SDH / SONET
Operating Manual

HP 37717C
Communications
Performance Analyzer

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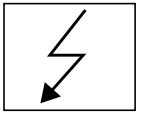

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HP 37717C Communications Performance Analyzer

About This Book

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

- How to select and use the SDH / SONET features provided with the SDH / SONET options
- How to make SDH / SONET 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 Communications Performance Analyzer irrespective of the option configuration.

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

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

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

Contents

1

SDH / SONET Modules

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

Introduction to SDH / SONET

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

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

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

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

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

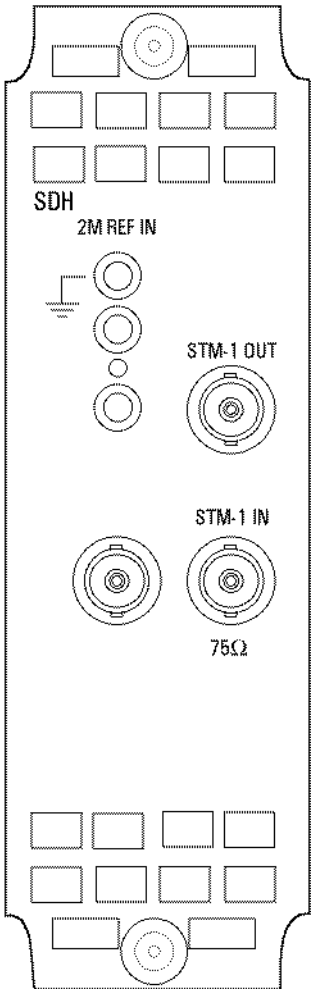
This means that SDH / SONET can be deployed as an overlay to the existing network thus providing enhanced network flexibility.

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

SDH / SONET Options

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

Option US1 (US5)



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

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

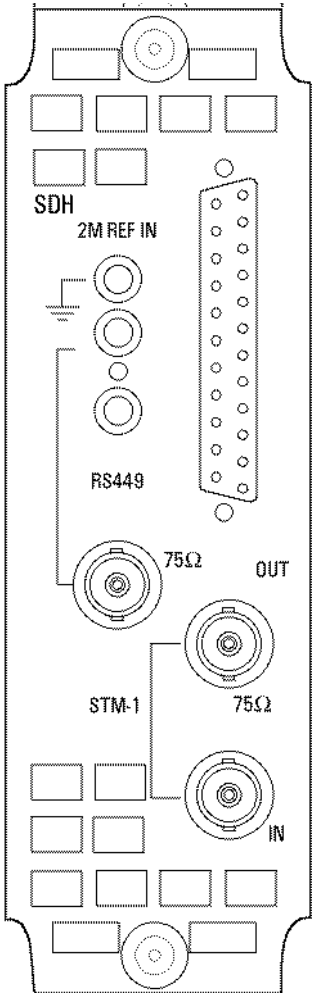
Payloads of 140 Mb/s, 34 Mb/s and 2 Mb/s are available.(If Option UKJ U.S.A. Structured PDH is fitted, Structured Payloads are available and a 2Mb/s Insert port is provided.)

Bit errors can be added to the Payload.

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

The K1K2 MSP bytes can be user programmed
The S1 byte can be user programmed.

Option A1T (A1U)



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

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

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

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

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

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

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

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

DCC Drop and Insert capability is included.

Optical Clock stress capability is included.

Additional SDH interface capability is provided by the following Options:

STM-1/STM-4 optical interface at 1550 nm, **option URU.**

STM-1/STM-4 optical interface at 1330 nm and 1550 nm with access to STM-4 overhead and Optical power measurement, **option USN.**

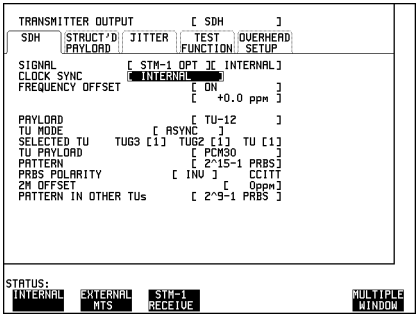
STM-1/STM-4 optical interface at 1330 nm and 1550 nm with access to STM-4 overhead and Optical power measurement, **option UKT.**

SDH binary interface for Option UKT and USN only, **option 0YH.**

SDH / SONET Features

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

SDH Settings

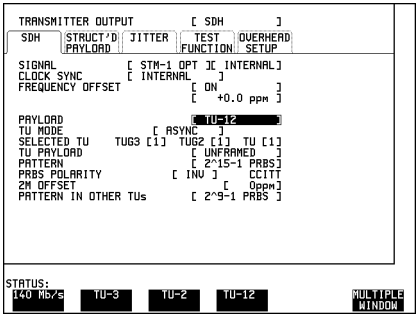


SIGNAL selection is normally STM-1. If Option UH1 is fitted STM-1 OPT is added. If Option UH2, URU, USN or UKT is fitted STM-1 OPT and STM-4 OPT are added.

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

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

FREQUENCY OFFSET allows SDH line rate offset of ± 999 ppm).



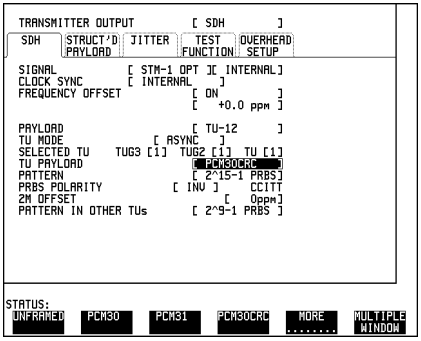
PAYLOAD selection is 140 Mb/s, TU3 (34 Mb/s Option US1 (US5)), TU2 (Option A1T (A1U) only) or TU12 (ASYNC2 Mb/s Option US1 (US5)).

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

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

SELECTED TU allows the selection of the Tributary required for testing which in a TU12 payload is 1 of 63 Tributaries.

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



PATTERN allows selection of the Tributary test pattern.

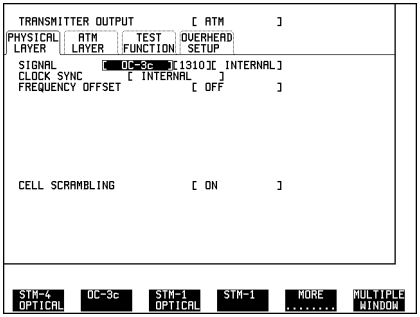
OFFSET (Option A1T (A1U) only) allows the tributary payload to be frequency offset relative to its virtual container (VC-12, VC-3 or VC-4) in the range ± 100 ppm. 2M OFFSET if payload TU12, 34M OFFSET if payload TU3, 140M OFFSET if payload 140 Mb/s. This affects the stuff rate but does not cause pointer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

PATTERN IN OTHER TU's allows selection of the test pattern inserted in the non test tributaries.

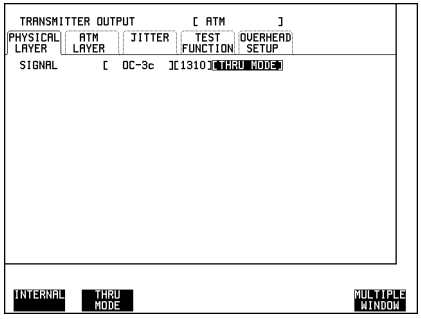
SONET With ATM Payload, Settings

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

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

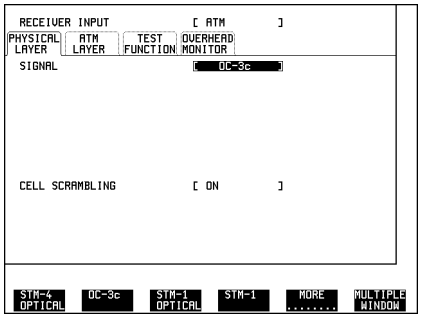


The signal received by the ATM module (UKN or UKZ) may be retransmitted by selecting THRU mode. Jitter from the jitter generator module may be added to the retransmitted signal.



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

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

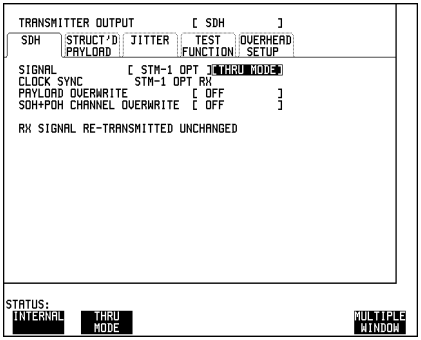


STM-1 THRU Mode (Option A1T (A1U) only)

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

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

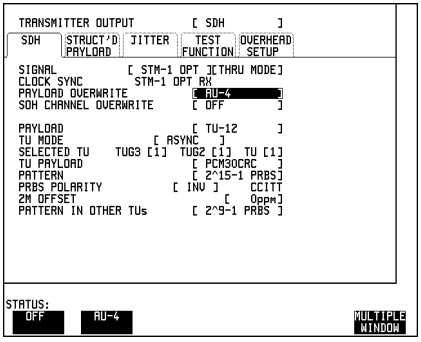
The B1, B2 and B3 BIPS are not recalculated.



When PAYLOAD OVERWRITE [AU4] is selected a user selectable Payload can be substituted for the received SDH payload.

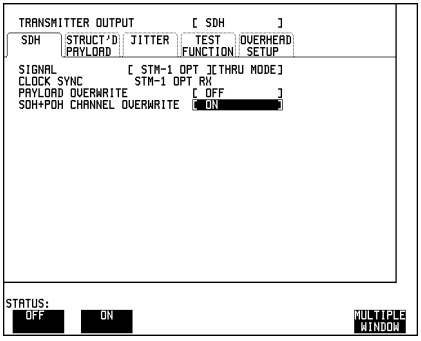
A new path overhead is generated and the B3 BIP is recalculated.

The payload is selected as for SDH Internal mode.



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

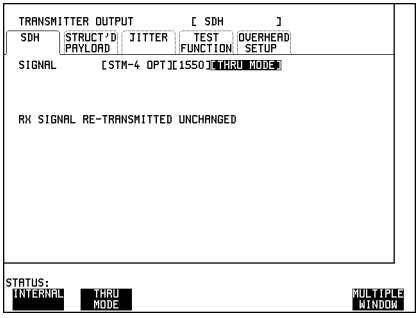
The user can only modify certain overhead bytes by using one of the TRANSMIT test functions: Errors & Alarms, Sequences, Overhead BER, MSP Messages, DCC Insert and Stress Test.



The overhead cannot be modified using OVERHEAD SETUP.

