SDH / SONET
Operating Manual

HP 37717C
Communications
Performance Analyzer

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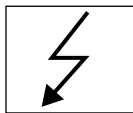
WARNING

For details of safety, see Safety information at the front of this manual.

Warning Symbols Used on the Product

The product is marked with this symbol when the user should refer to the instruction manual in order to protect the apparatus against damage.

The product is marked with this symbol to indicate that hazardous voltages are present

EN 60825 1991

The product is marked with this symbol to indicate that a laser is fitted. The user should refer to the laser safety information in the Calibration Manual.

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HP 37717C Communications Performance Analyzer

About This Book

"The HP 37717C SDH / SONET Operating Manual " explains the following :

- How to select and use the SDH / SONET features provided with the SDH / SONET options

- How to make SDH / SONET measurents

For some operations and measurements, information from one of the following associated books may be required:

"The HP 37717C Mainframe Operating Manual" explains how to obtain the required display, how to use the front panel keys, how to interpret the status indicators, how to connect to external equipment and how to perform instrument tasks associated with the HP 37717C Communications Performance Analyzer irrespective of the option configuration.

"The HP 37717C PDH /DSn Operating Manual" describes the selection of PDH / DSn features and how to peform PDH / DSn tests with the HP 37717C Communications Performance Analyzer.

"The HP 37717C Jitter Operating Manual" describes the selection of Jitter features and how to peform Jitter tests with the HP 37717C Communications Performance Analyzer.

"The HP 37717C ATM Operating Manual"describes the selection of ATM features and how to peform ATM tests with the HP 37717C Communications Performance Analyzer.

Contents

1 SDH / SONET Modules

2 SDH / SONET Application Measurements

3 ETSI / ANSI Terminology

1

SDH / SONET Modules

Information on the optional modules including
selection of the features available.

Introduction to SDH / SONET

Synchronous Digital Heirarchy (SDH) is an international standard (ETSI) for high speed synchronous optical telecommunications networks. Synchronous Optical NETwork (SONET) is the U.S. (ANSI) equivalent of SDH defined by Bellcore.

The concept of a synchronous transport system, based on SDH / SONET standards, goes beyond the basic needs of a point to point transmission system. It includes the requirements of telecommunications networking - switching, transmission and network control. These capabilities, allow SDH / SONET to be used in all three traditional network application areas - Local Network, Inter-exchange Network and Long Haul Network - thus providing a unified telecommunication network structure.

The SDH / SONET standards are based on the principle of direct synchronous multiplexing. This means that individual tributary signals (Payload) may be multiplexed directly into a higher rate SDH / SONET signal without intermediate stages of multiplexing. SDH / SONET network elements, even those supplied by different manufacturers, can be interconnected directly giving cost and equipment savings.

There are minor differences between SDH and SONET, mainly in nomenclature. The most obvious technical difference occurs in the 'SS' bits in the H2 pointer byte of the Section OverHead (SOH) / Transport OverHead (TOH). The terminology on the instrument display is mainly ETSI. A table of ETSI / ANSI equivalent terms is given at the rear of this manual.

SDH / SONET is capable of transporting all the common tributary signals E1 (2.048 Mb/s), E3 (34.368 Mb/s), E4 (139.264 Mb/s), DS1 (1.544 Mb/s) and DS3 (44.736 Mb/s) currently in use. In addition SDH / SONET has the flexibility to readily accommodate any new types of service which are being introduced for example (ATM) or which may be required in the future. Approximately 5% of the SDH / SONET signal structure (Overhead) is reserved for network management and maintenance.

This means that SDH / SONET can be deployed as an overlay to the existing network thus providing enhanced network flexibility.

The HP 37717C provides comprehensive testing of both payload and overhead at electrical and optical SDH / SONET interfaces.

2

SDH / SONET Options

SDH / SONET options are available according to your testing needs :

Option US1 (US5)
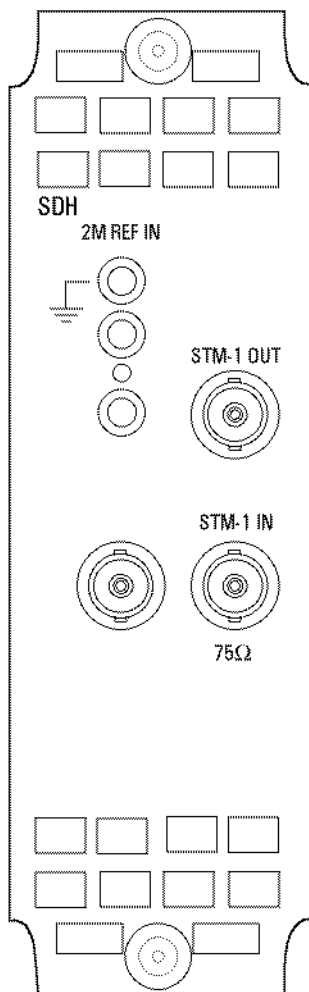
Provides an STM-1 Electrical interface. (When Option UH1 is fitted provides an STM-1 Optical interface. When Option UH2, URU, USN or UKT is fitted provides STM-1 and STM-4 optical interfaces.)

Provides frequency offset of the SDH signal of ±999 ppm.

Payloads of 140 Mb/s, 34 Mb/s and 2 Mb/s are available.(If Option UKJ (USA) (USA) Structured PDH is fitted, Structured Payloads are available and a 2Mb/s Insert port is provided.)

Bit errors can be added to the Payload.

Allows Errors & Alarms to be added to the SDH signal.

The K1K2 MSP bytes can be user programmed
The S1 byte can be user programmed.
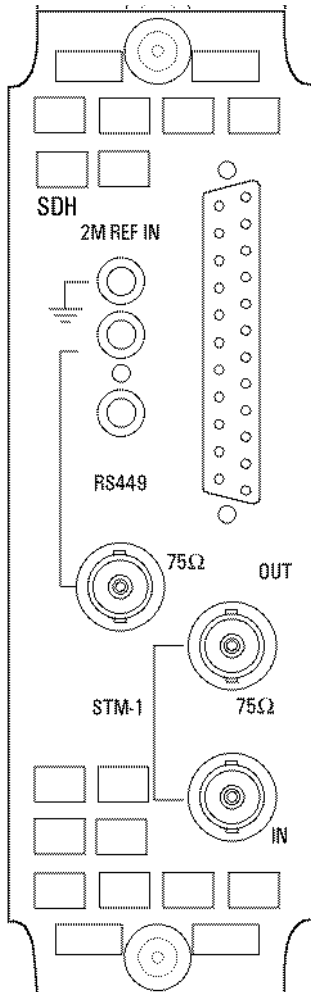
Option A1T (A1U)

Provides an STM-1 Electrical interface. (When Option UH1 is fitted provides an STM-1 Optical interface. When Option UH2, URU, USN or UKT is fitted provides STM-1 and STM-4 optical interface.)

When Option UKZ is also fitted, provides an additional OC-3c transmit and receive facility.

Includes a THRU mode capability such that the Payload and the Section / Transport Overhead of the incoming STM-1 signal can be overwritten by the test set.

Provides frequency offset of the SDH / SONET signal of ±999 ppm. Payloads of 140 Mb/s, TU3, TU2 and TU12 are available.(If Option UKJ (USA) or UKN (USE) Structured PDH is fitted, Structured Payloads are available and a 2Mb/s, 34 Mb/sand 140 Mb/s Insert port is provided). Bit errors can be added to the Payload.

Allows Errors & Alarms to be added to the SDH / SONET signal.

Pointer Movements can be added to the SDH / SONET signal and a Graphical display of Pointer activityis available.

Section / Transport and Path Overhead bytes are user programmable and can be monitored. Overhead byte activitycan be captured and displayed.

Allows BER testing of Section / Transport and Path Overhead bytes.

DCC Drop and Insert capability is included.

Optical Clock stress capability is included.

SDH / SONET Features

Various SDH / SONET features are available with Options US1 (US5) and A1T (A1U). The use of these features is explained in the following pages :

SDH Settings

SIGNAL selection is normally STM-1. If Option UH1 is fitted STM-1 OPT is added. If Option UH2, URU, USN or UKT is fitted STM-1 OPT and STM-4 OPT are added.

If Option A1T (A1U) is fitted selection between INTERNAL and THRU is avaiable.

```
TRANSMITTER OUTPUT          [ SDH        ]
  SDH  STRUCT'D  JITTER    TEST    OVERHEAD
       PAYLOAD           FUNCTION  SETUP

SIGNAL               [ STM-1 OPT ][ INTERNAL]
CLOCK SYNC           [ INTERNAL   ]
FREQUENCY OFFSET            [ ON        ]
                           [   +0.0 ppm ]

PAYLOAD                     [ TU-12     ]
TU MODE              [ ASYNC   ]
SELECTED TU    TUG3 [1]  TUG2 [1]  TU [1]
TU PAYLOAD                  [ PCM30       ]
PATTERN                     [ 2^15-1 PRBS]
PRBS POLARITY        [ INV ]      CCITT
2M OFFSET                   [    0ppm]
PATTERN IN OTHER TUs       [ 2^9-1 PRBS ]


STATUS:
INTERNAL  EXTERNAL  STM-1                 MULTIPLE
          MTS       RECEIVE               WINDOW
```

CLOCK SYNC can be derived internally from the test set, from the SDH Master Timing Source or from the received SDH signal.

FREQUENCY OFFSET allows SDH line rate offset of $\pm$ 999 ppm).

PAYLOAD selection is 140 Mb/s, TU3 (34 Mb/s Option US1 (US5)), TU2 (Option A1T (A1U) only) or TU12 (ASYNC2 Mb/s Option US1 (US5)).

TU MODE selection sets the Tributary Mapping mode to ASYNC or FLOATING BYTE and is only available on Option A1T (A1U) when TU12 payload is selected.

TU CONCATENATION selection (A1T (A1U) only) determines the number of TU2 tributaries to be tested.

```
TRANSMITTER OUTPUT          [ SDH        ]
  SDH  STRUCT'D  JITTER    TEST    OVERHEAD
       PAYLOAD           FUNCTION  SETUP

SIGNAL               [ STM-1 OPT ][ INTERNAL]
CLOCK SYNC           [ INTERNAL   ]
FREQUENCY OFFSET            [ ON        ]
                           [   +0.0 ppm ]

PAYLOAD                     [ TU-12      ]
TU MODE              [ ASYNC   ]
SELECTED TU    TUG3 [1]  TUG2 [1]  TU [1]
TU PAYLOAD                  [ UNFRAMED    ]
PATTERN                     [ 2^15-1 PRBS]
PRBS POLARITY        [ INV ]      CCITT
2M OFFSET                   [    0ppm]
PATTERN IN OTHER TUs       [ 2^9-1 PRBS ]


STATUS:
140 Mb/s   TU-3    TU-2    TU-12          MULTIPLE
                                         WINDOW
```
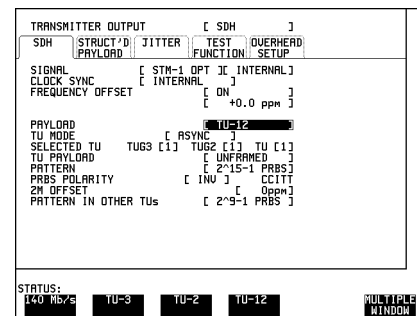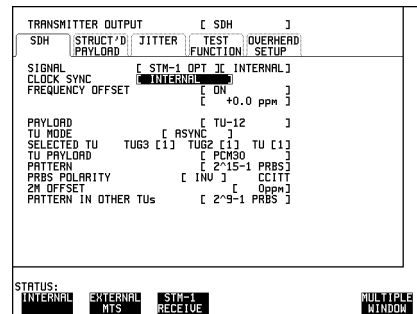
SELECTED TU allows the selection of the Tributary required for testing which in a TU12 payload is 1 of 63 Tributaries.

TU PAYLOAD sets the type of payload. If Unstructured PDH module, Option UKK (USB), is fitted only UNFRAMED is available. INSERT 34 Mb/s and INSERT 140 Mb/s are only available when Option A1T (A1U) is fitted.

```
TRANSMITTER OUTPUT        [ SDH       ]
 SDH  |STRUCT'D| JITTER |  TEST  |OVERHEAD|
      |PAYLOAD |        |FUNCTION| SETUP  |
SIGNAL            [ STM-1 OPT ][ INTERNAL]
CLOCK SYNC        [ INTERNAL  ]
FREQUENCY OFFSET              [ ON       ]
                             [  +0.0 ppm ]

PAYLOAD                   [ TU-12   ]
TU MODE             [ ASYNC    ]
SELECTED TU    TUG3 [1]  TUG2 [1]  TU [1]
TU PAYLOAD               [ PCM30CRC      ]
PATTERN                  [ 2^15-1 PRBS]
PRBS POLARITY           [ INV ]    CCITT
2M OFFSET                       [    0ppm]
PATTERN IN OTHER TUs     [ 2^9-1 PRBS ]




STATUS:
UNFRAMED    PCM30    PCM31    PCM30CRC   MORE   MULTIPLE
                                       .......  WINDOW
```

PATTERN allows selection of the Tributary test pattern.

OFFSET (Option A1T (A1U) only) allows the tributary payload to be frequency offset relative to its virtual container (VC-12, VC-3 or VC-4) in the range ± 100 ppm. 2M OFFSET if payload TU12, 34M OFFSET if payload TU3, 140M OFFSET if payload 140 Mb/s. This affects the stuff rate but does not cause pointer movements and can be used to test mapping Jitter.

PATTERN IN OTHER TU's allows selection of the test pattern inserted in the non test tributaries.
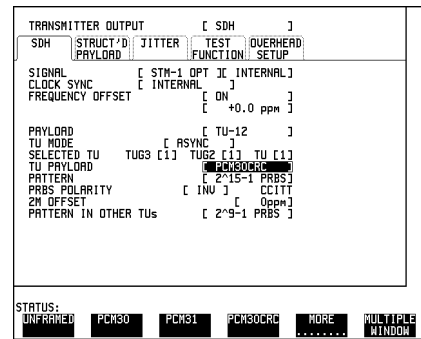
SONET With ATM Payload, Settings

An ATM payload produced by Options UKN and UKZ may be transmitted at STM-1 and OC-3c by the SDH / SONET Option A1T (A1U). The ATM payload may then be multiplexed into an OC-12 signal with the dual wavelength (1310 / 1550 nm) Option USN.

NOTE: the OC-12 is **not** 622Mb/s ATM (OC-12c)

```
TRANSMITTER OUTPUT        [ ATM       ]
PHYSICAL|  ATM  |  TEST  |OVERHEAD|
 LAYER  | LAYER |FUNCTION| SETUP  |
SIGNAL            [ OC-3c    ][1310][ INTERNAL]
CLOCK SYNC        [ INTERNAL  ]
FREQUENCY OFFSET             [ OFF      ]




CELL SCRAMBLING             [ ON       ]




STM-4    OC-3c   STM-1    STM-1    MORE   MULTIPLE
OPTICAL          OPTICAL          .......  WINDOW
```
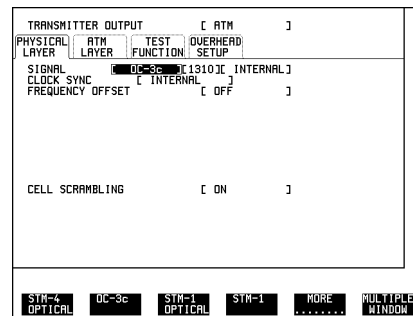
The signal received by the ATM module (UKN or UKZ) may be retransmitted by selecting THRU mode. Jitter from the jitter generator module may be added to the retransmitted signal.

```
TRANSMITTER OUTPUT        [ ATM        ]
PHYSICAL  ATM    JITTER   TEST   OVERHEAD
LAYER   LAYER            FUNCTION SETUP
 SIGNAL        [  OC-3c  ][1310][ THRU MODE ]




INTERNAL  THRU                      MULTIPLE
          MODE                      WINDOW
```
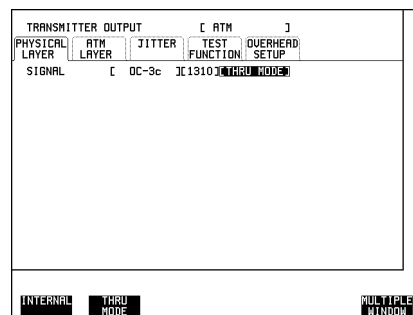
For ATM testing at STM-1, the ATM receiver of Option UKZ receives an ATM payload from Option A1T (A1U). For ATM testing at OC-3c or STM-1 within an OC-12, the dual wavelength (1310 / 1550 nm) module Option USN is required.

NOTE: the OC-12 is **not** 622Mb/s ATM (OC-12c)

```
RECEIVER INPUT           [ ATM        ]
PHYSICAL  ATM    TEST    OVERHEAD
LAYER   LAYER  FUNCTION  MONITOR
 SIGNAL                  [   OC-3c   ]



 CELL SCRAMBLING         [ ON       ]


STM-4   OC-3c   STM-1   STM-1   MORE   MULTIPLE
OPTICAL         OPTICAL        ......  WINDOW
```
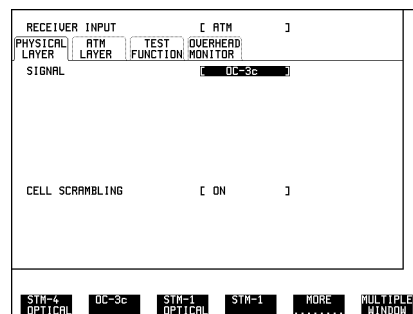
STM-1 THRU Mode (Option A1T (A1U) only)

The primary purpose of THRU mode is to non-intrusively monitor SDH / SONET lines where no protected monitor points are available.

THRU Mode allows a new Payload and/or Section Overhead to be substituted in the received STM-1 SDH signal for test purposes.
If PAYLOAD OVERWRITE [OFF] and SOH+POH CHANNEL OVERWRITE [OFF] are both selected the SDH signal is retransmitted without alteration.

