MPEG Test System

MTSA Family of Products Datasheet

The MTSA MPEG Test System provides comprehensive MPEG transport stream (TS) analysis and interoperability testing. Its deep analysis of the TS, PES (Packetized Elementary Stream), and elementary streams helps track down sources of picture anomalies and identify transport streams with syntax errors. Its ability to capture events for deep analysis is also critical to identifying the root cause of problems.

The MTSA can be delivered as a rack mountable 1RU full rack instrument (MTSA-HW) or as standalone software (MTSA-PC). The MTSA has a high-speed analysis engine that enables reduced time to insight, rapid development, evaluation, deployment, and diagnostics of next generation DTV and IPTV systems and services.

Key features and benefits

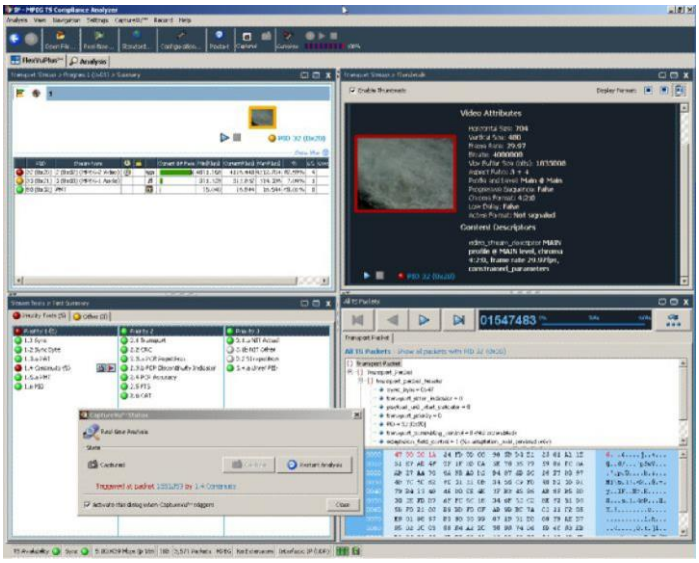
- Perform analysis of key regional DTV standards - The MTSA supports the DVB, ATSC, ISDB, and ISDB-TB (Brazil) regional standards and the specific SI (Service Information) for terrestrial, cable, and satellite transmission
- Connect to the most important physical interfaces used for transmission - A range of RF and IP interfaces and analysis capabilities provide the necessary connectivity to diagnose problems anywhere in the network environment, whether that be transmission links (RF or IP layer) or content processing (TS layer)
- Analyze content using the common DTV compression technologies - the MTSA tools support H.265 (HEVC), H.264, VC1, MPEG 2 and MPEG 1 compression standards
- Test and analyze the structure of the TS and the content contained within that stream - A full range of tools enables QoS (Quality of Service) and QoE (Quality of Experience) with logging for fault diagnosis and reduced time to insight for both constant and variable bit rate streams (CBR and VBR). [1] Using CaptureVu® technology lets engineers capture and analyze system events in real time and deferred time to debug intermittent and complex problems that traditional analyzers miss
- Perform custom parametric testing and analysis - The MTSA options include a versatile Multiplexer and Generator that can be used to provide stimulus with parametric capabilities and IP multisession replication to characterize behavior of network or the Device Under Test (DUT)
- Perform in depth, repeatable, objective Picture Quality Analysis - the MTSA PQ software can be used to perform full reference Picture Quality Analysis based on the Human Vision Model allowing users to assess CODEC performance and troubleshoot picture issues in their content. The MTSA PQ option is the award-winning PQA software

Applications

Equipment manufacturers - research and development

- CaptureVu® technology allows rapid isolation and debugging of equipment and system faults
- High-performance Gigabit Ethernet (GbE) IP connectivity and integrated cross-layer analysis enable diagnosis of complex timing problems in video over IP and IPTV network equipment
- Multiplexer/Remultiplexer allows flexible test stream creation and modification
- Rapid and in-depth analysis of selected elements of transport streams to confirm functionality and compliance to standards
- Set-top box buffer testing and verification
- Elementary stream analysis option for codec design and optimization High-accuracy picture quality analysis based upon the Human Vision Model for device design optimization and fault diagnosis

[1] Some timing related measurements are not possible with VBR streams.



MTSA CaptureVu®

Equipment manufacturers - manufacturing test

- Tclips Test Streams together with the Multiplexer/Remultiplexer allow custom test stream creation and editing for fast and flexible equipment stress testing
- Stream playout and recording provide a repeatable test source with seamless looping and continuous time-stamping for test and alignment of STBs, IRDs, and modulators
- Multiport ASI and IP interfaces allow multiple devices to be tested simultaneously
- Duplex operation allows end-to-end testing of system network elements

Broadcaster and network operator engineering

- RF and IP connectivity and analysis provide a single-box solution for broadcast system troubleshooting at any point in the network
- Integrated cross-layer fault analysis and logging for network fault diagnosis reduces time to insight when troubleshooting and removes the need for additional IP- or RF-specific diagnostic equipment
- CaptureVu® technology allows for the isolation of intermittent network problems that other analyzers are not capable of isolating
- Video and audio quality analysis that help distinguish between impairments resulting from network distribution versus artifacts resulting from compression
- Elementary stream compliance option for evaluating different vendors' compression equipment and diagnosing faults

Summary of available MTSA interfaces

The MTSA base instrument (Option MTSA-HW) is provided with the following Standard interface:

- Ethernet IP (10/100/1000BASE-T)

The following Optional interfaces can then be added to the base instrument (limited to a maximum of two interfaces):

- Multiport ASI interface (Option MTSA-HW ASI)
- SDR (Software Defined Radio) RF interface supporting DVB-T, ISDB-T, QAM A/B/C or 8VSB [2] (Option MTSA-HW SDR)
- 10GBASE-SR dual optical port 10 Gb/s NIC; includes short-reach SFP+ modules (850 nm) (Option MTSA-HW 10GS)
- Dual input DVB-S/S2 interface supporting QPSK, 8PSK, 16APSK and 32APSK demodulation (Option MTSA-HW DS2)

Summary of MTSA Analysis and Diagnostic tools

Whether provided on a base instrument (Option MTSA-HW) or as standalone software (Option MTSA-PC) the following optional tools can be added:

- Real-time and Deferred-time Transport Stream Compliance Analyzer (TSCA) including Closed Caption Analysis (Option TSCA)
- Stream generator and multiplexer including TS Editor, and Make Seamless (Option MUX)
- Enhanced ES (Elementary Stream) Analysis packages supporting HEVC/H.265, AVC/H.264 and MPEG 2 including Closed Caption Analysis (Option ESA)
- Picture Quality Analysis Software, Double Ended PQ Analysis based on the Human Vision Model that allows custom scripting and measurement (Option PQ)
- PES and T-STD Buffer Analyzer (Option PBUFFA)
- Bundled option pack that includes TSCA, ESA, MUX and PBUFFA options (Option ALZRPK)

2 QAM A/B/C and 8VSB functionality cannot be used simultaneously - requires two cards.

Transport Stream Compliance Analyzer (Option TSCA)

The MPEG Transport Stream Compliance Analyzer (TSCA) enables monitoring and interpretation of the contents of real-time, previously recorded, or synthesized Transport Streams using the latest ATSC, DVB, ISDB, and MPEG standards.

The analyzer is specifically designed to enable quick location and identification of problems within a Transport Stream using a minimum number of mouse clicks. By quickly identifying the problem areas, the TSCA software helps you save time during the development and test of equipment, networks, and services.

Users can configure the TSCA software to display stream information in user-selected fonts. This feature enables you to view stream information in your local language or to use custom fonts. The TSCA software can be purchased to run stand-alone on computers (MTSA-PC). Separate packages are available for Deferred-time Analysis and Real-time Video over IP Analysis. Both packages offer CaptureVu® technology plus IP and TS measurement, logging, and graphing capabilities.

TSCA displays

- Program-centric summary screen with go/no-go error indication of user specified tests
- Video thumbnails and real-time video and audio decode - H.264, H. 265 (HEVC), and MPEG-2 supported
- Ability to recognize JPEG2K and HEVC video carried in Transport Stream
- CaptureVu® technology/trigger views
- Hierarchical Tests display
- PCR, PTS, and Mean IP Packet Interarrival Time (PIT) graphing and measurement display
- SI/PSI/PSIP display
- Real-time and deferred-time EPG display
- Packet view for TS Packets, TS Sections, and IP Packets
- IP interface displays
- Real- and deferred-time analysis share the same displays and user interface

TSCA features

- Easy program-centric UI quickly isolates information of interest
- CaptureVu® technology captures and analyzes system events in real or deferred time
- In-depth analysis of stored Transport Streams including support for MPEG, ATSC, DVB, ISDB
- Data summaries and automated filters simplify the analysis of complex Transport Streams
- TR 101 290 Priority 1, 2, and 3 tests
- Cross-layer Timing provides user with “at-a-glance” view of timing across multiple layers, enabling rapid time to insight when used with IP interfaces to diagnose at which layer a fault was introduced
- Statistical display of mean IP Packet Interarrival Time (histograms)
- IP real- or deferred-time inspection and analysis down to the IP Packet level – uses industry-standard PCAP file format for use with files captured using Wireshark (Ethereal)
- Syntax analysis and display supported for ISDB-T, TMCC, and IIP data, including One Seg support
- Consistency checks performed between SI, TMCC, and IIP data ATSC Closed Caption support and consistency checking
- Proprietary PSI/SI syntax section rate error testing
- Informational logging of detected events
- Unicode support enables service information to be displayed in Japanese, Chinese, or other languages Unicode support enables service information to be displayed in Japanese, Chinese, or other languages
- Batch mode for integration into automated regression test systems

Deferred and real-time modes

The TSCA can be run in deferred-time or real-time for analysis of compressed video streams carried over an IP interface. Deferred-time analysis mode enables a stored stream to be analyzed and viewed at any time and is available on any recommended platform.

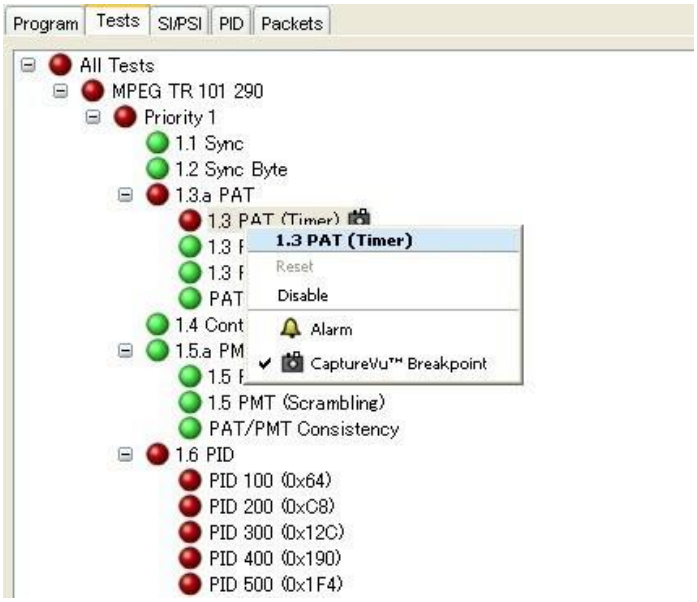
Using real-time analysis, live streams can be monitored on a continuous basis and can also be paused for more detailed deferred-time analysis. Real-time analysis can be resumed at any time. Real-time video and audio decode enables the user of the analyzer to select a program from within a Transport Stream and display the decoded video for viewing or listen to the audio. Video thumbnails with video wall, summary, and ES (Elementary Stream) header information views enable users to choose whether to see many channels' thumbnails simultaneously or view detailed descriptions of one at a time.

TSCA user interface

The TSCA software uses a single main program summary window with different context-sensitive views contained within tabbed frames. This provides the maximum amount of useful information while keeping the screen from appearing cluttered.

From the main window, you can access the following views:

CaptureVu® technology – CaptureVu® technology captures and analyzes system events in real time and deferred time to debug the intermittent and complex problems that traditional analyzers miss. CaptureVu technology lets the user set a breakpoint on a specific test or event and, when the breakpoint occurs, a dialog will show the breakpoint condition and exact location of the packet within the Transport Stream. CaptureVu technology automatically prebuffers the last 200 MB of the signal, pauses the analysis, and launches an in-depth deferred-time analysis that lets the user drill down into the problem.

