

thinklogical[®]

A **BELDEN** BRAND

TLX48 2RU

KVM MATRIX SWITCH

PRODUCT MANUAL

Revision: E, May 2023



Full 4K @ 60Hz Video and KVM Switching &
Extension Solutions in only 2RU of Rack Space

For both 6G and 10G Optics

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Preface

About Thinklogical, A BELDEN BRAND



thinklogical, A BELDEN BRAND

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Milford, CT 06460 U.S.A.

Thinklogical, A BELDEN BRAND, is the leading manufacturer and provider of fiber-optic and CATx video, KVM, audio, and peripheral extension and switching solutions used in video-rich, big-data computing environments.

Thinklogical offers the only fiber-optic KVM Matrix Switches in the world that are accredited to the Common Criteria EAL4, TEMPEST SDIP 24 Level B, and NATO NIAPC Evaluation Scheme: GREEN and the U.S. DoD DISA JITC UCR 2013 APL information assurance standards. And Thinklogical Velocity products are the first system with both KVM and video matrix switching capabilities to be placed on the Unified Capabilities Approved Product List (UC APL) under the Video Distribution System (VDS) category.

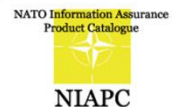
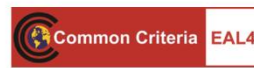
Thinklogical products are designed and manufactured in the USA and are certified to the ISO 9001:2015 standard.



Certified to
ISO 9001:2015



JITC






Thinklogical is headquartered in Milford, Connecticut and is owned by Belden, Inc., St. Louis, MO (<http://www.belden.com>). For more information about Thinklogical products and services, please visit <https://www.thinklogical.com>.

About This Manual

This document is meant primarily for authorized individuals acting in the roles of *System Administrator* or *System Operator*. The roles of *Administrator*, *Operators* and *Users* are defined on pg. [22].

Active Links

This document contains active cross-reference links in the *Table of Contents* and for referenced pages throughout, shown in this format: [18], and for external hyperlinks, shown in this format: [link.format](#).

- For **.pdf**: *point / left click* 
- For **.doc**: *Ctrl / point / left click* 
- To **return to the front of the document**: *Ctrl / Home.* 

This document has four sub-divided sections to help you find specific topics and procedures:

Section 1 – The TLX System Features: An overview of the features and functions of your TLX fiber-optic extension system. Pg. [5].

Section 2 – Set-Up and Installation: Contains all the requirements and procedures necessary to connect and install your equipment, including FPGA updates. Pg. [14].

Section 3 – Regulatory & Safety Requirements: Thinklogical® strongly recommends that you read this section prior to starting the hardware assembly. Pg. [29].

Section 4 – Thinklogical Support: Thinklogical provides outstanding customer support. To contact us for any reason, please refer to this section of the manual. Pg. [31].

This manual also contains Appendices, beginning on pg. [32].

Note and Warning Symbols

Throughout this manual you will notice certain symbols that bring your attention to essential information. These are **Notes** and **Warnings**. *Please read this information thoroughly.* Examples are shown below:



Note: A note is meant to call the reader's attention to helpful or valuable information at a point in the text that is relevant to the subject under discussion.



Warning! A warning is meant to call the reader's attention to critical information at a point in the text that is relevant to the subject under discussion.

Referenced Documents

All documents referenced in this manual (In_This_Text_Format) are available to view or download on the Thinklogical website at <https://www.thinklogical.com/downloads/>. Most online documents are stored as Adobe Acrobat "PDF" files.

! READ THE INSTRUCTIONS THOROUGHLY BEFORE STARTING ANY PROCEDURE! !



WARNING! Replace modules only. Do not attempt to repair.
Please contact your dealer or *thinklogical* for qualified servicing.



NO USER SERVICEABLE PARTS INSIDE !

Section 1: TLX System Features

The Logical Solution

The TLX48 2RU is a 10G high-performance, modular, non-blocking Matrix Switch that supports full, uncompressed 4K video with full-color depth at 60Hz frame-rate for complete, end-to-end routing of video and peripheral signals over multi-mode or single-mode fiber-optic cable, all within a one-third reduction in weight and form factor from its predecessor.

This reliable and resilient Matrix Switch is expandable from 24x24 to 48x48, allowing for flexible deployment configurations. In addition, the TLX Matrix Switches provide mission critical dependability and unrivalled signal integrity. The protocol agnostic switch supports DVI, SDI, HD-SDI, Dual-link DVI, Dual-link SDI, USB HID, USB 2.0 and audio.

The TLX48 2RU is available with multi-mode and single-mode LC-type fiber connectors, pg. [18].

Hybrid Switching Solution

For Uncompressed, High-Resolution Video & KVM Systems

TLX Matrix Switches are *protocol agnostic*, supporting most video, audio and peripheral signals and allow users to consolidate all their system switching requirements in a single chassis. TLX Matrix Switches are ideal for small or large system applications, with switch sizes ranging from **12 ports to 1280 ports**. Each port supports **10Gbps** bandwidth, preserving signal integrity to provide *uncompressed, high-resolution video* with no artifacts, latency or lost frames. Thinklogical's re-clocking technology ensures that every video and data stream is delivered in perfect synchronization.

Security

Creating physical separation between potential threats (Users) and the target (secure data) is essential to a secure system design. System administrators can safeguard sources in a centralized location, allowing users to maintain remote access to the sources, but with no means to breach the system, either accidentally or intentionally (such as downloading sensitive information onto a USB drive). Thinklogical's system permits users to **access sources up to 80 kilometers away, with no performance degradation**.



Note: Maintaining security requires that authorized Operators be non-hostile and follow all usage guidelines outlined in this document.

Thinklogical's Matrix Switches offer four secure modes for switching applications. They are **Restricted Switching Mode, Partition Mode, Point-to-Point (P2P) Mode and Restore Mode**. Each can be deployed singularly or jointly, depending on security requirements. Modes are enabled through the switch's firmware, which means a threat would have to physically access the switch to tamper with the settings. See *Appendix C: Secure Applications* on pg. [35] for a complete description of each mode.



Note: CATx Matrix Switching applications do not offer an EAL4 rated level of security. CATx is not available with the TLX48 2RU, TLX80, TLX160, TLX640 or TLX1280.

Resiliency

TLX Matrix Switches are designed to maximize system uptime. The modular approach allows Operators to **hot-swap all critical system components**, including power supplies (in dual supply models), fan tray, control cards, annunciator module, input/output cards and pluggable optics. Furthermore, the system can be easily reconfigured, such as adding an additional input/output card, without ever turning off the switch or interrupting active signals. **Redundant and current-sharing power supplies** ensure continuous, uninterrupted power to the switch. Matrix switches are also configurable to include **redundant control cards with automatic fail-over**. Strategically placed sensors and alarms provide real-time monitoring and diagnostics of critical switch functions.

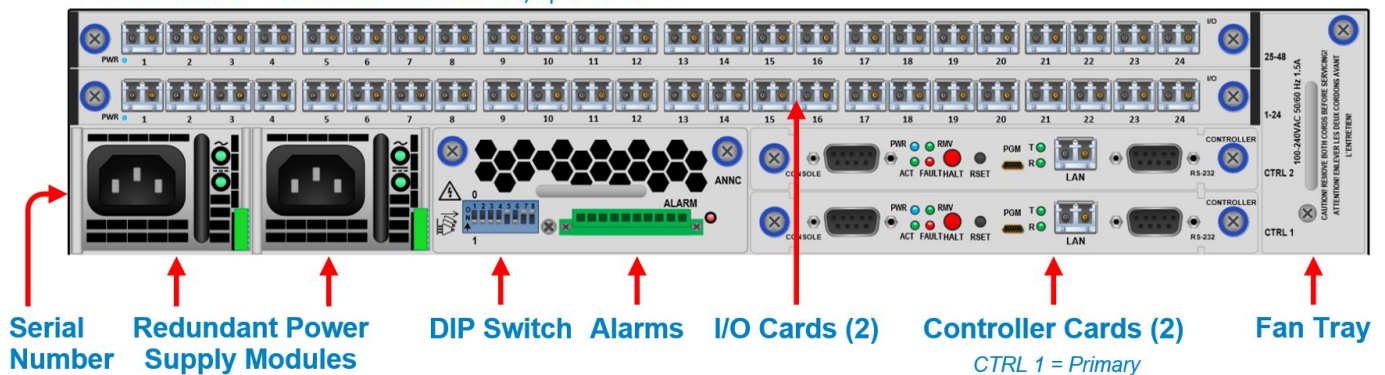
The TLX48 2RU Matrix Switch Design

The modular approach of the TLX48 2RU 10G Matrix Switch (sometimes referred to as a *Switch* or *Router*) allows all critical system components to be hot-swappable, including Input/Output Cards, Power Supplies, Annunciator Module, Control Cards and pluggable optics (SFP+), thus minimizing down-time during reconfigurations, updates or failures.

Thinklogical's TLX48 2RU line-replaceable modules include:

- (2) Redundant, Current Sharing Power Supply Modules
- (1) Fan Tray Module (3 fans)
- (2) Control Cards (Primary and Back-up)
- (Up to 2) 24-port Fiber-optic Input/Output Cards
- (1) Line-replaceable Annunciator Module with external DIP Switch and Alarm terminal

TLX-MSC-020048 TLX48 2RU Matrix Switch, up to 48 Ports



Design Features

Each **TLX48 2RU** includes the following features:

- Hot swappable, current sharing Power Supply Modules [7]
 - 2 required for redundancy
- Control Card [8]
 - SNMP and NTP control protocol
 - Controllable via LAN or serial connection
 - 2 required for redundancy
- Single Fan Tray with 3 fans [11]
- Up to 48 fiber-optic In and Out Ports for non-blocking matrix switching [12]
 - Each connection supports 10 Gbps / 6.25 Gbps with re-clocking input
 - 24 ports scalability for I/O Cards, hot swappable
 - Single-mode and multi-mode capability
- Line-Replaceable Annunciator Module [11]
 - 10-pin Terminal for Alarms [11]
 - External DIP switch for setting IP addresses [15]
- 2 Rack Unit chassis designed for standard EIA 19" rack mounting
- Comprehensive system setup and control provided via Thinklogical's SMP Module, SMP Appliance or SMP/ICT

Product Compatibility

The TLX48 2RU is compatible with the following Thinklogical® products:

- Single & Multi-Mode **TLX 10G KVM and Video Extenders** (10G to 10G only)
- Single & Multi-Mode **Velocity/Q-Series 6G KVM and Video Extenders** (6G to 6G only)
- **SDI Xtreme 3G+ Extenders**
- **System Management Portfolio**
- Standard **TLX Matrix Switch ASCII Interface** (via RS-232 port or via Network port)
- Standard **TLX Matrix Switch IP Address Configuration Procedure**
- Standard **TLX Matrix Switch SNMP Traps**

Power Supply Modules

The dual, redundant power supplies ensure continuous, uninterrupted power. The supplies are current sharing which means they share the load equally. If a power supply fails, the redundant power supply can support the entire current load of one fully populated Switch.

Each Power Supply module contains an internal cooling fan.

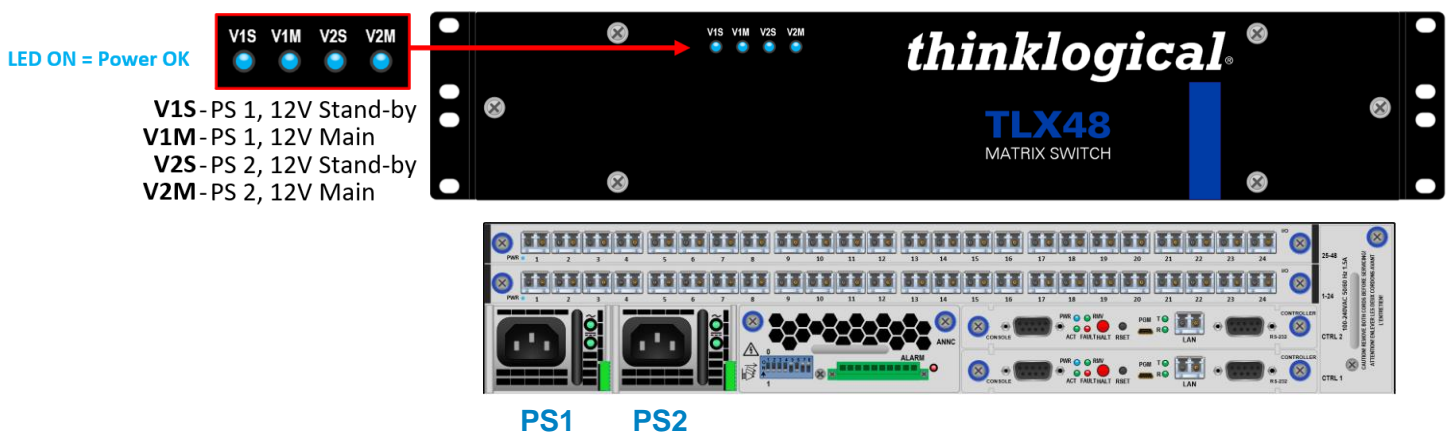
TLX-MSM-P20048:

- Universal input 100-240VAC, 50-60Hz, 1.5A.
- AC-DC 650 Watt, 12V/54.2A Main Output.
- 12V Standby Output, 2A max. Output Current.
- Mounted side-by-side from in rear panel.



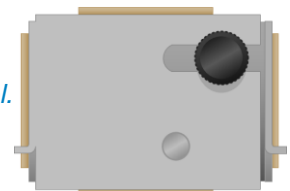
Although the switch functions properly with one power module, **Thinklogical recommends that both modules be used, preferably connected to independent power sources, for redundancy.** Additionally, the hot-swappable feature allows easy replacement of a module without interrupting the Switch's system functionality.

Power Supply status is displayed on the front panel.



If operating the TLX48 2RU with one power supply, it should be installed in the left (PS1) receptacle. A supplied filler panel should be installed to cover the right receptacle.

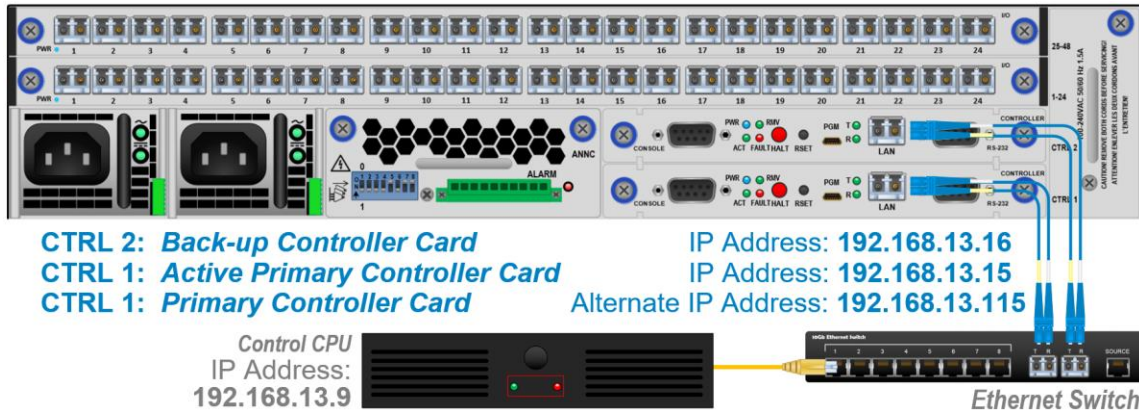
Power Supply filler panel.



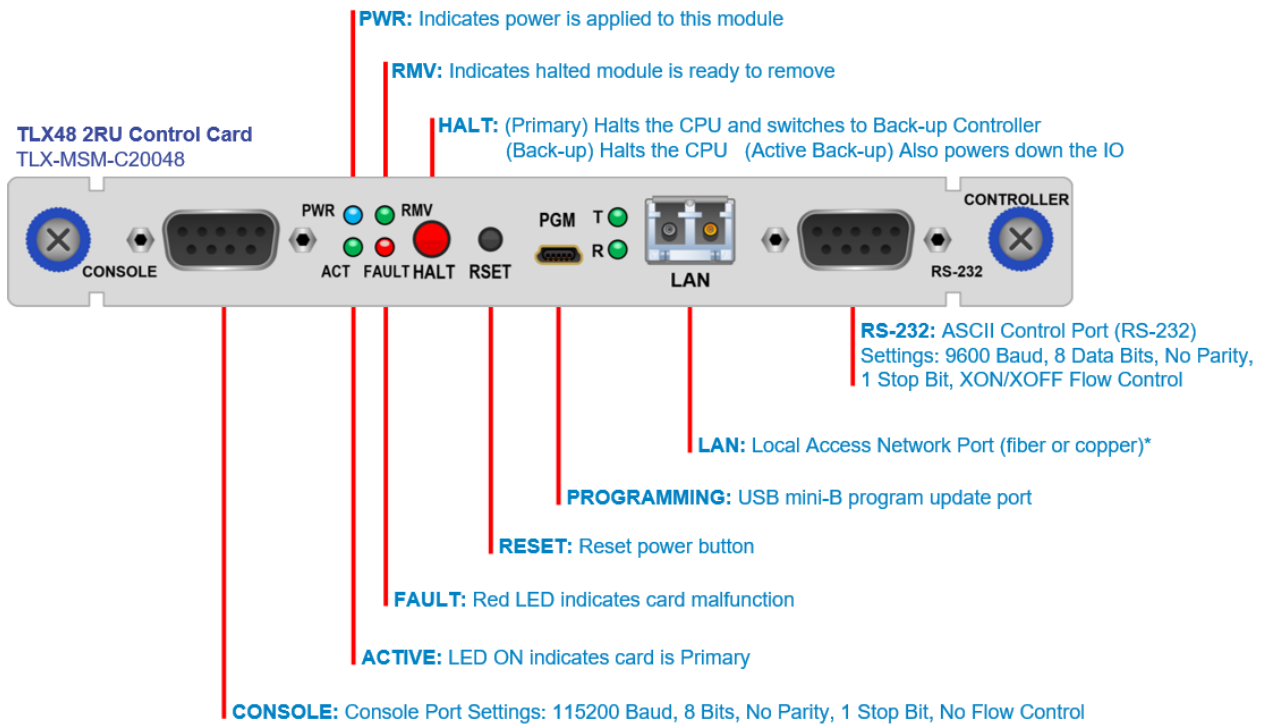
Also see *How to Remove and Replace a Power Supply*, pg. [27]

The Control Cards

The hot-swappable **Control Cards** (also referred to as *Controllers*) connect the TLX48 2RU to an **External CPU**. LAN Ports are available in either fiber-optic or copper RJ45 configurations. The RS-232 serial port may be used for third-party controller integration (such as Crestron, AMX or home-spun interfaces). Also, the SMP Software may be used to control the Switch via the LAN port.



