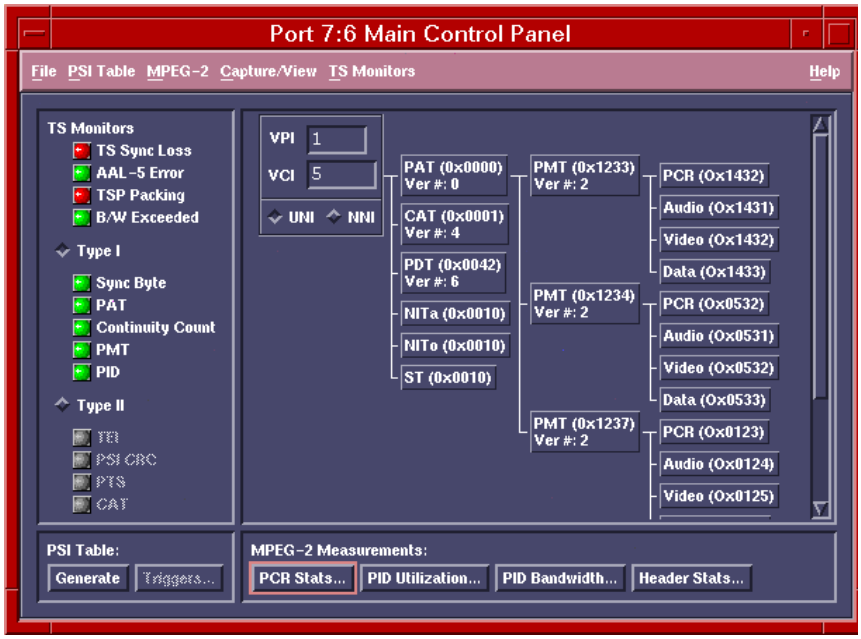
MPEGscope ATM Test Application

For the HP Broadband Series Test System

E6271A



The E6271A MPEGscope ATM is a real-time testing solution that can help accelerate product development, field trials, commissioning, and quality assurance procedures for ATM networks and network elements carrying MPEG-2 digital video traffic.

Whether you're designing an encoder, commissioning new equipment, or seeking to isolate problems within a multivendor environment, the MPEGscope ATM's real-time analysis capabilities and easy-to-use graphical user display provides immediate, clear feedback on the status and performance of your MPEG-2 traffic.

Designed for system architects, systems integrators, design engineers and operations engineers, the E6271A MPEGscope ATM is a software application for the Broadband Series Test System, the industry-standard ATM protocol and transmission tester.

Key Features:

- Virtual LED indicators continuously display the status of the MPEG-2 Transport Stream (TS) at a glance, indicating errors or problems.
- Performs real-time Program Specific Information (PSI) table hierarchical display and detailed protocol analysis of the PSI tables.
- Provides real-time MPEG-2 quality of service measurements, including Program Reference Clock (PCR) statistics, Program Identifier (PID) statistics, and Transport Stream header statistics.
- Facilitates error isolation with comprehensive triggering capabilities.
- In-depth post capture analysis including protocol decode of MPEG-2 Transport Stream Packets (TSP), Program Specific Information tables and Program Elementary Stream (PES) headers. Includes powerful display filters and clear highlighting of protocol and other errors. Eight megabytes of capture RAM is available.
- Extracts video content from data in the capture buffer, decompresses it, and displays it on-screen.

Using the MPEGscope ATM

The E6271A MPEGscope ATM is ideally suited for troubleshooting MPEG-2 implementations, system integration problems and interoperability issues. From basic error checking to protocol testing to real-time performance testing, the MPEGscope ATM provides a complete suite of tools to quickly isolate your problem.

The main control panel is divided into three major sections. Along the left panel are twelve TS Monitor virtual LEDs which provide a quick pass/fail indication. The right side of the panel shows a real-time hierarchic display of the PSI tables. The bottom of the panel provides hot buttons to quick access real-time statistics, measurements and triggers. In addition, the pull-down menu bar on the top of the main control panel provides access to other functions such as manual data capture.