The B1, B2 and B3 BIPS are not recalculated.

```
TRANSMITTER OUTPUT        [ SDH        ]
 SDH    STRUCT'D  JITTER   TEST   OVERHEAD
        PAYLOAD          FUNCTION SETUP
 SIGNAL          [ STM-1 OPT ][ THRU MODE ]
 CLOCK SYNC       STM-1 OPT RX
 PAYLOAD OVERWRITE        [ OFF      ]
 SOH+POH CHANNEL OVERWRITE [ OFF      ]

 RX SIGNAL RE-TRANSMITTED UNCHANGED




STATUS:
INTERNAL  THRU                      MULTIPLE
          MODE                      WINDOW
```
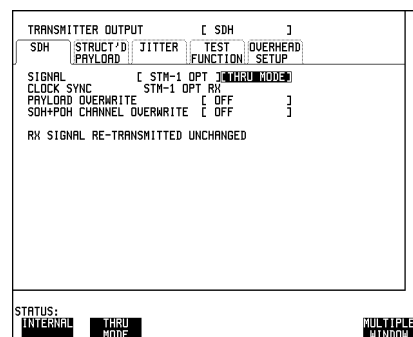
When PAYLOAD OVERWRITE [AU4] is selected a user selectable Payload can be substituted for the received SDH payload.

```
TRANSMITTER OUTPUT        [ SDH      ]
  SDH   STRUCT'D  JITTER    TEST   OVERHEAD
        PAYLOAD          FUNCTION  SETUP
SIGNAL            [ STM-1 OPT ][THRU MODE]
CLOCK SYNC          STM-1 OPT RX
PAYLOAD OVERWRITE           [ AU-4       ]
SOH CHANNEL OVERWRITE       [ OFF        ]

PAYLOAD                     [ TU-12    ]
TU MODE              [ ASYNC    ]
SELECTED TU    TUG3 [1] TUG2 [1]  TU [1]
TU PAYLOAD                  [ PCM30CRC   ]
PATTERN                     [ 2^15-1 PRBS]
PRBS POLARITY        [ INV ]      CCITT
2M OFFSET                       [   0ppm]
PATTERN IN OTHER TUs  [ 2^9-1 PRBS ]




STATUS:
  OFF      AU-4                      MULTIPLE
                                     WINDOW
```

A new path overhead is generated and the B3 BIP is recalculated.

The payload is selected as for SDH Internal mode.
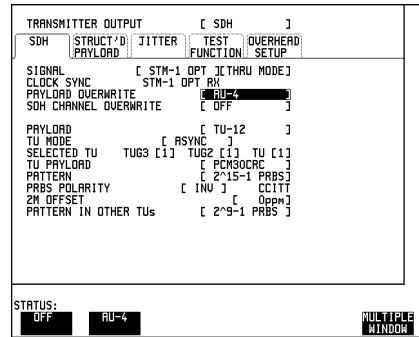
When SOH+POH OVERWRITE [ON] is selected new Section / Transport and Path Overhead, is substituted for the received overhead. The B1, B2 and B3 Bips are recalculated.

```
TRANSMITTER OUTPUT        [ SDH      ]
  SDH   STRUCT'D  JITTER    TEST   OVERHEAD
        PAYLOAD          FUNCTION  SETUP
SIGNAL            [ STM-1 OPT ][THRU MODE]
CLOCK SYNC          STM-1 OPT RX
PAYLOAD OVERWRITE           [ OFF        ]
SOH+POH CHANNEL OVERWRITE   [ ON         ]







STATUS:
  OFF      ON                        MULTIPLE
                                     WINDOW
```

The user can only modify certain overhead bytes by using one of the TRANSMIT test functions : Errors & Alarms, Sequences, Overhead BER, MSP Messages, DCC Insert and Stress Test.
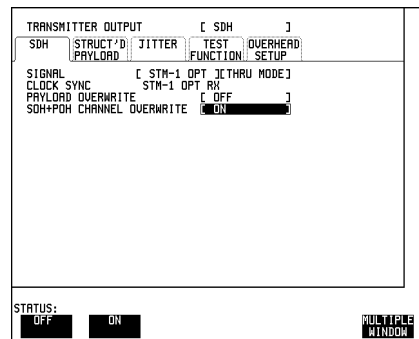
The overhead cannot be modified using OVERHEAD SETUP.

STM-4 THRU Mode (Option A1T (A1U) and UKT or USN only)

Provides a non-intrusive monitor of the STM-4 signal where no protected monitor points are available. Neither the payload or overhead can be altered and the received signal is retransmitted unchanged.

```
TRANSMITTER OUTPUT        [ SDH      ]
  SDH   STRUCT'D  JITTER    TEST   OVERHEAD
        PAYLOAD          FUNCTION  SETUP
SIGNAL        [STM-4 OPT][1550][THRU MODE]


RX SIGNAL RE-TRANSMITTED UNCHANGED






STATUS:
 INTERNAL   THRU                     MULTIPLE
            MODE                     WINDOW
```
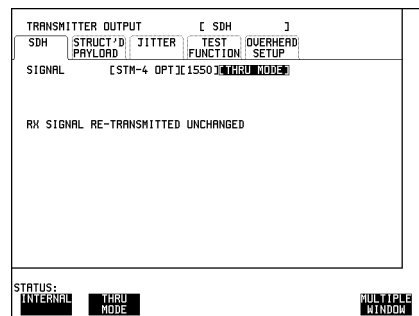
Transmit Static Overhead (Option A1T (A1U) only)

It can be desirable to set an overhead byte to a known static state to aid in troubleshooting, for example, to quickly check for "stuck bits" in path overhead bytes. This capability is provided under TRANSMIT OVERHEAD SETUP.

Path Overhead

The value of each bit of VC4 path overhead bytes : C2, F2, G1, H4, Z3, Z4 and Z5 can be set to 0 or 1. Byte B3 cannot be set. If TRANSMIT PAYLOAD [TU3] is selected the value of each bit of VC3 path overhead bytes C2, G1, F2, Z3, Z4 and Z5 can be set to 0 or 1.

An overhead byte cannot be set to a static value if a TEST FUNCTION is active in that byte, for example : If the ERROR & ALARMS Test Function is selected, and TU PATH UNEQUIPPED alarm is set, the value of C2 will be determined by the Alarm selection.

If TRANSMIT PAYLOAD [TU2] or [TU12] is selected H4 byte is set to carry a SEQUENCE. Selection between **FULL SEQUENCE** ; **REDUCED SEQUENCE** and **COC1 SEQUENCE** is available.

The Signal Label value for VC-2 or VC-12 can also be set.

Path Trace   The path trace capability allows:

A user selected data message to be inserted in the appropriate J1 byte to verify the VC-3 or VC-4 path connection

A user selected data message to be inserted in the appropriate J2 byte to verify the VC-2 or VC-12 path connection.

V C-3/VC-4 Path Trace

1 Press **TRANSMIT** ; **SDH** , **OVERHEAD SETUP** and using ⬅ ⬆ ⬇ and ➡ and the display softkeys set up the **TRANSMIT** display as shown opposite.

2. Selection of **DEFAULT MESSAGE** programs the J1 byte to carry 64 ASCIINull characters.
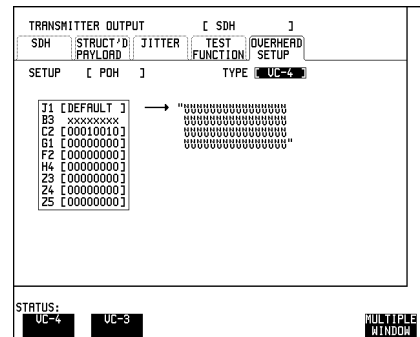
3. Selection of **TEST MESSAGE** programs the J1 byte to carry the displayed HP 37717C test message.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST  OVERHEAD
       PAYLOAD          FUNCTION SETUP
SETUP    [ POH  ]            TYPE [ VC-4 ]

J1 [  TEST  ]  → "HEWLETT-PACKARD,
B3  xxxxxxxx         HP37717C PDH/SD
C2 [00010010]        H FIELD TEST SET
G1 [00000000]       , GB00000000  ↑↓"
F2 [00000000]
H4 [00000000]
Z3 [00000000]
Z4 [00000000]
Z5 [00000000]

STATUS:
DEFAULT    TEST    USER    CRC7              MULTIPLE
MESSAGE  MESSAGE MESSAGE MESSAGE             WINDOW
```
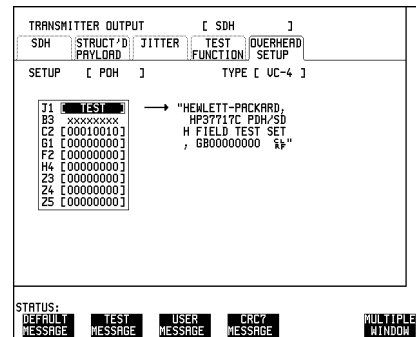
4. Selection of **USER MESSAGE** allows the user to program the message content of the J1 byte with up to 62 ASCII characters followed by CR LF.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST  OVERHEAD
       PAYLOAD          FUNCTION SETUP
SETUP    [ POH  ]            TYPE [ VC-4 ]

J1 [  USER  ]  → [uuuuuuuuuuuuuuuu]
B3  xxxxxxxx       [uuuuuuuuuuuuuuuu]
C2 [00010010]      [uuuuuuuuuuuuuuuu]
G1 [00000000]      [uuuuuuuuuuuuuuuu]
F2 [00000000]
H4 [00000000]      Terminate sequence
Z3 [00000000]      with ↑↓
Z4 [00000000]
Z5 [00000000]

STATUS:
DEFAULT    TEST    USER    CRC7              MULTIPLE
MESSAGE  MESSAGE MESSAGE MESSAGE             WINDOW
```

5. Selection of **CRC7 MESSAGE** allows the user to program the message content of the J1 byte with up to 15 ASCII characters (padded out with ASCII Null characters if necessary) followed by a frame marker byte with CRC7.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST  OVERHEAD
       PAYLOAD          FUNCTION SETUP
SETUP    [ POH  ]            TYPE [ VC-4 ]

J1 [  CRC7  ]  → [uuuuuuuuuuuuuuuu]
B3  xxxxxxxx
C2 [00010010]
G1 [00000000]
F2 [00000000]
H4 [00000000]
Z3 [00000000]
Z4 [00000000]
Z5 [00000000]

STATUS:
DEFAULT    TEST    USER    CRC7              MULTIPLE
MESSAGE  MESSAGE MESSAGE MESSAGE             WINDOW
```

VC-2/VC-12 Path Trace

6. Selection of **DEFAULT MESSAGE**
programs the J2 byte to carry 16 ASCII
Null characters.
Selection of **TEST MESSAGE** programs
the J2 byte to carry the test set Serial
number.
Selection of **USER MESSAGE** allows the
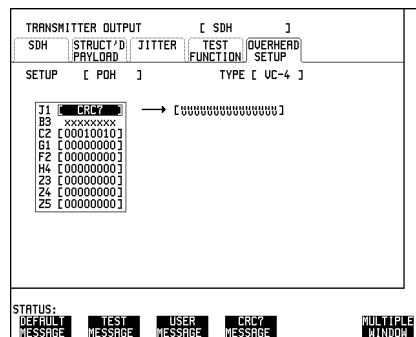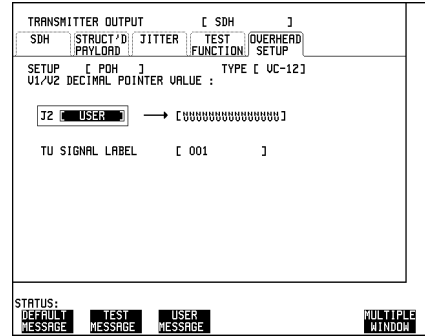user to program the message content of the
J2 byte with up to 14 ASCII characters
followed by CR LF.
 The VC-2 or VC-12 Signal Label value
can be set in the range 000 to 111.

```
 TRANSMITTER OUTPUT        [ SDH      ]
  SDH   STRUCT'D  JITTER    TEST   OVERHEAD
        PAYLOAD            FUNCTION  SETUP
 SETUP   [ POH  ]            TYPE [ VC-12]
 V1/V2 DECIMAL POINTER VALUE :

 J2 [ USER  ]  ──→ [UUUUUUUUUUUUUU]

   TU SIGNAL LABEL     [ 001     ]




 STATUS:
 DEFAULT    TEST     USER                MULTIPLE
 MESSAGE  MESSAGE  MESSAGE                 WINDOW
```

Section / Transport Overhead

The value of each bit of Section / Transport overhead bytes in columns 1,4,7 :
A1,A2 ; C1 ; E1 ; F1 ; D1 - D3 ; K1,K2 ; D4 - D12 ; Z1 ; Z2 and E2 can be set to 0
or 1. Only bits 5 and 6 of byte H1 can be set to 0 or 1. Bytes B1, B2, H2 and H3
cannot be set at any time.

If columns 2,5,8 or 3,6,9 are selected only bytes A1,A2 ; H1 - H3 ; B2 ; Z1 and Z2
are labelled as the other overhead functions have not yet been defined. The value of
each bit of Section / Transport overhead bytes : A1,A2 ; H1 ; H2 ; Z1 ; Z2 and all the
bits of the unlabelled functions can be set to 0 or 1. Bytes B2 and H3 cannot be set at
any time.

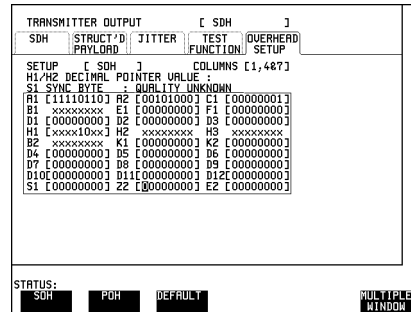An overhead byte cannot be set to a static value if a TEST FUNCTION is active in
that byte, for example : If the MSP MESSAGES Test Function is selected then
K1,K2 value will be determined by the MSP MESSAGES selections.

Setting Undefined Overhead Functions   For test purposes it may be important to
be able set the value of those overhead functions which are presently undefined (Z2)
or unlabelled as in columns 2,5,8 and 3,6,9.

SDH / SONET Modules
SDH / SONET Features

1. Press $\boxed{\text{TRANSMIT}}$; $\boxed{\text{SDH}}$;
$\boxed{\text{OVERHEAD SETUP}}$ and using
$\boxed{\Leftarrow}$ $\boxed{\Uparrow}$ $\boxed{\Downarrow}$ and $\boxed{\Rightarrow}$ set up the
TRANSMIT display as shown opposite

2. In this example the Z2 byte can be set
in the range 00000000 to 11111111
using the display softkeys.

```
TRANSMITTER OUTPUT        [ SDH      ]
┌─────┬────────┬───────┬──────┬────────┐
│ SDH │STRUCT'D│ JITTER│ TEST │OVERHEAD│
│     │PAYLOAD │       │FUNCTION│ SETUP │
SETUP    [ SDH   ]        COLUMNS [1,4&7]
H1/H2 DECIMAL POINTER VALUE :
S1 SYNC BYTE   : QUALITY UNKNOWN
A1 [11110110] A2 [00101000] C1 [00000001]
B1  xxxxxxxx  E1 [00000000] F1 [00000000]
D1 [00000000] D2 [00000000] D3 [00000000]
H1 [xxxx10xx] H2  xxxxxxxx  H3  xxxxxxxx
B2  xxxxxxxx  K1 [00000000] K2 [00000000]
D4 [00000000] D5 [00000000] D6 [00000000]
D7 [00000000] D8 [00000000] D9 [00000000]
D10[00000000] D11[00000000] D12[00000000]
S1 [00000000] Z2 [00000000] E2 [00000000]


STATUS:
┌────┬────┬───────┐              ┌────────┐
│SOH │POH │DEFAULT│              │MULTIPLE│
│    │    │       │              │ WINDOW │
```
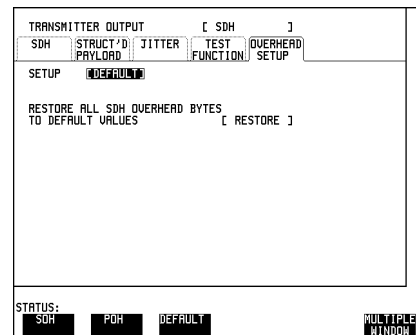
Static Overhead Known (Default) Conditions

After testing it may be desirable to return the static overhead to the known (default)
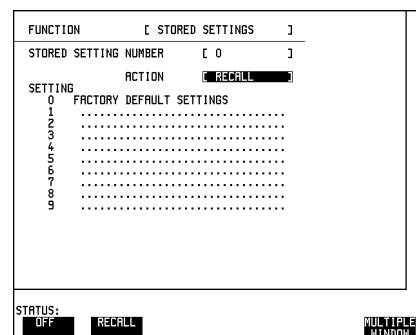state using one of the methods shown below.

1. Set up the $\boxed{\text{TRANSMIT}}$; $\boxed{\text{OVERHEAD}}$
$\boxed{\text{SETUP}}$ display as shown opposite. This
returns overhead, not set by a TRANSMIT
test function to the known (default) state.

Any overhead byte set by a TEST
FUNCTION will not be returned to the
default state, for example :
If the MSP MESSAGES Test Function is
selected then K1,K2 value will be
determined by the MSP MESSAGES
selections.

```
TRANSMITTER OUTPUT        [ SDH      ]
┌─────┬────────┬───────┬──────┬────────┐
│ SDH │STRUCT'D│ JITTER│ TEST │OVERHEAD│
│     │PAYLOAD │       │FUNCTION│ SETUP │
SETUP    [DEFAULT]


RESTORE ALL SDH OVERHEAD BYTES
TO DEFAULT VALUES            [ RESTORE ]




STATUS:
┌────┬────┬───────┐              ┌────────┐
│SOH │POH │DEFAULT│              │MULTIPLE│
│    │    │       │              │ WINDOW │
```

2. Set up the $\boxed{\text{OTHER}}$; $\boxed{\text{STORED}}$
$\boxed{\text{SETTINGS}}$ display as shown opposite.

This returns all settings, including
Overhead and TRANSMIT Test Functions,
to the known(default) state.

```
FUNCTION          [ STORED SETTINGS    ]

STORED SETTING NUMBER      [ 0        ]

              ACTION     [ RECALL     ]
SETTING
   0   FACTORY DEFAULT SETTINGS
   1   ................................
   2   ................................
   3   ................................
   4   ................................
   5   ................................
   6   ................................
   7   ................................
   8   ................................
   9   ................................