A **Back-up Control Card** ensures uninterrupted functionality if the **Primary Control Card** should fail or need to be replaced. The *Primary Control Card* should always be in the lower controller slot (CTRL 1). The Back-up Control Card (sometimes referred to as a *Secondary* or *Fail-Over* Control Card) must have a LAN connection that allows it to communicate with both the Primary Control Card and the SMP (required for the Back-up Control Card to take control of the TLX48 2RU). For more on Primary and Back-up Control Cards, see *Safely Remove an Active Control Card or Shut-down the System* on pg. [25].



*See pg. [28] for ordering information.

The Network Interfaces

A TLX48 2RU uses up to three IP addresses. The Primary Control Card uses address X and address X+100. The Back-up Control Card uses address X+1 and will take over address X in the event of a failure in the Primary Control Card. These addresses are set by an external DIP switch. See *TLX48 2RU DIP Switch Settings*, pg. [16]. The primary's IP address can be set from 15 to 45. **The default subnet used by the TLX48 2RU is 192.168.13.xxx.** An Administrator may use their own subnet by reconfiguring the switch's network startup.

This procedure is detailed in: [Manual_How_To_Change_A_TLX_Matrix_Switch's_IP_Address](#)

Referenced documents are available here: <https://www.thinklogical.com/downloads/>

The TLX48 2RU uses several network ports for control and status. Port 17567 accepts switch control commands. The command **API** (*Application Programming Interface*) is described in the document:

[Manual_TLX_Matrix_Switch_ASCII_API_V5](#)

There are other ports that can be read to access system configuration and operating data. The actual data format varies by model and is described in the following sections. There are five blocks of data available for reading.

These ports are documented in: [Manual_TLX_Matrix_Switch_Interfaces](#)

1. Switch connection status (broadcast over port 17564 every few seconds)

- The primary CPU IP address
- Upper or Lower chassis flag
- First port number in this block
- Last port number in this block
- 'N' port number values

2. Port settings (UDP port 17565, TLX48 2RU localhost only)

- Port output level value
- Port input enable status
- Input port number (big-endian format)

3. Hardware sensor status (TCP port 17566)

- Reserved for future use.

4. Alarm, Inventory and Power Supply Status (TCP port 17600)

- State of the alarm contacts
- Card Inventory
- Power Supply Status (internal TL use only)
- Switch card temperature readings

5. I/O Card data (TCP ports 17601 through 17640, 1 port per I/O card)

- | | |
|----------------------|------------------------|
| • SFP installed bits | • I/O card type |
| • SFP TxDisable bits | • I/O card temperature |
| • SFP TxFault bits | • SFP serial ID data |
| • SFP LOS bits | • SFP Diagnostic data |

6. Service Request (LOS) Signaling (UDP port 17560)

The TLX48 2RU can broadcast a message over the network when a remote receiver requests attention. When enabled, the receiver will toggle its TX pin, causing a LOS (loss of signal) event to occur at the Switch. When detected, the Switch broadcasts an 'Attention Request' message over the network. This message contains the IP address of the TLX48 2RU and the port number that detected the request. It is left up to an external system to detect, decode and act upon this request.

- 32-bits, TLX48 2RU's primary IP address
- 16-bits, 0 for the Upper (or only) Switch chassis, 1 for the Lower Switch chassis (in some models)
- 16-bits, port number (list starts from 1, not 0)
- 16-bits, key code in bits 0 – 7, 0x00 and 0xff are ignored

SNMP Support

The TLX48 2RU can be monitored via **SNMP Simple Network Management Protocol** (supports version V2c and V3 USM). Please call our technical support staff at 1-203-647-8700 for downloadable MIB *Management Information Base* definition files.

Entries in the SNMP configuration file (</etc/snmp/snmpd.conf>) that Administrators typically modify are:

- `syslocation` Text to aid in locating the unit
- `syscontact` Name/Phone/email address of a contact
- `trap2sink` IP address/name of a system to receive SNMP traps

The default name used by trap2sink is 'snmp.trap' and is defined in the file </etc/hosts> as pointing to 127.0.0.1. The easiest method to change the trap address is to modify the </etc/hosts> entry and not change the trap2sink setting in the configuration file. You may have multiple trap2sink entries in the configuration file to specify multiple trap destinations.

NTP Support

NTP, or Network Time Protocol, is used to keep the internal clock on the TLX48 set to the correct time.

By enabling this service, Administrators keep the Switch's clock synchronized to an external time reference. To use the service, Administrators must have a time server running on their network or allow the Switch to access a public time server. NTP configuration is contained in the file </etc/ntp.conf>

Details about NTP configuration may be found at: <http://tldp.org/LDP/sag/html/basic-ntp-config.html>

System Log Files Support

The TLX48 2RU records system events into files located in the directory </var/log/>. If you wish to preserve log files, you may redirect the logs to another system(s). This is a standard feature of Linux's `rsyslog.d` program. Redirection is enabled by entries in **rsyslog** configuration files located in </etc/rsyslog.d/>

Details about syslog configuration file entries may be found at: <http://www.rsyslog.com/doc/>

Serial/RS-232 Interfaces

The Control Card has two RS-232 serial ports. One Port is for the Linux command line interface (labeled CONSOLE), and the other is for the Switch's ASCII command interface (labeled RS232). *If a Back-up Control Card is installed, then its Linux console port is active, but only the RS232 port on the active Control Card will function.*

Linux Command Console (Console)

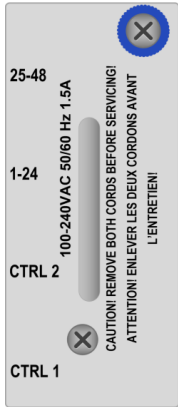
- Baud Rate: 115200
- Data Bits: 8
- Parity: none
- Stop Bits: 1
- Flow Control: none
- DB9 DCE
 - A straight cable is needed to connect to a PC (*not* a null-modem).

ASCII API (RS232)

- Baud Rate: 9600
- Data Bits: 8
- Parity: none
- Stop Bits: 1
- Flow Control: XON/XOFF (Software)
- DB9 DCE
 - A straight cable is needed to connect to a PC (*not* a null-modem).

The Fan Tray Module

The TLX48 2RU uses **3 DC fans** located in one modular, hot-swappable fan tray designed for easy replacement without interrupting system functionality. The Fan Tray introduces air into the chassis through air baffles along the chassis side panel. This cools the horizontally mounted I/O Cards, the Control Cards and the backplane. *Do not allow the TLX48 to operate without a Fan Tray for more than 90 seconds.*



TLX-MSM-F20048
TLX48 2RU Matrix Switch Fan Tray

Labelling includes module ID and input voltage parameters.

Shock Hazard

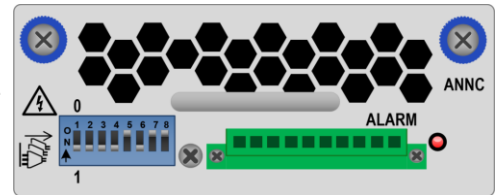


Multiple Power Cords

See pg. [26] before removing any module.

TLX-MSA-200048

TLX48 2RU Matrix Switch Annunciator Module



The Annunciator Module

The hot-swappable Annunciator Module is equipped with a ten-port terminal for **system alarms** which can be configured to trigger an external control system (adapter included) and an **external DIP Switch** for setting IP addresses. See pg. [16]. The module also features air baffles for additional output ventilation.

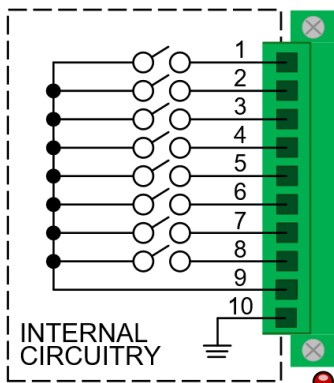


Note: Always ensure the DIP Switch settings on a replacement Annunciator Module match the settings on the removed Annunciator Module or a desired new setting.

Critical Hardware Alarms

The dry alarm contacts are *Normally Closed* when unpowered, *Normally Open* when powered (OK condition) and Closed for an alarm condition.

Maximum switching capacity is 2A at 12V.



- POWER SUPPLY 1 (LEFT):** Fan fail, temp. spikes, DC V/A, AC pwr interrupt, module removed
- POWER SUPPLY 2 (RIGHT):** Fan fail, temp. spikes, DC V/A, AC pwr interrupt, module removed
- FANS:** Individual fan monitoring
- TEMPERATURE WARNING:** Chassis over temperature, multiple sensors
- TEMPERATURE SHUTDOWN:** Chassis over temperature causing shutdown
- CPU:** Card failure (Only with a redundant card)
- INPUT/OUTPUT CARDS:** SFP+ failure, laser output fault
- ANY OF THE ABOVE**
- COMMON GROUND**

● Red LED lit for alarm condition

Terminal plug adapter with screw-flanges
CON-172-R



All fan speeds are monitored and any that do not meet specification will cause an alarm condition.

The temperature in the chassis is continuously monitored for any anomalous conditions by internal sensors in the Power Supply(s), Fan Tray and on the Control Card(s) and the I/O Card(s).

- (Pin 4) **Temperature Warning** – The upper limit is **60°C (140°F)** by default.
- (Pin 5) **Temperature Shutdown** – The upper limit is **65°C (149°F)** by default. This feature can be enabled or disabled, with disabled being the default state. To enable the *High Temperature Shutdown* feature, modify `/etc/default/tlxcntl` as shown below:

Add `--enable-high-temp-shutdown` to `TLXCNTL_ARGS=`

Power-cycle the TLX-48 2RU or use command `systemctl restart tlxcntl`.

The Input / Output Cards

TLX-MSD-M00024 TLX48 2RU Matrix Switch Data Input/Output Card, 24 Multi-Mode Ports
TLX-MSD-S00024 TLX48 2RU Matrix Switch Data Input/Output Card, 24 Single-Mode Ports

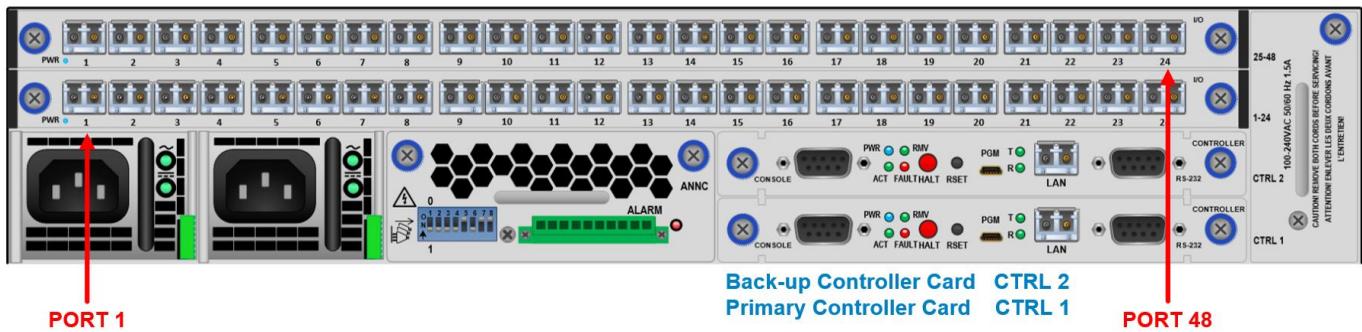


The TLX48 2RU contains up to 2 horizontally-mounted I/O Cards.

The hot-swappable Input/Output (I/O) cards provide in-service expansion capabilities in sets of 24 ports per I/O card, thus allowing re-configuration without interrupting signal processing.

Each standard I/O card consists of one Transmit (T) and one Receive (R) optic per port. **I/O Cards are available with LC-type fiber connectors and can be assembled with Single-mode or Multi-mode optics (SFP+).** Individual I/O Cards list the ports as 1 through 24. A blue LED located on each I/O card indicates when power is applied.

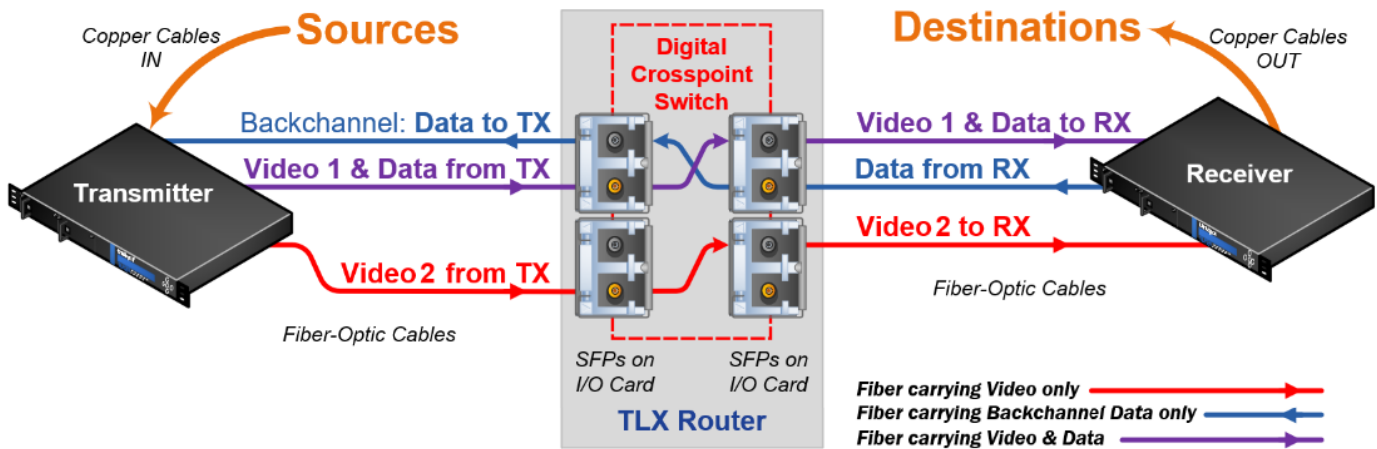
The TLX48 2RU can have a minimum of one I/O Card (24 x 24) and a maximum of 2 I/O Cards (48 x 48). Each TLX48 I/O card contains 24 ports, so that when fully configured, the TLX48 will provide a total of 48 Optical Input/Output connections (SFP+ T/R) described as Ports 1-48. The TLX48 switching matrix connects any port's optical output (SFP+ T) to any port's optical input (SFP+ R).



Port numbers begin at the left and start with the bottom I/O Card

The Digital Crosspoint Switch

The Digital Crosspoint Switch is a non-blocking asynchronous switch that can connect any input to any output of Thinklogical's TLX, VX and MX Matrix Switches. Video and Data signals are routed in both directions and the data stream is de-multiplexed at the receiver to deliver uncompressed, high-resolution video, audio and peripheral data at the end-user's workstation.



TLX48 2RU Technical Specifications



PHYSICAL	
TLX 48 2RU Chassis	<p>Dimensions: Rack Size: EIA 19.00" (482.6 mm) Height: 2 RU - 3.50" (88.9 mm) Depth: 12.50" (317.5 mm) Width: 17.47" (443.7 mm)</p> <p>Weight (fully loaded): 22.0 lbs. (10.0 kg) Shipping Weight: 27.0 lbs. (12 kg)</p>
Fiber Ports	24 x 24 min., 48 x 48 max., 1 LAN per Control Card (option)



ENVIRONMENTAL	
Operating Temperature Ranges	<p><i>Internal temperature indications for PC Boards and FPGAs:</i></p> <ul style="list-style-type: none"> Board operating temp. range is 32° to 176°F (0 to 80°C). <i>Temp. Alarm (Annunciator LED is Red) when board temp. is > 140°F (60°C). Overtemperature shutdown limit is 149°F (65°C).</i> FPGA operating temp. range is 32° to 212°F (0 to 100°C).
Temperature	<p>Operating: 0° to 50°C (32°F to 122°F) Ambient Storage: -20°C to 70°C (-4°F to 158°F)</p>
Humidity	<p>Operating: 5% to 95%, non-condensing Storage: Unlimited</p>
Altitude	<p>Operating: Thinklogical components are rated to 1000m max. elevation. Max. operating temp. de-rates by 3% for every 330m > 1000m Storage: Unlimited</p>



ELECTRICAL	
Alarm Relay Contacts	<p>Maximum DC: 1A at 30VDC Maximum AC: 0.3A at 125VAC Contact resistance max.: .1Ω</p>
Input Rating	100-240VAC, 50-60Hz, 1.5A
AC Power Consumption	<p>AC-DC 650 Watt, 12V / 54.2A Main Output. 12V Standby Output, 2A max. Output Current.</p>
Heat Load	2218 BTUs (BTU/HR)
Regulatory	US / Canada EN 90650, FCC 47 CFR Part 15, ICES, CE
Warranty	One year from date of shipment. Extended warranties available.

