HP 37717C
Communications
Performance Analyzer

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WARNING

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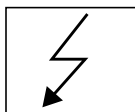
The product is marked with this symbol to indicate that hazardous voltages are present

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.

HP 37717C Communications Performance Analyzer

About This Book

The HP 37717C PDH /DSn Operating Manual explains the following:

- How to select and use the PDH / DSn features provided with the PDH /DSn options

- How to make PDH / DSn measurements

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 irrespective of the option configuration.

"The HP 37717C SDH / SONET Operating Manual" describes the selection of SDH / SONET features and how to perform SDH / SONET tests with the HP 37717C Communications Performance Analyzer.

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

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

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HP 37717C PDH / DSn Features

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

Introduction to PDH / DSn

The Plesiochronous Digital Hierarchy (PDH / DSn) is still the dominant technology in most existing telecommunications networks throughout the world, although it is being replaced in many networks by Synchronous Digital Hierarchy (SDH) or SONET networks. PDH / DSn networks were developed at a time when point-to-point transmission was the predominant network requirement. To support this requirement, the standard approach to network management and maintenance was to use manual distribution frames for access to individual signals. This is now considered out of date and consequently SDH / SONET is now the preferred network topology for new installations.

However PDH / DSn networks will exist for a long time to come even in networks where SDH /SONET is the preferred technology. PDH is the ETSI international standard, based on 2 Mb/s, defined by the ITU-T, and covers the hierarchal transmission rates of 2 Mb/s, 8 Mb/s, 34 Mb/s and 140 Mb/s. DSn is the ANSI standard covering transmission rates of 1.544 Mb/s (DS1) and 44.736 Mb/s (DS3). PDH is asynchronous at 8 Mb/s, 34 Mb/s and 140 Mb/s. In order to access a signal, for rerouting or test purposes, the whole line signal structure must be demultiplexed step by step down to the 2 Mb/s level, because of the asynchronous nature of the multiplexing.

At each multiplexing step, the bit rate of the individual tributary signals is controlled within specified limits and is not synchronized with the multiplex equipment. Because the bit rates of the individual tributaries are controlled within specific limits this type of multiplexing is referred to as Plesiochronous i.e. nearly synchronous. The individual tributaries are synchronized with the equipment at each multiplex step by the process of positive bit stuffing justification.

In new SDH / SONET networks, PDH / DSn signals are mapped into virtual containers / tributaries before being transported as part of the SDH / SONET payload. The SDH / SONET payload must then be demapped into a PDH / DSn tributary signal.

Therefore all PDH / DSn, SDH / SONET and mixed PDH/SDH DSn / SONET networks require test sets which have PDH / DSn interfaces and PDH / DSn test capability.

Options With PDH / DSn Capability

Unstructured PDH Generation and Measurement. Option UKK (USB)
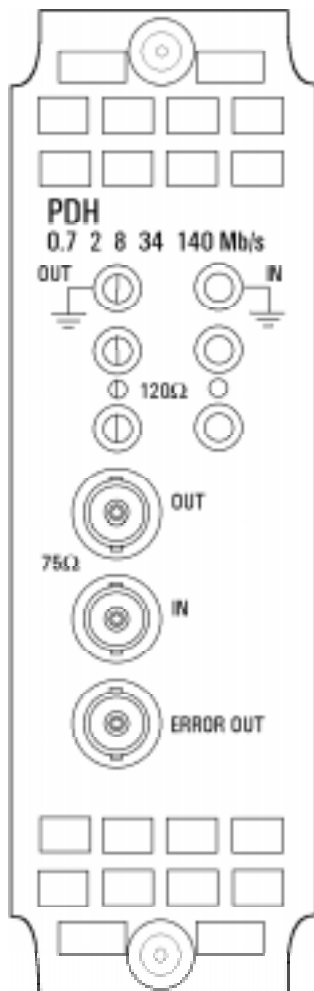
Option UKK (USB), Unstructured PDH, provides generation and measurement of unstructured PDH at interface rates of 704 kb/s, 2.048 Mb/s, 8.448 Mb/s, 34.368 Mb/s and 139.264 Mb/s.

Allows the addition of Frequency Offset to the PDH signal

Provides 75 Ω unbalanced or 120 Ω balanced input and output interfaces.

Allows selection of PRBS, WORD or USER patterns

Allows selection of Line Code AMI, HDB3 or CMI

Provides an ECL pulse each time an error occurs (Error Out)

HP 37717C PDH / DSn Features

Structured PDH Generation and Measurement. Options UKJ (USA) and UKN (USE)

Structured PDH Generation and Measurement. Options UKJ (USA) and UKN (USE)
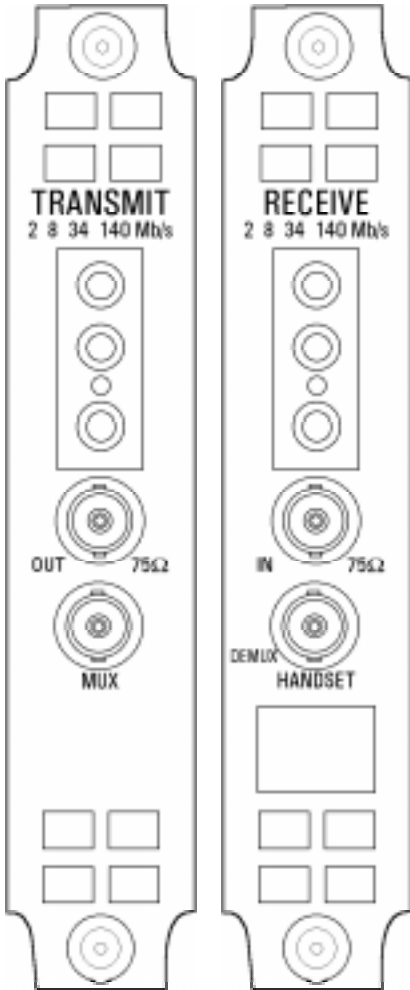
Options UKJ (USA) and UKN (USE), provide generation and measurement of Structured or Unstructured PDH at interface rates of 2.048 Mb/s (E1), 8.448 Mb/s (E2), 34.368 Mb/s (E3) and 139.264 Mb/s (E4).

Structured test signal rates of 64 kb/s, 2.048 Mb/s, 8.448 Mb/s and 34.368 Mb/s are provided.

Frequency Offset can be added at the interface rates.

Line rate frequency can be measured.

Provides 75 Ω unbalanced or 120 Ω balanced input and output interfaces.

Allows selection of PRBS, WORD or USER patterns

Allows selection of Line Code AMI, HDB3 or CMI

Interface and test signal rates can be Framed or Unframed

MUX connector allows a 2 Mb/s signal from external equipment to be inserted into the HP 37717C test signal.

DEMUX connector allows a 2 Mb/s signal from the HP 37717C to be Dropped to external equipment.

Option UKN (USE) also provides generation and measurement of PDH signals with ATM payloads. Option UKN (USE) therefore provides all of the PDH facilities described here with the additional facilities described on page 6.

Information on the ATM capabilities of the UKN (USE) module is given in "The ATM Operating Manual"

Option UKJ (USA)

DS1, DS3, E1 and E3 Transmit and Receive Interfaces for ATM Payloads. Option UKZ
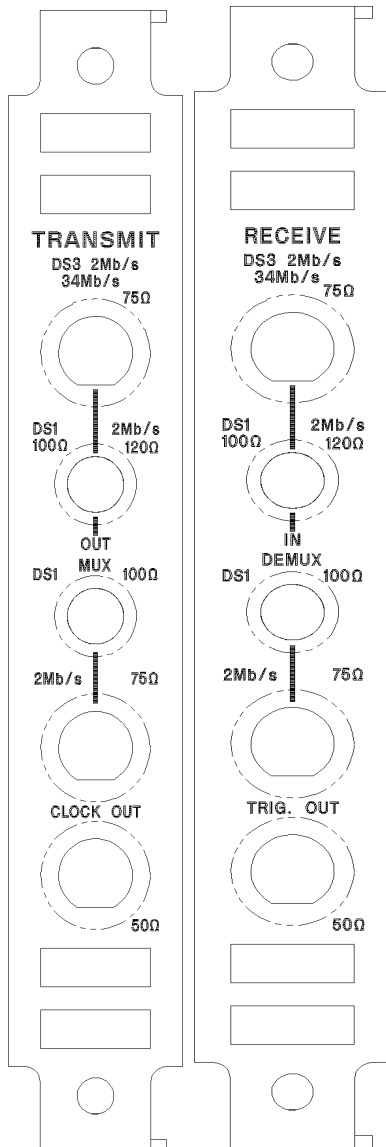
Option UKZ, provides generation and measurement of PDH /DSn signals with ATM payloads at interface rates of: 1.544 Mb/s (DS1), 44.736 Mb/s (DS3), 2.048 Mb/s (E1), and 34.368 Mb/s (E3).

Frequency Offset can be added at the interface rates.

Line rate frequency can be measured.

Provides the following RZ input and output interfaces:
DS3 and E3: 75 Ω unbalanced
E1: 75 Ω unbalanced, 120 Ω balanced.
DS1: 100 Ω balanced.

Allows selection of Line Code as AMI, HDB3, B3ZS or B8ZS

Provides Input sensitivity level selection.

Provides output level control for DS1 and DS3.

Allows error and alarm injection at the physical and ATM layers.

Allows selection of PCLP or Direct mapping at DS3.

Information on the ATM capabilities of this module is given in "The ATM Operating Manual"

E1, E3 and E4 Transmit and Receive Interfaces for ATM Payloads. Option UKN (USE)
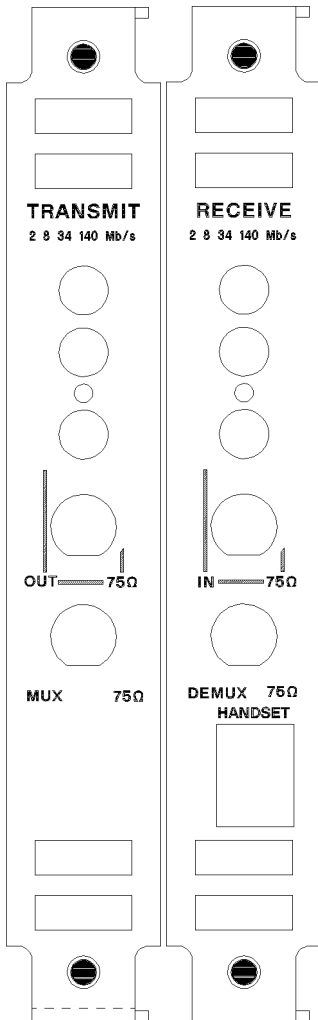
Option UKN (USE) provides generation and measurement of PDH signals with ATM payloads at rates of 2.048 (E1), 34.368 (E3) and 139.264 (E4) Mb/s.

Frequency Offset can be added at the interface rates.

Line rate frequency can be measured.

Provides the following input and output interfaces:

E1: RZ, 75 Ω unbalanced and 120 Ω balanced.

E3: RZ, 75 Ω unbalanced.

E4: CMI 75 Ω unbalanced.

Allows selection of E1 Line Code AMI, HDB3.

Allows selection of CRC-4 Multiframe at E1.

Information on the ATM capabilities of this module is given in "The ATM Operating Manual"

Binary Interfaces. Option UH3 (US7)

Option UH3 (US7) provides binary NRZ interfaces for the structured PDH module option UKJ (USA), and the unstructured PDH module option UKK (USB).

The interfaces can operate at any of the standard rates $\pm$ 100 ppm.

When used with option UKK (USB), with an external binary clock input, the interfaces can operate at any rate any rate in the range 700 kb/s to 170 Mb/s.

TTL signal levels, at data and clock ports, and external clock port, are valid from 700 kb/s to 50 Mb/s, 75Ω to ground.

ECL signals, at data and clock ports, and external clock port, are valid from 700 kb/s to 170 Mb/s, 75Ω to -2V.

The external clock input may be used to clock **coded** data from the PDH / DSn transmitter at standard rates. In addition if Option UKK (USB), Unstructured PDH, is fitted can clock **coded** data in the range 700 kb/s to 170 Mb/s.

Simultaneous jitter of binary clock and binary data outputs is possible (2, 8, 34 & 140 Mb/s) if Option UHK (USB) or A3K, Jitter Generator, is fitted.

Jitter measurement on the binary clock input is possible (2, 8, 34 & 140 Mb/s $\pm$;100 ppm) if Option UHN, A1M, A1N or A1P, Jitter Measurement, is fitted.

Frequency measurement of the external clock input and binary clock input is provided.

BINARY I/F

CLOCK OUT

DATA OUT

EXT CLOCK IN

CLOCK IN

DATA IN

Multiple PDH Outputs. Option UHC (US6)
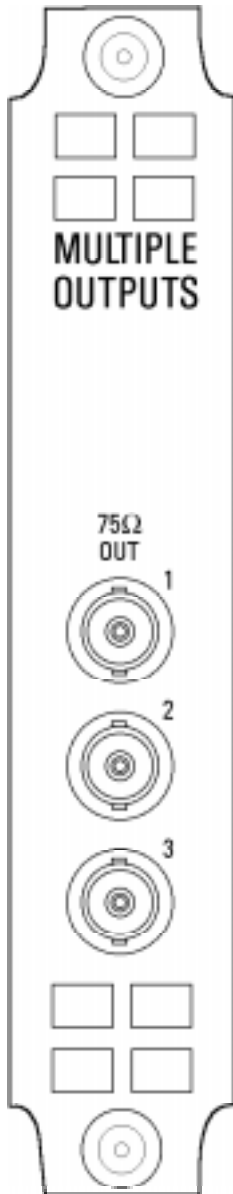
Option UHC (US6), Multiple PDH Outputs, provides three additional 75Ω PDH outputs.

OUT 1 is delayed by 4 bits relative to the main PDH OUT.

OUT 2 is delayed by 8 bits relative to the main PDH OUT.

OUT 3 is delayed by 12 bits relative to the main PDH OUT.

NOTE: When used with Option UKZ, multiple outputs are available at the 2 and 34 Mb/s E1 and E3 rates.

PDH / DSn Display Reference

Unstructured PDH Generation and Measurement. Option UKK (USB)

A choice of 5 SIGNAL rates is available.

The clock is normally synchronized to an internal clock.

When 2 Mb/s is selected the clock RECOVERED by the Receiver can be used as the synchronization source.

```
TRANSMITTER OUTPUT        [ PDH       ]
 PDH    | JITTER |  TEST
                   |FUNCTION
SIGNAL                    [ 8 Mb/s      ]
CLOCK SYNC                  INTERNAL
FREQUENCY OFFSET          [ OFF       ]

CODE                      [ HDB3      ]

PATTERN                   [ 2^15-1    ]

TERMINATION                75Ω UNBAL




STATUS:
 140 Mb/s   34 Mb/s    8 Mb/s    2 Mb/s    704 kb/s  MULTIPLE
                                                     WINDOW
```

FREQUENCY OFFSET can be added at preset CCITT values or as User defined values in the range ± 100 ppm.

The preset value will change according to the PDH signal rate selected.

```
TRANSMITTER OUTPUT        [ PDH       ]
 PDH    | JITTER |  TEST
                   |FUNCTION
SIGNAL                    [ 140 Mb/s   ]
CLOCK SYNC                  INTERNAL
FREQUENCY OFFSET          [ OFF       ]

CODE                        CMI

PATTERN                   [ 2^23-1    ]

TERMINATION                75Ω UNBAL




STATUS:
   OFF      +15      -15      USER               MULTIPLE
            ppm      ppm     OFFSET               WINDOW
```

PATTERN allows a choice of PRBS and WORD patterns.

