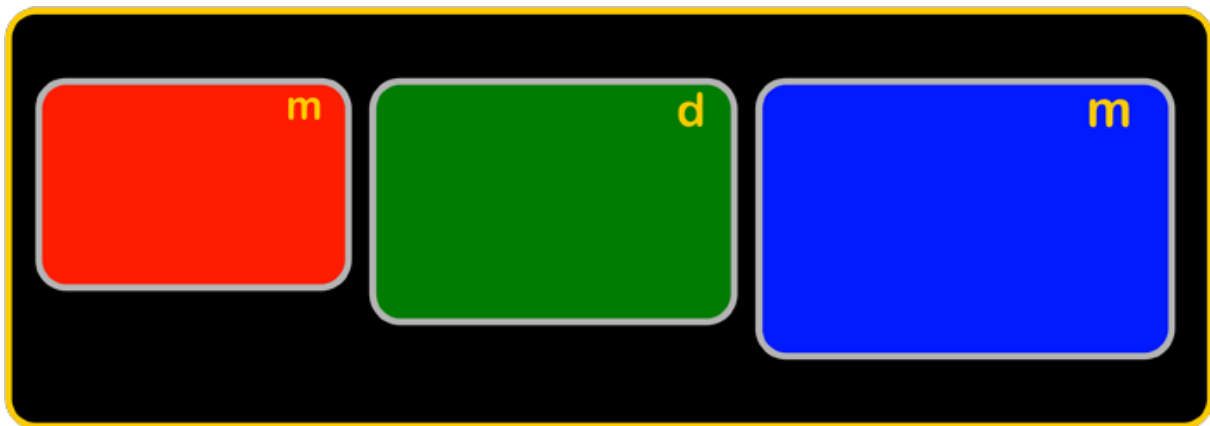# Installation Guide

Tritec
Multi-Desktop-Manager
MDM-5

Configuration: Model E
Basic / Advanced / Professional Edition
Model/Type Reference: MDM-5, MDM-5-2U

Tritec Electronic GmbH
Carl-Zeiss-Str. 41
55129 Mainz
Germany
www.tritec.de
support@tritec.de

Version history

2.0		J.Bullacher	Changes for Model D, removed older models
2.1	11.1.2019	J.Bullacher	Added chapter 9 Maintenance / Service Added chapter 10 trouble shooting Added French precautions. Added chapter 4.7.1 and Table 2.
2.2	17.1.2019	J.Bullacher	Added chapter 4.13
2.3	27.10.2020	J.Bullacher	Changed the EC Declaration of conformity
2.4	22.9.2021	J.Bullacher	Added Audio in/out
2.5	25.7.2023	S. Philipp	Removed MDM-1 / Model D Removed MDI-5 input card Added MDM-5 / Model E Added MDI-10 input card Added Etherface-1 converter Extended Chap 3.7 Rack System Warnings
2.6	23.10.2023	S. Philipp	Updated system bandwidth numbers, chap 4.20 Added redundant power supply LED status, Table 3 Added details about color depth and streaming.
2.7	22.11.2023	S. Philipp	Updated Figure 6, chap 7.2 Updated FCC notice to FCC Class B Updated Safety notes and warnings, chap 3 and 7.2.5 Updated Temp warning range chap 7.1 Updated MDI-7+MDI-10 bandwidth limits chap 4.12, 4.13, 7.2.5.2
2.8	19.01.2024	S. Philipp	Updated chap. 4.20 system bandwidth, approved combinations for MDM-Advanced model. Updated image of MDM-E-Pro with actual labeling.

Table of contents

List of all Figures

List of all Tables

1. Copyright Note

2. Regulatory Compliance Statements

Your Tritec product is marked to indicate its compliance class: A
Federal Communications Commission (FCC) — USA

2.1   FCC Class B Notice

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Note:
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.
However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

*   Reorient or relocate the receiving antenna.

*   Increase the separation between the equipment and receiver.

*   Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

*   Consult the dealer or an experienced radio/television technician for help.

Modifications:
Any modifications made to this device that are not approved by Tritec Electronic GmbH may void the authority granted to the user by the FCC to operate this equipment.

2.2 EC Declaration of Conformity

$\mathsf{C}\,\mathsf{E}$

EG-Konformitätserklärung

EC Declaration of Conformity

Hersteller:	**TRITEC Electronic GmbH**
Manufacturer:	Carl-Zeiss-Straße 41
	D - 55129 Mainz
	Germany

Wir bestätigen, dass das IT Gerät:
We certify that the IT product:

Produktname:	**Multi Display Manager**
Model Type Reference:	**MDM-5**

die grundlegenden Anforderungen der EMV-Richtlinie 2014/30/EU,
der Niederspannungsrichtlinie 2006/95/EG und der RoHS-Richtlinie EU 2015/863 erfüllt.

is conform to the regulations of the EMC Directive 2014/30/EU,
the Low Voltage Directive 2006/95/EC and the RoHS Directive EU 2015/863

Die Konformität mit diesen Richtlinien wird dadurch nachgewiesen, dass bei
dem bezeichneten Produkt folgende harmonisierte EU-Normen eingehalten werden:

> EN 55032:2015 + A11:2020, Klasse B
> EN 55035:2017 + A11:2020
> EN 61000-3-2:2019
> EN 61000-3-3:2013 + A1:2019
>
> EN 62368-1:2014 + A11:2017

The conformity with the instructions of these directives is proved by the
observation of the following EC harmonized standards:

> EN 55032:2015 + A11:2020, Klasse B
> EN 55035:2017 + A11:2020
> EN 61000-3-2:2019
> EN 61000-3-3:2013 + A1:2019
>
> EN 62368-1:2014 + A11:2017

Jahr der CE-Kennzeichnung:	2012
CE marking date:	
Datum / Date:	20.12.2022
Unterschrift / Signature:	_U. Schmidt_
Name:	Uwe Schmidt
Funktion / Function:	Quality Manager
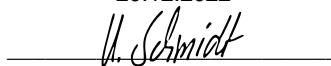
3. Safety Agency Compliance Statements

Read this section before beginning any procedure. The following text provides safety precautions to follow when installing a Tritec Electronic GmbH product.

3.1   Safety Precautions

For your protection, observe the following safety precautions when setting up your equipment:

- Follow all cautions and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source match the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous voltages may be present.
- Conductive foreign objects could produce a short circuit that could cause fire, electric shock, or damage to your equipment.

3.2   Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. Tritec Electronic GmbH is not responsible for regulatory compliance of a modified Tritec product.

3.3   Placement of a Tritec Product

Caution–Do not block or cover the openings of your Tritec product. Never place a Tritec product near a radiator or heat register. Failure to follow these guidelines can cause overheating and affect the reliability of your Tritec product.

3.4   Power Cord Connection

Caution– Tritec products a redesigned to work with power systems that have a grounded neutral (grounded return for DC-powered products). To reduce the risk of electric shock, do not plug Tritec products into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.

Caution–Not all power cords have the same current ratings. Do not use the power cord provided with your equipment for any other products or use. Household extension cords do not have overload protection and are not meant for use with computer systems. Do not use household extension cords with Tritec product.

Caution– The following caution applies only to devices with multiple power cords: For products with multiple power cords, all power cords must be disconnected to completely remove power from the system.

The current consumption in summary is independent of whether one or both power supply modules are in operation (automatic load sharing).

3.5   Battery Warning

Caution–There is a danger of explosion if batteries are mishandled or incorrectly replaced. On systems with replaceable batteries, replace only with the same manufacturer and type, or equivalent type, recommended by the manufacturer per the instructions provided in the product service manual. Do not disassemble batteries or attempt to recharge them outside the system. Do not dispose of batteries in fire. Dispose of batteries properly in accordance with the manufacturer's instructions and local regulations. Note that on a Tritec CPU board, there is a lithium battery.

3.6   System Unit Cover

Removal of the MDM cover can only be performed by a Tritec Authorized Service Center. Unauthorized removal voids the warranty. Warning: Power Off the System prior to removing the cover.

Caution–Do not operate Tritec products without the cover in place. Failure to take this precaution may result in personal injury and system damage.

3.7   Rack System Warning

The following warnings apply to Racks and Rack Mounted systems:

Caution–For safety considerations, equipment should always be loaded from the bottom up. For example, install the equipment that will be mounted in the lowest part of the rack first, then the next higher systems, etc.

Caution–To prevent the rack from tipping during equipment installation, the anti-tilt bar on the rack must be installed and in place.

Caution–To prevent extreme operating temperature within the rack insure that the maximum temperature does not exceed the product's ambient rated temperatures.

Caution–To prevent extreme operating temperatures due to reduced airflow, consideration should be made to the amount of airflow that is required for a safe operation of the equipment.

Caution - Elevated Operating Ambient - If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.

Caution - Reduced Air Flow - Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.

Caution - Mechanical Loading - Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

Caution - Circuit Overloading - Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

Caution - Reliable Earthing - Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g. use of power strips).

3.8 Security

The software shipped with the system is standard software. When connected to other computers, viruses or other harmful software may attack the software of this product. It is the sole responsibility of the user to protect this system against viruses and attacks from the Internet or other input devices of this system.

3.9 Laser Devices Used in SFP+ Ports

Warning: Only use optical transceiver Laser Class 1 which complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

Only use SFP+ modules with maximum power consumption of 1 W.

3.10 Français précautions

⚠ **AVERTISSEMENT**

Si de la fumée provient du moniteur, que celuici sent le brûlé ou émet des bruits anormaux, débranchez immédiatement tous les cordons secteur et prenez contact avec votre représentant local. Il peut être dangereux d'utiliser un système au fonctionnement défectueux.

