MPEG Test Systems

MTS400 Data Sheet

Features & Benefits

- Industry's fastest analysis engine enables reduced time to insight, rapid development, evaluation, deployment, and diagnostics of next-generation DTV and IPTV systems and services
- A wide range of DTV standards are supported, including MPEG, DVB, ATSC, ISDB, and **NEW** ISDB-TB*[1] (Brazil). Specific SI for Terrestrial, Cable, and Satellite, plus regional variations of these standards are also supported.
- Range of interfaces and analysis capabilities provide the necessary connectivity to diagnose problems anywhere in the network environment, whether that be transmission links (RF or IP layer) or content processing (TS layer).
- Integrated cross-layer fault analysis and logging provides a one-box solution for fault diagnosis, reducing time to insight when troubleshooting
- Playout functionality provides stimulus with parametric capabilities and IP multisession replication to characterize behavior of network or device under test
- CaptureVu™ technology captures and analyzes system events in real time and deferred time to debug the intermittent and complex problems that traditional analyzers miss
- Innovative program-centric user interface brings expert power to the novice user
- H.264 Buffer Analysis, Multiplexing, and ES Compliance Checking provide the most powerful suite of tools for creation and analysis of Transport Streams containing H.264 content
- **NEW**: Both Buffer Analysis and Multiplexing are now available for MPEG-4 AAC*[2], a mandatory ISDB-TB audio CODEC. These compliment the existing MPEG-4 AAC ES Compliance Checking
- **Try before you buy**: Demo versions of the TSCA, Multiplexer, and Buffer Analyzer are available to download

Tektronix®

Applications

Equipment Manufacturers - Manufacturing Test

- Equipment test is simplified and faster with CaptureVu™ and the High-speed Analysis Engine
- Multiplexer/Re-multiplexer allows custom test stream creation for fast and flexible equipment stress testing
- Stream Playout and Recording provides repeatable test sources with seamless looping and continuous time stamping for test and alignment of STBs, IRDs, and Modulators
- Duplex operation allows end-to-end testing of system network elements*3

Broadcasters and Network Operators

- RF and IP connectivity and analysis provide a single-box solution for broadcast system troubleshooting
- Integrated cross-layer fault analysis and logging for network fault diagnosis reduces time to insight when troubleshooting and removes the need for additional IP- or RF-specific diagnostic equipment
- CaptureVu ™ technology allows isolation of intermittent network problems that other analyzers would not be capable of isolating
- Tests contribution feeds or encoder outputs, multiplexer inputs/outputs, headend modulators, and IP encapsulators
- Tests PCR insertion, recovery, and regeneration equipment
- Encoder and other equipment for fault diagnosis and evaluation
- Analysis of transport streams to confirm correct system operation and isolate faults during installation and commissioning

*1 ISDB-TB available soon, please contact Tektronix for details.

*2 MPEG-4 AAC available soon, please contact Tektronix for details.

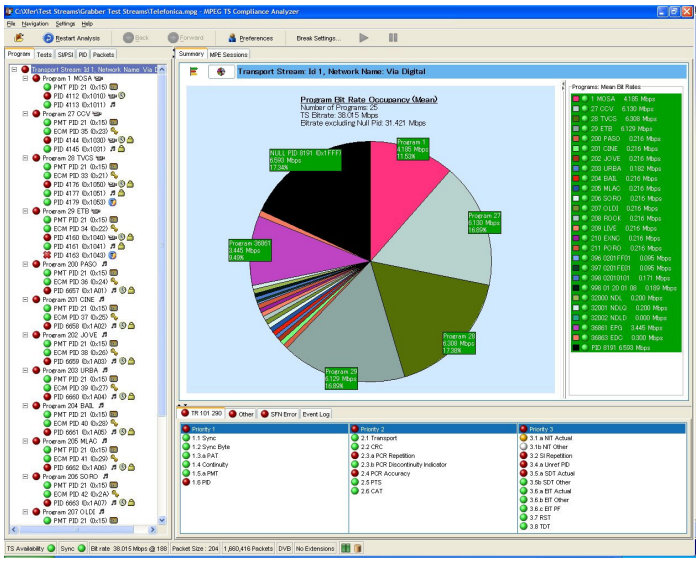
*3 Duplex is not available for Transport Streams over IP.

Summary of Tools

Further details of individual tools are available within the Additional Resources.

Transport Stream Compliance Analyzer (TSCA)

The TSCA offers significant enhancements over traditional software-based deferred-time (stored streams) MPEG analyzers. The combination of an



innovative high-speed analysis engine and built-in intelligence allows ultra-fast pinpointing and debugging of intermittent faults in MPEG Transport Streams used in next-generation DTV and IPTV systems and services.

