

# Technical Reference



## **MTM400A MPEG Transport Stream Monitor Specifications and Performance Verification 077-0176-00**

This document applies to firmware versions 3.1 and above.

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# Table of Contents

<b>General Safety Summary</b> .....	<b>v</b>
<b>Preface</b> .....	<b>vii</b>
Product Documentation .....	vii

## Specifications

Electrical, Hardware, and Signal Specifications .....	1-1
Power Source Characteristics .....	1-15
Environmental Characteristics .....	1-16
Mechanical (Physical) Characteristics .....	1-16
Certifications and Compliances .....	1-17

## Performance Verification

Requirements .....	2-1
Procedure .....	2-1

## List of Figures

<b>Figure 2–1: MTM400A monitor RUI display</b> .....	<b>2–3</b>
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## List of Tables

<b>Table i: Product documentation</b> .....	<b>vii</b>
<b>Table 1–1: Remote User Interface (RUI) platform characteristics</b> .....	<b>1–1</b>
<b>Table 1–2: TS processor card - system timing clock</b> .....	<b>1–1</b>
<b>Table 1–3: TS processor card - ASI interface</b> .....	<b>1–2</b>
<b>Table 1–4: TS processor card - SMPTE310M interface</b> .....	<b>1–2</b>
<b>Table 1–5: TS processor card - alarm connector</b> .....	<b>1–3</b>
<b>Table 1–6: TS processor card - alarms</b> .....	<b>1–4</b>
<b>Table 1–7: TS processor card - LTC connector</b> .....	<b>1–4</b>
<b>Table 1–8: TS processor card - Ethernet RJ-45 connector</b> .....	<b>1–4</b>
<b>Table 1–9: QAM Annex A interface card characteristics</b> .....	<b>1–5</b>
<b>Table 1–10: QAM Annex B2 interface card characteristics</b> .....	<b>1–5</b>
<b>Table 1–11: QAM Annex B2 measurements</b> .....	<b>1–6</b>
<b>Table 1–12: QAM Annex C interface card characteristics</b> .....	<b>1–6</b>
<b>Table 1–13: 8PSK/QPSK interface card characteristics with 8PSK input</b> .....	<b>1–7</b>
<b>Table 1–14: 8PSK/QPSK interface card characteristics with QPSK input</b> .....	<b>1–7</b>
<b>Table 1–15: 8PSK and QPSK measurements</b> .....	<b>1–8</b>
<b>Table 1–16: 8VSB interface card characteristics</b> .....	<b>1–8</b>
<b>Table 1–17: 8VSB measurements</b> .....	<b>1–9</b>
<b>Table 1–18: COFDM interface card characteristics</b> .....	<b>1–10</b>
<b>Table 1–19: COFDM measurements</b> .....	<b>1–11</b>
<b>Table 1–20: GigE interface card - general characteristics</b> .....	<b>1–12</b>
<b>Table 1–21: GigE interface card - Ethernet electrical port</b> .....	<b>1–12</b>
<b>Table 1–22: GigE interface card - Ethernet Optical port</b> .....	<b>1–13</b>

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<b>Table 1–23: GigE interface card - ASI input</b> .....	<b>1–14</b>
<b>Table 1–24: GigE interface card - ASI output (active loop-through of ASI/SMPTE input or TS from GigE interface card)</b> .....	<b>1–14</b>
<b>Table 1–25: GigE interface card - SMPTE310M input (loop-through to ASI output)</b> .....	<b>1–14</b>
<b>Table 1–26: AC power source characteristics</b> .....	<b>1–15</b>
<b>Table 1–27: Transport stream card batteries</b> .....	<b>1–15</b>
<b>Table 1–28: Environmental characteristics</b> .....	<b>1–16</b>
<b>Table 1–29: Mechanical characteristics</b> .....	<b>1–16</b>
<b>Table 1–30: Certifications and compliances</b> .....	<b>1–17</b>
<b>Table 1–31: Environmental limits and use classification for safety certification compliance</b> .....	<b>1–19</b>



# General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

## To Avoid Fire or Personal Injury

**Use Proper Power Cord.** Use only the power cord specified for this product and certified for the country of use.

**Ground the Product.** This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

**Ground Equipment Connected to the Product.** Ensure that any equipment connected to this product is grounded and at the same potential.

**Observe All Terminal Ratings.** To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits.

**Power Disconnect.** The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

**Do Not Operate Without Covers.** Do not operate this product with covers or panels removed.

**Do Not Operate With Suspected Failures.** If you suspect there is damage to this product, have it inspected by qualified service personnel.

**Avoid Exposed Circuitry.** Do not touch exposed connections and components when power is present.

**Use Proper Fuse.** Use only the fuse type and rating specified for this product.

**Do Not Operate in Wet/Damp Conditions.**

**Do Not Operate in an Explosive Atmosphere.**

**Keep Product Surfaces Clean and Dry.**

**Provide Proper Ventilation.** Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

**Terms in this Manual**

These terms may appear in this manual:



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**WARNING.** *Warning statements identify conditions or practices that could result in injury or loss of life.*

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**CAUTION.** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

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**Symbols and Terms on the Product**

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:





# Preface














This manual contains the following information about the MTM400A MPEG Transport Stream Monitor:

- *Specifications* lists the electrical, physical, and environmental specifications of the MTM400A monitor.
- *Performance Verification* contains a procedure to verify that the MTM400A monitor is operating normally.