STATUS:
┌────┬──────┐                   ┌────────┐
│OFF │RECALL│                   │MULTIPLE│
│    │      │                   │ WINDOW │
```

12

Transmit Overhead Sequence

It can be desirable to insert a pattern into a functional group of overhead bytes for testing or troubleshooting purposes. This capability is provided under TRANSMIT SDH TEST FUNCTION SEQUENCE.

Overhead Bytes

Sequences can be inserted into 3XA13XA2 (Framing), C1, E1, F1, D1-D3 (Regenerator Section / Transport Overhead) ; K1K2, D4-D12, S1, Z1 column 2, Z1 column 3, Z2 column 4, Z2 column 5, E2 (Multiplexer Section / Transport Overhead) and J1, C2, G1, F2, H4, Z3, Z4 or Z5 (Path Overhead).

If TRANSMIT PAYLOAD [TU2] or [TU12] is selected sequences can only be inserted into the H4 byte using **TRANSMIT** ; **OVERHEAD SETUP** .
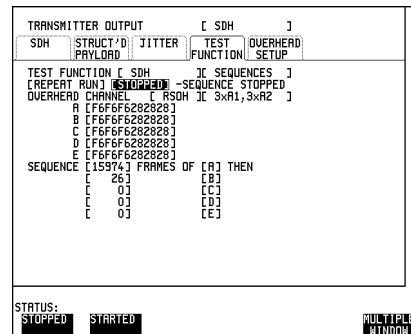
The sequence is derived from 5, user defined, hexadecimal blocks of data. Each block of data can be transmitted in up to 64000 frames.

The sequence can be run once only SINGLE RUN, or on a repetitive basis REPEAT RUN.

Transmit Frame Synchronization Sequence

1. Press **TRANSMIT** ; **SDH** **TEST** **FUNCTION** and using ◀ ▲ ▼ and ▶ and the display softkeys set up the display as shown opposite.

Press **STARTED** to start the sequence. As a result of this sequence one OOF alarm and one LOF alarm should occur every two seconds.

```
TRANSMITTER OUTPUT        [ SDH        ]
┌─────┐┌───────┐┌──────┐┌──────┐┌────────┐
│ SDH ││STRUCT'D││JITTER││ TEST ││OVERHEAD│
│     ││PAYLOAD ││      ││FUNCTION││SETUP  │
└─────┘└───────┘└──────┘└──────┘└────────┘
TEST FUNCTION [ SDH      ][ SEQUENCES   ]
[REPEAT RUN] STOPPED -SEQUENCE STOPPED
OVERHEAD CHANNEL    [ RSOH ][ 3xA1,3xA2  ]
       A [F6F6F62828281
       B [F6F6F62828281
       C [F6F6F62828281
       D [F6F6F62828281
       E [F6F6F62828281
SEQUENCE [15974] FRAMES OF [A] THEN
       [   26]          [B]
       [    0]          [C]
       [    0]          [D]
       [    0]          [E]

STATUS:
┌───────┐┌───────┐                MULTIPLE
│STOPPED ││STARTED │               WINDOW
└───────┘└───────┘
```

Receive Overhead Monitor

When first connecting to a network a start-up confidence check can be made by viewing the behavior of all the overhead bytes. If the network shows alarm indications, some diagnosis of the problem may be gained from viewing all the overhead bytes. This facility is provided on the RECEIVE display under **OVERHEAD MONITOR** .
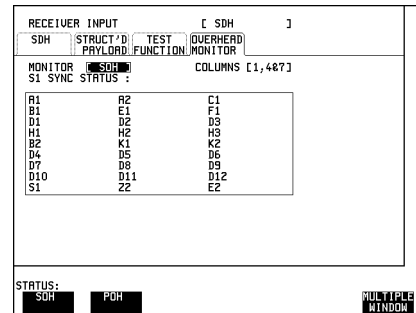
All path overhead bytes are monitored and displayed. VC4 path overhead is shown opposite. If TRANSMIT PAYLOAD [TU3] is selected VC-3 path overhead can be monitored and displayed. If TRANSMIT PAYLOAD [TU12] is selected VC-12 path overhead can be monitored and displayed.
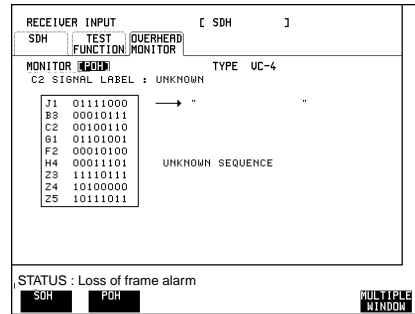
The display is updated once per second (once per 8000 frames approximately).

```
RECEIVER INPUT          [ SDH      ]
  SDH    |   TEST  |OVERHEAD|
         |FUNCTION|MONITOR |
MONITOR [POH]                    TYPE  VC-4
  C2 SIGNAL LABEL : UNKNOWN

  J1  01111000      ⟶  "               "
  B3  00010111
  C2  00100110
  G1  01101001
  F2  00010100
  H4  00011101      UNKNOWN SEQUENCE
  Z3  11110111
  Z4  10100000
  Z5  10111011


 STATUS : Loss of frame alarm
  SDH      POH                          MULTIPLE
                                         WINDOW
```

All Section / Transport overhead bytes are monitored and displayed as shown opposite.

The display is updated once per second (once per 8000 frames approximately).

```
RECEIVER INPUT          [ SDH      ]
  SDH   |STRUCT'D|  TEST  |OVERHEAD|
        |PAYLOAD|FUNCTION|MONITOR |
MONITOR [ SDH ]           COLUMNS [1,4&7]
S1 SYNC STATUS :
 A1          A2          C1
 B1          E1          F1
 D1          D2          D3
 H1          H2          H3
 B2          K1          K2
 D4          D5          D6
 D7          D8          D9
 D10         D11         D12
 S1          Z2          E2




STATUS:
  SDH      POH                          MULTIPLE
                                         WINDOW
```

If any abnormal behavior is observed on a particular path or Section / Transport overhead byte, or an associated group of bytes (3XA1,3XA2 ; D1 - D3) the **RECEIVE** ; **TEST** **FUNCTION** display of **OVERHEAD CAPTURE** can be used to "zoom" in on the suspect byte, or bytes, on a frame by frame basis.

Receive Overhead Capture

Regenerator Section / Transport, Multiplexer Section / Transport and Path overhead provide network support functions, responding dynamically to network conditions and needs. It is therefore desirable to be able to capture overhead activity on a frame by frame basis. This capability is provided under RECEIVE ; SDH ; TEST FUNCTION ; OVERHEAD CAPTURE .

Overhead Capture allows selection of the starting point of the capture by means of Trigger selection :

Trigger OFF   start immediately the capture is initiated

Trigger ON   capture activity after a specified overhead state has occurred

Trigger ON NOT   capture activity after the first occurrence of a deviation from a specified overhead state.

> Trigger OFF can be used to provide a "frame by frame monitor" of the selected byte, or bytes, immediately the capture is initiated.

> Trigger ON and ON NOT can be used for "transient detection" from a specified expected state.
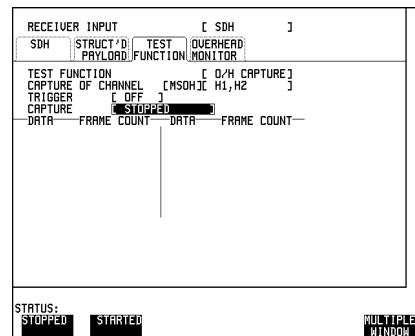
> The overhead capture feature provides up to 16 records of overhead state. Each record will represent between 1 and 64,000 frames. A capture is started by pressing STARTED and terminates when 16 records have been captured. The capture can be terminated sooner by pressing STOPPED .

Frame by Frame Monitor of H1,H2

The frame by frame monitor capability provides a "zoom" in version of the Receive Overhead Monitor feature using the Trigger OFF condition of overhead capture.

1. Press RECEIVE ; SDH ; TEST FUNCTION ; OVERHEAD CAPTURE and using ← ↑ ↓ and → and the display softkeys set up the RECEIVE display as shown opposite.
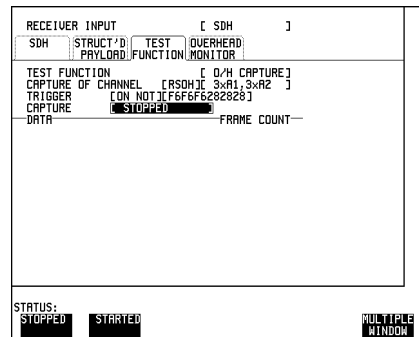
Press STARTED to start the capture.

```
RECEIVER INPUT          [ SDH       ]
 SDH    STRUCT'D  TEST   OVERHEAD
               PAYLOAD FUNCTION MONITOR
TEST FUNCTION            [ O/H CAPTURE]
CAPTURE OF CHANNEL   [MSOH][ H1,H2     ]
TRIGGER       [ OFF ]
CAPTURE       [ STOPPED      ]
 DATA   FRAME COUNT   DATA   FRAME COUNT




STATUS:
 STOPPED   STARTED                    MULTIPLE
                                      WINDOW
```

Transient Detection on A1,A1,A1,A2,A2,A2

Under normal operating conditions the A1,A2 bytes will remain in a known stable state (F6F6F6282828). Using the Trigger ON NOT condition of the Overhead Capture, any transient deviations from that state can be detected.

1. Press `RECEIVE` ; **SDH** ; **TEST** ; **FUNCTION** ; **OVERHEAD CAPTURE** and using ← ↑ ↓ and → and the display softkeys set up the `RECEIVE` display as shown opposite.
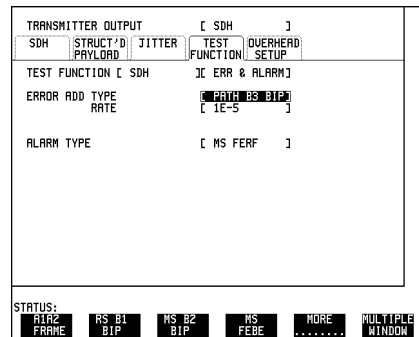
Press **STARTED** to start the capture.

```
RECEIVER INPUT           [ SDH      ]
┌─────┬───────┬──────┬────────┐
│ SDH │STRUCT'D│ TEST │OVERHEAD│
│     │PAYLOAD│FUNCTION│MONITOR │
└─────┴───────┴──────┴────────┘
TEST FUNCTION            [ O/H CAPTURE]
CAPTURE OF CHANNEL    [RSOH][ 3xA1,3xA2 ]
TRIGGER        [ON NOT][F6F6F6282828]
CAPTURE        [ STOPPED        ]
DATA                         ─FRAME COUNT─




STATUS:
┌────────┬────────┐                    ┌────────┐
│STOPPED │STARTED │                    │MULTIPLE│
│        │        │                    │WINDOW  │
└────────┴────────┘                    └────────┘
```

Errors and Alarms

`TRANSMIT` ; **TEST FUNCTION** ; **PDH** **PAYLOAD** ERRORS allows Bit errors to be added to the payload.

`TRANSMIT`; **TEST FUNCTION** ; **SDH** ; **ERRORS & ALARMS** allows Errors and Alarms to be added to the SDH Overhead.

```
TRANSMITTER OUTPUT       [ SDH      ]
┌─────┬───────┬──────┬────────┬────────┐
│ SDH │STRUCT'D│JITTER│ TEST   │OVERHEAD│
│     │PAYLOAD│      │FUNCTION│SETUP   │
└─────┴───────┴──────┴────────┴────────┘
TEST FUNCTION [ SDH     ][ ERR & ALARM]

ERROR ADD TYPE           [ PATH B3 BIP ]
        RATE             [ 1E-5        ]

ALARM TYPE               [ MS FERF     ]




STATUS:
┌──────┬──────┬──────┬──────┬──────┬────────┐
│A1A2  │RS B1 │MS B2 │ MS   │MORE  │MULTIPLE│
│FRAME │BIP   │BIP   │FEBE  │......│WINDOW  │
└──────┴──────┴──────┴──────┴──────┴────────┘
```

Overhead Bit Error Rate (A1T (A1U) only)

1. The `TRANSMIT`; `OVERHEAD BER` test function inserts a 2^7-1 PRBS test pattern into the user selected byte of, Regenerator Section / Transport, Multiplexer Section / Transport or Path, overhead.

```
TRANSMITTER OUTPUT        [ SDH        ]
 SDH   STRUCT'D  JITTER   TEST   OVERHEAD
       PAYLOAD           FUNCTION SETUP
TEST FUNCTION [ SDH       ][OVERHEAD BER]
INSERT PRBS INTO O/H BYTE  [ MSOH  ][ S1]


PRESS SINGLE TO ERROR O/H BYTE




STATUS:
 RSOH      MSOH      POH                 MULTIPLE
                                          WINDOW
```
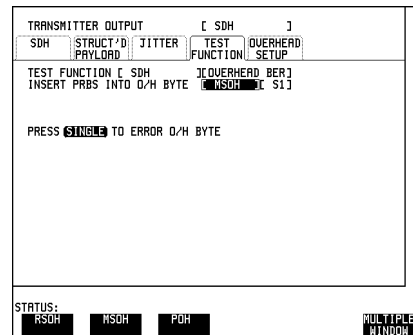
Single bit errors can be added to the PRBS test pattern.

2. The `RECEIVE`; `OVERHEAD BER` test function counts the errors present in the PRBS test pattern within the user selected overhead byte.
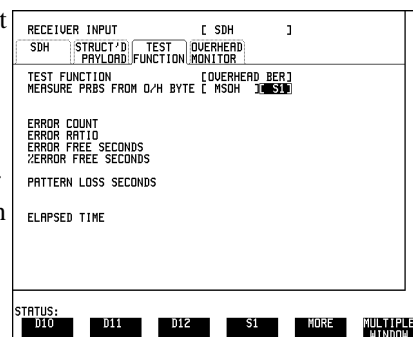
Results of Error Seconds, Error Ratio, Error Free Seconds, % Error Free Seconds, Pattern Loss Seconds and Elapsed Time are displayed.

```
RECEIVER INPUT           [ SDH        ]
 SDH   STRUCT'D  TEST   OVERHEAD
       PAYLOAD FUNCTION MONITOR
TEST FUNCTION            [OVERHEAD BER]
MEASURE PRBS FROM O/H BYTE [ MSOH  ][ S1]

ERROR COUNT
ERROR RATIO
ERROR FREE SECONDS
%ERROR FREE SECONDS

PATTERN LOSS SECONDS


ELAPSED TIME



STATUS:
  D10       D11       D12       S1     MORE   MULTIPLE
                                     ........  WINDOW
```

Add Pointer Adjustments (A1T (A1U) only)

The `TRANSMIT`; `ADJUST POINTER` test function allows the transmitted AU or TU pointer value to be changed for testing purposes in four different ways :

1. `BURST` provides a burst of pointers. The size of the burst is determined by the number of PLACES selected. In this example 5 PLACES are selected and the pointer value will be stepped five times in unit steps eg. 0 (start value), 1, 2, 3, 4, 5 (final value). The interval between steps is 4 frames (500 us).
The direction of change is determined by the `INCREMENT`, `DECREMENT`, `ALTERNATE` selection.
If `ALTERNATE` is selected the burst will be in the opposite direction to the preceding burst.
The burst is transmitted when ADJUST POINTER `ACTION` is selected.
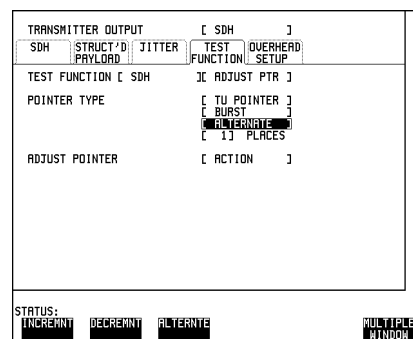
```
TRANSMITTER OUTPUT        [ SDH        ]
 SDH   STRUCT'D  JITTER   TEST   OVERHEAD
       PAYLOAD           FUNCTION SETUP
TEST FUNCTION [ SDH       ][ ADJUST PTR ]
POINTER TYPE              [ TU POINTER ]
                         [ BURST      ]
                         [ ALTERNATE  ]
                         [ 1] PLACES
ADJUST POINTER           [ ACTION    ]




STATUS:
INCREMNT  DECREMNT  ALTERNTE            MULTIPLE
                                        WINDOW
```

2. **NEXT SUMMARY** allows a user defined pointer value to be transmitted in the range 0 to 782, with or without a New Data Flag (NDF). A NDF signifies a controlled change of Payload.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST   OVERHEAD
       PAYLOAD           FUNCTION  SETUP
TEST FUNCTION [ SDH      ][ ADJUST PTR ]

POINTER TYPE              [ AU POINTER ]
                         [ NEW POINTER]
NEW POINTER VALUE        [ 782        ]
                         [ WITH NDF   ]

ADJUST POINTER            [ ACTION    ]

CURRENT TX AU POINTER



STATUS:
WITHOUT   WITH                      MULTIPLE
  NDF      NDF                       WINDOW
```

The current Pointer value is displayed for reference. The New Pointer is transmitted when ADJUST POINTER **ACTION** is selected.

3. **OFFSET** allows either the line rate or the VC/TU rate to be frequency offset, relative to each other, by up to ±100 ppm thus producing pointer movements.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST   OVERHEAD
       PAYLOAD           FUNCTION  SETUP
TEST FUNCTION [ SDH      ][ ADJUST PTR ]

POINTER TYPE              [ TU POINTER ]
                         [ OFFSET     ]
                         [ +100   ppm ]
OUTPUT SIGNAL RATE        [ OFFSET     ]
TU RATE                     CONSTANT



STATUS:
CONSTANT   OFFSET                   MULTIPLE
                                     WINDOW
```

When a VC-4 is offset relative to the line rate the 87:3 sequence of pointer movements is generated.

If the line rate is offset the TU rate is locked to the reference. If the TU rate is offset the line rate is locked to the reference.

4. **G.783** provides pointer movement sequences as per ITU G.783 :

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST   OVERHEAD
       PAYLOAD           FUNCTION  SETUP
TEST FUNCTION [ SDH      ][ ADJUST PTR ]

POINTER TYPE              [ TU POINTER ]
                         [ G.783      ]
ADJUSTMENT TYPE          [ SINGLE     ]
                         [ WITH ADDED ]
        POLARITY         [ NEGATIVE   ]
        INTERVAL         [ 10 ms      ]

POINTER SEQUENCES         [ STARTED    ]



STATUS:
ALT'NATE   WITH      WITH            MULTIPLE
POLARITY  CANCEL'D   ADDED            WINDOW
```

a. Peridioc Single adjustments, each with opposite polarity to the preceding adjustment.

b. Peridioc Single adjustments, with selectable polarity and added adjustment (1 extra). The added adjustment occurs 4 frames (500) after a periodic adjustment.The sequence has a repetition rate of approximately 30 seconds.

c. Periodic Single adjustments, with selectable polarity and cancelled adjustment (1 less). The sequence has a repetition rate of approximately 30 seconds.

d. Periodic Double adjustments (pair of adjustments). The pair alternate in polarity. The spacing between pairs of adjustments, of like polarity, is 4 frames (500).
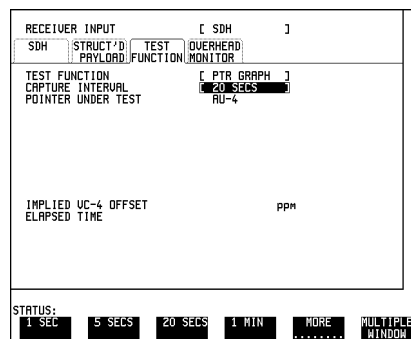
In all cases the interval between adjustments (between pairs in d) is user selectable.

