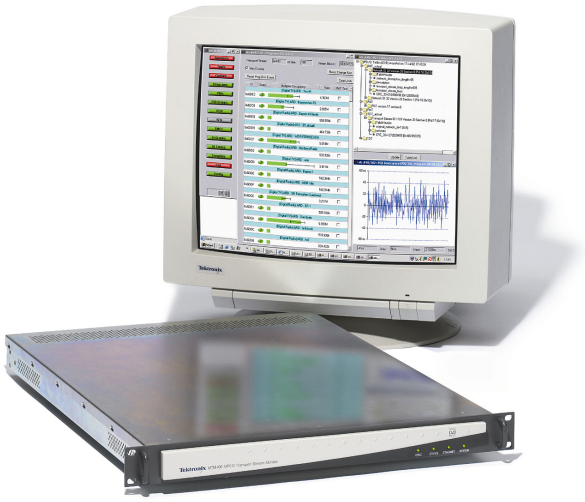
MPEG Transport Stream Monitor

MTM400 Data Sheet



MTM400 MPEG Transport Stream Monitor – Right content, right place, right time

Features & Benefits

- Multilayer, Multichannel, Remote Monitoring and Measurement at IP, RF, and Transport Layers to DVB (TR 101 290), ATSC, DigiCipher® II (DCII), and ISDB-T (Terrestrial and Mobile) Standards
- The Gigabit Ethernet Interface*1 Allows Monitoring and Measurement of Key IP Parameters. Designed for Monitoring Networks which Carry Multiprogram Transport Streams (MPTS) or Single Program Transport Streams (SPTS) over Gigabit Ethernet Networks. MTM400 Opt. GE Provides:
  - Simultaneous Monitoring of Both IP and MPEG Layers to Enable Rapid Fault Isolation
  - Comprehensive Confidence Monitoring of Video over IP with Optional Gigabit Ethernet Electrical and Optical Interfaces, IP Protocol Support Including UDP, RTP with Internet Group Management Protocol (IGMP), Address Resolution Protocol (ARP), and Internet Control Message Protocol (ICMP remote ping)
  - For Detailed Information on the MTM400 MPEG over IP Gigabit Ethernet Real Time Monitor, See the Separate Datasheet 2AW-20409
- Comprehensive Confidence Monitoring at the RF Modulated Layer with Optional COFDM, 8VSB, Turbo 8PSK, QPSK (L Band), and QAM Interface MER, BER, and Constellation Displays
- Critical RF Measurements, MER, and EVM Provide Early Indication of Signal Degradation before Any Picture Impairment is Visible to the End Customer without Additional Costly RF Test Equipment (MER up to 37 dB typical)
- MTM400 with IP or RF Interface can Switch between IP or RF Monitoring and Transport Stream Monitoring within the One Probe
- DPI (SCTE-35) Local Content Insertion Monitoring
- DigiCipher® II (DCII) Protocol Support
- User-defined Template Monitoring Option to Ensure Right Content at the Right Place at the Right Time while Content Ratings Checking Ensures Only Appropriate Content Broadcast
- Remote Recording Allows Capture and Analysis of Stream Events for Expert Offline Analysis to Diagnose Difficult and Intermittent Problems, Requiring No Engineer Site Visits
- Scalable, Upgradeable Monitoring Capability Provides Extended Confidence Monitoring, where You Buy the Capability You Need when You Need It
- In-field Upgrades Minimizes Upgrade Time
- Simple User Interface Minimizes Staff Familiarization Time

Applications

- Contribution and Primary Distribution
  - Terrestrial Distribution
  - Cable Head-end Monitoring
  - DTH or Network Operator Satellite Uplink Monitoring
- IPTV
- Edge Network Monitoring
  - ASI to RF
  - IP to RF (Requires two MTM400 units)
  - IP to ASI

*1 Separate data sheet is available.

Tektronix®

Technical Overview

The MTM400 is a real-time MPEG Transport Stream monitor. The MTM400 provides a complete solution for transmission monitoring of MPEG Transport Streams over RF, IP, and ASI interfaces.

The MTM400 uses a single Transport Stream processor platform packaged in a 1 RU rackmount chassis to provide monitoring of a Transport Stream at data rates up to 155 Mb/s*2. The platform is used to provide an extended confidence monitoring product that, with the addition of software options, provides diagnostic monitoring capabilities.

The extended confidence monitor provides the key MPEG tests; this basic level of functionality and low cost enables widespread deployment throughout a transmission network, facilitating rapid fault isolation. The diagnostic monitoring options provide more in-depth analysis of the MPEG Transport Stream including recording capability, PSI/SI/PSIP/ARIB analysis, and unique user-defined template tests to ensure right content, right place, right time. Deployed at key network nodes, the MTM400 equipped as a diagnostic monitor enables the cause of faults to be pinpointed and solved.