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

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



Transmit Static Overhead (Option A1T (A1U) only)

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

Path Overhead

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

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

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

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

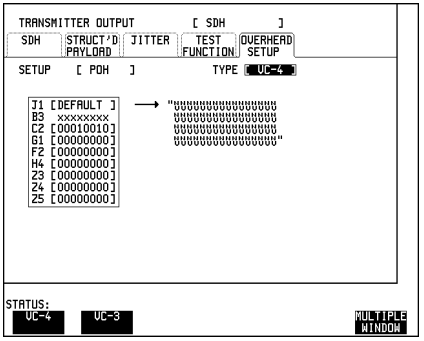
Path Trace The path trace capability allows:

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

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

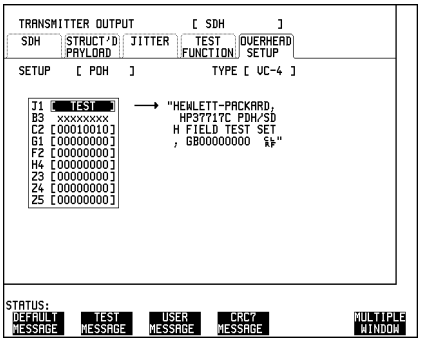
V C-3/VC-4 Path Trace

1 Press TRANSMIT; **SDH**; **OVERHEAD SETUP** and using ← ↑ ↓ → and the display softkeys set up the TRANSMIT display as shown opposite.

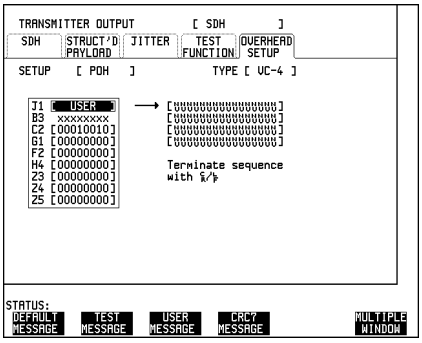


2. Selection of **DEFAULT MESSAGE** programs the J1 byte to carry 64 ASCII Null characters.

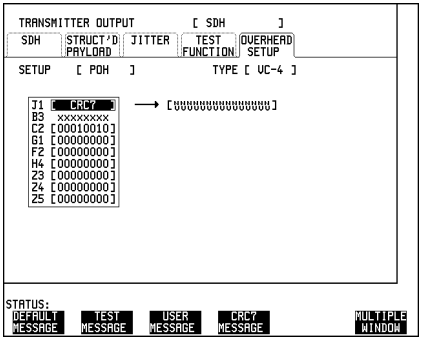
3. Selection of **TEST MESSAGE** programs the J1 byte to carry the displayed HP 37717C test message.



4. Selection of **USER MESSAGE** allows the user to program the message content of the J1 byte with up to 62 ASCII characters followed by CR LF.

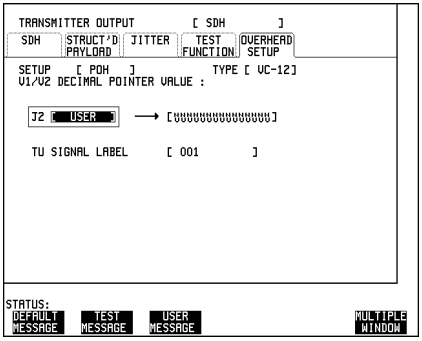


5. Selection of **CRC7 MESSAGE** allows the user to program the message content of the J1 byte with up to 15 ASCII characters (padded out with ASCII Null characters if necessary) followed by a frame marker byte with CRC7.



VC-2/VC-12 Path Trace

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



Section / Transport Overhead

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

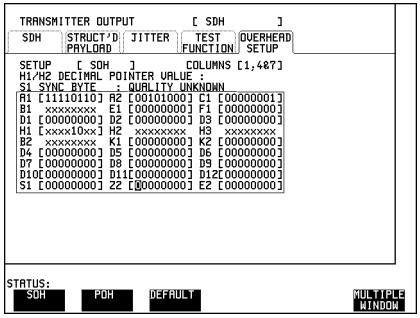
If columns 2,5,8 or 3,6,9 are selected only bytes A1,A2; H1 - H3; B2; Z1 and Z2 are labelled as the other overhead functions have not yet been defined. The value of each bit of Section / Transport overhead bytes: A1,A2; H1; H2; Z1; Z2 and all the bits of the unlabeled functions can be set to 0 or 1.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

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

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

1. Press TRANSMIT; SDH; OVERHEAD SETUP and using ← ↑ ↓ and → set up the TRANSMIT display as shown opposite

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

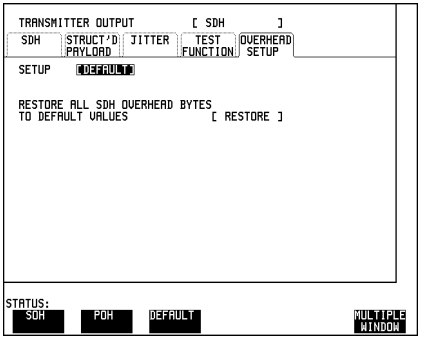


Static Overhead Known (Default) Conditions

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

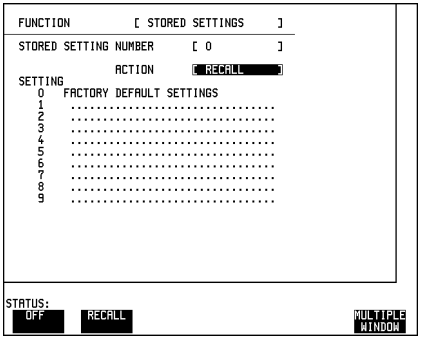
1. Set up the TRANSMIT; OVERHEAD SETUP display as shown opposite. This returns overhead, not set by a TRANSMIT test function to the known (default) state.

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



2. Set up the OTHER; STORED SETTINGS display as shown opposite.

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



Transmit Overhead Sequence

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

Overhead Bytes

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

If TRANSMIT PAYLOAD [TU2] or [TU12] is selected sequences can only be inserted into the H4 byte using TRANSMIT; OVERHEAD SETUP.

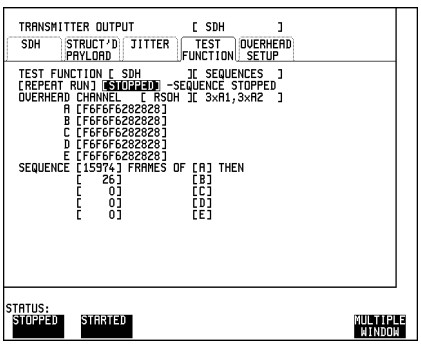
The sequence is derived from 5, user defined, hexadecimal blocks of data. Each block of data can be transmitted in up to 64000 frames.

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

Transmit Frame Synchronization Sequence

1. Press TRANSMIT; SDH TEST FUNCTION and using ← ↑ ↓ and → and the display softkeys set up the display as shown opposite.

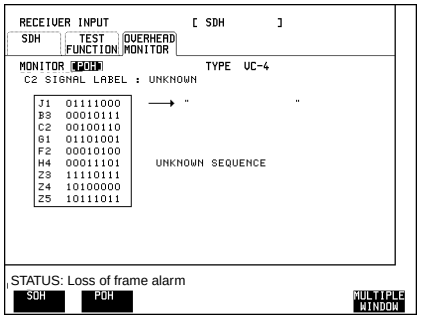
Press STARTED to start the sequence. As a result of this sequence one OOF alarm and one LOF alarm should occur every two seconds.



Receive Overhead Monitor

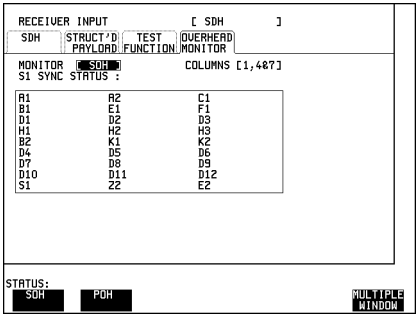
When first connecting to a network a start-up confidence check can be made by viewing the behavior of all the overhead bytes. If the network shows alarm indications, some diagnosis of the problem may be gained from viewing all the overhead bytes. This facility is provided on the RECEIVE display under **OVERHEAD MONITOR**.

All path overhead bytes are monitored and displayed. VC4 path overhead is shown opposite. If TRANSMIT PAYLOAD [TU3] is selected VC-3 path overhead can be monitored and displayed. If TRANSMIT PAYLOAD [TU12] is selected VC-12 path overhead can be monitored and displayed.



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

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



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

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

Receive Overhead Capture

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

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

Trigger OFF start immediately the capture is initiated

Trigger ON capture activity after a specified overhead state has occurred

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

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

Trigger ON and ON NOT can be used for “transient detection” from a specified expected state.

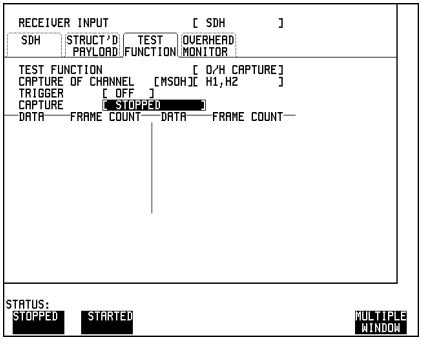
The overhead capture feature provides up to 16 records of overhead state. Each record will represent between 1 and 64,000 frames. A capture is started by pressing STARTED and terminates when 16 records have been captured. The capture can be terminated sooner by pressing STOPPED.

Frame by Frame Monitor of H1,H2

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

1. Press RECEIVE; SDH; TEST FUNCTION; OVERHEAD CAPTURE and using ⬅ ⬆ ⬇ and ➡ and the display softkeys set up the RECEIVE display as shown opposite.

Press STARTED to start the capture.

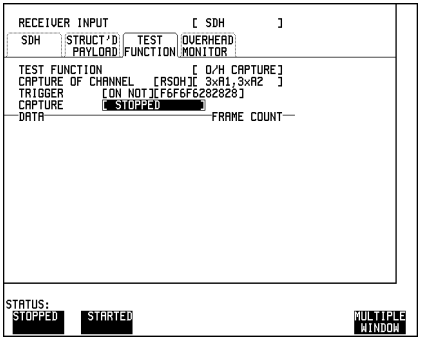


Transient Detection on A1,A1,A1,A2,A2,A2

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

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

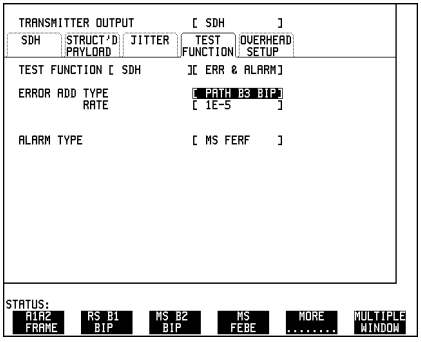
Press STARTED to start the capture.