Ne démontez pas la carrosserie et ne modifiez pas le système. Le démontage de la carrosserie ou la modification du système peut causer un choc électrique ou une brûlure.

Confiez toute intervention à un technicien qualifié. Ne tentez pas de dépanner vous-même cet appareil, l'ouverture ou la dépose des capots vous expose à un risque d'incendie, de choc électrique ou de dégâts à l'appareil.

Eloignez les petits objets ou les liquides de l'appareil. L'introduction accidentelle de petits objets ou de liquide dans les fentes de ventilation de la carrosserie peut entraîner un choc électrique, un incendie ou des dégâts à l'appareil. Si un objet tombe dans la carrosserie ou si du liquide se répand sur ou à l'intérieur de l'appareil, débranchez immédiatement le cordon secteur. Faites contrôler l'appareil par un technicien qualifié avant de l'utiliser à nouveau.

ATTENTION II y a danger d'explosion s'il y a remplacement incorrect de la batterie. Remplacer uniquement avec une batterie du même type ou d'un type équivalent recommandé par le constructeur. Mettre au rebut les batteries usagées conformément aux instructions du fabricant.

Systèmes avec alimentation redondante:
La consommation de courant en résumé est indépendante du fait qu'un ou les deux modules d'alimentation sont en service (répartition automatique de la charge).

Mise en garde - Pour mettre un système équipé de plusieurs cordons d'alimentation hors tension, il est nécessaire de débrancher tous les cordons d'alimentation.

Mise en garde - Utilisez uniquement un émetteur-récepteur optique de classe 1 conforme aux normes de performance de la FDA pour les produits laser, à l'exception de la conformité à la norme IEC 60825-1 Ed. 3, comme décrit dans l'avis laser n° 56 du 8 mai 2019.

Instructions de montage en rack La mise en garde suivante s'applique aux racks et aux systèmes montés en rack.

Température ambiante de fonctionnement élevée: en cas d'installation dans un châssis fermé ou contenant plusieurs appareils, la température ambiante de fonctionnement au niveau du rack peut être supérieure à la température ambiante de la pièce. En conséquence, il convient de veiller à installer le matériel dans un environnement compatible avec la température ambiante maximale (Tma), spécifiée par le fabricant.

Débit d'air réduit : l'installation du matériel dans un rack doit être effectuée de façon à ne pas compromettre le débit d'air nécessaire pour un fonctionnement sûr de ce matériel.

Charge mécanique: le montage de l'équipement en rack doit être réalisé de manière à éviter toute situation dangereuse résultant d'une charge déséquilibrée.

Surcharge de circuit: il convient de prendre les précautions nécessaires pour la connexion du matériel au circuit d'alimentation et de réfléchir aux conséquences d'une éventuelle surcharge des circuits sur la protection de surintensité et sur le câblage d'alimentation. En l'occurrence, les valeurs nominales de la plaque signalétique du matériel doivent être prises en compte.

Mise à la terre fiable: une mise à la terre fiable du matériel monté en rack doit être assurée. Une attention toute particulière est requise pour les raccordements d'alimentation autres que ceux effectués directement sur le circuit principal (par exemple, en cas d'utilisation de blocs multiprises).

4. Multi Desktop Manager Technical Details

The MDM Model E product ships in three different editions:

- Basic, featuring GPU-0 with, 2 x DP, 1 x HDMI outputs
- Advanced, featuring GPU-4 with 4 x DP outputs
- Professional, featuring GPU-6 with 6 x miniDP outputs

All MDM systems consist of a base unit with various output boards and plug-in cards that provide video inputs (MDI-7, MDI-10), KVM-functionality (KMS, MDI-10) and external 5VDC power supply (PPB). The MDM configuration has to be defined when ordered and cannot be changed in the field.

Basic and Advanced versions are available in a 2U height chassis with limited form factor. All versions are available in 4U height chassis.

An additional device 'Etherface-1' is available with input card MDI-10 to provide long-distance video inputs via optical connects to MDM.

	Basic		**Advanced**		**Professional**
Form Factor	2U	4U	2U	4U	4U
Video Outputs	GPU-0	GPU-0	GPU-4	GPU-4	GPU-6
Connectors	2 x DP 1 x HDMI	2 x DP 1 x HDMI	4 x DP	4 x DP	6 x miniDP
Max output resolution per display	3840 x 2160 px		5120 x 2880 px		
Max extended output resolution	8192 x 4320 px		16384 x 16384 px		
Display Arrangement	1 x independent display (8MP), 2 x mirrored displays (8MP, FHD)		4 x independent displays (5K)		6 x independent displays (5K)
Output Licenses (Base)	8MP or 1x Connector	8MP or 1x Connector	8MP or 1x Connector	8MP or 1x Connector	16MP or 2x Connector
Output Licenses (max)	20MP or 4x Connector	20MP or 4x Connector	36MP or 6x Connector	36MP or 6x Connector	52MP or 8x Connector
Input Boards	MDI-7 (base version) or MDI-10	MDI-7 (base version) or MDI-10	MDI-7 (base version) or MDI-10	MDI-7 (base version) or MDI-10	MDI-7 (base version) or MDI-10
Base Number of Video Inputs (*)	9	9	9	9	18
Max Number of Video Inputs (*)	9	27	14	27	27
Max Number of USB KVM outputs	7x via KMS board plus 5x via MDI-10	14x via KMS board plus 15x via MDI-10	7x via KMS board plus 5x via MDI-10	14x via KMS board plus 15x via MDI-10	14x via KMS board plus 15x via MDI-10
Power Breakout Boards (PBB)	optional	optional	optional	optional	optional
Power Supply	non-redundant	redundant, non-redundant	non-redundant	redundant, non-redundant	redundant

(*) actual type and number of inputs depends on type and number of input boards

4.1   MDM Model E, Basic Edition

MDM Basic edition features a single output display with two optional mirrors.
It is available in 2U and 4U chassis.
An optional KMS board with USB KVM functionality can be added to connect up to 7 PCs.
An optional PBB board can be added to power ADIO video converters (separate device).
Figure 1 shows an example configuration of MDM Model E, Basic edition, 2HE chassis with
KMS board and a single MDI-10 input card.

Figure 1: Rear View of MDM Model E, Basic Version, 2U chassis

4.2   Video Outputs Basic Version

Video output	Output Connectors	Marked as: **1A, 1B: 2**x DisplayPort 2.0, standard connector **1C:** HDMI 1.4 (max. 600MHz)
	Output resolution	**Up to 8MP 4096x2160** either as DP or HDMI
	Max. number of displays	Software and license dependent. In total 3 connectors can be used: 2x DP 2.0, 1x HDMI 1.4 Max. 1 x 8MP Display, 1 x 8MP Display (mirror) and 1 x HD Display (downscaled mirror) can be used.
	More details can be found in the browser interface, in the 'display arrangements' tab. The number of enabled license can be found in the 'About' tab.	

4.3   MDM Model E, Advanced Edition

MDM Advanced edition features 4 x DP video outputs.
It is available with 2U and 4U chassis.
Up to two KMS boards with USB KVM functionality can be added to connect up to 14 PCs.
An optional PBB board can be added to power ADIO video converters (separate device).
Figure 2 shows an example configuration of MDM Model E, Advanced edition, 4HE chassis
with PBB board, KMS board and a single MDI-7 input card.

Figure 2: Rear View of MDM Model E, Advanced Version, 4U Chassis

Keyboard/mouse inputs
Display 1-4

KMS board with
keyboard/mouse outputs 1-7

Non-red. power
supply

Power breakout
board

MDI-7,
video inputs 1-9

GPU-4, 4 x DP,
video outputs
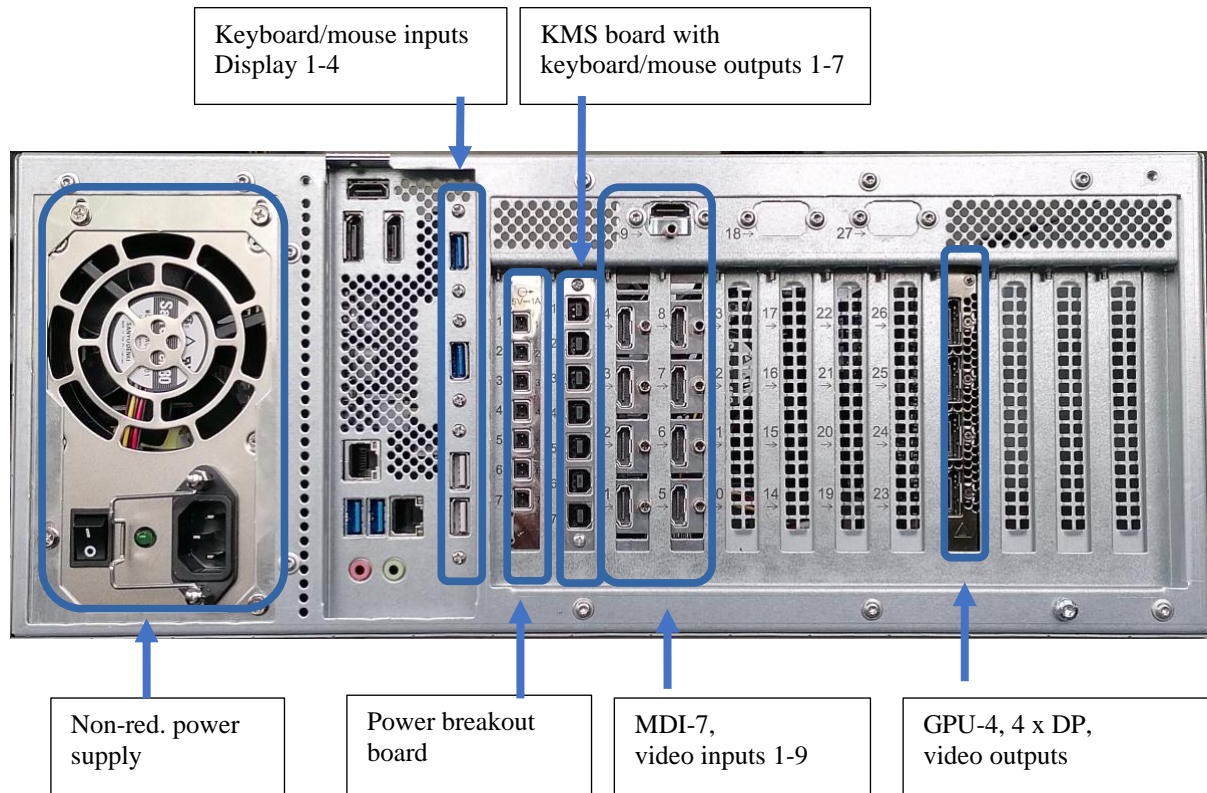
4.4   Video Outputs Advanced Version