## Product Documentation

Table i lists the product documentation supporting the MTM400A monitor.




**Table i: Product documentation**

Item (Tektronix part number)	Purpose	Location
Quick Start User Manual (071-2492-xx English, 071-2493-xx Japanese 071-2632-xx German)	Provides installation and high-level operational overviews	 +  +  www.Tektronix.com
RUI v3.x Upgrade Technical Reference (077-0174-xx)	Describes the remote user interface (RUI) changes introduced with the MTM400A monitor	 +  www.Tektronix.com
Technical Reference (077-0175-xx)	Provides in-depth operating information	 +  www.Tektronix.com
Specifications and Performance Verification Technical Reference (077-0176-xx)	Provides complete product specifications and a procedure for verifying the operation of the instrument (this document)	 +  www.Tektronix.com
Release Notes (077-0181-xx)	Describes late breaking product information and operational issues	 www.Tektronix.com
Test Parameter and Configuration File Technical Reference (077-0177-xx)	Provides information about using test parameters and configuration files	 www.Tektronix.com
Programmer Manual (077-0178-xx)	Provides information about remote command syntax	 www.Tektronix.com
Declassification and Security Instructions (077-0179-xx)	Provides instructions for removing your proprietary information from the instrument	 www.Tektronix.com

**Table i: Product documentation (Cont.)**

Item (Tektronix part number)	Purpose	Location
Upgrade Instructions (075-0973-xx)	Provides instructions for upgrading the product	 <a href="http://www.Tektronix.com">www.Tektronix.com</a>

**Key:**

	Printed document
	MTM400A product documentation CD - PDF format
 <a href="http://www.Tektronix.com">www.Tektronix.com</a>	Tektronix Web site - PDF format



# Specifications



# Specifications

This section lists the electrical, environmental, and physical specifications of the MTM400A monitor. All specifications are guaranteed unless labeled typical. Typical specifications are provided for your convenience and are not guaranteed. Electrical characteristics apply to test systems operating within the environmental conditions.

## Electrical, Hardware, and Signal Specifications

**Table 1-1: Remote User Interface (RUI) platform characteristics**

Characteristic	Description
Minimum Specification	1.2 GHz Intel Pentium Processor (Preferred: 2 GHz)
Operating System	Microsoft Windows operating systems Windows 2000, Windows XP, and Windows Vista (Recommended: Windows XP Pro)
Disk Space	2 GB free disk space
Ethernet	10/100-base T
Installed Software	Microsoft Internet Explorer, Version 7.0 minimum; Sun Java Runtime Environment Version 6 Update 3 minimum (1.6.0_10)
RAM	1 GB
CD-ROM Drive	8x
Display	1024 x 768 pixel video monitor with 16 available colors

**Table 1-2: TS processor card - system timing clock**

Characteristic	Description
PCR Offset Measurement Accuracy	$\pm 2.0$ ppm
System Timing Clock Drift	$\pm 1.0$ ppm per year (maximum)

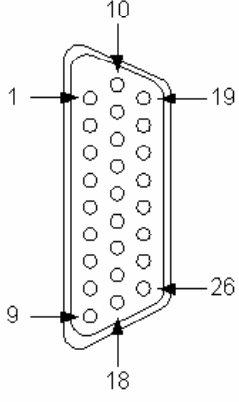
**Table 1-3: TS processor card - ASI interface**

Characteristic	Description
ASI Input	
Connector	BNC
Transport Stream Rate	155 Mbps maximum, 250 kbps minimum
Data Format	Accepts both Burst and Packet mode ASI format
Signal Amplitude	2.0 V <sub>p-p</sub> maximum; 200 mV <sub>p-p</sub> minimum
Termination	75 Ω nominal, transformer coupled
Return Loss	10 dB min, 5 MHz to 270 MHz
Link Rate	270 Mbaud ± 100 ppm
ASI Output	(The Output is an active loop-through of the Input.)
Connector	BNC
Impedance	75 Ω nominal, transformer coupled
Transport Stream Rate	Same as the ASI input
Signal Amplitude	1.0 V <sub>p-p</sub> max, 600 mV <sub>p-p</sub> min, into a 75 Ω load
Return Loss	10 dB min at 270 MHz

**Table 1-4: TS processor card - SMPTE310M interface**

Characteristic	Description
SMPTE310M Input	
Connector	BNC
Termination	75 Ω, transformer coupled
Data Format	Bi-phase coded. Compliant with SMPTE310M
Input Bit Rate	19,392,658.5 bps ± 2.8 ppm
Signal Amplitude	2.0 V <sub>p-p</sub> maximum, 200 mV <sub>p-p</sub> minimum
Return Loss	10 dB min at 20 MHz
SMPTE310M Output	(The Output is an active loop-through of the Input.)
Connector	BNC
Output Bit Rate	Same as the SMPTE310M input
Signal Amplitude	600 mV min, 1.0 V max, into a 75 Ω load
Output Impedance	75 Ω, transformer coupled
Return Loss	10 dB min at 20 MHz


