

PRELIMINARY

ATM Operating
Manual

HP 37717C
Communications
Performance Analyzer

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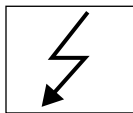
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For details of safety, see
Safety information at the
front of this manual.

Warning Symbols Used on the Product



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



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



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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.

ATM Operating Manual

**HP 37717C Communications
Performance Analyzer**

About This Book

The information on ATM testing in this book covers the following subjects:

- Measurement definitions and explanations
- Principal measurement modes
 - Channel View
 - In-Service Testing
 - Out-of-Service testing

Channel View (available with the services modules option USK, USL and the Broadband Auxiliary module option 0YK) gives a real time overview of the traffic on a link and provides an individual analysis of each channel.

The In-Service and Out-of-Service applications are sub-divided into groups which depend on combinations of options fitted to your instrument.

During In-Service testing, the tester is used to monitor what is happening. A wide range of results is produced simultaneously for each test.

In some situations, particularly where live traffic is not available, the use of a test signal for Out-of-Service testing is required. In addition to the monitoring capability of In-Service testing, Out-of-Service testing uses the ability to generate a test stimulus.

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

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

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

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

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

Contents

1 Introduction to ATM Testing

- Measurements 2
- Measurement Definitions and Explanations 7
- Traffic Simulation 20
- Alarms 23

2 ATM Modules

- ATM Modules 28
- ATM Module Features 32
- Cell Level ATM (Options UKN (USE) and UKZ) 32
- Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK) 37

3 Link Traffic Overview

- ATM Channel View 42

4 In-Service Testing

- Introduction to In-Service Testing 48
- Cell Layer Error Measurement 51
- Service Policing 55
- Individual Service Performance 57

5 Out-of-Service Testing

ATM Cell Performance Test 60

Cell Routing Test 66

Cell Congestion Test 67

Cell Sync and Header Error Correction Test 69

Constant Bit Rate Service Assessment 71

Alarm Testing 72

6 Pre-stored Cell Streams

1

Measurements page 2

Measurement Definitions and Explanations page 7

Traffic Simulation page 20

Alarms page 23

Introduction to ATM Testing

This chapter contains information about ATM testing and the facilities available in the HP37717C.

Measurements

Physical Measurements

Physical layer measurements indicate any problems which may give rise to errors on cells present on the physical link. The ATM layer impairments observed while testing a VPI or VCI may have originated on another physical transmission link. Correlation of physical layer results with ATM layer results will help to identify the source of the problem.

If interfacing at the STM-1, OC-3c or STM-4 physical layer generation and measurement of the SDH / SONET overhead is identical to that of normal SDH / SONET operation.

If interfacing at the 34 Mb/s or 140 Mb/s physical layer G.832 transmission convergence framing structure is used. This results in different measurements from those obtained during normal PDH / DS_n operation:

- EM BIP-8 errors
- FEBE errors
- Loss of frame (G.832) detected
- AIS and FERF alarms detected
- TR trail trace is user defined in the transmitter, and is detected and displayed in the receiver.

If interfacing at DS3, there is a choice of direct or PLCP convergence sub-layer. This results in the following additional results being available when PLCP mapping is selected:

- Trailer errors
- PLCP Frame Loss
- PLCP RAI
- PLCP Link Status, this value is captured

If interfacing at the 2 Mb/s or DS1 physical layer there is no additional transmission convergence information and the measurement results obtained are a subset of those obtained during normal PDH / DS_n operation.

Introduction to ATM Testing

Measurements

ATM Layer measurements - Out-of-Service.

Header Errors

ATM cell delineation (except in the case of DS3 PLCP mapping) and error detection or correction is achieved by using a Header Error Control byte (HEC). The HEC byte is the fifth byte of the ATM cell header. Using the HEC byte, a single header error may be corrected or multiple header errors may be detected. The HP 37717C measures corrected headers and non-corrected headers. If a header value is corrected, the payload is then available for measurement processing. If a non-correctable header error is detected, the event is recorded and the cell is discarded.

Cell Errors

Cell errors are usually due to physical layer transmission impairments. An errored cell will be recorded if one or more bit errors are detected in the ATM payload.

Cell Loss

Cells may be lost due to physical layer transmission errors on the ATM header or due to congestion in ATM switches.

Cell Misinsertion

Physical layer transmission errors on the ATM overhead may cause the VPI/VCI to be changed to another valid value. This will cause a cell to be misinserted into another channel. Other causes include malfunctions of the ATM switch fabric.

Cell Transfer Delays

Delay may be introduced because of physical layer switching and propagation delays. Such delay is predominately fixed delay. Delay may also occur because of traffic shaping. This delay is an aggregate of variable delay and fixed delay.

Cell Delay Variation (CDV)

CDV (or cell jitter) is the variation in cell transfer delay caused by variations in depths of queues in buffers and variations in cell multiplexing delays. This will be accentuated when a virtual circuit is multiplexed with highly variable traffic load or when congestion is approached in ATM switches.

2-point CDV, Mean Cell Transfer Delay and Maximum Cell Delay

These cell delay measurements, including 2-point Cell Delay Variation (2-pt CDV) are out-of-service measurements available when the Test Cell is selected as the ATM payload. Mean Cell Transfer Delay, Max Cell Transfer Delay and 2-pt CDV measurements use information at two points - the transmit end and the receive end.

Introduction to ATM Testing

Measurements

Test cells contain time stamps which are inserted when the test cell is generated in the test equipment. At the test equipment receiver, the time stamps are compared with the time of arrival of the test cells making it possible to measure the cell delay and cell delay variation across a network or network element connected between the transmitter and receiver of the test equipment.

Because timestamps are used, these delay measurements indicate the delay added to the ATM cells by the ATM network and are not a function of the cell transmission rate and distribution used e.g. periodic, burst etc. However, the ATM network may respond differently as the cell rate and distribution are varied.

Because it is not possible to synchronize the timestamps in two different instruments, cell delay measurements other than 1-point CDV must be performed using the same instrument to transmit and receive the test cell signal.

The 2-point CDV measurement conforms to ITU-T Recommendation I.356

Cell delay results are processed to provide the following cumulative (not short term) measurements:

- Mean cell transfer delay - the cell delay averaged over the gating period.
- Maximum cell transfer delay - the maximum cell delay over the gating period.
- Peak to peak 2-point CDV - the maximum cell delay minus the minimum cell delay over the gating period.

1-point CDV

1-point CDV is so called because the Cell Delay Variation is measured at one point i.e. where the signal is being received. It does not require the use of timestamps and so may be performed In-Service or Out-of-Service. 1-point CDV is a combination of the CDV of the source traffic and the CDV added by the network. 1-point CDV is more meaningful than Interarrival Time as it can be directly related to network buffer depths.

For example, the maximum 1-point CDV value represents the minimum buffer depth (in time) which would be required to remove the accumulated CDV at the measurement point. The 1-point CDV algorithm conforms to ITU-T Recommendation I.356. 1-point CDV measurements are available irrespective of cell payload.

Two 1-point CDV measurements are available:

- Maximum 1-point CDV
- Non-Conforming cell count - the number of cells exceeding a user selectable CDV threshold. This threshold is called the CDV tolerance.

Introduction to ATM Testing

Measurements

A more detailed account of the CDV measurement theory is given on page 16.

VP/VC Rate History.

Provides a graphical record of Maximum, Minimum and Mean cell rate over a period of time. For more information see page 15 and page 55.

Channel View

Provides a pictorial overview of the traffic present on a link by identifying every VPI/VCI and measuring cell count or cell rate on up to 1023 channels. Payload and alarm information is listed with each channel. An individual channel of interest may be selected conveniently from this display for subsequent performance error measurement, for example ATM Adaptation Layer (AAL) errors. For more information see page 5 and page 41.

AAL Error Monitoring

This in-service measurement uses the known structures of the AAL, generated by end equipment, to measure errors introduced by network transmission and switching.

AAL-1. The instrument analyses the sequence numbers in the single byte of the protocol control information (PCI). The only PCI in AAL-1 is the first byte of the 48-byte Segmentation and Reassembly Protocol Data Unit (SAR-PDU) (cell information field). This byte contains a 3-bit sequence number and a 1-bit CSI (convergence sublayer indication) which are protected (and to a limited extent corrected) by an additional 4 bits of sequence number protection. This consists of a 3-bit CRC and a 1-bit parity check. The integrity of the sequence is checked by the instrument to identify error instances caused by misinserted, reordered, and lost cells. There is no differentiation between lost and misinserted cells in the error calculation. The error algorithm merely counts all errors as if they were due to lost cells, and counts what it believes are lost cells. Hence, a pair of reordered cells (although unlikely) will appear as 8 'lost' cells. See page 8 and page 11. See also ITU-T Rec I.356.

AAL-3/4. The instrument measures various types of cell and segment error, counts SAR-PDUs and CS-PDUs. AAL-3/4 includes the possibility of multiplexing up to 1024 concurrent Convergence Sublayer Protocol Data Units (CS-PDUs) on the same virtual channel, with cells of the same stream being identified by their common 10-bit Multiplex IDentification (MID) value. The instrument copes with the resultant interleaved sequence numbers and segment-type sequences, treating them independently even although they are interleaved. However, since MID values are allocated by software in the terminal equipment, the MID values are not normally known to the user or installer. For this reason the error aggregate for all

Introduction to ATM Testing

Measurements

cells in a channel is displayed regardless of the MID. See also page 8 and page 12. See also ITU-T Rec I.356.

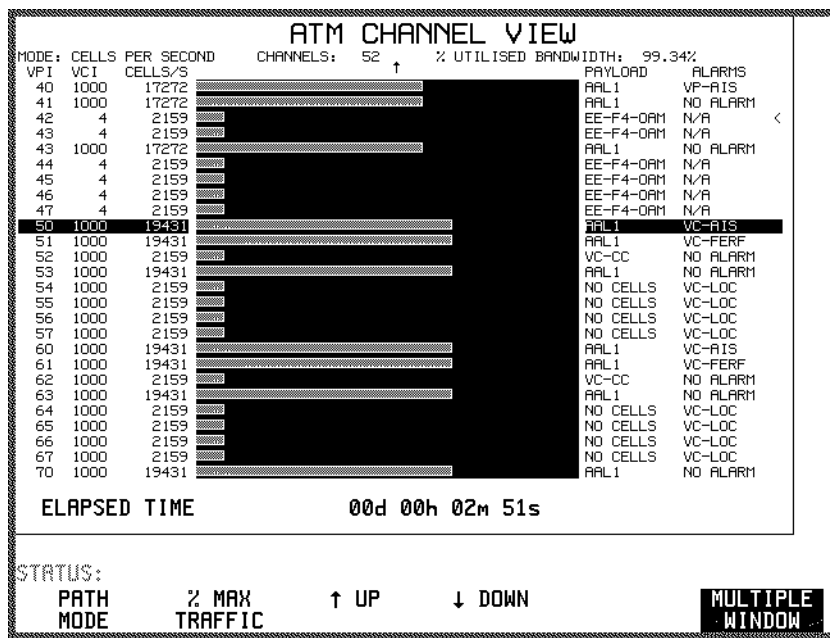
AAL-5. The instrument operates in AAL-5 analysis at a level in the AAL close to the structure of the user-service where the individual Cells are no longer visible. It first performs the receive functions of the Segmentation And Reassembly (SAR) sublayer to reassemble the data and then implements some of the Common Part Convergence Sublayer (CPCS) to check aspects of data integrity at the internal AAL packet level (CPCS-PDUs of up to 65,535 octets, which may already be blocks segmented from longer data). See page 8 and page 13. See also ITU-T Rec I.356.

Measurement Definitions and Explanations

Channel View

A graphic overview of the traffic at a point in the network is provided with Channel View which is available with the ATM Services modules, USK and USL and Broadband Auxiliary module 0YK. Channel View is therefore a normal starting point for many investigations.

Although its main use is for the investigation of In-Service conditions, it has applications Out-of-Service, for example in the rapid location of VPs and VCs from simulated data during installation. Channel View is therefore selectable as an alternative to In-Service or Out-of-Service operation.



The mean cell load (for example total cell count, cells/s, or % max traffic) is displayed in real time for each VPI / VCI present. Each channel is then analyzed in sequence for the payload and alarm information shown on the rightmost side of the display.

Idle or unassigned cells are also counted but not displayed.

Introduction to ATM Testing

Measurement Definitions and Explanations

The % overall bandwidth utilized by user and OAM cells is displayed. The idle / unassigned content can be derived by subtracting the % utilized bandwidth from 100%.

The measurement is performed on the first 1023 channels discovered.

Information on obtaining this display, restricting the VPs displayed and selecting the order of display is given on page 42.

Details of the Payload and Alarms information is given on page 45.

PDH / DS_n Physical Layer Measurements

The PDH / DS_n physical layer measurements are covered in “PDH / DS_n Testing with the HP 37717C”.

SDH / SONET Physical Layer Measurements

The SDH / SONET physical layer measurements are covered in “SDH / SONET Testing with the HP 37717C”.

AAL Sublayer Measurements

AAL sublayer measurements provide a powerful way of assessing quality of service using live data.

The mapping of services into ATM cells is performed by the ATM Adaptation Layer (AAL). Three AALs designed to transport specific types of service have been defined.

AAL-1 has been defined for the transport of constant bit rate (CBR) services. A 3-bit sequence number is used in AAL-1 to detect cell loss and misinsertion so that cells can be discarded or replaced to ensure the data transfer rate is not affected.

AAL- 3/4 has been defined to transport services made up of variable length frames such as those of SMDS and can handle frames from multiple services (data streams) multiplexed, cell by cell, in one virtual channel (VC), each service being identified by its own Message IDentification (MID). These frames are divided into segments called AAL 3/4 SAR-PDUs which additionally contain a 4-bit sequence number, a Message ID, a length indicator, a segment type and a CRC-10 (for error detection).

AAL-5 is a simpler alternative to AAL-3/4 and may be used to carry signalling, frame relay, other data, or video signals. The AAL-5 CPCS-PDU contains a length indicator and a CRC-32.

Introduction to ATM Testing

Measurement Definitions and Explanations

The effect of cell errors, cell loss and cell misinsertion and therefore the quality of service objectives for these parameters, will depend very much on the service being carried and the AAL being used. For example, if LAN traffic is being carried, cell errors, cell loss and cell misinsertion will be detectable by the AAL or higher layer protocol which can then initiate retransmission of errored frames. At some point depending on the frame length being used, the time taken for retransmission may make the throughput of the data unacceptable and will contribute to congestion.

For video data transfer using MPEG-2, AAL-1 or AAL-5 may be used. Cell loss and misinsertion may be detected by AAL-1 sequence number and lost cells substituted by padded payloads. Also, forward error correction may be used to detect and correct errors.

Cell delay and CDV should not materially affect data transfer applications but will affect audio and video services. For telephony and video conferencing the round-trip delay may make communication difficult. CBR services will require CDV to be controlled to allow clock recovery at the receive end. CDV may also cause problems with audio/video synchronisation in video applications.

For services using standard AALs, such as those which support CBR services, and packet protocols, the instrument provides in-service error examination of the AAL structures described above which support the service data. For AAL-1 and AAL-3/4, the SAR sublayer is examined for errors. For AAL-5, the CPCS sublayer is monitored for errors.

The instrument extracts structural information (protocol control information) created by the respective AALs, and analyses it for errors of various types. These may be transmission and switching errors or, more unusually, protocol faults created by end equipment.

This is an In-Service measurement, and the instrument does not specifically transmit any corresponding AAL structures itself. (For instrument test and demonstration purposes, the Stored Cell Stream may be used as a source.)

When there is no known AAL present, the receiver displays ATM ADAPTATION LAYER, NO AAL MEASUREMENT and prevents inappropriate AAL alarms.

AAL Loss Alarm

For measurement purposes, indication of the absence of an expected AAL is useful. The instrument therefore has an AAL LOSS indicator. The criteria used for declaring and clearing the AAL LOSS alarm are as follows:

For AAL Loss and Regain purposes, an ERRORED PDU is defined as follows:

Introduction to ATM Testing

Measurement Definitions and Explanations

AAL Loss Criterion. (all AALs)	7 consecutive ERRORED PDUs
Additional AAL Loss Criterion. (AAL-5 only)	Immediately in event of a length over-run (>65535 octets)
AAL Regain Criterion:	Receipt of the first PDU without error
AAL-1	A SAR-PDU containing a sequence number protection error OR one that is part of an all-zeros sequence. All-zeros is detected after two or more consecutive sequence numbers of value zero.
AAL-3/4	A SAR-PDU containing a CRC-10 error OR one that is part of an all-zeros sequence. All-zeros is detected when the length indicator is zero.
AAL-5	A CPCS-PDU containing a CRC-32 error.