Section 2: Set-Up & Installation

Contents

When you receive your Thinklogical® TLX48 2RU KVM Matrix Switch, you should find the following items in the quantities specified in your order:

- TLX48 2RU Chassis (includes one or two 2 Power Supply Modules, 1 Fan Tray, up to 2 Input/Output Cards and one or two Control Cards)
- Power Cord – Qty. 1 per power supply – PWR-000006-R (International connections may differ)



Note: Only use appropriately rated power cords with a grounding connection!

- Chassis Options (Spares):
 - Back-up Control Card
 - Spare Fan Tray
 - Spare Power Module
 - Data Input/Output Cards, 24 Ports
 - Spare Annunciator Module

The TLX48 2RU KVM Matrix Switch ships configured to customer specifications.

Unpacking the TLX48 2RU

The TLX48 2RU is a two rack unit chassis designed to be mounted in a standard EIA 19” rack. All physical connections to the product use industry-standard connectors. Non-supplied cables that may be needed are commercially available. All connections are found on the rear of the unit.

**! READ THE INSTRUCTIONS THOROUGHLY !
BEFORE STARTING ANY PROCEDURE!**

1 Carefully inspect the shipping container to ensure the “Tamper Evident Shipping Tape” has not been compromised. Two types of tape are used to seal the shipping box containing the product.

One type looks like plain, blue tape until removed. A message will transfer onto the cardboard if the tape is removed, providing evidence of tampering. Also, this type of tape cannot be resealed.

The second type is a red striped tape. This type of tape cannot be realigned once the box has been opened.



Properly Sealed



Tamper Evidence



Tamper Evidence



Note: If evidence of tampering is detected, immediately contact the Thinklogical-authorized dealer where you purchased the device, or if you purchased directly, call Thinklogical at 1-203-647-8700 or 1-800-291-3211.

2 Carefully remove the TLX48 2RU from its shipping container. Carefully inspect the entire unit to make certain that no damage occurred during shipment.

- 3 The I/O and Controller Cards are installed at the factory to meet your specific configuration. Ensure that the Cards are properly seated in the unit and that all the SFP modules are sealed with a removable dust plug. The I/O and Controller Cards are held in place by thumb screw retainers. **Ensure that all thumb screws are finger tight so that all the modules are properly secured in the chassis.**
- 4 Verify that each Power Supply is fully seated in the chassis and that the retaining latch is secure.
- 5 Verify that the Fan Tray and Annunciator Modules are fully seated in the chassis and that the thumb screws are secure.
- 6 When the TLX48 2RU has been inspected and found to be in suitable condition, the installation process can begin.



Note: If mounting the chassis in a rack, ensure that air flow to the fans is not restricted (minimum 2” of free space on all sides).



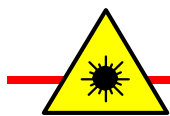
Note: If any of the sensors detect an over temperature condition, power will be removed from all sensitive components and the system will shut down.



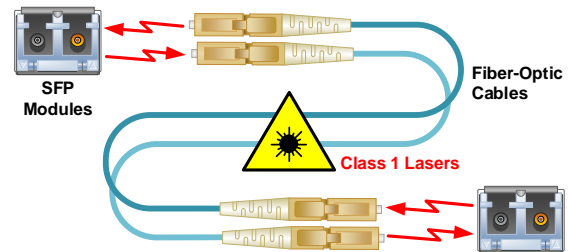
Note: All failure conditions send out notifications prior to shut-down. For a detailed list of the alarm functions, see pg. [11]: *Alarm Descriptions for the TLX48 2RU.*

Class 1 Laser Information

TLX Extenders and Matrix Switches, like all Thinklogical fiber-optic products, are designed and identified as **Class 1 LASER products**. This means the maximum permissible exposure (MPE) cannot be exceeded when viewing the laser with the naked eye or with the aid of typical magnifying optics, such as a magnifying glass, eye loupe, etc.



CLASS 1 LASERS do not require any special precautions under conditions of normal use.



Product Serial Number

Thinklogical products have a unique serial number, which includes a date-code, printed on an adhesive label that is affixed to the unit. The format for the date-code is *2 digits for the month*, dash, *2 digits for the year*, plus *at least four digits for a unique unit number*. For example:

05-230014 indicates the unit was built in the **5th** month of **2023** and is unit number **14**.

Connecting to the TLX48 2RU Matrix Switch

Connections and installation hardware for our products use industry-standard devices and methods. All wiring connections to the customer equipment are designed to minimize proprietary or customized connectors and cabling. Power connections are made with regionally appropriate power cords and approved methods.

Thinklogical’s line of TLX, Velocity and Q-Series Extenders come in both multi-mode and single-mode fiber-optic cable versions.

Thinklogical’s proprietary multiplexing technology combines video, audio and peripheral data on a single data stream for up to 80km over a single-mode fiber.

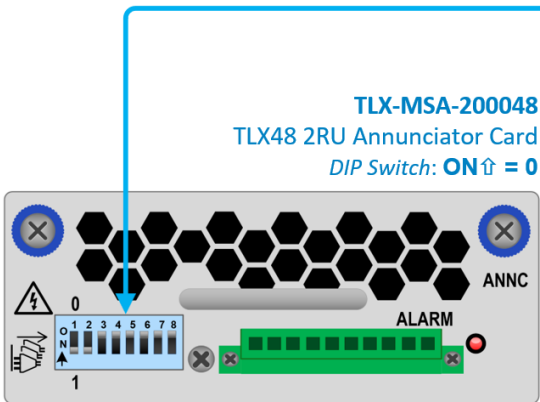
Product Compatibility

The TLX48 2RU is compatible with the following Thinklogical® products:

- Single- & Multi-Mode **TLX 10G KVM and Video Extenders** (10G to 10G only)
- Single- & Multi-Mode **Velocity/Q-Series 6G KVM and Video Extenders** (6G to 6G only)
- **SDI Xtreme 3G+ Extenders**
- **Hot-Key Manager / System Management Portfolio**
- Standard **TLX Matrix Switch ASCII Interface** (via RS-232 port or via Network port)
- Standard **TLX Matrix Switch IP Address Configuration Procedure**
- Standard **TLX Matrix Switch SNMP Traps**

Ethernet Control

If the TLX48 2RU KVM Matrix Switch is to be controlled via Ethernet, it will require a **static IP address**. This value can be set via the DIP switch located on the front of the Annunciator (ANNC) Module. Factory default setting is: **192.168.13.15** (00000000).



TLX-MSA-200048
TLX48 2RU Annunciator Card
DIP Switch: ON ↑ = 0

1	2	3	4	5	6	7	8	Primary Controller IP Addresses	Back-up Controller IP Address
0	0	0	0	0	0	0	0	192.168.13.15 & 192.168.13.115	192.168.13.16
1	0	0	0	0	0	0	0	192.168.13.17 & 192.168.13.117	192.168.13.18
0	1	0	0	0	0	0	0	192.168.13.19 & 192.168.13.119	192.168.13.20
1	1	0	0	0	0	0	0	192.168.13.21 & 192.168.13.121	192.168.13.22
0	0	1	0	0	0	0	0	192.168.13.23 & 192.168.13.123	192.168.13.24
1	0	1	0	0	0	0	0	192.168.13.25 & 192.168.13.125	192.168.13.26
0	1	1	0	0	0	0	0	192.168.13.27 & 192.168.13.127	192.168.13.28
1	1	1	0	0	0	0	0	192.168.13.29 & 192.168.13.129	192.168.13.30
0	0	0	1	0	0	0	0	192.168.13.31 & 192.168.13.131	192.168.13.32
1	0	0	1	0	0	0	0	192.168.13.33 & 192.168.13.133	192.168.13.34
0	1	0	1	0	0	0	0	192.168.13.35 & 192.168.13.135	192.168.13.36
1	1	0	1	0	0	0	0	192.168.13.37 & 192.168.13.137	192.168.13.38
0	0	1	1	0	0	0	0	192.168.13.39 & 192.168.13.139	192.168.13.40
1	0	1	1	0	0	0	0	192.168.13.41 & 192.168.13.141	192.168.13.42
0	1	1	1	0	0	0	0	192.168.13.43 & 192.168.13.143	192.168.13.44
1	1	1	1	0	0	0	0	192.168.13.45 & 192.168.13.145	192.168.13.46

TLX48 2RU DIP Switch Settings

The simplest network connection is an isolated network with only the TLX48, the control server, and any control clients using static IP addresses. The TLX48 can be set to any of the above settings. The **Control Server** must be at **192.168.13.9**, and the **Control Clients** can then be set to any other addresses in the **192.168.13.X** subnet.

If static IP addresses for the control server and its clients are not possible, then the control server will require two (2) network interfaces, with one interface set to the static address **192.168.13.9** and dedicated to the TLX48 2RU KVM Matrix Switch(s), while the other network interface can be configured as required by the facility's network administrator. *The Annunciator Module is a line-replaceable unit. Always ensure proper DIP Switch settings when replacing an Annunciator Module.*



Note: Always ensure the DIP Switch settings on a replacement Annunciator Module match the settings on the removed Annunciator Module or a desired new setting.

Redundancy and Network Requirements

The simplest network connection is an isolated network with only the TLX48, the control server, and any control clients using static IP addresses. The TLX48 can be set to any of the above settings. The **Control Server** must be at **192.168.13.9**, and the **Control Clients** can then be set to any other addresses in the **192.168.13.X** subnet. If static IP addresses for the control server and its clients are not possible, then the control server will require two (2) network interfaces, with one interface set to the static address **192.168.13.9** and dedicated to the TLX48 2RU KVM Matrix Switch(s), while the other network interface can be configured as required by the facility's Network Administrator.

Pluggable SFP+ Modules

Each Input and Output card contains a row of twenty-four SFP+ modules that serve as the fiber-optic couplers for the fiber cables to and from the Thinklogical transmitter and receiver extenders. Individual SFP+ modules can be easily accessed without removing the cards.

The SFP+ Optical Module is a 10Gbs Short-Wavelength Transceiver designed for use in bi-directional Fiber-optic Channel links. The modules are hot-pluggable and operate on 3.3VDC.

Always use **dust caps** to protect against dust and damage when a fiber-optic connector is not attached to its coupling device (fiber-optic equipment, bulkheads, etc.). All Thinklogical Matrix Switch SFPs are fully populated with dust plugs upon shipment.



SFP+ Module
Actual Size



Note: It is good practice to immediately install dust plugs in unused SFP modules and on the ferrules of unconnected fiber-optic cables.

Each TLX48 2RU I/O card has 24 SFP+ Modules, each mounted within a grounded metal enclosure. Each SFP is locked into its enclosure with a built-in latch handle that can be opened for removal or locked for installation (right).

The latch handle spans the two LC ports. Arrows printed on the handle indicate which port is an INPUT (➤) and which is an OUTPUT (➤).



SFP+ Latch Closed



SFP+ Latch Open

The Controller Card LAN Port SFP

Each TLX48 2RU Controller Card is available with either a fiber-optic or copper RJ45 SFP Module. The RJ45 SFP accepts a CATx cable. Either configuration connects the Controller to the external Control CPU.

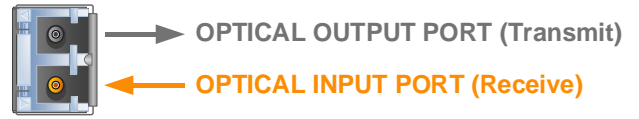
(See pg. [28] for Ordering Details.)



LC-Type Fiber-optic Cable

Installing Fiber-optic Cable

The TLX switching matrix connects any SFP's optical output port (Transmit) to any other SFP's optical input port (Receive) with LC-type Connectors.



Requirements

Thinklogical recommends LC-type (50 or 62.5 μm) fiber for the TLX48 2RU KVM Matrix Switch and Extension System. OM4 Multi-mode fiber can extend up to 400m and Single-mode fiber can extend up to 80km.

Multi-Mode: Up to 33 meters with Type OM1
 Up to 82 meters with Type OM2
 Up to 300 meters with Type OM3*
 Up to 400 meters with Type OM4
Single-Mode: Up to 80km with Type OS2 9/125
**Thinklogical recommends 50 or 62.5 micron, OM3 fiber-optic cables terminated with LC-type connectors.*

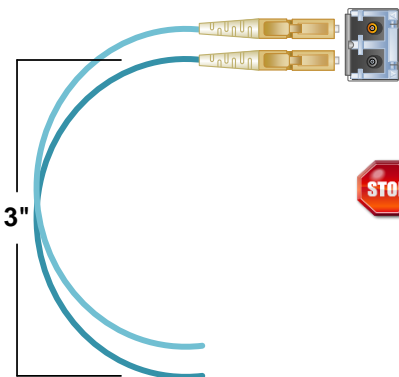


Handling Fiber-optic Cable

Unlike copper cabling, fiber-optic cable requires special handling. A small speck of dust or a scratch to the ferrule tip (the end of the connector) can attenuate the optical signal, rendering the cable inoperable.



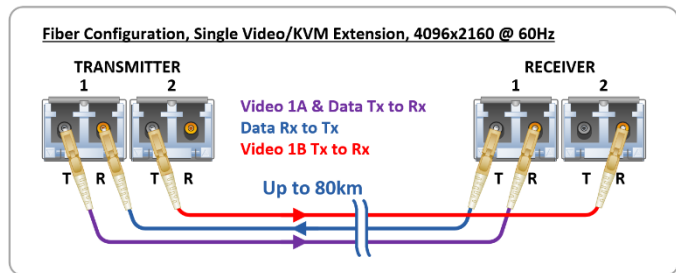
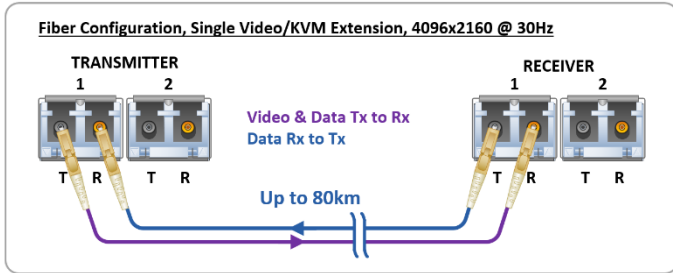
Warning! The ends of the connectors (the ferrule) should never contact any foreign object, including fingertips. Always install a dust cap immediately on the ferrule of any unused fiber to protect the tip.



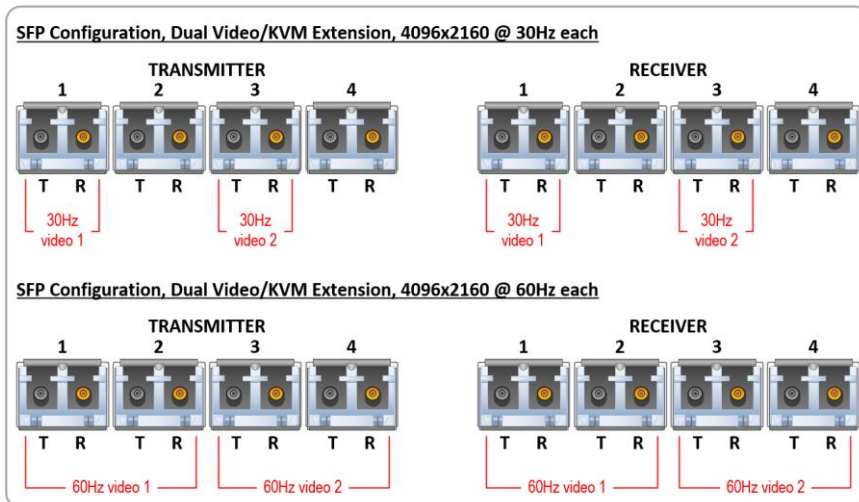
Warning! Minimum bend diameter must be no less than 3". Be careful not to kink or pinch the fiber when using ties.