Line CODE and TERMINATION can be selected to match the requirements of network equipment.

Errors of the type selected on the TEST FUNCTION display can be added to the PATTERN singly by pressing **SINGLE**. or at a selectable RATE.

TEST MODE allows Bit Error measurements to be made with the network equipment Out Of Service or Frame error measurements to be made with the network equipment In Service.

When In Service is selected the only PATTERN available is LIVE TRAFFIC.

If 2 Mb/s is selected as the SIGNAL rate, a choice of 2 Mb/s FRAMING type is provided.

Structured PDH Generation and Measurement. Options UKJ (USA) or UKN (USE)

A choice of four SIGNAL rates is available.

The clock is synchronized to an internal clock.

TERMINATION and Line CODE selections should match the requirements of the network equipment.

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



 STATUS:
 ┌──────┐┌──────┐┌──────┐┌──────┐      MULTIPLE
 │140 Mb/s││34 Mb/s ││ 8 Mb/s ││ 2 Mb/s │      WINDOW
 └──────┘└──────┘└──────┘└──────┘
```

FREQUENCY OFFSET can be added at preset CCITT values or as User defined values in the range ± 100 ppm

The preset value will change according to the PDH signal rate selected.

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



 STATUS:
 ┌──────┐┌──────┐┌──────┐┌──────┐      MULTIPLE
 │ OFF  ││ +50  ││ -50  ││ USER  │      WINDOW
 │      ││ ppm  ││ ppm  ││OFFSET │
 └──────┘└──────┘└──────┘└──────┘
```
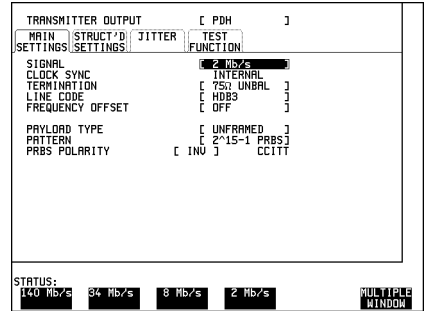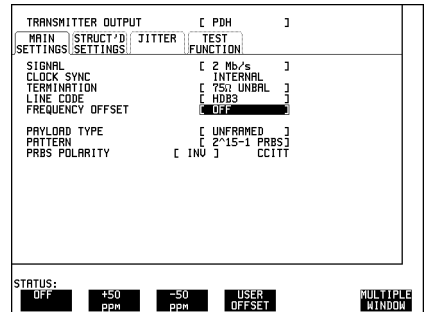
PAYLOAD TYPE determines whether the PDH signal is Unframed (Unstructured), Framed or Structured.

PATTERN allows a choice of PRBS and WORD patterns.

PRBS POLARITY allows a choice between Inverted (CCITT recommended) and Normal.

```
TRANSMITTER OUTPUT          [ PDH        ]
 ┌─────┐┌───────┐┌──────┐┌──────┐
 │ MAIN ││STRUCT'D││JITTER ││ TEST │
 │SETTINGS││SETTINGS│└──────┘│FUNCTION│
 └─────┘└───────┘        └──────┘
  SIGNAL                    [ 34 Mb/s    ]
  CLOCK SYNC                   INTERNAL
  TERMINATION                75Ω UNBAL
  LINE CODE                  HDB3
  FREQUENCY OFFSET          [ OFF        ]

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



 STATUS:
 ┌──────┐┌──────┐┌──────┐              MULTIPLE
 │UNFRAMED││FRAMED ││STRUCT'D│              WINDOW
 └──────┘└──────┘└──────┘
```
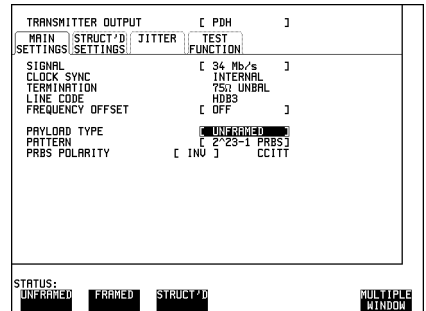
Structured PDH Generation and Measurement. Options UKJ (USA) or UKN (USE)

If 2Mb/s SIGNAL rate is selected the choice of Framing type is included in the PAYLOAD TYPE menu.

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




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

If STRUCTURED is selected a new display of **STRUCTURED SETTINGS** is obtained.

TEST SIGNAL allows a choice of rates (sub interface rate) at which testing is performed.

The example shown is for a 140 Mb/s main signal rate.

If 2Mb/s TEST SIGNAL rate is selected the choice of Framing type is included in the 2M PAYLOAD menu.

```
TRANSMITTER OUTPUT          [ PDH      ]
┌─────┐┌───────┐┌──────┐┌──────┐
│ MAIN ││STRUCT'D││JITTER││ TEST │
│SETTINGS││SETTINGS││      ││FUNCTION│
TEST SIGNAL                 [ 2 Mb/s   ]
2M  PAYLOAD                 [ PCM30    ]
         34Mb    8Mb    2Mb
        [ 1 ] [ 1 ] [ 1 ]


PATTERN                     [ 2^23-1 PRBS]
PRBS POLARITY          [ INV ]    CCITT
B/G PATTERN                 [ AIS      ]




STATUS:
34 Mb/s   8 Mb/s   2 Mb/s   64 kb/s    Nx64   MULTIPLE
                                      kb/s    WINDOW
```
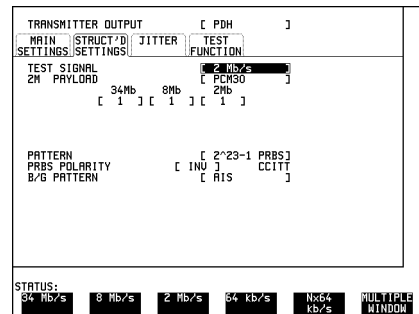
The 2M PAYLOAD menu includes a choice of INSERT 2Mb/s which allows an external 2 Mb/s Test Signal, presented at the MUX port, to be inserted into the structured PDH signal.

The capability to DROP the 2 Mb/s Test Signal to external equipment, via the DEMUX connector, is provided on the **RECEIVE** **STRUCTURED SETTINGS** display 2M PAYLOAD menu.

```
TRANSMITTER OUTPUT          [ PDH      ]
┌─────┐┌───────┐┌──────┐┌──────┐
│ MAIN ││STRUCT'D││JITTER││ TEST │
│SETTINGS││SETTINGS││      ││FUNCTION│
TEST SIGNAL                 [ 2 Mb/s   ]
2M  PAYLOAD                 [INSERT 2Mb/s]
         34Mb    8Mb    2Mb
        [ 1 ] [ 1 ] [ 1 ]



B/G PATTERN                 [ AIS      ]




STATUS:
PCM31CRC   INSERT                     MORE    MULTIPLE
          2 Mb/s                     ........  WINDOW
```
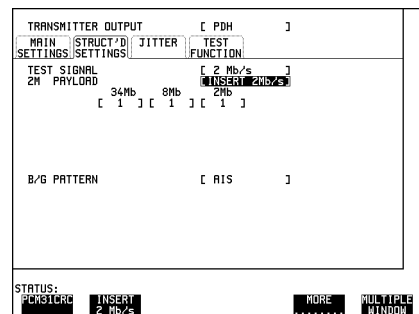
Structured PDH Generation and Measurement. Options UKJ (USA) or UKN (USE)

34Mb, 8Mb and 2Mb allow selection of the tributary of interest.

PATTERN allows a choice of PRBS and WORD patterns.

PRBS POLARITY allows a choice between Inverted (CCITT recommended) and Normal.

B/G PATTERN selection determines the pattern inserted in the non test tributaries.

```
TRANSMITTER OUTPUT        [ PDH       ]
  MAIN  STRUCT'D JITTER     TEST
SETTINGS SETTINGS          FUNCTION
TEST SIGNAL               [ 2 Mb/s    ]
2M PAYLOAD                [ PCM30     ]
            34Mb    8Mb    2Mb
            [  9  ][ 2 ][ 4 ]

PATTERN                   [ 2^23-1 PRBS]
PRBS POLARITY        [ INV ]     CCITT
B/G PATTERN               [ AIS      ]

STATUS:
   1         2       3        4          MULTIPLE
                                         WINDOW
```
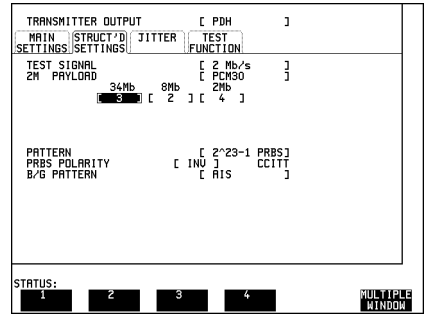
If Transmit and Receive TEST SIGNAL 64 kb/s is selected the 2 Mb/s Framing choice is made from the 2M PAYLOAD menu.

A telephone HANDSET can be connected to the 64 kb/s channel and used to LISTEN or TALK and LISTEN.

The B/G PATTERN in the non test 64 kb/s channels is always NUMBERED.

```
TRANSMITTER OUTPUT        [ PDH       ]
  MAIN  STRUCT'D  TEST
SETTINGS SETTINGS FUNCTION
TEST SIGNAL               [ 64 kb/s   ]
2M PAYLOAD                [ PCM30     ]
            34Mb   8Mb   2Mb   64kb
            [ 3 ][ 2 ][ 4 ][ 1 ]

HANDSET                   [ LISTEN ONLY]
PATTERN                   [ 2^11-1 PRBS]
PRBS POLARITY        [ NORM]     CCITT
B/G PATTERN               [ AIS      ]
B/G PATTERN 64 kb/s          NUMBERED

STATUS:
 LISTEN    TALK                          MULTIPLE
  ONLY    LISTEN                         WINDOW
```
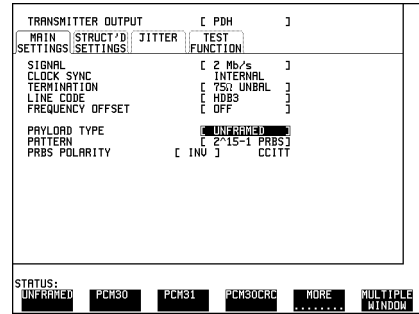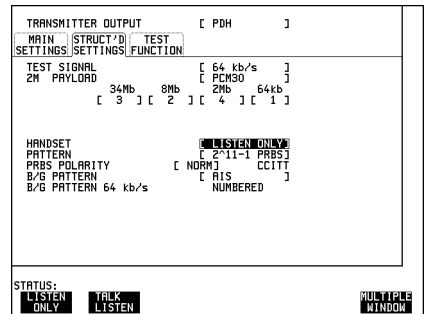
When N X 64kb/s is selected a test pattern can be inserted across a number of Timeslots even if the selected Timeslots are non contiguous.

The required Timeslots are selected using **DESELECT ALL** , **DESELECT** , **SELECT** , ⬅ and ➡ .

In this example timeslots 3, 5, 9, 25, 26 and 27 are selected.

```
TRANSMITTER OUTPUT        [ PDH       ]
  MAIN  STRUCT'D  TEST
SETTINGS SETTINGS FUNCTION
TEST SIGNAL               [ Nx64 kb/s ]
2M PAYLOAD                [ PCM31CRC  ]

Nx64 [ F..*.*...*.............***...█ ]
              Cursor On Timeslot #31
                 Bandwidth  384 kb/s

PATTERN                   [ 2^15-1 PRBS]
PRBS POLARITY        [ NORM]  NON-CCITT

B/G PATTERN NX64 kb/s        NUMBERED

STATUS:
 PCM30    PCM31   PCM30CRC PCM31CRC      MULTIPLE
                                         WINDOW
```
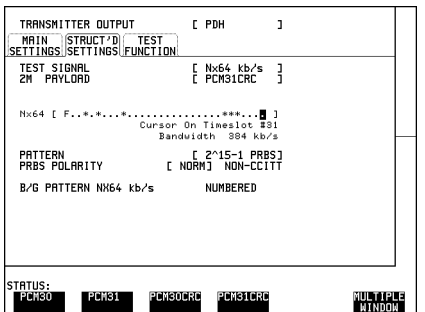
Structured PDH Generation and Measurement. Options UKJ (USA) or UKN (USE)

If the receiver input is derived from the network equipment monitor point then **SIGNAL IN** is pressed until the MONITOR indicator is lit.

 The received signal will be 20 to 30 dB below the normal level. To return the received signal to normal GAIN is required at the receiver input.

The received signal may also require equalization to compensate for cable losses.

```
RECEIVER INPUT              [ PDH      ]
  MAIN  STRUCT'D  JITTER
SETTINGS SETTINGS

  SIGNAL                    [ 2 Mb/s   ]

  TERMINATION               [ 75Ω UNBAL ]
  LINE CODE                 [ HDB3     ]
  LEVEL                     [ MONITOR  ]
  EQUALIZER    [ OFF ] GAIN [ 20 dB    ]
  PAYLOAD TYPE              [ UNFRAMED  ]
  PATTERN                   [ 2^15-1 PRBS]
  PRBS POLARITY      [ INV ]    CCITT

STATUS:
 UNFRAMED   PCM30    PCM31    PCM30CRC    MORE      MULTIPLE
                                      .......      WINDOW
```
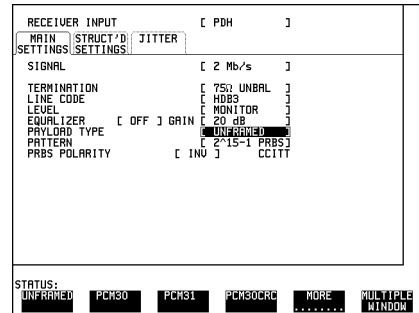
The **TRANSMIT** **TEST FUNCTION** allows the addition of errors.

Bit, Code or FAS (Frame) errors can be added dependent upon the SIGNAL and PAYLOAD TYPE selections.

Errors of the type selected on the TEST FUNCTION display can be added to the PATTERN singly by pressing **SINGLE**. or at a selectable RATE.

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

  TEST FUNCTION [ PDH    ] ERRORS

  ERROR ADD TYPE          [ BIT (TEST) ]
           RATE           [ OFF        ]

STATUS:
   BIT      FAS      CODE                MULTIPLE
 (TEST)   (LINE)                          WINDOW
```
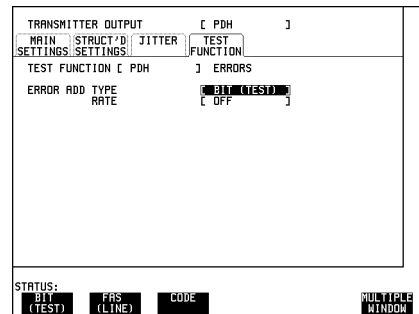
DS1, DS3, E1 and E3 Transmit and Receive Interfaces for ATM Payloads. Option UKZ

A choice of four PDH / DSn SIGNAL rates is available

The clock may be synchronized to an internal clock or the received clock.

TERMINATION and Line CODE selections should match the requirements of the network equipment.

For DS1 and DS3 signal rates, the OUTPUT LEVEL can be selected. At DS3 the CONVERGENCE LAYER can be configured

When SDH / SONET modules are fitted, additional transmission and reception rates are available. For example STM-1 and OC-3c transmission and reception is available via the SDH Overhead / Stress module A1T plus an optical module such as UH1.

FREQUENCY OFFSET can be added at preset values or as User defined values in the range ± 100 ppm

The preset value will change according to the PDH / DSn signal rate selected.

DS1, DS3, E1 and E3 Transmit and Receive Interfaces for ATM Payloads. Option UKZ

At the 34Mb/s SIGNAL rate a TRAIL TRACE facility is available. The default signal, HP37717C, may be replaced with a selectable message.