Introduction to ATM Testing
Measurement Definitions and Explanations

The Automatic Detection of AAL Type

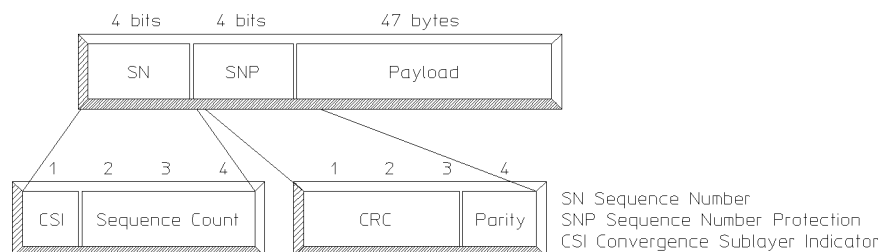
If the AAL type is not known, automatic examination and selection is provided.

When the receiver ATM ADAPTION LAYER is set to AUTO, the selected AAL is examined to determine whether it is AAL-1, AAL-3/4 or AAL-5. In some cases, for example where there is a lull in packet data, there may be a long delay before the correct type is identified. For this reason the instrument continues searching for an unlimited time.

AAL-1 SAR Sublayer Error Monitoring

Basic AAL-1 measurement information is given in AAL Error Monitoring on page 5.

AAL-1 supports most Constant Bit Rate (CBR) services. The instrument analyses the sequence numbers in the single byte of the protocol control information (PCI).



AAL-1 SAR-PDU

The measurements performed on the AAL-1 SAR sublayer are:

SAR-PDU Count.	Count
Corrected Seq. Number Protection:	Count; Ratio
Non-corrected Seq. Number Protection:	Count; Ratio
Lost Cells (based on seq. number):	Count

Corrected Sequence Number Protection refers to the count of SAR-PDUs (the same as count of cells) in which SN error protection has been required to be applied to effect correction, according to ITU-T rec. I.363. Non-corrected Sequence Number Protection refers to the count of SAR-PDUs in which a SN protection error was detected but could not, or would not, be corrected (as defined in I.363). Note that these refer to the sequence number protection, as indicated by the integrity/consistency of the whole PCI byte, not to the sequence numbers themselves. The

Introduction to ATM Testing

Measurement Definitions and Explanations

denominator for both of these measurements, when expressed as a ratio, is the total of SAR-PDUs received.

The Lost Cells count uses a Sequence Number check algorithm applied to lost cells based on SN errors as validated by the SN protection algorithm defined in I.363.

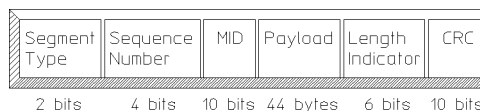
The derivation of a Sequence Number Error is as follows:

Any deviation from a normally incrementing sequence number is treated as a case of a lost cell(s), of quantity given by: $(\text{actual seq. no.} - \text{expected seq. no.}) \bmod 8$.

ITU-T rec. I.363 detection and correction is used. Sequence numbers are invalidated according to the I.363 specification. No measurements are made on invalid sequence numbers, but the reference is still incremented.

AAL-3/4 SAR Sublayer Error Monitoring

Basic AAL-3/4 measurement information is given in AAL Error Monitoring on page 5.



AAL 3-4 SAR-PDU

The measurements performed on the AAL-3/4 SAR sublayer are:

SAR-PDU Count.	Count
SAR-PDU CRC-10 Errors	Count; Ratio (CRC over each separate cell)
Lost Cells (based on seq. number)	Count
Segment-Type Errors	Count
No.of Abort SAR-PDUs Received	Count
No.of CPCS-PDUs Received	Count (as defined by the total number of BOM's and SSM's)

The definition and algorithm for Lost Cells count is as for AAL-1, except that mod-8 is replaced with mod-16.

The denominator for CRC-10 errors, when expressed as a ratio, is the total of SAR-PDUs received.

The derivation of a Segment-Type Error is as follows:

Introduction to ATM Testing

Measurement Definitions and Explanations

A Segment-Type error is an instance of successive cells having an invalid sequence of Beginning of Message (BOM), Continuation of Message (COM), End of Message (EOM) and Single Segment Message (SSM) coding types. Such an error may occur due to lost or misinserted cells, or possibly by end equipment faults.

The Segment-type error measurement is based on the ITU-T rec. I.363 reassembly algorithm for SAR-PDUs. Segment-type errors are defined by the following logical expression:

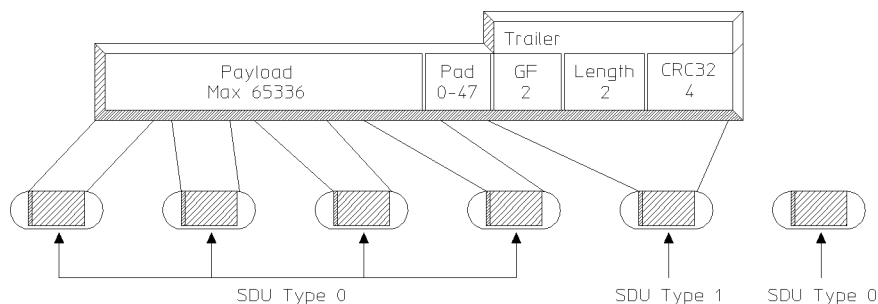
$(\text{CRC-error} + \text{abort}).((\text{EOM} + \text{COM}).\text{idle} + (\text{SSM} + \text{BOM}).\text{reass}).$

This is further modified such that only one error is counted if, for example, there is a missing BOM leading to a string of consecutive COMs while in the idle state. In addition, a pair of consecutive BOMs or consecutive EOMs will each register one error. Lost cells are only detected in the reassembly state.

The CRC-10 errors indicate cell payload errors.

AAL-5 CPCS Sublayer Error Monitoring

Basic AAL-5 measurement information is given in AAL Error Monitoring on page 5



AAL-5 CPCS-PDU

The measurements performed on the AAL-5 CPCS sublayer are:

Number of CPCS-PDUs Received	Count
CPCS-PDU CRC-32 Errors	Count; Ratio (CRC over the whole packet)
CPCS-PDU Length Errors	Count
CPCS-PDU Length Over-run	Count
Aborted CPCS-SDUs Received	Count

Introduction to ATM Testing

Measurement Definitions and Explanations

A CPCS-PDU Length Error is recorded when the actual number of octets disagrees with the Length field.

A CPCS-PDU Length Over-run is recorded when the ATM layer End-of-SAR-PDU, as indicated by the AUU bit, is not received by the time a maximum length CPCS-PDU (65535 octets), should have been completed.

Up to the level of the CPCS, the AAL is non-service-specific (by definition) and will apply to all services using the AAL-5.

Therefore, irrespective of the application of the packets, the instrument performs the important AAL-level CRC-32 check and verifies the Length (number of octets). This provides a good indication of whether the user or the network is the cause of packet transmission failure. For some user-services, the AAL-5 will not include a Service Specific Convergence Sublayer (SSCS), which otherwise lies above the CPCS, and in this case the checks described are performed directly on packets in exactly the form the user-service understands them.

There is no per-cell AAL level information for AAL-5, and therefore no per-cell SAR measurements.

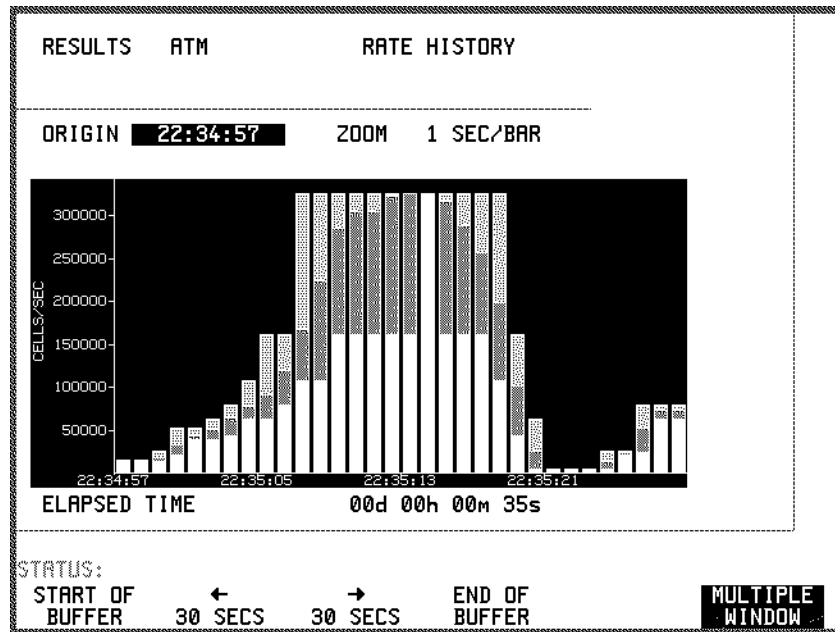
The CRC-32 is performed over all bits in the CPCS-PDU packet, and will record one packet error irrespective of how many bits are errored or underlying cells are errored, lost, or misinserted. A packet length error occurs whenever the length field disagrees with the number of octets actually counted. Cells lost or misinserted will cause the Length field to disagree by multiples of 48 octets, but any disagreement is regarded as one Length Error count. A Length Error will also give rise to a Packet Error, but a Packet Error may not necessarily produce a Length Error.

Note: Here, the loose term 'packet' means a CPCS-PDU (Protocol Data Unit) within the AAL, and will not always have the same higher level segmentation as that of the data passed to/from the service layers above - except where the SSCS is null .

Introduction to ATM Testing
Measurement Definitions and Explanations

VP/VC Rate History

This feature may be used to check actual usage of a single VPI / VCI over a period of time for comparison of negotiated mean cell rate with maximum, mean and minimum rates



Definitions of the maximum, minimum and mean cell rates are as follows:.

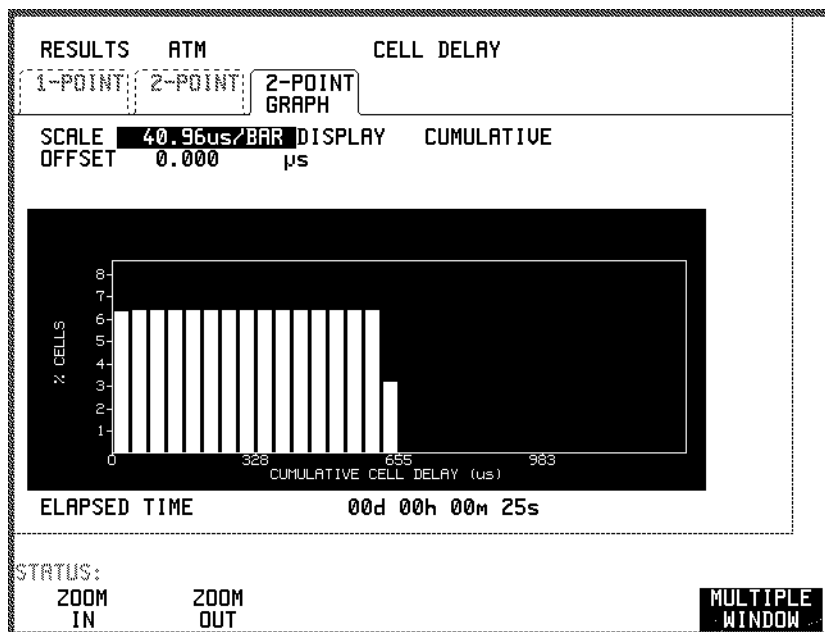
- Max Cell Rate** Inverse of shortest inter-cell time during measurement.
In the case of two cells appearing in consecutive positions in the composite stream, the Max Cell Rate measured will be the maximum possible for the link.
- Min Cell Rate** Inverse of longest inter-cell time during measurement.
- Mean Cell Rate** Average of number of cells received during the measurement interval divided by the interval.

The rates are displayed as superimposed coloured bars with the Max Cell Rate at the "back". If some of the rates are approximately equal, one or more of the colours may not be visible. In the case of a near perfect CBR service, all three rates, maximum, minimum and mean would tend to be equal and therefore only one colour will tend to be visible.

Introduction to ATM Testing
Measurement Definitions and Explanations

Cell Delay Variation (CDV) and Non-Conforming Cell Count

CDV detects delay variations which are of concern mainly for constant bit rate services. The closely related Non-conforming Cell Count checks circuit usage for comparison with customer service agreements



Cell Delay Variation (CDV) occurs whenever the transmission delay of the ATM signal varies from cell to cell. For example, a cell stream that is transmitted with a constant cell rate may arrive at its destination with the cells bunched together. This bunching is caused if several virtual channels require to output a cell from the switch at the same time. Cells must be buffered (and so delayed) until an output opportunity is available. This is known as multiplexing jitter. If a congestion condition is approached in an ATM switch, the delay may increase until eventually cell loss occurs. CDV also arises due to the segmentation process (data must wait until the start of the next cell) and the mapping of ATM cells into the physical layer.

What problems does it cause?

If a large amount of CDV is present in an ATM signal it may cause buffers in an ATM switch to overflow and cause cell loss in the VC. Other VCs using the switch may also be affected.

Introduction to ATM Testing

Measurement Definitions and Explanations

Excessive CDV causes problems in reconstructing a Constant Bit Rate (CBR) service. When using ATM for circuit emulation, e.g. carrying a 2Mbit/s circuit, CDV must be removed from the signal before the 2Mbit/s can be reconstructed.

How can CDV be controlled?

Each ATM VC may be policed at the input to the network and also at points throughout the network to ensure that traffic is not exceeding the negotiated Peak Cell Rate (PCR) and CDV tolerance. If the signal has too high a rate or too high a CDV value, cells are non-conforming and may be discarded. This is done to avoid buffer overflow in the switches in the link and so protect other channels in the network. The policing function may also be referred to as the UPC (Usage Parameter Control) at the UNI (User network interface) and the NPC (Network Parameter Control) at an NNI (Network Node Interface).

When reconstructing a CBR service at the ATM network termination, buffering must be provided to absorb the CDV. This will however add additional fixed delay to the signal that may also be a problem.

How can CDV be measured?

2-point CDV is a measure of CDV between two points i.e. between the source and the measurement point. This measurement is out-of-service using a special ATM test cell with a timestamp encoded in the payload as defined in ITU-T recommendation O.191. 2-point CDV is the CDV added to the signal by the ATM network, and takes no account of the cell time distribution of the test signal itself.

1-point CDV is a measure of CDV at one point, i.e. the measurement point and involves analysis of cell arrival times with respect to the expected arrival rate. 1-point CDV is a combination of the CDV of the signal source and the CDV added by the ATM network. 1-point CDV measurement may be performed by the GCRA (Generic Cell Rate Algorithm), and this is the technique adopted by the instrument.

What is a GCRA?

The Generic Cell Rate algorithm is standardized in ITU-T Recommendation I.371 and the equivalent ATM Forum Traffic Management Specification. The principal purpose of the GCRA is to perform the policing function and to determine if cells are non-conforming to the negotiated PCR and CDV tolerance.

ITU-T Recommendations and ATM Forum specifications illustrate various equivalent implementations of the GCRA, e.g. the leaky bucket and the virtual scheduling algorithm. The “leaky bucket” is a good analogy for the operation of the algorithm. Cells leak out of the bucket at a constant rate. This is the Peak Cell Rate (PCR). Cells may arrive at a variable rate. If more cells arrive over a given time

Introduction to ATM Testing

Measurement Definitions and Explanations

period than are leaked out, the bucket fills up. The CDV tolerance is the maximum possible depth of cells in the bucket. If the bucket is going to overflow, cells are discarded (and declared non-conforming) thus preventing overflow. If no cells arrive for a period of time, the bucket will drain at the PCR and remain in the empty state until more cells arrive. For stability of the measurement, the PCR must be greater than or equal to the average cell rate.

The filling up of the bucket illustrates how a FIFO buffer fills up with data. The difference between the input and output pointers is the depth of the buffer. When all data has been read out of the buffer, the buffer is then empty.

Constant Bit Rate Application of the GCRA.

If the Peak Cell Rate is set to equal the average cell rate of the CBR data, the depth of the bucket will fluctuate according to the CDV present. If the depth in the bucket is plotted as a graph, this shows the spread of 1-point CDV. For CBR data, the 1-point CDV measurement will approximate the 2-point CDV value, i.e. the CDV added by the ATM network. Non-conforming cells will distort the shape of the graph a little and clamp the maximum 1-point CDV value. It may therefore be useful to disable the declaration of non-conforming cells to get a complete picture of the CDV characteristic. So, it can be seen that the GCRA can be used to measure CDV as well as non-conforming cells.

Non-Constant Bit Rate Application of the GCRA.

For non-CBR data, cell arrival times depend on the time distribution of transmitted data as well as the CDV added by the network. If the transmitted data is not CBR, then the GCRA cannot usefully measure the network CDV. It can, however, be used to measure the distribution of the received data. The GCRA may be computed with the PCR set to any value (greater than the average value). As the PCR is increased, the maximum 1-point CDV value will decrease. Non-CBR traffic may be analyzed and policed by running the GCRA at more than one such rate.