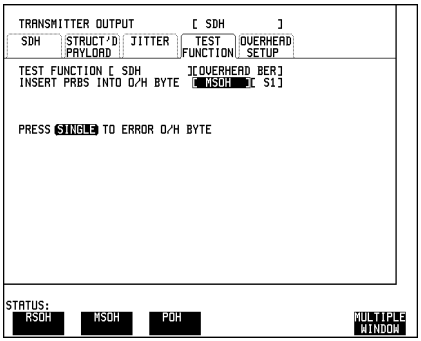
Errors and Alarms

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

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

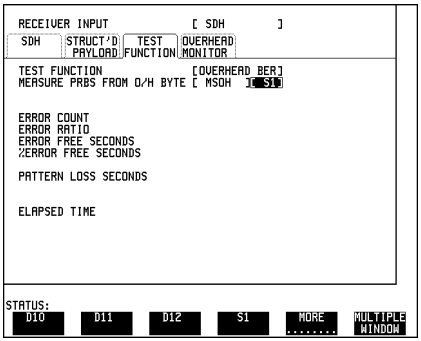


Overhead Bit Error Rate (A1T (A1U) only)



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

Single bit errors can be added to the PRBS test pattern.

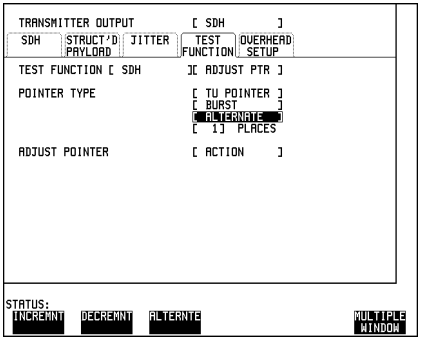


2. The **RECEIVE**; **OVERHEAD BER** test function counts the errors present in the PRBS test pattern within the user selected overhead byte.

Results of Error Seconds, Error Ratio, Error Free Seconds,% Error Free Seconds, Pattern Loss Seconds and Elapsed Time are displayed.

Add Pointer Adjustments (A1T (A1U) only)

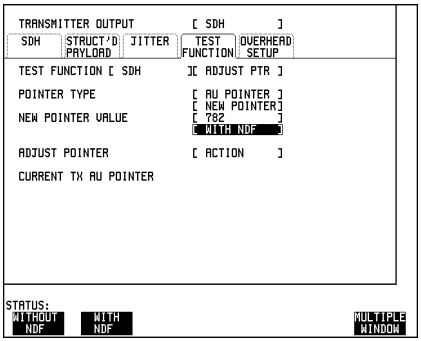
The **TRANSMIT**; **ADJUST POINTER** test function allows the transmitted AU or TU pointer value to be changed for testing purposes in four different ways:



1. **BURST** provides a burst of pointers. The size of the burst is determined by the number of PLACES selected. In this example 5 PLACES are selected and the pointer value will be stepped five times in unit steps e.g. 0 (start value), 1, 2, 3, 4, 5 (final value). The interval between steps is 4 frames (500 us).
The direction of change is determined by the **INCREMENT**, **DECREMENT**, **ALTERNATE** selection.
If **ALTERNATE** is selected the burst will be in the opposite direction to the preceding burst.
The burst is transmitted when ADJUST POINTER **ACTION** is selected.

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

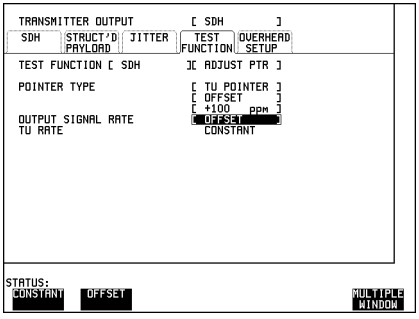
The current Pointer value is displayed for reference. The New Pointer is transmitted when ADJUST POINTER **ACTION** is selected.



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

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

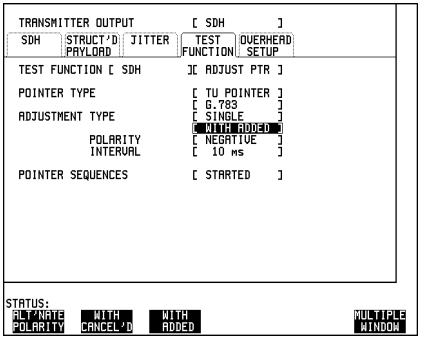
If the line rate is offset the TU rate is locked to the reference. If the TU rate is offset the line rate is locked to the reference.



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

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

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



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

d. Periodic Double adjustments (pair of adjustments). The pair alternate in polarity. The spacing between pairs of adjustments, of like polarity, is 4 frames (500).

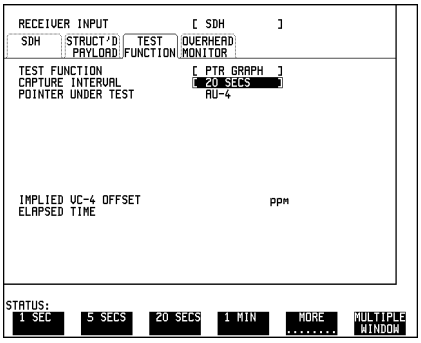
In all cases the interval between adjustments (between pairs in d) is user selectable.

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

Pointer Graph (A1T (A1U) only)

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

The capture interval is user programmable.



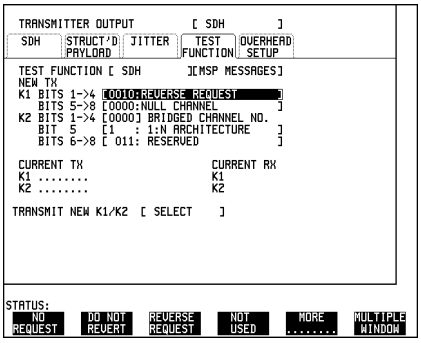
MSP (Multiplexer Section / Transport Protection) Messages

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

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

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

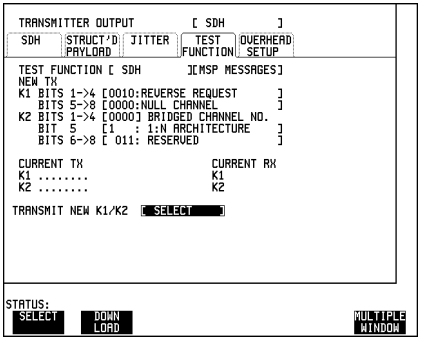
K2 BITS 6->8 select the Reserved bits (Not Defined as yet).



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

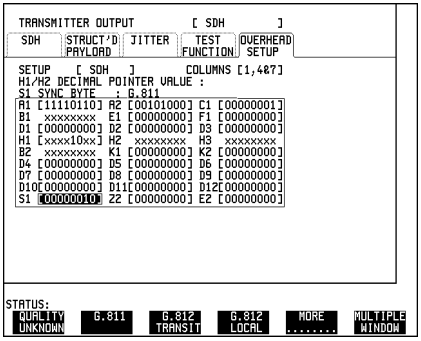
To set the new K1/K2 values select TRANSMIT NEW K1/K2 [SELECT].

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



SYNC Messages

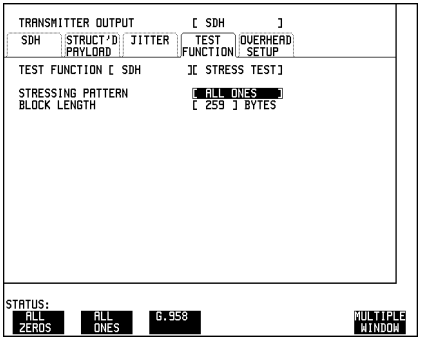
TRANSMIT; SDH ; TEST FUNCTION ; SYNC MESSAGES (Option US1 (US5) only) allows user programming of bits 5 to 8 of Multiplexer Section / Transport overhead byte S1. The current received value of S1 (Sync byte) is displayed for reference.



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

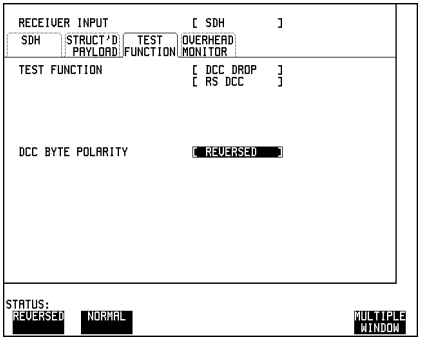
Optical Clock Recovery Stress (A1T (A1U) only)

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



DCC Insert and Drop (A1T (A1U) only)

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

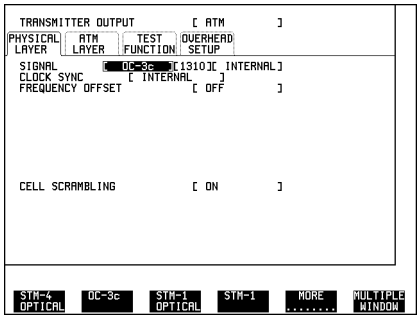


Optical Power Measurement (Options USN and UKT Only)

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

Select the required input signal rate on the **RECEIVE** display.

Select the required wavelength and view the result on the **RESULTS** display.

