

MPEG Test System

► AD953-II



Stream Playout and Recording

- Record, play at 90 Mb/s
- Continuous playout of looped streams with automatic updating of time stamps
- Transport stream recording with packet arrival time information stored for offline timing analysis*1
- Simultaneous play & record (option)

Real-time Monitoring

- PID and program-oriented dynamic bar 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
- TR101 290 and ATSC compliance checks

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

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

Stream Manipulation

- Stream cutter
- Packet editor
- PSI/SI/PSIP editor
- Enhanced hardware
- SCSI hard disk for stream storage (18 GB expandable) with sample test streams
- Wide range of interfaces including DVB-SPI, ASI, DHEI, M2S, SMPTE310M, L-Band, etc.

► 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 TR101 290 with Powerful Trigger Mode to Track Down Operational Faults Quickly

Transport Stream Timing Measurements Including PCR Accuracy (PCR_AC), PCR Overall Jitter (PCR_OJ), Arrival_time_jitter, PCR Frequency Offset (PCR_FO) and Drift Rate (PCR_DR) Measurement and Graphing*1

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

OpenTV, XSI and ViAccess Protocol Analysis

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

► Applications

- Development
- Production
- Transmission
- Satellite
- Cable
- Terrestrial

*1 New ASI Time Stamping interface card required, Option ASPT.

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Uses

Development

In the development environment the AD953-II is a convenient signal source and powerful diagnostic tool. Its ability to play out the same test stream repeatedly, at data rates of up to 90 Mb/s 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 AD953-II 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 AD953-II 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 down-time during the unit's working life.

Transmission Monitoring

For program and service providers, the real-time monitoring facility of the AD953-II 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

AD953-II has different ways of presenting the test results to suit users' varied needs:

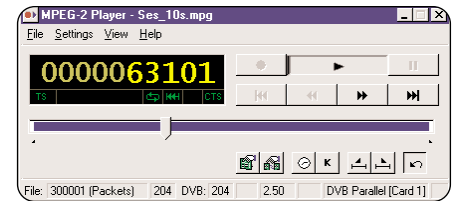
- ▶ Real-time monitor test logs (online)
 - Here as errors are encountered, they are displayed with description in an error log window which scrolls down. This can be accessed locally or from a remote test site and user-programmable color filters can be used to highlight specific errors
- ▶ Deferred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

Player Application

Recording and Playback

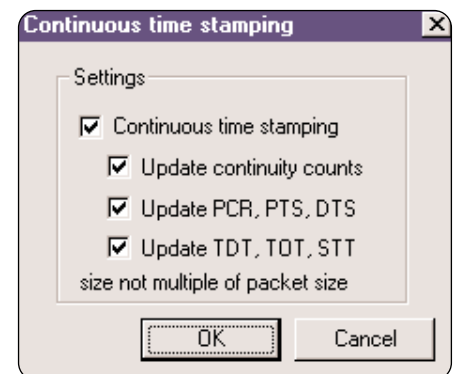
AD953-II's Player allows record and play at video data rates of up to 90 Mb/s through the appropriate interfaces. Recording and playback can be set to handle either 188, 204 or 208 byte packets depending on the interface. Files may be played out once only or continuously looped. Playback begin and end 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 playback rate can be manually selected.



Recording Streams with Time-stamping Information

AD953-II recording application now includes support for recording transport streams with time-stamping information. Incoming packets received at the interface are time stamped for use in offline timing analysis. (A new ASI Time-stamping interface card is required, Option ASPT.)

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.

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 AD953-II the ability to provide both stimulus and analysis ("loophthrough") 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 in the software suite 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 or jitter, following several laws (Gaussian, Random, sine wave, etc.)

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

Stream Monitor Plus

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 and bar 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 an 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 SIP/PSI/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 Graphs – There are three graphs that display information relating to the PCRs contained in the stream. They have a number of features in common:

- ▶ Simultaneous display of data from as many PCR PIDs as there are in the transport stream
- ▶ Scrolling data is frequently updated
- ▶ Zoom mechanism allows finer details to be enlarged, or conversely, the coarse patterns or stray values to be reduced
- ▶ Information on the last 250 PCRs in the designated PCR PID
- ▶ Samples that exceed the user-defined limit appropriate to the view are highlighted in a different color
- ▶ Menu option which allows the test parameter appropriate to the view to be quickly adjusted

PCR Arrival View – Shows the arrival intervals, in milliseconds, between adjacent PCRs on the designated PCR PID.