For non-CBR data, where data occurs in variable length bursts, the Peak Cell Rate is the rate during a burst and the long term average as the Sustainable Cell Rate (SCR). To police this data, a GCRA can operate with the Peak Cell Rate and CDV tolerance as before. Another GCRA operates using the SCR value instead of the PCR. The CDV value of the GCRA is much bigger when using the SCR value and is proportional to the size of the bursts and the gap between bursts. When used with the SCR value, the CDV tolerance is known as the Intrinsic Burst Tolerance.

Introduction to ATM Testing
Measurement Definitions and Explanations

Using the 1-Point CDV measurement.

ANALYSE THE TRAFFIC CDV PROFILE.

To analyze the CBR CDV characteristic, set the PCR to equal the mean rate of the CBR traffic. The maximum 1-point CDV value (in cell times) is the minimum buffer depth (in cells) required to remove the CDV. In practice, twice this buffer depth is required because the buffer must be reset at an unknown point in the CDV cycle. If a buffer overflow is occurring in CBR “payout buffers”, the fault may be sectionalised by performing measurements of 1-point CDV at various points in the network.

Traffic shaping may be used to smooth out the variations in non-CBR traffic and so make the signal more economical to transport across the ATM network. The maximum 1-point CDV value (in cell times) represents the buffer depth (in cells) required to smooth out the data to the selected Peak Cell Rate.

The distribution of the 1-point CDV graph gives further insight into the cause of CDV in the ATM network. By varying the PCR and observing the CDV the traffic distribution may be characterized completely .

VERIFY THE POLICING FUNCTION.

To verify the policing action, set the PCR and CDV tolerance to that used in the network element and compare the non-conforming cell ratio with the cell loss ratio available from the network element or measured using test equipment. If no non-conforming cells occur, the (CDV tolerance - maximum 1-point CDV value) gives the margin left available before reaching a condition of non-conformance.

Traffic Simulation

NOTE: The numbers of channels given here relate to the HP37717C fitted with the ATM Services option USK or USL. Instruments with other ATM options allow the configuration of 4 virtual channels, (1 foreground and 3 background channels).

The test set can generate modelled cell traffic which is statistically representative of single and aggregate services present on a single physical link (UNI or NNI), and can be used to provide a number of pre-configured 'Benchmark' traffic loads

Up to 10 virtual channels may be configured, of which one is the Foreground Channel (normally used for out-of-service measurements, e.g. with the Test Cell as payload), and the remaining 9 virtual channels are Background Channels.

The payload of the Foreground Channel is very flexible, but the Background Channels contain just a repeated configurable User Byte for channel identification after ATM routing.

An important feature of all 10 channels is the cell timing distributions which may be selected. Independently for each of the 10 channels, and in any combination, one of three basic cell timing distributions is available:

Constant (CBR)	Only one parameter, mean cell rate, requires selection.
Random	Only one parameter, mean cell rate, requires selection.
Burst	There are three definable parameters (a) the mean cell rate (b) the burst size (length of each burst in cells) (c) the peak rate (the cell rate during each burst).

The Constant distribution schedules the transmission of cells with timing as close to that of a constant bit rate (CBR) service as possible. Because the selected cell rate is implemented by a series of discrete cell events, for arithmetical reasons there will be some small unavoidable deviation from ideal periodic cell timing. Also, the precise timing of cells will be influenced by interaction with the repeating framing overhead of the physical layer. However, these effects are small.

In Burst distribution, the burst itself repeats with a period dependent arithmetically on the three parameters selected. A typical application of the Burst is in simulation of intermittent data traffic and in testing traffic policing functions where both mean and peak rates must be defined.

The Random distribution is based on a pseudo-random function. The decision to schedule a cell for transmission is dependent on a combination of the random

Introduction to ATM Testing

Traffic Simulation

function and the mean rate selected. Random is a particularly useful distribution for simulating the load which would be offered by the combination of a large number of independent traffic channels.

The 10 streams are all generated by independent sources. However, when the cell streams are combined to form the composite transmitted stream, a degree of cell timing interaction occurs, as in all ATM cell multiplexing. The independent streams scheduled by the generators will frequently contend for a particular cell slot. However, because the Foreground channel stream is intended principally for measurement, its distribution is considered most important and therefore any cell which the Foreground channel wishes to send is always accorded priority over the Background channels. After any Foreground channel cell, cells from the Backgrounds have equal priority amongst themselves and are sent in the order with which they are scheduled for transmission by the independent generators. Idle or Unassigned cells fill remaining slots.

As with usual ATM practice, Background channel cells awaiting transmission are held in a (virtual) buffer in their scheduled order until a slot is available. In extreme cases, particularly where the aggregate selected mean rate is close to 100% of the maximum possible, and two or more long bursts happen to coincide, there could be a large number of scheduled background channel cells awaiting transmission. The instrument allows up to 2048 pending cells. If extreme settings cause this buffer length to be exceeded, then Background channel cells will be lost. (Foreground channel cells are never lost.) When a cell is lost, a real-time warning: "Tx background cells are being discarded" appears momentarily on the status line of the display. In practice, repeated cell loss may show the warning for prolonged periods.

A benefit of the buffer is that mean rates very close to 100% may be tested even when the combined peak rates would considerably exceed 100% for significant periods. However, one consequence is that, in some circumstances, a user change of distribution parameters from a high aggregate rate (close to 100%) to a low rate may result in a significant delay before the visible transmitter output rate changes - due to the buffer emptying gradually. Ordinarily, this effect is not noticeable.

The cell headers, payloads and timing distributions for the Foreground (test) virtual channel and background virtual channels may be selected. Cell capacity not specifically assigned as Foreground channel or Background channel will be filled with Unassigned Cells or Idle Cells, and otherwise their details are treated in the user display like those of a Background channel. Either Unassigned or Idle Cells may be selected, but not both.

Generally any of the cell level receive measurements may be used with simulated traffic.

Introduction to ATM Testing

Traffic Simulation

OAM Cell Generation

OAM cell generation is selected (on or off) from the TEST FUNCTION display. The continuity check OAM code is not included as this is needed only during traffic gaps, and is not a traffic load requirement.

Distribution

Distribution Types

Constant

Near periodic with selectable rate in cells/s. Single cells are transmitted at regular intervals, the separation determined by the selected cell rate.

Burst

Periodic burst with selectable burst length in number of cells and mean cell rate in cells/s. With option USK and USL modules, the cell rate during the burst is also selectable.

Random

Poisson distribution with selectable mean cell rate. Individual cell opportunities are pseudo-randomly filled with a probability appropriate to provide the chosen mean cell rate.

Alarms

PDH / DS_n physical layer alarms are covered in “The HP 37717C PDH / DS_n Operating Manual”.

SDH / SONET physical layer alarms are covered in “The HP 37717C SDH / SONET Operating Manual”.

ATM Layer Alarms

ATM layer alarms differ from physical layer alarms in that they are transmitted using ATM fault management OAM cells. These are transmitted using different header values from the user data cells and are detected in parallel with the user cell stream selected for test. There are two levels of ATM layer alarms:

F4 or VP alarms

F5 or VC alarms

The HP 37717C can generate and detect VP-AIS, VP-FERF (VP-RDI), VC-AIS or VC-FERF (VC-RDI) alarms.

VP alarms will only be detected if CELL SELECTED FOR TEST is VP or VC.

VC alarms will only be detected if CELL SELECTED FOR TEST is VC.

Any VP or VC alarm detected will illuminate the front panel VP or VC alarm indicator, if selected. However, alarm analysis in Channel View is independent of these selections

Continuity check cells are another type of fault management OAM cell (VP-CC or VC-CC) and may be found as substitutes for the transmitted cell stream during pauses.

VP-CC or VC-CC cells are generated at a rate of one per second. If the transmitted cell distribution is set with a large burst size and low mean cell rate, long periods of silence can be arranged in the transmitted VC. If this period exceeds 3.5 seconds, a loss of continuity defect (VP-LOC or VC-LOC) may be declared in network equipment. This may cause VP-AIS or VC-AIS cells to be generated. Transmission of VC-CC or VP-CC cells by the instrument or network avoid this happening.

By setting up the transmit cell rate and burst size and selecting VP-CC or VC-CC on or off, the VP-LOC and VC-LOC mechanisms in network equipment may be tested. Continuity check cells may be segment or end to end. The HP 37717C transmits only end to end VP-CC or VC-CC cells.

Introduction to ATM Testing

Alarms

EFCI (explicit forward congestion indication) may be used to control congestion in ATM networks. This is detected in the PTI field of cells in the stream under test and indicated on the HP 37717C as CONGESTION EXPERIENCED alarm.

ATM Alarms and other conditions detected during a test are logged. The following list comprises the conditions which may be logged

ATM Alarm	Additional Information
PLCP Frame Loss	Applies to DS3 PLCP convergence layer
PLCP Remote Alarm	Applies to DS3 PLCP convergence layer
LOSS of CELL SYNC	also known as LOCD, Loss of Cell Delineation
SELECTED CELL NOT RX	
PATTERN LOSS	Loss of the expected test pattern
CONGESTION EXPERIENCED	
VP-AIS	Virtual path - Alarm Indication signal
VP-FERF	Virtual path - Far End Receive Failure (also called VP-RDI)
VP-LOC	Virtual path - Loss Of Continuity
VC-AIS	Virtual channel - Alarm Indication Signal
VC-FERF	Virtual channel - far End Receive Failure (also called VC-RDI)
VC-LOC	Virtual channel - Loss of Continuity
TEST CELL LOSS	
PM OAM LOSS	Performance Management OAM loss
AAL LOSS	Services level, for details see page 9

Introduction to ATM Testing

Alarms

Operation During Alarm Conditions

Error counting in measurements is inhibited during alarm conditions as defined in the following table

NOTE

Alarms from the SDH / SONET and PDH / DSn physical layers are not shown in the following table .

Measurement	Alarm
Received Cells	LOS, LOF, Loss of Cell Sync, PCLP LOF
Corrected HEC	LOS, LOF, AIS, Loss of Cell Sync, PCLP LOF
Non-corrected HEC	LOS, LOF, AIS, Loss of Cell Sync, PCLP LOF
Errored Cells	LOS, LOF, Loss of Cell Sync, Test Cell Loss, Pattern Loss, PCLP LOF
Lost Cells	LOS, LOF, Loss of Cell Sync, Test Cell Loss, PM OAM Loss, PCLP LOF
Misinserted Cells	LOS, LOF, Loss of Cell Sync, Test Cell Loss, PM OAM Loss, PCLP LOF
BEDC BIP-16	LOS, LOF, Loss of Cell Sync, PM OAM Loss, PCLP LOF
Bit Errors	LOS, LOF, Loss of Cell Sync, Pattern Loss, PCLP LOF
Gated MCTD	LOS, LOF, Loss of Cell Sync, Test Cell Loss, PCLP LOF
Max CTD	LOS, LOF, Loss of Cell Sync, Test Cell Loss, PCLP LOF
P-P 2-pt CDV	LOS, LOF, Loss of Cell Sync, Test Cell Loss, PCLP LOF
Max 1-pt CDV	LOS, LOF, Loss of Cell Sync, PCLP LOF
Non-conforming Cells	LOS, LOF, Loss of Cell Sync, PCLP LOF
AAL results except AAL over-run	LOS, LOF, MS-AIS, LOP, Path AIS, Loss of cell sync, AAL loss, PCLP LOF
AAL-5 over-run	LOS, LOF, MS-AIS, LOP, Path AIS, VP-AIS, VC-AIS, AAL loss, PCLP LOF
Channel View	LOS, LOF, MS-AIS, LOP, Path AIS, PCLP LOF

Introduction to ATM Testing
Alarms

2

ATM Modules page 28

Cell Level ATM Testing, Option UKN (USE) page 28

Cell Level ATM Testing, Option UKZ page 29

Broadband Auxiliary Testing, Option 0YK page 30

Services Layer ATM Testing, Options USK and USL page 31

ATM Module Features page 32

Cell Level ATM (Options UKN (USE) and UKZ) page 32

Traffic Simulation page 32

The Test Cell page 34

Trail Trace page 35

Alarm and Error Generation page 35

Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK) page 37

Traffic Simulation page 37

The Test Cell page 39

Trail Trace page 39

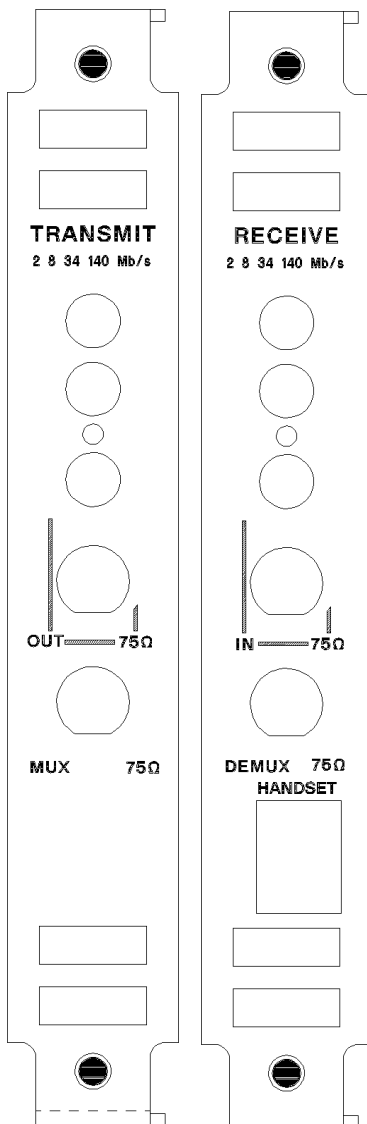
Alarm and Error Generation page 40

ATM Modules

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

ATM Modules

Cell Level ATM Testing. Option UKN (USE)



Option UKN (USE) provides generation and measurement of PDH / DS_n signals with ATM payloads at interfaces of 2.048 Mb/s (E1), 34.368 Mb/s (E3), and 139.264 Mb/s (E4).

Frequency Offset can be added at the interface rates

Line rate frequency measurement can be performed.

Provides the following RZ input and output interfaces:

E3 and E4: 75 Ω unbalanced

E1: 75 Ω unbalanced, 120 Ω balanced.

Allows selection of Line Code AMI, HDB3 or CMI

Allows error and alarm injection

Allows the selection of Foreground (F/G) and Background (B/G) distribution, headers and payloads.

Fill Cells may be Idle or Unassigned.

Provides selectable UNI or NNI interface.

Foreground timing distribution may be Constant or Periodic burst.

A Single burst of a selectable number of cells may be added

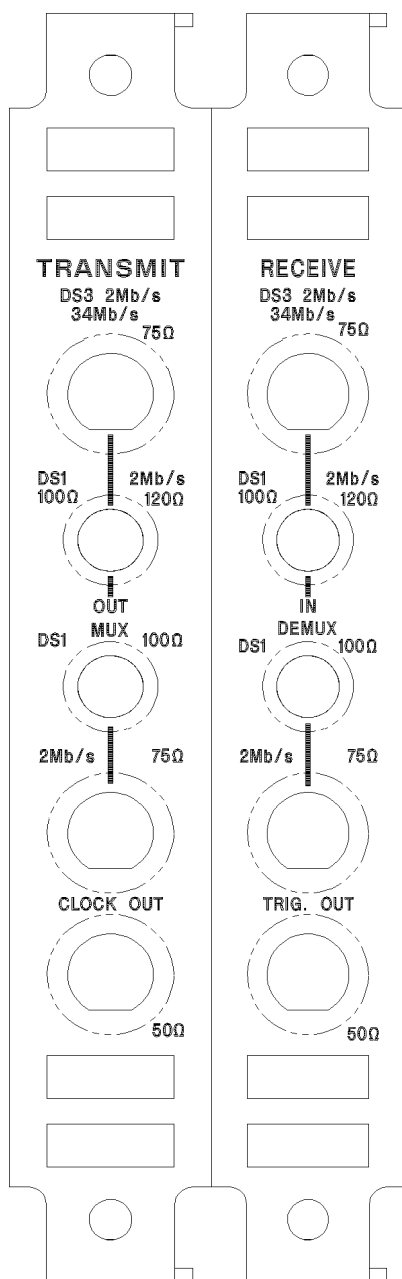
A Test Cell payload is provided for delay and cell misinsertion and loss measurements.

Single HEC, double HEC or bit errors may be added to the ATM payload. When added to all cells they may be added as a burst.

OAM alarms may be added to the transmitted stream.

ATM Modules
ATM Modules

Cell Level ATM Testing. Option UKZ



Physical Layer:

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

Frequency Offset can be added at the interface rates.

Line rate frequency measurement can be performed.

Provides the following RZ input and output interfaces:

DS3 and E3: 75 Ω unbalanced

E1: 75 Ω unbalanced, 120 Ω balanced.

DS1: 100 Ω balanced.

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

Provides Input sensitivity level selection.

Provides output level control for DS1 and DS3.

Allows error and alarm injection

Allows selection of PCLP or Direct mapping for DS3.

ATM Convergence Layer:

Allows selection of DS3 PCLP Growth Octets Z1 to Z6, Line signal status bits and Path Status FEBE, RAI, and LSS.

