MPEG Test System

AD953A

Features & Benefits

MPEG, DVB, ATSC, and ISDB Compliance Testing

In Depth Off-line Analysis Capability to Solve Problems and Isolate Faults Quickly

Real-time Monitoring to TR 101 290 with Powerful Trigger Mode to Track Down Operational Faults Quickly

Real-time and Deferred Time Transport Stream Timing Measurements Including PCR Arrival Interval, PCR Accuracy (PCR_AC), PCR Overall Jitter (PCR_OJ), PCR Arrival Time (network jitter), PCR Frequency Offset (PCR_FO), and Deferred Time Drift Rate (PCR_DR) Measurement and Graphing

Stream Playout and Recording Provides Repeatable Test Source and Capture Capability for the Development Environment

Easy-to-Interpret Detailed Graphical Display of Real-time and Off-line Analysis Tools

Wide Range of Industry Standard Interfaces for Plug-and-Play Connectivity

Modular Design Allows You to Purchase Only the Performance You Require Today

Easy to Upgrade for Changing Needs

Portable Platform with Hi Resolution Integrated Display

Stream Playout and Recording

Continuous playout of looped streams with automatic updating of time stamps.

Transport stream recording with packet arrival time information stored for off-line timing analysis.

Simultaneous play and record (option).

Real-time Monitoring

PID and program-oriented dynamic bar graphs and pie charts.

Moving PCR timing, TS rate and fullness plots.

Display of PSI/SI/PSIP information.

Flexible trigger-based capture of errors.

Extensive logging with colored fault identifiers.

TR 101 290 and ATSC compliance checks.

Applications

Development

Production

Transmission
- Satellite
- Cable
- Terrestrial

Tektronix
Enabling Innovation

Detailed Graphical Display and Off-line Testing of:

PSI/SI/PSIP tables with Huffman decoding.

Transport stream and PES packets.

T-STD buffer analysis including AC-3 audio.

PCR/PTS/DTS timestamps.

GOP (Group Of Picture), slice, macroblock and motion vector with MPEG/AC-3 audio information (option).

Stream Creation and Manipulation

Multiplexer/Demultiplexer to create multi-program transport streams with custom SI for both DVB and ATSC.

Stream cutter, Packet editor and PSI/SI/PSIP editor.

Carousel Analysis and Generation

DVB Data and Object carousel analysis including display of AIT tables and ARIB B15/B24 Data Carousel Analysis (option).

Creation and Multiplexing of Object Carousels for Multimedia Home Platform (MHP) and interactive TV test applications (option).

Interfaces

Wide range of interfaces including DVB-SPI (standard) and options for ASI, DHEI, M2S, SMPTE 310M.

Uses

Development

In the development environment the AD953A is a convenient signal source and powerful diagnostic tool. Its ability to play out the same test stream repeatedly provides the stimulus source for developers of integrated receiver decoders (IRD) and modulators.

Calibrated PCR inaccuracy can be added to test the performance of the IRD's clock-recovery phase locked loop.

The ability of the AD953A to capture and analyze long streams allows engineers to rapidly search and identify transport stream packets causing malfunctions in the equipment under test.

Production

In the production environment the AD953A provides a source of repeatable test patterns for the test and alignment of IRDs and modulators. The reliability, embedded diagnostics and modularity of the system provides for the minimum downtime during the unit's working life.

Transmission Monitoring

For program and service providers, the real-time monitoring facility of the AD953A provides confidence that the program material meets the MPEG, DVB, and ATSC standards. It also saves time delays inherent in post-processing and evaluating off-line data.

Test Methods

The AD953A has different ways of presenting the test results to suit users' varied needs:

Real-time Monitor Test Logs (online) – Here as errors are encountered, they are displayed with description in an error log window which scrolls down. This can be accessed locally or from a remote test site and user-programmable color filters can be used to highlight specific errors.

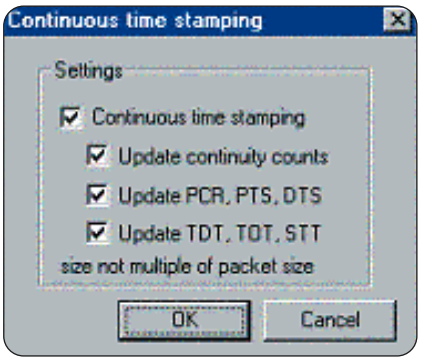
Deferred Test Modes (off-line) – Detailed error logs similar to those above are provided in each of the deferred file-test applications (Transport Stream analyzer, PES analyzer and buffer analyzer). These can all be printed or saved on a disk, along with all the graphical plots.

Regression Test Mode (ES analyzer option) – The elementary stream analyzer has a log window similar to the two above that fills with error reports as the stream is analyzed. Additionally, it has an automated "regression" mode, which will "health-check" the complex video and audio elementary layers to GOP and block levels, operating all menus and tests without any user intervention.

The above test modes have error filters that allow any frequently reported error type to be temporarily removed for reasons of clarity.

Recording and Playout

The AD953A's Player allows record and play at video data rates of up to 87.5 Mb/s through the appropriate interfaces. Recording and playout can be set to handle either 188, 204 or 208 byte packets depending on the interface. Files may be played out once only or continuously looped. Playout begin and end points may be set within a file, not just at the file beginning and end. Automatic determination of clock rate from PCR values in a stored file or the playout rate can be manually selected.



Continuous Time Stamping

Stream Player contains a "Continuous Time-stamping" option. This provides real-time modification to the timing information contained in the source stream during looped playback. This process removes timing discontinuities which would otherwise occur at the loop point.

The following values are modified:

- Continuity count
- PCR, PTS, DTS
- Time Offset Table (TOT), Time and Date Table (TDT), and System Time Table (STT ATSC)

This feature is configurable from the stream player user interface and will operate in real time at the maximum playout rate.