Video output	Output Connectors	**1A-1D: 4** x DisplayPort 2.0, standard connector
	Output resolution	**Up to 5K, 5120x2880 each output**
	Max. number of displays	4 (software and license dependent)
	More details can be found in the browser interface, in the 'display arrangements' tab. The number of enabled license can be found in the 'About' tab.	

4.5   MDM Model E, Professional Edition

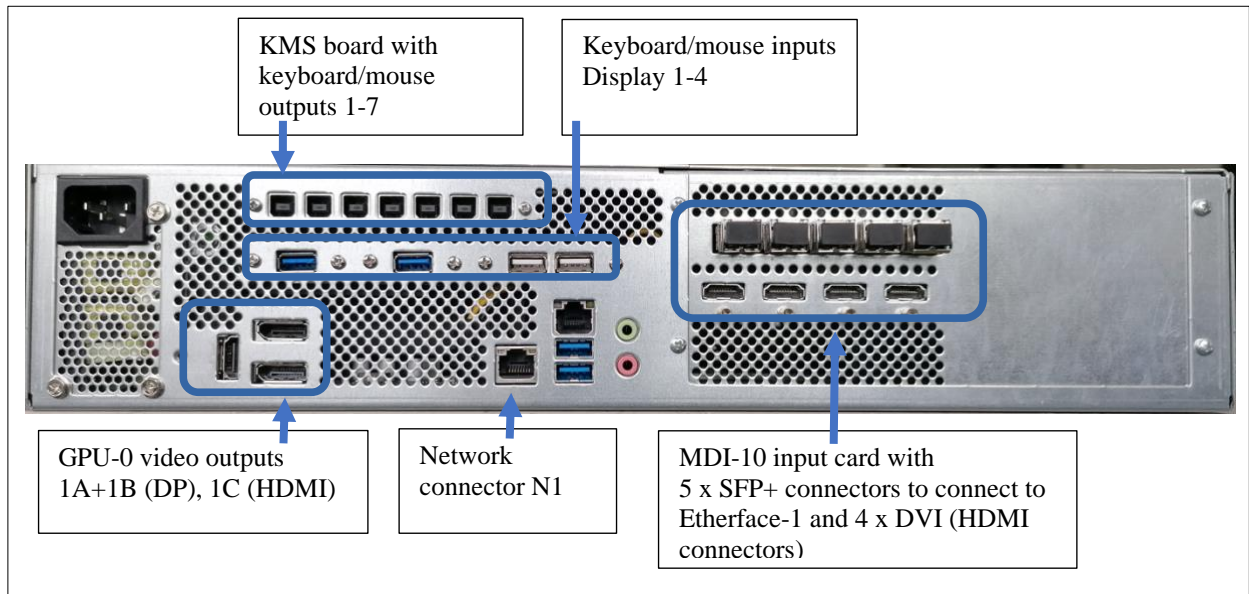MDM Professional edition features 6 x miniDP video outputs.
It is only available with the 4U chassis.
Up to two KMS boards with USB KVM functionality can be added to connect up to 14 PCs.
An optional PBB board can be added to power ADIO video converters (separate device).
Figure 3 shows an example configuration of MDM Model E, Professional edition, 4HE
chassis with 2xKMS board and 2xMDI-7 input card.

Figure 3: Rear View of MDM Model E, Professional Version, 4U chassis
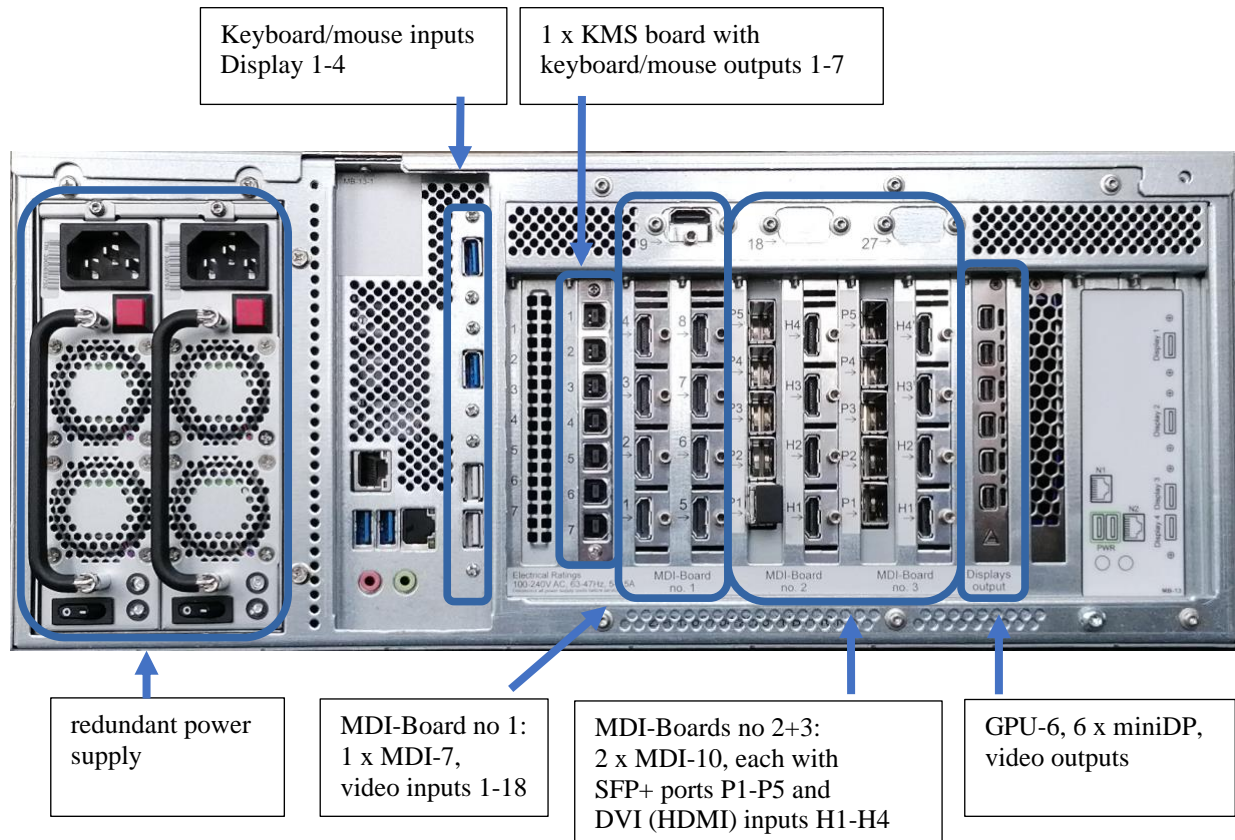
4.6   Video Outputs Professional Version

	Output Connectors	**1A-1F: 6** x DisplayPort 2.0, miniDP connector
Video output	Output resolution	**Up to 5K, 5120x2880 each output**
	Max. number of displays	6 (software and license dependent)
	More details can be found in the browser interface, in the 'display arrangements' tab. The number of enabled license can be found in the 'About' tab.	

4.7   Power Supply 4U System (non-redundant)

Power supply 4U system	Type	BEA-540H 400W
	Input Voltage	90 - 264VAC
	Input Frequency	47 to 63Hz
	Inrush Current	20A max. @115VAC / 40A max. @230VAC
	Isolation	Input to output 3100VAC
	Leakage Current	< 1.5mA, 250VAC
	Input Connector	IEC320/C14
	Efficiency	>80%
	Input Current	Max. 5A@115VAC / 2.5A @ 230VAC Typ. 3A@115VAC / 1.5A@230VAC
	Power Consumption	Typ. 340W
		Max. 380W with one Power Breakout Board fully loaded or 10 ADIOs connected to MDI-7
Power switch		Power switch at the back, no other hardware power off/on switch.

4.8   Power Supply 4U System (redundant)

Power supply 4U system	Type	FSP500-60MRB(S) 500W
	Input Voltage	90-140 VAC or 180-264 VAC
	Input Frequency	47 to 63Hz
	Inrush Current	40A max. @115VAC / 80A max. @230VAC
	Input Connector	IEC 320/C14
	Efficiency	>80%
	Input Current	Max. 5A@115VAC / 2.5 @ 230VAC Typ. 3A@115VAC / 1.5A@230VAC
Power switch		Power switch at the back, no other hardware power off/on switch.

