SDH / SONET Operating Manual

HP 37717C Communications Performance Analyzer

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



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

Hewlett-Packard Limited Communications Measurements Division South Queensferry West Lothian, Scotland EH30 9TG SDH / SONET Operating Manual

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.

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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.

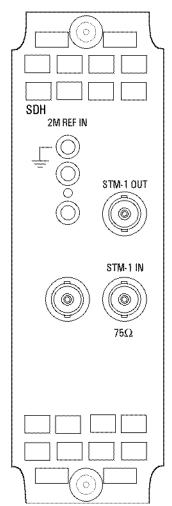
This means that SDH / SONET can be deployed as an overlay to the existing network thus providing enhanced network flexibility.

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.

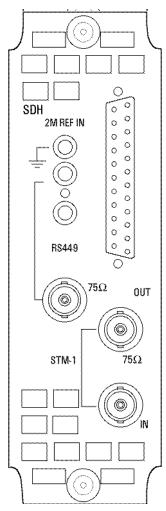
Payloads of 140 Mb/s, 34 Mb/s and 2 Mb/s are available.(If Option UKJ U.S.A. Structured PDH is fitted, Structured Payloads are available and a 2Mb/s Insert port is provided.)

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 \pm 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.

SDH STRU PAYL SIGNAL CLOCK SYNC FREQUENCY O	CAD E STM- E INTE	E ON	SETUP	
PAYLOAD TU MODE SELECTED TU TU PAYLOAD PATTERN PRBS POLARI 2M OFFSET PATTERN IN I	TUG3 [1]	ASYNC] 1 TUG2 [1] 2 TUG2 [1] 1 UNFRF 2^15- 1 INV] 1 INV] 1 INV]	TU [1]	

TRANSMITTER DUTPUT E SDH] SDH STRUCT'D JITTER TEST OVERHEAD FUNCTION SETUP	
SIGNAL C STM-1 OPT JC INTERNALJ CLOCK SYNC TIMERNALJ FREQUENCY OFFSET C ON J t +0.0 ppm J	
PP(UGR) [III-12]] TU MODE [RSYNC]] TU MODE [RSYNC]] TU SEVE [SYNC]] TU SEVE [CSYNC]] TU SEVE [CSYNC]] TU SEVE [CSYNC]] TU SEVE [CSYNC]] PHOTERN [CSYNC] [CSYNC] PROS FOLGENTY [INU] [CCITT ZM OFFSET [INU] [COPH] PATTERN IN OTHER TUS [2~9-1 PRBS]	
STATUS: INTERNAL STM-1 MTS RECEIVE	MULTIPLE WINDOW

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

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

PATTERN allows selection of the Tributary test pattern.

OFFSET (Option A1T (A1U) only) allows the tributary payload to be frequency offset

TRANSMITTER OUTPUT L SDH J SDH STRUCT'D JITTER TEST OUENHERD FUNCTION SETURAL ELUCK STURAL STURAL CLOCK SYNC EINTEINNEL INTERNAL FREQUENCY OFFSET EN	
PRYLORD [TU-12] TU MODE [RSYNC] SELECTED TU TUB2 [1] TU PAYLORD [PRISONED] PHTTERN [21:5-1 PRB5] PATTERN IN OTHER TUS [21:5-1 PRB5]	
STATUS: UNFRHNED PCH30 PCH31 PCH30CRC MORE MULTIPL MINDOM	

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

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

SONET With ATM Payload, Settings

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

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

TRANSMITTER OUTPUT PHYSICAL ATM TEST C LAYER LAYER FUNCTION	e atm Nuerhead Setup	1	
SIGNAL COLOC SCORE CLOCK SYNC C INTERNA FREQUENCY OFFSET	310]E INTERNAL L] E DFF	1 1	
CELL SCRAMBLING	E ON	1	
STM-4 OC-3c STM-1 OPTICAL OPTIC	STM-1	MORE MULTIP	

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.

LRYER L	AYER		
	E 0C-3c	FUNCTION SETUP	
STORIC	. 00-30	30 10 10 Jenniko Holler	
INTERNAL	THRU		MILTIP

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

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

RECEIVER INPUT PHYSICAL ATM LAYER LAYER FU	E ATM TEST OVERHEAD NCTION MONITOR	3	
SIGNAL	(OC-3c	1	
CELL SCRAMBLING	E ON	1	
CELL SURAMBLING	LUN	1	
STM-4 OC-3c Optical	STM-1 STM-1 OPTICAL	MORE	MULTIPLE WINDOW

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

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

THRU Mode allows a new Payload and/or Section Overhead to be substituted in the received STM-1 SDH signal for test purposes. If PAYLOAD OVERWRITE [OFF] and SOH+POH CHANNEL OVERWRITE [OFF] are both selected the SDH signal is

The B1, B2 and B3 BIPS are not recalculated.

retransmitted without alteration.

STATUS: INTERNAL THRU MODE	MULT	
RX SIGNAL RE-TRANSMITTED UNC	CHANGED	
CLOCK SYNC STM-1 OPT PRYLOAD OVERWRITE E	T J OTHRUMMODEN RX C OFF J C OFF J	
SDH STRUCT'D JITTER	E SDH] TEST OVERHEAD INCTION SETUP	

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.

TRANSMITTER OUTPUT E SDH J SDH STRUCT'D JITTER TEST OVERHEAD PAYLORD FUNCTION SETUP	
SIGNAL ESTM-1 OPT JETHRU MODE] CLOCK SYNC STM-1 OPT RX PAVLORD DUERWRITE []][][][][][][][][][][][][][][][][][][
РАЧ. URD ГU-12 J TU MODE Г SELECTED TU TUGS (1) TUG2 (1) TU (1) SELECTED TU TUGS (1) TUG2 (1) TU PAYLORD POMODE TU PAYLORD E POMODE POMODE POMODE PATTERN E POMODE COMPANIE PARS POLARITY E INU 3 CCITT PM OFFSET C OPPM3 PATTERN IN OTHER TUS E 2^9-1 PRBS 3	
STRTUS: OFF RU=4	MULTIPLE WINDOW

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.

TRANSMITTER OUTPUT [SDH]	
SDH STRUCT'D JITTER TEST OVERHEAD PAYLOAD FUNCTION SETUP	
SIGNAL ESTM-1 OPT JETHRU MODE] Clock Sync STM-1 Opt RX Prylord Ouerwrite E off J Soh+Poh Channel Overwrite (0)	
OFF ON	MULTIPLE WINDOW

The overhead cannot be modified using OVERHEAD SETUP.