The sequence is started by selecting POINTER SEQUENCES **STARTED** .

Pointer Graph (A1T (A1U) only)

The **RECEIVE** ; **POINTER GRAPH** test function provides a graphical display of pointer movements.

The capture interval is user programmable.

```
RECEIVER INPUT            [ SDH        ]
 SDH    STRUCT'D   TEST   OVERHEAD
        PAYLOAD FUNCTION MONITOR
 TEST FUNCTION            [ PTR GRAPH  ]
 CAPTURE INTERVAL         [ 20 SECS    ]
 POINTER UNDER TEST         AU-4



 IMPLIED VC-4 OFFSET              PPM
 ELAPSED TIME



 STATUS:
 1 SEC    5 SECS   20 SECS   1 MIN    MORE    MULTIPLE
                                      ........ WINDOW
```

MSP (Multiplexer Section / Transport Protection) Messages

[TRANSMIT] ; SDH ; TEST FUNCTION ; MSP MESSAGES allows user
programmingof the K1 and K2 bytes to exercise the MSP functions.K1 BITS 1->4
select the MSP Message to be transmitted.K1 BITS 5->8 select the channel in which
the MSP Message is transmitted. NULL channel is the Protection channel.

K2 BITS 1->4 indicate the channel which
has been switched to protection.

K2 BIT 5 selects the MSP architecture, 1:1
or 1:N. 1:1 means the working line has an
exclusive protection line. 1:N means the
protection line is shared by several (up to 14)
working lines.

K2 BITS 6->8 select the Reserved bits (Not
Defined as yet).

```
TRANSMITTER OUTPUT        [ SDH      ]
┌─────┬────────┬──────┬──────┬────────┐
│ SDH │STRUCT'D│JITTER│ TEST │OVERHEAD│
│     │PAYLOAD │      │FUNCTION│SETUP │
TEST FUNCTION [ SDH      ][MSP MESSAGES]
NEW TX
K1 BITS 1->4 [0010:REVERSE REQUEST    ]
   BITS 5->8 [0000:NULL CHANNEL       ]
K2 BITS 1->4 [0000] BRIDGED CHANNEL NO.
   BIT  5    [1   : 1:N ARCHITECTURE  ]
   BITS 6->8 [ 011: RESERVED          ]

CURRENT TX               CURRENT RX
K1 ........               K1
K2 ........               K2

TRANSMIT NEW K1/K2 [ SELECT    ]




STATUS:
┌──────┬──────┬───────┬──────┬───────┬────────┐
│  NO  │DO NOT│REVERSE│ NOT  │ MORE  │MULTIPLE│
│REQUEST│REVERT│REQUEST│ USED │.......│ WINDOW │
```

The current K1/K2 Transmit and Receive
states are displayed for reference.

To set the new K1/K2 values select
TRANSMIT NEW K1/K2 [SELECT].

To transmit the new K1/K2 values select
TRANSMIT NEW K1/K2 [DOWNLOAD].

```
TRANSMITTER OUTPUT        [ SDH      ]
┌─────┬────────┬──────┬──────┬────────┐
│ SDH │STRUCT'D│JITTER│ TEST │OVERHEAD│
│     │PAYLOAD │      │FUNCTION│SETUP │
TEST FUNCTION [ SDH      ][MSP MESSAGES]
NEW TX
K1 BITS 1->4 [0010:REVERSE REQUEST    ]
   BITS 5->8 [0000:NULL CHANNEL       ]
K2 BITS 1->4 [0000] BRIDGED CHANNEL NO.
   BIT  5    [1   : 1:N ARCHITECTURE  ]
   BITS 6->8 [ 011: RESERVED          ]

CURRENT TX               CURRENT RX
K1 ........               K1
K2 ........               K2

TRANSMIT NEW K1/K2 [ SELECT    ]




STATUS:
┌──────┬──────┬────────────────────────┬────────┐
│SELECT│ DOWN │                        │MULTIPLE│
│      │ LOAD │                        │ WINDOW │
```

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SYNC Messages

TRANSMIT ; **SDH** ; **TEST FUNCTION** ;
SYNC MESSAGES (Option US1 (US5)
only) allows user programming of bits 5 to
8 of Multiplexer Section / Transport
overhead byte S1. The current received
value of S1 (Sync byte) is displayed for
reference.

**This function can be performed on
Option A1T (A1U) using** TRANSMIT ;
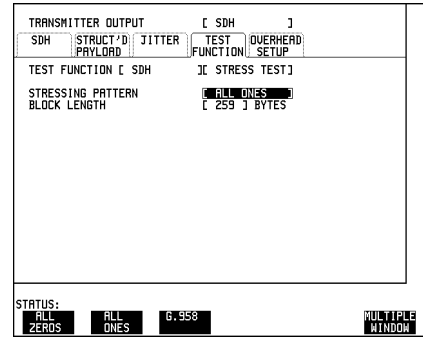**OVERHEAD SETUP** .

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST  OVERHEAD
       PAYLOAD         FUNCTION SETUP
 SETUP    [ SDH   ]      COLUMNS [1,4&7]
 H1/H2 DECIMAL POINTER VALUE :
 S1 SYNC BYTE  : G.811
 A1 [11110110] A2 [00101000] C1 [00000001]
 B1  xxxxxxxx  E1 [00000000] F1 [00000000]
 D1 [00000000] D2 [00000000] D3 [00000000]
 M1 [xxxx10xx] H2  xxxxxxxx  H3  xxxxxxxx
 B2  xxxxxxxx  K1 [00000000] K2 [00000000]
 D4 [00000000] D5 [00000000] D6 [00000000]
 D7 [00000000] D8 [00000000] D9 [00000000]
 D10[00000000] D11[00000000] D12[00000000]
 S1 [00000010] Z2 [00000000] E2 [00000000]



STATUS:
QUALITY   G.811   G.812   G.812   MORE  MULTIPLE
UNKNOWN          TRANSIT  LOCAL  ....... WINDOW
```

Optical Clock Recovery Stress (A1T (A1U) only)

The TRANSMIT ; **STRESS TEST** test
function allows the STM-1 OPT payload to
be overwritten with a block of zeros or
ones, after scrambling, thus stressing any
clock recovery circuits.
Alternatively the user can select the G.958
test pattern which consists of consecutive
blocks of four types of data :
All 1's ;
PRBS ;
All 0;s ;
 a data block consisting of the first row of Section / Transport overhead bytes.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST  OVERHEAD
       PAYLOAD         FUNCTION SETUP
 TEST FUNCTION [ SDH     ][ STRESS TEST]

 STRESSING PATTERN        [ ALL ONES   ]
 BLOCK LENGTH             [ 259 ] BYTES




STATUS:
ALL     ALL    G.958                 MULTIPLE
ZEROS   ONES                          WINDOW
```

DCC Insert and Drop (A1T (A1U) only)

The TRANSMIT ; **DCC INSERT** test
function and the RECEIVE ; **DCC DROP**
test function allow access to the Regenerator
Section / Transport Overhead (192 kb/s) or
Multiplexer Section / Transport Overhead
(576 kb/s) DCC channel for protocol
testing.f **NORMAL** is selected the first bit
received in each byte will be the last bit
dropped. Selection of **NORMAL** or
REVERSED on either display will affect
both.

```
RECEIVER INPUT           [ SDH      ]
 SDH   STRUCT'D  TEST   OVERHEAD
       PAYLOAD FUNCTION MONITOR
 TEST FUNCTION            [ DCC DROP  ]
                         [ RS DCC     ]


 DCC BYTE POLARITY        [ REVERSED  ]




STATUS:
REVERSED  NORMAL                      MULTIPLE
                                       WINDOW
```
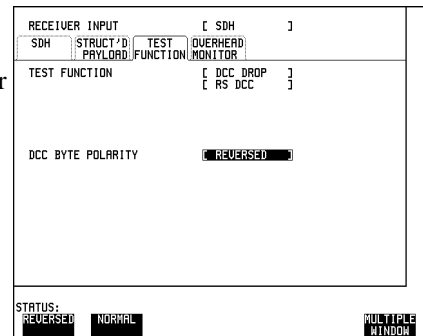
Optical Power Measurement (Options USN and UKT Only)

An optical power measurement is performed on the STM-1/STM-4 input signal if Option USN or UKT, Optical Interface Module is fitted.

Select the required input signal rate on the [RECEIVE] display.

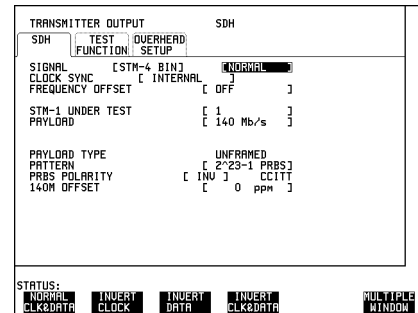Select the required wavelength and view the result on the [RESULTS] display.

```
RESULTS [ SDH          ][ OPTICAL POWER ]
RX WAVELENGTH              [ 1550 nm      ]




OPTICAL PWR              dBm

ELAPSED TIME

STATUS:
FREQ-    POINTER  OPTICAL           MORE
UENCY    VALUES   POWER            ........
```
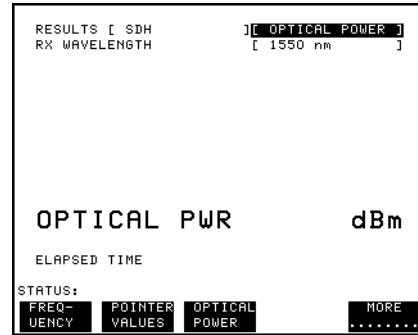
STM-1/STM-4 Binary Interface (Option OYH with USN or UKT)

If Option OYH is fitted in conjunction with Option USN or UKT, STM-1/STM-4 Optical Interface, binary STM-1 and STM-4 signals can be generated and analysed by the HP 37717B.

An STM-1 BINARY and STM-4 BINARY choice are added to the SIGNAL softkey menu.

The transmitter and receiver can be configured to operate with Normal or Inverted Clock and Data.

```
TRANSMITTER OUTPUT           SDH
 SDH    TEST   OVERHEAD
      FUNCTION  SETUP
SIGNAL     [STM-4 BIN]    [NORMAL    ]
CLOCK SYNC      [ INTERNAL    ]
FREQUENCY OFFSET         [ OFF      ]

STM-1 UNDER TEST        [ 1        ]
PAYLOAD                 [ 140 Mb/s ]


PAYLOAD TYPE            UNFRAMED
PATTERN                 [ 2^23-1 PRBS]
PRBS POLARITY       [ INV ]    CCITT
140M OFFSET             [   0  ppm  ]




STATUS:
NORMAL   INVERT   INVERT   INVERT    MULTIPLE
CLK&DATA CLOCK    DATA     CLK&DATA  WINDOW
```

2

SDH / SONET Application Measurements

Add/Drop Multiplexer Testing

Application

The insertion of tributary signals into the Add/Drop multiplexer, which are then mapped into the SDH / SONET signal, should take place without introducing errors. The insertion and mapping process is tested by adding a test pattern to the tributary inserted at the tributary insert port. At the SDH / SONET side of the Add/Drop multiplexer the tributary is demapped by the HP 37717C Communications Performance Analyzer. By using the Optical Splitter, at the optical side of the Add/Drop multiplexer, the Add/Drop multiplexer need not be taken out of service. A Bit error rate (BER) test is performed on the recovered tributary test pattern to determine whether errors have been introduced by the Add/Drop multiplexer.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Add/Drop Multiplexer Testing Test Setup Procedure

The following Options must be fitted to the HP 37717C to perform this test :

- UKJ (USA)or UKK (USB) - PDH Module

- US1 or A1T (A1U) - SDH / SONET Module

- UH2 or URU- STM-1/4 Optical Interface

In this setup a 2 Mb/s payload, containing a test pattern, is inserted at the tributary insert port of the Add/Drop multiplexer multiplexer. A portion of the STM4 Optical signal is tapped off by the Optical Splitter (approx 10%) and the 2 Mb/s tributary is demapped by the HP 37717C Communications Performance Analyzer.

An Error measurement is performed on the demapped 2 Mb/s tributary test pattern.

A SINGLE test period of 24 HOURS is used and the internal printer is enabled to record results and alarms.

The HP 37717C Communications Performance Analyzer GRAPHICS function is enabled. The graphical results can be viewed on the GRAPH display

1. Connect the HP 37717C to the network equipment and set up the **OTHER**; **SETTINGS CONTROL** display as shown opposite.

```
FUNCTION          [ SETTINGS CONTROL    ]

TRANSMITTER AND RECEIVER     [INDEPENDENT]




STATUS:
[INDEP-   COUPLED                         MULTIPLE
 ENDENT                                    WINDOW
```
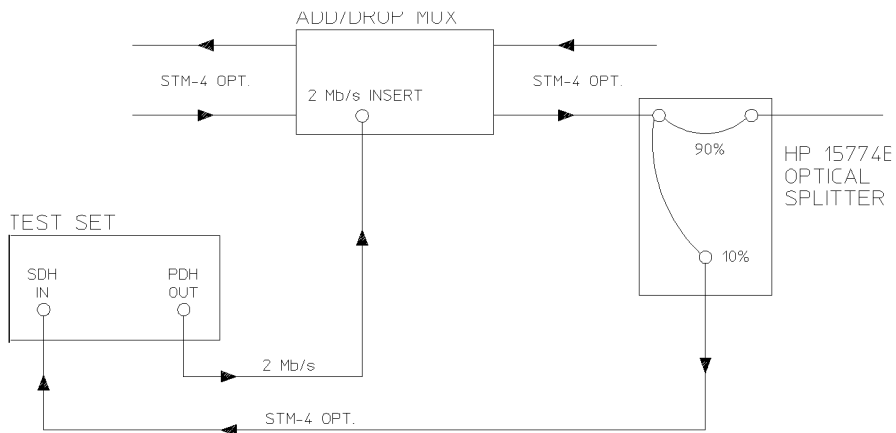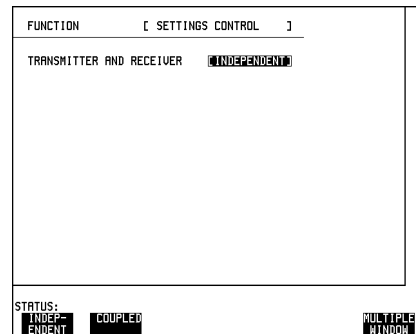
2. Set up the **TRANSMIT** display as shown opposite.

The PAYLOAD TYPE determines the Framing. .
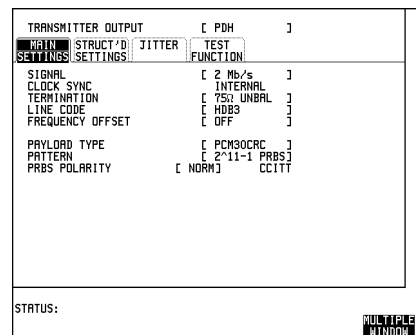
```
TRANSMITTER OUTPUT       [ PDH        ]
 MAIN  STRUCT'D JITTER   TEST
SETTINGS SETTINGS        FUNCTION

SIGNAL                  [ 2 Mb/s     ]
CLOCK SYNC                INTERNAL
TERMINATION             [ 75Ω UNBAL  ]
LINE CODE               [ HDB3       ]
FREQUENCY OFFSET        [ OFF        ]

PAYLOAD TYPE            [ PCM30CRC   ]
PATTERN                 [ 2^11-1 PRBS]
PRBS POLARITY        [ NORM]    CCITT




STATUS:
                                         MULTIPLE
                                          WINDOW
```

3. Set up the RECEIVE display as shown opposite.

```
RECEIVER INPUT           [ SDH      ]
 SDH   STRUCT'D
        PAYLOAD

 SIGNAL                  [ STM-4 OPT ]


 STM-1 UNDER TEST        [ 1        ]
 PAYLOAD                 [ ASYNC 2Mb/s]
 SELECTED 2Mb/s (TU) :
            TUG3 [1]  TUG2 [1]  TU [1]
 PAYLOAD TYPE            [ PCM30CRC   ]
 PATTERN                 [ 2^11-1 PRBS]
 PRBS POLARITY           [ NORM]   CCITT




 STATUS:
                                    MULTIPLE
                                    WINDOW
```

4. Set up the OTHER display, LOGGING function, as shown opposite.

```
 FUNCTION        [ LOGGING        ]

 LOGGING SETUP           [ CONTROL    ]

 LOGGING                 [ ON         ]
 LOGGING PERIOD          [ 1 HOUR     ]

 RESULTS LOGGED          [ SELECTED   ]
           WHEN          [ PERIOD EC>0 ]
           CONTENT       [ ER & ANAL  ]
                         [ PER & CUMUL ]
 LOG ERROR SECONDS       [ OFF        ]
 LOG AT END OF TEST        ALL RESULTS

 LOG ON DEMAND             RESULTS




 STATUS:
 ALWAYS   PERIOD                     MULTIPLE
          EC > 0                     WINDOW
```

Continuity Check

Before running the test carry out a continuity test to verify the measurement path.

