

# MPEG Test Systems

## ► MTS400 Series



### Introduction/Overview

The MTS400 Series is a new class of analysis tool, the world's first Compressed Digital Video Debugger/Analyzer that introduces CaptureVu™, a new-to-market capability that captures and analyzes system events in real time to debug the intermittent and complex problems that traditional analyzers miss. The MTS400 Series offers significant enhancements over traditional MPEG analyzers and operates both in real time (live streams) and deferred time (stored streams). The combination of real-time error capture, an innovative high-speed analysis engine, and built-in intelligence allows ultra-fast pinpointing and debugging of intermittent faults in MPEG transport streams. The MTS400 Series also introduces Real Time Video over IP analysis and recording, both as a component of MTS400 Test System instruments and as an MTS4SA stand-alone application for users' own

Windows PCs equipped with a standard 10/100 or Gigabit Ethernet Network Interface Card (NIC).

Tektronix' industry leadership offers the broadest (across multiple standards and video layers) and deepest (in depth of generation and analysis) solution for compressed video test. The MTS400 series can be applied anywhere, at any level, to diagnose and solve the most subtle, complex and intermittent DTV problems in the minimum time. The MTS400 Test System instruments generate, record and analyze at the highest ASI data rate possible (approximately 214 Mbps). A comprehensive suite of analysis tools includes Transport Stream (TS) compliance, buffer, PES, compressed video and audio elementary stream analyzers, together with TS editor, multiplexer and Data Broadcast applications for stream creation, analysis and error-injection.

**Test Equipment  
Depot**  
1-800-517-8431

## ► Features & Benefits

CaptureVu™ Technology Captures and Analyzes System Events in Real Time and Deferred Time to Debug the Intermittent and Complex Problems that Traditional Analyzers Miss

Real Time Video Over IP Analysis and Recording

Analyzes Stored Transport Streams at Up to 400 Mbps to Greatly Reduce Analysis Time

Innovative "Program Centric" User Interface Brings Expert Power to the Novice User

Broadest and Deepest Range of Analysis of Legacy and Next-generation Compressed Standards Including MPEG-2, MPEG-4, H.264, VC-1, 3GPP and DVB-H

Customizable Scripting Supports the Broadest Range of Ratified and Evolving Worldwide DTV Standards (ATSC, DVB and ISDB) and Includes Local Language Service Information

## ► Intended Applications

### **MTS430 Solution for Equipment Manufacturers - Research and Development**

CaptureVu Technology Allows Rapid Isolation and Debugging of Equipment and System Faults

Multiplexer/Re-multiplexer Allows Test Stream Creation and Modification

Rapid and In-depth Analysis of Selected Elements of Transport Streams to Confirm Functionality and Compliance to Standards

### **MTS400 Solution for Broadcasters and Network Operators**

CaptureVu Technology Allows Isolation of Intermittent Network Problems that Other Analyzers Would Not Be Capable of Isolating

Encoder and Other Equipment Fault Diagnosis and Evaluation

Analysis of Transport Streams to Confirm Correct System Operation and Isolate Faults During Installation and Commissioning

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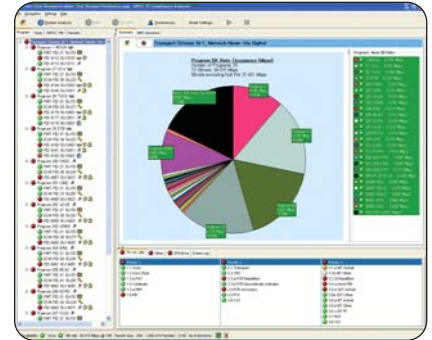
Standards compliance is ensured through in-built customizable scripting supporting the broadest range of ratified and evolving DTV standards, including ATSC, DVB-C, DVB-H, DVB-S, DVB-T, ISDB-S, ISDB-T and MPEG. To keep analysis up to date, flexibility is the key. New standards and proprietary tables can easily be catered for by loading Tektronix supplied updates, or creating your own custom scripts. The MTS400 Series instruments include a large integrated LCD display with a powerful 2.8 GHz processor with support for multiple physical layer interfaces, such as ASI, SPI, SMPTE 310M and Gigabit Ethernet. All units come supplied with 144 GB of video stream disk storage as well as a DVD reader/writer.

### Technical Features

- CaptureVu™ technology captures and analyzes system events in real time and deferred time
- New analysis engine that can analyze at up to 400 Mbps offers greatly reduced deferred analysis time (up to 90% reduction compared with traditional analyzers)
- Powerful TS compliance analyzer with CaptureVu technology – both in real time and deferred time
- ASI Analysis, Record and Playout to the maximum possible bit rate (214 Mbps)
- Video over IP Analysis with CaptureVu technology and Video over IP Recording (specified to 100 Mbps)
- DVB-ASI, 10/100/1000Base-T, SMPTE 310M and SPI/LVDS (DVB-Parallel) Transport Stream Interfaces