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

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

TRANSMITTER OUTPUT E SDH] SDH STRUCT'D JITTER TEST OVERHEAD PAYLORD FUNCTION SETUP		
SIGNAL [STM-4 OPT][1550][THRU NODE]		
RX SIGNAL RE-TRANSMITTED UNCHANGED		
STATUS: INTERNAL THRU MODE	MULTIPLE WINDOW	

Transmit Static Overhead (Option A1T (A1U) only)

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

Path Overhead

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

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

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

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

Path Trace The path trace capability allows:

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

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

1 Press **TRANSMIT**; **SDH OVERHEAD SETUP** and using **← 1 ↓ →** 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.

SDH	STRUCT'D PAYLOAD	JITTE	FUNCTION		
B3 C2 [G1 [F2 [H4 [[POH DEFAULT] XXXXXXXX D0010010] D0000000] D0000000] D0000000] D0000000]	」 →	TYPE	1000000 1000000	
Z4 [
TATUS: VC-4	VC-3				MULT

V C-3/VC-4 Path Trace

3. Selection of **TEST MESSAGE**

programs the J1 byte to carry the displayed HP 37717C test message.

	TRANSM SDH Setup	ITTER O STRUC PAYLOF C PO	T'D JIT AD	TER TE	SDH ST OVER TION SE TYPE [V			
	C2 [G1 [F2 [H4 [Z3 [Z4 [1EST xxxxxxx 0001001 0000000 0000000 0000000 0000000 000000	.0] 10] 10] 10] 10]	HP37 H FIEL	TT-PACKAR 177C PDHJ LD TEST S 0000000	'SD		
~;	STATUS: DEFRULT MESSAGE		est Sage	user Message	CRC7 Message		MULTIPL WINDOW	

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

TRANSMITTER OUTP SDH STRUCT'D PAYLOAD	IT E SDH] JITTER TEST OVERHEF FUNCTION SETUP	PD
SETUP [POH 31 [USE3] B3 XXXXXXXX C2 (00010010) B1 [00000000] F2 [00000000] 24 [00000000] 25 [00000000]] TYPE [UC-4 → [C0000000000000000 [C0000000000000000 C00000000000000000 C00000000	
STATUS: Default test Message message	USER CRC? Message Message	MULTIPLE Window

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

TRANSMITTER OUTPUT SDH STRUCT'D J PAYLOAD SETUP [POH]	E SDH 3 ITTER TEST OVERHERD FUNCTION SETUP TYPE [VC-4]	
71 (000630200) B3 XXXXXXXX C2 (00010010) G1 (0000000) F2 (00000000) H4 (00000000) 24 (00000000) 25 (00000000) 25 (00000000)	→ <i>Салалалалала</i> лала]	
STATUS: Default test Message message	USER CRC7 Message Message	MULTIPLE Window

VC-2/VC-12 Path Trace

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

TRANSMITTER DUTPUT [SDH] SDH STRUCT'D JITTER TEST DUERHEAD PAYLORD FUNCTION SETUP	
SETUP [POH] TYPE [VC-12] V1/V2 DECIMAL POINTER VALUE :	
TU SIGNAL LABEL [001]	
STATUS: DEFRULT TEST USER MESSAGE MESSAGE MESSAGE	MULTIPL

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.

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

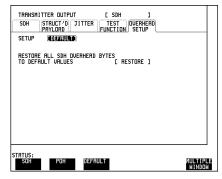
TRANSMITTER OUTPUT E SDH J SDH STRUCT'D JITTER TEST OVERHEAD FUNCTION SETUP	
SETUP E SDH COLUMNS [1,427] H1/42 DETURE PUINE HULE PUINE PUINE	
STATUS: Son Pon default	MULTIPLE Window

Static Overhead Known (Default) Conditions

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

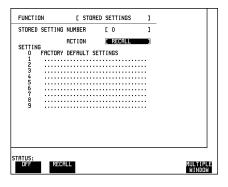
1. Set up the **TRANSMIT**; **OVERHEAD SETUP** display as shown opposite. This returns overhead, not set by a TRANSMIT test function to the known (default) state.

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.

STATUS:	STARTED			MULTIPLE WINDOW
	A LIFAFGF6282828 B LIFAFGF6282828 D LIFAFGF6282828 D LIFAFGF6282828 E LIS974] FRAME E 266 C 01 C 01 C 01 C 01			
TEST FU	NCTION E SDH RUNI ISTOCIETION	JE SEQUENO	ES] IPPED	
SDH	TTER OUTPUT STRUCT'D JITTE PAYLOAD	E SDH R TEST O FUNCTION] VERHEAD SETUP	

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

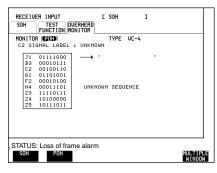
OVERHEAD MONITOR

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).



MONITOR	PRYLORD	T OVERHEAD TON MONITOR COLUMNS [1,	487]	_
S1 SYNC : R1 B1 D1 H1 B2 D4 D7 D10 S1	R2 E1 D2 H2 K1 D5 D8 D11 Z2	C1 F1 H3 H3 K2 D6 D9 D12 E2		

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

Receive Overhead Capture

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

TEST FUNCTION ; OVERHEAD CAPTURE

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

Trigger OFF	start immediately the capture is initiated
Trigger ON	capture activity after a specified overhead state has occurred
Trigger ON NOT	capture activity after the first occurrence of a deviation from a specified overhead state.

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

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

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

Frame by Frame Monitor of H1,H2

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

1. Press RECEIVE ; SDH ; TEST FUNCTION ; OVERHEAD CAPTURE and using → → and → and the display softkeys set up the RECEIVE display as shown opposite. Press STARTED to start the capture.	RECEIVER INPUT E SDH] SDH STRUCT/D) TEST OVERHERD TEST FUNCTION (D/HONITON) CAPTURE OF CHANNEL (L/HONITAL) TRIGGER L OFF J CAPTURE CONT DATA FRAME COUNT-	
	status: Stopped Staryed	MULTIPLE WINDOW

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

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

 Press RECEIVE; SDH; TEST; FUNCTION; OVERHEAD CAPTURE and using A and and the display softkeys set up the RECEIVE display as shown opposite. Press STARTED to start the capture. 	RECEIVER INPUT [SDH] SDH STRUCT'D TEST DUERHEAD PRYLOBOLFUNCTION MONITOR TEST FUNCTION [D/H CAPTURE] CAPTURE OF CHNNEL [RSDH] S.AR1, SAR2] TRIGGER [CON ADJIERSF6762828283] CAPTURE [CANODIAL DATA FRAME COUNT-	
Errors and Alarms	STATUS; Stopped Started	MULTIPLE Mindow
TRANSMIT ; TEST FUNCTION ; PDH PAYLOAD ERRORS allows Bit errors to be added to the payload.	TRANSMITTER DUTPUT L SDH J SDH STRUCT'D JITTER TEST DUERNERD FEST FUNCTION SETUP TEST FUNCTION SETUP ERROR RDD JE ERR & RLRRMJ ERROR RDE Implementation RTE Implementation Implementation	
TRANSMIT;TEST FUNCTION;SDH;ERRORS & ALARMS allowsErrors and Alarms to be added to the SDH	ALARM TYPE [MS FERF]	

E

[

E Overhead.