1. Set up the RESULTS display as shown opposite.

2. Press RUN/STOP to start a measurement.

3. Press error add SINGLE three times and check that the errors are recorded on the RESULTS display.

4. Press RUN/STOP to stop the measurement.

```
 RESULTS [ PDH PAYLOAD ][ CUMULATIVE   ]
  BIT    FAS    CRC    REBE
         2 Mb/s



 BIT EC
 BIT ER

 ELAPSED TIME



 STATUS:
                                    MULTIPLE
                                    WINDOW
```

Start the Add/Drop Multiplexer Test

1. Set up the RESULTS display as shown opposite.If you do not require stored graphics results select STORAGE [OFF].

```
RESULTS [ PDH PAYLOAD  ][ ERROR ANALYSIS]
 G.821    G.826    M.2100   M.2110   M.2120

                    [ BIT            ]

EC                    AnD ES          %
ES                                    %
EFS                                   %
SES                                   %
UNAV                                  %
DEG MIN                               %
CODE ES

ELAPSED TIME




STATUS:
  BIT      FAS      CRC      REBE            MULTIPLE
         2 Mb/s                              WINDOW
```

2. Press RUN/STOP to start the measurement.

The measurement results and alarms are available on the RESULTS display during the test period.
The graphical measurement results and alarms are stored in non volatile memory for viewing later on the GRAPH display.

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

```
FUNCTION         [ LOGGING        ]

LOGGING SETUP             [ CONTROL    ]

LOGGING                   [ ON         ]
LOGGING PERIOD            [ 1 HOUR     ]

RESULTS LOGGED           [ SELECTED   ]
         WHEN            [ PERIOD EC>0 ]
         CONTENT         [ ER & ANAL  ]
                         [ PER & CUMUL]
LOG ERROR SECONDS        [ OFF        ]
LOG AT END OF TEST         ALL RESULTS

LOG ON DEMAND             RESULTS




STATUS:
 ALWAYS    PERIOD                             MULTIPLE
          EC > 0                              WINDOW
```
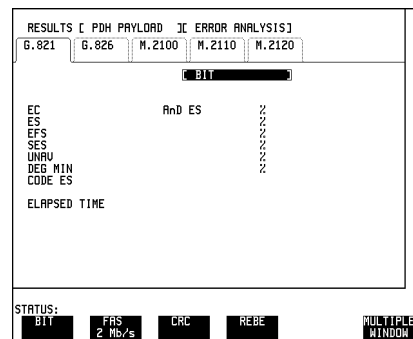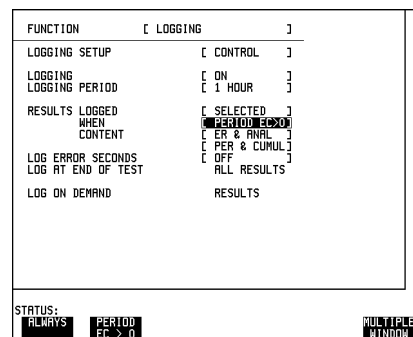
At the End of the Test (Add/Drop Multiplexer Testing)

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

- Results are logged on the internal printer at 1 hour intervals if the error count is greater than 0.

- Any alarms which occur during the test period will be logged on the internal printer.

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

- A graphical record of the results during the test period can be viewed on the GRAPH display. If Remote Control option A3B, A3D, 1A8 or 1CW is fitted the graph results can be logged to an external printer, at a later date. See *Graphics* and *External HP 550C DeskJet Printer*.

- Results and Alarm summaries can be viewed on the **GRAPH** display.

The total graphics store capacity is normally 20,000 events. If GRAPH STORAGE RESOLUTION [FULL] is selected on the **OTHER**; **MISCELLANEOUS** display the capacity reduces to 10,000 events.

The resolution, determined by the selection made under STORAGE on the **RESULTS** display, affects the ZOOM capability when viewing the bar graphs. If 1 SECOND is selected all resolutions are available under ZOOM. If 1 MIN is selected only 1 MIN/BAR, 15 MINS/BAR and 60 MINS/BAR are available. If 15 MINS is selected only 15 MINS/BAR and 60 MINS/BAR are available. If 1 HOUR is selected only 60 MINS/BAR is available.

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

To prevent accidental overwriting of previously stored results the graphics capability should be disabled, when graphical results are not required, by selecting STORAGE [OFF] on the **RESULTS** display.

Alarm Stimulus/Response

Application

Network elements transmit alarms in response to certain error/alarm conditions to advise upstream and downstream equipment that these conditions exist. If these alarms are not transmitted in the proper manner, at the proper time, degradations in service will occur.

Alarm testing entails transmitting an alarm signal from the Communications Performance Analyzer and monitoring the network equipment alarm indicators and the upstream or downstream signal for the correct response.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Alarm Stimulus/Response Test Setup Procedure

The following options must be fitted to the HP 37717C to perform this test:

- US1 or A1T (A1U) - SDH / SONET module

- UH1, UH2, URU, USN or UKT - STM-1 Optical interface

In this setup the Communications Performance Analyzer transmits MS AIS Alarm (Line AIS) into the network. The network equipment alarm indicators are monitored for the appropriate alarms. The upstream signal is monitored for occurrences of MS FERF (Line FERF). The downstream signal can be monitored for occurrences of PATH AIS (AIS-P).

A similar procedure can be used for testing all other SDH / SONET alarms. See the following tables.

```
TEST SET
          OPTICAL  ○      "STIMULUS"   ▷        "DOWNSTREAM"
          OUT                              SDH              ▷
          OPTICAL  ○      "UPSTREAM"   ◁   SYSTEM
          IN
```
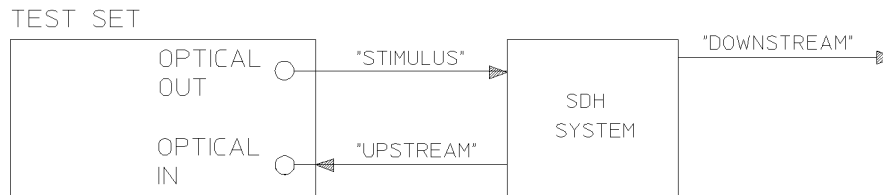
SDH Alarms

Alarm	RSTE		MSTE		PTE	
	Down	**Up**	**Down**	**Up**	**Down**	**Up**
Loss Of Signal	MS AIS	N/A	Path AIS	MS FERF	TU-Path AIS	TU-Path FERF
Loss Of Frame	MS AIS	N/A	Path AIS	MS FERF	TU-Path AIS	TU-Path FERF
Loss Of Pointer	N/A	N/A	Path AIS	MS FERF	TU-Path AIS	TU-Path FERF
MS AIS	N/A	N/A	Path AIS	MS FERF	TU-Path AIS	TU-Path FERF
MS FERF	N/A	N/A	N/A	N/A	N/A	N/A

SONET Alarms

Alarm	STE Maintenance Signals		LTE Maintenance Signals	
	Down	**Up**	**Down**	**Up**
Loss Of Signal	AIS-L	N/A	AIS-P	Line FERF
Loss Of Frame	AIS-L	N/A	AIS-P	Line FERF
Loss Of Pointer	N/A	N/A	AIS-P	Line FERF
Line AIS (AIS-L)	N/A	N/A	AIS-P	Line FERF
Line FERF	N/A	N/A	N/A	N/A

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

```
FUNCTION          [ SETTINGS CONTROL    ]

TRANSMITTER AND RECEIVER     [ COUPLED    ]
       RECEIVER COUPLED TO TRANSMITTER




STATUS:
 INDEP-   COUPLED                          MULTIPLE
 ENDENT                                     WINDOW
```

2. Set up the **TRANSMIT**; **SDH** display as shown opposite.

```
TRANSMITTER OUTPUT          [ SDH       ]
  SDH  STRUCT'D  TEST
       PAYLOAD FUNCTION
SIGNAL                      [ STM-1 OPT ]
CLOCK SYNC                  [ INTERNAL  ]

FREQUENCY OFFSET            [ OFF       ]


PAYLOAD                     [ 140 Mb/s  ]


PAYLOAD TYPE                [ UNFRAMED  ]
PATTERN                     [ 2^23-1 PRBS]
PRBS POLARITY          [ INV ]    CCITT



STATUS:
  STM-1    STM-1      STM-4                 MULTIPLE
          OPTICAL    OPTICAL                 WINDOW
```

3. Set up the **TRANSMIT**; **TEST** **FUNCTION** display as shown opposite.

The ERROR ADD TYPE selected does not matter as long as RATE [OFF] is selected.

```
TRANSMITTER OUTPUT          [ SDH       ]
  SDH   JITTER   TEST   OVERHEAD
               FUNCTION  SETUP
TEST FUNCTION [ SDH    ][ ERR & ALARM]

ERROR ADD TYPE              [ A1A2 FRAME ]
         RATE               [ OFF        ]

ALARM TYPE                  [ MS AIS      ]




STATUS:
 MS AIS   MS FERF  LOSS OF    PATH     MORE    MULTIPLE
                  POINTER     AIS    ........  WINDOW
```

4. Set up the **RESULTS** display as shown opposite. ALARM SECONDS are displayed but any of the other results can be selected from the softkey menu without affecting the measurement.

```
RESULTS [ SDH          ][ ALARM SECONDS ]



POWER LOSS              K1/K2 CHANGE
LOS                     MS FERF
LOF                     PATH FERF
OOF                     H4 MFRM LOSS
LOP                     TU LOP
MS AIS                  TU PATH AIS
PATH AIS                TU PATH FERF

ELAPSED TIME




STATUS:
 CUMUL    SHORT   ANALYSIS   ALARM    MORE    MULTIPLE
 ATIVE    TERM    (G.826)   SECONDS  .......   WINDOW
```
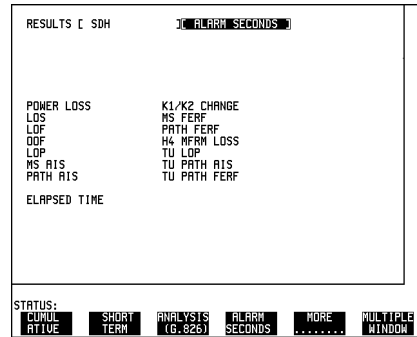
Start the Alarm Stimulus/Response Test

1. Connect the Communications Performance Analyzer to the upstream port of the network equipment and press **RUN/STOP** on the HP 37717C.

2. Check that the network equipment registers MS AIS and that MS FERF alarm seconds are recorded on the **RESULTS** display.

DCC Testing

Application

The section overhead contains two DataCommunication Channels (DCC), Regenerator Section DCC at 192 kb/s (overhead bytes D1- D3) and Multiplexer Section DCC at 576 kb/s (overhead bytes D4 - D12). The DCC communicates network management messages between network elements and the network controller via the operations support computer system.

If the DCC is not operating correctly these network management messages will be lost and degradations in network performance will pass unnoticed. This may result in a failure condition.

Full testing of the line and section DCC's can be carried out using a protocol analyzer connected via the HP 37717C Communications Performance Analyzer to the appropriate overhead bytes. At the far end the HP 37717C Communications Performance Analyzer can drop the selected DCC to the protocol analyzer allowing the DCC integrity to be analyzed.

If you do not have access to a protocol analyzer capable of handling SDH DCC protocol, the DCC integrity can be verified by a BER test using an HP 37732A, Digital Telecomm/Datacomm Analyzer.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state prior to setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

DCC Test Setup Procedure

Alarm Stimulus/Response Test Setup Procedure

The following options must be fitted to the HP 37717C to perform this test:

- A1T (A1U) - SDH / SONET module

- UH1, UH2, URU, USN or UKT - STM-1 Optical interface

IIn this procedure the HP 37717C Communications Performance Analyzer accepts a 576 kb/s test pattern via the protocol analyzer port, inserting the test pattern in bytes D4 - D12 of the Multiplexer Section overhead and transmitting an STM-1 optical

signal. The HP 37717C Communications Performance Analyzer receives the STM-1 optical signal and drops the Multiplexer Section DCC, via the protocol analyzer port, to the HP 37732A which performs the BER measurement.

```
HP 37732A DIGITAL
TELECOMM/DATACOMM
ANALYSER
```
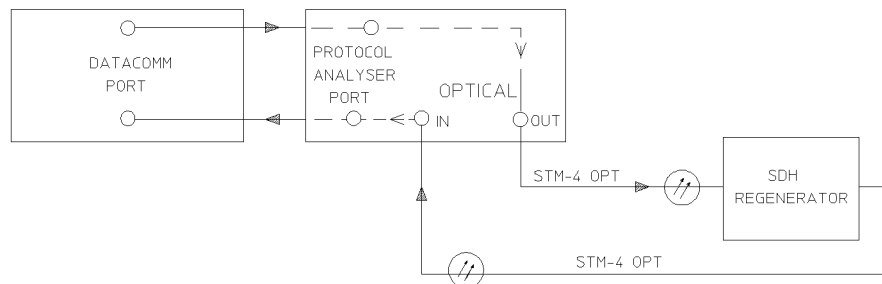

1. Connect the HP 37732A and the HP 37717C to the network element, as shown and set up the OTHER ; SETTINGS CONTROL display as shown opposite.

2. Set up the TRANSMIT SDH display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the TRANSMIT clock. If EXTERNAL MTS is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.
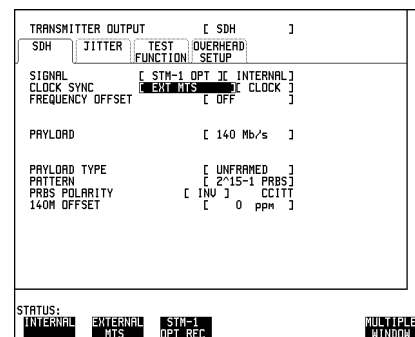
3. Set up the $\boxed{\text{TRANSMIT}}$; **TEST FUNCTION** display as shown opposite.

```
TRANSMITTER OUTPUT          [ SDH        ]
 SDH    JITTER   TEST   OVERHEAD
                FUNCTION  SETUP
TEST FUNCTION [ SDH       ][ DCC INSERT ]
                          [ MS DCC      ]



DCC BYTE POLARITY           [ NORMAL    ]





STATUS:
 AS DCC    MS DCC                       MULTIPLE
 D1-D3     D4-D12                        WINDOW
```

4. Set up the $\boxed{\text{RECEIVE}}$; **TEST FUNCTION** display as shown opposite.

```
RECEIVER INPUT              [ SDH        ]
 SDH   STRUCT'D   TEST   OVERHEAD
       PAYLOAD FUNCTION MONITOR
TEST FUNCTION               [ DCC DROP   ]
                            [ MS DCC     ]



DCC BYTE POLARITY           [ NORMAL    ]





STATUS:
                                        MULTIPLE
                                         WINDOW
```

Start the DCC Test

1. Select TEST SELECT DATACOM on the HP 37732A.

2. Set TX Clock Source and RX Clock Source to [INTERFACE] on the HP 37732A (Clock from HP 37717C protocol port).

3. Select the required pattern and monitor logic errors and frequency to verify the integrity of the DCC.

Desynchroniser Stress

Application

At the boundary of the SDH / SONET network the 2 Mb/s or 140 Mb/s payload is demapped from the SDH / SONET signal. Pointer adjustments in the signal may cause high levels of tributary jitter in the output payload. Excessive amounts of tributary jitter will result in errors.

The desynchronizing phase lock loop of the network element should minimize the level of tributary jitter in the payload but correct operation under stress conditions must be verified. The desynchronizing phase lock loop can be stressed by adding pointer movement sequences (defined in CCITT standard G.783) to the SDH / SONET signal such that the test virtual container moves with respect to the SDH / SONET frame.

A jitter measurement is made to verify that the desynchroniser output jitter is within the required specification.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Desynchroniser Stress Test Setup Procedure

The following options must be fitted to the HP 37717C to perform this test:

• UKK (USB) or UKJ (USA)- PDH module

• UHN (US9) - Jitter measurement module

• A1T (A1U) - SDH / SONET module

• UH1, UH2, URU, USN or UKT - STM-1/4 Optical interface

The HP 37717C Communications Performance Analyzer transmits an STM-4 optical signal carrying 2 Mb/s payload. Pointer movement sequences are added in a controlled manner. The desynchroniser output is returned to the HP 37717C and a jitter measurement is performed on the demapped 2 Mb/s signal.
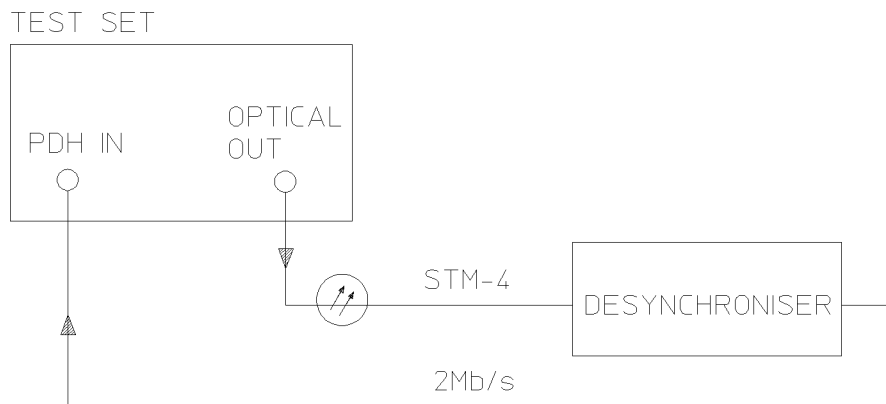
TEST SET

PDH IN

OPTICAL
OUT

STM-4

DESYNCHRONISER

2Mb/s

1. Connect the HP 37717C to the network equipment and set up the [TRANSMIT]; **SDH** display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the [TRANSMIT] clock. If **EXTERNAL MTS** is selected a 2 Mb/s reference must be connected to the 2M REF IN port. The format can be CLOCK or DATA.

```
TRANSMITTER OUTPUT          [ SDH        ]
 SDH    JITTER    TEST   OVERHEAD
                 FUNCTION SETUP

SIGNAL              [ STM-4 OPT ]
CLOCK SYNC          [ EXT MTS      ][ CLOCK ]
FREQUENCY OFFSET              [ OFF       ]

STM-1 UNDER TEST             [ 1         ]
PAYLOAD                      [ TU-12     ]
TU MODE             [ ASYNC   ]
SELECTED TU    TUG3 [1]  TUG2 [1]  TU [1]
TU PAYLOAD                   [ UNFRAMED   ]
PATTERN                      [ 2^15-1 PRBS]
PRBS POLARITY       [ INV ]     CCITT
2M OFFSET                    [    0ppm]
PATTERN IN OTHER TUs  [ 2^9-1 PRBS ]




STATUS:
INTERNAL  EXTERNAL    STM-4                 MULTIPLE
          MTS        OPT REC                 WINDOW
```

2. Set up the TRANSMIT; TEST FUNCTION display as shown opposite.

```
TRANSMITTER OUTPUT        [ SDH      ]
  SDH    JITTER   TEST   OVERHEAD
                 FUNCTION  SETUP
  TEST FUNCTION [ SDH     ][ ADJUST PTR ]
  POINTER TYPE             [ TU POINTER ]
                           [ G.783      ]
  ADJUSTMENT TYPE          [ SINGLE     ]
                           [ WITH ADDED ]
         POLARITY          [ POSITIVE   ]
         INTERVAL          [ 10 ms      ]
  POINTER SEQUENCES        [ STOPPED    ]




STATUS:
NEGATIVE  POSITIVE                       MULTIPLE
                                          WINDOW
```

Pointer adjustments are made every 10 ms with an extra ADDED adjustment as defined in CCITT standard G.783.