TLX Extender Fiber-Optic Cable Configurations

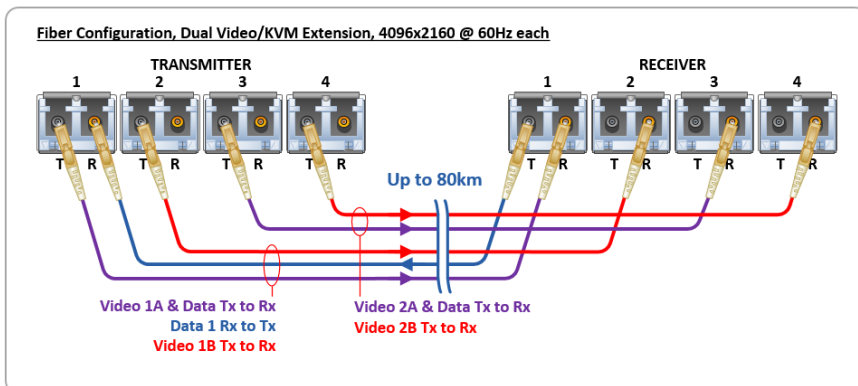
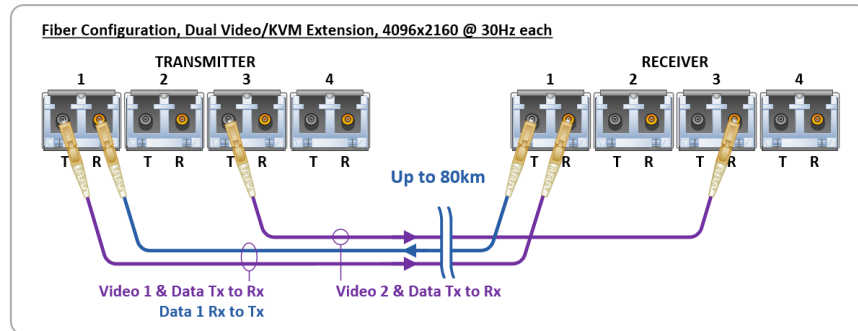
Single Video



Dual Video

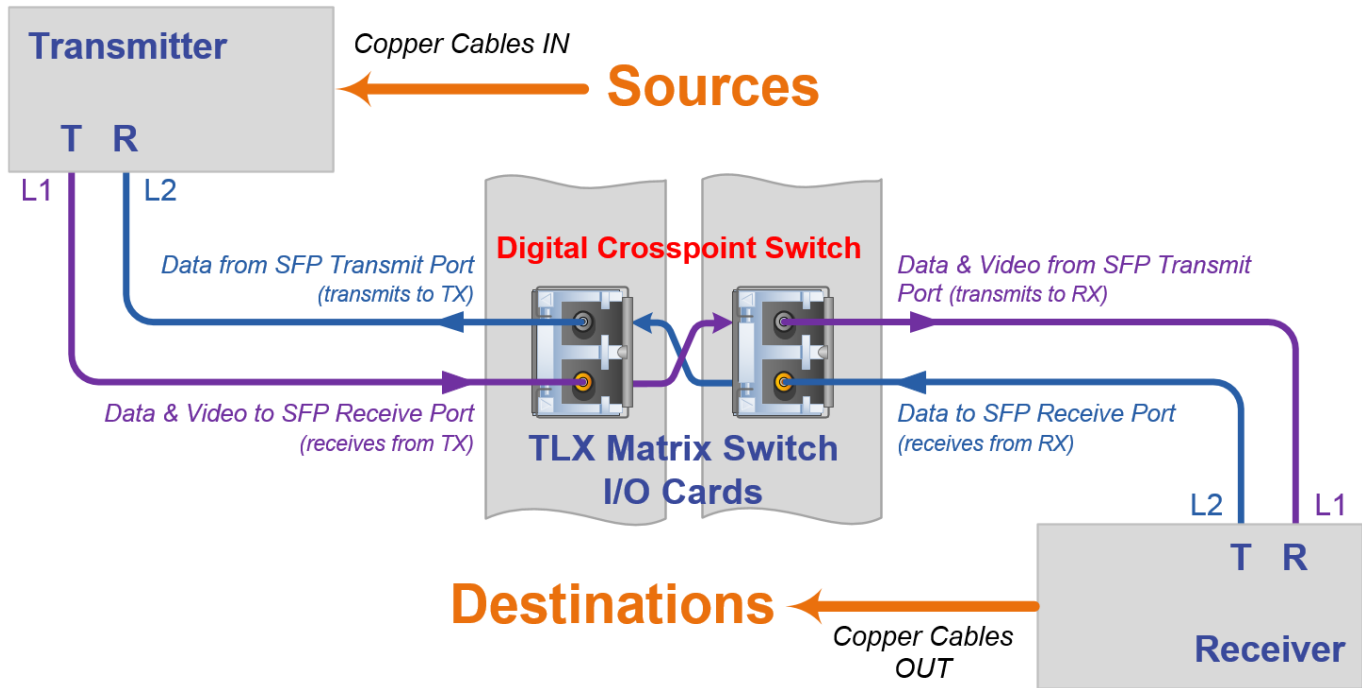


Note: On Dual Video models, SFPs 1 & 2 are Video 1 and SFPs 3 & 4 are Video 2.



Routing Thinklogical Extenders through the TLX48 2RU

Comprised of a fiber-in, fiber-out matrix switch and fiber-optic KVM Transmitter and Receiver Extenders, this complete system provides transparent and secure routing, switching and extension of video and high-speed data peripherals to remote destinations with ease.



Matrix Switch Transmit / Backchannel Concept

Connecting to the Receiver

The Receiver serves as the Destination (desktops, theaters, conference rooms, editing suites, control consoles, video walls, etc.). Depending on your configuration, your KMASS devices (audio, keyboard, mouse, etc.) are connected to the Receiver first, using standard cables. Power can then be applied to the unit. The Receiver then connects to the TLX48 Receiver ports using fiber (Multi-mode fiber for distances up to 400m; Single-mode fiber for distances beyond 400m). Data to the Transmitter is referred to as the *backchannel*.



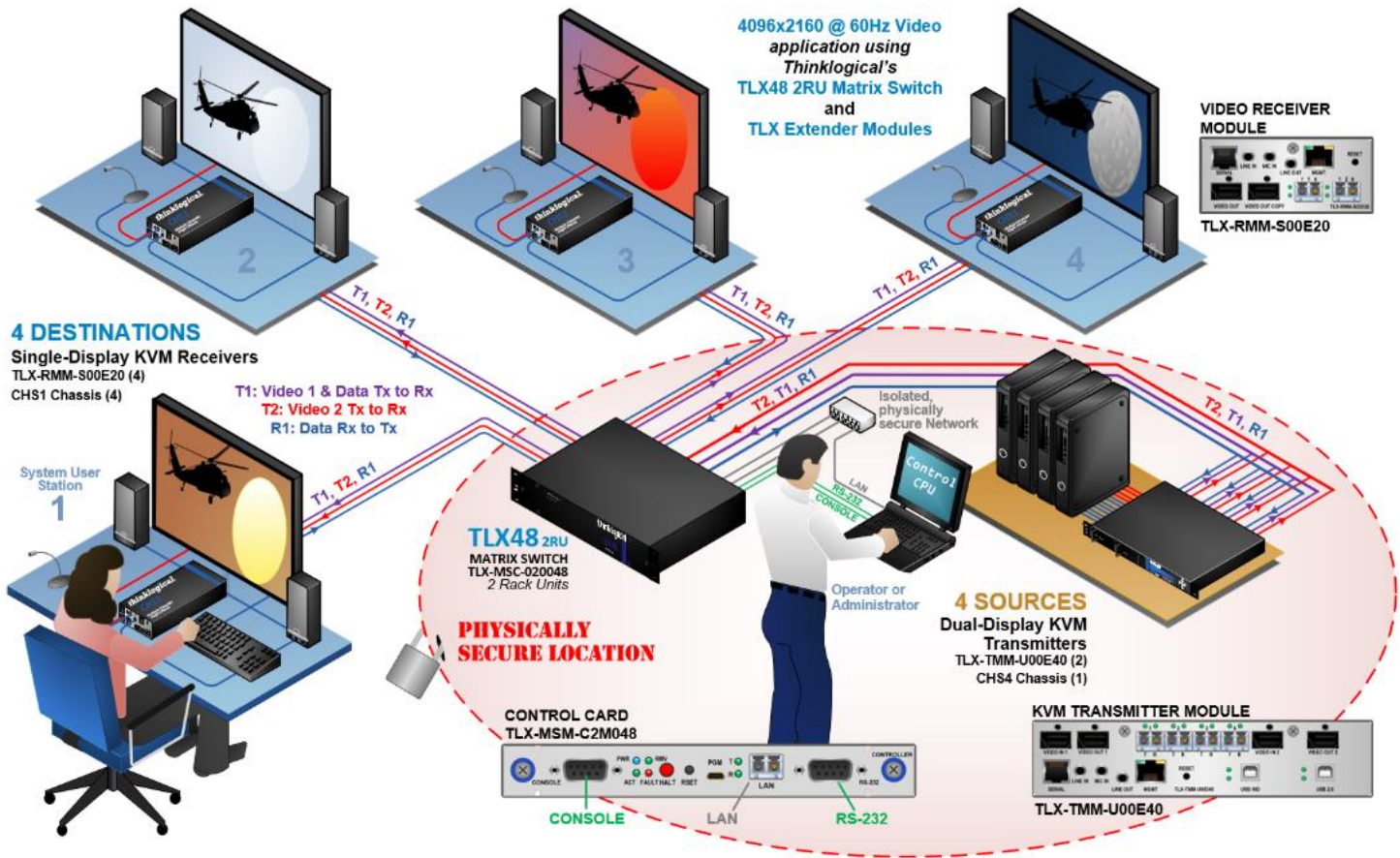
Warning! The Matrix Switch must be configured so that no KMASS input can ever be switched to more than one output. A KMASS input to the Switch connected to multiple outputs would control multiple sources.



Note: To ensure that no KMASS input ever gets multicast by the Switch, refer to **Point-to-Point Switching Mode** in Appendix C, pg. [43]

Connecting to the Transmitter

The Transmitter serves as the Source (computer and video entities). If the source includes a workstation, depending on your configuration, your local KMASS devices (audio, keyboard, mouse, etc.) should be connected first. The video sources (e.g., computers, tape decks, etc.) are connected next, followed by any local video devices. Power can then be applied to the unit. The Transmitter connects to the TLX48 Transmitter ports using fiber-optic cables (Multi-mode fiber for distances up to 400m; Single-mode fiber for distances beyond 400m).



Routing Thinklogical® TLX Extenders through the TLX48 2RU

Connecting to a Control CPU

The TLX48 2RU is controlled via a dedicated external Control CPU. This allows for customization as well as ease of control and administration. Access is provided via fiber-optics, CATx or serial RS-232.



Note: The Control CPU (Computer) is supplied separately.

The network and serial RS-232 connection both use the same low-level ASCII API syntax. This command syntax is defined in the document: [Manual_TLX_Matrix_Switch_ASCII_API_V5](#). Each line contains only one command and must end with a carriage return (CR) and line feed (LF), or just a line feed (LF). The characters are not echoed.

The serial port is configured for 9600 baud, 1 stop bit, no parity, and no flow control. The network interface listens on TCP (Transmission Control Protocol) port **17567**. It accepts the same commands as the serial interface. You may use telnet to manually open a connection and control the TLX48 using port 17567.

Third-party controllers will control the Switch by connecting to either the serial or network port. Automatic fail-over requires a Network connection.

Thinklogical offers a web-based control program called the System Management Portfolio, or 'SMP.' This program is described in greater detail in the documents: [Manual_SMP2](#) and [Manual_SMP3](#), available on the Thinklogical web site.

The Roles of System Administrator, Operator and User

Matrix Switches and the external computers (servers) used to manage the system must be in a physically secure environment to which only trusted Administrators and Operators have access. Similarly, the server used to manage the Matrix Switch must be physically protected and have suitable identification/authentication mechanisms to ensure that only a trusted Administrator has access.

The roles of authorized-access personnel are defined below.

- **System Administrator:** Has administrative rights in the CentOS system including access to, and modification of, .csv files. Has access to system hardware, can view log data and can make and break connections. Has second-level authentication system-login credentials and cannot be deleted by another operator. There can be only one System Administrator. See pg. [36] for *Administration Access*.
- **System Operator:** Has access to system hardware and can make and break connections. Has first-level authentication system-login credentials. The System Administrator can designate any number of individuals as authorized System Operators.
- **System User:** Typically located at a remote workstation. Does not have system login credentials or access to system hardware. Cannot make or break connections. Any number of individuals can be System Users.

Operating System Default Passwords

TLX48 2RU Matrix Switch Operating System: **Centos 7**

Installed on V5.09.XX

- OS default username/password
- centos/tempwd
- root/root (cannot remote into OS as root user)

Linux Command Console (CONSOLE)

- Baud Rate: 115200
- Data Bits: 8
- Parity: none
- Stop Bits: 1
- Flow Control: none
- DB9 DCE
 - A straight (NOT a null-modem) cable is needed to connect to a PC.

ASCII API Settings (RS-232)

- Baud Rate: 9600
- Data Bits: 8
- Parity: none
- Stop Bits: 1
- Flow Control: XON/XOFF (Software)
- DB9 DCE
 - A straight (NOT a null-modem) cable is needed to connect to a PC

Powering-Up the TLX48 2RU for the First Time

After the TLX48 2RU has been successfully unpacked, inspected and installed in the desired location, it will be time to power-up the unit for the first time.

Pre Power-up Checklist

Upon meeting the following conditions, proceed with power-up of the Matrix Switch:

- The chassis is securely mounted and grounded in its desired location.
- Adequate input power is available.
- Interface cables are connected.
- An active PC with a terminal program (PuTTY or equivalent) is connected to the Console Port with an RS-232 cable.
- The Linux Command Console is configured for 115200 baud, 8 data bits, 1 stop bit, no parity, and flow control is set to "none."
- The ASCII API (RS-232) settings are configured for 9600 baud, 8 data bits, 1 stop bit, no parity, and flow control is set to "XON/XOFF."
- The Administrator has selected new access control passwords to replace the default passwords.
- The Ethernet's static IP address is set via the DIP switch located on the front of the Annunciator Module.

Power-up Procedure

After meeting the requirements in the above checklist, follow the steps below to power-up the TLX48 2RU Matrix Switch and verify that it completes initialization and self-test. After completing this procedure, the Matrix Switch is ready to be configured.

- Plug each power supply into a standard AC source.
- Verify the information presented on the power-up com screen indicates OK on each scrolling line.
- Verify front and back panel LEDs are as described under **Initialization**, on the following page.

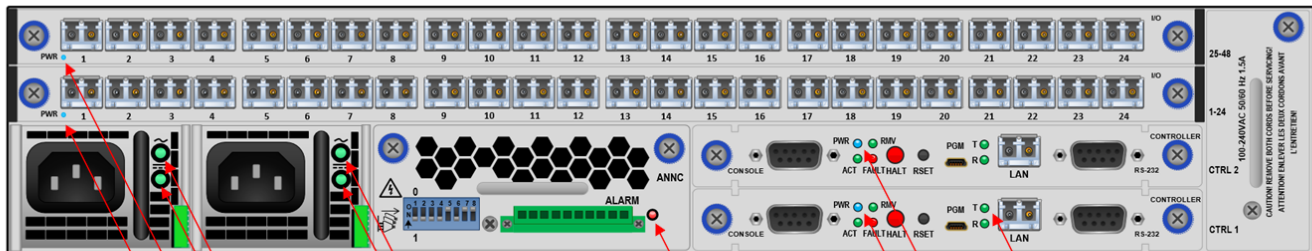
Refer to the **Quick Start Guide** included with your products for detailed instructions. The **TLX48 2RU Quick Start Guide** is also available in **Appendix A**, pg. [32].

Initialization

Once the system has been powered-up, look for the following between initialization and system-ready:

- The lower LEDs of each Power Supply will flash initially, then will become steadily ON.
- The PWR, RMV and FLT LEDs on both Controllers will be lit initially. Then PWR and ACT will be lit on the Primary and only PWR will be lit on the Back-up.
- Only the Primary Controller's connected LAN port LED(s) will be lit following initialization.
- The ALARM LED will be lit until initialization is complete.

PS1 LEDs, 12V Stand-by/Main: **ON Blue** PS2 LEDs, 12V Stand-by/Main: **ON Blue**



I/O Card 1 LED: ON Blue	PS1: Top LED: ON Green Lower LED: ON Green	PS2: Top LED: ON Green Lower LED: ON Green	Alarm LED: OFF Red	Ctrl 2 PWR LED: ON Blue Ctrl 1 PWR LED: ON Blue Primary ACT LED: ON Green	Primary Fiber-optic LAN: * SPEED T LED R LED 1G Green Green 100M Green OFF 10M OFF Green
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* These LED color codes do not adhere to the typical industry standard codes for Ethernet interfaces.

Alarm Condition

In the event of a persistent alarm condition (ALARM LED illuminated), check the following:

- Ensure the fans are running at full speed and there is adequate ventilation around the chassis.
- Ensure all modules are fully seated and their thumb screws secured.
- Check for I/O Card or Controller Card failures.
- All failure conditions send out notifications prior to shut-down. For a detailed list of the alarm functions, see *Alarm Descriptions for the TLX48 2RU* on pg. [11].

The TLX48 2RU records system events into files located in the directory `/var/log/`. To preserve log files, they can be redirected to another system(s). This is a standard feature of Linux's `rsyslog.d` program. Redirection is enabled by entries in `rsyslog` configuration files located in `/etc/rsyslog.d/`

Safely Remove an Active Control Card or Shut-down the System

During normal, non-maintenance operation, the **Primary Control Card (CTRL 1, lower card)** should always be the **Active controller for the system**. However, there may be times when other conditions temporarily exist, such as during maintenance, updates, repairs, etc.

Although the system will run normally on the Back-up Control Card, not having a second card eliminates the fail-over protection afforded by a redundant, two-card system.

The following commands allow the safe removal of a Control Card and the switch of activity from one Control Card to the other without interruption of connections



Note: During normal operation, the Primary Control Card (CTRL 1, lower card) should always be the active controller for the system.

During normal operation, the Primary or Back-up Controller can be managed via the console port or over an SSH connection.

The HALT Command

- Typing `halt` at the command line will perform an orderly shut-down of the active Control Card.
- Once the Control Card is inactive, it will stop signaling the other Control Card. This prompts the other card to become active. This typically takes just a few seconds.
- Remove any cables (LAN, RS-232, Console, etc.) from the inactive card. It can now be safely removed from the chassis. (See *next page*.)
- At this point, the system is now running on the Back-up Control Card.



Note: Re-inserting the Primary Control Card restores the system back to running on the Primary Control Card. Ensure that the LAN connection to the card is restored promptly.

The PWROFF Command

- Typing `pwroff` at the command line prompt, from either the Primary or the Back-up Control Card, will halt BOTH Control Cards and turn off the power to all the I/O Card slots in the system except the controllers.



Note: I/O card slot power cannot be turned off on the TLX48 2RU.