**Table 1-5: TS processor card - alarm connector**

26-Pin, D-Type Connector	Pin	Function	Description
	1	DGND	Ground
	2	TTL02	TTL Output 2
	3	DGND	Ground
	4	P5V	5 V
	5	RL1NC	Relay 1: Normally closed contact
	6	RL2NC	Relay 2: Normally closed contact
	7	RL3NC	Relay 3: Normally closed contact
	8	RL4NC	Relay 4: Normally closed contact
	9	RL5NC	Relay 5: Normally closed contact
	10	DGND	Ground
	11	DGND	Ground
	12	TTL03	TTL Output 3
	13	P5V	5 V
	14	RL1CC	Relay 1: Common contact
	15	RL2CC	Relay 2: Common contact
	16	RL3CC	Relay 3: Common contact
	17	RL4CC	Relay 4: Common contact
	18	RL5CC	Relay 5: Common contact
	19	TTL01	TTL Output 1
	20	DGND	Ground
	21	TTLI1	TTL Input 1
	22	RL1NO	Relay 1: Normally open contact
	23	RL2NO	Relay 2: Normally open contact
	24	RL3NO	Relay 3: Normally open contact
	25	RL4NO	Relay 4: Normally open contact
	26	RL5NO	Relay 5: Normally open contact
Connector shell - Chassis ground			

**Table 1-6: TS processor card - alarms**

Characteristic	Value
Alarm Relay	
Number of relays	5
Maximum Switching Current	1 Amp
Maximum Switch Voltage	24 Vdc
Contact Resistance	100 milli-Ω max
TTL Output Pins of the Alarms Output Connector	
Output Type	TTL open collector, requires external pull-up resistor
Logic High Voltage	2.0 V min
Logic Low Voltage	0.8 V max, sinking 100 mA
Maximum Switching Current	100 mA
TTL Input Pins of the Alarms Output Connector	
Maximum Input Voltage	5.1 V
Logic High Input Voltage	2.0 V min
Logic Low Input Voltage	0.8 V max
+5 V Output, Pins 4 and 13 of the Alarms Output Connector	
Output Voltage	4.9 V min, 5.1 V max, no load
Maximum Output Current	100 mA
Output Protection	Fused, self resetting

**Table 1-7: TS processor card - LTC connector**

LTC 2-pin connector	Pin	Function	Description
	1	IN+	
	2	IN-	
	Connector shell - Chassis ground		
Port Specification			
Type	Linear time code, SMPTE standard to ANSI/SMPTE 12M - 1995		
Input Voltage	2.0 V p-p differentially minimum		

**Table 1-8: TS processor card - Ethernet RJ-45 connector**

Characteristic	Description
Connector	10/100 Base-T; RJ-45 Use only good quality screened cable; Cat 6



**Table 1–9: QAM Annex A interface card characteristics**

Characteristic	Description
Input Frequency Range	51 MHz to 858 MHz, 62.5 kHz steps
Modulation Format	16 QAM, 64 QAM, 256 QAM (compliant with DVB-C ETS 300 421)
Modulation Baud Rate, QAM A	5.0 Mbaud/s minimum, 6.952 Mbaud/s maximum
Input Signal Level	-57 dBm (50 dBuV) to -27 dBm (80 dBuV), with a 16, 64, and 256 QAM input, providing five or fewer Transport Error Flags in 10 seconds, which corresponds to a post FEC rate of $1e^{-8}$
Modulation Error Ratio (with equalizer)	38 dB min, with a 64 QAM input and 256 QAM input
Receiver Bandwidth, QAM A	8 MHz nominal
Input Termination Impedance	75 $\Omega$ nominal
Input Return Loss	6 dB min, 10 dB typical, 51 MHz to 858 MHz
Loop Through Power Gain	1.5 dB to 4 dB typical, 51 MHz to 858 MHz typical
Loop Through Noise Figure	8 dB typical
Loop Through Output Return Loss	Greater than 10 dB typical

**Table 1–10: QAM Annex B2 interface card characteristics**

Characteristic	Description
Input Frequency Range	88 MHz to 858 MHz
Input Signal Level	-64 dBm to -19 dBm (45 dBuV to 90 dBuV relative to 75 $\Omega$ ) (With either a 64 or 256 QAM input, there are five or fewer Transport Error Flags in 11 seconds, which corresponds to a post FEC rate of $1e^{-8}$ ) $\geq$ -55 dBm to ensure compliance to EN 55103-2 immunity
Modulation Format	64QAM, 256QAM (compliant with ITU J-83 Annex B)
Interleaving Mode	Level 1 and Level 2 interleaving support compliant with all ITU J-83 Annex B, excluding I, J = (128,7) and (128,8), and in 256 QAM excluding (8, 16) and (16, 8)
Modulation Baud Rate	64 QAM: 5.056941 Mbaud/s 256 QAM: 5.360537 Mbaud/s
Spectrum Polarity	Demodulates both Normal and Inverted IF Spectrum.
Receiver Bandwidth, QAM B	6 MHz nominal
Connector Type	F type
Input Termination Impedance	75 $\Omega$ nominal
Input Return Loss	5 dB typical
Ultimate Modulation Error Ratio with Equalizer	$\geq$ 37 dB with equalizer; typical