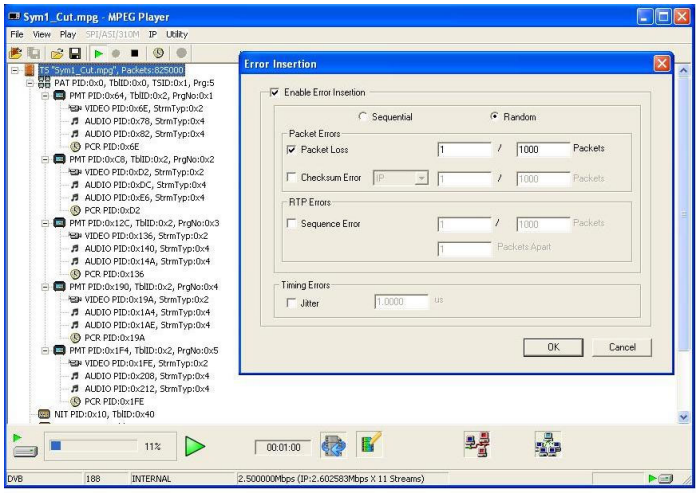
The TSCA also provides real-time analysis of Transport Streams received through the MTS430's stream interfaces, including IP and RF. The real-time analysis includes Cross-layer time-correlated IP and TS measurements, alarms, and error logging together with stream recording.

The TSCA includes the CaptureVu™ technology and PCR measurement and graphing capabilities. CaptureVu™ technology captures and analyzes system events in real time and deferred time to debug the intermittent and complex problems that traditional analyzers miss.

Standards compliance is ensured through built-in customizable scripting supporting the broadest ranges of ratified and evolving DTV standards, including ATSC, DVB-C, DVB-H, DVB-S, DVB-T, ISDB-S, ISDB-T, ISDB-TB, and MPEG. To maintain compatibility with the latest standards, 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.

Users can configure the TSCA software to display stream information in user-selected fonts. This feature enables you to view stream information in your local language or to use custom fonts.

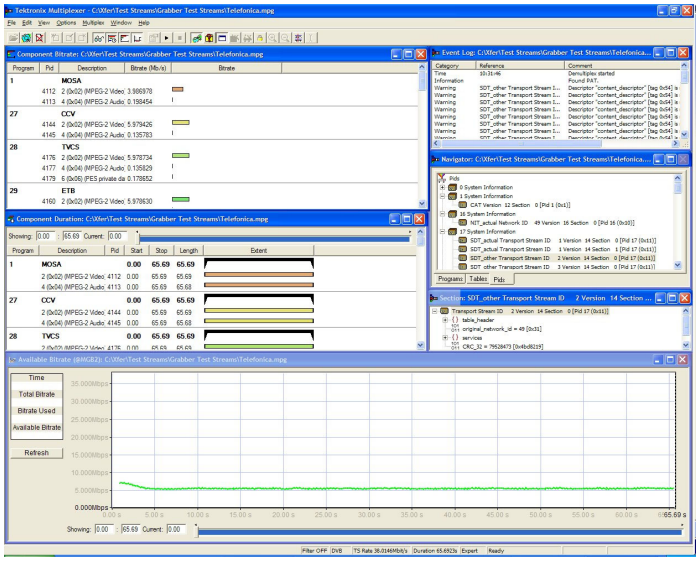
Duplex operation of the real-time TSCA and Player allows end-to-end system test (maximum aggregate bit rate is 214 Mb/s for simultaneous input and output operation)*3.



Playout (Transport Stream Generation) and Recording

The Player tool provides a Transport Stream stimulus for a device under test through the ASI, SMPTE310, LVDS (DVB Parallel), or IP stream interfaces. Continuous playout of looped streams is possible at up to maximum ASI rate of 214 Mb/s with automatic updating of time stamps. Playout rate can be automatically determined from file PCRs or manually set. Simultaneous playout and recording (duplex operation) for end-to-end system test is supported with the ASI/SMPTE310M and LVDS interfaces.

Playout through the IP interface provides stimulus with parametric capabilities and multisession replication to characterize behavior of a network or device under test. This capability enables equipment manufacturers developing hardware or software solutions for video distribution over IP and IPTV to ensure quality and performance of products, resulting in reduced development costs and accelerated rollout of next-generation IP broadcast services.



Multiplexer and SI 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 (Service Information) or other tables, or are multiplexed to the incorrect transport stream rate for the application.

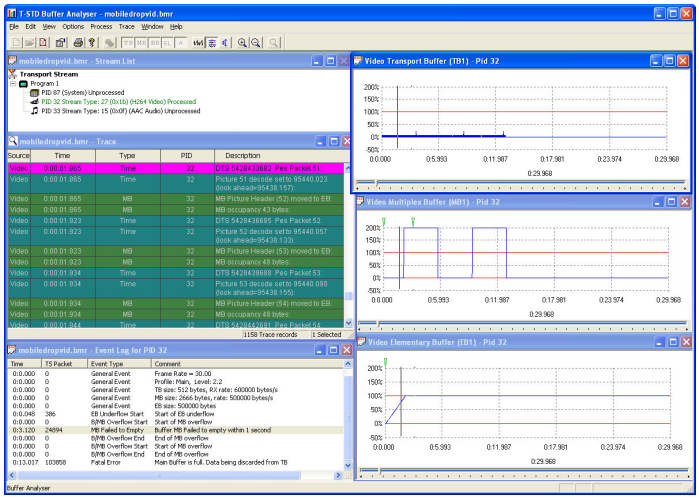
Use the Multiplexer/Re-multiplexer/De-multiplexer application to create and modify multiprogram Transport Streams with custom SI/PSI/PSIP information for DVB, ATSC, ISDB*[4], and MPEG-compliant Transport Streams.