- Remove the AC power cord(s) from the Matrix Switch or from the AC source for a complete system shut-down.
- Remove any cables (LAN, RS-232, Console, etc.) from the Control Cards.
- The Control Cards can now be removed, swapped or replaced as needed. (See *next page*.)

Upon turn-on, the Control Card in the lower slot will become the Primary and the Card in the upper slot will be the Back-up.

The HALT Button

HALT (Primary Controller): In a TLX48 2RU with an operational Back-up Controller, holding this button for >5 seconds will halt the CPU (iMX6) and switch active control to the Back-up Controller. If the TLX48 does not have a Back-up Controller, holding this button for >5 seconds will halt the CPU and power-down the I/O Cards. Note that the RMV (**remove**) LED will be lit and the ACT (**active**) LED will not.

HALT (Back-up Controller): Holding this button for >5 seconds will halt the CPU (iMX6). If the Back-up Controller was the active controller, the TLX48 will also power-down the I/O Cards. If the Back-up Controller was not the active controller, the CPU will be halted and is ready to be removed. Note that the RMV (**remove**) LED will be lit and the ACT (**active**) LED will not.

How to Remove and Replace Modules

**! READ THE INSTRUCTIONS THOROUGHLY !
BEFORE STARTING ANY PROCEDURE!**

**! CAUTION! REMOVE BOTH CORDS BEFORE SERVICING! !
ATTENTION! ENLEVER LES DEUX CORDONS AVANT L'ENTRETIEN!**



WARNING! Replace modules only. Do not attempt to repair.
Please contact your dealer or *thinklogical* for qualified servicing.

**NO USER SERVICEABLE
PARTS INSIDE !**

How to Remove and Replace an Input / Output Card



Note: No shutdown is required prior to installing/replacing Input / Output Cards.

1. Remove any connected fiber-optic cables.
2. Turn the card's two thumbscrews counterclockwise until they disengage from the chassis. Pull the I/O Card straight out using both handles located at the outer edges of the module. **Do not pull on the thumbscrews when removing the module – damage may occur! Use the handles!**



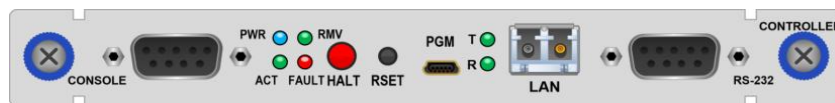
3. Grasp the replacement module by the handles and place it into the guide slots horizontally so that the POWER LED is on the left. The card should slide freely until it reaches the backplane connector. At this point, use just enough force to firmly engage the card with the mating connector. **If the module does not slide easily into the connector, do not force it! Damage may occur. Remove the card, realign it, and start over.** Hand-tighten the thumbscrews. **Do not tighten the thumbscrews with a screwdriver.**
4. Reinstall the fiber-optic cables.

How to Remove and Replace a Control Card



Note: When using a single Controller, the lower Controller slot is always Primary. Replacing the Primary Control Card will interrupt service if a Back-up Control Card is not installed.

1. Follow the shut-down procedure on the previous page. Remove any external cables.
2. Turn the card's two thumbscrews counterclockwise until they disengage from the chassis. Pull the Control Card straight out using both blue thumbscrew knobs.



3. Grasp the replacement module by the blue knobs and place it into the guide slots horizontally with the Console Port on the left. The card should slide freely until it reaches the backplane connector. At this point, use just enough force to firmly engage the card with the mating connector. **If the module does not slide easily into the connector, do not force it! Damage may occur. Remove the card, realign it, and start over.** Hand-tighten the thumbscrews. **Do not tighten the thumbscrews with a screwdriver.**
4. Reinstall the external cables.

How to Remove and Replace a Fan Tray

The TLX48 2RU uses three DC fans to move air horizontally through the enclosure. Always replace a failed Fan Tray immediately. *Do not allow the unit to run for more than 90 seconds before installing a working Fan Tray.* Be sure to not block the air vents on the sides of the unit and leave at least 2" of space on both sides.



Note: No shutdown is required prior to replacing the Fan Tray.

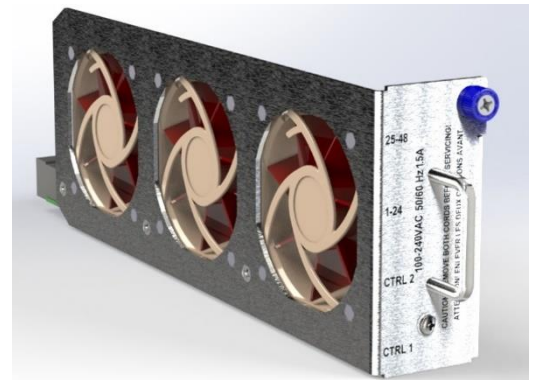


Warning! Do not operate the unit without a Fan Tray installed for more than 90 seconds.



Note: Leave adequate ventilation space on both sides of the units (2" minimum), especially if devices are being stacked above or below the TLX48 2RU.

1. Turn the thumbscrew counter-clockwise until it disengages from the chassis.
2. Pull the Fan Tray straight out using the handle.
3. Hold the replacement Fan Tray by the handle and slide the aluminum housing into the upper and lower card guides until it reaches the backplane connector. At this point, use just enough force to firmly engage the tray with the mating connector. **If the tray does not slide easily into the connector, do not force it! Damage may occur. Remove the tray, realign it, and start over.**
4. Hand-tighten the thumbscrew. **Do not tighten the thumb-screw with a screwdriver.**



How to Remove and Replace a Power Supply



Warning! Disconnect the module's power cord before proceeding!



Note: If only **ONE** power supply is installed in the chassis, shutdown **IS** required. If **TWO** power supplies are installed, shutdown **IS NOT** required.

The Power Supply modules are universal input 100-240VAC, 50-60Hz. Use the proper power cords for your region (US domestic PWR-000006-R supplied with the unit). Although the Switch functions properly with one Power Supply, it is recommended that the Primary and Back-up Control Cards be connected to two independent power sources for redundancy. The supply on the left is designated PS1. The inner supply is PS2.

1. Press and hold the green latch-lever toward the handle to release the module.
2. Pull the module straight out of the chassis by the handle.
3. Insert the new Power Supply module into the chassis and slide it in until it reaches the backplane connector. At this point, use just enough force to firmly engage the module with the mating connector and click the latch into place. **If the module does not slide easily into the connector, do not force it! Damage may occur. Remove the module, realign it, and start over.**

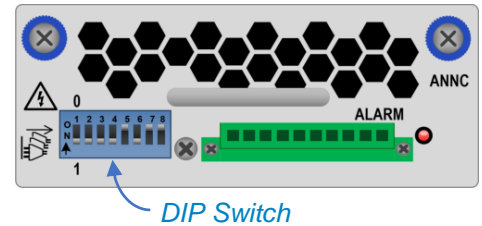


How to Remove and Replace an Annunciator Module



Note: No shutdown is required prior to installing/replacing the Annunciator Module.

1. Remove any external connections (alarm).
2. Turn the module's two thumbscrews counterclockwise until they disengage from the chassis. Pull the module straight out using the handle. **Do not pull on the thumbscrews when removing the module – damage may occur! Use the handle!**
3. Before installing a replacement Annunciator Module, **ensure that the DIP Switch settings on the new module match the settings on the module being replaced** or are set for desired new settings.



Note: Ensure the DIP Switch settings on the replacement Annunciator Module match the settings on the removed Annunciator Module or are set for desired new settings.

4. Grasp the replacement module by the handle and place it into the guide slots horizontally so that the DIP Switch is on the left. The module should slide freely until it reaches the backplane connector. At this point, use just enough force to firmly engage the module with the mating connector. **If the module does not slide easily into the connector, do not force it! Damage may occur. Remove the module, realign it, and start over.** Hand-tighten the thumbscrews. **Do not tighten the thumbscrews with a screwdriver.**
5. Reinstall external connections.

Ordering Information

Part numbers for the various components of the TLX48 2RU Matrix Switch are as follows:

Part Number

Options

TLX48 2RU Matrix Switch Chassis

- TLX-MSC-020048** TLX48 2RU Matrix Switch Chassis, 48 port max, 1 Ctrl Card/RJ45 LAN
TLX-MSC-02M048 TLX48 2RU Matrix Switch Chassis, 48 port max, 1 Ctrl Card/Multi-Mode LAN

TLX48 2RU Matrix Switch Data Input/Output Modules

- TLX-MSD-M00024** TLX Matrix Switch Data Input/Output Card 24 Multi-Mode Fiber Ports 10G
TLX-MSD-S00024 TLX Matrix Switch Data Input/Output Card 24 Single-Mode Fiber Ports 10G
TLX-MSD-MV0024 TLX Matrix Switch Data Input/Output Card 24 Multi-Mode Fiber Ports 6G
TLX-MSD-SV0024 TLX Matrix Switch Data Input/Output Card 24 Single-Mode Fiber Ports 6G
TLX-MSD-000024 TLX Matrix Switch Data Input/Output Card unpopulated for up to 24 Multi- or Single-Mode Fibers, 10G or 6G SFP+ Modules

TLX48 2RU Matrix Switch Controller Card

- TLX-MSM-C20048** TLX48 2RU Matrix Switch Module, Controller Card/RJ45 LAN Port
TLX-MSM-C2M048 TLX48 2RU Matrix Switch Module, Controller Card/Multi-Mode LAN Port

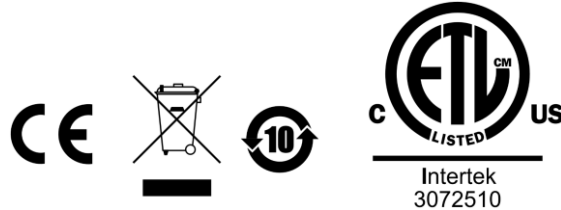
TLX48 2RU Matrix Switch Spare Modules

- TLX-MSM-F20048** TLX48 2RU Matrix Switch Module Fan Tray
TLX-MSM-P20048 TLX48 2RU Matrix Switch Module Power Supply
TLX-MSA-200048 TLX48 2RU Matrix Switch Annunciator Module

Section 3: Regulatory & Safety Requirements

Symbols Found on Our Products

Markings and labels on our products follow industry-standard conventions. Regulatory markings found on our products comply with all required domestic and many international requirements.



Regulatory Compliance

Thinklogical's® products are designed and made in the U.S.A. These products have been evaluated by a certified testing laboratory and found compliant with the following standards for both domestic USA and many international locations:

North America

Safety

UL 62368-1:2014Ed.2

CSA C22.2#62368-1:2014Ed.2

LASER Safety

CDRH 21 CFR 1040.10

Class 1 LASER Product

Canadian Radiation Emitting Devices Act, REDR C1370

IEC 60825:2001 Parts 1 and 2

Class 1 LASER Product

Electromagnetic Interference

FCC 47CFR Part 15 Subpart B: 2013 Class A

Industry Canada ICES-003: 2016 Ed. 6

Australia & New Zealand

This is a Class A product. In a domestic environment this product may cause radio interference, in which case the responsible party may be required to take corrective action.

European Union

Declaration of Conformity

Manufacturer's Name & Address:

Thinklogical, A BELDEN BRAND
100 Washington Street
Milford, Connecticut 06460 USA

Thinklogical's products comply with the requirements of the Low Voltage Directive 2006/95/EC, the EMC Directive 2004/108/EC, the RoHS Directive 2011/65/EU, the WEEE Directive 2012/19/EU and carry the CE marking accordingly.

Standards with Which Our Products Comply

Safety

IEC 62368-1:2014Ed.2+C1

CB Scheme Certificate

Electromagnetic Emissions

CENELEC EN 55022:2010 +AC:2011

Electromagnetic Immunity

EN 55024:2011+A1

CENELEC EN 55032:2015

EN 61000-3-2:2000 Harmonics

EN 61000-3-3:2008 Flicker

EN 61000-4-2:2009 Electro-Static Discharge Test

EN 61000-4-3:2006 A1:2008, A2:2010 Radiated Immunity Field Test

EN 61000-4-4:2004 Electrical Fast Transient Test

EN 61000-4-5:2006 Power Supply Surge Test

EN 61000-4-6:2009 Conducted Immunity Test

EN 61000-4-11:2004 Voltage Dips & Interruptions Test

Supplementary Information

The following statements may be appropriate for certain geographical regions and might not apply to your location:

- This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations. *Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.*
- This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the responsible party may be required to take corrective action.
- This equipment has been tested and found compliant with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications in which case the responsible party may be required to make adequate corrective measures at their own expense.
- This Class A digital apparatus complies with Canadian ICES-003 and has been verified as compliant within the Class A limits of the FCC Radio Frequency Device Rules (FCC Title 47, Part 15, Subpart B Class A), measured to CISPR 22:1993 limits and methods of measurement of Radio Disturbance Characteristics of Information Technology Equipment.
- The user may notice degraded audio performance in the presence of electro-magnetic fields.
- The customer shall verify that this product meets the appropriate national/regional requirements if those requirements for conducted/radiated electromagnetic emissions fall outside the scope of testing currently performed on this product.

Section 4: Thinklogical Support

Sales Support

Please contact our expert sales staff in Milford, CT **Monday-Friday from 8:30am to 5:00pm**, Eastern Time Zone. If leaving a voice message, please provide a preferred time to call back.

- **Telephone:** 1-203-647-8700 or 1-800-291-3211
- **Fax:** 1-203-783-9949

Customer Support

- **Website:** <https://www.thinklogical.com>

Check out our website for current products, support documents and useful information about all the products and services we offer, including:

- **Technical Specification Sheets**
- **Quick-Start Guides**
- **Product Manuals** (for viewing online or for download)
- **Chat live** with a Customer Service Representative.

Technical Support

For product support, technical issues/questions, product repairs or request for Return Merchandise Authorization, use any of the following methods:

- **Email:** support@thinklogical.com
- **Telephone:** 1-203-647-8700 or 1-800-291-3211
- **Fax:** 1-203-783-9949
Please specify the issue on your fax cover sheet and please provide contact information.
- **Website:** <https://www.thinklogical.com> **Chat live** with a Customer Service Representative.

Product Support

Warranty

Thinklogical warrants this product against defects in materials and workmanship for a period of one year from the date of delivery, with longer terms available at the time of purchase on most products. Thinklogical and its suppliers disclaim all other warranties. Please refer to your product invoice for the Warranty Terms & Conditions.

Defect remedy shall be the repair or replacement of the product, provided that the defective product is returned to the authorized dealer within a year from the date of delivery.

If you wish to return your device, contact the Thinklogical-authorized dealer where you purchased the device, or if you purchased directly, call Thinklogical at **1-203-647-8700** or **1-800-291-3211**.

Return Authorization

If you must return a product to Thinklogical directly, please call us and let us know. Customer Support will ask you to describe the issue and will provide you with a **Return Merchandise Authorization number** (RMA#). Pack the device in its original box, if possible, and return it with the RMA# printed on the outside of the box. **DO NOT return a product to Thinklogical without a *Return Merchandise Authorization*.**

Our Address

For any product issues or questions, or for technical assistance, please call us and let us help. If you need to write us or return a product, please use the following address:

Please include the Return Merchandise Authorization number: **Thinklogical, A BELDEN BRAND**
100 Washington Street
Milford, CT 06460 USA
Attn: RMA#

APPENDIX A: TLX48 2RU Quick Start Guide

QUICK-START GUIDE TLX48 2RU 6G/10G MATRIX SWITCH

Thinklogical's TLX48 2RU 10G Matrix Switch features redundant Power Supplies and Controller Modules for uninterrupted performance, even during system reconfiguration, updates or debug. The TLX48 remains fully functional with only one Power Supply installed or with one Controller activated.
NOTE: When using a single Controller, the lower module (CTRL 1) must be used.

With VQM-HA6, VQM-10A-V4, VQM-U1 and TLX-D20 Transmitter & Receiver Modules

MATRIX SWITCH:
STEP 7: Connect the TLX48 Controller Cards' LAN Ports to your Controller CPU with fiber-optic (or optional CAT5) cables. (CPU IP address: 192.168.13.9)

STEP 8: (Final Step) Connect the supplied AC Power Cords (PWR-000006-R) to the receptacles located on the TLX48's power supplies. Plug each of them into a standard AC source. Verify that all system functions are operating properly.