Optional IP and RF confidence monitoring interfaces including Gigabit Ethernet, COFDM, 8VSB, Turbo 8PSK, QPSK (L Band), and QAM are available. RF interfaces allow the MTM400 to receive RF inputs and display key RF monitoring parameters including MER, BER, and constellation displays before demodulating the signal to provide measurements on the health of the Transport Stream. Channel polling allows up to 200 channels to be polled sequentially from either the IP or the RF interface*1.

The polling capability for the MTM400 probe, combined with RF and IP interfaces, allows up to 200 RF channels or IP sessions (discovering up to 500 IP sessions) to be monitored in a repeating cyclic measurement process. Control and configuration of the polling is undertaken using flexible XML scripting. This polling ability makes a single MTM400 probe a broader tool, monitoring large numbers of network points in a time-sampled measurement mode.

The MTM remote user interface provides a summary screen for MPEG Transport Stream thumbnails and video metadata support for confidence monitoring. A full set of APIs is available to support displaying this information within network management platforms. This includes video walls that can display up to the full transmitted resolution of the video stream.

*1 Separate data sheet is available.

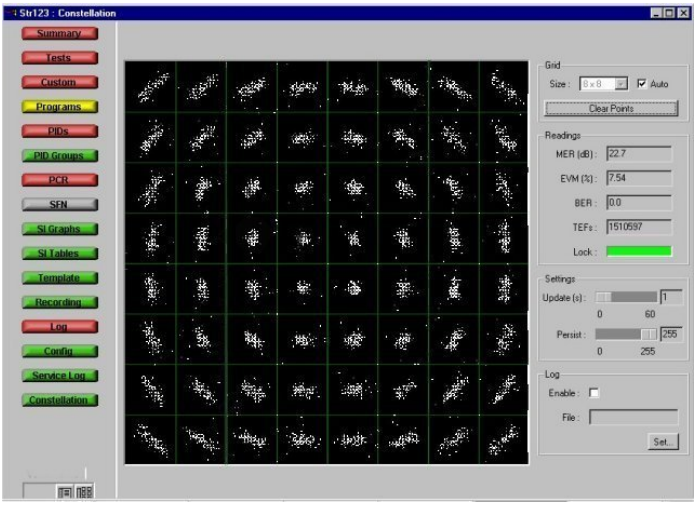
*2 Maximum Transport Stream bit rate is dependent on Transport Stream content and depth of analysis being performed. Depth of stream analysis is handled gracefully if SI/PSIP max content is exceeded to ensure critical measurements continue to be performed.

Flexible and Upgradeable

The MTM400 provides a flexible solution with an upgrade path, including diagnostic monitoring features that enable customers to build a cost-effective monitoring system to suit their individual requirements. Diagnostic capability can be added to the key monitoring points where Transport Streams are manipulated while extended confidence monitoring probes can be installed throughout the network:

- Triggered recording enables problems to be captured and analyzed in greater depth using offline analysis tools such as the Tektronix MPEG Test System Standalone Software*1
- PSI/SI/PSIP/ARIB SI Analysis and repetition rate graphing allows broadcasters to determine that the system information is present and correct in the Transport Stream
- Automatic Template Generation: Simple automated template generation from reference stream for exception monitoring. Template testing checks a number of key parameters to ensure that the Transport Stream has been constructed as the broadcaster intended. These parameters include the Transport Stream ID and Network ID, the number of programs in the multiplex, that each program has all of its components (Video, Audio, Data, Teletext, Subtitles) and Conditional Access (CA) status
- Bit rate testing determines whether PIDs, programs, services, or user-defined groups of PIDs are within user-definable limits to ensure correct multiplex operation. Tektronix-proprietary PID variability test gives indication of PID bit rate variation to assess effects of statistical multiplexing
- In-depth PCR analysis with graphical results views enable timing and Jitter measurements to be made to ensure correct operation of the network
- Service logging enables verification of service-level agreements to ensure that contractual obligations are met
- Offline analysis software applications for in-depth deferred-time analysis of streams captured using the MTM400 gives Tektronix the most powerful MPEG monitoring diagnostics available in the world today*3

*3 MTS400 Series MPEG Test System offline software tools are available for use with the MTM400. These are standalone software applications intended to run on the customer's control PC. Separate data sheet is available.



QAM signal monitoring

Applications

Contribution and Primary Distribution

Digital video contribution and distribution networks carry compressed video from many origination points to multiple delivery points over limited bandwidth links. Delivery of the right content at the right place at the right time is key to efficient network operation and customer satisfaction. Failure to deliver video services at the appropriate Quality of Service (QoS) leads to potential loss of revenue if video content is not delivered per the service-level agreement.