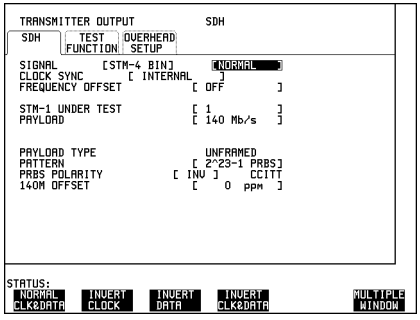


STM-1/STM-4 Binary Interface (Option OYH with USN or UKT)

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

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

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



2

SDH / SONET Application Measurements

Add/Drop Multiplexer Testing

Application

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

Default (Known State) Settings

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

Add/Drop Multiplexer Testing Test Setup Procedure

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

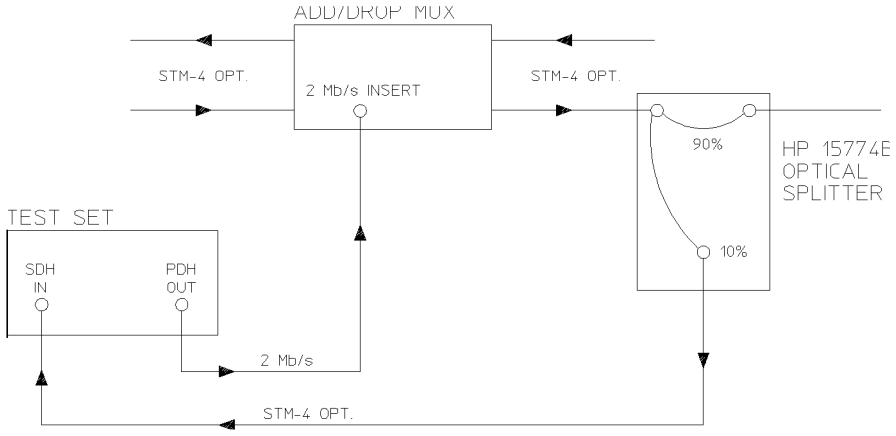
- UKJ (USA)or UKK (USB) - PDH Module
- US1 or A1T (A1U) - SDH / SONET Module
- UH2 or URU- STM-1/4 Optical Interface

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

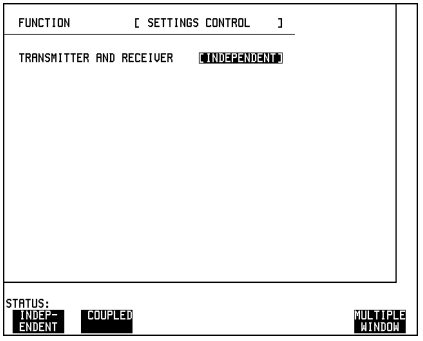
An Error measurement is performed on the demapped 2 Mb/s tributary test pattern.

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

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

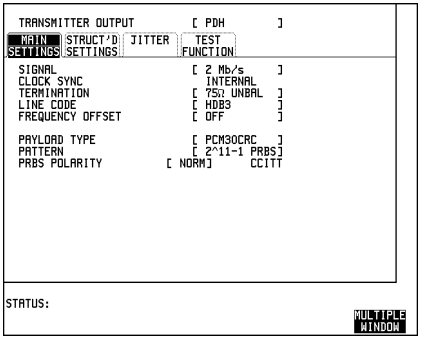


1. Connect the HP 37717C to the network equipment and set up the **OTHER**; **SETTINGS CONTROL** display as shown opposite.

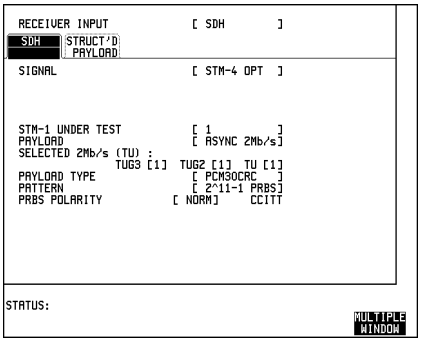


2. Set up the **TRANSMIT** display as shown opposite.

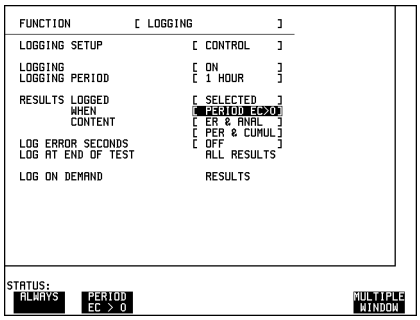
The PAYLOAD TYPE determines the Framing..



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



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



Continuity Check

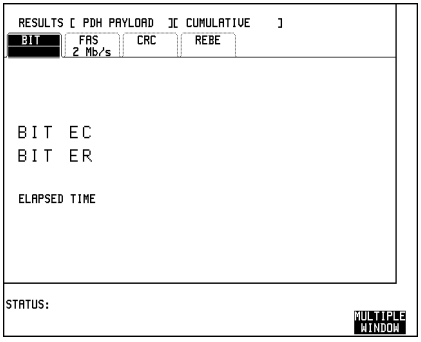
Before running the test carry out a continuity test to verify the measurement path.

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.

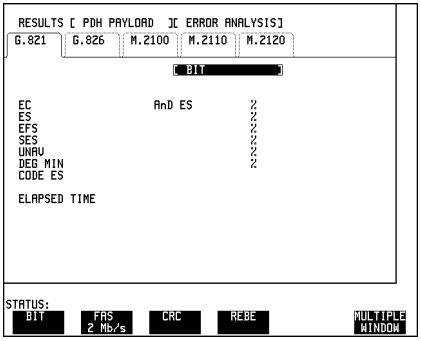
4. Press **RUN/STOP** to stop the measurement.



Start the Add/Drop Multiplexer Test

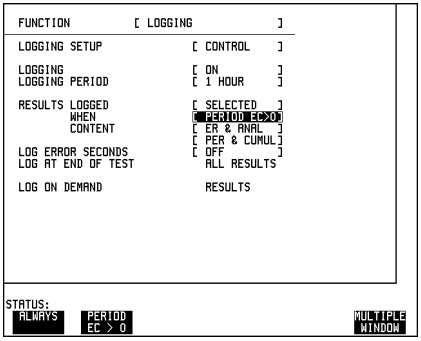
1. Set up the **RESULTS** display as shown opposite.If you do not require stored graphics results select STORAGE [OFF].

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



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

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



At the End of the Test (Add/Drop Multiplexer Testing)

- The Date and Time the test started and the instrument setup are logged on the internal printer.
- Results are logged on the internal printer at 1 hour intervals if the error count is greater than 0.
- Any alarms which occur during the test period will be logged on the internal printer.
- At the end of the test period a complete set of cumulative results are logged on the internal printer.
- A graphical record of the results during the test period can be viewed on the **GRAPH** display. If Remote Control option A3B, A3D, 1A8 or 1CW is fitted the graph results can be logged to an external printer, at a later date. See *Graphics* and *External HP 550C DeskJet Printer.*

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

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

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

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

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

Alarm Stimulus/Response

Application

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

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

Default (Known State) Settings

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

Alarm Stimulus/Response Test Setup Procedure

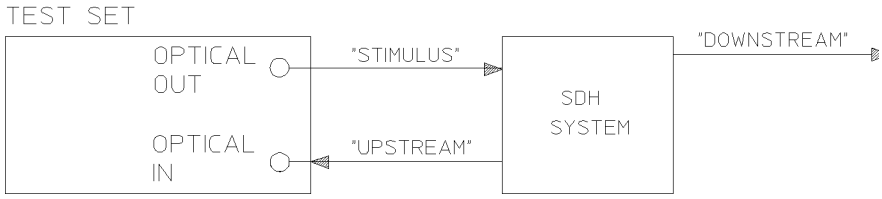
The following options must be fitted to the HP 37717C to perform this test:

- US1 or A1T (A1U) - SDH / SONET module
- UH1, UH2, URU, USN or UKT - STM-1 Optical interface

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

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

Alarm Stimulus/Response



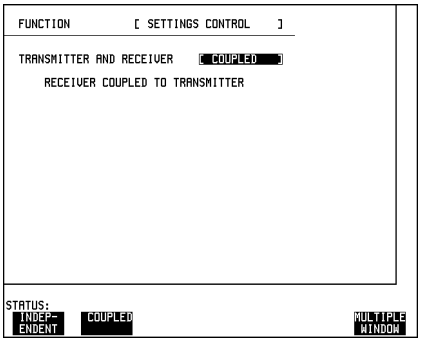
SDH Alarms

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

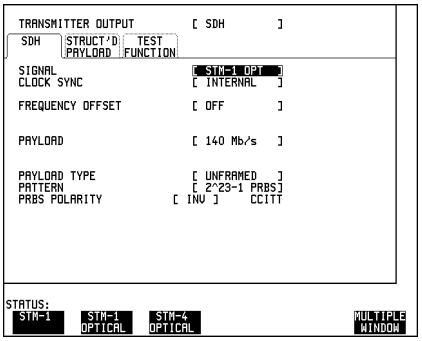
SONET Alarms

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

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

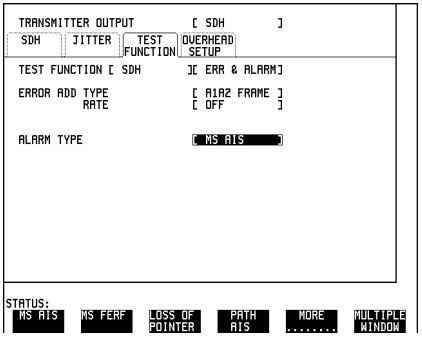


2. Set up the TRANSMIT; **SDH** display as shown opposite.

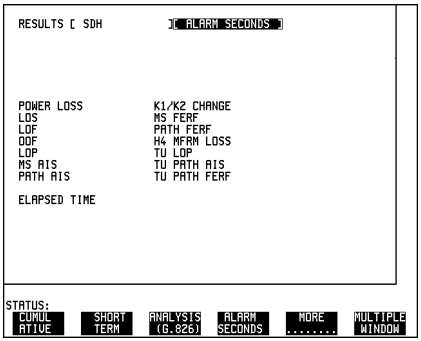


3. Set up the TRANSMIT; **TEST** **FUNCTION** display as shown opposite.

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



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



Start the Alarm Stimulus/Response Test

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

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

DCC Testing

Application

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

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

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

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

Default (Known State) Settings

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

DCC Test Setup Procedure

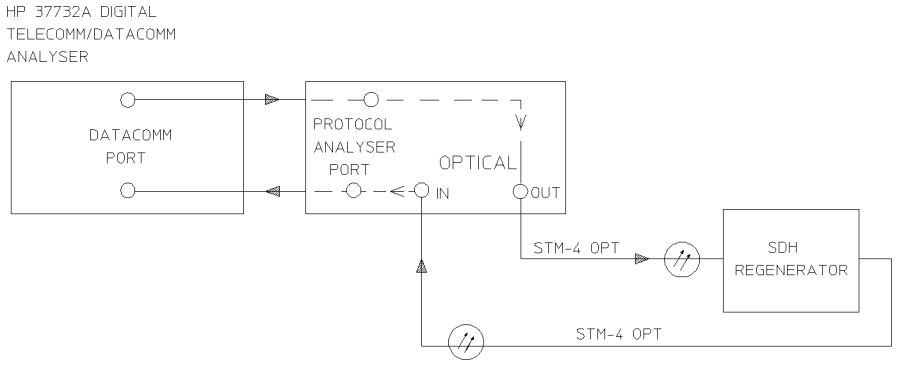
Alarm Stimulus/Response Test Setup Procedure

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

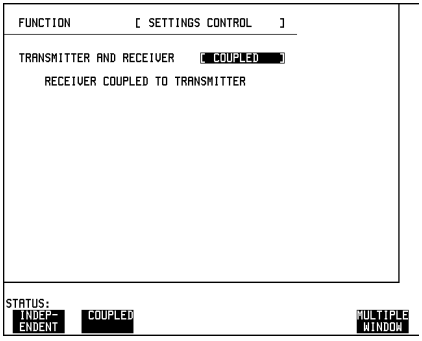
- A1T (A1U) - SDH / SONET module
- UH1, UH2, URU, USN or UKT - STM-1 Optical interface

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

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

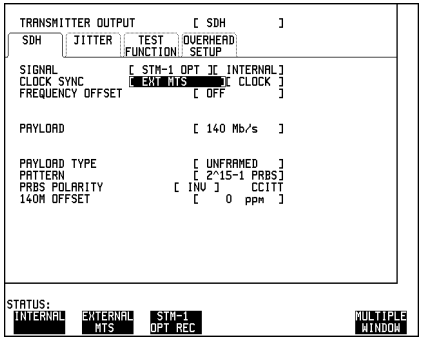


1. Connect the HP 37732A and the HP 37717C to the network element, as shown and set up the **OTHER**; **SETTINGS CONTROL** display as shown opposite.