Video and audio Elementary Streams may also be multiplexed into a Transport Stream. H.264 streams, both with and without SEI timing messages, are supported. Bit rate and frame rate auto-detection features aid the import process.

This enables the user to create their own test streams that they can use to validate and debug their designs more quickly, and also to create errored streams to perform parametric stress testing and ensure robustness and quality of their MPEG-2 or H.264 implementation.

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

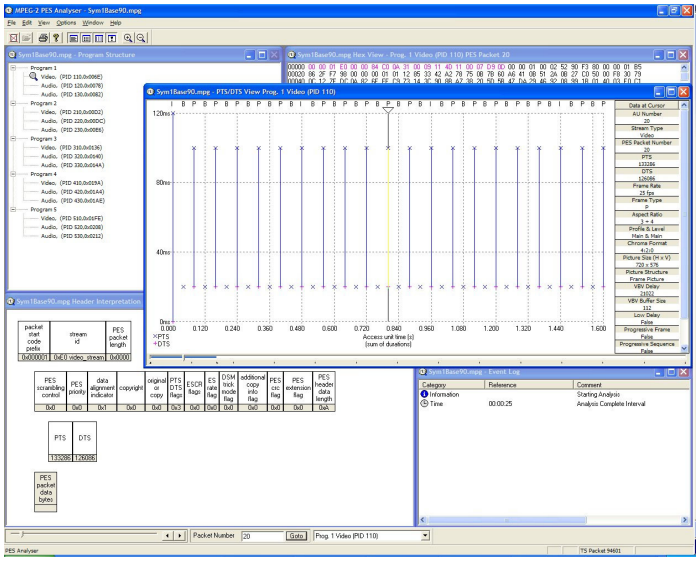
*[4] This includes ISDB-TB (Brazil) and Single Segment mode.

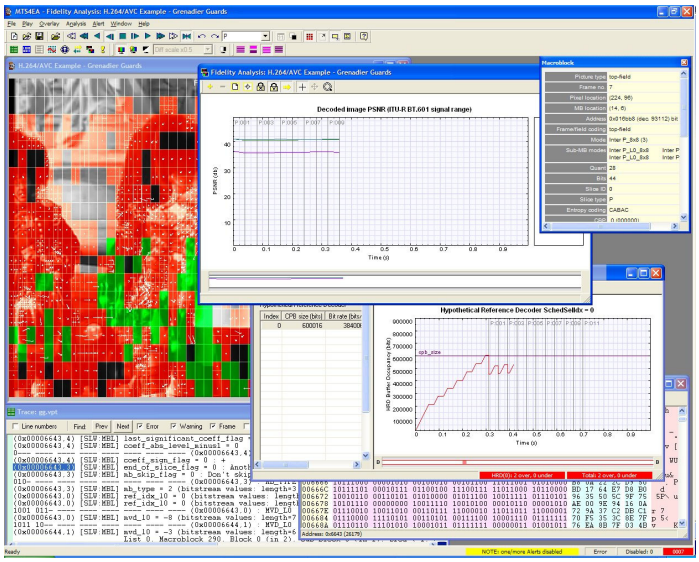


Buffer Analyzer

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

There are two types of buffer model; the one to use by the receiver is signaled within the Elementary Stream itself. The T-STD method is based upon the DTS values within the PES header and can be used for any contained CODEC type. Additionally, certain video CODECs such as MPEG-2 and H.264/AVC may contain buffer parameters within the ES itself. The Buffer Analyzer verifies conformance of a stream to the T-STD model. Verification of the H.264/AVC HRD method is covered by the MTS4EA product.





Packetized Elementary Stream (PES) Analyzer

When developing professional and consumer equipment, particularly encoders and set-top boxes, the characteristics of the test streams being either generated or used as stimulus need to be ascertained. The header associated with each PES packet is of particular interest, as it contains the decode and presentation time stamps (DTS and PTS) for the contained Elementary Stream. Errors in these time stamps may cause resets or picture freeze problems at the receiver in extreme cases. They are more typically the cause of lip sync problems where the time stamps of associated video and audio streams are not synchronized. The PES Analyzer is designed to help address these problems as well as verify conformance of the PES header contents to the MPEG, DVB and ATSC standards.

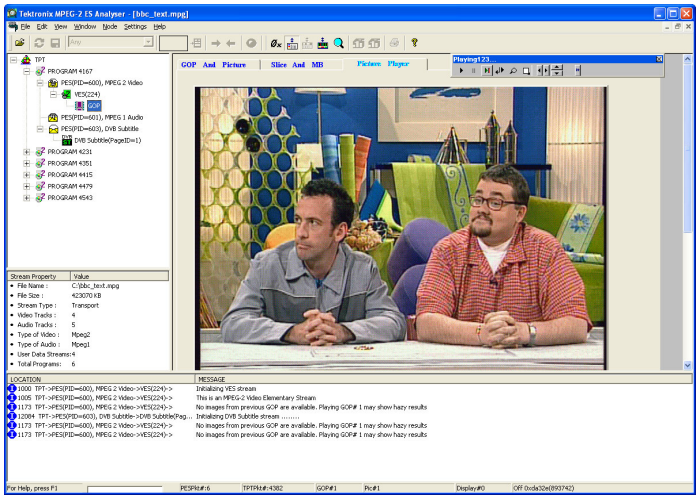
Creating, Editing, and Resizing Transport Streams

Two direct stream manipulation packages are supplied as standard with the MTS400. TS Cutter allows resizing of Transport Streams. TS Editor allows direct editing of Transport Streams using a hexadecimal view as well as a header interpretation guide.