4.9   Power Supply 2U System (non-redundant)

Power supply 2U system	Type	FSP 350-57FCB 350W
	Input Voltage	90 - 264VAC
	Input Frequency	47 to 63Hz
	Input Current	115Vac @ 5A, 230Vac @ 2.5A
	Inrush Current	cold start -25 degree, no damage
	Leakage Current	< 3.5 mA-rms @ 264VAC, 50 Hz.
	Input Connector	IEC320/C14
	Efficiency	>80%, 80 Plus Gold
	Input Current	Max. 6A@115VAC / 3A @ 230VAC
Power switch		No power switch

4.10   Mechanical Details 4U system

Mechanical	Size unpacked	width: 430mm height: 173mm depth: 450mm
	Weight	< 20kg
	Size packed standard / worldwide shipping	width: 640mm / 790mm height: 290mm / 460mm depth: 610mm / 790mm
	Weight	< 25kg

4.11   Mechanical Details 2U system

Mechanical	Size unpacked	Width: 430mm Height: 88mm Depth: 310mm
	Weight	8kg
	Size packed standard / worldwide shipping	width: 510mm height: 330mm depth: 410mm
	Weight	10kg

4.12   Video Inputs with MDI-7 Input board

Video Inputs	Digital per board	Input 1: HDMI input, up to 550Mhz pixel clock Input 2,3,4,9: HDMI input, up to 165Mhz pixel clock Input 5,6,7,8: DVI inputs with HDMI connector, up to 165Mhz pixel clock.
	Total number of inputs	9 inputs can be displayed
	Rotation	Each input can be rotated by 0, 90, 180, 270 degrees
	EDID	The input resolution can be set by programmable EDID data.
	Color Depth	30 bit input, RGB 24 bit internal
Input Video timing	Per Input Channel	
	H-Display	8x min. 320 max. 2560Pixel 1x min. 320 max. 4096Pixel
	V-Display	Min. 200 max. 2560 Lines
	Pixel-Clock	Min. 16MHz max. 165/550MHz
	H-Blank	Min. 8 pixel
	V-Blank	Min. 4 lines
	Interlace	Non-interlace only, progressive
	Refresh Rate	120 Hz max
Input Bandwidth	Per Input Board	The aggregated bandwidth of all input channels per MDI-7: max. 1,250MPx/s
	Per System	See chap 4.20

4.12.1 MDI-7 Technical Details

MDI-7 boards have two different technical solutions for the input channels.

Input 1, 2, 3, 4 and 9 use HDMI input connectors and HDMI signals handled by the onboard FPGA core.

Inputs 5, 6, 7, and 8 use HDMI connectors but DVI signals and these are handled by legacy DVI receivers.

Although HDMI signals should be downward compatible to DVI signals that is not always true. DVI signals from older graphics boards, onboard graphics GPU or analog to digital converted signals show a behavior that cannot be handled by the HDMI signal inputs.

Symptoms are flickering inputs or even 'No Signal' inputs. In these cases, use the inputs 5, 6, 7, or 8 and 14, 15, 16 or 17 and 24, 25 or 26 with the legacy DVI receiver chips.

4.13 MDI-10 Input board

Video Inputs	Video inputs via Etherface-1	5 x video signals received from external converter 'Etherface-1' using optical OM 3cable via SFP+ connectors. Video signals of data rates up to 10 Gbit/s are transmitted as YUV4:4:4 or RGB24 bit. UHD / 4K Video is transmitted as YUV4:2:2. Refer to Etherface-1 documentation for video input connectors.
	Video input onboard	4 x DVI inputs with HDMI connector, up to 165Mhz pixel clock, RGB 24 bit
	Total number of inputs	9 inputs can be displayed
	Rotation	Each input can be rotated by 0, 90, 180, 270 degrees
	EDID	The input resolution can be set by programmable EDID data.
Input Video timing, onboard video	Per Input Channel	
	H-Display	Min. 320 max. 1920Pixel
	V-Display	Min. 200 max. 1200 Lines
	Pixel-Clock	Min. 16MHz max. 165
	H-Blank	Min. 8 pixel
	V-Blank	Min. 4 lines
	Interlace	Non-interlace only, progressive
Input Video timing, via Etherface-1	Per Input Channel / Etherface-1	
	H-Display	Min. 320 max. 4096Pixel
	V-Display	Min. 200 max. 2560 Lines
	Pixel-Clock	Min. 16MHz max. 594MHz
	H-Blank	Min. 8 pixel
	V-Blank	Min. 4 lines
	Interlace	interlace
Input Bandwidth	Per Input Board	The aggregated bandwidth of all input channels per MDI-10: max. 1,500 MPx/s
	Per System	See chap 4.20

4.13.1 MDI-10 Technical Details

MDI-10 boards have two different technical solutions for the input channels.
Inputs 1, 2, 3, 4 and 5 use an optical connection to the Etherface-1 converter to transport video data at 10Gbit/s from Etherface-1 to MDM. For more details refer to chapter: 4.14.

Inputs 6, 7, 8, and 9 use HDMI connectors but process DVI signals handled by legacy DVI receivers (as with MDI-7 boards).

4.14 Etherface-1 Converter

Etherface-1 is a video input device that converts HDMI, DisplayPort or SDI video signals and transmits them over an optical fiber connection to the input card MDI-10 of the MDM. Parallel to the video connection, a USB (HID) connection can be established to use the KVM functionality.

The advantage of the optical fiber connection is the galvanic isolation and the transfer of video signals over longer distances (up to 1Km).

Figure 4 Etherface-1 Tx

Video inputs support DP, HDMI and SDI to up to 4096x2160x60. Resolutions above UHD@30Hz will be transferred using YCbCr 4:2:2 color format. Video inputs can additionally loop-backed to local displays. USB inputs at MDM can be transferred to a PC connected at Etherface-1.

A single MDI-10 input card can be connected to up to 5 Etherface-1 devices. The fiber connections use standard 10 Gbit Ethernet infrastructure and support commercial switches. Please see the Etherface-1 device datasheet for more details.

4.15 Other Inputs / Outputs

Networking	Ethernet	10/100/1000Mbit/s Ethernet twisted pair.
	Connector	Type RJ45
	Connection	N1: for administration and streaming N2: not used
USB	KVM enabled	4xUSB type A connections for 4 displays with mouse and keyboard (MDM-KVM mode). They are clearly marked as 'Display 1' etc..
Audio	Line in/out	
	Other available connectors	Not supported

4.16 Optional Power-Break-Out Board (PBS)

Hirose Power Connector	Connector	Hirose power connectors, Model 10501971
	Number of connectors	7
	Max. load	5VDC, 1A

4.17 Optional Keyboard-Mouse-Switch (KMS) Board

USB Inputs from hosts	Connector	USB type B connector
	Number of connections	7

4.18 Standby / Sleep Mode

Front LED	Green LED when power is turned on.
Standby Mode	MDI-7 input board only: MDM can be programmed to go to 'Standby' when no input signal is active for a given time. 'not active' means no +5VDC is connected to HDMI DDC input. See also notes below. Delay to enter MDM standby mode programmable from 0 to 999 minutes. Delay to exit standby mode: appr. 30s
Sleep Mode	MDM with KVM enabled can be programmed to send a monitor to sleep/ power down when no mouse and keyboard activity is detected. Delay to enter monitor sleep mode programmable from 'no' to 999 minutes. Delay to exit sleep mode: < 1s (is monitor dependent)

4.19 Important Notes and Restrictions

Notes MDM Model E, 4U system:

The KMS board is optional.
A system can never have more than two KMS boards.
A system can never have more than one Power-Break-Out board.

Notes MDM Model E, 2U system (Basic and Advanced Edition only):

The maximum size of external slots is 4 plus one for KMS boards only.
Whereas a full MDI-card uses 2 slots, a reduced MDI-card and the GPU-4 graphics card use a single slot each.

A system can be configured with standard MDI-card (MDI-7, MDI-10) of two slots size and optionally a second reduced-size MDI-card of single slot size only.
The second, reduced MDI-card miss the second slot additional HDMI connector (DVI signal)
MDI-7 card at second slot provides 5 x HDMI inputs
MDI-10 card at second slot provides 5 x SFP+ optical connects to Etherface-1 device.
As an example, two MDI-7 cards will feature 9 + 5 = 14 video inputs.

4.20 Approved Combinations of Input Channels, connected Displays and MDM Functions

MDM Model E can be used in many different variations. To get an overview how may displays can be used with input channels and certain functions, Tritec tested the following combinations. These combinations do not show any overruns of inputs or other problems. Other combinations are possible as well, but they should be tested under full load for safe usage.

Model E, Basic Edition

Displays Connected	Input channels	MDM-KVM function.	On-Screen	Annotations
1x8MP + 1x8MP mirror + 1xHD mirror	10 x HD	Yes	Yes	No
1x8MP + 1x8MP mirror + 1xHD mirror	2x8MP + 2xHD	Yes	Yes	No
1x8MP + 1x8MP mirror + 1xHD mirror	6 x HD	Yes	Yes	Yes

Model E, Advanced Edition

Displays Connected	Input channels	MDM-KVM function.	On-Screen	Annotations
Up to 4 x 5K	2 x 8MP + 12 x HD	Yes	Yes	No
Up to 4 x 5K	2 x 8MP + 6 x 8MP (30 Hz)	Yes	Yes	No
Up to 4 x 5K	20 x HD	Yes	Yes	No
Up to 4 x 5K	10 x HD	Yes	Yes	Yes

Model 'E', Professional Edition

Displays Connected	Input channels	MDM-KVM function.	On-Screen	Annotations
Up to 6 x 5K	No Limitation	Yes	Yes	Yes

Note:
For optimum usage of MDM-E hardware, always use latest software release.

