, Estimated bit slips. The Wander measurements are available in graphical form on the RESULTS display. Three +ve and -ve sliding graphs, each of ±1 UI, ±16UI and ±256 UI are provided.

**Alarms:** No reference and excess wander. If Wander is >5 UI then the status message “Excess Wander” is displayed and is updated once/minute.

**ATM Measurement (Option UKN)**

**Error results Physical Layer:**


**155.52 Mb/s, 622.08 Mb/s:** RS B1 BIP, MS B2 BIP, MS FEBE, Path B3 BIP, Path FEBE, Path IEC (Opt A1T only), per ITU-T Rec. G826.

**Error Results ATM Layer:**

All rates: Received cells, Corrected HEC, Non-corrected HEC, Cell loss, Errored cells, Non Conforming cells Misinserted cells, Mean Cell Transfer Delay, Maximum cell delay, pk_pk 2 Pt cell delay variation, Maximum 1 Pt cell delay variation, Bit.

**Error analysis per ITU-T G.826:**

Errored Blocks, Errored seconds, Severely errored seconds, Unavailable seconds, Path unavailable seconds, Block error count, Error second ratio, Severely errored second ratio, Background block error ratio for CRC4, REBE, EM BIP, FEBE, RS B1 BIP, MS B2 BIP, MS FEBE, Path B3 BIP, Path IEC and Path FEBE.

**Alarm indication Physical Layer:**

2.048, 34.368 and 139.264 Mb/s:

Signal Loss, Pattern Loss, AIS, Frame Loss, Multiframe Loss, Remote Alarm/FERF, Remote Multiframe Alarm.

155.52 Mb/s, 622.08 Mb/s: Loss of Signal, Pattern loss, Loss of pointer, Frame Loss, MS and path FERF, MS and path AIS, TU path AIS, TU path FERF.
General Information

Specifications

Alarm indication ATM Layer (All rates): Loss of cell sync, Selected cell not received, VP alarm, VC alarm.

Alarm seconds Physical Layer:
- 2.048 Mb/s, 34.368 Mb/s, 139.264 Mb/s: Power Loss, Loss of Signal, Loss of Frame, AIS, FERF, RAI.
- 155.52 Mb/s, 622.08 Mb/s: Loss of power, Loss of Signal, Loss of frame, Out of frame, Loss of pointer, MS and path AIS, K1/K2 change, MS and path FERF, H4 multiframe, TU loss of pointer, TU path AIS, TU path FERF.

Alarm seconds ATM Layer (All rates): Power Loss, Loss of cell sync, Selected cell not received, Congestion experienced, Test cell loss, Pattern Loss, PM OAM loss, VP AIS, VP FERF, VP LOC, VC AIS, VC FERF, VC LOC.

ETSI/ANSI Internal Transmitter Clock Rates (Option UKZ)

Rates and Frequency
- DS1: 1.544 Mb/s
- DS3: 44.736 Mb/s
- E1: 2.048 Mb/s
- E3: 34.368 Mb/s

Accuracy: DS1 ± 0.7 ppm @ 25°C
DS3, E1 and E3 DS1 ± 0.5 ppm @ 25°C

Temperature stability at all rates:
- ≤ 3 ppm (0 to +50°C)

Ageing Stability at all rates:
- ≤ 1 ppm/year

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Level</th>
<th>Waveshape</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSX-1</td>
<td>1.544 Mb/s</td>
<td>3.0V 20%</td>
<td>Fits mask T1.102-1993</td>
</tr>
<tr>
<td>DS1-LO</td>
<td>1.544 Mb/s</td>
<td></td>
<td>As DSX-1 with 655° ABAM Cable</td>
</tr>
<tr>
<td>DS3-HI</td>
<td>44.736 Mb/s</td>
<td>0.9V pk (nominal)</td>
<td></td>
</tr>
<tr>
<td>DSX-3</td>
<td>44.736 Mb/s</td>
<td>560mV pk (nominal)</td>
<td>Fits mask T1.102-1993</td>
</tr>
<tr>
<td>DS3-900</td>
<td>44.736 Mb/s</td>
<td>330mV pk (nominal)</td>
<td></td>
</tr>
<tr>
<td>E1 (bal)</td>
<td>2.048 Mb/s</td>
<td>3.00V 10%</td>
<td>As per ITU rec G703</td>
</tr>
<tr>
<td>E1 (unbal)</td>
<td>2.048 Mb/s</td>
<td>2.37V 10%</td>
<td>As per ITU rec G703</td>
</tr>
<tr>
<td>E3</td>
<td>34.368 Mb/s</td>
<td>1.0V 10%</td>
<td>As per ITU rec G703</td>
</tr>
</tbody>
</table>
### General Information

### Specifications

#### ETSI/ANSI Receiver Equalization (Option UKZ)

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Cable Loss Accommodation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048Mb/s</td>
<td>Up to 6dB for root f cable @ half-bit rate</td>
</tr>
<tr>
<td>34.368Mb/s</td>
<td>Automatic equalization up to 12dB for root f cable @ half-bit rate</td>
</tr>
<tr>
<td>1.544Mb/s (DS1)</td>
<td>Signal range from DS1-LO to DSX-1</td>
</tr>
<tr>
<td>44.736Mb/s (DS3)</td>
<td>Automatic equalization for up to 900 feet of type 728A Cable (root f)</td>
</tr>
</tbody>
</table>

#### ETSI/ANSI Receiver Monitor Levels (Option UKZ)

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Cable Loss Accommodation (Monitor mode)</th>
<th>Monitor Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048Mb/s (Unbalanced Mode)</td>
<td>Selectable OFF or Automatic (Up to 6dB for root f cable @ half-bit rate).</td>
<td>Selectable 20dB, 26dB or 30dB</td>
</tr>
<tr>
<td>2.048Mb/s (Balanced Mode)</td>
<td>Selectable OFF or Automatic - Up to 6dB (20dB selected) or 3dB (26 or 30dB selected) for root f cable @ half-bit rate.</td>
<td>Selectable 20dB, 26dB or 30dB</td>
</tr>
<tr>
<td>34.368Mb/s</td>
<td>Selectable OFF or Automatic (Up to 12dB for root f cable @ half-bit rate)</td>
<td>Selectable 20dB or 26dB</td>
</tr>
<tr>
<td>1.544Mb/s (DS1)</td>
<td>Signal range from DS1-LO to DSX-1</td>
<td>Selectable 20dB, 26dB or 30dB</td>
</tr>
<tr>
<td>44.736Mb/s (DS3)</td>
<td>Selectable OFF or Automatic (Up to 900 feet of type 728A Cable (root f)</td>
<td>Selectable 20dB or 26dB</td>
</tr>
</tbody>
</table>
General Information
Specifications

GRAPHICS and LOGGING

Graphic display or printout: Barchart (results versus 60 time periods) for current or stored measurement period.

Bar resolution: 1 second, 1, 15, 60 minutes.

Unframed PDH bar graphs: Bit error count, code error count, frame error count, CRC error count, REBE error count and PDH alarms.

Structured PDH bar graphs: Bit error count, code error count, 140M frame error count, 34M frame error count, 8M frame error count, 2M frame error count, CRC error count, REBE error count, M2120 Reports and SPDH alarms.

If Option A1T or A3R (SDH) is fitted bar graphs of DS3 frame count, DS1 frame count, P-bit count and C-bit count are available.

SDH bar graphs: RS B1 BIP error count, MS B2 BIP error count, MS FEBE error count, Path B3 BIP error count, Path FEBE error count, Path IEC error count, TU BIP error count, TU FEBE error count and SDH alarms.

Jitter bar graphs: Jitter hit count and Jitter alarms.

Wander bar graphs: Frame slip count and Bit slip count.

ATM bar graphs: EM BIP count, FEBE error count, CRC4 error count, REBE error count, Corrected HEC count, Non corrected HEC count, Non conforming cell count, Bit error count, Cell loss count, Misinserted cell count, Errored cell count, BDEC count and ATM alarms.

Printer

Internal: 24-column thermal printer.

External: 80-column HP 550C Deskjet printer (HP-IB).

HP 550C Deskjet printer or 40 column or 80 column printer (RS-232-C).

HP 550C Deskjet printer or 40 column or 80 column printer (Centronix)

Printing: Results, time, date and instrument control settings.

Print triggers: Power up, manual, start of test period, turning printer on during test period, any alarm or error second, start of new day.

Print period: 10 minutes, 1 hour, 24 hours, user-defined (10 to 99 minutes or 1 to 99 hours).

Disk Drive:

Configurations: Save/recall of instrument configurations to/from floppy disk drive (in addition to the 5 internal stored settings).

Graphics: Save/recall of stored measurement graphics to/from floppy disk drive. Extends internal event based storage from 20,000 events to 320,000 events.

Logging: Direction of logging output to floppy disk drive.

PC results format: Save SMG stored results in a CSV (comma separated variable) PC compatible format for importing to PC spreadsheets etc.

Disk management: Provides the following disk drive features:
General Information

Specifications

Copying of stored measurement graphics files from internal instrument storage to floppy disk drive.

Copying of instrument configuration files to/from internal instrument storage to/from floppy disk drive.

Deleting files or directories from floppy disk drive.

Renaming of files.

Labeling of floppy disks.

Formatting of floppy disks.

Allows the upgrading of instrument firmware from the floppy disk drive.
## General Information

### Recommended Test Equipment

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Critical Specification</th>
<th>Recommended Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscilloscope</td>
<td>400 MHz Bandwidth, 1 MΩ Input Termination</td>
<td>HP 54503A</td>
</tr>
<tr>
<td>Spectrum Analyzer</td>
<td>200 MHz Bandwidth, 75Ω Input, -70 to +20 dBm</td>
<td>HP 8568B Opt 001</td>
</tr>
<tr>
<td>Frequency Synthesizer</td>
<td>75Ω Output, Sinewave to 80 MHz, Amplitude to 2.5 V pk-pk, 1 Hz resolution</td>
<td>HP 3335A Opt 001</td>
</tr>
<tr>
<td>Frequency Synthesizer</td>
<td>Sinewave to 2.5 MHz, Amplitude to 5V pk-pk, 1 Hz Resolution</td>
<td>HP 3325B (Qty 2)</td>
</tr>
<tr>
<td>Signal Generator</td>
<td>Sinewave 700 kHz to 170 MHz, Amplitude 500 mV</td>
<td>HP 8657B</td>
</tr>
<tr>
<td>Frequency Counter</td>
<td>Range 0 to 200 MHz, 2 channels with accuracy &lt;0.1 ppm. (Ratio Mode)</td>
<td>HP 5335A Opt 010</td>
</tr>
<tr>
<td>Optical Power Meter and Sensor Module</td>
<td>Range -8 dBm to -15 dBm, Wavelength 1270-1340 nm</td>
<td>HP 8153A and HP 81536A</td>
</tr>
<tr>
<td>Dual Power Supply</td>
<td>±12V</td>
<td>HP 6253A</td>
</tr>
<tr>
<td>Lightwave Receiver</td>
<td>Wavelength 1300 to 1560 nm, Conversion Gain 750 volts/watt, Frequency Response &lt; 3 dB down at 1 GHz.</td>
<td>HP 83422A</td>
</tr>
<tr>
<td>Optical Attenuator</td>
<td>Wavelength 1200 - 1600 nm, Range 0 - 30 dB</td>
<td></td>
</tr>
<tr>
<td>FC/PC Optical Interface Connector</td>
<td>Unique</td>
<td>HP 81000FI</td>
</tr>
<tr>
<td>Optical Cables</td>
<td>Unique</td>
<td>HP 11871A (Qty 2)</td>
</tr>
<tr>
<td>Digital Transmission Analyzer</td>
<td>Unique</td>
<td>HP 3764A Option 006</td>
</tr>
<tr>
<td>PDH Structured Test Set</td>
<td>Unique</td>
<td>HP 37717B/C Opt UKJ</td>
</tr>
<tr>
<td>Digital Transmission Frame Generator</td>
<td>Unique</td>
<td>HP 37729A</td>
</tr>
<tr>
<td>Jitter Generation Module</td>
<td>Unique</td>
<td>HP 37717B/C Opt UHK</td>
</tr>
<tr>
<td>ThinkJet Printer</td>
<td>HP-IB Interface</td>
<td>HP 2225A</td>
</tr>
<tr>
<td>Attenuator</td>
<td>6 dB, 50Ω, 0 to 200 MHz</td>
<td>HP 8491A Opt 006</td>
</tr>
</tbody>
</table>
### General Information

#### Recommended Test Equipment

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Critical Specification</th>
<th>Recommended Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1 Test Set</td>
<td>Unique</td>
<td>HP 37701B</td>
</tr>
<tr>
<td>Attenuator</td>
<td>3 dB, 50Ω, 0 to 200 MHz</td>
<td>HP 8491A Opt 003</td>
</tr>
<tr>
<td>Cable Simulator #1</td>
<td>80 metres of 75Ω coaxial cable</td>
<td>8120-0049 (80 m)</td>
</tr>
<tr>
<td>Cable Simulator #2</td>
<td>60 metres of 75Ω coaxial cable</td>
<td>8120-0049 (60 m)</td>
</tr>
<tr>
<td>Cable Simulator #3</td>
<td>70 metres of 75Ω coaxial cable</td>
<td>8120-0049 (70 m)</td>
</tr>
<tr>
<td>Cable Simulator #4</td>
<td>30 metres of 75Ω coaxial cable</td>
<td>8120-0049 (30 m)</td>
</tr>
<tr>
<td>Converter</td>
<td>75Ω Unbalanced to 120Ω Balanced</td>
<td>HP 15508C</td>
</tr>
<tr>
<td>ECL Termination</td>
<td>Unique</td>
<td>HP 10086A</td>
</tr>
<tr>
<td>Blocking Capacitor</td>
<td>0.18 µf</td>
<td>HP 10240A</td>
</tr>
<tr>
<td>Cable Attenuator</td>
<td>Unique</td>
<td>HP 8120-0039 (70 m)</td>
</tr>
<tr>
<td>75Ω/50Ω Matching Pad</td>
<td>Insertion Loss 5.7 dB</td>
<td>HP 11852B (Qty 2)</td>
</tr>
<tr>
<td>75Ω Termination</td>
<td>0 to 200 MHz</td>
<td>HP 15522-80010</td>
</tr>
<tr>
<td>T Connector</td>
<td>BNC to Dual BNC</td>
<td>HP 1250-0781</td>
</tr>
<tr>
<td>Adaptor N Type (f) to BNC (m)</td>
<td>1250-1534 (Qty 2)</td>
<td></td>
</tr>
<tr>
<td>Adaptor N Type (m) to N Type (m)</td>
<td>1250-1475 (Qty 2)</td>
<td></td>
</tr>
<tr>
<td>Adaptor SMA to BNC</td>
<td>1250-1787 (Qty 2)</td>
<td></td>
</tr>
<tr>
<td>RS-232-C Loopback</td>
<td>Unique (See Figure 3-1)</td>
<td>5060-4462</td>
</tr>
<tr>
<td>Cable Simulator #5</td>
<td>450 feet of type 728A Cable (root f)</td>
<td>Unique (see Appendix D)</td>
</tr>
<tr>
<td>Cable Simulator #6</td>
<td>655 feet ABAM Cable</td>
<td>Unique (see Appendix D)</td>
</tr>
<tr>
<td>Balanced/Unbalanced Converter</td>
<td>110 Ωs balanced: 75 Ωs Unbalanced (nominal)</td>
<td>HP 15508B</td>
</tr>
<tr>
<td>Impedance Converter</td>
<td>75/ 50 Ω Insertion Loss 5.7dB</td>
<td>HP 11852B</td>
</tr>
</tbody>
</table>
Installation

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 the Calibration 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 the Calibration manual, 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.
Operating Environment

This instrument is designed for Indoor use only.

**DO NOT** operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.

This instrument may be operated in environments within the following limits:

**Temperature:** 0° C to +45° C

+5° C to +35° C with lid printer

**Altitude**

up to 3050m (10,000ft)

**Humidity**

up to 95% relative humidity to 40° C but it should be protected from temperature extremes which may cause condensation.

To ensure adequate cooling do not obstruct air vents in the instrument cabinet.

---

**CAUTION**

This instrument is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and 644 respectively.

---

**CAUTION**

VENTILATION REQUIREMENTS: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the instrument by 4°C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.
Preparation for Use

**WARNING**

FOR CONTINUED PROTECTION AGAINST FIRE HAZARD
REPLACE FUSE ONLY WITH SAME TYPE AND RATINGS (SEE “Fuses” on page 2-3).

**WARNING**

If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition only (in which all means for protection are intact).

**Power Requirements**

The HP 37717C Communications Performance Analyzer requires a power source of 90 V to 132 V ac and 198 V to 264 V ac at a frequency between 47 Hz and 63 Hz (nominal).

Total power consumption is 450 VA (maximum).

The fuse rating for the power source is given in the following Table.

**Fuses**

<table>
<thead>
<tr>
<th>Line Voltage</th>
<th>Fuse Rating</th>
<th>HP Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>90V to 264V</td>
<td>5A Timed, 250V</td>
<td>2110-1120</td>
</tr>
</tbody>
</table>

**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.
Installation
Preparation for Use

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

**WARNING**
ONLY USE A FUSE OF THE CORRECT RATING AS LISTED IN “Fuses” on page 2-3. **DO NOT** use repaired fuses or short-circuited fuseholders: For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.

The fuse is removed by inserting a suitable flat bladed tool into the slot in the fuse cap and turning counter-clockwise. The cap and the fuse can then be removed and the fuse changed for another of the correct rating. The fuse rating and HP part number are listed in “Fuses” on page 2-3.

**Connecting to the Power Supply**

**WARNING**
This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the powercord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.

**Line Voltage Selector Switch**
The Line Voltage Selector switch has 2 positions:

- 100 - 120V
- 200 - 240V

**CAUTION**
Before switching on this instrument, make sure that the line voltage selector switch is set to the voltage of the power supply. Ensure the supply voltage is in the specified range.
Installation
Preparation for Use

Power Cord

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

WARNING (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.

WARNING (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.

WARNING (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).

The power cord supplied with each instrument varies with the country of destination. The following figure 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.

Power Cord Configurations and Part Numbers

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>8120-2104</td>
<td></td>
</tr>
<tr>
<td>8120-1969</td>
<td></td>
</tr>
<tr>
<td>8120-1869</td>
<td></td>
</tr>
<tr>
<td>8120-1951</td>
<td></td>
</tr>
<tr>
<td>8120-1976 US</td>
<td></td>
</tr>
<tr>
<td>8120-4753 JAP</td>
<td></td>
</tr>
<tr>
<td>8120-2956</td>
<td></td>
</tr>
<tr>
<td>8120-4211</td>
<td></td>
</tr>
</tbody>
</table>
Connecting to the Network

The network connectors are located on the modules at the side of the instrument. The connections available depend on the options fitted to your instrument.

Before Connecting, note the Warning and Caution information given.

All Connectors

**CAUTION**

When connecting or disconnecting, ensure that you are grounded or, make contact with the metal surface of the Mainframe with your free hand to bring you, the module, and the mainframe to the same static potential.

Modules remain susceptible to ESD damage while the module is installed in the Mainframe.

Additional ESD information is required when servicing see “Additional Precautions for Service Engineers” on page 2-18.

**Electrical Interface Connectors**

**PDH IN**

PDH receiver input interface. Allows the connection of 75 Ω unbalanced data signals (all rates) and 120 Ω balanced data signals at 2 Mb/s (and 704 kb/s Option UKK[USB]).

**PDH OUT**

PDH transmitter output interface. Provides 75 Ω unbalanced data output (all rates) and 120 Ω balanced data output at 2 Mb/s (and 704 kb/s Option UKK[USB]).

**DS3, 2Mb/s, 34Mb/s 75 Ω IN**

PDH/DSn receiver input interface. Allows the connection of 75Ω unbalanced DS3, 2 M b/s and 34.368 Mb/s data signals.

**DS3, 2Mb/s, 34Mb/s 75 Ω OUT**

PDH / DSn transmitter output interface. Provides 75 Ω unbalanced DS3, 2 Mb/s and 34 M b/s data output. A “keep alive” signal is output when the transmit signal is SDH/SONET.
Installation

Connecting to the Network

**DS1 100 Ω, 2Mb/s 120 Ω IN**
PDH / DS1 receiver input interface. Allows the connection of 100 Ω balanced DS1 and 120 Ω balanced 2 Mb/s data signals.

**DS1 100 Ω, 2Mb/s 120 Ω OUT**
PDH / DS1 transmitter output interface. Provides 100 Ω balanced DS1 and 120 Ω balanced 2 Mb/s data signals. A “keep alive” signal is output when the transmit signal is SDH/SONET.

**75 Ω OUT 1**
Replica of PDH / DSn OUT delayed by 4 bits at all rates except 140 Mb/s.

**75 Ω OUT 2**
Replica of PDH / DSn OUT delayed by 8 bits at all rates except 140 Mb/s.

**75 Ω OUT 3**
Replica of PDH / DSn OUT delayed by 12 bits at all rates except 140 Mb/s.

**ERROR OUT**
Provides an ECL pulse each time an error occurs. If 2 or more errors occur within 16 clock periods only 1 pulse is output.

**STM-1 IN**
SDH receiver input interface. Allows the connection of 75 Ω unbalanced STM-1 electrical signals.

**STM-1 OUT**
SDH transmitter output interface. Provides a 75 Ω unbalanced STM-1 electrical output.

**EXT MTS CLOCK**
Allows connection of a, 75 Ω or 120 Ω, timing reference as per CCITT G.811. The reference format may be either clock or data. Options US1[US5] and A1T[A1U] only.

**CLOCK IN**
Allows connection of SDH/SONET binary clock to Options 130 or 131.

**CLOCK OUT (Opt OYH)**
Provides a STM-1/STM-4 binary clock from Options USN or UKT.
Installation

Connecting to the Network

**CLOCK OUT** *(Opt 110)*
Outputs the selected transmitter clock (internal or looped receiver clock). **Note that this output is turned OFF when the TRANSMIT module is supplying payload to the SDH module.**

**DATA IN**
Allows connection of SDH/SONET binary data to Options 130 or 131.

**DATA OUT**
Provides SDH/SONET binary data from Options 130 or 131.

**MUX**
Allows the insertion of an external 2 Mb/s tributary into the transmitted payload.

**MUX DS1 100 Ω**
Allows an externally supplied DS1 signal to be inserted in any or all timeslot(s) of a DS3 signal. In conjunction with the SDH/SONET module a DS1 signal can be inserted into a VT1.5 or TU-11.

**MUX 2 Mb/s 75 Ω**
Allows an externally supplied 2.048 Mb/s signal to be inserted in any or all timeslot(s) of a 34 Mb/s signal. In conjunction with the SDH module a 2.048 Mb/s signal can be inserted into a TU-12.

**DEMUX (Opt UKJ)**
Provides a 2 Mb/s tributary dropped from the received payload.

**DEMUX DS1 100 Ω**
Allows a DS1 signal to be dropped from any timeslot of a DS3 signal. In conjunction with the SDH/SONET module this port allows the demultiplexing of a DS1 signal carried in a VT1.5

**DEMUX 2 Mb/s 75 Ω**
Allows a 2.048 Mb/s signal to be dropped from any timeslot of an 8.448 Mb/s, 34.368 Mb/s or 139.264 Mb/s signal.

**STM-1E IN**
Allows connection of STM-1 electrical input for SDH Jitter Measurement.
Installation

Connecting to the Network

**STM-1 / STM-4 IN**  Allows connection of STM-1 / STM-4 optical input for SDH Jitter Measurement.

**2M REF IN**  Allows the connection of a 2 Mb/s reference, either Clock or Data for Wander measurement.

**DEMOD OUT**  Provides a demodulated Jitter output.

**TRIG OUT**  Not used in option 110 instruments.

**RS 449**  Allows the Drop and Insert of Regenerator Section (192 kb/s) and Multiplexer Section (576 kb/s) Data Communication Channels (DCC).

The following connections are available:

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Send Data (A)</td>
</tr>
<tr>
<td>5</td>
<td>Send Timing (A)</td>
</tr>
<tr>
<td>6</td>
<td>Receive Data (A)</td>
</tr>
<tr>
<td>8</td>
<td>Receive Timing (A)</td>
</tr>
<tr>
<td>19</td>
<td>Signal Ground (Chassis)</td>
</tr>
<tr>
<td>22</td>
<td>Send Data (B)</td>
</tr>
<tr>
<td>23</td>
<td>Send Timing (B)</td>
</tr>
<tr>
<td>24</td>
<td>Receive Data (B)</td>
</tr>
<tr>
<td>26</td>
<td>Receive Timing (A)</td>
</tr>
</tbody>
</table>
Installation

Connecting to the Network

Optical Interface Connectors

For your protection, review all laser information given in this manual before installing or using the instrument.

WARNING
To prevent personal injury, avoid use that may be hazardous to others, and maintain the module in a safe condition. Ensure the information given below is reviewed before operating the module.

Laser Product Classification

All Options UH1, UH2, URU, USN, 130, 131 and UKT are classified as Class I (non-hazardous) laser product in the USA which complies with the United States Food and Drug Administration (FDA) Standard 21 CFR Ch.1 1040.10. Options UH1 and UH2 are classified as Class 1 (non-hazardous) laser products in Europe which complies with EN 60825-1 (1994).

Options URU, USN, 130 and 131 are classified as Class 3A laser product in Europe, which complies with EN 60825-1 (1994) / IEC825-1 (1993).

Laser classification is based on the ability of the optical beam to cause biological damage to the eye or skin. The EN 60825-1 (1994) definition of Class 3A is:

"Any laser product which permits human access to laser radiation in excess of the accessible emission limits of Class I and Class 2 as applicable, but which does not permit human access to laser radiation in excess of the accessible emissions of Class 3A and Class 3B (respectively) for any emission duration and wavelength."

Options URU, USN, 130 and 131 fall into this category, under the EN 60825-1 (1994) (European) standard, because they have a maximum output power of 19.5 mW (under fault conditions), with a wavelength of 1550 nm.

To avoid hazardous exposure to laser radiation, it is recommended that the following practices are observed during system operation:

- **ALWAYS DEACTIVATE THE LASER BEFORE CONNECTING**
Installation
Connecting to the Network

OR DISCONNECTING OPTICAL CABLES.

- When connecting or disconnecting optical cables between the module and device-under-test, observe the connection sequences given below.

**Connecting:** Connect the optical cable to the input of the device-under-test before connecting to the module’s Optical Out connector.

**Disconnecting:** Disconnect the optical cable from the module’s Optical Out connector before disconnecting from the device-under-test. Always ensure the shutter closes properly and covers the laser aperture.

- NEVER examine or stare into the open end of a broken, severed, or disconnected optical cable when it is connected to the module’s Optical Out connector.

- Arrange for service-trained personnel, who are aware of the hazards involved, to repair optical cables.

**CAUTION**

1. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

2. Always leave the fibre optic connector dust caps on each connector when not in use. Before connection is made, always clean the connector ferrule tip with acetone or alcohol and a cotton swab. Dry the connector with compressed air. Failure to maintain cleanliness of connectors is liable to cause excessive insertion loss.

**Laser Warning Symbols**

The front panel of optical modules **Options UH1 and UH2** has the following label:

**CLASS 1 LASER PRODUCT**

This label indicates that the radiant energy present in this instrument is non-hazardous.

The front panel of optical modules **Options URU, UKT and USN** has the following label:

![INVISIBLE LASER RADIATION CLASS 3A LASER PRODUCT]
Installation

Connecting to the Network

The front panel of optical modules **Options 130 and 131** has the following label:

![CLASS 3A LASER PRODUCT]

**WARNING**

Direct intrabeam viewing of Class 3A laser beams with optical aids (e.g. binoculars, telescopes) may be hazardous. For laser emitting in the range from 400nm to 700nm, protection to the unaided eye is afforded by aversion responses including the blink reflex.

**Swedish and Finnish Labels**

VARO! NÄYMÄTÖNTÄ LASERSÄTEILYLLE
ALÄ TUIJOTA SÄTEESEEN ÄLÄKÄ KATSO SITÄ
OPTISEN LAITTEEN LÄPI
LUOKAN 3A LASERLAITE

WARNING - OSYNLIG LASERSTRÅLNING
STIRRÅ ET IN I STRÅLEN OCH BETRAKTA EJ
STRÅLEN MED OPTISKA INSTRUMENT
CLASS 3A LASER PRODUCT

WARNING - OSYNLIG LASERSTRÅLNING
STIRRÅ ET IN I STRÅLEN OCH BETRAKTA EJ
STRÅLEN GENOM OPTISKT INSTRUMENT
KLASS 3A LASER APPARAT

2-12
Installation
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Location of Laser Apertures on Options 130 and 131
Installation

Connecting to the Network

**OPTICAL IN**

Allows connection of an optical signal, wavelength 1200 to 1600 nm, at a maximum power level of -8 dBm.
Option UH1 accepts STM-1.
Options 130 and 131 accept STM-0, STM-1 or STM-4 and also SONET signals, STS-1, STS-3 and STS-12.

**OPTICAL OUT**

Provides an STM-0, STM-1 or STM-4 optical signal (STS-1, STS-3 and STS-12 SONET signals).
Option UH1 provides a STM-1 optical signal, wavelength 1280 to 1330 nm, at a nominal power level of -10 dBm.
Options 130 and 131 provide a STM-0, STM-1 and STM-4 optical signal, wavelength 1280 to 1330 nm, at a nominal power level of -10 dBm.
Option 131 also provides a STM-1 and STM-4 optical signal, wavelength 1550 to 1565 nm, at a nominal power level of -1 dBm.

**Cleaning Optical Connectors**

See “Optical Connector Cleaning” on page 1-12
Connecting Accessories

**LID**
Provides the output for the option UKX printer which is fitted in the cover (LID) of the instrument.

**VGA**
Provides the output for a display monitor.

**HANDSET**
Allows connection of a telephone handset for communication across the network.

**Printer**
External printer connection details are given in the Users Guide.
The port selected for external printer use is not available for remote control.

**Remote Control**
Remote control connection is given in the Remote Control Manual.
The port selected for remote control use is not available for an external printer.

**10 Base-T Lan Connection Radiated Emissions**
To ensure compliance with EN 55011 (1991) a category 5, FTP patch lead, RJ 45 cable should be used to connect the LAN port on the processor module marked "10 Base-T".
Installation

Connecting Accessories

Hewlett-Packard Interface Bus

The HP 37717C Communications Performance Analyzer (Option A3B or A3D) is connected to the HP-IB by means of an appropriate HP-IB cable. The HP-IB interconnecting cables available are listed in the following table.

**HP-IB Interconnecting Cables**

<table>
<thead>
<tr>
<th>Length</th>
<th>Accessory Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 meter</td>
<td>HP 10833A</td>
</tr>
<tr>
<td>2 meters</td>
<td>HP 10833B</td>
</tr>
<tr>
<td>4 meters</td>
<td>HP 10833C</td>
</tr>
<tr>
<td>0.5 meter</td>
<td>HP 10833D</td>
</tr>
</tbody>
</table>

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) \( \times \) the total number of devices connected to the bus.

A standard HP-IB connector is provided on the instrument. The connections are shown in their following figure. The mating connector part number is HP 1251-0293 or Amphenol 57-30240.
Installation

Connecting Accessories

HP-IB Connections

HP-IB Address Selection

The HP 37717C (Option A3B or A3D) HP-IB address is accessed on the OTHER display under the REMOTE CONTROL function.

The address can be set to any value between 0 and 30 inclusive.
Additional Precautions for Service Engineers

Safety Precautions

**DO NOT** substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure the safety features are maintained.

**DO NOT** service or adjust alone: Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

Review “Safety Precautions for the Operator” on page 1-9

ESD Precautions

**CAUTION**

When making connections to the modules, review “Connecting to the Network” on page 2-6

The module contains components sensitive to electrostatic discharge. To prevent component damage, carefully follow the handling precautions presented below.

The smallest static voltage most people can feel is about 3500 volts. It takes less than one tenth of that (about 300 volts) to destroy or severely damage static sensitive circuits. Often, static damage does not immediately cause a malfunction but significantly reduces the component's life. Adhering to the following precautions will reduce the risk of static discharge damage.

- Keep the module in its conductive storage box when not installed in the Mainframe. Save the box for future storage of the module.
- Before handling the module, select a work area where potential static sources are minimized. Avoid working in carpeted areas and non-conductive chairs. Keep body movement to a minimum. Hewlett-Packard
Installation

Additional Precautions for Service Engineers

recommends that you use a controlled static workstation.

- Handle the module by its front-panel. Avoid touching any components or edge connectors. When you install the module, keep one hand in contact with the protective bag as you pick up the module with your other hand. Then, before installing the module, ensure that you are grounded or make contact with the metal surface of the Mainframe with your free hand to bring you, the module, and the mainframe to the same static potential. This also applies whenever you connect/disconnect cables on the front-panel.
Installation

Additional Precautions for Service Engineers
Performance Tests

Introduction

The procedures given in this Section, test the HP 37717C 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 Chapter 1, General Information. Any equipment which meets or exceeds the critical specification of the equipment listed, may be substituted.

Extra Modules Required

Some of the Performance Tests require additional modules to be present in the instrument under test. Before starting Performance Tests, refer to Appendix B to decide if you need to fit any extra modules.

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.
Performance Tests

Introduction

Recall Default Settings

The Performance Tests require the HP 37717C to be set to a pre-defined (default) state at the beginning of each test. The pre-defined default settings are listed in Appendix A.

1. Using OTHER, display softkeys, 
   and set up the STORED SETTINGS display as shown opposite.

2. Press RECALL to recall the instrument default settings. The instrument display will blank for a few seconds while the settings are recalled and the status display will indicate stored settings number 0 recalled.
Performance Tests
Self Test - All Options

Self Test - All Options

Description
The instrument ALL TESTS self test is run to verify the functionality of the instrument prior to carrying out the performance tests.

Ensure the following loopbacks are in place before running the ALL TESTS Self Test.

1. Set up the display as shown opposite using OTHER, MORE and SELF TEST.
2. Insert a formatted disk into the instrument disk drive.
3. PDH Loopbacks:
   Connect 75 Ω Signal In to 75 Ω Signal Out.
   Connect 120 Ω Signal In to 120 Ω Signal Out.
   If Option UKJ is fitted, also connect MUX port to DEMUX port.
   If Option UH3 is fitted connect CLOCK OUT to CLOCK IN and DATA OUT to DATA IN.
4. SDH Loopbacks:
   Connect the STM-1 IN port to the STM-1 OUT port.
5. Optical Interface Loopbacks:
   Connect the IN port to the OUT Port.

CAUTION
If Option URU, STM-1/STM-4 Optical Interface, is fitted connect an Optical attenuator, set to 10 dB, between the IN and OUT Ports. Failure to attenuate the optical signal from option URU could result in damage to the optical receiver.

NOTE
If Option USN or UKT, Dual Wavelength Optical Interface, is fitted connect the 1310 nm OUT port to the IN port. Do not connect the 1550 nm OUT port to the IN port.
Performance Tests

Self Test - All Options

NOTE

If any or all of these connections are not made the HP 37717C will FAIL Self Test.

6. 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 37717C is functioning correctly, after a time of between 15 minutes and 1 hour, TEST STATUS [PASSED] is displayed.

If TEST STATUS [FAIL nnn] is displayed the HP 37717C should be returned to a service office for repair.

FAIL Error Numbers are listed and defined in Appendix B.

Additional Tests

Some options require additional test to be carried out to completely verify the option integrity. These require different connections and the tests run individually.

RS-232-C Tests: If Option A3B or A3D is fitted, the RS-232-C interface is not fully tested.

To fully test RS-232-C:

1. Select CPU TESTS
2. Fit a special RS-232-C connector with Loopback links as shown:

3. Run the CPU TESTS.
Performance Tests
Self Test - All Options

**Line Jitter Tests:** If Option A3L, A3V, A3N, A1M, A1N or A1P, SDH Line Jitter, is fitted the full set of jitter tests are not included under ALL TESTS.

To fully test SDH Line Jitter:
1. Select JITTER TESTS
2. Connect STM-1 OUT from the SDH module to STM-1E IN on the RX Jitter module.
3. For Options A1N and A1P only connect STM-1/STM-4 OUT on the Optical Module to STM-1/STM-4 IN on the RX Jitter module.
4. RUN the JITTER TESTS.

**1550 nm Dual Wavelength Tests:** If Option USN, 130 Dual Wavelength Optical Interface, is fitted the 1550 nm tests are not included under ALL TESTS.

To complete the 1550 nm tests:
1. Select STM-1/STM-4 OPTICS TESTS
2. Connect STM-1/STM-4 1550 nm OUT to STM-1/STM-4 1550 nm IN via an Optical Attenuator set to 10 dB.
3. RUN the STM-1/STM-4 OPTICS TESTS.

**Datacomm Tests:** If Option A1T[A1U] or A3R[A3S], 120 SDH/SONET Module, is fitted the Datacomm RS449 port is not tested under ALL TESTS.

To test the Datacomm port:
1. Select SDH TESTS
2. Make the following connections on the Datacomm port.

![Datacomm port loopback connections]

3. RUN the SDH TESTS.
Performance Tests

PDH Internal Transmitter Clocks (Options UKK, [USB], UKJ, [USA])

PDH Internal Transmitter Clocks (Options UKK, [USB], UKJ, [USA])

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Option</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>139.264 MHz</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>139.264 MHz ± 626.28 Hz</td>
</tr>
<tr>
<td>34.368 MHz</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>34.368 MHz ± 154.66 Hz</td>
</tr>
<tr>
<td>8.448 MHz</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>8.448 MHz ± 38.0 Hz</td>
</tr>
<tr>
<td>2.048 MHz</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>2.048 MHz ± 9.22 Hz</td>
</tr>
<tr>
<td>704 kHz</td>
<td>UKK, [USB]</td>
<td>704 kHz ± 3.17 Hz</td>
</tr>
</tbody>
</table>

Description

This test verifies that the PDH transmit data rates are within limits. These limits assume the instrument is within the annual calibration cycle. The Frequency Offset capability (deviation from Standard Bit Rate) is also tested here.