Recording Streams with Time-stamping Information

The AD953A recording application includes support for recording transport streams with time-stamping information. Incoming packets received at the interface are time stamped for use in off-line timing analysis.

Simultaneous Play and Record (duplex option)

This upgrade package includes enhanced hardware with two high-speed SCSI disk drives. This allows simultaneous play and record and gives the AD953A the ability to provide both stimulus and analysis ("loopthrough") in a digital transmission chain. Other uses include file play while recording on another file, to multitask the instrument in a lab development environment.

Editing and Cutting Transport Streams

There are 3 direct stream manipulation packages included, Stream Maker, TS Cutter and TS Editor. These allow stream packet editing using the hexadecimal view and with the header interpreter guide, the user can remap PIDs, recalculate PCR values and deliberately introduce calibrated PCR inaccuracies, following several laws (Gaussian, Random, sine wave, etc.)

See the multiplexer, which follows, for even more sophisticated stream manipulation.

Real-time Monitoring Application

Stream Monitor Plus is a real-time stream monitoring and recording system for MPEG-2, DVB, and ATSC streams. It adds the dimension of "live" stream graphs, bar graphs, and pie charts. This, together with compliance status indicators and logos, further improve the system's ability to pin down errant stream behavior and improve service quality.

Views

Streams Bar – Provides at-a-glance information relating to the current stream, including a digest of the program names, the current bit rate, the stream's mode, and whether the interface is in hardware sync.

Error View – Shows error status panel showing current state of each test, with color coding (green = pass, red = fail, yellow = failure/recovery). Shows a full explanation of each test and a reference to its definition in the appropriate standard. Each test has an adjustable threshold that allows the user to specify, for example, the maximum table repetition interval or maximum PCR inaccuracy that the particular test will allow.

Error LED View – A simplified "at-a-glance" version of above, simulating a LED front panel.

PID View – A bar chart showing:

- Relative multiplex occupancy of each PID present in the stream
- The number, type and bit rate of each PID
- User-defined limits for those PIDs on which limits have been imposed with a color-coded indication of whether these limits have been exceeded

The PIDs are grouped in order, by program, with non-program PIDs at the end. The integration period is 500 ms, and the screen is updated at this rate.

Program View – Like PID view, but instead of a single histogram entry for each PID, a single bar is displayed representing the sum of all the PIDs referenced by each program.

Structure View – A hierarchical display of the syntax of the PSI/SI/PSIP tables and descriptors present in the stream are displayed in a format very similar to that of the MPEG-2, DVB, and ATSC standards and their derivatives. The view can be quickly updated by the user and saved into a text file preserving the indentation.

PCR Measurements – Six PCR measurements are made:

- PCR Arrival Interval
- PCR Accuracy (PCR_AC)
- PCR Overall Jitter (PCR_OJ)
- PCR Frequency Offset (PCR_FO)
- PCR Drift Rate (PCR_DR)
- PCR Arrival Time (Network Jitter)

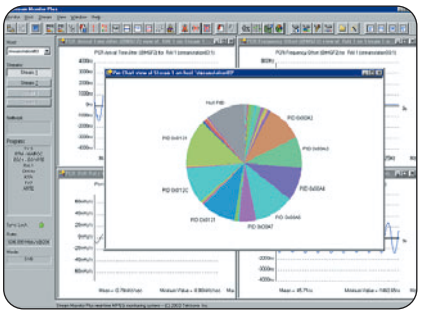
All measurements are made in accordance with TR 101 290 and all have graphical displays. Common features include:

- Simultaneous display of data from as many PCR PIDs as there are in the transport stream
- Frequent updating of scrolling data
- Zoom mechanism enabling enlargement of finer details or reduction of coarse patterns or stray values
- Display of, and information on, the last 250 PCRs in the designated PCR PID
- Samples exceeding the user-defined limit appropriate to the view are highlighted in a different color
- Menu option enabling quick adjustment of the test parameter appropriate to the view

Log View – Shows more than 64,000 entries describing a transgression of one of the tests. The exact time and details of the test are given, including (where appropriate) details of the PID, table ID, etc., of the offending packet. The log view may be highlighted by color to allow easy tracking of particular errors (or sets of errors) and may be saved to disk for later examination.

PCR Instantaneous Transport Rate View – For any two consecutive PCRs, the ratio of their separation in bits to the separation in time of their PCR clock values gives the ITR value. This may not equal the actual transport rate.

TS Fullness View – Using a similar format as the PCR graphs, the TS Fullness graphs show the changing fullness of the transport stream; i.e. the sum of the bit rates of all the PIDs except the null PID (0x1 fff). Historical minimum and maximum indicators are also shown.



PID Occupancy Pie Chart View – Provides at-a-glance multiplex occupancy statistics information used to determine if services are hogging bandwidth or to determine available bandwidth from size of null PID segment. Null PID's are always shown in the same color so that they are immediately identifiable

Recording Features

Stream Monitor Plus supports flexible, automatically-triggered recording, capable of capturing pretrigger data. The proportion of buffer designated for pretrigger is fully configurable. Incoming packets received at the interface can be time stamped for use in real-time or off-line analysis.

Triggering – In addition to manual triggering, any of the tests (described below) may be used to initiate a recording. In the case of TR 101 290, where tests are themselves composed of other tests (e.g. 2.3 PCR), triggers may be initiated either from the sub-tests (e.g. PCR discontinuity and PCR timer) or from the composite event itself. The contents of the MPEG packet header on a subset of PIDs may be used to trigger a recording. This feature is present in the monitor and allows (for example) a packet with the payload_unit_start indicator set on PIDs 0x100 – 0x1ff to cause a trigger. Trigger sets created by the user may be saved and reloaded in later sessions.