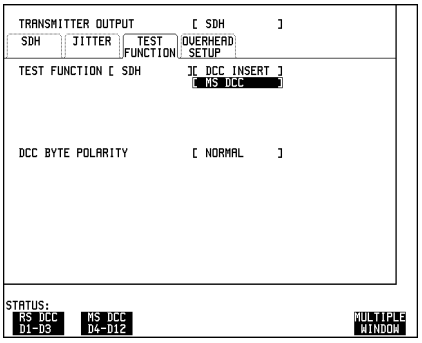


2. Set up the **TRANSMIT** SDH display as shown opposite.

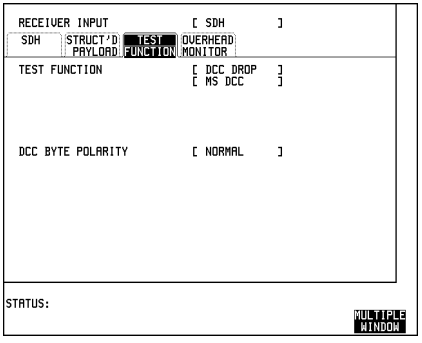
The CLOCK SYNC selection determines the synchronization source for the **TRANSMIT** clock. If **EXTERNAL MTS** is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.



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



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



Start the DCC Test

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

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

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

Desynchroniser Stress

Application

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

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

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

Default (Known State) Settings

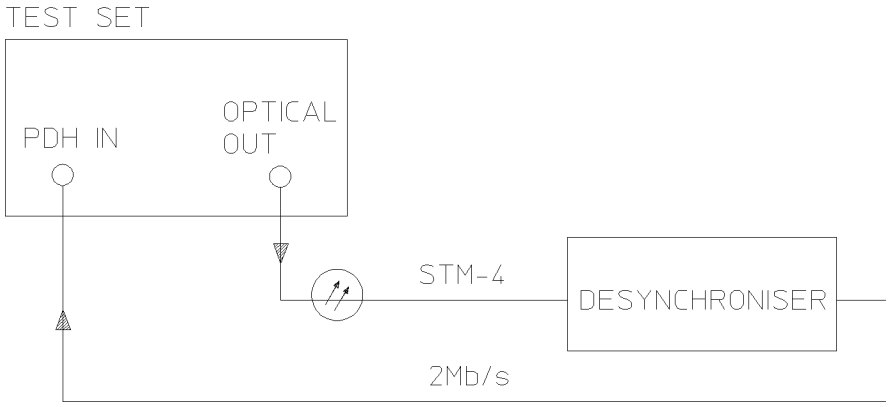
It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Desynchroniser Stress Test Setup Procedure

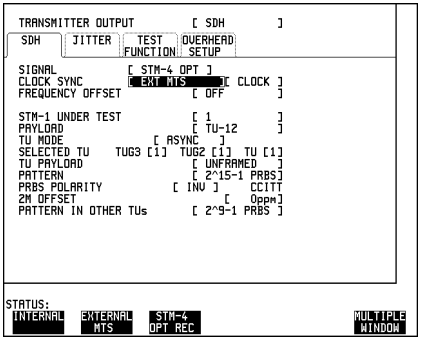
The following options must be fitted to the HP 37717C to perform this test:

- UKK (USB) or UKJ (USA)- PDH module
- UHN (US9) or A3N (A3P) - Jitter measurement module
- A1T (A1U) - SDH / SONET module
- UH1, UH2, URU, USN or UKT - STM-1/4 Optical interface

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

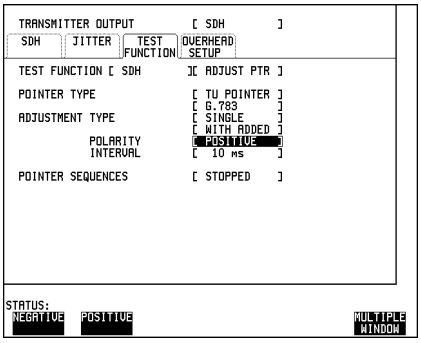


1. Connect the HP 37717C to the network equipment and set up the **TRANSMIT**; **SDH** display as shown opposite.



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

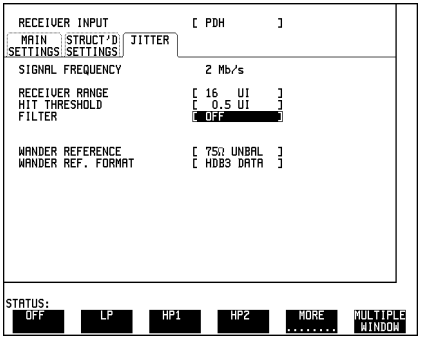
2. Set up the **TRANSMIT**; **TEST FUNCTION** display as shown opposite.



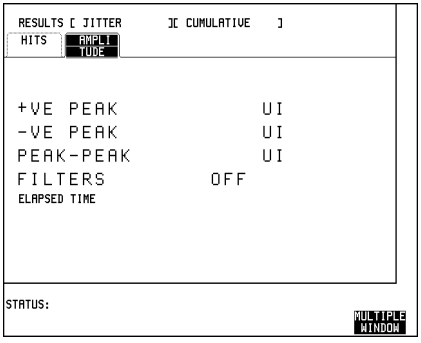
Pointer adjustments are made every 10 ms with an extra ADDED adjustment as defined in CCITT standard G.783.

Pointer sequences are started by selecting **STARTED**.

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



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



Start the Desynchroniser Stress Test

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

Frame Synchronization

Application

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

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

Default (Known State) Settings

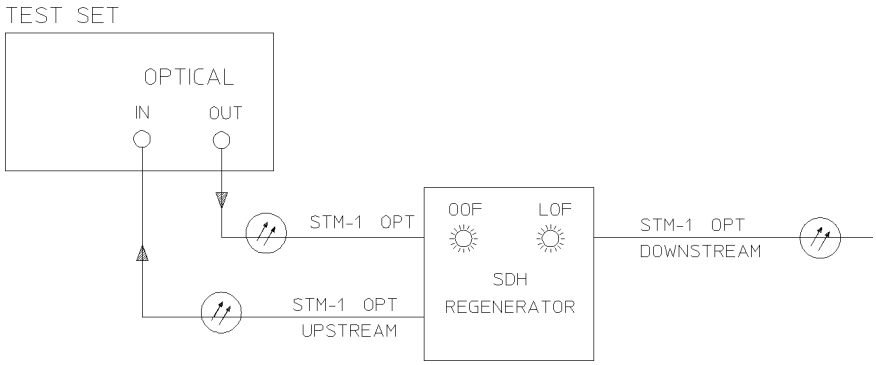
It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Frame Synchronization Test Setup Procedure

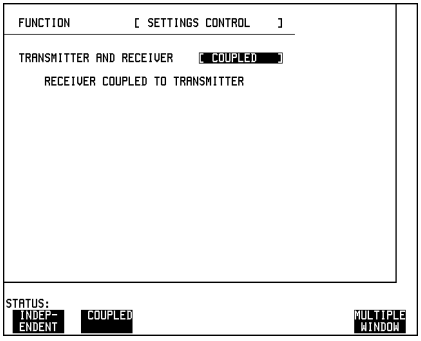
Frame Error Add Test Function In this setup the HP 37717C Communications Performance Analyzer is used to insert frame errors in the A1 and A2, framing bytes of the Regenerator section overhead of an STM-1 optical signal. The STM-1 optical signal is transmitted to the network equipment. The network equipment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

Sequence Generation Test Function

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

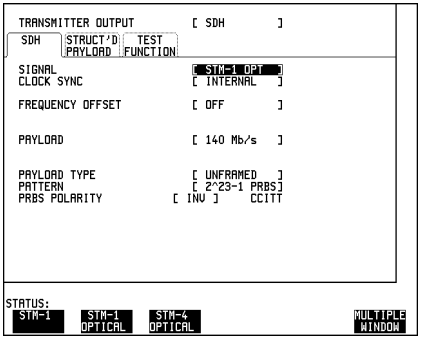


1. Connect the HP 37717C to the network equipment and set up the **OTHER**; **SETTINGS CONTROL** display as shown opposite.

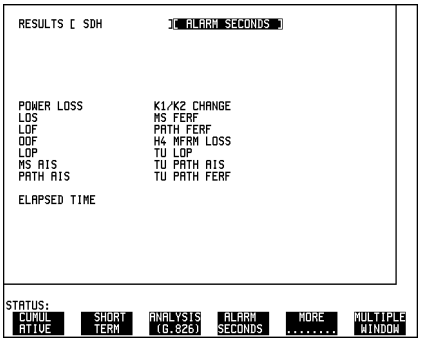


2. Set up the **TRANSMIT**; **SDH** display as shown opposite.

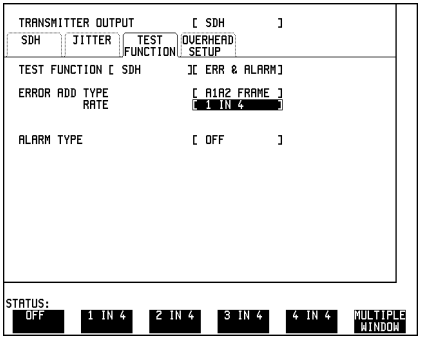
The CLOCK SYNC selection determines the synchronization source for the **TRANSMIT** clock. If **EXTERNAL MTS** is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.