```
TRANSMITTER OUTPUT        [ ATM       ]
PHYSICAL   ATM     TEST
LAYER    LAYER   FUNCTION
   SIGNAL        [ 34 Mb/s  ][ INTERNAL   ]
   CLOCK SYNC               [ INTERNAL   ]
   TERMINATION               75Ω UNBAL
   LINE CODE                 HDB3
   FREQUENCY OFFSET        [ OFF        ]

   TRAIL TRACE              [ TEST      ]
                             HP37717C


   SCRAMBLING              [ ON        ]




STATUS:
  TEST    USER                              MULTIPLE
                                            WINDOW
```

If the DS3 SIGNAL rate is selected the choice of CONVERGENCE SUB-LAYER is provided (Direct or PLCP mapping).

```
TRANSMITTER OUTPUT        [ ATM       ]
PHYSICAL   ATM     TEST
LAYER    LAYER   FUNCTION
   SIGNAL        [ DS3      ]   [ INTERNAL]
   CLOCK SYNC                    INTERNAL
   OUTPUT LEVEL               [ DS3-HI    ]
   TERMINATION                 75Ω UNBAL
   LINE CODE                   B3ZS
   FREQUENCY OFFSET          [ OFF        ]

   CONVERGENCE SUB-LAYER     [ PLCP      ]
   LINE SIGNAL STATUS(G1)    [ 000       ]
   CYCLE/STUFF COUNT         [ NOMINAL   ]
   GROWTH BYTES          [ 21 ] [111111111]
   SCRAMBLING               [ ON        ]




STATUS:
  DIRECT   PLCP                             MULTIPLE
                                            WINDOW
```

If the 2Mb/s SIGNAL rate is selected, CRC-4 Multiframing may be selected.

SCRAMBLING may be selected ON or OFF at any of the SIGNAL rates.

```
TRANSMITTER OUTPUT        [ ATM       ]
PHYSICAL   ATM     TEST
LAYER    LAYER   FUNCTION
   SIGNAL        [ 2 Mb/s   ][ INTERNAL   ]
   CLOCK SYNC                 INTERNAL
   TERMINATION              [ 75Ω UNBAL  ]
   LINE CODE                [ HDB3       ]
   FREQUENCY OFFSET         [ OFF        ]

   CRC-4 MULTIFRAME         [ OFF       ]


   SCRAMBLING              [ ON        ]




STATUS:
  OFF      ON                               MULTIPLE
                                            WINDOW
```

16

DS1, DS3, E1 and E3 Transmit and Receive Interfaces for ATM Payloads. Option UKZ

The **TRANSMIT** **TEST FUNCTION** allows the addition of errors and alarms at the physical and ATM layers.

The types of error available for selection will depend on the SIGNAL rate selected. The example shown is for DS1 which includes excess zeros (EXZ).

```
TRANSMITTER OUTPUT          [ ATM        ]
PHYSICAL  ATM      TEST
LAYER    LAYER   FUNCTION
TEST FUNCTION [ PDH       ] ERR & ALARM
ERROR ADD TYPE              [ FAS (LINE) ]
         RATE              [ OFF        ]
PRESS SINGLE KEY TO ERROR  [ 1 FRAME    ]
ALARM TYPE                 [ OFF        ]

STATUS:
 FAS      CODE      CRC      EX2                   MULTIPLE
(LINE)                                             WINDOW
```

The alarms which may be generated also depend on the SIGNAL rate selected.

The example shown here is for DS3.

The Far End Alarm and Control (FEAC) function allows alarm conditions and control codewords to be transmitted.

```
TRANSMITTER OUTPUT          [ ATM        ]
PHYSICAL  ATM      TEST
LAYER    LAYER   FUNCTION
TEST FUNCTION [ PDH       ] ERR & ALARM
ERROR ADD TYPE              [ FAS (LINE) ]
         RATE              [ OFF        ]
PRESS SINGLE KEY TO ERROR  [ 1 FRAME    ]
ALARM TYPE                 [ FEAC       ]
FEAC CODE TYPE             [ LOOPBACK   ]
MESSAGE            [ DEACTIVATE DS1][ 1]
REPEAT (TIMES)     [10   LOOP.][10 MESS.]
TRANSMIT NEW CODE          [ OFF        ]

STATUS:
 RAI      FEAC      IDLE               MORE  MULTIPLE
                                      ....... WINDOW
```

To make measurements on PDH / DSn signals with ATM payloads, set the **RECEIVE** PHYSICAL LAYER to the interface SIGNAL RATE. MONITOR and TERMINATE LEVELS should be set to match the signal level.

```
RECEIVER INPUT              ATM
PHYSICAL  ATM
LAYER    LAYER
SIGNAL                      [ DS1        ]

TERMINATION                 100Ω BAL
LINE CODE                  [ B8ZS       ]
LEVEL                      [ TERMINATE  ]


CELL SCRAMBLING            [ OFF        ]



tton
 DS3      34        2        DS1               MULTIPLE
         Mb/s     Mb/s                         WINDOW
```

DS1, DS3, E1 and E3 Transmit and Receive Interfaces for ATM Payloads. Option UKZ

Select ⎡RESULTS⎤ ⎡PDH RESULTS⎤
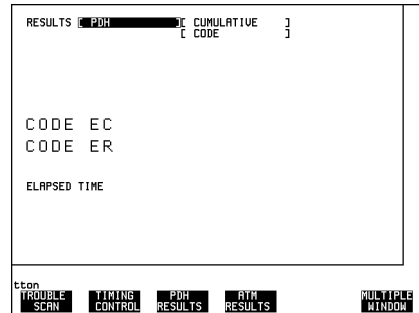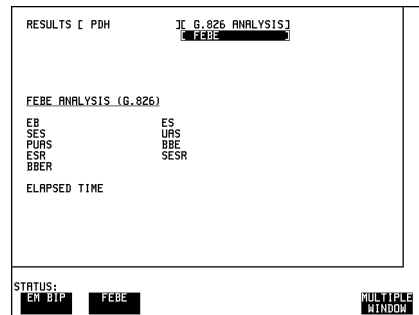
```
RESULTS [ PDH         ][ CUMULATIVE   ]
                       [ CODE         ]



    CODE  EC
    CODE  ER

    ELAPSED TIME




tton
TROUBLE    TIMING    PDH      ATM              MULTIPLE
 SCAN     CONTROL  RESULTS  RESULTS            WINDOW
```

Then select the type of result required.

```
RESULTS [ PDH          ][ G.826 ANALYSIS]
                        [ FEBE          ]



    FEBE ANALYSIS (G.826)

    EB                    ES
    SES                   UAS
    PUAS                  BBE
    ESR                   SESR
    BBER

    ELAPSED TIME




STATUS:
 EM BIP    FEBE                              MULTIPLE
                                             WINDOW
```

Information on the ATM features of this module is given in "The ATM Operating Manual"

E1, E3 and E4 Transmit and Receive Interfaces for ATM Payloads. Option UKN (USE)

A choice of three PDH SIGNAL rates is available

The clock may be synchronized to an internal clock or the received clock.

FREQUENCY OFFSET can be added at preset values or as User defined values in the range $\pm$ 100 ppm. The preset value will change according to the PDH signal rate selected.

A Trail Trace facility is available at the 140 and 34 Mb/s rates.

```
  TRANSMITTER OUTPUT        [ ATM      ]
┌────────┬───────┬────────┐
│PHYSICAL│  ATM  │  TEST  │
│ LAYER  │ LAYER │FUNCTION│
   SIGNAL          [140 Mb/s ]      [ INTERNAL]
   CLOCK SYNC                       INTERNAL
   TERMINATION                      75Ω UNBAL
   LINE CODE                        CMI
   FREQUENCY OFFSET       [ OFF         ]

   TRAIL TRACE              [ TEST      ]
                             HP37717C




   STATUS:
   ┌──────┐ ┌──────┐ ┌──────┐        ┌────────┐
   │ 140  │ │  34  │ │  2   │        │MULTIPLE│
   │ Mb/s │ │ Mb/s │ │ Mb/s │        │ WINDOW │
```

TERMINATION and Line CODE are preset at 140 and 34 Mb/s. at the 2 Mb/s rate the Termination and line code selections should match the requirements of the network equipment.

At the 2 Mb/s rate CRC-4 Multiframing can be selected.

```
  TRANSMITTER OUTPUT        [ ATM      ]
┌────────┬───────┬────────┐
│PHYSICAL│  ATM  │  TEST  │
│ LAYER  │ LAYER │FUNCTION│
   SIGNAL          [2 Mb/s  ]      [ INTERNAL]
   CLOCK SYNC                      INTERNAL
   TERMINATION             [ 75Ω UNBAL ]
   LINE CODE               [ HDB3       ]
   FREQUENCY OFFSET        [ OFF       ]

   CRC-4 MULTIFRAME        [ OFF      ]




   STATUS:
   ┌──────┐ ┌──────┐                 ┌────────┐
   │ HDB3 │ │ AMI  │                 │MULTIPLE│
   └──────┘ └──────┘                 │ WINDOW │
```

E1, E3 and E4 Transmit and Receive Interfaces for ATM Payloads. Option UKN (USE)

When SDH / SONET modules are fitted, additional transmission and reception rates are available. For example STM-1 OPTICAL and STM-1 (ELECTRICAL) transmission and reception is available via the SDH Overhead / Stress module A1T plus an optical module such as UH1.

```
 TRANSMITTER OUTPUT        [ ATM      ]
PHYSICAL  ATM   TEST
LAYER   LAYER  FUNCTION
 SIGNAL         [ 2 Mb/s   ]     [ INTERNAL]
 CLOCK SYNC                       INTERNAL
 TERMINATION                  [ 75Ω UNBAL ]
 LINE CODE                    [ HDB3     ]
 FREQUENCY OFFSET             [ OFF      ]

 CRC-4 MULTIFRAME             [ OFF      ]




STATUS:
 STM-1    STM-1     140       34        2     MULTIPLE
OPTICAL            Mb/s      Mb/s      Mb/s    WINDOW
```

To make measurements on PDH signals with ATM payloads, set **RECEIVE** to **ATM** and select the interface SIGNAL RATE. MONITOR and TERMINATE LEVELS are available.

```
 RECEIVER INPUT           [ ATM       ]
PHYSICAL  ATM
LAYER   LAYER
 SIGNAL                   [ 140 Mb/s  ]

 TERMINATION               75Ω UNBAL
 LINE CODE                 CMI
 LEVEL                    [ TERMINATE ]




STATUS:
 PDH       ATM                              MULTIPLE
                                            WINDOW
```

Select **RESULTS** **PDH RESULTS**

```
 RESULTS [ PDH        ][ SHORT TERM  ]
                       [ EM BIP      ]




 EM  BIP  EC
 EM  BIP  ER

 ELAPSED TIME



STATUS:
TROUBLE  TIMING    PDH      ATM        MULTIPLE
 SCAN   CONTROL  RESULTS  RESULTS      WINDOW
```

**E1, E3 and E4 Transmit and Receive Interfaces for ATM Payloads.
Option UKN (USE)**

Then select the type of result required.

```
RESULTS [ PDH        ][ G.826 ANALYSIS]
                     [ FEBE           ]



FEBE ANALYSIS (G.826)
EB                        ES
SES                       UAS
PUAS                      BBE
ESR                       SESR
BBER

ELAPSED TIME




STATUS:
 EM BIP     FEBE                          MULTIPLE
                                          WINDOW
```
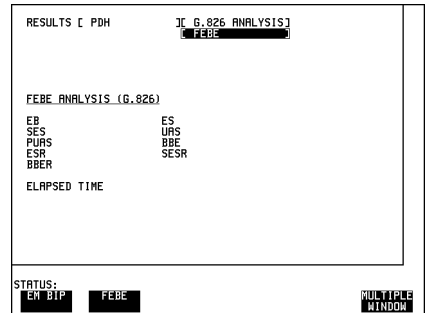
NOTE   When DS3 frame errors are being measured, errors in either FAS or MFAS bits are
included.

Information on the ATM features of this module is given in "The ATM Operating
Manual".

Binary Interfaces. Option UH3 (US7)

To enable the **TRANSMIT** selection of NRZ binary interfaces, select, **PDH**, MAIN SETTINGS, INTERFACE, **BINARY**.

The CLOCK SYNC for the transmitted signal may be selected as either the internal source or from an external binary (NRZ) input.

```
TRANSMITTER OUTPUT        [ PDH      ]
 MAIN   STRUCT'D  TEST  BINARY
SETTINGS SETTINGS FUNCTION
SIGNAL                    [ 2 Mb/s    ]
INTERFACE                 [ BINARY    ]
CLOCK SYNC                [ INTERNAL  ]

FREQUENCY OFFSET          [ OFF       ]

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




STATUS:
 CODED     BINARY                            MULTIPLE
                                             WINDOW
```

The binary clock and data output thresholds and polarity are selectable. Thresholds may be ECL (75 Ω to ground) or TTL (75 Ω to -2V), polarity may be normal or inverted.

```
TRANSMITTER OUTPUT        [ PDH      ]
 MAIN   STRUCT'D  TEST  BINARY
SETTINGS SETTINGS FUNCTION
SIGNAL                       2 Mb/s
INTERFACE                    BINARY
CLOCK SYNC                   INTERNAL

THRESHOLDS: CLOCK OUT     [ ECL      ]
            DATA OUT      [ ECL      ]

POLARITY:   CLOCK OUT     [ NORMAL   ]
            DATA OUT      [ NORMAL   ]




STATUS:
                                             MULTIPLE
                                             WINDOW
```

To enable the **RECEIVE** selection of binary interfaces, select, **PDH**, MAIN SETTINGS, INTERFACE, **BINARY**.

```
RECEIVER INPUT            [ PDH      ]
 MAIN   STRUCT'D  BINARY
SETTINGS SETTINGS
SIGNAL                    [ 2 Mb/s    ]
INTERFACE                 [ BINARY    ]


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




STATUS:
 CODED     BINARY                            MULTIPLE
                                             WINDOW
```

The binary clock and data input
thresholds and polarity are selectable.

```
RECEIVER INPUT           [ PDH      ]
 MAIN  STRUCT'D BINARY
SETTINGS SETTINGS
SIGNAL                    2 Mb/s
INTERFACE                BINARY

THRESHOLDS: CLOCK IN      [ ECL     ]
            DATA IN       [ ECL     ]

POLARITY:   CLOCK IN      [ NORMAL  ]
            DATA IN       [ NORMAL  ]




STATUS:
                                    MULTIPLE
                                    WINDOW
```

The DATA threshold selections are:

TTL (1.5V), ECL (-1.3V) and GND
(0V)

The CLOCK thresholds are as for data
plus AUTO (mean signal level).

The CLOCK and DATA polarity may be
normal or inverted.