**Table 1-11: QAM Annex B2 measurements**

Characteristic	Description
RF Lock	RF lock is indicated by LED and Status
Input Level (Signal Strength) (Typical)	Range: -64 dBm to -19 dBm (45 dBuV to 90 dBuV relative to 75 $\Omega$ s) Resolution: 1 dB Accuracy: $\pm 3$ dB
EVM (Error Vector Magnitude) (Typical)	Display Range for 64 QAM: $\leq 1\%$ to $\geq 5\%$ rms Display Range for 256 QAM: $\leq 1\%$ to $\geq 2.5\%$ rms Resolution: 0.1% Accuracy: $\pm 1\%$
MER (Modulation Error Ratio) with Equalizer (Typical)	Display Range: 64 QAM: 22 dB to 37 dB 256 QAM: 28 dB to 37 dB Resolution: 0.1 dB Accuracy: $\pm 1$ dB for MER < 25 dB; $\pm 3$ db for MER 25 dB to 34 dB (measured at -30 dBm input)
SNR (Signal to Noise Ratio) (Typical)	Display Range: 64QAM: 22 dB to 37 dB 256QAM: 28 dB to 37 dB Resolution: 1 dB Accuracy: $\pm 1$ dB for SNR < 25 dB; $\pm 3$ db for SNR 25 dB to 34 dB
BER (Bit Error Ratio)	Pre-RS BER is displayed
TEF (Transport Error Flag)	Transport Error Flags (uncorrectable error count) in a 1 second window and 10 second window are displayed.
Constellation	The RF constellation is displayed.

**Table 1-12: QAM Annex C interface card characteristics**

Characteristic	Description
Input Frequency Range	88 MHz to 858 MHz, 62.5 kHz steps
Modulation Format	16 QAM, 64 QAM, 256 QAM (compliant with ITU J-83 Annex C)
Modulation Baud Rate, QAM C	4.5 Mbaud/s min; 5.5 Mbaud/s max
Input Signal Level	-57 dBm (50 dBuV) to -27 dBm(80 dBuV), with a 16, 64, and 256 QAM input, providing five or fewer Transport Error Flags in 12 seconds, which corresponds to a post FEC rate of $1e^{-8}$
Modulation Error Ratio (with equalizer)	38 dB typical, with a 64 QAM input
Receiver Bandwidth, QAM C	6 MHz nominal
Input Termination Impedance	75 $\Omega$ nominal
Input Return Loss	6 dB min, 10 dB typical, 88 MHz to 858 MHz

**Table 1–13: 8PSK/QPSK interface card characteristics with 8PSK input**

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz with 1 MHz step size
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, 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 $\Omega$ nominal
Input Return Loss	4 dB min, 950 MHz to 2050 MHz typical
LNB Supply Voltage	Selectable; 13.0 V $\pm$ 1.5 V or 18.0 V $\pm$ 1.5 V, with 100 $\Omega$ , 5 watt resistor load
LNB Supply Maximum Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz $\pm$ 20%)
LNB 22 kHz Signaling Amplitude	600 mV p-p with 100 $\Omega$ load
Ultimate Modulation Error Ratio (with equalizer)	26 dB with equalizer

**Table 1–14: 8PSK/QPSK interface card characteristics with QPSK input**

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz with 1 MHz step size
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, 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 $\Omega$ nominal
Input Return Loss	4 dB min, 950 MHz to 2050 MHz typical
LNB Supply Voltage	Selectable; 13.0 V $\pm$ 1.5 V or 18.0 V $\pm$ 1.5 V, with 100 $\Omega$ , 5 watt resistor load
LNB Supply Maximum Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz $\pm$ 20%)
LNB 22 kHz Signaling Amplitude	600 mV p-p with 100 $\Omega$ load
Ultimate Modulation Error Ratio (with equalizer)	26 dB with equalizer

**Table 1-15: 8PSK and QPSK measurements**

Characteristic	Description
RF Lock	RF lock is indicated by LED and Status.
Input Level (Signal Strength)	Range: -60 dBm to -30 dBm; Resolution: 1 dBm; Accuracy: $\pm 5$ dBm; typical
EVM (Error Vector Magnitude)	Display Range: $\leq 4.0\%$ to $\geq 30.0\%$ rms; Resolution: 0.1%; Accuracy: $\pm 20\%$ of reading; typical
MER (Modulation Error Ratio) with Equalizer	Display Range: 10 dB to 26 dB with equalizer; Resolution: 1 dB; Accuracy: $\pm 2$ dB for range 10 dB to 20 dB; typical
SNR (Signal to Noise Ratio)	Display Range: 5 dB to 35 dB; Resolution: 1dB; Accuracy: $\pm 2$ dB for range from 5 dB to 30 dB; typical
Pre Reed Solomon (RS) BER (Bit Error Rate)	Pre-RS BER is displayed.
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.
Constellation	The RF constellation is displayed.