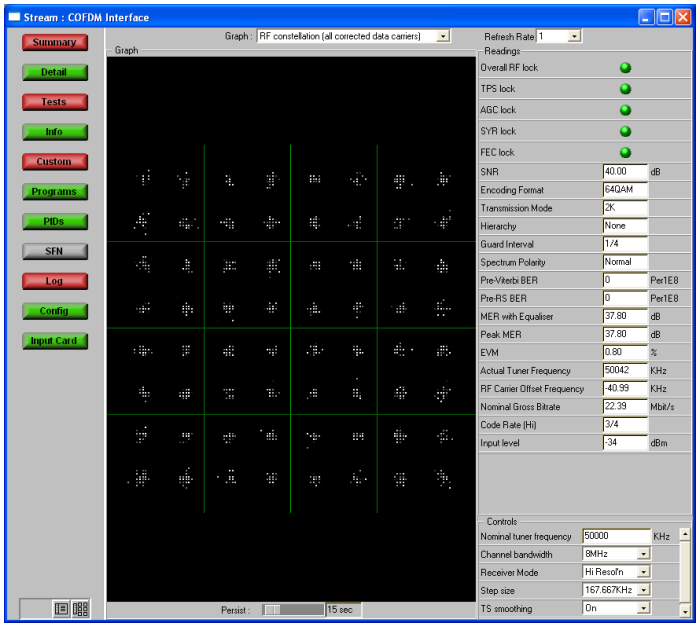
- MTM400's low-cost extended confidence monitoring enables widespread deployment
- High bit rate capability, up to 155 Mb/s*[2], for monitoring Transport Streams carried over GbE/ATM/OC3/SDH
- Bit rate testing and logging enables bandwidth usage to be monitored and Service-level Agreements to be verified

*[2] Maximum Transport Stream bit rate is dependent on Transport Stream content and depth of analysis being performed. Depth of stream analysis is handled gracefully if SI/PSIP max content is exceeded to ensure critical measurements continue to be performed.

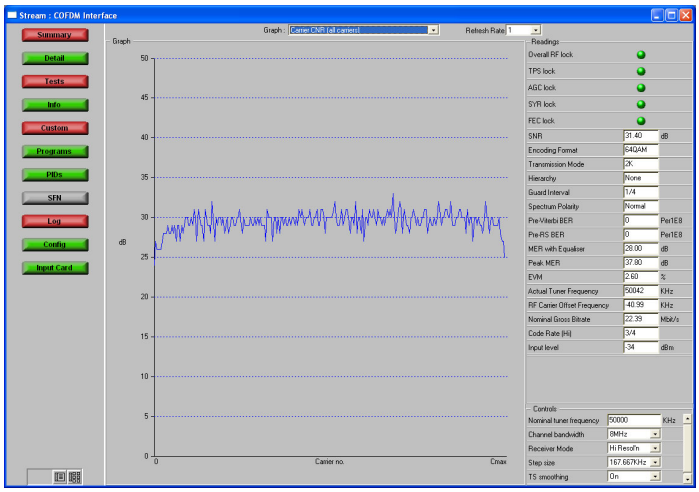
Cable Head-end Monitoring

Cable companies need to verify content accuracy at multiple unmanned head-end sites as operations are centralized. Budgets are tight and resources are limited. MTM400 solves these issues:

- The MTM400 is a cost-effective solution which can be used for unattended operation for unmanned regional head-ends
- Network monitoring units linked to central operations center reduces manpower requirements
- Comprehensive coverage of QAM Annex A/B/C RF interfaces allows cost-effective multichannel, multilayer monitoring
- Selection of PLL and AFC characteristics of the QAM interface enables constellation analysis on signals that are too poor for normal operation



COFDM QAM64 Constellation

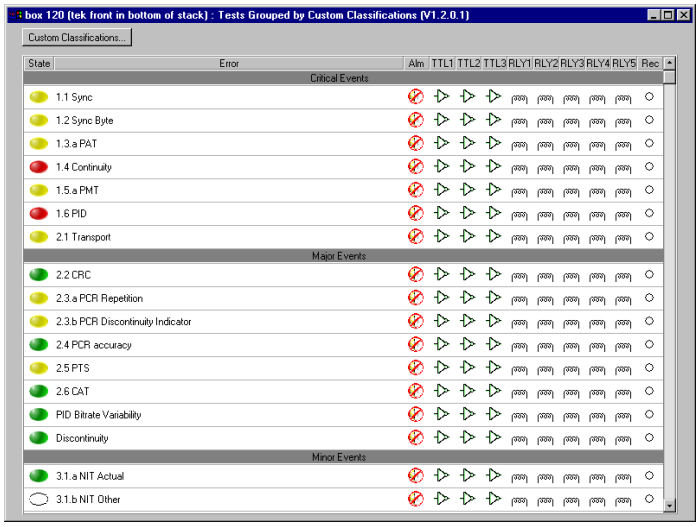


COFDM Channel C/N

Terrestrial Distribution

Terrestrial broadcasters need to verify accuracy of content at unmanned transmitter sites. They need to check for errors, troubleshoot problems, and capture errors for offline investigation.