```
RECEIVER INPUT           [ PDH      ]
 MAIN  STRUCT'D BINARY
SETTINGS SETTINGS
SIGNAL                    2 Mb/s
INTERFACE                BINARY

THRESHOLDS: CLOCK IN      [ ECL     ]
            DATA IN       [ ECL     ]

POLARITY:   CLOCK IN      [ NORMAL  ]
            DATA IN       [ NORMAL  ]




STATUS:
  ECL     TTL     GND     AUTO       MULTIPLE
                                     WINDOW
```

2

PDH / DSn Testing With The HP 37717C

Alarm Monitoring

Options Required Structured PDH **UKJ (USA)** or **UKN (USE)**

Application

Problems in the network at all levels in the hierarchy can be detected by the occurrence of alarms in each tributary of structured PDH systems.

Using the HP 37717C in a *receive only* mode, each tributary can be scanned and the state of Frame Loss, Remote (RAI) and AIS alarms viewed on the RESULTS display.

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 (Alarm Monitoring)

This setup procedure is based on Structured PDH 140 Mb/s line traffic interfaced at the line equipment 75 Ω protected Monitor point. If a protected Monitor Point is not available then an HP 15510A Protective Probe may be used at an unprotected Monitor point.

When 120 Ω Balanced alarm monitoring is desired at an unprotected Monitor point use an HP 15511A Protective Monitor Probe. The instrument is used in a *receive only* mode to monitor Frame Loss, AIS and Remote alarms.

1 Connect the HP 37717C to the line terminal equipment protected Monitor point and set up the [RECEIVE] display **MAIN SETTINGS** as shown opposite.

The GAIN and EQUALIZER settings should be set to optimize the received signal.

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

TERMINATION                    75Ω UNBAL
LINE CODE                         CMI
LEVEL                       [ MONITOR   ]
EQUALIZER    [ OFF ] GAIN [ 20 dB     ]
PAYLOAD TYPE                [ STRUCTURED ]

TO SET TEST SIGNAL, FIRST SELECT THE
'STRUCT'D SETTINGS' FOLDER ABOVE




STATUS:
                                      MULTIPLE
                                      WINDOW
```

2 Set up the [RECEIVE] display **STRUCTURED SETTINGS** as shown opposite.

2M PAYLOAD determines the Framing and selection which should match that of the network equipment.

```
RECEIVER INPUT              [ PDH       ]
 MAIN   STRUCT'D
SETTINGS SETTINGS
TEST SIGNAL                 [ 2 Mb/s    ]
2M PAYLOAD                  [ PCM30CRC  ]
        34Mb   8Mb    2Mb
       [ 3 ] [ 2 ] [ 4 ]



PATTERN                     [LIVE TRAFFIC]




STATUS:
                                      MULTIPLE
                                      WINDOW
```

27
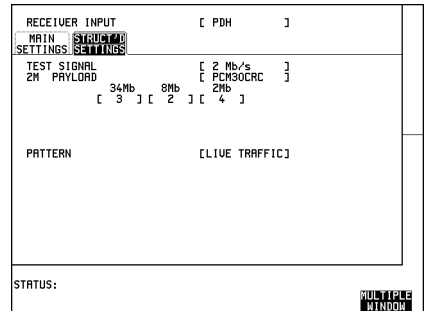
Start the Test (Alarm Monitoring)

1 . Set up the RESULTS display as shown opposite and select PDH ALM SCAN ON .

If any of the three alarms, Frame Loss, RAI or AIS has occurred the appropriate point in the hierarchy will be highlighted.

The test can be halted at any time by selecting OFF on the RESULTS PDH ALM SCAN display.

```
RESULTS [ PDH ALM SCAN ]      [OFF  ]

140Mb              INTERFACE

34Mb       1         2         3         4

8Mb    1 2 3 4   1 2 3 4   1 2 3 4   1 2 3 4
       | | | |   | | | |   | | | |   | | | |
2Mb    1 1 1 1   1 1 1 1   1 1 1 1   1 1 1 1
       2 2 2 2   2 2 2 2   2 2 2 2   2 2 2 2
       3 3 3 3   3 3 3 3   3 3 3 3   3 3 3 3
       4 4 4 4   4 4 4 4   4 4 4 4   4 4 4 4

STATUS:
     OFF      ON                         MULTIPLE
                                         WINDOW
```

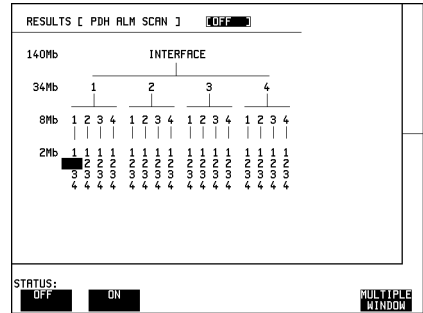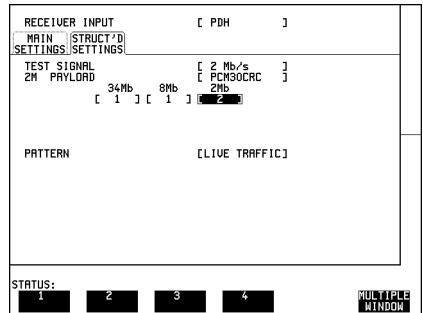**2** To determine which alarm has occurred set the PDH ALM SCAN OFF and then set the RECEIVE STRUCTURED SETTINGS display to the tributary highlighted as shown opposite and press RUN/STOP .

Example 2Mb number 2 of 8Mb number 1 of 34 Mb number 1 is highlighted.

```
RECEIVER INPUT              [ PDH      ]
 MAIN   STRUCT'D
SETTINGS SETTINGS
TEST SIGNAL                [ 2 Mb/s    ]
2M PAYLOAD                 [ PCM30CRC  ]
         34Mb     8Mb       2Mb
        [ 1 ] [  1  ] [    2    ]

PATTERN                    [LIVE TRAFFIC]

STATUS:
     1         2         3         4      MULTIPLE
                                         WINDOW
```

3 Now view the Alarm Seconds results on the RESULTS display to determine which alarms have occurred.

```
RESULTS [ PDH            ][ ALARM SECONDS ]

POWER LOSS              AIS
LOS                    PATTERN LOSS
LOF 140M               RAI
LOF  34M               MFRAME LOSS
LOF   8M               RMT MFRM ALM
LOF   2M

ELAPSED TIME

STATUS:
CUMUL-    SHORT    ERROR    ALARM    MORE   MULTIPLE
ATIVE     TERM    ANALYSIS SECONDS  .......  WINDOW
```
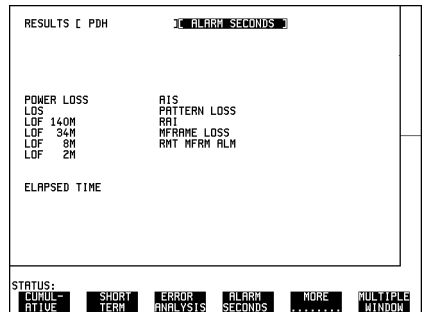
Analysis of N X 64 kb/s

Options Required Structured PDH **UKJ (USA)** or **UKN (USE)**

Application

Many customer premises receive subrate signals for example 128 Kb/s or 384 kb/s. The timeslots which make up these services may or may not be contiguous. Testing these services requires that the test set to be able to insert a pattern across the required timeslots.

Testing N X 64 kb/s channels structured within a 2 Mb/s signal can be carried out on an End to End basis using two test sets.

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 in the Mainframe Operating Manual*.

Test Setup Procedure (N X 64 kb/s Analysis)

This setup procedure is interfaced at 2 Mb/s, with a test signal of 6 X 64 kb/s non-contiguous timeslots. A PRBS test pattern is transmitted across the 6 timeslots. A BER measurement is performed on the received test pattern.
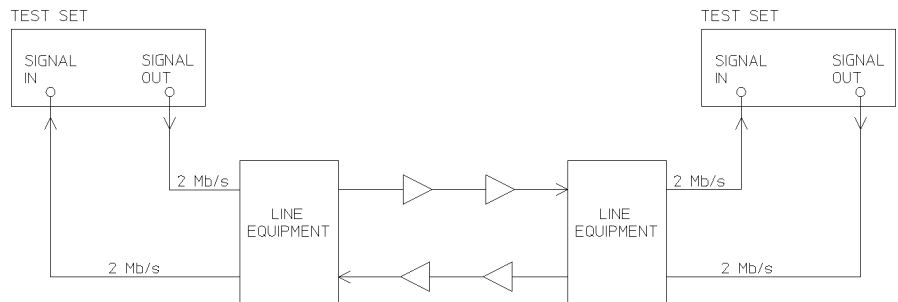
HP 37717C #1

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

Any 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
```
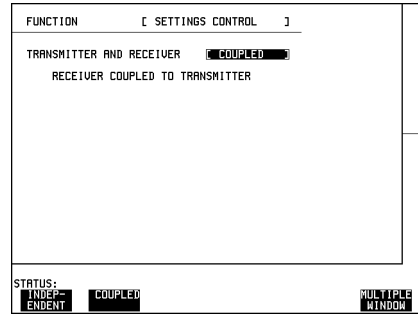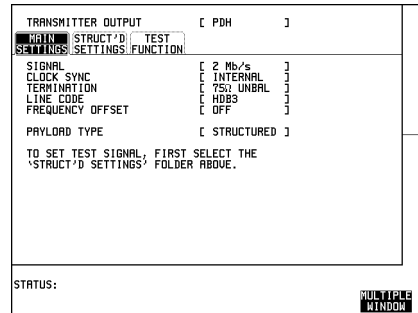
2. Connect the HP 37717C to the line
equipment and set up the [TRANSMIT]
MAIN SETTINGS display as shown
opposite.

The settings of SIGNAL rate and LINE
CODE must match those of the network
equipment.

```
TRANSMITTER OUTPUT        [ PDH      ]
 MAIN  STRUCT'D  TEST
SETTINGS SETTINGS FUNCTION
SIGNAL                    [ 2 Mb/s   ]
CLOCK SYNC                [ INTERNAL  ]
TERMINATION               [ 75Ω UNBAL ]
LINE CODE                 [ HDB3      ]
FREQUENCY OFFSET          [ OFF       ]

PAYLOAD TYPE              [ STRUCTURED ]

TO SET TEST SIGNAL, FIRST SELECT THE
'STRUCT'D SETTINGS' FOLDER ABOVE.




STATUS:
                                         MULTIPLE
                                         WINDOW
```

3. Set up the [TRANSMIT] display
STRUCTURED SETTINGS as shown
opposite.

In this example timeslots 3, 5, 9, 25, 26
and 27 are selected.

2M PAYLOAD selects the Framing which
must match that of the network equipment.

```
TRANSMITTER OUTPUT        [ PDH      ]
 MAIN  STRUCT'D  TEST
SETTINGS SETTINGS FUNCTION
TEST SIGNAL               [ Nx64 kb/s ]
2M  PAYLOAD               [ PCM31CRC  ]


Nx64 [ F...*.*...*...............***...█ ]
                 Cursor On Timeslot #31
                 Bandwidth  384 kb/s
PATTERN                   [ 2^15-1 PRBS]
PRBS POLARITY         [ NORM] NON-CCITT

B/G PATTERN NX64 kb/s       NUMBERED




STATUS:
 PCM30     PCM31    PCM30CRC  PCM31CRC    MULTIPLE
                                         WINDOW
```

4. Set up the $\boxed{\text{RESULTS}}$ display as shown opposite.

The RESULTS type may be changed during the measurement without interrupting the test.

```
RESULTS [ PDH        ][ 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
```

HP 37717C #2

1. Set up the $\boxed{\text{OTHER}}$ $\boxed{\text{SETTINGS}}$ $\boxed{\text{CONTROL}}$ display as shown opposite.

Any settings change made on the $\boxed{\text{TRANSMIT}}$ or $\boxed{\text{RECEIVE}}$ 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. Set up the $\boxed{\text{RECEIVE}}$ display $\boxed{\text{MAIN SETTINGS}}$ as shown opposite.

The settings of SIGNAL rate and LINE CODE must match those of the network equipment.

```
TRANSMITTER OUTPUT       [ PDH        ]
 MAIN  ║STRUCT'D║ TEST
SETTINGS SETTINGS FUNCTION
SIGNAL                  [ 2 Mb/s    ]
CLOCK SYNC              [ INTERNAL  ]
TERMINATION             [ 75% UNBAL ]
LINE CODE               [ HDB3      ]
FREQUENCY OFFSET        [ OFF       ]

PAYLOAD TYPE            [ STRUCTURED ]

TO SET TEST SIGNAL, FIRST SELECT THE
'STRUCT'D SETTINGS' FOLDER ABOVE.




STATUS:
                                           MULTIPLE
                                            WINDOW
```

3. Set up the **RECEIVE** **STRUCTURED SETTINGS** display as shown opposite.

In this example timeslots 3, 5, 9, 25, 26 and 27 are selected.

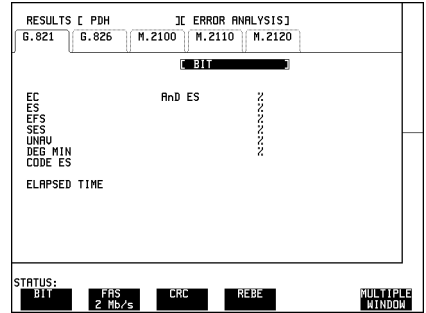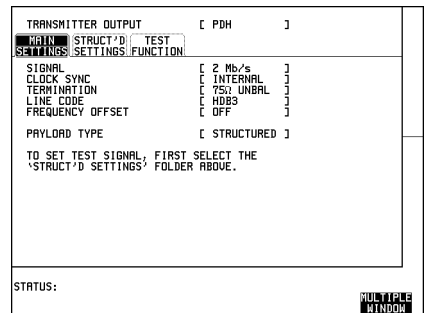2M PAYLOAD selects the Framing which must match that of the network equipment.

```
RECEIVER INPUT            [ PDH        ]
 MAIN  STRUCT'D
SETTINGS SETTINGS
TEST SIGNAL               [ Nx64 kb/s  ]
2M  PAYLOAD               [ PCM31CRC   ]

Nx64 [ F..*.*...*...............***...█ ]
                  Cursor On Timeslot #31
                    Bandwidth  384 kb/s
PATTERN                    [.2^15-1 PRBS]
PRBS POLARITY        [ NORM]  NON-CCITT




STATUS:
   PCM30     PCM31    PCM30CRC   PCM31CRC          MULTIPLE
                                                    WINDOW
```

4. Set up the **RESULTS** display as shown opposite.

The RESULTS type may be changed during the measurement without interrupting the test.

```
RESULTS [ PDH        ][ 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
```

Run the Test (N X 64 kb/s Analysis)

1. Press **RUN/STOP**.

- The measurement results and alarms are available on the **RESULTS** display during the test period.

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

BERT Testing

Options Required Structured PDH **UKJ (USA)** or **UKN (USE),** or Unstructured PDH **UKK (USB)**

Application

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

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

This can be performed in two ways:

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

Two HP 37717C's are required for this measurement, one at each end of the link.
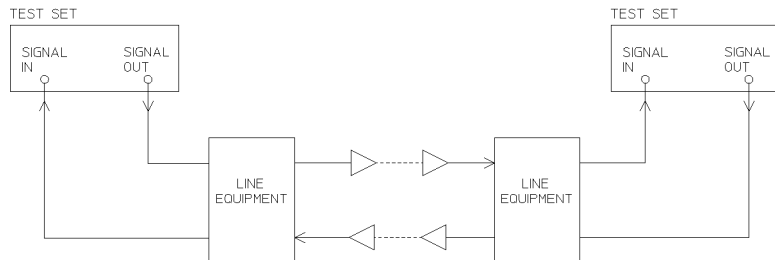
End-to End Test

• Loopback - Error performance measurements are made via a loopback at the remote end of the system testing the combined Go and Return paths. The measurements are often performed unattended and the results and other events, alarms for example, logged on a printer or disc and timed by a real time clock.
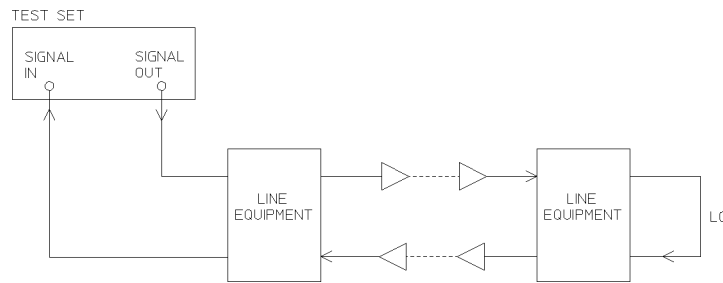
Loopback Test

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 (BERT Testing)

This setup procedure is based on 140 Mb/s, CMI, PRBS test data terminated in 75Ω A SINGLE test period of 24 HOURS is used and use of the a printer or disc for recording of results and alarms is included. A graphical record of the results can be viewed on the HP 37717C **GRAPH** display at the end of the test period.
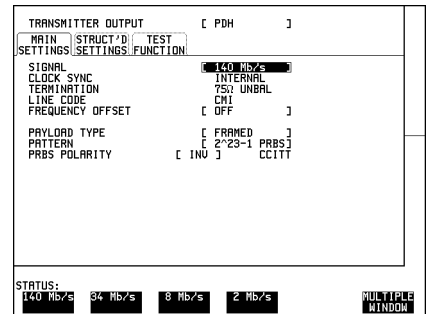
BERT Testing

1. Set up the [OTHER] [SETTINGS] [CONTROL] display as shown opposite (on both HP 37717C's if end to end).

Any 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 and set up the [TRANSMIT] display as shown opposite (on both HP 37717C's if end to end).