**Table 1-16: 8VSB interface card characteristics**

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) $\geq -60$ dBm to ensure compliance to EN 55103-2 immunity
Modulation Format	8VSB in accordance with ATSC A/53B.
Receiver Bandwidth	6 MHz
Input Termination Impedance	75 $\Omega$ nominal
Connector Type	F type
Input Return Loss	5 dB minimum; typical

**Table 1–17: 8VSB measurements**

<b>Characteristic</b>	<b>Description</b>
RF Lock	RF lock is indicated LED and Status
Input Level (Signal Strength) (Typical)	Display Range: -72 dBm to -2 dBm relative to 75 $\Omega$ (-23 dBmV to +47 dBmV) Resolution: 1dB Accuracy: $\pm$ 3dB
EVM (Error Vector Magnitude) (Typical)	Display Range: $\leq$ 3.0% to $\geq$ 12.5% rms Resolution: 0.1% Accuracy: $\pm$ 20% of reading
Equivalent MER (Modulation Error Ratio) with Equalizer (Typical)	Display Range: 17 dB to 31 dB with Equalizer Resolution: 0.1 dB Accuracy: $\pm$ 1 dB for MER > 25 dB; $\pm$ 3 db for MER 25 dB to 31 dB (Measured at -30 dBm input. For best MER accuracy, maintain the input signal level between -50 dBm and -15 dBm.)
SNR (Signal to Noise Ratio) (Typical)	Display Range: 15 dB to 35 dB Resolution: 1 dB Accuracy: $\pm$ 1 dB for SNR < 25 dB; $\pm$ 3 db for SNR 25 dB to 35 dB
BER	Pre-RS BER, SER 1 second and 10 seconds windows values are displayed.
TEF (Transport Error Flag)	Transport Error Flags (uncorrectable error count) in a 1 second window and 10 second window are displayed.
Constellation Diagram	The 8VSB constellation diagram is a display of I-data history with histograms (the IQ constellation is not available). This is displayed as Symbol Distribution in the user interface.
Echo Profile (Typical)	Equalizer filter tap information is displayed. Display Echo Level range: Normalized real tap values over the range of -1 to 1 Display Delay range: -6.7 $\mu$ s to 45.5 $\mu$ s

**Table 1-18: COFDM interface card characteristics**

Characteristic	Description
Input Frequency Range	50 MHz to 858 MHz (to include low VHF)
Input Signal Amplitude Range	The receiver delivers QEF (Quasi Error Free) operation over the following signal power ranges: QPSK (4QAM): -85 dBm to -10 dBm (24 dBuV to 99 dBuV) 16QAM: -80 dBm to -10 dBm (29 dBuV to 99 dBuV) 64QAM: -72 dBm to -15 dBm (37 dBuV to 94 dBuV) ≥ -60dBm to ensure compliance to EN 55103-2 immunity
Compliance	COFDM (DVB-T) receptions and demodulation, compliant with ETSI EN300-744, 2 K and 8 K transmission modes
Tuning Resolution	166.7 kHz or smaller increments
Tuning Accuracy	Better than ± 50 ppm
Channel Bandwidth	6 MHz, 7 MHz, and 8 MHz (software selectable)
Connector Style	F-style
Input Termination Impedance	75 Ω nominal
Input Return Loss	7 dB minimum, 50 MHz to 858 MHz; typical
Modulation Schemes Supported	QPSK (4QAM), 16QAM, and 64QAM modulation
Transmission Modes	2 K carriers and 8 K carriers
Hierarchical modulation	All hierarchies will be supported, to include no hierarchy, and alpha = 1, 2 and 4.
Viterbi puncture rates	1/2, 2/3, 3/4, 5/6, 7/8
Guard Intervals	1/32, 1/16, 1/8, 1/4
Spectrum Polarity	The receiver will operate with both inverted and normal spectral polarity.
Ultimate Modulation Error Ratio, with Equalizer	≥ 37 dB with equalizer; typical

**Table 1–19: COFDM measurements**

Characteristic	Description
Overall Receiver Lock Status	Overall receiver lock status is indicated by an LED on the rear panel.
Transmission Coding Parameters	The receiver reports the current status of the following transmission parameters: <ul style="list-style-type: none"> <li>- QPSK/16, QAM/64, QAM encoding</li> <li>- 2K/8K Transmission mode</li> <li>- Hierarchy status (hierarchy on/off, alpha value)</li> <li>- Viterbi puncture rate</li> <li>- Guard Interval Value</li> <li>- Gross bit rate in the channel</li> <li>- Spectrum polarity (inverted/non inverted)</li> </ul>
Input Level (Signal Strength) (Typical)	<p>Ranges, High Sensitivity mode:</p> <p>QPSK (4QAM): -85 dBm to -10 dBm (24 dBuV to 99 dBuV)</p> <p>16QAM: -80 dBm to -10 dBm (29 dBuV to 99 dBuV)</p> <p>64QAM: -72 dBm to -13 dBm (37 dBuV to 96 dBuV)</p> <p>Ranges, High Resolution mode:</p> <p>QPSK (4QAM): -45 dBm to -10 dBm (64 dBuV to 99 dBuV)</p> <p>16QAM: -45 dBm to -10 dBm (64 dBuV to 99 dBuV)</p> <p>64QAM: -45 dBm to -13 dBm (64 dBuV to 96 dBuV)</p> <p>Resolution: 1 dBm</p> <p>Accuracy: <math>\pm 3</math> dBm</p>
RF Carrier Offset	Accuracy: $\pm 50$ ppm, of the tuned frequency; typical
Carrier Power Distribution	The carrier-by-carrier signal-to-noise power ratio is displayed. Channel Flatness in dB can be viewed from spectrum display. Tilt in dB can be viewed from spectrum display.
SNR (Signal to Noise Ratio) (Typical)	<p>Display Range:</p> <p>6 dB to 40 dB for QPSK (4QAM):</p> <p>11 dB to 40 dB for 16QAM</p> <p>16 dB to 40 dB for 64QAM</p> <p>Resolution: 1 dB</p> <p>Accuracy: <math>\pm 1</math> dB to 30 dB SNR (measured at -30 dBm input in high resolution mode)</p>
EVM (Error Vector Magnitude) (Typical)	<p>Display Range:</p> <p><math>\leq 1\%</math> to <math>\geq 30\%</math> rms, for QPSK</p> <p><math>\leq 1\%</math> to <math>\geq 20\%</math> rms, 16QAM</p> <p><math>\leq 1\%</math> to <math>\geq 8.5\%</math> rms, 64QAM</p> <p>Resolution: 0.1%</p> <p>Accuracy: 1% (1 EVM unit), and additional <math>\pm 20\%</math> of reading</p>