- Duplex ASI operation (one input, one output simultaneously) offers end-to-end system test (maximum aggregate bit rate is 214 Mbps for simultaneous input and output operation)
- Powerful user-definable scripting offers flexibility to adapt product for customers' own protocols
- Elementary Stream Analysis support (including H.264, VC-1, MPEG-2, MPEG-4 and 3GPP)
- PES and Buffer Analysis, Multiplexer and Data broadcast Generation and Analysis support
- MPE, SFN and DVB-H table support
- H.264, VC-1, MPEG-2, MPEG-4 and DVB-H signaling and bit-rate support as standard
- Comprehensive PCR graphing and measurement (Accuracy, Arrival Interval, Overall Jitter, Frequency Offset and Drift Rate)
- PTS distance/arrival time graphing and measurement
- Bitrate measurements to TR 101 290 MGB2 Profile
- Unicode support displays service information in the user's local language (including double-byte character sets such as Chinese and Japanese)
- Error logs can be output in CSV or XML formats for compatibility with office applications
- Transport Stream Editor, Transport Stream Cutter and Transport Stream Make Seamless applications
- Fast 2.8 GHz Pentium P4 CPU, 80 GB system disk storage, 144 GB video stream disk storage, 1GB memory and additional 10/100Base-T Ethernet interface for integration with user networks

- Portable form factor with integrated LCD screen
- Future software and hardware option expandability
- Windows XP Operating System
- MTS4SA Standalone Software supports Windows NT 4.0, 2000 and XP Operating Systems



### Applications

#### Summary of Displays

- Program Centric summary screen with go/no-go error indication of user-specified tests
- CaptureVu technology/trigger views
- Tests display
- PCR and PTS graphing and measurement display
- SI/PSI/PSIP display
- Real time and deferred time EPG display
- Section and packet view
- Real time and deferred time analysis share the same displays and user interface

## Transport Stream Compliance Analyzer

The MTS400 MPEG Transport Stream Compliance Analyzer (TSCA) enables you to monitor and interpret the contents of real-time or previously recorded or synthesized transport streams using the latest ATSC, DVB, ISDB-S, ISDB-T and MPEG standards.

The analyzer is specifically designed to enable you to quickly locate and identify 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.

You 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 also be purchased to run stand-alone on computers with Microsoft Windows NT 4.0, Windows 2000 or Windows XP operating systems. Separate packages are available for Deferred Time Analysis and Real-time Video over IP Analysis. Both packages offer CaptureVu™ technology and PCR measurement and graphing capabilities.

## 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-T and ISDB-S table types
- Data summaries and automated filters simplify the analysis of complex transport streams

- TR 101 290 Priority 1, 2 and 3 tests
- Syntax analysis and display supported for ISDB-T, TMCC, and IIP data
- Consistency checks performed between SI, TMCC and IIP data
- Proprietary PSI/SI syntax section rate error testing
- Informational logging of detected errors
- Unicode support enables service information to be displayed in Japanese, Chinese or other languages

## Deferred and Real-time Modes

The TSCA can be run in deferred time or real time. Deferred-time analysis mode is available on any recommended platform (including users’ own PCs). In deferred-time analysis mode, a stored stream can be analyzed and viewed at any time. Real-time analysis is available as standard with the MTS400 and MTS430 MPEG Test Systems. Real-time monitoring of Video over IP is also available as a stand-alone application for running on a user’s own PC. 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.

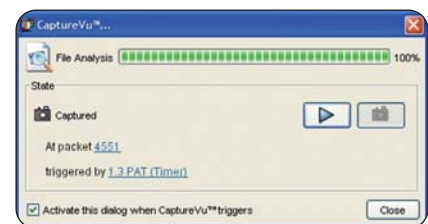
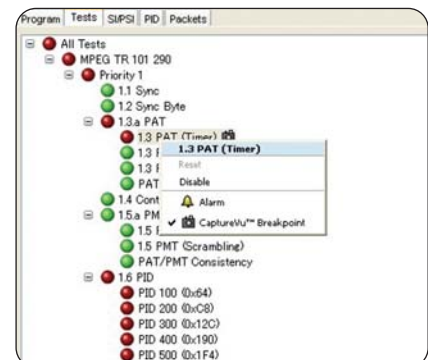
## TSCA User Interface

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 Triggering

### 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 pre-buffers 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 re-analysis with the deferred-time TSCA application. This powerful debug mode enables fast debugging of troublesome intermittent problems.



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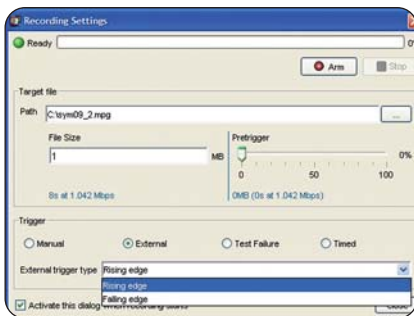
## ► MTS400 Series

### Triggered Recording

The MTS400 Series also supports triggered recording, allowing the user to set up a sophisticated trigger condition. When the trigger condition is met, the live Transport Stream is captured to disk without stopping or pausing real-time analysis.