Pointer sequences are started by selecting STARTED .

3. Set up the RECEIVE; JITTER display as shown opposite.

```
RECEIVER INPUT            [ PDH      ]
  MAIN    STRUCT'D  JITTER
SETTINGS SETTINGS
  SIGNAL FREQUENCY          2 Mb/s
  RECEIVER RANGE           [ 16   UI  ]
  HIT THRESHOLD            [ 0.5 UI   ]
  FILTER                   [ OFF      ]

  WANDER REFERENCE         [ 75Ω UNBAL ]
  WANDER REF. FORMAT       [ HDB3 DATA ]




STATUS:
  OFF     LP     HP1    HP2    MORE   MULTIPLE
                              ......  WINDOW
```

4. Set up the RESULTS display as shown opposite. Jitter Hits can also be viewed without affecting the measurement.

```
RESULTS [ JITTER     ][ CUMULATIVE   ]
  HITS    AMPLI
          TUDE


  +VE  PEAK              UI
  -VE  PEAK              UI
  PEAK-PEAK             UI
  FILTERS        OFF
  ELAPSED TIME



STATUS:
                                      MULTIPLE
                                       WINDOW
```

Start the Desynchroniser Stress Test

1. Press RUN/STOP to start the Jitter measurement.

Frame Synchronization

Application

A network element should maintain synchronization even in the presence of some frame errors. If the number of frame errors exceeds the specified threshold for 3 ms, the network element will lose frame synchronization causing a new search for frame alignment to begin.

The frame synchronization process of the network element can be stressed by injecting frame errors, into the A1 and A2 framing bytes of the Regenerator Section overhead. As the frame error injection rate is increased to the frame synchronization threshold, the network element should indicate Out Of Frame (OOF) and Loss Of Frame (LOF) conditions. As the frame error injection rate is decreased again, the network element should regain frame synchronization.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Frame Synchronization Test Setup Procedure

Frame Error Add Test Function   In this setup the HP 37717C Communications Performance Analyzer is used to insert frame errors in the A1 and A2, framing bytes of the Regenerator section overhead of an STM-1 optical signal. The STM-1 optical signal is transmitted to the network equipment. The network equipment OOF and LOF alarms are monitored as the frame error add rate is increased and decreased.

Sequence Generation Test Function

In this setup procedure the HP 37717C Communications Performance Analyzer generates a sequence of errored framing bytes to test the OOF and LOF alarm threshold criteria. The upstream STM-1 optical signal is monitored for occurrences of Multiplexer Section FERF. The downstream STM-1 optical signal can be monitored for AIS.

1. Connect the HP 37717C to the network equipment and set up the OTHER; SETTINGS CONTROL display as shown opposite.

2. Set up the TRANSMIT; SDH display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the TRANSMIT clock. If EXTERNAL MTS is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.

3. Set up the RESULTS display as shown opposite.

```
RESULTS [ SDH          ][ ALARM SECONDS ]



POWER LOSS          K1/K2 CHANGE
LOS                 MS FERF
LOF                 PATH FERF
OOF                 H4 MFRM LOSS
LOP                 TU LOP
MS AIS              TU PATH AIS
PATH AIS            TU PATH FERF

ELAPSED TIME




STATUS:
┌──────┐┌──────┐┌──────┐┌──────┐┌──────┐┌────────┐
│CUMUL ││SHORT ││ANALYSIS││ALARM ││MORE  ││MULTIPLE│
│ATIVE ││TERM  ││(G.826)││SECONDS││......││WINDOW  │
└──────┘└──────┘└──────┘└──────┘└──────┘└────────┘
```

4. Set up the TRANSMIT; TEST FUNCTION display as shown opposite.

```
TRANSMITTER OUTPUT       [ SDH      ]
┌─────┐┌──────┐┌──────┐┌────────┐
│ SDH ││JITTER││ TEST ││OVERHEAD│
└─────┘└──────┘│FUNCTION│SETUP  │
               └──────┘└────────┘
TEST FUNCTION [ SDH       ][ ERR & ALARM]

ERROR ADD TYPE            [ A1A2 FRAME ]
         RATE            [ 1 IN 4    ]

ALARM TYPE               [ OFF      ]




STATUS:
┌──────┐┌──────┐┌──────┐┌──────┐┌──────┐┌────────┐
│ OFF  ││1 IN 4││2 IN 4││3 IN 4││4 IN 4││MULTIPLE│
└──────┘└──────┘└──────┘└──────┘└──────┘│WINDOW  │
                                        └────────┘
```

Start the Frame Synchronization Test (Frame Error Add)

1. Check that the Loss Of Frame (LOF) alarm indicator on the network element remains unlit and no occurrences of MS FERF are recorded.

2. Increase the Frame Error Add Rate to 2 IN 4 and check that the Loss Of Frame (LOF) alarm indicator on the network element remains unlit and no occurrences of MS FERF are recorded.

3. Increase the Frame Error Add Rate to 3 IN 4 and check that the Loss Of Frame (LOF) alarm indicator on the network element remains unlit and no occurrences of MS FERF are recorded.

4. Increase the Frame Error Add Rate to 4 IN 4 and check that the OOF and LOF alarm indicators on the network equipment are lit and occurrences of MS FERF are recorded.

5. Decrease the Frame Error Add Rate to 3 IN 4 and check that the OOF and LOF alarm indicators on the network equipment remain lit and occurrences of MS FERF are still being recorded.

6. Decrease the Frame Error Add Rate to 2 IN 4 and check that the OOF and LOF alarm indicators on the network equipment go off, and no further occurrences of MS FERF are recorded.

Sequence Generation Test Function

1. Connect the HP 37717C to the network equipment and set up the OTHER SETTINGS CONTROL display as shown opposite.

```
FUNCTION          [ SETTINGS CONTROL    ]

TRANSMITTER AND RECEIVER      [ COUPLED ]
     RECEIVER COUPLED TO TRANSMITTER




STATUS:
  INDEP-    COUPLED                            MULTIPLE
  ENDENT                                       WINDOW
```

2. Set up the TRANSMIT; SDH display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the TRANSMIT clock. If EXTERNAL MTS is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.

```
TRANSMITTER OUTPUT          [ SDH      ]
 SDH   STRUCT'D   TEST
       PAYLOAD  FUNCTION
SIGNAL                      [ STM-1 OPT ]
CLOCK SYNC                  [ INTERNAL  ]

FREQUENCY OFFSET            [ OFF      ]

PAYLOAD                     [ 140 Mb/s ]

PAYLOAD TYPE                [ UNFRAMED ]
PATTERN                     [ 2^23-1 PRBS]
PRBS POLARITY           [ INV ]    CCITT




STATUS:
  STM-1     STM-1     STM-4                    MULTIPLE
           OPTICAL   OPTICAL                   WINDOW
```

3. Set up the RESULTS display as shown opposite.

```
RESULTS [ SDH            ][ ALARM SECONDS ]




POWER LOSS           K1/K2 CHANGE
LOS                  MS FERF
LOF                  PATH FERF
OOF                  H4 MFRM LOSS
LOP                  TU LOP
MS AIS               TU PATH AIS
PATH AIS             TU PATH FERF

ELAPSED TIME




STATUS:
  CUMUL    SHORT   ANALYSIS   ALARM     MORE   MULTIPLE
  ATIVE    TERM    (G.826)   SECONDS  ........  WINDOW
```

4. Set up the [TRANSMIT]; TEST
FUNCTION display as shown opposite.

```
TRANSMITTER OUTPUT            [ SDH      ]
  SDH       TEST  ||OVERHEAD
         ||FUNCTION|| SETUP

TEST FUNCTION [ SDH        ][ SEQUENCES  ]
[SINGLE RUN] [STOPPED] -SEQUENCE STOPPED
OVERHEAD CHANNEL    [ RSOH ][ 3xA1,3xA2  ]
        A [F6F6F6282828]
        B [090909D7D7D7]
        C [000000000000]
        D [000000000000]
        E [000000000000]
SEQUENCE [15974] FRAMES OF [A] THEN
        [     24]          [B]
        [      0]          [C]
        [      0]          [D]
        [      0]          [E]




STATUS:
[STOPPED]  [STARTED]                   MULTIPLE
                                        WINDOW
```

Start the Frame Synchronization Test (Sequence Test)

1. Press **STARTED** on the [TRANSMIT]; **TEST FUNCTION** display to start the
sequence. As a result of this sequence one OOF alarm second and one LOF alarm
second should occur every two seconds.

2. Check that the network element OOF and LOF alarm indicators cycle ON and
OFF and that an occurrence of MS FERF is recorded every two seconds.

3. Press **STOPPED** to stop the sequence
and set up the [TRANSMIT]; **TEST
FUNCTION** display as shown opposite.

4. Press **STARTED** on the [TRANSMIT];
TEST FUNCTION display to start the
sequence. As a result of this sequence one
OOF alarm second should occur every two
seconds but LOF should not occur.

5. Check that the network element OOF
alarm indicator cycles ON and OFF. The

```
TRANSMITTER OUTPUT            [ SDH      ]
  SDH    || JITTER ||  TEST  ||OVERHEAD
                   ||FUNCTION|| SETUP

TEST FUNCTION [ SDH        ][ SEQUENCES  ]
[REPEAT RUN] [STOPPED] -SEQUENCE STOPPED
OVERHEAD CHANNEL    [ RSOH ][ 3xA1,3xA2  ]
        A [F6F6F6282828]
        B [F6F6F6282828]
        C [F6F6F6282828]
        D [F6F6F6282828]
        E [F6F6F6282828]
SEQUENCE [15974] FRAMES OF [A] THEN
        [     26]          [B]
        [      0]          [C]
        [      0]          [D]
        [      0]          [E]




STATUS:
[STOPPED]  [STARTED]                   MULTIPLE
                                        WINDOW
```

LOF alarm should not occur and no occurrences of MS FERF should be recorded.

SDH Jitter Transfer

Digital transmission systems use Regenerators to transport the signal over long distances. These Regenerators are cascaded together and it is important that each regenerator adds minimal amounts of jitter to the signal.

It is necessary during installation and maintenance to measure the degree to which jitter present at the input is amplified or attenuated by the network elements (Jitter Gain/Transfer).

The jitter transfer measurement entails measuring the input and output jitter at selected jitter frequencies within the jitter bandwidth. The jitter gain is calculated :
Jitter Gain (dB) = 20 Log $\{$Jitter out $\backslash\backslash$over Jitter in$\}$

When the network equipment meets CCITT specification G.823 it should be possible to connect network elements without incurring bit errors.
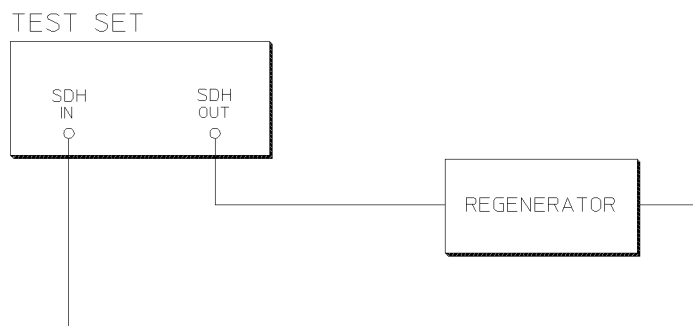
Default (Known State) Settings

It can be advisable to set the HP 37717C to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Test Setup Procedure (Jitter Transfer Test)

The following Options must be fitted to the HP 37717C to perform this test :

- UHK - Jitter Generation

- A1N (A1R) or A1P (A1S)- SDH Jitter Measurement

- US1 or A1T (A1U) - SDH Module

This setup procedure is based on 155.52 Mb/s (STM-1), 140 Mb/s payload, PRBS test data with jitter. The Jitter frequency is varied within the jitter bandwidth and the received jitter is measured to allow calculation of the jitter gain. The internal printer is enabled for recording of results and alarms.

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

Any SDH settings change made on the **TRANSMIT** or **RECEIVE** displays will automatically occur on the other.

```
FUNCTION        [ SETTINGS CONTROL    ]

TRANSMITTER AND RECEIVER    [ COUPLED    ]
          RECEIVER COUPLED TO TRANSMITTER




STATUS:
 INDEP-   COUPLED                        MULTIPLE
 ENDENT                                   WINDOW
```

2. Connect the HP 37717C to the line equipment, select **TRANSMIT**; **SDH** and set up the display as shown opposite.

```
TRANSMITTER OUTPUT      [ SDH        ]
 SDH  STRUCT'D  JITTER   TEST   OVERHEAD
      PAYLOAD          FUNCTION  SETUP
SIGNAL           [ STM-1   ][ INTERNAL]
CLOCK SYNC       [ INTERNAL    ]
FREQUENCY OFFSET        [ OFF        ]

PAYLOAD                [ 140 Mb/s   ]

PAYLOAD TYPE           [ UNFRAMED   ]
PATTERN                [ 2^23-1 PRBS]
PRBS POLARITY      [ INV ]    CCITT
140M OFFSET            [    0 ppm  ]



STATUS:
                                        MULTIPLE
                                         WINDOW
```

3. Select [TRANSMIT]; [JITTER] and set up the display as shown opposite.

Select the required Jitter MODULATING FREQUENCY and AMPLITUDE.

```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  JITTER   TEST  OVERHEAD
       PAYLOAD          FUNCTION SETUP
JITTER                    [ ON        ]
SIGNAL FREQUENCY            STM-1
JITTER MASK               [ OFF       ]

MODULATION FREQUENCY      [   1000 Hz ]
RANGE                     [     10 UI ]
AMPLITUDE                 [    1.0 UI ]




STATUS:
                                  MULTIPLE
                                  WINDOW
```

4. Setup the [RECEIVE]; [SDH JITTER] display as shown opposite.

If Jitter filtering is required select from the softkey menu.

```
RECEIVER INPUT            [SDH JITTER ]


SIGNAL                    [ STM-1    ]

RECEIVER RANGE            [ 16   UI  ]
HIT THRESHOLD             [  0.5 UI  ]
FILTER                    [ OFF      ]




STATUS:
 PDH      SDH      ATM      SDH      LAN    MULTIPLE
                           JITTER          WINDOW
```

Run the Test (Jitter Transfer)

1. Select [RESULTS] and set up the display as shown opposite.

Press [RUN/STOP] to start the measurement.

3. Record the Jitter Amplitude result from the [RESULTS] display.

```
RESULTS [ JITTER      ][ SHORT TERM   ]



+VE PEAK                 UI
-VE PEAK                 UI
PEAK-PEAK                UI
FILTERS          OFF
ELAPSED TIME



STATUS:
TROUBLE   TIMING   JITTER                MULTIPLE
 SCAN    CONTROL                         WINDOW
```

4. Select each jitter Modulating Frequency and Amplitude in turn on the [TRANSMIT] display, press [RUN/STOP] twice and record the Jitter Amplitude result from the RESULTSdisplay.

5. Calculate the Jitter gain for each frequency selected.

Jitter Gain (dB) = 20 Log {Jitter   out / Jitter   in}.   Where Jitter In is the AMPLITUDE selected on the [TRANSMIT] display.

MSP Stimulus/Response

Application

Multiplexer Section Protection (MSP) is an optional feature for SDH / SONET Multiplexer Section Terminating Equipment (MSTE). For those MSTE's, in which it is provided, the MSP system is standardized to ensure the interworking of MSP between MSTE's from different suppliers.

Standard messages, carried in the K1 and K2 bytes of the SDH / SONET signal transport overhead, indicate the state of the MSP.

Switching to the protection line occurs when one of the following conditions exists for a specified length of time :

- Loss Of Signal (LOS)

- Loss Of Frame (LOF)

- Signal Fail - Bit Error Ratio $> 1 \times 10^{-3}$

- Signal Degrade - Bit Error Ratio programmable

- MS AIS

The Signal Degrade Bit Error Ratio threshold is normally programmable in the range 1×10^{-5} to 1×10^{-9}.

The HP 37717C Communications Performance Analyzer can be used to test Multiplexer Section Protection switching by :

Generating the switching conditions listed above.

Transmitting and monitoring the K1 K2 messages.