Notes:

Displays Connected:

it doesn't matter if displays are connected via DP to DL-DVI converter or directly. The displays are handled independently; except for mirrors.

Input channels:

4 inputs with a resolution HD of 1920x1080 fill the entire screen of an 8MP output display without overlapping. It doesn't matter if 4x HD are used or 6x 1280x1024 or any other combination. Tests with 2 or more displays use different input channels for each monitor.

MDM-KVM functionality:

MDM or MDM-with KVM can be used as long as 'onscreen user interface' is not activated.

On-Screen user interface:

If 'onscreen user interface' is activated in the 'Display Settings' the bandwidth is reduced due to the additional drawing of the user interface onscreen.

Annotations:

Annotations do need more bandwidth due to the additional drawing onscreen.

Streaming:

Multiple input and output streams are supported up to a resolution of UHD. Note that high resolution streams require significant CPU and network bandwidth.

4.21 Environmental Specifications

Environmental Requirements		
Unpackaged Operating	Temperature	Temperature 40 °C according EN 60068-2-2. Temperature 5 °C according EN 60068-2-1
	Humidity:	Damp heat, 25°C, 10 to 80% RH (non condensing) according EN 60068-2-38.
	Pressure:	700-1060 hPa (525 -795 mmHg) or up to 3050m (10,000ft).
Packaged Non-Operating (Storage, Transportation):	Temperature	Temperature +70°C according EN 60068-2-2. Temperature -20 °C according EN 60068-2-1
	Humidity:	+25°C 10 to 95% RH (non-condensing) according 60068-2-38.
	Pressure:	500 -1060 hPa (375 -795 mmHg) or up to 5,050m (18,000 ft).
Packaged Tests	Continuous Shock:	according EN 60068-2-29 and EN60721-3-2, class 2M2.
	Drop Test:	according EN 24180-2.

5. Glossary

Input Channel

The physical input of a video stream. It is connected to the output of a PC or other video source. It is either a DVI or analog signal.

Output Monitor

When a 'set' is selected, it is the monitor on which all input channels are displayed during set-up and after arrangement.

Channel enable

When a channel is enabled and all parameters are set up, it is visible in the arrangement window and can be part of an arrangement (see also 'Screen enable').

Channel connected

Indicates the status of the input channel. When there is a stable input signal (h- and v-total are constant for several frames), then the channel is 'connected' or 'online'.

Screen

An input channel can be displayed as 1 or 2 screens:
- Screen 1 is always enabled and is the original input channel stream.
- Screen 2 is a copy of the input channel. It may be cropped and positioned differently. It does not reduce the bandwidth.

Screen enabled

Enabled screens take part in the arrangement. If they are disabled they are not displayed in the arrangement window.

Arrangement

The way input channels are arranged on the output monitor.

Layout / Set

A saved arrangement. For each 'layout' or 'set', any input screen can vary in position, size, scaling and cropping. The input screens and layout configuration screens are limited only by bandwidth and output monitor resolution. A 'layout' or 'set' can be selected by the browser interface or a remote interface.

Default Layout /Set

The default layout / set displayed after booting, as long as no other layout / set is selected.

MDI-7, MDI-10

MDI-7 and MDI-10 are the names for the input boards. MDI-7 and MDI-10 support 8 MP input bandwidth.
- For details see the technical specification of the boards.

Display Settings

Each display can be used in several ways – with an MDM-like functionality, or with MDM-KVM-functionality for video streaming. Not all of the selections may be visible for certain displays.

MDM-like functionality

In 'MDM-Mode' the display is located in the OR room. Layouts are switched by a bedside Touch PC or Table etc. No keyboard and mouse can be used to arrange or switch the layouts for this display. Therefore, the arrangement of layouts, and the select and button assignments for this display are activated.

MDM-KVM-like functionality

In 'MDM-KVM-Mode' the display is located in the control room and keyboard and mouse can be used to arrange and switch layouts. The behavior is similar to the MDM-Mode but the windows can be moved and resized by the mouse. A double click connects keyboard and mouse to the attached PC. The layouts (grids) can be pre-arranged like in MDM mode.

Screenshot

Is a copy of the current content of the display to a storage device in .png format.

How to use MDM

MDM has two interfaces to use:
The Administration and Service interface and the User interface.
The Administration and Service interface needs to be used once during set up and in-service cases. It is accessed through a browser interface (Firefox, Chrome or Edge) and needs keyboard and mouse to be used. It is accessed at http://mdm-ip-address.
It is used for setting up: the network, the connected display, input channels, the user interface etc. For more details refer to the 'Help' tab in the browser interface.

The User interface is used by the end user to switch layouts.
There are several ways to implement a user interface:

- Through a touch monitor interface, or with a mouse and keyboard interface.
- With a tablet or any PC with a touch monitor or monitor and mouse.
- Via remote control commands sent via network with REST commands. For details see the document 'External Software Interface Definition' available from Tritec Electronic under NDA.

6. Accessing the MDM via the Administration Interface

Please set up the MDM-5 in the following order:

- Connect the power with either one or two power cords.
- Connect the network.
  - Either switch on the power supply. Connect to MDM via a browser connection (details see below) and read more details in the 'Help' menu.
  - Or proceed with the hardware set up.
- Connect the output and input cables. See chapter 7.2 Hardware connections.
- Switch on the power.
- Connect to MDM via a browser connection (details see below) and read more details in the 'Help' menu.

To open the administration interface from a remote browser, use the default IP address: 169.254.213.44. Netmask 255.255.255.0. This address can never be changed but a second IP address can be specified in the network settings.

Depending on the MDM customization, the user is required to log on with username and password and the initial default password may have to be changed, refer to the MDM Software Manual for more details.

Web Interface
The Web-Interface of the MDM has 7 tabs (see Figure 5: MDM Web Interface Tabs below), which are used to set up and manage the MDM. Refer to the 'Help' tab for more information to set up MDM.

Figure 5: MDM Web Interface Tabs
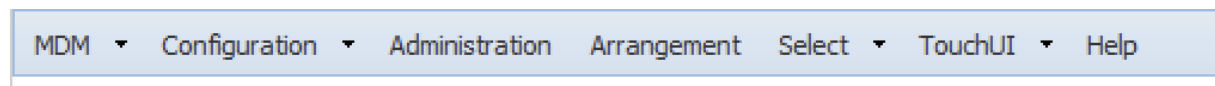
7. Setting up the Hardware

Please set up the MDM-5 in the following order:

- Connect the power with either one or two power cords.
- Connect the network.
  - Either switch on the power supply. Connect to MDM via a browser connection (details see chapter 6 'Accessing the MDM via the Administration Interface') and read more details about output connections to the displays in the 'Help' menu.
  - Or proceed with the hardware set up.
- Connect the output and input cables. See chapter 7.2 Hardware connections.
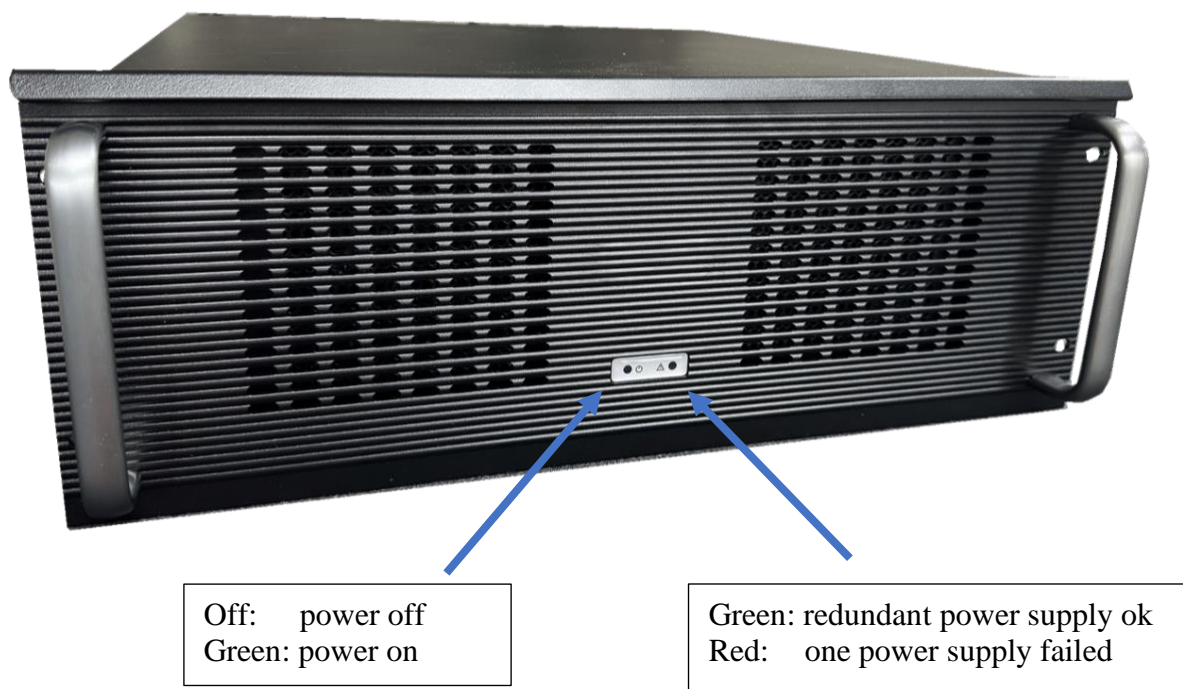- Switch on the power.