### Trigger Sources and Conditions

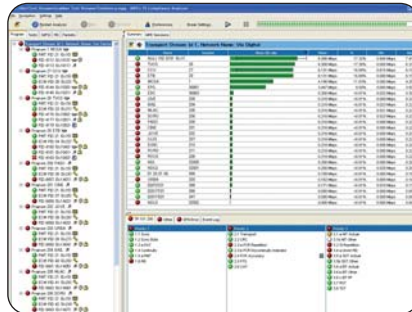
- TR 101 290 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> priority tests or ATSC and ISDB tests
- Multiplex occupancy outside of user-defined limits
- External TTL Trigger
- Date and time
- In triggered recording mode, the size of the pre-trigger buffer can be specified as a percentage of the overall file size range from 0 to 100%



### Program View

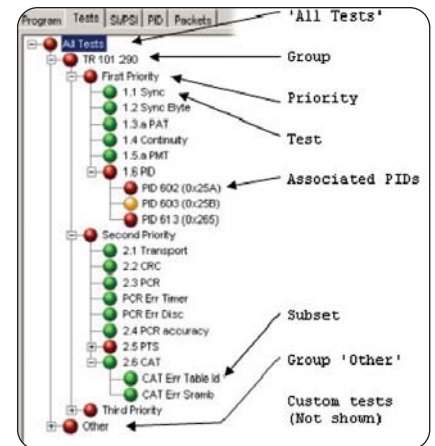
The Program view provides a fast overview of the transport stream contents in terms of program content, bit rate use by each program and ATSC, DVB TR 101 290 or ISDB test results. Red, amber and green LEDs highlight errors associated with each program or element.

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.

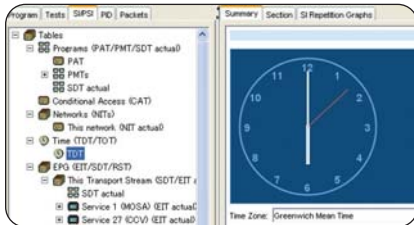


### Tests View

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 first, second and third priority tests included in TR 101 290 standard, tests are available for PCR jitter 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, ISDB-T and ISDB-S streams.

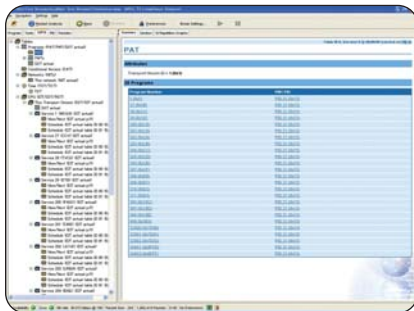


### SI/PSI and PSIP (Tables) View



The SI/PSI and PSIP Table 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.



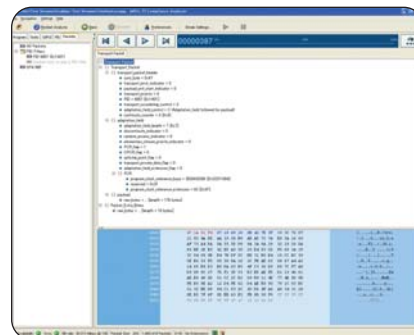
### PID View

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-orientated 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 will be 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.

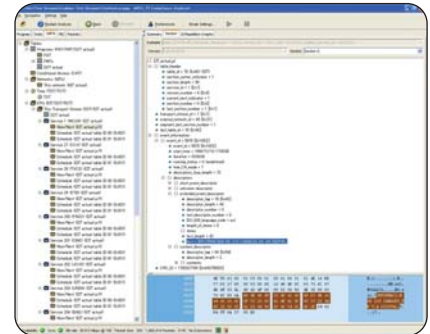
### Packet View

The Packet view displays information about all of the packets found in the transport stream grouped according to content. These groups include PID value, SFN Mega-frame initialization packets (MIPs to DVB only) and information packets (IIPs to ISDB-T only). When you select a specific PID or MIP, only packets carrying that particular PID or MIP are displayed.



### Section View

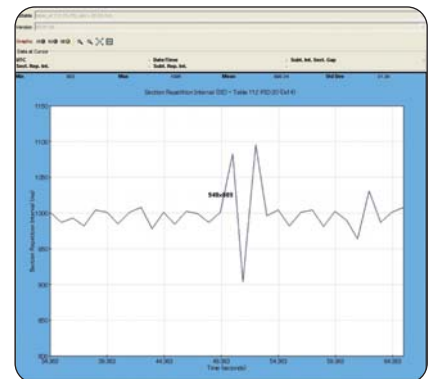
The Section view uses customizable script files, which allow you to specify and view proprietary information.



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 sub-tables are easily analyzed and directly traceable to packet data.

### Section Graphing

Section repetition interval – this graph displays the interval between two sections of a table on a particular PID.



Sub-table intersection gap – this graph displays the interval between sections in a particular sub-table.

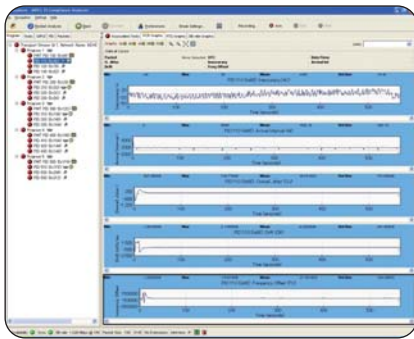
Sub-table repetition interval – this graph displays the time between receiving one complete sub-table and receiving the next complete sub-table.