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



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



Start the Frame Synchronization Test (Frame Error Add)

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

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

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

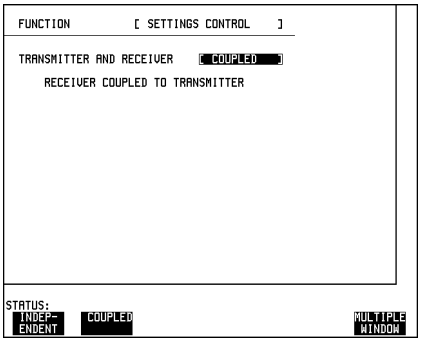
4. Increase the Frame Error Add Rate to 4 IN 4 and check that the OOF and LOF alarm indicators on the network equipment are lit and occurrences of MS FERF are recorded.

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

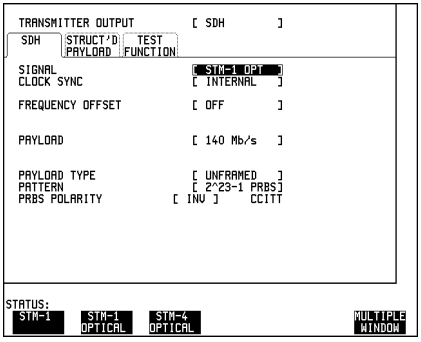
6. Decrease the Frame Error Add Rate to 2 IN 4 and check that the OOF and LOF alarm indicators on the network equipment go off, and no further occurrences of MS FERF are recorded.

Sequence Generation Test Function

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

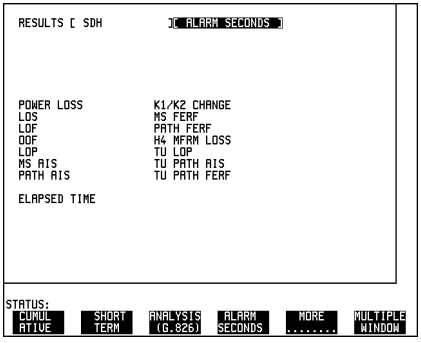


2. Set up the **TRANSMIT**; **SDH** display as shown opposite.

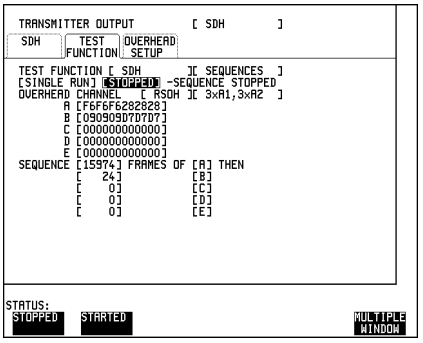


The CLOCK SYNC selection determines the synchronization source for the **TRANSMIT** clock. If **EXTERNAL MTS** is selected a 2 Mb/s reference must be connected to the front panel 2M REF IN port. The format can be CLOCK or DATA.

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



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

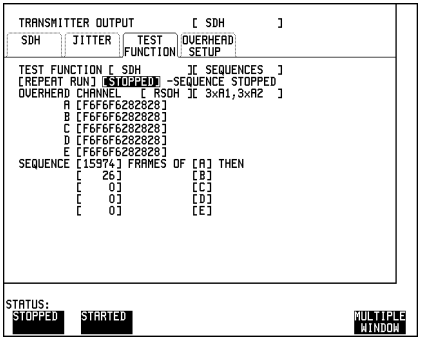


Start the Frame Synchronization Test (Sequence Test)

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

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

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



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

5. Check that the network element OOF alarm indicator cycles ON and OFF. The LOF alarm should not occur and no occurrences of MS FERF should be recorded.

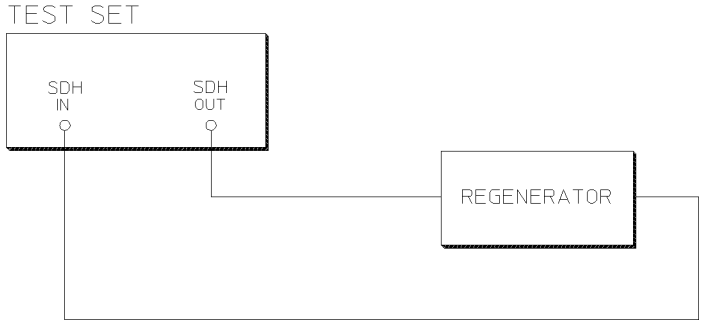
SDH Jitter Transfer

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

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

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

When the network equipment meets CCITT specification G.823 it should be possible to connect network elements without incurring bit errors.



Default (Known State) Settings

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

Test Setup Procedure (Jitter Transfer Test)

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

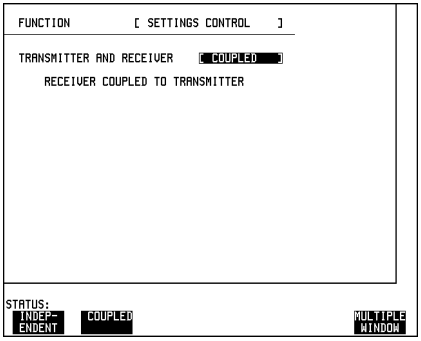
- UHK - Jitter Generation

- A1N (A1R), A1P (A1S), A3L (A3M), A3V (A3W) or A3N (A3P) - SDH Jitter Measurement
- US1 or A1T (A1U) - SDH Module

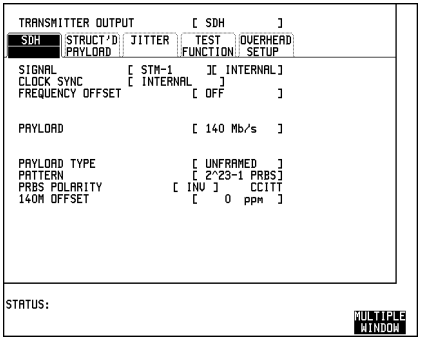
This setup procedure is based on 155.52 Mb/s (STM-1), 140 Mb/s payload, PRBS test data with jitter. The Jitter frequency is varied within the jitter bandwidth and the received jitter is measured to allow calculation of the jitter gain. The internal printer is enabled for recording of results and alarms.

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

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

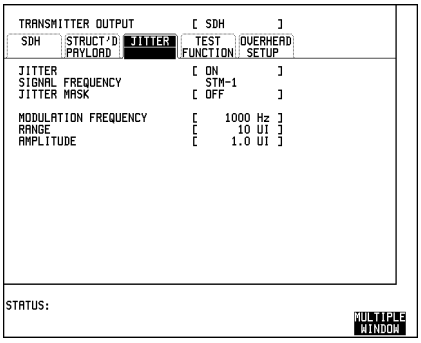


2. Connect the HP 37717C to the line equipment, select **TRANSMIT**; **SDH** and set up the display as shown opposite.



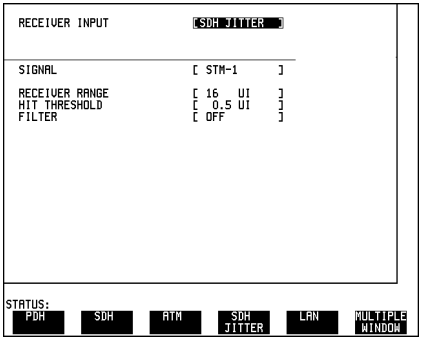
3. Select **TRANSMIT**; **JITTER** and set up the display as shown opposite.

Select the required Jitter MODULATING FREQUENCY and AMPLITUDE.



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

If Jitter filtering is required select from the softkey menu.

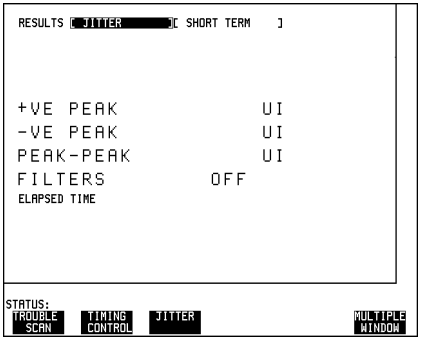


Run the Test (Jitter Transfer)

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

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

3. Record the Jitter Amplitude result from the **RESULTS** display.



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

5. Calculate the Jitter gain for each frequency selected.

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

MSP Stimulus/Response

Application

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

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

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

- Loss Of Signal (LOS)
- Loss Of Frame (LOF)
- Signal Fail - Bit Error Ratio > 1 X 10^{-3}
- Signal Degrade - Bit Error Ratio programmable
- MS AIS

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

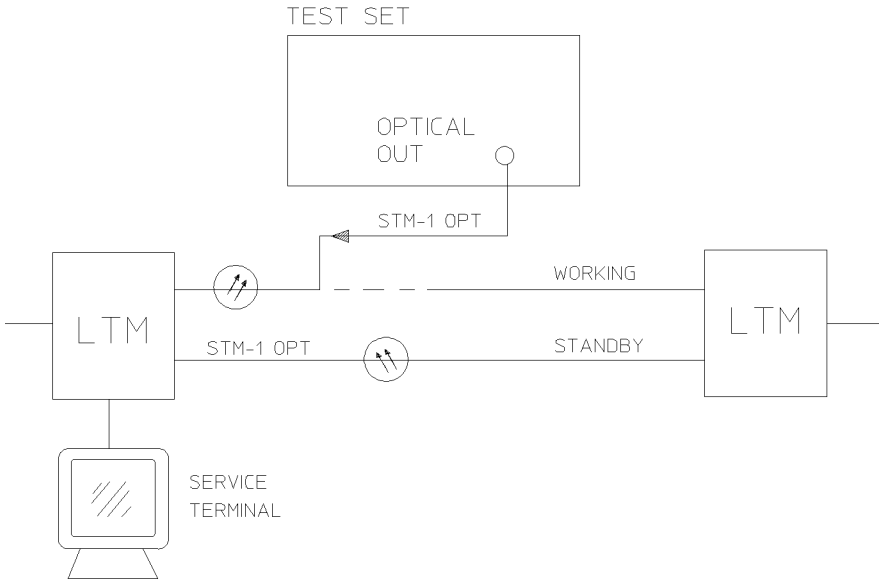
The HP 37717C Communications Performance Analyzer can be used to test Multiplexer Section Protection switching by:

Generating the switching conditions listed above.

Transmitting and monitoring the K1 K2 messages.