The test uses a Frequency Counter connected to the PDH Signal Out port to measure the data rate on an "all ones" pattern. This gives an indirect measure of the internal transmitter clock frequency as the data is clocked by the internal clock oscillator. Because the Frequency Counter triggers from the positive pulses only, the frequency count will be half the selected data rate.

Equipment Required

- **Frequency Counter**: HP 5335A Option 010
- **75Ω Termination**: HP 15522-80010
- **T Connector**: HP 1250-0781
Performance Tests
PDH Internal Transmitter Clocks (Options UKK, [USB], UKJ, [USA])

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the 75Ω Unbalanced SIGNAL OUT port to the Frequency Counter. Terminate the Frequency Counter input in 75Ω (use the T connector).
3. Set the frequency counter to:
FUNCTION - FREQ A
ATTEN - X10

NOTE
Steps 4 and 5 are only valid for Option UKK, [USB].

4. Press TRANSMIT and set up the display as shown opposite.

5. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 351997.53 Hz and 352002.46 Hz.

6. Select SIGNAL [2 Mb/s], adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 1023992.8 Hz and 1024007.2 Hz.

7. Select signal [8 Mb/s], adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 4223970.4 Hz and 4224029.6 Hz.

8. Select SIGNAL [34 Mb/s], adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 17183879.7 Hz and 17184120.3 Hz.

9. Select SIGNAL [140 Mb/s], adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 69631512.6 Hz and 69632487.4 Hz.
Performance Tests

PDH Internal Transmitter Clocks (Options UKK, [USB], UKJ, [USA])

Frequency Offsets

10. Press [TRANSMIT] and set up the display as shown opposite.

11. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 69632557.05 Hz and 69633531.91 Hz.

**NOTE**

At each step wait for the Status message "VCXO output Bit Rate settling" to clear from the bottom line of the display before reading the frequency counter.

12. Select TX CLOCK OFFSET: [-15PPM], adjust the Frequency Counter Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 69630642.18 Hz and 69631268.86 Hz.

13. Select TX CLOCK OFFSET: [USER OFFSET] [+100PPM] and ensure that the Frequency Counter reads between 69638649.86 Hz and 69639276.54 Hz.

14. Select TX CLOCK OFFSET: [USER OFFSET] [-100PPM], adjust the Frequency Counter Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 69624723.46 Hz and 69625350.14 Hz.

15. Select each BIT RATE and TX CLOCK OFFSET listed in Table 3-1.

16. For each selection adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between the limits listed in Table 3-1.
Performance Tests

PDH Transmitter Output (UKK, [USB], UKJ, [USA])

Table 3-1

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Offset</th>
<th>Option</th>
<th>Counter Reading Hz (minimum)</th>
<th>Counter Reading Hz (maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 Mbit/s</td>
<td>+20 ppm</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>17184266.35</td>
<td>17184421.01</td>
</tr>
<tr>
<td>34 Mbit/s</td>
<td>-20 ppm</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>17183578.99</td>
<td>17183733.65</td>
</tr>
<tr>
<td>8 Mbit/s</td>
<td>+30 ppm</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>4224107.7</td>
<td>4224145.73</td>
</tr>
<tr>
<td>8 Mbit/s</td>
<td>-30 ppm</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>4223854.27</td>
<td>4223892.29</td>
</tr>
<tr>
<td>2 Mbit/s</td>
<td>+50 ppm</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>1024046.59</td>
<td>1024055.81</td>
</tr>
<tr>
<td>2 Mbit/s</td>
<td>-50 ppm</td>
<td>UKJ, [USA], UKK, [USB]</td>
<td>1023944.19</td>
<td>1023953.41</td>
</tr>
<tr>
<td>704 kbit/s</td>
<td>+50 ppm</td>
<td>UKK, [USB]</td>
<td>352016.0</td>
<td>352019.18</td>
</tr>
<tr>
<td>704 kbit/s</td>
<td>-50 ppm</td>
<td>UKK, [USB]</td>
<td>351980.82</td>
<td>351983.98</td>
</tr>
</tbody>
</table>

PDH Transmitter Output (UKK, [USB], UKJ, [USA])

Specifications

Pulse Shape: As per ITU Rec. G.703

Pulse Amplitude:

- **120Ω Balanced (704 kb/s & 2 Mb/s)**: 3.00V ±10%
- **75Ω Unbalanced (704 kb/s, 2 Mb/s & 8 Mb/s)**: 2.37V ±10%
- **75Ω Unbalanced (34 Mb/s)**: 1.00V ±10%
- **75Ω Unbalanced (140 Mb/s)**: 0.50V ±10%

**NOTE**

704 kb/s is only valid when Option UKK, [USB] is fitted.
Performance Tests

PDH Transmitter Output (UKK, [USB], UKJ, [USA]

Description

This test verifies that the PDH transmitter output level and pulse shape meet required ITU specifications for all rates. The SIGNAL OUT Port is connected to a Digitizing Oscilloscope and the waveform is checked for required amplitude and duty cycle at the nominal mid-points. The waveform shape is also checked by comparison with the special ITU masks. These may be obtained from the oscilloscope memory (if this feature is fitted) or can be traced from the attached figures and compared with a printout of the oscilloscope waveform.

NOTE

A Balanced to unbalanced Converter is required to test the Balanced output port. The 3V peak at the output is reduced to 2.37V peak on the oscilloscope by this device. The oscilloscope must be terminated in 75Ω for both balanced and unbalanced outputs.

Equipment Required

- Oscilloscope: HP 54503A
- 120W/75W Balanced to Unbalanced Converter: HP 15508C
- ThinkJet Printer: HP 2225A

Procedure

704 kb/s Unbalanced Output

1. Recall the HP 37717C DEFAULT SETTINGS as shown on Page 3-2.
2. Connect the Unbalanced 75Ω SIGNAL OUT port to the Oscilloscope Input 1 via a 75Ω termination and "T" connector. Set the oscilloscope termination to 1MΩ.

NOTE

Steps 3 to 10 are only valid for Option UKK, [USB].
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA])

3. Press **TRANSMIT** and set up the display as shown opposite.

4. Press **AUTOSCALE** on the oscilloscope.

5. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

6. Verify the Pulse in Figure 3-1 meets the following criteria:
   - **Pulse Amplitude**: 2.133V to 2.607V
   - **Pulse Width**: 639 ns to 781 ns
   - **Overshoot**: \( \leq 0.474 \)V
   - **Undershoot**: \( \leq 0.474 \)V

   ![Figure 3-1 704 kb/s Pulse Criteria](image)

7. Adjust the Oscilloscope Delay to position the negative peak pulse amplitude at mid-pulse-width point in the centre of the screen and verify that the negative pulse meets the criteria listed in step 6.

**704 kb/s Balanced Output**

8. Connect the Balanced to Unbalanced Converter between the HP 37717C 120\( \Omega \) Balanced SIGNAL OUT port and the Oscilloscope, leaving the 75\( \Omega \) termination and "T" connector in place.
Performance Tests

PDH Transmitter Output (UKK, [USB], UKJ, [USA])

10. Repeat steps 4 through 7.

2.048 Mb/s Unbalanced Output

11. Select SIGNAL [2 Mb/s]; TERMINATION [75Ω UNBAL].
12. Connect the Unbalanced 75Ω SIGNAL OUT port to the Oscilloscope Input 1. Set the oscilloscope termination to 1MΩ and press [AUTOSCALE] on the oscilloscope.
13. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.
14. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.
15. Select the 2Mb G.703 mask on the oscilloscope and store it on the display.
16. Press SHIFT [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask in Figure 3-2. Verify that the pulse falls within the mask as shown in Figure 3-3.

![Figure 3-2 2 Mb/s Pulse Mask](image)

**NOTE**

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-2, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA])

![Graph](image)

**Figure 3-3**
2 Mb/s Isolated Positive Pulse

17. Press [AUTOSCALE] on the oscilloscope to display the full waveform.

18. Use the following sequence to display the isolated negative pulse.
   - Select [TRIG] menu.
   - Set trigger level to middle of negative pulse.
   - Set trigger to pattern.
   - Set sequence to H X X.

19. Use the oscilloscope [STORE INVERT] to display an inverted mask on the oscilloscope.

20. Adjust the oscilloscope timebase and vertical sensitivity controls to verify that the pulse meets the mask as shown in Figure 3-3. Use the displayed settings as a guide.

21. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.
Performance Tests

PDH Transmitter Output (UKK, [USB], UKJ, [USA])

Figure 3-4  2 Mb/s Isolated Negative Pulse

22. Ensure that the ratio of +ve and -ve pulse amplitudes is between 0.95 and 1.05.
23. Ensure that the ratio of +ve and -ve pulse widths is between 0.95 and 1.05.

2.048 Mb/s Balanced Output

24. Connect the Balanced to Unbalanced Converter between the HP 37717C 120Ω Balanced SIGNAL OUT port and the Oscilloscope.
25. Select TERMINATION [120Ω BAL] on the TRANSMIT display.
26. Repeat steps 13 through 23.

8.448 Mb/s Unbalanced Output

27. Select SIGNAL [8 Mb/s] and TERMINATION [75Ω UNBAL] on the TRANSMIT display.
28. Connect the Unbalanced 75Ω SIGNAL OUT port to the Oscilloscope Input 1. Set the oscilloscope termination to 1MΩ and press AUTOSCALE on the oscilloscope.
29. Select the 8 Mb G.703 mask on the oscilloscope and store it on the display.
30. Repeat steps 13 through 23 to verify the 8 Mb/s unbalanced output.
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA])

NOTE

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-6, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).

Figure 3-5  8 Mb/s Pulse Mask

Figure 3-6  8 Mb/s Isolated Positive Pulse
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA]

Figure 3-7 8 Mb/s Isolated Negative Pulse
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA]

34.368 Mb/s Unbalanced Output

31. Press [TRANSMIT] and set up the display as shown opposite.


33. Select the 34 Mb G.703 mask on the oscilloscope and store it on the display.

34. Repeat steps 13 through 23 (in step 21 ensure the peak pulse amplitude is 0.9V to 1.1V) to verify the 34 Mb/s unbalanced output.

![Figure 3-8](image)

**Figure 3-8**

34 Mb/s Pulse Mask

**NOTE**

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-8, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA])

Figure 3-9  34 Mb/s Isolated Positive Pulse

Figure 3-10  34 Mb/s Isolated Negative Pulse
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA]

139.264 Mb/s Unbalanced Output

35. Press [TRANSMIT] and set up the display as shown opposite.


37. Select the BIN1 140 Mb G.703 mask on the oscilloscope and store it on the display.

38. Adjust the Oscilloscope Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

39. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 0.900V and 1.100V.

40. Press SHIFT [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-12.

NOTE

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-11, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).

Figure 3-11 140 Mb/s Pulse Mask All 1’s
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA]

Figure 3-12 140 Mb/s All Ones Pulse

41. Select PATTERN [ALL ZEROS] on the display.

42. Select BIN0 140 Mb/s G.703 mask on the oscilloscope and store it on the display.

43. Adjust the Oscilloscope Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

44. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 0.900V and 1.100V.

45. Press SHIFT [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-14.

NOTE

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-13, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).
Performance Tests
PDH Transmitter Output (UKK, [USB], UKJ, [USA])

Figure 3-13  140 Mb/s Pulse Mask All 0's

Figure 3-14  140 Mb/s All Zeros Pulse
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

Multiple PDH Transmitter Outputs (Options UHC, [US6])

**NOTE**
A PDH Option must be fitted for this option to operate - see Appendix B.

**Specifications**

**Pulse Shape:** As per ITU Rec. G.703

**Pulse Amplitude:**

<table>
<thead>
<tr>
<th>Rate</th>
<th>Amplitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>704 kb/s</td>
<td>2.37V ±10%</td>
</tr>
<tr>
<td>2 Mb/s</td>
<td>2.37V ±10%</td>
</tr>
<tr>
<td>8 Mb/s</td>
<td>2.37V ±10%</td>
</tr>
<tr>
<td>34 Mb/s</td>
<td>1.00V ±10%</td>
</tr>
<tr>
<td>140 Mb/s</td>
<td>0.50V ±10%</td>
</tr>
</tbody>
</table>

**Additional Outputs Delay**

<table>
<thead>
<tr>
<th>Rate</th>
<th>Signal Out</th>
<th>Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>704 kb/s, 2, 8 and 34 Mb/s</td>
<td>Signal Out 2</td>
<td>4 bits</td>
</tr>
<tr>
<td>704 kb/s, 2, 8 and 34 Mb/s</td>
<td>Signal Out 3</td>
<td>8 bits</td>
</tr>
<tr>
<td>704 kb/s, 2, 8 and 34 Mb/s</td>
<td>Signal Out 4</td>
<td>12 bits</td>
</tr>
<tr>
<td>140 Mb/s</td>
<td>Signal Out 2, 3, 4</td>
<td>No delay</td>
</tr>
</tbody>
</table>

**NOTE**
704 kb/s is only valid when Option UKK, [USB] is fitted.

**Description**

This test verifies that the 3 additional PDH transmitter outputs meet ITU pulse shape and level specifications for all rates. Each PDH Signal Out Port is connected to a Digitizing Oscilloscope terminated in 75Ω and the waveform is checked for required amplitude and duty cycle at the nominal mid-points.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

The waveform shape is also checked by comparing with the special ITU masks. These may be obtained from the oscilloscope memory (if this feature is fitted) or can be traced from the attached figures and compared with a printout of the oscilloscope waveform. The relative delay at each output is also verified using the second channel of the oscilloscope.

Equipment Required

- Oscilloscope : HP 54503A
- 120/75Ω Bal/Unbal Converter : HP 15508C
- ThinkJet Printer : HP 2225A

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

704 kb/s Output Pulse

2. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

Steps 3 to 16 are only valid for Option UKK, [USB].

3. Press [TRANSMIT] and set up the display as shown opposite.


5. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

6. Verify the Pulse meets the following criteria:
   Pulse Amplitude  2.133V to 2.607V
   Pulse Width      639 ns to 781 ns
   Overshoot       $\leq 0.474V$
   Undershoot      $\leq 0.474V$

![Figure 3-15 704 kb/s Pulse Criteria](image)

7. Repeat steps 5 and 6 with the Oscilloscope Channel 1 connected to SIGNAL OUT 3 and SIGNAL OUT 4 in turn.

8. Adjust the Oscilloscope Timebase and Delay to position the negative peak pulse amplitude at mid-pulse-width point in the centre of the screen and verify that the negative pulse meets the criteria listed in step 6.

9. Repeat step 8 with the Oscilloscope Channel 1 connected to SIGNAL OUT 2 and SIGNAL OUT 3 in turn.

704 kb/s Additional Outputs Delay

10. Connect the PDH SIGNAL OUT 1 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

11. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 2. Set the Oscilloscope termination to 1MΩ.

12. Check that the pulse on Channel 2 is 4 bits delayed with respect to the pulse on Channel 1.

13. Disconnect the SIGNAL OUT 2 port from the oscilloscope and connect the SIGNAL OUT 3 port to the oscilloscope Channel 2.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

14. Check that the pulse on Channel 2 is 8 bits delayed with respect to the pulse on Channel 1.

15. Disconnect the SIGNAL OUT 3 port from the oscilloscope and connect the SIGNAL OUT 4 port to the oscilloscope Channel 2.

16. Check that the pulse on Channel 2 is 12 bits delayed with respect to the pulse on Channel 1.

2.048 Mb/s Output Pulse

17. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

18. Press [TRANSMIT] and set up the display as shown opposite.


20. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

21. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.

22. Select the 2Mb/s G703 Mask on the oscilloscope and store it on the Display.

23. Press [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-16.

**NOTE**

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask shown in Figure 3-16 over the pulse and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).
Performance Tests
Multiple PDH Transmitter Outputs (Options UHC, [US6])

Figure 3-16  2 Mb/s Pulse Mask

24. Repeat steps 20 to 23 with the Oscilloscope Channel 1 connected to SIGNAL OUT 3 and SIGNAL OUT 4 in turn.

25. Press [AUTOSCALE] on the oscilloscope to display the full waveform and use the following sequence to display the isolated negative pulse:

   Select [TRIG] menu.
   Set trigger level to middle of negative pulse.
   Set Trigger to PATTERN.
   Set Sequence to HXX.

26. Use the oscilloscope [STORE INVERT] function to display an inverted pulse mask on the oscilloscope.

27. Adjust the oscilloscope timebase, delay and vertical sensitivity controls to verify that the pulse meets the mask as shown in Figure 3-16. Use the displayed settings as a guide.

28. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.

29. Repeat steps 27 and 28 with the Oscilloscope Channel 1 connected to SIGNAL OUT 2 and SIGNAL OUT 3 in turn.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

2.048 Mb/s Additional Output Delay

30. Connect the PDH SIGNAL OUT 1 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

31. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 2. Set the Oscilloscope termination to 1MΩ.

32. Check that the pulse on Channel 2 is 4 bits delayed with respect to the pulse on Channel 1.

33. Disconnect the SIGNAL OUT 2 port from the oscilloscope and connect the SIGNAL OUT 3 port to the oscilloscope Channel 2.

34. Check that the pulse on Channel 2 is 8 bits delayed with respect to the pulse on Channel 1.

35. Disconnect the SIGNAL OUT 3 port from the oscilloscope and connect the SIGNAL OUT 4 port to the oscilloscope Channel 2.

36. Check that the pulse on Channel 2 is 12 bits delayed with respect to the pulse on Channel 1.

37. Ensure that the ratio of +ve and -ve pulse amplitudes is between 0.95 and 1.05.

38. Ensure that the ratio of +ve and -ve pulse widths is between 0.95 and 1.05.

8.448 Mb/s Output Pulse

39. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 1.

40. Press [TRANSMIT] and set up the display as shown opposite.


42. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

43. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.

44. Select the 8Mb/s G703 Mask on the oscilloscope and store it on the Display.

45. Press [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-17.
Performance Tests
Multiple PDH Transmitter Outputs (Options UHC, [US6])

NOTE
If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask shown in Figure 3-17 over the pulse and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

Figure 3-17 8 Mb/s Pulse Mask

46. Repeat steps 42 to 45 with the Oscilloscope Channel 1 connected to SIGNAL OUT 3 and SIGNAL OUT 4 in turn.

47. Press [AUTOSCALE] on the oscilloscope to display the full waveform and use the following sequence to display the isolated negative pulse:

   Select [TRIG] menu.
   Set trigger level to middle of negative pulse.
   Set Trigger to PATTERN.
   Set Sequence to H X X.

48. Use the oscilloscope [STORE INVERT] function to display an inverted pulse mask on the oscilloscope.

49. Adjust the oscilloscope timebase, delay and vertical sensitivity controls to verify that the pulse meets the mask as shown in Figure 3-17. Use the displayed settings as a guide.

50. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

51. Repeat steps 49 and 50 with the Oscilloscope Channel 1 connected to SIGNAL OUT 2 and SIGNAL OUT 3 in turn.

8.448 Mb/s Additional Output Delay

52. Connect the PDH SIGNAL OUT 1 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

53. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 2. Set the Oscilloscope termination to 1MΩ.

54. Check that the pulse on Channel 2 is 4 bits delayed with respect to the pulse on Channel 1.

55. Disconnect the SIGNAL OUT 2 port from the oscilloscope and connect the SIGNAL OUT 3 port to the oscilloscope Channel 2.

56. Check that the pulse on Channel 2 is 8 bits delayed with respect to the pulse on Channel 1.

57. Disconnect the SIGNAL OUT 3 port from the oscilloscope and connect the SIGNAL OUT 4 port to the oscilloscope Channel 2.

58. Check that the pulse on Channel 2 is 12 bits delayed with respect to the pulse on Channel 1.

59. Ensure that the ratio of +ve and -ve pulse amplitudes is between 0.95 and 1.05.

60. Ensure that the ratio of +ve and -ve pulse widths is between 0.95 and 1.05.

34.368 Mb/s Output Pulse

61. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 1.

62. Press [TRANSMIT] and set up the display as shown opposite.


64. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

65. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 0.900V and 1.100V.
Performance Tests
Multiple PDH Transmitter Outputs (Options UHC, [US6])

66. Select the 34Mb/s G703 Mask on the oscilloscope and store it on the Display.

67. Press SHIFT [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-18.

NOTE
If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask shown in Figure 3-18 over the pulse and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

Figure 3-18 34 Mb/s Pulse Mask

68. Repeat steps 64 to 67 with the Oscilloscope Channel 1 connected to SIGNAL OUT 3 and SIGNAL OUT 4 in turn.

69. Press [AUTOSCALE] on the oscilloscope to display the full waveform and use the following sequence to display the isolated negative pulse:
   - Select [TRIG] menu.
   - Set trigger level to middle of negative pulse.
   - Set Trigger to PATTERN.
   - Set Sequence to H X X.

70. Use the oscilloscope STORE INVERT function to display an inverted pulse mask on the oscilloscope.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

71. Adjust the oscilloscope timebase, delay and vertical sensitivity controls to verify that the pulse meets the mask as shown in Figure 3-18. Use the displayed settings as a guide.

72. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 0.900V and 1.100V.

73. Repeat steps 71 and 72 with the Oscilloscope Channel 1 connected to SIGNAL OUT 2 and SIGNAL OUT 3 in turn.

34.368 Mb/s Additional Outputs Delay

74. Connect the PDH SIGNAL OUT 1 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

75. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 2. Set the Oscilloscope termination to 1MΩ.

76. Set the Transmitter Output PATTERN to USER WORD 1111111110001000 and check that the pulse on Channel 2 is 4 bits delayed with respect to the pulse on Channel 1.

77. Disconnect the SIGNAL OUT 2 port from the oscilloscope and connect the SIGNAL OUT 3 port to the oscilloscope Channel 2.

78. Check that the pulse on Channel 2 is 8 bits delayed with respect to the pulse on Channel 1.

79. Disconnect the SIGNAL OUT 3 port from the oscilloscope and connect the SIGNAL OUT 4 port to the oscilloscope Channel 2.

80. Check that the pulse on Channel 2 is 12 bits delayed with respect to the pulse on Channel 1.

81. Ensure that the ratio of +ve and -ve pulse amplitudes is between 0.95 and 1.05.

82. Ensure that the ratio of +ve and -ve pulse widths is between 0.95 and 1.05.

139.264 Mb/s Output Pulse

83. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 1.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

84. Press (TRANSMIT) and set up the display as shown opposite.

85. Press (AUTOSCALE) on the oscilloscope.

86. Select the BIN1 140 Mb G.703 mask on the oscilloscope and store it on the display.

87. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

88. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 0.900V and 1.100V.

89. Press SHIFT (AUTOSCALE) on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-20.

90. Repeat steps 87 to 89 with the Oscilloscope Channel 1 connected to SIGNAL OUT 3 and SIGNAL OUT 4 in turn.

NOTE

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask shown in Figure 3-19 over the pulse and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

Figure 3-19   140 Mb/s Pulse Mask All 1's
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

91. Select PATTERN [ALL ZEROS] on the Transmit display.

92. Select the BIN 0 140Mb/s G703 Mask on the oscilloscope and store it on the Display.

93. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

94. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 0.900V and 1.100V.

95. Press SHIFT on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-20.

NOTE
If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask shown in Figure 3-20 over the pulse and ensure that the pulse falls within the mask (a transparent copy of the mask should be used).

Figure 3-20  140 Mb/s Pulse Mask All 0’s

96. Repeat steps 93 to 95 with the Oscilloscope Channel 1 connected to SIGNAL OUT 2 and SIGNAL OUT 3 in turn.
Performance Tests

Multiple PDH Transmitter Outputs (Options UHC, [US6])

Additional Outputs Delay at 139.264 Mb/s

97. Connect the PDH SIGNAL OUT 1 port to the Oscilloscope Channel 1. Set the Oscilloscope termination to 1MΩ.

98. Connect the PDH SIGNAL OUT 2 port to the Oscilloscope Channel 2. Set the Oscilloscope termination to 1MΩ.

99. Set the Transmitter Output PATTERN to 1000 and check that the pulse on Channel 1 is in phase with the pulse on Channel 2.

100. Disconnect the SIGNAL OUT 2 port from the oscilloscope and connect the SIGNAL OUT 3 port to the oscilloscope Channel 2.

101. Check that the pulse on Channel 1 is in phase with the pulse on Channel 2.

102. Disconnect the SIGNAL OUT 3 port from the oscilloscope and connect the SIGNAL OUT 4 port to the oscilloscope Channel 2.

103. Check that the pulse on Channel 1 is in phase with the pulse on Channel 2.

104. Disconnect the test equipment.
Performance Tests

PDH Frame Analysis (Options UKK, [USB])

PDH Frame Analysis (Options UKK, [USB])

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Frame Loss</th>
<th>Frame Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>140 Mb/s</td>
<td>4 consecutive incorrect FAS words.</td>
<td>3 consecutive correct FAS words (1111010000).</td>
</tr>
<tr>
<td>34 Mb/s</td>
<td>4 consecutive incorrect FAS words.</td>
<td>3 consecutive correct FAS words (1111010000).</td>
</tr>
<tr>
<td>8 Mb/s</td>
<td>4 consecutive incorrect FAS words.</td>
<td>3 consecutive correct FAS words (1111010000).</td>
</tr>
<tr>
<td>2 Mb/s</td>
<td>3 consecutive incorrect FAS words or NFAS words.</td>
<td>1 correct sequence of FAS - NFAS - FAS words.</td>
</tr>
<tr>
<td>2 Mb/s CRC</td>
<td>MultiFrame Loss - 3 out of 4 MultiFrame sequences in error</td>
<td>MultiFrame Gain - 2 out of 4 MultiFrame sequences are correct.</td>
</tr>
<tr>
<td>2 Mb/s CAS</td>
<td>MultiFrame Loss - 2 consecutive MultiFrame patterns in error.</td>
<td>MultiFrame Gain - 1 correct MultiFrame pattern is correct.</td>
</tr>
</tbody>
</table>

Equipment Required

Frame Generator : HP 37729A

Description

An HP 37729A Frame Generator is used to generate the appropriate Frame Alignment Signals (FAS) which are used to test the HP 37717C In-Service Analysis at all bit rates with this capability.

NOTE

If the HP 37729A is not available, a HP 37714/17A with Option UKJ, [USA] may be substituted.
Performance Tests
PDH Frame Analysis (Options UKK, [USB])

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

Option UKK, [USB] Unstructured PDH
2. Setup the **RECEIVE** Display as shown opposite.

3. Setup the **RESULTS** display as shown opposite.

Option UKJ, [USA] Structured PDH
2. Setup the **RECEIVE** Display as shown opposite.
Performance Tests
PDH Frame Analysis (Options UKK, [USB])

3. Setup the RESULTS display as shown opposite.

2 Mb/s Frame Analysis
1. Set the HP 37729A Frame Generator parameters as follows:
   OUTPUT; FREQ [2]; CODE [HDB3]
   Press the [MENU] key to select the MENU display.
   Use [PAGE UP] and [PAGE DOWN] to select [ALIGNMENT].
   Press [ENTER] to select the ALIGNMENT parameters.
   Use [PAGE UP] and [PAGE DOWN] to select ALIGNMENT [2M].
   FAS [10011011]
   NFAS [01011111]
   Press until all the 2048 Kbit/s Led’s are OFF.
2. Connect the Frame Generator AMI/HDB3 output to the HP 37717C 75Ω SIGNAL IN port.
3. Press [RUN/STOP] on the HP 37717C to start the measurement.
4. Check that all PDH Alarm Led’s are OFF. Error Count and Error Ratio should be 0.

CAS Multiframe
5. Press the Frame Generator 2048 Kbit/s [SELECT] key until the CAS MFL Led is flashing.
6. Press the Frame Generator 2048 Kbit/s [ON/OFF] key and check that the HP 37717C PDH Multiframe Loss Alarm Led is ON.
Performance Tests

PDH Frame Analysis (Options UKK, [USB])

7. Press the Frame Generator 2048 Kbit/s [ON/OFF] key and ensure all HP 37717C Alarm Led’s are OFF.

8. Press [RUN/STOP] on the HP 37717C to stop the measurement.

CRC Multiframe


11. Press [RUN/STOP] on the HP 37717C to start the measurement.

12. Use the Frame Generator [SELECT] and [ON/OFF] keys to select and enable CRC MFL.

13. Check that the HP 37717C displays a CRC errors count and that the Errors Led is ON.

14. Check that after several seconds, the HP 37717C CRC error count stops and the PDH Frame Loss and Multiframe Loss Alarm Led’s are ON.

15. Press the Frame Generator 2048 Kbit/s [ON/OFF] key and check that the PDH Frame Loss and Multiframe Loss Alarm Led’s are now OFF.

Error Detection

16. Use the Frame Generator 2048 Kbit/s [SELECT] and [ON/OFF] keys to select and enable BIT ERROR 2Mb/s.

17. Check that the HP 37717C counts FRAME (FAS), CRC and REBE errors. A minimum of 1 REBE error should occur in a 1 minute period. The CODE Error Count should be 0.

Alarm Detection

18. Use the Frame Generator 2048 Kbit/s [SELECT] and [ON/OFF] keys to select and enable DF (Remote Alarm) and check that the HP 37717C Remote Alarm Led is ON.


20. 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 37717C Remote Multiframe Alarm Led is ON.


22. Press [RUN/STOP] on the HP 37717C once to stop the measurement.
Performance Tests

**PDH Frame Analysis (Options UKK, [USB])**

**8 Mb/s Frame Analysis**

1. Select SIGNAL [8 Mb/s] on the HP 37717C display then return to **RESULTS** Display.
2. Set the HP 37729A Frame Generator parameters as follows:
   - OUTPUT: FREQ [8]; CODE [HDB3]
   - ALIGNMENT [8M]
   - SB [00]
   - FAS [1111010000]
   - Press the **SELECT** key until all 8448 Kbit/s ERROR and AIS Led’s are OFF.
3. Press [**RUN/STOP**] on the HP 37717C to start a measurement and check that all Alarm Led’s are OFF on the HP 37717C. The Error Count and Error Ratio should be 0.

**Error Detection**

4. Use the Frame Generator 8448 Kbit/s **SELECT** and **ON/OFF** keys to select and enable BIT ERROR.
5. Check that HP 37717C Errors and Remote alarm Led’s are ON (may be flashing).
6. Check that the HP 37717C counts Frame (FAS) Errors. The Code Error count should be 0.
7. Press the Frame Generator 8448 Kbit/s **ON/OFF** key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.

**Alarm Detection**

8. Set the Frame Generator SB parameter to [10].
9. Check that the HP 37717C Remote Alarm Led is ON. Error Count and Error Ratio should be 0.
10. Reset the Frame Generator SB parameter to [00].

**FAS Error and AIS**

11. Use the Frame Generator 8448 Kbit/s **SELECT** and **ON/OFF** keys to select and enable FAS ERROR.
12. Check that the HP 37717C Frame Loss alarm Led is ON.
13. Press the Frame Generator 8448 Kbit/s **ON/OFF** key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.
Performance Tests
PDH Frame Analysis (Options UKK, [USB])

14. Use the Frame Generator 8448 Kbit/s [SELECT] and [ON/OFF] keys to select and enable AIS OUT.
15. Check that the HP 37717C Frame Loss and AIS alarm Led’s are ON.
16. Press the Frame Generator 8448 Kbit/s [ON/OFF] key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.
17. Press [RUN/STOP] on the HP 37717C once to stop the measurement.

34 Mb/s Frame Analysis
1. Select SIGNAL [34 Mb/s] on the HP 37717C [RECEIVE] display then return to [RESULTS] Display.
2. Set the HP 37729A Frame Generator parameters as follows:
   - OUTPUT: FREQ [34]; CODE [HDB3]
   - ALIGNMENT [34M]
   - SB [00]
   - FAS [1111010000]
   - Press the 34368 Kbit/s [SELECT] key until all 34368 Kbit/s ERROR and AIS Led’s are OFF.
3. Press [RUN/STOP] on the HP 37717C to start a measurement and check that all HP 37717C Alarm Led’s are OFF. The Error Count and Error Ratio should be 0.

Error Detection
4. Press the 34368 Kbit/s [SELECT] key until all 34368 Kbit/s ERROR and AIS Led’s are OFF.
5. Use the Frame Generator 34368 Kbit/s [SELECT] and [ON/OFF] keys to select and enable BIT ERROR.
6. Check that Errors and Remote alarm Led’s are ON.
7. Check that the HP 37717C counts Frame (FAS) Errors. The Code Error count should be 0.
8. Press the Frame Generator 34368 Kbit/s [ON/OFF] key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.

Alarm Detection
9. Set the Frame Generator SB parameter to [10].
Performance Tests

PDH Frame Analysis (Options UKK, [USB])

10. Check that the HP 37717C Remote Alarm Led is ON. Error Count and Error Ratio should be 0.

11. Reset the Frame Generator SB parameter to [00].

FAS Error and AIS

12. Use the Frame Generator 34368 Kbit/s [SELECT] and [ON/OFF] keys to select and enable FAS ERROR.

13. Check that the HP 37717C Frame Loss alarm Led is ON.

14. Press the Frame Generator 34368 Kbit/s [ON/OFF] key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.

15. Use the Frame Generator 34368 Kbit/s [SELECT] and [ON/OFF] keys to select and enable AIS OUT.

16. Check that the HP 37717C Frame Loss and AIS alarm Led’s are ON.

17. Press the Frame Generator 34368 Kbit/s [ON/OFF] key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.

18. Press [RUN/STOP] on the HP 37717C once to stop the measurement.

140 Mb/s Frame Analysis

1. Select SIGNAL: [140 Mb/s] on the HP 37717C [RECEIVE] display then return to [RESULTS] Display.

2. Set the HP 37729A Frame Generator parameters as follows:
   - OUTPUT: FREQ [139]; CODE [CMI]
   - ALIGNMENT [140M]
   - SB [0000]
   - FAS [111110100000]
   - Press the 139264 Kbit/s [SELECT] key until all the 139264 Kbit/s ERROR and AIS Led’s are OFF.

3. Connect the Frame Generator CMI/NRZ output to the HP 37717C 75Ω SIGNAL IN port.

4. Press [RUN/STOP] on the HP 37717C to start a measurement and ensure all Alarm Led’s are OFF. Check that the HP 37717C Error Count and Error Ratio is 0.
Performance Tests

PDH Frame Analysis (Options UKK, [USB])

Error Detection

5. Use the Frame Generator 139264 Kbit/s [SELECT] and [ON/OFF] keys to select and enable BIT ERROR.

6. Check that Errors and Remote alarm Led’s are ON.

7. Check that the HP 37717C counts Frame (FAS) Errors. The Code Error count should be 0.

8. Press the Frame Generator [ON/OFF] key and check that the FRAME (FAS) and CODE error count is 0 and the Alarm Led’s are OFF.

Alarm Detection

9. Set the Frame Generator SB parameter to [1000].

10. Check that the HP 37717C Remote Alarm Led is ON. Check that the Error Count and Error Ratio is 0.

11. Reset the Frame Generator SB parameter to [0000].

FAS Error and AIS

12. Use the Frame Generator 139264 Kbit/s [SELECT] and [ON/OFF] keys to select and enable FAS ERROR.

13. Check that the HP 37717C Frame Loss alarm Led is ON.

14. Press the Frame Generator 139264 Kbit/s [ON/OFF] key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.

15. Use the Frame Generator 139264 Kbit/s [SELECT] and [ON/OFF] keys to select and enable AIS OUT.

16. Check that the HP 37717C Frame Loss and AIS alarm Led’s are ON.

17. Press the Frame Generator 139264 Kbit/s [ON/OFF] key and check that the FRAME (FAS) Error Count is 0 and all Alarm Led’s are now OFF.

18. Press [RUN/STOP] on the HP 37717C once to stop the measurement.

19. Disconnect the test equipment.
Performance Tests

PDH Receiver Equalization (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Option</th>
<th>Equalization at 1/2 Bit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>704 kb/s</td>
<td>UKK, [USB]</td>
<td>6dB</td>
</tr>
<tr>
<td>2.048 Mb/s</td>
<td>UKK, [USB], UKJ, [USA],</td>
<td>6dB</td>
</tr>
<tr>
<td></td>
<td>UKL, [USC], UKN, [USE]</td>
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<td>8.448 Mb/s</td>
<td>UKK, [USB], UKJ, [USA],</td>
<td>6dB</td>
</tr>
<tr>
<td></td>
<td>UKL, [USC], UKN, [USE]</td>
<td></td>
</tr>
<tr>
<td>34.368 Mb/s</td>
<td>UKK, [USB], UKJ, [USA],</td>
<td>12dB</td>
</tr>
<tr>
<td></td>
<td>UKL, [USC], UKN, [USE]</td>
<td></td>
</tr>
<tr>
<td>139.264 Mb/s</td>
<td>UKK, [USB], UKJ, [USA],</td>
<td>12dB</td>
</tr>
<tr>
<td></td>
<td>UKL, [USC], UKN, [USE]</td>
<td></td>
</tr>
</tbody>
</table>

Description

The PDH receiver equalization is checked using a Synthesizer set for a sinewave at half the data rate. This sinewave corresponds to a ternary all ones signal and the HP 37717C receiver should sync up with no errors if PATTERN [ALL ONES] is selected. The amplitude of the synthesizer signal is set to the specified maximum loss for each bit rate. At that amplitude no errors should result.