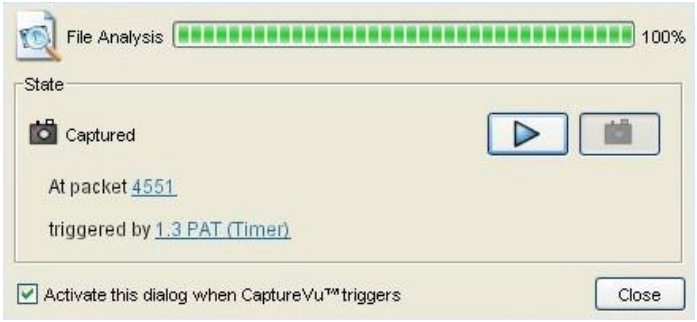


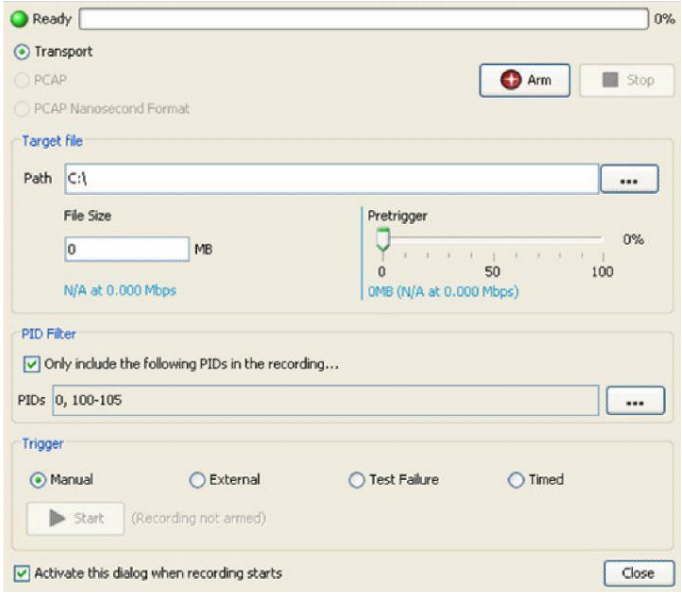
The captured stream can also be permanently stored on the hard disk for subsequent reanalysis with the deferred time TSCA application. This powerful debug mode enables fast debugging of troublesome intermittent problems. CaptureVu technology also supports triggering events based upon IP Layer measurements, providing integrated cross-layer fault analysis and logging in a single box solution for network fault diagnosis.

Triggered recording – The TSCA supports triggered recording, allowing the user to set up a sophisticated trigger condition. When the trigger condition is met, the live input stream is captured to disk without stopping or pausing real-time analysis.

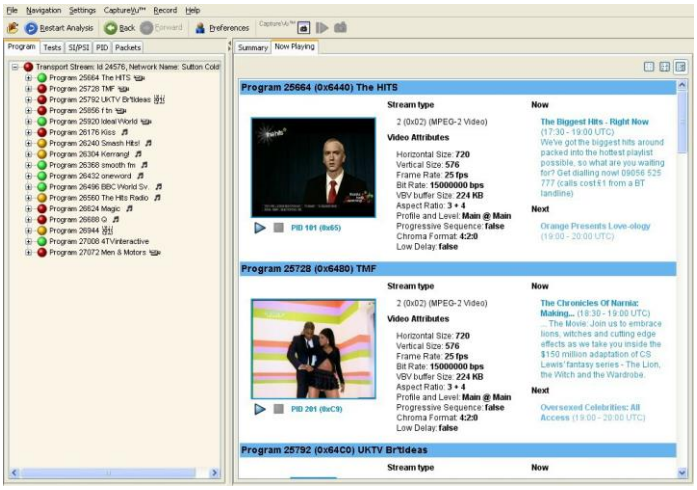
Trigger sources and conditions include:

- DVB TR 101 290 1st, 2nd, 3rd priority tests, ATSC A/78, ISDB, or proprietary tests
- IP Layer measurements, including PIT tests, RTP dropped packet count and rate, out-of-order packets count and rate
- Multiplex occupancy outside user-defined bit rate limits
- Date and time
- In triggered recording mode, the size of the pretrigger buffer can be specified as a percentage of the overall file size range from 0 to 100%





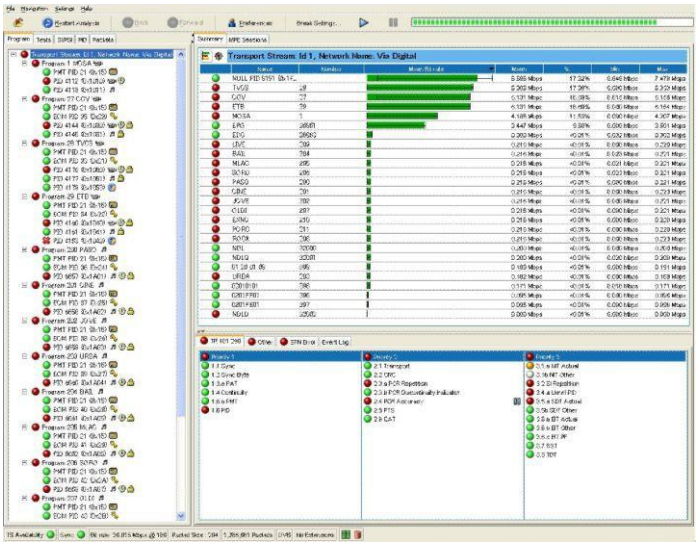
Program view – The Program view provides a fast overview of the Transport Stream contents in terms of program content, bit rate use by each program and DVB TR 101 290, ATSC A/78, or ISDB test results. Red, amber, and green LEDs highlight errors associated with each program or element. Video wall, summary, and detail views enable the user to choose whether to see many channels' thumbnails simultaneously or view detailed info of one at a time. Real-time video and audio decode enables the user of the analyzer to select a program from within a Transport Stream and display the decoded video for viewing or listen to the audio.

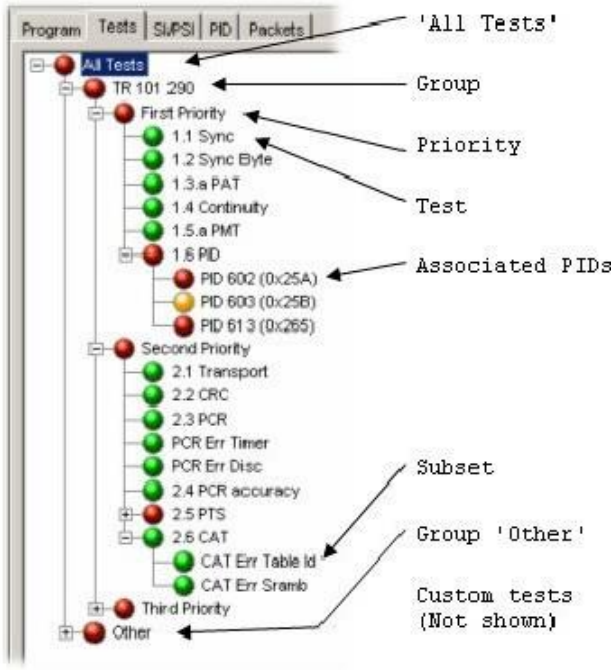


In addition to displaying a video thumbnail, the video format parameters from within ES headers are also displayed and can be checked for consistency with Transport Stream layer signaling of video parameters. This cross-check enables the operator to verify that the format of the content in the stream matches the format that they have signaled. An inconsistency could cause the STB to be unable to decode video and the viewers to lose their pictures.

Errors that are detected at lower levels in the program stream hierarchy propagate up to the highest level. This allows you to monitor all of the programs in the stream at a high level and then quickly go to lower levels as necessary to locate a problem.

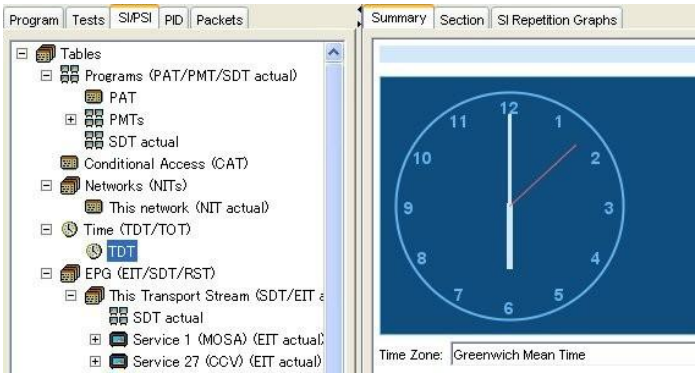
Tests view – The Tests view enables you to isolate errors to the specific tests that have been applied to the Transport Stream. The error log is automatically filtered by the selected test and can also be filtered by PID. In addition to the standard 1st, 2nd, and 3rd priority tests included in TR 101 290 standard, tests are available for PCR timing, IP Layer measurements, and program/ PID bit rate. A variability test enables you to test the changes in the bit rate of a specific PID. In addition to TR 101 290, there are many tests that are specific to ATSC A/78, ISDB-T, and ISDB-S streams.





SI/PSI and PSIP (tables) view – The SI/PSI and PSIP tables view displays the service information tables contained in the analyzed stream which comply with the selected digital video standard. This includes ATSC PSIP, DVB, and ISDB service information and MPEG program-specific information.

A summary view displays key values for each table in a meaningful way. The view includes hyperlinks enabling you to quickly access related information within other tables and views.

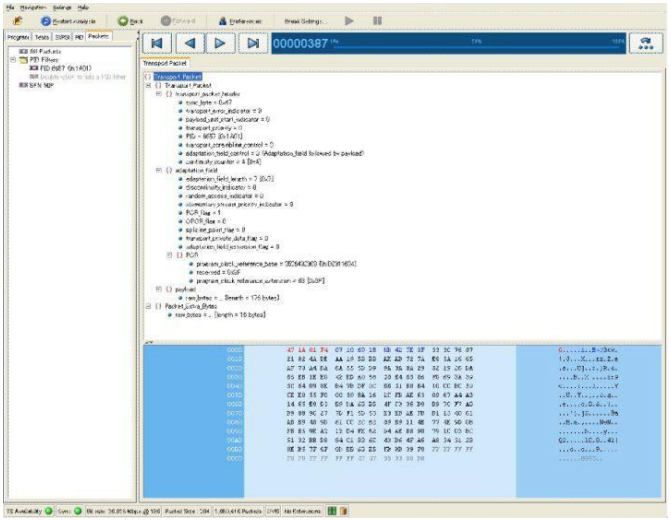


PID view – The Packet Identifier (PID) view displays information about all of the PIDs found in the Transport Stream. When you select a PID, the associated summary view provides a PID-oriented overview of the Transport Stream, displaying the relative data rates of all of the PIDs contained within the stream. The information can be displayed as either a bar chart or as a pie chart. Pop-up menus enable fast limit selection.

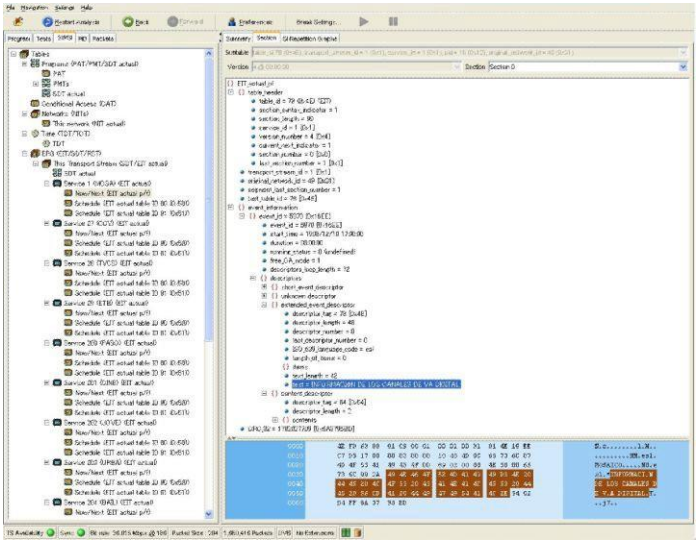
When one or more tests fail, each failed test is listed under the relevant PID. Specific PIDs can be selected to display a summary of all the associated tests. A specific test can be selected to display its event log and parameters.

Packet view – The Packet view displays information about all of the packets found in the Transport Stream grouped according to content or for IP streams, Ethernet Packets can be displayed for the session. These groups include PID value, SFN Megaframe Initialization Packets (MIPs - DVB only), Information Packets (IIPs - ISDB-T only), RTP or UDP IP Packet contents.

When you select a specific PID, MIP, or IP, session-only packets carrying that particular PID, MIP, or session are displayed. For Ethernet Packets, the RTP/UDP header information is displayed in both real and deferred time and can be used to display packet header information and payload.