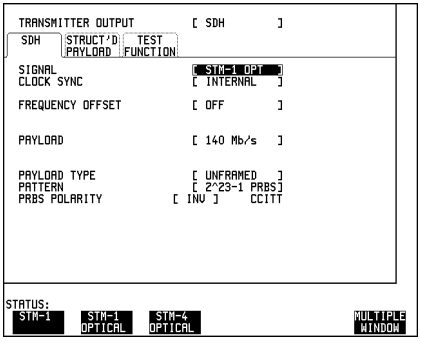
MSP Stimulus/Response 1+1 Architecture Test Setup Procedure

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



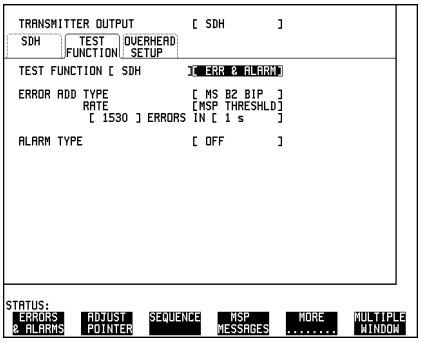
1. Set up the **TRANSMIT**; **SDH** display as shown opposite.

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



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

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



MSP Stimulus/Response 1:N Architecture

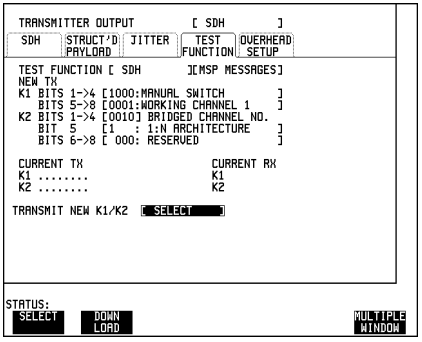
The HP 37717C Communications Performance Analyzer **TRANSMIT**; **TEST FUNCTION**; **MSP MESSAGES** can be used to transmit and monitor the K1 K2 messages.

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

Two displays of K1 and K2 are provided:

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

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



K1 Bits 1 ->4 Selects the MSP message to be transmitted.

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

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

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

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

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

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

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

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

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

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

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

Optical Clock Recovery Stress

Application

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

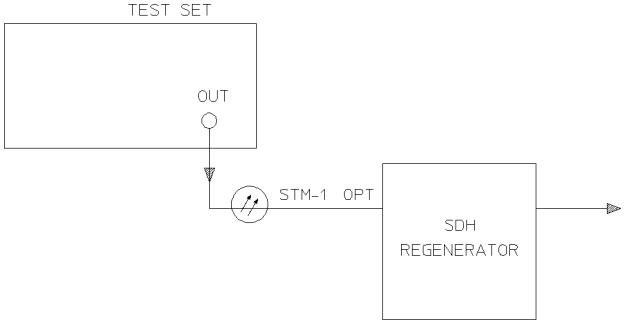
The optical clock recovery performance of the network equipment can be measured by increasing the length of a zero substitution block until errors occur.

Default (Known State) Settings

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

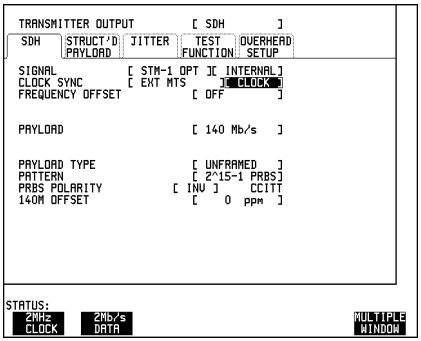
Optical Clock Recovery Stress Test Setup Procedure

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



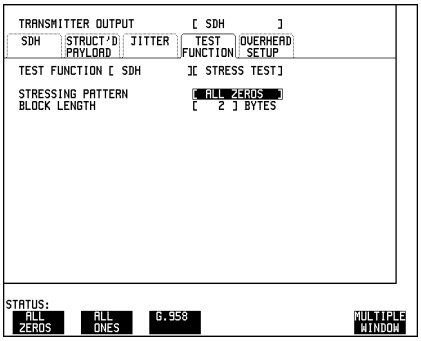
Optical Clock Recovery Stress

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



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

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



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

Start the Optical Clock Recovery Stress Test

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

Payload Mapping/Demapping

Application

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

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

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

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

Default (Known State) Settings

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

Payload Mapping/Demapping Test Setup Procedure

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

- US1 or A1T (A1U) - SDH / SONET Module
- UH1, UH2, URU, USN or UKT - STM-1/STM-4 Optical Interface

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

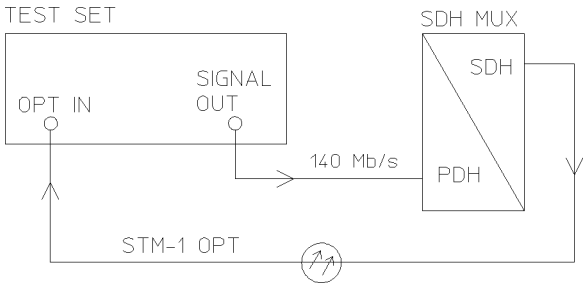
For demapping an STM-4 Optical signal is transmitted into the high-rate side of the Add Drop multiplexer. The 140 Mb/s signal, on the low-rate side of the Add Drop multiplexer, is received by the HP 37717C Communications Performance Analyzer.

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

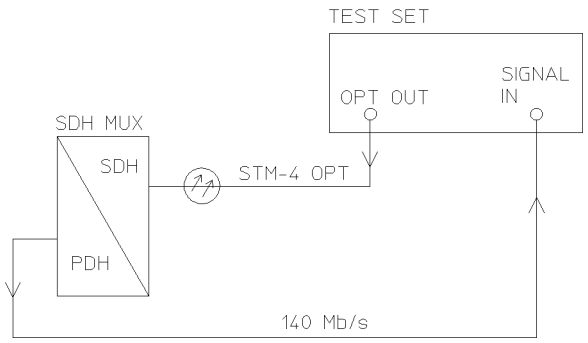
A SINGLE test period of 24 HOURS is used and the internal printer is enabled to record results and alarms.

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

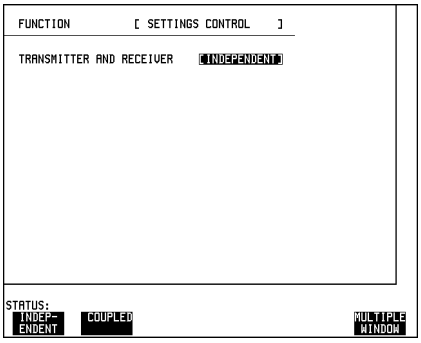
Payload Mapping



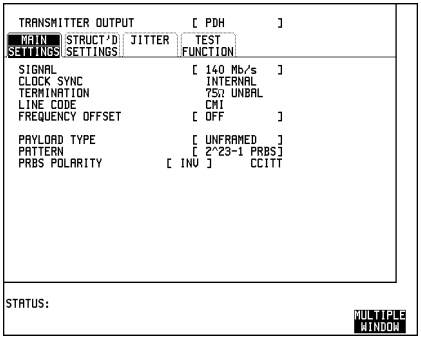
Payload Demapping



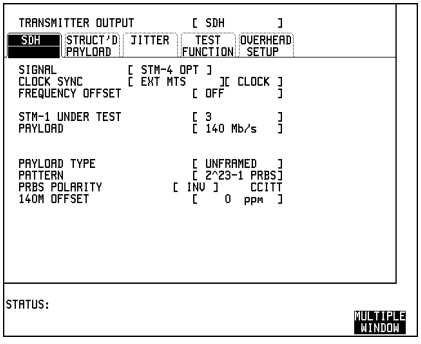
1. Connect the HP 37717C to the network equipment and set up the **OTHER** **SETTINGS CONTROL** display as shown opposite.



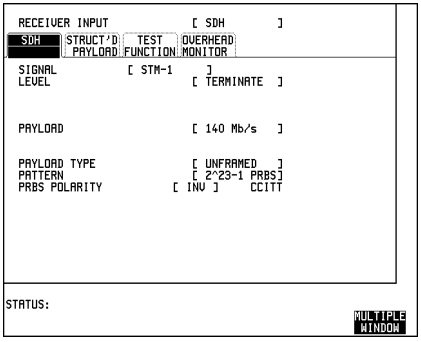
2. For Mapping set up the **TRANSMIT** display as shown opposite.



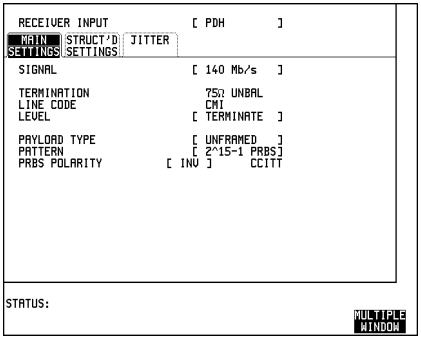
2a. For Demapping set up the **TRANSMIT** display as shown opposite.



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

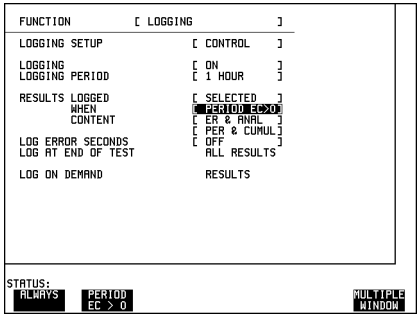


3a. For Demapping set up the **RECEIVE** display as shown opposite.



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

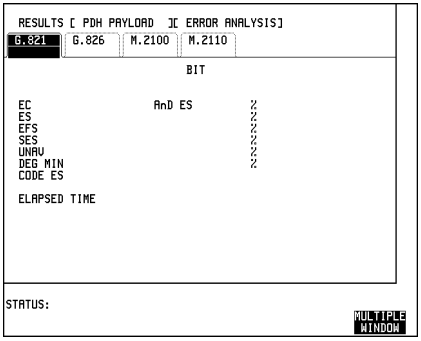
All results are logged on the internal printer at 1 hour intervals. Any alarms which occur during the test period will be logged on the internal printer.



Start the Payload Mapping/Demapping Test

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

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



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

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

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

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

- The Date and Time the test started and the instrument setup are logged on the internal printer.
- All results are logged on the internal printer at 1 hour intervals.
- Any alarms which occur during the test period will be logged on the internal printer.
- At the end of the test period a complete set of cumulative results are logged on the internal printer.
- A graphical record of the results during the test period can be viewed on the GRAPH display. If Remote Control option A3B, A3D, 1A8 or 1CW is fitted the graph results can be logged to an external printer, at a later date. See *Graphics* and *External HP 550C DeskJet Printer.*
- Results and Alarm summaries can be viewed on the **GRAPH** display.