MTS4EA ES Analyzer

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

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



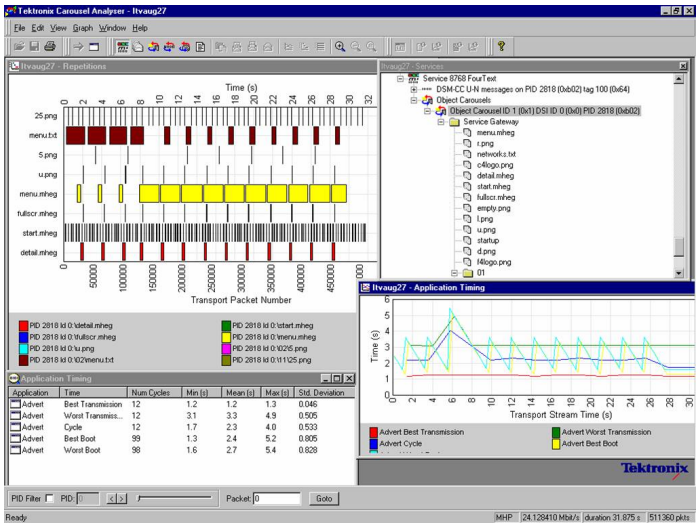
Elementary Stream (ES) Analyzer

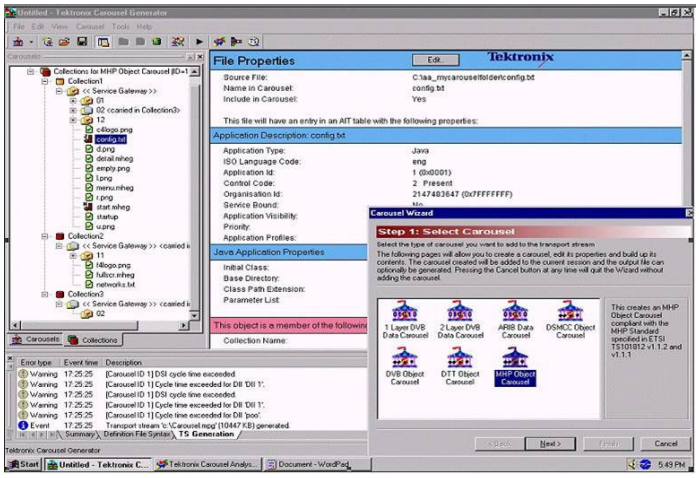
The ES Analyzer is intended for CODEC design, optimization, and conformance purposes. It provides the ability to view the moving picture from within a PES stream and carry out a whole range of sophisticated tests on the lower layers of an elementary stream within a Transport Stream. In addition, it both analyzes and displays a range of extended media formats, including ATSC Closed Captions, DVB Subtitles, and Teletext associated with video Elementary Streams.

For analysis of MPEG-4, AVC/H.264, and VC-1 as well as MPEG-2 Elementary Streams, please refer to the MTS4EA.

Carousel Analyzer

When developing either data or object carousels for interactive applications, designers not only need to verify the content of carousels, but also whether they are compliant with the relevant standards, and to optimize the settings between transmission bandwidth and responsiveness of the user experience. These settings are mainly concerned with the repetition rates of the various carousel groups. The Carousel Analyzer is designed to address all of these needs for a Transport Stream file containing carousel components. It analyzes carousels compliant with MPEG-2 DSM-CC, DVB (including MHP), DTT (MHEG-5), or ARIB standards.





Carousel Generator

The Carousel Generator product is used for creating object carousel contents within an output Transport Stream. This is particularly useful in test situations where the effects of varying parameters, such as individual repetition intervals, may be quickly ascertained. The generator will create object carousels conforming to the MPEG-2 DSM-CC, DVB, DTT (MHEG-5), or MHP standards.