**Table 1-19: COFDM measurements (Cont.)**

Characteristic	Description
MER (Modulation Error Ratio) with Equalizer (Typical)	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: $\pm 1$ dB to 30 dB (Measured at -30 dBm input in High Resolution mode). For best MER accuracy, use High Resolution mode, and maintain the input signal level between -45 dBm and -15 dBm.
Channel Equalization Status	Channel estimate I and Q values for each carrier are displayed.
Constellation	The RF constellation is displayed.
BER	Pre-Viterbi BER and Pre Reed-Solomon 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.

**Table 1-20: GigE interface card - general characteristics**

Characteristic	Description
Ethernet Port	The Ethernet Interfaces supports 1000/100/10 Mbit/s data transmission. The Ethernet Interface to the card will be an IEEE 802.3 compliant 10/100/1000 Ethernet interface supporting 10/100/1000BT, 1000BSX(multi-mode), and 1000BLX(single-mode).  Two Ethernet interfaces are available - a copper RJ-45 interface and an MSA (multi-source agreement) compliant SFP (Small Form-factor Pluggable) connector. The SFP connector will provide for pluggable optical interfaces. Only one interface, either the copper or optical, will be active at a time for video over IP monitoring. The active interface will be selectable via software control.
Transport stream rate over IP	250 Kbps to 155 Mbps; typical

**Table 1-21: GigE interface card - Ethernet electrical port**

Characteristic	Description
Standard	10/100/1000BASE-T IEEE 802.3
Connector Type	RJ-45
Data Format 10/100 Base T	NRZ
Data Format 1000 Base T	Trellis encoded, PAM5 symbols full-duplex on 4-pair Cat-5 UTP per IEEE 802.3ab



**Table 1–22: GigE interface card - Ethernet Optical port**

Characteristic	Description
<b>Ethernet Optical Transmitter - General Characteristics</b>	
Optical Operating Mode	Single Mode or Multimode
Connector Type	Duplex data link MSA compliant SFP connector
Standard	1000 BASE-X
Data Format	NRZ
<b>Ethernet Optical Transmitter - Single mode 1550nm Using Tek supplied SFP module</b>	
Output Power	-2 dBm to +4 dBm; typical
Center Wavelength - 1550 nm	1530 nm Min, 1550 nm Typ, 1570 nm Max; typical
Total Jitter (Peak-to-Peak)	< 170 ps
Extinction Ratio	≥ 9.0 dBm
<b>Ethernet Optical Receiver - Single mode 1550nm Using Tek supplied SFP module</b>	
Optical Input Power	-26 dBm to -3 dBm, BER $1 \times 10^{-12}$ ; typical
Input Wavelength	1270 nm = $\lambda$ = 1610 nm
<b>Ethernet Optical Transmitter - Single mode 1310nm Using Tek supplied SFP module</b>	
Output Power	-11 dBm to -3 dBm; typical
Center Wavelength - 1310 nm	1270 nm Min, 1310 nm Typ, 1355 nm Max; typical
Total Jitter (Peak-to-Peak)	< 170 ps
Extinction Ratio	≥ 9.0 dBm
<b>Ethernet Optical Receiver - Single mode 1310nm Using Tek supplied SFP module</b>	
Optical Input Power	-19 dBm to -3 dBm, BER $1 \times 10^{-12}$ ; typical
Input Wavelength	1270 nm = $\lambda$ = 1610 nm
<b>Ethernet Optical Transmitter - Multimode 850nm Using Tek supplied SFP module</b>	
Output Power	-9.5 dBm to -2 dBm; typical
Center Wavelength - 850 nm	830 nm Min, 850 nm Typ, 860 nm Ma; typical
Total Jitter (Peak-to-Peak)	< 170 ps
Extinction Ratio	≥ 9.0 dBm
<b>Ethernet Optical Receiver - Multimode 850nm Using Tek supplied SFP module</b>	
Optical Input Power	-17 dBm to 0 dBm, BER $1 \times 10^{-12}$ ; typical
Input Wavelength	770 nm = $\lambda$ = 860 nm

**Table 1-23: GigE interface card - ASI input**

Characteristic	Description
Connector	BNC
Transport Stream Rate	250 Kbps to 155 Mbps; typical
Data Format	Accepts both Burst and Packet mode ASI format
Signal Amplitude	2.0 V <sub>p-p</sub> max; 200 mV pk to pk min
Termination	75 Ω nominal, transformer coupled
Return Loss	10 dB min, 5 MHz to 270 MHz
Link Rate	270 Mbaud ± 100 ppm