- The MTM400 is designed for 24×7 unattended operation
- Low-cost extended confidence monitoring enables widespread deployment
- Centralized, networked operation minimizes staffing requirements
- Remote stream capture means engineers do not have to visit the site
- COFDM and 8VSB RF terrestrial interfaces allow monitoring at the transmitter site or remote off-air monitoring



MTM400 stream testing

DTH or Network Operator Satellite Uplink Monitoring

Large numbers of channels may be monitored by limited personnel. A fault on a single signal could result in great customer dissatisfaction and churn. Errors in the stream or incorrect content must be identified before large numbers of viewers are affected. Therefore, operators need to monitor both before and after modulation.

- The cost-effective MTM400 solution provides low cost per stream
- QPSK (L Band) and Turbo 8PSK RF interfaces allow a stream to be monitored both at the ASI/SMPTE310M interface and the RF interface by switching between the two

Measurement Functions

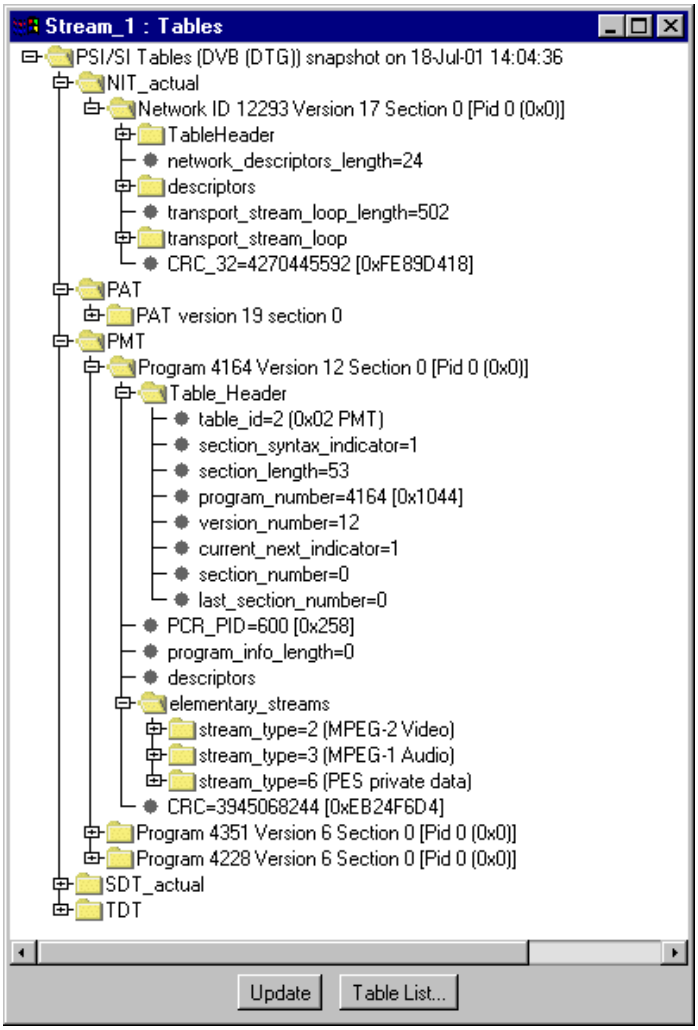
MTM400 Extended Confidence Monitor in Standard Configuration

- MPEG-2, DVB (TR 101 290), ATSC, and ISDB supported
- TR 101 290 Priority 1, 2, and 3 measurements*4 in accordance with the techniques specified in TR 101 290
- Continuity count displayed on a per PID or per TS basis
- Bit rate measurement in accordance with the methodology specified in TR 101 290 MGB2
- Maximum input Transport Stream bit rate up to 155 Mb/s*2
- SFN measurements according to TR 101 290
- Packet size detection
- Error log
- Status of all tests and measurements available through SNMP MIB with support for SNMP traps*5

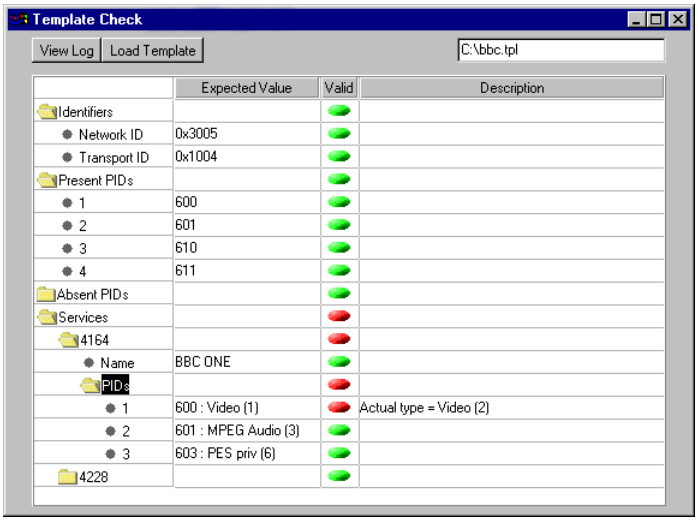
*2 Maximum Transport Stream bit rate is dependent on Transport Stream content and depth of analysis being performed. Depth of stream analysis is handled gracefully if SI/PSIP max content is exceeded to ensure critical measurements continue to be performed.