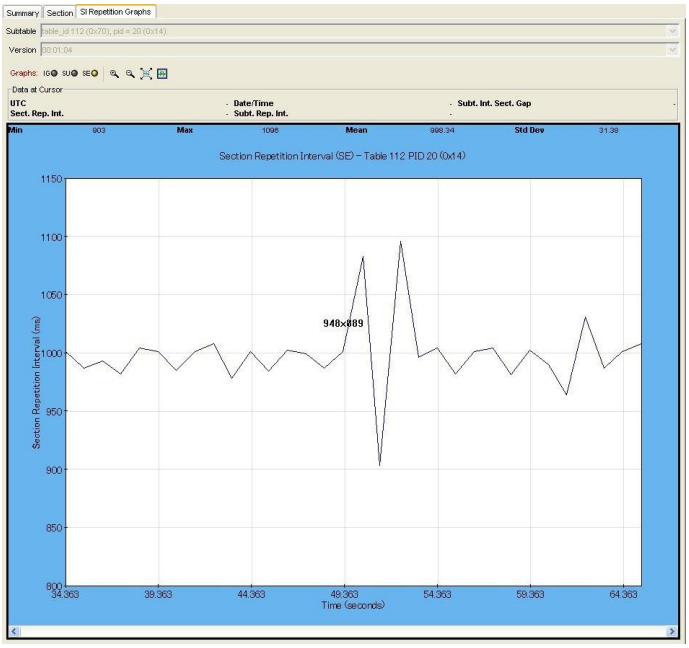
Section view – The Section view uses customizable script files, which allow you to specify and view proprietary information.



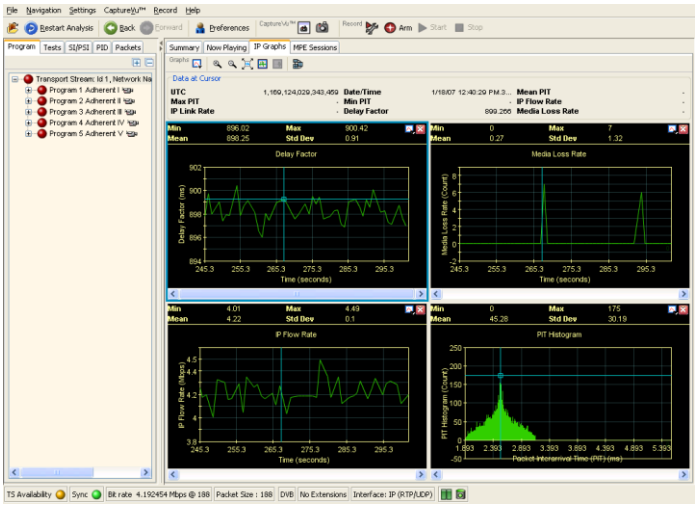
Tables and their data source are displayed. This shows the data bytes (in both hexadecimal number format and ASCII character format), for the selected table, version, and section. Tables and subtables are easily analyzed and directly traceable to packet data.

Section graphing –

- Section Repetition Interval graph – Displays the interval between two sections of a table on a particular PID
- Subtable Intersection Gap graph – Displays the interval between sections in a particular subtable
- Subtable Repetition Interval graph – Displays the time between receiving one complete subtable and receiving the next complete subtable



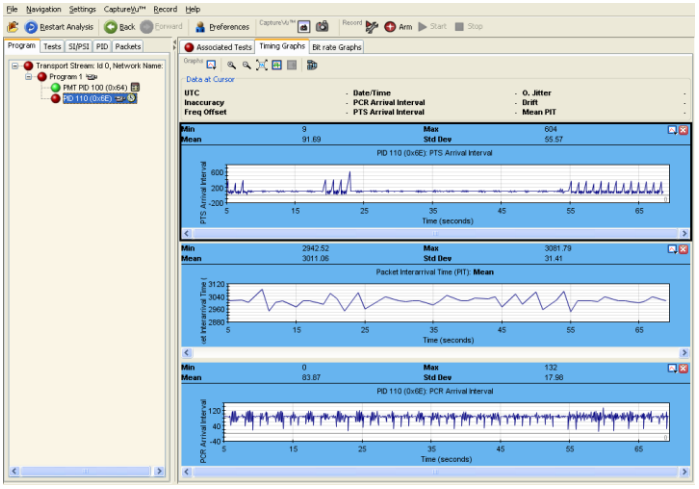
Timing analysis – The TSCA supports comprehensive PCR measurements to the TR 101 290 and A/78 standard. When the selected Elementary Stream PID contains PCR information, PCR trend analysis views are available, displaying graphs of: PCR accuracy, PCR arrival interval, PCR overall jitter, PCR frequency offset, and PCR drift rate.



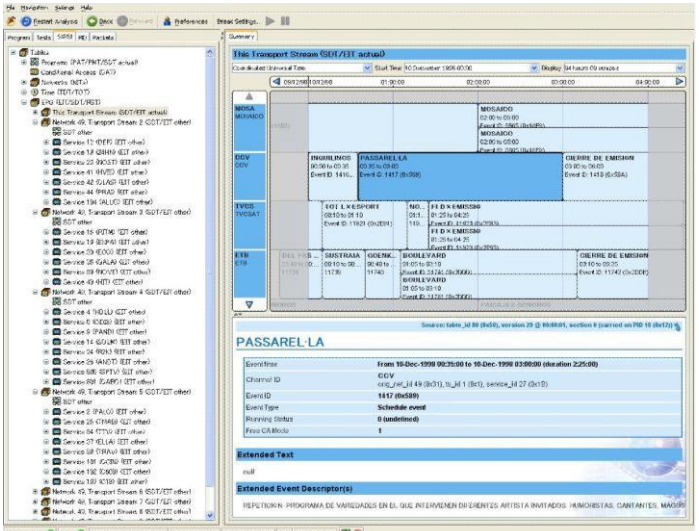
PCR graphs are available in real time and deferred time. Time stamping data makes sure that these can be captured and viewed on stream recordings. Selectable MGF filters provide maximum flexibility and compatibility in these important PCR measurements. The TSCA is also able to display PTS Arrival Interval graphing in real time or deferred time and includes PTS-PCR and DTS-PCR graphs to detect possible Receiver buffer under- and overflow problems.

IP Layer timing can be analyzed using statistical display of mean IP Packet Interarrival Time (histograms).

Cross-layer timing – Cross-layer timing provides the user with an at-a-glance view of timing at IP, TS, and PES Layers. This functionality addresses tough unsolved timing problems introduced using Video and Audio over IP technologies. Enables rapid time to insight when diagnosing at which layer a fault was introduced.



Real-time and deferred-time electronic program guide (EPG) view – The EPG view allows at-a-glance checking across many EIT tables and can be set to any time zone from local time, UTC, or the Transport Stream time itself. The number of days of EPG events displayed are broadcaster dependent but are not limited by the analyzer. When a Transport Stream EPG is selected, a panel shows the names of the services listed in the Event panel. The services displayed will depend on the node selected in the navigation view. ATSC, DVB, and ISDB EPGs are supported. ATSC Rating and Closed Caption signaling information are also displayed in this view.



Event panel – The event panel shows the events for one or more services, depending on the node selected. Individual events are color coded and shown as blocks. Each block (and its associated tooltip) displays event information extracted from the EIT. When a block is selected, the complete event information is shown in the Event detail panel, including a link to the section carrying the information. Events are color coded as follows:

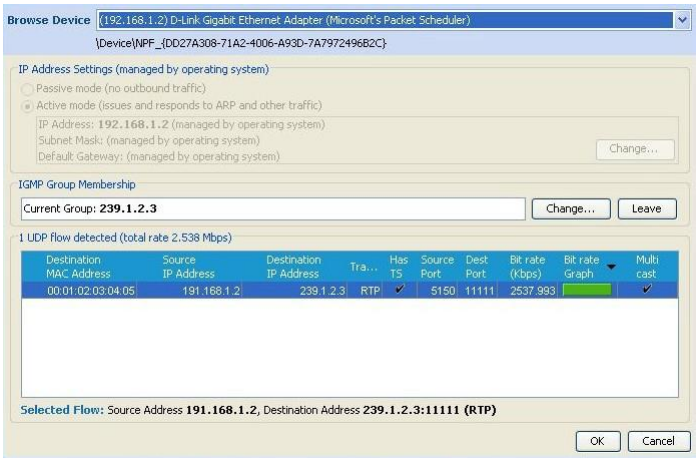
Color	Description
Red	Present event
Green	Following event
Blue	Schedule event
Yellow	(ISDB only) After event

MPE/IP view data broadcast – MPE data (internet IP sessions over MPEG TS) can be viewed as a separate entry for each MPE session either detected within the TS, or manually signaled since the view became active. Information displayed for each session includes:

- PID
- MAC address
- Network Layer source and destination IP addresses
- Transport layer protocol and port numbers
- Total data transmitted by the session so far since monitoring commenced
- Instantaneous bit rate using MGB1 profile

DVB SFN – For real time, data contained in the most recently received MIP is interpreted and displayed in a view depicting each field value. TPS MIP, STS time stamps, and other detailed information are available in navigator views.

Video over IP analysis and recording – The Ethernet port is provided for monitoring IP streams carrying MPEG video. This allows connection to a streaming IP video source for Video over IP analysis with CaptureVu® technology. The analyzer allows the selection of any current UDP session on a LAN segment for subsequent analysis. [3]

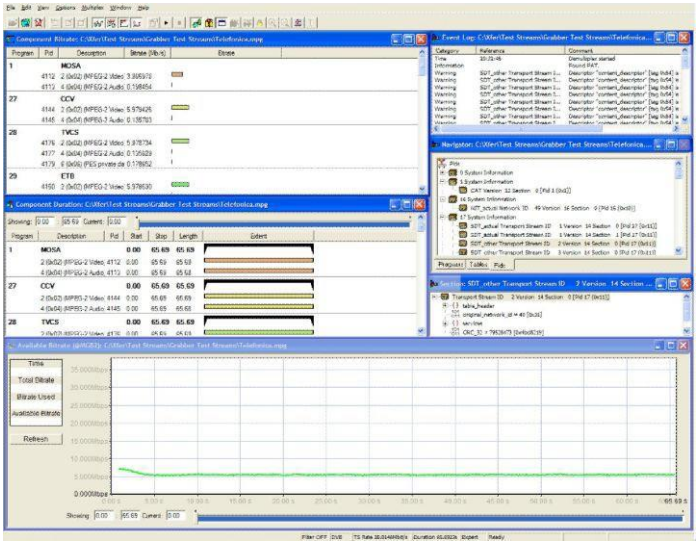


UDP sessions carrying MPEG TS traffic are indicated and may be selected for analysis and recording. Transport Stream packets are time stamped as they are received from any Network Interface Card, allowing PCR measurements and graphing to be supported. In addition, a display of the mean IP Packet Interarrival Time (PIT) histogram is available.

[3] Network traffic loading is specified to 600 Mb/s maximum bit rate.

Transport Stream and ISDB-T/Tb Multiplexer and Generator tools (Option MUX)

When testing network elements or set-top boxes, a Transport Stream of the representative type needed is often not available. Even if there is a similar one, vital components within it may be missing or suffer from a lack of SI (system information) or other tables, or are multiplexed to the incorrect Transport Stream rate for the application.



Use the Multiplexer/Remultiplexer/Demultiplexer application to create multi program Transport Streams with custom SI/PSI/PSIP information for DVB (including Annex A string support), ATSC, ISDB, and MPEG compliant Transport Streams including ISDB-T Single Segment mode.

H.265 (HEVC) and H.264 Elementary Streams can also be multiplexed into a Transport Stream. This enables the user to create their own test streams that they can use to validate and debug their designs more quickly. Errored streams can be created to perform parametric stress testing and ensure the robustness and quality of MPEG-2, MPEG-4 (AVC) or HEVC (H.265) implementations.

The Telestream Multiplexer/Remultiplexer/Demultiplexer application supports:

- MPEG-1 video
- MPEG-1 audio
- MPEG-2 video
- MPEG-2 audio
- MPEG-2 AAC audio
- AC-3 audio
- H.264 ES (both with and without optional SEI timing messages)
- H.265 (HEVC) elementary streams
- MPEG-2 Video PES (Packetized Elementary Streams)
- MPEG-2 Audio PES
- AC-3 Audio PES
- All the above are supported in Elementary and PES formats
- PIDs from other Transport Streams can be imported including any format including H.264 and VC-1
- Other data - the bit rate must be specified

The multiplexer solution

The multiplexer allows the user to collect together components from recorded and stored streams, manipulate them in an unlimited manner, and then rebuild a fully compliant output stream. The software's built-in knowledge of table syntax and descriptors ensures compliance and high-quality output of the final multiplexed Transport Stream.

Demultiplex existing streams

The multiplexer accepts any recorded Transport Stream as an input source. The user can then demultiplex this Transport Stream into its component PES. The user can then save the resulting PES and ES streams to disk. The demultiplexer is an Elementary Stream diagnostic and can be used to extract H.264 and VC-1 Elementary Streams from a Transport Stream.