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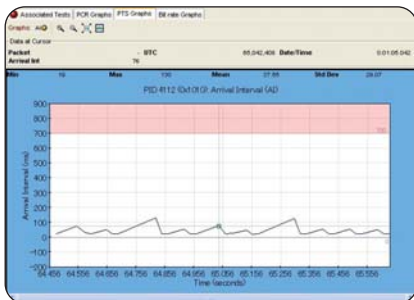
### PCR Analysis

The MTS400 Series supports comprehensive PCR measurements to the TR 101 290 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.

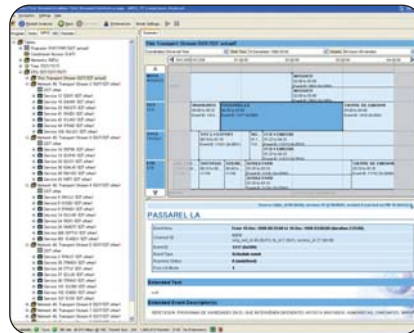


PCR graphs are available in real time and deferred time. Time stamping data ensure that these can be captured and viewed on stream recordings. This timestamp is compatible with recordings from other Tektronix equipment including the MTM400 Transport Stream monitor. Selectable MGF filters provide maximum flexibility and compatibility in these important PCR measurements.

The MTS400 Series is also able to display PTS Arrival Interval graphing in real time or deferred time as shown.



### 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 currently displayed in the event panel. The services displayed will depend on the node selected in the navigation view. ATSC, DVB and ISDB EPGs are supported.

#### Event Panel

This 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 tool-tip) 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:

- 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 signalled since the view became active. Information displayed for each session includes:

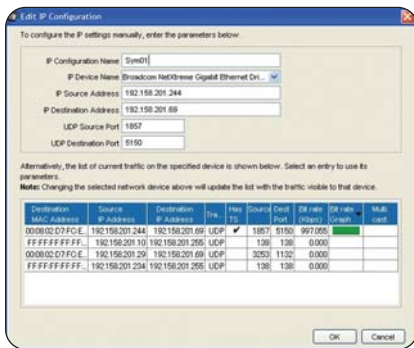
- PID
- MAC address
- Network layer source and destination IP addresses
- Transport layer protocol and port numbers
- Total data transmitted by the session so far since monitoring commenced
- Instantaneous bit rate using MGB1 profile

### DVB SFN

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

## GigE Interface for Video Over IP Analysis and Recording

Two Ethernet ports are fitted as standard to the MTS400 Series, one 10/100 and one 10/100/1000Base-T. This allows connection to a corporate LAN while simultaneously using the second port 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 and extraction to disk.<sup>\*\*1</sup>



UDP sessions carrying MPEG TS traffic are indicated and may be selected for analysis and recording, in a similar manner to any other physical interface. Real-time Video over IP analysis is also available as a stand-alone software package for use on any PC with a standard NIC card. Transport Stream packets are time-stamped as they are received from any Network Interface Card, allowing PCR measurements and graphing to be supported both on the MTS400 Series instruments and on a user's own PC.

<sup>\*\*1</sup> Network traffic loading is specified to 100 Mbps maximum bit rate.

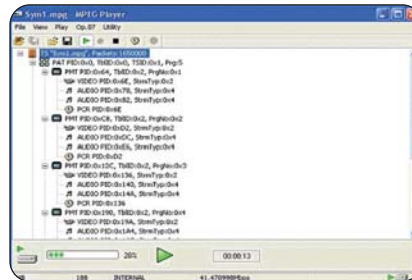
## Log Entry Format

Each log entry consists of time stamp from the system clock in real time and PCRs in deferred time.

- ▶ Error Reference. This would normally be a PID or Program
- ▶ Event description can be in local language
- ▶ Errors per stream and per PID. Circular log of 10 Kb entries, with overwrite warning
- ▶ Logs can be viewed in entirety or filtered pertaining to PID, Program test or test and PID
- ▶ Log files can be saved in CSV or XML format for subsequent analysis

## Playback (Transport Stream Generation) and Recording

Both playback and recording are supported as standard on both the MTS400 and MTS430 MPEG Test Systems. Both instruments also support simultaneous playback and recording (duplex operation).



## Playback

Continuous playback of looped streams is possible at up to maximum ASI rate of 214 Mbps with automatic updating of time stamps. One-shot play or selected file segment looping is possible. Playback rate can be automatic from file PCRs or manually set. Simultaneous playback and recording (duplex operation) for end-to-end system test is supported as standard with a maximum aggregate bit rate of 214 Mbps.

## Continuous Time Stamping

The transport stream player application offers a "Continuous Time-Stamp" option. This provides real-time modification of 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 to DVB only)
- ▶ Time and Date Table (TDT to DVB only)
- ▶ System Time Table (STT to ATSC only)
- ▶ Normal Play Time (NPT to MHP)
- ▶ Reed Solomon (ISDB-T only)

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

## Recording

Time-stamped transport stream recording can be made with packet arrival time information stored for offline PCR timing analysis. The maximum record length is limited only by available disk space. It is not necessary to pre-allocate a file before recording.

## Triggered Recording

It is possible to make either an immediate or triggered recording, with the user definable pre-trigger buffer being used to capture stream before, during or after the trigger point.