Provides scrambling on/off selection.

ATM Cell Layer:

Allows the selection of Foreground (F/G) and Background (B/G) distribution, headers and payloads.

Fill Cells may be Idle or Unassigned.

Provides selectable UNI or NNI interface.

Foreground timing distribution may be Constant or Periodic burst.

A Single burst of a selectable number of cells may be added

A Test Cell payload is provided for delay and cell misinsertion and loss measurements.

Single HEC, double HEC or bit errors may be added to the ATM payload. When added to all cells they may be added as a burst.

OAM alarms may be added to the transmitted stream.

ATM Modules
ATM Modules

Broadband Auxiliary Testing. Option 0YK



The Broadband Auxiliary module needs one of the cell layer modules: ETSI cell layer option UKN (USE) or ANSI / ETSI cell layer option UKZ. With the ETSI cell layer option UKN (USE), a physical layer interface, for example, Structured PDH / DS_n Option UKJ (USA) is required.

Allows the selection of 1 Foreground (F/G) and up to 9 Background (B/G) distribution, headers and payloads.

Fill Cells may be Idle or Unassigned.

Provides selectable UNI or NNI interface.

Foreground and Background timing distributions are individually selectable and may be Constant, Random or Periodic burst.

A Test Cell payload is provided for delay and cell misinsertion and loss measurements.

Single HEC, double HEC or bit errors may be added to the ATM payload. When added to all cells they may be added as a burst.

OAM alarms may be added to the transmitted stream.

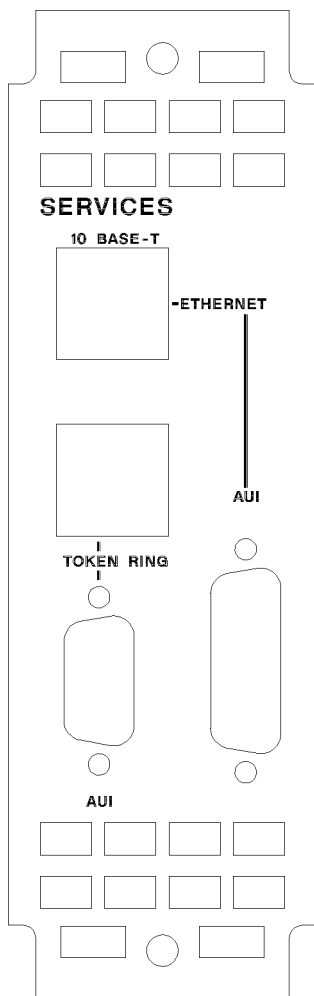
Provides a graphical overview of the traffic at a point in the network with Channel View.

Provides graphical displays of Rate History and 2-Point Cell Delay Variation

Provides AAL Sublayer Measurements

ATM Modules
ATM Modules

Services Layer ATM Testing. Options USK and USL



The Services Layer modules need one of the cell layer modules: ETSI cell layer option UKN (USE) or ANSI / ETSI cell layer option UKZ. With the ETSI cell layer option UKN (USE), a physical layer interface, for example, Structured PDH / DS_n Option UKJ (USA) is required.

Allows the selection of 1 Foreground (F/G) and up to 9 Background (B/G) distribution, headers and payloads.

Fill Cells may be Idle or Unassigned.

Provides selectable UNI or NNI interface.

Foreground and Background timing distributions are individually selectable and may be Constant, Random or Periodic burst.

A Test Cell payload is provided for delay and cell misinsertion and loss measurements.

Single HEC, double HEC or bit errors may be added to the ATM payload. When added to all cells they may be added as a burst.

OAM alarms may be added to the transmitted stream.

Provides a graphical overview of the traffic at a point in the network with Channel View.

Provides graphical displays of Rate History and 2-Point Cell Delay Variation

Provides AAL Sublayer Measurements

ATM Modules
ATM Module Features

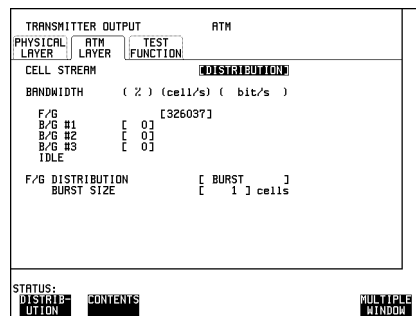
ATM Module Features

ATM Cell layer features are enhanced if one of the options 0YK, USK or USL are also fitted. To accommodate these enhanced features, there are differences in their presentation on the display.

Cell Level ATM (Options UKN (USE) and UKZ)

Traffic Simulation

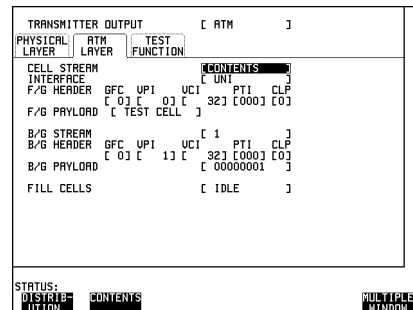
Traffic simulation is provided for out-of-service testing where real user traffic is not suitable and user control of cell timing distribution is needed..



Use the **TRANSMIT** display **ATM ATM LAYER** settings to select the cell stream headers, payloads and distribution.

You can select the headers, payloads and distributions of the Foreground (F/G) channel and Background (B/G) channel cells. The Foreground channel cell is used as the subject of the test and the background channel cells are transmitted with it in the same physical link

The test stream comprises: 1 Foreground Channel, 3 Background Channels and the remaining cell opportunities which are filled with unassigned or idle cells selectable from the CELL STREAM **CONTENTS** display.



ATM Modules

Cell Level ATM (Options UKN (USE) and UKZ)

Different types of traffic may be simulated by selecting the cell timing distributions.

The four channels can have any of the following two cell timing distributions: Constant or periodic Burst. A number of traffic models may be stored in the instrument as part of complete instrument stored settings

```

TRANSMITTER OUTPUT [ ATM ]
PHYSICAL LAYER [ ATM ] TEST FUNCTION
CELL STREAM [ DISTRIBUTION ]
BANDWIDTH ( % ) ( cell/s ) ( bit/s )
F/G [ 326037 ]
B/G #1 [ 0 ]
B/G #2 [ 0 ]
B/G #3 [ 0 ]
IDLE
F/G DISTRIBUTION [ PERIODIC ]
ADD SINGLE BURST OF [ OFF ] cells
    
```

STATUS: BURST PERIODIC MULTIPLE WINDOW

Type of Service	Useful Equivalent Cell Timing Distribution
Constant Bit Rate	Constant (periodic)
Service Protocol Packet	Burst (Periodic burst)

```

TRANSMITTER OUTPUT [ ATM ]
PHYSICAL LAYER [ ATM ] TEST FUNCTION
CELL STREAM [ DISTRIBUTION ]
BANDWIDTH ( % ) ( cell/s ) ( bit/s )
F/G [ 326037 ]
B/G #1 [ 0 ]
B/G #2 [ 0 ]
B/G #3 [ 0 ]
IDLE
F/G DISTRIBUTION [ PERIODIC ]
ADD SINGLE BURST OF [ 1000 ] cells
    
```

STATUS: OFF ADD BURST MULTIPLE WINDOW

The number of parameters selectable in burst mode depends on the optional modules fitted. All ATM Cell layer, ATM Services and Broadband Auxiliary modules provide the capability to select the burst length in cells and mean cell rate in number of cells per second.

A Single burst of a preset number of cells may be added.

The payload of the foreground and background channels may be selected independently of the distributions by selecting **ATM LAYER CONTENTS**

```

TRANSMITTER OUTPUT [ ATM ]
PHYSICAL LAYER [ ATM ] TEST FUNCTION
CELL STREAM [ DISTRIBUTION ]
INTERFACE [ UN1 ]
F/G HEADER BFC UPI UCI PTI CLP
[ 0 ] [ 0 ] [ 32 ] [ 000 ] [ 0 ]
F/G PAYLOAD [ TEST CELL ]
B/G STREAM [ 1 ]
B/G HEADER BFC UPI UCI PTI CLP
[ 0 ] [ 1 ] [ 32 ] [ 000 ] [ 0 ]
B/G PAYLOAD [ 00000001 ]
FILL CELLS [ IDLE ]
    
```

STATUS: DISTRIBUTION CONTENTS MULTIPLE WINDOW

ATM Modules

Cell Level ATM (Options UKN (USE) and UKZ)

Each background channel header and payload is selected and set-up in turn by using the B/G STREAM selection.

TRANSMITTER OUTPUT		[ATM]
PHYSICAL LAYER	ATM LAYER	TEST FUNCTION
CELL STREAM	[CONTENTS]	
INTERFACE	[UNI]	
F/G HEADER	BFC UPI UCI	PTI CLP
	[0] [0] [32]	[000] [0]
F/G PAYLOAD	[TEST CELL]	
B/G STREAM	[1]	
B/G HEADER	BFC UPI UCI	PTI CLP
	[0] [1] [32]	[000] [0]
B/G PAYLOAD	[00000001]	
FILL CELLS	[IDLE]	

STATUS: 1 2 3 MULTIPLE WINDOW

The cross cell PRBS runs continuously from cell to cell. With the cross cell PRBS, error instances of cell misinsertion or cell loss will cause pattern sync loss.

With the single cell PRBS, the PRBS is restarted in every cell. Cell loss will **NOT** cause pattern sync loss but, of course, payload errors will be counted.

TRANSMITTER OUTPUT		[ATM]
PHYSICAL LAYER	ATM LAYER	TEST FUNCTION
CELL STREAM	[CONTENTS]	
INTERFACE	[UNI]	
F/G HEADER	BFC UPI UCI	PTI CLP
	[0] [0] [32]	[000] [0]
F/G PAYLOAD	[TEST CELL]	
B/G STREAM	[1]	
B/G HEADER	BFC UPI UCI	PTI CLP
	[0] [1] [32]	[000] [0]
B/G PAYLOAD	[00000001]	
FILL CELLS	[IDLE]	

STATUS: CROSS CELL SINGLE CELL USER BYTE TEST CELL MULTIPLE WINDOW

The Test Cell

Delay measurements and cell misinsertion and loss measurements use a special test cell. The test cell is that defined in ITU-T O.191. Delay measurements use the time stamp and cell misinsertion and loss measurements use the sequence number. Errored cells are indicated by the EDCs (Error Detection Codes) in the test cell.

The test cell is selectable from the **TRANSMIT** **ATM** **ATM LAYER** display by selecting the test cell in the CELL STREAM **CELL PAYLOAD**. The header of the test cell may then be set using **CELL HEADER**.

TRANSMITTER OUTPUT		[ATM]
PHYSICAL LAYER	ATM LAYER	TEST FUNCTION
CELL STREAM	[CONTENTS]	
INTERFACE	[UNI]	
F/G HEADER	BFC UPI UCI	PTI CLP
	[0] [0] [32]	[000] [0]
F/G PAYLOAD	[TEST CELL]	
B/G STREAM	[1]	
B/G HEADER	BFC UPI UCI	PTI CLP
	[0] [1] [32]	[000] [0]
B/G PAYLOAD	[00000001]	
FILL CELLS	[IDLE]	

STATUS: CROSS CELL SINGLE CELL USER BYTE TEST CELL MULTIPLE WINDOW

ATM Modules

Cell Level ATM (Options UKN (USE) and UKZ)

Trail Trace

Use the **TRANSMIT** display **ATM** **PHYSICAL LAYER** settings to select the trail trace content.

TRANSMITTER OUTPUT [ATM]	
PHYSICAL LAYER [ATM]	TEST FUNCTION []
SIGNAL [34 Mb/s]	[INTERNAL]
CLOCK SYNC []	INTERNAL
TERMINATION [75% UNBAL]	
LINE CODE [HDB3]	
FREQUENCY OFFSET [OFF]	
TRAIL TRACE [USE]	HP37717C
CELL SCRAMBLING [ON]	
STATUS: TEST USER MULTIPLE WINDOW	

Alarm and Error Generation

Header Errors

Errors may be added to the ATM cell header. Selecting SINGLE HEC adds one error to the ATM header when activated. An isolated single error will be corrected by the HEC mechanism and will result in a measurement of a corrected HEC error.

Selecting DOUBLE HEC adds two errors to the same header. This will cause the HEC check to fail and the cell to be discarded.

A burst error add feature is also available whenever header errors are selected to be added to ALL CELLS. BURST can be used to stress the ATM cell delineation algorithm. You can select a burst of from 1 to 8 consecutive errored cell headers. Usually six header errors can be added before cell delineation is lost. A burst of single header errors will cause only the first error to be corrected because of the detection/correction mode inherent in the header error correction algorithm.

TRANSMITTER OUTPUT [ATM]	
PHYSICAL LAYER [ATM]	TEST FUNCTION []
TEST FUNCTION [ATM PAYLD]	ERR & ALARM
ERROR ADD TYPE [DOUBLE HEC]	[ALL CELLS]
STREAM []	
BURST SIZE [5]	
ADD BURST [OFF]	
DRM ALARM TYPE [OFF]	
STATUS: OFF ADD BURST MULTIPLE WINDOW	

ATM Modules

Cell Level ATM (Options UKN (USE) and UKZ)

HEC Errors

Header error correction may be checked with the introduction of single header errors. The detection and discard operation of devices may be checked with double header errors. Cell delineation may be checked with the introduction of header error sequences.

TRANSMITTER OUTPUT				ATM
PHYSICAL LAYER	ATM LAYER	JITTER	TEST FUNCTION	
TEST FUNCTION	[OFF]	ATM PAYLD	[OFF]	ERR & ALARM
ERROR ADD	TYPE			[SINGLE HEC]
	STREAM			[P/B CELLS]
	RATE			[OFF]
OAM CELL ALARMS				[OFF]

STATUS:
SINGLE HEC DOUBLE HEC BIT MULTIPLE WINDOW

Payload Errors

Bit errors may be introduced into the ATM payload.

Use the **TRANSMIT** display **ATM TEST FUNCTION** settings to produce ATM errors and OAM alarms in the transmitted stream.

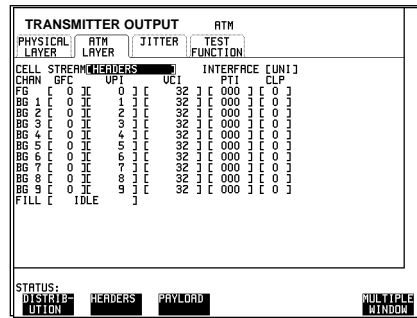
ATM Modules

Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK)

Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK)

Traffic Simulation

Traffic simulation is provided for out-of-service testing where real user traffic is not suitable and user control of cell timing distribution is needed..



Use the **TRANSMIT** display **ATM ATM LAYER** settings to select the cell stream headers, payloads and distribution.

You can select the headers, payloads and distributions of the Foreground channel and Background channel cells. The Foreground channel cell is used as the subject of the test and the background channel cells are transmitted with it in the same physical link

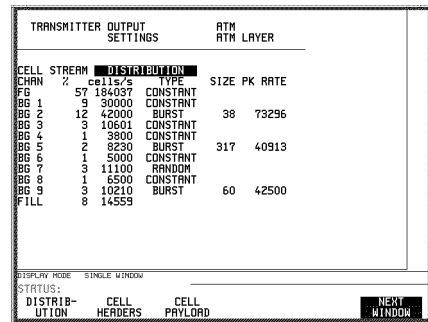
The number of background channels selectable varies with optional modules. This example uses the ATM services module USK or USL.

The test stream comprises: 1 Foreground Channel, up to 9 Background Channels and the remaining cell opportunities filled with unassigned or idle cells.

Different types of traffic may be simulated by selecting the cell timing distributions.

The ten channels can have any of the following three cell timing distributions: Constant, periodic Burst or Random, see page 20. Particular combinations of settings allow traffic models to be constructed by the user.

A number of traffic models may be stored in the instrument as part of complete instrument stored settings.

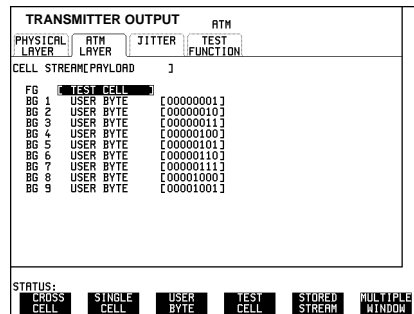


ATM Modules

Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK)

Type of Service	Useful Equivalent Cell Timing Distribution
Constant Bit Rate	Constant (periodic)
Service Protocol Packet	Burst (Periodic burst)
Multiple channels considered together as a composite load	Random (Poisson)

The number of parameters selectable in burst mode depends on the optional modules fitted. All ATM and ATM Services / Broadband Auxiliary modules provide the capability to select the burst length in cells and mean cell rate in number of cells per second. The ATM Services / Broadband Auxiliary modules, options 0YK, USK and USL provide the additional capability of selecting a cell rate during the burst which is different to the mean cell rate, and also provide the Random Distribution.