TRANSMITTER OUTPUT SDH STRUCT'D JITTER PAYLOAD TEST FUNCTION E SDH	[SDH] TEST OVERHEAD FUNCTION SETUP][ERR & ALARM]	
ERROR ADD TYPE RATE	[PATH ES BIP] [1E-5]	
ALARM TYPE	[MS FERF]	
STATUS: A1A2 RS B1 MS B Frame BIP BIP		MULTIPLE WINDOW

Overhead Bit Error Rate (A1T (A1U) only)

1. The **TRANSMIT**; **OVERHEAD BER** test function inserts a 2⁷-1 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.

TRANSMITTER OUTPUT [SDH] SDH STRUCT'D JITTER TEST OVERHEAD PAYLOAD FUNCTION SETUP	
TEST FUNCTION [SDH][OVERHEAD BER] INSERT PRBS INTO 0/H BYTE [WSDH][S1]	
PRESS (SINGLE) TO ERROR O/H BYTE	
TRTUS:	

st	RECEIVER INPUT E SDH] SDH STRUCT'D TEST OVERHERD PRVLDRD FUNCTION MONITOR	
	TEST FUNCTION EOVERHEAD BER] MERSURE PRBS FROM O/H BYTE E MSOH I	
	ERROR COUNT ERROR RATIO ERROR FREE SECONDS ZERROR FREE SECONDS	
r	PRTTERN LOSS SECONDS	
n	ELAPSED TIME	
	STATUS:	
	D10 D11 D12 S1 MORE MULTIPU	E

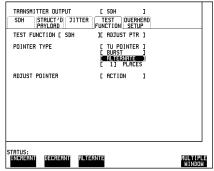
Add Pointer Adjustments (A1T (A1U) only)

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. **EURST** 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.

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.

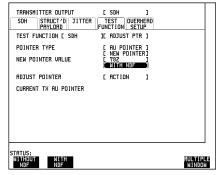
4. **G.783** provides pointer movement sequences as per ITU G.783:

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.



ſ	SDH STRUCT'D JITTER	SDH] TEST OVERHEAD NCTION SETUP	
	TEST FUNCTION [SDH]	ADJUST PTR]	
	POINTER TYPE	TU POINTER] OFFSET] +100 ppm]	
	OUTPUT SIGNAL RATE	CONSTRUCT	
ST	ATUS: CONSTRNT OFFSET		MULTIPLE WINDOW

TRANSMITTER OUTPUT SDH STRUCT'D JIT PAYLORD	C SDH TER TEST OVERH FUNCTION SETU] EAD
TEST FUNCTION [SDH	JE ADJUST PTR	1 L
POINTER TYPE Adjustment type	E TU POINTER E G.783 E Single]
POLARITY INTERVAL	[WITH ADDED [NEGATIVE [10 ms	
POINTER SEQUENCES	[STARTED	3
STATUS:		
ALT'NATE WITH POLARITY CANCEL'D	WITH Added	MULTIPLE WINDOW

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

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

The sequence is started by selecting POINTER SEQUENCES STARTED.

Pointer Graph (A1T (A1U) only)

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

The capture interval is user programmable.

RECEIVER INPUT SDH STRUCT'D T PRYLORD FUN	C SDH] EST OVERHEAD CTION MONITOR	
TEST FUNCTION CAPTURE INTERVAL POINTER UNDER TEST	[PTR GRAPH] [20 SECS] RU-4	
IMPLIED VC-4 OFFSET ELRPSED TIME	рри	
STATUS: 1 SEC 5 SECS	20 SECS 1 MIN MORE	MULTIPLE WINDOW

MSP (Multiplexer Section / Transport Protection) Messages

TRANSMIT; SDH ; TEST FUNCTION ; MSP MESSAGES allows user

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.

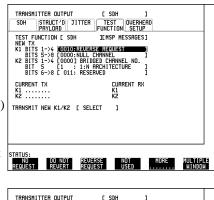
K2 BIT 5 selects the MSP architecture, 1:1 or 1:N. 1:1 means the working line has an exclusive protection line. 1:N means the protection line is shared by several (up to 14) working lines.

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].



TRANSMITTER OUTPUT E SDH J SDH STRUCT'D JITTER TEST OVERHEAD PAYLORD FUNCTION SETUP	
$\label{eq:constraint} \begin{array}{ c c c c c c c c c c c c c c c c c c c$	
CURRENT TX CURRENT RX K1 K1 K2 K2	
TRANSMIT NEW K1/K2 [SELECTION]	
STATUS: Select Down Load	MULTIPLE WINDOW

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

	PAYLOA			T OVER		
	E SOH Decimal	POINTER U		MNS [1,48	87]	
A1 [1 B1 ×	xxxxxx	: G.811 A2 [0010] E1 [00000	0000] F1	0000000	101	
H1 E×	xxx10xx]	D2 00000	XXX H3	XXXXXXX	(X	
D4 [0	0000000]	K1 [00000 D5 [00000	0000] D6	[0000000	100	
DIOCO	00000000	D8 [00000 D11[00000 22 [00000	0000j D1	0000000 2000000 2000000	00]	
	00000103	22 [00000	0001 12	2000000	101	

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;

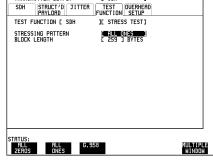
PRBS;

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.



[SDH

1

TRANSMITTER OUTPUT

RECEIVER INPUT	E SDH	3	
SDH STRUCT'D TES PRYLORD FUNCT	T OVERHEAD		
TEST FUNCTION	E DCC DROP E RS DCC]	
	2 110 200	-	
DCC BYTE POLARITY	C REVERSED]	
STATUS: Reversed Norval			MIII TTPI

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.

TRANSMITTER OUTPUT PHYSICAL ATM LAYER LAYER FUN	L ATM TEST OVERHEAD ICTION SETUP	1	
SIGNAL CLOCK SYNC C FREQUENCY OFFSET	3C [[1310][INTERN INTERNAL] [OFF	1L]]	
CELL SCRAMBLING	E ON	J	
STM-4 OC-3c Optical	STM-1 STM-1 Optical	MORE	MULTIPLE WINDOW

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.