PCR Inaccuracy View – Shows the inaccuracy of each PCR on the designated PCR PID. Two possible calculation methods are available.

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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 – Shows the rate at which the PCRs were encoded in the designated PCR PID, which may not equal the actual transport rate. 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.

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.

Recording Features

Stream Monitor Plus supports flexible, automatically-triggered recorder, capable of capturing pre-trigger data. The proportion of buffer designated for pre-trigger is fully configurable. Incoming packets received at the interface can be time stamped for use in off-line analysis. (A new ASI Time-stamping interface card is required, Option ASPT.)

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, tests which 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.

Pre-trigger 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 pre-trigger 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 could 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, or more on remote units.

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

Remote Monitoring - The application can be used for remote monitoring of other AD953-IIs.

Tests

Real-time Test List DVB

Automatic Checking and Display of DVB Constraints Defined by TR 101 154, ETR 211, TR 101 290 and EN 300 468 V1.4.1, 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.

Off-line Analysis Applications

Applications Include:

- ▶ MPEG, DVB and ATSC (TS Analyzer)
- ▶ ISDB Analysis (Option)
- ▶ PES layer (PES Analyzer)
- ▶ T-STD buffer analyzer

Transport Display and Analysis

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.

▶ 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 | | |

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. 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
- ▶ 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 New ASI Time Stamping interface card required, Option ASPT.

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.

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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 AD953-II decodes and identifies AC-3 audio streams (A/52 as constrained by A/53). The AD953-II decodes and identifies the program identifier stream (A/57) for the transport stream in use.

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_OPCR_flags
- ▶ Transport_private_data

MPEG-2 Table Tests

PAT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ $9 \leq \text{section_length} \leq 1021$
- ▶ Zero bit = 0
- ▶ Reserved bits = 1
- ▶ CRC_32
- ▶ Program ID duplicated
- ▶ Network PID invalid
- ▶ PMT PID invalid

PMT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ $9 \leq \text{section_length} \leq 1021$
- ▶ 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
- ▶ $1 = \text{descriptor_tag} \leq 16$ or $\text{descriptor_tag} > 63$

CAT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ $9 \leq \text{section_length} \leq 1021$
- ▶ 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 Table Tests

As defined by ETR 154, ETR 211, ETS 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

*2 As described in DVB Measurement Guides 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_broadcast_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
- ▶ $14 \leq \text{section_length} \leq 4,093$
- ▶ 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
- ▶ $14 \leq \text{section_length} \leq 1,021$
- ▶ 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
- ▶ $13 \leq \text{section_length} \leq 1,021$
- ▶ Zero bit = 0
- ▶ Reserved bits = 1
- ▶ CRC_32

TVCT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ $13 \leq \text{section_length} \leq 1,021$
- ▶ 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
- ▶ $11 \leq \text{section_length} \leq 4,093$
- ▶ CRC_32

STT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ $17 \leq \text{section_length} \leq 1,021$
- ▶ Reserved bits = 1
- ▶ Last_section = 0
- ▶ CRC_32

ETT Conformance Test

- ▶ Section_syntax_indicator = 1
- ▶ Private_indicator = 1
- ▶ Current_next_indicator = 1
- ▶ $14 \leq \text{section_length} \leq 4,093$
- ▶ 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

Display and Analysis

- ▶ Graphical display of PES header information
- ▶ 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

Display and Analysis

- ▶ Calculation and graphical display of buffer fullness
- ▶ Based on the MPEG-2 Transport Stream System Target Decoder (T-STD) buffer model. As described in ISO/IEC 13818-1 and for ATSC in A53/A65
- ▶ Detection of T-STD buffer overflow and underflow
- ▶ Support for 3:2 pulldown streams
- ▶ 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?

For testing of 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

AD953-II's off-line 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 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, e.g., teletext). The original timing relationships are preserved. These streams and/or other pre-recorded 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

A 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.