Fiber Optic Cables:

- K1: Data TX to RX
- K2: Data RX to TX
- L1: Data TX to RX & Video
- L2: Data RX to TX

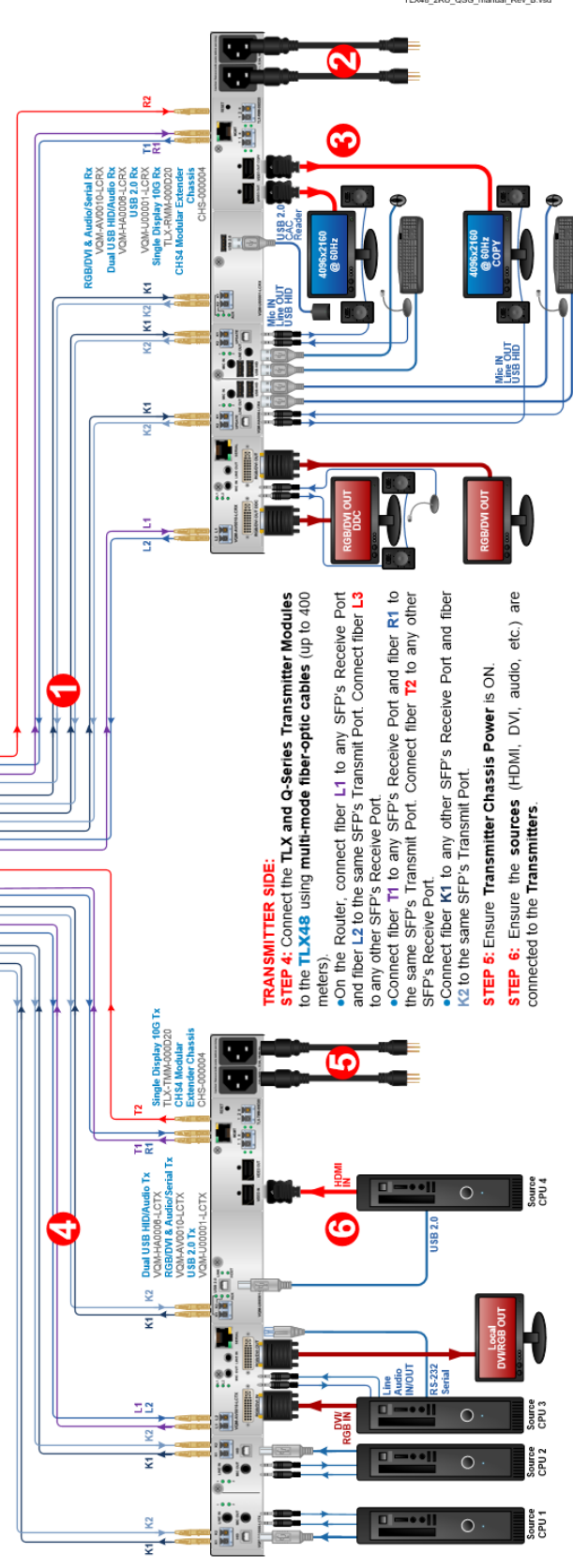
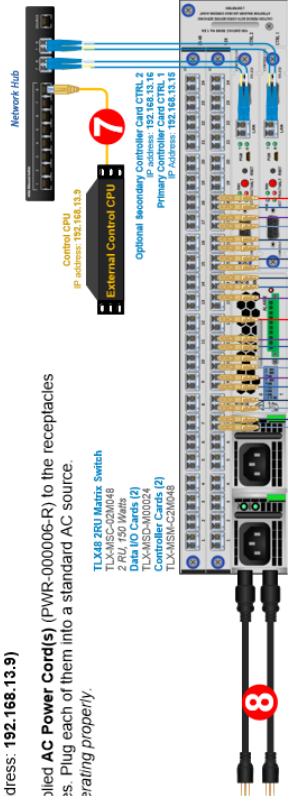
- 1: Video 4096x2160 @ 60HZ
- T1 to R1: Video & Data TX to RX
- R1 to T1: Data RX to TX
- T2 to R2: Video TX to RX

RECEIVER SIDE:
STEP 1: Connect the TLX and Q-Series Receivers to the TLX48 using multi-mode fiber-optic cables (up to 400 meters).

- On the Matrix Switch, connect fiber L1 to any SFP's Transmit Port and fiber L2 to the same SFP's Receive Port. Connect fiber L3 to any other SFP's Transmit Port.
- Connect fiber R1 to any SFP's Transmit Port and fiber T1 to the same SFP's Receive Port. Connect fiber R2 to any other SFP's Transmit Port.
- Connect fiber K1 to any other SFP's Transmit Port and fiber K2 to the same SFP's Receive Port.

STEP 2: Ensure Receiver Chassis Power is ON.

STEP 3: Ensure the peripheral devices (monitors, audio, USB, etc.) are connected to the Receivers.



TRANSMITTER SIDE:
STEP 4: Connect the TLX and Q-Series Transmitter Modules to the TLX48 using multi-mode fiber-optic cables (up to 400 meters).

- On the Router, connect fiber L1 to any SFP's Receive Port and fiber L2 to the same SFP's Transmit Port. Connect fiber L3 to any other SFP's Receive Port.
- Connect fiber T1 to any SFP's Receive Port and fiber R1 to the same SFP's Transmit Port. Connect fiber T2 to any other SFP's Receive Port.
- Connect fiber K1 to any other SFP's Receive Port and fiber K2 to the same SFP's Transmit Port.

STEP 5: Ensure Transmitter Chassis Power is ON.

STEP 6: Ensure the sources (HDMI, DVI, audio, etc.) are connected to the Transmitters.

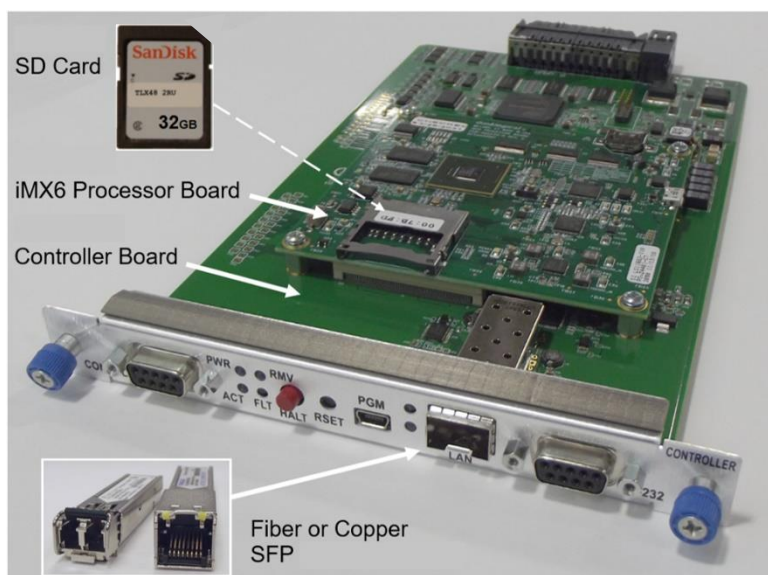
APPENDIX B: SD Card Replacement for TLX48 2RU Controller Cards

This procedure assumes a normally operating TLX system that is using both a Primary and a Back-up Controller Card.



Note: If Partition, Restricted Switching or P2P Mode is being used, copy the `upstream.csv` file from the appropriate `/var/local/router` subdirectory. This file will be copied onto the new SD card.

1. Connect a Linux Command Line Interface serial cable to the Controller Card via the serial CONSOLE port. Datacomm parameters are: 115200, 8, N, 1, None.
2. Connect a Linux Command Line Interface serial cable to the Back-up Controller Card via the serial CONSOLE port and issue a `poweroff` command. Wait until the ACTIVE LED goes off.
3. Remove the Back-up Controller and replace the SD card. (See *instruction, below.*)
4. Install the Back-up Controller Card into the chassis with a CONSOLE serial connection. Do not connect the network cable.
5. When the card boots up, then verify the IP settings with the `ipconfig` utility.
6. Check the 'date/time/timezone' with a `date` command.*
7. Perform other site-specific operations as necessary (*password, NTP, etc.*).
8. Issue a reboot command.
9. When `reboot` is ready, connect the network cable to the back-up controller card and wait 10 seconds.
10. Unplug the network cable from the Primary Controller Card.
11. After 20 seconds the system will fail-over to the Back-up Controller Card and the ACTIVE LED on the Back-up will come ON. On the Primary the ACTIVE LED will be OFF and the FAULT LED will be ON.
12. Verify the Back-up Controller's function by performing a switching operation.
13. On the primary controller, issue a `poweroff` command. When the ACTIVE LED goes off, pull the Controller out and replace the SD card. (See *instruction, below.*)
14. Install the Primary Controller with the serial cable only. Do not connect the network cable.
15. When the Controller Card boots up, check the IP settings with the `ipconfig` utility and make any needed changes.
16. Check the 'date/time/time zone' with a `date` command.*
17. Perform other site-specific operations as necessary (*password, NTP, etc.*).
18. Connect the network cable to the Primary Controller.
19. Reboot the Primary Controller Card. The system will fail-over to the Back-up Controller Card and the ACTIVE LED on the Back-up will come ON.
20. Verify the Primary Controller's function by performing a switching operation.



Remove an installed SD Card:

1. Gently press in on the top of the installed SD Card to release the spring latch.
2. Once released, pull the card straight out of the receptacle.
3. See next page for proper packing & shipping.

Install an SD Card:

1. Gently insert the Card into the receptacle and press in until the latch catches.
2. Release the Card. It is now locked into the receptacle.

*To check and change the 'date, time & time zone,' see next page.

Packaging and Shipping of SD Cards

Special precautions are necessary for shipping EAL4 (Evaluation Assurance Level) Certified Products such as programmed SD Cards. EAL4 is an international standard which certifies an IT product following the completion of a Common Criteria security evaluation. Any shipments containing EAL4 certified SD Cards are required to use a **Security Bag for shipment of SD Cards**.

This specially designed bag is used to securely seal and protect EAL4 certified memory cards. The Security Bag has a self-sealing closure, contains a unique alphanumeric serial number with barcode and a has receipt for tracking purposes. Each bag uses visible void graphics to identify any tampering.



Security Bag for shipment of SD Cards

When shipping the SD Card, the instructions on the bag explain how to use the tear-away tab containing the serial number and send it to the customer separately. When the customer receives the shipment, they can match it to the tab and verify that the Security Bag has not been tampered with.

Set or Change the Date, Time and Time Zone

Having the clocks set on system devices ensures that the log entries will have accurate timestamps if the system needs troubleshooting or the logs need to be examined.

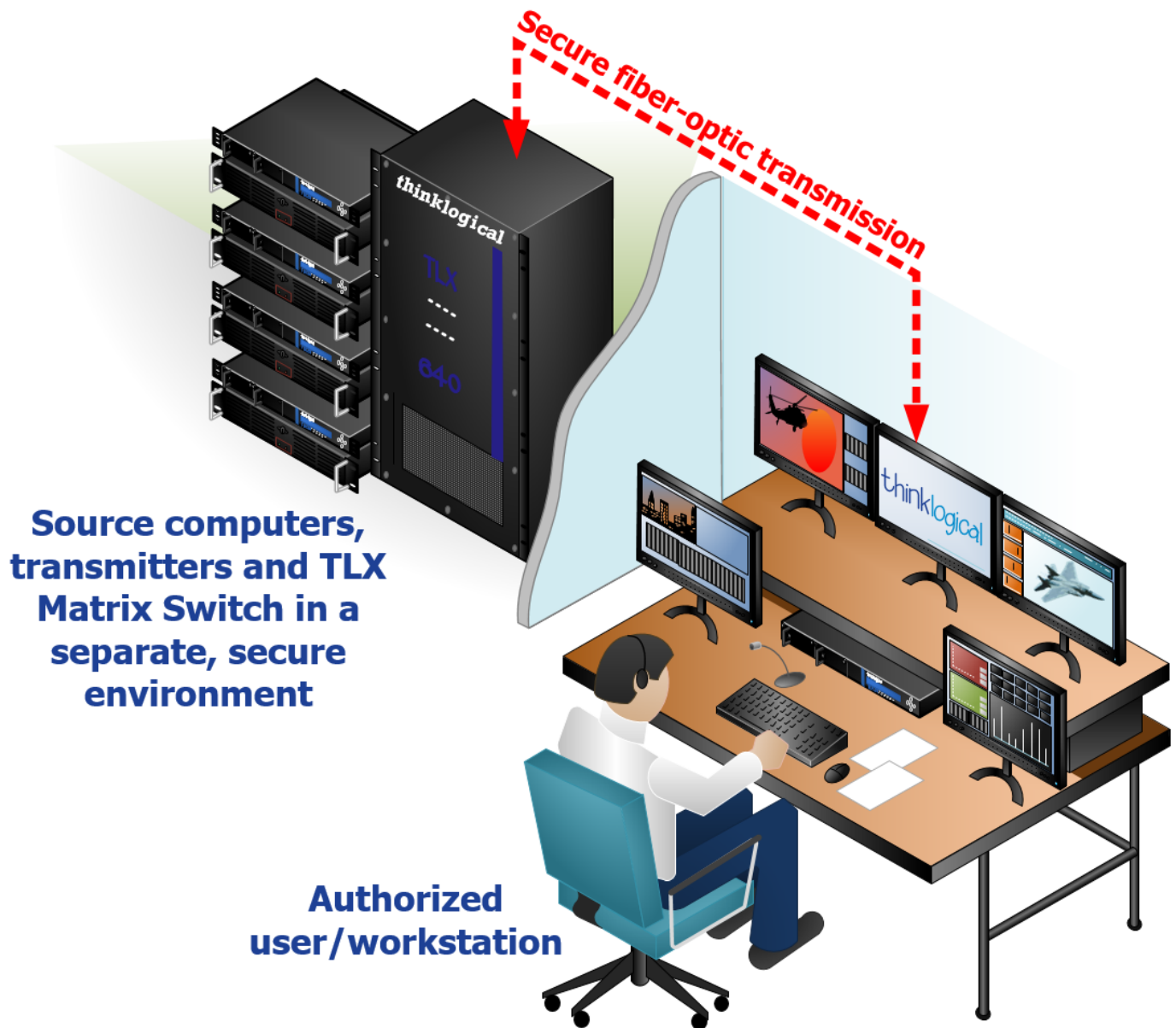
1. Log into the device as **root**.
2. Check the date, time and time zone by issuing a **“date”** command.
3. To change the time zone, issue a **“timedatectl set-timezone UTC”** command (for example). For a list of available time zones, issue a **“timedatectl list-timezones”** command.
4. To set the date and time, issue the command in the format **“date mmddhhmmyy”** for month, day, hour, minute, year. For example: **“date 0503163823”** will set the module for **May 3, 4:38PM, 2023**. This sets the Linux clock. However, this will be lost after repowering the unit.
5. Check the date, time and time zone again to verify that it is correct.
6. Set the permanent hardware clock with the following command: **“hwclock --systohc”**. *Note that there is a space and double hyphen between the parameters.* When Linux boots it will read the H/W clock correctly.

Verify the date & time setting after configuring it. Accidentally changing the date too far in the past will prevent Linux from booting at all. If this happens, remove and replace the RTC battery to reset the date/time to a known state, then correct it.

APPENDIX C: Secure Applications

TLX Matrix Switch Control

Matrix Switches and External Computers (servers) used to manage the system must be in a physically secure environment to which only trusted Administrators and Operators have access. Similarly, the server used to manage the Matrix Switch must be physically protected and have suitable identification/authentication mechanisms to ensure that only a trusted Administrator has access. The roles of authorized-access personnel are defined on pg. [22].



Note: CATx Matrix Switching applications do not offer an EAL4 rated level of security. CATx is not available with the TLX48 2RU, TLX80, TLX160, TLX640 or TLX1280.

Administration Access

There are two methods by which the Administrator can access the Switch Controller Configurations:

- 2) **The Serial Console is directly connected to the Switch.** Because an administrator password is required to use the Serial Console, physical access to the Switch is required. Therefore, the Switch should be stored in a physically secure location to avoid unauthorized access.
- 3) **SSH access.** The Switch allows SSH connections to the Switch for management purposes. SSH sessions are authenticated using an encrypted password file.

sudo superuser security privileges

The system comes preconfigured with user 'centos' as part of the sudo group. This allows the 'centos' user to escalate their security privileges to 'root' without being an authorized administrator.



Note: To ensure that only 'root' has sudo superuser security privileges, it is recommended that the system administrator remove the default user 'centos' from the wheel group.

To check that 'centos' has sudo superuser security privileges, the administrator should do the following:

- Enter: `cat /etc/group | grep wheel`
- Confirm response: `wheel:x:10:centos`

To ensure that only 'root' has sudo superuser security privileges, the administrator should do the following:

- To remove users, issue the following command at the command line: `gpasswd -d centos wheel`
- Confirm the command line response: `removing user centos from group wheel`
- To verify centos is no longer in group wheel, issue the following command at the command line: `cat /etc/group | grep wheel`
- To confirm the command line response: `wheel:x:10:`

Password Security

For security purposes, the Switch defaults to using the Message-Digest Algorithm (MD5) and shadow passwords. **It is highly recommended that you DO NOT alter these settings.** If you select the older Data Encryption Standard (DES) format, passwords will be limited to eight alphanumeric characters (disallowing punctuation and other special characters) with a modest 56-bit level of encryption. **The single most important thing you can do to protect the Switch is create a strong password.**

Creating Strong Passwords:

The password can contain up to 127 characters and cannot contain a space.

MAKE THE PASSWORD AT LEAST EIGHT CHARACTERS LONG. The longer the password, the more effective it will be. If you are using an MD5 password, it should be approximately 15 characters long. With DES passwords, use the maximum eight-character length.

Mix UPper AnD lowER CASE LETTERS. Passwords are case sensitive, so mixing will multiply the number of available combinations.

Mix LETTER5 AND NUM8ER5 within the password to enhance its strength.

Include NON-ALPHANUMERIC CHARACTER\$. Special characters (& # % >) and punctuation marks (? " - !) increase the strength of a password.

Modes of Operation

Thinklogical's TLX, VX and MX Matrix Switches support four modes of operation that provide the Administrator with additional capabilities to configure the switch's security. These are **Restricted Switching, Partitioning, Point-to-Point (P2P) and Restore Modes.** *These methods can be deployed singularly or jointly, depending on security requirements.*

These four modes are described in the following pages.

Restricted Switching Mode

Restricted Switching Mode provides multiple levels of security classification domains on the same **Matrix Switch**. Each destination must ensure that no unauthorized content is displayed or accessed. Therefore, every input and output must be prioritized. Priorities can range from 1 to the total number of ports in the Matrix Switch. An output can connect to an input with a priority greater than, or equal to, its own. Thus, a priority level of 1 on an output can connect to any input (priority 1, 2, 3...).