Complete Transport Streams are recorded, with recorded file parameters being displayed upon completion. These include file size, bit rate, number of packets, trigger conditions, trigger position and time.

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#### Other Applications

##### Creating, Editing and Re-sizing Transport Streams

Two direct stream manipulation packages are supplied as standard with all MTS400 Series products. TS Cutter allows re-sizing of Transport Streams, while TS Editor allows direct editing of Transport Streams using a hexadecimal view as well as a header interpretation guide.

##### 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 Transport Streams.

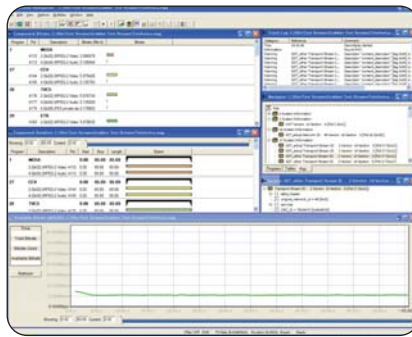
##### Stream Creation and Manipulation

Use the Multiplexer/Re-multiplexer/De-multiplexer application to create multi-program Transport Streams with custom SI/PSI/PSIP information for DVB, ATSC, ISDB and MPEG compliant Transport Streams (see detail below).

##### Multiplexer and DVB/ATSC Table Editor

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/Re-multiplexer/De-multiplexer application to create multi-program Transport Streams with custom SI/PSI/PSIP information for DVB, ATSC, ISDB and MPEG compliant Transport Streams.



##### The Tektronix Multiplexer/Re-multiplexer/De-multiplexer Application Supports:

- MPEG-1 Video
- MPEG-1 Audio
- MPEG-2 Video
- MPEG-2 Audio
- AC-3 Audio
- MPEG-2 Video PES (packetized elementary streams)
- MPEG-2 Audio PES
- AC-3 Audio PES
- AAC Audio
- 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 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. The software's built-in knowledge of table syntax and descriptors ensures compliance and high-quality output of the final multiplexed transport stream.

##### De-multiplex Existing Streams

The Multiplexer accepts any recorded transport stream as an input source. The user can then De-multiplex this transport stream into its component PES. The user can then save the resulting PES and ES streams onto disk. The De-multiplexer is elementary stream agnostic and can be used to extract H.264 and VC-1 Elementary Streams from a Transport Stream.

##### 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 (such as Teletext/Closed Caption and MHP applications) with the original timing preserved. PIDs can be re-mapped as required.

##### Component Views and Available Bandwidth View

The Component Bit Durations view graphically displays the durations as well as start and stop times for each video or audio content PID. Duration and start and 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 or optimize.

##### Map, Check and Rebuild Your Own Multiplex

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

##### Generate Compliant Timing and Output Bit Rates as Required

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

### Create, Add or Modify SI/PSIP Flexibility

The Multiplexer allows all the standard ATSC/DVB/ISDB and MPEG PSIP/SI 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.

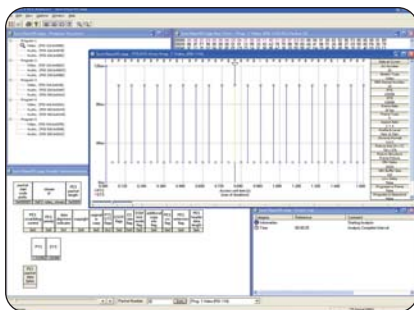
### Expert and Standard Modes

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

### Wizards for Common Tasks

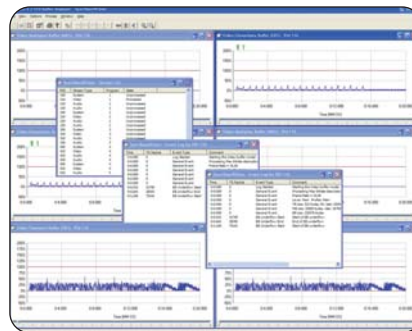
- ▶ Create new Transport Streams
- ▶ Specify ATSC, DVB, ISDB and MPEG standards
- ▶ Add programs
- ▶ Add events

### Packetized Elementary Stream (PES) Analyzer



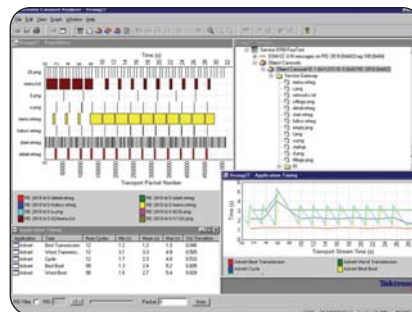
- ▶ Analyzes PES headers
- ▶ Analyzes presentation and decode time stamps (PTS/DTS)
- ▶ Detects encoder drift against real-time errors

### Buffer Analyzer



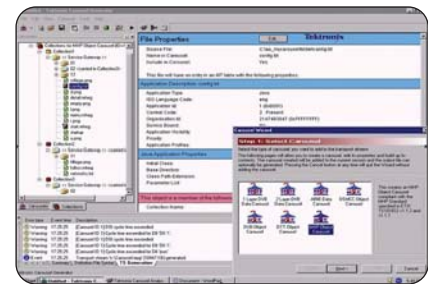
- ▶ Verifies encoder is correct using T-STD buffer analysis
- ▶ Processes video, audio and system control streams to ISO/IEC 13818 parts 1-3, AC-3 (A/S2) and AAC 13818 part 7