Regroup PES with stored streams

These PES, or elementary video and audio streams, can be grouped together into logical groups - Programs of video, audio, and other associated data (such as Teletext / Closed Caption and MHP applications) with the original timing preserved. PIDs can be remapped as required.

Component views and Available Bandwidth view

The Component Bit Durations view graphically displays the durations and start and stop times for each video or audio content PID. Duration and start/stop times can be changed by "drag and drop" or numerical entry. The Available Bandwidth view clearly shows the user how much content can be added into a Transport Stream so the user can expand oroptimize.

Map, check, and rebuild your own multiplex

Streams can be rebuilt into a larger multiplex stream. Also, SI/PSIP tables can be customized and added safely with built-in compliance checks.

Generate compliant timing and output bit rates as required

The multiplexer can insert PCRs at the correct repetition rate and lets the user specify the PCR repetition rate, if required.

Create, add, or modify PSIP/SI/PSI flexibility

The multiplexer allows all the standard ATSC/DVB/ISDB and MPEG PSIP/SI and PSI tables and descriptors to be added or edited. Scripting allows new or custom tables to be added. The user is permitted to generate illegal conditions that allow stress of decoder or transmission chain equipment to verify its robustness.

Make Seamless wizard

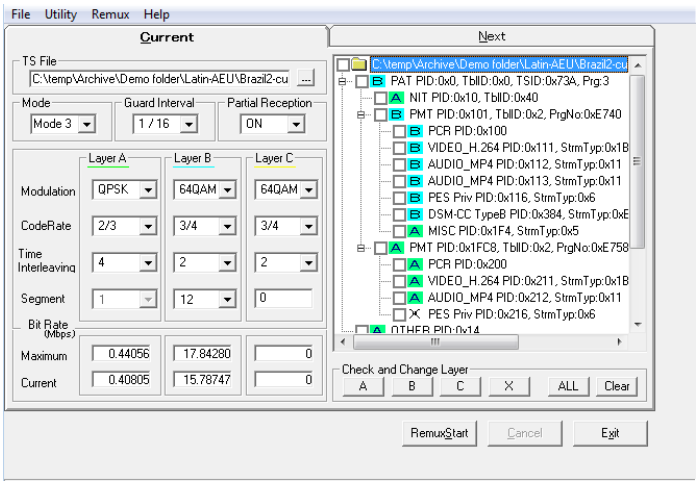
When looping a Transport Stream to simulate continuous playout, errors can be generated at the loop point caused by discontinuities in timing information. The Make Seamless wizard provides the opportunity of creating a seamless version of a Transport Stream file by adjusting SI and ES components within the stream.

Standard and Expert modes

Standard mode will calculate related fields and table pointers. Expert mode lets the user set fields and table pointers to illegal conditions for stress and robustness test of network elements and STB decoders.

ISDB-T Remux

The ISDB-T Remux application shows each of the transport stream PIDs being dedicated to Layers A, B, or C. The remultiplexed .RMX file can be played over ASI to a ISDB-T/Tb modulator.



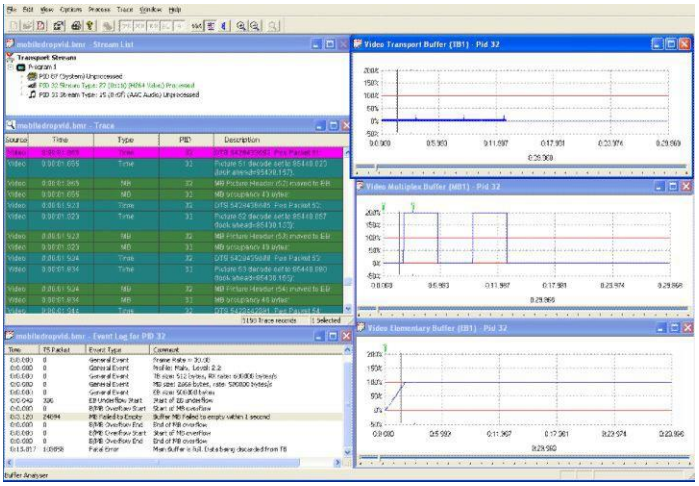
Wizards for common tasks

- Create new Transport Streams
- Create a seamless loop of a Transport Stream
- Specify ATSC, DVB, ISDB, and MPEG standards
- Add programs
- Add events

PES and T-STD Buffer Analyzer (Option PBUFFA)

T-STD Buffer Analyzer

When developing professional and consumer equipment, particularly encoders and set-top boxes, the characteristics of the test streams being either generated or used as stimulus need to be ascertained. Of critical importance among these characteristics is adherence to the buffer model. That is, when the stream is processed by a receiver, will any of the internal buffers be caused to either under- or overflow. Consequences of these conditions are freeze frames and receiver resets.



There are two types of buffer model; the one to use by the receiver is signaled within the Elementary Stream itself. The T-STD method is based upon the DTS values within the PES header and can be used for any contained CODEC type. Additionally, certain video CODECs such as MPEG-2, MPEG-4 (AVC) or HEVC (H.265) may contain buffer parameters within the ES itself.

The Buffer Analyzer verifies conformance of a stream to the T-STD model. Verification of the H.264/AVC HRD method is covered by the ESA product.

The Buffer Analyzer application supports:

- MPEG-2 Video
- H.264/AVC (MPEG-4 part 10)
- H.265 (HEVC)
- MPEG-2 Audio
- MPEG-2 AAC Audio
- AC-3 Audio
- PSI (ISO/IEC 13818 parts 1)

The Buffer Analyzer solution

The Buffer Analyzer accepts any recorded Transport Stream as an input source. The TS is then demultiplexed into its component PES, grouped by program. The user can select one or more PES to analyze for conformance to the T-STD model according to the buffer parameters for the codec type in question. General information such as profile and level together with any buffer errors are recorded in a log.

The user can manually set buffer sizes and other parameters before analysis, rather than use those specified by the standard or signaled within the stream.

Buffer graphs

The occupancy level for each buffer within the model (3 for video, 2 for audio, and 2 for PSI) is plotted on a graph for each PES being analyzed. Graphs may be zoomed for ease of use. A Synchronization feature allows for comparisons at a particular point in time between each of the graphs and individual log entries.

Trace view

The Trace view provides details of the buffer movements for in-depth analysis of the results. Trace entries are included in the Synchronization feature for ease of diagnosis.

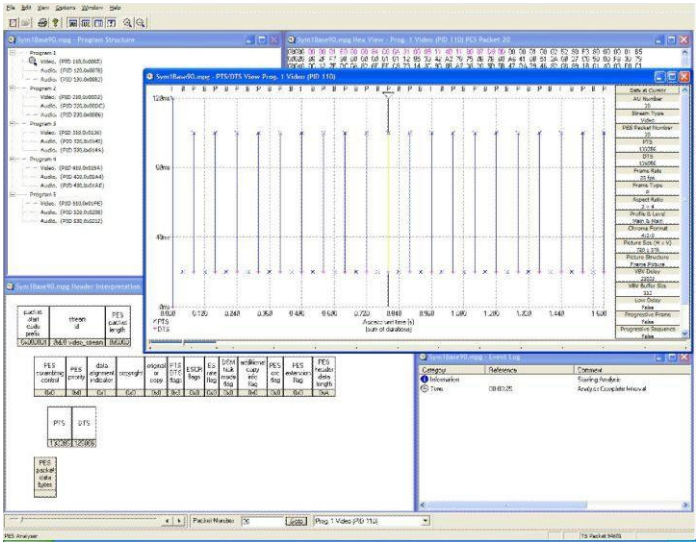
Buffer Model Results (BMR) files

The analysis results are stored in a Buffer Model Results (BMR) file to save having to reanalyze the same file. Results files may be opened directly in the Buffer Analyzer, whereby logs, graphs, and Trace contents (maximum of 7000 entries) are repopulated. They are far smaller than the original TS files and thus useful to add as e-mail attachments.

Packetized Elementary Stream (PES) Analyzer

When developing professional and consumer equipment, particularly encoders and set-top boxes, the characteristics of the test streams being either generated or used as stimulus need to be ascertained. The header associated with each PES packet is of particular interest, as it contains the decode and presentation time stamps (DTS and PTS) for the contained Elementary Stream.

Errors in these time stamps may cause resets or picture freeze problems at the receiver in extreme cases. They are more typically the cause of lip sync problems where the time stamps of associated video and audio streams are not synchronized. The PES Analyzer is designed to help address these problems and verify conformance of the PES header contents to the MPEG, DVB, and ATSC standards.

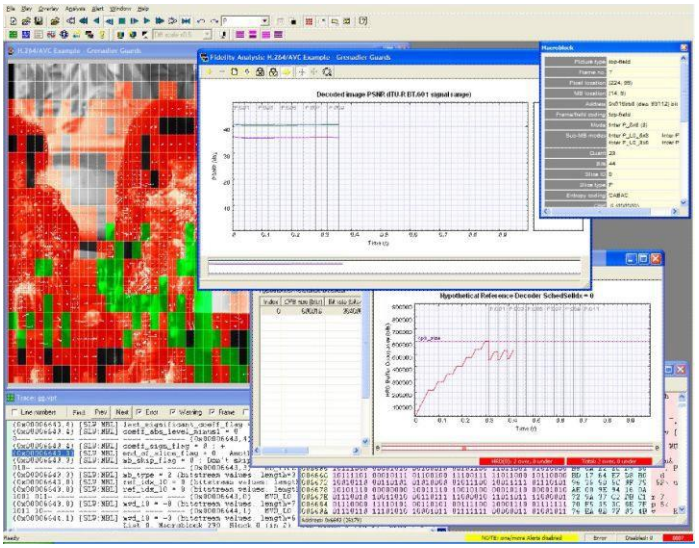


Packetized Elementary Stream (PES) Analyzer

Elementary Stream tools (Option ESA)

Whether developing a new codec chip, integrating a codec into professional or consumer equipment, or integrating different vendor's equipment when rolling out new services, the ability to verify the compliance of an Elementary Stream is crucial. This tool checks for compliance of an Elementary Stream to either next-generation VC-1, HEVC/H.265, AVC/ H. 264, and MPEG-4 standards, or legacy MPEG-2 and H.263. Audio decode and waveform display of MPEG-2 audio (ISO/IEC 13818 parts 3 and 7), AC-3, and MPEG-4 AAC are also supported.

Comprehensive diagnostic capabilities including semantic trace view to determine Frame-by-Frame and Block-by-Block encoder decision making. Synchronized displays allow the user to quickly ascertain the details of each reported error. A bitstream editor allows the effects of planned encoder updates to be quickly understood.

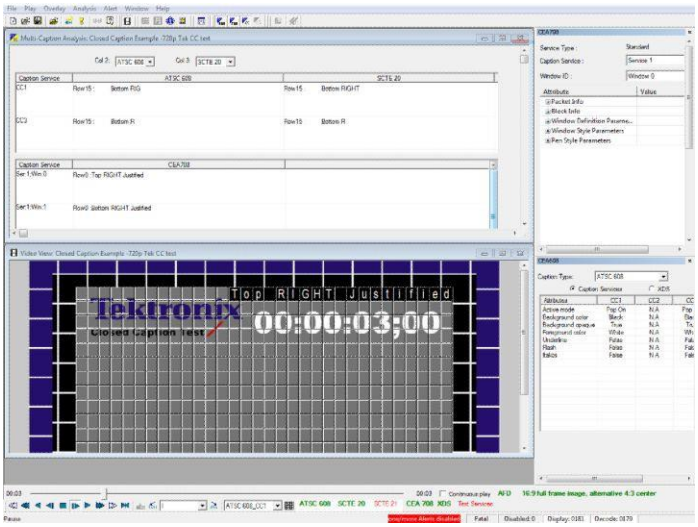


Key features

- Video, audio and caption decode and analysis
- Verification of the stream's compliance with the encoding standard
- Extraction of elementary streams from containers
- Comprehensive stream navigation and tracking to follow all aspects of the decoding process
- Multiple displays and overlays of Coding Unit (CU), Prediction Unit (PU), Transform Unit (TU), Macroblocks (MB)
- Easy selection of specified CU/MB and navigation using Zoom in and out for analysis
- Synchronized video, audio, and data views for instant cross reference
- Wide range of frame and Coding Tree Unit (CTU), Coding Unit (CU), Prediction Unit (PU), Transform Unit (TU), macroblock statistics, syntax traces - bitstream, interpret, alerts, frame, macroblock, transform, pixel level, fidelity traces
- Buffer analysis with graphical plots - spatial bits/MB, MV histogram, quantization, DCT frequency, MB coded frequency, intracoding frequency
- Video differencing and fidelity analysis
- Bitstream editor for making changes, reanalyzing the stream, then saving
- Exports data for detailed graphical analysis (requires Microsoft Excel®)
- Comprehensive batch mode for automated regression testing with log reports
- YUV decoded video output for baseband video analysis
- Audio compression analysis
- AV delay measurement
- Built-in help and tutorials
- Quicker and partial analysis by extracting to smaller files
- Closed Caption syntax and compliance analysis with ability to render captions over video, save captions to standard file format (SRT, SCC MCC), and debug capabilities, with support for Korean characters

Closed Caption Analyzer

The Closed Caption analyzer is intended for Closed Caption compliance testing and for debugging Closed Caption problems when captions do not appear over video. The analyzer allows you to extract the captions to SCC, MCC and SRT files and provides the ability to render captions over video and to align the CEA608, CEA708 and SCTE 20/21 control commands alongside the video. MPEG-2 and AVC video with TS and MXF containers are supported.



Picture Quality Analysis (Option PQ)

The PQ Option is Picture Quality Analysis (PQA) Software based on the concepts of the human vision system which provides a suite of repeatable, objective quality measurements that closely correspond with subjective human visual assessment. These measurements provide valuable information to engineers working to optimize video compression and recovery, and maintaining a level of common carrier and distribution transmission service to clients and viewers.

Key features

- Fast, accurate, repeatable, and objective picture quality measurement
- Predicts DMOS (Differential mean opinion score) based on human vision system model
- IP interface with simultaneous Generation/Capture and 2-Ch capture
- Picture quality measurements can be made on a variety of UHDTV1/4K formats (3840x2160), HD video formats (1080p, 1080i, 720p) and SD video formats (525i or 625i)
- User-configurable viewing condition and display models for reference and comparison
- Attention/Artifact weighted measurement
- Region of interest (ROI) on measurement execution and review
- Automatic temporal and spatial alignment
- Embedded reference decoder
- Easy regression testing and automation using XML scripting with "Export/Import" file from GUI
- Multiple results view options
- Embedded sample reference and test sequences
- Wide variety of file format support including YUV 4:2:0 planar 10 bit, which is in the uncompressed file generated by the Telestream MTSA ESA when decoding a HEVC Main 10 profile stream

Compressed video requires new test methods

The true measure of any television system is viewer satisfaction. While the quality of analog and full-bandwidth digital video can be characterized indirectly by measuring the distortions of static test signals, compressed television systems pose a far more difficult challenge. Picture quality in a compressed system can change dynamically based on a combination of data rate, picture complexity, and the encoding algorithm employed. The static nature of test signals does not provide true characterization of picture quality.

Human viewer testing has been traditionally conducted as described in ITUR Rec. BT.500-11. A test scene with natural content and motion is displayed in a tightly controlled environment, with human viewers expressing their opinion of picture quality to create a Differential Mean Opinion Score, or DMOS. Extensive testing using this method can be refined to yield a consistent subjective rating.

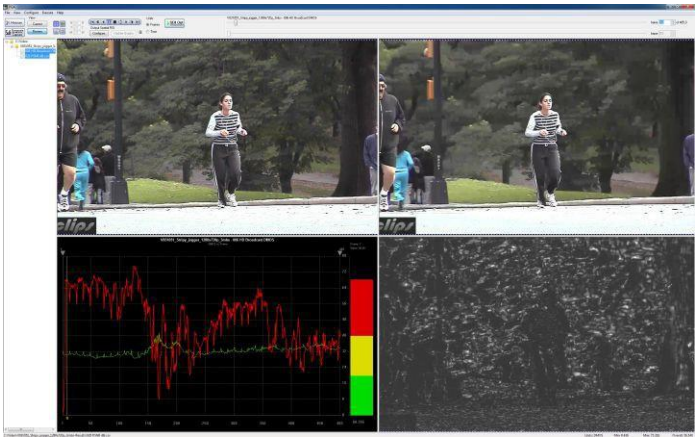
However, this method of evaluating the capabilities of a compressed video system can be inefficient, taking several weeks to months to perform the experiments. This test methodology can be extremely expensive to complete, and often the results are not repeatable. Thus, subjective DMOS testing with human viewers is impractical for the CODEC design phase, and inefficient for ongoing operational quality evaluation. The PQA provides a fast, practical, repeatable, and objective measurement alternative to subjective DMOS evaluation of picture quality.

System evaluation

The PQA can be used for installation, verification, and troubleshooting of each block of the video system because it is video technology agnostic: any visible differences between video input and output from processing components in the system chain can be quantified and assessed for video quality degradation. Not only can CODEC technologies be assessed in a system, but any process that has potential for visible differences can also be assessed. For example, digital transmission errors, format conversion (i.e. 1080i to 480p in set-top box conversions), analog transmission degradation, data errors, slow display response times, frame rate reduction (for mobile transmission and videophone teleconferencing), and more can all be evaluated.

How it works

The PQA takes two video files as inputs: a reference video sequence and a compressed, impaired, or processed version of the reference. First, the PQA performs a spatial and temporal alignment between the two sequences, without the need for a calibration stripe embedded within the video sequence. Then the PQA analyzes the quality of the test video, using measurements based on the human vision system and attention models, and then outputs quality measurements that are highly correlated with subjective assessments.



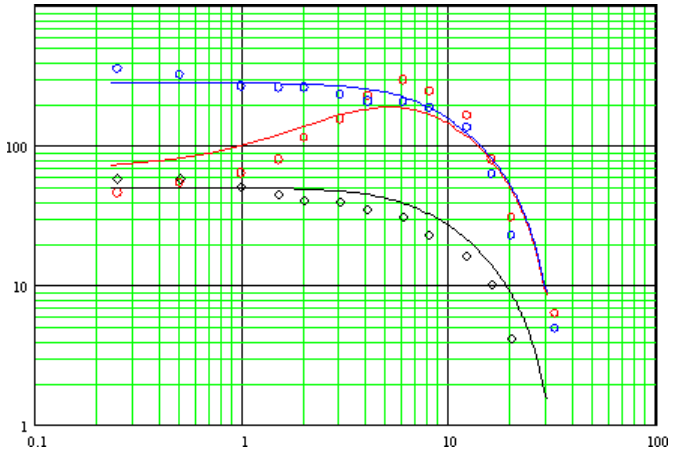
User interface of PQA showing reference, test sequences, with difference map and statistical graph

The results include overall quality summary metrics, frame-by-frame measurement metrics, and an impairment map for each frame. The PQA also provides traditional picture quality measures such as PSNR (Peak Signal-to-Noise Ratio) as an industry benchmark impairment diagnosis tool for measuring typical video impairments and detecting artifacts.

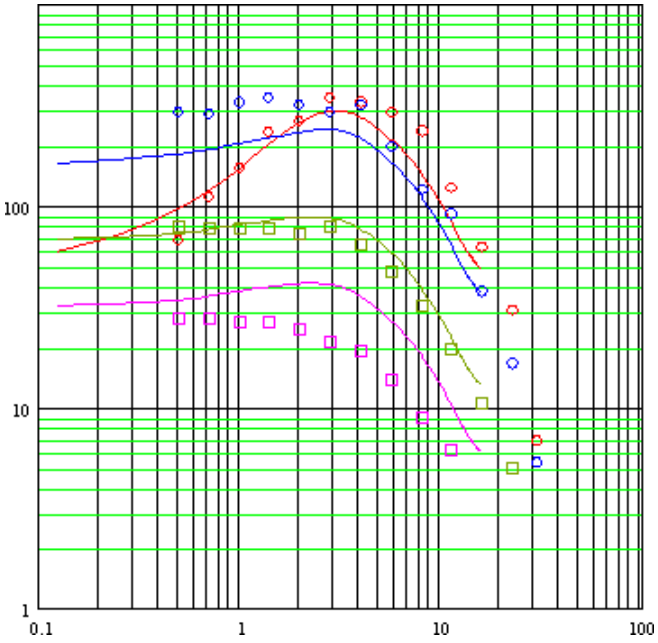
Each reference video sequence and test clip can have different resolutions and frame rates. This capability supports a variety of repurposing applications such as format conversion, DVD authoring, IP broadcasting, and semiconductor design. The PQA can also support measurement clips with long sequence duration, allowing a video clip to be quantified for picture quality through various conversion processes.

Prediction of the human vision perception

PQA measurements are developed from the human vision system model. The technology takes into consideration different display types used to view the video (for example, interlaced or progressive and CRT or LCD) and different viewing conditions (for example, room lighting and viewing distance).



A: Modulation sensitivity vs. temporal frequency



B: Modulation sensitivity vs. spatial frequency

A model of the human vision system has been developed to predict the response to light stimulus with respect to the following parameters:

- Contrast including supra-threshold
- Mean luminance
- Spatial frequency
- Temporal frequency
- Angular extent
- Temporal extent
- Surround
- Eccentricity
- Orientation
- Adaptation effects

This model has been calibrated, over the appropriate combinations of ranges for these parameters, with reference stimulus-response data from vision science research. As a result of this calibration, the model provides a highly accurate prediction. The graphs above are examples of scientific data regarding human vision characteristics used to calibrate the human vision system model in the PQA. Graph (A) shows modulation sensitivity vs. temporal frequency, and graph (B) shows modulation sensitivity vs. spatial frequency. The use of over 1400 calibration points supports high-accuracy measurement results.

C: Reference picture

D: Perceptual contrast map

Picture (C) is a single frame from the reference sequence of a moving sequence, and picture (D) is the perceptual contrast map calculated by the PQA. The perceptual contrast map shows how the viewer perceives the reference sequence. The blurring on the background is caused by temporal masking due to camera panning and the black area around the jogger shows the masking effect due to the high contrast between the background and the jogger. The PQA creates the perceptual map for both reference and test sequences, then creates a perceptual difference map for use in making perceptually based, full-reference picture quality measurements.

Comparison of predicted DMOS with PSNR

In the examples, Reference (E) is a scene from one of the VClips library files. The image Test (F), has been passed through a compression system which has degraded the resultant image. In this case, the background of the jogger in Test (F) is blurred compared to the Reference image (E).

E: Reference picture

F: Test picture

A PSNR measurement is made on the PQA of the difference between the Reference and Test clip. The highlighted white areas of PSNR Map (G) shows the areas of greatest difference between the original and degraded image.

G: PSNR map

Another measurement is then made by the PQA, this time using the Predicted DMOS algorithm and the resultant Perceptual Difference Map for DMOS (H) image is shown. Whiter regions in this Perceptual Contrast Difference map indicate greater perceptual contrast differences between the reference and test images.

In creating the Perceptual Contrast Difference map, the PQA uses a human vision system model to determine the differences a viewer would perceive when watching the video.

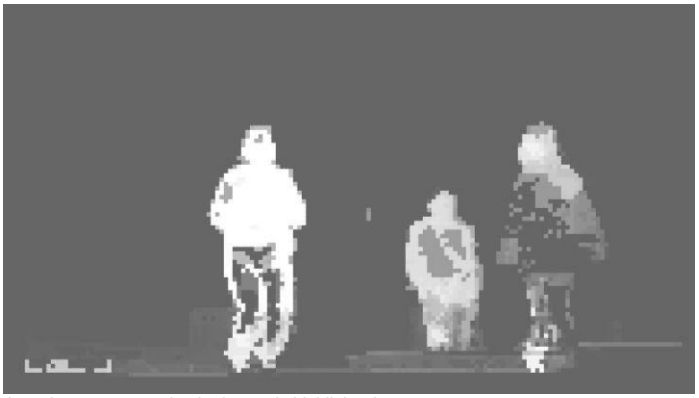
H: Perceptual difference map for DMOS

The Predicted DMOS measurement uses the Perceptual Contrast Difference Map (H) to measure picture quality. This DMOS measurement would correctly recognize the viewers perceive the jogger as less degraded than the trees in the background. The PSNR measurement uses the difference map (G) and would incorrectly include differences that viewers do not see.

Attention model

The PQA also incorporates an attention model that predicts focus of attention. this model considers:

- Motion of objects
- Skin coloration (to identify people)
- Location
- Contrast
- Shape
- Size
- Viewer distraction due to noticeable quality artifacts



Attention map example: the jogger is highlighted

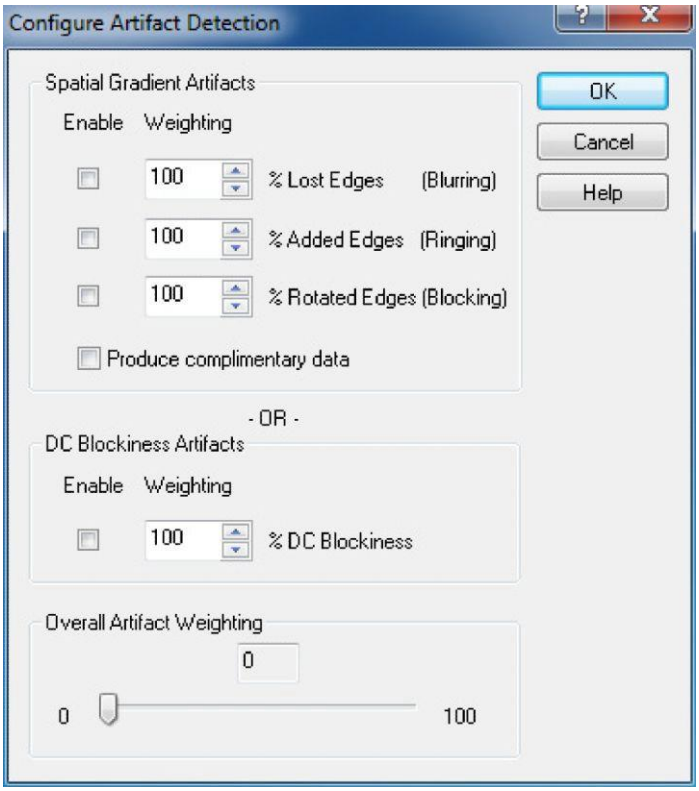
These attention parameters can be customized to give greater or less importance to each characteristic. This allows each measurement using an attention model to be user-configurable. The model is especially useful to evaluate the video process tuned to the specific application. For example, if the content is sports programming, the viewer is expected to have higher attention in limited regional areas of the scene. Highlighted areas within the attention image map will show the areas of the image drawing the eye's attention.

Artifact detection

Artifact detection reports a variety of different changes to the edges of the image:

- Loss of edges or blurring
- Addition of edges or Ringing/Mosquito noise
- Rotation of edges to vertical and horizontal or edge blockiness
- Loss of edges within an image block or DC blockiness

They work as weighting parameters for subjective and objective measurements with any combination. The results of these different measurement combinations can help to improve picture quality through the system.



Artifact detectionsettings

For example, artifact detection can help answer questions such as: "Will the DMOS be improved with more de-blocking filtering?" or, "Should less prefiltering be used?"

If edge-blocking weighted DMOS is much greater than blurring-weighted DMOS, the edge-blocking is the dominant artifact, and perhaps more de-blocking filtering should be considered.

In some applications, it may be known that added edges, such as ringing and mosquito noise, are more objectionable than the other artifacts. These weightings can be customized by the user and configured for the application to reflect this viewer preference, thus improving DMOS prediction.

Likewise, PSNR can be measured with these artifact weightings to determine how much of the error contributing to the PSNR measurement comes from each artifact.

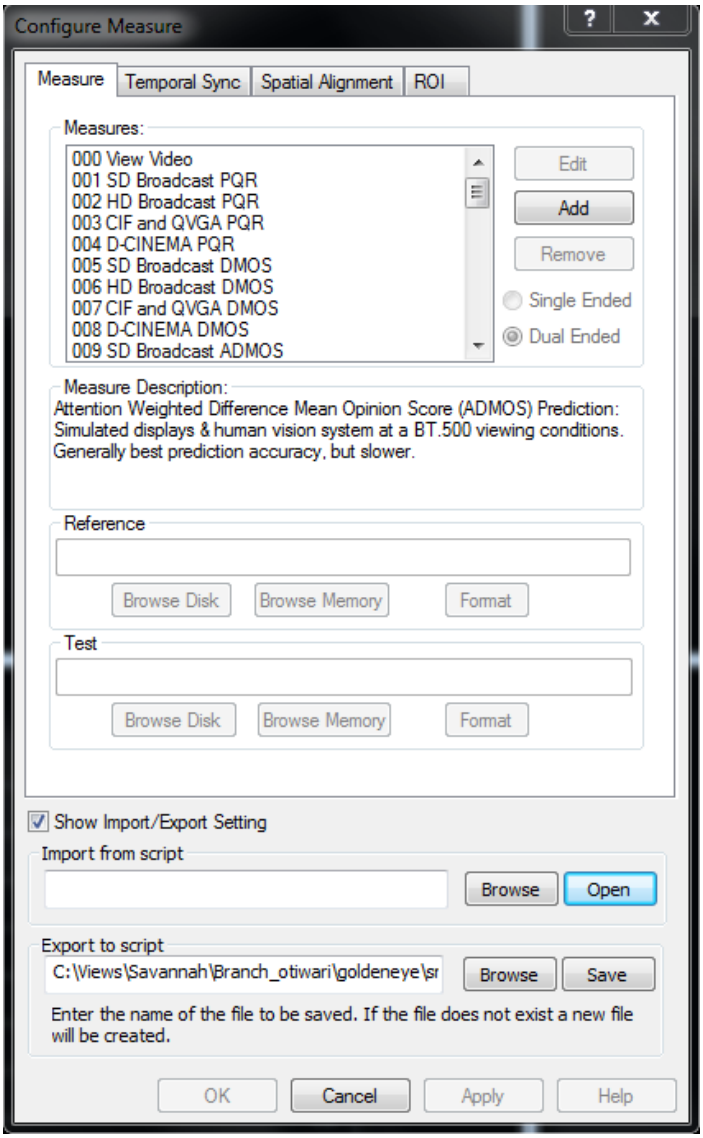
The Attention Model and Artifact Detection can also be used in conjunction with any combination of picture quality measurements. This allows, for example, evaluation of how much of a particular noticeable artifact will be seen where a viewer is most likely to look.

Comprehensive picture quality analysis

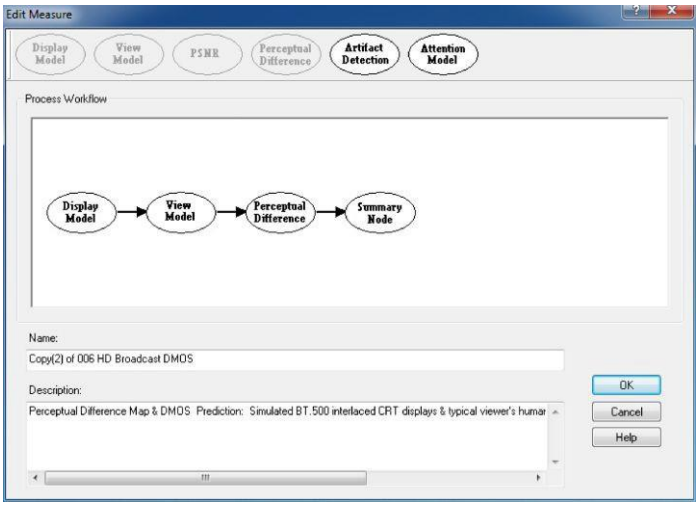
The PQA provides Full Reference (FR) picture quality measurements that compare the luminance signal of reference and test videos. It also offers some No Reference (NR) measurements on the luminance signal of the test video only. Reduced Reference (RR) measurements can be made manually from differences in No Reference measurements. The suite of measurements includes:

- Critical viewing (Human vision system model-based, Full reference) picture quality
- Casual viewing (Attention weighted, Full reference, or No reference) picture quality
- Peak Signal-to-Noise ratio (PSNR, Full reference)
- Focus of attention (Applied to both Full reference and No reference measurements)
- Artifact detection (Full reference, except for DC blockiness)
- DC blockiness (Full reference and No reference)

The PQA supports these measurements through preset and user-defined combinations of display type, viewing conditions, human vision response (demographic), focus of attention, and artifact detection, in addition to the default ITU BT-500 conditions. The ability to configure measurement conditions helps CODEC designers evaluate design trade-offs as they optimize for different applications, and helps any user investigate how different viewing conditions affect picture quality measurement results. A user-defined measurement is created by modifying a preconfigured measurement or creating a new one, then saving and recalling the user-defined measurement from the Configure Measure dialog menu.



Configure measure dialog



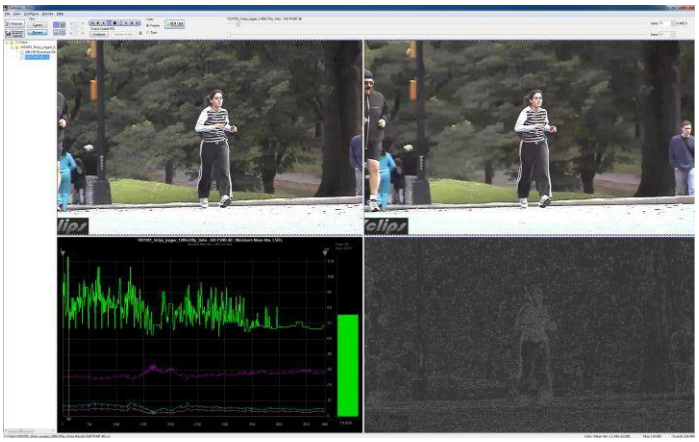
Edit measure dialog

Easy-to-use interface

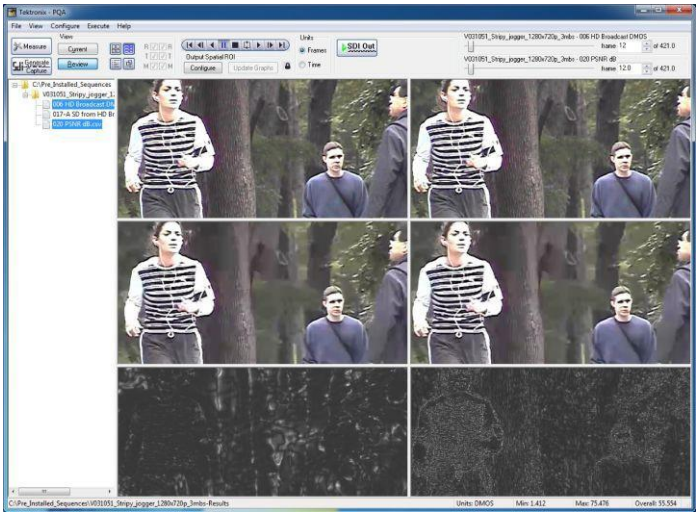
The PQA has two modes: Measurement and Review. The Measurement mode is used to execute the measurement selected in the Configure Dialog. During measurement execution, the summary data and map results are displayed on-screen and saved to the system hard disk. The Review mode is used to view previously saved summary results and maps created either with the measurement mode or XML script execution. The user can choose multiple results in this mode and compare each result side by side using the synchronous display in Tile mode. Comparing multiple results maps made with the different CODEC parameters and/or different measurement configurations enables easy investigation of the root cause of any difference.

Multiple result display

Resultant maps can be displayed synchronously with the reference and test video in a summary, six-tiled, or overlaid display.


Integrated graph

In Summary display, the user can see the multiple measurement graphs with a barchart along with the reference video, test video, and difference map during video playback. Summary measures of standard parameters and perceptual summation metrics for each frame and overall video sequence are provided.


Six-tiled display

In Six-tiled display, the user can display the two measurement results side by side. Each consists of a reference video, test video, and difference map to compare to each other.

Overlay display, reference and map

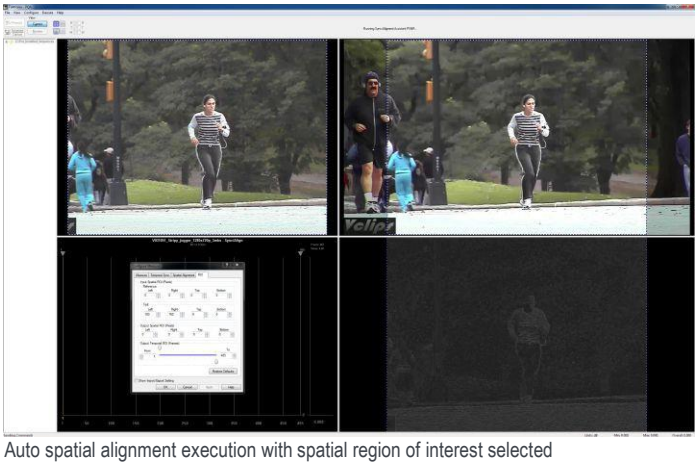
In Overlay display, the user can control the mixing ratio with the fader bar, enabling co-location of difference map, reference, and impairments in test videos.

Error logging and alarms are available to help users efficiently track down the cause of video quality problems.

All results, data, and graphs can be recalled to the display for examination.

Automatic temporal/spatial alignment

The PQA supports automatic temporal and spatial alignment, as well as manual alignment.



Auto spatial alignment execution with spatial region of interest selected

The automatic spatial alignment function can measure the cropping, scale, and shift in each dimension, even across different resolutions and aspect ratios. If extra blanking is present within the standard active region, it is measured as cropping when the automatic spatial alignment measurement is enabled.