**Table 1-24: GigE interface card - ASI output (active loop-through of ASI/SMPTE input or TS from GigE interface card)**

Characteristic	Description
Connector	BNC
Impedance	75 Ω nominal, transformer coupled
Transport Stream Rate	250 Kbps to 155 Mbps max
Transport Stream Smoothing	Smoothing mechanism for the TS packets before retransmitting packets out on ASI port
Signal Amplitude	600 mV pk to pk min, 1.0V <sub>p-p</sub> max into a 75 Ω load
Return Loss	10 dB min at 270 MHz

**Table 1-25: GigE interface card - SMPTE310M input (loop-through to ASI output)**

Characteristic	Description
Connector	BNC
Termination	75 Ω nominal, transformer coupled
Data Format	Bi-phase coded. Compliant with SMPTE310M
Input Bit Rate	19,392,658.5 bps ± 2.8 ppm
Signal Amplitude	2.0V <sub>p-p</sub> max; 200 mV pk to pk min
Return Loss	10 dB min at 20 MHz

## Power Source Characteristics

**Table 1–26: AC power source characteristics**

Characteristic	Description
Source Voltage	100 VAC to 240 VAC
Frequency Range	50 Hz/60 Hz
Power Consumption	1 A max
Peak Inrush Current	7.2 A peak at 240 VAC, 50 Hz
Fuse Rating	Mains fuse is 3.15 A, 250 V (Not operator replaceable. Refer servicing to qualified service personnel.)

**Table 1–27: Transport stream card batteries**

Characteristic	Description
Quantity	2 (In single carrier)
Voltage	3 V
Capacity	210 mAh
Continuous Discharge (Maximum)	3 mA
Overall Dimensions (Single cell)	
Height	3.2 mm (0.13 in)
Width (Diameter)	20 mm (0.79 in)
Battery Type	Tektronix part number: 146-0096-xx

## Environmental Characteristics

**Table 1–28: Environmental characteristics**

Characteristic	Description
Temperature	
Operating	+5 °C to +40 °C
Non-operating	-10 °C to +60 °C
Humidity	
Operating	10% to 80% relative humidity up to 31 °C Above 31 °C, decreasing linearly to 50% at 40 °C
Non-operating	10% to 95% relative humidity, non-condensing
Altitude	
Operating	0 m to 3000 m (9800 ft)
Non-operating	0 m to 12000 m (40000 ft)

## Mechanical (Physical) Characteristics

**Table 1–29: Mechanical characteristics**

Characteristic	Description
Classification	Transportable platform also intended for 19-inch rack mounted applications, 1RU high.
Overall Dimensions	
Height	44 mm (1.73 in) (1RU)
Width	430 mm (17.13 in)
Depth	600 mm (23.62 in)
Required Clearance	Top and bottom: 0 mm; Sides: Standard 19 in rack mount
Weight	6.0 kg (13.3 lbs); fully loaded
Packaged Dimensions	
Height	241 mm (9.5 in)
Width	590 mm (23.1 in)
Depth	760 mm (30 in)
Weight (Packaged)	9 kg (19.7 lbs)

## Certifications and Compliances

**Table 1–30: Certifications and compliances**

Category	Standard or Description
EC Declaration of Conformity - EMC	<p>Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <p>EN 55103 Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use<sup>1</sup>. Environment E4 - controlled EMC environment</p> <p>Part 1 Emission</p> <p>EN 55022 Class A radiated and conducted emissions</p> <p>EN 55103-1, Annex A Radiated magnetic field emissions</p> <p>Part 2 Immunity<sup>1</sup></p> <p>IEC 61000-4-2 Electrostatic discharge immunity</p> <p>IEC 61000-4-3 RF electromagnetic field immunity</p> <p>IEC 61000-4-4 Electrical fast transient / burst immunity</p> <p>IEC 61000-4-5 Power line surge immunity</p> <p>IEC 61000-4-6 Conducted RF Immunity</p> <p>IEC 61000-4-11 Voltage dips and interruptions immunity</p> <p>EN 55103-2, Annex A Radiated magnetic field immunity</p> <p>EN 55103-2, Annex B Balanced ports common mode immunity</p> <p>EN 61000-3-2 AC power line harmonic emissions</p> <p>EN 61000-3-2 Voltage Changes, fluctuations and flicker</p> <p><sup>1</sup> Refer to RF interface card specification for minimum RF input level required to ensure EMC immunity performance.</p>
Australia/New Zealand Declaration of Conformity - EMC	<p>Complies with EMC provision of Radiocommunications Act per the following standard(s):</p> <p>AS/NZS 2064.1/2 Class A limits for Industrial, Scientific, and Medical Equipment: 1992</p>
FCC	<p>Radiated and conducted emissions do not exceed the levels specified in FCC 47 CFR, Part 15, Subpart B, for Class A equipment.</p>
EC Declaration of Conformity - Low Voltage	<p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:</p> <p>Low Voltage Directive 2006/95/EC</p> <p>EN 61010-1:2001. Safety requirements for electrical equipment for measurement control and laboratory use.</p>
U.S. Nationally Recognized Testing Laboratory Listing	<p>UL61010B-1:2003 Standard for electrical measuring and test equipment.</p>
Canadian Certification	<p>CAN/CSA C22.2 No. 1010.1:1997 Particular requirements for electrical equipment for measurement, control, and laboratory use. Part 1.</p>