Characteristics

Platform Characteristics

Characteristic	Description
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 (72 GB SCSI Hard Disk Drives x2)
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, 1024 × 768, 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 10/100-base T; RJ45 connector One 10/100/1000-base 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 2.0 x2

Instrument Characteristics

External Reference/Clock Input

Characteristic	Description
Input Connector Type	50 Ω, BNC, AC Coupled
Frequency	8.12698 MHz, 10 MHz, 27 MHz (<1 ppm recommended)
Amplitude	0 ±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)

External Trigger Input

Characteristic	Description
Input Connector Type	1 kΩ, 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

Characteristic	Description
SPI Input Connector Type	D-sub 25 pin
Output Amplitude	240 mV to 550 mV BUS LVDS with 100 Ω termination
Data Rate	250 Kb/s to 108 Mb/s (in accordance DVB specification maximum)
Output Impedance	100 Ω between differential outputs with “Output Off”
Data Delay	±5 ns From DCLK rising edge
Input Level	>200 mV $_{p\text{-}p}$ (RI+)-(RI-) with 100 Ω termination
Input Impedance	100 Ω between differential inputs

ASI

Characteristic	Description
Connector	BNC (uses a common connector with the SMPTE 310M interface) 75 Ω transformer-coupled input and output 800 mV ±10% into 75 Ω load output 200 mV to 880 mV input Return loss less than -17 dB (5 MHz to 270 MHz) into a 75 Ω load
Bit Rate	250 Kb/s to 214 Mb/s (in accordance DVB specification maximum) Input and output aggregate bit rate (simplex or duplex operation)

SMPTE310M

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

Standalone 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 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 (800 × 600) resolution video adapter and monitor (XVGA (1024 × 768) or higher resolution recommended)
- CD-ROM or DVD drive
- 3.5 in. 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

Interface Options Characteristics

GigE Interface (Option GBE)

Characteristics	Description
Ethernet Ports	The Ethernet Interface supports 1000 Mb/s data transmission. IEEE 802.3 compliant 1000 Ethernet interface supporting 1000BASE-T through copper to SFP adapter, 1000BASE-SX (multi mode), and 1000BASE-LX (single mode), 1000BASE-ZX.
Ethernet Optical port	
Optical operating mode	Single Mode or Multi Mode
Connector type	Duplex data link MSA-compliant SFP connector
Standard	1000BASE-X
Data format	NRZ
Ethernet optical transmitter/receiver	Single Mode 1550 nm SFP module Single Mode 1310 nm SFP module Multi Mode 850 nm SFP module
Ethernet Electrical Port	
Standard	1000BASE-T IEEE 802.3
Connector type	RJ-45
Data format 1000BaseT	Trellis encoded, PAM5 symbols full-duplex on 4-pair Cat-5 UTP per IEEE 802.3ab
Protocol Stack Support	IPv4 support UDP/IP/Ethernet UDP/IP/VLAN/Ethernet RTP/UDP/IP/Ethernet RTP/UDP/IP/VLAN/Ethernet
Multicast and Control Support	IGMP v2 support ARP
IP Packet Support	7 transport stream packets per IP packet FEC (FEC is parsed but is not processed)
Session Support	Discovery of all sessions/flows on the link with RTP/UDP, TS present indicator and Session bit rate display

COFDM Interface (Option CF)

Characteristic	Description
Input Frequency Range	50 MHz to 858 MHz
Channel Bandwidth	6 MHz, 7 MHz, and 8 MHz (SW selectable)
Connector Style	F-type with BNC adaptor
Input Termination Impedance	75 Ω nominal
Input Return Loss	7 dB typical 50 MHz to 858 MHz
Rx Lock Status	Indicated by LED on rear panel and by the UI
Modulation Scheme Supported	QPSK (4QAM), 16QAM, and 64QAM modulation
Transmission Modes	2K carriers and 8K carriers
Hierarchical Modes	All hierarchies are be supported, including no hierarchy, and alpha = 1, 2, and 4
Viterbi Puncture Rates	1/2, 2/3, 3/4, 5/6, 7/8
Guard Interval	1/32, 1/16, 1/8, 1/4
Spectrum Polarity	The receiver will operate with both inverted and normal spectral polarity
Input Signal Amplitude Range*[5]	QPSK (4QAM): -85 dBm to -15 dBm (24 dBuV to 94 dBuV) typical 16QAM: -80 dBm to -15 dBm (29 dBuV to 94 dBuV) typical 64QAM: -72 dBm to -15 dBm (37 dBuV to 94 dBuV) typical
RF Measurements	
Carrier offset	Carrier offset is measured from the tuned channel frequency to an accuracy of ±50 ppm typical
Signal to Noise Ratio (SNR)	Display Range: 6 dB to 40 dB for QPSK (4QAM) 11 dB to 40 dB for 16QAM 16 dB to 40 dB for 64QAM Resolution: 1 dB Accuracy: ±1 dB to 30 dB SNR (measured at -30 dBm in high-resolution mode) typical
EVM (Error Vector Magnitude)	Display Range: 1% to 30% RMS, for QPSK 1% to 20% RMS, 16QAM 1% to 8.5% RMS, 64QAM Resolution: 0.1%
Modulation Error Ratio (MER) with Equalizer	Both MER Peak and MER Average are displayed as measured across all carriers Display Range: 6 dB to 37 dB for QPSK (4QAM) 11 dB to 37 dB for 16QAM 16 dB to 37 dB for 64QAM Resolution: 0.1 dB Accuracy: ±1 dB to 30 dB (measured at -30 dBm in high-resolution mode) typical
Constellation	The RF constellation is displayed on the UI
Channel impulse response	Measurement of channel impulse response and SFN delay
Channel spectral response	Active receive channel spectrum, RF level vs. frequency
Bit Error Ratio (BER)	Pre FEC, BER, and Error Sec BER values are displayed
Post Reed Solomon BER	Post RS BER (Uncorrectable Error Count) displayed
Transport Error Flag (TEF)	Alarm generated on detection of a TEF

*[5] For compliance with IEC61000-4-3 (Immunity) the Input Signal Amplitude must be ≥ *-40 dBm*.