The spatial alignment function can be used when the reference video and test video both have progressive content. In the case where the reference video and test video have content with different scanning (interlace versus progressive or vice versa), the full reference measurement may not be valid. In the case where the reference video and test video both have interlaced content, the measurement is valid when spatial alignment is not needed to be set differently from the default scale and shift.

Region of interest (ROI)

There are two types of spatial/temporal Region of Interest (ROI): Input and Output. Input ROIs are used to eliminate spatial or temporal regions from the measurement which are not of interest to the user. For example, Input Spatial ROI is used when running measurements for reference and test videos which have different aspect ratios. Input Temporal ROI, also known as temporal sync, is used to execute measurements just for selected frames and minimize the measurement execution time.

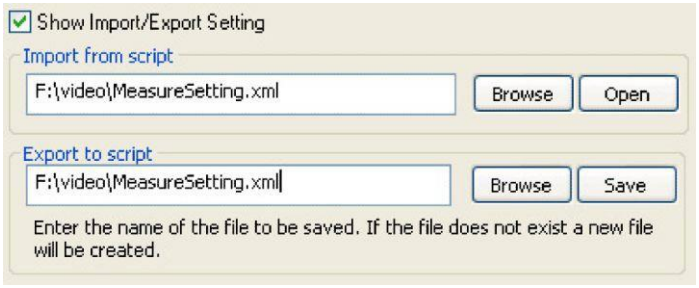
Output spatial ROI on review mode for in-depth investigation

Output ROIs can be used to review precalculated measurement results for only a subregion or temporal duration. Output Spatial ROI is instantly selected by mouse operation and gives a score for just the selected spatial area. It's an effective way to investigate a specific spatial region in the difference map for certain impairments. Output Temporal ROI is set by marker operation on the graph and allows users to get a result for just a particular scene when the video stream has multiple scenes. It also allows users to provide a result without any influence from initial transients in the human vision model. Each parameter can be embedded in a measurement for the recursive operation.

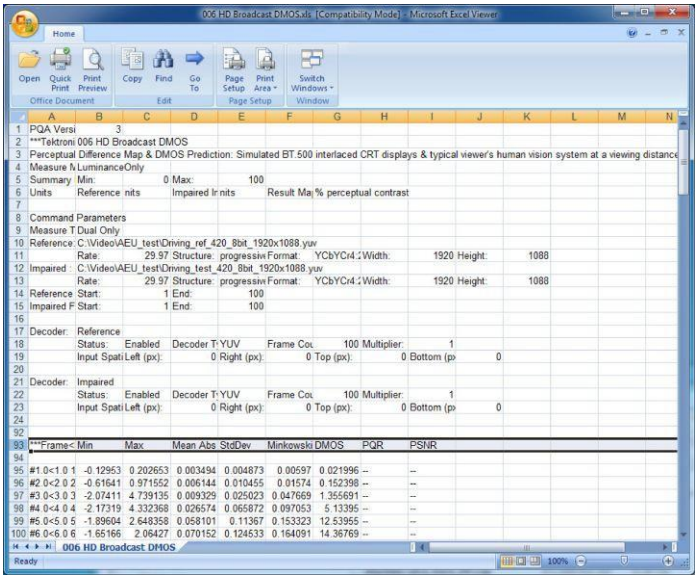
Automated testing with XML scripting

In the CODEC debugging/optimizing process, the designer may want to repeat several measurement routines as CODEC parameters are revised. Automated regression testing using XML scripting can ease the restrictions of manual operation by allowing the user to write a series of measurement sequences within an XML script. The script file can be exported from or imported to the measurement configuration menu to create and manage the script files easily. Measurement results of the script operation can be viewed by using either the PQA user interface or any spreadsheet application that can read the created .csv file format as a summary. Multiple scripts can be executed simultaneously for faster measurement results.

Script sample



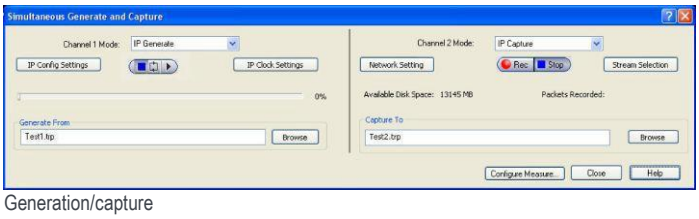
Import/Export script in configure measure dialog



Result file sample

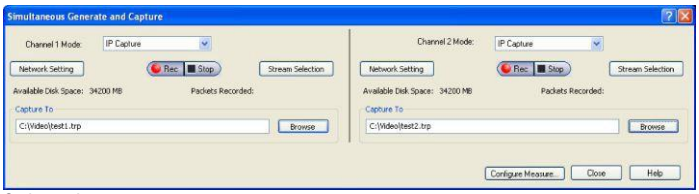
IP interface

The IP interface enables both generation and capture of compressed video with two modes of simultaneous operation.



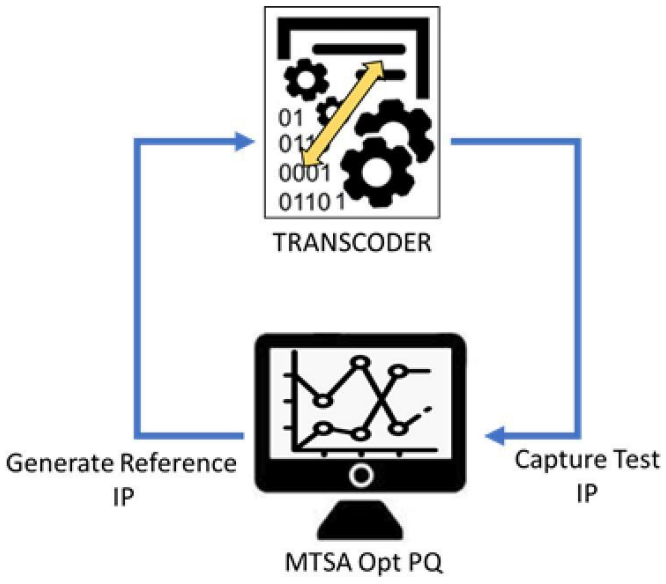
Generation/capture

Simultaneous generation and capture lets the user playout the reference video clips directly from an IP port in the PC into the device under test. The test output from the device can then be simultaneously captured by the PC. This saves the user from having to use an external video source to apply any required video input to the device under test. With this generation capability, files created by video editing software can be directly used as reference and test sequences for picture quality measurements.



2-channel capture

Simultaneous 2-channel capture lets the user capture two live signals to use as reference and test videos in evaluating the device under test in operation. In both modes, the captured compressed stream will be decoded to the uncompressed file by the embedded reference decoder, and the user can run the picture quality measurement without any additional tool or manual processes.



Supported file formats for IP interface

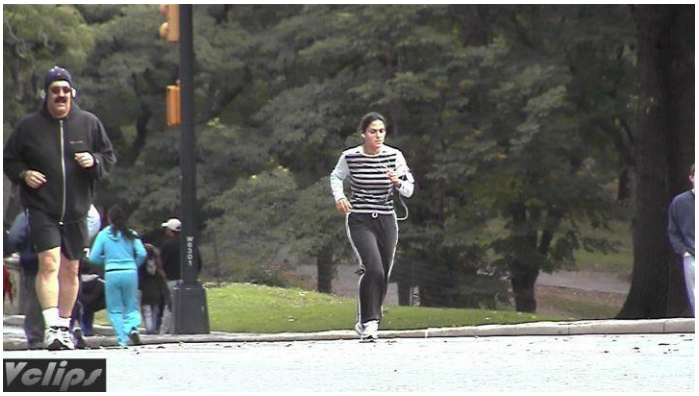
The IP interface option can generate and capture compressed files in compliance with ISO/IEC 13818-1 (TS support over UDP).

IGMP support

IGMP support in IP capture will make stream selection simple at multicast streaming. The compressed video file captured through IP will be converted to an uncompressed file by an internal embedded decoder.

Embedded sample video files

The user can run the measurement with the embedded sample video file when the software is invoked without valid option key code or dongle.



Jogger video file

Avenue video file

Video	Description
Jogger	Reference, 320×180, 1 mb/s, 2 mb/s
Avenue	Reference, 320×180, 1 mb/s, 2 mb/s

Support file formats for measurement

All formats support 8 bit unless otherwise stated:

- .yuv (UYVY, YUY2, YUV4:4:4, YUV 4:2:0 planar 8/10 bit)
- .v210 (10 bit, UYVY, 3 components in 32 bits)
- .rgb (BGR24, GBR24)
- .avi (uncompressed, BGR32 (discard alpha channel) / BGR24 / UYVY / YUY2 / v210)
- ARIB ITE format (4:2:0 planar with 3 separate files (.yyy))
- .vcap (created by PQA600A, PQA600B or PQA600C SDI video capture)
- .vcap10 (10 bit, created by PQA600A, PQA600B or PQA600C video capture)

The following compressed files are internally converted to an uncompressed file before measurement execution. The format support listed here is available in software version 4.0 and later.

Format	ES	ADF	MP4	3GPP	Quicktime	MP2 PES	MP2 PS	MP2 TS	MXF	GXF	AVI	LXF
H263	X		X	X	X						X	
MP2	X				X	X	X	X	X	X	X	X
MP4	X		X	X	X						X	X
H264/AVC	X		X	X	X	X	X	X	X		X	X
DV	X				X				X	X	X	X
VC-1	X	X									X	
ProRes					X							
Quicktime			X	X	X							
JPEG2000	X		X	X	X				X			
VC3/ DNxHD	X		X	X	X				X			
Raw	X										X	X

Preconfigured measurements set

Subjective prediction: Full reference

Noticeable differences

SD display and viewing measurement class

"001 SD Broadcast PQR"measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default weightings	PQR Units

HD display and viewing measurement class

"002 HD Broadcast PQR"measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default weightings	PQR Units

CIF display and viewing measurement class

"003 CIF and QVGA PQR" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Typical	NA	Default weightings	PQR Units

D-CINEMA Projector and viewing measurement class

"004 D-CINEMA PQR" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
DMD Projector	3 scrn heights, . 1 cd/m^2	NA	Typical	NA	Default weightings	PQR Units

Subjective rating predictions

SD display and viewing measurement class

"005 SD Broadcast DMOS"measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

HD display and viewing measurement class

"006 HD Broadcast DMOS"measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

CIF display and viewing measurement class

"007 CIF and QVGA DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

D-CINEMA Projector and viewing measurement class

"008 D-CINEMA DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
DMD Projector	3 scrn heights, . 1 cd/m^2	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

Attention biased subjective rating predictions

SD display and viewing measurement class

"009 SD broadcast ADMOS"measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

HD display and viewing measurement class

"010 HD Broadcast ADMOS"measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

CIF display and viewing measurement class

"011 CIF and QVGA ADMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
CIF/QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Typical	NA	Default weightings	DMOS Units Re: BT.500 Training

SD sports measurement class "012 SD Sports Broadcast ADMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Motion and Foreground Dominant	DMOS Units Re: BT.500 Training

HD sports measurement class "013 HD Sports Broadcast ADMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
HD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Motion and Foreground Dominant	DMOS Units Re: BT.500 Training

SD talking head measurement class "014 SD Talking Head Broadcast ADMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD Broadcast CRT	(ITU-R BT.500)	NA	Typical	NA	Motion and Foreground Dominant	DMOS Units Re: BT.500 Training

Repurposing: reference and test are independent Use any combination display model and viewing conditions with each measurement.