7.1   Placing MDM-5 Systems

The operating temperature of MDM systems is specified from 5ºC to 40ºC. With a strong airflow from back to front. Do not block these air inlets and outlets. A min. of 10cm in the front and back should be left open for the airflow. MDM systems monitor their internal temperatures, when messages like 'temperature is now at xxxC' immediate actions should be taken to reduce the ambient temperature, check any filter or check the fans (see chapter 9 Maintenance / Service). Warnings start at 80 ºC (FPGA) resp. 75 ºC (mainboard).

7.2   Hardware connections

For images of hardware connections of video, USB and power please see chapter 4, Figure 1 to Figure 3 on page 13 ff.

Figure 6: Front of MDM with Status LEDs

Off: power off
Green: power on

Green: redundant power supply ok
Red: one power supply failed

7.2.1　Power connection

On the left side are the power connectors and the main switches. With redundant power supplies connect both power connectors.
When the system is turned on, a green LED near the power on switch and on the front will light up. (Figure 6: Front of MDM with Status LEDs).
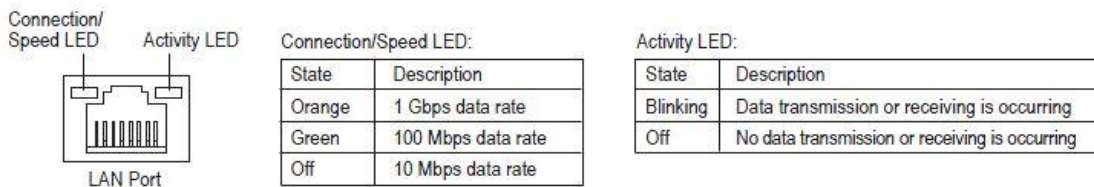
　　　　　Power can be turned on/off at any time, as long as the logging mode is disabled.

7.2.2　Network connection

N1 is the network interface. Use N1 to connect an Ethernet connector to access the MDM by a browser or remote interface, see Figure below.

RJ-45 LAN Port

The Gigabit Ethernet LAN port provides Internet connection at up to 1 Gbps data rate. The following describes the states of the LAN port LEDs.

Connection/Speed LED:

State	Description
Orange	1 Gbps data rate
Green	100 Mbps data rate
Off	10 Mbps data rate

Activity LED:

State	Description
Blinking	Data transmission or receiving is occurring
Off	No data transmission or receiving is occurring

7.2.3　Output Monitor Connection

Output monitors are connected to connectors marked '1A', '1B', …, '1F'.
Planning the output connections to the monitor should be one of the first tasks after connecting the MDM to power and networking.

MDM Model E, Basic Edition:
In total 3 connectors can be used: 2x DP, 1x HDMI 2.0.
Max. 2x 8MP and 1x HD displays can be used.
Only 1x 8MP as individual display, others as mirrors

MDM Model E, Advanced Edition:
In total 4 connectors can be used: 4x DP
Max. 4x 5K 5120x2880 displays can be used.

MDM Model E, Professional Edition:
In total 6 connectors can be used: 6xminiDP
Max. 6x 5K 5120x2880 displays can be used.

The 'Display arrangement' tab in 'Configuration' in the browser interface shows which connector of the graphics board can be connected to a certain display depending on resolution, refresh rate and connection type (DP, DVI, HDMI etc.) and which type of converter has to be used.

Graphics boards with DisplayPort outputs may need a converter for DVI single link or dual link connections. Such converters are available Tritec (DP-to Dual Link DVI converter). This converter has two cables. One is the DisplayPort connector and is plugged into the graphics card and the other is a USB connector and that has to be plugged into the USB connectors of the motherboard marked with 'PWR' (Power). The Dual-Link DVI connecter is connected to the display.

7.2.4   Mouse, Keyboard and USB stick connection

Connect mouse and keyboard to the USB type A connectors (the 'typical' mouse and keyboard connector) at the rear of the MDM marked with 'Display 1' …. 'Display 4'.

- Keyboards, mice and USB sticks can be connected to 4 different displays.
- Each output display can be programed to use one of the USB display inputs.
- An USB hub has to be used to connect keyboard, mouse and USB stick.
- The 'Display settings' tab shows more details which MDM USB connector is related to which output display.

7.2.5   Input Video Channel Connection to host

The video inputs are marked with numbers from 1 to 26. The numbers correspond to the numbers found in the set up.

For MDI-7 boards:
- All input connectors are HDMI connectors
- Input 1 has a maximum pixel clock of 550Mhz. It can be connected to UHD outputs
- Input 2, 3, 4, 9 are compatible to HDMI signals of max. 165Mhz.
- Input 5, 6, 7, 8 are compatible to DVI signals of max. 165Mhz.
- Interlace signals are not supported.

For MDI-10 boards:
- Inputs 1 to 5 are network inputs for optical connects to 'Etherface-1' device.
  See Etherface-1 device datasheet for details.
  Connections are to be established using appropriate SFP+ modules.

  Warning:
  Only use optical transceiver Laser Class 1 which complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.
  Only use SFP+ modules with maximum power consumption of 1 W.

- Video inputs 6, 7, 8, 9 are compatible to DVI signals of max. 165Mhz with HDMI connector.
- Interlace signals are supported.

For all MDI boards:
- Any input refresh rate can be used. But the input refresh rate should be as close as possible to the output displays refresh rate. Otherwise the input and output windows are not fully synchronous. Frames will be dropped or inserted as necessary.
- The maximum number of input pixels horizontally is 4096/2560 for any input.

7.2.5.1 Bandwidth Considerations

The MDM has some internal bandwidth limitations due to the very high data rates of the video streams. If video input data rates are used above the specified bandwidth, some output windows show no content but 'overrun'. The maximum usable bandwidth depends on the MDM-5 model and has been approved for certain combinations, see chap. 4.20

7.2.5.2 Input Board Limitations

In the MDM, the throughput of a video stream is measured in Mega Pixel/s (MPx/s).
MDI-7 input boards have a limitation of 1,250MPx/s. This is the equivalent of 10 x HD inputs.
MDI-10 input boards have a limitation of 1,500MPx/s due to optimized data transfer, this results in an equivalent of 12 x HD inputs.

7.2.5.3 Input Signal Validation

The input board has some logic integrated to detect a valid input signal for each input channel.

MDI-7 input boards and MDI-10 DVI inputs:

- A signal is detected as a valid signal to be displayed on the screen if all of the following conditions are met:

  1. The pixel (TMDS) clock must be higher than 16MHz
  2. V-Display (active) is not zero
  3. V-Display is constant for more than 2 frames
  4. Number of pixels in any line is between 320 and 4096/2560 pixels.
  5. Number of lines in any frame is between 200 and 2560 lines.

- A signal is immediately detected as invalid, and the 'No Signal' message is shown on the output window if one of the following conditions is met:

  1. The pixel (TMDS) clock is less than 16MHz
  2. V-Display (active) is zero
  3. V-Display is different for sequential frames
  4. Number of pixels in any line is below 320 pixels and above 4096/3000 pixels.
  5. Number of lines in any frame below 200 lines and above 2560 lines.

- If a signal is changing between valid and invalid for more than 20 times per second, the input signal has a problem. The input channel is set to invalid and the 'Out of range' string is shown. To activate the signal again, change the layout or the input channel.

7.2.6 USB host connections

MDM with keyboard & mouse host connection to inputs either need a KMS board installed, an external ADIO converter connected or an external Etherface-1 device connected. The USB connection is set up in the 'Administration'; 'Channel x'; 'Keyboard & Mouse' tab.

7.2.6.1 USB host connection with KMS board

A KMS-board has 7 USB type B connectors to connect to the host USB keyboard and mouse input.

One USB connection is needed for mouse and keyboard only. The slot is marked with 'KMS-1' and the USB connectors are numbered from 1 to 7. The numbers correspond with the numbers used in the set up (see 'Help' tab in the browser).

Be sure to connect the USB connectors to the host as shown in Table 1 Factory default set up.

7.2.6.2 USB host connection with ADIO converter

ADIO is an extern 'Analog-Digital Converter', see separate data sheets. It can be used to connect analog, DP, HDMI, DVI or SDI video signals to an MDI-7 board. It includes a USB connection as well.
To setup the USB go to the 'Administration' 'Keyboard & Mouse' tab and follow the instructions found in the on-line help.

7.2.6.3 USB host connection with Etherface-1 converter

Etherface-1 is an external video input/output device connected to MDM via optical fibers, see chapter 4.14 and separate data sheet. It includes a USB connection as well.
To setup the USB go to the 'Administration' 'Keyboard & Mouse' tab and follow the instructions found in the on-line help.

7.2.7   Connectors marked 'PWR'

Connectors marked with 'PWR' are USB power connectors for the DisplayPort to DVI converter. They should not be used as USB connectors.

7.2.8   Other connectors

All other connectors should not be used and are not supported by software.

8. Software default set up

The MDM ships with a factory default setup with all input channels visible on screen. Connect a display with a resolution of at least 1920x1080 to output 1A to see the inputs.