### Carousel Analyzer



- ▶ Analyzes stored Transport Streams
- ▶ Provides analysis and display of:
  - Carousel Signalling
  - Carousel Transport
  - Data Carousels (MPEG, DVB and ARIB B24)
  - Object Carousels (MHP and MHEG-5)
  - View objects (including GIF, JPEG, PCX, PND, .txt and MPEG "I" frame backdrops)
  - Extract and Save Objects
- ▶ Drag and Zoom Graphing
  - Repetition rates
  - Carousel cycle times
  - Entity cycle times
  - PID and component bitrates
  - Bandwidth
  - Application load timing statistics
- ▶ Comprehensive error reporting

### Carousel Generator



- ▶ Wizard helps easy stream generation
- ▶ Built-in Multiplexer for easy video and audio insertion
- ▶ Variable delivery weightings to optimize carousel load times
- ▶ Generates all required SI tables for terrestrial, satellite and cable applications
- ▶ Integrates with the Tektronix Carousel Analyzer for load time optimization

### Next-generation Video Elementary Stream Analyzer



### Applications

- ▶ Semiconductor manufacturers
- ▶ Developers of set top boxes, encoders and decoders
- ▶ Broadcasters, mobile and fixed network operators

# MPEG Test Systems

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### Standards

- MPEG-2
- MPEG-4 Part 2 and MPEG-4 Part 10 (H.264/AVC)
- VC-1
- H.263+, H.263, H.261
- Container/Wrapper format support includes: 3GP, MP4, ASF, Transport Stream and Program Stream

### Features

- Display motion vectors, variable-size macroblocks and types
- Buffer analysis
- Powerful syntax checking alerts and macro-block semantic parsing and interpretation
- Picture thumbnail navigator
- Frame-by-Frame graphing
  - Bits per MacroBlock
  - Bits per coded MacroBlock
  - Motion vector histogram
  - DCT frequencies
  - Average quantization
  - Coding frequency
  - Intra-coding frequency
- Picture Fidelity Analysis
  - PSNR
  - Root mean square error
  - Mean square error
  - Mean absolute difference
  - Sum absolute difference
- Powerful Batch Mode
  - Analyze from command-line/batch file/script file
  - Automatically test thousands of video files
  - Use for regression testing and algorithm comparison
  - Alert functions logging
  - Analysis trace logging
  - YUV decoding to a file

## ► Characteristics

### ► Platform Characteristics

Operating System	Microsoft Windows XP Pro
Processor	Intel Pentium P4, 2.8 GHz minimum
Disk Storage for Operating System and Software Applications	80 GB, Ultra ATA100 IDE Hard Drive
Disk Storage for Captured Video Streams	144 GB (two x 72 GB SCSI hard disk drives)
Video Stream Storage Disk I/O Port	SCSI-3 (Ultra 160), Micro D68 connector, 68 pin
RAM	1 GB (one SIM of DDRS memory)
Optical Storage Drive	CD-R/W, DVD-R/RW, DVD+R/RW
Floppy Disk Drive	3.5 inch, 1.44 MB high-density double sided (2 HD)
Display	LCD, 1024x768, 10.4 inch
External VGA Output	15-pin, high density, D-Sub. Resolution needs to be set to the same as the integral LCD display
Ethernet	One 10/100Base-T; RJ45 connector One 10/100/1000Base-T; RJ45 connector
Keyboard port	Mini DIN, PS-2, one at the rear and one at left front side (not hot pluggable)
Mouse port	Mini DIN, PS-2, one at the rear and one at left front side (not hot pluggable)
Printer Port	IEEE P1284
COM Port	RS-232
USB Port	USB 1.0

### Instrument Characteristics

#### ► External Reference/Clock Input

Input Connector Type	50 $\Omega$ , BNC, AC Coupled
Frequency	8.12698 MHz, 10 MHz, 27 MHz ( $<1$ ppm recommended)
Amplitude	0 $\pm$ 6 dBm (Peak-to-Peak, Sine Wave), 0.5 V to 3.0 V (Square Wave)
Clock Inputs	
Frequency	160 KHz to 25 MHz (Parallel Clock), 1.28 MHz to 32 MHz (Serial Clock)
Amplitude	0.5 V to 3.0 V (Square Wave)

**Instrument Characteristics (continued)****► External Trigger Input**

Input Connector Type	1 k $\Omega$ , BNC
Threshold Level	Rising/Falling edge programmable
High Level	>3.5 V (the maximum limit voltage is 7 V)
Low Level	<0.8 V

**► SPI I/O**

SPI Input Connector Type	D-sub 25 pin
Output Amplitude	240 mV to 550 mV BUS LVDS with 100 $\Omega$ termination
Data Rate	250 kbps to 108 Mbps (in accordance DVB specification maximum)
Output Impedance	100 $\Omega$ between differential outputs with "Output Off"
Data Delay	$\pm 5$ ns from DCLK rising edge
Input level	>200 mV <sub>pk-pk</sub> (RI+)-(RI-) with 100 $\Omega$ termination
Input Impedance	100 $\Omega$ between differential inputs