Equipment Required

Synthesizer  : HP 3335A option 001
Oscilloscope : HP 54503A
Performance Tests

PDH Receiver Equalization (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect up the equipment as shown in Figure 3-21.
3. Set the oscilloscope: TERMINATION - 1 MΩ PROBE - 1:1

Figure 3-21 PDH Receiver Equalization Test Setup

704 kb/s

NOTE Steps 4 to 8 are only valid if Option UKK, [USB] is fitted.

4. Press [RECEIVE] and set up the display as shown opposite.

5. Select [RESULTS] TIMING CONTROL TEST TIMING [SINGLE] [5 SECS]
Performance Tests
PDH Receiver Equalization (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

6. Press [RESULTS] and set up the display as shown opposite.

7. Set the Synthesizer to: FREQUENCY - 352 KHz sinewave AMPLITUDE - 2.37 V pk-pk (6dB down) as measured on the oscilloscope.

8. Press [RUN/STOP] and verify that no errors are displayed at the end of the test period (5 seconds).

2.048 Mb/s

9. Press [RECEIVE] and set up the display as shown opposite.

10. Select [RESULTS] [TIMING] [CONTROL] [TEST TIMING] [SINGLE] [5 SECS]

11. Press [RESULTS] and set up the display as shown opposite.

12. Set the Synthesizer to: FREQUENCY, 1024 KHz sinewave AMPLITUDE, 2.37 V pk-pk (6dB down) as measured on the oscilloscope.

13. Press [RUN/STOP] and verify that no errors are displayed on the display at the end of the test period (5 seconds).
Performance Tests

**PDH Receiver Equalization (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])**

**8.448 Mb/s**


15. Set the Synthesizer to: FREQUENCY - 4224 KHz sinewave AMPLITUDE - 2.37 V pk-pk (6dB down) as measured on the oscilloscope.

16. Press RUN/STOP and verify that no errors are displayed on the RESULTS display at the end of the test period (5 seconds).

**34.368 Mb/s**

17. Select SIGNAL [34 Mb/s] on the RECEIVE display.

18. Set the Synthesizer to: FREQUENCY - 17184 KHz sinewave AMPLITUDE - 0.5 V pk-pk (12dB down) as measured on the oscilloscope.

19. Press RUN/STOP and verify that no errors are displayed on the RESULTS display at the end of the test period (5 seconds).

**139.264 Mb/s**

20. Select SIGNAL [140 Mb/s] on the RECEIVE display.

21. Set the Synthesizer to: FREQUENCY - 69632 KHz sinewave AMPLITUDE - 0.25 V pk-pk (12dB down) as measured on the oscilloscope.

22. Press RUN/STOP and verify that no errors are displayed on the RESULTS display at the end of the test period (5 seconds).
Performance Tests
PDH Receiver Monitor Levels (Options UKK, [USB])

PDH Receiver Monitor Levels (Options UKK, [USB])

Specification

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Nominal Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>704 kb/s</td>
<td>26 to 30dB</td>
</tr>
<tr>
<td>2.048 Mb/s</td>
<td>26 to 30dB</td>
</tr>
<tr>
<td>8.448 Mb/s</td>
<td>26 to 30dB</td>
</tr>
<tr>
<td>34.368 Mb/s</td>
<td>26dB</td>
</tr>
<tr>
<td>139.264 Mb/s</td>
<td>26dB</td>
</tr>
</tbody>
</table>

Description
The PDH receiver Monitor levels are checked by attenuating the synthesizer output level by an amount equivalent to the extra gain provided by the Monitor Amplifier. The synthesizer is set to generate a sinewave at half the bit rate which corresponds to a ternary all ones signal. The receiver should sync up with no errors if PATTERN [ALL ONES] is selected.

Equipment Required

- Synthesizer : HP 3335A option 001
- Oscilloscope : HP 54503A

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect up the equipment as shown in Figure 3-22.
3. Set the oscilloscope to: TERMINATION - 1 MΩ PROBE - 1:1
4. Select RESULTS TIMING CONTROL TEST TIMING [SINGLE] [5 SECS]
Performance Tests
PDH Receiver Monitor Levels (Options UKK, [USB])

Figure 3-22 PDH Receiver Monitor Levels Test Setup

704 kb/s

5. Press **RECEIVE** and set up the display as shown opposite.

   Press **RUN/STOP** until the Monitor led is lit.

6. Press **RESULTS** and set up the display as shown below.

7. Set the Synthesizer to: FREQUENCY - 352 KHz sinewave AMPLITUDE - 150 mV pk-pk (30dB down) as measured on the oscilloscope.

8. Press **RUN/STOP** and verify that no errors are displayed at the end of the test period (5 seconds).
Performance Tests
PDH Receiver Monitor Levels (Options UKK, [USB])

2.048 Mb/s
10. Set the Synthesizer to: FREQUENCY - 1024 KHz sinewave AMPLITUDE - 150 mV pk-pk (30dB down) as measured on the oscilloscope.
11. Press [RUN/STOP] and verify that no errors are displayed at the end of the test period (5 seconds).

8.448 Mb/s
13. Set the Synthesizer to: FREQUENCY - 4224 KHz sinewave AMPLITUDE - 150 mV pk-pk (30dB down) as measured on the oscilloscope.
14. Press [RUN/STOP] and verify that no errors are displayed at the end of the test period (5 seconds).

34.368 Mb/s
15. Select SIGNAL [34 Mb/s] on the [RECEIVE] display.
16. Set the Synthesizer to: FREQUENCY - 17184 KHz sinewave AMPLITUDE - 100 mV pk-pk (26dB down) as measured on the oscilloscope.
17. Press [RUN/STOP] and verify that no errors are displayed at the end of the test period (5 seconds).

139.264 Mb/s
19. Set the Synthesizer to: FREQUENCY - 69632 KHz sinewave AMPLITUDE - 50 mV pk-pk (26dB down) as measured on the oscilloscope.
20. Press [RUN/STOP] and verify that no errors are displayed at the end of the test period (5 seconds).
Performance Tests

SPDH Receiver Monitor Levels (Options UKJ, [USA], UKL, [USC], UKN, [USE])

SPDH Receiver Monitor Levels (Options UKJ, [USA], UKL, [USC], UKN, [USE])

NOTE

An SPDH Tx Module must be fitted for this test - see Appendix B.

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Nominal Loss</th>
<th>Equalization at 1/2 Bit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048 Mb/s</td>
<td>20, 26, 30dB</td>
<td>3dB</td>
</tr>
<tr>
<td>8.448 Mb/s</td>
<td>20, 26, 30dB</td>
<td>3dB</td>
</tr>
<tr>
<td>34.368 Mb/s</td>
<td>20, 26dB</td>
<td>6dB</td>
</tr>
<tr>
<td>139.264 Mb/s</td>
<td>20, 26dB</td>
<td>6dB</td>
</tr>
</tbody>
</table>

Description

The signal from the HP 37717C PDH Transmitter is applied to the PDH Receiver after attenuating by an amount equal to the selected Receiver Flat Loss plus the specified Cable Loss. The Flat Loss is obtained by inserting a number of 50Ω fixed attenuators in series with a 75/50Ω Matching Pad at one end and a 50/75Ω Matching Pad at the other end. The loss of the two Matching Pads is included in the overall attenuation equation. The Cable Loss is supplied by inserting the correct Cable Simulators for each bit rate in the attenuation path.

Equipment Required

Table 3-2

<table>
<thead>
<tr>
<th>Cable Simulator #1</th>
<th>80 metres (262 ft) of 75Ω coaxial cable (8120-0049)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Simulator #2</td>
<td>60 metres (197 ft) of 75Ω coaxial cable (8120-0049)</td>
</tr>
<tr>
<td>Cable Simulator #3</td>
<td>70 metres (230 ft) of 75Ω coaxial cable (8120-0049)</td>
</tr>
<tr>
<td>Cable Simulator #4</td>
<td>30 metres (98 ft) of 75Ω coaxial cable (8120-0049)</td>
</tr>
</tbody>
</table>
Performance Tests

SPDH Receiver Monitor Levels (Options UKJ, [USA], UKL, [USC], UKN, [USE])

---

Table 3-2 continued

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Attenuator (Qty 2)</td>
<td>HP 8491A Option 006 (6dB; 50Ω)</td>
</tr>
<tr>
<td>Fixed Attenuator (Qty 2)</td>
<td>HP 8491A Option 003 (3dB; 50Ω)</td>
</tr>
<tr>
<td>Matching Pad 75/50Ω (7.6dB loss)</td>
<td>HP 11852B</td>
</tr>
<tr>
<td>Matching Pad 50/75Ω (4.2dB loss)</td>
<td>HP 11852B</td>
</tr>
</tbody>
</table>

---

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the equipment as shown in Figure 3-23.

---

Figure 3-23

SPDH Receiver Monitor Input
Performance Tests
SPDH Receiver Monitor Levels (Options UKJ, [USA], UKL, [USC], UKN, [USE])

2.048 Mb/s

3. Press [TRANSMIT] and set up the MAIN SETTINGS display as shown opposite.

4. Press [RECEIVE] and set up the MAIN SETTINGS display as shown opposite.

5. Press [RESULTS] TROUBLE SCAN

Press [RUN/STOP] to start the measurement.

6. Ensure that NO TROUBLE is displayed on the RESULTS display

7. After 30 seconds. Press [RUN/STOP] to stop the measurement.

8. Press [RECEIVE] and select EQUALIZATION [ON] GAIN [20 dB].

9. Connect Cable Simulator #1 between the PDH OUT Port and the Matching Pad.


11. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press [RUN/STOP] to stop the measurement.

12. Connect the second 6dB Fixed Attenuator in the signal path to give a total path attenuation of 26.8dB (7.6+3+6+6+4.2).

13. Press [RECEIVE] and set MONITOR LEVEL [26dB].

Performance Tests

SPDH Receiver Monitor Levels (Options UKJ, [USA], UKL, [USC], UKN, [USE])

15. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press RUN/STOP to stop the measurement.

16. Remove Cable Simulator #1 from the signal path.

17. Press RECEIVE and select EQUALIZATION [OFF].

18. Press RESULTS, TROUBLE SCAN. Press RUN/STOP to start the measurement.

19. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press RUN/STOP to stop the measurement.

20. Connect the second 3dB Fixed Attenuator in the signal path to give a total path attenuation of 29.8dB (7.6+3+3+6+6+4.2).


22. Press RESULTS, TROUBLE SCAN. Press RUN/STOP to start the measurement.

23. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press RUN/STOP to stop the measurement.

24. Press RECEIYE and select EQUALIZATION [ON].

25. Connect Cable Simulator #1 between the PDH OUT Port and the Matching Pad.

26. Press RESULTS, TROUBLE SCAN. Press RUN/STOP to start the measurement.

27. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press RUN/STOP to stop the measurement.

8.448 Mb/s

28. Repeat steps 1 to 26 (20dB, 26dB and 30dB tests) with the HP 37717C TRANSMIT and RECEIVE displays set to SIGNAL [8 Mb/s] and Cable Simulator #2 fitted in place of Cable Simulator #1.

34.368 Mb/s

29. Repeat steps 1 to 18 (20dB and 26dB tests) with the HP 37717C TRANSMIT and RECEIVE displays set to SIGNAL [34 Mb/s] and Cable Simulator #3 fitted in place of Cable Simulator #2.
Performance Tests

SPDH Receiver Monitor Levels (Options UKJ, [USA], UKL, [USC], UKN, [USE])

139.264 Mb/s

30. Repeat steps 1 to 18 (20dB and 26dB tests) with the HP 37717C transmit and receive displays set to SIGNAL [140 Mb/s] and Cable Simulator #4 fitted in place of Cable Simulator #3.

31. Disconnect all test equipment.
Performance Tests

External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

Specifications

**Multiplexer:**

- **Frequency**: 2.048 Mb/s
- **Interface**: Meets ITU Rec. G.703, for unbalanced coaxial pair. HDB3 line coding only.
- **Source**: Accepts a 2 Mb/s signal conforming to ITU Rec. G.703, Unbalanced only.

**De-Multiplexer**

- **Frequency**: 2.048 Mb/s
- **Interface**: Meets section 6 of ITU Rec. G.703, for unbalanced coaxial pair. HDB3 line coding only.

Description

This test verifies operation of the SPDH Mux and demux hardware and confirms the output characteristics of the external demux port on the SPDH Receiver.

The *PDH Test Set* is set up to transmit an Unbalanced 75Ω unframed 2Mb/s pattern. This is applied to the HP 37717C INSERT Port. The 2Mb/s signal is multiplexed into a 140Mb/s data stream. The HP 37717C transmitter and receiver are looped. The unframed 2Mb/s signal is Demultiplexed from the 140Mb/s data stream to the HP 37717C DROP port. The DROP Port signal is then applied to the *PDH Test Set* and a BER test is performed to verify the integrity of the 2 Mb/s signal.

The output from the DROP Port is then applied to an oscilloscope, and the waveform characteristics are checked to ensure they meet specifications.
Performance Tests

External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

Equipment Required

- Oscilloscope : HP 54503A
- PDH Test Set : HP 37717C Option UKJ, [USB] or equivalent
- 75Ω Termination : HP 15522-80010
- 50/75Ω Matching Pad : HP 11852B
- T Connector : HP 1250-0781

NOTE

The Test Set used in this procedure is an HP 37717C Option UKJ. Any other PDH Test Set, capable of generating and measuring at 2 Mb/s unframed, can be used.

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the equipment as shown in Figure 3-24.

Figure 3-24

External 2 Mb/s Mux/Demux
Performance Tests
External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

3. Press **TRANSMIT** on the Test Set and set up the display as shown opposite.

4. Press **RECEIVE** on the Test Set and set up the display as shown opposite.

5. Press **TRANSMIT** on the HP 37717C and set up the **MAIN SETTINGS** display as shown opposite.
Performance Tests

External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

6. Press [TRANSMIT] on the HP 37717C and set up the **STRUCTURED SETTINGS** display as shown opposite.

7. Press [RECEIVE] on the HP 37717C and set up the **MAIN SETTINGS** display as shown opposite.

8. Press [RECEIVE] on the HP 37717C and set up the **STRUCTURED SETTINGS** display as shown opposite.


10. Press SINGLE error add key on the Test Set and ensure the Bit Error count increments by one each time the key is pressed.

11. Disconnect the UUT Drop Port from the Test Set and connect this to the oscilloscope Input 1 via a 75Ω termination and "T" connector. Set the oscilloscope termination to 1MΩ and press [AUTOSCALE].

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Performance Tests

External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

12. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

13. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.

14. Select the 2Mb G.703 mask on the oscilloscope and store it on the display.

15. Press SHIFT [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-25.

![2 Mb/s Pulse Mask](image)

**Figure 3-25**

**2 Mb/s Pulse Mask**

**NOTE**

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-25, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).

16. Press [AUTOSCALE] on the oscilloscope to display the full waveform.

17. Use the following sequence to display the isolated negative pulse.

   Select [TRIG] menu.
   Set trigger level to middle of negative pulse.
   Set trigger to pattern.
   Set sequence to H X X.
Performance Tests

External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

18. Use the oscilloscope **STORE INVERT** to display an inverted mask on the oscilloscope.

19. Adjust the oscilloscope timebase and vertical sensitivity controls to verify that the pulse meets the mask as shown in Figure 3-27. Use the displayed settings as a guide.

20. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.

---

**Figure 3-26** 2 Mb/s Isolated Positive Pulse

---

**Figure 3-27** 2 Mb/s Isolated Negative Pulse

---

3-60
Performance Tests

External 2Mb/s Mux/Demux (Options UKJ, [USA], UKN, [USA])

21. Ensure that the ratio of +ve and -ve pulse amplitudes is between 0.95 and 1.05.
22. Ensure that the ratio of +ve and -ve pulse widths is between 0.95 and 1.05.
23. Disconnect all test equipment.
Performance Tests

External 2Mb/s Demux (Options UKL, [USC])

Specifications

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
</tr>
<tr>
<td><strong>Interface</strong></td>
</tr>
</tbody>
</table>

Description

This test verifies operation of the demux hardware and confirms the output characteristics of the external demux port on the SPDH Receive Only option.

The *Structured PDH Test Set* is set up to transmit a structured 140Mb/s signal containing an unframed 2Mb/s pattern. This is applied to the HP 37717C PDH IN Port. The unframed 2Mb/s signal is Demultiplexed from the 140Mb/s data stream to the HP 37717C DROP port. The DROP Port signal is then applied to the *Structured PDH Test Set* and a BER test is performed to verify the integrity of the 2 Mb/s signal.

The output from the DROP Port is then applied to an oscilloscope, and the waveform characteristics are checked to ensure they meet specifications.

Equipment Required

<table>
<thead>
<tr>
<th>Equipment Name</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscilloscope</td>
<td>HP 54503A</td>
</tr>
<tr>
<td>PDH Test Set</td>
<td>HP 37717C Option UKJ or equivalent (See Note)</td>
</tr>
<tr>
<td>75Ω Termination</td>
<td>HP 15522-80010</td>
</tr>
<tr>
<td>50/75Ω Matching Pad</td>
<td>HP 11852B</td>
</tr>
<tr>
<td>T Connector</td>
<td>HP 1250-0781</td>
</tr>
</tbody>
</table>

**NOTE**

The *Test Set* used in this procedure is an HP 37717C Option UKJ. Any other Structured PDH Test Set, capable of generating an unframed 2 Mb/s signal within a structured 140 Mb/s, can be used.
Performance Tests

External 2Mb/s Demux (Options UKL, [USC])

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the equipment as shown in Figure 3-28.

3. Press [TRANSMIT] on the Test Set and set up the MAIN SETTINGS display as shown opposite.
Performance Tests
External 2Mb/s Demux (Options UKL, [USC])

4. Press [TRANSMIT] on the Test Set and set up the STRUCTURED SETTINGS display as shown opposite.

5. Press [RECEIVE] on the Test Set and set up the MAIN SETTINGS display as shown opposite.

6. Press [RECEIVE] on the HP 37717C and set the MAIN SETTINGS display as shown below.
Performance Tests

External 2Mb/s Demux (Options UKL, [USC])

7. Press [RECEIVE] on the HP 37717C and set the display as shown opposite.

8. Press [RUN/STOP] on the Test Set. Press [RESULTS] PDH on the Test Set and ensure that the Bit Error Count and Code Error Count are both zero.

9. Press [SINGLE] error add key on the Test Set and ensure the Bit Error count increments by one each time the key is pressed.

10. Disconnect the Drop Port from the Test Set and connect it to the oscilloscope Input 1 via a "T" connector and a 75Ω termination. Set the oscilloscope termination to 1MΩ and press [AUTOSCALE].

11. Adjust the Oscilloscope Timebase and Delay to position the positive peak pulse amplitude at mid-pulse-width point in the centre of the screen.

12. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.

13. Select the 2Mb G.703 mask on the oscilloscope and store it on the display.

14. Press SHIFT [AUTOSCALE] on the oscilloscope to automatically align the pulse to the mask. Verify that the pulse falls within the mask as shown in Figure 3-30.

---

**Figure 3-29** 2 Mb/s Pulse Mask
Performance Tests
External 2Mb/s Demux (Options UKL, [USC])

**NOTE**

If your oscilloscope does not have the Mask feature, obtain a printout of the displayed pulse. Place the mask, shown in Figure 3-29, over the pulse and ensure that the pulse falls within the mask. (A transparent copy of the mask should be used).

15. Press **AUTOSCALE** on the oscilloscope to display the full waveform.
16. Use the following sequence to display the isolated negative pulse.
   - Select **TRIG** menu.
   - Set trigger level to middle of negative pulse.
   - Set trigger to pattern.
   - Set sequence to H X X.

![Figure 3-30](image)

2 Mb/s Isolated Positive Pulse

17. Use the oscilloscope **STORE INVERT** to display an inverted mask on the oscilloscope.
18. Adjust the oscilloscope timebase and vertical sensitivity controls to verify that the pulse meets the mask as shown in Figure 3-31. Use the displayed settings as a guide.
19. Measure the peak pulse amplitude at mid-pulse-width using the Oscilloscope and verify that this is between 2.133V and 2.607V.
Performance Tests

External 2Mb/s Demux (Options UKL, [USC])

Figure 3-31 2 Mb/s Isolated Negative Pulse

20. Ensure that the ratio of +ve and -ve pulse amplitudes is between 0.95 and 1.05.
21. Ensure that the ratio of +ve and -ve pulse widths is between 0.95 and 1.05.
22. Disconnect all test equipment.
PDH Receiver Monitor Levels (Special Option 808)

### Specification

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Nominal Loss</th>
<th>Equalization at 1/2 Bit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>704 kb/s</td>
<td>20dB Flat</td>
<td>3dB</td>
</tr>
<tr>
<td>2.048 Mb/s</td>
<td>20dB Flat</td>
<td>3dB</td>
</tr>
<tr>
<td>8.448 Mb/s</td>
<td>20dB Flat</td>
<td>3dB</td>
</tr>
<tr>
<td>34.368 Mb/s</td>
<td>20dB Flat</td>
<td>6dB</td>
</tr>
<tr>
<td>139.264 Mb/s</td>
<td>20dB Flat</td>
<td>6dB</td>
</tr>
</tbody>
</table>

### Description

Option 808 provides an equalized Monitor input. This is checked by attenuating the synthesizer output level by an amount equivalent to the extra gain provided by the Monitor Amplifier. The synthesizer is set to generate a sinewave at half the bit rate which corresponds to a ternary all ones signal. The receiver should sync up with no errors if PATTERN [ALL ONES] is selected.

### Equipment Required

- **Synthesizer**: HP 3335A option 001 (75Ω)
- **Oscilloscope**: HP 54503A

### Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect up the equipment as shown in Figure 3-32.
3. Set the oscilloscope to: TERMINATION - 1 MΩ PROBE - 1:1
Performance Tests
PDH Receiver Monitor Levels (Special Option 808)

Figure 3-32  PDH Receiver Monitor Levels Test Setup

704 kb/s

4. Press [RECEIVE] and set up the display as shown below. Press [SIGNAL IN] until the Monitor led is lit.

5. Select [RESULTS] [TIMING] [CONTROL] TEST TIMING [SINGLE] [5 SECS]

6. Press [RESULTS] and set up the display as shown below.

7. Set the Synthesizer to: FREQUENCY - 352 KHz sinewave AMPLITUDE - 237.5 mV pk-pk (26dB down) as measured on the oscilloscope.

8. Press [RUN/STOP] and verify that no errors are displayed at the end of the test period (5 seconds).
Performance Tests
PDH Receiver Monitor Levels (Special Option 808)

2.048 Mb/s
10. Set the Synthesizer to: FREQUENCY - 1024 KHz sinewave AMPLITUDE - 237.5 mV pk-pk (26dB down) as measured on the oscilloscope.
11. Press RUN/STOP and verify that no errors are displayed at the end of the test period (5 seconds).

8.448 Mb/s
13. Set the Synthesizer to: FREQUENCY - 4224 KHz sinewave AMPLITUDE - 237.5 mV pk-pk (26dB down) as measured on the oscilloscope.
14. Press RUN/STOP and verify that no errors are displayed at the end of the test period (5 seconds).

34.368 Mb/s
15. Select SIGNAL [34 Mb/s] on the RECEIVEDisplay.
16. Set the Synthesizer to: FREQUENCY - 17184 KHz sinewave AMPLITUDE - 71 mV pk-pk (29dB down) as measured on the oscilloscope.
17. Press RUN/STOP and verify that no errors are displayed at the end of the test period (5 seconds).

139.264 Mb/s
18. Select SIGNAL [140 Mb/s] on the RECEIVEDisplay.
19. Set the Synthesizer to: FREQUENCY - 69632 KHz sinewave AMPLITUDE - 50 mV pk-pk (26dB down) as measured on the oscilloscope.
20. Press RUN/STOP and verify that no errors are displayed at the end of the test period (5 seconds).
Performance Tests

PDH Error Output (Options UKK, [USB])

---

**PDH Error Output (Options UKK, [USB])**

**NOTE**

A PDH Tx Module must be fitted for this test - see Appendix B.

**Specifications**

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output</strong></td>
<td>1 pulse per error</td>
</tr>
<tr>
<td><strong>Output During Sync Loss</strong></td>
<td>Continuous pulses at 16 Clock period intervals</td>
</tr>
<tr>
<td><strong>Pulse Width</strong></td>
<td>Nominal 8 clock periods</td>
</tr>
<tr>
<td><strong>Level</strong></td>
<td>Nominal ECL</td>
</tr>
</tbody>
</table>

**Description**

The HP 37717C Transmitter generates a 2Mb/s Bit stream with injected errors. These errors are counted by the receiver and the signal appearing at the Error Output Port is checked to verify that error pulses are present at the correct rate. The Error Output signal is also checked with Pattern Sync Loss to verify that pulses are still present at 16 Clock Period intervals.

**Equipment Required**

- **Oscilloscope**: HP 54503A
- **Blocking Capacitor**: HP 10240B

**Procedure**

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the HP 37717C SIGNAL OUT 75Ω port to the SIGNAL IN 75Ω port.
3. Connect the HP 37717C ERROR OUT port to the Oscilloscope Channel 1 via the Blocking Capacitor (terminate scope in 1MΩ).
4. Select SIGNAL [2 Mb/s] on the **TRANSMIT** and **RECEIVE** displays.
Performance Tests

**PDH Error Output (Options UKK, [USB])**

5. Press **RESULTS** and set up the display as shown opposite.
6. Press **RUN/STOP** to start a measurement.
7. Check that the displayed BIT EC result is 0.
8. Press **TRANSMIT**, set up the TEST FUNCTION display as shown below to add errors to the signal and check that the BIT ER result is 1 in $10^{-3}$.

![Error Output Signal](image)

9. Adjust the Timebase and Range of the Oscilloscope to display two pulses.
10. Check that the pulse period is approximately 488µS (1 pulse per error - 1000 clock periods).
11. Press **TRANSMIT** and set the TEST FUNCTION ERROR ADD RATE to OFF to stop the error add. Check that pulses are no longer present on the Oscilloscope.
12. Select PATTERN $[2^{23}-1]$ on the **RECEIVE** display and check that the Pattern Loss LED is lit.
13. Adjust the Timebase and Range of the Oscilloscope to display a single pulse.
14. Check that the pulse period is 7.8µS (continuous pulses).
15. Disconnect all the equipment.
Performance Tests

PDH Frequency Measurement and Looped Clock (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±7 ppm</td>
</tr>
<tr>
<td>Measured Offset</td>
<td>±100 ppm</td>
</tr>
</tbody>
</table>

Description

This test verifies that the HP 37717C Receiver Frequency Measurement is within specified limits. These limits assume the instrument is within the annual calibration cycle.

A Synthesizer is used to generate a sinewave at half the data rate. This is applied to the HP 37717C Receiver Signal In port. As this signal corresponds to an All Ones Ternary Signal, the HP 37717C receiver should sync up with no errors if set to PATTERN [ALL ONES]. The Frequency Measurement accuracy of the HP 37717C can be determined by comparison with the frequency displayed on the Synthesizer. Frequency Offset Measurement is also verified during this test as the HP 37717C will display deviation from the expected Signal In frequency in ppm. The PDH transmitter recovered clock function is also verified at 2 Mb/s using the frequency counter in RATIO mode.

Equipment Required

- **Synthesizer**: HP 3335A Option 010 (75Ω)
- **Frequency Counter**: HP 5335A Option 010

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect up the equipment as shown in Figure 3-33.
Performance Tests

PDH Frequency Measurement and Looped Clock (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

Figure 3-33 Receiver Frequency Measurement Test Setup

3. Set the Synthesizer to: FREQUENCY - 1024.000 kHz sinewave AMPLITUDE - +10dBm.

4. Set the frequency counter to RATIO A/B.

5. Press [RECEIVE] and set up the display as shown opposite.

6. Press [TRANSMIT] and set up the display as shown opposite.
Performance Tests
PDH Frequency Measurement and Loop Clock (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

7. Press [RESULTS] and set up the display as shown opposite. (If MEASUREMENT TIME field is present, set to 16 seconds.)

8. Verify that the FREQUENCY displayed is between 2047986 Hz and 2048014 Hz.

9. Verify that the Offset displayed is between +7 ppm and -7 ppm.

10. Set the synthesizer frequency to 1024.102 kHz and verify that the frequency displayed on the [RESULTS] display is between 2048.190 kHz and 2048.219 kHz.

11. Verify that the Offset displayed is between 93 ppm and 107 ppm. The frequency counter should read 1.00.

12. Set the synthesizer frequency to 1023.898 kHz and verify that the frequency displayed on the [RESULTS] display is between 2047.781 kHz and 2047.810 kHz.

13. Verify that the Offset displayed is between -93 ppm and -107 ppm. The frequency counter should read 1.00.

14. Set the synthesizer and the HP 37717C to the settings given in Table 3-3 and verify the displayed Offset at each point.

Table 3-3

<table>
<thead>
<tr>
<th>Option</th>
<th>Receive Frequency</th>
<th>Synthesizer Frequency</th>
<th>Synthesizer Level</th>
<th>Displayed Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>UKK, [USB]</td>
<td>704 kb/s</td>
<td>352.000 kHz</td>
<td>+10 dBm</td>
<td>-7 to +7 ppm</td>
</tr>
<tr>
<td>UKK, [USB]</td>
<td>704 kb/s</td>
<td>351.965 kHz</td>
<td>+10 dBm</td>
<td>-93 to -107 ppm</td>
</tr>
<tr>
<td>UKK, [USB]</td>
<td>704 kb/s</td>
<td>352.035 kHz</td>
<td>+10 dBm</td>
<td>+93 to +107 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>8 Mb/s</td>
<td>4224.000 kHz</td>
<td>+10 dBm</td>
<td>-7 to +7 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>8 Mb/s</td>
<td>4223.578 kHz</td>
<td>+10 dBm</td>
<td>-93 to -107 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>8 Mb/s</td>
<td>4224.422 kHz</td>
<td>+10 dBm</td>
<td>+93 to +107 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>34 Mb/s</td>
<td>17.184.000 kHz</td>
<td>+10 dBm</td>
<td>-7 to +7 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>34 Mb/s</td>
<td>17.182.282 kHz</td>
<td>+10 dBm</td>
<td>-93 to -107 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>34 Mb/s</td>
<td>17.185.718 kHz</td>
<td>+10 dBm</td>
<td>+93 to +107 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>140 Mb/s</td>
<td>69.632.000 kHz</td>
<td>+4 dBm</td>
<td>-7 to +7 ppm</td>
</tr>
</tbody>
</table>
Performance Tests
PDH Frequency Measurement and Looped Clock (Options UKK, [USB], UKJ, [USA], UKL, [USC], UKN, [USE])

<table>
<thead>
<tr>
<th>Option</th>
<th>Receive Frequency</th>
<th>Synthesizer Frequency</th>
<th>Synthesizer Level</th>
<th>Displayed Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>140 Mb/s</td>
<td>69,625,036 kHz</td>
<td>+4 dBm</td>
<td>-93 to -107 ppm</td>
</tr>
<tr>
<td>UKK, [USB], UKJ, [USA]</td>
<td>140 Mb/s</td>
<td>69,638,963 kHz</td>
<td>+4 dBm</td>
<td>+93 to +107 ppm</td>
</tr>
</tbody>
</table>
Performance Tests

Internal SDH Transmitter Clock (Options US1, [US5], A1T, [A1U], A3R [A3S])

---

Internal SDH Transmitter Clock (Options US1, [US5], A1T, [A1U], A3R [A3S])

Specification

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>155.52 Mb/s</td>
<td>±4.5 ppm</td>
</tr>
</tbody>
</table>

Description

The test uses a Frequency Counter connected to the SDH Signal Out port to measure the STM-1 All Ones data rate. This gives an indirect measure of the transmitter clock frequency as the data is clocked by the internal 10MHz clock oscillator. The test limits assume the instrument is within the annual calibration cycle. The STM-1 Framing is disabled for this test using the MODULE DEBUG function of the HP 37717C.

Equipment Required

- Frequency Counter : HP 5335A Option 010
- 75Ω Termination   : HP 15522-80010
- T Connector       : HP 1250-0781

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the HP 37717C STM-1 OUT port to the Frequency Counter Input A, terminated in 75Ω (use the T Connector).
Performance Tests

Internal SDH Transmitter Clock (Options US1, [US5], A1T, [A1U], A3R [A3S])

3. Press **TRANSMIT** SDH SDH and set up the display as shown opposite.

4. Make the following key sequence on the HP 37717C to obtain the special **MODULE DEBUG** display.

   Press **OTHER**: **<**; **MORE**: **<**;
   **MORE**: **<**; **MORE**: **<**; **OTHER**: **<**.

   Press **MORE** until **MODULE DEBUG** appears in the softkey menu.

   Press **MODULE DEBUG** and set up the display as shown opposite.

**CAUTION**

When using the **MODULE DEBUG** display, ONLY modify the STM-1 TEST PATTERN. Altering other parameters can damage instrument firmware - exit this display after setup to eliminate any possibility of accidental modification.

5. Adjust the Frequency Counter Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 77.759650 MHz and 77.760350 MHz.

6. Disconnect all the test equipment.
Performance Tests
SDH Frequency Offsets (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Specifications

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>±999 ppm</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>0.1 ppm</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>0.02 ppm (from 0 to ±100 ppm)</td>
</tr>
<tr>
<td></td>
<td>0.2 ppm (from ±100 to ±999 ppm)</td>
</tr>
</tbody>
</table>

Description

The SDH Transmitter Offset Clock is checked for range and accuracy using a Frequency Counter to measure the STM-1 Data rate. This gives an indirect measure of the transmitter clock frequency as the data is clocked by the internal 10MHz clock oscillator. A measurement with no offset is performed to establish a reference Clock frequency. The frequency accuracy is then measured over the specified offset range. The STM-1 Framing is disabled during this test using the MODULE DEBUG function of the HP 37717C.

Equipment Required

- **Frequency Counter**: HP 5335A Opt 010
- **T Connector**: HP 1250-0781

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the STM-1 OUT port to the Frequency Counter terminated in 75Ω (use the T connector).
Performance Tests
SDH Frequency Offsets (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

3. Press [TRANSMIT] and set up the display as shown opposite.

4. Make the following key sequence on the HP 37717C to obtain the special display.
   Press \[OTHER\] \[\leftarrow\] \[MORE\] \[\leftarrow\] \[MORE\] \[\rightarrow\] \[MORE\] \[\rightarrow\] \[OTHER\].
   Press \[MORE\] until MODULE DEBUG appears in the softkey menu.
   Press MODULE DEBUG and set up the display as shown opposite.

   CAUTION
   When using the MODULE DEBUG display, ONLY modify the STM-1 TEST PATTERN. Altering other parameters can damage instrument firmware - exit this display after setup to eliminate any possibility of accidental modification.

5. Adjust the Frequency Counter Trigger Level to obtain a stable reading.
6. Take note of the measured frequency (MF).
7. Select the frequency offset settings given in Table 3-4 and verify the frequency at each step against the measured frequency (MF) noted in step 6.
Performance Tests
SDH Frequency Offsets (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Table 3-4 Measured Offset

<table>
<thead>
<tr>
<th>Offset (ppm)</th>
<th>Min Expected Frequency</th>
<th>Max Expected Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100ppm</td>
<td>MF - (0.00010452 x MF)</td>
<td>MF - (0.00009548) x MF</td>
</tr>
<tr>
<td>-66.6ppm</td>
<td>MF - (0.00007114 x MF)</td>
<td>MF - (0.00006208) x MF</td>
</tr>
<tr>
<td>+33.3ppm</td>
<td>MF + (0.00002878 x MF)</td>
<td>MF + (0.00003782) x MF</td>
</tr>
<tr>
<td>+100ppm</td>
<td>MF + (0.00009548 x MF)</td>
<td>MF + (0.00010452) x MF</td>
</tr>
<tr>
<td>+999ppm</td>
<td>MF + (0.00099448 x MF)</td>
<td>MF + (0.00100352) x MF</td>
</tr>
<tr>
<td>-999ppm</td>
<td>MF - (0.00100352 x MF)</td>
<td>MF - (0.00099448) x MF</td>
</tr>
</tbody>
</table>

8. Disconnect all the test equipment.
Performance Tests

External MTS Clock (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Specifications

Accepts Timing Reference as per ITU G.811

Description

This test verifies that signal integrity is maintained when the EXT MTS clock is used as a reference.

Equipment Required

<table>
<thead>
<tr>
<th>Synthesizer</th>
<th>HP 3335A option 001 (75Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Mb/s PDH Test Set</td>
<td>HP 37717A/B option UKK or UKJ or HP 37714A option UKK or UKJ or HP 37721A</td>
</tr>
<tr>
<td>75Ω/120Ω Converter</td>
<td>HP 15508B</td>
</tr>
</tbody>
</table>

Procedure

External MTS - 2MHz Clock

1. Connect the STM-1 OUT port to the STM-1 IN port and Recall HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Press [TRANSMIT] and set up the display as shown opposite.
3. Connect the HP 3335A to the HP 37717C Unbalanced 75Ω 2M REF IN port (EXT MTS clock).
4. Set the HP 3335A to 2.048 MHz at 2.0V p-p.
Performance Tests

External MTS Clock (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

5. Press [RECEIVE] and set up the display as shown opposite.
6. Press [RESULTS], TROUBLE SCAN.
7. Press [RUN/STOP], check that the display reads NO TROUBLE and all the Alarm leds are off.
8. Press [RUN/STOP] to halt the measurement.
9. Disconnect the HP 3335A and check that the CLOCK LOSS led is on, but the display reads NO TROUBLE.

External MTS - 2MHz Data
10. Select CLOCK : EXTERNAL [MTS 2M DATA].
11. Set the HP 3335A to output a 1.024MHz, 2V p-p signal.
12. Connect the HP 3335A to the 75Ω 2M REF IN port.
13. Press [RUN/STOP] to start the measurement and check that the RESULTS display reads NO TROUBLE and all the Alarm leds are off.
14. Disconnect the HP 3335A and check that the CLOCK LOSS led is on.
15. Connect the HP 3335A via the 75Ω/120Ω Converter to the 120Ω 2M REF IN port.
16. Press [RUN/STOP] and check that the RESULTS display reads NO TROUBLE and all the Alarm leds are off.