Checking the MPEG-2 status with TS Monitors

The TS Monitor allows you to check the general status of the MPEG-2 transport stream at a glance. The twelve virtual LEDs provide a quick pass/fail indication on the some of the more obvious problems that can occur. The virtual LEDs are normally green, and briefly turn red each time the tester detects an error condition.

If TS Monitor errors are occurring, the you can set up the tester to trigger on any of the indicators. When an error occurs, the tester captures data into the 8 MB capture RAM. You can set up the trigger to capture a specified percentage of data before and after the trigger fires.

Monitoring the PSI Tables

The right-hand side of the main control panel shows a live hierarchical display of Program Specific Information tables.

The MPEGscope ATM automatically generates the display using the PSI table information in the stream. Changes to the tables are tracked and reflected in the display in real-time.

The PSI table display provides an intuitive view of the elements in the MPEG-2 transport stream.

Each table in the display provides the table name, the PID number of the table and the version number of the table. The Program Map Tables (PMT) show the associated elementary stream PIDs as well as the PCR-carrying PID.

If there is an error in a PSI table, the table turns red to visibly indicate that there is a problem in that table. You can even set up triggers on table syntax errors or CRC errors which cause the PSI table updates to stop when the trigger condition occurs. Then, by simply clicking on a PSI table, the tester brings up a detailed protocol decode of the selected table.

Real-time MPEG-2 Statistical Measurements

The MPEG-2 measurements on the MPEGscope ATM provide an accurate, real-time characterization of an MPEG-2 network or system component. The real-time measurements (except for the PCR statistics) are based on a user-controlled integration period which has a range of 1 second to 48 hours.

The buttons along the bottom of the main control panel provide quick access to key MPEG-2 measurements including PCR statistics, PID utilization, PID bandwidth and TS header statistics. Clicking on any of these hot buttons brings you to a setup screen for that measurement.

Measuring PCR Statistics

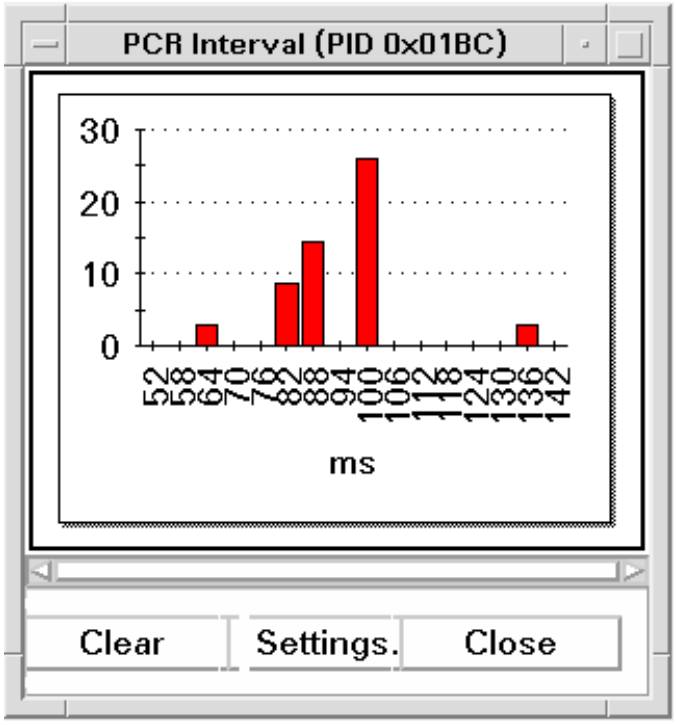
The PCR statistics measurement setup allows you to select up to two PIDs from a list of active PIDs, or by manually entering the PIDs, to measure PCR jitter and/or PCR interval. There are also separate display range settings for the jitter and interval histograms. Separate setup panels for setting up trigger points and for logging measurement data are easily accessible via the tabs on the right side of the screen.

Applying the setup then produces histograms showing the real-time PCR jitter and/or interval. If a trigger was set to trigger on a PCR interval exceeding a specified number, and the condition was met, then a specified percentage of the data before and after the trigger point would be captured. You could then use the protocol viewer to further investigate the conditions leading to the trigger point.