8VSB Interface (Option VS)

Characteristic	Description
Input Frequency Range	54 MHz to 860 MHz, VHF/UHF channels 2 to 69 (to include low VHF frequencies)
Input Signal Level	-72 dBm to -6 dBm (-23 dBmV to +43 dBmV) typical
Modulation Format	8VSB in accordance with ATSC A/53B
Receiver Bandwidth	6 MHz
Input Termination Impedance	75 Ω nominal
Connector Type	F-type Connector
Input Return Loss	5 dB typical
RF Measurements	
RF lock	RF lock is indicated by a LED on the rear panel and a status indicator on the UI
Input level	Range: -72 dBm to -2 dBm -23 dBmV to +47 dBmV relative to 75 Ω Resolution: 1 dB Accuracy: ±3 dB up to -6 dBm input level typical ≥ -50 dBm to ensure compliance to IEC 61000-4-3 immunity
Error Vector Magnitude (EVM)	Display Range: 3% to 12.5% RMS Resolution: 0.1% typical
Equivalent Modulation Error Ratio (MER)	Display Range: 15 dB to 36 dB Resolution: 1 dB Accuracy: ±1 dB for MER <25 dB typical ±3 dB for MER 25 dB to 31 dB typical
Signal to Noise Ratio (SNR)	Display Range: 15 dB to 35 dB Resolution: 1 dB Accuracy: ±1 dB for SNR <25 dB ±3 dB for SNR 25 dB to 35 dB typical
Bit Error Ratio (BER)	Pre FEC, SER, and Error Sec BER values displayed on UI

Interface Option EP provides both QPSK (L-Band) and Turbo 8PSK interface and measurement capability

QPSK (L-Band) and Turbo 8PSK Interface Card (Option EP)

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz step size of 1 MHz
Input Signal Amplitude Range	-60 dBm to -30 dBm for CBER < 1e -6
Modulation Format	QPSK in accordance with ETSI EN 300 421
Modulated Baud Rate	1 MBaud min, 30 MBaud max
Viterbi Values Supported	1/2, 2/3, 3/4, 5/6, 6/7, 7/8
FEC	In accordance with ETSI EN 300 421
Turbo Viterbi Values Supported	1/2, 2/3, 3/4, 5/6, 7/8
Turbo FEC	Turbo Code
Connector Style	F - style
Input Termination Impedance	75 Ω nominal
LNB Supply Voltage	Selectable; 13.0 V ±1.5 V or 18.0 V ±1.5 V
LNB Supply Maximum Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz ±20%)
LNB 22 kHz Signaling Amplitude	600 mV_{p-p} nominal with 100 Ω load
Modes Supported	Turbo QPSK, QPSK DSS, QPSK DCII, QPSK DVB
RF Measurements	
RF lock	RF lock is indicated to the user by an LED on the rear panel and a status icon on the UI
Input level (signal strength)	Range: -60 dBm to -30 dBm Resolution: 1 dBm Accuracy: ±5 dBm typical
EVM (Error Vector Magnitude)	Display Range: ≤4.0% to ≥30.0% RMS Resolution: 0.1%
MER (Modulation Error Ratio) with Equalizer	Display Range: 10 to 26 dB with Equalizer Resolution: 1 dB Accuracy: ±2 dB typical for range 10 to 20 dB
SNR (Signal to Noise Ratio)	Display Range: 5 to 35 dB Resolution: 1 dB Accuracy: ±2 dB typical for range from 5 to 30 dB
Pre Reed Solomon (RS) BER	Pre-RS BER is displayed on the UI
Post RS BER and TEF (Transport Error Flag)	Post Reed Solomon BER (TEF ratio), TEF rate, and number of Transport Error Flags (TEF count) are displayed on the UI.
Constellation	The RF constellation is displayed on the UI

Turbo 8PSK Interface (Option EP)

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz in 100 kHz steps
Modulation Format	Turbo 8PSK*6
Modulated Baud Rate	1 MBaud min, 30 MBaud max
Turbo Viterbi Values Supported	2/3, 3/4 (2.05), 3/4 (2.1), 5/6, 8/9
Turbo FEC	Turbo Code
Connector Style	F - style
Input Termination Impedance	75 Ω nominal
LNB Supply Voltage	Selectable; 13.0 V ±1.5 V or 18.0 V ±1.5 V
LNB Supply Maximun Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz ±20%)
LNB 22 kHz Signaling Amplitude	600 mV_{p-p} with 100 Ω load
Modes Supported	Turbo 8PSK
RF Measurements	
RF lock	RF lock is indicated to the user by an LED on the rear panel and a status icon on the UI
Input level (signal strength)	Range: -60 dBm to -30 dBm Resolution: 1 dBm Accuracy: ±5 dBm typical
EVM (Error Vector Magnitude)	Display Range: ≤4.0% to ≥30.0% RMS Resolution: 0.1%
MER (Modulation Error Ratio) with Equalizer	Display Range: 10 to 26 dB with Equalizer Resolution: 1 dB Accuracy: ±2 dB typical for range 10 to 20 dB
SNR (Signal to Noise Ratio)	Display Range: 5 to 35 dB Resolution: 1 dB Accuracy: ±2 dB typical for range from 5 to 30 dB
Pre Reed Solomon (RS) BER	Pre-RS BER is displayed on the UI
Post RS BER and TEF (Transport Error Flag)	Post Reed Solomon BER (TEF ratio), TEF rate, and number of Transport Error Flags (TEF count) are displayed on the UI
Constellation	The RF constellation is displayed on the UI