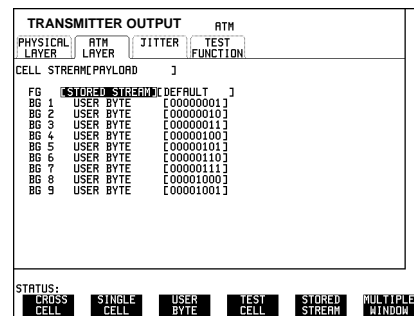
The payload of the foreground and background channels may be selected independently of the distributions

The cross cell PRBS runs continuously from cell to cell. With the cross cell PRBS, error instances of cell mis-insertion or cell loss will cause pattern sync loss.

With the single cell PRBS, the PRBS is restarted in every cell. Cell loss will **NOT** cause pattern sync loss but, of

course, payload errors will be counted.

Instead of normal operation where the Foreground Channel is a single VC, the same cell *positions* may be substituted by one of the composite cell streams stored in the instrument. The stored cell streams contain a *number* of fixed VCs which periodically repeat, some containing deliberate errors. The stored streams are intended for instrument demonstration, test and training purposes. For details see page 73



Note that when a stored cell stream is selected, the terms “Foreground” and “Payload” are no longer meaningful.

ATM Modules

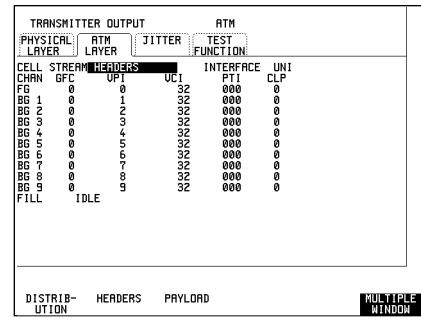
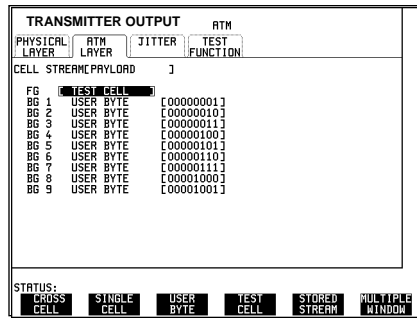
Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK)

With the cell layer modules options UKN (USE) or UKZ and WITHOUT the modules 0YK, USK or USL, a single burst of contiguous cells may be **added** to the Constant Foreground channel distribution on a single event basis. The burst size is selected from the TEST FUNCTION display.

The Test Cell

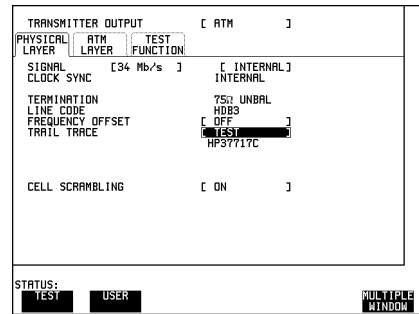
Delay measurements and cell misinsertion and loss measurements use a special test cell. The test cell is that defined in ITU-T draft O.191. Delay measurements use the time stamp and cell misinsertion and loss measurements use the sequence number. Errored cells are indicated by the EDCs (Error Detection Codes) in the test cell.

The test cell is selectable from the **TRANSMIT** **ATM** **ATM LAYER** display by selecting the test cell in the **CELL STREAM** **CELL PAYLOAD**. The header of the test cell may then be set using **CELL HEADER**.



Trail Trace

Use the **TRANSMIT** display **ATM** **PHYSICAL LAYER** settings to select the trail trace content.



ATM Modules

Services Modules (Options USK and USL) and Broadband Auxiliary Module (Option 0YK)

Alarm and Error Generation

Header Errors

Errors may be added to the ATM cell header. Selecting SINGLE HEC adds one error to the ATM header when activated. An isolated single error will be corrected by the HEC mechanism and will result in a measurement of a corrected HEC error.

Selecting DOUBLE HEC adds two errors to the same header. This will cause the HEC check to fail and the cell to be discarded.

A burst error add feature is also available whenever header errors are selected to be added to ALL CELLS. BURST can be used to stress the ATM cell delineation algorithm. You can select a burst of from 1 to 8 consecutive errored cell headers. Usually six header errors can be added before cell delineation is lost. A burst of single header errors will cause only the first error to be corrected because of the detection/correction mode inherent in the header error correction algorithm.

TRANSMITTER OUTPUT	ATM	TEST
PHYSICAL LAYER	ATM LAYER	FUNCTION
TEST FUNCTION	ATM PAYLD	ERR & ALARM
ERROR ADD TYPE	DOUBLE HEC	
STREAM	ALL CELLS	
BURST SIZE	5	
ADD BURST	OFF	
OAM ALARM TYPE	OFF	

STATUS: OFF ADD BURST MULTIPLE WINDOW

HEC Errors

Header error correction may be checked with the introduction of single header errors. The detection and discard operation of devices may be checked with double header errors. Cell delineation may be checked with the introduction of header error sequences.

Payload Errors

Bit errors may be introduced into the ATM payload.

Use the **TRANSMIT** display **ATM TEST FUNCTION** settings to produce ATM errors and OAM alarms in the transmitted stream.

TRANSMITTER OUTPUT	ATM	JITTER	TEST
PHYSICAL LAYER	ATM LAYER	FUNCTION	FUNCTION
TEST FUNCTION	ATM PAYLD	ERR & ALARM	
ERROR ADD TYPE	SINGLE HEC		
STREAM	ALL CELLS		
RATE	OFF		
OAM CELL ALARMS	OFF		

STATUS: SINGLE HEC DOUBLE HEC BIT MULTIPLE WINDOW

3

ATM Channel View	page 42
Measurement Set-Up	page 43
Cell Count Mode	page 43
Channel View Set-up	page 43
Filtering	page 43
Sorting	page 44
Starting the Channel View Measurement	page 44
VPI and VCI Identification	page 44
Load Indication and Bar Graph Display	page 44
Payload Analysis (PAYLOAD Column)	page 45
Continuity Checks	page 45
ATM Alarms Analysis (ALARMS Column)	page 45
Selection of a Channel for Further Analysis	page 46

Link Traffic Overview

The starting point for many applications, Channel View gives you a fast pictorial indication of link activity.

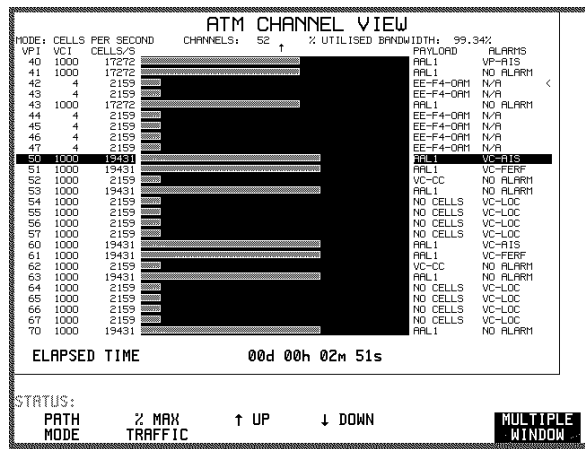
Link Traffic Overview
ATM Channel View

ATM Channel View

Options required 0YK USK or USL (plus UKN (USE) or UKZ)

Channel View allows you to find quickly what is present on the link, identify problem paths / channels and to select them for further analysis. This feature may be used for In-Service and Out-of-Service applications. You can rapidly check routing tables and check for “rogue” cells. Rogue cells are cells which have been translated by error to an incorrect VPI / VCI value, whether that value is already in use or not. When a rogue cell has been translated to a VPI / VCI value in use it is a misinserted cell.

All of the VPs and VCs containing traffic, even down to a single cell, are detected and the mean cell load is displayed in real time. The bars on the display give a pictorial indication of activity.

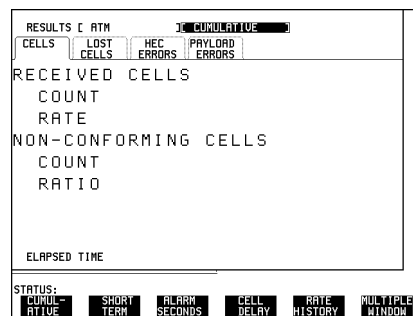


Link Traffic Overview
ATM Channel View

Measurement Set-Up

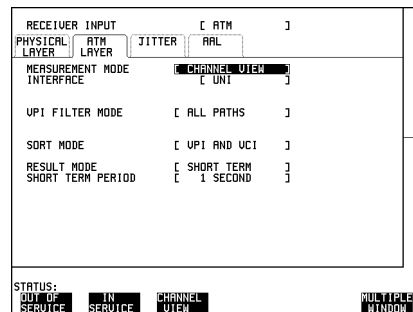
Cell Count Mode

The cell counts used for the Channel View display may be short term or cumulative. Before selecting Channel View, select the cell count mode.



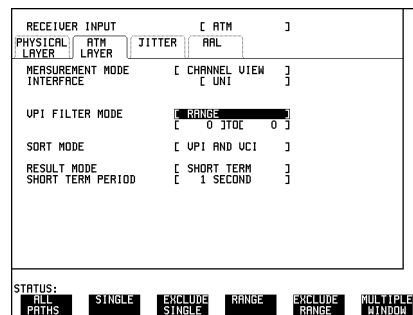
Channel View Set-up

Press **RECEIVE** and select the display shown.



Filtering

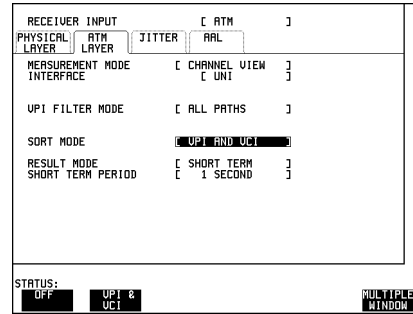
Make any filter adjustments required. If more than 1023 channels are expected to be present on the link, it may be desirable to restrict the range by selecting one of the VPI FILTER MODE ranges available otherwise the instrument identifies the first 1023 different VPI / VCI values it finds. This may also be desirable if only a limited range of virtual channels is of interest.



Link Traffic Overview
ATM Channel View

Sorting

With the SORT MODE set to OFF the CHANNEL VIEW display will be presented in the order that cells are detected. The “last page” of the CHANNEL VIEW display will show new or added virtual channels. With the SORT MODE set to VPI and VCI the CHANNEL VIEW display will be presented by VPI (and VCI) in numerical order.



Starting the Channel View Measurement

With the set-up complete, press **RESULTS** to obtain the Channel View display and then press **RUN/STOP** to start the measurement.

VPI and VCI Identification

The leftmost two columns show the VPI and VCI in all modes.

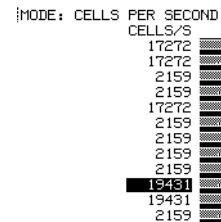
VPI	VCI
40	1000
41	1000
42	4
43	4
43	1000
44	4
45	4
46	4
47	4
50	1000
51	1000
52	1000

Load Indication and Bar Graph Display

The third column shows the value for the mode selected. The current mode selection is shown at the top of the display:

Three modes are available for load indication:

- Cells/second
- % of maximum possible link traffic
- Cell count from the start of the measurement



These modes are selected using the three way toggling softkey at the bottom of the display. The bar graph display is colour coded to indicate short term or cumulative cell count selected; see page 43. A green bar graph display indicates short term cell count and a blue bar graph display indicates cumulative cell count.

Link Traffic Overview

ATM Channel View

The bar graph display is auto-scaling and designed to show *relative* levels of results without a scale displayed. The display may re-scale during a measurement, causing a “jump back” effect.

Payload Analysis (PAYLOAD Column)

Each channel is subsequently scanned in turn and the result of this analysis is presented in the PAYLOAD column and, where appropriate, in the ALARMS column to the right of the bar graphs. The analysis is performed first on the page displayed and then on any subsequent hidden pages.

```
.....
PAYLOAD
| AAL1
| AAL1
| EE-F4-OAM
| EE-F4-OAM
| AAL1
| EE-F4-OAM
| EE-F4-OAM
| EE-F4-OAM
| EE-F4-OAM
| AAL1
| AAL1
| VC-CC
| AAL1
```

The PAYLOAD column shows the AAL-type or OAM stream information. The hierarchy used for this display is as follows:

(AAL-1, AAL-3/4, AAL-5), TEST CELL, UNKNOWN, VP-CC, VC-CC, NO CELL.

Where cells are found in VCI<32, the payload is described by the expected content as specified in ITU-T Rec I.610. The display “No Cell” indicates that a cell was detected in a VC but no cell activity was detected at the time of the previous scan.

Continuity Checks

Virtual Path continuity checks performed by VP-CC OAM cells, are carried in VCI = 3 (segment) and VCI= 4 (End-to-End) of the virtual path concerned.

As part of PAYLOAD analysis, Channel View looks for Virtual Channel continuity check (CC) OAM cells in each channel of VCI > 31. The VC-CC legend displayed is the result of a logical-OR of the presence of segment and end-to-end VC-CC cells.

ATM Alarms Analysis (ALARMS Column)

VP and VC alarms (AIS and FERF) are signaled in fault management OAM cells. Because path alarms override channel alarms in importance, a VP alarm is indicated in the ALARM column against all the subsidiary VCs affected (all VCs in that VP). Any simultaneous VC alarms are then not visible. However, if a VC alarm occurs alone, it will be displayed against the channel bar for that VC

```
ALARMS
| VP-AIS
| NO ALARM
| N/A
| N/A
| NO ALARM
| N/A
| N/A
| N/A
| N/A
| VC-AIS
| VC-FERF
| NO ALARM
```

Other information shown in the ALARM column includes channel associated indications such as VC-LOC, VP-LOC and Congestion for any VCI>31. The hierarchy is as follows: VC-AIS, VC-FERF, VC-LOC, VP-AIS, VP-FERF, VP-LOC, CONGESTION (taken from the PTI), NO ALARM.

Link Traffic Overview

ATM Channel View

Selection of a Channel for Further Analysis

Having used Channel View to identify the virtual channels present, the cursor bar may be used to select a particular channel for further analysis.

Press **RUN/STOP** to stop the measurement. (green LED goes out)

Use **↓** and **↑** to move the cursor bar to the chosen channel.

Press **SET**. This action will transfer the VPI / VCI value into the instrument receive filter for analysis when using IN-SERVICE or OUT-OF-SERVICE measurements.

RESULTS [RAL]		[CUMULATIVE]	
ARL1	ARL2		
MAIN	SUBARRY		
SRR-PDU	COUNT		
CORRECTED SN PROTECTION	EC		
	ER		
NON-CORR SN PROTECTION	EC		
	ER		
LOST CELL	COUNT		
ELAPSED TIME			
STATUS:			
MULTIPLE WINDOW			

4

Introduction to In-Service Testing page 48

Cell Layer Error Measurement page 51

Service Policing page 55

Individual Service Performance page 57

In-Service Testing

Information on general In-Service measurement techniques and some practical examples of tests.

Introduction to In-Service Testing

PDH / DS_n physical layer testing is covered in “The HP 37717C PDH / DS_n Operating Manual”.

SDH / Sonet physical layer testing is covered in “The HP 37717C SDH / SONET Operating Manual”.

ATM Layer Testing

An effective form of in-service measurement may be performed by monitoring the AAL in use. The AAL may include a sequence number, length count and/or CRC. Measuring errors in these fields will give a feel for the Quality of Service being delivered on the VC being monitored. It is difficult to map the measurements obtained into values for ATM performance parameters to determine compliance with the traffic contract. However, AAL measurements may reflect more accurately than Out-of-Service intrusive tests the effect that degradation of performance parameters is having on the service being transported.

Because of the nature of ATM, the VP or VC under test may be Out-of-Service but the rest of the physical link may still be carrying live traffic. In some situations it may be useful to set up a test VP or VC for measurement purposes in addition to the VP/VC carrying the user data traffic. It may however be difficult to guarantee that the test VC follows the same route, has the same timing distribution, or is given the same priority as the VC carrying live traffic.

To perform improved in-service measurements, it may be possible to periodically insert test cells of the format described above into live traffic. This, however, would not give a very good indication of the performance of the live data cells because measurements could only be performed on a sampled basis. For example cell loss measurements would only indicate lost test cells.

A more powerful technique using performance management OAM flows has been defined in ITU-T Recommendation I.610. Performance management OAM cells are inserted periodically into live traffic and contain information about the user cell stream. Measurements of ATM performance parameters can be made by monitoring both the live traffic and the OAM cells.

ITU-T Rec I.610 defines a forward monitoring cell and a backward reporting cell. A forward monitoring cell is used to measure the performance of the user cell stream flowing in the same direction and a backward reporting cell reports the results back to the VP or VC source.