The Administrator must provide a table defining the priorities for each input and output of the switch matrix. This table is in the form of a comma separated value (csv) file. This file contains the values in three columns: **Port Direction** (i=input, o=output), **Port Number** and **Port Priority**. For example:

"i",	1,	1	
"i",	2,	2	
"i",	3,	3	Output 1 can connect to ports 1-5.
"i",	4,	1	Output 2 can connect to ports 3 and 5.
"i",	5,	3	Output 3 can connect to ports 2, 3, and 5.
"o",	1,	1	Output 4 cannot connect to any ports.
"o",	2,	3	Output 5 can connect to ports 1-5.
"o",	3,	2	
"o",	4,	4	
"o",	5,	1	

Note that Port Direction (i or o) is in quotes and that the table must use only the following ASCII printable characters:

Double quotes (or speech marks)	character code = 34	(")
Lower case i	character code = 105	(i)
Lower case o	character code = 111	(o)
Comma	character code = 44	(,)
Carriage Return	character code = 13	(CR)
Line Feed	character code = 10	(LF)



Note: Any input or output ports not listed in the `upstream.csv` file will default to a priority of 1. Thus, outputs not listed in the file will have access to priority 1 inputs both listed and unlisted in the `upstream.csv` file.

The Restricted Switching Table file is stored on the Controller Card at:

`/var/local/router/restrict/upstream.csv`

To verify that the `upstream.csv` file has been detected by the system, the Administrator must run `tlxid` by issuing the following commands:

```
su
root
tlxid
```

If the `upstream.csv` file is found, the screen will indicate `restricted switching file found`

If the `upstream.csv` file is not found, the screen will indicate `restricted switching file not found`.

At system power-up, after initial boot-up, the **Primary Controller Card** will only evaluate its Restricted Switching Table (`upstream.csv` file) once upon becoming active. The **Back-Up Controller Card** will NOT evaluate its Restricted Switching Table (`upstream.csv` file) at initial boot-up, but it will when a switchover occurs from Primary Active to Back-Up Active.

If an `upstream.csv` file is found, a log entry is made to the `tlxcntl.log`:

```
imxswitch tlxcntl[612]: Restrictive switching ENABLED
```

If no file is found, then the following log entry is made:

```
imxswitch tlxcntl[612]: No such file or directory, /var/local/router/restrict/upstream.csv
```

```
imxswitch tlxcntl[612]: Restrictive switching DISABLED
```

The inactive Back-Up Controller Card will not verify its Restricted Switching Table (**upstream.csv** file), so it will not log error messages with current time stamp entries until it becomes active. Also, any errors that occur during the Restricted Switching Table evaluation process will be logged in the `/var/log/errors.log` file as follows:

```
imxswitch t1xcntl[606]: error /var/local/router/restrict/upstream.csv field 3 on line 1 is invalid
```

Note that the example above shows an invalid character entry in the third column of the first line in the **upstream.csv** file.

For access to the **errors.log** file via SSH, refer to *The Network Interfaces* section of this document on pg. [9] for correct IP addresses of Controller Cards when in Primary Active or Back-Up Active mode.



Note: The System Administrator must review the `errors.log` file each time an `upstream.csv` file is changed and immediately correct any reported errors.

To verify the system's **Restricted Switching policy**, Thinklogical recommends the following:

- 1) Review the **t1xcntl.log** as well as the **errors.log** file on the active Controller Card and correct any errors in the Restricted Switching Table before implementing multiple levels of security classification domains on the same Matrix Switch.
- 2) Fully verify the **Restricted Switching** on the active Primary Controller Card before implementing multiple levels of security classification domains on the same Matrix Switch.
- 3) In a redundant system, make the Back-Up Controller Card active by disconnecting the LAN cable from the Primary Controller Card's LAN port. The Back-Up Controller Card, upon becoming active, will evaluate its Restricted Switching Table. Check the **t1xcntl.log** as well as the **errors.log** file on the Back-Up Controller Card for any errors in the Restricted Switching Table and correct them before implementing multiple levels of security classification domains on the same Matrix Switch using the Back-Up Controller Card.
- 4) Fully verify the Back-Up Controller Card's **Restricted Switching** before implementing multiple levels of security classification domains on the same Matrix Switch.

There are cases where updates to the Restricted Switching Table must be made in an active system. The following method can be used when an update is made to the table, the Controller will not evaluate the updated table until the following procedures are followed:

- When updates are made to the Restricted Switching Table in a **non-redundant system**, Thinklogical recommends the following: (**★ This procedure WILL be disruptive to system connections!**)
 - 1) Update the Restricted Switching Table of the Primary Controller Card.
 - 2) Take the Primary Controller Card out of service by following guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [25].
 - 3) Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure WILL be disruptive to system connections.

- When updates are made to the Restricted Switching Table in a **redundant system**, Thinklogical recommends the following (*This procedure will NOT be disruptive to system connections*):
 - 1) Update the Restricted Switching Table of the inactive Back-Up Controller Card.
 - 2) Take the Primary Controller Card out of service by following guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [25]. This will cause the Back-Up Controller Card to become active and evaluate its Restricted Switching Table.
 - 3) Update the Restricted Switching Table of the inactive Primary Controller Card with the same table used for the Back-Up Controller Card.
 - 4) Extract and re-insert the Primary Controller Card back into the chassis to cause the system to make the Primary Controller Card the active controller and begin using the updated Restrict Switching Table. Ensure that the LAN connection to the Primary Controller Card is restored promptly.

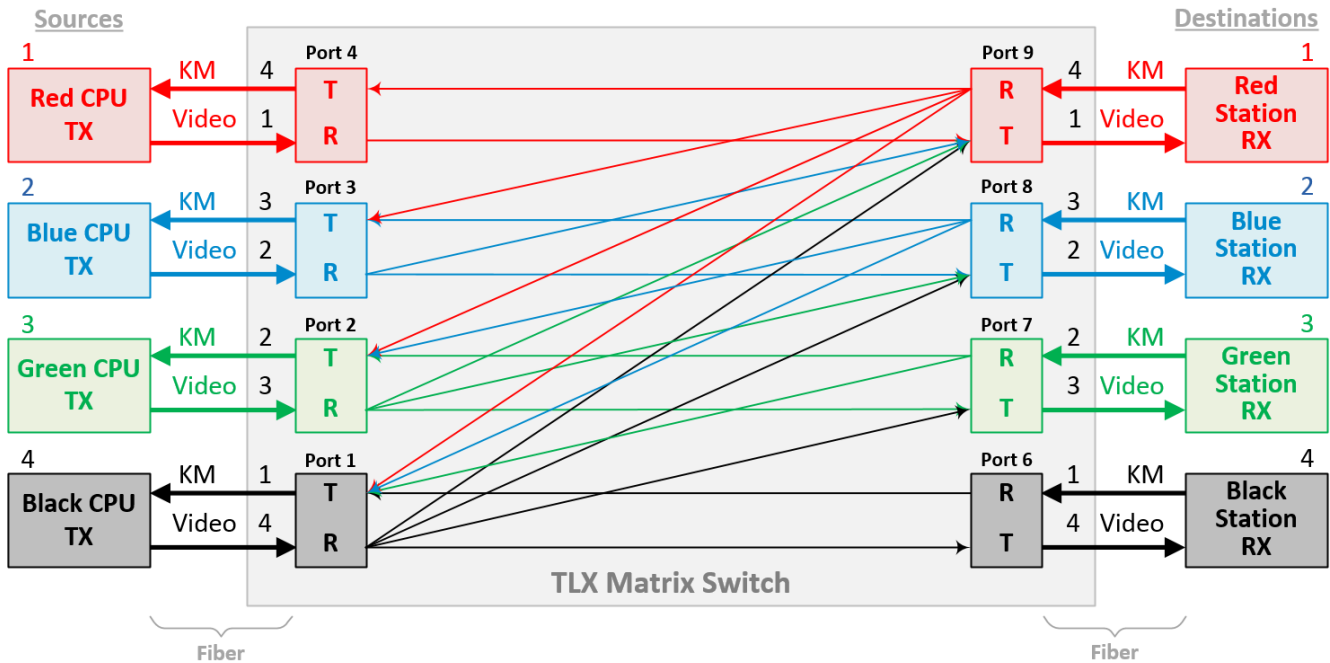


Note: When using a Back-Up Controller configuration, both controllers must have the same Restricted Switching Table file(s) to maintain the security of the system.

Restricted Switching mode is disabled when the Restricted Switching Table file is removed. By default, when there is no Restricted Switching Table file, all input and output ports will have a priority of 1. All Switches are shipped without a Restricted Switching Table file stored on the Controller Card and therefore do not restrict any connection.

Restricted Switching Priority Scheme with TLX, VX and MX Matrix Switches

The following example shows a **priority scheme** for four levels of security managed by one TLX Matrix Switch:



VIDEO:

Destination Workstation Network

- RED
- BLUE
- GREEN
- BLACK

Source Computer Network Transmissions That Can Be Seen

- BLACK, GREEN, BLUE, RED
- BLACK, GREEN, BLUE
- BLACK, GREEN
- BLACK

KEYBOARD/MOUSE:

Destination Workstation Network

- RED
- BLUE
- GREEN
- BLACK

Source Computer Networks That Can Be Controlled

- BLACK, GREEN, BLUE, RED
- BLACK, GREEN, BLUE
- BLACK, GREEN
- BLACK

"i"	1	4
"i"	2	3
"i"	3	2
"i"	4	1
"i"	6	1
"i"	7	2
"i"	8	3
"i"	9	4
"o"	1	1
"o"	2	2
"o"	3	3
"o"	4	4
"o"	6	4
"o"	7	3
"o"	8	2
"o"	9	1

Restricted switching is configured via an **upstream.csv** file loaded into the Matrix Switch. The configuration file for this scenario will appear like the table at right, with values in three columns:

Port Direction (i=input, o=output), **Port Number** and **Port Priority**. →

Partition Mode

Partitions allow TLX, VX and MX Matrix Switch sources and destinations to be segregated. Therefore, destination workstations will only receive signals that are transmitted from source computers in the same partition. In addition, it is impossible for a source computer to be inadvertently routed outside of its designated partition as the signals will not be transmitted.

The Administrator must provide a table defining the partitions required in the Matrix Switch. This table is in the form of a **Comma Separated Value (CSV)** file. This file contains the port number and the partition number to which it belongs.

Example:

"Port", "Partition"	
1, 2	Port 1 is part of Partition 2
2, 2	Port 2 is part of Partition 2
3, 2	Port 3 is part of Partition 2
4, 2,3	Port 4 is part of Partition 2 and 3
5, 3	Port 5 is part of Partition 3

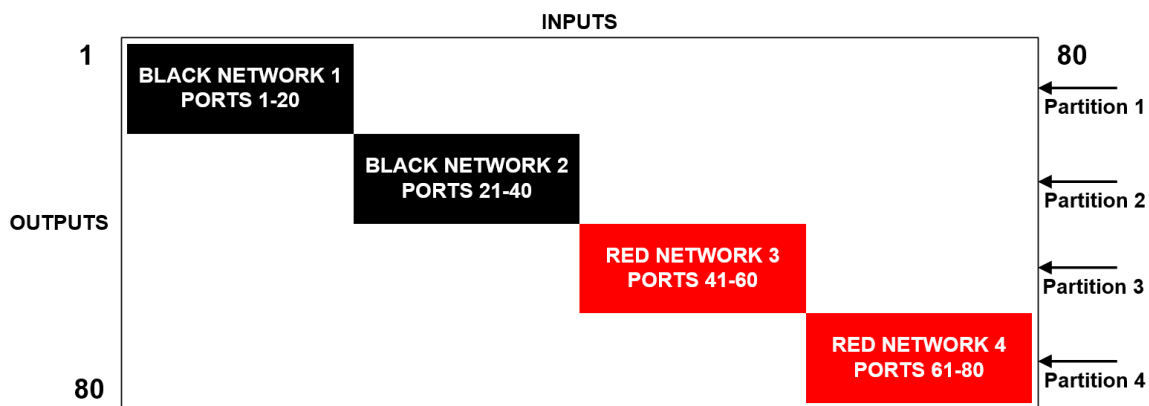
Note that the table uses only the following ASCII printable characters:

Double quotes (or speech marks)	character code = 34	(")
Comma	character code = 44	(,)
Carriage Return	character code = 13	(CR)
Line Feed	character code = 10	(LF)



Note: All ports not listed in the `upstream.csv` file will default to partition 1. Thus, any ports not listed in the file will have access to priority 1 inputs both listed and unlisted in the `upstream.csv` file.

Detailed Example: TLX80 Matrix Switch with four distinct partitions:

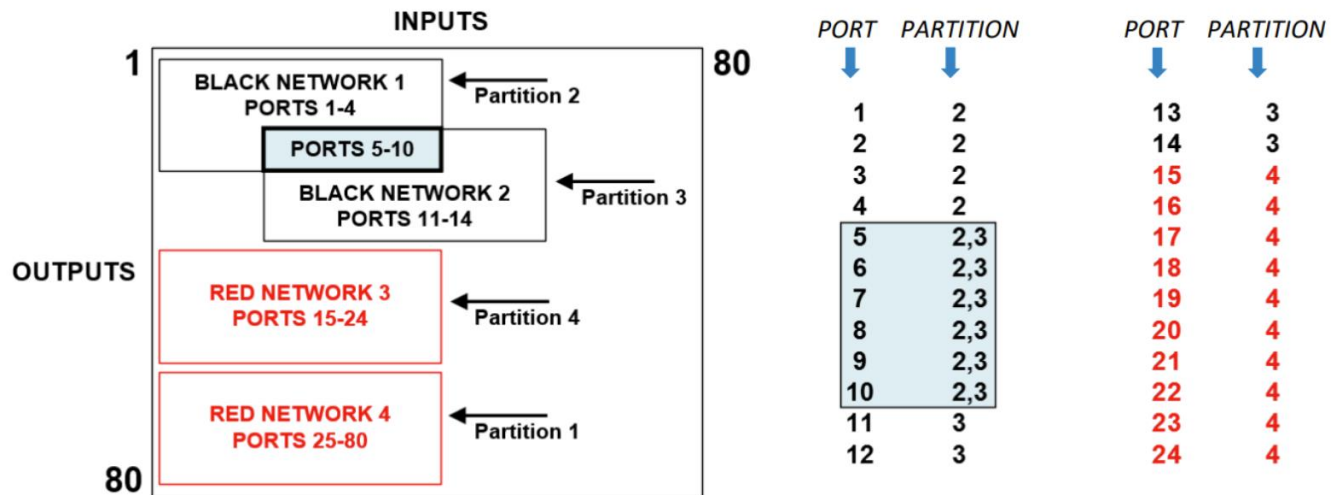


Four partitions set up for secure routing and extension applications. Signals are only capable of transmitting and receiving within a single partition and not across partitions

The maximum number of partitions is the number of ports that make up the Switch (12-1280). A TLX80, for example, can be configured with up to 80 partitions, a TLX160 with up to 160, and so forth. There are also overlapping partition configurations.

A TLX80 with four partitions: Ports 5-10 are accessible to both partitions 2 and 3.

The following example shows a TLX80 Switch with an overlapping partition:



The Partition Table file is stored on the Controller Card at:

[/var/local/router/partition/upstream.csv](#)

To verify that the **upstream.csv** file has been detected by the system, the Administrator must run **tlxid** by issuing the following commands:

```
su
root
tlxid
```

If the **upstream.csv** file is found, the screen will indicate **partitioning file found**

If the **upstream.csv** file is not found, the screen will indicate **partitioning file not found**.

At system power-up, after initial boot-up, the **Primary Controller Card** will only evaluate its Partition Table (**upstream.csv** file) once upon becoming active. The **Back-Up Controller Card** will NOT evaluate its Partition Table (**upstream.csv** file) at initial boot-up, but it will when a switchover occurs from Primary Active to Back-Up Active.

If an **upstream.csv** file is found, a log entry is made to the **tlxcntl.log** file:

```
imxswitch tlxcntl[609]: Partitioning ENABLED
```

If no file is found, then the following log entry is made:

```
imxswitch tlxcntl[612]: No such file or directory, /var/local/router/partition/upstream.csv
```

```
imxswitch tlxcntl[609]: Partitioning DISABLED
```

The inactive Back-Up Controller Card will not verify its Partition Table (**upstream.csv** file), so it will not log error messages with current time stamp entries until it becomes active. Also, any errors that occur during the Partition Table evaluation process will be logged in the [/var/log/errors.log](#) file:

```
imxswitch tlxcntl[605]: error /var/local/router/partition/upstream.csv field 3 on line 1 is invalid
```

*Note that the example above shows an invalid character entry in the third column of the first line in the **upstream.csv** file*

For access to the **errors.log** file via SSH, refer to *The Network Interfaces* section of this manual on pg. [9] for correct IP addresses of Controller Cards when in Primary Active or Back-Up Active mode.



Note: The System Administrator must review the **errors.log** file each time an **upstream.csv** file is changed and immediately correct any reported errors.

To verify the system's **Partition Mode policy**, Thinklogical recommends the following:

- 1) Review the **tlxcntl.log** file as well as the **errors.log** file on the active controller card and correct any errors in the Partition Table before implementing multiple levels of security classification domains on the same Matrix Switch.
- 2) Fully verify the **Partition Mode** on the active Primary Controller Card before implementing multiple levels of security classification domains on the same Matrix Switch.
- 3) In a redundant system, make the Back-Up Controller Card active by disconnecting the LAN cable from the Primary Controller Card's LAN port. Check the **tlxcntl.log** file as well as the **errors.log** file on the Back-Up Controller Card for any errors in the Partition Table and correct them before implementing multiple levels of security classification domains on the same Matrix Switch using the Back-Up Controller Card.
- 4) Fully verify the Back-Up Controller Card's **Partition Domains** before implementing multiple levels of security classification domains on the same Matrix Switch.