```
TRANSMITTER OUTPUT       [ PDH       ]
  MAIN    STRUCT'D   TEST
SETTINGS SETTINGS FUNCTION
 SIGNAL                      [ 140 Mb/s   ]
 CLOCK SYNC                     INTERNAL
 TERMINATION                    75Ω UNBAL
 LINE CODE                      CMI
 FREQUENCY OFFSET            [ OFF        ]

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




STATUS:
 140 Mb/s   34 Mb/s    8 Mb/s    2 Mb/s            MULTIPLE
                                                   WINDOW
```
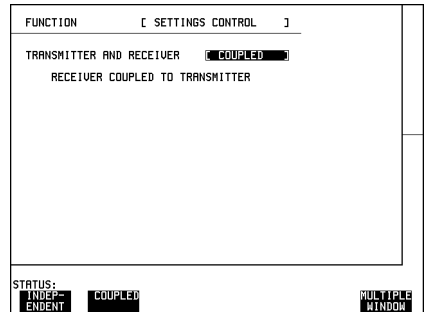
3. Select the [LOGGING] function as shown opposite (on both HP 37717C's if end to end).

A LOGGING PERIOD selection of [USER PROGRAM] [10 MIN] provides the following:

A complete set of period and a complete set of cumulative results logged on the printer or disc every 10 minutes.

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

 LOGGING                    [ ON        ]
 LOGGING PERIOD             [USER PROGRAM]
                            [ 10 ] [ MINS]
 RESULTS LOGGED             [ ALL       ]


 LOG ERROR SECONDS          [ OFF       ]
 LOG AT END OF TEST          ALL RESULTS

 LOG ON DEMAND               RESULTS




STATUS:
  OFF      10 MINS   1 HOUR   24 HOURS    USER     MULTIPLE
                                         PROGRAM    WINDOW
```

A complete set of cumulative results logged on the printer or to disc at the end of the test period.
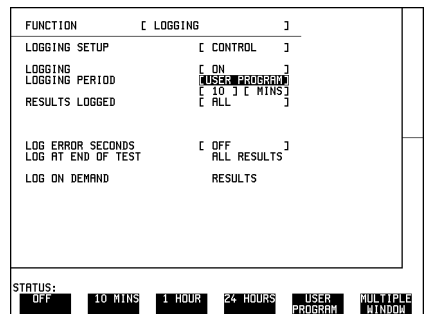
4. Set up the [**RESULTS**] display as shown opposite (on both HP 37717C's if end to end).

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

The RESULTS **TIMING CONTROL** STORAGE selection enables the graphics. To disable graphics select STORAGE [OFF].

```
RESULTS [ PDH      ][ 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:
 CUMUL-    SHORT     ERROR     ALARM      MORE    MULTIPLE
 ATIVE     TERM    ANALYSIS  SECONDS   ........   WINDOW
```
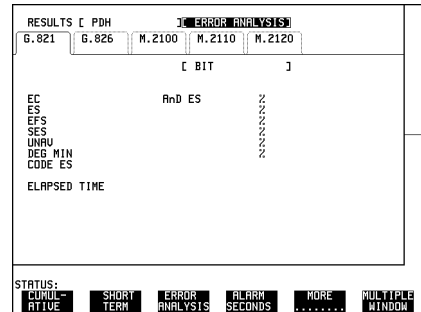
Start the Test (BERT Testing)

1. Press [**RUN/STOP**] (on both HP 37717C's if end to end).

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 (BERT Testing)

- The Date and Time the test started and the instrument setup are logged on the selected logging device.

- All results are logged on the selected logging device at 10 minute intervals.

- Any alarms which occur during the test period will be logged on a printer or disc.

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

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

- 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 TIMING CONTROL 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 TIMING CONTROL display.

Cross Multiplexer Testing

Options Required Structured PDH **UKJ (USA)**or **UKN (USE)**

Application

For comprehensive testing of network equipment it is essential that the test equipment can multiplex/demultiplex the test signal.

The insertion of tributary signals into the PDH multiplexer, which are then multiplexed into the 140 Mb/s PDH structure should take place without introducing errors. The insertion and structuring process is tested by adding a test pattern to the tributary inserted at the tributary insert port. At the high rate side of the PDH multiplexer the tributary is destructured and a BER test performed.

By using a protected monitor point at the high rate side of the PDH multiplexer the mux/demux need not be taken out of service.

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 in the Mainframe Operating Manua*.

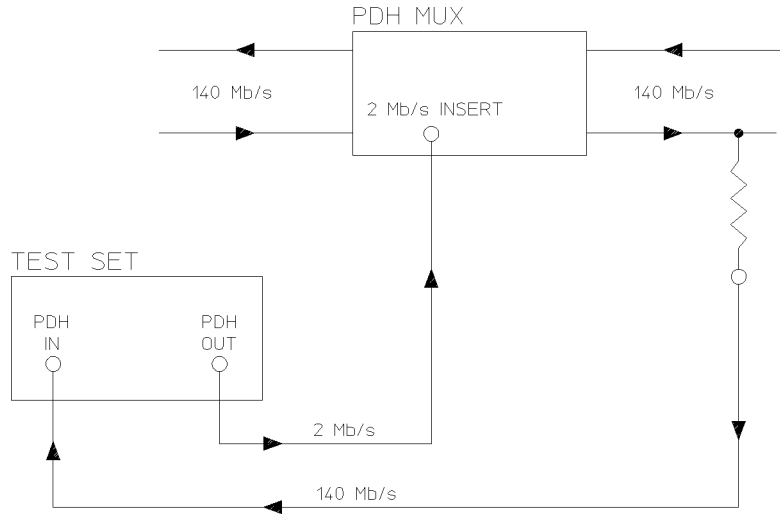### Cross Multiplexer Testing Test Setup Procedure

In this setup a 2 Mb/s Framed tributary, containing a test pattern, is inserted at the tributary insert port of the PDH multiplexer. The 140 Mb/s structured PDH signal is obtained from a protected monitor point. The 2 Mb/s tributary is destructured by the HP 37717C test set and an Error measurement is performed on the 2 Mb/s tributary test pattern.

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

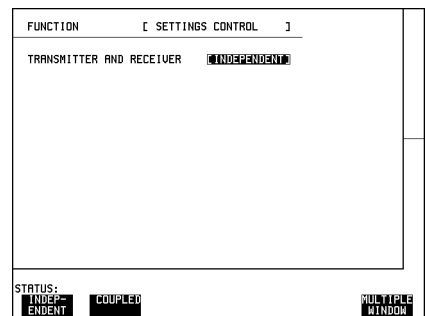The HP 37717C PDH/SDH test set GRAPHICS function is enabled. The graphical results can be viewed on the GRAPH display.

```
                        PDH MUX
              ◄──────┌──────────────┐──────◄──────
   140 Mb/s          │              │          140 Mb/s
              ──────►│ 2 Mb/s INSERT│──────►──────●
                     │      ○       │              │
                     └──────────────┘              ⌇
                            │                       ⌇
      TEST SET              │                      ○
    ┌──────────────────┐    │                       │
    │  PDH        PDH   │    │                       │
    │  IN         OUT   │    │                       │
    │  ○          ○     │    ▲                       │
    └──│──────────│─────┘    │                       │
       │          │          │                       │
       │          └────►──────┐  2 Mb/s               │
       ▲                                              ▼
       │              140 Mb/s                        │
       └──────────────────◄───────────────────────────┘
```

Cross Multiplexer Testing

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, which is selected from the softkey menu.

Selections of Framing and Code must match those of the network equipment.

```
TRANSMITTER OUTPUT        [ PDH      ]
 MAIN   STRUCT'D   TEST
SETTINGS SETTINGS FUNCTION
 SIGNAL                       [ 2 Mb/s   ]
 CLOCK SYNC                     INTERNAL
 TERMINATION                  [ 75Ω UNBAL ]
 LINE CODE                    [ HDB3     ]
 FREQUENCY OFFSET             [ OFF      ]

 PAYLOAD TYPE                 [ PCM31CRC  ]
 PATTERN                      [ 2^11-1 PRBS]
 PRBS POLARITY          [ NORM]    CCITT




STATUS:
PCM31CRC  STRUCT'D                  MORE   MULTIPLE
                                   ......   WINDOW
```

3. Set up the [**RECEIVE**] display **MAIN SETTINGS** as shown opposite.

The GAIN and EQUALIZER settings should be set to optimize the received signal.

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

 TERMINATION                   75Ω UNBAL
 LINE CODE                      CMI
 LEVEL                        [ MONITOR  ]
 EQUALIZER     [ OFF ] GAIN [ 20 dB   ]
 PAYLOAD TYPE                 [ STRUCTURED ]

 TO SET TEST SIGNAL, FIRST SELECT THE
 'STRUCT'D SETTINGS' FOLDER ABOVE




STATUS:
                                    MULTIPLE
                                     WINDOW
```

4. Set up the [**RECEIVE**] display **STRUCTURED SETTINGS** as shown opposite.

The required 2 Mb/s test signal is selected under 34Mb: 8Mb: 2Mb

2M Payload determines the test signal framing and must match that of the network equipment.

```
RECEIVER INPUT            [ PDH      ]
 MAIN   STRUCT'D
SETTINGS SETTINGS
 TEST SIGNAL                  [ 2 Mb/s   ]
 2M  PAYLOAD                  [ PCM31CRC  ]
           34Mb    8Mb    2Mb
          [ 2 ] [ 3 ] [ 4 ]


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




STATUS:
   1        2        3        4      MULTIPLE
                                      WINDOW
```

5. Select the logging device and set up the
OTHER display, **LOGGING** function,
as shown opposite.

WHEN [PERIOD EC>0] ensures results
are not logged on the selected logging
device when a print period is error free.
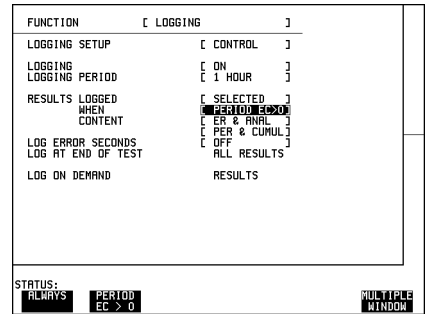
```
FUNCTION        [ LOGGING          ]

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        ][ CUMULATIVE   ]
 BIT      FAS     FAS     FAS    MORE
         140 Mb/s 34 Mb/s 8 Mb/s



BIT EC
BIT ER

ELAPSED TIME



STATUS:
                                       MULTIPLE
                                       WINDOW
```
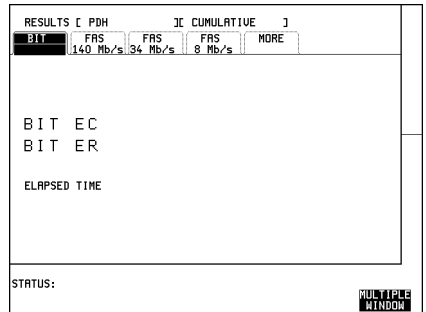
Start the Cross Multiplexer Test

1. Set up the **RESULTS** display as shown
opposite.

G.821 Analysis results are displayed but
any of the other results can be viewed
without affecting the measurement.

```
RESULTS [ PDH         ][ 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     FAS     FAS    MORE   MULTIPLE
        140 Mb/s 34 Mb/s 8 Mb/s ....... WINDOW
```
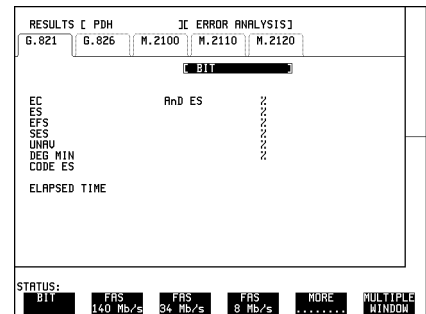
If you do not require stored graphics results select STORAGE [OFF] on the **RESULTS** **TIMING CONTROL** display.

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

```
RESULTS [TIMING CONTROL]

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

STORAGE          [ OFF                ]