In-Service Testing

Introduction to In-Service Testing

The format of the forward monitoring performance management OAM cell defined in ITU-T Rec I.610 comprises the following fields:

- OAM type and function type
- MCSN: monitoring cell sequence number.
- TUC 0+1: total user cell number (CLP 0+1 flow)
- EDC 0+1: block error detection code (CLP 0+1 flow)
- TUC 0: total user cell number (CLP 0 flow)
- TSTP: optional timestamp
- reserved for future use (revision indicator)
- CRC-10 error detection code

The sequence number (MCSN) in this case performs a different function from the sequence number used in the out-of-service test cell. It is used to identify discontinuities in the OAM flow so that certain measurements can be suspended.

Measurement of cell loss or misinsertion can be made using the total user cell number field (TUC). The TUC field is a 16-bit counter which increments for every user cell which is transmitted between OAM cells. If this differs from the number of user cells detected at the receiver between OAM cells, the number of lost or misinserted cells can be calculated.

The BEDC field contains the result of a BIP-16 calculated on the transmitted user cells and is used to estimate the error performance of the user cell stream.

An optional timestamp field has been defined. This may be used by end equipment to perform delay and CDV measurements. These can, however, only be sampled measurements and may not reflect the characteristics of the user traffic very well.

The contents of the OAM cell are protected by a CRC-10. No information is processed if the CRC is in error.

Performance management OAM may be activated and deactivated as required on specific VPs or VCs.

For example, if an end-to-end VC OAM flow (F5) is activated by an end user to monitor the Quality of Service being provided by the network operator, it is possible for the network operator to monitor the backward reporting cells to assess the end-to-end performance. Also, forward monitoring cells can be monitored at any point in the network to isolate faults. In addition, the network operator may activate VP end-to-end OAM to verify the performance of virtual paths within the network or also VP or VC segment OAM.

In-Service Testing

Introduction to In-Service Testing

Any OAM flows set up by the end user will have to be included in the service contract and policed as part of the user data. Performance management OAM flows may be monitored by network equipment or test equipment.

The instrument analyzes some of the performance management OAM fields to provide In-Service measurements.

Cell Layer Error Measurement

Options required ATM Cell Layer **UKN (USE) or UKZ**
For SDH interfaces **US1 (US5)**
For SDH / SONET interfaces **A1T (A1U) and USN**

It can be extremely useful to measure the performance of the ATM service while transporting live traffic. Measurement of physical layer overhead, corrected and non-corrected ATM header errors and 1-point CDV are possible as well as monitoring the received cell count in the VP or VC under test.

In addition, performance management OAM flows generated by network equipment may be used to perform In-Service measurements of cell loss, cell misinsertion and cell errors. In this case the cell error measurement is performed using a BEDC (block error detection code) transmitted in the OAM cells. Performance management OAM cells are inserted periodically into live traffic and contain information about the user cell stream. Measurements of ATM performance parameters can be made by monitoring both the live traffic and the OAM cells.

If a VP has been selected for test, VP segment or end to end performance management OAM cells (F4 flow) are monitored. If a VC has been selected for test, VC segment or end to end Performance management OAM cells (F5 flow) are monitored.

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. The default settings are set by selecting **OTHER**
STORED SETTINGS STORED SETTING NUMBER 0.

ATM In-Service Test Setup Procedure, SDH Interface Example

This example uses ATM module **UKN** with SDH interface module **US1**.

In this setup an STM-1 optical or electrical cell stream is monitored and Performance Management OAM measurements are made using the HP 37717C in a *Receive only* mode.

In-Service Testing Cell Layer Error Measurement

- 1 Set up the **RECEIVE** **ATM** **PHYSICAL LAYER** display for the appropriate interface rate.

RECEIVER INPUT	[ATM]
PHYSICAL LAYER	ATM TEST OVERHEAD
LAYER	FUNCTION MONITOR
SIGNAL [STM-1 OPT]	
CELL SCRAMBLING [ON]	

rLog MULTIPLE WINDOW

- 2 Set up the **RECEIVE** **ATM** **ATM LAYER** display as shown.

LIVE TRAFFIC allows In-Service testing at the ATM layer.

PERFORMANCE MANAGEMENT [END TO END] allows Cell Loss, Cell Misinsertion and BEDC BIP-16 measurements to be made on the performance management OAM.

The OAM block size may be entered. If this is unknown, select 1024 (maximum available). Selecting a block size smaller than that in use may cause PM OAM LOSS. If the OAM cells selected are not present, a status message "PM OAM LOSS alarm" will appear on the display.

RECEIVER INPUT	[ATM]
PHYSICAL LAYER	ATM TEST OVERHEAD
LAYER	FUNCTION MONITOR
INTERFACE [UNI]	
CELL SELECTED FOR TEST [UC]	
CELL HEADER OFC	UPI UCI [UC]
	PTI CLP [X]
	X [0] [32] OAM [X]
CELL PAYLOAD [LIVE TRAFFIC]	
MEASURED AVG. CELL RATE	
PERK CELL RATE (cell/s)	[100]
CDU TOLERANCE (usec)	[10]
PERFORMANCE MANAGEMENT	[END TO END]
BLOCK SIZE	[1024]

UC OAM ANALYSIS ENABLED.

rLog OFF SEGMENT END-TO-END MULTIPLE WINDOW

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

BEDC BIP-16 results are displayed. Any other results can be displayed without affecting the measurement.

RESULTS [ATM]	[CUMULATIVE]
ERRORED CELLS	MISINS CELLS
BEDC BIP-16	NONCONF CELLS
MORE	
BEDC BIP-16	
COUNT	
RATIO	
ELAPSED TIME	

rLog MULTIPLE WINDOW

Run the In-service ATM Test

- 1 Press **RUN/STOP** to start the test.

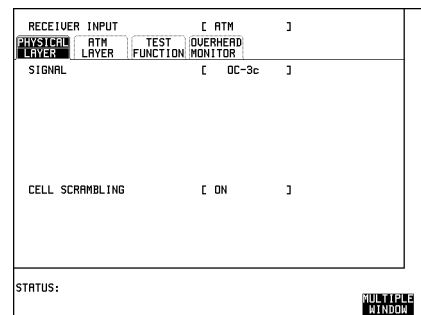
In-Service Testing
Cell Layer Error Measurement

ATM In-Service Test Setup Procedure, SDH / SONET Interface Example

This example uses ATM module **UKZ** with SDH / SONET interfaces **A1T (A1U)** and **USN**.

In this setup an OC-3c cell stream is monitored and Performance Management OAM measurements are made using the HP 3717C in a *Receive only* mode.

- 1 Set up the **RECEIVE ATM PHYSICAL LAYER** display for the appropriate interface rate.

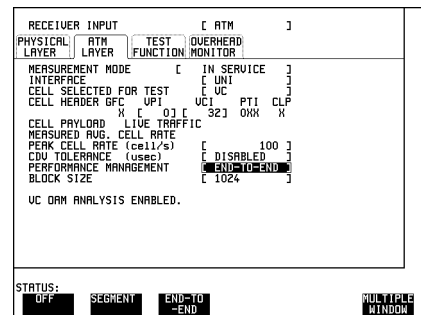


- 2 Set up the **RECEIVE ATM ATM LAYER** display as shown.

MEASUREMENT MODE

IN SERVICE allows LIVE TRAFIC testing at the ATM layer.

PERFORMANCE MANAGEMENT [END TO END] allows Cell Loss, Cell Misinsertion and BEDC BIP-16 measurements to be made on the performance management OAM.



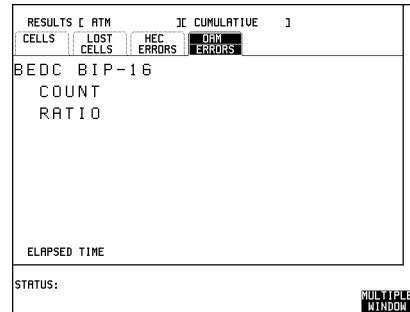
The OAM block size may be entered. If this is unknown, select 1024 (maximum available). Selecting a block size smaller than that in use may cause PM OAM LOSS. If the OAM cells selected are not present, a status message “PM OAM LOSS alarm” will appear on the display.

In-Service Testing

Cell Layer Error Measurement

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

BEDC BIP-16 results are displayed. Any other results can be displayed without affecting the measurement.



Run the In-service ATM Test

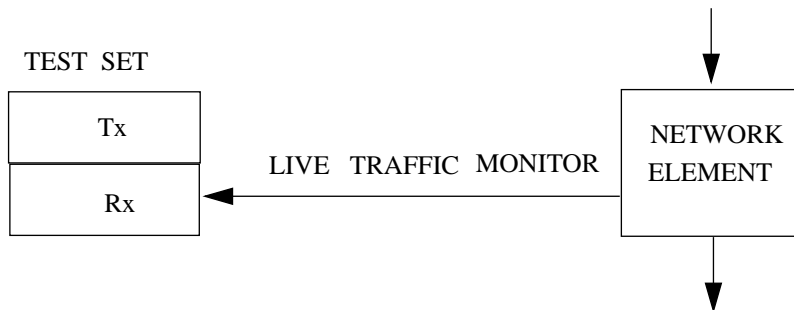
Press **RUN/STOP** to start the test.

In-Service Testing
Service Policing

Service Policing

Options required 0YK, USK or USL

An In-service Rate History test to check that a service is operating within agreed rate limits.



Select the VPI/VCI to be tested.

```

RECEIVER INPUT [ ATM ]
PHYSICAL LAYER [ ATM ] JITTER [ AAL ]
MEASUREMENT MODE [ IN SERVICE ]
INTERFACE [ UNI ]
CELL SELECTED FOR TEST [ UC ]
CELL HEADER GFC [ 03 ] PTI [ 32 ] CLP [ X ]
CELL PAYLOAD [ LIVE TRAFFIC ]
MEASURED AVG. CELL RATE [ 100 ]
PEAK CELL RATE (cell/s) [ DISABLED ]
CDU TOLERANCE (ussec) [ OFF ]
PERFORMANCE MANAGEMENT [ OFF ]

UC DAM ANALYSIS ENABLED.

STATUS:
AVERAGE [ +1 ] USER [ DEFINED ] MULTIPLE [ WINDOW ]
  
```

At the interface (physical layer) level, set the results storage to the resolution required for the Rate History display .

```

RESULTS [TIMING CONTROL]
SHORT TERM PERIOD [ 10 SECONDS ]
TEST TIMING [ MANUAL ]
STORAGE [ 1 MIN RESOL'N ]

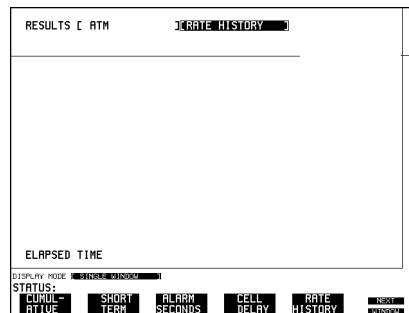
STATUS:
OFF [ 1 SEC RESOL'N ] [ 1 MIN RESOL'N ] [ 15 MIN RESOL'N ] [ 1 HR RESOL'N ] MULTIPLE [ WINDOW ]
  
```

In-Service Testing

Service Policing

At the ATM level. Press **RESULTS** and select **RATE HISTORY**. This is a simple monitoring function of maximum, mean and minimum cell rates of a specified VP or VP / VC. The received cells selected for test are “VPI value” or “VCI value” with a payload of live traffic.

Note: the setting of the payload to live traffic avoids the instrument making erroneous measurements on non-test data.



Each bar on the graph represents a time interval as selected for the storage resolution of physical layer results as shown on page 55. The numeric values of cell rate for any single bar on the graph may be displayed by selecting the point of interest with the cursor. The Maximum, Mean and Minimum cell rates for the whole of the test period are always displayed.

Definitions of maximum, mean and minimum cell rates are as follows:

Maximum cell rate: The inverse of the shortest inter-cell time received during the measurement interval.

Minimum cell rate: The inverse of the longest inter-cell time received during the measurement interval.

Mean cell rate: The average number of cells received during the measurement interval, divided by the interval.

In-Service Testing
Individual Service Performance

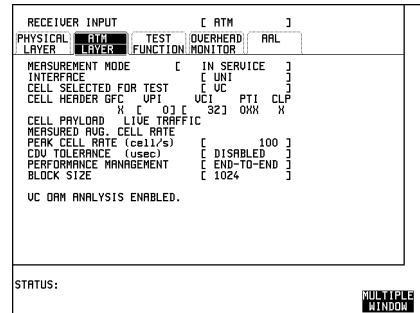
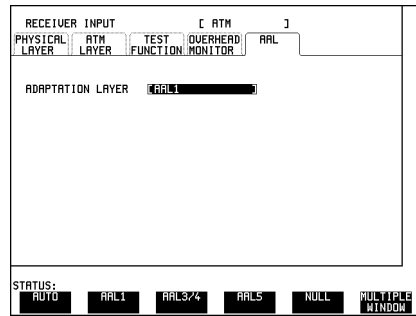
Individual Service Performance

Options required 0YK, USK or USL

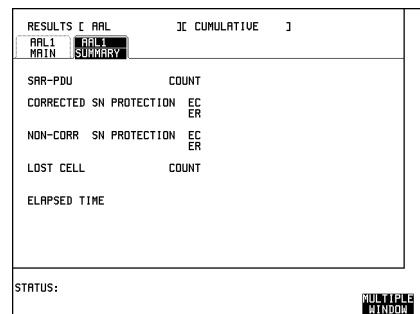
In-service AAL Monitoring provides performance monitoring related to individual services.

The receiver must be set for the appropriate AAL service (AAL-1, AAL3-4 or AAL-5). The instrument will automatically search for AAL type when ADAPTATION LAYER is set to

AUTO



The **RESULTS** provides In-Service error examination of the AAL structures supporting the service data.



In-Service Testing
Individual Service Performance

5

ATM Cell Performance Test page 60

Cell Routing Test page 66

Cell Congestion Test page 67

Cell Sync and Header Error Correction Test page 69

Constant Bit Rate Service Assessment page 71

Alarm Testing page 72

Out-of-Service Testing

Information on setting up the stimuli for out of service tests and some practical examples of tests.

ATM Cell Performance Test

Options required ATM cell generation and analysis, UKN (USE) or UKZ

NOTE: Displays for the selection of some functions will vary, depending on the optional modules fitted. The following example uses displays from an instrument with options 0YK, USK or USL. The selection procedure will vary slightly for instruments without an ATM Services module see “ATM Module Features” on page 32

Application

Services carried on ATM have differing sensitivities to the problems related to ATM. Constant Bit Rate traffic, such as voice and video conferencing, are sensitive to Cell Delay and Cell Delay Variation. Video on Demand and Cable TV are sensitive to Cell Delay Variations.

Some services, such as Compressed Video, are sensitive to Cell Loss. All these parameters must be tested to verify the ATM network will carry the appropriate service error free. Similarly these parameters are used during Quality of Service tariff negotiations with customers and therefore need to be verified.

The HP 37717C can perform these measurements for both Constant Bit Rate and Variable Bit Rate traffic. Constant Bit Rate traffic is simulated using the Foreground Channel (measurement channel) constant distribution. Variable Bit Rate traffic is simulated by adding bursts of cells using the CONSTANT and BURST features of the HP 37717C.

A number of background (non-measurement channels) channels (3 with Cell Layer modules only and 9 with Cell Layer and Services modules) can be independently set to give different traffic profiles for testing the ATM link under real conditions.

Default (Known State) Settings

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

ATM Cell Performance Test Setup Procedure

In this setup example, a 34 Mb/s cell stream containing a test cell is transmitted into the network equipment.

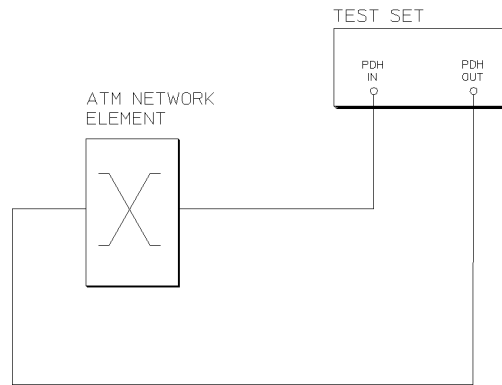
Out-of-Service Testing

ATM Cell Performance Test

To perform simultaneous measurements of most ATM performance parameters, TEST CELL should be chosen as the payload. Alternatively, if a BER measurement on the cell payload is required then select cross-cell or single-cell PRBS.

A SINGLE test period of 24 HOURS is used and use of a printer for recording of results and alarms is included.