	TRANSMITTER OUTPUT	SDH	
J	SDH TEST OVERHEAD FUNCTION SETUP SIGNAL ESTM-4 BIN]	(NORMAL)	
	CLOCK SYNC [INTERNAL FREQUENCY OFFSET [OFF 3	
	STM-1 UNDER TEST E Paylord E	1] 140 Mb/s]	
	PAYLOAD TYPE E Pattern E Prbs Polarity E in 140m dffset E	UNFRAMED 2^23-1 PRBS] V J CCITT O ppm]	
ST	ATUS: Normal invert invert LK&DATA CLOCK data	INVERT Clk&data	MULTIPLE WINDOW

2

Add/Drop Multiplexer Testing page 24 Alarm Stimulus/Response page 29 DCC Testing page 33 Desynchroniser Stress page 36 Frame Synchronization page 39 SDH Jitter Transfer page 44 MSP Stimulus/Response page 47 Optical Clock Recovery Stress page 51 Payload Mapping/Demapping page 53 Performance Monitor Stimulus/ Response page 59 Selective Jitter Transfer Measurement page 62

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

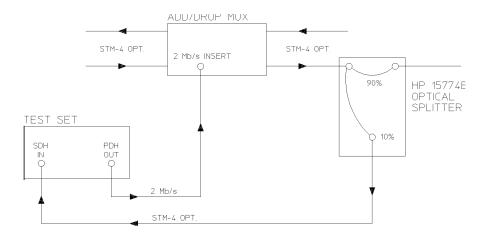
In this setup a 2 Mb/s payload, containing a test pattern, is inserted at the tributary insert port of the Add/Drop multiplexer. A portion of the STM4 Optical signal is tapped off by the Optical Splitter (approx. 10%) and the 2 Mb/s tributary is demapped by the HP 37717C Communications Performance Analyzer.

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

SDH / SONET Application Measurements Add/Drop Multiplexer Testing



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

FUNCTION	[SETTIN	NGS CONTROL]	
TRANSMITTER	RND RECEIVER	[INDEPENDENT]	
STATUS: Indep- Endent	DUPLED		MULTIPLE WINDOW

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

The PAYLOAD TYPE determines the Framing..

TRANSMITTER OUTPUT		3	
SIGNAL CLOCK SYNC TERMINATION LINE CODE FREQUENCY OFFSET	[2 Mb/s Internal [750 Unbal [HDB3 [OFF]]]	
PRYLORD TYPE PRITERN PRBS POLARITY	E PCM3OCRC E 2^11-1 PR E NORM] CC		
STATUS:			MULTIPLE WINDOW

SDH / SONET Application Measurements Add/Drop Multiplexer Testing

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

RECEIVER INPUT	E SDH	1
SIGNAL	E STM-4 OPT	J
STM-1 UNDER TEST PAYLORD SELECTED 2Mb/s (TU) : TUG3 [1] PAYLORD TYPE PATTERN PRES POLARITY	[1 [RSYNC 2M6/s TUG2 [1] TU [1] [PCMSORC [2^11-1 PRBS [NORM] CCIT	
STATUS:		MULTIPLE Window

4. Set up the OTHER		
	FUNCTION E LOGG	ING]
display, LOGGING function, as shown	LOGGING SETUP	[CONTROL]
opposite.	LOGGING LOGGING PERIOD	C ON] C 1 HOUR]
	RESULTS LOGGED WHEN CONTENT	[SELECTED]
	LOG ERROR SECONDS LOG AT END OF TEST	C OFF] ALL RESULTS
	LOG ON DEMAND	RESULTS

Continuity Check

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

ALWAYS PERIOD EC > 0

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

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

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

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

RESULTS [PDH PAYLORD][CUMULATIVE] FAS CRC REBE 2 Mb/s CRC REBE	
BIT EC BIT ER	
ELRPSED TIME	
STATUS: CITIBATE	

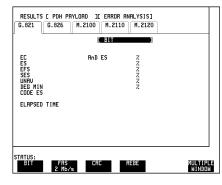
MULTIPLE WINDOW

SDH / SONET Application Measurements Add/Drop Multiplexer Testing

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**

STATUS: Always	PERIOD EC > 0				MULTIPL WINDO
LOG ON I	DEMAND		RESULTS		
LOG AT I	WHEN Content Dr Seconds End of Test		PERIOD ECX ER & ANAL PER & CUMUI OFF ALL RESULTS	l]	
LOGGING	LOGGED	t c	1 HOUR SELECTED	i ı	
	SETUP	[CONTROL ON	1	
FUNCTIO	4	E LOGGING		3	

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*.

SDH / SONET Application Measurements Add/Drop Multiplexer Testing

• 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

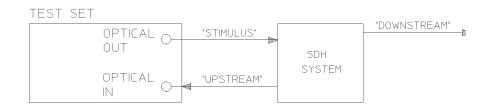
The following options must be fitted to the HP 37717C to perform this test:

- 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.

SDH / SONET Application Measurements Alarm Stimulus/Response



SDH Alarms

Alarm	RST	E	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	

SDH / SONET Application Measurements Alarm Stimulus/Response

1. Set up the OTHER ; SETTINGS CONTROL display as shown opposite.	FUNCTION E SETTINGS CONTROL] TRANSMITTER AND RECEIVER (COUPLED) RECEIVER COUPLED TO TRANSMITTER	
2. Set up the TRANSMIT ; SDH display	STATUS: INDEP- ENDENT COUPLED	MULTIPLE
as shown opposite.	TRANSMITTER OUTPUT [SDH] SDH STRUCTION STORAL CLOCK SWC [INTERNAL] FREQUENCY OFFSET [OFF] PAYLORD [140 Mb/s] PAYLORD TYPE [UNFRAMED] PATTERN [Z 27257 PBB5] PRBS POLARITY [INU] CCITT	
	STATUS: STM-1 STM-1 STM-4 DPTICAL OPTICAL	MULTIPLE WINDOW
3. Set up the TRANSMIT ; TEST FUNCTION display as shown opposite.	TRANSMITTER OUTPUT [SDH] SDH JITTER TEST OUERHEAD FUNCTION ESTUP TEST FUNCTION [SDH] [ERR & ALARM]	
The ERROR ADD TYPE selected does not matter as long as RATE [OFF] is selected.	ERROR ADD TYPE [DIR2 FRAME] Rate [DFF] Alarm type (USPATS)	
	STATUS: NS RIS WS FERF LOSS OF PATH MORE Pointer Ais	MULTIPLE WINDOW