*4 Except T-STD buffer model analysis.

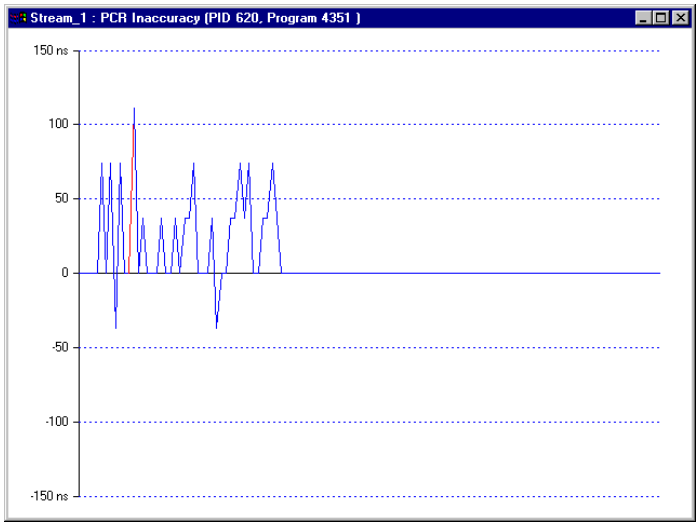
*5 Programmers Guide is available on request with full SNMP MIB and HTTP interface documentation.



MTM400 SI tables



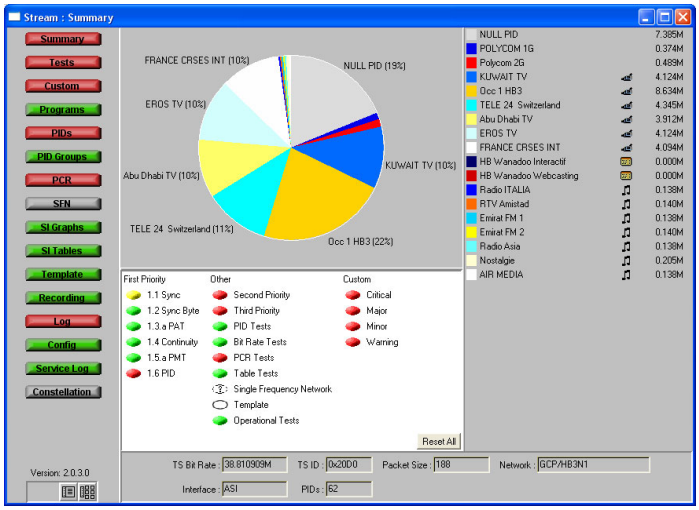
MTM400 template testing



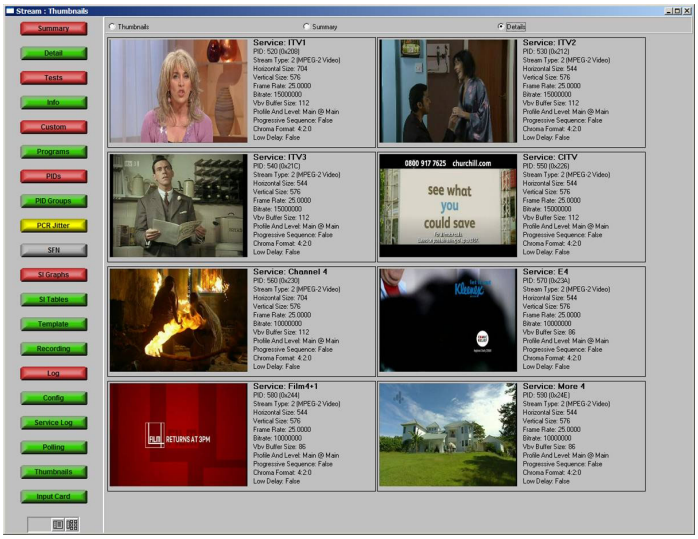
MTM400 PCR inaccuracy analysis

Diagnostic Monitoring Options

- Triggered recording with user-definable pretriggered buffering and up to 160 MB available storage
- PSI/SI/PSIP/ARIB SI Analysis and repetition rate graphing. Transport Stream structure view with ability to drill down to examine tables and service contents plus real-time graphical representation of table repetition rates
- Template testing (for user-defined service plan testing). User-definable tests with scheduled template updating
- Bit rate testing on a per PID, program, or user-defined groups of PIDs basis
- In-depth timing analysis with graphical results views of:
  PCR_OJ (overall Jitter)
  PCR_AC (accuracy)
  PCR_FO (frequency offset)
  PCR_DR (drift rate)
  PTS Arrival interval
- Service logging of user-selected PIDs to record packet rates at user-definable intervals
- Channel polling allows up to 200 channels to be polled sequentially from either the IP or the RF interface



The summary status screen provides a quick overview of the health and contents of the stream



MTM400 thumbnails with additional inclusion of video metadata

Remote User Interface

The Remote User Interface (RUI) software is a Java applet downloaded from the MTM400. It is accessed through a web browser (Microsoft Internet Explorer with Microsoft Virtual Machine installed) on any networked personal computer.