Measuring PID Utilization

The PID utilization measurement is a quick method to determine what PIDs are active in the transport stream and what PIDs are occurring most often. The PID utilization setup menu permits manual entry of the PIDs to plot, or to select the PIDs to plot from a list of active PIDs automatically generated from the PSI tables. The setup menu also provides an option to log the measurement results to a file.

This real-time measurement provides a plot of the number of TSPs versus the PID number. This plot will show which PIDs are most active over the user-controlled integration period.



Measuring PID Bandwidth

The MPEGscope ATM's PID Bandwidth statistics measurement measures the data rate of each PID in terms of Mb/s or percentage of the total bandwidth of the TS.

This measurement could be used to determine if the proper bandwidth is being used in each channel (e.g. video PID bandwidth is 4 Mb/s and audio PID bandwidth is 128 kb/s).

In an MPEG-2 system, it is important to minimize the PSI table overhead. The PID measurement could measure the percentage of the overall bandwidth used by the PSI tables.

You can log bandwidth measurement results to a file and set up triggers on bandwidth thresholds. For example, you could set the trigger to fire if the bandwidth on PID=100 exceeded 6.1 Mb/s. When the trigger condition occurs, the protocol viewer can then be used to view information before and after the trigger event.

Measuring TSP Header Statistics

TSP Header Statistics provide real-time measurements on some of the more critical fields in the TS header. These statistics provide an indication of the quality of service at the MPEG-2 transport layer.

The setup screen for the Header Statistics shows four setup panels for each of the four types of header errors: Sync Byte Error, Continuity Count Error, Continuity Repeat Error and Transport Error Indicator. The four panels are easily selected using the tabs on the right side of the screen. In addition, the setup screen has two additional tabs for setting up the logging and the capture memory. Each of the measurements can simultaneously measure errors on up to 32 PIDs.

Each of the error statistics can be presented as a total count, as an error versus time graph, or as a percentage of the number of packets. You can log the results to a file or set up trigger threshold to trigger if an error exceeds the trigger point. For

example, it is very difficult to debug intermittent problems such as continuity count errors. However, with the MPEGscope ATM, you can simply set up a trigger if this error occurs, then use the protocol viewer to determine circumstances before and after the error.

Header Triggers

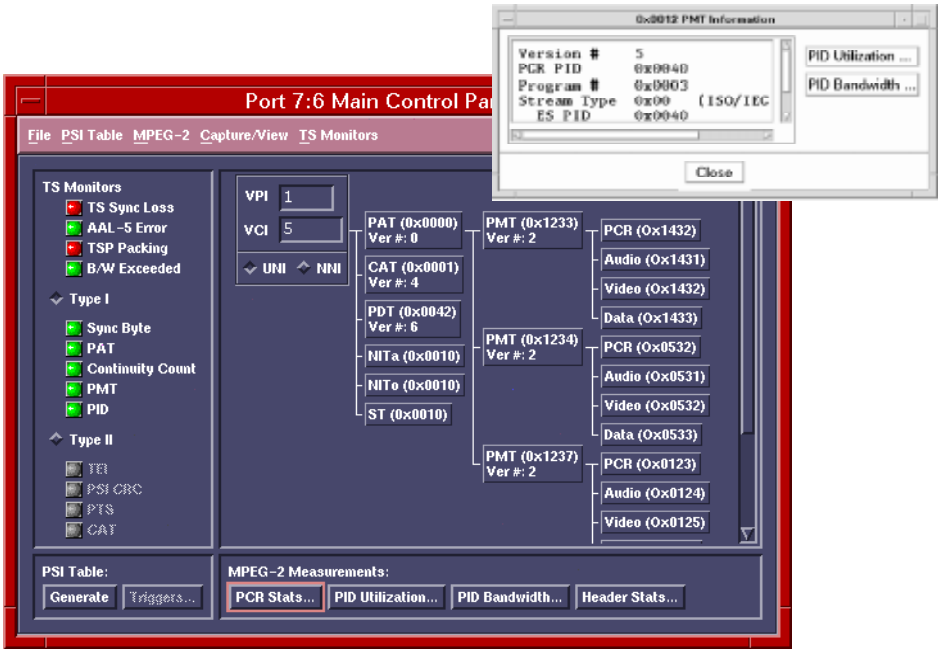
Header triggers enable you to trigger on TSP header and adaptation fields. For example, if you want to start capturing information when a PCR occurs, you can set the filter to trigger when the Adaptation Field Control field asserts that an adaptation field is present and when the PCR flag in the adaptation field is asserted. When the boolean expression becomes true, the trigger will fire and start capturing data. Of course, you can set up the trigger so that you can capture data both before and after the trigger point.