SDH / SONET Application Measurements Alarm Stimulus/Response

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

RESULTS [SDH	IC ALARM SECONDS		
POWER LOSS LOS LOF LOF LOP MS AIS PATH AIS ELRPSED TIME	K1/K2 CHANGE NS FERF PATH FERF H4 NFRM LOSS TU LOP TU PATH AIS TU PATH FERF		
STATUS: Cumul Short Ative term	ANALYSIS ALARM (g.826) seconds	MORE	MULTIPLE Hindow

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

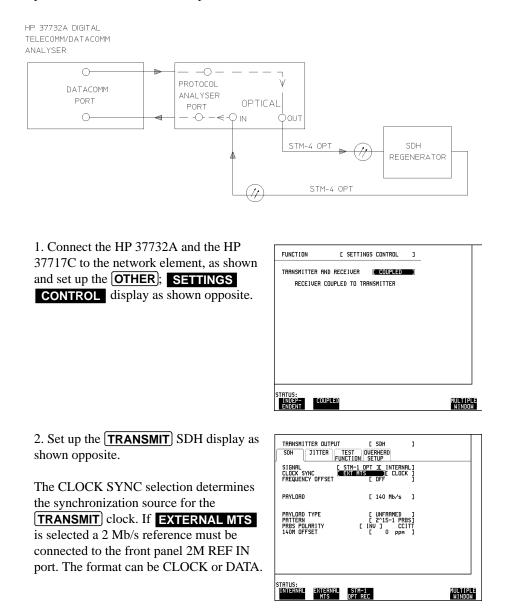
The following options must be fitted to the HP 37717C to perform this test:

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

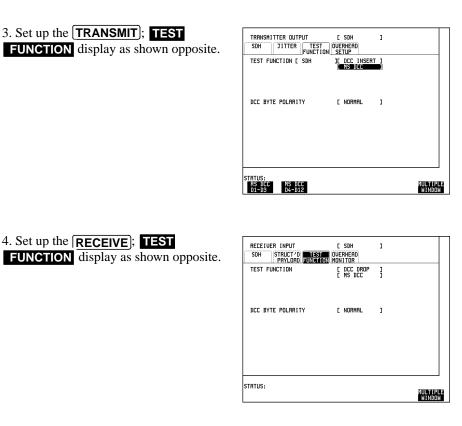
In this procedure the HP 37717C Communications Performance Analyzer accepts a 576 kb/s test pattern via the protocol analyzer port, inserting the test pattern in bytes D4 - D12 of the Multiplexer Section overhead and transmitting an STM-1 optical

SDH / SONET Application Measurements **DCC Testing**

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.



SDH / SONET Application Measurements **DCC Testing**



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*.

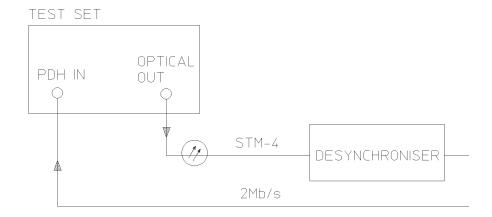
Desynchroniser Stress Test Setup Procedure

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.

SDH / SONET Application Measurements **Desynchroniser 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 2M REF IN port. The format can be CLOCK or DATA.

TRANSMITTER OUTPUT [SDH] SDH JITTER TEST OVERHEAD FUNCTION SETUP	
SIGNAL [STM-4 OPT] CLOCK SYNC [STM-4 OPT] FREQUENCY OFFSET [OFF]	
STM-1 LUNDER TEST [1]] PMYLOBD [TU-12]] TU MODE [RSYNC]] SELECTED TU TUGS [1] TUGZ [1] TU [1] TU PMYLOBD [UNFRAMED] TU PMYLOBD [UNFRAMED] [UNFRAMED] PHTTERN [Z'15-1 PRBS] PHTTERN [Z'15-1 PRBS] PRTTERN [Z'15-1 PRBS] PRTTERN [Z'15-1 PRBS] PRTTERN [Z'15-1 PRBS] PRTTERN [Z'15-1 PRBS]	
STATUS: Internal External STM-4 MTS Opt Rec	MULTIPLE WINDOW

SDH / SONET Application Measurements **Desynchroniser Stress**

 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. 	TRRNSMITTER OUTPUT C SDH J SDH JITTER TEST OUERHERD FUNCTION SETUP J TEST FUNCTION [SDH JC ADJUST PTR] POINTER TYPE [U.POINTER] RDJUSTMENT TYPE [G.783] POLRTITY KITH RODE] POLRTITY INTERNAL POINTER SEQUENCES C STOPPED]
Pointer sequences are started by selecting STARTED .	STATUS: NEGATIVE RULTIPLE MINORM
3. Set up the RECEIVE ; JITTER display as shown opposite.	RECEIVER INPUT [PDH] MAIN STRUCT'D JITTER SIGNAL FREQUENCY Z Mb/s RECEIVER RANGE [16 UI] HIT TWAESHOLD FILTER WANDER REFERENCE [75; UNBRL] WANDER REF. FORMAT [HDB3 DATA]

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

RESULTS [JITTER HITS HWPLI TUDE	JE CUMULATIVE J	
+VE PEAK -VE PEAK PEAK-PEAK FILTERS ELAPSED TIME	UI UI UI OFF	
STATUS:		MULTIPLE Window

Start the Desynchroniser Stress Test

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

Frame Synchronization

Application

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

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

Default (Known State) Settings

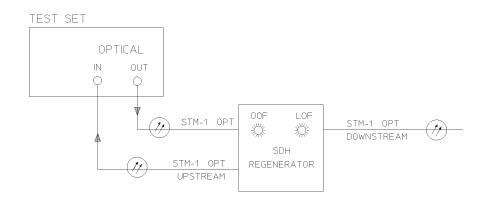
It is advisable to set the HP 37717C to a known state before setting up a measurement. This clears all previous settings and provides a clearly defined instrument state. For a list of Default Settings and the procedure for accessing them see *Stored Settings*.

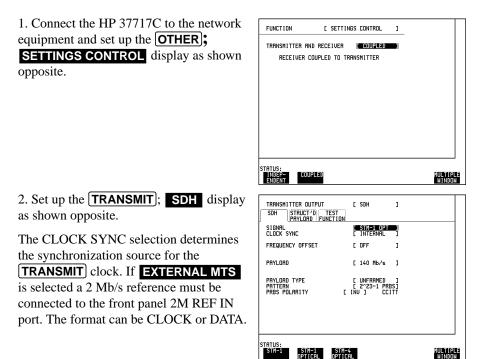
Frame Synchronization Test Setup Procedure

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

Sequence Generation Test Function

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





3. Set up the RESULTS display as shown opposite.	RESULTS [SDH][RIERRY SECONDS]
	POWER LOSS K1-K2 CHANGE LOS MS FERF OF HS FERF LOF HK HFRM LOSS LOP TU LOP MS AIS TU PATH AIS PATH AIS TU PATH FERF ELRPSED TIME
	STATUS: Cumul Shart Analysis Rlarn More Wultiple Ative Tern (6.826) Seconds Kindok
4. Set up the TRANSMIT ; TEST FUNCTION display as shown opposite.	TRANSMITTER OUTPUT [SDH] SDH] JITTER FTEST OUERHERD FUNCTION [SDH] [ERR & ALARM] ERROR ADD TYPE [ALA2 FRAME] ARTE [ALA2 FRAME]
	ALRRW TYPE [DFF]
	STRTUS:
	OFF 1 IN 4 2 IN 4 3 IN 4 4 IN 4 MULTIPLE NINDOW

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.