*6 Please note that the Turbo 8PSK option does not support nonturbo 8PSK (DVB-DSNG), or DVB-S2. For information, please contact Tektronix.

QAM Interface (Option QB2)

Characteristic	Description
Input Frequency Range	88 MHz to 858 MHz , 62.5 kHz steps
Modulation Format	64QAM, 256QAM compliant with ITU J-83*7 SCTE07 Compliant
Modulation Baud Rate	5.057 Mbaud/s and 5.360 Mbaud/s
Input Signal Level	-64 dBm to -19 dBm (45 dBuV to 90 dBuV relative to 75 Ω) with a 64 and 256 QAM input typical
Ultimate Modulation Error Ratio	37 dB typical
Receiver Bandwidth	6 MHz nominal
Input Termination Impedance	75 Ω nominal
Input Return Loss	-6 dB min, -10 dB typical, 51 MHz to 858 MHz
RF Measurements	
RF lock	RF lock is indicated by a LED on the rear panel and a status icon on UI
Input level (signal strength)	Range: -64 dBm to -19 dBm Resolution: 1 dBm Accuracy: ±3 dBm typical
EVM (Error Vector Magnitude)	Display Range for 64 QAM: ≤1% to ≥5% RMS Display Range for 256 QAM: ≤1% to ≥2.5% RMS Resolution: 0.1% Accuracy: within 20% of reading for S/N >25 dB typical
MER (Modulation Error Ratio) with Equalizer	Display Range for 64 QAM: 22 dB to 37 dB Display Range for 256 QAM: 28 dB to 37 dB Resolution: 0.1 dB Accuracy: ±1 dB for MER <25 dB ±3 dB for MER 25 dB to 34 dB typical
SNR	Display Range for 64 QAM: 22 dB to 37 dB Display Range for 256 QAM: 28 dB to 37 dB Resolution: 1 dB Accuracy: ±1 dB for MER <25 dB ±3 dB for MER 25 dB to 34 dB typical
BER	Pre FEC, SER, and Error Sec BER values are displayed
Post RS BER and TEF (Transport Error Flag)	Post Reed Solomon BER (uncorrectable error count) and number of Transport Error Flags are displayed on the UI
Constellation	The RF constellation is displayed on the UI

*7 Level 1 and Level 2 interleaving support compliant with all ITU J-83 Annex B, excluding I, J = 128, 7 and 128, 8 for 64QAM and in 256QAM excluding I, J = 8, 16 and 16, 8.

Ordering Information

MTS400 (Network Operators) Base System

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 Options

Option	Description
Opt. TSCA	Deferred-time Transport Stream Compliance Analyzer with CaptureVu™ technology
Opt. IPE	Real-time 10/100/1000Base-T Video over IP Analysis with CaptureVu™ technology
Opt. MX	Multiplexer
Opt. ES	ES Analyzer
Opt. PA	PES Analyzer
Opt. BA	Buffer Analyzer
Opt. DB	Carousel Analyzer
Opt. CG	Carousel Generator
Opt. DBCG	Carousel Analyzer and Carousel Generator
Opt. GBE	GIGE Video-over-IP interface to MTS430 or MTS400 (SFP required)
Opt. VS	8VSB interface to MTS430 or MTS400
Opt. QB2	QAM Annex b interface to MTS430 or MTS400
Opt. CF	COFDM DVB-T interface to MTS430 or MTS400
Opt. EP	QPSK/8PSK interface to MTS430 or MTS400
Opt. LX	1000BASE-LX long wavelength optical port with LC connector for MTS430/MTS400 gigabit ethernet interface (single mode 1310 NM)
Opt. SX	1000BASE-SX short wavelength optical port with LC connector for MTS430/MTS400 gigabit ethernet interface (multi mode 850 NM)
Opt. ZX	1000BASE-ZX long wavelength optical port with LC connector for MTS430/MTS400 gigabit ethernet interface (single mode 1550 NM)
Opt. CU	1000BASE-T electrical port with RJ45 connector for MTS430/MTS400 gigabit ethernet interface
Repair Service	
Opt. R3	3 years
Opt. R5	5 years
Documentation	
Opt. L0	English
Opt. L5	Japanese
Opt. L99	Electronic user documentation supplied only (no printed hardcopy)
Power Cord/Adapter	
Opt. A0	North American
Opt. A1	Universal Euro
Opt. A2	United Kingdom
Opt. A3	Australia
Opt. A4	240 V, North America
Opt. A5	Switzerland
Opt. A6	Japan
Opt. A10	China
Opt. A11	India
Opt. A99	No power cord or AC adapter