Playback Viewer

The Playback Viewer provides in-depth protocol analysis of the MPEG-2 TSPs, PES packets and PSI tables. You can manually capture data into the playback viewer or use one of the triggers to capture data.

The captured packets are shown with timestamps indicating when they were received. The data is parsed into fields and then interpreted using standard terminology.

You can optionally select to display the data in summary, detailed, or hex format. In summary format only the most important fields are shown, whereas in the detailed format, all of the fields are shown. Hex format provides a hexadecimal view of all data.



The filter setup in the playback viewer allows you to selectively view only packets of interest. For each protocol layer (ATM, AAL-5, MPEG-2 TS, PSI and PES), you can create sophisticated filters.

For example to only view TSPs with a PID of 0x0100 which contains a PCR, you would simply select these as the criteria in the TS packet filter setup. In addition to filtering on field values, you can also filter on decode errors such as Length Errors and Invalid Sync. Similarly with the PES filter, you can filter on stream types (e.g. video, audio, data, etc.) or stream ID numbers.

The PSI filter allows you to filter on table types or table ID numbers. You can even match on a combination of multiple filters that you define at each protocol level and/or between protocol levels.

Feature Summary

MPEG-2 Analysis

- Quickly identifies and isolates problems in the MPEG transport stream that can impact or degrade video or audio quality

MPEG-2 Status Monitor

- 12 virtual LEDs show transport stream and AAL-5 status at a glance

PSI Table Display

- Graphical hierarchical display of PSI tables
- Display updates in real-time as PSI tables change
- PSI table turns red when table error occurs
- PSI table turns green when table version changes

Real-time Measurements

- PCR jitter
- PCR interval
- PID utilization
- PID bandwidth
- TSP header statistics
- User-controlled integration period

Triggering

- Trigger on errors, measurement thresholds, PSI table occurrence,header matching or other conditional events
- Specify percentage of data to capture before and after trigger point

Protocol Analysis

- Protocol decode of TSPs, PSI tables and PES headers
- Highlights errors and trigger condition
- Post-capture filtering

Video Display

- Decompresses and displays actual video data on-screen

Event Logging

- Measurement results, events, data samples, and errors

ATM Reassembly

- Supports MPEG-2 reassembled over AAL-5 with one to eight transport streams packets per AAL-5 frame

Physical Interfaces

- Works with the wide range of physical line interface modules available for the Broadband Series Test System

User Interface

- Graphical user interface eases earning curve
- Quick, direct access from one screen to others via hot buttons

Configuration & Use With Other BSTS Line Interfaces, Hardware Modules & Test Software

The E6271A MPEGscope ATM Test Application is a software/firmware application that runs on the Broadband Series Test System. When starting a session with the E6271A application, the BSTS downloads specific firmware to the E4209 Cell Protocol Processor which programs it to support the MPEGscope ATM application.

A minimal configuration of an E4200A or E4210A chassis with UNIX controller, E4209 Cell Protocol Processor and any line interface operating at line rates up to 155 Mb/s is required. A minimum configuration will support all of the features described except for decoding video. An E4200B or E4210B chassis with the V743 controller enables the video decoding feature.

Adding optional E4212A AAL Test Software allows you to test at the AAL layer. Using an E4219A ATM Network Impairment Emulator Module allows you to emulate ATM impairments and see the effects on the MPEG quality of service.

Requires Version 3.04 or later of the BSTS Base System Software. One software license is required per BSTS test system chassis.