BITS 1.5 Mb/s (Option 120 only)
17. Select CLOCK : EXTERNAL [BITS : 1.5M].
18. Set the HP 3335A to output a 772kHz, 2V p-p signal.
19. Connect the HP 3335A to the 100Ω 1.5M REF IN port.
20. Press [RUN/STOP] and check that the RESULTS display reads NO TROUBLE and all the Alarm leds are off.
Performance Tests

External MTS Clock (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

External - MTS 64k Clock
21. Select CLOCK : EXTERNAL [MTS 64K CLOCK].
22. Set the HP 3335A to output a 32kHz, 2V p-p signal.
23. Connect the HP 3335A to the 100Ω 64K REF IN port.
24. Press [RUN/STOP] and check that the RESULTS display reads NO TROUBLE and all the Alarm leds are off.

STM-1 RX
25. Select CLOCK : STM-1 [RX].
26. Set the HP 3335A to output a 77.760MHz, 2V p-p signal.
27. Connect the HP 3335A to the STM-1 IN port and check that the CLOCK LOSS led is off. (Ignore any other Alarm leds.)
Performance Tests
STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Specifications

Meets ITU Recommendation G.703

Description

An oscilloscope is connected to the HP 37717C Transmitter STM-1 output and used to view the waveforms with All Ones and All Zeros patterns selected in turn. The displayed waveshape is checked against the relevant ITU G.703 mask. The STM-1 Framing is disabled during this test using the MODULE DEBUG function of the HP 37717C.

Equipment Required

Oscilloscope : HP 54503A
ThinkJet Printer : HP 2225A
75Ω Termination : HP 15522-80010
T Connector : HP 1250-0781

Procedure

CMI All Ones Waveshape

1. Connect up the equipment as shown in Figure 3-34 and recall HP 37717C DEFAULT SETTINGS as shown on 3-2.
Performance Tests

STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

2. Press [TRANSMIT] and set up the display as shown opposite.

3. Make the following key sequence on the HP 37717C to obtain the special display.

4. Adjust the Oscilloscope controls to display the waveform as shown in Figure 3-35, STM-1 All Ones Pattern.

5. Use the Oscilloscope PRINT function to obtain a printout of the STM-1 waveform on the external printer.

6. Ensure this printout fits the STM-1 Mask of Figure 3-36.

NOTE

If a mylar mask is not available, the figure shown may be traced or photocopied onto a transparency.
Performance Tests

STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Figure 3-35  STM-1 All Ones Pattern

Figure 3-36  STM-1 All Ones Mask

CMI All Zeros Waveshape

7. Select PATTERN [ALL ZEROS] on the OTHER DEBUG FUNCTION display.
Performance Tests

STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

8. Adjust the Oscilloscope controls to display the waveform as shown in Figure 3-37, STM-1 All Zeros Pattern Example.

9. Use the Oscilloscope PRINT function to obtain a printout of the STM-1 waveform on the external printer.

10. Ensure this printout fits the STM-1 Mask of Figure 3-38.

**NOTE**

If a mylar mask is not available, the figure shown may be traced or photocopied onto a transparency.

---

![STM-1 All Zeros Pattern](image)

**Figure 3-37**  STM-1 All Zeros Pattern
Performance Tests
STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Figure 3-38 STM-1 All Zeros Mask

11. Select STM-1 TEST PATTERN [OFF] on the OTHER DEBUG FUNCTION display.


13. Adjust the Oscilloscope controls to display the eye diagram as shown in Figure 3-39, STM-1 Eye Diagram Example. Check that the waveform meets the STM-1 eye diagram mask. It may be necessary to adjust the V/div gain on the Oscilloscope.
Performance Tests
STM-1 Transmitter Output Waveshape (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Figure 3-39    STM-1 Eye Diagram Pattern

Figure 3-40    STM-1 Eye Diagram Mask

NOTE    If the mask is not available then Figure 3-40 may be traced/copied and compared with the Oscilloscope print out.
Performance Tests
STM-1 Receiver Monitor Input (Options US1, [US5])

STM-1 Receiver Monitor Input (Options US1, [US5])

Specification

**Receiver Monitor Mode**  Selectable 20 dB of flat gain, no equalization

Description

An attenuator is inserted between the STM-1 OUT port and the STM-1 IN port. The Receiver monitor mode is verified by attenuating the signal by 20 dB and checking for error-free operation.

Equipment Required

- **3 dB Attenuator (N-type)**  : HP 8491A Option 003
- **6 dB Attenuator (N-type)**  : HP 8491A Option 006
- **75/50Ω Matching Pad (N-type)**  : HP 11852B (Qty 2)
- **N-type (f) to BNC (f) Adaptor**  : HP 1250-1536 (Qty 2)
- **N-type (m) to N-type (f) Adaptor**  : HP 1250-1475

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] and RECEIVER INPUT [SDH].
3. Connect up the equipment as shown in Figure 3-41.
Performance Tests
STM-1 Receiver Monitor Input (Options US1, [US5])

Figure 3-41  STM-1 Receiver Monitor Input

4. Press **RECEIVE** and select SIGNAL LEVEL [STM-1] [MONITOR].
5. Verify that all the front panel ALARM leds are off.
6. Press **RESULTS** **TROUBLE SCAN** and **RUN/STOP**, and check that the display indicates NO TROUBLE.
7. Press **RUN/STOP** to halt the measurement.
8. Disconnect all test equipment.
Performance Tests

STM-1 Receiver Monitor Input (Options A1T, [A1U], A3R [A3S], 120)

STM-1 Receiver Monitor Input (Options A1T, [A1U], A3R [A3S], 120)

Specification

- **Receiver Monitor Mode**
  - Selectable 20 dB and 26 dB of flat gain
  - 12 dB equalization at 1/2 Bit Rate

Description

An attenuator and special cable attenuator are inserted between the STM-1 OUT port and the STM-1 IN port. The Receiver monitor mode is verified by attenuating the signal by 20 and 26 dB and checking for error-free operation.

Equipment Required

- 3 dB Attenuator (N-type) : HP 8491A Option 003
- 6 dB Attenuator (N-type) (2 off) : HP 8491A Option 006
- 75/50Ω Matching Pad (N-type) : HP 11852B (Qty 2)
- N-type (f) to BNC (f) Adaptor : HP 1250-1536 (Qty 2)
- N-type (m) to N-type (f) Adaptor : HP 1250-1475
- Cable Attenuator (70 m) : HP 8120-0049

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] and RECEIVER INPUT [SDH].
3. Connect up the equipment as shown in Figure 3-42.
Performance Tests
STM-1 Receiver Monitor Input (Options A1T, [A1U], A3R [A3S], 120)

4. Press \textbf{RECEIVE} and select SIGNAL LEVEL [STM-1] [MONITOR].
5. Select GAIN [20 dB].
6. Verify that all the front panel ALARM LEDs are off.
7. Press \textbf{RESULTS} \textbf{TROUBLE SCAN} and \textbf{RUN/STOP}, and check that the display indicates NO TROUBLE.
8. Press \textbf{RUN/STOP} to halt the measurement.
9. Connect the second 6 dB Fixed Attenuator between the 3 dB attenuator and the Cable Attenuator.
10. Press \textbf{RECEIVE} and select GAIN [26 dB].
11. Press \textbf{RESULTS} \textbf{TROUBLE SCAN} and \textbf{RUN/STOP}, and check that the display indicates NO TROUBLE.
12. Disconnect all test equipment.
Performance Tests
STM-1 Receiver Monitor Input (Special Option 808)

STM-1 Receiver Monitor Input (Special Option 808)

Specification

- **Receiver Monitor Mode**: 20 dB of flat gain
- 6dB Equalization at 1/2 Bit Rate

Description

A fixed attenuator and a special cable attenuator are inserted between the STM-1 OUT port and the STM-1 IN port. The Receiver monitor mode is verified by attenuating the signal by 20dB, along with the cable attenuator, and checking for error-free operation.

Equipment Required

- **3 dB Attenuator (N-type)**: HP 8491A Option 003
- **6 dB Attenuator (N-type)**: HP 8491A Option 006
- **75/50Ω Matching Pad (N-type)**: HP 11852B (Qty 2)
- **N-type (f) to BNC (f) Adaptor**: HP 1250-1536 (Qty 2)
- **N-type (m) to N-type (f) Adaptor**: HP 1250-1475
- **Cable Attenuator (35m)**: HP 8120-0049

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] and RECEIVER INPUT [SDH].
3. Connect up the equipment as shown in Figure 3-43.
Performance Tests
STM-1 Receiver Monitor Input (Special Option 808)

Figure 3-43 STM-1 Receiver Monitor Input

4. Press [RECEIVE] and select SIGNAL LEVEL [STM-1] [MONITOR].
5. Verify that all the front panel ALARM leds are off.
6. Press [RESULTS] TROUBLE SCAN and [RUN/STOP] and check that the display indicates NO TROUBLE.
7. Press [RUN/STOP] to halt the measurement.
8. Disconnect all the test equipment.
Performance Tests
STM-1 Receiver Input Equalization (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

STM-1 Receiver Input Equalization (Options US1, [US5], A1T, [A1U], A3R [A3S], 120)

Specification

**Receiver Equalization** Automatic for cable loss up to 12dB at half the bit rate.

Description
Receiver Equalization is verified by inserting the special Cable between the STM-1 OUT port and the STM-1 IN port and checking for error-free operation.

Equipment Required

**Cable Attenuator (70 m)** : HP 8120-0049

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] and RECEIVER INPUT [SDH].
3. Connect the STM-1 OUT port to the STM-1 IN port, via the Cable Attenuator.
4. Verify that all the front panel Alarm leds are off.
5. Press **RESULTS** **TROUBLE SCAN** **RUN/STOP** and check that the display indicates NO TROUBLE.
6. Press **RUN/STOP** to halt the measurement.
7. Disconnect all the test equipment.
Performance Tests
STM-1 Optical Interface (Option UH1)

STM-1 Optical Interface (Option UH1)

NOTE
An SDH Option must be fitted for this option to operate - see Appendix B.

Specification (Transmitter)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1280 nm to 1330 nm</td>
</tr>
<tr>
<td>Fiber Power Output</td>
<td>-9 dBm nominal</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Safety Class</td>
<td>Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825</td>
</tr>
<tr>
<td>Data Rate</td>
<td>155.52 Mb/s (Nominal)</td>
</tr>
</tbody>
</table>

Specification (Receiver)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1200 nm to 1600 nm</td>
</tr>
<tr>
<td>Maximum Input Power</td>
<td>-8 dBm (for BER of 1.0E-10)</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>20 dB minimum</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-28 dBm Minimum (wavelength=1300nm, Modulation=100%, Data=2^{23}-1, BER=1.0E-10)</td>
</tr>
</tbody>
</table>

Description
The 155 Mb/s output of the optical transmitter is checked for power level.
The receiver sensitivity is verified by attenuating the transmitter output and checking for no errors in a back to back mode.
Performance Tests
STM-1 Optical Interface (Option UH1)

Equipment Required

- **Power Meter**: HP 8153A
- **Power Meter Sensor Module**: HP 81536A
- **FC/PC Connector Interface**: HP 81000FI (Qty. 4)
- **Optical Attenuator**: HP 8157A
- **Optical Cables (Qty. 2)**: HP 11871A

**WARNING**
Safety precautions must be observed when handling the HP 37717C Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:

1. Check the connector configuration of the Fiber Optic Interfaces. If these are fitted with a connector interface other than FC/PC then remove the existing connector interface and fit the FC/PC connector interface.
2. Check for any damage to the HP 37717C Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.
3. Make all connections to the HP 37717C Fiber Optic Interfaces before powering up the instrument.

**Procedure**

1. Connect the STM-1 Optical Out Port to the HP 8153A (ensure that all connections are tight and that the cable has no twists).
2. Switch on the HP 37717C, check that immediately on power up the LASER ON led on the front panel illuminates for a few seconds and Recall the HP 37717C DEFAULT SETTINGS as shown on Page 3-2.
3. Recall default settings on the HP 8153A:
   - Press [MODE] to select MENU mode on the HP 8153A.
   - Press [SYSTEM] to display RECALL.
   - Press [EDIT], select 0 — [A] and press [EXEC] to recall the default settings (wavelength = 1300 nm, measurement time = 200 ms, autorange).
Performance Tests
STM-1 Optical Interface (Option UH1)

4. Press [MODE] then [dBmw] to select the Power Level measurement on the HP 8153A.

5. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT].

6. Verify that the front panel LASER ON led is on indicating the laser is enabled.

7. Check the HP 8153A Power Meter reading is between -15 dBm and -8 dBm (Typically -9 dBm)

8. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].

9. Verify that the front panel LASER ON led is off before continuing.

10. Set the Optical Attenuator to ATTEN 0 dB, WAVELENGTH 1310 nm ; CAL=0. Connect the Optical Attenuator between the Power Meter and the HP 37717C Optical Out port (ensure that all connections are tight and that the cable has no twists).

11. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT].

12. Adjust the Optical Attenuator to obtain a reading of -28 dBm on the Power Meter.

13. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].

14. Verify that the front panel LASER ON led is off before continuing.

15. Disconnect the Optical Attenuator Output from the HP 8153A and connect to the HP 37717C Optical In Port.


17. Press [TRANSMIT] [SDH] and select SIGNAL [STM-1 OPT].

18. Press [RESULTS] TROUBLE SCAN, and then [RUN/STOP] to start a measurement.

19. After 5 minutes check that NO TROUBLE is displayed on the [RESULTS] display.

20. Press[OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].

21. Verify that the front panel LASER ON led is off.

22. Disconnect the test equipment.
Performance Tests
STM-1/STM-4 Optical Interface (Option UH2)

NOTE
An SDH Option must be fitted for this option to operate - see Appendix B.

Specification (Transmitter)
- **Wavelength**: 1280 nm to 1330 nm
- **Power Output**: -10 dBm (Nominal)
- **Line Coding**: NRZ
- **Safety Class**: Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825
- **Data Rate**: 155.52 Mb/s or 622.08 Mb/s (Nominal)

Specification (Receiver)
- **Wavelength**: 1200 nm to 1600 nm
- **Maximum Input Power**: -8 dBm (for BER of 1.0E-10)
- **Line Coding**: NRZ
- **Sensitivity**: -26 dBm Minimum (wavelength=1300nm, Modulation=100%,Data=2^{23}-1, BER=1.0E-10)

Description
The 155.52/622.08 MHz output of the optical transmitter is checked for power level.
The receiver sensitivity is verified by attenuating the transmitter output and checking for no errors in back-to-back mode.
Performance Tests
STM-1/STM-4 Optical Interface (Option UH2)

Equipment Required

- **Power Meter**: HP 8153A
- **Power Meter Sensor Module**: HP 81536A
- **FC/PC Connector Interface**: HP 81000FI (Qty. 4)
- **Optical Attenuator**: HP 8157A
- **Optical Cables (Qty. 2)**: HP 11871A

Safety precautions must be observed when handling the HP 37717C Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:

- Check the connector configuration of the Fiber Optic Interfaces. If these are fitted with a connector interface other than FC/PC then remove the existing connector interface and fit the FC/PC connector interface.
- Check for any damage to the HP 37717C Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.
- Make all connections to the HP 37717C Fiber Optic Interfaces before powering up the instrument.

Procedure

1. Connect the STM-4 Optical Out Port to the HP 8153A (ensure that all connections are tight and that the cable has no twists).
2. Switch on the HP 37717C, check that immediately on power up the LASER ON led on the front panel illuminates for a few seconds and Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
3. Recall default settings on the HP 8153A:
   - Press [MODE] to select MENU mode on the HP 8153A.
   - Press [SYSTEM] to display RECALL.
   - Press [EDIT], select 0 — [A] and press [EXEC] to recall the default settings (wavelength = 1300 nm, measurement time = 200 ms, autorange).
4. Press [MODE] then [dBmw] to select the Power Level measurement on the HP 8153A.
5. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT].
Performance Tests
STM-1/STM-4 Optical Interface (Option UH2)

6. Verify that the front panel LASER ON led is on, indicating the laser is enabled.
7. Check the HP 8153A Power Meter reading is between -15 dBm and -8 dBm (Typically -9 dBm).
8. Press **TRANSMIT** SDH on the HP 37717C and select SIGNAL [STM-4 OPT].
9. Repeat steps 6 and 7.
10. Press **OTHER** select STORED SETTINGS NUMBER [0] (Default Settings) and press **RECALL**
11. Verify that the front panel LASER ON led is off before continuing.
12. Set the Optical Attenuator to ATTEN 0 dB, WAVELENGTH 1310 nm ; CAL=0. Connect the Optical Attenuator between the Power Meter and the HP 37717C Optical Out port (ensure that all connections are tight and that the cable has no twists).
13. Press **TRANSMIT** SDH on the HP 37717C and select SIGNAL [STM-1 OPT].
14. Adjust the Optical Attenuator to obtain a reading of -26 dBm on the Power Meter.
15. Press **OTHER** select STORED SETTINGS NUMBER [0] (Default Settings) and press **RECALL**
16. Verify that the front panel LASER ON led is off before continuing.
17. Disconnect the Optical Attenuator Output from the HP 8153A and connect to the HP 37717C Optical In Port.
18. Press **OTHER** then **SETTINGS CONTROL** and select TRANSMITTER AND RECEIVER [COUPLED].
19. Press **TRANSMIT** SDH and select SIGNAL [STM-1 OPT].
20. Press **RESULTS** TROUBLE SCAN and then **RUN/STOP** to start a measurement.
21. After 5 minutes check that NO TROUBLE is displayed on the **RESULTS** display.
22. Press **OTHER** select STORED SETTINGS NUMBER [0] (Default Settings) and press **RECALL**
23. Verify that the front panel LASER ON led is off before continuing.
25. Disconnect the test equipment.
Performance Tests
STM-1/STM-4, 1550nm Optical Interface (Option URU)

NOTE
An SDH Option must be fitted for this option to operate - see Appendix B.

Specification (Transmitter)

<table>
<thead>
<tr>
<th>Description</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1520 nm to 1565 nm</td>
</tr>
<tr>
<td>Power Output</td>
<td>-1 dBm (Nominal)</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Safety Class</td>
<td>Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825</td>
</tr>
<tr>
<td>Data Rate</td>
<td>155.52 Mb/s or 622.08 Mb/s (Nominal)</td>
</tr>
</tbody>
</table>

Specification (Receiver)

<table>
<thead>
<tr>
<th>Description</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1200 nm to 1600 nm</td>
</tr>
<tr>
<td>Maximum Input Power</td>
<td>-8 dBm (for BER of 1.0E-10)</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-26 dBm Minimum (wavelength=1550nm, Modulation=100%, Data=2^{23}-1, BER=1.0E^{-10})</td>
</tr>
<tr>
<td>PMP Electrical Input</td>
<td>150mV (Nominal)</td>
</tr>
<tr>
<td>PMP Impedance</td>
<td>Nominal 50Ω</td>
</tr>
</tbody>
</table>

Description
Minimum and maximum Optical Rx Input levels are verified by looping the Optical Tx and Rx ports through the Optical Attenuator and checking for error-free operation with identical Tx and Rx patterns selected. The signal level to the Optical Rx input is measured using the Power Meter and adjusted using the Optical Attenuator for the required minimum and maximum levels.
Performance Tests
STM-1/STM-4, 1550nm Optical Interface (Option URU)

The Protected Monitor Point (PMP) functionality is verified by looping the HP 37717C Optical Output to the PMP input via an Optical Attenuator and Optical to Electrical Converter, then checking for error-free operation with identical Tx and Rx patterns selected. The specified electrical level for the PMP input is obtained by adjusting the optical signal level to the O/E Converter using the Optical Attenuator.

Equipment Required

<table>
<thead>
<tr>
<th>Equipment Required</th>
<th>HP Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Meter</td>
<td>8153A</td>
</tr>
<tr>
<td>Power Meter Sensor Module</td>
<td>81536A</td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>54503A</td>
</tr>
<tr>
<td>Dual Power Supply (+/-12V)</td>
<td>6253A</td>
</tr>
<tr>
<td>Lightwave Receiver</td>
<td>83442A opt 012</td>
</tr>
<tr>
<td>Optical Attenuator</td>
<td>8157A</td>
</tr>
<tr>
<td>FC/PC Connector Interface</td>
<td>81000FI (Qty. 4)</td>
</tr>
<tr>
<td>Optical Cables (qty 2)</td>
<td>11871A</td>
</tr>
<tr>
<td>Adaptor (SMA to BNC)</td>
<td>1250-1787</td>
</tr>
</tbody>
</table>

**CAUTION**

The performance of Optical Interfaces will be seriously impaired if any dirt or contamination is present on the interface connectors. Always cover the ends of optical cables and connectors with protective caps when not in use.

Always examine the ends of each fibre optic cable before use and if visible contamination is present DO NOT USE - Dirt is easily transferred to the Optical Module connector causing permanent damage. The cable should be replaced or cleaned - If cleaning, refer to Hewlett-Packard booklet *Lightwave Connection Techniques for better measurements*. HP Part Number 08703-90028.

**Procedure**

1. Set the Optical Attenuator to ATTEN 0 dB, WAVELENGTH 1550 nm ; CAL=0. Connect the HP 37717C STM1/4 Optical Out Port to the HP 8153A Power Meter via the HP 8157A Optical Attenuator - ensure that all connections are tight and that optical cables have no twists or tight bends.
Performance Tests
STM-1/STM-4, 1550nm Optical Interface (Option URU)

2. Setup the HP 8153A as follows:
   a. Press \textbf{PARAM} key to display wavelength [\lambda].
   b. Using \textbf{PARAM} and \textbf{keys}, set the wavelength to 1550nm.
   c. Press \textbf{PARAM} key to display Time [t].
   d. Using \textbf{PARAM} and \textbf{keys}, set the time to 200mS.
   e. Press \textbf{PARAM} key to display REF.
   f. Using \textbf{PARAM} and \textbf{keys}, set the REF to 0.000dBm.
   g. Press \textbf{PARAM} key to display CAL.
   h. Using \textbf{PARAM} and \textbf{keys}, set the CAL to 0.000dBm.
   i. Cover the end of the Power Meter Optical Input connector with a protective cap.
   j. Press the \textbf{ZERO} key on the Power Meter to calibrate - the Power Meter is now ready.

3. Switch on the HP 37717C, check that immediately on power-up the Optical Module LASER ON led illuminates for a few seconds and Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

4. Press \textbf{TRANSMIT SDH} on the HP 37717C and set up the display as shown opposite.

5. Verify that the Optical Module LASER ON led is lit indicating that the laser is enabled.

6. Adjust the level to obtain a reading of 8dBm on the Power Meter. Typically around 6dB of attenuation will be required to achieve this reading.

7. Press \textbf{TRANSMIT SDH} on the HP 37717C and select SIGNAL [STM-1].

8. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

9. Disconnect the optical cable from the Power Meter and connect to the HP 37717C STM1/4 Optical Rx Input.
Performance Tests
STM-1/STM-4, 1550nm Optical Interface (Option URU)

10. Press **RECEIVE** on the HP 37717C and set up the display as shown opposite.

11. Press **TRANSMIT** on the HP 37717C and select **SIGNAL [STM-4 OPT]**.

12. Press **RESULTS** then **TROUBLE SCAN** to start the measurement.

13. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C display. Press **RUN/STOP** to stop the measurement.

14. Press **TRANSMIT** **SDH** on the HP 37717C and select **SIGNAL [STM-1]**.

15. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

16. Reconnect the HP 37717C STM1/4 Optical Out Port to the HP 8153A Power Meter via the HP 8157A Optical Attenuator.

17. Press **TRANSMIT** **SDH** on the HP 37717C and select **SIGNAL [STM-4 OPT]**.

18. Adjust the Optical Attenuator level to obtain a reading of -26dBm on the Power Meter.

19. Press **TRANSMIT** **SDH** on the HP 37717C and select **SIGNAL [STM-1]**.

20. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

21. Disconnect the optical cable from the Power Meter and connect to the HP 37717C STM1/4 Optical Rx Input.

22. Press **TRANSMIT** **SDH** on the HP 37717C and select **SIGNAL [STM-4 OPT]**.

23. Press **RESULTS** **TROUBLE SCAN** then **RUN/STOP** to start the measurement.

24. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C display. Press **RUN/STOP** to stop the measurement.

25. Press **TRANSMIT** **SDH** on the HP 37717C and select **SIGNAL [STM-1]**.

26. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

27. Disconnect the optical cable from the HP 37717C STM1/4 Optical Rx Input and connect to the HP 83442A Optical/Electrical Converter input.
Performance Tests
STM-1/STM-4, 1550nm Optical Interface (Option URU)

28. Connect the output from the Optical/Electrical Converter to the Oscilloscope using the SMA/BNC adaptor and 50Ω BNC cable.
29. Set the Dual Power Supply to +12V and -12V, then connect to the HP 83442A O/E Converter and switch on.

**CAUTION**
Take care to connect the supply correctly as incorrect voltage or polarity could result in damage to the HP 83442A. Refer to HP 83442A Operating Instructions, HP p/n 5091-6448A.

30. Press [TRANSMIT] SDH on the HP 37717C and select SIGNAL [STM-4 OPT].
31. Press [AUTOSCALE] on the oscilloscope and adjust the Timebase and Range to obtain an STM-4 waveform.
32. Measure the amplitude of this STM-4 waveform using the oscilloscope and adjust the Optical Attenuator until the amplitude is 150mV.

**NOTE**
If the input power is greater than -8 dBm then the Optical/Electrical converter is liable to saturate.

33. Disconnect the output of the O/E Converter from the oscilloscope and connect instead to the HP 37717C STM1/4 Optical Module Monitor Input.
34. Press [RECEIVE] on the HP 37717C and set up the display as shown opposite.
35. Press [RESULTS] TROUBLE SCAN then [RUN/STOP] to start the measurement.
36. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C [RESULTS] display. Press [RUN/STOP] to stop the measurement.
37. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
38. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.
39. Repeat steps 1 to 38 but with [STM-1 OPT] selected on the HP 37717C Tx and Rx display parameters instead of [STM-4 OPT].
40. Disconnect all Test equipment.
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

---

STM-1/STM-4 Optical Interface (Options UKT, USN)

**NOTE**
An SDH Option must be fitted for this option to operate - see Appendix B.

**Specification (Transmitter)**

- **Wavelength**
  - UKT - 1280 nm to 1330 nm,
  - USN - 1280 nm to 1330 nm or 1520 nm to 1565 nm
- **Power Output**
  - 1310 nm -10 dBm (Nominal).
  - 1550 nm -1dBm (Nominal)
- **Line Coding**
  - NRZ
- **Safety Class**
  - Class 3A, FDA 21 CFR Ch.1 1040.10 and EN 60825
- **Data Rate**
  - 155.52 Mb/s or 622.08 Mb/s (Nominal)

**Specification (Receiver)**

- **Wavelength**
  - 1200 nm to 1600 nm
- **Maximum Input Power**
  - -8 dBm (for BER of $1.0 \times 10^{-10}$)
- **Line Coding**
  - NRZ
- **Sensitivity**
  - -34 dBm Minimum (STM-1),
  - -28 dBm Minimum (STM-4)
  (wavelength=1300nm, Modulation=100%, Data=$2^{23}-1$, BER=$1.0 \times 10^{-10}$)
- **PMP Input**
  - 150mV pk-pk minimum
- **PMP Impedance**
  - Nominal 50Ω

**Description**

The 155.52/622.08 MHz output of the optical transmitter is checked for power level at 1310 nm (and 1550 nm wavelengths if Option USN). The receiver sensitivity is verified by attenuating the transmitter output and checking for no errors in back-to-
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

back mode at 1310 nm (and 1550 nm wavelengths if Option USN).
The Protected Monitor Point (PMP) functionality is verified by looping the HP 37717C Optical Output to the PMP input via an Optical Attenuator and Optical to Electrical Converter, then checking for error-free operation with identical Tx and Rx patterns selected. The specified electrical level for the PMP input is obtained by adjusting the optical signal level to the O/E Converter using the Optical Attenuator.

Equipment Required

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Model</th>
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<tbody>
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<td>Power Meter</td>
<td>HP 8153A</td>
</tr>
<tr>
<td>Power Meter Sensor Module</td>
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</tr>
<tr>
<td>Lightwave Receiver</td>
<td>HP 83442A opt 012</td>
</tr>
<tr>
<td>FC/PC Connector Interface</td>
<td>HP 81000FI (Qty. 4)</td>
</tr>
<tr>
<td>Optical Attenuator</td>
<td>HP 8157A</td>
</tr>
<tr>
<td>Optical Cables (Qty. 2)</td>
<td>HP 11871A</td>
</tr>
<tr>
<td>Adaptor (SMA to BNC)</td>
<td>HP 1250-1787</td>
</tr>
</tbody>
</table>

WARNING

Safety precautions must be observed when handling the HP 37717C Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:

Check the connector configuration of the Fiber Optic Interfaces. If these are fitted with a connector interface other than FC/PC then remove the existing connector interface and fit the FC/PC connector interface.

Check for any damage to the HP 37717C Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.

Make all connections to the HP 37717C Fiber Optic Interfaces before powering up the instrument.
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

Procedure Option UKT and USN
1. Connect the HP 37717C 1310 nm Optical Out Port to the HP 8153A (ensure that all connections are tight and that the cable has no twists).

2. Switch on the HP 37717C, check that immediately on power up the LASER ON led on the front panel illuminates for a few seconds and Recall the HP 37717C DEFAULT SETTINGS as shown on page 3-2.

3. Recall default settings on the HP 8153A:
   - Press [MODE] to select MENU mode on the HP 8153A.
   - Press [SYSTEM] to display RECALL.
   - Press [EDIT], select 0 — \rightarrow A and press [EXEC] to recall the default settings (wavelength = 1300 nm, measurement time = 200 ms, autorange).

4. Press [MODE] then [dBmw] to select the Power Level measurement on the HP 8153A.

5. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT] [1310 nm].

6. Verify that the front panel LASER ON led is on, indicating the laser is enabled.

7. Check the HP 8153A Power Meter reading is between -15 dBm and -8 dBm (Typically -10 dBm).

8. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1310 nm].

9. Repeat steps 6 and 7.

10. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].

11. Verify that the front panel LASER ON led is off before continuing.

12. Connect the Optical Attenuator between the Power Meter and the HP 37717C 1310 nm Optical Out port (ensure that all connections are tight and that the cable has no twists). Set the Optical Attenuator to ATTEN 0dB, WAVELENGTH 1310 nm ; CAL=0.

13. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT] [1310 nm].

14. Adjust the Optical Attenuator to obtain a reading of -34 dBm on the Power Meter.

15. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

16. Verify that the front panel LASER ON led is off before continuing.

17. Disconnect the Optical Attenuator Output from the HP 8153A and connect to the HP 37717C Optical In Port.

18. Press [OTHER] then [SETTINGS CONTROL] and select TRANSMITTER AND RECEIVER [COUPLED].

19. Press [TRANSMIT] [SDH] and select SIGNAL [STM-1 OPT] [1310 nm].

20. Press [RESULTS] [TROUBLE SCAN], and then [RUN/STOP] to start a measurement.

21. After 5 minutes check that NO TROUBLE is displayed on the display.

22. Repeat steps 10 through 21, selecting SIGNAL [STM-4 OPT] [1310 nm] in steps 13 and 19 and -28 dBm in step 14.

23. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

24. Disconnect the optical cable from the HP 37717C STM1/4 Optical IN Port and connect to the HP 83442A Optical/Electrical Converter input.

25. Connect the output from the Optical/Electrical Converter to the Oscilloscope using the SMA/BNC adaptor and 50Ω BNC cable.

26. Set the Dual Power Supply to +12V and -12V, then connect to the HP 83442A O/E Converter and switch on.

CAUTION
Take care to connect the supply correctly as incorrect voltage or polarity could result in damage to the HP 83442A. Refer to HP 83442A Operating Instructions, HP p/n 5091-6448A.

27. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1310 nm].

28. Press [AUTOSCALE] on the oscilloscope and adjust the Timebase and Range to obtain an STM-4 waveform.

29. Measure the amplitude of this STM-4 waveform using the oscilloscope and adjust the Optical Attenuator until the amplitude is 150mV pk-pk.

NOTE
If the input power is greater than -8 dBm then the Optical/Electrical converter is liable to saturate.
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

30. Disconnect the output of the O/E Converter from the oscilloscope and connect instead to the HP 37717C STM1/4 Optical Module Monitor Input.

31. Press [RECEIVE] on the HP 37717C and set up the display as shown opposite.

32. Press [RESULTS] then [RUN/STOP] to start the measurement.

33. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C display. Press [RUN/STOP] to stop the measurement.

34. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

35. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.


Procedure Option USN only

37. Set the Optical Attenuator to WAVELENGTH 1550 nm ; CAL=0.
Connect the HP 37717C 1550 nm Optical Out Port to the HP 8153A Power Meter via the HP 8157A Optical Attenuator, set to ATTEN 10 dB - ensure that all connections are tight and that optical cables have no twists or tight bends.

38. Setup the HP 8153A as follows:

a. Press [PARAM] key to display wavelength [\(\lambda\)]
b. Using [←] [→] [↑] and [↓] keys, set the wavelength to 1550nm.
c. Press [PARAM] key to display Time [\(t\)]
d. Using [←] [→] [↑] and [↓] keys, set the time to 200mS.
e. Press [PARAM] key to display REF.
f. Using [←] [→] [↑] and [↓] keys, set the REF to 0.000dBm.
g. Press [PARAM] key to display CAL.
h. Using [←] [→] [↑] and [↓] keys, set the CAL to 0.000dBm.
i. Cover the end of the Power Meter Optical Input connector with a protective cap.
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

j. Press the **ZERO** key on the Power Meter to calibrate - the Power Meter is now ready.

39. Switch on the HP 37717C and check that immediately on power-up the Optical Module LASER ON led illuminates for a few seconds.

40. Press **TRANSMIT** on the HP 37717C and set up the display as shown opposite.

41. Verify that the Optical Module LASER ON led is lit indicating that the laser is enabled.

42. Adjust the level to obtain a reading of -8dBm on the Power Meter. Typically around 7dB of attenuation will be required to achieve this reading.

43. Recall the HP 37717C DEFAULT SETTINGS as shown on Page 3-2.

44. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

45. Disconnect the optical cable from the Power Meter and connect to the HP 37717C Optical IN Port.

46. Press **RECEIVE** on the HP 37717C and set up the display as shown opposite.

47. Press **TRANSMIT** on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].

48. Press **RESULTS** then **TROUBLE SCAN** **RUN/STOP** to start the measurement.

49. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C **RESULTS** display. Press **RUN/STOP** to stop the measurement.

50. Recall the HP 37717C DEFAULT SETTINGS as shown on Page 3-2.

51. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

52. Reconnect the HP 37717C 1550 nm Optical Out Port to the HP 8153A Power Meter via the HP 8157A Optical Attenuator.

53. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].

54. Adjust the Optical Attenuator level to obtain a reading of -28dBm on the Power Meter.

55. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

56. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

57. Disconnect the optical cable from the Power Meter and connect to the HP 37717C Optical IN Port.

58. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].

59. Press [RESULTS] [TROUBLE SCAN] then [RUN/STOP] to start the measurement.

60. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C [RESULTS] display. Press [RUN/STOP] to stop the measurement.

61. Repeat steps 50 through 60, selecting SIGNAL [STM-1 OPT] [1550 nm] in steps 53 and 58 and -34dBm in step 54.

62. Recall the HP 37717C DEFAULT SETTINGS as shown on Page 3-2.

63. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

64. Disconnect the optical cable from the HP 37717C STM1/4 Optical IN Port and connect to the HP 83442A Optical/Electrical Converter input.

65. Connect the output from the Optical /Electrical Converter to the Oscilloscope using the SMA/BNC adaptor and 50Ω BNC cable.

66. Set the Dual Power Supply to +12V and -12V, then connect to the HP 83442A O/E Converter and switch on.

CAUTION

Take care to connect the supply correctly as incorrect voltage or polarity could result in damage to the HP 83442A. Refer to HP 83442A Operating Instructions, HP p/n 5091-6448A.
Performance Tests
STM-1/STM-4 Optical Interface (Options UKT, USN)

67. Press [TRANSMIT SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].

68. Press [AUTOSCALE] on the oscilloscope and adjust the Timebase and Range to obtain an STM-4 waveform.

69. Measure the amplitude of this STM-4 waveform using the oscilloscope and adjust the Optical Attenuator until the amplitude is 150mV pk-pk.

**NOTE**
If the input power is greater than -8 dBm then the Optical/Electrical converter is liable to saturate.

70. Disconnect the output of the O/E Converter from the oscilloscope and connect instead to the HP 37717C STM1/4 Optical Module Monitor Input.

71. Press [RECEIVE] on the HP 37717C and set up the display as shown opposite.

72. Press [RESULTS TROUBLE SCAN] then [RUN/STOP] to start the measurement.

73. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C RESULTS display. Press [RUN/STOP] to stop the measurement.

74. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

75. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

76. Repeat steps 62 through 75, selecting SIGNAL [STM-1 OPT] [1550 nm] in step 67 and [STM-1 MON] in step 71.

77. Disconnect all the test equipment.
Performance Tests
STM-1/STM-4 Optical Interface (Options 130, 131)

NOTE
An SDH Option must be fitted for this option to operate - see Appendix B.