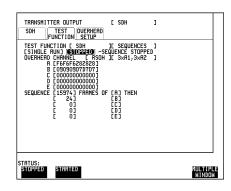
6. Decrease the Frame Error Add Rate to 2 IN 4 and check that the OOF and LOF alarm indicators on the network equipment go off, and no further occurrences of MS FERF are recorded.

Sequence Generation Test Function

 Connect the HP 37717C to the network equipment and set up the OTHER SETTINGS CONTROL display as shown opposite. 	FUNCTION C SETTINGS CONTROL 3 TRANSMITTER AND RECEIVER (COUPLED) RECEIVER COUPLED TO TRANSMITTER	
	STATUS: TRDEF- COUPLED ENDENT	MULTIPLE WINDOW
2. Set up the TRANSMIT ; SDH display as shown opposite.	TRANSMITTER OUTPUT [SDH] SDH STRUCT'D TEST SDH STRUCT'D TEST SIGNAL SPACE SIGNAL STATES SIGNAL STATES S	
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	PRYLORD E 140 Mb/s] PAYLORD TYPE E UNFRAMED] PATTERN E 2*23-1 FRBS] PRBS POLARITY E INU 3 CCITT	
be CLOCK or DATA.	STATUS: STM-1 STM-4 Optical Optical	MULTIPLE WINDOW
3. Set up the RESULTS display as shown opposite.	RESULTS [SDH][ALARN SECONDS]	
	POWER LOSS K1/K2 CHANGE LOS MS FERF LOF PATH FERF OOF H4 MFRH LOSS LOP TU LOP MS RIS TU PATH RIS PATH RIS TU PATH FERF ELRPSED TIME	

STATUS: Cumul Short Analysis Alarm More Multiple Ative Term (g.826) Seconds Window

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



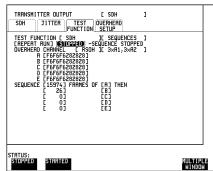
Start the Frame Synchronization Test (Sequence Test)

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.

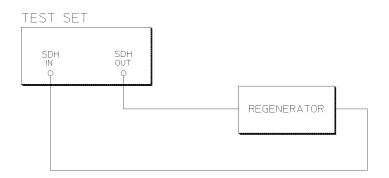
SDH Jitter Transfer

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 $(dB) = 20 \text{ Log } \{\text{Jitter out } \backslash \text{over Jitter in} \}$

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

SDH / SONET Application Measurements **SDH Jitter Transfer**

- 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.

STATUS: INDEP- COU	PLED			MULTIPLE WINDOW
RECEIVER	COUPLED TO TR	RNSMITTER		
TRANSMITTER A	ID RECEIVER	[COUPLED		
FUNCTION	E SETTIN	GS CONTROL	1	

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

SIGNAL [ITTER TEST OVER FUNCTION SET	UP
CLOCK SYNC E Frequency offset	INTERNAL] [OFF	J
PRYLORD	[140 Mb/s	1
PAYLOAD TYPE PATTERN PRBS POLARITY 140M OFFSET	E UNFRAMED E 2^23-1 PRI E INV] CC1 E 0 ppm	
STATUS:		MULTIPL WINDOW

SDH / SONET Application Measurements **SDH Jitter Transfer**

3. Select TRANSMIT ; JITTER and set up the display as shown opposite.	TRANSMITTER OUTPUT [SDH] SDH TTRUCT'D STITTER TEST OVERHEAD PARLADD FUNCTION SETUP
Select the required Jitter MODULATING FREQUENCY and AMPLITUDE.	JITTER C 0N J SIGNAL FREQUENCY STM-1 J JITTER MASK C DFF J MODULATION FREQUENCY C 1000 Hz RMNE RNNE L 1000 Hz I RNNE C 1.0 U I I

STRTUS:

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

If Jitter filtering is required select from the softkey menu.

RECEIVER INPUT	[SDH JITTER	
SIGNAL	[STM-1	1
RECEIVER RANGE HIT THRESHOLD FILTER	[16 UI [0.5 UI [OFF]
STATUS: Fdh Sdh	ATM SDH Jitter	LAN MULTIPLE WINDOW

MULTIPLE WINDOW

Run the Test (Jitter Transfer)

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

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

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

4. Select each jitter Modulating Frequency and Amplitude in turn on the **TRANSMIT**

RESULTS [JITTER	C SHORT TERM]	
+VE PEAK -VE PEAK PEAK-PEAK FILTERS ELAPSED TIME	UI UI UI OFF	
STATUS: Trouble Timing Scan Control	JITTER	MULTIPLE WINDOW

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 1×10^{-5} to 1×10^{-9} .

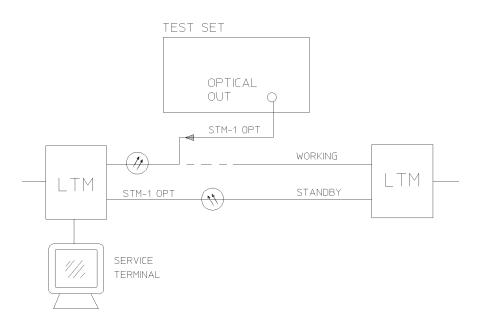
The HP 37717C Communications Performance Analyzer can be used to test Multiplexer Section Protection switching by:

Generating the switching conditions listed above.

Transmitting and monitoring the K1 K2 messages.