STATUS:
  OFF      1 SEC    1 MIN   15 MIN    1 HR   MULTIPLE
         RESOL'N  RESOL'N  RESOL'N  RESOL'N   WINDOW
```
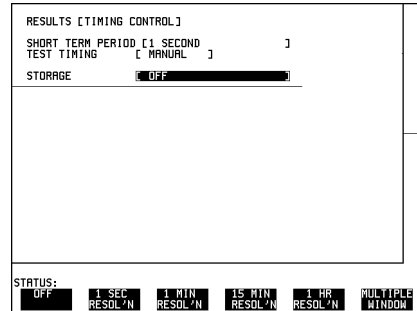
The following error results are available on the **RESULTS** display during the test period:

- 2 Mb/s - FAS, CRC, REBE and BIT

- 8, 34 and 140 Mb/s - FAS

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 (Cross Multiplexer Testing)

- The Date and Time the test started and the instrument set-up are logged on the logging device selected.

- Results are logged on the selected logging device 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 selected logging device.

- At the end of the test period a complete set of cumulative results are logged on the selected logging device.

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

- 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] **TIMING CONTROL** 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] **TIMING CONTROL** display.

FAS Monitoring

Options Required Structured PDH **UKJ (USA)** or **UKN (USE),** or Unstructured PDH **UKK (USB)**

Alternatively for PDH / DSn with ATM payloads Option **UKZ**.

NOTE

Option UKK (USB) - Unstructured PDH allows FAS Monitoring to be carried out at 2, 8, 34 and 140 Mb/s.
Option UKZ - allows FAS Monitoring to be carried out at DS1 and DS3 (Incorrect F and M framing sequence) rates as well as at 2 and 34 Mb/s ETSI rates.

Application

Degradation in error performance can be detected by the occurrence of Frame Alignment Signal (FAS) errors in PDH /DSn systems.

Using the HP 37717C in a *receive only* mode, FAS errors can be measured and viewed on the **RESULTS** display. In addition, the results can be logged on the selected logging device for examination later.

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 (FAS Monitoring)

This setup procedure is based on Structured PDH 140 Mb/s line traffic interfaced at the line equipment protected Monitor point. If a protected Monitor Point is not available then an HP 15510A Protective Probe may be used at an unprotected Monitor point.

The instrument is used in a *receive only* mode to measure FAS Errors. A Timed Start test period is used which allows the measurement to be started at a time when the user would not normally be available.

All Error Ratio and Analysis results are logged on the selected logging device at 2 hour intervals and at the end of the test period. Occurrences of error seconds and

alarms are logged on the selected logging device in real time.
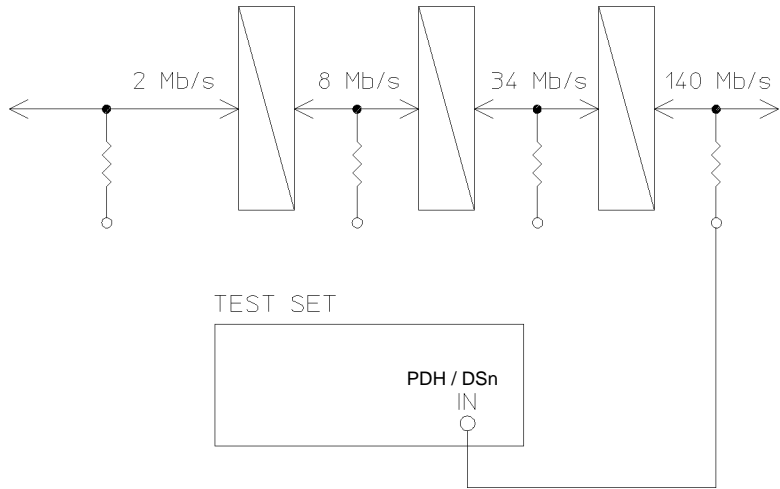
FAS Monitoring

1. Connect the HP 37717C to the line terminal equipment protected Monitor point and set up the $\boxed{\text{RECEIVE}}$ display $\boxed{\textbf{MAIN SETTINGS}}$ as shown opposite.

When Balanced FAS monitoring is desired at an unprotected Monitor point use an HP 15511A Protective Monitor Probe.

The GAIN and EQUALIZER settings should be set to optimize the received signal.
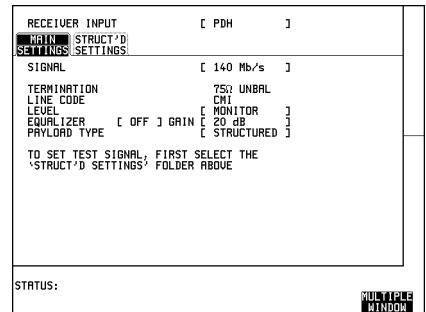
2. Set up the RECEIVE display
STRUCTURED SETTINGS as shown
opposite.

2M PAYLOAD Framing selection should
match that of the network equipment.

```
RECEIVER INPUT          [ PDH      ]
 ┌────┐ ┌────────┐
 │MAIN│ │STRUCT'D│
 │SETTINGS│ SETTINGS│
TEST SIGNAL             [ 2 Mb/s   ]
2M  PAYLOAD             [ PCM30CRC ]
        34Mb   8Mb    2Mb
       [ 2  ][  3  ][  4  ]


PATTERN                 [LIVE TRAFFIC]




STATUS:
                              MULTIPLE
                              WINDOW
```

3. Set up the OTHER LOGGING
display 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
```

Start the Test (FAS Monitoring)

Set up the RESULTS display as shown
opposite.

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

```
RESULTS [ PDH        ][ CUMULATIVE   ]
 ┌─────┐ ┌─────┐ ┌─────┐ ┌─────┐ ┌─────┐
 │ FAS │ │ FAS │ │ FAS │ │ FAS │ │MORE │
 │140 Mb/s│34 Mb/s│8 Mb/s│2 Mb/s│



 FAS  140M  EC
 FAS  140M  ER

 ELAPSED TIME




STATUS:
                              MULTIPLE
                              WINDOW
```

The following error types can be monitored:

   140 Mb/s - FAS (Short Term, Cumulative and G.821 Analysis)4 Mb/s- FAS

(Short Term, Cumulative and G.821 Analysis)

8 Mb/s - FAS (Short Term, Cumulative and G.821 Analysis)

2 Mb/s - FAS, CRC and REBE (Short Term, Cumulative and G.821 Analysis)

- Any occurrence of Alarms or Error Seconds during the test period are logged on the selected logging device.

- Cumulative and Period versions of Error Results and Analysis Results are logged on the selected logging device at 1 hour intervals.

- The test can be halted at any time by pressing $\boxed{\textbf{RUN/STOP}}$.

At the End of the Test

Cumulative and Period versions of Error Results and Analysis Results are logged on the selected logging device.

Frequency Measurement

Options Required Structured PDH **UKJ (USA)** or **UKN (USE),** or Unstructured PDH **UKK (USB)**

Alternatively for PDH / DSn with ATM payloads Option **UKZ**.

Application

The clock frequency and the amount of offset from the ITU standard rate can be measured to give an indication of probability of errors. The measurement can be made in out of service or monitor mode and is generally of short duration.

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 (Frequency Measurement)

If measuring frequency at PDH rates one of the following options is required.

- UKJ (USA), UKN (USE), UKK (USB) or UKL - Modules with PDH capability.

- UKZ - Module with PDH / DSn capability

If measuring frequency at SDH rates the following options must be fitted:

- US1 (US5) or A1T (A1U) - SDH Module (STM-1 electrical)

- UH1 or UH2 or URU (STM-1 or STM-4 optical)

If measuring on live traffic the measurement is interfaced at the line terminal equipment Monitor point.

The HP 37717C is used in a *receive only* mode to measure the PDH / DSn frequency. The PDH / DSn frequency is measured and compared with the internal ITU standard frequency selected

.
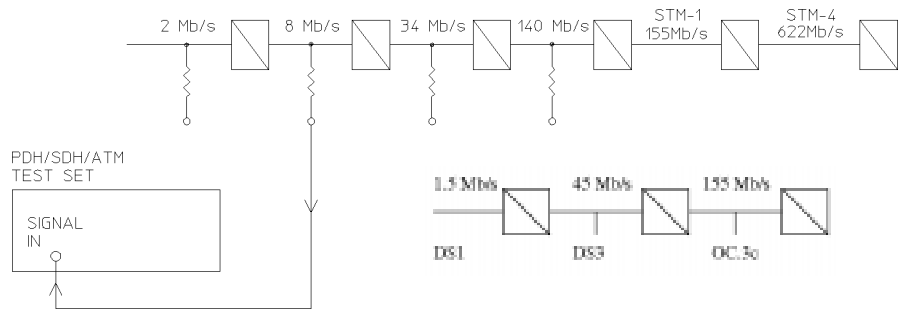
Figure 1   **Frequency Measurement**

1. Select SIGNAL [8 Mb/s] on the
RECEIVE display.

For frequency measurement PATTERN;
TERMINATION and CODE are not
relevant.
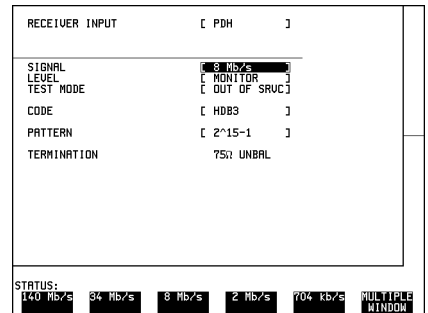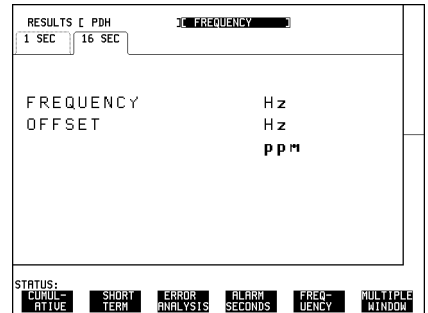
```
RECEIVER INPUT          [ PDH     ]

SIGNAL                  [ 8 Mb/s  ]
LEVEL                   [ MONITOR  ]
TEST MODE               [ OUT OF SRVC]
CODE                    [ HDB3     ]
PATTERN                 [ 2^15-1   ]
TERMINATION             75Ω UNBAL

STATUS:
140 Mb/s  34 Mb/s  8 Mb/s  2 Mb/s  704 kb/s  MULTIPLE
                                             WINDOW
```

2. Select **RESULTS** **PDH**
FREQUENCY .

```
RESULTS [ PDH        ][ FREQUENCY      ]
 1 SEC   16 SEC

FREQUENCY              Hz
OFFSET                 Hz
                       ppm

STATUS:
CUMUL-  SHORT   ERROR    ALARM    FREQ-   MULTIPLE
ATIVE   TERM    ANALYSIS SECONDS  UENCY   WINDOW
```

Run the Test (Frequency Measurement)

Connect the PDH / DSn IN port to the line terminal equipment monitor point.

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

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

```
RESULTS [ PDH          ][ FREQUENCY      ]
 1 SEC  | 16 SEC |


    FREQUENCY     8447999Hz
    OFFSET            -1Hz
                     +0ppm



STATUS:
 CUMUL-    SHORT    ERROR    ALARM    FREQ-   MULTIPLE
 ATIVE     TERM    ANALYSIS SECONDS  UENCY    WINDOW
```
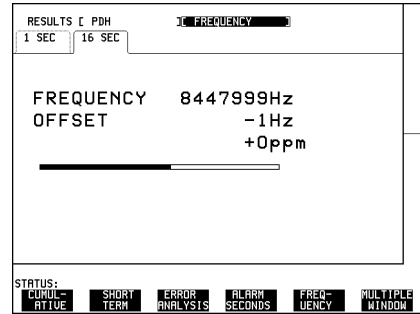
At the End of the Test (Frequency Measurement)

Disconnect the HP 37717C from the line terminal equipment.

Frequency Offset Tolerance

Application

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

The measurement can be made via a loopback or in a cross-multiplexer configuration, and is generally of short duration.

The ITU G.703 Recommendation for Clock Tolerance is:

- DS1 1.544 Mb/s $\pm$ 32 ppm

- E1 2.048 Mb/s $\pm$ 50 ppm

- E2 8.448 Mb/s $\pm$ 30 ppm

- E3 34.368 Mb/s $\pm$ 20 ppm

- DS3 44.736 Mb/s $\pm$ 20 ppm

- E4 139.264 Mb/s $\pm$ 15 ppm

In SDH systems if the master timing reference is lost a standby reference within 20 ppm can be used for a limited time:

- STM-1 155.520 Mb/s $\pm$ 20 ppm

- STM-4 622.080 Mb/s $\pm$ 20 ppm.

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 in the Mainframe Operating Manual*.

Test Setup Procedure (Frequency Offset Tolerance)

If checking frequency offset tolerance at PDH /DSn rates one of the following options is required.

- UKJ (USA) UKN (USE), or UKK (USB) - Modules with PDH capability

- UKZ - Module with PDH / DSn capability.

If checking frequency offset tolerance at SDH rates one of the following options must be fitted:

• US1 (US5) or A1T (A1U) - SDH Module (STM-1 electrical)

• UH1 or UH2 or URU (STM-1 or STM-4 optical)

This setup procedure tests the clock recovery capability of the line terminal equipment at 34 Mb/s using a PRBS pattern connected to the 75Ω interface. The frequency of the generated data is offset and the data is looped back and monitored for errors.
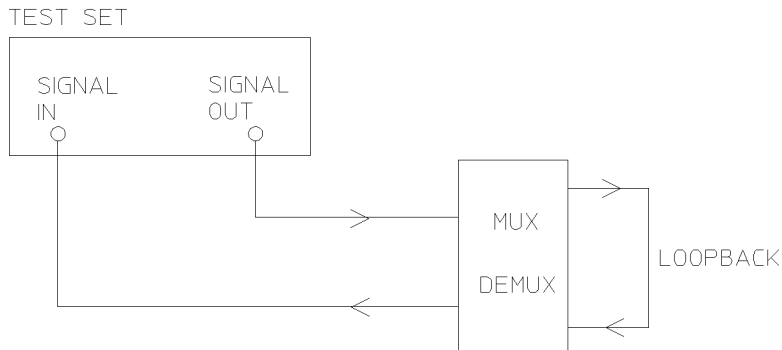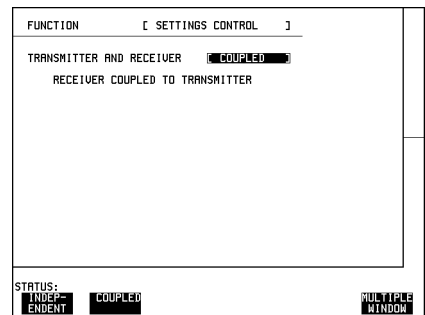

Figure 2   **Frequency Offset Tolerance Test**

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

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

Frequency Offset Tolerance

2. Set up the ⌜RECEIVE⌟ display as shown opposite.

Select the PATTERN required from the menu.

```
RECEIVER INPUT          [ PDH      ]

SIGNAL                  [ 34 Mb/s        ]
LEVEL                   [ TERMINATE  ]
TEST MODE               [ OUT OF SRVC]
CODE                    HDB3
PATTERN                 [ 2^15-1    ]
TERMINATION             75Ω UNBAL

STATUS:
140 Mb/s  34 Mb/s  8 Mb/s  2 Mb/s  704 kb/s  MULTIPLE
                                             WINDOW
```
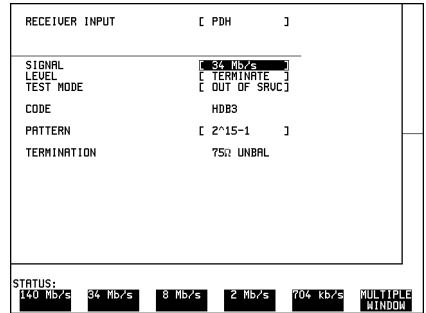
3. Set up the ⌜RESULTS⌟ display as shown opposite.

Any of the other results can be selected without affecting the measurement.
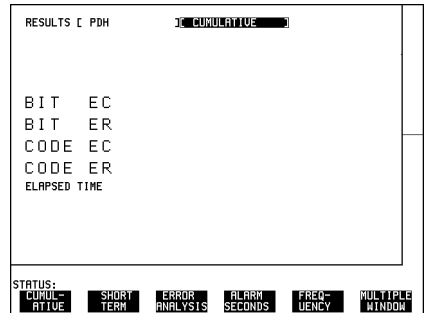
```
RESULTS [ PDH          ][ CUMULATIVE    ]


BIT   EC
BIT   ER
CODE  EC
CODE  ER
ELAPSED TIME


STATUS:
CUMUL-   SHORT  ERROR    ALARM    FREQ-   MULTIPLE
ATIVE    TERM   ANALYSIS SECONDS  UENCY   WINDOW
```

Continuity Check

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

1. Connect a loopback at the desired point on the line terminal or cross-multiplexer equipment.

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.

Run the Test (Frequency Offset Tolerance)

1. Connect the HP 37717C to the 75Ω interface of the multiplexer and set up the **TRANSMIT** display as shown opposite.

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

```
TRANSMITTER OUTPUT         [ PDH      ]
 PDH    STRUCT'D   TEST
        SETTINGS FUNCTION
 SIGNAL                    [ 34 Mb/s  ]
 CLOCK SYNC                  INTERNAL
 FREQUENCY OFFSET           [ OFF      ]

 CODE                        HDB3

 PATTERN                    [ 2^15-1   ]

 TERMINATION                 75Ω UNBAL




STATUS:
    OFF       +20      -20      USER            MULTIPLE
              ppm      ppm     OFFSET            WINDOW
```

3. Select TX CLOCK OFFSET [+20ppm] and check that the Error Count and Error Ratio results are unchanged.

4. Select TX CLOCK OFFSET [-20ppm] and check that the Error Count and Error Ratio results are unchanged.

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

At the End of the Test

1. Halt the test by pressing **RUN/STOP**, and disconnect the HP 37717C.

2. Remove the loopback from the line terminal or cross-multiplexer equipment.

Multiplexer Testing

Application

PDH multiplexers combine four lower rate signals into a higher rate signal for transmission or further multiplexing. It is important that each multiplexer port operates error free and no "crosstalk" occurs between ports.