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

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

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

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

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

Performance Monitor Stimulus/ Response

Application

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

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

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

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

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

PATH - B3 Byte of path overhead

Default (Known State) Settings

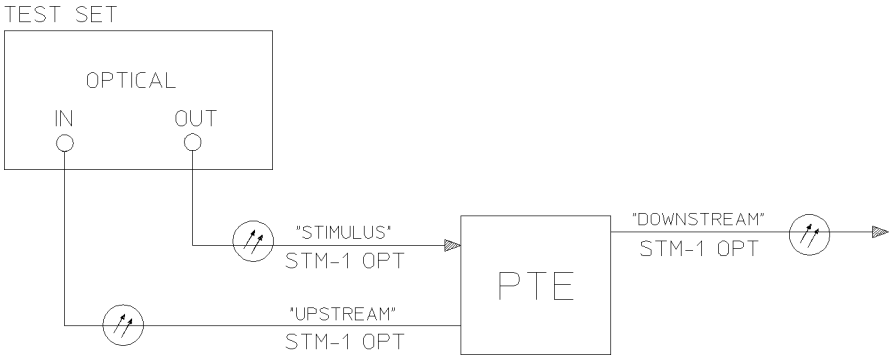
It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

Performance Monitor Stimulus/Response Test Setup Procedure

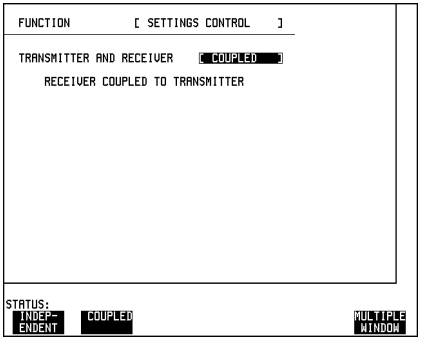
The following Options must be fitted to the HP 37717C to perform this test:

- US1 or A1T (A1U) - SDH / SONET Module
- UH1, UH2, URU, USN or UKT - STM-1/STM-4 Optical Interface

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

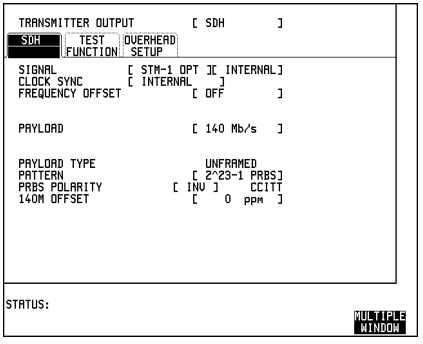


1. Connect the HP 37717C to the network equipment and set up the **OTHER**; **SETTINGS CONTROL** display as shown opposite.



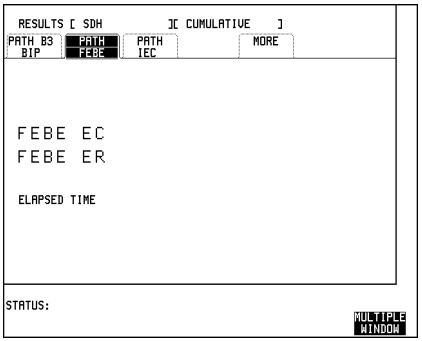
2. Set up the **TRANSMIT**; **SDH** display as shown opposite.

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



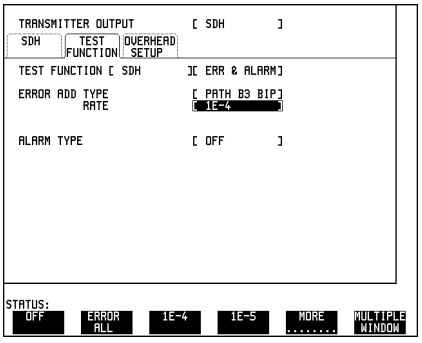
3. Set up the **RESULTS** display as shown opposite.

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



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

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



Start the Performance Monitor Stimulus/Response Test

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

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

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

At the end of the test:

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

Selective Jitter Transfer Measurement

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

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

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

Default (Known State) Settings

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

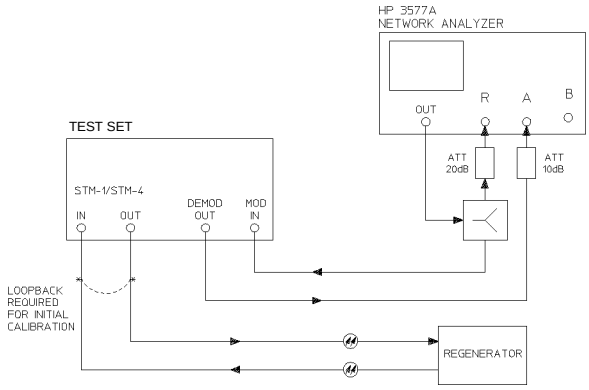
Test Setup Procedure (Jitter Transfer Test)

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

- A3K - Jitter Generation
- A1M, A1N, A1P, A3L, A3V or A3N - SDH Jitter Measurement
- US1 or A1T - SDH Module

Selective Jitter Transfer Measurement

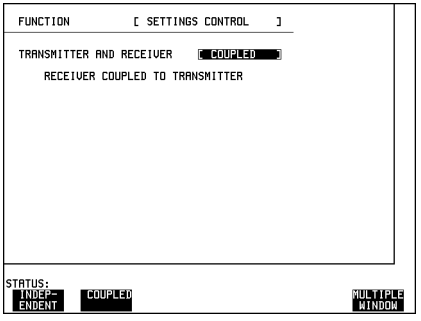
This setup procedure is based on 155.52 Mb/s (STM-1), 140 Mb/s payload, PRBS test data with jitter. The jitter modulation is provided by the network analyzer. The HP 37717C demodulated jitter output is returned to the network analyzer for measurement. Before connecting to the regenerator to be tested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



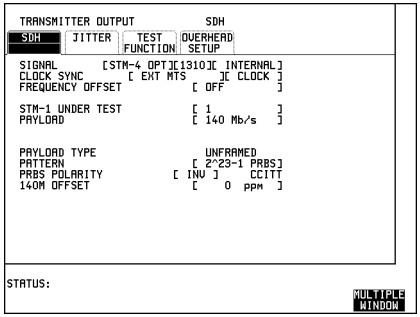
Selective Jitter Transfer Test

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

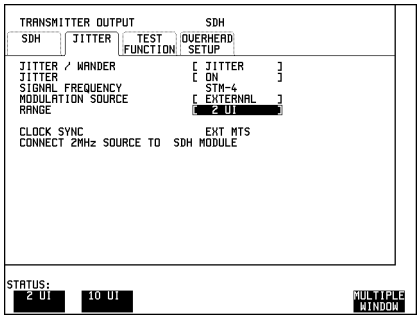
Any SDH settings change made on the **TRANSMIT** or **RECEIVE** displays will automatically occur on the other.



2. Connect the HP 37717C to the network analyzer as shown. Connect STM-1/STM-4 IN to STM-1/STM-4 OUT. Select **TRANSMIT** **SDH** **SDH** and set up the display as shown opposite.

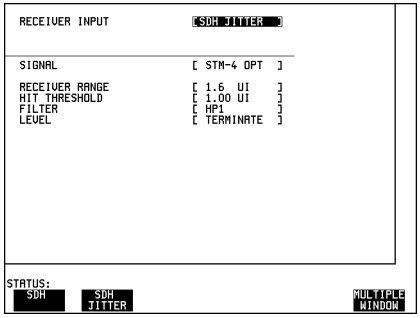


3. Select **TRANSMIT** **SDH** **JITTER** and set up the display as shown opposite.



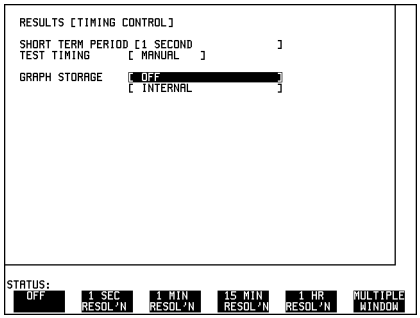
4. Setup the **RECEIVE** **SDH JITTER** display as shown opposite.

If Jitter filtering is required select from the softkey menu.



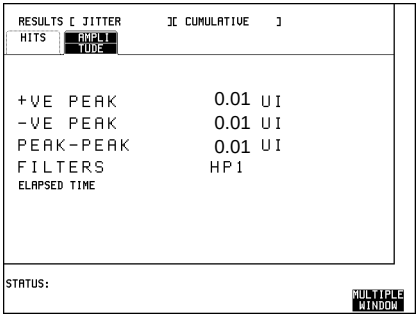
5. Select **RESULTS** and set up the display as shown opposite.

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



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

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



8. Start the network analyzer sweep and store the resultant “reference trace”

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

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

3

ETSI / ANSI Terminology

A table of ETSI Terms with their ANSI equivalents.

ETSI / ANSI Equivalent Terms

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

ETSI Term	ANSI Term
I-n Inter Office, STM-n	Intermediate Reach (IR)
L-n.1 or L-n.2 long haul	LR long reach
Multiplexer Section (MS)	Line
MS-AIS	Line AIS (AIS-L)
MS-BIP	Line BIP
MS-DCC	Line DCC
MS FERF	Line FERF
MS-RDI	RDI-L
Multiplexer Section Overhead	Line Overhead
Network Node Interface	Line Interface
Path AIS	AIS-P
Path FERF	RDI-P
Regenerator	Repeater
Regenerator Section (RS)	Section
Remote Alarm Indicator	Yellow Alarm
Regenerator Section Overhead	Section Overhead
RS-DCC	Section DCC
S-n.1 or S-n.2 short haul	Short Reach (SR)
STM-n	STS-n
SOH	TOH
Section Overhead (SOH)	Transport Overhead (TOH)

ETSI / ANSI Equivalent Terms

ETSI Term	ANSI Term
Tributary Unit (TU)	Virtual Tributary (VT)
TU	VT
TU AIS	VT AIS (AIS-V)
TU FERF / TU RDI	RDI-V / VT FERF
TU REI	VT FEBE
VC	SPE
Virtual Container	Payload Envelope
Virtual Container (VC)	Synchronous Payload Envelope (SPE)
VP-FERF	VP-RDI
VC-FERF	VC-RDI

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

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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 prestored 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 37717-90284 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 SDH / SONET 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

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