**► ASI**

Connector	BNC (uses a common connector with the SMPTE 310M interface) 75 $\Omega$ transformer coupled input and output 800 mV $\pm 10\%$ into 75 $\Omega$ load output 200 mV to 880 mV input Return loss less than -17 dB (5 MHz to 270 MHz) into a 75 $\Omega$ load
Bit Rate	250 kbps to 214 Mbps (in accordance DVB specification maximum) input and output aggregate bit rate (simplex or duplex operation)

**► SMPTE 310M**

Connector	BNC (uses a common connector with the ASI interface) 75 $\Omega$ transformer coupled input and output 800 mV $\pm 10\%$ into 75 $\Omega$ load output 200 mV to 880 mV input return loss less than <-17 dB (5 MHz to 38.785316 MHz) at 75 $\Omega$ load
Bit Rate	19,392,658.5 b/s

**Stand-alone Software System Requirements**

(Required when software is purchased to be installed on a user's own PC)

- PC with Genuine Intel Pentium class 1.2 GHz processor
- Intel or 100% compatible motherboard chipset
- Windows NT 4.0, Windows 2000 or Windows XP Operating System
- Internet Explorer 5.0 or above
- 256 MB of RAM
- 500 MB of available hard disk space for the applications and documentation
- Additional space will be required for storage of captured video streams
- SVGA (800x600) resolution video adapter and monitor (XVGA (1024x768) or higher resolution recommended)
- CD-ROM or DVD drive
- 3.5" floppy disk drive
- Keyboard and Microsoft mouse or compatible pointing device
- Video over IP Analysis option requires a standard Network Interface Card (NIC)
- Detailed graphical displays provided by the next-generation compressed video analyzer (MTS4EA) require Microsoft Excel

## MPEG Test Systems

### ► MTS400 Series

## ► Ordering Information

### ► MTS430 (Equipment Manufacturers) Base System and Standard Options

Item	Option	Description
MTS430		MTS430 MPEG Test System includes: Real-time and Deferred-time Transport Stream Compliance Analyzer with CaptureVu™ technology, Real Time Video over IP Analysis, Simultaneous Play/Record on one channel, Multiplexer, PES Analyzer, Buffer Analyzer, TS Editor, TS Cutter and Make Seamless Applications
MTS430	ES	Add ES Analyzer
MTS430	DB	Add Carousel Analyzer
MTS430	CG	Add Carousel Generator
MTS430	DBCG	Add Carousel Analyzer and Carousel Generator
MTS430	R3	Repair service 3 years
MTS430	R5	Repair service 5 years
MTS430	L0	English documentation
MTS430	L5	Japanese documentation
MTS430	A0	North American power
MTS430	A1	Universal Euro power
MTS430	A2	United Kingdom power
MTS430	A3	Australia power
MTS430	A4	240 V North America power
MTS430	A5	Switzerland power
MTS430	A6	Japan power
MTS430	A10	China power
MTS430	A99	No power cord or AC adapter

### ► Add MTS4EA Compressed Video ES Analyzer onto MTS430 System at Initial Time of Ordering

Item	Option	Description
MTS430	4EAB	Base software with video standard package including: MPEG-4 Simple Profile, H.263+, H.263, H.261, TS Extraction, CD and manual
MTS430	M4SP	MPEG-4 Advanced Simple Profile (Levels 0 to 5)
MTS430	M2ML	MPEG-2 Main Profile Main Level
MTS430	M2HL	MPEG-2 Main Profile High Level and High Level 1440 (high definition)

## ► Add MTS4EA Compressed Video ES Analyzer onto MTS430 System at Initial Time of Ordering (continued)

Item	Option	Description
MTS430	AVCE	H.264/AVC Baseline and Extended Profiles (Levels 1 to 5)
MTS430	AVCM	H.264/AVC Main Profile (Levels 1 to 5)
MTS430	AVCH	H.264/AVC High Profile with FExt (10 bit, 4:2:2:, 4:4:4)
MTS430	VC1	VC-1 (all Profiles, all Levels) and Windows Media V9 (ASF)
MTS430	AUD	Audio (including AAC, HE AAC)
MTS430	SWSE	First 12 months software subscription on the MTS4EA software and its options purchased with a new MTS430. (Does not cover the MTS430 base software and standard options)

## ► MTS400 (Network Operators) Base System and Standard Options

Item	Option	Description
MTS400		MTS400 MPEG Test System includes: Real-time Transport Stream Compliance Analyzer with CaptureVu™ technology, Simultaneous play/record on one channel, TS Editor and TS Cutter applications
MTS400	TSCA	Add Deferred Time Transport Stream Compliance Analyzer with CaptureVu technology
MTS400	IPE	Add Real Time 10/100/1000Base-T Video over IP Analysis with CaptureVu technology
MTS400	MX	Add Multiplexer
MTS400	ES	Add ES Analyzer
MTS400	PB	Add PES and Buffer Analyzer
MTS400	DB	Add Carousel Analyzer
MTS400	CG	Add Carousel Generator
MTS400	DBC	Add Carousel Analyzer and Carousel Generator
MTS400	R3	Repair service 3 years
MTS400	R5	Repair service 5 years
MTS400	L0	English documentation
MTS400	L5	Japanese documentation
MTS400	A0	North American power
MTS400	A1	Universal Euro power
MTS400	A2	United Kingdom power
MTS400	A3	Australia power
MTS400	A4	240 V North America power
MTS400	A5	Switzerland power
MTS400	A6	Japan power
MTS400	A10	China power
MTS400	A99	No power cord or AC adapter