Specification (Transmitter)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>130 - 1280 nm to 1330 nm, 131 - 1280 nm to 1330 nm or 1520 nm to 1565 nm</td>
</tr>
<tr>
<td>Power Output</td>
<td>1310 nm - 10 dBm (Nominal), 1550 nm - 1 dBm (Nominal)</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Safety Class</td>
<td>Class 3A, FDA 21 CFR Ch.1 1040.10 and EN 60825</td>
</tr>
<tr>
<td>Data Rate</td>
<td>51.84 Mb/s, or 155.52 Mb/s or 622.08 Mb/s (Nominal)</td>
</tr>
</tbody>
</table>

Specification (Receiver)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1200 nm to 1600 nm</td>
</tr>
<tr>
<td>Maximum Input Power</td>
<td>-8 dBm (for BER of 1.0E-10)</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-34 dBm Minimum (STM-0 &amp; STM-1), -28 dBm Minimum (STM-4)</td>
</tr>
<tr>
<td></td>
<td>(wavelength=1300nm, Modulation=100%, Data=2^{23}-1, BER=1.0E^{-10}, 2^{23}-1 PRBS)</td>
</tr>
<tr>
<td>PMP Input</td>
<td>150mV pk-pk minimum</td>
</tr>
<tr>
<td>PMP Impedance</td>
<td>Nominal 50Ω</td>
</tr>
</tbody>
</table>

Description
The 51.84/155.52/622.08 MHz output of the optical transmitter is checked for power level at 1310 nm (and 1550 nm wavelengths if Option131). The receiver sensitivity is verified by attenuating the transmitter output and checking for no
Performance Tests

STM-1/STM-4 Optical Interface (Options 130, 131)

errors in back-to-back mode at 1310 nm (and 1550 nm wavelengths if Option 131). The Protected Monitor Point (PMP) functionality is verified by looping the HP 37717C Optical Output to the PMP input via an Optical Attenuator and Optical to Electrical Converter, then checking for error-free operation with identical Tx and Rx patterns selected. The specified electrical level for the PMP input is obtained by adjusting the optical signal level to the O/E Converter using the Optical Attenuator.

Equipment Required

Power Meter : HP 8153A
Power Meter Sensor Module : HP 81536A
Oscilloscope : HP 54503A
Dual Power Supply (+/-12V) : HP 6253A
Lightwave Receiver : HP 83442A opt 012
FC/PC Connector Interface : HP 81000FI (Qty. 4)
Optical Attenuator : HP 8157A
Optical Cables (Qty. 2) : HP 11871A
Adaptor (SMA to BNC) : HP 1250-1787

WARNING

Safety precautions must be observed when handling the HP 37717C Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:
Check the connector configuration of the Fiber Optic Interfaces. If these are fitted with a connector interface other than FC/PC then remove the existing connector interface and fit the FC/PC connector interface.
Check for any damage to the HP 37717C Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.
Make all connections to the HP 37717C Fiber Optic Interfaces before powering up the instrument.

Procedure Option 130 and 131

1. Connect the HP 37717C 1310 nm Optical Out Port to the HP 8153A (ensure that all connections are tight and that the cable has no twists).
Performance Tests
STM-1/STM-4 Optical Interface (Options 130, 131)

2. Switch on the HP 37717C, check that immediately on power up the LASER ON led on the front panel illuminates for a few seconds and Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

3. Recall default settings on the HP 8153A:
   - Press [MODE] to select MENU mode on the HP 8153A.
   - Press [SYSTEM] to display RECALL.
   - Press [EDIT], select 0 — [A] and press [EXEC] to recall the default settings (wavelength = 1300 nm, measurement time = 200 ms, autorange).

4. Press [MODE] then [dBmw] to select the Power Level measurement on the HP 8153A.

5. Press [TRANSMIT] SDH on the HP 37717C and select SIGNAL [STM-1 OPT] [1310 nm].

6. Verify that the front panel LASER ON led is on, indicating the laser is enabled.

7. Check the HP 8153A Power Meter reading is between -15 dBm and -8 dBm (Typically -10 dBm).

8. Press [TRANSMIT] SDH on the HP 37717C and select SIGNAL [STM-4 OPT] [1310 nm].

9. Repeat steps 6 and 7.

10. Press [TRANSMIT] SDH on the HP 37717C and select SIGNAL [STM-0 OPT] [1310 nm].

11. Repeat steps 6 and 7.

12. Press [OTHER] to select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL]

13. Verify that the front panel LASER ON led is off before continuing.

14. Connect the Optical Attenuator between the Power Meter and the HP 37717C 1310 nm Optical Out port (ensure that all connections are tight and that the cable has no twists). Set the Optical Attenuator to ATTEN 0dB, WAVELENGTH 1310 nm ; CAL=0.

15. Press [TRANSMIT] SDH on the HP 37717C and select SIGNAL [STM-1 OPT] [1310 nm].

16. Adjust the Optical Attenuator to obtain a reading of -34dBm ±1dB on the Power Meter.
Performance Tests
STM-1/STM-4 Optical Interface (Options 130, 131)

17. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].
18. Verify that the front panel LASER ON led is off before continuing.
19. Disconnect the Optical Attenuator Output from the HP 8153A and connect to the HP 37717C Optical In Port.
20. Press [OTHER] then [SETTINGS CONTROL] and select TRANSMITTER AND RECEIVER [COUPLED].
21. Press [TRANSMIT] [SDH] and select SIGNAL [STM-1 OPT] [1310 nm].
22. Press [RESULTS] [TROUBLE SCAN] and then [RUN/STOP] to start a measurement.
23. After 5 minutes check that NO TROUBLE is displayed on the [RESULTS] display.
24. Repeat steps 12 through 23, selecting SIGNAL [STM-0 OPT] [1310 nm] in steps 15 and 21.
25. Repeat steps 12 through 23, selecting SIGNAL [STM-4 OPT] [1310 nm] in steps 15 and 21 and -28dBm ±1dB in step 16.
26. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
27. Disconnect the optical cable from the HP 37717C STM1/4 Optical IN Port and connect to the HP 83442A Optical/Electrical Converter input.
28. Connect the output from the Optical /Electrical Converter to the Oscilloscope using the SMA/BNC adaptor and 50Ω BNC cable.
29. Set the Dual Power Supply to +12V and -12V, then connect to the HP 83442A O/E Converter and switch on.

**CAUTION**
Take care to connect the supply correctly as incorrect voltage or polarity could result in damage to the HP 83442A. Refer to HP 83442A Operating Instructions, HP p/n 5091-6448A.

30. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1310 nm].
31. Press [AUTOSCALE] on the oscilloscope and adjust the Timebase and Range to obtain an STM-4 waveform.
32. Measure the amplitude of this STM-4 waveform using the oscilloscope and adjust the Optical Attenuator until the amplitude is 150mV pk-pk.
NOTES

If the input power is greater than -8 dBm then the Optical/Electrical converter is liable to saturate.

33. Disconnect the output of the O/E Converter from the oscilloscope and connect instead to the HP 37717C STM1/4 Optical Module Monitor Input.

34. Press [RECEIVE] on the HP 37717C and set up the display as shown opposite.

35. Press [RESULTS] [TROUBLE SCAN] [RUN/STOP] then to start the measurement.

36. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C [RESULTS] display. Press [RUN/STOP] to stop the measurement.

37. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

38. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

39. Repeat steps 26 through 38, selecting SIGNAL [STM-1 OPT] [1310 nm] in step 30 and [STM-1 MON] in step 34.

40. Repeat steps 26 through 38, selecting SIGNAL [STM-0 OPT] [1310 nm] in step 30 and [STM-1 MON] in step 34.

PROCEDURE OPTION 130 ONLY

41. Set the Optical Attenuator to WAVELENGTH 1550 nm ; CAL=0. Connect the HP 37717C 1550 nm Optical Out Port to the HP 8153A Power Meter via the HP 8157A Optical Attenuator, set to ATTN 10 dB - ensure that all connections are tight and that optical cables have no twists or tight bends.

42. Setup the HP 8153A as follows:
   a. Press [PARAM] key to display wavelength [λ]
   b. Using [+] [-] [↑] and [↓] keys, set the wavelength to 1550nm.
   c. Press [PARAM] key to display Time [t]
   d. Using [+] [-] [↑] and [↓] keys, set the time to 200mS.
   e. Press [PARAM] key to display REF.
Performance Tests

STM-1/STM-4 Optical Interface (Options 130, 131)

f. Using ←, →, ↑ and ↓ keys, set the REF to 0.000dBm.

g. Press PARAM key to display CAL.

h. Using ←, →, ↑ and ↓ keys, set the CAL to 0.000dBm.

i. Cover the end of the Power Meter Optical Input connector with a protective cap.

j. Press the ZERO key on the Power Meter to calibrate - the Power Meter is now ready.

43. Switch on the HP 37717C and check that immediately on power-up the Optical Module LASER ON led illuminates for a few seconds.

44. Press TRANSMIT on the HP 37717C and set up the display as shown opposite.

45. Verify that the Optical Module LASER ON led is lit indicating that the laser is enabled.

46. Adjust the level to obtain a reading of -8dBm ±1dB on the Power Meter. Typically around 7dB of attenuation will be required to achieve this reading.

47. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

48. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

49. Disconnect the optical cable from the Power Meter and connect to the HP 37717C Optical IN Port.

50. Press RECEIVE on the HP 37717C and set up the display as shown opposite.

51. Press TRANSMIT on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].

52. Press RESULTS TROUBLE SCAN then [RUN/STOP] to start the measurement.

53. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C RESULTS display. Press [RUN/STOP] to stop the measurement.
Performance Tests
STM-1/STM-4 Optical Interface (Options 130, 131)

54. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
55. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.
56. Reconnect the HP 37717C 1550 nm Optical Out Port to the HP 8153A Power Meter via the HP 8157A Optical Attenuator.
57. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].
58. Adjust the Optical Attenuator level to obtain a reading of -28dBm ±1dB on the Power Meter.
59. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
60. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.
61. Disconnect the optical cable from the Power Meter and connect to the HP 37717C Optical IN Port.
62. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].
63. Press [RESULTS] [TROUBLE SCAN] then [RUN/STOP] to start the measurement.
64. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C RESULTS display.
Press [RUN/STOP] to stop the measurement.
65. Repeat steps 54 through 64, selecting SIGNAL [STM-1 OPT] [1550 nm] in steps 57 and 62 and -34dBm ±1dB in step 58.
66. Repeat steps 54 through 64, selecting SIGNAL [STM-0 OPT] [1550 nm] in steps 57 and 62 and -34dBm ±1dB in step 58.
67. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
68. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.
69. Disconnect the optical cable from the HP 37717C STM1/4 Optical IN Port and connect to the HP 83442A Optical/Electrical Converter input.
70. Connect the output from the Optical /Electrical Converter to the Oscilloscope using the SMA/BNC adaptor and 50Ω BNC cable.
Performance Tests
STM-1/STM-4 Optical Interface (Options 130, 131)

71. Set the Dual Power Supply to +12V and -12V, then connect to the HP 83442A O/E Converter and switch on.

**CAUTION**
Take care to connect the supply correctly as incorrect voltage or polarity could result in damage to the HP 83442A. Refer to HP 83442A Operating Instructions, HP p/n 5091-6448A.

72. Press **TRANSMIT SDH** on the HP 37717C and select SIGNAL [STM-4 OPT] [1550 nm].

73. Press **AUTOSCALE** on the oscilloscope and adjust the Timebase and Range to obtain an STM-4 waveform.

74. Measure the amplitude of this STM-4 waveform using the oscilloscope and adjust the Optical Attenuator until the amplitude is 150mV pk-pk.

**NOTE**
If the input power is greater than -8 dBm then the Optical/Electrical converter is liable to saturate.

75. Disconnect the output of the O/E Converter from the oscilloscope and connect instead to the HP 37717C STM1/4 Optical Module Monitor Input.

76. Press **RECEIVE** on the HP 37717C and set up the display as shown opposite.

77. Press **RESULTS** then **TROUBLE SCAN** to start the measurement.

78. After 5 minutes, check that NO TROUBLE is displayed on the HP 37717C **RESULTS** display. Press **RUN/STOP** to stop the measurement.

79. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

80. Verify that the Optical Module LASER ON led is NOT lit indicating that the laser is disabled before continuing.

81. Repeat steps 67 through 80, selecting SIGNAL [STM-1 OPT] [1550 nm] in step 72 and [STM-1 MON] in step 76.

82. Repeat steps 67 through 80, selecting SIGNAL [STM-0 OPT] [1550 nm] in step 72 and [STM-0 MON] in step 76.

83. Disconnect all the test equipment.
Performance Tests

Transmitted Jitter Amplitude Accuracy (Option UHK)

Transmitted Jitter Amplitude Accuracy (Option UHK)

Specifications

Data Rates
2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264 Mb/s, 155.52 Mb/s (STM-1), 622.08 Mb/s (STM-4)

Overall Accuracy
± 5% ± range accuracy ± intrinsic jitter

Range 1
± 0.01 UI

Range 10
± 0.1 UI

Intrinsic Jitter 2 Mb/s
± 0.02 UI

Intrinsic Jitter 8 Mb/s
± 0.02 UI

Intrinsic Jitter 34 Mb/s
± 0.03 UI

Intrinsic Jitter 140 Mb/s
200 Hz to 5 kHz - ± 0.10 UI
5 kHz to 10 kHz - ± 0.05 UI
>10 kHz - ± 0.02 UI

Frequency Range
2 Hz to 4 MHz

Frequency Accuracy
± 1%

Corner and Cut-off Frequencies

<table>
<thead>
<tr>
<th>Data Rate</th>
<th>Corner Frequency</th>
<th>Cut-off Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Mb/s</td>
<td>13 kHz</td>
<td>102 kHz</td>
</tr>
<tr>
<td>8 Mb/s</td>
<td>50 kHz</td>
<td>422 kHz</td>
</tr>
<tr>
<td>34 Mb/s</td>
<td>210 kHz</td>
<td>840 kHz</td>
</tr>
<tr>
<td>140 Mb/s</td>
<td>5 kHz</td>
<td>4 MHz</td>
</tr>
</tbody>
</table>
Performance Tests
Transmitted Jitter Amplitude Accuracy (Option UHK)

Description
The HP 37717C Transmitter Unbalanced PDH Output is connected to the Spectrum Analyzer. The HP 37717C Jitter modulation frequency is set to the specified maximum for 10UI at the selected Bit Rate and the Spectrum Analyzer set to optimize the displayed spectrum centered at this bit rate. The HP 37717C jitter Modulation amplitude is set to the level at which a Bessel Null is expected, then fine-tuned to maximize the null. The jitter Amplitude (UI pk-pk) displayed on the HP 37717C is checked to ensure it is within specified limits.

Equipment Required
- **Spectrum Analyzer**: HP 8568B Opt 001
- **Oscilloscope**: HP 54503A
- **75Ω/50Ω Matching Pad**: HP 11825B

Pre-Adjustment Setup
Before carrying out any adjustments to the HP 37717C Jitter Transmitter Module, perform the following pre-adjustment setup.

**CAUTION**
This procedure uses the special **MODULE DEBUG** display on the HP 37717C. When using the **MODULE DEBUG** display, **ONLY** modify the parameters shown. Altering other parameters can damage instrument firmware - exit the **MODULE DEBUG** display after setup to prevent accidental damage.

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Setup the HP 37717C **OTHER** display as shown opposite.
Performance Tests

Transmitted Jitter Amplitude Accuracy (Option UHK)

3. Make the following key sequence on the HP 37717C to obtain the special **MODULE DEBUG** display.

   Press **OTHER** [→] **MORE** [←] **MORE** [→] **OTHER**.

   Press **MORE** until **MODULE DEBUG** appears in the softkey menu.

   Press **MODULE DEBUG** and select **MODULE**: PDH Module.

   Set the VCO Control Mode to FIXED.

   **CAUTION**
   The sequence above must be performed each time the power is cycled on the HP 37717C, as all **MODULE DEBUG** parameters adopt DEFAULT values when power is cycled.

   **Procedure**

   **Transmitted Jitter Amplitude Accuracy on Range 1**

   1. Setup the HP 37717C **TRANSMIT** display as shown opposite.
Performance Tests

Transmitted Jitter Amplitude Accuracy (Option UHK)

2. Select TRANSMITTER OUTPUT SETTINGS [JITTER] and setup the display as shown opposite.

3. Set the Spectrum Analyzer as follows:
   - Centre Frequency - 2048 kHz
   - Frequency Span - 25 kHz
   - Reference Level - 0 dBm
   - Sweep Time - 1.0 s
   - Video Bandwidth - 1 kHz
   - Resolution Bandwidth - 100Hz

4. Connect up the equipment as shown in Figure 3-44.

5. Adjust the HP 37717C jitter amplitude until the first Bessel Null is observed on the Spectrum Analyzer i.e first dip in the carrier level. (As an example, Figure 3-45 shows the first Bessel Null for 34MHz.)

6. Ensure the Jitter amplitude displayed on the HP 37717C is between the minimum and maximum limits given in Table 3-5.
Performance Tests
Transmitted Jitter Amplitude Accuracy (Option UHK)

7. Check the Jitter accuracy for each value in Table 3-5. In each case, set the HP 37717C Rate and Spectrum Analyzer Center Frequency to the value given in column 1 of the table (Set the HP 37717C PATTERN to ALL ONES and jitter AMPLITUDE to minimum after each change of Bit Rate). Set the HP 37717C Jitter Modulation Frequency and Amplitude to the values given in columns 2 and 3 of the table. Fine-tune the amplitude to obtain the lowest carrier level on the Spectrum Analyzer display and check that the jitter amplitude displayed on the HP 37717C is between the limits given in columns 4 and 5 of Table 3-5.

![Figure 3-45 Bessel Null Example](image)

**Table 3-5**
**Range 1 Tx Jitter Amplitude Accuracy**

<table>
<thead>
<tr>
<th>Bit Rate/Center Frequency</th>
<th>Modulation Frequency</th>
<th>Jitter Amplitude (UI)</th>
<th>Minimum Jitter (UI)</th>
<th>Maximum Jitter (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>0.77</td>
<td>0.69</td>
<td>0.83</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>0.77</td>
<td>0.69</td>
<td>0.83</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>0.77</td>
<td>0.69</td>
<td>0.83</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>0.77</td>
<td>0.68</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Performance Tests

Transmitted Jitter Amplitude Accuracy (Option UHK)

Transmitted Jitter Accuracy on Range 10

8. Setup the HP 37717C display as shown opposite.

9. Select JITTER and setup the display as shown opposite.

10. Set the Spectrum Analyzer as follows:
    - Centre Frequency - 2048 kHz
    - Frequency Span - 25 kHz
    - Reference Level - 0 dBm
    - Sweep Time - 1.0 s
    - Video Bandwidth - 1 kHz
    - Resolution Bandwidth - 100 Hz

11. Adjust the HP 37717C jitter amplitude until the second Bessel Null is observed on the Spectrum Analyzer i.e second dip in the carrier level.

12. Ensure the Jitter amplitude displayed on the HP 37717C is between the minimum and maximum limits given in Table 3-6.

13. Check the Jitter accuracy for each value in Table 3-6. In each case, set the HP 37717C Rate and Spectrum Analyzer Center Frequency to the value given in column 1 of the table (Set the HP 37717C PATTERN to ALL ONES and the jitter
Performance Tests

Transmitted Jitter Amplitude Accuracy (Option UHK)

AMPLITUDE to minimum after each change of Bit Rate). Set the HP 37717C Jitter Modulation Frequency and Amplitude to the values given in columns 2 and 3 of the table. Fine-tune the amplitude to obtain the lowest carrier level on the Spectrum Analyzer display and check that the jitter amplitude displayed on the HP 37717C is between the limits given in columns 4 and 5 of Table 3-6.

<table>
<thead>
<tr>
<th>Bit Rate/ Center Frequency</th>
<th>Modulation Frequency</th>
<th>Jitter Amplitude (UI)</th>
<th>Minimum Jitter (UI)</th>
<th>Maximum Jitter (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>1.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>4.8</td>
<td>4.4</td>
<td>5.1</td>
</tr>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>8.8</td>
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<td>9.3</td>
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<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>1.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>5.8</td>
<td>5.3</td>
<td>6.2</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>8.8</td>
<td>8.2</td>
<td>9.3</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>2.8</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>6.8</td>
<td>6.2</td>
<td>7.3</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>8.8</td>
<td>8.2</td>
<td>9.3</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>3.8</td>
<td>3.3</td>
<td>4.2</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>7.8</td>
<td>7.1</td>
<td>8.4</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>8.8</td>
<td>8.1</td>
<td>9.4</td>
</tr>
</tbody>
</table>
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Specifications

Jitter Generation:

Data Rates  
2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264 Mb/s, 155.52 Mb/s (STM-1), 622.08 Mb/s (STM-4)

Amplitude Range:

Overall Accuracy  
± 5% ± range accuracy ± intrinsic jitter
± High Frequency accuracy (STM-1E only)

Range 1  
± 0.01 UI

Range 10  
± 0.1 UI

Range 50  
± 0.5 UI

Range 80  
± 1.0 UI

Range 200  
± 2.0 UI

Intrinsic Jitter 2 Mb/s  
± 0.02 UI

Intrinsic Jitter 8 Mb/s  
± 0.02 UI

Intrinsic Jitter 34 Mb/s  
± 0.03 UI

Intrinsic Jitter 140 Mb/s  
200 Hz to 5 kHz - ± 0.10 UI
5 kHz to 10 kHz - ± 0.05 UI
>10 kHz - ± 0.02 UI

Intrinsic Jitter 155.52 Mb/s  
< 10 kHz - ± 0.04 UI; > 10 kHz - ± 0.03 UI

Intrinsic Jitter 622.08 Mb/s  
± 0.1 UI

High Frequency (STM-1E only)  
± 0.0 to 0.2 UI, > 1.3 MHz - typically ± 10%
> 0.2 UI, > 1.3 MHz - typically ± 20%
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

External Jitter:
- Frequency Range: 0.1 Hz to 5 MHz
- Frequency Accuracy: > 3 Hz – ± 1%; < 3 Hz – ± 3%

Wander Generation:
- Data Rates: 2.048 Mb/s, 155.52 Mb/s (STM-1), 622.08 Mb/s (STM-4)
- Overall Accuracy: ± 5% ± amplitude accuracy ± intrinsic jitter
- Amplitude Accuracy 2 Mb/s: ± 1.0 UI
- Amplitude Accuracy 155 Mb/s: ± 0.5 UI
- Amplitude Accuracy 622 Mb/s: ± 0.5 UI
- Intrinsic Jitter 2 Mb/s: ± 0.1 UI
- Intrinsic Jitter 155 Mb/s: ± 0.1 UI
- Intrinsic Jitter 622 Mb/s: ± 0.1 UI
- Frequency Range: 0.000010 Hz to 0.125000 Hz
- Frequency Accuracy: ± 1%

Wander Timing Reference Input:
- Bit Rate: 2.048 Mb/s ± 100 ppm
- Format: Clock or HDB3 Data
- Peak Level: Balanced - 3V ± 10%
  - Unbalanced 2.37V ± 10%

External Jitter Modulation Input:
- Input Range: 10 UI, 2 UI
- Voltage Range (At 10 kHz): 0.7V pk_pk/UI ± 0.2V pk_pk/UI on 10 UI range
  - 3 V pk_pk/UI ± 1 V pk_pk/UI on 2 UI range
- Maximum Input Level: 6V peak AC/DC composite
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Description
To check the accuracy of the internal jitter generator, a signal is output from the HP 37717C to a Spectrum Analyzer. The signal can be at one of the PDH rates of 2 Mb/s, 8 Mb/s, 34 Mb/s or 140 Mb/s from the PDH TX module or at 155 Mb/s from the SDH module. At each of the rates, jitter is added to the signal until Bessel Null points are observed on the Spectrum Analyzer. The jitter amplitudes required to obtain these Bessel Nulls are checked to ensure they are within the specified limits.

For high levels of jitter amplitude at 2 Mb/s and 155 Mb/s, it is difficult to measure Bessel Null points accurately on the Spectrum Analyzer. To measure Bessel Null points at high jitter amplitudes, a Modulation Analyzer is used. The Modulation Analyzer demodulates the jitter from the carrier and converts the jitter amplitude to frequency deviation. The frequency deviation result is based upon the level of jitter amplitude and the modulating frequency. Jitter generation at 622 Mb/s is a function of the HP 37717C firmware and is based on jitter generation at 155 Mb/s and is not tested in this performance test.

For external jitter generation, a modulating signal is input from the synthesizer at the MOD input of the A3K module. The amplitude of the modulating signal is increased until a Bessel Null is observed on the Spectrum Analyzer. The modulating signal level is checked on the Oscilloscope to ensure it is within the specified limits.

To check Wander generation, an external reference 2 Mb/s clock is input to the 2M REF IN port on the Jitter TX module of the HP 37717C under test and to the 2M REF IN port on the Jitter RX module of the reference HP 37717C. Low frequency Wander is added to the 2 Mb/s data which is output from the PDH OUT port and compared with the 2 Mb/s reference clock to allow Wander measurements to be made. Wander generation at 155 Mb/s and 622 Mb/s is a function of the HP 37717C firmware and is based on jitter generation at 2 Mb/s and is therefore not tested in this performance test.
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Equipment Required

- Communications Performance Analyzer : HP 37717C Opt UHN
- Spectrum Analyzer : HP 8568B Opt 001
- Oscilloscope : HP 54503A
- Modulation Analyzer : HP 9801A/B
- Synthesizer : HP 3325B
- 75Ω/50Ω Matching Pad : HP 11825B

Pre-Adjustment Setup

Before carrying out any adjustments to the HP 37717C Jitter Transmitter Module, perform the following pre-adjustment setup.

CAUTION

This procedure uses the special MODULE DEBUG display on the HP 37717C. When using the MODULE DEBUG display, ONLY modify the parameters shown. Altering other parameters can damage instrument firmware - exit the MODULE DEBUG display after setup to prevent accidental damage.

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Setup the HP 37717C OTHER display as shown opposite.
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

3. Make the following key sequence on the HP 37717C to obtain the special display.

   Press \textbf{OTHER} \text{,} \text{MORE} \text{,} \text{MORE} \text{,} \text{MORE} \text{,} \text{MORE} \text{,} \text{OTHER}.

   Press \textbf{MORE} until \textbf{MODULE DEBUG} appears in the softkey menu.

   Press \textbf{MODULE DEBUG} and select MODULE PDH Module.

   Set the VCO Control Mode to FIXED.

\textbf{CAUTION}\hspace{1cm} The sequence above must be performed each time the power is cycled on the HP 37717C, as all parameters adopt DEFAULT values when power is cycled.

\textbf{Procedure}\hspace{1cm} Transmitted PDH Jitter Amplitude Accuracy on Range 1

1. Select \textbf{TRANSMIT} and setup the HP 37717C display as shown opposite.
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

2. Select **TRANSMIT JITTER** and setup the display as shown opposite.

3. Set the Spectrum Analyzer as follows:
   - Centre Frequency - 2048 kHz
   - Frequency Span - 25 kHz
   - Reference Level - 0 dBm
   - Sweep Time - 1.0 s
   - Video Bandwidth - 1 kHz
   - Resolution Bandwidth - 100Hz

4. Connect up the equipment as shown in Figure 3-46.

5. Adjust the HP 37717C jitter amplitude (approximately 0.77 UI) until the first **Bessel Null** is observed on the Spectrum Analyzer i.e first dip in the carrier level. (As an example Figure 3-47 shows the first Bessel Null for 34MHz.)

6. Ensure the Jitter amplitude displayed on the HP 37717C is between the minimum and maximum limits given in Table 3-7.
7. Check the Jitter accuracy for each value in Table 3-7. In each case, set the HP 37717C Rate and Spectrum Analyzer Center Frequency to the value given in column 1 of the table (Set the HP 37717C PATTERN to ALL ONES and jitter AMPLITUDE to minimum after each change of Bit Rate). Set the HP 37717C Jitter Modulation Frequency and Amplitude to the values given in columns 2 and 3 of the table. Fine-tune the amplitude to obtain the lowest carrier level on the Spectrum Analyzer display and check that the jitter amplitude displayed on the HP 37717C is between the limits given in columns 4 and 5 of Table 3-7.
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Performance Tests

Table 3-7

<table>
<thead>
<tr>
<th>Bit Rate/Center Frequency</th>
<th>Modulation Frequency</th>
<th>Jitter Amplitude (UI)</th>
<th>Minimum Jitter (UI)</th>
<th>Maximum Jitter (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>0.77</td>
<td>0.69</td>
<td>0.83</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>0.77</td>
<td>0.69</td>
<td>0.83</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>0.77</td>
<td>0.69</td>
<td>0.83</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>0.77</td>
<td>0.68</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Transmitted PDH Jitter Accuracy on Range 10

8. Setup the HP 37717C display as shown below.

9. Select and setup the display as shown below.
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

10. Set the Spectrum Analyzer as follows:
   - Centre Frequency - 2048 kHz
   - Frequency Span - 25 kHz
   - Reference Level - 0 dBm
   - Sweep Time - 1.0 s
   - Video Bandwidth - 1 kHz
   - Resolution Bandwidth - 100Hz

11. Adjust the HP 37717C jitter amplitude until the second Bessel Null is observed on the Spectrum Analyzer i.e second dip in the carrier level.

12. Ensure the Jitter amplitude displayed on the HP 37717C is between the minimum and maximum limits given in Table 3-8.

13. Check the Jitter accuracy for each value in Table 3-8. In each case, set the HP 37717C Rate and Spectrum Analyzer Center Frequency to the value given in column 1 of the table (Set the HP 37717C PATTERN to ALL ONES and the jitter AMPLITUDE to minimum after each change of Bit Rate). Set the HP 37717C Jitter Modulation Frequency and Amplitude to the values given in columns 2 and 3 of the table. Fine-tune the amplitude to obtain the lowest carrier level on the Spectrum Analyzer display and check that the jitter amplitude displayed on the HP 37717C is between the limits given in columns 4 and 5 of Table 3-8.

Table 3-8

<table>
<thead>
<tr>
<th>Bit Rate/Center Frequency</th>
<th>Modulation Frequency</th>
<th>Jitter Amplitude (UI)</th>
<th>Minimum Jitter (UI)</th>
<th>Maximum Jitter (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>1.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>4.8</td>
<td>4.4</td>
<td>5.1</td>
</tr>
<tr>
<td>2048kHz</td>
<td>2400Hz</td>
<td>8.8</td>
<td>8.2</td>
<td>9.3</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>1.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>5.8</td>
<td>5.3</td>
<td>6.2</td>
</tr>
<tr>
<td>8448kHz</td>
<td>10700Hz</td>
<td>8.8</td>
<td>8.2</td>
<td>9.3</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>2.8</td>
<td>2.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

3-140
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Table 3-8

Range 10 Tx Jitter Amplitude Accuracy continued

<table>
<thead>
<tr>
<th>Bit Rate/Center Frequency</th>
<th>Modulation Frequency</th>
<th>Jitter Amplitude (UI)</th>
<th>Minimum Jitter (UI)</th>
<th>Maximum Jitter (UI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>6.8</td>
<td>6.2</td>
<td>7.3</td>
</tr>
<tr>
<td>34368kHz</td>
<td>4000Hz</td>
<td>8.8</td>
<td>8.2</td>
<td>9.3</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>3.8</td>
<td>3.3</td>
<td>4.2</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>7.8</td>
<td>7.1</td>
<td>8.4</td>
</tr>
<tr>
<td>139264kHz</td>
<td>4000Hz</td>
<td>8.8</td>
<td>8.1</td>
<td>9.4</td>
</tr>
</tbody>
</table>

Transmitted SDH Jitter Accuracy on Ranges 1 & 10

1. Setup the HP 37717C TRANSMIT SDH display as shown opposite.

2. Select TRANSMIT JITTER and setup the display as shown opposite.
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

3. Set the Spectrum Analyzer as follows:
   Centre Frequency - 155.52 MHz
   Frequency Span - 25 kHz
   Reference Level - 0 dBm
   Sweep Time - 1.0 s
   Video Bandwidth - 1 kHz
   Resolution Bandwidth - 100 Hz

4. Connect up the equipment as shown in Figure 3-48.

Figure 3-48   TX Jitter Accuracy Test Setup SDH Ranges 1 & 10

5. Adjust the HP 37717C jitter amplitude (approximately 0.77 UI) until the first Bessel Null is observed on the Spectrum Analyzer i.e first dip in the carrier level (see Figure 3-47).

6. Ensure the Jitter amplitude displayed on the HP 37717C is between 0.69 UI and 0.83 UI.

7. Select RANGE [10 UI] on the TRANSMIT JITTER display and adjust the jitter amplitude until the second Bessel Null is observed on the Spectrum Analyzer i.e second dip in the carrier level.

8. Ensure the Jitter amplitude displayed on the HP 37717C is between 1.7 UI and 1.8 UI.
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Transmitted SDH Jitter Accuracy on Range 50

1. Setup the HP 37717C display as shown opposite.

2. Select and setup the display as shown opposite.

3. Connect up the equipment as shown in Figure 3-49.

4. Press the [FREQ] key on the Modulation Analyzer and check that a frequency of 155.52 MHz is displayed. If 155.52 MHz is not displayed ENTER 155.52 MHz via the keypad.

5. Press [FM]: [3kHz] and [Peak+] keys on the Modulation Analyzer and check that the result displayed is 62.4 kHz ± 3.95kHz.
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

Transmitted PDH Jitter Accuracy on Range 80

1. Select [TRANSMIT] and setup the HP 37717C display as shown opposite.

2. Select [TRANSMIT] JITTER and setup the display as shown opposite.

3. Connect up the equipment as shown in Figure 3-50.

4. Press the [FREQ] key on the Modulation Analyzer and check that a frequency of 1.024 MHz is displayed. If 1.024 MHz is not displayed ENTER 1.024 MHz via the keypad.

5. Press [FM]; [3kHz] and [Peak+] keys on the Modulation Analyzer and check that the result displayed is 6.24 kHz ± 480 Hz.

Figure 3-50 TX Jitter Accuracy Test Setup PDH Range 80

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Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

External Jitter Generation

1. Select **TRANSMIT** and setup the HP 37717C display as shown opposite.

2. Select **TRANSMIT JITTER** and setup the display as shown opposite.

3. Set the Spectrum Analyzer as follows:
   - Centre Frequency - 2048 kHz
   - Frequency Span - 25 kHz
   - Reference Level - 0 dBm
   - Sweep Time - 1.0 s
   - Video Bandwidth - 1 kHz
   - Resolution Bandwidth - 100Hz

4. Set the Synthesizer to Frequency 10 kHz and minimum Output Level.
Performance Tests
Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

5. Connect up the equipment as shown in Figure 3-51.

![Figure 3-51](image)

**External Jitter Generation**

6. Increase the Synthesizer output level until the first Bessel Null is observed on the Spectrum Analyzer.

7. Check that the amplitude of the Oscilloscope waveform is between 1.76V pk-pk and 2.84V pk-pk.

**Wander Generation**

1. Select [TRANSMIT] and setup the Test HP 37717C display as shown opposite.
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

2. Select TRANSMIT JITTER and setup the Test HP 37717C display as shown opposite.

3. Connect up the equipment as shown in Figure 3-52.

4. Set the Synthesizer to Frequency 2.048 MHz and Output Level 5V pk-pk.
Performance Tests

Transmitted Jitter/Wander Amplitude Accuracy (Option A3K [A3Q])

5. Select **RECEIVE** PDH and setup the Reference HP 37717C display as shown opposite.

6. Select **RECEIVE** JITTER and setup the Reference HP 37717C display as shown opposite.

7. Select **RESULTS** TIMING CONTROL and setup the Reference HP 37717C display as shown opposite.

8. Press **RUN/STOP** and check that at the end of the measurement period (10 seconds) the **RESULTS** WANDER display PEAK-PEAK result is 80.000 BITS ±5.5 BITS.

9. Disconnect all the test equipment.
Performance Tests

Received Jitter Accuracy (Options UHN, [US9], A1M [A1Q], A1N [A1R], A1P [A1S], A3L [A3M], A3V [A3W], A3N [A3P])

NOTE
PDH Tx and Rx modules must be fitted for this test - see Appendix B.

Specifications

Range 1.6 1.0V/UI ±10%
Range 16 0.1V/UI ±10%

Overall Accuracy: See main specifications in Section 1.

Description

The HP 37717C Jitter Receiver performance is verified using a special internal instrument calibration routine. This routine is automatic and tests all parameters except Hit Count and Demodulated Jitter Output.

Hit Count is tested by connecting PDH Signal Out to PDH Signal In with the transmitted jitter amplitude just exceeding the receiver Hit Threshold and a check made to ensure the Hit count is within the modulation frequency accuracy limits.

The Demodulated Jitter Output is verified for accuracy by measuring the amplitude on an oscilloscope.

Equipment Required

Spectrum Analyzer : HP 8568B
75Ω/50Ω Matching Pad : HP 11825B
Calibrated Jitter Generation Module : See Note.
Oscilloscope : HP 54503A
75Ω Termination : HP 15522-80010
Performance Tests

Received Jitter Accuracy (Options UHN, [US9], A1M [A1Q], A1N [A1R], A1P [A1S], A3L [A3M], A3V [A3W], A3N [A3P])

Received Jitter Accuracy Procedure

1. Connect the HP 37717C Unbalanced 75Ω PDH Signal Out to PDH Signal In.
2. Connect the HP 37717C SDH OUT port on the SDH Module to the STM-1E port on the STM Jitter Receiver Module - only if fitted.
3. Connect the HP 37717C Optical Output on the STM-1/4 Optical Module to the Optical Input on the STM-1/4 Jitter Receiver Module - only if fitted.

CAUTION

If option URU is fitted, the Optical Output must be attenuated by 10 dB before connecting to the optical input of the Jitter Receiver Module. Failure to do this could result in damage to the HP 37717C. Refer to the Recommended Test Equipment Table for a suitable attenuator.

4. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
5. Setup the HP 37717C OTHER display as shown opposite.
6. Set CALIBRATE PASSWORD [1243].
7. Select CALIBRATION ITEM [JITTER RX] and press [RUN/STOP]. The green [RUN/STOP] led will light.

The test is automatic and takes between approximately 30 minutes and 1 hour depending on which option is fitted.

When completed the [RUN/STOP] led will be off and the HP 37717C display will indicate the new calibration date.

Press [TRANSMIT] to return to normal operation.
Performance Tests
Received Jitter Accuracy (Options UHN, [US9], A1M [A1Q], A1N [A1R], A1P [A1S], A3L [A3M], A3V [A3W], A3N [A3P])

Hit Count
8. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

9. Setup the HP 37717C **RECEIVE** display as shown opposite.

10. Select **RECEIVE JITTER** and setup the display as shown opposite.

11. Setup the 37717C **TRANSMIT** display as shown opposite.
Performance Tests

Received Jitter Accuracy (Options UHN, [US9], A1M [A1Q], A1N [A1R], A1P [A1S], A3L [A3M], A3V [A3W], A3N [A3P])

12. Select **TRANSMIT JITTER** and setup the display as shown below.

![Measurement Setup Diagram]

13. Select **RESULTS TIMING CONTROL** TEST TIMING [SINGLE] [10 SECS].

14. Set up the HP 37717C **RESULTS** as shown opposite.

Press **RUN/STOP** to start the measurement.

When the measurement is complete check the displayed Hit Count is between 211,860 and 216,140.

Demodulated Jitter Output

15. Connect the HP 37717C Demodulated Jitter Output to the oscilloscope terminated in 75Ω.

16. Check that the amplitude of the 10.7 kHz displayed waveform is between 435mV pk-pk and 565mV pk-pk.

17. Disconnect all test equipment.
Performance Tests


NOTE

A jitter Tx Module must be fitted for this test - see Appendix B.

Specifications

Timing Reference Input:

<table>
<thead>
<tr>
<th>Type</th>
<th>External MTS Clock as per ITU G.811.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>2.048Mb/s ± 100 ppm</td>
</tr>
<tr>
<td>Format</td>
<td>Clock or HDB3 Data.</td>
</tr>
<tr>
<td>Impedance</td>
<td>75Ω Unbalanced (nominal); 120Ω Balanced (nominal).</td>
</tr>
<tr>
<td>Peak Level</td>
<td>2.37V ±10% (unbalanced), 3V ±10% (balanced).</td>
</tr>
<tr>
<td>Indication</td>
<td>If no reference input signal is present NO REF is displayed.</td>
</tr>
<tr>
<td>Connectors</td>
<td>BNC (unbalanced); 3-pin Siemens audio (balanced).</td>
</tr>
</tbody>
</table>

Wander Measurement:

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Low pass response -3dB at 10Hz (nominal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0.125 UI</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.125 UI ±0.5% of reading valid up to 1Hz wander frequency.</td>
</tr>
<tr>
<td>Range</td>
<td>±999999 UI</td>
</tr>
<tr>
<td>Alarm Indication</td>
<td>&quot;Excess Wander&quot; displayed if &gt;5UI</td>
</tr>
</tbody>
</table>

Wander Measurements: Positive Peak, Negative Peak, Peak to Peak 15 mins, Peak to Peak 24 hours, Time Interval Error

Slips Measurements: Estimated Bit Slips, Estimated Frame Slips
Performance Tests

Description
In the first part of the test the HP 37717C Transmitter output is connected to the Receiver Data and Reference Inputs simultaneously. The Wander measurement result should be zero with this configuration since both inputs are effectively in phase at the same frequency. This tests the wander measurement accuracy and the Timing Reference Input circuitry (Balanced and Unbalanced data) as the wander counters are latched by a division of the Reference Input and used to count the received input bits.

In the second part of the test Wander and Slips measurements are verified using two Clock Sources - one as input to the Receiver port and the other as input to the Reference port. The sources are locked together but with one source offset by a known frequency. This provides a known number of Bit Slips which are counted and displayed by the HP 37717C as Frame/Bit Slips and Wander.

Equipment Required

- **Synthesizer (2 off)**: HP 3325B
- **120/75Ω Bal/Unbal Converter**: HP 15508C
- **T Connector**: HP 1250-0781

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2. Select **OTHER** SETTINGS CONTROL TRANSMITTER AND RECEIVER [COUPLED].

Wander Accuracy

2. Press **TRANSMIT** and set up the display as shown opposite.
Performance Tests

3. Press \textbf{RECEIVE} and set up the display as shown opposite.

4. Press \textbf{RESULTS} and set up the display as shown opposite.

5. Connect the unbalanced 75Ω PDH OUT port to the unbalanced 75Ω PDH IN port and the unbalanced 75Ω TIMING REF INPUT (Jitter Receiver Module) simultaneously using the T-piece.

6. Press \textbf{RUN/STOP} and verify that the display shows POSITIVE PEAK WANDER and NEGATIVE PEAK WANDER readings of 0.000 ± 0.125 BITS.

7. Press \textbf{RUN/STOP} to stop the measurement.

8. Disconnect the PDH OUT port from the unbalanced 75Ω TIMING REF INPUT and connect to the balanced 120Ω TIMING REF INPUT via the HP 15508C Balanced to Unbalanced Converter.

9. Press \textbf{RECEIVE} and select WANDER REFERENCE [120Ω BAL].

10. Press \textbf{RUN/STOP} and verify that the display shows POSITIVE PEAK WANDER and NEGATIVE PEAK WANDER readings of 0.000 ± 0.125 BITS.

11. Remove the input from the TIMING REF port and check that the display indicates \textbf{NO REF}.

12. Press \textbf{RUN/STOP} to stop the measurement.
Performance Tests


Slips and Wander

13. Connect up the equipment as shown in Figure 3-53.

![Figure 3-53 Slips and Wander Test Setup](image)

14. Press [**TRANSMIT**](image) and set up the Display as shown opposite.

15. Press [**RECEIVE**](image) and set up the display as shown opposite.
Performance Tests

16. Select \textbf{RESULTS TIMING CONTROL} \textbf{TEST TIMING [SINGLE] [60 SECS]}.

17. Press \textbf{RESULTS} and set up the Display as shown opposite.

18. Set both Synthesizers amplitude to 10dBm.

19. Set the Synthesizer connected to PDH IN to generate a sinewave at 1,024,094.4Hz and the Synthesizer connected to the TIMING REF INPUT to generate a sinewave at 2,048,204.8Hz.

20. Press \textbf{RUN/STOP} and verify that the Display shows the following at the end of the test period:

\begin{itemize}
  \item \textbf{ESTIMATED BIT SLIPS} : -955 TO -964 BITS
  \item \textbf{ESTIMATED FRAME SLIPS} : -3 to -4
\end{itemize}

21. Select RESULTS [WANDER] [WANDER] and verify that the display shows the following:

\begin{itemize}
  \item \textbf{POSITIVE PEAK} \hspace{5cm} 0.000 BITS
  \item \textbf{NEGATIVE PEAK} \hspace{5cm} 955.125 to 964.875 BITS
  \item \textbf{PEAK TO PEAK} \hspace{5cm} 955.125 to 964.875 BITS
  \item \textbf{PEAK TO PEAK 15 MINUTES} \hspace{5cm} ….BITS
  \item \textbf{PEAK TO PEAK 24 HOURS} \hspace{5cm} ….BITS
  \item \textbf{TIME INTERVAL ERROR} \hspace{5cm} -955.125 to -964.875 BITS
\end{itemize}

NOTE: In some cases the above two sets of results will all be on the same display.

22. Select RESULTS [WANDER] [BIT SLIPS].

23. Set The Synthesizer connected to PDH IN to generate 1,023,889.6Hz and the Synthesizer connected to the TIMING REF INPUT to generate 2,047,795.2Hz and repeat steps 19 to 21.

24. Set The Synthesizer connected to PDH IN to generate 1,023,905.6 Hz.
Performance Tests


25. Press [RUN/STOP] and verify that the display shows the following at the end of the test period:

   | ESTIMATED BIT SLIPS | 955 to 964 |
   | ESTIMATED FRAME SLIPS | 3 to 4 |

26. Select RESULTS [WANDER] [WANDER] and verify that the display shows the following:

   | POSITIVE PEAK | 955.125 to 964.875 BITS |
   | NEGATIVE PEAK | 0.000 BITS |
   | PEAK TO PEAK | 955.125 TO 964.875 BITS |
   | PEAK TO PEAK 15 MINUTE | ....BITS |
   | PEAK TO PEAK 24 HOURS | ....BITS |
   | TIME INTERVAL ERROR | 955.125 to 964.875 BITS |

NOTE: In some cases the above two sets of results will all be on the same display.
Performance Tests


NOTE
An SDH Module must be fitted for this test - see Appendix B.

Specification

Receiver Equalization Automatic for cable loss up to 12dB at half the bit rate.

Description
STM-1E Jitter Receiver Equalization is verified by inserting the special Cable between the STM-1 OUT port on the SDH Module and the STM-1 IN port on the Jitter Receiver Module and checking for error-free operation.

Equipment Required

Cable Attenuator (70 m) : HP 8120-0049

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] and RECEIVER INPUT [SDH JITTER].
3. Connect the STM-1 OUT port on the SDH Module to the STM-1 JITTER IN port on the Jitter Receiver Module, via the Cable Attenuator.
4. Verify that all the front panel Alarm leds are off.
5. Press [RESULTS] [TROUBLE SCAN] [RUN/STOP] and check that the display indicates NO TROUBLE.
6. Press [RUN/STOP] to halt the measurement.
7. Disconnect all the test equipment.
Performance Tests


NOTE
An SDH Option must be fitted for this option to operate - see Appendix B.

Specification

Receiver Monitor Mode  20 dB of flat gain, 12dB Equalization at 1/2 Bit Rate

Description
A fixed attenuator and a special cable attenuator are inserted between the STM-1 OUT port and the Jitter Receiver STM-1 IN port. The STM-1E Jitter Receiver monitor mode is verified by attenuating the signal by 20dB, along with the cable attenuator, and checking for error-free operation.

Equipment Required

3 dB Attenuator (N-type) : HP 8491A Option 003
6 dB Attenuator (N-type) : HP 8491A Option 006 (Qty 2)
75/50Ω Matching Pad (N-type) : HP 11852B (Qty 2)
N-type (f) to BNC (f) Adaptor : HP 1250-1536 (Qty 2)
N-type (m) to N-type (f) Adaptor : HP 1250-1475
Cable Attenuator (70m) : HP 8120-0049

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] and RECEIVER INPUT [SDH JITTER].

3-160
Performance Tests


3. Connect up the equipment as shown in Figure 3-54. If Option A3L [A3M] or A3V [A3W] or A3N [A3P] is fitted connect both 6 dB attenuators between the Cable Attenuator and STMN-1 IN.

![Figure 3-54 STM-1 Receiver Monitor Input](image)

4. Press [SIGNAL IN] until the Monitor led above the key is lit.
5. Verify that all the front panel ALARM leds are off.
6. Press [RESULTS], [TROUBLE SCAN] and [RUN/STOP], and check that the display indicates NO TROUBLE.
7. Press [RUN/STOP] to halt the measurement.
8. Disconnect all the test equipment.
Performance Tests
Jitter Receiver STM-1 Optical Interface (Options A1N, [A1R], A3V [A3W])

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Jitter Receiver STM-1 Optical Interface (Options A1N, [A1R], A3V [A3W])

**NOTE**
This test requires other modules to be fitted - see Appendix B.

**Specification**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>1200 nm to 1600 nm</td>
</tr>
<tr>
<td>Maximum Input Power</td>
<td>-8 dBm (for BER of 1.0E^-10)</td>
</tr>
<tr>
<td>Line Coding</td>
<td>NRZ</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>20 dB minimum</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-28 dBm Minimum (wavelength=1300nm, Modulation=100%, Data=2**23-1, BER=1.0E^-10)</td>
</tr>
</tbody>
</table>

**Description**
The jitter receiver optical sensitivity is verified by attenuating the transmitter output and checking for no errors in back to back mode.

**Equipment Required**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Meter</td>
<td>HP 8153A</td>
</tr>
<tr>
<td>Power Meter Sensor Module</td>
<td>HP 81536A</td>
</tr>
<tr>
<td>FC/PC Connector Interface</td>
<td>HP 81000FI (Qty. 4)</td>
</tr>
<tr>
<td>Optical Attenuator</td>
<td>HP 8157A</td>
</tr>
<tr>
<td>Optical Cables (Qty. 2)</td>
<td>HP 11871A</td>
</tr>
</tbody>
</table>
Performance Tests

Jitter Receiver STM-1 Optical Interface (Options A1N, [A1R], A3V [A3W])

WARNING

Safety precautions must be observed when handling the HP 37717C Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:

Check the connector configuration of the Fiber Optic Interfaces. If these are fitted with a connector interface other than FC/PC then remove the existing connector interface and fit the FC/PC connector interface.

Check for any damage to the HP 37717C Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.

Make all connections to the HP 37717C Fiber Optic Interfaces before powering up the instrument.

Procedure

1. Connect the STM-1 Optical Out Port to the HP 8153A via the Optical Attenuator (ensure that all connections are tight and that the cable has no twists). Set the Optical Attenuator to ATTEN 0 dB, WAVELENGTH 1310 nm; CAL=0.

2. Switch on the HP 37717C, check that immediately on power up the LASER ON led on the Optical Module illuminates for a few seconds.

3. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

4. Recall default settings on the HP 8153A:
   - Press [MODE] to select MENU mode on the HP 8153A.
   - Press [SYSTEM] to display RECALL.
   - Press [EDIT], select 0 — [→]A and press [EXEC] to recall the default settings (wavelength = 1300 nm, measurement time = 200 ms, autorange).

5. Press [MODE] then [dBmw] to select the Power Level measurement on the HP 8153A.

6. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT].

7. Verify that the Optical Module LASER ON led is on indicating the laser is enabled.

8. Adjust the Optical Attenuator to obtain a reading of -28 dBm on the Power Meter.

9. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].
Performance Tests
Jitter Receiver STM-1 Optical Interface (Options A1N, [A1R], A3V [A3W])

10. Verify that the LASER ON led is off before continuing.
11. Disconnect the Optical Attenuator Output from the HP 8153A and connect to the Optical In Port on the STM Jitter Receiver Module.
13. Press [RECEIVE] and select SDH Jitter. Set signal to [STM-1 OPT].
14. Press [RESULTS] TROUBLE SCAN and then [RUN/STOP] to start a measurement.
15. After 5 minutes check that NO TROUBLE is displayed on the [RESULTS] display.
16. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].
17. Verify that the LASER ON led is off.
18. Disconnect the test equipment.
Performance Tests
Jitter Receiver STM-1/STM-4 Optical Interface (Options A1P, [A1S], A3N [A3P])

NOTE
This test requires other modules to be fitted - see Appendix B.

Specification
- **Wavelength**: 1200 nm to 1600 nm
- **Maximum Input Power**: -8 dBm (for BER of 1.0E-10)
- **Line Coding**: NRZ
- **Dynamic Range**: 18 dB minimum
- **Sensitivity**: -26 dBm Minimum (wavelength=1300nm, Modulation=100%, Data=2^{23}-1, BER=1.0E-10)

Description
The Jitter Receiver optical sensitivity is verified by attenuating the transmitter outputs and checking for no errors in back to back mode at both STM-1 and STM-4 rates.

Equipment Required
- **Power Meter**: HP 8153A
- **Power Meter Sensor Module**: HP 81536A
- **FC/PC Connector Interface**: HP 81000FI (Qty. 4)
- **Optical Attenuator**: HP 8157A
- **Optical Cables (Qty. 2)**: HP 11871A
Performance Tests
Jitter Receiver STM-1/STM-4 Optical Interface (Options A1P, [A1S], A3N [A3P])

WARNING
Safety precautions must be observed when handling the HP 37717C Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:

Check the connector configuration of the Fiber Optic Interfaces. If these are fitted with a connector interface other than FC/PC then remove the existing connector interface and fit the FC/PC connector interface.

Check for any damage to the HP 37717C Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.

Make all connections to the HP 37717C Fiber Optic Interfaces before powering up the instrument.

Procedure

1. Connect the STM-1/STM-4 Optical Out Port to the HP 8153A Power Meter via the Optical Attenuator (ensure that all connections are tight and that the cable has no twists). Set the Optical Attenuator to ATTEN 0 dB, WAVELENGTH 1310 nm, CAL=0.

2. Switch on the HP 37717C, check that immediately on power up the LASER ON led on the Optical Module illuminates for a few seconds and Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

3. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

4. Recall default settings on the HP 8153A:
   - Press [MODE] to select MENU mode on the HP 8153A.
   - Press [SYSTEM] to display RECALL.
   - Press [EDIT], select 0 — [A] and press [EXEC] to recall the default settings (wavelength = 1300 nm, measurement time = 200 ms, autorange).

5. Press [MODE] then [dBm] to select the Power Level measurement on the HP 8153A.

6. Press [TRANSMIT] [SDH] on the HP 37717C and select SIGNAL [STM-1 OPT].

7. Verify that the Optical Module LASER ON led is on indicating the laser is enabled.

8. Adjust the Optical Attenuator to obtain a reading of -28 dBm on the Power Meter.
Performance Tests

Jitter Receiver STM-1/STM-4 Optical Interface (Options A1P, [A1S], A3N [A3P])

9. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].

10. Verify that the LASER ON led is off before continuing.

11. Disconnect the Optical Attenuator Output from the HP 8153A and connect to the Optical In Port on the STM Jitter Receiver Module.

12. Press [TRANSMIT] [SDH] and select SIGNAL [STM-1 OPT].

13. Press [RECEIVE] and select SDH Jitter. Set signal to [STM-1 OPT].

14. Press [RESULTS] [TROUBLE SCAN] and then [RUN/STOP] to start a measurement.

15. After 5 minutes check that NO TROUBLE is displayed on the [RESULTS] display.

16. Press [OTHER] select STORED SETTINGS NUMBER [0] (Default Settings) and press [RECALL].

17. Verify that the LASER ON led is off before continuing.

18. Repeat steps 1 through 16, selecting SIGNAL [STM-4 OPT] on both the Transmit and Receive pages.

19. Disconnect the test equipment.
Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

PDH Binary Interfaces (Option UH3, [US7])

Specifications

<table>
<thead>
<tr>
<th></th>
<th>Clock O/P</th>
<th>Data O/P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rate</strong></td>
<td>700 kb/s to 50 Mb/s (TTL)</td>
<td>700 kb/s to 50 Mb/s (TTL)</td>
</tr>
<tr>
<td></td>
<td>700 kb/s to 170 Mb/s (ECL)</td>
<td>700 kb/s to 170 Mb/s (ECL)</td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>Nominal squarewave, 60/40 to 40/60 duty cycle</td>
<td>NRZ</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>Nominal TTL into 75Ω to ground</td>
<td>Nominal TTL into 75Ω to ground</td>
</tr>
<tr>
<td><strong>Impedance</strong></td>
<td>Nominal ECL into 75Ω to -2V</td>
<td>Nominal ECL into 75Ω to -2V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Clock I/P</th>
<th>Data I/P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rate</strong></td>
<td>700 kb/s to 50 Mb/s (TTL)</td>
<td>700 kb/s to 50 Mb/s (TTL)</td>
</tr>
<tr>
<td></td>
<td>700 kb/s to 170 Mb/s (ECL)</td>
<td>700 kb/s to 170 Mb/s (ECL)</td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>Nominal squarewave, 60/40 to 40/60 duty cycle</td>
<td>NRZ</td>
</tr>
<tr>
<td><strong>Logic</strong></td>
<td>1.5V (TTL), -1.3V (ECL), ground, signal mean level</td>
<td>1.5V (TTL), -1.3V (ECL), ground, signal mean level</td>
</tr>
<tr>
<td><strong>Threshold</strong></td>
<td>Nominal TTL into 75Ω to ground</td>
<td>Nominal TTL into 75Ω to ground</td>
</tr>
<tr>
<td></td>
<td>Nominal ECL into 75Ω to -2V</td>
<td>Nominal ECL into 75Ω to -2V</td>
</tr>
</tbody>
</table>

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Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

Rate (Option UKK [USB])
- 700 kb/s to 50 Mb/s (TTL)
- 700 kb/s to 170 Mb/s (ECL)

Rate (Option UKJ [USA])
- 2.048 Mb/s ± 10% (ECL & TTL)
- 8.448 Mb/s ± 10% (ECL & TTL)
- 34.368 Mb/s ± 10% (ECL & TTL)
- 139.264 Mb/s ± 10% (ECL only)

Format
Nominal squarewave, 60/40 to 40/60 duty cycle

Logic Threshold
- 1.5V (TTL), -1.3V (ECL), ground, signal mean level

Termination
Nominal TTL into 75Ω to ground;
Nominal ECL into 75Ω to -2V

Description
This test verifies that the PDH Binary Interface External Clock input meets its specification. The Clock input, Clock output, Data input and Data output are verified during self test.

Equipment Required

Digital Transmission Analyzer : HP 3764A Option 006

Signal Generator : HP 8657B

Oscilloscope : HP 54503A

75Ω/50Ω Matching Pad : HP 11825B

ECL Termination : HP 10086A

Procedure

External Clock Thresholds
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect up the equipment as shown in Figure 3-55.
Performance Tests

PDH Binary Interfaces (Option UH3, [US7])

3. Press **TRANSMIT PDH MAIN SETTINGS** and set up the display as shown opposite.

4. Press **TRANSMIT PDH BINARY** and set up the display as shown opposite.
Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

5. Press [RECEIVE] PDH MAIN SETTINGS and set up the display as shown opposite.

6. Press [RECEIVE] PDH BINARY and set up the display as shown opposite.

7. Recall default settings on the Digital Transmission Analyzer and select: Interface - NRZ BIN  ECL Frequency - 170 MHz Pattern - 2^{23}.1

8. Check that the HP 37717C Pattern Loss and Signal Loss indicators are not lit.

9. Select the following on the Digital Transmission Analyzer:
   - Frequency - 700 kHz
   - Pattern 2^{15}.1

10. Select SIGNAL 2 Mb/s and PATTERN 2^{15}.1 on the HP 37717C [TRANSMIT] and [RECEIVE] displays.

11. Check that the HP 37717C Pattern Loss and Signal Loss indicators are not lit.


13. Check that the HP 37717C Pattern Loss and Signal Loss indicators are not lit.
Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

14. Select Frequency - 50 MHz on the Digital Transmission Analyzer and check that the HP 37717C Pattern Loss and Signal Loss indicators are not lit.

15. Select the following parameters on the Signal Generator: Frequency - 50 MHz
Output Level - 500 mV

16. Disconnect the Digital Transmission Analyzer and connect the Signal Generator to the HP 37717C EXT CLOCK INPUT.

17. Press **TRANSMIT** PDH BINARY and set up the display as shown opposite.

Check that the HP 37717C Pattern Loss and Signal Loss indicators are not lit.

Select THRESHOLDS EXT CLOCK [GND] and check that the HP 37717C Pattern Loss and Signal Loss indicators are not lit.

External Clock Mark to Space Ratio

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.

2. Connect up the equipment as shown in Figure 3-56.

---

**Figure 3-56** Mark to Space Ratio
Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

Unstructured PDH Option UKK [USB]

3. Press \textbf{TRANSMIT PDH MAIN SETTINGS} and set up the display as shown opposite.

4. Press \textbf{TRANSMIT PDH BINARY} and set up the display as shown opposite.

5. Set the Signal Generator to Frequency - 700 kHz, Output Level - 500 mV and connect to the EXT CLOCK input port of the binary interfaces module.

6. Connect the HP 37717C binary CLOCK O/P to the oscilloscope via the 75\,\Omega/50\,\Omega matching pad and check that the mark/space ratio of the displayed clock waveform is between 60/40 and 40/60.

7. Press \textbf{TRANSMIT PDH MAIN SETTINGS} and set up the display as shown opposite.
Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

8. Press (TRANSMIT) PDH BINARY and set up the display as shown opposite.

9. Set the Signal Generator to Frequency - 170 MHz, Output Level - 500 mV and connect to the EXT CLOCK input port of the binary interfaces module.

10. Connect the HP 37717C binary CLOCK O/P to the oscilloscope via the 75Ω/50Ω matching pad and the ECL termination and check that the mark/space ratio of the displayed clock waveform is between 60/40 and 40/60.

Structured PDH Option UKJ [USA]

1. Press (TRANSMIT) PDH MAIN SETTINGS and set up the display as shown opposite.

2. Press (TRANSMIT) PDH BINARY and set up the display as shown opposite.

3. Set the Signal Generator to Frequency - 1.843 MHz, Output Level - 500 mV and connect to the EXT CLOCK input port of the binary interfaces module.

4. Connect the HP 37717C binary CLOCK O/P to the oscilloscope via the 75Ω/50Ω matching pad and check that the mark/space ratio of the displayed clock waveform is between 60/40 and 40/60.

5. Repeat steps 3 and 4 with the Signal Generator frequency set to 2.253 MHz.
Performance Tests
PDH Binary Interfaces (Option UH3, [US7])

6. Select SIGNAL [8 Mb/s] and repeat 3 and 4 with the Signal Generator frequency set to 7.6 MHz and 9.29 MHz in turn.

7. Select SIGNAL [34 Mb/s] and repeat 3 and 4 with the Signal Generator frequency set to 30.93 MHz and 37.8 MHz in turn.

8. Press [TRANSMIT] PDH MAIN SETTINGS and set up the display as shown opposite.

9. Press [TRANSMIT] PDH BINARY and set up the display as shown opposite.

10. Set the Signal Generator to Frequency-125.3 MHz, Output Level - 500 mV and connect to the EXT CLOCK input port of the binary interfaces module.

11. Connect the HP 37717C binary CLOCK O/P to the oscilloscope via the 75Ω/50Ω matching pad and the ECL termination and check that the mark/space ratio of the displayed clock waveform is between 60/40 and 40/60.

12. Repeat steps 10 and 11 with the Signal Generator frequency set to 153.2 MHz.
Performance Tests

ETSI/ANSI Internal Transmitter Clock Rates (Option UKZ)

ETSI/ANSI Internal Transmitter Clock Rates (Option UKZ)

Specification

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Accuracy</th>
<th>Temperature Stability</th>
<th>Ageing Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1</td>
<td>1.544Mb/s</td>
<td>+/-0.7ppm @25C</td>
<td>&lt;=3ppm (0 to +50C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
<tr>
<td>DS3</td>
<td>44.736Mb/s</td>
<td>+/-0.5ppm @25C</td>
<td>&lt;=3ppm (0 to +50C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
<tr>
<td>E1</td>
<td>2.048Mb/s</td>
<td>+/-0.5ppm @25C</td>
<td>&lt;=3ppm (0 to +50C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
<tr>
<td>E3</td>
<td>34.368Mb/s</td>
<td>+/-0.5ppm @25C</td>
<td>&lt;=3ppm (0 to +50C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
</tbody>
</table>

Description

A frequency Counter terminated in 75 ohms and connected to the Option UKZ Transmit Module front panel Clock Out Port is used to verify the frequency accuracy of the transmitted data at all rates.

**DS3 Frequency Accuracy**

1. Recall the HP 37717C Default Settings as shown on 3-2.
2. Connect the Clock Output port on the HP 37717C Option UKZ Transmit Module to the Frequency Counter Channel A. Terminate in 75 ohm.
3. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44735798.6 Hz and 44736201.4 Hz.
4. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set FREQUENCY OFFSET to [+20PMP].
5. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 4473693.4 Hz and 44737096.0 Hz.
6. Set the FREQUENCY OFFSET to [-20PMP].
Performance Tests

ETSI/ANSI Internal Transmitter Clock Rates (Option UKZ)

7. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44734904.0 Hz and 44735306.6 Hz.

**E1 (2.048Mb/s) Frequency Accuracy**

1. Set the transmitter to Signal [E1 2Mb/s].
2. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 2047985.6 Hz and 2048014.4 Hz.
3. Set the FREQUENCY OFFSET to [USER OFFSET] [+50PPM].
4. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 2048088 Hz and 2048116.8 Hz.
5. Set the FREQUENCY OFFSET to [USER OFFSET] [-50PPM].
6. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 2047883.2 Hz and 2047912.0 Hz.

**E3 (34.368Mb/s) Frequency Accuracy**

1. Set the transmitter to Signal [E3 34Mb/s].
2. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 34367759.4 Hz and 34368240.6 Hz.
3. Set the FREQUENCY OFFSET to [USER OFFSET] [+20PPM].
4. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 34368446.8 Hz and 34368928 Hz.
5. Set the FREQUENCY OFFSET to [USER OFFSET] [-20PPM].
6. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 34367072.0 Hz and 34367553.2 Hz.
Performance Tests

ETSI/ANSI Internal Transmitter Clock Rates (Option UKZ)

**DS1 Frequency Accuracy**

1. Set the transmitter to Signal [DS1 1.5Mb/s].
2. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1543993 Hz and 1544007 Hz.
3. Set the FREQUENCY OFFSET to [+32PPM].
4. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1544042.4 Hz and 1544056.4 Hz.
5. Set the FREQUENCY OFFSET to [-32PPM].
6. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1543943.6 Hz and 1543957.6 Hz.
ETSII/ANSI Transmitter Output Level and Waveshape (Option UKZ)

Specifications

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Level</th>
<th>Waveshape</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSX-1</td>
<td>1.544Mb/s</td>
<td>3.0V +/-20%</td>
<td>Fits mask T1.102-1993</td>
</tr>
<tr>
<td>DS1-LO</td>
<td>1.544Mb/s</td>
<td></td>
<td>As DSX-1 with 655' ABAM Cable</td>
</tr>
<tr>
<td>DS3-HI</td>
<td>44.736Mb/s</td>
<td>0.9V pk (nominal)</td>
<td></td>
</tr>
<tr>
<td>DSX-3</td>
<td>44.736Mb/s</td>
<td>560mV pk (nominal)</td>
<td>Fits mask T1.102-1993</td>
</tr>
<tr>
<td>DS3-900</td>
<td>44.736Mb/s</td>
<td>330mV pk (nominal)</td>
<td></td>
</tr>
<tr>
<td>E1 (bal)</td>
<td>2.048Mb/s</td>
<td>3.00V +/-10%</td>
<td>As per ITU rec G703</td>
</tr>
<tr>
<td>E1 (unbal)</td>
<td>2.048Mb/s</td>
<td>2.37V +/-10%</td>
<td>As per ITU rec G703</td>
</tr>
<tr>
<td>E3</td>
<td>34.368Mb/s</td>
<td>1.0V +/-10%</td>
<td>As per ITU rec G703</td>
</tr>
</tbody>
</table>

Description

This test ensures the transmitter output level and pulse shape meet the required specifications at E1,E3,DS1 and DS3 rates. The Transmitter output is connected to an oscilloscope and the waveshape compared with the predefined masks stored in the oscilloscope memory. The signal levels are also measured using the oscilloscope.
Performance Tests
ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

34.368 Mb/s Positive Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

3. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows;

4. Connect the Transmit Module (Option UKZ) 75 ohms Unbalanced Output to the Oscilloscope via the 75/50 ohm converter.

5. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

6. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

7. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

e. MASK CCITT G703 34Mb softkey.
f. STORE to M1 + M2 softkey.
g. STORE softkey.

8. Press the SHIFT key on the oscilloscope (coloured blue), then MASK AUTO key then 1 key.

The oscilloscope will now automatically display and compare an isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask. A PASS message should appear on the oscilloscope display when completed.

NOTE

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

9. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 900 mV and 1.100 Volts.

34.368 Mb/s Negative Pulse

1. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows;

2. Select CHAN on the oscilloscope and set OFFSET to -500mV.
3. Select TRIG on the oscilloscope and set to PATTERN H X X X.
4. Select TIMEBASE on the Oscilloscope and set DELAY to 8nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.

5. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK CCITT G703 34Mb softkey.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

c. STORE to M1 + M2
d. STORE INVERSE

6. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.

7. Ensure the waveform fits the mask.

**NOTE**

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

8. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 900 mV and 1.100 Volts.

**2.048 Mb/s Positive Pulse**

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

3. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows;
Performance Tests
ETS/ANSI Transmitter Output Level and Waveshape (Option UKZ)

4. Connect the UKZ Transmit Module 75 ohms Unbalanced Output to the Oscilloscope via the 75/50 ohm converter.

5. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

6. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

7. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
   e. MASK CCITT G703 DS1E 2.0 Mb softkey.
   f. STORE to M1 + M2 softkey
   g. STORE softkey

8. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key, then 1 key.
   The oscilloscope will now automatically display and compare the isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask.

   **NOTE**
   It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

9. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607V.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

2.048 Mb/s Negative Pulse

1. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follow:

![Graphical representation of a circuit or waveform]

2. Select CHAN on the oscilloscope and set OFFSET to -800mV.
3. Select TRIG on the oscilloscope and set to PATTERN H X X X.
4. Select TIMEBASE on the Oscilloscope and set DELAY to 126 nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.
5. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK CCITT G703 DS1E 2.0 Mb softkey.
   c. STORE to M1 + M2.
   d. STORE INVERSE.
6. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.
7. Ensure the waveform fits the mask.

**NOTE**

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

8. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607V.
Performance Tests
ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

DSX-3 Positive Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

<table>
<thead>
<tr>
<th>TRANSMITTER OUTPUT [ HTM ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL LAYER TEST FUNCTION</td>
</tr>
<tr>
<td>VIDEO LAYERS [ HTM ]</td>
</tr>
<tr>
<td>DRS (3.35 MHz) [ DRDS ]</td>
</tr>
<tr>
<td>INTERNAL</td>
</tr>
<tr>
<td>TRANSMIT LEVEL [ HTM ]</td>
</tr>
<tr>
<td>LVM (953.6 Hz) [ DLVM ]</td>
</tr>
<tr>
<td>900</td>
</tr>
<tr>
<td>DIRECT [ DIF ]</td>
</tr>
<tr>
<td>CONSERVANCE SUB-LAYER [ DIF ]</td>
</tr>
<tr>
<td>CELL SCRAMBLING [ OFF ]</td>
</tr>
</tbody>
</table>

3. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows;

<table>
<thead>
<tr>
<th>TRANSMITTER OUTPUT [ HTM ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICAL LAYER TEST FUNCTION</td>
</tr>
<tr>
<td>ATM LAYERS [ HTM ]</td>
</tr>
<tr>
<td>CONNECTION [ HTM ]</td>
</tr>
<tr>
<td>PROTOCOL [ HTM ]</td>
</tr>
<tr>
<td>G.703 (1536 bps) [ C1536 ]</td>
</tr>
<tr>
<td>1536</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>DIRECT [ DIF ]</td>
</tr>
<tr>
<td>CELL SCRAMBLING [ OFF ]</td>
</tr>
</tbody>
</table>

4. Connect the UKZ Transmit Module 75 ohms Unbalanced Output to the Oscilloscope via the 75/50 ohm converter.

5. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

6. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

7. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

e. MASK DS3 45 Mb ANSI T1.102 softkey.
f. STORE to M1 + M2 softkey.
g. STORE softkey.

8. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key, then 1 key.

The oscilloscope will now automatically display and compare the isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask.

---

NOTE

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

---

DSX-3 Negative Pulse

1. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows;

2. Select CHAN on the oscilloscope and set OFFSET to -270 mV.

3. Select TRIG on the oscilloscope and set to PATTERN H X X X.

4. Select TIMEBASE on the Oscilloscope and set DELAY to -186 nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.

5. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK DS3 45 Mb ANSI T1.102 softkey.
   c. STORE to M1 + M2.
   d. STORE INVERSE.
Performance Tests

ETS/ANSI Transmitter Output Level and Waveshape (Option UKZ)

6. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.

7. Ensure the waveform fits the mask.

NOTE

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

DSX-1 Positive Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows:

3. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows:

4. Connect the UKZ Transmit Module 100 ohm Balanced Output to the Oscilloscope via the HP 15508B Balanced to unbalanced Converter and HP 11852B 75/50 ohm converter.

5. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

6. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

7. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
   e. MASK DS1 new 1.5 Mb ANSI T1.102 softkey.
   f. STORE to M1 + M2 softkey.
   g. STORE softkey.

8. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key, then 1 key.
The oscilloscope will now automatically display and compare the isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask.

NOTE

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

9. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 1.984V and 2.976V.

DSX-1 Negative Pulse

1. Select the HP 37717C TRANSMIT page, select ATM LAYER and set as follows:
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option UKZ)

2. Select CHAN on the oscilloscope and set OFFSET to -390 mV.
3. Select TRIG on the oscilloscope and set to PATTERN H X X X.
4. Select TIMEBASE on the Oscilloscope and set DELAY to 300 nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.
5. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK DS1 new 1.5 Mb ANSI T1.102 softkey.
   c. STORE to M1 + M2.
   d. STORE INVERSE.
6. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.
7. Ensure the waveform fits the mask.

**NOTE**

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

8. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 1.984V and 2.976V.
Performance Tests

ETSI/ANSI Receiver Equalization (Option UKZ)

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Cable Loss Accommodation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048Mb/s</td>
<td>Up to 6dB for root f cable @ half-bit rate</td>
</tr>
<tr>
<td>34.368Mb/s</td>
<td>Automatic equalization up to 12dB for root f cable @ half-bit rate</td>
</tr>
<tr>
<td>1.544Mb/s (DS1)</td>
<td>Signal range from DS1-LO to DSX-1</td>
</tr>
<tr>
<td>44.736Mb/s (DS3)</td>
<td>Automatic equalization for up to 900 feet of type 728A Cable (root f)</td>
</tr>
</tbody>
</table>

Description

The Receiver Equalization is checked by looping the transmitter output to receiver input through a special Cable Simulator. This device is designed to simulate the specified cable loss at the rate under test. A BER measurement is run and a check made for no errors in the results page.