A Component Bit Rates View graphically displays the bit rate of each PID that does not contain PSI/SI/PSIP information. Programs can be sorted by PID, stream type, or bit rate.

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 or ATSC-compliant output stream. AD953-II's 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 system information tables (SI) and descriptors to be edited and a stream interpretation dialog box enables the user to automatically load appropriate scripts for pre-defined 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 visible clearly 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.

MPEG Test System

▶ AD953-II

“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.

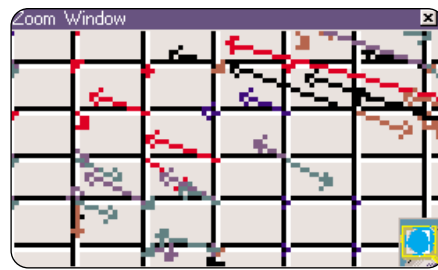
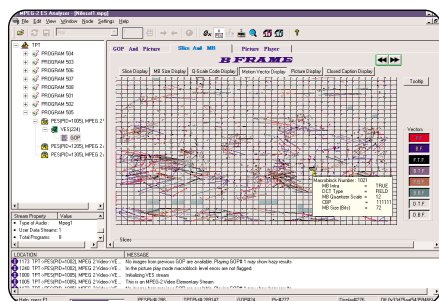
Wizards for Common Tasks

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

Video and Audio Elementary Stream Analysis and Display (option)

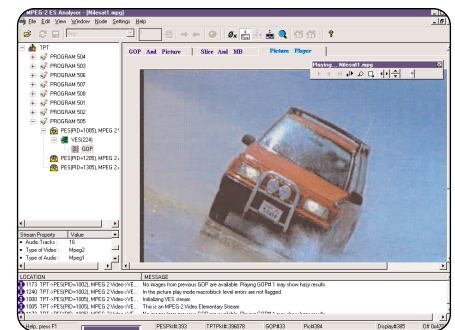
ES Analyzer

This application brings to AD953-II not only 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.



- ▶ 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

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.

► Characteristics

Product Specifications

Record –

Maximum record time at the rate of 60 Mb/s with standard hard disk: 18 minutes.
 Maximum data rate: 90 Mb/s.
 (trig rec/monitor: 60 Mb/s.)
 Minimum data rate: 250 kb/s.

Playback –

Maximum playback time at 60 Mb/s: 18 minutes.
 Maximum data rate: 90 Mb/s.
 Minimum data rate:
 Using internal clock: 2.5 Mb/s.
 Using external clock: 250 kb/s.
 Bit rate resolution: 1 b/s.
 Frequency resolution: 0.03 Hz.
 Clock Accuracy: ±1 ppm.
 Aging & drift: <1 ppm per year.

Receive and Monitoring –

208 byte with GPSI interface option.

Electrical

External Triggering – Input and output.

Triggering on Input – Edge sensitive.

Connector Format – 15 Way D Type.

Specification – TTL.

External Clock -

Signal Input – AC coupled.

Min. Signal Level – 200 mV.

Input Impedance – 500 Ω.

Connector Format – BNC.

Hardware Configuration

9 GB SCSI disk for stream storage DVD (tower only).
 Ultra-wide SCSI port for external storage.
 100Base-T Ethernet.

Display

Display (tower) –

17" 1280x1024.

SVGA.

Color CRT monitor.

► Packet Handling - Record

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

► Packet Handling - Playback

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

► Environmental Specifications

| | Tower | Portable |
|-----------------------|----------------------|----------------------|
| Operating Temperature | 10°C min. 40°C max. | 0°C min. 40°C max. |
| Storage Temperature | -20°C min. 70°C max. | -40°C min. 70°C max. |
| Humidity | 70% noncondensing | 70% noncondensing |

Power Requirements

Voltage Range – 100 to 260 V_{RMS} (switchable).

Frequency Range – 45 to 65 Hz.

Power Consumption (Max.) – 300 VA.

Safety –

CSA C22.2 No. 1010.1, EN61010-1, IEC61010-1, UL 3111-1.