There are cases where updates to the Partition Table need to be made in an active system. When an update is made to the table, the Controller will not evaluate the updated table until the procedures outlined below are followed.

- When updates are made to the Partition Table in a **non-redundant system**, Thinklogical recommends the following (*This procedure WILL be disruptive to system connections*):

- 1) Update the Partition Table of the Primary Controller Card.
- 2) Take the Primary Controller Card out of service by following the guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [25].
- 3) Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure WILL be disruptive to system connections.

- When updates are made to the Partition Table in a **redundant system**, Thinklogical recommends the following (*This procedure will NOT be disruptive to system connections*):

- 1) Update the Partition Table of the inactive Back-Up Controller Card.
- 2) Take the Primary Controller Card out of service by following guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [25]. This will cause the Back-Up Controller Card to become active and evaluate its Partition Table.
- 3) Update the Partition Table of the inactive Primary Controller Card with the same table used for the Back-Up Controller Card.
- 4) Extract and re-inserted the Primary Controller Card back into the chassis to cause the system to make the Primary Controller Card the active controller and begin using the updated Partition Table. Ensure that the LAN connection to the Primary Controller Card is restored promptly.



Note: When using a Back-Up Controller configuration, both controllers must have the same Partition Table file(s) to maintain the security of the system.

Partition Switching is disabled when the Partition Table file is removed. By default, when there is no Partition Table file, all ports not listed will default to partition 1. All Switches are shipped without a Partition Table file stored on the Controller Card and therefore do not restrict any connection.

Point-to-Point Switching Mode

Point-to-Point Switching Mode, or P2P, disables broadcasting by ensuring that input ports are restricted to one output port at a time on the same Matrix Switch. To specify which inputs will be P2P, the Administrator must provide a P2P definition file with a table defining each input that will have an output restriction on the Matrix Switch.

Each entry in the file represents an input port that will be restricted to one output in P2P mode. One or more entry per line is allowed. Blank lines are also allowed. The only characters allowed in the file are the digits 0 through 9, commas and spaces. Tables may be configured at the Administrator's discretion.

Examples of ways to set input ports 1- 3 to P2P mode are:

Ex. 1: 1,2,3

Ex. 2: 1
2,3

Ex. 3: 1
2
3

Ex. 4:
1,2,3

Ex. 5: 1,2
3



Note: Concerning the P2P `upstream.csv` file-

- All inputs listed in the `upstream.csv` file will connect to the last configured output connection as the output connections are changed.
- The shortcut value 9999 may be used to indicate 'all input ports.'
- All inputs not listed in the `upstream.csv` file can be multicast. Thus, undefined inputs, if they are backchannels, could be multicast to a single source if not added to the P2P `upstream.csv` file.

The P2P Switching Table file is stored on the Controller Card at:

`/var/local/router/p2p/upstream.csv`

To verify that the `upstream.csv` file has been detected by the system, the Administrator must run `tlxid` by issuing the following commands:

```
su
root
tlxid
```

If the `upstream.csv` file is found, the screen will indicate `point-to-point file found`

If the `upstream.csv` file is not found, the screen will indicate `point-to-point file not found`.

At system power-up, when initial boot-up is complete, the **Primary Controller Card** will only evaluate its P2P Table (`upstream.csv` file) once upon becoming active. The **Back-Up Controller Card** will NOT evaluate its P2P Table (`upstream.csv` file) at initial boot-up, but it will evaluate the table when a switch-over occurs from Primary Active to Back-Up Active.

If an `upstream.csv` file is found, the following log entry is made to the **CentOS journal**:

```
imxswitch tlxapi[981]: parsing P2P csv file /var/local/router/p2p/upstream.csv
```

If no file is found, then the following log entry is made:

```
imxswitch tlxapi[982]: vxASCIIdapi.c@4425 configure_api_shared(): /var/local/router/p2p/upstream.csv stat failed: No such file or directory
```

The inactive Back-Up Controller Card will not verify its P2P Table (`upstream.csv` file), so it will not log error messages with current time-stamp entries until it becomes active. Also, any errors that occur during the P2P Table evaluation process will be logged in the `/var/log/errors.log` file as follows:

```
imxswitch tlxapi[984]: parse_api_csv_file.c@77: Error: 'Invalid character `-' in file' at line 1 column 2 of csv file /var/local/router/p2p/upstream.csv data: '-2
```

Note that the example above shows an invalid character entry of -2 in the `upstream.csv` file.

For access to the `errors.log` file via SSH, refer to *The Network Interfaces* section of this document on pg. [9] for correct IP addresses of Controller Cards when in Primary Active or Back-Up Active mode.



Note: The System Administrator must review the `errors.log` file each time an `upstream.csv` file is changed and immediately correct any reported errors.

To verify the system's **P2P policy**, Thinklogical recommends the following:

- 1) Review the **CentOS journal** file as well as the **errors.log** file on the active Controller Card and correct any errors in the P2P Table before implementing single-output control domains on the same Matrix Switch.
- 2) Fully verify the **P2P Policy** on the active Primary Controller Card before implementing single-output control domains on the same Matrix Switch.
- 4) In a redundant system, make the Back-Up Controller Card active by disconnecting the LAN cable from the Primary Controller Card's LAN port. The Back-Up Controller Card, upon becoming active, will evaluate its P2P Table. Check the **CentOS journal** file as well as the **errors.log** file on the Back-Up Controller Card for any errors in the P2P Table and correct them before implementing single-output control domains on the Matrix Switch using the Back-Up Controller Card.
- 5) Fully verify the **P2P Policy** on the Back-Up Controller Card before implementing single-output control domains on the same Matrix Switch.

To review the **CentOS journal** file, use the following command: `journalctl | grep p2p`

There are cases where updates to the P2P Table must be made in an active system. When an update is made to the table, the Controller will not evaluate the updated table until the following procedures are followed:

- When updates are made to the P2P Table in a **non-redundant system** (*This procedure WILL be disruptive to system connections*):
 - 1) Update the P2P Table of the Primary Controller Card.
 - 2) Take the Primary Controller Card out of service by following guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [25].
 - 3) Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure WILL be disruptive to system connections.

- When updates are made to the P2P Table in a **redundant system** (*This procedure will NOT be disruptive to system connections*):
 - 1) Update the P2P Table of the inactive Back-Up Controller Card.
 - 2) Take the Primary Controller Card out of service by following guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [25]. This will cause the Back-Up Controller Card to become active and evaluate its P2P Table.
 - 3) Update the P2P Table of the inactive Primary Controller Card with the same table used for the Back-Up Controller Card.
 - 4) Extract and re-insert the Primary Controller Card into the chassis to cause the system to make the Primary Controller Card the active controller and begin using the updated P2P Table. Ensure that the LAN connection to the Primary Controller Card is restored promptly.



Note: When using a Back-Up Controller configuration, both controllers must have the same P2P Table file(s) to maintain system security.

Point to Point Switching is disabled when the P2P Table file is removed. By default, when there is no P2P file, an input can connect to any number of outputs. All Switches are shipped without a P2P file stored on the Controller Card and therefore allow for multicasting or broadcasting.

Restore Mode

Restore Mode continuously saves the system configuration as connections are changed in the Matrix Switch. If input X is first connected to output A, and then connected to output B, that last connection will be saved so that the system will maintain its configuration after a power-cycle.

To enable Restore Mode, use the Linux “touch” command to create a timestamped file called `restore`. The Restore application will automatically update connection information as connection changes are made in the system.

The Restore Table file is stored on the Controller Card at: `/etc/default`

To enable the Restore Mode in a **non-redundant** system the Administrator must create the restore file using the **touch command**, then power-cycle the system as follows:

```
su
root
touch /etc/default/restore
```

Take the Primary Controller Card out of service by following guidelines in the “Safely Remove an Active Controller Card” section of this document on pg. [25].

Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure WILL be disruptive to system connections.

To enable the Restore Mode in a **redundant** system the Administrator must create the restore file using the **touch command**, and then power-cycle the system as follows:

```
su (on the active Primary Controller)
root (on the active Primary Controller)
touch /etc/default/restore (on the active Primary Controller)
```

Then add the restore file to the inactive Back-up Controller Card

```
su (on the inactive Back-up Controller)
root (on the inactive Back-up Controller)
touch /etc/default/restore (on the inactive Back-up Controller)
```

Take the Primary Controller Card and the Back-up Controller Card out of service by pressing their HALT buttons simultaneously for > 5 seconds. Follow the guidelines in the “Safely Remove an Active Controller Card” section of this document on pg. [25].

Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure WILL be disruptive to system connections.

To verify that the restore file has been detected by the system, the Administrator must run `tlxid` by issuing the following commands:

```
su
root
tlxid
```

If the **restore** file is found, the screen will indicate `restore connections on powerup enabled`

If the **restore** file is not found, the screen will indicate `restore connections on powerup disabled`

To disable the Restore Mode in a **non-redundant** system, the Administrator must remove the restore file using the **command below**, then power-cycle the system as follows:

```
su
root
rm /etc/default/restore
```

Take the Primary Controller Card out of service by following guidelines in the “Safely Remove an Active Controller Card” section of this document on pg. [25].

Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure **WILL** be disruptive to system connections.

To disable the Restore Mode in a **redundant** system the Administrator must remove the restore file using the command below, and then power-cycle the system as follows:

```
su (on the active Primary Controller)
root (on the active Primary Controller)
rm /etc/default/restore (on the active Primary Controller)
```

Then remove the restore file to the inactive Back-up Controller Card

```
su (on the inactive Back-up Controller)
root (on the inactive Back-up Controller)
rm /etc/default/restore (on the inactive Back-up Controller)
```

Take the Primary Controller Card and the Back-up Controller Card out of service by depressing their HALT buttons simultaneously for > 5 seconds. Follow the guidelines in the “Safely Remove an Active Controller Card” section of this document on pg. [25].

Power-cycle the system by following the **Power-up Procedure** on pg. [23]



Note: This procedure **WILL** be disruptive to system connections.

To verify that the restore file has been deleted, the Administrator must run **tlxid** on both Controller Cards in a redundant system by issuing the following commands:

```
su
root
tlxid
```

If the **restore** file is not found, the screen will indicate `restore connections on powerup disabled`

At system power-up, when initial boot-up is complete, the **Primary Controller Card** will evaluate if the restore file exists in the `/etc/default` directory once upon becoming active.

The **Back-Up Controller Card** will NOT evaluate its `/etc/default` directory at initial boot-up, but it will when a switchover occurs from Primary Active to Back-Up Active.

If a **restore** file is found, a log entry to the **messages** file will indicate

```
imxswitch restore[984]: starting to save connections
```

If a **restore** file is not found, a log entry to the **messages** file will indicate

```
imxswitch restore[987]: file /etc/default/restore is missing, sleeping until it appears
```

The inactive **Back-Up Controller Card** will not verify its Restore file, so it will not log error messages with current time stamp entries until it becomes active. Also, any errors that occur during the restore file evaluation process will be logged as in the `/var/log/errors.log` file. For access to the **errors.log** file via SSH, refer to *The Network Interfaces* section of this document on pg. [9] for correct IP addresses of Controller Cards when in Primary Active or Back-Up Active mode.



Note: The System Administrator must review the `errors.log` file each time an `upstream.csv` file is changed and immediately correct any reported errors.

To verify the system's **Restore policy**, Thinklogical recommends the following:

- 1) Review the **messages** as well as the **errors.log** file on the active Controller Card to ensure the Restore File was detected. Otherwise, repeat the `touch /etc/default/restore` command, described above.
- 2) Fully verify **Restore** on the active Primary Controller Card before implementing multiple levels of security classification domains on the same Matrix Switch.
- 3) In a redundant system, make the Back-Up Controller Card active by disconnecting the LAN cable from the Primary Controller Card's LAN port. The Back-Up Controller Card, upon becoming active, will evaluate its Restore Table. Check the **messages** as well as the **errors.log** file on the Back-Up Controller Card for any errors in the Restore Table and correct them before implementing multiple levels of security classification domains on the same Matrix Switch using the Back-Up Controller Card.
- 4) Fully verify the Back-Up Controller Card's **Restore policy** before implementing multiple levels of security classification domains on the same Matrix Switch.



Note: The restore function uses an internal timestamp to determine which file is used to do the restore. This is not an issue if there is only one CPU in the Matrix Switch. If the switch has two CPU cards, then it is important that the clocks on both CPUs are in sync. We recommend setting up an external time service (NTP) and configure the switch to use this service at 192.168.13.9. The configuration file is `/etc/ntp.conf`.

Restore mode is disabled when the Restore file is removed. By default, when there is no Restore file, all input to output ports will be disconnected. All Switches are shipped without a Restore file stored on the Controller Card and therefore do not create any connections at power-up.

Secure Application Example

The Diagram on the following page shows the TLX48 2RU Matrix Switch in a secure application. **The highly secure components are described as the Red Network and the other, lower security components are described as the Black Network.** The Red Network, containing the computers (sources), is shown in a physically secure environment along with the TLX Matrix Switch, the computer server used to manage the Switch, and the Network Hub. The Network Hub is a dedicated network used only to connect the TLX Switch to the computer server. This dedicated network does not connect to any other components and does not extend beyond the physically secure environment. The dedicated network connection may be replaced by a direct serial connection (RS-232) between the TLX Switch and the computer server.

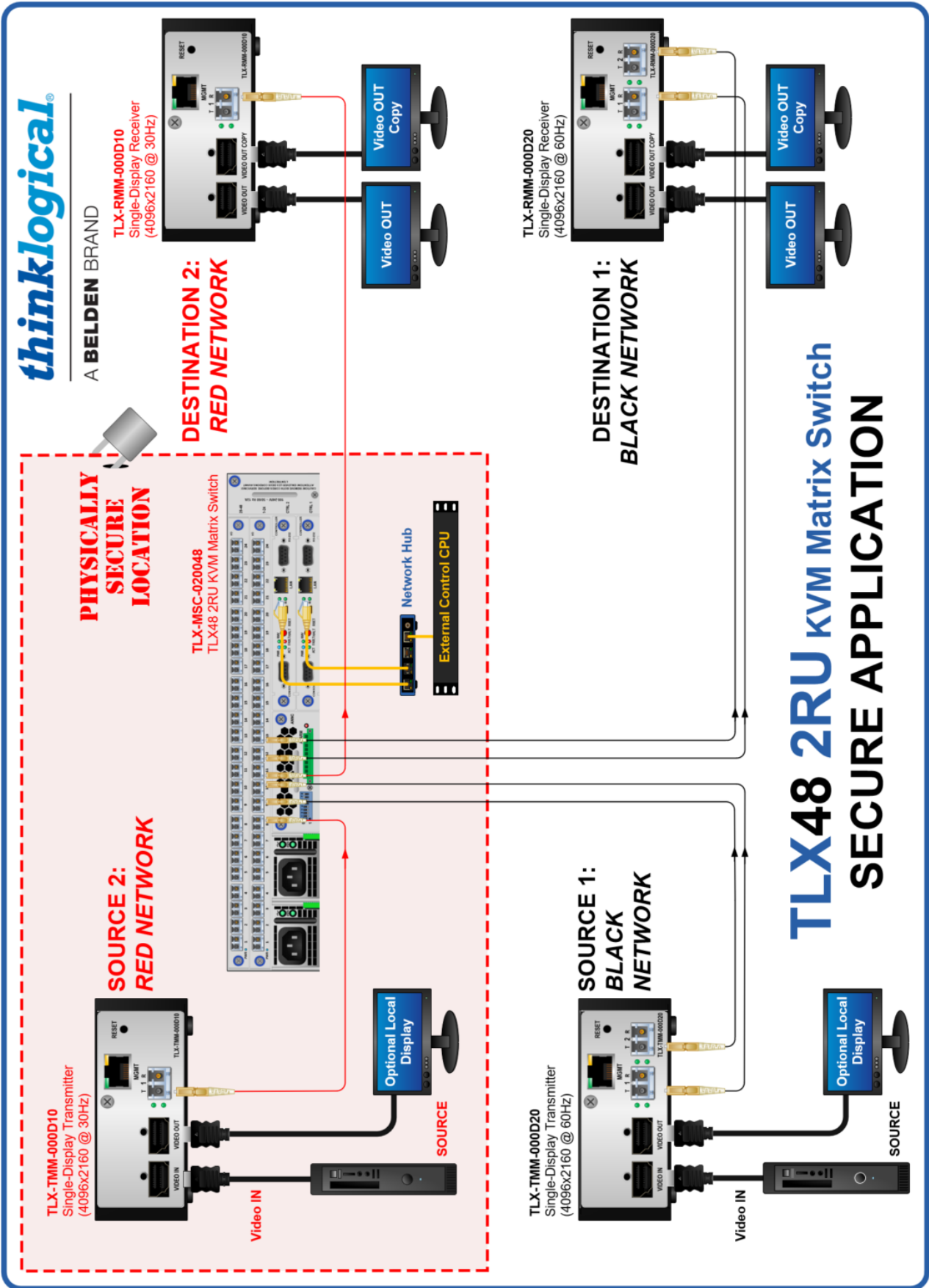


Note: The TLX Matrix Switch and the computer server used to manage the Switch must be protected according to the highest security classification of any component in the entire network application. The optical connections and Destination Receiver designated as *Red Network* must be kept physically secure.

The configuration of the TLX Matrix Switch should be reviewed regularly to ensure that it continues to meet organizational security policies concerning:

- Changes in the TLX Matrix Switch configuration
- Changes in the organizational security policy
- Changes in the threats presented from non-trusted network interfaces
- Changes in the administration, operation staff or the physical environment of the TLX Matrix Switch





NOTES:
