Installation and
Verification
Manual

# HP 37718A/37719A Communications Performance Analyzer

**Documentation Warranty**

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

*Hewlett-Packard makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties or merchantability and fitness for a particular purpose.*

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

**WARNING**

For details of safety, see Safety information in this manual.

Installation and Verification Manual

# HP 37718A/37719A Communications Performance Analyzer

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Contents

# 1        General Information

## Warranty

HP PRODUCT                    DURATION OF WARRANTY

HP 37718A/19A                          3 years

**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.

7  TO THE EXTENT ALLOWED BY LOCAL LAW, THE ABOVE WARRANTIES ARE EXCLUSIVE AND NO OTHER WARRANTY OR CONDITION, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED AND HP SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY, SATISFACTORY QUALITY, AND FITNESS FOR A PARTICULAR PURPOSE.

8  HP will be liable for damage to tangible property per incident up to the greater of $300,000 or the actual amount paid for the product that is the subject of the claim, and for damages for bodily injury or death, to the extent that all such damages are determined by a court of competent jurisdiction to have been directly caused by a defective HP product.

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.

FOR CONSUMER TRANSACTIONS IN AUSTRALIA AND NEW ZEALAND: THE WARRANTY TERMS CONTAINED IN THIS STATEMENT, EXCEPT TO THE EXTENT LAWFULLY PERMITTED, DO NOT EXCLUDE, RESTRICT OR MODIFY AND ARE IN ADDITION TO THE MANDATORY STATUTORY RIGHTS APPLICABLE TO THE SALE OF THIS PRODUCT TO YOU.

## 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.

## 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.

## Notice

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# 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.

```
┌──────────────────────────────┐
│  SER   GB00000101            │
├──────────────────────────────┤
│  OPT                         │
├──────────────────────────────┤
│    [hp]  HEWLETT PACKARD     │
│          MADE IN U.K.        │
└──────────────────────────────┘
```

**Serial Number Plate**

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# Storage and Shipment

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

**Temperature**  $-20^o$ C to $+70^o$ C

$-15^o$ C to $+50^o$ 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.

**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).

# 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 37718A/19A" 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 37718A/19A

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.

## 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.
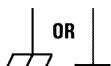
Frame or chassis ground terminal - typically connects to the
equipment's metal frame.

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 pro-
ceed 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.

# Operators Maintenance

**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:

| Description | HP Part Number |
|---|---|
| Blow Brush | 9300-1131 |
| Isopropyl Alcohol | 8500-5344 |
| Lens Cleaning Paper | 9300-0761 |
| Adhesive Tape Kit | 15475-68701 |

**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 37718A/19A.

**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.

$C\,\epsilon$  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)

# 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 HP37718A/19A 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 2-11

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**Declaration of Conformity**
according to ISO/IEC Guide 22 and EN45014

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

Declares that the product

| | |
|---|---|
| **Product Name:** | Communications performance Analyzer |
| **Model Numbers:** | HP 37718A |
| **Product Options:** | This declaration covers all options of the above products as detailed in TCF A-5951-9852-01 |

Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility.

Against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992

| | |
|---|---|
| **As Detailed in:** | Electromagnetic Compatibility (EMC) |
| | Technical Construction File (TCF) No. A-5951-9852-01 |
| **Assessed by:** | Dti Appointed Competent Body<br>EMC Test Centre,<br>GEC-Marconi Avionics Ltd.,<br>Maxwell Building,<br>Donibristle Industrial Park,<br>KY11 5LB<br>Scotland, United Kingdom |

Technical Report Number:6893/2200/CBR, dated 21 August 1997

**Supplementary Information:**

The product conforms to the following safety standards:

IEC 61010-1:1992
EN 61010-1:1993
CSA-C22.2 No. 1010 Series M-93
EN 60825-1(1994) / IEC 825-1 (1993)

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and carries the CE-marking accordingly.

| | | |
|---|---|---|
| *South Queensferry, Scotland* | *9 September 1998* | *W.R. Pearson* |
| *Location* | *Date* | *W.R. Pearson / Quality Manager* |

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**Declaration of Conformity**
according to ISO/IEC Guide 22 and EN45014

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Declares that the product

| | |
|---|---|
| **Product Name:** | Communications Performance Analyzer |
| **Model Numbers:** | HP 37719A |
| **Product Options:** | This declaration covers all options of the above products as detailed in TCF A-5951-9852-01 |

Conforms with the protection requirements of European Council Directive 89/336/EEC on the approximation of the laws of the member states relating to electromagnetic compatibility.

Against EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992

| | |
|---|---|
| **As Detailed in:** | Electromagnetic Compatibility (EMC) |
| | Technical Construction File (TCF) No. A-5951-9852-01 |
| **Assessed by:** | Dti Appointed Competent Body<br>EMC Test Centre,<br>GEC-Marconi Avionics Ltd.,<br>Maxwell Building,<br>Donibristle Industrial Park,<br>KY11 5LB<br>Scotland, United Kingdom |

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| | | |
|---|---|---|
| *South Queensferry, Scotland* | *9 September 1998* | *W R Pearson* |
| *Location* | *Date* | *W.R. Pearson / Quality Manager* |

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# 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.

## PDH (Option 010 with Option 001)

**Bit rates:** 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s, 139.264Mb/s
**Interface:** Meets ITU-T G.703
**Connectors:** BNC 75$\Omega$ unbalanced, 3 pin Siemens 120$\Omega$ balanced

**Clock:** Internal ±4.5 ppm.
Loop Timed - recovered from receiver.

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

**Line coding:** 140 Mb/s - CMI
34 Mb/s - HDB3.
8 Mb/s, 2 Mb/s - AMI, HDB3.

## Framing:
**All Rates:** Unframed, Framed or Structured.
**2 Mb/s:** PCM30 CAS with or without CRC4, PCM31 with or without CRC4. As ITU-T Recs. G.704, G.706 and G.732
**8 Mb/s:** As ITU-T Rec. G.742
**34 Mb/s:** As ITU-T Rec. G.751
**140 Mb/s:** As ITU-T Rec. G.751

**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.
**Live traffic -** Receiver only.

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

**Error add type:** Bit, Frame - all rates.
CRC4, REBE - 2 Mb/s only.
Code - 2, 8 and 34 Mb/s only.
**Error add rate:** Single and $1X10^n$ (n = 3 to 7). Frame burst = 1 to 4 consecutive framewords.

**Alarm generation:** LOS, AIS, LOF, RAI, RMFAI, CASMFL, Minor alarm.

## Spare bits generation:
**140 Mb/s:** FAS bits 14 to 16
**8 & 34 Mb/s:** FAS bit 12
**2 Mb/s:**
**Si bits (international bits):** Timeslot 0 bit 1 in both FAS and NFAS frames.
**E bits:** CRC4 frames 13 and 15; timeslot 0 bit 1.
**Sa bit (national bits):** NFAS timeslot bits 4 to 8.
**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.
**CAS multiframe:** MFAS timeslot bits 5, 7 and 8.

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

**CAS signalling:** Modify and monitor ABCD signalling bits (PCM30 or PCM30CRC framing)

**Receiver capture range:**
**All rates:** ±100 ppm.

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

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

**Synchronization:** Sync loss when BER ≥ 20% over 100 ms for PRBS or ≥ 4% over100 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:** 6 dB
**34.368 Mb/s, 139.264 Mb/s:** 12 dB

**Monitor point compensation:**
**2.048 Mb/s, 8.448 Mb/s:** 20 dB, 26 dB or 30 dB.
**34.368, 139.264 Mb/s:** 20 dB or 26 dB.

**Frame alignment**
**2 Mb/s:** As ITU-T Rec. G.706
**2 Mb/s CRC4:** As ITU-T Rec. G.706.
**2 Mb/s CAS:** As ITU-T Rec. G.732.
**8 Mb/s:** As ITU-T Rec. G.742.
**34 Mb/s:** As ITU-T Rec. G.751.
**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.

**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 - days, hours, minutes, seconds.

**Real-time clock:** Date, time and elapsed test time.

**Error summary:** Bit, Code, Frame, CRC, REBE - error count and ratio

**Error analysis**
**ITU-T G.821:** Bit, Frame - All rates, CRC REBE - 2 Mb/s only.
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
Degraded minutes
Percentage degraded minutes
Code error seconds
Elapsed time
**M.2100:** TX Error seconds, RX error seconds. TX severely errored seconds, RX severely errored seconds, TX unavailability, RX unavailability.
**M.2110:** 2 hour BIS result, 24 hour BIS result, 7 day BIS result.

**M.2120:** TX 15 minute threshold report, RX 15 minute threshold report, TX 24 hour threshold report, RX 24 hour threshold report.

**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 line rate 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, 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.

**Trouble Scan:** Up to four prioritised non-zero error results are displayed in extra-large characters.

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

**Frequency measurement:** Frequency in Hz, resolution 1 Hz
Offset from internal clock rate (ppm), (Hz)

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

**Autosetup:** Detects line rate, signal structure and test pattern of the received signal.

**DSn/PDH (Option 011 with Option 002)**

**Bit rates:** 1.544, 2.048, 34.368, 44.736 Mb/s.

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

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

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

**Clock timing:** Internal ±4.5 ppm.
Loop Timed - recovered from receiver.

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

**Test signal rates:** N X 64 kb/s, 64 kb/s, 2.048 Mb/s, 8.448 Mb/s and 34.368 Mb/s. N X 56 kb/s, 56 kb/s, DS1 and DS2.

**Line coding:**
**DS1:** B8ZS, AMI.
**DS3**: B3ZS.
**E1:** AMI, HDB3.
**E3:** HDB3.

**Framing:**
**All rates:** Unframed, framed and structured.
**DS1:** D4, SLC-96, ESF. 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. 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.

**Test pattern:**
**PRBS:** $2^9$-1, $2^{11}$-1, $2^{15}$-1, $2^{20}$-1, $2^{23}$-1, QRSS (DS1only), 3-in-24 stress pattern (DS1 only).
**Word:** 1010, 1000, 16 bit user word, all ones, all zeros.
**Live traffic:** Receiver only.

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

**Error add type:**
**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, Code, CRC-4, REBE.
**E3:** Bit, FAS, Code.

**Error add 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:** LOS; Out of frame (OOF); AIS; 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. N and M are in the range 1 through 15.
**Alarm/status codes:** Any ANSI T1.107-1995 message or a 0xxxxxx011111111 message where x is selectable may be transmitted either in a single burst of 1 to 15 times or continuously.

**Spare bits generation:**
**34 Mb/s**: FAS bit 12
**2 Mb/s**
**Si bits (international bits):** Timeslot 0 bit 1 in both FAS and NFAS frames.
**E bits:** CRC4 frames 13 and 15; timeslot 0 bit 1.
**Sa bit (national bits):** NFAS timeslot bits 4 to 8.
**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.
**CAS multiframe:** MFAS timeslot bits 5, 7 and 8.

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

**Signaling bits**
**Modify and monitor:** AB for DS1 SF and SLC-96 framing.
ABCD bits for DS1 ESF, E1 PCM30 and PCM30CRC framing.
**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.

**Receiver capture range:**
**All rates:** ±100 ppm.

**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.

**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.

**Synchronization:** Sync loss when BER ≥ 20% over 100 ms for PRBS or ≥ 4% over100 ms for word patterns. Sync gain when 32 consecutive error free bits received.

**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.

**Frame alignment:**
**2 Mb/s:** As ITU-T Rec. G.704
**2 Mb/s CRC4:** As ITU-T Rec. G.706.
**2 Mb/s CAS:** As ITU-T Rec. G.732.
**8 Mb/s:** As ITU-T Rec. G.742
**34 Mb/s:** As ITU-T Rec. G.751.
**DS3 frame alignment:** As ANSI T1.107

**2 Mb/s frame gain:** 1 correct sequence of FAS-NFAS-FAS.
**2 Mb/s frame loss:** 3 consecutive incorrect FAS or NFAS words.

**2 Mb/s CAS frame gain:** 1 correct CAS multiframe and the previous CAS word is not 0000.
**2 Mb/s CAS frame loss:** 2 consecutive errored CAS multiframe patterns or 16 frames with CAS word 0000.

**DS1 ESF frame gain:** 24 successive error-free FAS bits followed by 3 error-free CRC checks.
**DS1 ESF frame loss:** 2 in any 4 FAS bits errored.

**DS1 D4, SLC-96 frame gain:** 24 successive error-free F bits i.e 12 Ft and 12 Fs.
**DS1 D4, SLC-96 frame loss:** 2 in any 4 Ft bits errored or 2 Fs bits in any 4, errored.

**DS2 frame gain:** 16 consecutive error-free F-bits.
**DS2 frame loss:** 3 out of 16 F-bits in error.
**DS2 multiframe gain:** 2 consecutive

'011' M1M2M3 sequences error-free.
**DS2 multiframe loss:** 3 consecutive
'011' M1M2M3 sequences in error**.**

**DS3 frame gain:** 16 consecutive error-free F-bits.
**DS3 frame loss:** 3 out of 16 F-bits in error.

**DS3 multiframe gain:** 2 consecutive
'011' M5M6M7 sequences error-free.
**DS3 multiframe loss:** 3 consecutive
'011' M5M6M7 sequences in error**.**

**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 - days, hours, minutes, seconds.

**Real-time clock:** Date, time and elapsed test time.

**Error summary:**
**DS1:** Bit, Code, Frame and CRC6 - error count and ratio.
**DS3:** Bit, Code Frame, P-bit Parity, CP-Parity and FEBE- error count and ratio.
**2 Mb/s:** Bit, Code, Frame, CRC4 and REBE- error count and ratio.
**8/34 Mb/s:** Bit, Code and Frame- error count and ratio.

**Error analysis**
**ITU-TG.821:** Bit, Frame - All rates, CRC4 REBE - 2 Mb/s only.
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
Degraded minutes
Percentage degraded minutes
Code error seconds
Elapsed time

**M.2100:** TX Error seconds, RX error seconds. TX severely errored seconds, RX severely errored seconds, TX unavailability, RX unavailability.

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

**PDH M.2120:** TX 15 minute threshold report, RX 15 minute threshold report, TX 24 hour threshold report, RX 24 hour threshold report.

**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 line rate is selected. If framed all above for NEAR end and FAR end.

**Alarm indication:** Signal loss, pattern loss, AIS, frame loss, out of frame, multiframe loss, remote alarm, FEAC, remote multiframe alarm, excess zero's, idle signal.

**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, minor alarm, DS3 out of frame,

DS2 out of frame, DS1 out of frame, FEAC, DS1 excess zero's, DS3 excess zero's, idle signal.

**Trouble Scan:** Up to four prioritised non-zero error results are displayed in extra-large characters.

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

**Frequency measurement:** Frequency in Hz, resolution 1 Hz
Offset from internal clock rate (ppm), (Hz)

**Round trip delay:** Measures up to 2 seconds delay between transmit and receive.
**Autosetup:** Detects line rate, signal structure and test pattern of the received signal.

**SDH Electrical: Options 001 & 002**

**SDH rate:** 51.84 Mb/s, 155.52 Mb/s

**STM-1 Output**

**Line code:** CMI.

**Output level:** ±0.5V ±10%

**Pulse shape:** As per ITU-T G.703 mask.

**Connector:** BNC, 75$\Omega$ unbalanced.
**Return Loss:**
Typically >15dB 8 MHz to 240 MHz.

**STM-0 Output**

**Line code:** B3ZS.

**Pulse shape:**
**STM-0 450 ft:** 530 mV peak nominal. As per Draft Rec. ITU-R F.750, Appendix 1.
**STM-0 HI:** 1.1V peak nominal
**STM-0 900 ft:** 350 mV peak nominal.

**Power level:** -2.7 dBm to +4.7 dBm when measured, at the STM-0 450 ft output, using a low pass filter with a 3dB cutoff frequency of at least 200 MHz.

**Connector:** BNC, 75$\Omega$ unbalanced

.**Clock synchronization:**
**Maximum offset:** The selected reference must be < ±110 ppm.to allow lock to be achieved.

**Internal:** 10 MHz ±4.5 ppm
**Recovered:** Recovered from the SDH receive signal.
**External MTS Clock:** Timing reference as per ITU-T G.811.
**External 64 kb/s Clock:** 64 kb/s centralized clock as per ITU-T G.703 Section 1.2.2.
**External 10 MHz Clock**

**Frequency Offset:** up to ±999 ppm.
**Accuracy:** 0.02 ppm of selected offset.

**Simultaneous STM-1e, STM-1o and STM-0e, STM-0o:** When used in conjunction with the appropriate optical interfaces, transmit STM-0 or STM-1 electrical output signal simultaneously with STM-0 or STM-1 optical output signal.

**Payloadmapping:** As per ITU-TG.707.
**Test patterns:**
**PRBS:** $2^9$-1, $2^{11}$-1, $2^{15}$-1, $2^{23}$-1 at all payload rates.
**Word:** User-defined 16 bit word, all ones, all zeros, 1010, 1000.

**SDH alarm generation:**
Loss of signal (LOS), loss of frame (LOF), out of frame (OOF), MS-AIS, MS-RDI, AU-LOP, AU-AIS, HP-RDI, HP-UNEQ, TU-LOP, TU-AIS, LP-RDI, LP-UNEQ, H4 LOM.

**Payload framing:**
**140/34/2 Mb/s:** Unframed, Framed and structured.

**Drop/insert:**
**139.264Mb/s, 34.368 Mb/s:** Drop/insert via Tx/Rx.
**2.048 Mb/s:** Drop/insert via Mux/Demux ports.

| Error Generation | | | | | |
|---|---|---|---|---|---|
| **Error type** | **Single** | **Rate $10^{-N}$** | **Error All** | **Variable** | **Other** |
| Entire Frame | * | 3 - 9 | | * | Max. $1.1XE^{-3}$ |
| Frame A1A2 | * | | | | N in 4 frame words |
| B1 (STM-0) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| B1 (STM-1) | * | 4 - 9 | * | * | Max. $4.1XE^{-4}$ |
| B1 (STM-4) | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| B1 (STM-16) | * | 5 - 9 | * | * | Max. $2.5XE^{-5}$ |
| B2 (All rates) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| MSP threshold (B2) | | | | | N in T. T=10 ms to 10000s. N is variable with rate. STM-0 = 0 to 640 STM-1 = 0 to 1920 STM-4 = 0 to 7680 STM-16 = 0 to 30720 |
| MS REI (STM-0/ STM-1/STM-4) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| MS REI (STM-16) | * | 3 - 9 | * | * | Max. $8.2XE^{-3}$ |
| B3 (AU-3/TU-3) | * | 3 - 9 | * | * | Max. $1.3XE^{-3}$ |

| Error Generation | | | | | |
|---|---|---|---|---|---|
| **Error type** | **Single** | **Rate $10^{-N}$** | **Error All** | **Variable** | **Other** |
| B3 (AU-4/TU-4) | * | 4 - 9 | * | * | Max. $4.2XE^{-4}$ |
| B3 (AU-4-4c) | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| B3 (AU-16-16c) | * | 5 - 9 | * | * | Max. $2.6XE^{-4}$ |
| HP REI (AU/TU-3) | * | 3 - 9 | * | * | Max. $1.3XE^{-3}$ |
| HP REI (AU-4) | * | 4 - 9 | * | * | Max. $4.2XE^{-4}$ |
| HP REI (AU-4-4c) | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| HP REI (AU-4-16c) | * | 5 - 9 | * | * | Max. $2.6XE^{-4}$ |
| Path IEC (AU/TU-3) | * | 3 - 9 | * | * | Max. $1.3XE^{-3}$ |
| Path IEC (AU-4) | * | 4 - 9 | * | * | Max. $4.2XE^{-4}$ |
| Path IEC (AU-4-4c) | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| Path IEC (AU-4-16c) | * | 5 - 9 | * | * | Max. $2.6XE^{-4}$ |
| BIP-2 (TU-12) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| BIP-2 (TU-2) | * | 4 - 9 | * | * | Max. $5.8XE^{-4}$ |
| BIP-2 (TU-11) | * | 3 - 9 | * | * | Max. $2.4XE^{-3}$ |
| LP REI (TU-12) | * | 4 - 9 | * | * | Max. $1.2XE^{-3}$ |
| LP REI (TU-2) | * | 4 - 9 | * | * | Max. $5.8XE^{-4}$ |
| LP REI (TU-11) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| Payload Bit | * | 3 - 9 | | * | Max. $1.0XE^{-3}$ |

**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.

### TX Overhead

**Regenerator section overhead:** All bytes except B1 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

A1A2 contains pattern F628 (hexadecimal)

J0 is set to "00000001".

Z0 is present in all STM-1's and is a number between 2 and N which signifies the order of multiplexing.

B1 is the BIP-8 parity (using even parity) calculated over the entire previous frame, after scrambling.

E1, F1, D1-D3, and all other bytes are all zeros.

**Multiplexer section overhead:
STM-0/STM-1, STM-4/STM-16, STM-4c/**

**STM-16c:** All bytes except B2, H1, H2 and H3 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

H1/H2 bytes are present in all STM-1's. The pointer offset value of the STM-1 under test is determined by the last setting of New Pointer test feature. The default value of the SS bits is 10. H1/H2 bytes in columns 1 and 4 of the background signals are set to New Data Flag - disabled, SS Bits - AU-4, Decimal Pointer Value - 0 i.e.
H1 = 01101000, H2= 00000000.

H1/H2 bytes in columns 2, 3, 5 and 6 of all STM-1's in the STM-4/STM-16 are set to the concatenation condition i.e.
H1=10010011, H2=11111111

H3 is transmitted as all zeros except when used as a payload byte during negative justification.

B2 is the BIP-24 parity (using even parity) calculated over the MSOH bytes and the VC-4 capacity. It is calculated for each STM-1.

K1,K2, D4-D12, S1, M0, M1, E2, Z1, Z2 and all other bytes are all zero's.

**VC-4 path overhead:** All bytes except B3 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

J1 - 64 ASCII Null characters.

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) or FE (VC-4 Bulk Filled)

H4 is transmitted as all zeros. If TU-2, TU-11 or TU-12 structured payloads

are generated the Full H4 sequence is transmitted as per ITU-T G.709.
G1, F2, F3, K3, N1 and all other bytes are all zero's.

**Background STM-1-VC-4 path overhead (STM-4/STM-16 Only):** All bytes except B3 can be changed from the default state using OVERHEAD SETUP.
**Default values:**
J1 is transmitted as all zeros.
B3 is the BIP-8 parity (using even parity) calculated over the previous VC-4,before scrambling.
C2 is transmitted as 00000000 (Unequipped)
G1, F2, F3, K3, N1, H4 and all other bytes are all zero's.

**VC-4c/Vc-16c path overhead:** 1 column of 9 bytes followed by 3 (VC-4c) or 15 (VC-16c) **c**olumns of fixed stuff indication.
All bytes except B3 can be changed from the default state using OVERHEAD SETUP.
**Default values:**
J1 - 64 ASCII Null characters.
B3 is the BIP-8 parity (using even parity) calculated over the previous VC-4-4c or VC-4-16c,before scrambling.
C2 is transmitted as 00000001 (PRBS or Word)
G1, F2, F3, K3, N1, H4 and all other bytes are all zero's.

**AU-3 and TU-3 overhead:**
H1/H2 - H2 and the 2 least significant bits of H1 indicate the offset from the pointer to the first byte of the VC-3. The SS bits are set to 10.

The pointer offset value of the STM-0 is determined by the last setting of New Pointer test feature.
H3 is transmitted as all zero's except when used as a payload byte during negative justification.

**VC-3 path overhead:** All bytes except B3 can be changed from the default state using OVERHEAD SETUP.
**Default values:**
J1 - 64 ASCII Null characters.
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), 02 (TU Structured) or FE (Bulk Filled).
H4 is transmitted as all zeros. If TU-2, TU-11 or TU-12 structured payloads are generated the Full H4 sequence is transmitted as per ITU-T G.709.
G1, F2, F3, K3, N1 and all other bytes are all zero's.

**Background STM-1 - VC-3 path overhead: (STM-1/4/16 only)** All bytes except B3 can be changed from the default state using OVERHEAD SETUP.
**Default values:**
J1 is transmitted as all zeros.
B3 is the BIP-8 parity (using even parity) calculated over the previous VC-3,before scrambling.
C2 is transmitted as 00000000 (Unequipped)
G1, F2, F3, K3, N1, H4 and all other bytes are all zero's.

**TU-12/TU-2 path overhead:** All bytes except V1, V2, V5 can be changed from the default state using OVERHEAD SETUP.

**Default values:**
V1,V2 - V2 and the 2 least significant bits of V1 indicate the offset from the pointer to the first byte of the TU payload. The SS bits are 10 (TU-12) or 00 (TU-2).The pointer offset value is determined by the last setting of New Pointer test feature.
V5 - Bits 1 and 2 are the BIP-2 parity of the previous VC including V5 but excluding V1 - V4 (unless V3 contains a stuff byte). Bits 5 - 7 are set to 001 (Equipped). All other bits are set to 0.
J2 - 16 ASCII Null characters.
N2 is transmitted as all zeros.
K4 - is transmitted as all zeros.

**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: J0, Z0, E1, F1.
**MSOH**:
 9-byte channel D4 to D12
2-byte channel K1K2.
Single byte channels: S1, M1, M0†, Z1†, Z2†, E2.
† Z1 and Z2 are not present, and M0 replaces M1, in STM-0 mode.
**High order POH***:*
Single byte channels: J1, C2, G1, F2, H4, F3, K3, N1.

**Overhead BER test:** 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.

**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:**
N bytes of the payload are overwritten with a block of zeros or ones after scrambling. N varies according to the STM rate: STM-0 N=2 to 85.
STM-1 N=2 to 259.
STM-4 N=2 to 1042
STM-16 N=2 to 4174
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, $> 0$, $\geq 10$-3, $\geq 10$-6.

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

## Thru mode
**Transparent thru mode:**
**T**he 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, 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-0e receiver functions

## STM-1 receive input

**Line code:** CMI

**Input level:** Nominal 1V pk-pk in 75Ω
**Connector:** BNC, 75Ω unbalanced.

**Return Loss:**
Typically >15dB 8 MHz to 240 MHz.

**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

**Line code:** B3ZS

**Operating level:** Automatic equalization up to 900 feet. Conforms to ITU-T G.772.

## Connector: BNC, 75Ω unbalanced.

**Return Loss:**
Typically >20dB at 25.92 MHz.

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

**SDH error summary:** Frame (A1A2), B1, B2, MS REI, B3 (TU-3, AU-3, AU-4), HP- REI (TU-3, AU-3, AU-4), HP-IEC (TU-3, AU-3, AU-4), TU BIP V5 (TU-2, TU-11, TU-12), LP-REI (TU-2, TU-11, TU-12), bit errors (bulk filled, PDH payload).

**PDH payload error summary:** Bit, code, 140 Mb/s frame, 34 Mb/s frame, DS3 frame, 8 Mb/s frame, 2 Mb/s frame, DS1 frame, P-bit, C-bit, FEBE, CRC, REBE.

**SDH error analysis:** To ITU-T G.826 for error sources - B1, B2, MS-REI, B3, HP-REI, HP-IEC, TU BIP, LP-REI.
Errored blocks
Error seconds
Severely errored seconds
Unavailable seconds
Path unavailable seconds
Background block error
Error second ratio
Severely errored second ratio
Background block error ratio

**PDH payload error analysis:**
**ITU-T G.821:** For error sources - 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
Degraded minutes
Percentage degraded minutes
Code error seconds
Elapsed time

**ITU-T G.826:**
Error seconds
Severely errored seconds
Unavailable seconds
Path unavailable seconds
Background block error
Error second ratio
Severely errored second ratio
Background block error ratio
If framed all above for NEAR end and FAR end.

**ITU-T M.2100:**
TX Error seconds, RX error seconds. TX severely errored seconds, RX severely errored seconds, TX unavailability, RX unavailability.

**ITU-T M.2110:**
2 hour BIS result, 24 hour BIS result, 7 day BIS result.

**ITU-T M.2120:**
TX 15 minute threshold report, RX 15 minute threshold report, TX 24 hour threshold report, RX 24 hour threshold report.

**SDH alarm indication:**
Loss of signal(LOS), loss of frame (LOF), loss of pointer (AU-4-16c LOP, AU-4-4c LOP, AU-4 LOP, AU-3 LOP, TU-3 LOP), MS-AIS, MS-RDI, K1K2 change, AU-AIS, HP-RDI, TU-LOP, TU-AIS, TU- RDI, H4 multiframe sync loss, pattern sync loss, clock loss and errors (any type).

**SDH alarm seconds:**
Power loss, loss of signal (LOS), loss of frame (LOF), out of frame (OOF), AU-LOP, MS-AIS, AU-AIS, K1K2 change, MS-RDI, HP-RDI, H4 multiframe sync loss, TU LOP, TU AIS, LP-RDI.

**PDH payload alarm indication:**
Loss of signal (LOS), AIS, pattern loss, frame loss, multiframe loss, remote alarm, remote multiframe alarm and errors (any type).

**PDH payload alarm seconds:**
Loss of frame (140 M LOF, 34M LOF, 8M LOF, 2M LOF)), out of frame (DS1 OOF, DS3 OOF), AIS, pattern loss, RAI, H4 multiframe sync loss, remote multiframe alarm.

**SDH Alarm 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 AIS, LP-RDI.
**BIP errors:** AU-4 payloads -VC-4 B3 AU-3 payloads - VC-3 B3.
TU-3 payloads - VC-4 B3 and VC-3 B3.
TU payloads - VC-4/VC-3 B3 and V5 BIP-2.
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.

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

**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 offset.

**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 sequence capture:**
Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values together with the number of consecutive frames containing the value, are displayed.
**RSOH**:
6-byte channel A1A2
3-byte channel D1 to D3
Single byte channels: J0, Z0, E1, F1, A1A2 boundary, row2 column2, row2 col3, row3 col2, row3 col3.
**MSOH**:
9-byte channel D4 to D12
2-byte channels K1K2 and H1H2.
Single byte channels - S1, M1, M0†, Z1†, Z2†, E2.
† Z1 and Z2 are not present, and M0 replaces M1, in STM-0 mode.

**High order POH***:*
Single byte channels - J1, C2, G1, F2, H4, F3, K3, N1.

## 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.

**PDH payload 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, DS3 frame error count, DS1 frame error count, P-Bit error count, C-Bit error count, DS3 FEBE, M2120 Reports and PDH alarms.

**SDH bar graphs:** B1 BIP error count, B2 BIP error count, MS-REI error count, B3 BIP error count, HP-REI error count, HP-IEC error count, TU BIP error count, LP-REI error count and SDH alarms.

### SDH/SONET Electrical: Option 002
**SONET rate:** 51.84 Mb/s, 155.52 Mb/s

### STS-3 Output
**Line code:** CMI.

**Output level:** ±0.5V ±10%

**Pulse shape:** As per ITU-T G.703 mask.

**Connector:** BNC, 75Ω unbalanced.
**Return Loss:**
Typically >15dB 8 MHz to 240 MHz.

### STS-1 Output

**Line code:** B3ZS.

**Pulse shape:**
**STS-1 450 ft:** 530 mV peak nominal. As per GR-253, Issue1, Figure 4-10.
**STS-1 HI:** 1.1V peak nominal
**STS-1 900 ft:** 350 mV peak nominal.

**Power level:** -2.7 dBm to +4.7 dBm when measured, at the STM-0 450 ft output, using a low pass filter with a 3dB cutoff frequency of at least 200 MHz.

**Connector:** BNC, 75Ω unbalanced.

**Clock synchronization:**
**Maximum offset:** The selected reference must be $< \pm110$ ppm.to allow lock to be achieved.

**Internal:** 10 MHz ±4.5 ppm
**Recovered:** Recovered from the SDH receive signal.
**External BITS Clock:** DS1 timing reference as per TA-TSY-000378.
**External 64 kb/s Clock:** 64 kb/s centralized clock as per ITU-T G.703 Section 1.2.2.
**External 10 MHz Clock**

**Frequency Offset:** up to ±999 ppm.
**Accuracy:** 0.02 ppm of selected offset.

**Simultaneous STS-3e, STS-3o and STS-1e, STS-1o:** When used in conjunction with the appropriate optical interfaces, transmit STS-1 or STS-3 electrical output signal simultaneously with STS-1 or STS-3 optical output signal.

**Payload mapping:** As per ITU-T G.707.

**Test patterns:**

**PRBS:** $2^9$-1, $2^{11}$-1, $2^{15}$-1, $2^{23}$-1 at all payload rates and QRSS at DS1 only.
**Word:** User-defined 16 bit word, all ones, all zeros, 1010, 1000.

**Alarm generation:**
Loss of signal (LOS), loss of frame (LOF), SEF, line AIS (AIS-L), line RDI (RDI-L), STS path -AIS (AIS-P), STS path RDI (RDI-P), STS loss Of Pointer (LOP-P), STS path unequipped (UNEQ-P), VT-1.5 path AIS (AIS-V), VT-1.5 path RDI (RDI-V), VT-1.5 loss of pointer (LOP-V), VT-1.5 unequipped (UNEQ-V), H4 loss of multiframe (H4 LOM).

**Payload framing:**
**All rates:** Unframed, Framed and structured.
**Drop/insert:**
**34.368Mb/:** Via Tx/Rx.
**2.048 Mb/s:** Via Mux/Demux ports.

| Error Generation | | | | | |
|---|---|---|---|---|---|
| **Error type** | **Single** | **Rate $10^{-N}$** | **Error All** | **Variable** | **Other** |
| Entire Frame | * | 3 - 9 | | * | Max. $1.1XE^{-3}$ |
| Frame A1A2 | * | | | | N in 4 frame words |
| CV-S (STS-1) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| CV-S (STS-3) | * | 4 - 9 | * | * | Max. $4.1XE^{-4}$ |
| CV-S (STS-12) | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| CV-S (STS-48) | * | 5 - 9 | * | * | Max. $2.5XE^{-5}$ |
| CV-L (All rates) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| APS threshold (CV-S) | | | | | N in T. T=10 ms to 10000s. N is variable with rate. STS-1 = 0 to 640 STS-3 = 0 to 1920 STS-12 = 0 to 7680 STS-48 = 0 to 30720 |
| STS REI-L (STS-1/ STS-3/STS-12) | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| STS REI-L (STS-48) | * | 3 - 9 | * | * | Max. $8.2XE^{-3}$ |
| STS-1 SPE CV-P | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| STS-3c SPE CV-P | * | 4 - 9 | * | * | Max. $4.2XE^{-4}$ |

| Error Generation | | | | | |
|---|---|---|---|---|---|
| **Error type** | **Single** | **Rate $10^{-N}$** | **Error All** | **Variable** | **Other** |
| STS-12c SPE CV-P | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| STS-48c SPE CV-P | * | 5 - 9 | * | * | Max. $2.6XE^{-4}$ |
| STS-1 SPE REI-P | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| STS-3c SPE REI-P | * | 4 - 9 | * | * | Max. $4.2XE^{-4}$ |
| STS-12c SPE REI-P | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| STS-48c SPE REI-P | * | 5 - 9 | * | * | Max. $2.6XE^{-4}$ |
| STS-1 SPE STS IEC | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| STS-3c SPE STS IEC | * | 4 - 9 | * | * | Max. $4.2XE^{-4}$ |
| STS-12c SPE STS IEC | * | 4 - 9 | * | * | Max. $1.0XE^{-4}$ |
| STS-48c SPE STS IEC | * | 5 - 9 | * | * | Max. $2.6XE^{-4}$ |
| CV-V | * | 3 - 9 | * | * | Max. $2.4XE^{-3}$ |
| REI-V | * | 3 - 9 | * | * | Max. $1.2XE^{-3}$ |
| Payload Bit | * | 3 - 9 | | * | Max. $1.1XE^{-3}$ |

**Pointer adjustment generation**
**Increment/decrement/alternating:**
Provides a burst, selectable between 1 and 10 pointer adjustments (between 1 and 5 for VT-1.5 pointer).
**New pointer value:** The STS SPE 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 SPE or VT-1.5 and the line rate relative to each other (in these modes the 87:3 sequence is generated to ITU-T G.783)

**Range:** 100 ppm in 0.1 ppm steps
**Accuracy:** ±0.2 ppm
**GR-253, T1.105.03 sequences:** Periodic single adjustments of the same polarity. Periodic burst of 3 adjustments of the same polarity which can be selected. Periodic phase transient burst of 7 adjustments, polarity is selectable. Periodic added/cancelled adjustments, polarity is selectable. 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.

**TX Overhead**

**Section overhead:** All bytes except B1 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

A1A2 contains pattern F628 (hexadecimal)

J0 is set to "00000001".

Z0 is present in all STS-1's and is a number between 2 and N which signifies the order of multiplexing.

B1 is the SBIP-8 parity (using even parity) calculated over the entire previous frame, after scrambling.

E1, F1, D1-D3, and all other bytes are all zeros.

**Line overhead:**

**OC-48, OC-12, OC-3, OC-48c/OC-12c/OC-3c, STS-1:** All bytes except B2, H1, H2 and H3 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

H1/H2 bytes are present in all STS-1's within the STS-3/STS-12/STS-48. H2 and the 2 least significant bits of H1 indicate the offset from the pointer to the first byte of the STS-1 SPE. The pointer offset value of the STS-1 under test is determined by the last setting of New Pointer test feature. The default value of the SS bits is 10. H1/H2 bytes in columns 1 and 4 of the background signals are set to New Data Flag - disabled, SS Bits - AU-4, Decimal Pointer Value - 0 i.e.

H1 = 01101000, H2= 00000000.

H1/H2 bytes in columns 2, 3, 5 and 6 of all STS-1's in the STS-3/STS-12/STS-48 are set to the concatenation condition i.e.

H1=10010011, H2=11111111

H3 is transmitted as all zeros except when used as a payload byte during negative justification.

B2 is the Line BIP-8 parity (using even parity) calculated over the LOH bytes and the STS SPE container.

S1 is transmitted as all zeros (Quality Unknown).

K1,K2, D4-D12, M0, M1, E1, Z1, Z2 and all other bytes are all zero's.

**STS path overhead:** All bytes except B3 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

J1 - 64 ASCII Null characters.

B3 is the BIP-8 parity (using even parity) calculated over the previous STS SPE, before scrambling.

C2 is transmitted as Hexadecimal 04 (DS3 Mapping) or 02 (DS1 Mapping) or 01 (STS SPE Bulk Filled)

H4 is transmitted as all zeros for DS3 payloads. If DS1 payload bits 1 to 6 are all zeros and bits 7 and 8 contain a binary count sequence (0 to 3).

G1, F2, Z3, Z4 and Z5 are all zeros.

**Background STS-3c/STS-1 SPE path overhead:** All bytes except B3 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

J1 is transmitted as all zeros.

B3 is the BIP-8 parity (using even parity) calculated over the previous STS-3c/STS-1 SPE, before scrambling.

C2 is transmitted as 00000000 (Unequipped)

G1, F2, H4, F3, K3, N1 and all other bytes are all zero's.

**VT-1.5 path overhead:** All bytes except V1, V2, V5 can be changed from the default state using OVERHEAD SETUP.

**Default values:**

V1,V2 - V2 and the 2 least significant bits of V1 indicate the offset from the pointer to the first byte of the VT payload. The SS bits are 11. The pointer offset value is determined by the last setting of New Pointer test feature.

V5 - Bits 1 and 2 are the BIP-2 parity of the previous VT including V5 but excluding V1 - V4 (unless V3 contains a stuff byte). Bits 5 - 7 are set to 001 (Equipped). All other bits are set to 0.

J2 - 16 ASCII Null characters.

Z6 is transmitted as all zeros.

Z7 - is transmitted as all zeros.

**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 J0, Z0, E1, F1, A1A2 boundary, Row2 Column2, Row2 Col3, Row3 Col2, Row3 Col3.

**MSOH**:

9-byte channel D4 to D12

2-byte channel K1K2.

Single byte channels: S1, M1, M0†, Z1†, Z2†, E2.

† Z1 and Z2 are not present, and M0 replaces M1, in STS-1 mode.

**High order POH*:**

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

**Overhead BER test:**

**SOH:** J0, Z0, E1, F1, D1, D2, D3.

**LOH:** K1, K2, D4, D5, D6, D7, D8, D9, D10, D11, D12, S1, M1, E2, M0.

**POH:** J1, C2, G1, F2, H4, Z3, Z4, N1

Any of the bytes listed above can be 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.

**APS 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 section or line 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 (SOH DCC), 576 kb/s (LOH DCC).

**Optical interface stress test:**

N bytes of the payload are overwritten with a block of zeros or ones after scrambling. N varies according to the OC-n rate: OC-1 N=2 to 85.

OC-3 N=2 to 259.

OC-12 N=2 to 1042

OC-48 N=2 to 4174

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, $> 0$, $\geq 10$-3, $\geq 10$-6.

## Thru mode

**Transparent thru mode:** **T**he 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).

**STS overwrite thru mode:**
In addition to both of the above, overwrites the complete STS 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 STS SPE and/or the POH are enabled (i.e. errors and alarms, adjust pointer, overhead sequences, MSP messages, overhead BER. Full Rx functionality also available).

**VT overwrite thru mode:**
When the payload passing through the instrument contains a VT structure, 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 VT and/or the POH are enabled (i.e. errors and alarms, adjust pointer. Full Rx functionality also available).

## STS-1e and STS-3e receiver functions

### STS-3 receive input

**Line code:** CMI

**Input level:** Nominal 1V pk-pk into 75Ω.

**Connector:** BNC, 75Ω unbalanced.

**Return Loss:**
Typically >15dB 8 MHz to 240 MHz.

**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.

### STS-1 receive input

**Line code:** B3ZS

**Operating level:** Automatic equalization up to 900 feet. Conforms to ITU-T G.772.

**Connector:** BNC, 75Ω unbalanced.

**Return Loss:**
Typically >20dB at 25.92 MHz.

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

**SONET error summary:** Frame (A1A2), CV-S, CV-L, REI-L, CV-P, REI-P, CV-IEC, CV-V, REI-V, Bit**.**

**DSn payload error summary:** Bit, BPV, 140 Mb/s frame, 34 Mb/s frame, DS3 frame, 8 Mb/s frame, 2 Mb/s frame, DS1 frame, P-bit, C-bit, FEBE, CRC, REBE.

**SONET error analysis:** To ITU-T G.826 for error sources - CV-S, CV-L, REI-L, CV-P, REI-P, CV-IEC, CV-V, REI-V.
Errored blocks
Error seconds
Severely errored seconds
Unavailable seconds
Path unavailable seconds
Background block error
Error second ratio
Severely errored second ratio
Background block error ratio

## DSn payload error analysis:
**ITU-T G.821:** For error sources - 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
Degraded minutes
Percentage degraded minutes

BPV error seconds
Elapsed time

**ITU-T G.826:**
Error seconds
Severely errored seconds
Unavailable seconds
Path unavailable seconds
Background block error
Error second ratio
Severely errored second ratio
Background block error ratio
If framed all above for NEAR end and FAR end.

**ITU-T M.2100:**
TX Error seconds, RX error seconds. TX severely errored seconds, RX severely errored seconds, TX unavailability, RX unavailability.

**ITU-T M.2110:**
2 hour BIS result, 24 hour BIS result, 7 day BIS result.

**ITU-T M.2120:**
TX 15 minute threshold report, RX 15 minute threshold report, TX 24 hour threshold report, RX 24 hour threshold report.

**SONET alarm indication:**
Loss of signal(LOS), loss of frame (LOF), loss of pointer, AIS-L, RDI-L, AIS-P, RDI-P, AIS-V, RDI-V, pointer adjust, pattern sync loss and errors (any type).

**SONET alarm seconds:**
Power loss, loss of signal (LOS), loss of frame (LOF), SEF, LOP-P, AIS-L, AIS-P, K1K2 change, RDI-L, RDI-P, H4 multiframe sync loss, LOP-V, AIS-V, RDI-V.

**DSn payload alarm indication:**
AIS, pattern loss, frame loss, multiframe loss, remote alarm, remote multiframe alarm and errors (any type).
**DSn payload alarm seconds:**
Power loss, LOS, LOF 140 Mb/s, LOF 34 Mb/s, LOF 8Mb/s, LOF 2Mb/s, DS1 OOF, DS3 OOF, AIS, pattern loss, RAI/FERF, multiframe loss, remote multiframe alarm, DS3 idle, excess zeros, DS3 frame mismatch.

**SDH Alarm 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-P, AIS-P, RDI-P, H4 LOM, LOP-V, AIS-V, RDI-V.
**BIP errors:** STS payloads - CV-P VT1.5 payloads -CV-P and CV-V and V5 BIP-2.
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.

**Pointer results:** STS pointer value, STS NDF seconds, STS missing NDF seconds, STS +ve adjustment count/seconds, STS -ve adjustment count/seconds, VT pointer value, VT NDF seconds, VT missing NDF seconds, VT +ve adjustment count/seconds, VT -ve adjustment count/seconds, Implied offset.

**Pointer location graph:** A graphical display that shows the variation with time of the STS-n and VT-1.5 pointer location. Up to four days of pointer location activity can be monitored. Implied STS offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean STS offset calculated from this total.

**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.

**RSOH**:
6-byte channel A1A2
3-byte channel D1 to D3
Single byte channels: J0, Z0, E1, F1, A1A2 boundary, row2 column2, row2 col3, row3 col2, row3 col3.
**MSOH**:
9-byte channel D4 to D12
2-byte channels K1K2 and H1H2.
Single byte channels: S1, M1, M0†, Z1†, Z2†, E2.
† Z1 and Z2 are not present, and M0 replaces M1, in STS-1 mode.
**High order POH***:*
Single byte channels: J1, C2, G1, F2, H4, Z3, Z4, Z5.

**Overhead BER measurement:**
**SOH:** J0, E1, F1, D1, D2, D3.
**LOH:** K1, K2, D4, D5, D6, D7, D8, D9, D10, D11, D12, S1, M1, E2.

**POH:** J1, C2, G1, F2, H4, Z3, Z4, Z5. Any of the overhead bytes listed above 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.

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

## 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.

**DSn payload bar graphs:** Bit error count, code error count, 140M frame error count, 34M frame error count, 2M frame error count, CRC error count, REBE error count, DS3 frame error count, DS1 frame error count, P-Bit error count, C-Bit error count, DS3 FEBE, M2120 Reports and PDH alarms.

**SONET bar graphs:** Frame error count, CV-S error count, CV-L error count, CV-LFE (REI-L) error count, CV-P error count, CV-LFE (REI-P) error count CV-IEC error count, CV-V error count, CV-VFE (REI-V) error count and SONET alarms.

**STM-0/STM-1/STM-4/STM-16/OC-1/OC-3/OC-12/OC-48 OPTICAL INTERFACE (Option 104 - 1310nm. Option 105 - 1550 nm. Option 106 1310 and 1550 nm).**

**Rate:** 51.84 Mb/s, 155.52 Mb/s, 622.08 Mb/s, 2.48832 GHz.
**Line code:** NRZ
**Connectors:** FC/PC.

**Transmit:**
**Wavelength:** 1280 - 1330 nm and 1530 - 1570 nm.
**Spectral width (3dB):** <=0.3 nm rms nominal (1310 and 1550 nm)
**Spectral width (20dB):** <=1 nm rms nominal (1310 and 1550 nm)
**Extinction ratio:** >10 dB (1310 and 1550 nm).

**Fibre power output:** +1dBm typical (1310 and 1550 nm). Minimum 0.0 dBm, Maximum +3.0dBm

**Safety classification:** Class 1, FDA 21 CFR Chapter1, Subchapter J and IEC825-1.

**Optical rise and fall times:** Meets ITU-T G.957 and Bellcore GR-253-CORE.

**Pulse mask:** Meets ITU-T G.957 and Bellcore GR-253-CORE masks at the four standard rates when observed over a 20s gating interval.

**Receive:**
**Wavelength:** 1280 - 1335 nm and 1500 - 1580 nm
**Connector:** FC/PC

**Sensitivity:**
STM-0/STM-1/STM-4/OC-1/OC-3/
OC-12 -34dBm minimum.
 STM-16/OC-48 -28 dB minimum

**Maximum input power:** -8 dBm (for
BER of $10^{-10}$ with $2^{23}$-1 PRBS or test
signal at any of the four standard rates).
**Bit rate tolerance:** ±100 ppm
**Jitter tolerance:** As per ITU-T O.17S

**Protected monitor point:**
**Connector:** SMA female.
**Input level:** nominal 150 mV to 1000
mV pk-pk

**Line code:** NRZ
**Impedance:** Nominal 50$\Omega$, AC coupled
**Return loss:** >15dB up to half the bit
rate

**Optical power measurement:** Range -10
to -30dBm, Accuracy ±2dB

**REMOTE CONTROL:**

GP-IB + RS-232-C + LAN interface
option 601.

**Printer**
**In Lid:** 80 column graphics printer
option 602.
**External:** 80-column HP 550C Deskjet
printer (GP-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:

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:**

**Dimensions mm (inch):** 190 (7.5) high, 340 (14) wide, 420 (17) deep (including cover).

**Weight:** Typically 16 kg (35 lb) fully loaded.

**Supply:** 90 V to 132 V ac and 198 V to 264 V ac. 450 VA (maximum). 47 to 63 Hz (nominal).

**Temperature**: 0 to $+50^0$ C operating. -20 to $+70^0$C storage.

**Altitude**: 3.050m

**Humidity:** 50% to 95% rh over $25^0$ to $40^0$C.

**Recommended Test Equipment**

| Instrument | Critical Specification | Recommended Model |
|---|---|---|
| Oscilloscope | 400 MHz Bandwidth, 1 MΩ Input Termination | HP 54520A Option 001 |
| Frequency Synthesizer | 75Ω Output, Sinewave to 80 MHz, Amplitude to 2.5 V pk-pk, 1 Hz resolution | HP 3335A Opt 001 |
| Signal Generator | Sinewave 700 kHz to 170 MHz, Amplitude 500 mV | HP 8657A |
| Frequency Counter | Range 0 to 200 MHz, 2 channels with accuracy <0.1ppm. (Ratio Mode) | HP 5335A Opt 010 |
| Optical Power Meter and Sensor Module | Range -8 dBm to -15 dBm, Wavelength1270-1560 nm | HP 8153A and HP 81536A |
| Lightwave Converter | Wavelength 1300 to 1560 nm, Conversion Gain >300 volts/watt, Frequency Response < 3 dB down at 1 GHz. | HP 11982A |
| Optical Attenuator | Wavelength 1200 - 1600 nm, Range 0 - 30 dB | HP 8157A |
| FC/PC Optical Interface Connector | Unique | HP 81000FI (Qty 4) |
| Optical Cables | Unique | HP 11871A (Qty 2) |
| PDH Structured Test Set | Unique | HP 37718A/37719A or HP 37717C Opt UKJ |
| 64 kb/s Clock Generator | 64 kb/s ternary clock. | HP 37732A |
| 75Ω Attenuator Kit | 0 to 200 MHz 3, 6, 10, 20 dB fixed attenuator pads | HP 86213A |
| Cable Simulator #E1 | 75Ω coaxial cable 6dB loss at 1 MHz | 8120-0049 (120 m) |
| Cable Simulator #E2 | 75Ω coaxial cable 6dB loss at 4 MHz | 8120-0049 (80 m) |
| Cable Simulator #E3 | 75Ω coaxial cable 12dB loss at 17 MHz | 8120-0049 (120 m) |
| Cable Simulator #E4 | 75Ω coaxial cable 12dB loss at 70 MHz | 8120-0049 (80 m) |
| Cable Simulator #E1-M | 75Ω coaxial cable 3dB loss at 1 MHz | 8120-0049 (60 m) |
| Cable Simulator #E2-M | 75Ω coaxial cable 3dB loss at 4 MHz | 8120-0049 (40 m) |
| Cable Simulator #E3-M | 75Ω coaxial cable 6dB loss at 17 MHz | 8120-0049 (60 m) |
| Cable Simulator #E4-M | 75Ω coaxial cable 6dB loss at 70 MHz | 8120-0049 (40 m) |

**Recommended Test Equipment**

| Instrument | Critical Specification | Recommended Model |
|---|---|---|
| Cable Simulator #DS1 | 75Ω coaxial cable. Equivalent to 655 feet ABAM cable. | 8120-0049 (80m) |
| Cable Simulator #DS3 | 75Ω coaxial cable. Equivalent to 450 feet of 728A cable. | 8120-0049 (55m) |
| Cable Simulator STM-0/ STS-1 | 75Ω coaxial cable 6dB loss at 26 MHz | 8120-0049 (50 m) |
| Cable Simulator STM-1/ STS-3 | 75Ω coaxial cable 12dB loss at 78 MHz | 8120-0049 (75 m) |
| 75Ω Termination | 0 to 200 MHz | HP 15522-80010 |
| T Connector | BNC to Dual BNC | HP 1250-0781 |
| Adaptor | SMA to BNC | 1250-1787 (Qty 2) |
| Adaptor | Type N to BNC | HP 1250-1534 (Qty 2) |
| Adaptor | Type N to N | HP 1250-1528 (Qty 2) |
| RS-232-C Loopback | Unique | 5060-4462 |
| Balanced/Unbalanced Converter | 110Ω balanced: 75Ω Unbalanced (nominal) | HP 15508B (Qty 2) |

# 2      **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:**  $0^o$ C to $+45^o$ C

$+5^o$ C to $+35^o$ C with lid printer

**Altitude**  up to 3050m (10,000ft)

**Humidity**  up to 95% relative humidity to $40^o$ 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 $4^0$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 37718A/19A 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

| Line Voltage | Fuse Rating | HP Part Number |
|---|---|---|
| 90V to 264V | 5A Timed, 250V | 2110-1120 |

## 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.**

**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.

**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).** |
|---|---|
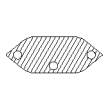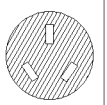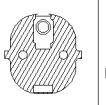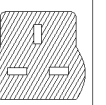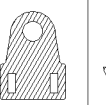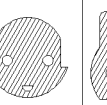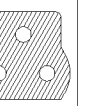
The power cord supplied with each instrument varies with the country of destination. The following figure illustrates the standard power plug and cord configurations that are commonly used. The part number shown beneath each plug is the part number of the appropriate power cord and plug. If the appropriate 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**

| 8120-2104 | 8120-1369 | 8120-1689 | 8120-1351 | 8120-1378 US<br>8120-4753 JAP | 8120-2956 | 8120-4211 |
|---|---|---|---|---|---|---|

# 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
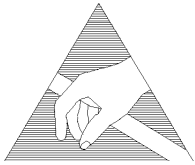
**CAUTION**
When connecting or disconnecting, ensure that you are grounded or, make contact with the metal surface of the Mainframe with your free hand to bring you, the module, and the mainframe to the same static potential.
Modules remain susceptible to ESD damage while the module is installed in the Mainframe
Additional ESD information is required when servicing see "Additional Precautions for Service Engineers" on page 2-14

## Electrical Interface Connectors

***RECEIVER 2,8,34,140 IN***
PDH receiver input interface. Allows the connection of 75 $\Omega$ unbalanced data signals (all rates) and 120 $\Omega$ balanced data signals at 2 Mb/s.

***TRANSMIT 2,8,34,140 OUT***
PDH transmitter output interface. Provides 75 $\Omega$ unbalanced data output (all rates) and 120 $\Omega$ balanced data output at 2 Mb/s

***DS3, 2Mb/s, 34Mb/s 75 $\Omega$ IN***
PDH/DSn receiver input interface. Allows the connection of 75$\Omega$ unbalanced DS3, 2 Mb/s and 34.368 Mb/s data signals.

***DS3, 2Mb/s, 34Mb/s 75 $\Omega$ OUT***
PDH / DSn transmitter output interface. Provides 75 $\Omega$ unbalanced DS3, 2 MB/s and 34 Mb/s data output. A "keep alive" signal is output when the transmit signal is SDH/SONET.

| | |
|---|---|
| *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. |
| *52/155 Mb/s DATA IN* | SDH/SONET receiver input interface. Allows the connection of 75 Ω unbalanced STM 0/1, STS 1/3 electrical signals. |
| *52/155 Mb/s DATA OUT* | SDH/SONET transmitter output interface. Provides a 75 Ω unbalanced STM 0/1, STS 1/3 electrical output. |
| *64k REF IN 1.5M REF IN 2M REF IN* | These ports allow connection of timing reference signals. |
| *REF OUT* | Provides a 2 MHz reference Clock Output. |
| *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 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. |

*CLOCK TRIGGER*    Reference SDH/SONET clock trigger output 51 MHz.

*DCC*    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:

| Pin Number | Connection |
|---|---|
| 4 | Send Data (A) |
| 5 | Send Timing (A) |
| 6 | Receive Data (A) |
| 8 | Receive Timing (A) |
| 19 | Signal Ground (Chassis) |
| 22 | Send Data (B) |
| 23 | Send Timing (B) |
| 24 | Receive Data (B) |
| 26 | Receive Timing (A) |

## Optical Interface Connectors

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

**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 optical modules 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, and are classified as Class 1 (non-hazardous) laser products in Europe which complies with EN 60825-1 (1994).

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 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 fit the fibre optic connector dust caps over 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 fit 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 the optical module has the following label:

**CLASS 1 LASER PRODUCT**

**NOTE**
CLASS 1 LASER PRODUCT translates as follows:

Finnish -   LUOKAN 1 LASERLAITE

Finnish/Swedish - KLASS 1 LASER APPARAT

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

*OPTICAL IN*
Allows connection of an optical signal, wavelength 1200 to 1600 nm, at a maximum power level of -9 dBm.
Accepts  STM-0 ,  STM-1,  STM-4 and  STM-16. Also accepts SONET signals, STS-1,  STS-3,  STS-12,  STS-48,  OC-1, OC-3,  OC-12 and OC-48.

*OPTICAL OUT*
Provides an STM-0,  STM-1,  STM-4 or STM-16 optical signal (OC-1, OC-3,  OC-12  or  OC-48  SONET signals) at wavelength1280 to 1330nm, and/or 1550 to 1565 nm,  at a nominal power level of +1 dBm.

**Cleaning Optical Connectors**

See "Optical Connector Cleaning" on page 1-8

# Connecting Accessories

*LID*                     Provides the output for the option 602 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.
*HP-IB, RS232,*           The port selected for external printer use is not available for remote
*PARALLEL ONLY*           control.

*Remote Control*          Remote control connection is given in the Remote Control Manual.
*HP-IB, RS232,*           The port selected for remote control use is not available for an external
*10 BASE -T*              printer.

## 10 Base-T Lan Connection Radiated Emissions

To ensure compliance with EN 55011 (1991) a category 5, FTP patch
lead, RJ45 cable should be used to connect the LAN port on the processor
module marked
"10 Base-T".

# Hewlett-Packard Interface Bus

The HP 37718A/19A  Communications Performance Analyzer (Option 601) 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**

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

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

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

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

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

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

SIGNAL COMMON   24   12   SHIELD
SIGNAL COMMON TWISTED WITH PIN 11   23   11   ATN
SIGNAL COMMON TWISTED WITH PIN 10   22   10   SRQ
SIGNAL COMMON TWISTED WITH PIN 9   21   9   IFC
SIGNAL COMMON TWISTED WITH PIN 8   20   8   NDAC
SIGNAL COMMON TWISTED WITH PIN 7   19   7   NRFD
SIGNAL COMMON TWISTED WITH PIN 6   18   6   DAV
REN   17   5   EOI
D108   16   4   DIO4
D107   15   3   DIO3
D106   14   2   DIO2
D105   13   1   DIO1

**TYPE 57 MICRORIBBON CONECTOR**
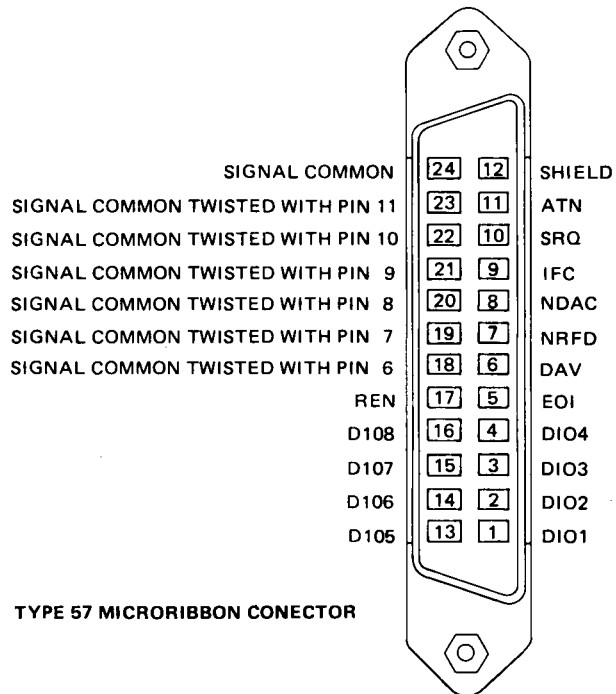
### HP-IB Connections

### HP-IB Address Selection

The HP 37718A/19A (Option 601) 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 1-6

## ESD Precautions

**CAUTION**
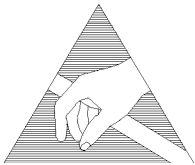


When making connections to the modules, review "Connecting to the Network" on page 2-6

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

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.**

# 3      Performance Tests

## Introduction

The procedures given in this Section, test the HP37718A/19A performance using the Specifications listed in Section 1, General Information, as performance standards. Tests are intended to be performed in the recommended order for a full instrument calibration check. Tests can be run individually, however it will be assumed that any preceding test would meet specifications.

## 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.

## Performance Test Record

The results of the Performance Tests may be recorded on the 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 every 2 years, using these Performance Tests.

## Recall Default Settings

The Performance Tests require the HP37718A/19A 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 $\boxed{\text{OTHER}}$, display softkeys, $\boxed{\downarrow}$ $\boxed{\uparrow}$ $\boxed{\rightarrow}$ and $\boxed{\leftarrow}$ set up the $\boxed{\text{OTHER}}$ **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.

# Self Test

## Description

Before using the HP 37718A/19A to make measurements, you can run
Self Test ALL TESTS to ascertain the integrity of the HP 37718A/19A.
These tests take at least 1 hour to complete depending on the options
fitted. Alternatively you can run Confidence Tests which only takes 2 to 3
minutes to complete. This is not a full verification but performs BER
measurements with internal and external loopbacks fitted.



*HOW TO:*    **Run ALL TESTS**

**1** Choose TEST TYPE **ALL TESTS** on the **OTHER** **SELF TEST** display.

**2** Insert a formatted disk into the instrument disk drive.

**3** Make the loopback connections listed below:
Connect Transmit module 75Ω OUT to Receive module 75Ω IN
Connect Transmit module 100/120Ω OUT to Receive module 100/
120Ω IN
Connect Transmit module 75Ω MUX to Receive module 75Ω DEMUX
Connect Transmit module 100/120Ω MUX to Receive module 100/
120Ω DEMUX
Connect Multirate Analyser IN to OUT
Connect the 15 dB optical attenuator provided to Optical OUT and
connect the attenuator output to Optical IN.

**CAUTION**    Safety precaution, care and connection cleanliness are essential to avoid
optical signal degradation or damage.  see Operators Maintenance in
chapter 1 and see Optical Interface Connectors in chapter 2 if in doubt.
The use of air-gap attenuators is not recommended.
Failure to attenuate the optical signal could result in damage to the
optical receiver.

**NOTE**    If the Optical Interface is a Dual Wavelength Option the **1550 nm** IN and OUT ports
are not connected at this stage and can be tested later.
If any or all of these connections are not made the HP 37718A/19A will
FAIL Self Test.

**4** 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 37718A/19A is functioning correctly, after a time of at least
1 hour, TEST STATUS PASSED is displayed.
If TEST STATUS [FAIL nnn] is displayed, the HP 37718A/19A should
be returned to a service office for repair.



*HOW TO:*    **Run Confidence TESTS**

**1** Choose TEST TYPE **CONF. TESTS** on the **OTHER** **SELF TEST**
display.

**2** Insert a formatted disk into the instrument disk drive.

**3** Make the loopback connections listed below:
Connect Transmit module 75Ω OUT to Receive module 75Ω IN
Connect Transmit module 100/120Ω OUT to Receive module 100/120Ω IN
Connect Transmit module 75Ω MUX to Receive module 75Ω DEMUX
Connect Transmit module 100/120Ω MUX to Receive module 100/120Ω DEMUX
Connect Multirate Analyser IN to OUT
Connect the 15 dB optical attenuator provided to Optical OUT and connect the attenuator output to Optical IN.

**4** 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 37718A/19A is functioning correctly, after a time of 2 to 3minutes, TEST STATUS PASSED is displayed.
If TEST STATUS [FAIL nnn] is displayed, the HP 37718A/19A should be returned to a service office for repair.

**NOTE**       Each individual self test requires unique loopback connections. To obtain a list of the connections required move the highlighted cursor to CABLING INFO and press SET. The Loopbacks list will appear on the display.

```
FUNCTION              SELF TEST

TEST TYPE             PDH TESTS
TEST NUMBER           3
SUBTEST NUMBER        ---
TEST STATUS           READY

PDH SELFTEST - CABLING INFORMATION

PAYLOAD MODULE CONNECTIONS :
    CONNECT PDH OUT TO PDH IN (UNBALANCED 75) 2Mb/s, 34Mb/s)
    CONNECT PDH OUT TO PDH IN (BALANCED 8Mb/s)
    CONNECT MUX TO DEMUX (BALANCED 2Mb/s)
    CONNECT MUX TO DEMUX (UNBALANCED 2Mb/s)

STATUS:
```

### 1550 nm Dual Wavelength Tests:

If a Dual Wavelength Optical Interface is fitted, run BER test with 1550 nm selected.

**1**  Select 1550 nm OPTICS wavelength

**2**  Connect 1550 nm OUT to IN via 15dB Optical Attenuator.

**3**  Run the BER test.

### RS-232-C Tests:

**1**  Select CPU TESTS

**2**  Fit a special RS-232-C connector with Loopback links as shown:
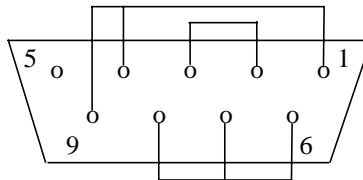


**3**  Run the CPU TESTS.

**Datacomm Tests:**

**1**   Select SDH TESTS

**2**   Make the following connections on the Datacomm port.
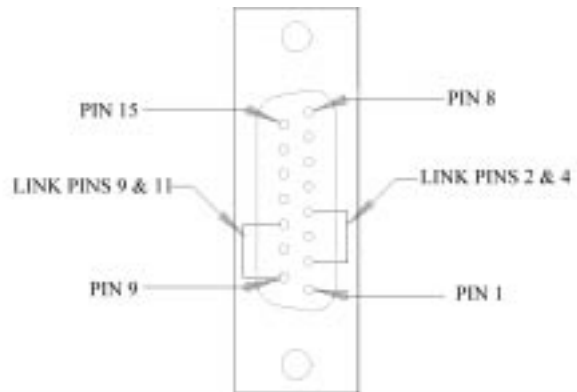


**3**   Run the SDH TESTS.

## PDH/DSn Internal Transmitter Clock Accuracy & Offset

### Specifications

| Rate | Frequency |
|------|-----------|
| E4 | 139.264 MHz $\pm$ 4.5 ppm |
| E3 | 34.368 MHz $\pm$ 4.5 ppm |
| E2 | 8.448 MHz $\pm$4.5 ppm |
| E1 | 2.048 MHz $\pm$4.5 ppm |
| DS1 | 1.544 MHz $\pm$4.5 ppm |
| DS3 | 44.736 MHz $\pm$4.5 ppm |

**NOTE**   The Rates available are dependent on the HP37718A/19A option.

### Description

This test verifies that the PDH transmit data rates are within limits.
These limits assume the instrument is within the calibration cycle. The
Frequency Offset capability (deviation from Standard Bit Rate) is also
checked.
For E1 to E4 a Frequency Counter connected to the PDH/DSn Signal Out
port measures 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,
for Ternary signals E1, E2 & E3, be half the selected data rate.
For DS-1 and DS-3 the Frequency Counter is connected to the CLOCK
OUT port.

### Equipment Required

| | |
|---|---|
| **Frequency Counter** | : HP 5335A Option 010 |
| **75$\Omega$ Termination** | : HP 15522-80010 |
| **T Connector** | : HP 1250-0781 |

## Procedure

**1** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**2** Connect the 75W OUT port of the PDH/DSn module to the Frequency Counter. Terminate the Frequency Counter input in 75W (use the T connector).

**3** Set the `TRANSMIT` display as shown opposite.



**NOTE** When changing the PDH Rate or Offset value the VCXO takes time to settle. As a consequence the frequency counter reading will not stabilize until *"VCXO OUTPUT BIT RATE SETTLING"* clears from the STATUS line of the display.

## E1 (2.048Mb/s) Frequency Accuracy

**4** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1023995Hz and 1024005Hz.

**5** Select FREQUENCY 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 1024046.5Hz and 1024055.5Hz.

**7** Select FREQUENCY OFFSET [-50PPM].

**8** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1023944Hz and 1023953Hz.

## E2 (8.448Mb/s) Frequency Accuracy

**9** Select SIGNAL [8Mb/s] ; PATTERN [ALL 1's] on the [TRANSMIT] display.

**10** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 4223981Hz and 4224019Hz.

**11** Select FREQUENCY OFFSET [+30PPM].

**12** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 4224107.5Hz and 4224291.5 Hz.

**13** Select FREQUENCY OFFSET [-30PPM].

**14** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 4223854Hz and 4223892Hz.

## E3 (34.368Mb/s) Frequency Accuracy

**15** Select SIGNAL [34Mb/s] PATTERN [ALL 1's] on the [TRANSMIT] display.

**16** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 17183922.7Hz and 17184077.4Hz.

**17** Select FREQUENCY OFFSET [+20PPM]

**18** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 17184266 and 17184421Hz.

**19** Select FREQUENCY OFFSET [-20PPM]

**20** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 17183579Hz and 17183734Hz.

**21** Select FREQUENCY OFFSET [USER OFFSET] [+100PPM]

**22** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 17185641Hz and 17185796Hz.

**23** Select FREQUENCY OFFSET [USER OFFSET] [-100PPM]

**24** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 17182205Hz and 17182359Hz.

## E4 (139.264Mb/s) Frequency Accuracy

**25** Select SIGNAL [140Mb/s] PATTERN [ALL 1's] on the ⟨TRANSMIT⟩ display.

**26** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 69631686.5Hz and 69632318.5Hz.

**27** Select FREQUENCY OFFSET [+15PPM].

**28** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 69632731Hz and 69633358Hz.

**29** Select FREQUENCY OFFSET [-15PPM].

**30** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 69630642Hz and 69631269Hz.

## DS1 (1.544Mb/s) Frequency Accuracy

**31** Connect the CLOCK OUT port of the PDH/DSn module to the Frequency Counter.

**32** Select SIGNAL [DS1 1.5Mb/s] on the ⟨TRANSMIT⟩ display.

**33** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1543993Hz and 1544007Hz.

**34** Select FREQUENCY OFFSET [+32PPM]

**35** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1544042Hz and 1544056Hz.

**36** Select FREQUENCY OFFSET [-32PPM]

**37** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 1543944Hz and 1543958Hz.

## DS3 (44.736Mb/s) Frequency Accuracy

**38** Connect the CLOCK OUT port of the PDH/DSn module to the Frequency Counter.

**39** Select SIGNAL [DS3] on the TRANSMIT display.

**40** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44735799Hz and 44736201Hz

**41** Select FREQUENCY OFFSET [+20PPM]

**42** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44736693Hz and 44737096Hz.

**43** Select FREQUENCY OFFSET [-20PPM]

**44** Adjust the Frequency Counter ATTEN and Trigger Level to obtain a stable reading and ensure that the frequency counter reading is between 44734904Hz and 44735307Hz.

**45** Disconnect all the test equipment.

## PDH/DSn Transmitter Output

### Specification

| Rate | Level | Waveshape |
|---|---|---|
| DSX-1 | 3.0V 20% | Fits mask T1.102-1993 |
| DS1-LO | As DSX-1 with 655' ABAM Cable | |
| DS3-HI | 0.9V pk (nominal) | |
| DSX-3 | 560mV pk (nominal) | Fits mask T1.102-1993 |
| DS3-900 | 330mV pk (nominal) | |
| E1 Balanced | 3.00V 10% | As per ITU rec G703 |
| E1 Unbalanced | 2.37V 10% | As per ITU rec G703 |
| E2 Unbalanced | 2.37V 10% | As per ITU rec G703 |
| E3 Unbalanced | 1.0V 10% | As per ITU rec G703 |
| E4 Unbalanced | 0.5V 10% | As per ITU rec G703 |

**NOTE** The Rates available are dependent on the HP37718A/19A option

### Description

This test ensures the transmitter output level and pulse shape meet the required specifications at all PDH/DSn 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.

## Equipment Required

| | |
|---|---|
| **Oscilloscope** | : HP 54520A Option 001 |
| **110Ω/75Ω Balanced to Unbalanced Converter** | : HP 15508B |
| **75Ω Termination** | : HP 15522-80010 |

## Procedure

**NOTE**   This performance test is written using the HP54520A Oscilloscope with Option 001 - Telecom Masks Application. If any other Oscilloscope is used the keystrokes given in this procedure will not apply.
The Positive pulse masks are contained in the ROOT directory of the Telecom Mask Application Disk and the Negative pulse masks are in the INV_MASK directory.

**Installing the Telecom Masks Option**

**1**   Insert the Disk containing the Telecom Mask into the Oscilloscope Disk Drive.

**2**   Press SHIFT (Blue Key) DISK

**3**   Press **DIRECTORY** softkey then **ROOT DIRECTORY** softkey

139.264 Mb/s - All 1's Pulse

**1**   Recall the HP37718A Default Settings as shown on page 3-2.

**2**   Set the **TRANSMIT** display as shown opposite.

**3**   Connect the PDH/DSn 75Ω OUT port to the Oscilloscope CHAN 1, terminate in 75Ω

**4**   Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

**Load the Telecom Mask**

**5** On the oscilloscope, use the following key sequence to select and load
the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select 139BIN1 in the
highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**6** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**7** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope.

---

**NOTE**   It may be necessary to visibly fit the waveform to the mask by adjusting
the oscilloscope vertical position and horizontal delay 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 450 mV and 550 mV. (i.e.
900 mV-1.1V Pk-Pk)

**All 0's Pulse**

**9** Select PATTERN [ALL 0's] on the `TRANSMIT` display.

**Load the Telecom Mask**

**10** On the oscilloscope, use the following key sequence to select and load
the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.

---

c/ Use ENTRY/MEASURE control to select 139BIN0 in the
highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**11** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL **8**
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**12** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope.

**NOTE**

It may be necessary to visibly fit the waveform to the mask by adjusting
the oscilloscope vertical position and horizontal delay to obtain a PASS on
the Mask.

**13** Measure the peak pulse amplitude at the mid pulse-width using the
oscilloscope and verify that this is between 450 mV and 550 mV. (i.e.
900 mV-1.1V Pk-Pk)

**14** Select PATTERN to [ALL 0's] on the `TRANSMIT` display.

**15** On the Oscilloscope, use the following key sequence to access the
inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

**16** Repeat steps 5 to 13 to check pulses against Inverted masks.

## Procedure - **34.368 Mb/s**

### Positive Pulse

**1**  Recall the HP37718A/19A Default Settings as shown on page 3-2.

**2**  Set the TRANSMIT display as shown opposite.

**3**  Connect the PDH/DSn 75Ω OUT port to the Oscilloscope CHAN 1, terminate in 75Ω

**4**  Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**5**  On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT  (Blue Key) APPLICATION.
b/ TELECOM MASK/MASK softkey.
c/ Use ENTRY/MEASURE control to select 34MG703 in the highlighted MSK FILES window.
d/ LOAD SETUP 8 M1M2 softkey.

### Compare Pulse with Mask

**6**  On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/  RECALL 8
b/ DEFINE MEAS
c/ COMPARE softkey
d/ TEST ON softkey
e/ M1M2 softkey
f/ AFTER FAIL CONTINUE softkey
g/ RUN

**7**  The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**   It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay 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.

### Negative Pulse

**9**   On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

### Load the Telecom Mask

**10** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select 34MG703 in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

### Compare Pulse with Mask

**11** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/  RECALL 8
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**12** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope

| NOTE | It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay to obtain a PASS on the Mask. |

**13** 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.

## Procedure - **8.448 Mb/s**

### Positive Pulse

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2.

**2** Set the [TRANSMIT] display as shown opposite.

**3** Connect the PDH/DSn 75Ω OUT port to the Oscilloscope CHAN 1, terminate in 75Ω

**4** Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**5** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select 8MG703 in the highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

### Compare Pulse with Mask

**6** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ **COMPARE** softkey
d/ **TEST ON** softkey
e/ **M1M2** softkey
f/ **AFTER FAIL CONTINUE** softkey
g/ RUN

**7** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**   It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay 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 2.607 Volts.

**Negative Pulse**

**9** On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

**Load the Telecom Mask**

**10** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select 8MG703 in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**11** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**12** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope

**NOTE**
It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay to obtain a PASS on the Mask.

**13** Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607 Volts.

## Procedure - **2.048 Mb/s**

### Positive Pulse

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2.

**2** Set the [TRANSMIT] display as shown opposite.

**3** Connect the PDH/DSn 75Ω OUT port to the Oscilloscope CHAN 1, terminate in 75Ω

**4** Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**5** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select DS_1E in the highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

### Compare Pulse with Mask

**6** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ **COMPARE** softkey

d/ **TEST ON** softkey
e/ **M1M2** softkey
f/ **AFTER FAIL CONTINUE** softkey
g/ RUN

**7** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**    It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay 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 2.607 Volts.

**Negative Pulse**

**9** On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ **DIRECTORY** softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ **CHANGE DIRECTORY** softkey

**Load the Telecom Mask**

**10** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select DS_1E in the highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

**Compare Pulse with Mask**

**11** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/  RECALL 8
b/ DEFINE MEAS
c/ **COMPARE** softkey
d/ **TEST ON** softkey
e/ **M1M2** softkey

> **f/** `AFTER FAIL CONTINUE` softkey
> **g/** RUN

**12** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

---

**NOTE**     It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay to obtain a PASS on the Mask.

---

**13** Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607 Volts.

## Procedure - DSX-3

### Positive Pulse

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2.

**2** Set the `TRANSMIT` display as shown opposite.

**3** Connect the PDH/DSn 75Ω OUT port to the Oscilloscope CHAN 1, terminate in 75Ω

**4** Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**5** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select DS3_92 in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**6** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL **8**
b/ DEFINE MEAS
c/ **COMPARE** softkey
d/ **TEST ON** softkey
e/ **M1M2** softkey
f/ **AFTER FAIL CONTINUE** softkey
g/ RUN

**7** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE** It may be necessary to select **MASK** softkey and **MASK AUTO** / **MASK ALIGN** or visibly fit the waveform to the mask by adjusting the oscilloscope vertical gain/position and horizontal delay 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 nominally 560 mV.

**Negative Pulse**

**9** On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ **DIRECTORY** softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ **CHANGE DIRECTORY** softkey

**Load the Telecom Mask**

**10** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select DS3_92 in the highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

**Compare Pulse with Mask**

**11** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**12** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope.

---

**NOTE**

It may be necessary to select `MASK` and `MASK AUTO`/`MASK ALIGN` to
visibly fit the waveform to the mask by adjusting the oscilloscope vertical
gain/position and horizontal delay to obtain a PASS on the Mask.

---

**13** Measure the peak pulse amplitude at the mid pulse-width using the
oscilloscope and verify that this is nominally 560 mV.

**14** Set the `TRANSMIT` signal to HIGH and check that the peak pulse
amplitude is approximately 0.9V.

**15** Set the `TRANSMIT` signal to LOW and check that the peak pulse
amplitude is approximately 0.3V.

## Procedure - DSX-1

**Positive Pulse**

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2.

**2** Connect the DSn 100Ω OUT port to the Oscilloscope via the HP
15508B Balanced to unbalanced Converter and terminate in 75Ω at
the Oscilloscope input.

**3**

**4** Set the [TRANSMIT] display as shown opposite.

**5** Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**6** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select DS1_NEW in the highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

### Compare Pulse with Mask

**7** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8, (Ensure CH1 Impedance is reset to 1MΩ. Select TRIGGER, SETUP and set **PATTERN TRIGGER** softkey to **Trig'd** ).
b/ DEFINE MEAS
c/ **COMPARE** softkey
d/ **TEST ON** softkey
e/ **M1M2** softkey
f/ **AFTER FAIL CONTINUE** softkey
g/ RUN

**NOTE**    Using the balanced to unbalanced converter reduces the pulse amplitude by a factor of 1.266. This will cause the comparison with the mask to fail. To overcome this select CHAN 1 ON and reduce the Volts/Division setting (highlighted on the softkey display). Reduced Volts/Division = highlighted value/1.266. The new value can be entered using the keypad

**8** The oscilloscope will compare the positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

| | |
|---|---|
| **NOTE** | It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay 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 1.896V and 2.844V.

**Negative Pulse**

**10** On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ **DIRECTORY** softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ **CHANGE DIRECTORY** softkey

**Load the Telecom Mask**

**11** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select DS1_NEW in the highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

**Compare Pulse with Mask**

**12** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8, (Ensure CH1 Impedance is reset to 1MΩ Select TRIGGER, SETUP and set **PATTERN TRIGGER** softkey to **Trig'd** ).
b/ DEFINE MEAS
c/ **COMPARE** softkey
d/ **TEST ON** softkey
e/ **M1M2** softkey
f/ **AFTER FAIL CONTINUE** softkey
g/ RUN

**NOTE**
Using the balanced to unbalanced converter reduces the pulse amplitude by a factor of 1.266. This will cause the comparison with the mask to fail. To overcome this select CHAN 1 ON and reduce the Volts/Division setting (highlighted on the softkey display). Reduced Volts/Division = highlighted value/1.266. The new value can be entered using the keypad

**13** The oscilloscope will compare the negative pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**
It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay to obtain a PASS on the Mask.

**14** Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 1.896V and 2.844V.

**15** Set the ⌈TRANSMIT⌉ signal to LOW and check that the peak pulse amplitude reduces by approximately 20% and pulse shape has slower rise/fall edges.

**16** Disconnect all the test equipment.

# PDH/DSn Receiver Equalization

## Specifications

| Rate | Equalization |
|------|-------------|
| E1- 2.048 Mb/s | 6dB for root f cable at 1/2 bit rate |
| E2 - 8.448 Mb/s | 6dB for root f cable at 1/2 bit rate |
| E3 - 34.368 Mb/s | 12dB for root f cable at 1/2 bit rate |
| E4 - 139.264 Mb/s | 12dB for root f cable at 1/2 bit rate |
| DS1- 1.544 Mation b/s | Single range from DS1-LO to DSX -1 |
| DS3 - 44.736 Mb/s | Automatic equalization for up to 900 feet of root f cable. |

**NOTE**  The Rates available are dependent on the HP37718A/19A option

## Description

The Receiver Equalization is checked by looping the transmitter output to receiver input through a special Cable. This simulates 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.

## Equipment Required

**Cable Simulator E4**  80 metres of 8120-0049

**Cable Simulator E3**  120 metres of 8120-0049

**Cable Simulator E2**  80 metres of 8120-0049

**Cable Simulator E1**  120 metres of 8120-0049

**Cable Simulator DS3**  55 metres of 8120-0049

**Cable Simulator DS1**  80 metres of 8120-0049

**110Ω/75Ω Balanced to Unbalanced Converter**  HP 15508B (Qty 2)

## Procedure

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2.

**2** Select **SETTINGS CONTROL** TRANSMITTER and RECEIVER [COUPLED] on the OTHER display.

### 139.264 Mb/s

**3** Set the TRANSMIT display as shown opposite.

**4** Connect Cable Simulator E4 between the PDH/DSn 75Ω OUT and 75Ω IN ports.

**5** Press RESULTS **TROUBLE SCAN** then RUN/STOP to start the measurement.

**6** Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds.

**7** Press RUN/STOP to stop the measurement.

### 34.368 Mb/s

**8** Set the TRANSMIT display as shown opposite.

**9** Connect Cable Simulator E3 between PDH/DSn 75Ω OUT and 75Ω IN ports.

**10** Press RESULTS **TROUBLE SCAN** then RUN/STOP to start the measurement.

**11** Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds.

**12** Press RUN/STOP to stop the measurement.

**DS3 (44.736 Mb/s)**

**13** Set the $\boxed{\text{TRANSMIT}}$ display as shown opposite.

**14** Connect Cable Simulator DS3 between the DSn 75Ω OUT and 75Ω IN ports.

**15** Press $\boxed{\text{RESULTS}}$ **TROUBLE SCAN** then $\boxed{\text{RUN/STOP}}$ to start the measurement.

**16** Ensure that NO TROUBLE is displayed on the $\boxed{\text{RESULTS}}$ display after 30 seconds.

**17** Press $\boxed{\text{RUN/STOP}}$ to stop the measurement.

---

**NOTE**

If Cable Simulator DS3 is not available, it is permissible to select DS3-900' on the $\boxed{\text{TRANSMIT}}$ display and connect the HP37718A/19A 75Ω OUT port direct to the 75Ω IN port. This setup assumes the DS3-900' output signal is within specification.

---

**8.448 Mb/s**

**18** Set the $\boxed{\text{TRANSMIT}}$ display as shown opposite.

**19** Connect Cable Simulator E2 between the PDH/DSn 75Ω OUT and 75Ω IN ports.

**20** Press $\boxed{\text{RESULTS}}$ **TROUBLE SCAN** then $\boxed{\text{RUN/STOP}}$ to start the measurement.

**21** Ensure that NO TROUBLE is displayed on the $\boxed{\text{RESULTS}}$ display after 30 seconds.

**22** Press $\boxed{\text{RUN/STOP}}$ to stop the measurement.

**2.048Mb/s**

**23** Set the [TRANSMIT] display as shown opposite.

**24** Connect Cable SimulatorE1 between the PDH/DSn 75Ω OUT and 75Ω IN ports.

**25** Press [RESULTS] **TROUBLE SCAN** then [RUN/STOP] to start the measurement.

**26** Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds.

**27** Press [RUN/STOP] to stop the measurement.

**DS1 (1.544 Mb/s)**

**28** Set the [TRANSMIT] display as shown opposite.

**29** Connect Cable Simulator DS1 between the 110Ω OUT and 110Ω IN ports via two Balanced to Unbalanced Converters (HP 15508B).

**30** Press [RESULTS] **TROUBLE SCAN** then [RUN/STOP] to start the measurement.

**31** Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds.

**32** Press [RUN/STOP] to stop the measurement.

**NOTE**     If Cable Simulator DS1 is not available, it is permissible to select DS1-LO on the [TRANSMIT] display and connect the 110Ω OUT port direct to the 110Ω IN port. This setup assumes the DS1-LO output signal is within specification.

## PDH/DSn Receiver Monitor Levels

### Specifications

| Bit Rate | Nominal Loss | Equalization at 1/2 Bit Rate |
|---|---|---|
| E1 - 2.048 Mb/s | 20, 26, 30dB | 3dB |
| E2 - 8.448 Mb/s | 20, 26, 30dB | 3dB |
| E3 - 34.368 Mb/s | 20, 26dB | 6dB |
| E4 - 139.264 Mb/s | 20, 26dB | 6dB |
| DS1 - 1.544 Mb/s | 20, 26, 30dB | 3dB |
| DS3 - 44.736 Mb/s | 20, 26dB | 6dB |

**NOTE**   The Rates available are dependent on the HP37718A/19A option

### Description

The signal from the HP37718A/19A 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 from a 75$\Omega$, attenuator kit. The Cable Loss is supplied by
inserting the correct Cable Simulators for each bit rate in the
attenuation path.

### Equipment Required

**Cable Simulator E4-M**       40 metres of 8120-0049

**Cable Simulator E3-M**       60 metres of 8120-0049

**Cable Simulator E2-M**       40 metres of 8120-0049

**Cable Simulator E1-M**       600 metres of 8120-0049

**Cable Simulator DS3**        55 metres of 8120-0049

**Cable Simulator DS1**        80 metres of 8120-0049

**75$\Omega$ Attenuator Kit**       HP 86213A

**Type N/BNC adaptors**        HP 1250-1534 & -1528 (2off each)

## Procedure

**1** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**2** Connect the equipment as shown in Figure 3-1.
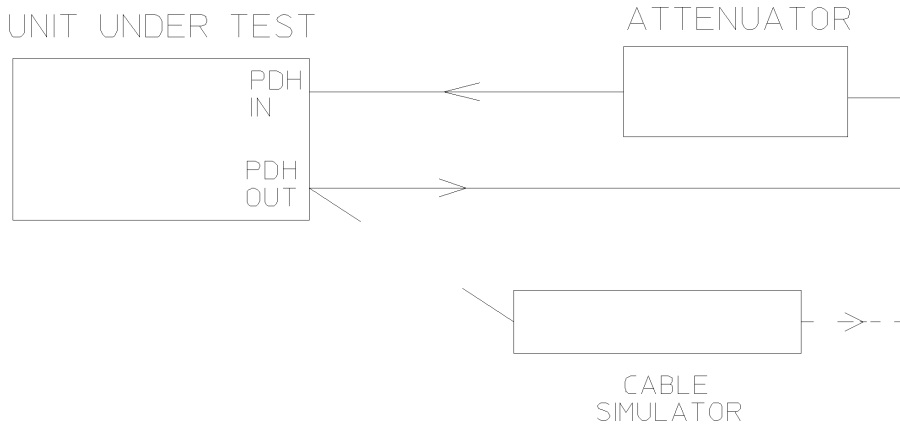


**Figure 3-1**          **Receiver Monitor Input**

### 2.048 Mb/s (E1)

**1** Press **TRANSMIT** and set up the **MAIN SETTINGS** display as shown opposite.

**2** Press RECEIVE and set up the
   MAIN  SETTINGS  display as
   shown opposite.

**3** Press RESULTS TROUBLE SCAN

**4** Press RUN/STOP to start the
   measurement.

**5** Ensure that NO TROUBLE is
   displayed on the RESULTS
   display after 30 seconds.

**6** Press RUN/STOP to stop the
   measurement.

**7** Press RECEIVE and select EQUALIZATION [ON] GAIN [20 dB].

**8** Connect Cable Simulator E1-M between the PDH OUT Port and the
   attenuator.

**9** Press RESULTS TROUBLE SCAN then RUN/STOP to start the
   measurement.

**10** Ensure that NO TROUBLE is displayed on the RESULTS display after
   30 seconds. Press RUN/STOP to stop the measurement.

**11** Connect the 6dB Fixed Attenuator in the signal path to give a total
   path attenuation of 26dB.

**12** Press RECEIVE and select MONITOR LEVEL [26dB].

**13** Press RESULTS; TROUBLE SCAN then RUN/STOP to start the
   measurement.

**14** Ensure that NO TROUBLE is displayed on the RESULTS display after
   30 seconds. Press RUN/STOP to stop the measurement.

**15** Remove Cable Simulator E1-M from the signal path.

**16** Press RECEIVE and select EQUALIZATION [OFF].

**17** Press RESULTS; TROUBLE SCAN then RUN/STOP to start the
   measurement.

**18** Ensure that NO TROUBLE is displayed on the RESULTS display after
   30 seconds. Press RUN/STOP to stop the measurement.

**19** Remove the 6dB fixed attenuator and connect the 10dB Fixed
   Attenuator in the signal path to give a total path attenuation of 30dB.

**20** Press RECEIVE and set MONITOR LEVEL [30dB].

**21** Press RESULTS **TROUBLE SCAN** then RUN/STOP to start the measurement.

**22** Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press RUN/STOP to stop the measurement.

**23** Press RECEIVE and select EQUALIZATION [ON].

**24** Connect Cable Simulator E1-M between the PDH OUT Port and the attenuator.

**25** Press RESULTS **TROUBLE SCAN** . Press RUN/STOP to start the measurement.

**26** Ensure that NO TROUBLE is displayed on the RESULTS display after 30 seconds. Press RUN/STOP to stop the measurement.

**8.448 Mb/s (E2)**

**27** Repeat steps 1 to 26 (20dB, 26dB and 30dB tests) with the HP37718A/19A TRANSMIT and RECEIVE displays set to SIGNAL [8 Mb/s] and Cable Simulator E2-M fitted in place of Cable Simulator E1-M.

**34.368 Mb/s (E3)**

**28** Repeat steps 1 to 18 (20dB and 26dB tests) with the HP37718A/19A TRANSMIT and RECEIVE displays set to SIGNAL [34 Mb/s] and Cable Simulator E3-M fitted in place of Cable Simulator E1-M.

**139.264 Mb/s (E4)**

**29** Repeat steps 1 to 18 (20dB and 26dB tests) with the HP37718A/19A TRANSMIT and RECEIVE displays set to SIGNAL [140 Mb/s] and Cable Simulator E4-M fitted in place of Cable Simulator E1-M.

**1.544 Mb/s (DS-1)**

**30** Repeat steps 1 to 26 (20dB, 26dB and 30dB tests) with the HP37718A/19A TRANSMIT and RECEIVE displays set to SIGNAL [DSX-1]. Connect Cable Simulator DS1 between two Balanced to Unbalanced converters and fit in place of Cable Simulator E1-M.

**44.736 Mb/s (DS-3)**

**31** Repeat steps 1 to 18 (20dB and 26dB tests) with the HP37718A/19A
TRANSMIT and RECEIVE displays set to SIGNAL [DSX-3] and Cable
Simulator DS3 fitted in place of Cable Simulator E1-M.

**32** Disconnect all the test equipment.

## External Mux/Demux

### Specifications

| Rate | Interface | Source |
|------|-----------|--------|
| 2.048 Mb/s (E1) | Meets ITU-T Rec. G.703 for unbalanced coaxial pair. | Accepts a 2 Mb/s Unbalanced signal conforming to ITU-T Rec. G.703. |
| 1.544 Mb/s (DS-1) | Meets T1.102-1993 for Balanced pair. | Accepts a DS-1 balanced signal conforming to T1.102-1993. |

**NOTE**    The Mux/Demux Rate available is dependent on the HP37718A/19A option.

### Description

This test verifies operation of the PDH/DSn Mux and demux hardware and confirms the output characteristics of the external demux port on the PDH/DSn Receiver.

The *PDH/DSn Test Set* is set up to transmit an unframed 2Mb/s/DS-1 pattern. This is applied to the HP37718A/19A INSERT Port. The 2Mb/s/DS-1 signal is multiplexed into a 34Mb/s/DS-3 data stream. The HP37718A/19A transmitter and receiver are looped. The unframed 2Mb/s/DS-1 signal is Demultiplexed from the 34Mb/s/DS-3 data stream to the *PDH/DSn Test Set via the* HP37718A/19A DROP port. A BER test is performed to verify the integrity of the 2 Mb/s/DS-1 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

**Oscilloscope**      : HP 54520A Option 001

**PDH Test Set**      : HP37718A/19A

**75Ω Termination**   : HP 15522-80010

**T Connector**       : HP 1250-0781

**NOTE**        The *Test Set* used in this procedure is an 37718A/37719A. Any other PDH
Test Set, capable of generating and measuring at 2 Mb/s/DS-1 unframed,
can be used.

## Procedure

### 2Mb/s Mux/Demux

**1** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**2** Connect the equipment as shown in Figure 3-2.

```
              UNIT  UNDER  TEST

         2 Mb/s      PDH         2 Mb/s
         INSERT                   DROP
                   IN   OUT
           o        o    o         o

   PDH
   Test Set

     OUT o   2 Mb/s
              ----->

      IN o   2 Mb/s
              <-----
```
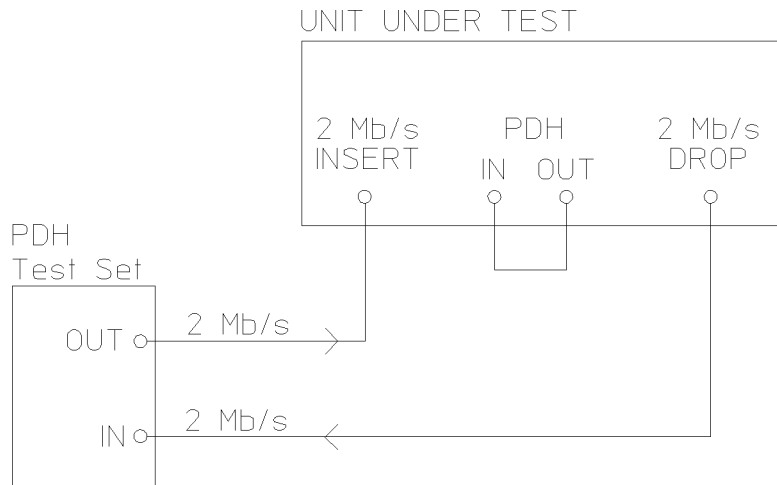
**Figure 3-2**        **External Mux/Demux**

**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 HP37718A/19A and set up the **MAIN SETTINGS** display as shown opposite.

**6** Press [TRANSMIT] on the HP37718A/19A and set up the **STRUCTURED** **SETTINGS** display as shown opposite.

**7** Press [RECEIVE] on the HP37718A/19A and set up the **MAIN SETTINGS** display as shown opposite.

**8** Press [RECEIVE] on the HP37718A/19A and set up the **STRUCTURED** **SETTINGS** display as shown opposite.

**9** Press [RUN/STOP] on the Test Set. Press [RESULTS] **TROUBLE SCAN** on the Test Set and ensure that NO TROUBLE is displayed.

**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.

## 2.048 Mb/s Positive Pulse

**11** Disconnect the UUT 75Ω DROP port from the Test Set and connect to the Oscilloscope. Terminate in 75Ω at the Oscilloscope input.

**12** Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**13** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select DS_1E in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

### Compare Pulse with Mask

**14** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL **8**
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**15** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**    It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay to obtain a PASS on the Mask.

**16** Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 2.133V and 2.607 Volts.

### 2.048 Mb/s Negative Pulse

**17** On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

**Load the Telecom Mask**

**18** On the oscilloscope, use the following key sequence to select and load
the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select DS_1E in the highlighted
MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**19** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**20** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope.

---

**NOTE**     It may be necessary to visibly fit the waveform to the mask by adjusting
the oscilloscope vertical position and horizontal delay to obtain a PASS on
the Mask.

---

**21** Measure the peak pulse amplitude at the mid pulse-width using the
oscilloscope and verify that this is between 2.133V and 2.607 Volts.

**DS-1 Mux and Demux**

**1** Connect the UUT balanced DS-1 Insert and Drop ports to the DS-1
Balanced Ports of the Test Set and repeat steps 3 through 10
substituting DS-1 for 2Mb/s and DS-3 for 34Mb/s.

**DS-1 Positive Pulse**

**2** Disconnect the UUT 100Ω DROP port from the Test Set and connect
to the Oscilloscope via the HP 15508B Balanced to unbalanced
Converter. Terminate in 75Ω at the Oscilloscope input.

**3** Select CHAN 1 on the oscilloscope and set to 1MΩ input impedance.

### Load the Telecom Mask

**4** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select DS1_NEW in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

### Compare Pulse with Mask

**5** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8, (Ensure CH1 Impedance is reset to 1MΩ. Select TRIGGER, SETUP and set `PATTERN TRIGGER` softkey to `Trig'd`).
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**NOTE** Using the balanced to unbalanced converter reduces the pulse amplitude by a factor of 1.266. This will cause the comparison with the mask to fail. To overcome this select CHAN 1 ON and reduce the Volts/Division setting (highlighted on the softkey display). Reduced Volts/Division = highlighted value/1.266. The new value can be entered using the keypad

**6** The oscilloscope will compare the positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE** It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay 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 1.896V and 2.844V.

### DS-1 Negative Pulse

**8** On the Oscilloscope, use the following key sequence to access the inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

### Load the Telecom Mask

**9** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select DS1_NEW in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

### Compare Pulse with Mask

**10** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8, (Ensure CH1 Impedance is reset to 1MΩ Select TRIGGER,                    SETUP and set `PATTERN TRIGGER` softkey to `Trig'd` ).
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**NOTE**    Using the balanced to unbalanced converter reduces the pulse amplitude by a factor of 1.266. This will cause the comparison with the mask to fail. To overcome this select CHAN 1 ON and reduce the Volts/Division setting (highlighted on the softkey display). Reduced Volts/Division = highlighted value/1.266. The new value can be entered using the keypad

**11** The oscilloscope will compare the negative pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**

It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay to obtain a PASS on the Mask.

**12** Measure the peak pulse amplitude at the mid pulse-width using the oscilloscope and verify that this is between 1.896V and 2.844V.

**13** Disconnect all test equipment.

## PDH/DSn Frequency Measurement and Looped Clock

### Specifications

| Accuracy | 4.5 ppm |
|---|---|
| **Measured Offset** | 100 ppm |

**NOTE**   The Rates available are dependent on the HP37718A/19A option

### Description

This test verifies that the HP37718A/19A Receiver Frequency
Measurement is within specified limits. These limits assume the
instrument is within the calibration cycle.

A Synthesizer is used to generate a sinewave at half the data rate. This
is applied to the HP37718A/19A Receiver Signal In port. As this signal
corresponds to an *All Ones Ternary Signal*, the HP37718A/19A receiver
should sync up with no errors if set to PATTERN [ALL ONES]. The
Frequency Measurement accuracy of the HP37718A/19A can be
determined by comparison with the frequency displayed on the
Synthesizer. Frequency Offset Measurement is also verified during this
test as the HP37718A/19A 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 001 (75Ω)

**Frequency Counter**    : HP 5335A Option 010

### Procedure

1  Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-
   2.

2  Connect up the equipment as shown in Figure 3-3.

**Figure 3-3**          **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.

**7** Press ⎡RESULTS⎤ and set up the display as shown opposite.

**8** Verify that the FREQUENCY displayed is between 2047991 Hz and 2048009 Hz.

**9** Verify that the Offset displayed is between +4.5 ppm and -4.5 ppm.

**10** Set the synthesizer frequency to 1024.102 kHz and verify that the frequency displayed on the ⎡RESULTS⎤ display is between 2048.194 kHz and 2048.214 kHz.

**11** Verify that the Offset displayed is between 95.5 ppm and 104.5 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 2047.786 kHz and 2047.806 kHz.

**13** Verify that the Offset displayed is between -95.5 ppm and -104.5 ppm. The frequency counter should read 1.00.

**14** Set the synthesizer level to +10 dBm, synthesizer frequency and the HP37718A/19A to the settings given in Table 3-1 and verify the displayed Offset at each point.

| Table 3-1 | PDH/DSn Offsets | |
|---|---|---|
| **Receive Frequency** | **Synthesizer Frequency** | **Displayed Offset** |
| 8 Mb/s (E2) | 4224,000 Hz | -4.5 to +4.5 ppm |
| 8 Mb/s (E2) | 4223,578 Hz | -95.5 to -104.5 ppm |
| 8 Mb/s (E2) | 4224,422 Hz | +95.5 to +104.5 ppm |
| 34 Mb/s (E3) | 17,184,000 Hz | -4.5 to +4.5 ppm |
| 34 Mb/s (E3) | 17,182,282 Hz | -95.5 to -104.5 ppm |
| 34 Mb/s (E3) | 17,185,718 Hz | +95.5 to +104.5 ppm |
| 140 Mb/s (E4) | 69,632,000 Hz | -4.5 to +4.5 ppm |
| 140 Mb/s (E4) | 69,625,036 Hz | -95.5 to -104.5 ppm |

**Table 3-1**              **PDH/DSn Offsets**

| Receive Frequency | Synthesizer Frequency | Displayed Offset |
|---|---|---|
| 140 Mb/s E4) | 69,638,963 Hz | +95.5 to +104.5 ppm |
| 1.544 Mb/s (DS-1) | 772,000 Hz | -4.5 to +4.5 ppm |
| 1.544 Mb/s (DS-1) | 771,923 Hz | -95.5 to -104.5 ppm |
| 1.544 Mb/s (DS-1) | 772,077 Hz | +95.5 to +104.5 ppm |
| 44.736 Mb/s (DS-3) | 22,368,000 Hz | -4.5 to +4.5 ppm |
| 44.736 Mb/s (DS-3) | 22,365,763 Hz | -95.5 to -104.5 ppm |
| 44.736 Mb/s (DS-3) | 22,370,237 Hz | +95.5 to +104.5 ppm |

## SDH/SONET Transmitter Clock Accuracy

### Specification

| Bit Rate | Accuracy |
|----------|----------|
| 51.84 Mb/s | 4.5 ppm |

### Description

The test uses a Frequency Counter connected to the Multirate Analyzer module Clock Trigger output port. This output is derived from the Clock module internal 10MHz clock oscillator providing a 51.84 MHz that is directly related to all SDH/SONET output rates.

### Equipment Required

**Frequency Counter**        : HP 5335A Option 010

### Procedure

**1**   Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**2**   Set the Transmitter Output to SDH/SONET.

**3**   Connect the HP37718A/19A Multirate Analyzer module CLOCK TRIGGER port to the Frequency Counter Input A, set the input termination to 50$\Omega$

**4**   Adjust the Frequency Counter Trigger Level to obtain a stable reading and ensure that the Frequency Counter reads between 51.839670 MHz and 51.840230 MHz.

**5**   Disconnect all the test equipment.

## External Clock/Data Reference Inputs & Clock Reference Output

### Specifications

| Clock Rate | Description |
|---|---|
| 2.048 Mb/s MTS | Accepts timing reference as per ITU-T G.811 |
| 10 MHz Reference | Accepts 10 MHz timing reference |
| 1.544 Mb/s BITS | Accepts DS-1 timing reference as per TA-TSY-000378 |
| 64 kb/s | Accepts 64 kb/s timing reference as per ITU-T G.703 Section 1.2.2 |
| STM-1/STS-3 Receive | Recovers clock from received STM/STS input signal. |

**NOTE**    The Rates available are dependent on the HP37718A/19A option

### Description

This test verifies that signal integrity is maintained when an
EXTERNAL clock is used as a reference.

### Equipment Required

| | |
|---|---|
| **Synthesizer** | : HP 3335A option 001 (75$\Omega$) |
| **PDH/DSn Test Set** | : HP37718A/19A |
| **110$\Omega$/75$\Omega$ Balanced to Unbalanced Converter** | : HP 15508B |
| **Frequency Counter** | : HP 5335A Opt 010 |
| **64kb/s Test Set** | : HP 37732A |

## Procedure

**MTS Clock** - **Clock Format**

**1** Connect the 52/155 Mb/s DATA OUT port to the 52/155 Mb/s DATA IN port.

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2 and set the `OTHER` `SETTINGS` `CONTROL` display as shown opposite.

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

**3** Set the HP 3335A to 2.048 MHz at +10 dBm.

**4** Connect the HP 3335A to the HP37718A/19A 75Ω 2M REF IN port on the Clock module.

**5** Press `RESULTS`; `TROUBLE` `SCAN` .

**6** Press `RUN/STOP`, check that the display reads NO TROUBLE and all the Alarm leds are off.

**7** Press `RUN/STOP` to halt the measurement.

**Clock REF OUT**

**8** Connect the Clock REF Out port to the Frequency Counter and check that a 2.048MHz signal is present.

**MTS Clock** - **Data**

**9** Disconnect the HP 3335A Synthesizer from the HP37718A/19A 75Ω 2M REF IN port.

**10** Set the PDH/DSn Test Set to transmit a 2 Mb/s unframed signal.

**11** Connect the PDH/DSn Test Set, 75Ω Output to the HP37718A/19A
75Ω 2M REF IN Port and Recall the DEFAULT SETTINGS as shown
on page 3-2.

**12** Set the ⌈**TRANSMIT**⌉ display as
shown opposite.

**13** Select CLOCK SYNC FORMAT [2
Mb/s DATA] on the SDH
⌈**TRANSMIT**⌉ Display.

**14** Press ⌈**RESULTS**⌉ **TROUBLE SCAN**
then ⌈**RUN/STOP**⌉.

**15** Check that the ⌈**RESULTS**⌉ Display
reads NO TROUBLE and all the
Alarm LEDS are off. Press
⌈**RUN/STOP**⌉ to halt the measurement.

**16** Disconnect the PDH/DSn Test Set, 75Ω 2 Mb/s PDH Output from the
75Ω 2M REF IN Port.

**17** Connect the PDH/DSn Test Set, 120Ω 2 Mb/s PDH Output to the
120Ω 2M REF IN Port.

**18** Change the PDH O/P termination to 120Ω on the PDH/DSn Test Set
and the HP37718A/19A.

**19** Press ⌈**RESULTS**⌉ **TROUBLE SCAN** then ⌈**RUN/STOP**⌉ on the HP37718A/
19A.

**20** Check that the ⌈**RESULTS**⌉ Display reads NO TROUBLE and all the
Alarm LEDS are off. Press ⌈**RUN/STOP**⌉ to halt the measurement.

**STM-1/STS-3 Receive Data**

**21** Disconnect the PDH/DSn Test Set Data Output from the HP37718A/
19A, 120Ω 2M REF IN port.

**22** Disconnect the 52/155 Mb/s DATA OUT port from the 52/155 Mb/s
DATA IN port

**23** Select CLOCK SYNC [STM-1/STS-3 RECEIVE] ON THE HP37718A/
19A ⌈**TRANSMIT**⌉ display.

**24** The SDH Clock Loss Alarm led should be lit on the HP37718A/19A.

**25** Set the Synthesizer frequency to 77.760MHz and amplitude to
+10dBm.

**26** Connect the Synthesizer to the 75Ω 52/155 Mb/s DATA IN port.

**27** Ensure that the SDH/SONET Clock Loss Alarm Led is not lit.

**NOTE**    As the signal is unframed the LOF/OOF etc. alarms will be on.

### 10 MHz Reference

**28** Select CLOCK SYNC [10MHz REF] ON THE HP37718A/19A
[TRANSMIT] display.

**29** The SDH/SONET Clock Loss Alarm led should be lit on the
HP37718A/19A.

**30** Set the Synthesizer frequency to 10.000MHz and amplitude to
+10dBm.

**31** Connect the Synthesizer to the HP37718A/19A, 75Ω 2M REF IN Port.

**32** Ensure that the SDH/SONET Clock Loss Alarm Led is not lit.

### BITS Clock

**33** Select CLOCK SYNC [BITS] ON THE HP37718A/19A [TRANSMIT]
display.

**34** The SDH/SONET Clock Loss Alarm led should be lit on the
HP37718A/19A.

**35** Set the Synthesizer frequency to 772kHz and amplitude to +10dBm.

**36** Connect the Synthesizer, via the Balanced to Unbalanced converter, to
the HP37718A/19A, 100Ω BITS Clock Port.

**37** Ensure that the SDH/SONET Clock Loss Alarm Led is not lit.

### 64 kb/s Clock

**38** Select CLOCK SYNC [64 kb/s] ON THE HP37718A/19A [TRANSMIT]
display.

**39** The SDH/SONET Clock Loss Alarm led should be lit on the
HP37718A/19A.

**40** Set the 64kb/s Test Set to provide a 64kb/s Clock Signal.

**41** Connect the Clock Signal to the HP37718A/19A balanced 64K Clock
input.

**42** Ensure that the SDH/SONET Clock Loss Alarm Led is not lit.

**43** Disconnect all the test equipment.

## SDH/SONET Frequency Offsets

### Specifications

| | |
|---|---|
| **Range** | ±999 ppm |
| **Resolution** | 0.1 ppm |
| **Accuracy** | 0.02 ppm |

### Description

The test uses a Frequency Counter connected to the Multirate Analyzer module Clock Trigger output port. This output is derived from the Clock module and is directly related to the SDH/SONET output rate. An external 10 MHz reference from a Signal Generator is used to clock the HP37718A/19A and also provides a timebase reference for the Frequency counter. The counter measures the Clock Trigger frequency to check the offset accuracy and range.

### Equipment Required

**Signal Generator**      : HP 8657A

**Frequency Counter**   : HP 5335A Opt 010

**T Connector**           : HP 1250-0781

### Procedure

1   Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2. Set the Transmitter Output to SDH/SONET.

2   Select CLOCK SYNC [10MHz REF] ON THE HP37718A/19A ⸤TRANSMIT⸥ display.

3   Connect the HP8657A to the HP37718A/19A Unbalanced 75Ω 2M REF IN port on the Clock Module.

4   Set the Signal Generator frequency to 10.000MHz and amplitude to +10dBm.

5   Check the Clock Loss Alarm Led is not lit.

**6** Connect the Signal Generator, Timebase OUT port (rear panel), to the counter Timebase IN port (rear panel).

**7** Check the Counter EXT TIME BASE flag is illuminated on the front panel.

**8** Connect the HP37718A/19A Multirate Analyzer module CLOCK TRIGGER port to the Frequency Counter, set input termination to 50Ω.

**9** Adjust the Frequency Counter Trigger Level to obtain a stable reading.

**10** The reading should be between 51.839999 - 51.840001MHz. If not check setup and ensure the Counter is locked to the Signal Generator.

**11** Set the HP37718A/19A frequency offset to the settings given in Table 3-2 and verify the frequency at each step is within the Min/Max limits.

**Table 3-2**                          **SDH/SONET Offset**

| Offset (ppm) | Min Expected Frequency | Max Expected Frequency |
|---|---|---|
| -999ppm | 51788210.8 Hz | 51788212.9 Hz |
| -100ppm | 51834814.9 Hz | 51834817.1 Hz |
| -66.6ppm | 51836546.4 Hz | 51836548.5 Hz |
| +33.3ppm | 51841725.2 Hz | 51841727.3 Hz |
| +100ppm | 51845182.9 Hz | 51845185.1 Hz |
| +999ppm | 51891787.1 Hz | 51891789.2 Hz |

**12** Disconnect all the test equipment.

# STM-0/STS-1 Transmitter Output Waveshape

## Specifications

| Level | Pulse Amplitude & Shape |
|---|---|
| Cross-Connect (450 feet) | 530 mV peak (nominal). Compliant with GR-253, Issue 1, Figure 4-10 and draft recommendation ITU-R F.750, Appendix1 |
| HIGH | 1 V peak (nominal) |
| LOW | 300 mV peak (nominal) |

## Description

An oscilloscope is connected to the HP37718A/19A Transmitter STM-0/STS-1 output and used to check the STM-0/STS-1 waveshape against the relevant mask.

## Equipment Required

**Oscilloscope** : HP 54520A Option 001

**75Ω Termination** : HP 15522-80010

**T Connector** : HP 1250-0781

## Procedure

### Positive Pulse

1  Recall HP37718A/19A DEFAULT SETTINGS as shown on page 3-2 and set up the [TRANSMIT] display as shown opposite.

2  Connect the 52/155 Mb/s 75Ω DATA OUT port to the Oscilloscope CHAN 1, terminate in 75Ω

3  Select CHAN 1 on the oscilloscope

and set to 1MΩ input impedance.

**Load the Telecom Mask**

**4** On the oscilloscope, use the following key sequence to select and load
the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select STS1_93 in the
highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**5** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**6** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope.

---

**NOTE**      It may be necessary to select `MASK` softkey and `MASK AUTO` /
`MASK ALIGN` or to visibly fit the waveform to the mask by adjusting the
oscilloscope vertical gain/position and horizontal delay 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 nominally 530 mV.

**Negative Pulse**

**8** On the Oscilloscope, use the following key sequence to access the
inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

### Load the Telecom Mask

**9** On the oscilloscope, use the following key sequence to select and load
the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ **TELECOM MASK/MASK** softkey.
c/ Use ENTRY/MEASURE control to select STS1_93 in the
highlighted MSK FILES window.
d/ **LOAD SETUP 8 M1M2** softkey.

### Compare Pulse with Mask

**10** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL 8
b/ DEFINE MEAS
c/ **COMPARE** softkey
d/ **TEST ON** softkey
e/ **M1M2** softkey
f/ **AFTER FAIL CONTINUE** softkey
g/ RUN

**11** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope

**NOTE**    It may be necessary to select **MASK** and **MASK AUTO** / **MASK ALIGN** to
visibly fit the waveform to the mask by adjusting the oscilloscope vertical
gain/position and horizontal delay to obtain a PASS on the Mask.

**12** Measure the peak pulse amplitude at the mid pulse-width using the
oscilloscope and verify that this is nominally 530 mV.

**13** Change the signal to STM-0/STS-1 HIGH and check that the +ve and
-ve pulses are nominally 1 V.

**14** Change the signal to STM-0/STS-1 LOW and check that the +ve and -
ve pulses max) peaks are nominally 300 mV.

# STM-1/STS-3 Transmitter Output Waveshape

## Specifications

| Pulse Shape | Meets ITU Recommendation G.703 |
|-------------|-------------------------------|
| Amplitude   | ±0.5V ±10% |

## Description

An oscilloscope is connected to the HP37718A/19A Transmitter STM-1/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 mask. The STM/STS Framing is disabled during this test.

## Equipment Required

**Oscilloscope**        : HP 54520A

**75Ω Termination**     : HP 15522-80010

**T Connector**         : HP 1250-0781

## Procedure

**NOTE**    This performance test is written using the HP54520A Oscilloscope with Option 001 - Telecom Masks Application. If any other Oscilloscope is used the keystrokes given in this procedure will not apply.

### Installing the Telecom Masks Option

**1**  Insert the Disk containing the Telecom Mask into the Oscilloscope Disk Drive.

**2**  Press `SHIFT` (Blue Key) `DISK`

**3**  Press **DIRECTORY** then **ROOT DIRECTORY**.

### All Ones Pulse

**1** Connect up the equipment as shown in Figure 3-4 and Recall
HP37718A/19A DEFAULT SETTINGS as shown on page 3-2.



**Figure 3-4**          **STM-1/STS-3 Transmitter Output Waveshape Test Setup**

**2** Press ⟦TRANSMIT⟧ and set up the
display as shown opposite.

**3** Press ⟦OTHER⟧ ⟦CALIBRATION⟧ and
enter the calibration password -
1243. Set up the display as shown
opposite.

**4**  Connect the 52/155 Mb/s 75Ω
DATA OUT port to the
Oscilloscope, terminate in 75Ω

**5**  Select CHAN on the oscilloscope
and set to 1MΩ input impedance.

**Load the Telecom Mask**

**6** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.
c/ Use ENTRY/MEASURE control to select 155BIN1 in the highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**7** On the oscilloscope, use the following key sequence to compare the pulse with the mask:
a/ RECALL 8, (Ensure CH1 Impedance is reset to 1MΩ)
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**8** The oscilloscope will automatically display and compare an isolated positive pulse with the mask limits. A PASS message should appear on the Oscilloscope.

**NOTE**

It may be necessary to visibly fit the waveform to the mask by adjusting the oscilloscope vertical position and horizontal delay 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 450 mV and 550 mV. (i.e. 900 mV-1.1V Pk-Pk)

**All 0's Pulse**

**10** Select PATTERN [ALL 0's] on the `OTHER` `CALIBRATION` display.

**Load the Telecom Mask**

**11** On the oscilloscope, use the following key sequence to select and load the required Telecom Mask:
a/ SHIFT (Blue Key) APPLICATION.
b/ `TELECOM MASK/MASK` softkey.

    c/ Use ENTRY/MEASURE control to select 155BIN0 in the
highlighted MSK FILES window.
d/ `LOAD SETUP 8 M1M2` softkey.

**Compare Pulse with Mask**

**12** On the oscilloscope, use the following key sequence to compare the
pulse with the mask:
a/ RECALL 8, (Ensure CH1 Impedance is reset to 1M$\Omega$)
b/ DEFINE MEAS
c/ `COMPARE` softkey
d/ `TEST ON` softkey
e/ `M1M2` softkey
f/ `AFTER FAIL CONTINUE` softkey
g/ RUN

**13** The oscilloscope will automatically display and compare an isolated
positive pulse with the mask limits. A PASS message should appear on
the Oscilloscope.

**NOTE**　　It may be necessary to visibly fit the waveform to the mask by adjusting
the oscilloscope vertical position and horizontal delay to obtain a PASS on
the Mask.

**14** Measure the peak pulse amplitude at the mid pulse-width using the
oscilloscope and verify that this is between 450 mV and 550 mV.   (i.e.
900 mV-1.1V Pk-Pk)

**15** On the Oscilloscope, use the following key sequence to access the
inverted mask.
a/ SHIFT (Blue Key) DISK
b/ `DIRECTORY` softkey
c/ Use ENTRY/MEASURE control to highlight INV_MASK
d/ `CHANGE DIRECTORY` softkey

**16** Repeat steps 6 to 14 to check pulses against Inverted masks.

**17** Set CALIBRATION PATTERN to OFF and disconnect all the test
equipment.

# SDH/SONET Receiver Equalization

## Specifications

| Rate | Equalization |
|---|---|
| STM-0/STS-1 - 51.84 Mb/s | 12dB for root f cable at 1/2 bit rate |
| STM-1/STS-3 - 155.52 Mb/s | 12dB for root f cable at 1/2 bit rate |

## 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.

## Equipment Required

**Cable Simulator STM-0/STS-1** 50 metres of 8120-0049

**Cable Simulator STM-1/STS-3** 75 metres of 8120-0049

## Procedure

**STM-0/STS-1**

**1** Recall the HP37718A/19A Default Settings as shown on page 3-2 and set the OTHER SETTINGS CONTROL display as shown opposite.

**2** Set the [TRANSMIT] display as shown opposite.

**3** Connect Cable Simulator STS-1 between the 52/155 Mb/s 75Ω DATA OUT and 52/155 Mb/s 75Ω DATA IN ports.

**4** Press [RESULTS] **TROUBLE SCAN** then [RUN/STOP] to start the measurement.

**5** Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds.

**6** Press [RUN/STOP] to stop the measurement.

## Procedure

### STM-1/STS-3

**7** Set the [TRANSMIT] display as shown opposite.

**8** Connect Cable Simulator STS-3 between the 52/155 Mb/s 75Ω DATA OUT and 52/155 Mb/s 75Ω DATA IN ports.

**9** Press [RESULTS] **TROUBLE SCAN** then [RUN/STOP] to start the measurement.

**10** Ensure that NO TROUBLE is displayed on the [RESULTS] display after 30 seconds.

**11** Press [RUN/STOP] to stop the measurement.

**12** Disconnect all the equipment.

## SDH/SONET Receiver Monitor Levels

### Specifications

| Bit Rate | Nominal Loss | Equalization at 1/2 Bit Rate |
|---|---|---|
| STM-0/STS-1 - 51.84 Mb/s | 20, 26dB | 12dB |
| STM-1/STS-3 - 155.52 Mb/s | 20, 26dB | 12dB |

### Description

The signal from the HP37718A/19A SDH/SONET Transmitter is applied to the SDH/SONET Receiver after attenuating by an amount equal to the selected Receiver Flat Loss plus the specified Cable Loss. The Flat Loss is obtained from a 75$\Omega$, attenuator kit. The Cable Loss is supplied by inserting the correct Cable Simulators for each bit rate in the attenuation path.

### Equipment Required

**Cable Simulator STM-0/STS-1** 50 metres of 8120-0049

**Cable Simulator STM-1/STS-3** 75 metres of 8120-0049

**75$\Omega$ Attenuator Kit** HP 86213A

### Procedure

**1** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**2** Connect the equipment as shown in Figure 3-5.
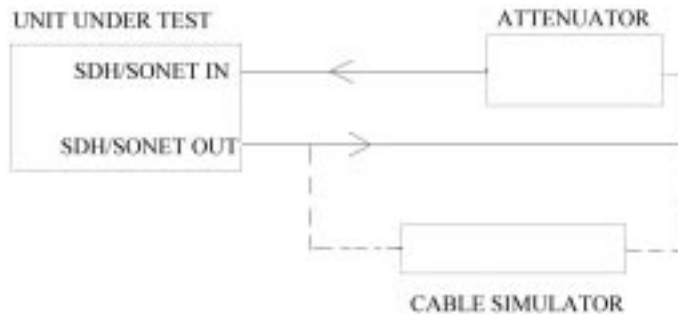
**Figure 3-5**          **Receiver Monitor Input**

**STM-0/STS-1**

**1** Set the  OTHER   SETTINGS 
 CONTROL  display as shown
opposite.



**2** Press  RECEIVE  and set up the
 MAIN   SETTINGS  display as
shown opposite.

**3** Press  RESULTS   TROUBLE SCAN 

**4** Press  RUN/STOP  to start the
measurement.

**5** After 30 seconds ensure that NO
TROUBLE is displayed on the
 RESULTS  display

**6** Press  RUN/STOP  to stop the
measurement.

**7** Connect Cable Simulator STS-1 between the52/155 Mb/s DATA OUT Port and the attenuator.

**8** Press `RESULTS` **TROUBLE SCAN** then `RUN/STOP` to start the measurement.

**9** Ensure that NO TROUBLE is displayed on the `RESULTS` display after 30 seconds.

**10** Press `RUN/STOP` to stop the measurement.

**11** Connect the 6dB Fixed Attenuator in the signal path to give a total path attenuation of 26dB.

**12** Press `RECEIVE` and select MONITOR LEVEL [26dB].

**13** Press `RESULTS`; **TROUBLE SCAN** then `RUN/STOP` to start the measurement.

**14** Ensure that NO TROUBLE is displayed on the `RESULTS` display after 30 seconds.

**15** Press `RUN/STOP` to stop the measurement.

**16** Remove Cable Simulator STS-1 from the signal path.

**17** Press `RESULTS`; **TROUBLE SCAN** then `RUN/STOP` to start the measurement.

**18** Ensure that NO TROUBLE is displayed on the `RESULTS` display after 30 seconds.

**19** Press `RUN/STOP` to stop the measurement.

**STM-1/STS-3**

**20** Repeat steps 1 to 19 (20dB and 26dB tests) with the `RECEIVE` display set to SIGNAL [STM-1/STS-3] and Cable Simulator STS-3 fitted in place of Cable Simulator STS-1.

**21** Disconnect all the equipment.

## Multirate Optical Interfaces

### Specification (1310 nm Transmitter)

| Wavelength | 1280 nm to 1330 nm (Typical 1310 nm) |
|---|---|
| Power Output | +0.0 dBm to +3.0 dBm (Typical +1 dBm) |
| Line Coding | NRZ |
| Safety Class | Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825 |
| Data Rates | 51.84, 155.52, 622.08 or 2488.32 Mb/s (Nominal) |

### Specification (1550 nm Transmitter)

| Wavelength | 1530 nm to 1570 nm (Typical 1550 nm) |
|---|---|
| Power Output | 0.0 dBm to +3.0 dBm (Typical +1dBm) |
| Line Coding | NRZ |
| Safety Class | Class 1, FDA 21 CFR Ch.1 1040.10 and EN 60825 |
| Data Rates | 51.84, 155.52, 622.08 or 2488.32 Mb/s (Nominal) |

**NOTE**   The Transmitter Wavelengths installed are dependent on 37718A/37719A option.

### Specification (Receiver)

| Wavelength | 1200 nm to 1600 nm |
|---|---|
| Maximum Input Power | -8 dBm (for BER of $1.0E^{-10}$) |
| Line Coding | NRZ |
| Sensitivity | -34 dBm (STM-0/1/4, OC-1/3/12 -28 dBm Minimum (STM-16, OC-48) (wavelength=1310/1550 nm, Modulation = 100%, Data=$2^{23}$-1, BER=$1.0E^{-10}$) |
| PMP Electrical Input | 150mV pk-pk (Nominal) 51.84, 155.52 and 622.08 Mb/s only |
| PMP Impedance | Nominal 50$\Omega$ |

## Description

The optical power output is measured on a power meter.

The receiver sensitivity is verified by attenuating the transmitter output and checking for no errors in back-to-back mode.

The Protected Monitor Point (PMP) functionality is verified by looping the HP37718A/19A Optical Output to the PMP input via an Optical Attenuator and Lightwave Converter, then checking for error-free operation.

## Equipment Required

| | |
|---|---|
| **Power Meter** | : HP8153A |
| **Power Meter Sensor Module** | : HP 81536A |
| **Oscilloscope** | : HP 54520A |
| **Lightwave Converter** | : HP 11982A |
| **Optical Attenuator** | : HP 8157A |
| **FC/PC Connector Interface** | : HP 81000FI (Qty. 4) |
| **Optical Cables (qty 2)** | : HP 11871A |
| **Adaptor (SMA to BNC)** | : HP 1250-1787 |

**WARNING**  **Safety precautions must be observed when handling the HP37718A/19A 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 HP37718A/19A 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 HP37718A/19A Fiber Optic Interfaces before powering up the instrument.**

**Procedure 1310nm - Optical Power Output**

**1** Switch on the HP37718A/19A and recall the DEFAULT SETTINGS as shown on Page 3-2.

**2** Connect the HP37718A/19A Optical Out Port to the HP8153A (ensure that all connections are tight and that the cable has no twists).

**3** Setup the HP 8153A as follows:
a. Press **PARAM** key to display wavelength [λ]
b. Using ←, → ↑ and ↓ keys, set the wavelength to 1310nm.
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. Press the **ZERO** key on the Power Meter to calibrate - the Power Meter is now ready.

**4** Press MODE to select the Power Level measurement on the HP8153A.

**5** Press TRANSMIT **SDH** or **SONET** and select SIGNAL [STM-0 OPT] or [OC-1].

**6** Check the HP8153A Power Meter reading is between 0 dBm and +3 dBm (Typically +1 dBm).

**7** Press TRANSMIT **SDH** or **SONET** and select SIGNAL [STM-1 OPT] or [OC-3].

**8** Check the HP8153A Power Meter reading is between 0 dBm and +3 dBm (Typically +1 dBm).

**9** Press TRANSMIT **SDH** or **SONET** and select SIGNAL [STM-4 OPT] or [OC-12].

**10** Check the HP8153A Power Meter reading is between 0 dBm and +3 dBm (Typically +1 dBm).

**11** Press TRANSMIT **SDH** or **SONET** and select SIGNAL [STM-16 OPT] or [OC-48].

**12** Check the HP8153A Power Meter reading is between 0 dBm and +3 dBm (Typically +1 dBm).

**Optical Receiver Sensitivity**

**13** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**14** Set the Optical Attenuator to ATTEN 15 dB, WAVELENGTH 1310 nm ; CAL=0 ; ENB ON. Connect the Optical Attenuator between the Power Meter and the HP37718A/19A Optical Out port (ensure that all connections are tight and that the cable has no twists).

**15** Press `TRANSMIT` **SDH** or **SONET** and select SIGNAL [STM-0 OPT] or [OC-1].

**16** Adjust the Optical Attenuator to obtain a reading of -34 dBm on the Power Meter.

**17** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**18** Disconnect the Optical Attenuator Output from the HP8153A and connect to the HP37718A/19A Optical IN Port.

**19** Press `OTHER` then **SETTINGS CONTROL** and select TRANSMITTER AND RECEIVER [COUPLED].

**20** Press `TRANSMIT` **SDH** or **SONET** and select SIGNAL [STM-0 OPT] or [OC-1].

**21** Press `RESULTS` **TROUBLE SCAN** then `RUN/STOP` to start a measurement.

**22** After 5 minutes check that NO TROUBLE is displayed on the `RESULTS` display.

**23** Repeat steps 13 through 22, substituting SIGNAL [STM-1 OPT] or [OC-3] in steps 15 & 20.

**24** Repeat steps 13 through 22, substituting SIGNAL [STM-4 OPT] or [OC-12] in steps 15 & 20.

**25** Repeat steps 13 through 22, substituting SIGNAL [STM-16 OPT] or [OC-48] in steps 15 & 20 and -28 dBm in step 16.

**PNP Electrical Input**

**26** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**27** Disconnect the optical cable from the HP37718A/19A Optical IN port and connect to the HP 11982A Lightwave Converter input.

**28** Connect the output from the Lightwave Converter to the Oscilloscope using the SMA/BNC adaptor and 50Ω BNC cable.

**29** Press **TRANSMIT** **SDH** or **SONET** and select SIGNAL [STM-0 OPT] or [OC-1].

**30** Press **AUTOSCALE** on the oscilloscope and adjust the Timebase and Range to obtain an STM-0/OC-1 waveform.

**31** Measure the amplitude of the waveform using the oscilloscope and adjust the Optical Attenuator until the amplitude is 150mV pk-pk.

**32** Disconnect the output of the Lightwave Converter from the oscilloscope and connect instead to the HP37718A/19A Optical Module Monitor input.

**33** Press **RECEIVE** and set up the display as shown opposite.

**34** Press **RESULTS** **TROUBLE SCAN** then **RUN/STOP** to start the measurement.

**35** After 5 minutes, check that NO TROUBLE is displayed on the **RESULTS** display. Press **RUN/STOP** to stop the measurement.

**36** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**37** Disconnect the optical cable from the HP37718A/19A Optical Module Monitor input and connect to the HP11982A Lightwave Converter input.

**38** Repeat steps 28 to 36 but with [STM-1 OPT] or [OC-3] selected on the HP37718A/19A **TRANSMIT** and **RECEIVE** displays.

**39** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2.

**40** Disconnect the optical cable from the HP37718A/19A Optical Module Monitor input and connect to the HP11982A Lightwave Converter input.

**41** Repeat steps 28 to 36 but with [STM-4 OPT] or [OC-12] selected on the HP37718A/19A **TRANSMIT** and **RECEIVE** displays.

**Procedure 1550 nm - Optical Power Output**

**42** Repeat steps 1 through 12 substituting 1550nm for 1310nm.

## Optical Receiver Sensitivity

**43** Repeat Steps 13 through 25 substituting 1550nm for 1310nm.

## PNP Electrical Input

**44** Repeat steps 26 through 41 substituting 1550nm for 1310nm.

**45** Recall the HP37718A/19A DEFAULT SETTINGS as shown on Page 3-2 and disconnect the test equipment.

## Performance Test Record

| Hewlett-Packard Model 37718/37719A Communications Performance Analyzer | |
|---|---|
| Location: | Serial No.: |
| Tested by: | Options: |
| Temperature: | Certified by: |
| Humidity: | Date: |

**Table 3**          **Performance Test Record**

| Page No. | Test Description | | Result | | |
|---|---|---|---|---|---|
| | | | Min | Actual | Max |
| | **Self Test** | | | | |
| 3-4 | Step 4: | All Tests | | Pass/Fail | |
| 3-5 | Step 4: | Confidence Tests | | Pass/Fail | |
| 3-6 | Step 3: | 1550nm Tests | | Pass/Fail | |
| | Step 3: | RS-232-C Tests | | Pass/Fail | |
| | Step 3: | Datacomm Tests | | Pass/Fail | |
| | **PDH/DSn Internal Transmitter Clock Accuracy & Offset** | | | | |
| 3-8 | Step 4: | 2 Mb/s | 1.023995 MHz | | 1.024005 MHz |
| | Step 6: | 2 Mb/s +50ppm | 1.0240465 MHz | | 1.0240555 MHz |
| | Step 8: | 2 Mb/s -50ppm | 1.023944 MHz | | 1.023953 MHz |
| 3-9 | Step 10: | 8 Mb/s | 4.223981 MHz | | 4.224019 MHz |
| | Step 12: | 8 Mb/s +30ppm | 4.2241075 MHz | | 4.2242915 MHz |
| | Step 14: | 8 Mb/s -30ppm | 4.223854 MHz | | 4.223892 MHz |