## MPEG Test Systems

### ► MTS400 Series

#### ► Add MTS4EA Compressed Video ES Analyzer onto MTS400 System at Initial Time of Ordering

Item	Option	Description
MTS400	4EAB	Base software with video standard package including: MPEG-4 Simple Profile, H.263+, H.263, H.261, TS Extraction, CD and manual
MTS400	M4SP	MPEG-4 Advanced Simple Profile (Levels 0 to 5)
MTS400	M2ML	MPEG-2 Main Profile Main Level
MTS400	M2HL	MPEG-2 Main Profile High Level and High Level 1440 (high definition)
MTS400	AVCE	H.264/AVC Baseline and Extended Profiles (Levels 1 to 5)
MTS400	AVCM	H.264/AVC Main Profile (Levels 1 to 5)
MTS400	AVCH	H.264/AVC High Profile with FExt (10 bit, 4:2:2, 4:4:4)
MTS400	VC1	VC-1 (all profiles, all levels) and Windows Media V9 (ASF)
MTS400	AUD	Audio (including AAC, HE AAC)
MTS400	SWSE	First 12 months software subscription on the MTS4EA software and its options purchased with a new MTS400. (Does not cover the MTS400 base software and standard options)

#### ► MTS4SA Stand-alone Software For Installation On A User's own PC

Item	Option	Description
MTS4SA		Stand-alone Deferred Time Software Package for installation on a user's own PC (see minimum system requirements)
MTS4SA	USB	USB security dongle supplied with Stand-alone software package
MTS4SA	PPD	Parallel port security dongle supplied with Stand-alone software package
MTS4SA	TSCA	Security dongle key to add Deferred Time Transport Stream Compliance Analyzer with CaptureVu™ technology
MTS4SA	TSCL	Security dongle key to add Deferred Time Transport Stream Compliance Analyzer with CaptureVu technology (file size limited to 200 MB)
MTS4SA	TSCR	Security dongle key to add Real-time Video over IP Transport Stream Compliance Analyzer with CaptureVu technology (for use with a standard network interface card)

## ► MTS4SA Stand-alone Software For Installation On A User's own PC (continued)

Item	Option	Description
MTS4SA	MX	Security dongle key to add Deferred-time Multiplexer
MTS4SA	ES	Security dongle key to add ES Analyzer
MTS4SA	PB	Security dongle key to add PES and Buffer Analyzer
MTS4SA	DB	Security dongle key to add Carousel Analyzer
MTS4SA	CG	Security dongle key to add Carousel Generator
MTS4SA	DBC	Security dongle key to add Carousel Analyzer and Carousel Generator
MTS4SA	L0	English documentation
MTS4SA	L5	Japanese documentation

## ► Upgrade or Add Standard Options After Initial Purchase of MTS400, MTS430 or MTS4SA

Item	Option	Description
MTS4UP		MTS400 Series Field Upgrade Kit
MTS4UP	DDP	Dongle Upgrade Disk – Parallel
MTS4UP	DDU	Dongle Upgrade Disk – USB
MTS4UP	TSCA	Upgrade to add Deferred-time Transport Stream Compliance Analyzer (available for MTS400 or MTS4SA only)
MTS4UP	TACL	Upgrade to add Deferred-time Transport Stream Compliance Analyzer file size limited to 200 MB (available for MTS4SA only)
MTS4UP	TSCR	Upgrade to add Real-time Video over IP Transport Stream Compliance Analyzer (available for MTS4SA only)
MTS4UP	IPE	Upgrade to add Real-time Video over IP Analysis (available for MTS400 only)
MTS4UP	MX	Upgrade to add Deferred-time Multiplexer (available for MTS400 or MTS4SA only)
MTS4UP	PB	Upgrade to add PES and Buffer Analyzer (available for MTS400 or MTS4SA only)
MTS4UP	ES	Upgrade to add ES Analyzer to any MTS400 Series product
MTS4UP	DB	Upgrade to add Carousel Analyzer to any MTS400 Series product
MTS4UP	CG	Upgrade to add Carousel Generator to MTS400 Series
MTS4UP	DBC	Upgrade to add Carousel Analyzer and Carousel Generator to MTS400 Series
MTS4UP	UPG	Upgrade to latest version of MTS400 Series base software and installed options. Includes CD and manual (does not include upgrades to MTS4EA software)
MTS4UP	IF	Return to depot installation of MTS4UP on an MTS400 or MTS430 only (not available with MTS4SA software installed on a user's own PC)

**Note:** To upgrade or add MTS4EA compressed video ES Analyzer options after initial purchase of MTS400 or MTS430 instruments, please see specific MTS4EA Ordering Information.