The interface initially displays a main status view with menu buttons to access either stream status summary or device status summary. The stream status summary provides an overview of the health and contents of the stream with the ability to access all available tests and measurements licensed for the unit. Summaries can be focused on program content, SI content, or on all PIDs.

Characteristics

Power Requirements

Power Consumption (nominal) – 40 VA.
Voltage – 100 to 240 V.
Frequency – 50/60 Hz.

Monitoring

Data Rate

Maximum Data Rate – 155 Mb/s*6.
Minimum Data Rate – 250 Kb/s.

*6 Maximum Transport Stream bit rate is dependent on Transport Stream content and depth of analysis being performed. Stream analysis is handled gracefully if SI/PSIP max content is exceeded to ensure critical measurements continue to be performed.

TR 101 290 Tests and Measurements

1st Priority Measurements	2nd Priority Measurements	3rd Priority Measurements
1.1 Ts_sync_loss	2.1 Transport error	3.1a NIT_actual_error
1.2 Sync_byte_error	2.2 CRC_error	3.1b NIT_other_error
1.3a PAT_error_2	2.3a PCR_repetition_error	3.2 SI repetition error
1.4 Continuity_count_error	2.3b PCR_discontinuity_indicator_error	3.4a Unreferenced PID
1.5a PMT_error_2	2.4 PCR_accuracy_error	3.5a SDT_actual_error
1.6 PID_error	2.5 PTS_error	3.5b SDT_other_error
	2.6 CAT_error	3.6a EIT_actual_error
		3.6b EIT_other_error
		3.6c EIT_PF_error
		3.7 RST_error
		3.8 TDT_error

MPEG over Gigabit Ethernet (Gigabit Ethernet IP Option GE)

Characteristic	Description
Interconnect Port Options	
Opt. GE	Gigabit Ethernet Interface with 10/100/1000Base-T RJ45 electrical port
Optical SFP Modules	Plug into MTM400 Opt. GE to provide optical connectivity
Opt. SX	1000Base-SX Short-wavelength optical port with LC connector for MTM400 Gigabit Ethernet Interface (Multi Mode 850 nm)
Opt. LX	1000Base-LX Long-wavelength optical port with LC connector for MTM400 Gigabit Ethernet Interface (Single Mode 1310 nm)
Opt. ZX	1000Base-ZX Optical port with LC connector for MTM400 Gigabit Ethernet Interface (Single Mode 1550 nm)
Maximum Data Rate	Line rate
ASI Output	ASI compliant with specification EN 50083-9 ASI smoothing can be activated to compensate for bursty IP traffic
Protocol Stack Support	IPv4 support UDP/IP/Ethernet UDP/IP/VLAN/Ethernet RTP/UDP/IP/Ethernet RTP/UDP/IP/VLAN/Ethernet
Alarms	User-definable thresholds for: (1) Errored packets (2) Dropped packets (3) Packet interarrival time
Control	Controls: (1) Line select (optical, electrical rate) (2) Filters for MAC, IP, Port (3) Protocol control for ARP, RTP, IGMP, and VLAN
RTP Support	Indicate out-of-order packets Indicate dropped packets
Multicast and Control Support	IGMP v2 support ARP ICMP (inbound and outbound ping)
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 and TS present indicator, session bit rate monitoring, and IP packet error status of all sessions
Display Features	
Statistics	Statistics: (1) Static IP header contents (2) Total bit rate for all Ethernet traffic (3) Instantaneous TS bit rate for selected IP session (4) Errored packets (5) Dropped packets
Graphs	(1) IP session TS bit rate (2) Select IP address and port number from a tabular sessions list (sessions graph) (3) IP packet interarrival time of selected IP session Min, Max, and Average (trend graphs)

COFDM Interface Characteristics (Option CF)

Characteristic	Description
Input Frequency Range	50 MHz to 858 MHz in 166.7 or 62.5 kHz steps
Tuning Accuracy	Better than ±50 ppm typical
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	QPSK (4QAM): -85 dBm to -10 dBm (24 dBuV to 99 dBuV) typical 16QAM: -80 dBm to -10 dBm (29 dBuV to 99 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 ±10 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, QPSK 1% to 20% RMS, 16QAM 1% to 8.5% RMS, 64QAM Resolution: 0.1%
MER (Modulation Error Ratio) 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