Warranty & Support Options

HP Broadband Series Test System software and firmware products are supplied on transportable media such as disk, CD-ROM or integrated circuits. The warranty covers physical defects in the media, and defective media is replaced at no charge during the warranty period. When installed in an HP Broadband Series Test System, the software/firmware media has the same warranty period as the product.

This test software has no components requiring calibration.

Product Numbers

- **E6271A** MPEGscope ATM Test Application
- **E6271A Option QAO** Scheduled software updates

Technical Specifications

System Specifications

Performance	• Maximum TS rate of 36 Mb/s on one virtual channel • Execution of other simultaneous applications on the BSTS not supported
Capacity	• Multi-program transport stream (MPTS) on one virtual channel (VPI/VCI) • Measurements are performed on one transport stream
ATM support	• MPEG-2 TS reassembled over AAL-5 • Supports packing 1 to 8 TSPs per AAL-5 frame • Supports User-Network Interface (UNI) and Network-Node Interface (NNI)

Transport Stream Monitors

The MPEGscope ATM continuously monitors the health of the AAL-5 adaptation layer and MPEG-2 transport streams. Results are shown with on-screen virtual LEDs which are normally green and turn red when an error is detected.

The global indicators are always available; either Type I or Type II indicators can be selected. When executing real-time measurements, the Type I and II indicators are not available.

Global Indicators

TS Sync Loss	• Sync byte is not equal to 0x47 for 2 (configurable) consecutive TSPs
AAL-5 Error	• AAL-5 time-out AAL-5 length error • AAL-5 CRC-32 error
TS Packing	• Number of TSPs per AAL-5 frame is greater than 8 • AAL-5 frame length is not a multiple of 188 bytes
Bandwidth Exceeded	• TS data rate exceeds 36 Mb/s

Type I Indicators

Sync Byte	• Sync Byte is not equal to 0x47
PAT	• PID 0x0000 does not occur at least every 0.5 sec (configurable) • PID 0x0000 does not contain a table_id = 0x00 (PAT) • Transport_scrambling_control field not '00' for PID 0x0000 (PAT)
Continuity Count	• Incorrect packet order • A packet occurs more than twice • Lost packet
PMT	• Sections with table_id 0x02 do not occur at least every 0.5 sec (configurable) • Transport_scrambling_control field not '00' for all PMTs

Type II Indicators

TEI	• TEI bit in TSP set to '1'
PSI CRC	• CRC error occurred in PAT, PMT or CAT
PTS	• PTS repetition period > 700 msec (configurable)
CAT	• TSPs with transport_scrambling control field not equal to '00' present, but no section with table_id = 0x01 (CAT) present • Section with table_id not '0x01' found on PID 0x0001 (CAT)

Triggering

Assertion of indicators	• TS Sync Loss • Sync Byte • PAT • Continuity Count • PMT • TEI • PSI CRC • PTS • CAT

Pre-store/Post-store Settings.

TS Sync Loss	• Sync Acquire 1 to 15 packets (default 5) • Sync Loss 1 to 15 packets (default 2)
AAL-5 Time-out	• 1 to 255 msec (default 255 msec)
PAT Interval	• 0.1 to 10 sec (default 0.5 sec)
PMT Arrival Lag	• 0.1 to 10 sec (default 0.5 sec) PTS Interval
PTS Interval	• 0.1 to 10 sec (default 0.7 sec)

Program Specific Information Table Display

Program Specific Information (PSI) Tables are used to match PIDs to programs. PSI Tables are sent in the transport stream. The MPEGscope ATM provides real-time display of up to 24 PSI Tables. Table triggers freeze the hierarchical display for analysis.