Add MTS4EA Compressed Video ES Analyzer onto MTS430/MTS400 System at Initial Time of Ordering

Option	Description
Opt. 4EAB	Base software with video standard package including: MPEG-4 Simple Profile, H.263+, H.263, TS Extraction, CD, and Manual
Opt. M4SP	MPEG-4 Advanced Simple Profile (Levels 0 - 5)
Opt. M2ML	MPEG-2 Main Profile Main Level
Opt. M2HL	MPEG-2 Main Profile High Level and High Level 1440 (High Definition)
Opt. AVCE	H.264/AVC Baseline and Extended Profiles (Levels 1 - 5)
Opt. AVCM	H.264/AVC Main Profile (Levels 1 - 5)
Opt. AVCH	H.264/AVC High Profile with FREXt (10 bit, 4:2:2:, 4:4:4)
Opt. AVDM	Audio/Visual Delay Measurement
Opt. VC1	VC-1 (all Profiles, all Levels) and Windows Media V9 (ASF)
Opt. AUD	Audio (incl. AAC, HE AAC)
Opt. SWSE	First 12 months software subscription on the MTS4EA software and its options purchased with a new MTS430/MTS400. (Does not cover the MTS430/MTS400 base software and standard options)

Upgrade or Add Standard Options after Initial Purchase of MTS400, MTS430, or MTS4SA

Item	Option	Description
MTS4UP		MTS400 Series Field Upgrade Kit
Upgrade to add Deferred-time Transport Stream Compliance Analyzer		
MTS4UP	Opt. TSCA	Available for MTS400 or MTS4SA only
Upgrade to add Real-time Video-over-IP		
MTS4UP	Opt. IPE	Analysis (available for MTS400 only)
Upgrade to add		
MTS4UP	Opt. MX	Deferred-time Multiplexer (available for MTS400 or MTS4SA only)
MTS4UP	Opt. PA	PES Analyzer (available for MTS400 or MTS4SA only)
MTS4UP	Opt. BA	Buffer Analyzer (available for MTS400 or MTS4SA only)
MTS4UP	Opt. ES	ES Analyzer to any MTS400 Series product
MTS4UP	Opt. DB	Carousel Analyzer to any MTS400 Series product
MTS4UP	Opt. CG	Carousel Generator to MTS400 Series
MTS4UP	Opt. DBCG	Carousel Analyzer and Carousel Generator to MTS400 Series
Upgrade kit to add		
MTS4UP	GBE	GIGE interface to MTS4x0 (SFP required). Includes upgrade to latest software
MTS4UP	LX	1000BASE-LX long wavelength optical port with LC connector for MTS4x0 GIGE interface (single mode 1310 NM)
MTS4UP	SX	1000BASE-SX short wavelength optical port with LC connector for MTS4x0 GIGE interface (multi mode 850 NM)
MTS4UP	ZX	1000BASE-ZX long wavelength optical port with LC connector for MTS4x0 GIGE interface (multi mode 1550 NM)
MTS4UP	CU	1000BASE-T electrical port with RJ45 connector for MTS4x0 GIGE interface
MTS4UP	VS	8VSB interface to MTS400. Includes upgrade to latest software
MTS4UP	QB2	QAM Annex B interface to MTS400. Includes upgrade to latest software
MTS4UP	CF	COFDM DVB-T interface to MTS400. Includes upgrade to latest software
MTS4UP	EP	QPSK/8PSK interface to MTS400. Includes upgrade to latest software
Other		
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.

CE

ISO 9001

Product(s) are manufactured in ISO registered facilities.

Contact Tektronix:

ASEAN / Australasia (65) 6356 3900

Austria +41 52 675 3777

Balkans, Israel, South Africa and other ISE Countries +41 52 675 3777

Belgium 07 81 60166

Brazil +55 (11) 40669400

Canada 1 (800) 661-5625

Central East Europe, Ukraine, and the Baltics +41 52 675 3777

Central Europe & Greece +41 52 675 3777

Denmark +45 80 88 1401

Finland +41 52 675 3777

France +33 (0) 1 69 86 81 81

Germany +49 (221) 94 77 400

Hong Kong (852) 2585-6688

India (91) 80-42922600

Italy +39 (02) 25086 1

Japan 81 (3) 6714-3010

Luxembourg +44 (0) 1344 392400

Mexico, Central/South America & Caribbean 52 (55) 54247900

Middle East, Asia, and North Africa +41 52 675 3777

The Netherlands 090 02 021797

Norway 800 16098

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

Poland +41 52 675 3777

Portugal 80 08 12370

Republic of Korea 82 (2) 6917-5000

Russia & CIS +7 (495) 7484900

South Africa +27 11 206 8360

Spain (+34) 901 988 054

Sweden 020 08 80371

Switzerland +41 52 675 3777

Taiwan 886 (2) 2722-9622

United Kingdom & Ireland +44 (0) 1344 392400

USA 1 (800) 426-2200

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

Updated 30 October 2008

For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit **www.tektronix.com**

17 Jul 2009 2AW-18624-3