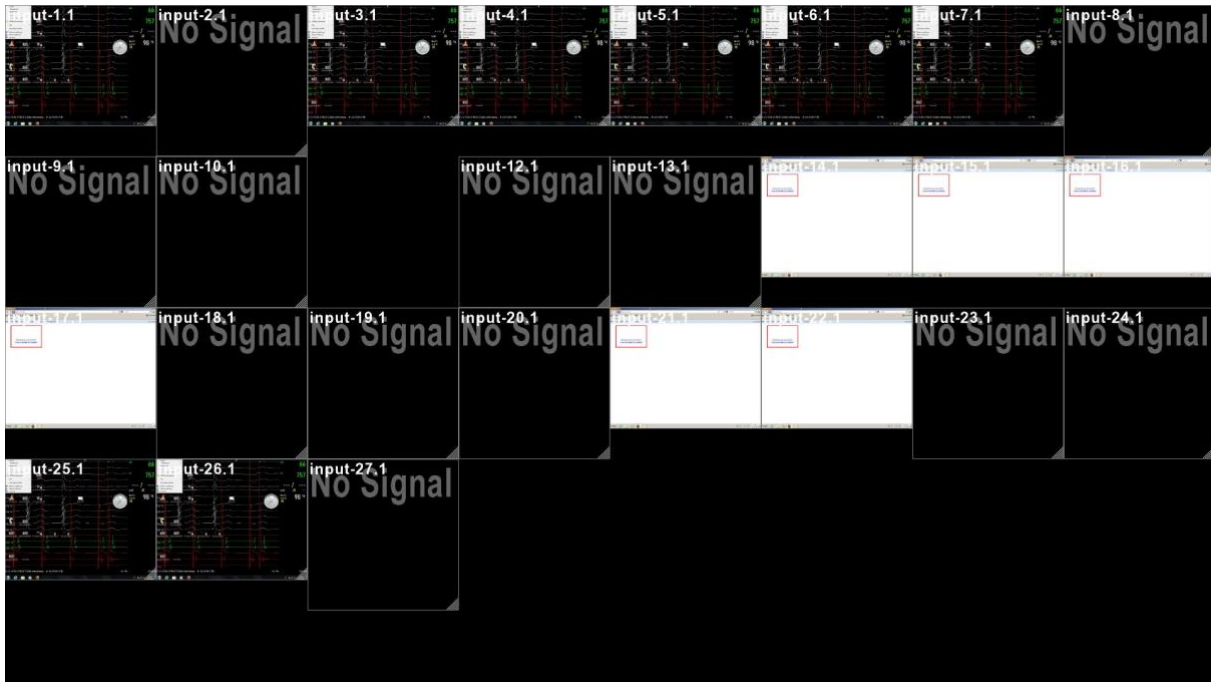**Figure 7: MDM Output Monitor with Default Layout**

Table 1 Factory default set up for input channels

Source / Name	Default resolution	Input Connector no.	USB Input no.	Priority 1 … high x … low	Desktop arrangement
Input 1	Auto resolution EDID: 1280x1024	1	no	1	auto
Input x	Auto resolution EDID: 1280x1024	x	no	x	auto

8.1 Software setup

Follow these rules to set up the system:

1. Chose the 'Display Arrangement' from the configuration tab.
   - This configures the number of displays, the resolution (8MP or lower) and the behavior (extended desktop).
   - During this set up the output connector numbers are shown to connect the displays correctly.
   - The system will reboot.
2. Chose the 'Display Settings' form configuration tab and follow the selections.
3. Change the network setting if necessary.
4. Set up the input channels.
5. Set up all other parameters.

8.2 Software Versions and their related Hardware Models

Following is a list of software versions and the hardware platform these run on.

Table 2: Hardware Models and related Software Versions

Software Version	Hardware Model
2.6.x	Model D only
2.7.x	Model D and Model E, Basic / Advanced / Professional

9. Maintenance / Service

The MDM system monitors several parameters and sends alerts when they out of range. These alerts are visible in the 'messages' tab of the browser in the top right corner (more details can be found in the related on-line 'help' tab). Besides messages of connected or unconnected inputs and output, there is a group of messages that require attention by service personnel to prevent further damage to the system. These messages are marked with a blue background.

Figure 8: Service Messages

There are three areas where the MDM system can be serviced on-site.

9.1   Redundant Power Supply

When the message 'power supply failed' is visible or when the right LED at the front turns red (see Figure 6: Front of MDM with Status LEDs) one of the redundant power supplies must be swapped against a new one.
Follow the instructions of the recommended spare part kit to swap the power supplies.

The LEDs on the back show the status of the redundant modules. Each module features a separate green and amber LED. See Table 3 for status information.

Table 3: Redundant Power Supply LEDs

Power state	Green LED	Amber LED
No power	off	off
Power available, power supply turned off	blink	off
Power on	on	off
Power problem: no power when redundant partner has power, disconnect, over current	--	blink / on

9.2   Fans

When the message 'Case Fan…' or 'Additional Fan…' is visible all of the fans must be swapped against new ones.
Follow the instructions of the recommended spare part kit to swap the fans.

9.3   Motherboard Battery

The motherboard battery has a lifetime of more than 8 years. Nevertheless, when the message 'motherboard battery low' is visible the motherboard battery must be replaced against a new one.

10.   Trouble Shooting

10.1 Connection to Output Monitors

The MDM can be connected to several output monitors via different connection types lsuch as DP, DVI, etc. To help detect errors in the connection from the MDM to the monitors read the following chapters carefully.

Output monitor connections must be defined in the 'Configuration', 'Display Arrangement' tab in the browser interface. Only connectors and monitors defined there are initialised.
All defined output monitors (and DLSx2 Splitters) are monitored during booting and runtime if they are available or missing. To test the connection to the monitor the software tries to read the EDID data of the monitor every few seconds. If the data is not available or different from the last reading, an error message is shown like here: Figure 9: Error message: Display not found.
If any of the following 'Display not found' error messages are shown and the software version is older than 2.x.x, the MDM has to be rebooted in order to fix the issue. Newer software versions are hot plug capable.

10.1.1 Error Message 'Display at address 1x not found'

There can be several reasons for an error message like this: Figure 9: Error message: Display not found

<u>Figure 9: Error message: Display not found</u>
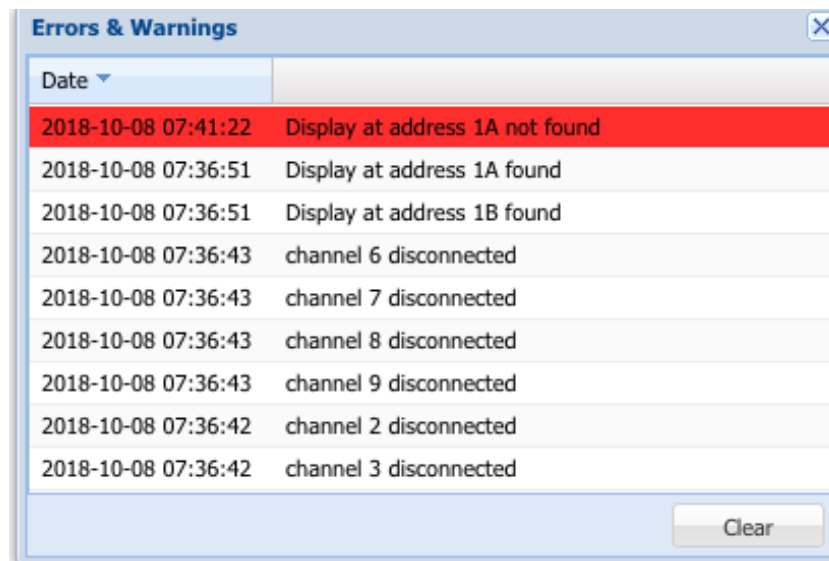
For more details about the possible problem refer to the 'MDM', 'Status' tab.

Figure 10: Status with no connection at Output 1A

```
Graphic PCIE : Lanes x16  8Gt/s
CRTC output 1A :  0 x 0
DP-DL DVI Converter 1A : not found
Display output 1A : not found
CRTC output 1B :  1920 x 2160
DP-DL DVI Converter 1B : found version 203 HW 0
DP-DL DVI Converter 1B : link up x4, 2.7Gb, DL DVI, DVI 1 con
Display output 1B : SDT-0220 #816
MDI 1 : Lanes x8  5 Gt/s  Boot block 1  Cal.ADC 2 9
Display output : unlocked
```

Figure 10: Shows a typical error message when nothing is connected to the MDM connector 1A. In this case in the 'Display Arrangement' an 8MP display with two DP to DL-DVI converters is defined. Therefore, the error message says 'No DP-DL DVI converter 1A found' is shown and the right side of the 8MP monitor is without content.
The reason can be:

    a. The DP connection between MDM output 1A and the DP DL-DVI converter is missing.
    b. The USB power connection to the DP DL-DVI converter is missing. Check the LEDs of the converter.
        o On the DP converter with the mini DP connectors: the LED closer to the cable is blinking red: USB power is missing.
        o On the DP converter with the standard DP connectors: If no LED is lit up power is missing.