8VSB Interface Characteristics (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
Error Vector Magnitude (EVM)	Display Range: 3% to 12.5% RMS Resolution: 0.1% typical
Equivalent MER (Modulation Error Ratio)	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 32 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

QPSK (L-Band) Interface Characteristics (Option QP)

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 a CBER of <1e $^{-6}$
Modulation Format	QPSK in accordance with ETSI EN 300 421
Modulated Baud Rate	1 MBaud min, 45 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
Connector Style	F - style
Input Termination Impedance	75 Ω nominal
Input Return Loss	10 dB min, 950 MHz to 2150 MHz typical
Loopthrough Output Amplitude	-6 dB to +3 dB typical
Loopthrough Output Reverse Isolation	30 dB typical
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 Signalling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz ±20%)
LNB 22 kHz Signalling Amplitude	600 mV_{p-p} nominal with 100 Ω load

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

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

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 Characteristics (Option EP)

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz in 100 kHz steps
Modulation Format	Turbo 8PSK*[7]
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

*[7] Please note that the Turbo 8PSK option does not support non-turbo 8PSK (DVB-DSNG), or DVB-S2. For information, please contact Tektronix.

QAM Interface Characteristics (Options QA, QB2, QC)

Characteristic	QAM Annex A	QAM Annex B	QAM Annex C
Input Frequency Range	51 MHz to 858 MHz, 62.5 kHz steps	88 MHz to 858 MHz, 62.5 kHz steps	
Modulation Format	16QAM, 64QAM, 256QAM compliant with ITU J-83 and DVB-C ETS 300 429	64QAM, 256QAM compliant with ITU J-83*8 SCTE07 compliant	16QAM, 64QAM, 256QAM compliant with ITU J-83
Modulation Baud Rate	5 Mbaud/s min 6.952 Mbaud/s max	5.057 Mbaud/s and 5.360 Mbaud/s	5 Mbaud/s min 5.5 Mbaud/s max
Input Signal Level	-59 dBm to -19 dBm (50 dBuV to 90 dBuV relative to 75 Ω), with a 16, 64, and 256 QAM input typical	-64 dBm to -19 dBm (45 dBuV to 90 dBuV relative to 75 Ω) with a 64 and 256 QAM input typical	-59 dBm to -19 dBm (50 dBuV to 90 dBuV relative to 75 Ω), with a 16, 64, and 256 QAM input typical
Ultimate Modulation Error Ratio	37 dB typical		
Receiver Bandwidth	8 MHz nominal	6 MHz nominal	
Input Termination Impedance	75 Ω nominal		
Input Return Loss	-6 dB min, -10 dB typical, 51 MHz to 858 MHz		
Loopthrough Power Gain	1.5 dB to 4 dB typical, 51 MHz to 858 MHz	N/A	N/A
Loopthrough Noise Figure	8 dB typical	N/A	N/A
Loopthrough Output Return Loss	>10 dB typical	N/A	N/A

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

QAM Annex A/C Measurements (Option QA or QC)

Characteristic	Description
RF Lock	RF lock is indicated by a LED on the rear panel and a status icon on UI
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
Ultimate MER (Modulation Error Ratio)	38 dB typical
Post RS BER and TEF (Transport Error Flag)	Post Reed Solomon indicative BER (uncorrectable error count) and number of Transport Error Flags are displayed on the UI
Constellation	The RF constellation is displayed on the UI

QAM Annex B Measurements (Option QB2)

Characteristic	Description
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

Environmental

Characteristic	Description
Temperature	
Operating	+5 °C to +40 °C
Nonoperating	-10 °C to +60 °C
Humidity	
Operating	Maximum relative humidity 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C
Nonoperating	10% to 95% relative humidity, noncondensing
Altitude	
Operating	0 m to 3000 m (9800 ft.)
Nonoperating	0 m to 12000 m (40000 ft.)
Random Vibration	
Operating	5 to 500 Hz, G_{RMS} = 2.28
Nonoperating	.5 to 500 Hz, G_{RMS} = 0.27
Functional Shock	
Operating	30 G, half sine, 11 ms duration
Electromagnetic Compatibility	
EC Declaration of Conformity	Meets EN55103. Electromagnetic environment E4
Australia / New Zealand Declaration of Conformity	Meets AS/NZS 2064
FCC	Emissions are within FCC CFR 47, Part 15, Subpart B, Class A limits
Safety	Meets 73/23/EEC, EN61010-1, UL3111-1 and CAN/CSA 22.2 No. 1010.1-92, IEC61010-1

Physical Characteristics

Dimension	mm	in.
Height	44	1.73
Width	430	17.13
Depth	600	23.62
Weight*[9]	**kg**	**lb.**
Net	6.0	13.3
Shipping	9.0	19.7
Required Clearance	**mm**	**in.**
Top	0	0
Bottom	0	0
Left Side	Standard 19 in. rackmount	
Right Side	Standard 19 in. rackmount	
Front	Clearance for handles required	
Rear	Clearance for connectors required	

*[9] Weight does not include optional interface cards.