Pretrigger Recording – Rather than the trigger event being at the beginning of the recorded stream file, it may be desirable to have some context around the trigger event. Thus, Stream Monitor Plus provides pretrigger recording, allowing the user to specify what percentage of the file is to contain data received before the trigger event.

Filtering – Stream Monitor Plus allows the user to specify a filter for the recording, so that only a subset of PIDs are recorded. This may be useful, for example, in demultiplexing, where the extraction of a single video or audio PID is desirable. Alternatively, record time may be maximized so that when monitoring an infrequently-occurring SI problem, the user can discard the video and audio PID data, allowing many hours of recording at a lower rate. Filters created by the user may be saved and reloaded in later sessions.

Wizard – A Wizard helps the user through the procedure of setting up a recording, from choosing the number of files and their sizes to the recording and rewinding.

Multiple Recordings – Stream Monitor Plus allows multiple recordings to be made unattended; the files are queued up, and as each trigger event is received, a file is filled until the queue is empty.

Input – Two streams may be monitored simultaneously (requires duplex option).

Rates – Stream Monitor Plus can monitor and record a single stream at up to 60 Mb/s.

Tests

Real-time Test List DVB

Automatic Checking and Display of DVB Constraints Defined by TR 101 154, TR 101 211, TR 101 290 and EN 300 468, including:

- TS_sync_loss
- Sync_byte_error
- PAT_error
- Continuity_count_error
- PMT_error
- PID_error
- Transport_error
- CRC_error
- PCR_error
- PCR_accuracy_error
- PTS_error
- CAT_error
- NIT_error
- SI_repetition_error
- Unreferenced_PID
- SDT_error
- EIT_error
- RST_error, TDT_error

Real-time Test List ATSC to A53 and A65

- TS_sync_loss
- Sync_byte_error
- PAT_error
- Continuity_count_error
- PMT_error
- PID_error
- Transport_error
- CRC_error
- PCR_error
- PCR_accuracy_error
- PTS_error
- CAT_error
- Unreferenced_PID
- PID occupancy test
- Program paradigm error
- Program occupancy test
- MGT_error
- VCT_error
- EIT_error
- RRT_error
- Base_PID
- PID/Program occupancy: the user may impose maximum and minimum limits on the bit rate of each PID/Program. These limits may be saved for later sessions

Other Real-time Tests

In addition to the tests listed above, the log also reports a number of other errors, including:

Table ID Error	Reserved Bits Error	Section Length Error
Pointer Field Invalid	Descriptor loop length error	PMT last section number not 0
Table Size Exceeded Limit	Descriptor error	PMT program info length invalid
Table Section Continuation Error	PAT number of program entries invalid	PMT elementary stream info length invalid
Forbidden Table ID	PMT section number not 0	
Section Syntax Error		

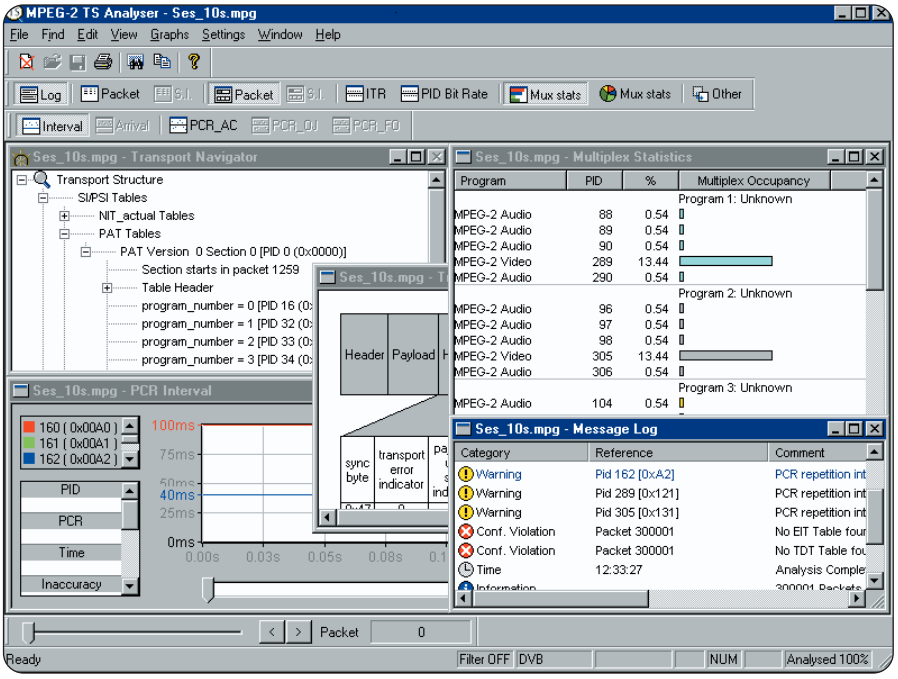
Off-line Analysis Applications

TS Analyzer – Transport Stream Display and Analysis

The TS Analyzer provides deferred time Transport Stream packet display and analysis, with timing and statistical displays, calculation and graphical display of PCR information for each PCR on a PID by PID basis, PID Bit Rate Analysis Graphs and Electronic Program Guide (EPG) Analysis Views.

Packet Display and Analysis – Transport stream packet header interpretation and adaptation field information for individual packets. Hexadecimal representation of transport stream packet header and payload information. Location of a transport stream packet to match a particular condition in the packet header.

Timing and Statistical Displays – Statistical display of the components of the transport stream and their data rates on a program-oriented basis. Calculation and graphical display of the instantaneous and mean bit rate for each PID and for the entire transport stream from Program Clock Reference (PCR) time stamp values with facility to display multiplex statistics as a Pie chart in the PID Occupancy Pie Chart View. Calculation and graphical display of PCR information for each PCR on a PID by PID basis:



- The repetition interval between successive PCRs
- PCR inaccuracy (PCR_AC)
- PCR overall jitter (PCR_OJ)*1
- PCR arrival_time_jitter*1
- PCR frequency offset (PCR_FO)*1
- PCR drift rate (PCR_DR)*1

PID Bit Rate Analysis Graph – Using DVB measurement guidelines MGB2 standard.