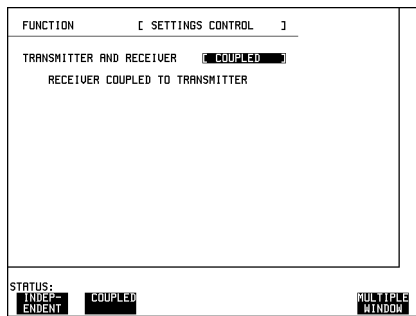
The HP 37717C Communications Performance Analyzer GRAPHICS function is enabled. The graphical results can be viewed on the **GRAPH** display



ATM Cell Performance

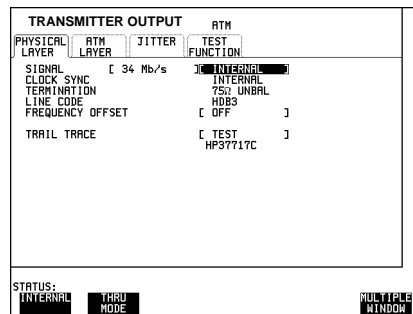
Out-of-Service Testing ATM Cell Performance Test

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



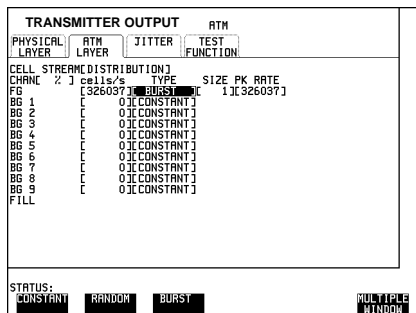
Any settings change made on the **TRANSMIT** or **RECEIVE** displays will automatically occur on the other

- 2 Set up the **TRANSMIT ATM PHYSICAL LAYER** display as shown below.



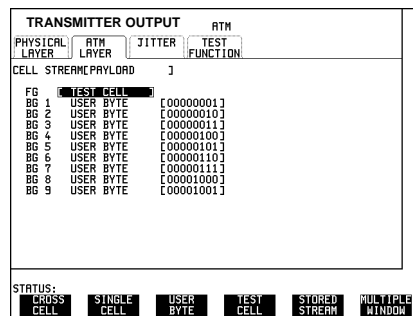
Frequency Offset can be added for stress testing. Trail Trace allows tracing of the test signal.

- 3 Set up the **TRANSMIT ATM LAYER DISTRIBUTION** display as shown below.



The number of backgrounds available varies with optional modules.

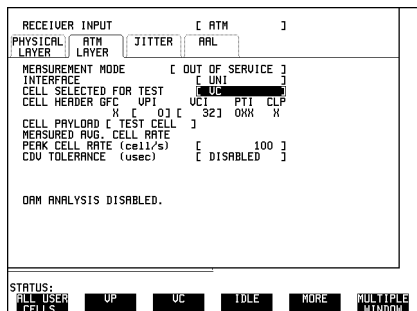
- 4 Set up the **TRANSMIT ATM LAYER PAYLOAD** display as shown below.



For BER testing select **CROSS CELL** or **SINGLE CELL** and required PRBS.

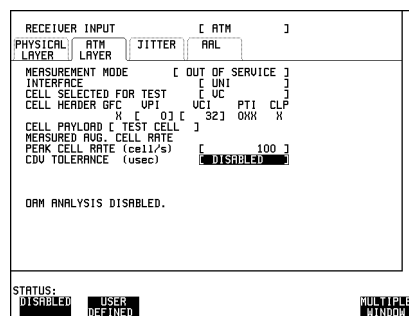
Out-of-Service Testing ATM Cell Performance Test

5 VPI and VCI settings determine the routing of the cell stream



6 Set up the **RECEIVE** **ATM LAYER** display as shown below

If PEAK CELL RATE and CDV TOLERANCE are known, enter these values. The Non Conforming Cell count and ratio results will indicate the number of cells exceeding these parameters. If no non-conforming cells are counted, the max one-point CDV result shows the max CDV present. The margin to non-conformance can then be calculated as (CDV tolerance - max 1-point CDV)



Non-conforming cells can be caused in two ways, with the following effects:

- If the received cell rate exceeds the PCR, the non-conforming cell count will equal (Rx cell count - PCR).
- If the received cell stream contains CDV exceeding the CDV tolerance, non-conforming cells will be counted. For example, if the Rx cell rate = PCR, and a known uniform burst distribution is received, the CDV is related to the burst size. If the CDV tolerance is NOT known, select CDV tolerance DISABLED. The max one-point CDV result then shows the CDV tolerance required to ensure the cells are conforming to the PCR chosen.

If the PEAK CELL RATE is not known, this should be set to at least equal the average cell rate for a Constant Bit Rate service and can be estimated by gating the HP 37717C for a few seconds. This value can then be transferred into the PEAK CELL RATE by selecting **AVERAGE+1** on the display.

Out-of-Service Testing ATM Cell Performance Test

NOTE

The inherent nature of the 1-point CDV algorithm requires that the PEAK CELL RATE selected by the user **must** be no less than the peak cell rate - otherwise the measurement becomes unstable with an ever increasing 1-point CDV value being displayed. In the graphical CDV case (options 0YK, USK or USL), the CDV distribution display rapidly drifts across the screen.

- 7 Select the type of printer you have connected and set up the **OTHER** display, **LOGGING** function, as shown below.

FUNCTION	[LOGGING]
LOGGING SETUP	[CONTROL]
LOGGING PERIOD	[ON] [1 HOUR]
RESULTS LOGGED WHEN	[SELECTED]
CONTENT	[PERIOD EC>0] [PER & ANUL]
LOG ERROR SECONDS	[PER & CUMUL]
LOG AT END OF TEST	[OFF]
LOG ON DEMAND	RESULTS

STATUS:
ALWAYS PERIOD MULTIPLE
EC > 0 WINDOW

WHEN [PERIOD EC>0] ensures results are not logged on the printer when a print period is error free.

- 8 Set up the **RESULTS** display, as shown below.

RESULTS [ATM]	[CELL DELAY]
1-POINT	2-POINT 2-POINT
	GRAPH
MAX 1-PT	
CDV	PS
ELAPSED TIME	
STATUS:	
CUMUL-RTIME	SHORT TERM ALARM SECONDS CELL DELAY RATE HISTORY MULTIPLE WINDOW

Any of the other results can be viewed without affecting the measurement.

If you do not require stored graphics results select STORAGE [OFF].

Start the ATM Cell Performance Test

- 1 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**.

Out-of-Service Testing

ATM Cell Performance Test

At the End of the Test (ATM Cell Performance)

- The Date and Time the test started and the instrument setup are logged on the printer.
- Results are logged on the 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 is logged on the printer.
- A graphical record of the results during the test period can be viewed on the **GRAPH** display. If Remote Control option 1A8 (HP-IB) or 1CW (RS-232-C) is fitted the graph results can be logged to an external printer, at a later date.
- 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.

Out-of-Service Testing Cell Routing Test

Cell Routing Test

Options required: ATM cell generation and analysis, **UKN (USE) or UKZ**

NOTE: Displays for the selection of some functions will vary, depending on the optional modules fitted. The following example uses displays from an instrument with a Broadband Auxiliary module 0YK or an ATM Services module USK or USL. The selection procedure will vary slightly for instruments without these modules.

This test is designed for installation and troubleshooting devices such as ATM cross-connects and switches which use routing tables. The object of this type of test is to check the implementation of switch routing tables and therefore the VP and VC mapping ability of the switch.

All ten virtual channels can be used for this test. The payload of each channel is set to a different fixed byte (for individual channel identification after routing) and the cell stream is applied to one input of the ATM switch / cross-connect. Initially, Channel View may be used to confirm the output of the ten channels. The receiver may then be used to check that only the appropriate channel is routed to particular outputs.

The image displays two side-by-side screenshots of an ATM test instrument's interface. Both screens have a status bar at the bottom with 'STATUS: SET 0', 'SET 1', navigation arrows, and 'MULTIPLE WINDOW'.

Left Screenshot: TRANSMITTER OUTPUT

PHYSICAL LAYER: ATM LAYER: JITTER: TEST FUNCTION: ATM

CELL STREAM/PAYLOAD

Channel	User Byte	Hex Value
FG	USER BYTE	[00000000]
BG 1	USER BYTE	[00000001]
BG 2	USER BYTE	[00000010]
BG 3	USER BYTE	[00000011]
BG 4	USER BYTE	[00000100]
BG 5	USER BYTE	[00000101]
BG 6	USER BYTE	[00000110]
BG 7	USER BYTE	[00000111]
BG 8	USER BYTE	[00001000]
BG 9	USER BYTE	[00001001]

Right Screenshot: RECEIVER INPUT

PHYSICAL LAYER: ATM LAYER: JITTER: RAL: [ATM]

MEASUREMENT MODE: [OUT OF SERVICE]

INTERFACE: [UNI]

CELL SELECTED FOR TEST: [UC]

CELL HEADER GFC: VPI: UC1: PTI: CLP: [0] [32] [000]

CELL PAYLOAD: [USER BYTE] [00000000]

MEASURED AVG. CELL RATE: [100]

PEAK CELL RATE (cell/s): [100]

CDV TOLERANCE (usec): [DISABLED]

DAM ANALYSIS DISABLED.

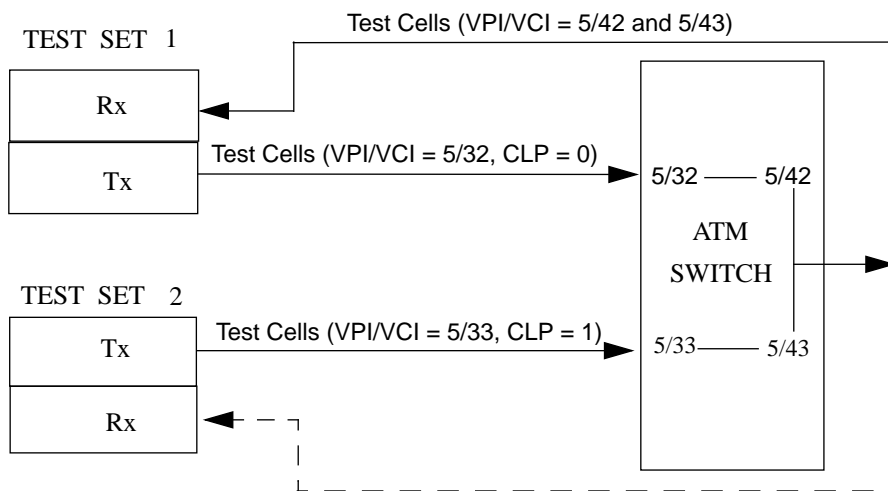
Out-of-Service Testing
Cell Congestion Test

Cell Congestion Test

Options required ATM cell generation and analysis, **UKN (USE) or UKZ**

NOTE: Displays for the selection of some functions will vary, depending on the optional modules fitted. The following example uses displays from an instrument **with** an ATM Services module **USK or USL**. The selection procedure will vary slightly for instruments without an ATM Services module.

This test is designed mainly for ATM switch installation and acceptance testing.



Cell Discard Test

Two test sets are used to generate test cells. The VPI/VCI chosen for each test cell stream is arbitrary but the test cells from Test Set 1 should be sent with CLP = 0 (high priority) and the test cells from Test Set 2 should be sent with CLP = 1 (low priority).

The ATM switch should be configured as shown. The routing table in the switch should be configured to route the cells from the two test sets to the same output port but with different (but known) VPI/VCIs. In this example, Test Cells from Test Set 1 arrive at the switch with VPI/VCI = 5/32 and those from Test Set 2 with VPI/VCI = 5/33. The switch is set to translate the cell routing labels from 5/32 to 5/42 and from

Out-of-Service Testing

Cell Congestion Test

5/33 to 5/43. Cells from both test sets now appear on the same output link from the switch.

Assuming that the maximum cell rate of the switch output is less than the sum of the maximum cell input rates, it is possible to arrange that congestion occurs in the switch by suitable loading of the inputs.

Test Set 2 is set to send cells at 50% of the maximum rate.

The output rate of Test Set 1 (with higher priority cells) is slowly increased while the switch output is monitored by Test Set 1.

If Test Set 1 monitors high priority cells (in this example VPI / VCI = 5 / 42), originally from the same test set, no cell loss should be observed, though the STATUS line at the bottom of the display should indicate "congestion experienced" if the switch sets the PTI field appropriately.

If Test Set 1 is reconfigured to monitor the low priority cell stream which originated from Test Set 2 (in this example VPI / VCI = 5 / 43), cell loss should be observed.

If the signal from the switch can be physically split and routed to the receiver of Test Set 2, the measurements for each cell stream can be performed simultaneously.

As an alternative means of monitoring for cell loss (with options 0YK, USK or USL), Channel View may be used to monitor both cell stream rates at the switch output. Furthermore, both input cell streams (a Foreground and a Background, say) may be generated by Test Set 1 on a single physical port. Test Set 2 is then not required.

Cell Sync and Header Error Correction Test

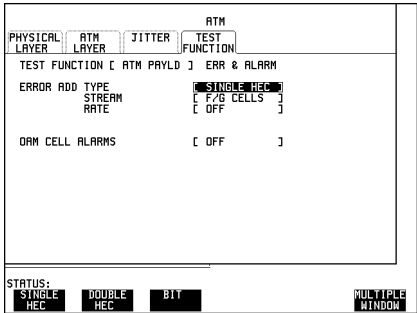
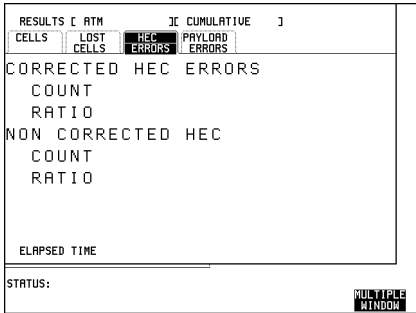
Options required ATM cell generation and analysis, UKN (USE) or UKZ

This test is designed mainly for ATM switch installation and acceptance testing.

The ability of the network element to pass an error free, identifiable stream without sync loss is checked.

Checking Single Header Error Performance

The ability to pass cells with single header errors and generate a valid HEC for the new header is checked. This is achieved as follows:

<p>1 Introducing headers with one error by selecting single HEC errors</p>  <p>The screenshot shows a terminal window with the following text: PHYSICAL LAYER ATM JITTER TEST LAYER LAYER FUNCTION TEST FUNCTION [ATM PAYLD] ERR & ALARM ERROR ADD TYPE [SINGLE HEC] STREAM [P/B CELLS] RATE [OFF] DAM CELL ALARMS [OFF] STATUS: SINGLE HEC DOUBLE HEC BIT MULTIPLE WINDOW</p>	<p>2 Checking that the output corrected HEC error rate is zero.</p>  <p>The screenshot shows a terminal window with the following text: RESULTS [ATM] [CUMULATIVE] CELLS LOST CELLS HEC PAYLOAD ERRORS ERRORS CORRECTED HEC ERRORS COUNT RATIO NON CORRECTED HEC COUNT RATIO ELAPSED TIME STATUS: MULTIPLE WINDOW</p>
---	---

The corrected HEC error rate checks that the HEC is valid for the new header added by the network element under test.

Checking Double Header Error Performance

The ability to discard cells with two or more detected header errors is tested. This is achieved as follows:

Out-of-Service Testing Cell Sync and Header Error Correction Test

1 Introducing headers with two errors.

PHYSICAL LAYER	ATM LAYER	JITTER	ATM TEST FUNCTION
TEST FUNCTION [ATM PAYLD] ERR & ALARM			
ERROR ADD TYPE	STREAM RATE	DOUBLE HEC [F/G CELLS] [OFF]	
OAM CELL ALARMS [OFF]			

STATUS: SINGLE HEC DOUBLE HEC BIT MULTIPLE WINDOW

2 Checking that the errored cells are discarded as indicated by cell lossI.

RESULTS [ATM]	[CUMULATIVE]	[]	[]
CELLS [LOST CELLS]	HEC [ERRORS]	PAYLOAD []	HEC [ERRORS]
CELL LOSS COUNT RATIO			
MISINSERTED CELLS COUNT RATE			
ELAPSED TIME			
STATUS: MULTIPLE WINDOW			

A sequence of more than 40 errors may be used in order to check that the result is valid for errors occurring in any header bit as the test set is designed to cycle the errored bit through all 40 bit positions of the header on consecutive instances of ERROR ADD (manual or continuous).

Constant Bit Rate Service Assessment

Options required ATM cell generation and analysis, **UKN (USE) or UKZ**

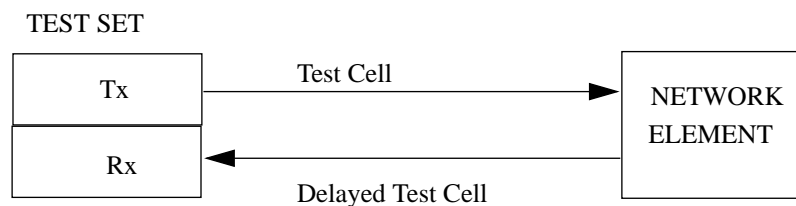
The object of this test is to check that a network element is suitable for a constant bit rate service where the regular arrival of cells is essential for the integrity of the service.

Each bar on the results graph represents a time interval as selected for the storage resolution of physical layer results (for selection see page 55). The test timing is as selected for the physical layer results

This test uses the time stamp function of the test cell.

The 2-point Cell Delay Variation measurement is based on absolute delays measured from the Test Cell timestamp. This measurement may be considered as ATM Jitter.