2.048Mb/s Equalization

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Press OTHER key, then SETTINGS CONTROL softkey, then set the TRANSMITTER and RECEIVER to COUPLED.

3. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;
Performance Tests

ETSI/ANSI Receiver Equalization (Option UKZ)

4. Connect Cable Simulator #5 (see Recommended Test Equipment Table in Chapter 1) between the HP 37717C Transmitter Output and Receiver Input ports.

5. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

6. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

7. Press RUN/STOP key to stop the measurement.

34.368 Mb/s Equalization

1. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows:

2. Connect Cable Simulator #6 (see “Recommended Test Equipment” in Chapter 1 on Page 67) between the HP 37717C Transmitter Output and Receiver Input ports.

3. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

4. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

5. Press RUN/STOP key to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Equalization (Option UKZ)

**DS3 Equalization**

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows:

3. Connect Cable Simulator #5 (see “Recommended Test Equipment” in Chapter 1 on Page 67) between the HP 37717C UKZ Unbalanced Transmitter Output and Receiver Input ports.

   **NOTE**

   If Cable Simulator #5 is not available, it is permissible to select DS3-900' on the Transmitter Page and connect the HP 37717C UKZ Unbalanced Transmitter Output port direct to the Receiver Input port. This setup assumes the DS3-900' output signal is within specification.

4. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

5. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

6. Press RUN/STOP key to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Equalization (Option UKZ)

**DS1 Equalization**

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

3. Connect Cable Simulator #6 (see “Recommended Test Equipment” in Chapter 1 on Page 67) between the HP 37717C Transmitter Balanced Output and Receiver Balanced Input ports via two Balanced to Unbalanced Converters (HP 15508B).

   **NOTE**
   
   If Cable Simulator #6 is not available, it is permissible to select DS1-LO on the Transmitter Page and connect the HP 37717C UKZ Unbalanced Transmitter Output port direct to the Receiver Input port. This setup assumes the DS1-LO output signal is within specification.

4. Press RESULTS [TROUBLE SCAN] , then RUN/STOP key to start the measurement.

5. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

6. Press RUN/STOP key to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option UKZ)

ETSI/ANSI Receiver Monitor Levels (Option UKZ)

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Cable Loss Accommodation (Monitor mode)</th>
<th>Monitor Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048Mb/s</td>
<td>Selectable OFF or Automatic (Up to 6dB for root f cable @ half-bit rate).</td>
<td>Selectable 20dB, 26dB or 30dB</td>
</tr>
<tr>
<td>(Unbalanced Mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.048Mb/s</td>
<td>Selectable OFF or Automatic - Up to 6dB (20dB selected) or 3dB (26 or 30dB selected) for root f cable @ half-bit rate.</td>
<td>Selectable 20dB, 26dB or 30dB</td>
</tr>
<tr>
<td>(Balanced Mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.368Mb/s</td>
<td>Selectable OFF or Automatic (Up to 12dB for root f cable @ half-bit rate).</td>
<td>Selectable 20dB or 26dB</td>
</tr>
<tr>
<td>1.544Mb/s (DS1)</td>
<td>Signal range from DS1-LO to DSX-1</td>
<td>Selectable 20dB, 26dB or 30dB</td>
</tr>
<tr>
<td>44.736Mb/s (DS3)</td>
<td>Selectable OFF or Automatic (Up to 900 feet of type 728A Cable (root f)).</td>
<td>Selectable 20dB or 26dB</td>
</tr>
</tbody>
</table>

Description

The Receiver Monitor capability is checked by looping the transmitter output to receiver input through a series of matching pads and selectable fixed attenuators. The total attenuation of this loop is calculated to be the same as the selected Monitor attenuation. A BER measurement is run and a check made for no errors in the results page for each selection of Bit Rate and monitor attenuation.
Performance Tests
ETSI/ANSI Receiver Monitor Levels (Option UKZ)

2.048Mb/s 20dB Monitor

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

3. Select the HP 37717C RECEIVE page, select PHYSICAL LAYER and set as follows;

4. Connect the equipment as shown in Figure 3-57 below (no attenuation in the additional Attenuation position).

5. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

6. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

7. Press RUN/STOP key to stop the measurement.
Performance Tests
ETSI/ANSI Receiver Monitor Levels (Option UKZ)

**2.048Mb/s 26dB Monitor**
8. Connect a fixed 6dB Attenuator in the Additional Attenuation position of the circuit of Figure 3-57.
9. Set the HP 37717C MONITOR GAIN to 26dB mode.
10. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.
11. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.
12. Press RUN/STOP key to stop the measurement.

**2.048Mb/s 30dB Monitor**
13. Connect a fixed 6dB attenuator and a fixed 3dB Attenuator in the Additional Attenuation position of the circuit of Figure 3-57.
14. Set the HP 37717C MONITOR GAIN to 30dB mode.
15. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.
16. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.
17. Press RUN/STOP key to stop the measurement.

**34.368 Mb/s 20dB Monitor**
1. Recall the HP 37717C Default Settings as shown on 3-2.
2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option UKZ)

3. Select the HP 37717C RECEIVE page, select PHYSICAL LAYER and set as follows:

4. Connect the equipment as shown in Figure 3-57 below (no attenuation in the additional Attenuation position).

5. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

6. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

7. Press RUN/STOP key to stop the measurement.

8. Connect a fixed 6dB Attenuator in the Additional Attenuation position of the circuit of Figure 3-57.

9. Set the HP 37717C MONITOR GAIN to 26dB mode.

10. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

11. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

12. Press RUN/STOP key to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option UKZ)

**DS3 20dB Monitor**

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

3. Select the HP 37717C RECEIVE page, select PHYSICAL LAYER and set as follows;

4. Connect the equipment as shown in Figure 3-57 below (no attenuation in the additional Attenuation position).

5. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

6. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

7. Press RUN/STOP key to stop the measurement.

**DS3 26dB Monitor**

8. Connect a fixed 6dB Attenuator in the Additional Attenuation position of the circuit of Figure 3-57.

9. Set the HP 37717C MONITOR GAIN to 26dB mode.
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option UKZ)

10. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

11. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

12. Press RUN/STOP key to stop the measurement.

DS1 20dB Monitor

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows:

3. Select the HP 37717C RECEIVE page, select PHYSICAL LAYER and set as follows:

4. Connect the equipment as shown in Figure 3-57 below, but use the Balanced DS1 output and input ports on the HP 37717C connected via two 110/75 ohm bal to Unbal converters.

5. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

6. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

7. Press RUN/STOP key to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option UKZ)

**DS1 26dB Monitor**
8. Connect a fixed 6dB Attenuator in the Additional Attenuation position of the circuit of Figure 3-57.
9. Set the HP 37717C MONITOR GAIN to 26dB mode.
10. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.
11. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.
12. Press RUN/STOP key to stop the measurement.

**DS1 30dB Monitor**
13. Connect a fixed 6dB Attenuator and a fixed 3dB Attenuator in the Additional Attenuation position of the circuit of Figure 3-57.
14. Set the HP 37717C MONITOR GAIN to 30dB mode.
15. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.
16. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.
17. Press RUN/STOP key to stop the measurement.
Performance Tests

Trigger Output (Option UKZ)

Trigger Output (Option UKZ)

Specification
Output available on selected receive errors.
Pulse level: TTL, (typical)

Description

This is a functional check of the Option UKZ Receive Module Trigger Port as this has supplemental specifications only and does not require a full Performance test. The HP 37717C is set up to generate and receive an errored PDH signal. A frequency Counter terminated in 75 ohms and connected to the option UKZ Receive Module front panel Trigger Out Port is used to verify the presence of pulses at the appropriate received error rate.

Trigger Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;
Performance Tests

Trigger Output (Option UKZ)

3. Select the HP 37717C TRANSMIT page, select TEST FUNCTION and set as follows:

4. Select the HP 37717C RECEIVE page, select PHYSICAL LAYER and set as follows:

5. Select the HP 37717C RECEIVE page, select TRIGGERS and set as follows:

6. Connect the Transmit Module (Option UKZ) 75 ohms Unbalanced Output to the Receive Module (Option UKZ) 75 ohms Unbalanced Input.

7. Connect the Trigger Output port on the Receive Module (Option UKZ) to the Oscilloscope Channel A. Terminate in 75 ohm.

8. Press AUTOSCALE on the Oscilloscope and ensure the displayed Trigger Output pulse has TTL levels.
Performance Tests

Trigger Output (Option UKZ)

Figure 3-57  Monitor Input Test Setup
Performance Tests
Internal SONET Transmitter Clock (Option 120)

Internal SONET Transmitter Clock (Option 120)

Specification

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>155.52 Mb/s</td>
<td>±4.5 ppm</td>
</tr>
</tbody>
</table>

Description
The test uses a Frequency Counter connected to the SDH/SONET Signal Out port to measure the STS-3 All Ones data rate. This gives an indirect measure of the transmitter clock frequency as the data is clocked by the internal 10MHz clock oscillator. The test limits assume the instrument is within the annual calibration cycle. The STS-3 Framing is disabled for this test using the MODULE DEBUG function of the HP 37717C.

Equipment Required
- **Frequency Counter**: HP 5335A Option 010
- **75Ω Termination**: HP 15522-80010
- **T Connector**: HP 1250-0781

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the HP 37717C OUT port to the Frequency Counter Input A, terminated in 75Ω (use the T Connector).
Performance Tests

Internal SONET Transmitter Clock (Option 120)

3. Press **TRANSMIT** and set up the display as shown opposite.

4. Make the following key sequence on the HP 37717C to obtain the special **MODULE DEBUG** display.
   
   Press **OTHER**: MORE : MORE : MORE : MORE : **OTHER**.
   
   Press **MORE** until **MODULE DEBUG** appears in the softkey menu.
   
   Press **MODULE DEBUG** and set up the display as shown opposite.

---

**CAUTION**

When using the **MODULE DEBUG** display, ONLY modify the STM-1 TEST PATTERN. Altering other parameters can damage instrument firmware - exit this display after setup to eliminate any possibility of accidental modification.

5. Adjust the Frequency Counter Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 77.759650 MHz and 77.760350 MHz.

6. Disconnect all the test equipment.
Performance Tests
SONET Frequency Offsets (Option 120)

### SONET Frequency Offsets (Option 120)

#### Specifications

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>±999 ppm</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>0.1 ppm</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>0.02 ppm</td>
</tr>
</tbody>
</table>

#### Description

The SONET Transmitter Offset Clock is checked for range and accuracy using a Frequency Counter to measure the STS-3 Data rate. This gives an indirect measure of the transmitter clock frequency as the data is clocked by the internal 10MHz clock oscillator. A measurement with no offset is performed to establish a reference Clock frequency. The frequency accuracy is then measured over the specified offset range. The STS-3 Framing is disabled during this test using the MODULE DEBUG function of the HP 37717C.

#### Equipment Required

- **Frequency Counter**: HP 5335A Opt 010
- **T Connector**: HP 1250-0781

#### Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the OUT port to the Frequency Counter terminated in 75Ω (use the T connector).
Performance Tests
SONET Frequency Offsets (Option 120)

3. Press **TRANSMIT** and set up the display as shown opposite.

4. Make the following key sequence on the HP 37717C to obtain the special **MODULE DEBUG** display.

   - Press **OTHER** (←): **MORE** (←): **MORE** (←): **MORE** (OTHER).
   - Press **MORE** until **MODULE DEBUG** appears in the softkey menu.
   - Press **MODULE DEBUG** and set up the display as shown opposite.

   **CAUTION**

   When using the **MODULE DEBUG** display, ONLY modify the STM-1 TEST PATTERN. Altering other parameters can damage instrument firmware - exit this display after setup to eliminate any possibility of accidental modification.

5. Adjust the Frequency Counter Trigger Level to obtain a stable reading.

6. Take note of the measured frequency (MF).

7. Select the frequency offset settings given in Table 3-9 and verify the frequency at each step against the measured frequency (MF) noted in step 6.
### Performance Tests

**SONET Frequency Offsets (Option 120)**

#### Table 3-9  Measured Offset

<table>
<thead>
<tr>
<th>Offset (ppm)</th>
<th>Min Expected Frequency</th>
<th>Max Expected Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>-100ppm</td>
<td>MF - (0.00010452 \times MF)</td>
<td>MF - (0.00009548) \times MF</td>
</tr>
<tr>
<td>-66.6ppm</td>
<td>MF - (0.00007114 \times MF)</td>
<td>MF - (0.00006208) \times MF</td>
</tr>
<tr>
<td>+33.3ppm</td>
<td>MF + (0.00002878 \times MF)</td>
<td>MF + (0.00003782) \times MF</td>
</tr>
<tr>
<td>+100ppm</td>
<td>MF + (0.00009548 \times MF)</td>
<td>MF + (0.00010452) \times MF</td>
</tr>
<tr>
<td>+999ppm</td>
<td>MF + (0.00099448 \times MF)</td>
<td>MF + (0.00100352) \times MF</td>
</tr>
<tr>
<td>-999ppm</td>
<td>MF - (0.00100352 \times MF)</td>
<td>MF - (0.00099448) \times MF</td>
</tr>
</tbody>
</table>

8. Disconnect all the test equipment.
Performance Tests
STS-3 Transmitter Output Waveshape (Option 120)

STS-3 Transmitter Output Waveshape (Option 120)

Specifications

Meets ITU Recommendation G.703

Description

An oscilloscope is connected to the HP 37717C Transmitter STS-3 output and used to view the waveforms with All Ones and All Zeros patterns selected in turn. The displayed waveshape is checked against the relevant ITU G.703 mask. The STS-3 Framing is disabled during this test using the MODULE DEBUG function of the HP 37717C.

Equipment Required

- Oscilloscope : HP 54503A
- ThinkJet Printer : HP 2225A
- 75Ω Termination : HP 15522-80010
- T Connector : HP 1250-0781

Procedure

CMI All Ones Waveshape

1. Connect up the equipment as shown in Figure 3-58 and Recall HP 37717C DEFAULT SETTINGS as shown on 3-2.

![Figure 3-58: STS-3 Transmitter Output Waveshape Test Setup](image)
2. Press (TRANSMIT) and set up the display as shown opposite.

3. Make the following key sequence on the HP 37717C to obtain the special display.

   Press **OTHER**, **MORE**, **MORE**, **MORE**, **OTHER**.
   Press **MORE** until **MODULE DEBUG** appears in the softkey menu.
   Press **MODULE DEBUG** and set up the display as shown opposite.

---

**CAUTION**

When using the **MODULE DEBUG** display, ONLY modify the STM-1 TEST PATTERN. Altering other parameters can damage instrument firmware - exit this display after setup to eliminate any possibility of accidental modification.

4. Adjust the Oscilloscope controls to display the waveform as shown in Figure 3-59, STS-3 All Ones Pattern.

5. Use the Oscilloscope PRINT function to obtain a printout of the STS-3 waveform on the external printer.

6. Ensure this printout fits the STS-3 Mask of Figure 3-60.

---

**NOTE**

If a mylar mask is not available, the figure shown may be traced or photocopied onto a transparency.
Performance Tests

STS-3 Transmitter Output Waveshape (Option 120)

Figure 3-59  STS-3 All Ones Pattern

Figure 3-60  STS-3 All Ones Mask

CMI All Zeros Waveshape

7. Select PATTERN [ALL ZEROS] on the OTHER DEBUG FUNCTION display.
Performance Tests
STS-3 Transmitter Output Waveshape (Option 120)

8. Adjust the Oscilloscope controls to display the waveform as shown in Figure 3-61, STS-3 All Zeros Pattern Example.

9. Use the Oscilloscope PRINT function to obtain a printout of the STS-3 waveform on the external printer.

10. Ensure this printout fits the STS-3 Mask of Figure 3-62.

NOTE
If a mylar mask is not available, the figure shown may be traced or photocopied onto a transparency.

Figure 3-61 STS-3 All Zeros Pattern
Performance Tests

STS-3 Transmitter Output Waveshape (Option 120)

Figure 3-62  STS-3 All Zeros Mask

11. Select STS-3 TEST PATTERN [OFF] on the OTHER DEBUG FUNCTION display.


13. Adjust the Oscilloscope controls to display the eye diagram as shown in Figure 3-63, STS-3 Eye Diagram Example. Check that the waveform meets the STS-3 eye diagram mask. It may be necessary to adjust the V/div gain on the Oscilloscope.
Performance Tests
STS-3 Transmitter Output Waveshape (Option 120)

Figure 3-63  STS-3 Eye Diagram Pattern

Figure 3-64  STS-3 Eye Diagram Mask

**NOTE**
If the mask is not available then Figure 3-64 may be traced/copied and compared with the Oscilloscope print out.
Performance Tests
STM-1/STS-3 Receiver Monitor Input (Options A1T, A1U, A3R, [A3S], 120)

STM-1/STS-3 Receiver Monitor Input (Options A1T, A1U, A3R, [A3S], 120)

Specification

Receiver Monitor Mode
- Selectable 20 dB and 26 dB of flat gain
- 12 dB equalization at 1/2 Bit Rate

Description
An attenuator and special cable attenuator are inserted between the STS-3 OUT port and the STS-3 IN port. The Receiver monitor mode is verified by attenuating the signal by 20 dB and checking for error-free operation.

Equipment Required

- 3 dB Attenuator (N-type) : HP 8491A Option 003
- 6 dB Attenuator (N-type) (2 off) : HP 8491A Option 006
- 75/50Ω Matching Pad (N-type) : HP 11852B (Qty 2)
- N-type (f) to BNC (f) Adaptor : HP 1250-1536 (Qty 2)
- N-type (m) to N-type (f) Adaptor : HP 1250-1475
- Cable Attenuator (70 m) : HP 8120-0049

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] or [SONET] and RECEIVER INPUT [SDH] or [SONET].
3. Connect up the equipment as shown in Figure 3-65.
Performance Tests
STM-1/STS-3 Receiver Monitor Input (Options A1T, A1U, A3R, [A3S], 120)

Figure 3-65  STS-3 Receiver Monitor Input

4. Press [SIGNAL IN] until the Monitor led above the key is lit.
5. Press [RECEIVE] and select GAIN [20 dB].
6. Verify that all the front panel ALARM leds are off.
7. Press [RESULTS] TROUBLE SCAN and [RUN/STOP], and check that the display indicates NO TROUBLE.
8. Press [RUN/STOP] to halt the measurement.
9. Connect the second 6 dB Fixed Attenuator between the 3 dB attenuator and the Cable Attenuator.
Performance Tests

STM-1/STS-3 Receiver Input Equalization (Options US1, [US5], A1T, [A1U], A3R, [A3S], 120)

STM-1/STS-3 Receiver Input Equalization (Options US1, [US5], A1T, [A1U], A3R, [A3S], 120)

Specification

Receiver Equalization Automatic for cable loss up to 12dB at half the bit rate.

Description

Receiver Equalization is verified by inserting the special Cable between the STS-3 OUT port and the STS-3 IN port and checking for error-free operation.

Equipment Required

Cable Attenuator (70 m) HP 8120-0049

Procedure

1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Select TRANSMITTER OUTPUT [SDH] or [SONET] and RECEIVER INPUT [SDH] or [SONET].
3. Connect the OUT port to the IN port, via the Cable Attenuator.
4. Verify that all the front panel Alarm leds are off.
5. Press [RESULTS] [TROUBLE SCAN] [RUN/STOP] and check that the display indicates NO TROUBLE.
6. Press [RUN/STOP] to halt the measurement.
7. Disconnect all the test equipment.
Performance Tests
ETS/ANSI Internal Transmitter Clock Rates (Option 110)

ETS/ANSI Internal Transmitter Clock Rates
(Option 110)

Specification

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Accuracy</th>
<th>Temperature Stability</th>
<th>Ageing Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1</td>
<td>1.544Mb/s</td>
<td>+/-0.7ppm @25°C</td>
<td>&lt;=3ppm (0 to +50°C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
<tr>
<td>DS3</td>
<td>44.736Mb/s</td>
<td>+/-0.5ppm @25°C</td>
<td>&lt;=3ppm (0 to +50°C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
<tr>
<td>E1</td>
<td>2.048Mb/s</td>
<td>+/-0.5ppm @25°C</td>
<td>&lt;=3ppm (0 to +50°C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
<tr>
<td>E3</td>
<td>34.368Mb/s</td>
<td>+/-0.5ppm @25°C</td>
<td>&lt;=3ppm (0 to +50°C)</td>
<td>&lt;=1ppm/Year</td>
</tr>
</tbody>
</table>

Description
A frequency Counter terminated in 75 ohms and connected to the Option 110 Transmit Module front panel Clock Out Port is used to verify the frequency accuracy of the transmitted data at all rates.

E3 (34.368Mb/s) Frequency Accuracy
1. Recall the HP 37717C Default Settings as shown on 3-2. Select TRANSMIT, PDH/DSn, MAIN SETTINGS and set the SIGNAL to 34 Mb/s.
2. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 34367845.3 Hz and 34368154.7 Hz.
3. Set the FREQUENCY OFFSET to [USER OFFSET] [+20PPM].
4. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 34368532.7 Hz and 34368842.0 Hz.
5. Set the FREQUENCY OFFSET to [USER OFFSET] [-20PPM].
6. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 34367158.0 Hz and 34367467.3 Hz.

3-218
Performance Tests
ETSI/ANSI Internal Transmitter Clock Rates (Option 110)

**E1 (2.048Mb/s) Frequency Accuracy**
1. Set the transmitter to Signal [E1 2Mb/s].
2. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 2047990.8 Hz and 2048009.2 Hz.
3. Set the FREQUENCY OFFSET to [USER OFFSET] [+50PPM].
4. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 2048093.2 Hz and 2048111.6 Hz.
5. Set the FREQUENCY OFFSET to [USER OFFSET] [-50PPM].
6. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 2047888.4 Hz and 2047906.8 Hz.

**DS1 Frequency Accuracy**
1. Set the transmitter to Signal [DS1 1.5Mb/s].
2. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1543992.7 Hz and 1544007.3 Hz.
3. Set the FREQUENCY OFFSET to [+32PPM].
4. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1544042.2 Hz and 1544056.7 Hz.
5. Set the FREQUENCY OFFSET to [-32PPM].
6. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1543943.3 Hz and 1543957.8 Hz.

**DS3 Frequency Accuracy**
1. Set the transmitter to Signal [DS3].
2. Connect the Clock Output port on the HP 37717C Option 110 Transmit Module to the Frequency Counter Channel A. Terminate in 75 ohm.
Performance Tests

ETSI/ANSI Internal Transmitter Clock Rates (Option 110)

3. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44735798.7 Hz and 44736201.3 Hz.

4. Select the HP 37717C TRANSMIT page, and set FREQUENCY OFFSET to [+20PPM].

5. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44736693.4 Hz and 44737096.0 Hz.

6. Set the FREQUENCY OFFSET to [-20PPM].

7. Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44734904.0 Hz and 44735306.6 Hz.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

Specification

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Level</th>
<th>Waveshape</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSX-1</td>
<td>1.544Mb/s</td>
<td>3.0V +/-20%</td>
<td>Fits mask T1.102-1993</td>
</tr>
<tr>
<td>DS1-LO</td>
<td>1.544Mb/s</td>
<td></td>
<td>As DSX-1 with 655’ ABAM Cable</td>
</tr>
<tr>
<td>DS3-HI</td>
<td>44.736Mb/s</td>
<td>0.9V pk (nominal)</td>
<td></td>
</tr>
<tr>
<td>DSX-3</td>
<td>44.736Mb/s</td>
<td>560mV pk (nominal)</td>
<td>Fits mask T1.102-1993</td>
</tr>
<tr>
<td>DS3-900</td>
<td>44.736Mb/s</td>
<td>330mV pk (nominal)</td>
<td></td>
</tr>
<tr>
<td>E1 (bal)</td>
<td>2.048Mb/s</td>
<td>3.00V +/-10%</td>
<td>As per ITU rec G703</td>
</tr>
<tr>
<td>E1 (unbal)</td>
<td>2.048Mb/s</td>
<td>2.37V +/-10%</td>
<td>As per ITU rec G703</td>
</tr>
<tr>
<td>E3</td>
<td>34.368Mb/s</td>
<td>1.0V +/-10%</td>
<td>As per ITU rec G703</td>
</tr>
</tbody>
</table>

Description

This test ensures the transmitter output level and pulse shape meet the required specifications at E1, E3, DS1 and DS3 rates. The Transmitter output is connected to an oscilloscope and the waveshape compared with the predefined masks stored in the oscilloscope memory. The signal levels are also measured using the oscilloscope.
Performance Tests
ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

34.368 Mb/s Positive Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, and set as follows:

3. Connect the Transmit Module (Option 110) 75 ohms Unbalanced Output to the Oscilloscope via the 75/50 ohm converter.

4. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

5. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

6. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
   e. MASK CCITT G703 34Mb softkey.
   f. STORE to M1 + M2 softkey.
   g. STORE softkey.

7. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key then 1 key.

The oscilloscope will now automatically display and compare an isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask. A PASS message should appear on the oscilloscope display when completed.
Performance Tests
ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

NOTE
It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

8. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 900 mV and 1.100 Volts.

34.368 Mb/s Negative Pulse
1. Select CHAN on the oscilloscope and set OFFSET to -500mV.
2. Select TRIG on the oscilloscope and set to PATTERN H X X X.
3. Select TIMEBASE on the Oscilloscope and set DELAY to 8nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.
4. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK CCITT G703 34Mb softkey.
   c. STORE to M1 + M2.
   e. STORE INVERSE.
5. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.
6. Ensure the waveform fits the mask.

NOTE
It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

7. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 900 mV and 1.100 Volts.

2.048 Mb/s Positive Pulse
1. Recall the HP 37717C Default Settings as shown on 3-2.
Performance Tests

ETSI/ANSi Transmitter Output Level and Waveshape (Option 110)

2. Select the HP 37717C TRANSMIT page, and set as follows;

3. Select the HP 37717C TRANSMIT page, and set as follows:

4. Connect the 110 Transmit Module 75 ohms Unbalanced Output to the Oscilloscope via the 75/50 ohm converter.

5. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

6. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

7. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
   e. MASK CCITT G703 DS1E 2.0 Mb softkey.
   f. STORE to M1 + M2 softkey.
   g. STORE softkey.

8. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key, then 1 key.
The oscilloscope will now automatically display and compare the isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask.

**NOTE**
It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

9. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607V.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

2.048 Mb/s Negative Pulse

1. Select CHAN on the oscilloscope and set OFFSET to -800mV.
2. Select TRIG on the oscilloscope and set to PATTERN H X X X.
3. Select TIMEBASE on the Oscilloscope and set DELAY to 126 nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.
4. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK CCITT G703 DS1E 2.0 Mb softkey.
   c. STORE to M1 + M2.
   d. STORE INVERSE.
5. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.
6. Ensure the waveform fits the mask.

**NOTE**

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

7. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607V.

DSX-3 Positive Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.
2. Select the HP 37717C TRANSMIT page, select PHYSICAL LAYER and set as follows;

   ![Diagram](image)

3. Connect the 110 Transmit Module 75 ohms Unbalanced Output to the Oscilloscope via the 75/50 ohm converter.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

4. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

5. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

6. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
   e. MASK DS3 45 Mb ANSI T1.102 softkey.
   f. STORE to M1 + M2 softkey.
   g. STORE softkey.

7. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key, then 1 key.
   The oscilloscope will now automatically display and compare the isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask.

   **NOTE**
   It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

DSX-3 Negative Pulse

1. Select CHAN on the oscilloscope and set OFFSET to -270 mV.

2. Select TRIG on the oscilloscope and set to PATTERN H X X X.

3. Select TIMEBASE on the Oscilloscope and set DELAY to -186 nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.

4. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK DS3 45 Mb ANSI T1.102 softkey.
   c. STORE to M1 + M2.
   d. STORE INVERSE.

5. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

6. Ensure the waveform fits the mask.

NOTE

It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

DSX-1 Positive Pulse

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, and set as follows:

3. Connect the 110 Transmit Module 100 ohm Balanced Output to the Oscilloscope via the HP 15508B Balanced to unbalanced Converter and HP 11852B 75/50 ohm converter.

4. Select CHAN on the oscilloscope and set to 50 ohms input impedance, DC coupled.

5. Select CHANNEL 1 on the oscilloscope and select PROBE 2.45 (attenuation level to compensate for the 75/50 ohm converter).

6. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. DEFINE MEAS key.
   b. COMPARE softkey.
   c. TEST ON softkey.
   d. WFORM SAVE key.
   e. MASK DS1 new 1.5 Mb ANSI T1.102 softkey.
   f. STORE to M1 + M2 softkey.
   g. STORE softkey.

7. Press the SHIFT key on the oscilloscope (colored blue), then MASK AUTO key, then 1 key.
Performance Tests

ETSI/ANSI Transmitter Output Level and Waveshape (Option 110)

The oscilloscope will now automatically display and compare the isolated positive pulse from the HP 37717C with the limits in the selected Telecom Mask.

**NOTE**
It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

8. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 1.984V and 2.976V.

**DSX-1 Negative Pulse**

1. Select CHAN on the oscilloscope and set OFFSET to -390 mV.
2. Select TRIG on the oscilloscope and set to PATTERN HX X X.
3. Select TIMEBASE on the Oscilloscope and set DELAY to 300 nS. Adjust the delay manually until the negative pulse is centred on the oscilloscope display.
4. If using the HP 54503A oscilloscope, use the following key sequence to select and store the correct Telecom Mask.
   a. WFORM SAVE key.
   b. MASK DS1 new 1.5 Mb ANSI T1.102 softkey.
   c. STORE to M1 + M2.
   e. STORE INVERSE.
5. Compare the isolated negative pulse from the HP 37717C with the limits in the selected Telecom Mask.
6. Ensure the waveform fits the mask.

**NOTE**
It may be necessary to visibly check the waveform fits the mask and manually adjust amplitude and offset parameters on the oscilloscope to obtain a PASS on the Mask.

7. Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 1.984V and 2.976V.
Performance Tests

ETSI/ANSI Receiver Equalization (Option 110)

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Cable Loss Accommodation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048 Mb/s</td>
<td>Up to 6dB for root f cable @ half-bit rate</td>
</tr>
<tr>
<td>34.368 Mb/s</td>
<td>Automatic equalization up to 12dB for root f cable @ half-bit rate</td>
</tr>
<tr>
<td>1.544 Mb/s (DS1)</td>
<td>Signal range from DS1-LO to DSX-1</td>
</tr>
<tr>
<td>44.736 Mb/s (DS3)</td>
<td>Automatic equalization for up to 900 feet of type 728A Cable (root f)</td>
</tr>
</tbody>
</table>

Description

The Receiver Equalization is checked by looping the transmitter output to receiver input through a special Cable Simulator. This device is designed to simulate the specified cable loss at the rate under test. A BER measurement is run and a check made for no errors in the results page.

34.368 Mb/s Equalization

1. Recall the HP 37717C Default Settings as shown on 3-2.
2. Select the HP 37717C TRANSMIT page, and set as follows;

3. Connect Cable Simulator #3 (see Recommended Test Equipment list in Chapter 1) between the HP 37717C Transmitter Output and Receiver Input ports.
Performance Tests

ETSI/ANSI Receiver Equalization (Option 110)

4. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

5. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

6. Press RUN/STOP key to stop the measurement.

2.048Mb/s Equalization

1. Press OTHER key, then SETTINGS CONTROL softkey, then set the TRANSMITTER and RECEIVER to COUPLED.

2. Select the HP 37717C TRANSMIT page, and set as follows;

3. Connect Cable Simulator #1 (see “Recommended Test Equipment” in Chapter 1 on Page 67) between the HP 37717C Transmitter Output and Receiver Input ports.

4. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.

5. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

6. Press RUN/STOP key to stop the measurement.
Performance Tests

**ETSI/ANSI Receiver Equalization (Option 110)**

**DS3 Equalization**

1. Recall the HP 37717C Default Settings as shown on 3-2.

2. Select the HP 37717C TRANSMIT page, and set as follows;

3. Connect Cable Simulator #6 (see “Recommended Test Equipment” in Chapter 1 on Page 67) between the HP 37717C 110 Unbalanced Transmitter Output and Receiver Input ports.

**NOTE**

If Cable Simulator #6 is not available, it is permissible to select DS3-900' on the Transmitter Page and connect the HP 37717C 110 Unbalanced Transmitter Output port direct to the Receiver Input port. This setup assumes the DS3-900' output signal is within specification.

4. Press RESULTS [TROUBLE SCAN] , then RUN/STOP key to start the measurement.

5. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.

6. Press RUN/STOP key to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Equalization (Option 110)

**DS1 Equalization**

1. Recall the HP 37717C Default Settings as shown on 3-2.
2. Select the HP 37717C TRANSMIT page, and set as follows;

   ![Transmit Page Settings]

3. Connect Cable Simulator #5 (see “Recommended Test Equipment” in Chapter 1 on Page 67) between the HP 37717C Transmitter Balanced Output and Receiver Balanced Input ports via two Balanced to Unbalanced Converters (HP 15508B).

   **NOTE**

   If Cable Simulator #5 is not available, it is permissible to select DS1-LO on the Transmitter Page and connect the HP 37717C 110 Unbalanced Transmitter Output port direct to the Receiver Input port. This setup assumes the DS1-LO output signal is within specification.

4. Press RESULTS [TROUBLE SCAN], then RUN/STOP key to start the measurement.
5. Ensure that NO TROUBLE is displayed on the RESULTS page after 30 seconds.
6. Press RUN/STOP key to stop the measurement.

---

3-232
Performance Tests
ETSI/ANSI Receiver Monitor Levels (Option 110)

NOTE
An SPDH Tx Module must be fitted for this test - see Appendix B.

Specifications

<table>
<thead>
<tr>
<th>Bit Rate</th>
<th>Nominal Loss</th>
<th>Equalization at 1/2 Bit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.048 Mb/s</td>
<td>20, 26, 30dB</td>
<td>3dB</td>
</tr>
<tr>
<td>1.544 Mb/s (DS-1)</td>
<td>20, 26, 30dB</td>
<td>3dB</td>
</tr>
<tr>
<td>34.368 Mb/s</td>
<td>20, 26dB</td>
<td>6dB</td>
</tr>
<tr>
<td>44.736 Mb/s (DS-3)</td>
<td>20, 26dB</td>
<td>6dB</td>
</tr>
</tbody>
</table>

Description
The signal from the HP 37717C Option 110 PDH Transmitter is applied to the Option 110 PDH Receiver after attenuating by an amount equal to the selected Receiver Flat Loss plus the specified Cable Loss. The Flat Loss is obtained by inserting a number of 50Ω fixed attenuators in series with a 75/50Ω Matching Pad at one end and a 50/75Ω Matching Pad at the other end. The loss of the two Matching Pads is included in the overall attenuation equation. The Cable Loss is supplied by inserting the correct Cable Simulators for each bit rate in the attenuation path.

Equipment Required

<table>
<thead>
<tr>
<th>Table 3-10</th>
</tr>
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<tbody>
<tr>
<td>2M Bit Rate</td>
</tr>
<tr>
<td>34M Bit Rate</td>
</tr>
<tr>
<td>1.5M Bit Rate</td>
</tr>
<tr>
<td>44M Bit Rate</td>
</tr>
</tbody>
</table>
Performance Tests
ETSI/ANSI Receiver Monitor Levels (Option 110)

Table 3-10

<table>
<thead>
<tr>
<th>Component Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Attenuator (Qty 2)</td>
<td>HP 8491A Option 006 (6dB; 50Ω)</td>
</tr>
<tr>
<td>Fixed Attenuator (Qty 2)</td>
<td>HP 8491A Option 003 (3dB; 50Ω)</td>
</tr>
<tr>
<td>Matching Pad 75/50Ω (7.6dB loss)</td>
<td>HP 11852B</td>
</tr>
<tr>
<td>Matching Pad 50/75Ω (4.2dB loss)</td>
<td>HP 11852B</td>
</tr>
</tbody>
</table>

Procedure
1. Recall the HP 37717C DEFAULT SETTINGS as shown on 3-2.
2. Connect the equipment as shown in Figure 3-66.

Figure 3-66  Option 110 Receiver Monitor Input
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option 110)

2.048 Mb/s

3. Press [TRANSMIT] and set up the MAIN SETTINGS display as shown opposite.

4. Press [RECEIVE] and set up the MAIN SETTINGS display as shown opposite.


6. Ensure that NO TROUBLE is displayed on the RESULTS display.

7. After 30 seconds. Press [RUN/STOP] to stop the measurement.

8. Press [RECEIVE] and select EQUALIZATION [ON] GAIN [20 dB].

9. Connect Cable Simulator #1 between the PDH OUT Port and the Matching Pad.


11. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press [RUN/STOP] to stop the measurement.

12. Connect the second 6dB Fixed Attenuator in the signal path to give a total path attenuation of 26.8dB (7.6+3+6+6+4.2).

13. Press [RECEIVE] and set MONITOR LEVEL [26dB].


15. Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press [RUN/STOP] to stop the measurement.
Performance Tests

ETSI/ANSI Receiver Monitor Levels (Option 110)

16. Remove Cable Simulator #1 from the signal path.

17. Press [RECEIVE] and select EQUALIZATION [OFF].

18. Press [RESULTS]: TROUBLE SCAN. Press [RUN/STOP] to start the measurement.

19. Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds. Press [RUN/STOP] to stop the measurement.

20. Connect the second 3dB Fixed Attenuator in the signal path to give a total path attenuation of 29.8dB (7.6+3+3+6+6+4.2).


23. Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds. Press [RUN/STOP] to stop the measurement.

24. Press [RECEIVE] and select EQUALIZATION [ON].

25. Connect Cable Simulator #1 between the PDH OUT Port and the Matching Pad.


27. Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds. Press [RUN/STOP] to stop the measurement.