Physical Characteristics

AD953-II (tower)

| Dimensions | cm | in. |
|----------------------|------|-------|
| Width | 23.5 | 9.25 |
| Height | 44 | 17.32 |
| Depth | 43 | 16.93 |
| Weight (system unit) | kg | lbs. |
| Net | 16.9 | 37.26 |

Electrical Interface

Transport Stream

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.

MPEG Test System

▶ AD953-II

▶ Ordering Information

AD953-II MPEG Test Systems

Options

AD950 – DVB/ATSC/ARIB Analysis Software License.

MICS – MIC 1.1S (with accurate clock circuit). Only for AD953-II tower platform applications mentioned below.

ASI – ASI/M2S interface.

ASPT – ASI PCI interface.

LBPC – L-Band + Card.

GPPC – GPSI II Card (SMPTE 310M, RS422 Serial, DVB SSI, DHEI).

DB – MPEG/DVB Carousel Analyzer.

DU – Duplex operation player/monitor or player/recorder. Excluding AD953P-II portables.

IN – ES Analyzer with AAC Player and 608 CC and 708 CC.

AA – AAC player standalone - no ES Analyzer.

CC – CC standalone - no ES Analyzer.

IX – Broadcast Satellite digital multiplexer (Japan).

BC – Broadcast Cable digital multiplexer (Japan).

VI – Viaccess Analysis. Approved customers only.

OP – Open TV Analysis. Approved customers only.

XS – XSI Analysis software. Approved customers only.

18GBA – Internal 18 GB disk drive (in addition to standard drive).

36GB – Internal 36 GB disk drive (replace current drive).

36GBA – Internal 36 GB disk drive (in addition to standard drive).

CDW – Internal CD ROM writer plus Adaptec Easy CD Creator software - excluding portables.

FCT – Flight case for AD953-II.

Service

Opt. R5 – Repair Service five years.

Contact Tektronix:

ASEAN Countries & Pakistan (65) 6356 3900

Australia & New Zealand (65) 6356 3900

Austria +43 2236 8092 262

Belgium +32 (2) 715 89 70

Brazil & South America 55 (11) 3741-8360

Canada 1 (800) 661-5625

Central Europe & Greece +43 2236 8092 301

Denmark +45 44 850 700

Finland +358 (9) 4783 400

France & North Africa +33 (0) 1 69 86 80 34

Germany +49 (221) 94 77 400

Hong Kong (852) 2585-6688

India (91) 80-2275577

Italy +39 (02) 25086 1

Japan 81 (3) 3448-3111

Mexico, Central America & Caribbean 52 (55) 56666-333

The Netherlands +31 (0) 23 569 5555

Norway +47 22 07 07 00

People's Republic of China 86 (10) 6235 1230

Poland +48 (0) 22 521 53 40

Republic of Korea 82 (2) 528-5299

Russia, CIS & The Baltics +358 (9) 4783 400

South Africa +27 11 254 8360

Spain +34 (91) 372 6055

Sweden +46 8 477 6503/4

Taiwan 886 (2) 2722-9622

United Kingdom & Eire +44 (0) 1344 392400

USA 1 (800) 426-2200

USA (Export Sales) 1 (503) 627-1916

For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

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06/02 HB/XBS

21W-14844-1

▶ AD953-II MPEG Test System Platform - Options

| Interface Card Options | Modes | Bit Rate | Connector |
|------------------------|-------------------------------------|---|---------------------------|
| GPSI Interface | SMPTE310M | 19.392 Mb/s and 38.785 Mb/s (support for 8 VSB & 16 VSB) to 48 Mb/s | BNC in BNC out |
| | DHEI | | |
| GPSI-II (DHEITX/RX) | ECL (AC) I | To 50 Mb/s | 26 Way High Density D |
| | ECL (DC) | To 50 Mb/s | |
| GPSI-II + (DHEITX/RX) | RS422 differential SSI (DVB serial) | 20 Mb/s 1 to 44 Mb/s | 26 Way High Density D BNC |
| L-Band/RF input | See separate data sheet | 15 to 30 Mb/s | F-Type |
| ASI and M2S (DIVICOM) | Data, packet burst | 270 Mb/s tx rate 0 to 90 Mb/s data rate 100 Mb/s transmission rate | 0 to 90 Mb/s data rate |