EPG Analysis View – Electronic program (EPG) analysis view for both DVB and ATSC streams.

Stream Interpretation Dialog Box – A user friendly script loader automatically loads appropriate scripts and modules including region and data standard (e.g. Nordig, MHP, etc.).

*1 Stream must have been captured using either MTM400, AD953A or AD95X with ASI time stamping interface card.

MPEG-2 Tables Displayed – Display and interpretation of MPEG Program Specific Information (PSI) tables:

- Program Association Table (PAT)
- Conditional Access Table (CAT)
- TS Program Map Table (PMT)
- Network Information Table (NIT)
- TS Description Table (TSDT)

DVB Tables Displayed – Display and interpretation of DVB Service Information (SI) tables:

- Network Information Table (NIT) as defined by DVB
- Bouquet Association Table (BAT)
- Service Description Table (SDT)
- Event Information Table (EIT)
- Running Status Table (RST)
- Time and Date Table (TDT)
- Stuffing Table (ST)
- Time Offset Table (TOT)
- Selection Information Table (SIT)
- Discontinuity Information Table (DIT)

Enhanced DVB SI – UK DTG (Digital Television Group) descriptors for UK digital TV. Custom SI descriptor script package available.

ATSC PSIP Tables Displayed

- Master Guide Table (MGT)
- Terrestrial Virtual Channel Table (TVCT)
- Cable Virtual Channel Table (CVCT)
- Rating Region Table (RRT)
- Event Information Table (EIT)
- Extended Text Table (ETT)
- System Time Table (STT)

The TSA decodes and identifies AC-3 audio streams (A52 as constrained by A53). The TSA decodes and identifies the program identifier stream (A57) for the transport stream in use.

MPEG-2 Transport Stream Tests

MPEG-2

Transport packet header tests to ISO/IEC 13818-4 including:

- Sync_byte
- Payload_unit_start_indicator
- PID semantic checks
- Transport_scrambling_control
- Adaptation_field_control
- TS continuity
- Duplicate_packet
- Adaptation_field_length
- Random_access_indicator
- Random_access_PCR
- Random_access_PTS
- PCR_OCPR_flags
- Transport_private_data

MPEG-2 Table Tests

PAT Conformance Test

- Section_syntax_indicator = 1
- 9 ≤section_length ≤1021
- Zero bit = 0
- Reserved bits = 1
- CRC_32
- Program ID duplicated
- Network PID invalid
- PMT PID invalid

PMT Conformance Test

- Section_syntax_indicator = 1
- 9 ≤section_length ≤1021
- Zero bit = 0
- Reserved bits = 1
- Program_info_length <1008
- Program_info_length and descriptor lengths are compatible
- Section_syntax_indicator = 1
- Elementary_PID >10 and elementary_PID ! = 0x1fff
- ES_info_length < 1003
- 1 = descriptor tag ≤16 or descriptor_tag >63

CAT Conformance Test

- Section_syntax_indicator = 1
- 9 ≤section_length ≤1021
- Zero bit = 0
- Reserved bits = 1
- CRC_32

MPEG-2 Descriptor Tests

In each of the following cases a check is made on the validity of the descriptor length.

- Video_stream_descriptor
- Audio_stream_descriptor
- Hierarchy_descriptor
- Registration_descriptor
- Data_stream_alignment_descriptor
- Target_background_grid_descriptor
- Video_window_descriptor
- CA_descriptor
- ISO_639_language_descriptor
- System_clock_descriptor
- Multiplex_buffer_utilization_descriptor
- Copyright_descriptor
- Maximum bit rate descriptor
- Private date indicator descriptor
- Smoothing buffer descriptor
- STD_descriptor
- IBP descriptor

MPEG-2 Timing Tests to ISO/IEC 13818-1

- PCR Accuracy
- PCR repetition interval
- T-STD Buffer overflow/underflow test on 6 profiles:
  - Simple, Main, SNR, Spatial, High and 4:2:2
- It supports 4 levels:
  - High, High – 1440, Main, and Low
- MPEG video, audio, and system buffers

DVB Transport Stream Tests

DVB Table Tests

As defined by TR 101 154, TR 101 211, EN 300 468 and TR 101 290 including:

BAT Conformance Test

- Checks section_syntax_indicator is 1
- Checks section_length is 11-1021
- Checks '0' is 0
- Checks reserved is 1
- Checks section_length agrees with actual size
- CRC_32
- Bouquet descriptor length invalid
- Transport descriptor length invalid

EIT Conformance Test

- Checks section_syntax_indicator is 1
- Checks section_length is 15-4093
- Checks '0' is 0
- Checks reserved is 1
- Checks section_length agrees with actual size
- CRC_32
- Descriptor loop length invalid
- EIT_error*2

RST Conformance Test

- Checks section_syntax_indicator is 0
- CRC_32
- RST_error*2

SDT Conformance Test

- Checks section_syntax_indicator is 1
- Checks section_length is 12-1021
- Checks section_length agrees with actual size
- CRC_32
- Descriptor loop length invalid
- SDT_error*2

TDT Conformance Test

- Checks section_syntax_indicator is 0
- CRC_32
- TDT_error*2

TOT Conformance Test

- Checks section_syntax_indicator is 0
- Checks section_length is 11-1021
- Checks section_length agrees with actual size
- CRC_32
- Descriptor loop length invalid

PAT Conformance Test

- PAT_error*2

CAT Conformance Test

- CAT_error*2
- Unreferenced PID*2
- PID_error*2

PMT Conformance Test

- PMT_error*2

NIT Conformance Test

- Section length agrees with actual size
- CRC 32
- Network descriptors length invalid
- Transport descriptors length invalid
- NIT_error*2
- SI_repetition_error*2

*2As described in DVB Measurement guidelines TR 101 290.

DVB Descriptor Tests

In each of the following cases a check is made on the validity of descriptor length:

- Network_name_descriptor
- Service_list_descriptor
- Stuffing_descriptor
- Satellite_delivery_system_descriptor
- Cable_delivery_system_descriptor
- Service_descriptor
- Country_availability_descriptor
- Linkage_descriptor
- NVOD_reference_descriptor
- Time_shifted_service_descriptor
- Short_event_descriptor
- Extended_event_descriptor
- Time_shifted_event_descriptor
- Component_descriptor
- Mosaic_descriptor
- Stream_identifier_descriptor
- CA_identifier_descriptor
- Content_descriptor
- Parental_rating_descriptor
- Teletext_descriptor
- Telephone_descriptor

- ▶ Local_time_offset_descriptor
- ▶ Subtitling_descriptor
- ▶ Terrestrial_delivery_system_descriptor
- ▶ Multilingual_network_name_descriptor
- ▶ Multilingual_bouquet_name_descriptor
- ▶ Multilingual_service_name_descriptor
- ▶ Multilingual_component_descriptor
- ▶ Private_data_specifier_descriptor
- ▶ Service_move_descriptor
- ▶ Short_smoothing_buffer_descriptor
- ▶ Frequency_list_descriptor
- ▶ Partial_transport_stream_descriptor
- ▶ Data_broadcast_descriptor
- ▶ CA_system_descriptor
- ▶ Data_broadcase_id_descriptor

ATSC Transport Stream Tests

Program Paradigm Test

Program Identifier Table Test (A57)

- ▶ Section_syntax_indicator = 0
- ▶ Private_indicator = 1
- ▶ CRC_32

PSIP Table Tests

MGT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ 14 ≤section_length ≤4,093
- ▶ Zero bit = 0
- ▶ Reserved bits = 1
- ▶ Last_section = 0
- ▶ CRC_32

RRT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ 14 ≤section_length ≤1,021
- ▶ Zero bit = 0
- ▶ Reserved bits = 1
- ▶ Last_section = 0
- ▶ CRC_32

CVCT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ 13 ≤section_length ≤1,021
- ▶ Zero bit = 0
- ▶ Reserved bits = 1
- ▶ CRC_32

TVCT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ 13 ≤section_length ≤1,021
- ▶ Zero bit = 0
- ▶ Reserved bits = 1
- ▶ CRC_32

EIT Conformance Test (ATSC version of EIT)

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ 11 ≤section_length ≤4,093
- ▶ CRC_32

STT Conformance Test

- Section_syntax_indicator = 1
- Private_indicator = 1
- Current_next_indicator = 1
- 17 ≤section_length ≤1,021
- Reserved bits = 1
- Last_section = 0
- CRC_32

ETT Conformance Test

- Section_syntax_indicator = 1
- Private_indicator = 1
- Current_next_indicator = 1
- 14 ≤section_length ≤4,093
- Reserved bits = 1
- Last_section = 0
- CRC_32

ATSC Descriptors

In each of the following cases a check is made on the validity of descriptor length:

- Stuffing descriptor
- AC-3 audio descriptor
- Program identifier descriptor
- Caption service descriptor
- Content advisory descriptor
- Extended channel name descriptor
- Service location descriptor
- Time-shifted service descriptor
- Component name descriptor

Timing Tests – ATSC

- PCR tests as for MPEG
- T-STD Buffer overflow/underflow test
- MPEG video and AC-3 audio

PES Analyzer

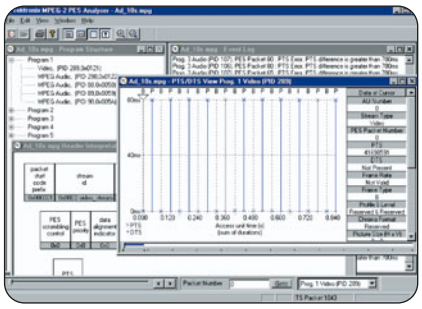
The PES Analyzer provides a graphical display of PES header information plus extraction and display of Presentation Time Stamp (PTS) and Display Time Stamp (DTS) information from the packet header.

Tests of PES Header

- PES_packet_length
- PTS_DTS-flags
- PES_header_data_length
- Rep_cntrl
- Previous_PES_packet_CRC
- Pack_header_field_flag
- Program_packet
- Sequence_counter
- Original_stuff_length
- Stuffing_byte
- Padding_byte

PES Timing Tests

- Relationship PTS/DTS
- PTS repetition interval

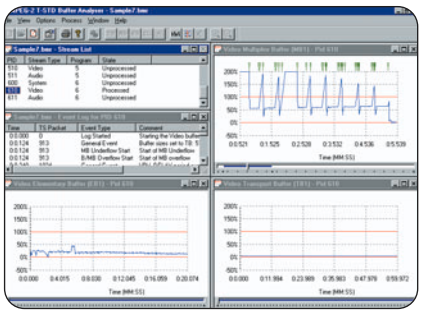


T-STD Buffer Model Analyzer

The T-STD Buffer Analyzer provides calculation and graphical display of buffer fullness based on the MPEG-2 Transport Stream System Target Decoder (T-STD) buffer model. Detection of T-STD buffer overflow and underflow as described in ISO/IEC 13818-1 and for ATSC in A53/A65. Support for 3:2 pulldown streams plus smoothing buffer and Max Bit Rate descriptor processing analysis.

Buffer Tests

- T-STD Buffer overflow/underflow test on seven buffers
- 6 profiles:
  - Simple, Main, SNR, Spatial, High, and 4:2:2 (supports 4 levels: High, High-1440, Main and Low)
- MPEG video
- Audio and AC-3 audio



Multiplexer and DVB/ ATSC Table Editor

Why Multiplex?

When testing transmission chain equipment or set-top boxes, quite often a transport stream of the representative type needed is just simply 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 simply multiplexed to the incorrect transport stream rate for the application.

The software can re-multiplex:

- ▶ MPEG-2 Video elementary streams
- ▶ MPEG-2 Audio elementary streams
- ▶ AC-3 Audio elementary streams
- ▶ MPEG-2 Video PES (packetized elementary streams)
- ▶ MPEG-2 Audio PES
- ▶ AC-3 Audio PES
- ▶ PIDs from other transport streams
- ▶ Other data – the bit rate must be specified

The Solution

The multiplexer allows the user to collect together components from streams recorded off hard disk or CD/DVD-ROM, manipulate them in an unlimited manner, and then rebuild a fully compliant output stream for whatever use is desired. Along the way, the system's in-built syntax knowledge of tables and descriptors ensure compliance and high quality output of the final multiplex transport stream.

Decompose Existing Streams

The multiplexer accepts any recorded transport stream as an input source. The user can then decompose this transport stream into its component PES. The user can then save the resulting PES and ES streams onto disk.

Regroup Them with Stored Streams

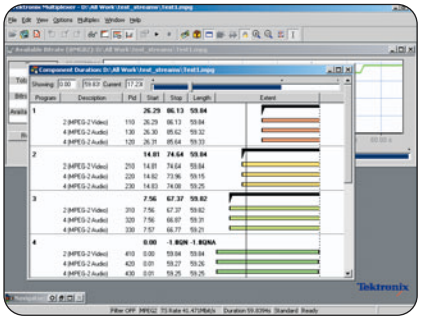
These PES, or elementary video and audio streams, can be grouped together into logical groups – "Programs" of video, audio, and other associated data (private data, such as teletext). The original timing relationships are preserved. These streams and/or other prerecorded PES or ES streams can then be reassembled together to build up a totally new transport stream as the user desires. Regrouping of elementary streams or programs can be achieved within an existing transport stream, by allowing the individual stream identifiers (PIDs) to be remapped as required.

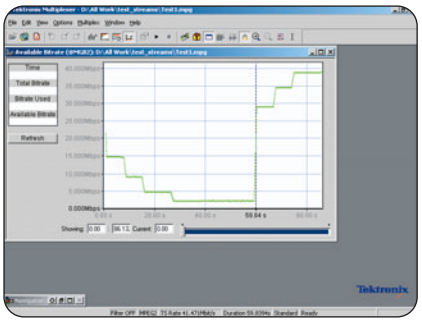
Component Views and Available Bandwidth View

The Component Bit Durations View graphically displays the durations and start and stop times of each PID that does not contain PSI/SI/PSIP information.

Duration and start and stop times can be changed using edit boxes or "click and drag." Programs can be grouped or stored by stream type, PID, start time, stop time, duration, or bit rate. An Available Bandwidth view clearly shows the user how much content can be added into a transport stream within the overall transport stream bit rate.

The Component Duration View can be synchronized with the Available Bandwidth view so user changes to either view automatically update the other.





Map, Check and Rebuild Your Own Multiplex

These streams can then be rebuilt into a larger multiplex stream and new system information tables can be customized and added. Powerful syntax auto-check warns the user of mis-mapped, reserved, or duplicate PIDs, including the Program Paradigm, by checking and automatically updating PAT, PMT, and derivable fields (in its "standard" mode) accordingly, to create a final legal and DVB, ATSC, or ISDB-compliant output stream. The multiplexer allows the user to be able to construct a transport stream for any rate equal to or greater than the sum of the individual components to be multiplexed. Another facility offered is the ability for the multiplexer to insert correct PCR values on the PIDs defined by the user. This allows for PCRs to be on a separate PID or embedded on an existing PID.

Generate Compliant Timing and Output Bit Rates as Required

The multiplexer is able to insert the PCRs at the correct repetition rate and also allows the user to specify the PCR repetition rate, if desired.

Create, Add or Modify SI Flexibility

The multiplexer allows all the standard MPEG/DVB/ATSC/ISDB system information tables (SI) and descriptors to be edited and a stream interpretation dialog box enables the user to automatically load appropriate scripts for predefined stream types. The user is permitted to generate illegal conditions that allow stress of decoder or transmission chain equipment to verify its robustness. It is also possible to generate private tables and descriptors.

Test Feature – Deliberately Create Illegal Streams

The software can be set to generate an optional warning when certain illegal conditions have been generated. This is clearly visible on the user interface. In a similar manner, the multiplexer allows all legal descriptors to be added to each table. The repetition rate for each table can be changed, overriding the default value. A conditional warning is generated if an illegal repetition rate is defined.

"Expert" and "Standard" Modes

Standard mode will calculate related fields and table pointers (e.g., checksums) for the user without his having to worry, but an expert mode is also provided to allow the user to set these to illegal conditions for test conditions as described above.

Wizards for Common Tasks

- ▶ Creating a new transport stream
- ▶ Supporting MPEG, DVB, and ATSC standards
- ▶ Adding programs
- ▶ Adding events

Make Seamless

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 module provides the opportunity of creating seamless MPEG-2 files.

Sky XSI Analysis Module for TS Analyzer – Option (approved customers only)

Plug in module for XSI proprietary DTV standard.

Viaccess Module for TS Analyzer – Option (approved customers only)

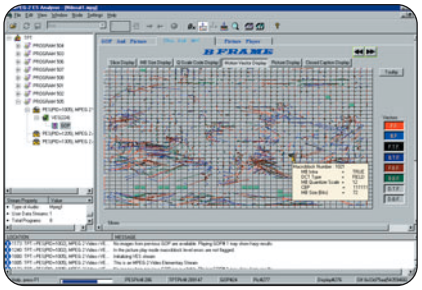
Plug in module for Viaccess proprietary DTV standard.

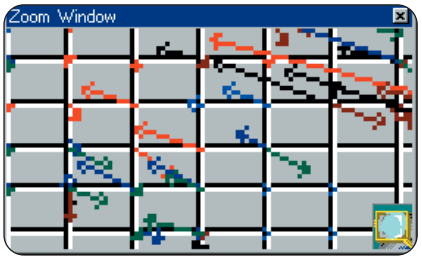
OpenTV Module for TS Analyzer – Option (approved customers only)

Plug in module for OpenTV proprietary DTV standard.

ES Analyzer – Option

This application offers the ability to actually view the moving picture from within a PES stream, but also to carry out a whole range of sophisticated new tests on the lower layers of an elementary stream within a transport multiplex. This gives added confidence when analyzing streams because encoder performance can be verified right down to slice and block layer together with motion vectors. The ES Analyzer also includes support for Program (System) Stream Analysis for program streams as used in low cost PC based MPEG-2 encoders and DVDs.





Display and analysis of GOP, Picture, Slices and Macroblock layer.

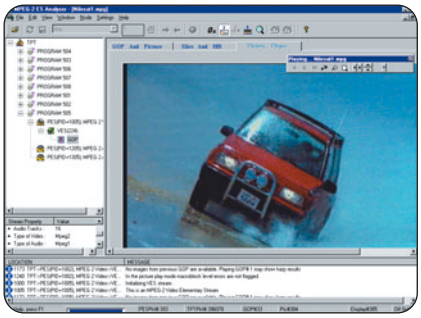
Picture quality analysis including Quantizer Scale distribution, motion vector graphs, macroblock and picture-size plots.

Analysis of MPEG-2 audio to provide plots of allocation bits, scalefactor grouping and SCFSI against sub bands.

Support for VBI Teletext signaling within PES, including WSS (Wide Screen Signaling) and VPS (Video Program System) used for PVR control.

The sequence header can be viewed along with the extensions. The picture rate, chroma format, and the video type (NTSC, PAL, etc.) appear in the status bar when the sequence headers are displayed. The stream can be run through with the option of analysis of the stream at picture level or at the macroblock level. When analyzing the group of pictures (GOP), it is possible to randomly access any picture from within the group, view the picture type, spectrum and display picture size plots. The user can zoom in on the picture to see details at the slice or macroblock levels or view the encoded picture. Picture player can be operated until a degradation in quality is seen, the picture paused and the details reviewed down to the macroblock level.

An easy mechanism is provided to switch between the picture display and the data analysis windows.



Macroblocks can be selected and detailed coding investigated. The picture analysis can be performed with special displays of quantizer scale distribution, slice size distribution, macroblock-size spectrum and motion vector plots.

Quantizer matrices can be downloaded for any picture, at most four matrices namely intra-quantizer matrix, non-intra-quantizer matrix, chroma intra-quantizer and chroma non-intra-quantizer matrix.

The picture coding extension is always displayed, while the other picture extensions are displayed on tabbed folders, these are copyright extension, picture display extension (PDE), picture spatial scalable extension (PSSE) and picture temporal scalable extension (PTSE). The B and P frame motion vector displays allow you to select Macroblock Intra, pattern motion backward and forward together with macroblock quantization, quantizer scale DCT type, and motion vector format.

Comprehensive error logging is provided during stream analysis and selectable error filters are available. There is also an automated “regression” test mode that can save data from selected fields to report files for viewing later.

The audio analysis capability includes navigation to any audio frame and viewing its details, header, frame data plots. Audio descriptors are interpreted and displayed in higher level streams and validated against the stream.

Finally, the ES Analyzer also offers analysis of Teletext and Subtitle information carried within the Transport Stream.

Broadcast Satellite Digital Multiplexer – Option

A complete multiplexer, demultiplexer, editing, and analysis tool for Japanese ISDB-S standard streams. It provides off-line multiplexing of existing transport streams and TMCC (Transmission and Multiplexing Configuration Control) information in order to produce ISDB-S transport streams. It can also be used to demultiplex existing ISDB-S transport streams and edit the TMCC information.

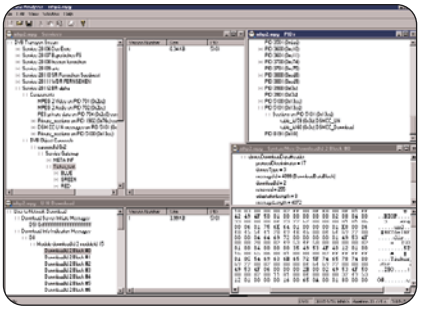
Broadcast Cable Digital Multiplexer – Option

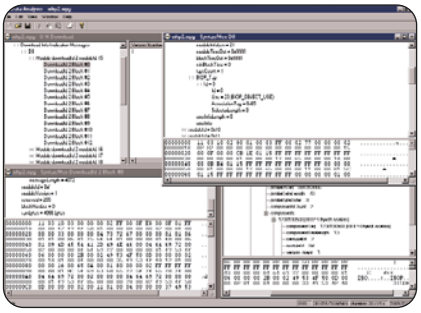
A complete multiplexer, demultiplexer, editing, and analysis tool for Japanese ISDB-C standard streams. It provides off-line multiplexing of existing transport streams and TSMF (Transport Stream Multiplexing Frame) information in order to produce ISDB-C streams. It can also be used to demultiplex existing ISDB-C streams and edit the TSMF information.

Carousel Analyzer – Option

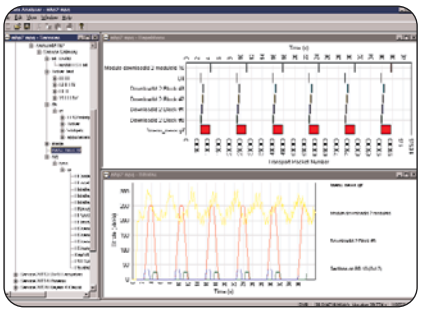
The Carousel Analyzer provides an ideal analysis tool for those involved in development of Interactive Television systems, whether in software development, MHP Set Top Box design, or in Carousel Multiplexing. It offers:

- DVB Data and Object carousel analysis
- Bit rate and repetition rate display of blocks, modules, objects, UN messages, SI tables, and video/audio PIDs
- BIOP, DSI, DII, DDB, and DSM-CC section display and interpretation
- Display of MHP AIT table
- ARIB B15/B24 Data Carousel Analysis
- MPE analysis including syntax of datagram sections





Typical applications include conformance checking of streams containing Data and Object Carousels, but also analysis of application load times and cycle times.



Carousel Generator – Option

The Carousel Generator provides a means of creating Object carousels and multiplexing these into Transport Streams for Multimedia Home Platform (MHP) and interactive TV test applications. The Transport Streams incorporate selected audio and video as well as Carousels and associated AIT tables required by MHP. Additional SI may also be configured such that at least the mandatory information required by the relevant standard is included. Therefore, the generated Transport Stream is suitable for playing directly into Set Top Boxes without the need for further processing, enabling fast checking of MHP applications on Set Top Boxes.

▶ Characteristics

Product Specifications

Record

Maximum Record Time at the Rate of 60 Mb/s – Over 1 hour.

Maximum Data Rate – 87.5 Mb/s.

(Trig Rec/Monitor – 60 Mb/s.)

Minimum Data Rate – 250 kb/s.

▶ Packet Handling - Record

Input Format	Storage Format	
	188 byte	204 byte
188 byte	Y	
204 byte	Y	Y
208 byte (GPSI)	Y	

▶ Packet Handling - Playout

Storage Format	Output Format		
	188 byte	204 byte	208 byte (GPSI)
188 byte	Y	Y (Dummy RS)	Y (Zero RS)
204 byte	Y	Y	

Playout

Maximum Data Rate – 87.5 Mb/s.

Minimum Data Rate –
Using internal clock: 250 kb/s.
Using external clock: 250 kb/s.

Bit Rate Resolution – 1 b/s.

Frequency Resolution – 0.03 Hz.

Clock Accuracy – ±1 ppm.

Aging and Drift – <1 ppm per year.

External Clock

Signal Input – AC coupled.

Min. Signal Level – 200 mV.

Input Impedance – 50 Ω.

Connector Format – BNC.

Hardware Configuration

36 GB SCSI disk for stream storage.
DVD Read, CD-Read/Write drive.
Ultra-wide SCSI port for external storage.
100Base-T Ethernet.

▶ Transport Stream Interface Options

Interface Card Options	Modes	Bit Rate	Connector
GPSI Interface – Opt. GPPC	SMPTE 310M	19.392 Mb/s and 38.785 Mb/s (support for 8 VSB and 16 VSB)	BNC
	DHEI	To 48 Mb/s	26 Way High Density D
	ECL (AC)	To 50 Mb/s	26 Way High Density D
	ECL (DC)	To 50 Mb/s	26 Way High Density D
	RS422 differential	To 20 Mb/s	26 Way High Density D
	SSI (DVB serial)	To 44 Mb/s	BNC
ASI and M2S (DIVICOM) Opt. ASPT	Data, packet burst	Data rate to 87.5 Mb/s Transmission rate 270 Mb/s	BNC

Display
Integrated LCD, 1024x768

Power Requirements
Voltage Range – 100 to 240 V_{RMS} ±10%

Frequency Range – 50/60 Hz.

Power Consumption (Typical) – 105 W.

Certification and Compliance – CSA C22.2 No. 1010.1-92, UL61010B-1, Low Voltage Directive 73/23/EEC, amended by 93/68/EEC.

Environmental Specifications
Operating Temperature +5 ºC min. to +40 ºC max.

Transport Stream Interfaces
Parallel Input and Output Port –
Connector format input: 25 Way D Type.
Connector format output: 25 Way D Type.

Electrical Specification – LVDS (differential).

Input Impedance – 100 Ω.

Output Impedance – 100 Ω.

Physical Characteristics

Dimensions	**mm**	**in.**
Height (without bottom feet)	226	8.9
Width	432	17
Depth	560	22
Weight (system unit)	**kg**	**lbs.**
Net	15.5	34

▶ Ordering Information

AD953A
The AD953A includes as standard:

- ▶ Mainframe with integrated Hi Res display
- ▶ One I/O card including DVB SPI interface
- ▶ Record and Play software
- ▶ TSA, PES and Buffer, and Monitor Plus software
- ▶ MUX software
- ▶ Make Seamless, Cutter, Maker and Editor software
- ▶ Keyboard with integrated pointing device

MPEG Test System

▶ AD953A

Options

Opt. DU – Adds second I/O card and HDD for duplex operation.

Opt. ASPT – ASI Interface card with time stamping.

Opt. GPPC – GPSI Interface card.

Opt. DB – Carousel Analyzer.

Opt. CG – Carousel Generator.

Opt. DBCG – Bundle software including Carousel Analyzer and Carousel Generator.

Opt. ES – ES Analyzer.

Opt. IX – Satellite Mux – Japan.

Opt. BC – Cable Mux – Japan.

Opt. RM – Rackmount.

Power Plug Options

Opt. A0 – North America power.

Opt. A1 – Universal EURO power.

Opt. A2 – United Kingdom power.

Opt. A3 – Australia power.

Opt. A4 – 240 V, North America power.

Opt. A5 – Switzerland power.

Opt. A6 – Japan power.

Opt. A10 – China power.

Opt. A99 – No power cord or AC adapter.

Service

Opt. R3 – Repair Service 3 Years.

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