1.544 Mb/s (DS-1)

28. Repeat steps 1 to 26 (20dB, 26dB and 30dB tests) with the HP 37717C [TRANSMIT] and [RECEIVE] displays set to SIGNAL [DSX-1] and Cable Simulator #5 fitted in place of Cable Simulator #1.

34.368 Mb/s

29. Repeat steps 1 to 18 (20dB and 26dB tests) with the HP 37717C [TRANSMIT] and [RECEIVE] displays set to SIGNAL [34 Mb/s] and Cable Simulator #2 fitted in place of Cable Simulator #5.

44.736 Mb/s (DS-3)

30. Repeat steps 1 to 18 (20dB and 26dB tests) with the HP 37717C [TRANSMIT] and [RECEIVE] displays set to SIGNAL [DSX-3] and Cable Simulator #6 fitted in place of Cable Simulator #2.

31. Disconnect all test equipment.
Performance Tests

Performance Test Record

Hewlett-Packard Model 37717C Communications Performance Analyzer

<table>
<thead>
<tr>
<th>Location:</th>
<th>Serial No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tested by:</td>
<td>Certified by:</td>
</tr>
<tr>
<td>Temperature:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

Table 11: Performance Test Record

<table>
<thead>
<tr>
<th>Page No.</th>
<th>Test Description</th>
<th>Result</th>
<th>Min</th>
<th>Actual</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self Test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-3</td>
<td>Step 3 All Tests</td>
<td>Pass/Fail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PDH Internal Transmitter Clocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-7</td>
<td>Step 5: 704 kb/s (UKK only)</td>
<td>351.99753 kHz</td>
<td>352.00246 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Step 6: 2 Mb/s</td>
<td>1.0239928 MHz</td>
<td>1.0240072 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Step 7: 8 Mb/s</td>
<td>4.2239704 MHz</td>
<td>4.2240296 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Step 8: 34 Mb/s</td>
<td>17.183797 MHz</td>
<td>17.1841203 MHz</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Step 9: 140 Mb/s</td>
<td>69.6315126 MHz</td>
<td>69.6324874 MHz</td>
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<td></td>
</tr>
<tr>
<td><strong>Frequency Offset Bit Rates</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140 Mb/s</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3-8</td>
<td>Step 11: + 15 ppm</td>
<td>69.63255705 MHz</td>
<td>69.63353191 MHz</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Step 12: - 15 ppm</td>
<td>69.63064218 MHz</td>
<td>69.63126886 MHz</td>
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<tr>
<td></td>
<td>Step 13: + 100 ppm</td>
<td>69.63864986 MHz</td>
<td>69.63927654 MHz</td>
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</tr>
<tr>
<td></td>
<td>Step 14: - 100 ppm</td>
<td>69.62472346 MHz</td>
<td>69.625535014 MHz</td>
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<td></td>
</tr>
</tbody>
</table>
## Table 11 Performance Test Record

<table>
<thead>
<tr>
<th>Page No.</th>
<th>Test Description</th>
<th>Result</th>
<th>Min</th>
<th>Actual</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Frequency Offset</strong></td>
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<tr>
<td>3-12</td>
<td>+ 20 ppm</td>
<td>17.1842234 MHz</td>
<td>17.1844640 MHz</td>
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<tr>
<td></td>
<td>- 20 ppm</td>
<td>17.1835360 MHz</td>
<td>17.1837766 MHz</td>
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<tr>
<td>3-12</td>
<td>+ 30 ppm</td>
<td>4.2240972 MHz</td>
<td>4.2241563 MHz</td>
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<td></td>
<td>- 30 ppm</td>
<td>4.2238437 MHz</td>
<td>4.2239028 MHz</td>
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<tr>
<td>3-12</td>
<td>+ 50 ppm</td>
<td>1.0240440 MHz</td>
<td>1.0240584 MHz</td>
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<tr>
<td></td>
<td>- 50 ppm</td>
<td>1.0239416 MHz</td>
<td>1.0239560 MHz</td>
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<tr>
<td></td>
<td><strong>704 kb/s (UKK only)</strong></td>
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<td></td>
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<tr>
<td>3-12</td>
<td>+ 50 ppm</td>
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<td>352.0201 kHz</td>
<td>352.0151 kHz</td>
<td>352.0201 kHz</td>
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<td></td>
<td>- 50 ppm</td>
<td>351.9799 kHz</td>
<td>351.9849 kHz</td>
<td>351.9799 kHz</td>
<td>351.9849 kHz</td>
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<tr>
<td></td>
<td><strong>PDH Transmitter Output</strong></td>
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<td></td>
<td>Unbal 704 kb/s (UKK only)</td>
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</tr>
<tr>
<td>3-11</td>
<td>+ve Pulse Amp</td>
<td>2.133 V pk</td>
<td>2.607 V pk</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>+ve Pulse Width</td>
<td>639 ns</td>
<td>781 ns</td>
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<tr>
<td></td>
<td>Overshoot</td>
<td></td>
<td>0.474 V</td>
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<tr>
<td></td>
<td>Undershoot</td>
<td></td>
<td>0.474 V</td>
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<tr>
<td>3-11</td>
<td>-ve Pulse Amp</td>
<td>2.133 V pk</td>
<td>2.607 V pk</td>
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<tr>
<td></td>
<td>-ve Pulse Width</td>
<td>639 ns</td>
<td>781 ns</td>
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<td>3-11</td>
<td>Overshoot</td>
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<td>0.474 V</td>
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<td>3-11</td>
<td>Undershoot</td>
<td></td>
<td>0.474 V</td>
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<td></td>
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<tr>
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<td><strong>Bal 704 kb/s (UKK only)</strong></td>
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<tr>
<td>3-12</td>
<td>+ve Pulse Amp</td>
<td>2.133 V pk</td>
<td>2.607 V pk</td>
<td></td>
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</tr>
</tbody>
</table>
### Table 11: Performance Test Record

<table>
<thead>
<tr>
<th>Page No.</th>
<th>Test Description</th>
<th>Result</th>
<th>Min</th>
<th>Actual</th>
<th>Max</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>+ve pulse Width</td>
<td>639 ns</td>
<td></td>
<td>781 ns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overshoot</td>
<td></td>
<td></td>
<td>0.474 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Undershoot</td>
<td></td>
<td></td>
<td>0.474 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-ve Pulse Amp</td>
<td>2.133 V pk</td>
<td>2.607 V pk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-ve Pulse Width</td>
<td>639 ns</td>
<td>781 ns</td>
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<tr>
<td></td>
<td>Overshoot</td>
<td></td>
<td></td>
<td>0.474 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Undershoot</td>
<td></td>
<td></td>
<td>0.474 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unbal 2 Mb/s</strong></td>
<td></td>
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<tr>
<td></td>
<td>Step 14: +ve Pulse Amp</td>
<td>2.133 V pk</td>
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<td>2.607 V pk</td>
<td></td>
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<tr>
<td></td>
<td>Step 16: +ve Pulse Mask</td>
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<td>Pass/Fail</td>
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<td></td>
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<tr>
<td>3-13</td>
<td>Step 20: -ve Pulse Mask</td>
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<td>Pass/Fail</td>
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<td></td>
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<tr>
<td></td>
<td>Step 21: -ve Pulse Amp</td>
<td>2.133 V pk</td>
<td></td>
<td>2.607 V pk</td>
<td></td>
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<tr>
<td>3-14</td>
<td>Step 22: Pulse Amplitude Ratio</td>
<td>0.95</td>
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<td>1.05</td>
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<td></td>
<td>Step 23: Pulse Width Ratio</td>
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<td>0.95</td>
<td>1.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Bal 2 Mb/s</strong></td>
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<td></td>
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**Performance Tests**

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**PDH Receiver Equalization**
## Performance Tests

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*External 2 Mb/s Max/Demux*

UKJ only

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| 3-59     | Step 11: Bit Error Add                    | Pass/Fail     |     |        |      |
| 3-59     | Step 14: +ve Pulse Amp 2.133 V pk         | 2.607 V pk    | 2.133 V pk |
| 3-60     | Step 16: +ve Pulse Mask                   | Pass/Fail     |     |        |      |
| 3-60     | Step 20: -ve Pulse Mask                   | Pass/Fail     |     |        |      |
| 3-61     | Step 21: -ve Pulse Amp 2.133 V pk         | 2.607 V pk    | 2.133 V pk |
| 3-61     | Step 22: Pulse Amplitude Ratio 0.95       | 1.05          | 0.95 |        |      |

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**Step 23:** Pulse Width Ratio
- **External 2 Mb/s Demux**
  - UKL only

- **Step 23:** Pulse Width Ratio 0.95 1.05

**Step 20:** -ve Pulse Amp
- **Step 67:** 2.133 V pk 2.607 V pk

**Step 22:** Pulse Width Ratio
- **Step 22:** Pulse Width Ratio 0.95 1.05

**PDH RX Mon Levels**
*Special Option 808*

- **Step 7:** 704 kb/s (-26 dB) Pass/Fail
- **Step 10:** 2 Mb/s (-26 dB) Pass/Fail
- **Step 13:** 8 Mb/s (-26 dB) Pass/Fail
- **Step 16:** 34 Mb/s (-29 dB) Pass/Fail
- **Step 19:** 140 Mb/s (-26 dB) Pass/Fail

**PDH Error Output**

- **Step 7:** Bit EC Pass/Fail
- **Step 8:** Bit ER Pass/Fail
- **Step 10:** Pulse Period Pass/Fail
- **Step 11:** No Pulses Pass/Fail
- **Step 12:** Alarms On Pass/Fail
- **Step 14:** Pulse Period Pass/Fail
### Performance Test Record

#### Table 11

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# Performance Tests

## Performance Test Record

### Internal SDH Transmitter Clock

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### SDH Frequency Offsets

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### STM-1 RX Mon I/P (Special Option 808)

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Performance Tests
Performance Test Record

Table 11 Performance Test Record

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| **TX Jitter Amplitude Accuracy**  
*Option UHK*  
**Range 1**  
3-129 | Step 7: 2048 kHz | | 0.69 UI | 0.83 UI |
| | 8448 kHz | | 0.69 UI | 0.83 UI |
| | 34368 kHz | | 0.69 UI | 0.83 UI |
| | 139264 kHz | | 0.68 UI | 0.84 UI |
| **2 Mb/s Range 10**  
3-130 | Step 13: 1.8 UI | | 1.5 UI | 2.0 UI |
| | 4.8 UI | | 4.4 UI | 5.1 UI |
| | 8.8 UI | | 8.2 UI | 9.3 UI |
| **8 Mb/s, Range 10**  
3-130 | 1.8 UI | | 1.5 UI | 2.0 UI |
| | 5.8 UI | | 5.3 UI | 6.2 UI |
| | 8.8 UI | | 8.2 UI | 9.3 UI |
| **34 Mb/s, Range 10**  
3-130 | Step 13: | | 2.8 UI | 3.0 UI |
| | 6.8 UI | | 6.2 UI | 7.3 UI |
| | 8.8 UI | | 8.2 UI | 9.3 UI |
| **140 Mb/s, Range 10**  
| 3.8 UI | | 3.3 UI | 4.2 UI |
| | 7.8 UI | | 7.1 UI | 8.4 UI |
| | 8.8 UI | | 8.1 UI | 9.4 UI |
| **TX Jitter/Wander Amplitude Accuracy**  
*Option A3K*  
**Range 1**  
| | | | | |

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3-255
## Performance Test Record

**Table 11**

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### Performance Test Record

#### RX Jitter Accuracy Option UHN

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#### Demodulated Jitter O/P

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#### Wander/Slips Accuracy

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#### Jitter Receiver STM-1E Input Equalization

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## Table 11 Performance Test Record

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Table 11: Performance Test Record

ETSI/ANSI Internal Transmitter Clock Rates (Option UKZ)

**DS3 Frequency Accuracy**

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<td>Step 5 Frequency</td>
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<td>44737096.0 Hz</td>
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**E1 (2.048Mb/s) Frequency Accuracy**

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**E3 (34.368Mb/s) Frequency Accuracy**

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**DS1 Frequency Accuracy**

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Transmitter Output Level and Waveshape (Option UKZ)

**34.368 Mb/s Positive Pulse**

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<td>Step 9 peak pulse amplitude</td>
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**34.368 Mb/s Negative Pulse**

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<td>Step 8 peak pulse amplitude</td>
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<td>1.100 Volts</td>
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**2.048 Mb/s Positive Pulse**
### Performance Test Record

**Table 11**

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3-260
## Performance Tests

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**Trigger Output (Option UKZ)**

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**STS-3 Transmitter Output Waveshape (Option 120)**

| 3-210   | Step 6: ALL ONES Mask                                | Pass/Fail            |
| 3-212   | Step 10 ALL ZEROS Mask                               | Pass/Fail            |
| 3-213   | Step 13: Eye Diagram Mask                            | Pass/Fail            |

**STM-1/STS-3 Receiver Monitor Input (Option 120)**

| 3-216   | Step 6: Alarms Off                                   | Pass/Fail            |
|         | Step 7: Trouble Scan                                 | Pass/Fail            |

**ETS/ANSI Internal Transmitter Clock Rates (Option 110)**

**DS3 Frequency Accuracy**

| 3-220   | Step 5: Frequency                                    | 44735798.7 Hz        | 44736201.3 Hz        |
|         | Step 6: Frequency                                    | 44736693.4 Hz        | 44737096.0 Hz        |
|         | Step 7: Frequency                                    | 44734904.0 Hz        | 44735306.6 Hz        |

**E1 (2.048Mb/s) Frequency Accuracy**

| 3-219   | Step 2: Frequency                                    | 2047990.8 Hz         | 2048009.2 Hz         |
### Performance Test Record

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<td>Step 23</td>
<td>Trouble Scan</td>
<td>Pass/Fail</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ETSI / ANSI Equivalent Terms

Terms

This section contains Tables of ETSI Terms with their ANSI equivalents and current terms with their equivalent earlier terms.

ETSI / ANSI Equivalent Terms

The Terminology used on the instrument display is mainly ETSI terminology. The equivalent ANSI terminology is given in the following table.

<table>
<thead>
<tr>
<th>ETSI Term</th>
<th>ANSI Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-n Intra Office, STM-n</td>
<td>Intermediate Reach (IR)</td>
</tr>
<tr>
<td>L-n.1 or L-n.2 long haul</td>
<td>LR long reach</td>
</tr>
<tr>
<td>Multiplexer Section (MS)</td>
<td>Line</td>
</tr>
<tr>
<td>MS-AIS</td>
<td>AIS-L (Line AIS)</td>
</tr>
<tr>
<td>MS-BIP</td>
<td>Line BIP</td>
</tr>
<tr>
<td>MS-DCC</td>
<td>Line DCC</td>
</tr>
<tr>
<td>MS-RDI (MS FERF)</td>
<td>RDI-L (Line FERF)</td>
</tr>
<tr>
<td>Multiplexer Section Overhead</td>
<td>Line Overhead</td>
</tr>
<tr>
<td>Network Node Interface</td>
<td>Line Interface</td>
</tr>
<tr>
<td>AU-AIS (Path AIS)</td>
<td>AIS-P</td>
</tr>
<tr>
<td>HP-RDI (Path FERF)</td>
<td>RDI-P</td>
</tr>
<tr>
<td>Regenerator</td>
<td>Repeater</td>
</tr>
<tr>
<td>Regenerator Section (RS)</td>
<td>Section</td>
</tr>
<tr>
<td>Remote Alarm Indicator</td>
<td>Yellow Alarm</td>
</tr>
<tr>
<td>Regenerator Section Overhead</td>
<td>Section Overhead</td>
</tr>
<tr>
<td>RS-DCC</td>
<td>Section DCC</td>
</tr>
</tbody>
</table>
Installation

ETSI / ANSI Equivalent Terms

<table>
<thead>
<tr>
<th>ETSI Term</th>
<th>ANSI Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-n.1 or S-n.2 short haul</td>
<td>Short Reach (SR)</td>
</tr>
<tr>
<td>STM-n</td>
<td>STS-n</td>
</tr>
<tr>
<td>SOH</td>
<td>TOH</td>
</tr>
<tr>
<td>Section Overhead (SOH)</td>
<td>Transport Overhead (TOH)</td>
</tr>
<tr>
<td>Tributary Unit (TU)</td>
<td>Virtual Tributary (VT)</td>
</tr>
<tr>
<td>TU</td>
<td>VT</td>
</tr>
<tr>
<td>TU-AIS</td>
<td>VT AIS (AIS-V)</td>
</tr>
<tr>
<td>TU FERF / TU RDI</td>
<td>RDI-V / VT FERF</td>
</tr>
<tr>
<td>TU REI</td>
<td>VT FEBE</td>
</tr>
<tr>
<td>VC</td>
<td>SPE</td>
</tr>
<tr>
<td>Virtual Container</td>
<td>Payload Envelope</td>
</tr>
<tr>
<td>Virtual Container (VC)</td>
<td>Synchronous Payload Envelope (SPE)</td>
</tr>
<tr>
<td>VP-RDI (VP-FERF)</td>
<td>VP-RDI</td>
</tr>
<tr>
<td>VC-RDI (VC-FERF)</td>
<td>VC-RDI</td>
</tr>
</tbody>
</table>

NOTE: VC is an ETSI abbreviation for Virtual Container and an ETSI / ANSI abbreviation for (ATM) Virtual Channel. The context of VC must therefore be taken into account when converting between standards.
## Current / Previous Terminology

<table>
<thead>
<tr>
<th>Current Terminology</th>
<th>Previous Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 BIP</td>
<td>RS B1 BIP</td>
</tr>
<tr>
<td>B2 BIP</td>
<td>MS B2 BIP</td>
</tr>
<tr>
<td>B3 BIP</td>
<td>Path B3 BIP</td>
</tr>
<tr>
<td>MS-AIS</td>
<td>MS AIS</td>
</tr>
<tr>
<td>MS-RDI</td>
<td>MS RDI</td>
</tr>
<tr>
<td>MS-REI</td>
<td>MS FEBE</td>
</tr>
<tr>
<td>HP-IEC</td>
<td>Path IEC</td>
</tr>
<tr>
<td>AU-LOP</td>
<td>LOP</td>
</tr>
<tr>
<td>AU-AIS</td>
<td>Path AIS</td>
</tr>
<tr>
<td>HP-RDI</td>
<td>Path FERF</td>
</tr>
<tr>
<td>HP-REI</td>
<td>Path FEBE</td>
</tr>
<tr>
<td>TU-LOP</td>
<td>TU LOP</td>
</tr>
<tr>
<td>TU-AIS</td>
<td>TU Path AIS</td>
</tr>
<tr>
<td>LP-RDI</td>
<td>TU Path FERF</td>
</tr>
<tr>
<td>LP-REI</td>
<td>TU Path FEBE</td>
</tr>
</tbody>
</table>
Appendix A - Default 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 in the HP 37717C on the OTHER STORED SETTINGS display.

One preset store is provided which cannot be overwritten, STORED SETTING NUMBER [0], and is used to set the HP 37717C to a known state. The known state is the FACTORY DEFAULT SETTINGS as listed below.

**TRANSMIT** display (UPDH Option UKK)

<table>
<thead>
<tr>
<th>Signal</th>
<th>140 Mb/s</th>
<th>Clock Sync</th>
<th>Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>CMI</td>
<td>Pattern</td>
<td>$2^{23}$-1</td>
</tr>
<tr>
<td>Termination</td>
<td>75Ω Unbal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TRANSMIT** display (SPDH Option UKJ)

<table>
<thead>
<tr>
<th>Settings</th>
<th>Main</th>
<th>Signal</th>
<th>140 Mb/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock Sync</td>
<td>Internal</td>
<td>Termination</td>
<td>75Ω Unbal</td>
</tr>
<tr>
<td>Line Code</td>
<td>CMI</td>
<td>Frequency Offset</td>
<td>Off</td>
</tr>
<tr>
<td>Payload Type</td>
<td>Unframed</td>
<td>Pattern</td>
<td>$2^{23}$-1</td>
</tr>
<tr>
<td>PRBS Polarity</td>
<td>INV</td>
<td>Test Signal</td>
<td>34 Mb/s</td>
</tr>
<tr>
<td>34M Payload</td>
<td>Unframed</td>
<td>2M Payload</td>
<td>Unframed</td>
</tr>
<tr>
<td>2M Payload</td>
<td>Unframed</td>
<td>34 Mb</td>
<td>1</td>
</tr>
<tr>
<td>8 Mb</td>
<td>1</td>
<td>2 Mb</td>
<td>1</td>
</tr>
<tr>
<td>64 kb</td>
<td>1</td>
<td>BG Pattern</td>
<td>AIS</td>
</tr>
<tr>
<td>User Word</td>
<td>1111111111111111</td>
<td>Error Add</td>
<td>Bit</td>
</tr>
<tr>
<td>Error Add Rate</td>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Appendix A - Default Settings

## TRANSMIT display (SDH)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Payload</th>
<th>Clock Sync</th>
<th>Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>140 Mb/s</td>
<td>Payload Pattern</td>
<td>$2^{23}$.1</td>
</tr>
<tr>
<td>TUG3</td>
<td>1</td>
<td>TUG2</td>
<td>1</td>
</tr>
<tr>
<td>TU</td>
<td>1</td>
<td>2 Mb/s Pattern</td>
<td>$2^{15}$.1</td>
</tr>
</tbody>
</table>

## TRANSMIT display (ATM Option UKN)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Code</th>
<th>Cell Stream</th>
<th>B/G 1 Bandwidth</th>
<th>B/G 2 Bandwidth</th>
<th>B/G 3 Bandwidth</th>
<th>Burst Size</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 Mb/s, Internal</td>
<td>HDB3</td>
<td>Distribution</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 Cell</td>
<td>UNI</td>
</tr>
<tr>
<td>Code</td>
<td>Termination</td>
<td>F/G Bandwidth</td>
<td>B/G Stream</td>
<td>F/G Distribution</td>
<td>Burst</td>
<td>F/G Payload</td>
<td>B/G Payload</td>
</tr>
<tr>
<td>Internal</td>
<td>75Ω Unbal</td>
<td>80,000 c/s</td>
<td>1</td>
<td>1</td>
<td>Idle</td>
<td>00000001</td>
<td>Fill Cells</td>
</tr>
</tbody>
</table>

## RECEIVE display (UPDH Option UKK)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Code</th>
<th>Test Mode</th>
<th>Out of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>140 Mb/s</td>
<td>CMI</td>
<td>Pattern</td>
<td>$2^{23}$.1</td>
</tr>
<tr>
<td>Code</td>
<td>Termination</td>
<td>75Ω Unbal</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix A - Default Settings

### RECEIVE display (SPDH Option UKJ, UKL)

<table>
<thead>
<tr>
<th>Settings</th>
<th>Main</th>
<th>Signal</th>
<th>140 Mb/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination</td>
<td>75Ω Unbal</td>
<td>Line Code</td>
<td>CMI</td>
</tr>
<tr>
<td>Gain</td>
<td>20 dB</td>
<td>Equalizer</td>
<td>Off</td>
</tr>
<tr>
<td>Payload Type</td>
<td>Unframed</td>
<td>Pattern</td>
<td>2^{23}-1</td>
</tr>
<tr>
<td>PRBS Polarity</td>
<td>INV</td>
<td>Test Signal</td>
<td>34 Mb/s</td>
</tr>
<tr>
<td>34M Payload</td>
<td>Unframed</td>
<td>8M Payload</td>
<td>Unframed</td>
</tr>
<tr>
<td>2M Payload</td>
<td>Unframed</td>
<td>34 Mb</td>
<td>1</td>
</tr>
<tr>
<td>8 Mb</td>
<td>1</td>
<td>2 Mb</td>
<td>1</td>
</tr>
<tr>
<td>64 kb</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RECEIVE display (SDH)

<table>
<thead>
<tr>
<th>Signal</th>
<th>STM-1</th>
<th>Payload</th>
<th>140 Mb/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payload Pattern</td>
<td>2^{23}-1</td>
<td>TUG3</td>
<td>1</td>
</tr>
<tr>
<td>TUG2</td>
<td>1</td>
<td>TU</td>
<td>1</td>
</tr>
</tbody>
</table>

### RECEIVE display (ATM Option UKN)

<table>
<thead>
<tr>
<th>Signal</th>
<th>34 Mb/s</th>
<th>Termination</th>
<th>75Ω Unbal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
<td>HDB3</td>
<td>Interface</td>
<td>UNI</td>
</tr>
<tr>
<td>Test Cell</td>
<td>All User</td>
<td>Cell Payload</td>
<td>Cross Cell, 2^{15}-1</td>
</tr>
</tbody>
</table>

### RESULTS display

<table>
<thead>
<tr>
<th>Results</th>
<th>Trouble Scan</th>
<th>Short Term Period</th>
<th>1 Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Timing</td>
<td>Manual</td>
<td>Single Test Duration</td>
<td>1 Hour</td>
</tr>
<tr>
<td>Storage</td>
<td>OFF</td>
<td>SDH Results</td>
<td>Short Term, RS B1 BIP</td>
</tr>
<tr>
<td>PDH Results</td>
<td>Short Term</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A - Default Settings

#### OTHER display

<table>
<thead>
<tr>
<th>Stored Setting Lock</th>
<th>On</th>
<th>Stored Setting Number</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printer</td>
<td>Internal Printing</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>Print Period</td>
<td>OFF</td>
<td>Print Error Seconds</td>
<td>OFF</td>
</tr>
<tr>
<td>Print Mode</td>
<td>Normal</td>
<td>Print Speed</td>
<td>9600 Baud</td>
</tr>
<tr>
<td>Clock Mode</td>
<td>Run</td>
<td>Keyboard lock</td>
<td>OFF</td>
</tr>
<tr>
<td>Beep On Error</td>
<td>OFF</td>
<td>Analysis Display Mode</td>
<td>G.821</td>
</tr>
<tr>
<td>Suspend Test on LOS</td>
<td>OFF</td>
<td>Self Test</td>
<td>All Tests</td>
</tr>
<tr>
<td>Settings Control</td>
<td>Independent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Status Registers

<table>
<thead>
<tr>
<th>Register</th>
<th>+ve Transition</th>
<th>-ve Transition</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESR</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>QUES</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 0s</td>
</tr>
<tr>
<td>OPER</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 0s</td>
</tr>
<tr>
<td>INST</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>DATA</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>PDH</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>FAS</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>SDH</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>SDH2</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>SPDH</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>M140</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>M34</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>M8</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
<tr>
<td>M2</td>
<td>All 1s</td>
<td>All 0s</td>
<td>All 1s</td>
</tr>
</tbody>
</table>
Appendix B - Fitting, Calibrating & Testing New Modules

Some of the Performance Tests for the HP 37717C require additional modules to be present in the instrument. Table B-1 lists each module (and option) under test and the additional modules which must be present to test it.

To decide if you need to fit any modules, compare Table B-1 with the options listed on the Rear Panel of the instrument under test.

If additional modules are required, follow the procedure below when fitting, calibrating and testing. Some modules also need to be calibrated after fitting (see Table B-1). Calibration procedures for these modules are included here.

<table>
<thead>
<tr>
<th>Module Under Test</th>
<th>Option Under Test</th>
<th>Module(s) Required</th>
<th>Part Number</th>
<th>Calibration Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstructured PDH Tx/Rx</td>
<td>UKK, [USB]</td>
<td>None</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>special 808</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured PDH Tx</td>
<td>UKJ, [USA]</td>
<td>SPDH Rx</td>
<td>37717-60021</td>
<td>No</td>
</tr>
<tr>
<td>Structured PDH Rx</td>
<td>UKJ, [USA],</td>
<td>SPDH Tx</td>
<td>37717-60020</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>UKL, [USC]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDH Tx/Rx</td>
<td>US1, [US5],</td>
<td>None</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>A1T, [A1U]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A3R [A3S]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Tx/Rx</td>
<td>UH1, UH2,</td>
<td>SDH Tx/Rx</td>
<td>37714-60048</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>URU, USN,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>UKT, 130,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>131</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDH/SDH Jitter Tx</td>
<td>UHK, A3K</td>
<td>PDH Tx</td>
<td>37714-60044*</td>
<td>No</td>
</tr>
<tr>
<td>PDH Jitter Rx</td>
<td>UHN [US9],</td>
<td>Jitter Tx PDH</td>
<td>37717-60010</td>
<td>Jitter Tx</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx/Rx</td>
<td>37714-60044*</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix B - Fitting/Calibrating/Testin New Modules

**CAUTION**

If 37714-60012 (Option URU) is fitted, the optical output must be attenuated by 10 dB before connecting to the Optical input of any other 37717C optical module. Failure to do this could result in damage to the HP 37717C. Table 3-1 lists a suitable attenuator.

---

Table B-1

**Additional Modules Required for Performance Tests**

<table>
<thead>
<tr>
<th>Module Under Test</th>
<th>Option Under Test</th>
<th>Module(s) Required</th>
<th>Part Number</th>
<th>Calibration Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional PDH Outputs</td>
<td>UHC, [US6]</td>
<td>PDH Tx/Rx</td>
<td>37714-60044*</td>
<td>No</td>
</tr>
</tbody>
</table>

* 37717-60020/21 may be used (Structured PDH Modules). ** 37714-60012/60013 may be used (STM1/4 Modules).
Appendix B - Fitting/Calibrating/Testing New Modules

**Location of Modules in HP 37717C Mainframe**

### Table B-2

<table>
<thead>
<tr>
<th>Module Description</th>
<th>Option Numbers</th>
<th>Fitting Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optics</td>
<td>UH1, UH2, URU, USN, UKT, 130, 131</td>
<td>Always Slot 1.</td>
</tr>
<tr>
<td>SDH Binary I’face</td>
<td>0YH</td>
<td>Attached to UKT or USN or 130 or 131 in slot 2.</td>
</tr>
<tr>
<td>SDH</td>
<td>US1 [US5], A1T [A1U], A3R [A3S]</td>
<td>Immediately to right of SDH Binary. If SDH Binary not fitted immediately to right of Optics..</td>
</tr>
<tr>
<td>Unstructured/Structured PDH (Tx and Rx Modules)</td>
<td>UKK [USB], UKJ [USA]</td>
<td>Tx Module is always on the left side. To right of Jitter TX, PDH Multiple O/P’s, or SDH.</td>
</tr>
<tr>
<td>Multiple Outlets</td>
<td>UHC [US6]</td>
<td>Immediately to the right of SDH.</td>
</tr>
<tr>
<td>PDH Binary I’face</td>
<td>UH3 [US7]</td>
<td>Immediately to right of PDH RX.</td>
</tr>
</tbody>
</table>
Appendix B - Fitting/Calibrating/Testing New Modules

Retrofit Procedure

The following procedure should be used when fitting any new Module into the HP 37717C.

**CAUTION**

This procedure should only be carried out by qualified Service Personnel.

**CAUTION**

Anti-static precautions must be observed at all times. Use the anti-static wrist-strap provided in this kit if an anti-static work-area conforming to Corporate Standard 741.808 is unavailable.

**CAUTION**

Read the anti-static documentation at the end of this procedure.

1. Switch off the instrument and disconnect the power cord.
2. Remove the rear panel feet.

---

**Table B-2**

<table>
<thead>
<tr>
<th>Module Description</th>
<th>Option Numbers</th>
<th>Fitting Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jitter Tx</td>
<td>UHK, A3K [A3Q], 140 [141]</td>
<td>If Mult O/P fitted, immediately to the right of this. If Mult O/P not fitted, immediately to the right of SDH. If SDH and Mult. O/P not fitted immediately to right of Optics.</td>
</tr>
<tr>
<td>Jitter Rx</td>
<td>UHN [US9], A1M [A1Q], A1N [A1R], A1P [A1S], A3L [A3M], A3V [A3W], A3N [A3P]</td>
<td>If Binary Interfaces (UH3) fitted immediately to the right of it. If UH3 not fitted immediately to right of PDH RX. If UH3 and PDH not fitted immediately to right of SDH.</td>
</tr>
<tr>
<td>Blanking Plates</td>
<td>37714-00013 (single) 37714-00014 (double)</td>
<td>Blanking Plates should be fitted at the rear (CPU end) to fill in any gaps left after fitting all required modules.</td>
</tr>
</tbody>
</table>
Appendix B - Fitting/Calibrating/Testing New Modules

3 If Optical Modules are fitted (option UH1, UH2 or URU), unscrew the optical shield from each input and output connector.

4 Withdraw the outer cabinet sleeve back and out of the instrument.

5 Remove the clamp screws along the top and bottom right-hand side of the chassis which secure blanking plates and modules.

CAUTION Modules must be removed and fitted in the correct sequence to prevent damage:

CAUTION From Front to back when removing.

CAUTION From back to front when fitting.

6 Withdraw modules and blanking plates from the instrument.

7 Fit all existing modules plus the new module(s) and blanking plates back into the instrument in the order shown in Figure B-1 and Table B-2.

8 Secure each module with the two clamp screws.

9 Replace the Optical Shields (if optical module fitted), then fit the Outer Cabinet Sleeve and Rear Panel feet as a reversal of the removal procedure.

Testing

1 Power on the instrument and check for a sensible display.

2 Carry out the instrument selftests (see page 3-5). If the new module also needs to be calibrated (see Table B-1), this must be done before running the selftests. Use the procedures which follow to calibrate the module.

3 You can now carry out the required Performance Tests. When all Performance Tests have been successfully completed, return the instrument to it’s original module configuration.
Appendix B - Fitting/Calibrating/Testing New Modules

**Jitter Transmitter Module Calibration**

If a new Jitter Transmitter Module has been fitted this will need to be calibrated before it can be used, as all calibration data for this module is stored in a special eeprom on the CPU Module.

**Description**

The Jitter Transmitter Calibration is semi-automatic and is performed by using a special internal calibration routine and a Spectrum Analyzer. The HP 37717C TX PDH OUTPUT is connected to the Analyzer (via 75Ω/50Ω Matching Pad) and set to the first calibration point in the routine. With the Analyzer set to display the transmitted data spectrum, a Bessel Null should be observed. The HP 37717C DAC output is adjusted using the calibration routine to optimise this Bessel Null. This sets the transmitted jitter to exactly 0.765UI. This process is repeated for all other Calibration points in the routine.

**Equipment**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum Analyser</td>
<td>HP 8568B</td>
</tr>
<tr>
<td>75Ω/50Ω Matching Pad</td>
<td>HP 8568B</td>
</tr>
</tbody>
</table>

**Pre-Adjustment Setup**

Before carrying out Jitter Transmitter Calibration, you will need to perform the following pre-adjustment setup.

1. Recall the HP 37717C Default Settings with the following key sequence;
2. Press OTHER, then STORED SETTINGS. Select STORED SETTINGS number [0]. Select ACTION [RECALL].
3. Couple the HP 37717C transmitter and Receiver with the following key sequence;
   - Press OTHER, then SETTINGS CONTROL. Select TRANSMITTER & RECEIVER [COUPLED]
Appendix B - Fitting/Calibrating/Testing New Modules

4. Make the following key sequence on the HP 37717C to obtain the MODULE DEBUG display.

   Press \texttt{OTHER}, \texttt{MORE}, \texttt{MORE}, \texttt{MORE}, \texttt{MORE}, \texttt{MORE}.

   Press \texttt{MORE} until MODULE DEBUG appears in the softkey menu.

\textbf{CAUTION}

When using the MODULE DEBUG display, only modify parameters shown below. Altering other parameters can cause damage to the instrument - prevent accidental damage by leaving the Module Debug Page after setting up.


6. Select VCO CONTROL MODE [FIXED].

7. Select MODULE [JITTER MODULE] on the Module Debug Display.

8. Select TX CALIBRATION [ON].

9. Select RX CALIBRATION [OFF].

\textbf{CAUTION}

The previous pre-adjustment sequence will need to be performed again if power is cycled during Jitter Calibration, as MODULE DEBUG parameters return to default values when instrument power is cycled.

\textbf{Jitter Transmitter Calibration Procedure}

1. Connect the HP 37717C Transmitter Output to the Spectrum Analyzer via the 75Ω/50Ω Matching Pad.

2. Set the Spectrum Analyzer as follows:

   Centre Frequency 2048kHz
   Reference Level 0dBm
   Video Bandwidth 1kHz
   Frequency Span 100kHz
   Sweep Time 1.0 seconds
   Resolution Bandwidth 100Hz

3. Press the \texttt{OTHER} then \texttt{MORE} twice. Select the CALIBRATION function.
Appendix B - Fitting/Calibrating/Testing New Modules

4. Select CALIBRATE PASSWORD and set to [1243] using INCREASE DIGIT and DECREASE DIGIT.

5. Select the calibration item [JITTER Tx].

6. Press [RUN/STOP] to start calibration. The Spectrum analyzer should display a symmetrical spectrum of lines similar to that shown in Figure B-2. The central line is the transmission carrier.

NOTE
If the calibration routine will not start ([RUN/STOP] led will not light), ensure that the instrument TIME and DATE are set correctly - refer to the Mainframe Operating Manual for setup procedures for the internal clock.

7. Move the cursor to DAC and adjust the DAC value (using only the Least Significant Bit) until the carrier level displayed on the Spectrum Analyzer is at a minimum. (Bessel Null).

8. When the Bessel Null is obtained, move the cursor to TOGGLE WHEN AT ZERO POINT and press ZERO POINT softkey. This stores the value for the modulation frequency and the routine automatically moves on to the next calibration value.

9. Repeat steps 7 and 8 for each new calibration value. At each change of BIT RATE, set the Spectrum Analyzer center frequency to the new BIT RATE and re-adjust the span to optimise the spectrum around the carrier.

10. When finished, the HP 37717C display should show the new Calibration Date and the [RUN/STOP] led should be extinguished.

11. Press [TRANSMIT] to return to normal operation then disconnect all test equipment.
Appendix B - Fitting/Calibrating/Testing New Modules

Typical Jitter Transmit Spectrum
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In This Book
This book contains the instrument specifications and provides techniques for checking them.