**Table 3**                    **Performance Test Record**

| Page No. | Test Description | | Min | Result Actual | Max |
|---|---|---|---|---|---|
| 3-9 | Step 16: | 34 Mb/s | 17.18389227 MHz | | 17.1840774 MHz |
| | Step 18: | 34 Mb/s +20ppm | 17.184266 MHz | | 17.184421 MHz |
| | Step 20: | 34 Mb/s -20ppm | 17.183579 MHz | | 17.183734 MHz |
| | Step 22: | 34 Mb/s +100ppm | 17.185641 MHz | | 17.185796 MHz |
| | Step 24: | 34 Mb/s -100ppm | 17.182205 MHz | | 17.182359 MHz |
| 3-10 | Step 26: | 140 Mb/s | 69.6316865 MHz | | 69.6323185 MHz |
| | Step 28: | 140 Mb/s +15ppm | 69.632731 MHz | | 69.633358 MHz |
| | Step 30: | 140 Mb/s -15ppm | 69.630642 MHz | | 69.631269 MHz |
| | Step 33: | 1.544 Mb/s | 1.543993 MHz | | 1.544007 MHz |
| | Step 35: | 1.544 Mb/s +32ppm | 1.544042 MHz | | 1.544056 MHz |
| | Step 37: | 1.544 Mb/s -32ppm | 1.543944 MHz | | 1.543958 MHz |
| 3-11 | Step 40: | 44.736 Mb/s | 44.735799 MHz | | 44.736201 MHz |
| | Step 42: | 44.736 Mb/s +20ppm | 44.736693 MHz | | 44.737096 MHz |
| | Step 44: | 44.736 Mb/s -20ppm | 44.734904 MHz | | 44.735307 MHz |
| | **PDH/DSn Transmitter Output** | | | | |
| | | **139.264Mb/s (E4)** | | | |
| 3-14 | Step 7: | All 1's Pulse | | Pass/Fail | |
| | Step 8: | Pulse amplitude | 0.45V pk | | 0.55V pk |
| | Step 12: | All 0's Pulse | | Pass/Fail | |
| 3-15 | Step 13: | Pulse amplitude | 0.45V pk | | 0.55V pk |
| | | **34.368Mb/s (E3)** | | | |
| 3-16 | Step 7: | +ve Pulse | | Pass/Fail | |
| | Step 8: | +ve Pulse amplitude | 0.900V pk | | 1.100V pk |
| 3-17 | Step 12: | -ve Pulse | | Pass/Fail | |

**Table 3**               **Performance Test Record**

| Page No. | Test Description | | Result Min | Actual | Max |
|---|---|---|---|---|---|
| 3-17 | Step 13: | -ve Pulse amplitude | 0.900V pk | | 1.100V pk |
| | | **8.448Mb/s (E2)** | | | |
| 3-18 | Step 7 | +ve Pulse | | Pass/Fail | |
| | Step 8: | +ve Pulse amplitude | 0.900V pk | | 1.100V pk |
| 3-19 | Step 12: | -ve Pulse | | Pass/Fail | |
| | Step 13: | -ve Pulse amplitude | 0.900V pk | | 1.100V pk |
| | | **2.048Mb/s (E1)** | | | |
| 3-20 | Step 7: | +ve Pulse | | Pass/Fail | |
| | Step 8: | +ve Pulse amplitude | 2.133V pk | | 2.607V pk |
| 3-21 | Step 12: | -ve Pulse | | Pass/Fail | |
| | Step 13: | -ve Pulse amplitude | 2.133V pk | | 2.607V pk |
| | | **44.736Mb/s (DSX3)** | | | |
| 3-22 | Step 7: | +ve Pulse | | Pass/Fail | |
| | Step 8: | +ve Pulse amplitude | | Pass/Fail | |
| 3-23 | Step 12: | -ve Pulse | | Pass/Fail | |
| | Step 13: | -ve Pulse amplitude | | Pass/Fail | |
| | Step 14: | High amplitude | | Pass/Fail | |
| 3-24 | Step 15: | Low amplitude | | Pass/Fail | |
| | | **1.544Mb/s (DSX1)** | | | |
| 3-25 | Step 7: | +ve Pulse | | Pass/Fail | |
| | Step 8: | +ve Pulse amplitude | 1.984V pk | | 2.976V pk |
| 3-26 | Step 12: | -ve Pulse | | Pass/Fail | |
| | Step 13: | -ve Pulse amplitude | 1.984V pk | | 2.976V pk |
| | Step 14: | Low amplitude | | Pass/Fail | |

**Table 3** **Performance Test Record**

| Page No. | Test Description | | Result Min | Actual | Max |
|---|---|---|---|---|---|
| | **PDH/DSn Receiver Equalization** | | | | |
| 3-28 | Step 6: | 139.264Mb/s (E4) | | Pass/Fail | |
| | Step 11: | 34.368Mb/s (E3) | | Pass/Fail | |
| 3-29 | Step 16: | 8.448 Mb/s (E2) | | Pass/Fail | |
| | Step 21: | 2.048Mb/s (E1) | | Pass/Fail | |
| 3-30 | Step 26: | 44.736Mb/s (DS3) | | Pass/Fail | |
| | Step 31: | 1.544Mb/s (DS1) | | Pass/Fail | |
| | **PDH/DSn Receiver Monitor Levels** | | | | |
| | | **2.048Mb/s (E1)** | | | |
| 3-33 | Step 5: | 20dB | | Pass/Fail | |
| | Step 10: | 20dB & Equalization | | Pass/Fail | |
| | Step 14: | 26dB & Equalization | | Pass/Fail | |
| | Step 18: | 26dB | | Pass/Fail | |
| 3-34 | Step 22: | 30dB | | Pass/Fail | |
| | Step 26: | 30dB & Equalization | | Pass/Fail | |
| | | **8.448Mb/s (E2)** | | | |
| | Step 27: | 20dB | | Pass/Fail | |
| | Step 27: | 20dB & Equalization | | Pass/Fail | |
| | Step 27: | 26dB & Equalization | | Pass/Fail | |
| | Step 27: | 26dB | | Pass/Fail | |
| | Step 27: | 30db | | Pass/Fail | |
| | Step 27: | 30dB & Equalization | | Pass/Fail | |
| | | **34.368Mb/s (E3)** | | | |
| | Step 28: | 20dB | | Pass/Fail | |

**Table 3**                    **Performance Test Record**

| Page No. | Test Description | | Result Min | Result Actual | Max |
|---|---|---|---|---|---|
| 3-34 | Step 28: | 20dB & Equalization | | Pass/Fail | |
| | Step 28: | 26dB & Equalization | | Pass/Fail | |
| | Step 28: | 26dB | | Pass/Fail | |
| | | **139.264Mb/s (E3)** | | | |
| | Step 29: | 20dB | | Pass/Fail | |
| | Step 29: | 20dB & Equalization | | Pass/Fail | |
| | Step 29: | 26dB & Equalization | | Pass/Fail | |
| | Step 29: | 26dB | | Pass/Fail | |
| | | **1.544Mb/s (DS1)** | | | |
| | Step 30: | 20dB | | Pass/Fail | |
| | Step 30: | 20dB & Equalization | | Pass/Fail | |
| | Step 30: | 26dB & Equalization | | Pass/Fail | |
| | Step 30: | 26dB | | Pass/Fail | |
| | Step 30: | 30db | | Pass/Fail | |
| | Step 30: | 30dB & Equalization | | Pass/Fail | |
| | | **44.736Mb/s (E3)** | | | |
| | Step 31: | 20dB | | Pass/Fail | |
| | Step 31: | 20dB & Equalization | | Pass/Fail | |
| | Step 31: | 26dB & Equalization | | Pass/Fail | |
| | Step 31: | 26dB | | Pass/Fail | |
| | **External Mux/Demux** | | | | |
| 3-38 | Step 9: | 2 Mb/s Bit & Code EC | | Pass/Fail | |
| | Step 10: | 2 Mb/s Bit Error Add | | Pass/Fail | |
| 3-39 | Step 15: | +ve Mask 2 Mb/s | | | |
| | Step 16: | +ve Amp 2 Mb/s | 2.133 V pk | | 2.607 V pk |
| 3-40 | Step 20 | -ve Mask 2 Mb/s | | Pass/Fail | |

**Table 3** **Performance Test Record**

| Page No. | Test Description | | Result | | |
|---|---|---|---|---|---|
| | | | Min | Actual | Max |
| 3-40 | Step 21: | -ve Amp 2Mb/s | 2.133 V pk | | 2.607 V pk |
| | Step 1: | DS-1 Bit & Code EC | | Pass/Fail | |
| | Step 1: | DS-1 Bit Error Add | | Pass/Fail | |
| 3-41 | Step 6: | +ve Pulse Mask DS-1 | | Pass/Fail | |
| | Step 7: | +ve Pulse Amp DS-1 | 1.896 V pk | | 2.844 V |
| 3-42 | Step 11 | -ve Pulse Mask DS-1 | | Pass/Fail | |
| | Step 12: | -ve Pulse Amp DS-1 | 1.896 V pk | | 2.844 V pk |
| | **PDH Frequency Measurement and Looped Clock** | | | | |
| 3-45 | Step 8: | 2Mb/s frequency | 2.047991 MHz | | 2.048009 MHz |
| | Step 9: | Offset (0 ppm) | -4.5 ppm | | +4.5 ppm |
| | Step 10: | Frequency+100 ppm | 2.048194 MHz | | 2.048214 MHz |
| | Step 11: | Offset +100 ppm | +95.5 ppm | | +104.5 ppm |
| | Step 12: | Frequency-100 ppm | 2.047786 MHz | | 2.047806 MHz |
| | Step 13: | Offset -100 ppm | -95.5 ppm | | -104.5 ppm |
| | Step 13: | Frequency Counter | | Pass/Fail | |
| | Step 14: | 8Mb/s 0 ppm | -4.5 ppm | | +4.5 ppm |
| | Step 14: | 8Mb/s -100 ppm | -95.5 ppm | | -104.5 ppm |
| | Step 14: | 8Mb/s +100 ppm | +95.5 ppm | | +104.5 ppm |
| | Step 14: | 34 Mb/s 0 ppm | -4.5 ppm | | +4.5 ppm |
| | Step 14: | 34 Mb/s -100 ppm | -95.5 ppm | | -104.5 ppm |
| | Step 14: | 34 Mb/s +100 ppm | +95.5 ppm | | +104.5 ppm |
| | Step 14: | 40 Mb/s 0 ppm | -4.5 ppm | | +4.5 ppm |
| | Step 14: | 140 Mb/s -100 ppm | -95.5 ppm | | -104.5 ppm |
| | Step 14: | 140 Mb/s +100 ppm | +95.5 ppm | | +104.5 ppm |

**Table 3**          **Performance Test Record**

| Page No. | Test Description | | Result Min | Result Actual | Max |
|---|---|---|---|---|---|
| 3-45 | Step 14: | 1.544Mb/s 0 ppm | -4.5 ppm | | +4.5 ppm |
| | Step 14: | 1.544Mb/s -100 ppm | -95.5 ppm | | -104.5 ppm |
| | Step 14: | 1.544Mb/s +100 ppm | +95.5 ppm | | +104.5 ppm |
| | Step 14: | 44.736Mb/s 0 ppm | -4.5 ppm | | +4.5 ppm |
| | Step 14: | 44.736Mb/s -100 ppm | -95.5 ppm | | -104.5 ppm |
| | Step 14: | 44.736Mb/s+100 ppm | +95.5 ppm | | +104.5 ppm |
| | **SDH/SONET Transmitter Clock Accuracy** | | | | |
| 3-47 | Step 4: | Frequency | 51.839670 MHz | | 51.840230 MHz |
| | **External MTS Clock** | | | | |
| 3-49 | Step 7: | 2Mb/s Clock | | Pass/Fail | |
| | Step 9: | Ref Clock Out | | Pass/Fail | |
| 3-50 | Step 16: | 2Mb/s Data | | Pass/Fail | |
| | Step 21: | 2Mb/s Data Balanced | | Pass/Fail | |
| | Step 25: | Rx Data Clock Loss | | Pass/Fail | |
| | Step 28: | Rx Data Clock Gain | | Pass/Fail | |
| 3-51 | Step 30: | 10 MHz Clock Loss | | Pass/Fail | |
| | Step 33: | 10MHz Clock Gain | | Pass/Fail | |
| | Step 35: | BITS Clock Loss | | Pass/Fail | |
| | Step 38: | BITS Clock Gain | | Pass/Fail | |
| | Step 41: | 64kb/s Clock Loss | | Pass/Fail | |
| | Step 42: | 64kb/s Clock Gain | | Pass/Fail | |
| | **SDH/SONET Offsets** | | | | |
| 3-52 | Step 5: | Clock Loss | | Pass/Fail | |
| 3-53 | Step 10: | 0ppm | | 51.84MHz | |
| | Step 11: | -999ppm | 51.7882108MHz | | 51.7882129MHz |

**Table 3**                    **Performance Test Record**

| Page No. | Test Description | | Result | | |
|---|---|---|---|---|---|
| | | | Min | Actual | Max |
| 3-53 | Step 11: | -100ppm | 51.8348149MHz | | 51.8348171MHz |
| | Step 11: | -66ppm | 51.8365464MHz | | 51.8365485MHz |
| | Step 11: | +33ppm | 51.8417252MHz | | 51.8417273MHz |
| | Step 11: | +100ppm | 51.8451829MHz | | 51.8451851MHz |
| | Step 11: | +999ppm | 51.8917871MHz | | 51.8917892MHz |
| | **STM-0/STS-1 Transmitter Output Waveshape** | | | | |
| 3-55 | Step 6: | +ve Pulse | | Pass/Fail | |
| | Step 7: | +ve Pulse Amp | | Pass/Fail | |
| 3-56 | Step 11: | -ve Pulse | | Pass/Fail | |
| | Step 12: | -ve Pulse Amp | | Pass/Fail | |
| | Step 13: | High amplitude | | Pass/Fail | |
| | Step 14: | Low Amplitude | | Pass/Fail | |
| | **STM-1/STS-3 Transmitter Output Waveshape** | | | | |
| 3-59 | Step 8: | All 1's Pulse | | Pass/Fail | |
| | Step 9: | Pulse Amp | 450 mV pk | | 550 mV pk |
| 3-60 | Step 13 | All 0's Pulse | | Pass/Fail | |
| | Step 14: | Pulse Amp | 450 mV pk | | 550 mV pk |
| | **SDH/SONET Receiver Equalization** | | | | |
| 3-62 | Step 5: | STM-0/STS-1 | | Pass/Fail | |
| | Step 10: | STM-1/STS-3 | | Pass/Fail | |
| | **SDH/SONET Receiver Monitor Levels** | | | | |
| | | **STM-0/STS-1** | | | |
| 3-64 | Step 5: | 20dB | | Pass/Fail | |

**Table 3**  **Performance Test Record**

| Page No. | Test Description | | Result Min | Result Actual | Max |
|---|---|---|---|---|---|
| 3-65 | Step 9: | 20dB + Equalization | | Pass/Fail | |
| | Step 14: | 26dB + Equalization | | Pass/Fail | |
| | Step 18: | 26dB | | Pass/Fail | |
| | | **STM-1/STS-3** | | | |
| | Step 20: | 20dB | | Pass/Fail | |
| | Step 20: | 20dB + Equalization | | Pass/Fail | |
| | Step 20: | 26dB + Equalization | | Pass/Fail | |
| | Step 20: | 26dB | | Pass/Fail | |
| | **Multirate Optical Interface** | | | | |
| | | **Power 1310nm** | | | |
| 3-68 | Step 6: | STM-0/OC-1 | 0 dBm | | +3 dBm |
| | Step 8: | STM-1/OC-3 | 0 dBm | | +3 dBm |
| | Step 10: | STM-4/OC-12 | 0 dBm | | +3 dBm |
| | Step 12: | STM-16/OC-48 | 0 dBm | | +3 dBm |
| | | **Sensitivity 1310nm** | | | |
| 3-69 | Step 22: | STM-0/OC-1 | | Pass/Fail | |
| | Step 23: | STM-1/OC-3 | | Pass/Fail | |
| | Step 24: | STM-4/OC-12 | | Pass/Fail | |
| | Step 25: | STM-16/OC-48 | | Pass/Fail | |
| | | **PNP Input 1310nm** | | | |
| 3-70 | Step 35: | STM-0/OC-1 | | Pass/Fail | |
| | Step 38: | STM-1/OC-3 | | Pass/Fail | |
| | Step 41: | STM-4/OC-12 | | Pass/Fail | |
| | | **Power 1550nm** | | | |
| | Step 42: | STM-0/OC-1 | 0 dBm | | +3 dBm |
| | Step 42: | STM-1/OC-3 | 0 dBm | | +3 dBm |

**Table 3**        **Performance Test Record**

| Page No. | Test Description | | Result Min | Actual | Max |
|---|---|---|---|---|---|
| 3-70 | Step 42: | STM-4/OC-12 | 0 dBm | | +3 dBm |
| | Step 42: | STM-16/OC-48 | 0 dBm | | +3 dBm |
| | | **Sensitivity 1550nm** | | | |
| | Step 43: | STM-0/OC-1 | | Pass/Fail | |
| | Step 43: | STM-1/OC-3 | | Pass/Fail | |
| | Step 43: | STM-4/OC-12 | | Pass/Fail | |
| | Step 43: | STM-16/OC-48 | | Pass/Fail | |
| | | **PNP Input 1550nm** | | | |
| | Step 44: | STM-0/OC-1 | | Pass/Fail | |
| | Step 44: | STM-1/OC-3 | | Pass/Fail | |
| | Step 44: | STM-4/OC-12 | | Pass/Fail | |

# **4**          **Terms**

This section contains Tables of ITU-T Terms with their ANSI equivalents and current terms with their equivalent earlier terms.

## **ITU-T / ANSI Equivalent Terms**

The Terminology used on the instrument display is mainly ITU-T terminology. The equivalent ANSI terminology is given in the following table

| ITU-T Term | ANSI Term |
|---|---|
| I-n Intra Office, STM-n | Intermediate Reach (IR) |
| L-n.1 or L-n.2 long haul | LR long reach |
| Multiplexer Section (MS) | Line |
| MS-AIS | AIS-L (Line AIS) |
| MS-BIP | Line BIP |
| MS-DCC | Line DCC |
| MS-RDI (MS FERF) | RDI-L (Line FERF) |
| Multiplexer Section Overhead | Line Overhead |
| Network Node Interface | Line Interface |
| AU-AIS (Path AIS) | AIS-P |
| HP-RDI (Path FERF) | RDI-P |
| Regenerator | Repeater |
| Regenerator Section (RS) | Section |
| Remote Alarm Indicator | Yellow Alarm |
| Regenerator Section Overhead | Section Overhead |
| RS-DCC | Section DCC |

| ITU-T Term | ANSI Term |
|---|---|
| S-n.1 or S-n.2 short haul | Short Reach (SR) |
| STM-n | STS-n |
| SOH | TOH |
| Section Overhead (SOH) | Transport Overhead (TOH) |
| Tributary Unit (TU) | Virtual Tributary (VT) |
| TU | VT |
| TU-AIS | VT AIS (AIS-V) |
| TU FERF / TU RDI | RDI-V / VT FERF |
| TU REI | VT FEBE |
| VC | SPE |
| Virtual Container | Payload Envelope |
| Virtual Container (VC) | Synchronous Payload Envelope (SPE) |
| VP-RDI (VP-FERF) | VP-RDI |
| VC-RDI (VC-FERF) | VC-RDI |

NOTE: VC is an ITU-T abbreviation for Virtual Container and an ITU-T / ANSI abbreviation for (ATM) Virtual Channel. The context of VC must therefore be taken into account when converting between standards.

# Current / Previous Terminology

| Current Terminology | Previous Terminology |
|---|---|
| B1 BIP | RS B1 BIP |
| B2 BIP | MS B2 BIP |
| B3 BIP | Path B3 BIP |
| MS-AIS | MS AIS |
| MS-RDI | MS RDI |
| MS-REI | MS FEBE |
| HP-IEC | Path IEC |
| AU-LOP | LOP |
| AU-AIS | Path AIS |
| HP-RDI | Path FERF |
| HP-REI | Path FEBE |
| TU-LOP | TU LOP |
| TU-AIS | TU Path AIS |
| LP-RDI | TU Path FERF |
| LP-REI | TU Path FEBE |

# Index

# Index

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**About This Edition**

This is the first edition of
the 37718-90006 manual.
It documents the product
as of 10/98. Edition dates
are as follows:

1st Edition October 98

**In This Book**

This book contains the instrument specifications and provides techniques for checking them.