TS Sync Loss	• Sync Acquire 1 to 15 packets (default 5) • Sync Loss 1 to 15 packets (default 2)
AAL-5 Time-out	• 1 to 255 msec (default 255 msec)
PAT Interval	• 0.1 to 10 sec (default 0.5 sec)
PMT Arrival Lag	• 0.1 to 10 sec (default 0.5 sec) PTS Interval
PTS Interval	• 0.1 to 10 sec (default 0.7 sec)

PSI Table CRC Error Detection

Presentation	• Total count (numeric) • Error event versus time graph • Error % versus time graph
Triggering	• User-defined PSI Table CRC error count threshold • Pre-store/post-store trigger setting
Logging	• Logs error rate to user-specified file at 1 second intervals

Program Clock Reference Statistics

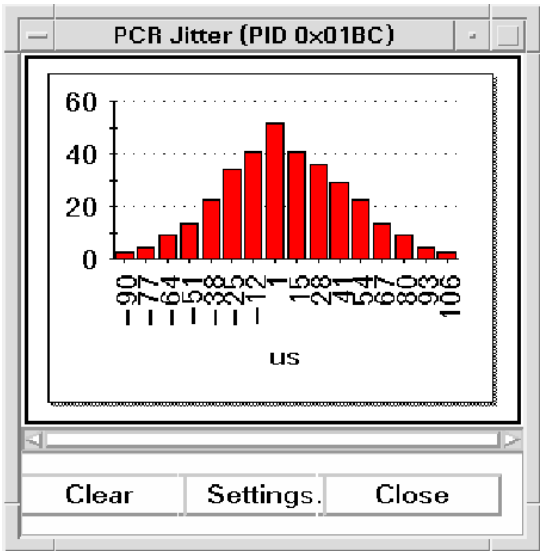
The Program Clock Reference (PCR) is a snap-shot of the 27 MHz system time clock of the encoder or multiplexer that originated the transport stream. It is used to recreate the 27 MHz system clock signal at the decoder. The MPEGscope ATM can measure PCR jitter and PCR interval simultaneously on up to two PCR-carrying PIDs.

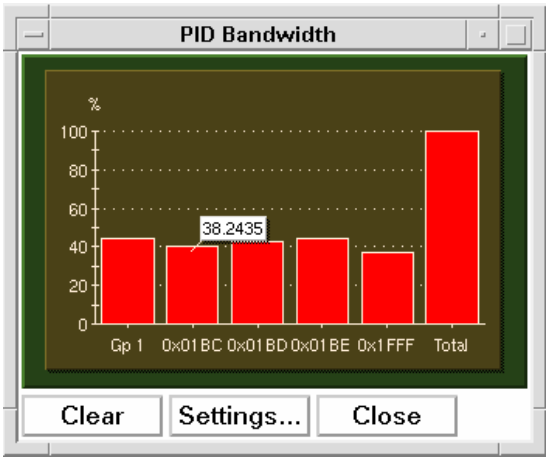
PCR Jitter

Performance	• Max processing rate is up to 1000 PCR/s per PID • Max 2 PIDs measured simultaneously
Range	• +/-10 msec
Resolution	• 0.1 usec
PID selection	• Select from list of PIDs generated from PSI tables • Manual entry
Presentation	• Histogram with zoom-in display (16, 32, 48 or 64 bins) • Number of samples • Mean and variance
Triggering	• User-defined jitter threshold value • Pre-store/post-store trigger setting
Logging	• Logs histogram values to user-specified file at 1 second intervals

PCR Interval Measurement

Performance	• Max processing rate < 1000 PCR/s • Max 2 PIDs measured simultaneously
Range	• 0 to 500 msec
Resolution	• 0.1 msec
PID selection	• Select from list of PIDs generated from PSI tables • Manual entry
Presentation	• Histogram with zoom-in display (16, 32, 48 or 64 bins) • Number of samples • Mean and variance
Triggering	• User-defined interval threshold value • Pre-store/post-store trigger setting
Logging	• Logs histogram values to a user-specified file at 1 second intervals





Packet Identifier Utilization

Packet identifiers (PIDs) are 13-bit values found in the second and third byte of every transport stream packet (TSP). PIDs are used to associate the elementary streams (video, audio, and data) of a program in a Transport Stream. The MPEGscope ATM measures PID utilization displaying the #TSPs versus the PID number over the integration period.

PID Utilization Measurement.

Performance	• Max 32 PIDs measured simultaneously
Resolution	• 1 TSP
PID selection	• Select from list of PIDs generated from PSI tables • Manual entry
Presentation	• Histogram with zoom-in display (#TSPs versus PID)
Logging	• Logs histogram values to a user-specified file at 1 second intervals

Packet Identifier Statistics

The PID bandwidth measurement provides a real-time display of the bandwidth used by a PID or a program (a group of PIDs) in the transport stream. The MPEGscope ATM can measure the bandwidth of a PID or a program in either Mb/s or as a percentage of the total TS bandwidth.