The 2-point CDV relies on the time stamp in the test cell and therefore the Test Set transmitter and receiver must be coupled. The time of cell arrival is monitored and compared with the transmission time extracted from the test cell. The results are presented in the form of Maximum, Peak-to-Peak and Mean Cell Transfer delays. The variation is presented in terms of the peak to peak values recorded. With options USK or USL, more detail of the time distribution of cell delays can be seen by using the graphical display facility.

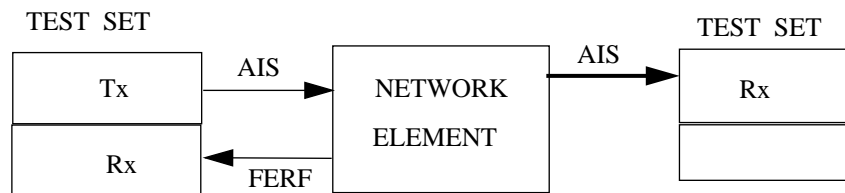


Out-of-Service Testing
Alarm Testing

Alarm Testing

Options required ATM cell generation and analysis, **UKN (USE) or UKZ**

The object of this series of tests is to check the ability of a network element to recognize and respond to AIS and FERF alarms.



There are two groups of tests: F4 flow tests for the VP OAM and F5 flow for the VC OAM. Each group comprises three parts.

1 Ability to Generate AIS

The network element is stimulated with a stream which will cause it to originate an AIS alarm.

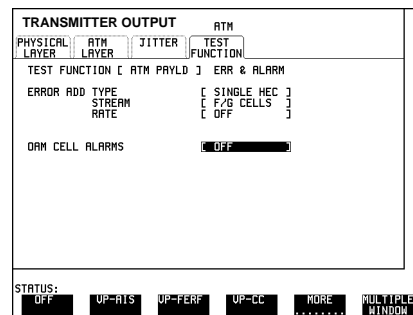
2 Ability to Forward AIS and Return FERF

The network element is stimulated with a stream containing the VP-AIS or VC-AIS alarm. The forward path AIS and the return path FERF are monitored.

3 Ability to Signal Received FERF

The network element is stimulated with a stream containing the OAM cell FERF alarm and the network element FERF indicator, if available, is observed.

I.610 defines the fixed VPI and VCI values which the instrument uses for the OAM cells in these tests



Pre-stored Cell Streams

Pre-stored Cell Streams

Pre-stored Cell Streams

At the time of shipping, five cell streams are stored in the HP 37717C when one of the options 0YK, USK or USL is fitted. These stored cell streams were developed for testing features of the instrument and are included as they can be useful for training and demonstration purposes. The first test cell ("Default") is hard coded and cannot be destroyed as it is used during the instrument's self test. The remaining four cell streams are stored in non-volatile memory and may be overwritten by other externally generated cell streams. Note that, as a cell stream is fully defined (i.e. every bit of the header and payload of each cell is programmed) the header VPI/VCI values cannot be altered by the user operating the usual header manipulation facilities.

Details of the five stored cell streams shipped with the instrument are as follows:

DEFAULT

This stored cell stream contains 6 virtual channels (two for each type of AAL). If NNI is selected in the receiver, AAL-1 channels have VPI=100, AAL-3/4 channels have VPI=300, AAL-5 channels have VPI=500. The channels are six selections from the cell stream described in STREAM 1 and consequently one of each AAL is error-free and the other has all possible AAL errors. See the description below under STREAM 1.

STREAM 1 ("AAL-TEST")

This stored cell stream exercises Channel View, AAL monitoring and the cell delay variation (CDV) capability of the instrument. It is suitable as a training or demonstration aid. The information given below describes two aspects of the cell stream: first, the VPI/VCI and AAL details for each of the 27 virtual channels; second, the cell distribution for each channel. Certain virtual channels contain deliberate AAL faults, as indicated. If NNI is selected in the receiver, AAL-1 channels have VPI=100, AAL-3/4 channels have VPI=300, AAL-5 channels have VPI=500

Pre-stored Cell Streams

<i>VPI/VCI</i>	<i>AAL</i>	<i>% of traffic</i>	<i>Channel characteristics</i>	<i>Traffic Type</i>
100/100	1	4	All errors (2 corrected, 3 invalid, 16 sequence errors per 8 cells)	CBR with minor perturbations
100/110	1	10	No errors, high rate (1 in 10 user cells)	Sawtooth Interarrival Function
100/111	1	3.33	No errors, medium rate (1 in 30)	Constant Bit Rate (CBR) with minor perturbations
100/112	1	2	No errors, low rate	Pure CBR
100/120	1	1.04	Misinserted cells (7 sequence errors per 25 cells)	CBR with minor perturbations
100/121	1	0.625	Lost cells (1 sequence error per 15 cells)	CBR with minor perturbations
100/122	1	1	Out-of-sequence cells (8 sequence errors per 24 cells)	CBR with minor perturbations
100/130	1	1	Sporadic CPI errors (1 corrected error per 24)	CBR with minor perturbations
100/131	1	4	Bursty CPI errors (3 corrected, 6 invalid cell errors per 96)	CBR with minor perturbations and a gap of 3 cells
300/100	3	4	All errors (2 CRC, 21 sequence, 4 segment, 2 abort in 96 cells, 24 PDUs)	Random (Poisson)
300/110	3	12	No errors, 288cell PDUs	Random (Poisson). Exponential Interarrival Function.
300/111	3	4	No errors, 24 cell PDUs	CBR with large gaps
300/112	3	2.79	No errors, single cell PDUs	Random (Uniform) with perturbations and gaps.
300/120	3	2.67	Aborts (1 abort per 6 PDUs)	Bursty, short bursts (6 cells).
300/130	3	2.67	Segment errors (4 errors in 16 cells)	Bursty, medium bursts (10 cells)
300/140	3	2	CRC errors (1 error in 16 cells)	Available bit rate (ABR) bursts.
300/150	3	0.33	Misinserted cells (15 sequence errors in 8 cells)	CBR with minor perturbations
300/151	3	0.33	Lost cells (1 sequence error in 8 cells)	CBR with perturbations
300/152	3	0.33	Out-of-sequence cells (1 sequence error in 8 cells)	CBR with perturbations
300/160	3	0.667	Multiple MIDs	'CBR' with major perturbations

Pre-stored Cell Streams

<i>VPI/VCI</i>	<i>AAL</i>	<i>% of traffic</i>	<i>Channel characteristics</i>	<i>Traffic Type</i>
500/100	5	0.667	All errors except overrun (1 CRC, 1 LE, 1 abort in 5 PDUs, 16 cells)	Small burst (16 cells)
500/110	5	12	No errors, 288 cell PDUs	Highly bursty
500/111	5	1	No errors, 8 cell PDUs	Small Burst (24 cells)
500/112	5	26.54	No errors, single cell PDUs	ABR (fills cell opportunities)
500/120	5	0.33	Aborted PDUs (1 abort in 4 PDUs, 8 cells)	Small burst (8 cells)
500/130	5	0.33	Length errors (1 LE in 5 PDUs, 8 cells)	Small burst (8 cells)
500/140	5	0.33	CRC errors (1 CRC error in 4 PDUs, 8 cells)	Small burst (8 cells)

STREAM 2 ("OAM-TEST")

This stored cell stream contains several channels and is intended to demonstrate the OAM and reserved channel (VCI= 1 to 31) monitoring features of Channel View. VP OAM cells have reserved VCIs (3 & 4) but any alarm indicated by them is shown against all virtual channels in the virtual path. Note that continuity checks are not alarms, so they are shown in the payload column. Also, NO CELLS indicates no *user* cells; OAM cells may be still be present and would give rise to indications of bandwidth usage. Examples of the following are given:

VPI= 0, VCI= 0 - 15 (which contain some of the following)

Payloads

VCI=1	META-SIG	(meta-signalling)
VCI=2	GEN-B'CAST	(general broadcast signalling)
VCI=3	PP-SIG	(point-to-point signalling)
VCI=4	EE-F4-OAM	(end-to-end VP OAM)
VCI=5	SEG-F4-OAM	(segment VP OAM)
VCI=6	RM	(VP resource management)
	VP-CC	(continuity check, in F4-OAM)
	VCV-CC	(continuity check, in F5-OAM)

Pre-stored Cell Streams

Alarms

EE-F4, Seg-F4 (VP) FERF	(shown as VP-FERF against all VCs affected)
EE-F4, Seg-F4 (VP) AIS	(shown as VP-AIS against all VCs affected)
EE-F5, Seg-F5 (VC) FERF	(shown as VC-FERF against all VCs affected)
EE-F5, Seg-F5 (VC) AIS	(shown as VC-AIS against all VCs affected)

STREAM 3 ("VCL_1023")

This cell stream comprises 1023 virtual channels, one less than the maximum capacity of Channel View; by adding two or more background channels of other VPI/VCI values, the status line of the instrument will report a Channel View overflow condition. It is for testing this feature that this cell stream was designed.

STREAM 4 ("REGRESSN")

This cell stream stresses the AAL monitoring capability of the instrument. It was designed for regression testing the instrument.

Pre-stored Cell Streams

Glossary

AAL ATM adaptation layer	CSNP Corrected sequence number protection
ABR Available bit rate (traffic type)	DQDB Distributed queue dual bus
ANSI American national standards institute	EDC Error detection code
ATM Asynchronous transfer mode	EM BIP Error monitoring byte of the G.832 overhead (34 and 140 Mb/s)?
BEDC-BIP16 Block error detection code- Bit interleaved parity	EOM End of Message
BG Display abbreviation for background	ETSI European telecommunications standards institute (ex CCITT)
B-ISDN Broadband integrated services digital network	FERF .An alarm indicating “far end receive failure” also RDI
B-ISUP Broadband integrated services user part	FG Display abbreviation for foreground
BOM Beginning of Message	GFC Generic flow control
CBDS Connectionless broadband data services	HDTV High definition television
CBR Constant bit rate (traffic type)	HEC Header error control
CTD Cell transfer delay	IAM ISUP initial address message
C LOSS Cell loss	ISDN Integrated services digital network
CLP Cell loss priority	ITU-T International telecommunications union, telecom standards sector (ex CCITT)
COM Continuation of Message	LAN Local area network
CORR HEC Corrected header error count	LAP-D Link access protocol for D channel
CPCS Common part convergence sublayer	LOC Loss of continuity

Glossary

MAN Metropolitan area network	PTT Post, telephone and telegraph (A public telecom operator)
MCSN Error monitoring cell sequence number in performance management OAM cell	PVC Permanent virtual connection
MCTD Mean cell transfer delay	RAI Remote alarm indication
MISIN CELLS Misinserted cells	RDI An alarm “remote defect indication” previously FERF (far end receive failure)
MSVC Metasignalling virtual channel	SAAL Signaling ATM adaptation layer
MTP Message transfer part	SAR Segmentation and reassembly
NCORR HEC Non corrected header error check	SDH Synchronous digital hierarchy
NCONF CELLS Non-conforming cells	SIP SMDS interface protocol
NCSNP Non-corrected sequence number protection	SMDS Switched multimegabit data service
N-ISDN Narrowband integrated services digital network	SONET Synchronous Optical NETwork, the U.S. (ANSI) equivalent of SDH
NNI Network node interface	SOH Section OverHead, the ETSI equivalent of ANSI term TOH (Transport OverHead)
NT Network termination	SRTS Synchronous residual time stamp
OAM Operation and Maintenance	SSM Single segment message
PCLP Physical Layer Convergence Protocol	ST Segment type error (AAL3)
PDH Plesiochronous digital hierarchy	SVC Switched virtual connection
PDU Protocol data unit	SVCI Signaling virtual channel identifier
PTI Payload type indicator	

Glossary

TA Terminal adaptor

TAXI FDDI physical layer protocol

TE Terminal equipment

TOH Transport OverHead, the ANSI equivalent of ETSI term SOH (Section OverHead)

UNI User network interface

VBR Variable bit rate (traffic type)

VC Virtual channel

VCC Virtual channel connection

VCI Virtual connection identifiers

VP Virtual path

VPC Virtual path connection

VPI Virtual path identifier

WAN Wide area network

Glossary

Index

Numerics

- 1-point CDV, 4
- 1-Point CDV measurement
 - Using, 19
- 2-point CDV, 3

A

- AAL Loss Alarm, 9
- AAL Monitoring
 - Selection, 57
- AAL monitoring in-service, 57
- AAL Sublayer Measurements, 8
- AAL type
 - automatic detection, 11
- AAL-1 error monitoring, 11
- AAL-3/4 error monitoring, 12
- AAL-5 error monitoring, 13
- Adding burst to distribution, 39
- Alarm
 - and error generation ATM, 35, 40
 - Generation, 72
 - Monitoring, 72
 - Testing, 71
- Alarm Conditions
 - Operation under, 25
- Alarms, 23
- ATM Layer Receive Selections
 - Option UKN, 52
 - Option UKZ, 53

B

- Background Channels, 20
- Bit errors
 - Adding, 36, 40
- Broadband Auxiliary Testing
 - Option OYK Module Information, 30
- Burst
 - Add to foreground, 39
- Burst distribution, 20
- Burst error add, 35, 40

C

- Cell
 - Congestion testing, 67
 - Content selection, 32, 37
 - Routing test, 66
 - Sync testing, 69
- Cell Delay Variation (CDV), 3, 16

- Cell error measurement
 - In-service, 51
- Cell Errors, 3
- Cell Level ATM Testing
 - Option UKN Module Information, 28
 - Option UKZ Module Information, 29
 - Option USE Module Information, 28
- Cell Loss, 3
- Cell loss measurement
 - Use of OAM flow, 49
- Cell Misinsertion, 3
- Cell performance test, 60
- Cell streams pre-stored
 - Details, 74
 - Selection, 38
- Cell Transfer Delay, 3
- Channel View, 5
- Channel View display, 42
- Congestion testing, 67
- Constant bit rate services
 - Assessment of, 71
- Constant distribution, 20
- Cross cell PRBS, 34, 38

D

- Delay
 - Time stamp for, 34, 35, 39
- Delay measurement, 71
- Distribution selection, 32, 37
- Distribution Types, 22

E

- End to End performance
 - Use of OAM flow, 49
- Error
 - and alarm generation, ATM, 35, 40
- Error add, 35, 40
- Error correction testing, 69

F

- Fault isolation
 - Use of OAM flow, 49
- Foreground Channel, 20

H

- Header error correction testing, 69
- Header Errors, 3
- Header selection, 32, 37

- HEC error testing, 69

I

- In-service AAL monitoring, 57
- In-Service Testing
 - Introduction, 48
- Isolating network / customer problems, 57

L

- Link traffic overview, 42
- Live Traffic Selection
 - Option UKN, 52
 - Option UKZ, 53

M

- Measurement Mode Selection
 - Option UKN, 52
 - Option UKZ, 53
- Measurements, 2
- Mis-insertion and loss
 - Sequence number for, 34, 39
- Missinsertion measurement
 - Use of OAM flow, 49

N

- Non-Conforming Cell Count, 16

O

- OAM alarm generation, 35, 40
- OAM Cell Generation, 22
- OAM fault management, 72
- OAM flows
 - Use in in-service testing, 48
- Overview of link traffic, 42

P

- Payload selection, 32, 37
- Policing of service, 55
- Pre-stored Cell Streams
 - Details, 74
 - Selection, 38
- Problem path identification, 42

Q

- Quality of service measurement
 - Use of OAM flow, 49

Index

R

- Random distribution, 20
- Rate History
 - Selection, 55
- Rate history resolution, 56
- Resolution
 - Rate history, 56

S

- Service
 - Individual, performance check, 57
- Service malfunction source tracing, 57
- Services Layer ATM Testing
 - Option USK Module Information, 31
 - Option USL Module Information, 31
- Single cell PRBS, 34, 38
- Storage of results
 - Selection, 55
- Stored cell streams
 - Details, 74
 - Selection, 38
- Stream content selection, 32, 37

T

- Test cell, 34, 39
- Timing distribution selection, 32, 37
- Traffic Simulation, 20
- Traffic simulation
 - selection, 37
- Trail Trace, 35, 39

V

- VC
 - Mapping ability test, 66
 - Rate history display, 55
- VC and VP mapping ability testing, 66
- VP
 - Mapping ability test, 66
 - Rate history display, 55
- VP and VC mapping ability testing, 66
- VP/VC Rate History, 15
- VP/VC Rate History., 5

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Learning Products Map

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

The HP 37717C Mainframe Operating Manual- 37717-90221

General operating information irrespective of option.

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

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

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

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

The HP 37717C Jitter Operating Manual - 37717-90224

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

The HP 37717C ATM Operating Manual - 37717-90225

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

Remote Control Manual - 37717-90227:

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

Calibration Manual - 37717-90228:

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

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In This Book

This book provides measurement definitions and explanations which are associated with the 37717C ATM Cell layer, ATM Services layer and Broadband Auxiliary modules. It also provides applications associated with these modules. The individual applications contain techniques which may be of value for purposes other than those shown.