Multiplexing of the tributaries can be verified by performing a BER test at each of the four ports. However a more rigorous test involves loading all four ports to simulate live traffic conditions. This verifies the individual ports and detects any crosstalk problems between the ports.

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*.

Multiplexer Test Setup Procedure

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

- UHC (US6) - Multiple Outputs

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

In this setup the PDH OUT signal and the three additional data outputs, from the Multiple Outputs option, load the 34 Mb/s input ports of the multiplexer. The HP 37717C (Structured PDH Option UKJ (USA)) destructures the 140 Mb/s signal and a BER test is performed on each of the 34 Mb/s signals in turn.

A SINGLE test period of 15 Minutes is used and the selected logging device is enabled to record results and alarms.
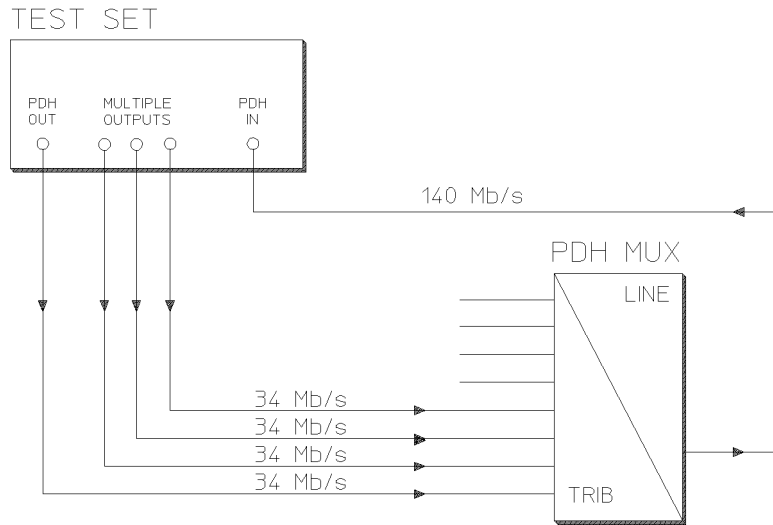
Figure 3   **Structured PDH Multiplexer Test**

NOTE   This test can be performed using the Unstructured PDH Option UKK (USB) but the equipment configuration is slightly different as shown below.
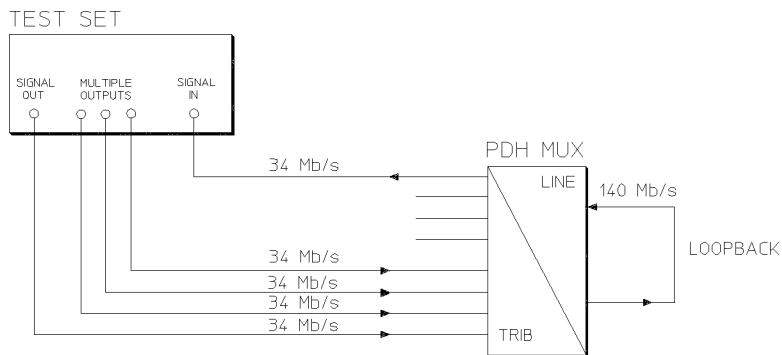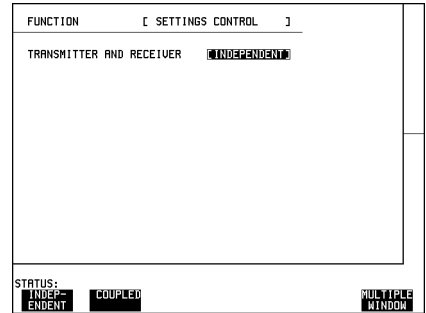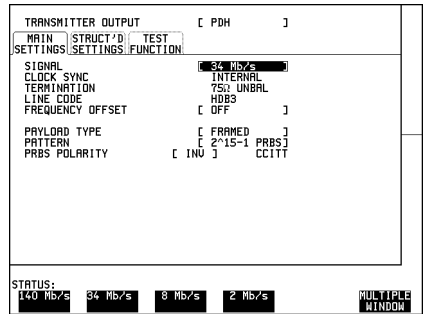

Figure 4   **Unstructured PDH Multiplexer Test**

Multiplexer Testing

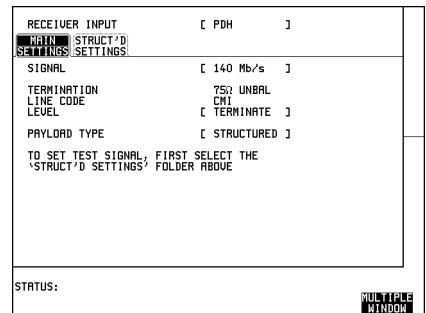1. Connect the HP 37717C to the network equipment and set up the OTHER SETTINGS CONTROL display as shown opposite.

```
FUNCTION          [ SETTINGS CONTROL   ]

TRANSMITTER AND RECEIVER      [INDEPENDENT]




STATUS:
 INDEP-    COUPLED                              MULTIPLE
 ENDENT                                         WINDOW
```

2. Set up the TRANSMIT display MAIN SETTINGS as shown opposite.

PAYLOAD TYPE, PATTERN and PRBS POLARITY selections should meet the requirements of the network equipment.

```
TRANSMITTER OUTPUT       [ PDH      ]
 MAIN  |STRUCT'D| TEST
SETTINGS SETTINGS FUNCTION
 SIGNAL                    [ 34 Mb/s    ]
 CLOCK SYNC                   INTERNAL
 TERMINATION                  75Ω UNBAL
 LINE CODE                    HDB3
 FREQUENCY OFFSET          [ OFF       ]

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




STATUS:
 140 Mb/s  34 Mb/s  8 Mb/s   2 Mb/s            MULTIPLE
                                               WINDOW
```

3. Set up the RECEIVE display MAIN SETTINGS as shown below.

PAYLOAD TYPE [STRUCTURED] ensures the 140 Mb/s signal is destructured into the four 34 Mb/s test signals

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

 TERMINATION                  75Ω UNBAL
 LINE CODE                    CMI
 LEVEL                     [ TERMINATE ]

 PAYLOAD TYPE              [ STRUCTURED ]

 TO SET TEST SIGNAL, FIRST SELECT THE
 'STRUCT'D SETTINGS' FOLDER ABOVE




STATUS:
                                               MULTIPLE
                                               WINDOW
```
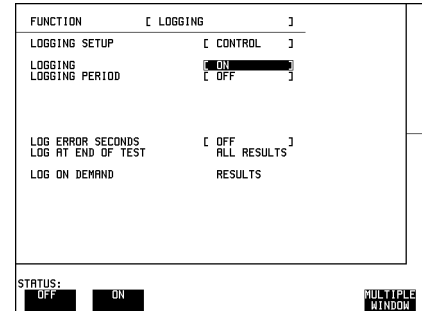
4. Set up the ⌈**RECEIVE**⌉ display
STRUCTURED SETTINGS as shown
opposite.

The required 34 Mb/s test signal is
selected under 34Mb.

```
RECEIVER INPUT          [ PDH      ]
 MAIN   STRUCT'D
SETTINGS SETTINGS
TEST SIGNAL             [ 34 Mb/s   ]
34M PAYLOAD             [ FRAMED     ]
          34Mb
         [ 3 ]


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




STATUS:
                                MULTIPLE
                                WINDOW
```
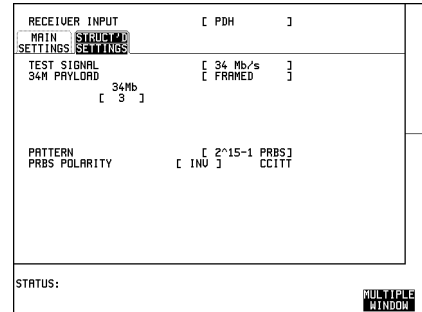
5. Select the logging output required with
the ⌈**OTHER**⌉ display, **LOGGING**
function, LOGGING SETUP **DEVICE**
then select LOGGING SETUP
CONTROL and set up the display as
shown opposite.

```
FUNCTION        [ LOGGING       ]

LOGGING SETUP           [ CONTROL   ]

LOGGING                 [ ON        ]
LOGGING PERIOD          [ OFF       ]


LOG ERROR SECONDS       [ OFF       ]
LOG AT END OF TEST       ALL RESULTS

LOG ON DEMAND            RESULTS




STATUS:
   OFF      ON               MULTIPLE
                             WINDOW
```

Start the Multiplexer Test

1. Set up the ⌈**RESULTS**⌉ display as shown
opposite.

2. Press ⌈**RUN/STOP**⌉ to start the
measurement.

3. Repeat the test for the other three 34
Mb/s signals, selectable on the ⌈**RECEIVE**⌉
STRUCTURED SETTINGS display.

G.821 ANALYSIS is selected but any of
the other results can be selected from the
softkey menu without affecting the
measurement.
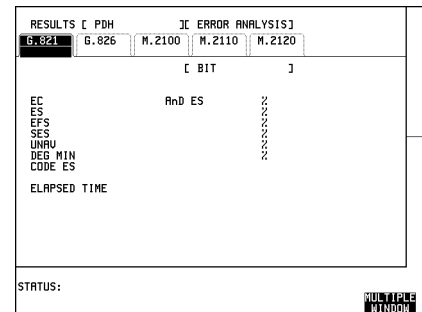
```
RESULTS [ PDH      ][ ERROR ANALYSIS]
 G.821  G.826  M.2100  M.2110  M.2120

                      [ BIT       ]

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

ELAPSED TIME




STATUS:
                                MULTIPLE
                                WINDOW
```

• The measurement results and alarms are available on the ⌈**RESULTS**⌉ display

during the test period.

• The test can be halted at any time by pressing $\boxed{\textbf{RUN/STOP}}$.

At the End of the Multiplexer Test

• The Date and Time the test started and the instrument setup are logged on the selected logging device.

• All results are logged on the selected logging device at the end of the test.

• Any alarms which occur during the test period will be logged on the selected logging device.

Round Trip Delay

Application

In certain applications the time taken for a signal to pass through the network can be very important for example Voice Traffic where excessive delay can make speech difficult to understand. The Round Trip delay feature of the HP 37717C allows measurement of the delay at any interface or test signal rate.

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 in the Mainframe Operating Manual*.

Test Setup Procedure (Round Trip Delay)

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

•   UKJ (USA) - Structured PDH Module

This setup is interfaced at 140 Mb/s with a test signal of 64 kb/s. A test pattern is transmitted in the 64 kb/s slot and a timer is set running. A loopback is applied to the network equipment to return the test signal. The received pattern stops the timer and the Round Trip Delay is calculated.
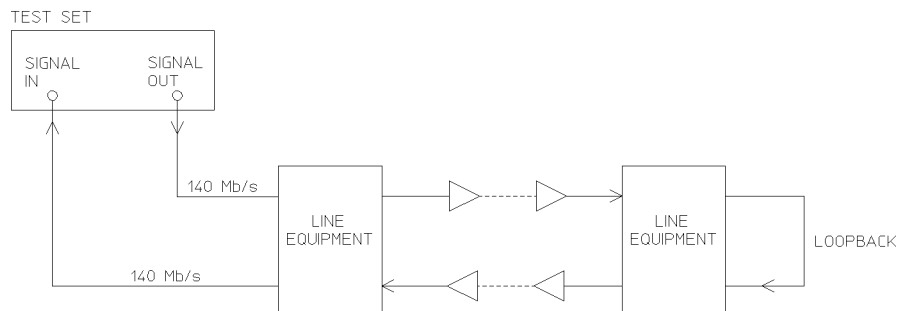
Round Trip Delay

Round Trip Delay

1. Connect the HP 37717C to the network equipment as shown and set up the OTHER SETTINGS CONTROL display as shown opposite.
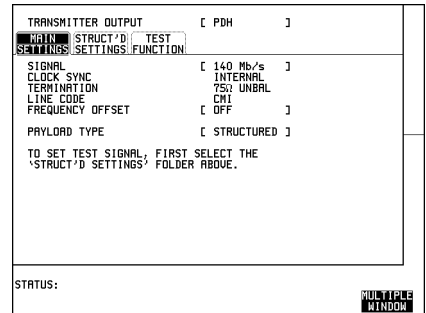
Any settings change made on the TRANSMIT or RECEIVE displays will automatically occur on the other.

```
FUNCTION          [ SETTINGS CONTROL    ]

TRANSMITTER AND RECEIVER      [ COUPLED    ]
     RECEIVER COUPLED TO TRANSMITTER




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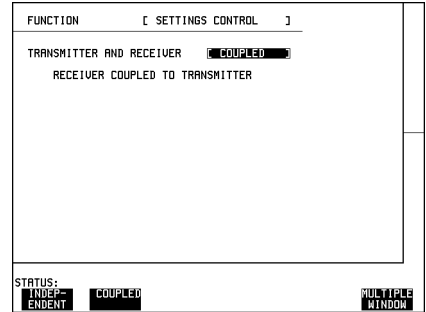
2. Set up the TRANSMIT display MAIN SETTINGS as shown opposite.

The SIGNAL rate and LINE CODE settings must match those of the network equipment.

Ensure that the TRANSMIT TEST FUNCTION display is set for bit errors.

```
TRANSMITTER OUTPUT          [ PDH      ]
 MAIN   STRUCT'D   TEST
SETTINGS SETTINGS FUNCTION
 SIGNAL                   [ 140 Mb/s   ]
 CLOCK SYNC                 INTERNAL
 TERMINATION                75% UNBAL
 LINE CODE                  CMI
 FREQUENCY OFFSET         [ OFF       ]

 PAYLOAD TYPE             [ STRUCTURED ]

 TO SET TEST SIGNAL, FIRST SELECT THE
 'STRUCT'D SETTINGS' FOLDER ABOVE.



STATUS:
                                           MULTIPLE
                                           WINDOW
```

3. Set up the TRANSMIT display STRUCTURED SETTINGS as shown opposite.

The 2M PAYLOAD selection determines the Framing which should match that of the network equipment.

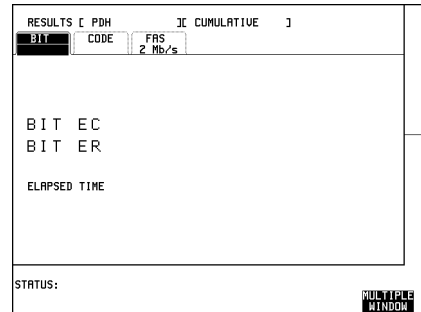The test 64 kb/s slot is selected under 34Mb; 8Mb; 2Mb; 64kb.

```
TRANSMITTER OUTPUT          [ PDH      ]
 MAIN  STRUCT'D   TEST
SETTINGS SETTINGS FUNCTION
 TEST SIGNAL               [ 64 kb/s    ]
 2M PAYLOAD                [ PCM31      ]
             34Mb    8Mb    2Mb    64kb
           [ 2 ] [ 3 ] [ 4 ] [ 1 ]


 HANDSET                   [ OFF       ]
 PATTERN                   [ 2^11-1 PRBS]
 PRBS POLARITY      [ NORM]      CCITT
 B/G PATTERN               [ AIS       ]
 B/G PATTERN 64 kb/s         NUMBERED


STATUS:
                                           MULTIPLE
                                           WINDOW
```

Continuity Check

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

1. Connect a loopback at the desired point on the line terminal equipment and 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.