PID Bandwidth Measurement

Performance	• Max 6 individual PIDs or program measured simultaneously
Resolution	• 1 TSP
PID selection	• Select from list of PIDs generated from PSI tables • Manual entry
Presentation	• Line graph with zoom-in display (PID/group data rate versus time) • Histogram with zoom-in display (% of total bandwidth versus PID or program)
Triggering	• User-defined rate or % total bandwidth threshold • Pre-store/post-store trigger setting
Logging	• Logs rate or % values for each PID/group to a user-specified file at 1 second intervals

Header Statistics

Header information is contained in the first four bytes of every TSP which starts with a Sync_Byte = 0x47. The following measurements are available..

Description	• Sync Byte Error Count • Continuity Counter Error Count • Continuity Counter Repeat Count • Transport Error Indicator Count
Performance	• Max 32 PIDs monitored simultaneously
PID Selection	• Select from list of PIDs generated from PSI tables • Manual entry
Presentation	• Total count (numeric) • Line graph with zoom-in display (event versus time) • Line graph with zoom-in display (% errored packets versus time)
Triggering	• User-defined count or % errored packets threshold • Pre-store/post-store trigger setting
Logging	• Logs count or % errored packets to a user-specified file at second intervals

Triggers

Triggers are available on most measurements to facilitate error isolation and debugging. Triggers stop data capture with a user- definable delay of 10 to 90% of the capture buffer. The following triggers are discussed in their respective sections above:

- PCR statistics
- PID statistics
- PSI Table monitoring
- Virtual LED health indicators

Header Field Matching

In addition to the above triggers, header field matching triggers are available. Header Field Matching also allows you to trigger on a data value matching one or more of the following TS header and adaptation fields. Versatile bit matching masks can be created using zeros, ones, don't cares, and AND/OR logical operators (e.g., PID=001110XX AND transport_priority=1)...

Header fields	• Transport_error_indicator payload_unit_start_indicator • Transport_priority • PID • Transport_scrambling_control • Adaptation_field_control • Continuity_count
Adaptation field	• Discontinuity_indicator • Random_access_indicator • Elementary_stream_priority indicator • PCR_flag • OPCR_flag • Splicing_point_flag • Transport_private_data_flag • Adaptation_field_extension_flag

Protocol Viewer

A large 8 MB buffer is available to capture received Transport Stream data for off-line analysis. The protocol viewer is then used for analyzing and saving Transport Stream data contained in the capture buffer. Data can be analyzed at all levels of the protocol stack, including ATM, AAL-5, Transport Stream, and PES or PSI. Protocol errors are highlighted in red. Filtering can be done at all protocol levels to quickly focus on events of interest...