MSP Stimulus/Response 1+1 Architecture Test Setup Procedure

In this setup the HP 37717C PDH/SDH test set, inserted in the working line, generates MS B2 BIP errors in sufficient quantity to violate the Signal Degrade threshold of the Multiplexer Section Protection. The network equipment Service Terminal indicates that switching to the standby line has occurred. The activity on the K1 K2 bytes can be monitored on the TRANSMIT TEST FUNCTION MSP Messages display.
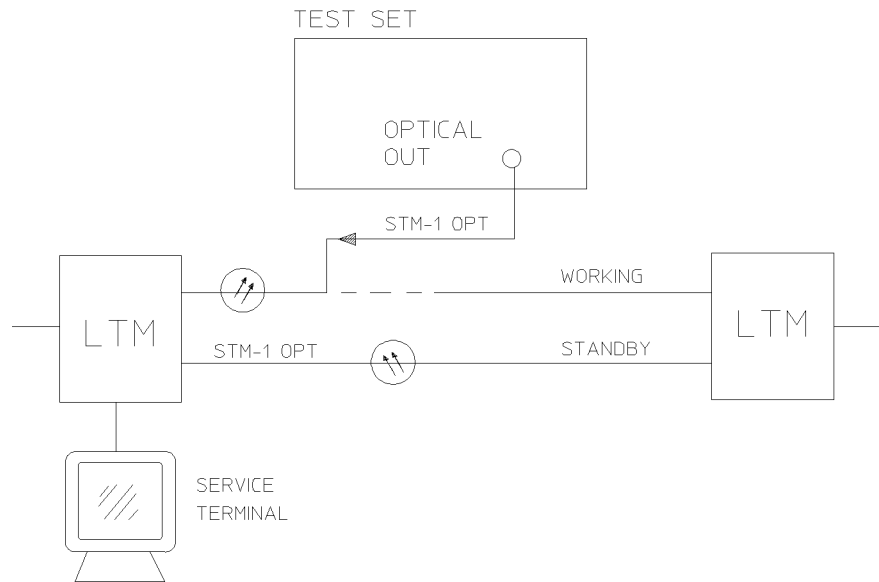
1. Set up the [**TRANSMIT**]; [**SDH**] display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the [**TRANSMIT**] clock. If [**EXTERNAL MTS**] is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.


```
TRANSMITTER OUTPUT        [ SDH      ]
 SDH   STRUCT'D  TEST
       PAYLOAD FUNCTION
SIGNAL                    [ STM-1 OPT   ]
CLOCK SYNC                [ INTERNAL    ]

FREQUENCY OFFSET          [ OFF      ]

PAYLOAD                   [ 140 Mb/s  ]

PAYLOAD TYPE              [ UNFRAMED   ]
PATTERN                   [ 2^23-1 PRBS]
PRBS POLARITY             [ INV ]    CCITT




STATUS:
  STM-1      STM-1     STM-4                    MULTIPLE
            OPTICAL   OPTICAL                    WINDOW
```
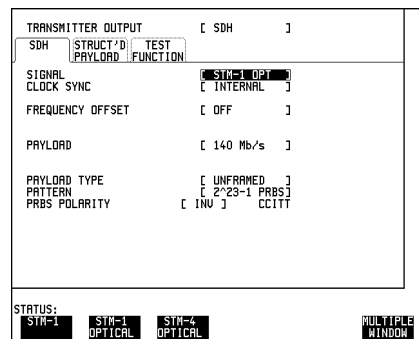
2. Set up the **TRANSMIT** ; **TEST FUNCTION** display as shown opposite.

1530 MS B2 BIP errors in 1 second corresponds to a BER of 1 in 10^{-5}. The Service terminal should indicate switching to standby within 1 second.

```
TRANSMITTER OUTPUT           [ SDH      ]
  SDH      TEST   OVERHEAD
         FUNCTION SETUP

TEST FUNCTION [ SDH      ][ ERR & ALARM]

ERROR ADD TYPE               [ MS B2 BIP ]
            RATE            [MSP THRESHLD]
            [ 1530 ] ERRORS IN [ 1 s     ]

ALARM TYPE                   [ OFF      ]




STATUS:
 ERRORS   ADJUST  SEQUENCE   MSP    MORE   MULTIPLE
& ALARMS  POINTER          MESSAGES ....... WINDOW
```
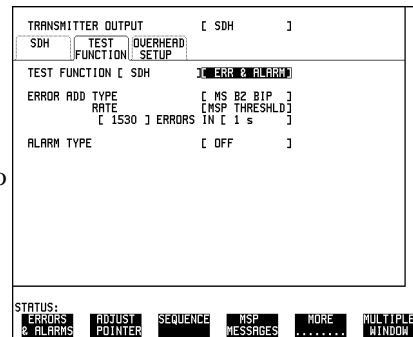
MSP Stimulus/Response 1:N Architecture

The HP 37717C Communications Performance Analyzer **TRANSMIT** ; **TEST FUNCTION** ; **MSP MESSAGES** can be used to transmit and monitor the K1 K2 messages.

The MSP Messages are transmitted when **DOWNLOAD** is pressed.

Two displays of K1 and K2 are provided :

1. Current TX - Values of K1 and K2 bytes which are currentlybeing transmitted.

2. Current RX - Values of K1 and K2 bytes which are currentlybeing received.

```
TRANSMITTER OUTPUT           [ SDH      ]
  SDH   STRUCT'D JITTER   TEST   OVERHEAD
        PAYLOAD         FUNCTION SETUP
TEST FUNCTION [ SDH      ][MSP MESSAGES]
NEW TX
K1 BITS 1->4 [1000:MANUAL SWITCH     ]
   BITS 5->8 [0001:WORKING CHANNEL 1  ]
K2 BITS 1->4 [0010] BRIDGED CHANNEL NO.
   BIT  5   [1  : 1:N ARCHITECTURE   ]
   BITS 6->8 [ 000: RESERVED         ]

CURRENT TX              CURRENT RX
K1 ........             K1
K2 ........             K2

TRANSMIT NEW K1/K2 [ SELECT     ]


STATUS:
 SELECT    DOWN                       MULTIPLE
          LOAD                        WINDOW
```
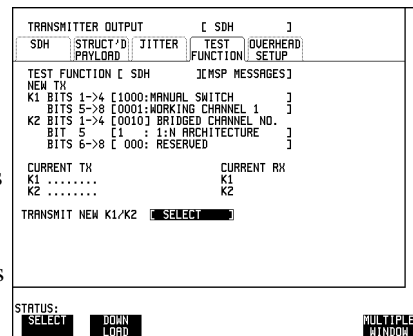
K1 Bits 1 ->4 Selects the MSP message to be transmitted.

Table 1   **K1 Bits 1 - >4**

Selection	Message	Selection	Message
0000	NO REQUEST	1000	MANUAL SWITCH
0001	DO NOT REVERT	1001	NOT USED
0010	REVERSE REQUEST	1010	SD - Low Priority
0011	NOT USED	1011	SD - High Priority

Table 1 **K1 Bits 1 - >4**

Selection	Message	Selection	Message
0100	EXERCISE	1100	SF - Low Priority
0101	NOT USED	1101	SF - High Priority
0110	WAIT TO RESTORE	1110	FORCED SWITCH
0111	NOT USED	1111	LOCKOUT OF PROT

SD - High Priority and SF - High Priority are only available when K2 bit 5 is set to 1 - 1 : N architecture.

K1 Bits 5 ->8 Selects the channel used by the MSP Messages.

Table 2 **K1 Bits 5 - >8**

Selection	Message	Selection	Message
0000	NULL CHANNEL	1000	WORKING CHANNEL #8
0001	WORKING CHANNEL #1	1001	WORKING CHANNEL #9
0010	WORKING CHANNEL #2	1010	WORKING CHANNEL #10
0011	WORKING CHANNEL #3	1011	WORKING CHANNEL #11
0100	WORKING CHANNEL #4	1100	WORKING CHANNEL #12
0101	WORKING CHANNEL #5	1101	WORKING CHANNEL #13
0110	WORKING CHANNEL #6	1110	WORKING CHANNEL #14
0111	WORKING CHANNEL #7	1111	EXTRA TRAFFIC CHANNEL

WORKING CHANNEL #2 through WORKING CHANNEL #14 and EXTRA TRAFFIC CHANNEL are only available when K2 Bit 5 is set to 1 : N architecture. If K1 bits 1 >4 are set to 1111 LOCKOUT OF PROT then K1 bits 5 ->8 are fixed at 0000 NULL CHANNEL.

K2 bits 1 - >4 Selects the bridged channel used by the MSP Messages. Can be set in the range 0000 to 1111.

K2 bit 5 Determines the automatic protection switch architecture. 0 - 1 + 1 architecture 1 - 1 : N architecture

Optical Clock Recovery Stress

Application

Ideally the clock recovery circuits in the network equipment optical interfaces should recover a clock even in the presence of long strings of 0's.

The optical clock recovery performance of the network equipment can be measured by increasing the length of a zero substitution block until errors occur.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Optical Clock Recovery Stress Test Setup Procedure

In this setup procedure the HP 37717C Communications Performance Analyzer transmits an STM-1 optical signal with zero's substituted into the payload data pattern. The length of the block of zero's is increased until the network equipment alarms are triggered.
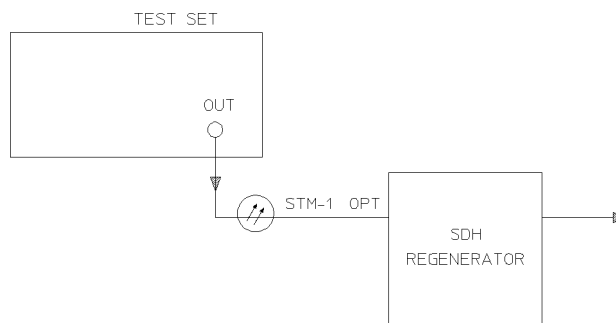
SDH / SONET Application Measurements
Optical Clock Recovery Stress

1. Connect the HP 37717C to the network equipment and set up the **TRANSMIT**; **SDH** display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the **TRANSMIT** clock. If **EXTERNAL MTS** is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.

```
TRANSMITTER OUTPUT        [ SDH      ]
┌─SDH─┬─STRUCT'D┬─JITTER─┬─TEST───┬─OVERHEAD─┐
│     │ PAYLOAD │        │FUNCTION│ SETUP    │
SIGNAL             [ STM-1 OPT ][ INTERNAL]
CLOCK SYNC         [ EXT MTS   ][ CLOCK ]
FREQUENCY OFFSET             [ OFF    ]

PAYLOAD                     [ 140 Mb/s  ]

PAYLOAD TYPE                [ UNFRAMED   ]
PATTERN                     [ 2^15-1 PRBS]
PRBS POLARITY        [ INV ]    CCITT
140M OFFSET                 [   0  ppm  ]


STATUS:
┌─2MHz──┐┌─2Mb/s─┐                    ┌─MULTIPLE─┐
│ CLOCK ││ DATA  │                    │ WINDOW   │
```

2. Set up the **TRANSMIT**; **TEST FUNCTION** display as shown opposite

G.958 Test Pattern consists of consecutive blocks of four types of data :
All 1's
PRBS
All 0's
a data block consisting of the first row of section overhead bytes.

```
TRANSMITTER OUTPUT        [ SDH      ]
┌─SDH─┬─STRUCT'D┬─JITTER─┬─TEST───┬─OVERHEAD─┐
│     │ PAYLOAD │        │FUNCTION│ SETUP    │
TEST FUNCTION [ SDH      ][ STRESS TEST]

STRESSING PATTERN          [ ALL ZEROS ]
BLOCK LENGTH               [   2 ] BYTES




STATUS:
┌─ALL───┐┌─ALL──┐┌─G.958─┐            ┌─MULTIPLE─┐
│ ZEROS ││ ONES ││       │            │ WINDOW   │
```

Start the Optical Clock Recovery Stress Test

Increase the Block Length until the network equipment alarms are triggered.

Payload Mapping/Demapping

Application

The mapping and demapping of a 2 Mb/s or 140 Mb/s payload into/from the appropriate SDH / SONET containers should take place without introducing errors.

The mapping process is tested by inserting a test pattern in the 2 Mb/s or 140 Mb/s payload at the low-rate side of the terminal multiplexer. On the high-rate side of the terminal multiplexer, the payload is demapped from the SDH / SONET signal by the HP 37717C Communications Performance Analyzer.

The demapping process is tested by transmitting a SDH / SONET signal to the high-rate side of the multiplexer. On the low-rate side of the multiplexer the payload is received by the HP 37717C Communications Performance Analyzer.

A Bit error rate (BER) test is performed on the recovered payload test pattern to determine whether errors have been introduced by the mapping process.

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Payload Mapping/Demapping Test Setup Procedure

The following Options must be fitted to the HP 37717C to perform this test :

- US1 or A1T (A1U) - SDH / SONET Module

- UH1, UH2, URU, USN or UKT - STM-1/STM-4 Optical Interface

For mapping a 140 Mb/s payload, containing a test pattern, is transmitted into the low-rate side of the terminal multiplexer. The 140 Mb/s payload is demapped from the STM-4 Optical signal at the high-rate side of the terminal multiplexer.

For demapping an STM-4 Optical signal is transmitted into the high-rate side of the Add Drop multiplexer. The 140 Mb/s signal, on the low-rate side of the Add Drop multiplexer, is received by the HP 37717C Communications Performance Analyzer.

A BER measurement is performed on the demapped 140 Mb/s payload test pattern.

A SINGLE test period of 24 HOURS is used and the internal printer is enabled to record results and alarms.

The HP 37717C Communications Performance Analyzer GRAPHICS function is
enabled. The graphical results can be viewed on the GRAPH display

Payload Mapping
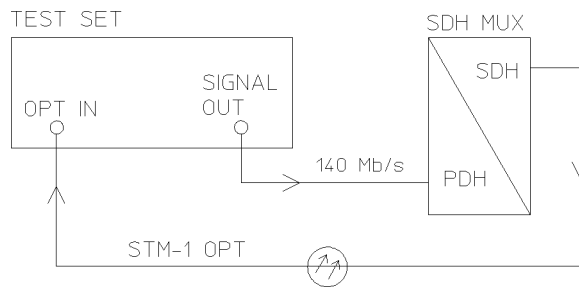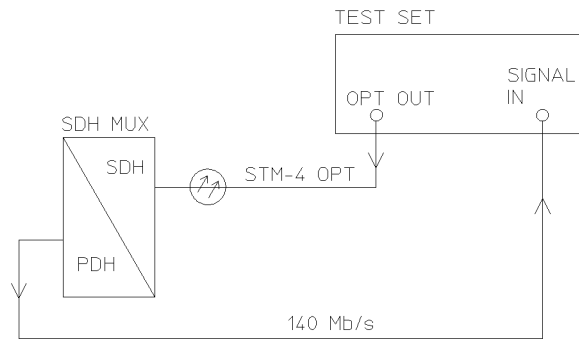
Payload Demapping

1. Connect the HP 37717C to the network equipment and set up the OTHER SETTINGS CONTROL display as shown opposite.

```
FUNCTION          [ SETTINGS CONTROL    ]

TRANSMITTER AND RECEIVER    [INDEPENDENT]









STATUS:
INDEP-   COUPLED                              MULTIPLE
ENDENT                                         WINDOW
```

2. For Mapping set up the TRANSMIT display as shown opposite.

```
TRANSMITTER OUTPUT        [ PDH        ]
 MAIN  STRUCT'D JITTER   TEST
SETTINGS SETTINGS       FUNCTION

SIGNAL                    [ 140 Mb/s   ]
CLOCK SYNC                  INTERNAL
TERMINATION                75Ω UNBAL
LINE CODE                  CMI
FREQUENCY OFFSET          [ OFF        ]

PAYLOAD TYPE             [ UNFRAMED    ]
PATTERN                   [ 2^23-1 PRBS]
PRBS POLARITY          [ INV ]    CCITT








STATUS:
                                              MULTIPLE
                                               WINDOW
```

2a. For Demapping set up the TRANSMIT display as shown opposite.

```
TRANSMITTER OUTPUT        [ SDH        ]
 SDH  STRUCT'D JITTER   TEST   OVERHEAD
     PAYLOAD        FUNCTION  SETUP

SIGNAL            [ STM-4 OPT ]
CLOCK SYNC        [ EXT MTS   ][ CLOCK ]
FREQUENCY OFFSET           [ OFF       ]

STM-1 UNDER TEST          [ 3          ]
PAYLOAD                   [ 140 Mb/s   ]

PAYLOAD TYPE             [ UNFRAMED    ]
PATTERN                   [ 2^23-1 PRBS]
PRBS POLARITY          [ INV ]    CCITT
140M OFFSET               [    0 ppm   ]




STATUS:
                                              MULTIPLE
                                               WINDOW
```

3. For Mapping set up the **RECEIVE**
display as shown opposite.

```
RECEIVER INPUT            [ SDH       ]
  SDH    STRUCT'D  TEST   OVERHEAD
         PAYLOAD FUNCTION MONITOR

SIGNAL            [ STM-1    ]
LEVEL                      [ TERMINATE  ]


PAYLOAD                    [ 140 Mb/s  ]

PAYLOAD TYPE               [ UNFRAMED   ]
PATTERN                    [ 2^23-1 PRBS]
PRBS POLARITY       [ INV ]    CCITT




STATUS:
                                   MULTIPLE
                                   WINDOW
```

3a. For Demapping set up the **RECEIVE**
display as shown opposite.

```
RECEIVER INPUT            [ PDH       ]
  MAIN   STRUCT'D  JITTER
SETTINGS SETTINGS
SIGNAL                     [ 140 Mb/s  ]

TERMINATION                 75Ω UNBAL
LINE CODE                   CMI
LEVEL                      [ TERMINATE  ]

PAYLOAD TYPE               [ UNFRAMED   ]
PATTERN                    [ 2^15-1 PRBS]
PRBS POLARITY       [ INV ]    CCITT




STATUS:
                                   MULTIPLE
                                   WINDOW
```

4. Set up the **OTHER** display, **LOGGING**
function, as shown opposite.

All results are logged on the internal printer
at 1 hour intervals. Any alarms which occur
during the test period will be logged on the
internal printer.

```
FUNCTION        [ LOGGING         ]
LOGGING SETUP            [ CONTROL    ]

LOGGING                 [ ON         ]
LOGGING PERIOD          [ 1 HOUR     ]

RESULTS LOGGED          [ SELECTED   ]
        WHEN            [ PERIOD EC>0 ]
        CONTENT         [ ER & ANAL  ]
                        [ PER & CUMUL]
LOG ERROR SECONDS       [ OFF        ]
LOG AT END OF TEST       ALL RESULTS

LOG ON DEMAND            RESULTS




STATUS:
 ALWAYS    PERIOD                    MULTIPLE
           EC > 0                    WINDOW
```

Start the Payload Mapping/Demapping Test

1. Set up the RESULTS display as shown opposite. If you do not require stored graphics results select STORAGE [OFF].

```
RESULTS [ PDH PAYLOAD ][ ERROR ANALYSIS]
 G.821   G.826   M.2100   M.2110

                        BIT

EC                    AnD ES          %
ES                                    %
EFS                                   %
SES                                   %
UNAV                                  %
DEG MIN                               %
CODE ES

ELAPSED TIME


STATUS:
                                  MULTIPLE
                                  WINDOW
```

2. Press RUN/STOP to start the measurement.
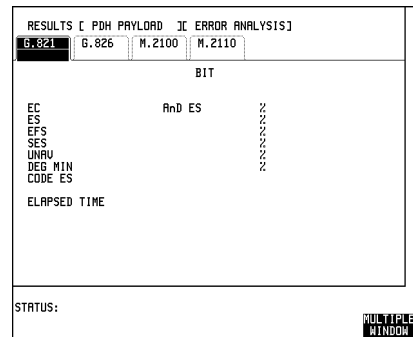
The measurement results and alarms are available on the RESULTS display during the test period.

The graphical measurement results and alarms are stored in non volatile memory for viewing later on the GRAPH display.