Format conversion: cinema to SD DVD measurement class "015 SD DVD from D-Cinema DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
DMD projector and SD CRT	7 scrn heights, 20 cd/m^2 and (ITU-R BT.500)	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training

Format conversion: SD to CIF measurement class "016 CIF from SD Broadcast DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
LCD and SD Broadcast CRT	7 scrn heights, 20 cd/m^2 and (ITU-R BT.500)	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training

Format conversion: HD to SD measurement class "017 SD from HD Broadcast DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD and HD Broadcast CRT	(ITU-R BT.500)	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training

Format conversion: SD to HD measurement class "017-A SD from HD Broadcast DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
SD and HD Progressive CRT	(ITU-R BT.500)	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training

Format conversion: CIF to QCIF measurement class "018 QCIF from CIF and QVGA DMOS" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
QCIF and CIF/ QVGA LCD	7 scrn heights, 20 cd/m^2	NA	Expert	NA	NA	DMOS Units Re: BT.500 Training

Attention

Attention measurement class "019 Stand-alone Attention Model" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	NA	NA	NA	NA	Default weightings	Map units: % Probability of focus of attention

Objective measurements: Full reference

General difference

PSNR measurement class "020 PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	NA	NA	dB units

Artifact measurement

Removed edges measurement class "021 Removed Edges Percent" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	NA	NA	Blurring	NA	%

Added edges measurement class "022 Added Edges Percent" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	NA	NA	Ringing / Mosquito Noise	NA	%

Rotated edges measurement class "023 Rotated Edges Percent" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	NA	NA	Edge Blockiness	NA	%

% of original deviation from block DC measurement class "024 DC Blocking Percent" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	NA	NA	DC Blockiness	NA	%

Artifact classified (filtered) PSNR

Removed edges measurement class

"025 Removed Edges Weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	Blurring	NA	dB units

Added edges measurement class

"026 Added Edges Weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	Ringing / Mosquito Noise	NA	dB units

Rotated edges measurement class

"027 Rotated Edges Weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	Edge Blockiness	NA	dB units

% of original deviation from block DC measurement class

"028 DC Blocking Weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	DC Blockiness	NA	dB units

Artifact annoyance weighted (filtered) PSNR

PSNR with default artifact annoyance weights measurement class

"029 Artifact Annoyance Weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units

Repurposing:

Use View model to resample, shift, and crop test to map to measurement

Format conversion: Cinema to SD DVD measurement class

"030 SD DVD from D-Cinema Artifact weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units

Format conversion: SD to CIF measurement class

"031 CIF from SD Broadcast Artifact weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units

Format conversion: HD to SD measurement class

"032 SD from HD Broadcast Artifact weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units

Format conversion: CIF to QCIF measurement class

"033 QCIF from CIF and QVGA Artifact weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	Auto-align spatial	Selected	NA	All artifacts selected	NA	dB units

Attention weighted objective measurements

General differences

PSNR measurement class

"034 Attention Weighted PSNR dB" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	NA	Selected	NA	NA	Default weightings	dB units

Objective measurements: No reference

Artifact

Artifact measurement class

"035 No Reference DC Blockiness Percent" measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
NA	NA	NA	NA	No-reference DC block	NA	% DC blockiness

Subjective prediction calibrated by subjective rating

Conducted in 2009 with 1080i29 Video Contents and H.264 CODEC (Refer to application note 28W-24876-0) 036 HD PQR ITU-BT500 with Interlaced CRT measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
Custom HD CRT	3 scrn heights	NA	Custom	NA	NA	PQR units

37 HD DMOS ITU-BT500 with Interlaced CRT measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
Custom HD CRT	3 scrn heights	NA	Custom	NA	NA	DMOS Units Re:BT. 500 Training

38 HD ADMOS ITU-BT500 with Interlaced CRT measurement

Display model	View model	PSNR	Perceptual difference	Artifact detection	Attention model	Summary node
Custom HD CRT	3 scrn heights	NA	Custom	NA	Typical	DMOS Units Re:BT. 500 Training

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

MTSA-HW platform characteristics

Operating system	Windows 10 Enterprise 2016 LTSB, 64 bit
Processor	Intel i7-7700T
Hard disk drive	500 GB SSD (Solid State Drive)
RAM	16 GB
Display	User selectable
Ethernet	Ethernet 10/100/1000 (GigE) for video input; identical port for control

MTSA-PC and Option PQ minimum platform requirements

Operating system	Windows 10 Enterprise 2016 LTSB, 64 bit
Processor	Intel i7-7700T
Hard disk drive	500 GB SSD (Solid State Drive)
RAM	16 GB
Display	User selectable
Ethernet	Ethernet 10/100/1000 (GigE) for video input

Multiport ASI interface characteristics (Option ASI)

Connector	BNC (×4) 75 Ω transformer-coupled input and output 800 mV ±10% into 75 Ω load output 200 mV to 880 mV input Return loss less than –17 dB (5 MHz to 270 MHz) into a 75 Ω load
Bit rate	250 Kb/s to 214 Mb/s (in accordance DVB specification maximum) Input and output aggregate bit rate (simplex or duplex operation)

SDR RF interface characteristics (Option SDR)

Connector	F-type female, 75 Ω
Input sensitivity	–90 to –20 dBm
Input return loss	>8 dB
SNR (Signal to Noise Ratio)	50 dB
MER (Modulation Error Ratio)	10 dB to 42 dB ± 2 dB
RF level	–90 dBm to –20 dBm ± 3 dB
Modulation standards supported	8VSB, ISDB-T, QAM-A/B/C, DVB-T

10G interface characteristics

Ethernet ports	Dual 10G-BASE
Port options	Standard Dual SFP plus Short Wavelength Optical port with LC connector for 10 Gb Ethernet interface (Multi Mode 850 nm)
Maximum data rate	600 Mb/s

Dual input DVB-S/S2 interface characteristics (Option DS2)

Input frequency range	950-2150 MHz (center frequency), step size of 1 MHz
Input signal amplitude range	–60 dBm to –30 dBm
Modulation format	DVB-S QPSK DVB-S2 QPSK, 8PSK, 16APSK, and 32APSK
Symbol rate	2-40 MSps
FEC modes	S1 QPSK: 1/2, 2/3, 3/4, 5/6, 7/8 S2 QPSK: 1/4, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 S2 8PSK: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10 S2 16APSK: 2/3, 3/4, 4/5, 5/6, 8/9, 9/10 S2 32APSK: 3/4, 4/5, 5/6, 8/9, 9/10
Roll off	DVB-S: 35% DVB-S2: 20%, 25%, 35%
Connector style	F-type
Input termination impedance	75 Ω
Input return loss	>10 dB @ 0 to 1 GHz >4 dB @ 1 to 2 GHz
LNB power	Off, 13 V, 14 V, 18 V, 19 V (DC)

Dual input DVB-S/S2 interface characteristics (Option DS2)

LNB supply maximum current	150 mA
LNB 22 kHz signaling frequency	On or Off
LNB 22 kHz signaling amplitude	DiSEqC compliant (0.65 V_{p-p} typical)
Ultimate MER (Modulation Error Ratio), with Equalizer	0 to 40 dB
Measurements	
RF Lock	RF lock is indicated by a LED on the rear panel and a status indicator on the UI
Input Level	Range: –60 dBm to –30 dBm
Signal Strength	Resolution: 0.1 dBm
MER (Modulation Error Ratio) with Equalizer	Display Range: 0 dB to 40 dB with equalizer Resolution: 0.1 dB
CNR (Carrier-to-Noise Ratio)	Display Range: 0 dB to 40 dB Resolution: 0.1 dB
SNR (Signal-to-Noise Ratio)	Display Range: 0 dB to 40 dB Resolution: 0.1 dB
Pre-Viterbi BER	Pre-Viterbi BER displayed
Pre-Reed Solomon (RS) BER	Pre-RS BER displayed
Pre-LDPC BER	Pre-LDPC BER displayed
Pre-BCH BER	Pre-BCH BER displayed
Post-RS BER and TEF (Transport Error Flag)	Post Reed Solomon BER (TEF ratio), TEF rate, and number of Transport Error Flags (TEF count) displayed to the user
Transmission Parameters	All coding and modulation parameters are indicated to the user in the UI; Transport Stream monitor must be tuned to a valid Transport Stream in order to report RF transmission parameters
Constellation	The RF constellation is displayed on the UI

Physical characteristics

Height	4.45 cm (1.75 in)
Width	48.26 cm (19.00 in)
Depth	45.72 cm (18.00 in)
Weight, net	3.9 kg (8.7 lbs.)

Environmental characteristics

Source voltage	100 to 240 VAC ±10%
Frequency	50 to 60 Hz
Consumption	100 W (typical) 200 W (maximum)

Ordering information

Models

MTSA-HW	MPEG test system incorporating 1RU 19" full rack platform. This includes: GbE (NIC) interface.
MTSA-PC	MPEG test system standalone software. Requires options to be enabled.

Instrument options

MTSA-HW standard options

Hardware options

MTSA-HW ASI	Add multiport ASI interface.
MTSA-HW 10GS	Add 10 Gbase-SR dual optical port 10 Gb/s NIC. Includes short reach SFP + modules (850 nm).
MTSA-HW SDR	Add multifunction SDR RF interface. with support for DVB-T, ISDB-T/Tb, QAM A/B/C and 8VSB. Includes level, BER, MER, constellation points.
MTSA-HW DS2	Add dual input DVB-S/S2 interface. Card supports dual port QPSK/8PSK or single port 16APSK/32APSK demodulation. Includes level, BER, MER, SNR, constellation points.
MTSA-HW RACK	Add MTSA rackmount kit. Includes rackmount slides and rails.

Software options

MTSA-HW TSCA **MTSA-PC TSCA**	Add real and deferred time Transport Stream Compliance Analyzer. includes real and deferred time TSCA for MPEG-2, ATSC1.0, DVB, ISDB-S, ISDB-T, ISDB-TB. Compliance for MPEG-2, DSM-CC, DVB (INC. MHP), DTT(MHEG-5), and ARIB. Closed Caption analysis, rendering and alignment to CEA608, CEA708 and SCTE20/21 control commands.
MTSA-HW MUX **MTSA-PC MUX**	Add Stream Multiplexer and Generator. Includes TS and ISDB-T/Tb Multiplexer, ISDB-T Remux, TS Editor, Make Seamless, and Tclips Test Streams; also includes HEVC stream generation capabilities.
MTSA-HW ESA **MTSA-PC ESA**	Add elementary stream analyzer. Includes support for VC1, AVC/H.264, MPEG-4, MPEG-2, H.263, HEVC/H.265. Closed Caption analysis, rendering and alignment to CEA608, CEA708 and SCTE20/21 control commands.
MTSA-HW PBUFFA **MTSA-PC PBUFFA**	Add PES and T-STD Buffer Analyzers; includes HEVC buffer analysis and PES with AVC, HEVC and AC-3 codec analysis.
MTSA-HW PQ **MTSA-PC PQ**	Add Picture Quality Analysis Software, Single and Double Ended. Includes the PQA software with Option ESA to enable conversion of VC1, AVC/H.264, HEVC/H.265 source files to YUV for PQ Analysis.
MTSA-HW ALZRPK **MTSA-PC ALZRPK**	Add Analyzer Software Bundle. Includes TSCA, ESA, MUX and PBUFFA.

MTSA-UP field upgrade options

Hardware upgrades

Can be applied only to previously purchased MTSA-HW products.

MTSA-UP ASI	Add multiport ASI interface.
MTSA-UP 10GS	Add 10Gbase-SR dual optical port 10Gb/s NIC. Includes short reach SFP+ modules (850 nm).
MTSA-UP SDR	Add multifunction SDR RF interface. with support for DVB-T, ISDB-T/Tb, QAM A/B/ C and 8VSB. Includes level, BER, MER, constellation points.
MTSA-UP DS2	Add dual input DVB-S/S2 interface. Card supports dual port QPSK/8PSK or single port 16APSK/32APSK demodulation. Includes level, BER, MER, SNR, constellation points.
MTSA-UP RACK	Add MTSA rackmount kit. Includes rackmount slides and rails .

Software upgrades

Can be applied only to previously purchased MTSA-HW or MTSA-PC products.

MTSA-UP TSCA	Add real and deferred time Transport Stream Compliance Analyzer. includes real and deferred time TSCA for MPEG-2, ATSC1.0, DVB, ISDB-S, ISDB-T, ISDB-TB. Compliance testing for MPEG-2, DSM-CC, DVB (INC. MHP), DTT (MHEG-5), and ARIB. Closed Caption analysis, rendering and alignment to CEA608, CEA708 and SCTE20/21 control commands.
MTSA-UP MUX	Add Stream Multiplexer and Generator. Includes TS and ISDB-T/Tb Multiplexer, ISDB-T Remux, TS Editor, Make Seamless, and Tclips Test Streams; also includes HEVC stream generation capabilities .
MTSA-UP ESA	Add elementary stream analyzer. Includes support for VC1, AVC/H.264, MPEG-4, MPEG-2, H.263, HEVC/H.265. Closed Caption analysis, rendering and alignment to CEA608, CEA708 and SCTE20/21 control commands.
MTSA-UP PBUFFA	Add PES and T-STD Buffer Analyzers; includes HEVC buffer analysis and PES with AVC, HEVC and AC-3 codec analysis.
MTSA-UP PQ	Add Picture Quality Analysis Software, Single and Double Ended. Includes the PQA software with Option ESA to enable conversion of VC1, AVC/H.264, HEVC/H. 265 source files to YUV for PQ Analysis
MTSA-UP ALZRPK	Add Analyzer Software Bundle. Includes TSCA, ESA, MUX and PBUFFA

Service options

There are a variety of service and repair option available for this product. Contact Telestream for further information.

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For Further Information. Telestream maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.telestream.net/video for sales and support contacts.

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