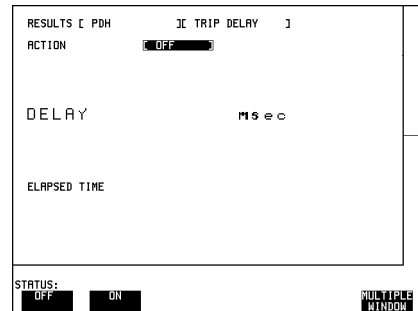4. Press [**RUN/STOP**] to stop the measurement.

```
RESULTS [ PDH        ][ CUMULATIVE   ]
 BIT      CODE    FAS
                  2 Mb/s



 BIT EC
 BIT ER

 ELAPSED TIME



STATUS:
                                        MULTIPLE
                                        WINDOW
```

Start the Test (Round Trip Delay)

1. Set up the [**RESULTS**] display as shown opposite.

Select ACTION **ON** to start the test.

The Round Trip Delay result is displayed in milliseconds.

```
RESULTS [ PDH        ][ TRIP DELAY   ]
ACTION              [ OFF      ]



 DELAY                  Msec



 ELAPSED TIME



STATUS:
 OFF        ON                          MULTIPLE
                                        WINDOW
```

The delay measurement range is up to 2 seconds. The Resolution varies according to the received rate:

- 2 Mb/s - 1μs

- 8, 34, 140 Mb/s - 10μs

- STM-1 - 0.5 ms

M2100, M2110, M2120 Analysis

Application

Previously ITU-T G.821 was the only international recommendation available to measure the quality of a communications link. ITU-T G.821 was originally an "Out of Service" measurement and analysis for commissioning a link and troubleshooting during severe disruption. The commissioning test was a one month "Out of Service" test based on errored and severely errored seconds. A one month test with the subsequent loss of revenue is clearly unacceptable.

Due to demand ITU-T G.821 also evolved into proprietary methods for "In Service" testing based on FAS and code errors. Demand for high quality leased lines meant an "In Service" performance standard, closer to real conditions and allowing comparisons between providers, was required.

The ITU-T M.2100 series was specifically defined to provide a clear indication of link quality, for service providers using long term performance analysis. "Bringing into Service" and "repair criteria" analysis were also included.

M.2100 analysis is based on frame errors and provides Error Seconds (anomaly), Severely Errored Seconds (defect) and Unavailability results for receive and transmit directions. Transmit results are only available for 2 Mb/s signals with CRC framing. "Out of Service" testing is only available for the receive direction. M.2110 is an "Out of Service" measurement for "bringing into service" testing of paths. A 15 minute BER test (G.821) is performed and if this is error free a 24 hour M.2110 test is performed. If the 24 hour M.2110 test displays PASS (S1 limit not reached) the path can be returned to service. If FAIL is displayed (S2 limit reached or exceeded) the 15 minute BER test should be repeated, If m-d-;- (UNCERTAIN)is displayed (result between the S1 and S2 limits) run the 7 day BIS test.

The PASS FAIL and UNCERTAIN parameters are determined by the S1 and S2 limits which are user selectable.
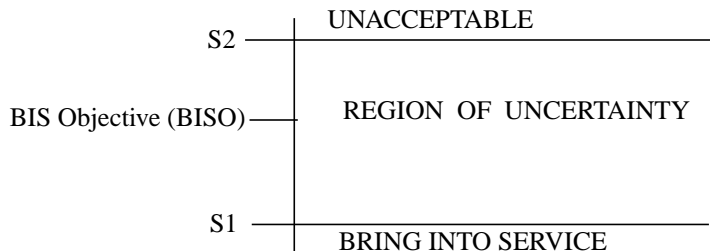
S2 ——— UNACCEPTABLE

BIS Objective (BISO) ——— REGION OF UNCERTAINTY

S1 ——— BRING INTO SERVICE

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 in the Mainframe Operating Manual*.
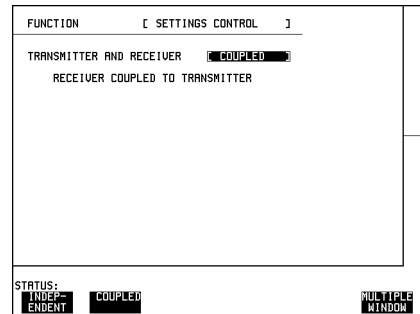
Test Setup Procedure M2110 Analysis

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

• UKJ - Structured PDH Module

This setup procedure is interfaced at 140 Mb/s, with a test signal of 2 Mb/s with PCM30CRC framing.

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

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

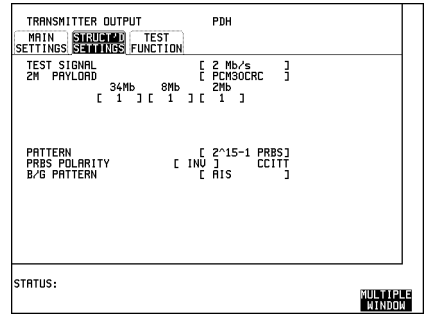The settings of SIGNAL rate and LINE CODE must match those of the network equipment.

```
TRANSMITTER OUTPUT          PDH
 MAIN  STRUCT'D  TEST
SETTINGS SETTINGS FUNCTION
SIGNAL                      [ 140 Mb/s  ]

CLOCK SYNC                    INTERNAL
TERMINATION                   75Ω UNBAL
LINE CODE                     CMI
FREQUENCY OFFSET            [ OFF       ]

PAYLOAD TYPE               [ STRUCTURED ]

TO SET TEST SIGNAL, FIRST SELECT THE
'STRUCT'D SETTINGS' FOLDER ABOVE.




STATUS:
                                              MULTIPLE
                                               WINDOW
```
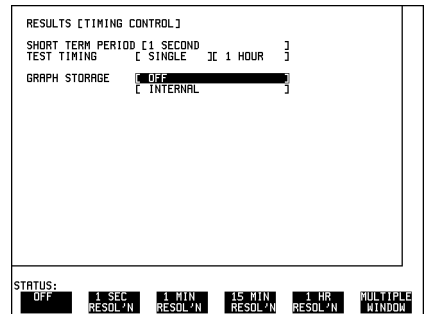
3. Set up the [TRANSMIT] display [STRUCTURED SETTINGS] as shown opposite.

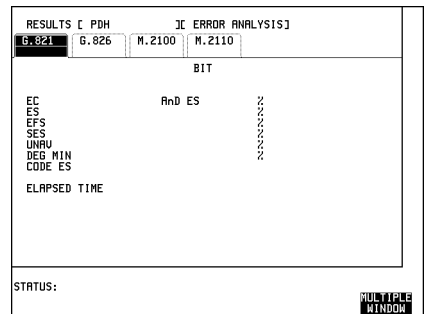2M PAYLOAD selects the Framing which must match that of the network equipment.

```
TRANSMITTER OUTPUT          PDH
  MAIN  STRUCTD   TEST
SETTINGS SETTINGS FUNCTION
TEST SIGNAL               [ 2 Mb/s   ]
2M  PAYLOAD               [ PCM30CRC  ]
             34Mb    8Mb      2Mb
             [  1  ] [  1  ] [  1  ]


PATTERN                   [ 2^15-1 PRBS]
PRBS POLARITY        [ INV ]    CCITT
B/G PATTERN               [ AIS      ]




STATUS:
                                    MULTIPLE
                                    WINDOW
```

4. Set up the [RESULTS] display as shown opposite.

```
RESULTS [TIMING CONTROL]

SHORT TERM PERIOD [1 SECOND    ]
TEST TIMING      [ SINGLE  ][ 1 HOUR  ]

GRAPH STORAGE    [ OFF              ]
                 [ INTERNAL         ]









STATUS:
   OFF      1 SEC   1 MIN   15 MIN  1 HR   MULTIPLE
          RESOL'N RESOL'N RESOL'N RESOL'N WINDOW
```
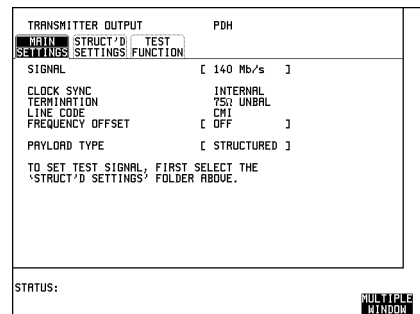
5. Press [RUN/STOP] to start the measurement.

At the end of the test period check that the G.821 results are error free.

```
RESULTS [ PDH        ][ 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
```

6. Set up the ⎡**RESULTS**⎤ display as shown opposite

Select the Path Allocation value required in the range 0.5% to 40%.

The Path Allocation value determines the S1 and S2 limits and these will change on the display as the Path Allocation value is changed.

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

 BIS LIMITS          [ PATH ALLOC ][20.0% ]
                     2-hr    24-hr    7-day
           ES  S1
 BIS       S2                    "
 LIMITS-   SES S1
           S2                    "
 BIS RESULTS-
 ELAPSED TIME


STATUS:
 PATH     USER                        MULTIPLE
 ALLOC.   PROGRAM                      WINDOW
```
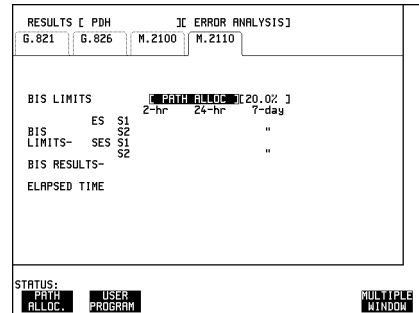
7. Set up the ⎡**RESULTS**⎤ display as shown opposite.

Press ⎡**RUN/STOP**⎤ to start the measurement.

```
RESULTS TIMING CONTROL

 SHORT TERM PERIOD [1 SECOND        ]
 TEST TIMING      [ SINGLE  ][ 24 HOURS ]

 GRAPH STORAGE    [ OFF           ]
                  [ INTERNAL      ]




STATUS:
 TROUBLE  TIMING   PDH      PDH       MULTIPLE
 SCAN     CONTROL  RESULTS  ALM SCAN  WINDOW
```
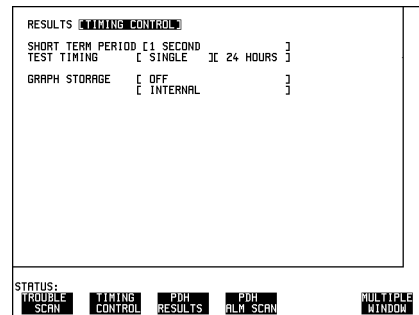
8. View the M.2110 results.

BIS Results of PASS, FAIL and m-d-;- (uncertain) are possible.

If PASS is displayed (S1 limit not reached) the path may be returned to service immediately.

If FAIL is displayed (S2 limit reached or exceeded) repeat the BER (G.821) test.

If m-d-;- is displayed (result between the S1 and S2 limits) run the 7 day BIS test.

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

 BIS LIMITS          [ PATH ALLOC ][20.0% ]
                     2-hr    24-hr    7-day
           ES  S1
 BIS       S2                    "
 LIMITS-   SES S1
           S2                    "
 BIS RESULTS-
 ELAPSED TIME


STATUS:
 PATH     USER                        MULTIPLE
 ALLOC.   PROGRAM                      WINDOW
```
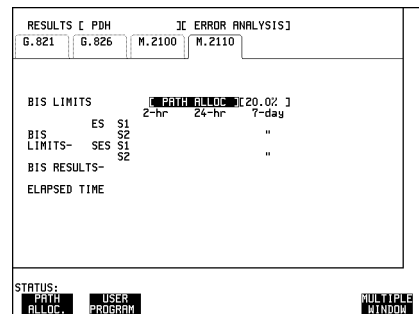
Monitoring DS3 with ATM Payloads

Option Required DS1, DS3, E1 and E3 Transmit and Receive Interfaces for ATM Payloads. **Option UKZ**

Connect the HP 37717C RECEIVE DS3 IN to the network monitor point, select the **RECEIVE** display and DS3 rate.

```
RECEIVER INPUT              ATM
PHYSICAL   ATM
LAYER      LAYER
SIGNAL                      [ DS3            ]

TERMINATION                 75Ω UNBAL
LINE CODE                   B3ZS
LEVEL                       [ TERMINATE  ]

CONVERGENCE SUB-LAYER       [ DIRECT    ]


CELL SCRAMBLING             [ ON        ]




STATUS:
   DS3       34        2         DS1                MULTIPLE
             Mb/s      Mb/s                         WINDOW
```

Select the convergence layer, Direct or PLCP.

```
RECEIVER INPUT              ATM
PHYSICAL   ATM
LAYER      LAYER
SIGNAL                      [ DS3       ]

TERMINATION                 75Ω UNBAL
LINE CODE                   B3ZS
LEVEL                       [ TERMINATE  ]

CONVERGENCE SUB-LAYER       [ PLCP       ]


CELL SCRAMBLING             [ ON        ]




STATUS:
   DIRECT     PLCP                              MULTIPLE
                                                WINDOW
```

Select **RESULTS** **PDH** for the physical and convergence layer results.

```
RESULTS [ PDH        ][ CUMULATIVE   ]
  FEBE     PLCP      PLCP    PLCP    MORE
           BIP       FEBE    TRAILER




   PLCP  TRAILER-
   MISMATCHES


   ELAPSED TIME



STATUS:
                                        MULTIPLE
                                        WINDOW
```

Select [RESULTS] [PDH] ALARM
SECONDS to display the physical and
convergence layer alarms.

```
RESULTS [ PDH          ][ ALARM SECONDS ]




POWER LOSS
LOS                    PLCP LOF
DS3 LOF                PLCP RAI
DS1 LOF
M34 LOF
M2 LOF
AIS
FERF
RAI

ELAPSED TIME




STATUS:
 CUMUL-   SHORT    ALARM    G.826    MORE    MULTIPLE
 ATIVE    TERM    SECONDS  ANALYSIS .......  WINDOW
```
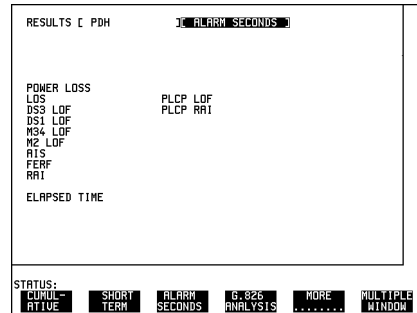
Information on cell level testing is given in "The ATM Operating Manual".

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Learning Products Map

All of the learning products which apply to the HP 37717C Communications Performance Analyzer with ATM Services and LAN testing capability are shown below:

The HP 37717C Mainframe Operating Manual- 37717-90282

General operating information irrespective of option.

The HP 37717C PDH / DSn Operating Manual - 37717-90283

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

The HP 37717C SDH / SONET Operating Manual - 37717-90284

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 - 37717-90285

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

The HP 37717C ATM + LAN Operating Manual - 37717-90286

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

Calibration Manual - 37717-90287:

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

Remote Control Manual - 37717-90288:

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

About This Edition

This is the 1st edition of
the 37717-90283 manual.
It documents the product
as of September 1997.
Edition dates are as
follows:

1st Edition, September
1997

In This Book

This book provides information on HP 37717C
modules with PDH / DSn capability when used
with instruments which have ATM Services
and LAN testing 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.