MSP Stimulus/Response 1+1 Architecture Test Setup Procedure

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



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

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

TRANSMITTER OUTPUT SDH STRUCT'D TEST PRYLORD FUNCTION	[SDH]	
SIGNAL CLOCK SYNC	[STM-1 OPT] [INTERNAL]	
FREQUENCY OFFSET	[OFF]	
PRYLOAD	[140 Mb/s]	
PRYLOAD TYPE Pattern Prbs Polarity C	[UNFRAMED] [2^23-1 PRBS] INV] CCITT	
STATUS: STM-1 STM-1 STM- Optical Optic	4 AL	MULTIPLE WINDOW

SDH / SONET Application Measurements **MSP Stimulus/Response**

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

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

	TRANSMITTER OUTPUT SDH TEST OVERHEAD FUNCTION SETUP	[SDH	1	
	TEST FUNCTION [SDH	1 ERR & ALAR	HD)	
	ERROR ADD TYPE Rate [1530] Errors	[MS B2 BIP [MSP THRESHL 5 IN [1 s		
	ALARM TYPE	C OFF	1	
0				
	STATUS: Errors adjust sequer & Alarms pointer	NCE MSP Messrges	MORE	MULTIPLE WINDOW

MSP Stimulus/Response 1:N Architecture

The HP 37717C Communications Performance Analyzer **TRANSMIT**;

TEST FUNCTION; **MSP MESSAGES** can be used to transmit and monitor the K1 K2 messages.

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

Two displays of K1 and K2 are provided:

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

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

TRANSMITTER OUTPU	T E SDH	3	
SDH STRUCT ' D PRYLORD	JITTER TEST FUNCTION	OVERHEAD SETUP	
TEST FUNCTION [S NEW TX		SSAGES]	
K1 BITS 1->4 [100 BITS 5->8 [000 K2 BITS 1->4 [001	1:WORKING CHANNEL		
BIT 5 [1 BIT 6->8 [00	: 1:N ARCHITECTUR		
CURRENT TX K1 K2	CURRI K1 K2	ENT RX	
TRANSMIT NEW K1/K2	[SELECT]		
STATUS:	_		
SELECT DOWN Load			MULTIPLE

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

Table 1

K1 Bits 1 - >4

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

Table 1

K1 Bits 1 - >4

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

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

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

Table 2 K1 Bits 5 - >8

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

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

K2 bits 1 - >4	Selects the bridged channel used by the MSP Messages. Can be set in the range 0000 to 1111.
K2 bit 5	Determines the automatic protection switch architecture. 0 - 1 + 1 architecture 1 - 1: N architecture

Optical Clock Recovery Stress

Application

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

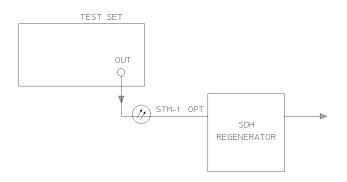
The optical clock recovery performance of the network equipment can be measured by increasing the length of a zero substitution block until errors occur.

Default (Known State) Settings

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

Optical Clock Recovery Stress Test Setup Procedure

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



SDH / SONET Application Measurements Optical Clock Recovery Stress

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

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

TRANSMITTER OUTPUT	E SDH] ITTER TEST OVERHEAD	
PRYLORD	FUNCTION SETUP	
	STM-1 OPT][INTERNAL] Ext MTS][Clock] [OFF]	
PAYLOAD	[140 Mb/s]	
PRYLORD TYPE PATTERN PRBS POLARITY 140M OFFSET	[UNFRRMED] [2^15-1 PRBS] [INV] CCITT [0 ppm]	
STATUS: 2MHz 2Mb/s Clock Data		MULTIPLE WINDOW

2. Set up the TRANSMIT; TEST
FUNCTION display as shown opposite
G.958 Test Pattern consists of consecutive blocks of four types of data:
All 1's
PRBS
All 0's
a data block consisting of the first row of section overhead bytes.

TRANSM	ITTER OUTPUT	E SDH	1	
SDH	STRUCT'D JI PAYLOAD	TTER TEST FUNCTION	OVERHEAD SETUP	
TEST F	UNCTION [SDH	JE STRES	S TEST]	
	ING PATTERN LENGTH	[ALL 2] [2]	BYTES	
STATUS:				
ALL ZEROS	ALL	G.958		MULTIPLE WINDOW

Start the Optical Clock Recovery Stress Test

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

Payload Mapping/Demapping

Application

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

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

The demapping process is tested by transmitting a SDH / SONET signal to the highrate 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.

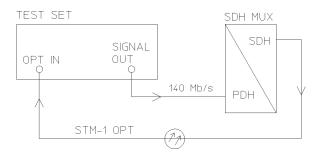
For demapping an STM-4 Optical signal is transmitted into the high-rate side of the Add Drop multiplexer. The 140 Mb/s signal, on the low-rate side of the Add Drop multiplexer, is received by the HP 37717C Communications Performance Analyzer.

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.

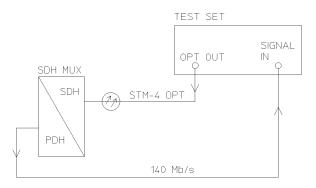
SDH / SONET Application Measurements **Payload Mapping/Demapping**

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



Payload Mapping

Payload Demapping



SDH / SONET Application Measurements Payload Mapping/Demapping

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

FUNCTION	[SETTI	NGS CONTROL]	_
TRANSMITTER I	RND RECEIVER	[INDEPENDENT]	
STATUS:	JUPLED		
ENDENT			MULTIPLE WINDOW

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

SEMMINGS SIGNAL CLOCK SYNC TERMINATION	E 140 Mb/s INTERNAL 75Ω UNBAL	-	
LINE CODE FREQUENCY OFFSET	CMI CMI COFF	J	
PAYLOAD TYPE PATTERN PRBS POLARITY	[UNFRAMED [2^23-1 PR [INV] CC		

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

	IT E SDH J JITTER TEST OVERHEA FUNCTION SETUP	D
SIGNAL CLOCK SYNC FREQUENCY OFFSET	[STM-4 OPT] [EXT MTS][CLOCK] [OFF]	
STM-1 UNDER TEST PAYLORD	[3] [140 Mb/s]	
PAYLORD TYPE PATTERN PRBS POLARITY 140M OFFSET	[UNFRAMED] [2^23-1 PRBS] [INV] CCITT [0 ppm]	
STATUS:		MULTIPLE WINDOW

SDH / SONET Application Measurements **Payload Mapping/Demapping**

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

RECEIVER INPUT	D TEST D FUNCTION	E SDH OVERHEAD MONITOR	3	
SIGNAL LEVEL	[STM-1] [TERMINATE	3	
PAYLOAD		[140 Mb/s	J	
PAYLOAD TYPE PATTERN PRBS POLARITY	C	[UNFRAMED [2^23-1 PR INV] CC] BS] ITT	
TATUS:				MULTIP

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

RECEIVER INPUT	C	PDH]	
SIGNAL	C	140 Mb/s	3	1
TERMINATION LINE CODE LEVEL	0	75Ω UNBAL CMI TERMINATE	J	
PRYLOAD TYPE Pattern Prbs Polarity [L L INV	UNFRAMED 2^15-1 PRB] CCI	3 5 1 1	
STATUS:]
			MULTIP WINDO	

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

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

FUNCTION	[LOGGING		3	
LOGGING SETUP	C	CONTROL	1	
LOGGING LOGGING PERIOD	Ę	on 1 Hour]	
RESULTS LOGGED WHEN CONTENT		SELECTED ER & ANAL PER & CUML	1	
LOG ERROR SECONDS LOG AT END OF TES	r t	OFF ALL RESULT	- <u>i</u>	
LOG ON DEMAND		RESULTS		
STATUS: Always Period	1			MULTIF
EC > 0				WINDO

SDH / SONET Application Measurements Payload Mapping/Demapping

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.