**Table 1-30: Certifications and compliances (Cont.)**

Category	Standard or Description
Additional Compliance	IEC61010-12001 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Installation (Overvoltage) Category Descriptions	<p>Terminals on this product may have different installation (overvoltage) category designations. The installation categories are:</p> <p>CAT IV For measurements performed at the source of low-voltage installation.</p> <p>CAT III For measurements performed in the building installation.</p> <p>CAT II For measurements performed on circuits directly connected to the low-voltage installation.</p> <p>CAT I For measurements performed on circuits not directly connected to MAINS.</p>
Overvoltage Category	Overvoltage Category II (as defined in IEC61010-1)
Pollution Degree Description	<p>A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.</p> <p>Pollution Degree 1 No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.</p> <p>Pollution Degree 2 Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.</p> <p>Pollution Degree 3 Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.</p> <p>Pollution Degree 4 Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.</p>
Pollution Degree	Pollution Degree 2 (as defined in IEC61010-1). Rated for indoor use only.

**Table 1-31: Environmental limits and use classification for safety certification compliance**

<b>Category</b>	<b>Standard or Description</b>
Temperature, operating	+5 °C to +40 °C
Altitude (maximum operating)	3000 meters
Equipment Type	Test and measuring
Safety Class	Class 1 - grounded product
Source Voltage Range	100 VAC to 240 VAC, 50 Hz/60 Hz, single phase
Fuse Rating	Mains fuse is 3.15 A, 250 V, Fast; Not operator replaceable. Refer servicing to qualified service personnel.
Current Rating	1 Amp
Pollution Degree	Pollution Degree 2 (as defined in IEC 61010-1) Note: Rated for indoor use only.







# Performance Verification



# Performance Verification

To verify that the MTM400A monitor is operating correctly, perform the following procedure.

## Requirements

The MTM400A monitor must be connected to a network and have a valid IP address as described in the *MTM400A Quick Start User Manual*.

The client PC must satisfy the requirements listed in Table 1–1 on page 1–1.

## Procedure

1. Connect the MTM400A monitor to an Ethernet network.
2. Power on the MTM400A monitor and wait for the instrument initialization to complete.
3. On a client PC (connected to the same network and subnet mask as the MTM400A monitor), launch the Microsoft Internet Explorer Web browser.

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**NOTE.** *This procedure describes how to access the the MTM400A monitor RUI using the Microsoft Internet Explorer Web browser. The RUI can also be accessed using the Tektronix Web Monitoring Systems Manager (WebMSM). This is described in the WebMSM User Manual, Tektronix part number 077-0116-xx.*

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4. In the Web browser address bar, enter the network identity or the IP address of the MTM400A monitor, for example: `http://TSMonitor01` or `http://111.222.333.444`.
5. Press **Enter**. A Java applet is downloaded from the MTM400A monitor and launched. The file size is approximately 1.5 MB; the download time will depend on the network speed and traffic.



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**CAUTION.** *The Java applet will not run unless a temp directory is properly configured on the PC. A temp directory is set up by default in the Windows XP operating system; previous operating systems may require operator action.*

*The Java applet will not run unless the Sun Java Virtual Machine is installed. Type `java -version` at the command prompt to verify that it is installed and that the version is 1.6.0\_10 or greater. If it is not installed, you can download the latest version from the Sun Web site, `www.java.com\getjava`.*

*If you have to update the Java version on the PC, you will need to restart this procedure at step 3.*

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6. In the Connect to MTM Device dialog box, select the Login Type from the drop-down list, Administrator or User.
7. Enter the password for the Login Type you selected in step 6. The default password for Administrator is tek; there is no default password for User.
8. Click **Connect** to start the connection process.
9. Read the End User License Agreement if it appears, and then click **I Accept**.
10. When the MTM400A monitor RUI opens, click **Device** in the button bar to display the Device Information view (see Figure 2-1).
11. In the Device Information view, verify that the Application Firmware Version is 3.0 or greater.
12. If the MTM400A monitor connects and presents the RUI, and displays the correct application firmware version in the Device Information window, then the instrument is operating normally.

The screenshot shows the MTM400A Transport Stream Monitor RUI. The title bar reads "Mktg COFDM (192.158.201.89) - MTM400A Transport Stream Monitor". The interface includes a menu bar (Analysis, View, Navigation, Settings, Help) and a toolbar with buttons for Connect, Interface, Standard, Configuration, Idle (0%), and Reset Tests. A sidebar on the left contains various monitoring and configuration options. The main content area is divided into several panels:

- Device Information:** A table showing various system parameters.
 

Parameter	Value
Application Firmware Version	3.1.063.624
FPGA Logic Firmware Version	4
BIOS Version	2.07
SNMP information (MIB)	3.1.063
Hardware Version	5
QA Build	RC 02
Build Timestamp	Nov 25 2008 18:36:08
Network MAC Address	08-00-11-29-C1-80
Options Enabled	01 (Rec) 02 (SI) 03 (Template) 04 (PCR) 05 (B Rates) 06 (Svc)
License Key	8E9K9-CKCOT-L3PG-PL9K-Q
- Device Event Log:** A table showing recent events.
 

Date	Time	Description
28 Nov 2008	12:28:19.552	Log cleared

The status bar at the bottom displays: Login: Admin, TS Availability (green), Sync (green), 18.096583 Mbps @ 188, 188, DVB, DTG, Interface: COFDM.

Figure 2-1: MTM400A monitor RUI display