Figure 11: Display resolution error

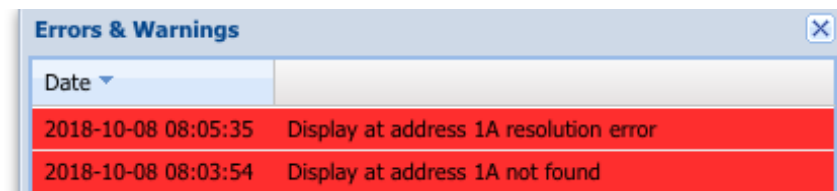| Errors & Warnings		✕
Date ▼		
2018-10-08 08:05:35	Display at address 1A resolution error	
2018-10-08 08:03:54	Display at address 1A not found	

Figure 12: Status with DP converter but no DVI connection

```
Graphic PCIE : Lanes x16  8Gt/s
CRTC output 1A :  2048 x 1536
DP-DL DVI Converter 1A : found version 203 HW 0
DP-DL DVI Converter 1A : link up x1, 1.6Gb, No DVI, No DVI conn
Display output 1A : not found
CRTC output 1B :  1920 x 2160
DP-DL DVI Converter 1B : found version 203 HW 0
DP-DL DVI Converter 1B : link up x4, 2.7Gb, DL DVI, DVI 1 conne
Display output 1B : SDT-0220 #816
MDI 1 : Lanes x8  5 Gt/s  Boot block 1  Cal.ADC 2 9
Display output : unlocked
```

Figure 12: shows another output monitor error message 'resolution error'. The details of this error can be seen in Figure 12: Status with DP converter but no DVI connection.

In this case the DP DL-DVI converter was found but the next line shows that 'No DVI connector' was found. The status LED on the DP converter next to the DP cable is constant yellow.

The reason can be:
   a. No DDC connection to the monitor, so no EDID data were found.
   b. If an optical extension is used the transmitter module may not have any or corrupted EDID data.

The CRTC output 1A resolution of 2048 x 1536 is the internal default dummy resolution of the DP converter needed to keep the DP connection to MDM established.

Figure 13: DP DL-DVI converter with valid connection

```
CRTC output 1B :  1920 x 2160
DP-DL DVI Converter 1B : found version 203 HW 0
DP-DL DVI Converter 1B : link up x4, 2.7Gb, DL DVI, DVI 1 conne
Display output 1B : SDT-0220 #816
```

Figure 13: shows a good connection from MDM via a DP DL-DVI converter to the monitor.
Line 1 shows the output resolution used.
Line 2 shows the DP converter with its firmware and hardware versions.
Line 3 shows the DP link between MDM and DP converter is up with 4 lanes 2.7Gb, DVI 1 connector is connected.
Line 4 shows the name and serial number of the connected monitor as read from the EDID data.

Table 4: DP DL-DVI Converter Status LEDs

Status LED	Color	
Left, closer to DP cable	Off (with standard DP connector) Red blinking (with mini DP connector)	No USB power
	Yellow blinking	Overload at the DDC power of the DVI connector.
	Green	USB power ok
Right,	Yellow	No EDID at DVI connection found
	Yellow blinking	Resolution of DVO monitor out of range
	Green	Monitor connection ok.

10.1.2 8MP Monitor connected via DSLx2 Splitter

When in the 'Configuration', 'Display Arrangement' tab an 8MP monitor with DP to DL-DVI converter is selected and a Dual Link Splitter (DLSx2) is used the error monitoring can be extended to include the DLSx2 splitter and a possible monitor at the secondary output.
To include the monitoring of the DLSx2 the check box in the 'Configuration', Display Settings' tab 'Splitter' has to be selected.
   o 'None': is without a splitter and the default value
   o 'With secondary display': use this setting when a DLSx2 is connected and a display is connected to the secondary output of the DLSx2.
   o 'Downscaler only, no secondary display': use this setting when a DLSx2 is connected but no display is connected to the secondary output of the DLSx2.
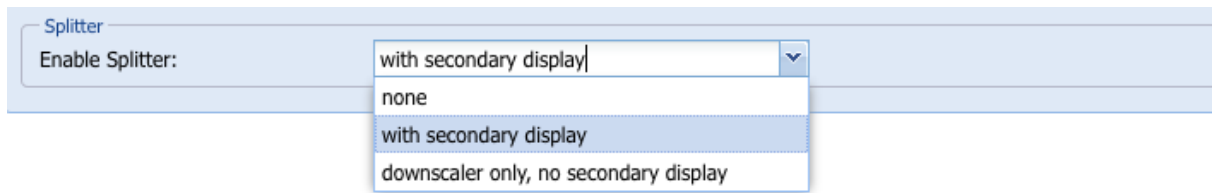
Figure 14: Enable monitoring of the DLSx2

Figure 15: Error Message with DLSx2

This message shows that two displays were found at the MDM output 1A and 1B with a DLSx2 at address 0 (the rotary address switch at the DLSx2 must be set to 0) and displays connected to the 'Main' output of DLSx2.
The displays at the secondary output of the DLSx2 are not connected (the EDID data could not be read).
If the DLSx2 is used as down-scaler only without a secondary display this error message can be ignored.

10.2 Output Monitor Connection Test

The MDM has some functions built in to test the output connection to the monitors.
In order to use these tests, the output monitors with/without DP DL-DVI converter and DLSx2 must be set up as mentioned in the above chapter.
The tests can be found in the 'Configuration' 'System' tab.

Figure 16: Connection Tests
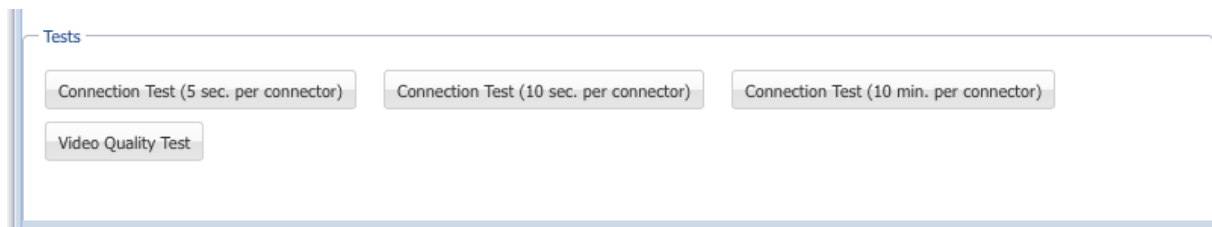
There are three 'Connection Tests' and one 'Video Quality Test'.

10.2.1 Connection Test

The 'Connection Tests' use the DDC communication channel (I2C) to detect which component is missing. Sometimes it might be helpful in noise environments or with very long cables to run this test for 10 minutes to see if there are any communication problems.

Figure 17: Shows the result of the 'Connection Test' of the problem shown in Figure 15: Error Message with DLSx2. The display connected to the 'Main' output was found without any problems. The 'Secondary' output display was not found and the problem was identified between DLSx2 and the display. The software found the DP DL-DVI converters and the DLSx2, but not the display at the 'Secondary' output.

<u>Figure 17: Connection Test with errors</u>
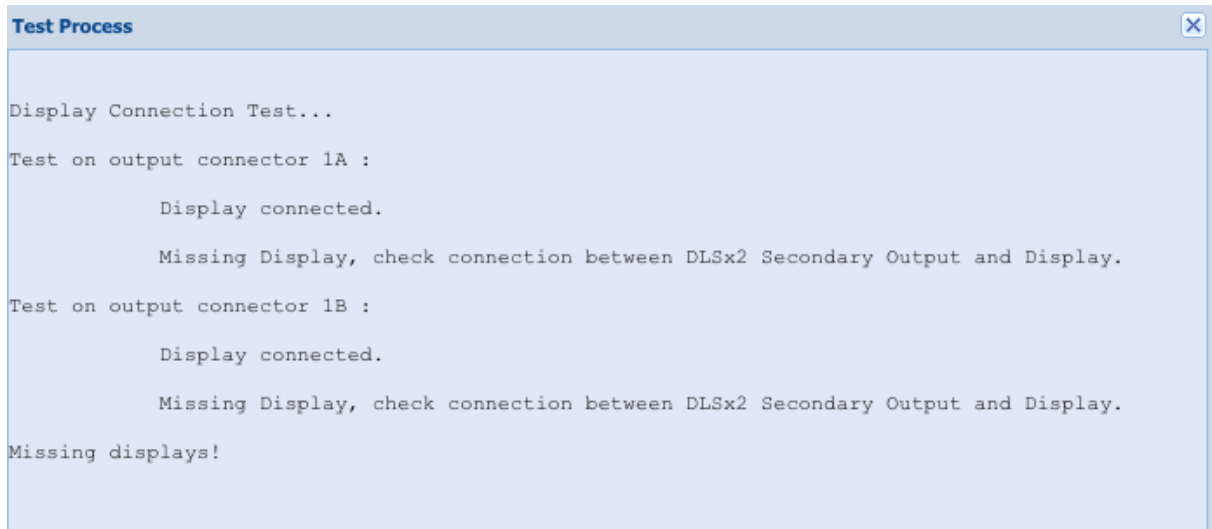
10.2.2 Video Quality Test

The 'Video Quality Test' tests the high-speed video signals. A random pattern is transmitted over the high-speed video connection from the MDM output to the displays and the DP DL-DVI converter and the DLSx2. Run the 'Connection Test 'before using this test to solve all connection related problems.
Figure 18: Shows the result of the 'Video Quality Test' of the same configuration as mention in the chapter 'Connection Test'. The result shows that the connection between MDM and DP DL-DVI converter and the DLSx2 is excellent. The display does not have the capability to check the video quality up to the display.
Possible results are: 'excellent' (no error found), 'good '(a few errors found, but still good enough to use the connection) and 'poor' (to many errors found).

Figure 18: Video Quality Test

```
Test Process

Video Quality Test...
While test is running a test pattern will be shown at the display.

Test on output connector 1A :

   DisplayPort Converter: excellent
      DLSx2              : excellent
            Display      : not testable


Test on output connector 1B :

   DisplayPort Converter: excellent
      DLSx2              : excellent
            Display      : not testable


Tests finished!
```

Figure 18: Video Quality Test