Ordering Information

MTM400
Single-stream extended confidence monitor packaged in 1RU chassis.

Includes: 1RU chassis fitted with Transport Stream processor card, manual, rack slides, power cord, and license key certificate.

Options
Opt. 01 – Triggered recording capability up to 160 MB.

Opt. 02 – Transport Stream service information analysis (PSI/SI/PSIP/ARIB view).

Opt. 03 – Template testing (for user-defined service plan testing).

Opt. 04 – In-depth PCR analysis with graphical result views.

Opt. 05 – Bit rate testing functionality.

Opt. 06 – Service logging.

Opt. 07 – IP/RF polling functionality.

Opt. CF – COFDM Interface.

Opt. QB2 – QAM Annex B Level 1 and Level 2 Interface.

Opt. EP – 8PSK/QPSK Interface.

Opt. VS – 8VSB Interface.

Opt. QA – QAM Annex A Interface.

Opt. QC – QAM Annex C Interface.

Opt. QP – QPSK Interface.

Opt. GE – Gigabit Ethernet Interface with 10/100/1000Base-T RJ45 electrical port.

Opt. SX – 1000Base-SX Short-wavelength optical port with LC connector for MTM400 Gigabit Ethernet Interface (Multi Mode 850 nm).

Opt. LX – 1000Base-LX Long-wavelength optical port with LC connector for MTM400 Gigabit Ethernet Interface (Single Mode 1310 nm).

Opt. ZX – 1000Base-ZX Optical port with LC connector for MTM400 Gigabit Ethernet Interface (Single Mode 1550 nm).

International Language Options
Opt. L0 – English User Guide.

Opt. L5 – Japanese User Guide.

Complementary Products
MTS4SA – Standalone Deferred Time Software package.

Opt. TSCL – DVB/ATSC/ARIB TS Compliance Analyzer Software (TS file size limited to 192 MB). For full details see separate data sheet.

Service
Opt. R3 – Repair Service 3 Years.

Opt. R5 – Repair Service 5 Years.

Power Connections
Opt. A0 – North America power plug.

Opt. A1 – Universal EURO power plug.

Opt. A2 – United Kingdom power plug.

Opt. A3 – Australia power plug.

Opt. A4 – 240 V North America power plug.

Opt. A5 – Switzerland power plug.

Opt. A6 – Japan power plug.

Opt. A10 – China power plug.

Opt. A99 – No power cord or AC adapter.

Field Upgrade Kits
MTM4FQA – Field upgrade kit to add QAM Annex A Interface to an existing probe.

MTM4FQC – Field upgrade kit to add QAM Annex C Interface to an existing probe.

MTM4FQP – Field upgrade kit to add QPSK Interface to an existing probe.

MTM4FCF – Field upgrade kit to add COFDM Interface.

MTM4FQB2 – Field upgrade kit to add QAM Annex B Interface.

MTM4FEP – Field upgrade kit to add 8PSK/QPSK Interface.

MTM4FVS – Field upgrade kit to add 8VSB Interface.

MTM4UP Opt. 01 – Field upgrade kit to add triggered recording capability up to 160 MB.

MTM4UP Opt. 02 – Field upgrade kit to add Transport Stream service information analysis (PSI/SI/PSIP/ARIB view).

MTM4UP Opt. 03 – Field upgrade kit to add template testing (for user-defined service plan testing).

MTM4UP Opt. 04 – Field upgrade kit to add in-depth PCR analysis with graphical result views.

MTM4UP Opt. 05 – Field upgrade kit to add bit rate testing functionality.

MTM4UP Opt. 06 – Field upgrade kit to add service logging.

MTM4UP Opt. 07 – Field upgrade kit to add IP/RF polling functionality

MTM4FGE – Gigabit Ethernet upgrade kit for MTM400. Requires appropriate options.
Note 1: At least one option must be ordered.
Note 2: Opt. GE is required if MTM400 does not already have GigE capability.

MTM4FGE Opt. GE – Upgrade kit to add Gigabit Ethernet Interface with 10/100/1000Base-T RJ45 electrical port to MTM400.

MTM4FGE Opt. SX – Upgrade kit to add 1000Base-SX Short-wavelength optical port with LC connector (Multi Mode 850 nm) for MTM400 Gigabit Ethernet Interface.

MTM4FGE Opt. LX – Upgrade kit to add 1000Base-LX Long-wavelength optical port with LC connector (Single Mode 1310 nm) for MTM400 Gigabit Ethernet Interface.

MTM4FGE Opt. ZX – Upgrade kit to add 1000Base-ZX optical port with LC connector (Single Mode 1550 nm) for MTM400 Gigabit Ethernet Interface.

MTM4FGE Opt. IFC – One-time install of all selected options and calibration for one product.

CE

ISO 9001 — Product(s) are manufactured in ISO registered facilities.

GPIB IEEE-488 — Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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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**

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