	BIT		
EC ES EFS UNAU DEG MIN CODE ES ELAPSED TIME	And ES	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	

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

SDH / SONET Application Measurements **Payload Mapping/Demapping**

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*.

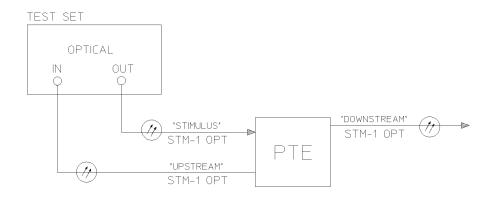
Performance Monitor Stimulus/Response Test Setup Procedure

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.

SDH / SONET Application Measurements Performance Monitor Stimulus/ Response



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

FUNCTION	[SETTING	s control	1	
TRANSMITTER A	ND RECEIVER	[COUPLED		
RECEIVER	COUPLED TO TRA	NSMITTER		
STATUS: INDEP- CO ENDENT	JPLED			MULTIPLE Window

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

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

TRANSMITTER OUTPUT	ERHEAD	1
SIGNAL C CLOCK SYNC C FREQUENCY OFFSET	STM-1 OPT JC INTERNA INTERNAL J C OFF	AL]]
PRYLORD	[140 Mb/s	1
PAYLORD TYPE PATTERN PRBS POLRRITY 140M OFFSET	UNFRAMED [2^23-1 PR] [INU] CC [0 ppm	
STATUS:		MULTIPLE WINDOW

SDH / SONET Application Measurements Performance Monitor Stimulus/ Response

3. Set up the RESULTS display as shown opposite.	RESULTS C SDH JC CUMULATIVE J PATH B3 FATH PATH MORE BIP FEBE IEC MORE	
PATH FEBE ERROR RESULTS are displayed but any of the other results can be selected from the softkey menu without affecting the measurement.	FEBE EC FEBE ER ELAPSED TIME	
	STATUS:	
	MINE	IOH
4. Set up the TRANSMIT ; TEST , FUNCTION display as shown opposite.	TRANSMITTER DUTPUT [SDH] SDH TEST DUERHEAD Function [Setup Test Function [Sdh][Err & Alarmi] Error add Type [Path B3 B1P] Rate [1255	

Start the Performance Monitor Stimulus/Response Test

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

STATUS: OFF

ERROR 1E-4 1E-5 ALL

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.

MULTIPLE WINDOW

MORE

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**

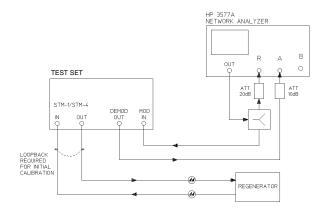
Test Setup Procedure (Jitter Transfer Test)

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

SDH / SONET Application Measurements 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.

FUNCTION	E SETTIN	GS CONTROL	1	
	ND RECEIVER]	
RECEIVER	COUPLED TO TR	RNSMITTER		
STATUS: INDEP- CO	UPLED			MULTIPLE

SDH / SONET Application Measurements Selective Jitter Transfer Measurement

2. Connect the HP 37717C to the network analyzer as shown. Connect STM-1/STM-4 IN to STM-1/STM-4 OUT. Select

TRANSMIT SDH SDH and set up

the display as shown opposite.

TRANSMITTER OUTPUT SDH SIG JITTER TEST OUERHEAD SIGHUR JITTER FUNCTION SETUP SIGHUR SIGHUR SETUP SIGHUR SIGHUR CSTM-4 OPTJLI310JL INTERNALJ LOCK SNC E KAT MTS DFC LOCK J FREQUENCY OFFSET L OF J J J STM-1 UNDER TEST [1.0 Mb/s] J PAYLORD TYPE UNFRAMED J PAYLORD LORK STATE CITT LOND/FSET 140M DFFSET L NO O PPM J	
STATUS:	MULTIPLE WINDOW

3. Select TRANSMIT SDH JITTER

and set up the display as shown opposite.

TRANSMITTER DUTPUT	SDH		
SDH JITTER TEST FUNCTI	OVERHEAD ON SETUP		
JITTER / WANDER JITTER	E JITTER E ON	ł	
SIGNAL FREQUENCY MODULATION SOURCE	STM-4 C EXTERNAL	1	
RANGE	[2 UI		
CLOCK SYNC CONNECT 2MHz SOURCE TO	EXT MTS		
CUNNELT ZNHZ SUURLE TU	SUH HUDULE		
STATUS:			
2 UI 10 UI			MULTIPLE
			WINDUW

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

If Jitter filtering is required select from the softkey menu.

RECEIVER INPUT	[SDH JITTER]]
SIGNAL	[STM-4 OPT]	
RECEIVER RANGE HIT THRESHOLD FILTER LEVEL	[1.6 UI] [1.00 UI] [H] [TERMINATE]	
STATUS: SDH SDH JITTER		MULTIPLE WINDOW

SDH / SONET Application Measurements Selective Jitter Transfer Measurement

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.

RESULTS [JITTER HITS RMPLI TUDE]E CUMULATIVE	1	
+VE PEAK	0.01	IIT	
-VE PEAK	0.01	UI	
РЕАК-РЕАК	0.01	UI	
FILTERS	HP1		
ELAPSED TIME			
TATUS:			MULTIPL
			WINDOW

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

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

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

SDH / SONET Application Measurements Selective Jitter Transfer Measurement

3

ETSI / ANSI Terminology

A table of ETSI Terms with their ANSI equivalents.

ETSI / ANSI Equivalent Terms

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

ETSI Term	ANSI Term
I-n 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	тон
Section Overhead (SOH)	Transport Overhead (TOH)

ETSI / ANSI Terminology ETSI / ANSI Equivalent Terms

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

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

ETSI / ANSI Terminology ETSI / ANSI Equivalent Terms

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Learning Products Map

All of the learning products which apply to the HP 37717C Communications Performance Analyzer 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

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1st Edition, September 1997

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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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