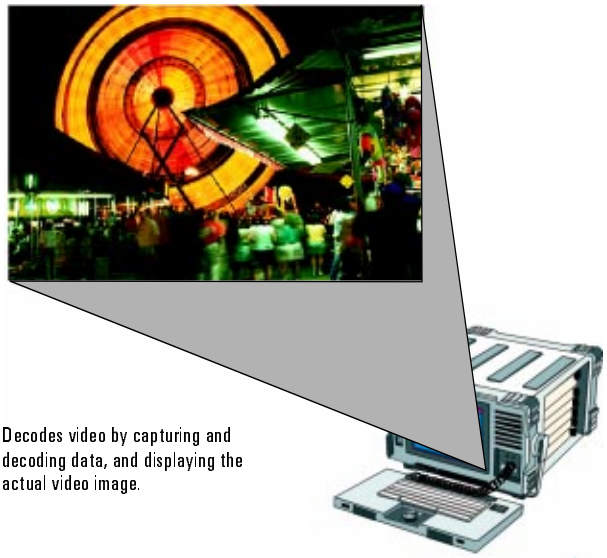
General	• Displays MPEG-2 Transport Streams transported over AAL-5 with automatic decoding and error highlighting • One VPI/VCI supported • Up to 8 Transport Stream packets per AAL-5 frame • Transport rates of up to 36 Mb/s • Displays input source warnings and AAL-5 error indicators
Capture buffer	• 8 MB data storage including AAL-5 and system overhead • 5.2 MB of Transport Stream data storage (typical: 2-TSP packing) • Capture can be manually controlled or triggered • Trigger point stops data capture after 10-90% of capture buffer is filled (user-selectable)
TSP display filter options	• Payload Unit Start Indicator • Transport Error Indicator • Transport Priority • PID value • Scramble control • Adaptation field control • Contains PCR TSP decode error filter options • Length errors • Invalid sync • NULL packet has invalid values • Reserved values • PAT or CAT is scrambled • OPCR without PCR • Bitstring filter
PSI table filter options	• Section Type • Table ID
PSI table decode	• Descriptor errors
Error filter options	• PAT: Duplicate Program • Invalid PID • Section Syntax Indicator error • Section Number error • CRC error • Section Length error • Invalid Section ID • Bitstring filter
PES packet display	• Stream Type • Field Filter Options Stream ID
Filed filter options	• Stream ID
PES packet display	• Invalid stuff/pad bytes

Decode error filter options	• Invalid Header Values • Length errors • Invalid Stream ID • Invalid Start Code • Bitstring filter
Save to disk	• Data recording, compatible with playback viewer sessions • Formatted text, a text snapshot of the decoded protocol • PDU library, compatible with the BSTS CPP or LIF transmitter • Raw data, a binary image of the viewed protocol layer

Video Decoding

Captured transport stream data can be extracted from the capture memory and saved to a file in raw binary format. A video elementary stream can be selected, by PID, decoded and viewed on the BSTS screen.

The video decoding feature requires the V743 controller used in E4200B and E4210B BSTS chassis.



Decodes video by capturing and decoding data, and displaying the actual video image.

Applicable Standards

Portions of the following standards are relevant to the E6271A MPEGscope ATM.I

- Audiovisual Multimedia Services: Video on Demand Specification 1.0, ATM Forum, December, 1995.
- ETR 290/Draft MG-66 Rev. 6 Digital Video Broadcasting DVB); Measurement guidelines for DVB systems. 24 July 1996
- ISO/IEC 11172-2:1993(E): Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbit/s – Video 1993.
- ISO/IEC 11172-3:1993(E): Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbit/s – Audio.1993.
- ISO/IEC 13818-1 Information technology – Generic coding of moving pictures and associated audio information: Systems. 1996-04-15
- ISO/IEC 13818-2: Information Technology – Generic Coding of Moving Pictures and Associated Audio: Video. 1995
- ISO/IEC 13818-3: Information Technology – Generic Coding of Moving Pictures and Associated Audio: Audio. 1995
- ISO/IEC 13818-4: Information Technology – Generic Coding of Moving Pictures and Associated Audio: Compliance Testing. 1995
- ISO/IEC 13818-9: Information Technology – Generic Coding of Moving Pictures and Associated Audio: Extensions for real time interface for system decoders.
- 1 Apr 1995.
- Q.2961, "Broadband Integrated Services Digital Network (B-ISDN) - Digital Subscriber Signalling System No. 2 (DSS 2) - Additional Traffic Parameters", ITU-T, 10/95
- Q.2971, "Broadband Integrated Services Digital Network (B-ISDN) - Digital Subscriber Signalling System No. 2 (DSS 2) - User- Network Interface (UNI) Layer 3 Specification for Point-to-Multipoint Call/Connection Control", ITU-T, 02/95

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For more information

For an introduction to the modular Broadband Series Test System, please request the *BSTS Product Catalog*, HP publication 5965-4721E or visit the BSTS web pages at http://www.hp.com/go/bsts

The *BSTS Ordering Guide*, HP publication 5964-0393E, helps you determine the appropriate system configuration for your testing needs. Technical specifications detailing other dedicated test modules and test software packages for the BSTS are also available.

How to Find Out About Other HP Products, Publications & Services

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Specifications subject to change.

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