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

At the End of the Test (Payload Mapping/Demapping)

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

- All results are logged on the internal printer at 1 hour intervals.

- Any alarms which occur during the test period will be logged on the internal printer.

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

- A graphical record of the results during the test period can be viewed on the GRAPH display. If Remote Control option A3B, A3D, 1A8 or 1CW is fitted the graph results can be logged to an external printer, at a later date. See *Graphics* and *External HP 550C DeskJet Printer*.

- Results and Alarm summaries can be viewed on the GRAPH display.

The total graphics store capacity is normally 20,000 events. If GRAPH STORAGE RESOLUTION [FULL] is selected on the OTHER; MISCELLANEOUS display the capacity reduces to 10,000 events.

The resolution, determined by the selection made under STORAGE on the RESULTS display, affects the ZOOM capability when viewing the bar graphs. If 1 SECOND is selected all resolutions are available under ZOOM. If 1 MIN is selected

only 1 MIN/BAR, 15 MINS/BAR and 60 MINS/BAR are available. If 15 MINS is selected only 15 MINS/BAR and 60 MINS/BAR are available. If 1 HOUR is selected only 60 MINS/BAR is available.

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

To prevent accidental overwriting of previously stored results the graphics capability should be disabled, when graphical results are not required, by selecting STORAGE [OFF] on the $\boxed{\textbf{RESULTS}}$ display.

Performance Monitor Stimulus/ Response

Application

Performance monitors built into the SDH / SONET network equipment count BIP errors, and communicate the results to the network controller via the DataCommunication Channel (DCC). Performance monitors in Path Terminating Equipment (PTE) also communicate with the upstream equipment.

If the performance monitors are not operating correctly, degradations in network performance will pass unnoticed and may result in a failure condition.

The performance monitors can be tested by the Communications Performance Analyzer transmitting BIP errors in the appropriate byte of the overhead and monitoring upstream for the correct response :

Regenerator Section (RS) - B1 Byte of regenerator section overhead

Multiplexer Section (MS) - B2 Bytes of multiplexer section overhead

PATH - B3 Byte of path overhead

Default (Known State) Settings

It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Performance Monitor Stimulus/Response Test Setup Procedure

The following Options must be fitted to the HP 37717C to perform this test :

• US1 or A1T (A1U) - SDH / SONET Module

• UH1, UH2, URU, USN or UKT - STM-1/STM-4 Optical Interface

In this setup the HP 37717C Communications Performance Analyzer inserts PATH BIP errors in byte B3 of the path overhead of the SDH / SONET signal. The upstream signal is monitored to provide a measure of the FEBE (Far End Block Error) count.

TEST SET

1. Connect the HP 37717C to the network equipment and set up the OTHER ; SETTINGS CONTROL display as shown opposite.

```
FUNCTION        [ SETTINGS CONTROL   ]

TRANSMITTER AND RECEIVER      [ COUPLED ]
    RECEIVER COUPLED TO TRANSMITTER




STATUS:
 INDEP-    COUPLED                      MULTIPLE
 ENDENT                                  WINDOW
```

2. Set up the TRANSMIT ; SDH display as shown opposite.

The CLOCK SYNC selection determines the synchronization source for the TRANSMIT clock.

```
TRANSMITTER OUTPUT      [ SDH      ]
 SDH    TEST  OVERHEAD
       FUNCTION  SETUP

SIGNAL         [ STM-1 OPT ][ INTERNAL]
CLOCK SYNC     [ INTERNAL   ]
FREQUENCY OFFSET            [ OFF      ]


PAYLOAD                    [ 140 Mb/s  ]

PAYLOAD TYPE               UNFRAMED
PATTERN                    [ 2^23-1 PRBS]
PRBS POLARITY      [ INV ]    CCITT
140M OFFSET                [   0  ppm  ]



STATUS:
                                       MULTIPLE
                                        WINDOW
```
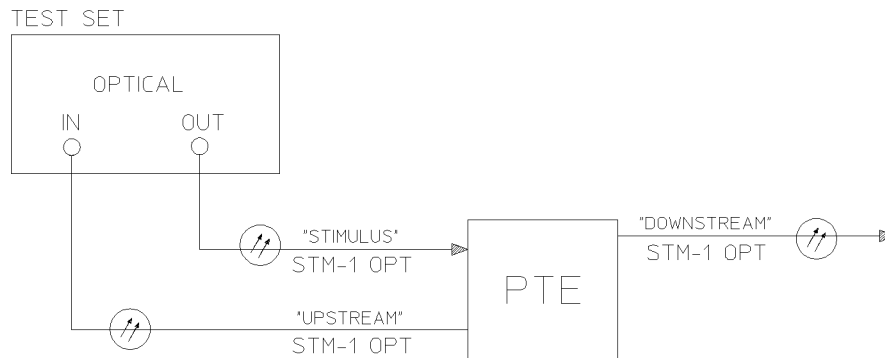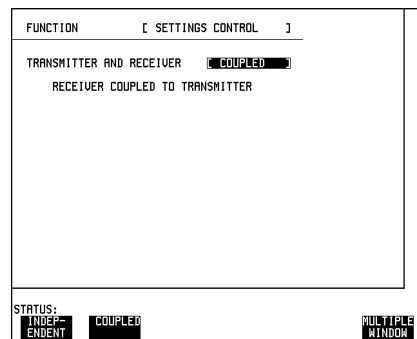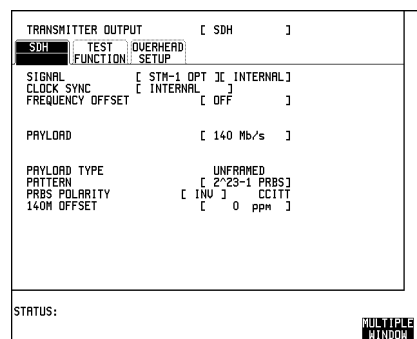
3. Set up the **RESULTS** display as shown opposite.

PATH FEBE ERROR RESULTS are displayed but any of the other results can be selected from the softkey menu without affecting the measurement.

```
RESULTS [ SDH        ][ CUMULATIVE   ]
PATH B3 | PATH  | PATH  |        | MORE |
   BIP  | FEBE  |  IEC  |        |      |




 F E B E   E C
 F E B E   E R

 ELAPSED TIME




STATUS:
                              MULTIPLE
                               WINDOW
```
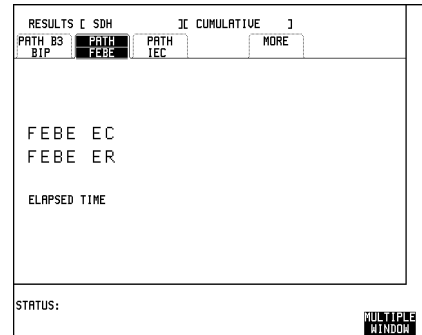
4. Set up the **TRANSMIT** ; **TEST FUNCTION** display as shown opposite.

The ERROR RATE required can be selected from the softkey menu.

```
TRANSMITTER OUTPUT        [ SDH      ]
  SDH  |  TEST  |OVERHEAD|
       |FUNCTION| SETUP  |
TEST FUNCTION [ SDH      ][ ERR & ALARM]
ERROR ADD TYPE            [ PATH B3 BIP]
        RATE             [ 1E-4        ]

ALARM TYPE                [ OFF     ]







STATUS:
 OFF  | ERROR | 1E-4 | 1E-5 | MORE  |MULTIPLE
      |  ALL  |      |      |.......| WINDOW
```
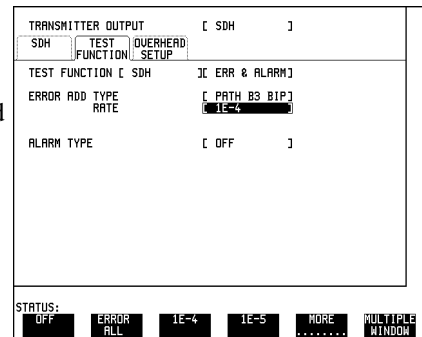
Start the Performance Monitor Stimulus/Response Test

1. Press **RUN/STOP** on the HP 37717C Communications Performance Analyzer.

2. Check that the PATH FEBE error rate is the same as the generated PATH B3 BIP rate.

All the measurement results are available, throughout the test, on the **RESULTS** display .

At the end of the test :

• the cumulative measurement results are available on the **RESULTS** display.

Selective Jitter Transfer Measurement

The problem with many SDH jitter analyzers is the fact that their receivers are wideband receivers and are not able to measure within a sufficiently narrow bandwidth. The reason is that these instruments are designed to measure peak to peak jitter in the transmission network for troubleshooting purposes and are not designed to make selective jitter measurements. The jitter analyzer just measures the peak-peak value of the incoming jitter over a wide frequency range. The problem occurs when testing the jitter transfer of real network equipment i.e. SDH regenerators.

The regenerator produces intrinsic jitter and this disturbs the measurement as the jitter receiver cannot determine whether it is measuring the jitter produced by the jitter analyzers transmitter or the intrinsic jitter which is generated, at a different frequency, by the regenerator. The problem is greatest at the higher jitter modulating frequencies when the amount of jitter generated, as per ITU-T G.958, is much smaller. The measurement is corrupted by the higher amplitude intrinsic jitter generated by the regenerator at lower frequencies and incorrectly measured by the analyzer.

The accurate method for measuring jitter transfer requires a selective measurement. One such method is to use a network analyzer in conjunction with the HP 37717C. The network analyzer provides the capability to measure jitter selectively and has increased sensitivity.

Default (Known State) Settings

It can be advisable to set the HP 37717C to a known state prior to setting up to make a measurement. This clears all previous settings and provides a clearly defined instrument state. The default settings are set by selecting OTHER STORED SETTINGS STORED SETTING NUMBER 0 and pressing RECALL

Test Setup Procedure (Jitter Transfer Test)

The following Options must be fitted to the HP 37717C to perform this test:

- A3K - Jitter Generation

- A1M or A1N or A1P - SDH Jitter Measurement

- US1 or A1T - SDH Module

This setup procedure is based on 155.52 Mb/s (STM-1), 140 Mb/s payload, PRBS test data with jitter. The jitter modulation is provided by the network analyzer. The HP 37717C demodulated jitter output is returned to the network analyzer for measurement. Before connecting to the regenerator to be tested the HP 37717C is looped back to back and the network analyzer is programmed to sweep over the required frequency range at the required amplitude. This provides a reference trace and removes the inaccuracies of the of the test configuration (inaccuracies of the HP 37717C and the Network Analyzer). The HP 37717C is connected to the regenerator and the network analyzer sweep is repeated. The difference between the two traces is the jitter transfer result.
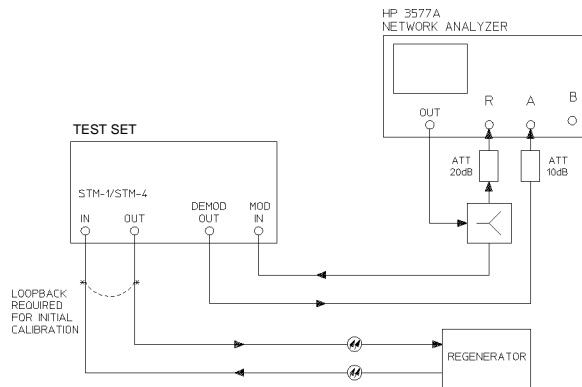
Selective Jitter Transfer Test

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

Any SDH settings change made on the [TRANSMIT] or [RECEIVE] displays will automatically occur on the other.
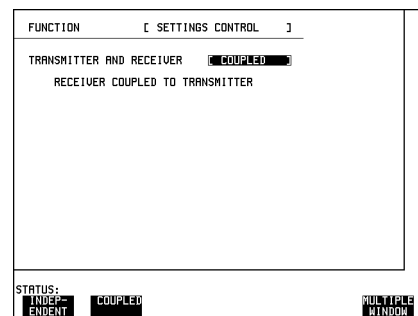
2. Connect the HP 37717C to the network analyzer as shown. Connect STM-1/STM-4 IN to STM-1/STM-4 OUT. Select TRANSMIT SDH SDH and set up the display as shown opposite.

```
TRANSMITTER OUTPUT          SDH
  SDH      JITTER    TEST   OVERHEAD
                   FUNCTION SETUP

SIGNAL        [STM-4 OPT][1310][ INTERNAL]
CLOCK SYNC      [ EXT MTS    ][ CLOCK ]
FREQUENCY OFFSET           [ OFF     ]

STM-1 UNDER TEST           [ 1      ]
PAYLOAD                    [ 140 Mb/s  ]


PAYLOAD TYPE               UNFRAMED
PATTERN                    [ 2^23-1 PRBS]
PRBS POLARITY          [ INV ]   CCITT
140M OFFSET                [    0  ppm ]




STATUS:
                                    MULTIPLE
                                    WINDOW
```

3. Select TRANSMIT SDH JITTER and set up the display as shown opposite.

```
TRANSMITTER OUTPUT          SDH
  SDH      JITTER    TEST   OVERHEAD
                   FUNCTION SETUP

JITTER / WANDER            [ JITTER    ]
JITTER                     [ ON        ]
SIGNAL FREQUENCY             STM-4
MODULATION SOURCE          [ EXTERNAL  ]
RANGE                      [ 2 UI      ]

CLOCK SYNC                   EXT MTS
CONNECT 2MHz SOURCE TO  SDH MODULE




STATUS:
  2 UI      10 UI                   MULTIPLE
                                    WINDOW
```

4. Setup the RECEIVE SDH JITTER display as shown opposite.

If Jitter filtering is required select from the softkey menu.

```
RECEIVER INPUT              [SDH JITTER  ]


SIGNAL                     [ STM-4 OPT ]

RECEIVER RANGE             [ 1.6  UI   ]
HIT THRESHOLD              [ 1.00 UI   ]
FILTER                     [ HP1       ]
LEVEL                      [ TERMINATE ]






STATUS:
  SDH        SDH                     MULTIPLE
             JITTER                  WINDOW
```

5. Select RESULTS and set up the
display as shown opposite.

Press RUN/STOP to start the
measurement.

```
RESULTS [TIMING CONTROL]

SHORT TERM PERIOD [1 SECOND         ]
TEST TIMING      [ MANUAL   ]

GRAPH STORAGE    [ OFF            ]
                 [ INTERNAL       ]




STATUS:
 OFF     1 SEC     1 MIN    15 MIN    1 HR    MULTIPLE
       RESOL'N   RESOL'N   RESOL'N   RESOL'N   WINDOW
```

6. Adjust the network analyzer output level
until the RESULTS display. records the
required peak-peak jitter value.

7. Press RUN/STOP to stop the
measurement.

```
RESULTS [ JITTER      ][ CUMULATIVE   ]
 HITS    AMPLI
         TUDE


+VE PEAK              0.01 UI
-VE PEAK              0.01 UI
PEAK-PEAK             0.01 UI
FILTERS              HP1
ELAPSED TIME



STATUS:
                                     MULTIPLE
                                      WINDOW
```
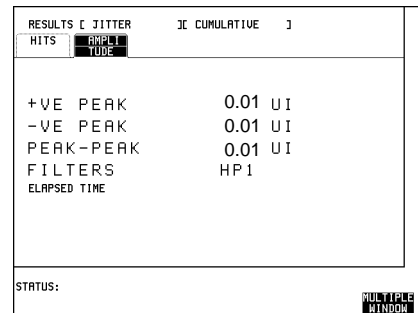
8. Start the network analyzer sweep and store the resultant "reference trace"

9. Connect the HP 37717C to the regenerator as shown (loopback removed) and
repeat the network analyzer sweep.

The difference between the two traces is the Jitter Transfer result.

SDH / SONET Application Measurements
Selective Jitter Transfer Measurement

3

ETSI / ANSI Terminology

A table of ETSI Terms with their ANSI equivalents.

ETSI / ANSI Equivalent Terms

The Terminology used on the instrument display is mainly ETSI terminology. The equivalent ANSI terminology is given in the following table

ETSI 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	Line AIS (AIS-L)
MS-BIP	Line BIP
MS-DCC	Line DCC
MS FERF	Line FERF
MS-RDI	RDI-L
Multiplexer Section Overhead	Line Overhead
Network Node Interface	Line Interface
Path AIS	AIS-P
Path FERF	RDI-P
Regenerator	Repeater
Regenerator Section (RS)	Section
Remote Alarm Indicator	Yellow Alarm
Regenerator Section Overhead	Section Overhead
RS-DCC	Section DCC
S-n.1 or S-n.2 short haul	Short Reach (SR)
STM-n	STS-n
SOH	TOH
Section Overhead (SOH)	Transport Overhead (TOH)

ETSI / ANSI Terminology
ETSI / ANSI Equivalent Terms

ETSI Term	ANSI Term
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-FERF	VP-RDI
VC-FERF	VC-RDI

NOTE: VC is an ETSI abbreviation for Virtual Container and an ETSI / ANSI abbreviation for (ATM) Virtual Channel. The context of VC must therefore be taken into account when converting between standards.

ETSI / ANSI Terminology
ETSI / ANSI Equivalent Terms

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Learning Products Map

:All of the learning products which apply to the HP 37717C Communications Performance Analyzer are shown below:

The HP 37717C Mainframe Operating Manual- 37717-90221

General operating information irrespective of option.

The HP 37717C PDH / DSn Operating Manual - 37717-90222

Information about the PDH / DSn modules, how to select the features available and measurement examples.

The HP 37717C SDH / SONET Operating Manual - 37717-90223

Information about the SDH / SONET modules, how to select the features available and measurement examples. This book also contains a table of ANSI / ETSI equivalent terms.

The HP 37717C Jitter Operating Manual - 37717-90224

Information about the Jitter modules, how to select the features available and measurement examples.

The HP 37717C ATM Operating Manual - 37717-90225

Information about the ATM modules, how to select the features available and measurement examples. This book also contains tutorial information on some ATM measurements, Information on pre-stored sequences and a glossary of ATM terms.

Remote Control Manual - 37717-90227:

Provides remote control information for instruments fitted with the RS232 and HP-IB remote control option modules.

Calibration Manual - 37717-90228:

Provides specifications and methods of testing that the instrument meets its specifications.

About This Edition

This is the 1st edition of
the 37717-90223 manual.
It documents the product
as of August 1996.
Edition dates are as
follows:

1st Edition, August 1996

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PACKARD

In This Book

This book provides information on HP 37717C
modules with SDH / SONET capability. It also
provides applications associated with these
modules. The individual applications contain
techniques which may be of value for purposes
other than those shown