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TLX160

10G MATRIX SWITCH PRODUCT MANUAL

Full 4K @ 60Hz Video and KVM Hybrid Switching & Extension Solutions over the Fewest Cables

Rev. I, December 2025

Thinklogical, A BELDEN BRAND • 100 Washington Street • Milford, Connecticut 06460 U.S.A.

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Subject: TLX160 Matrix Switch Product Manual
Revision: I, December 2025

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About This Manual

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: hyperlink.format.

- For **.pdf**: *point/left click* → pg. [18] Left-click
- For **.doc**: *Ctrl/point/left click* → Ctrl + pg. [18] Left-click
- To **return to the front of the document:** *Ctrl/Home.* → Ctrl + home

Note and Warning Symbols

Throughout this document you will notice 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.

Other important notes:

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. Most online documents are stored as .pdf files.

For any product support, technical issues or other questions not covered in this document, please feel free to contact us:

- **Email:** support@thinklogical.com
- **Telephone:** **1-203-647-8700** *or* **1-800-291-3211**
- **Website:** https://www.thinklogical.com **Chat live** with a Customer Service Representative.

Section 1: TLX System Features

The Logical Solution

The TLX160 is a 10G, high-performance, protocol agnostic, modular, non-blocking Matrix Switch that supports full, uncompressed 4K video with full color depth at a 60Hz frame rate for complete, end-to-end routing of video and peripheral signals over multi-mode or single-mode fiber-optic cables in a 9 RU Chassis.

The Switch supports DVI, SDI, HD-SDI, Dual-link DVI, Dual-link SDI, USB HID, USB 2.0 and Audio, adding simplicity and control over sophisticated video and KVM visual computing environments.

The TLX160 is a square crosspoint switch matrix for 160 optical transports to/from Thinklogical Transmitters and Receivers. The TLX160 accepts up to 160 SFP+ (**S**mall **F**orm-factor **P**luggable) Transceivers (Tx & Rx) supporting up to 160 Thinklogical Transmitters and Receivers.

The TLX160 is available with multi-mode and single-mode LC-type fiber connectors, as well as fiber or coax 12G SDI connectors, pg. [8].

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 *un-compressed, 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 users be non-hostile and follow all usage guidelines outlined in this document.

Thinklogical Matrix Switches have achieved Common Criteria EAL4 (**E**valuation **A**ssurance **L**evel **4**) certification and 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 E: Secure Applications* on pg. [40] for a complete description of each mode.

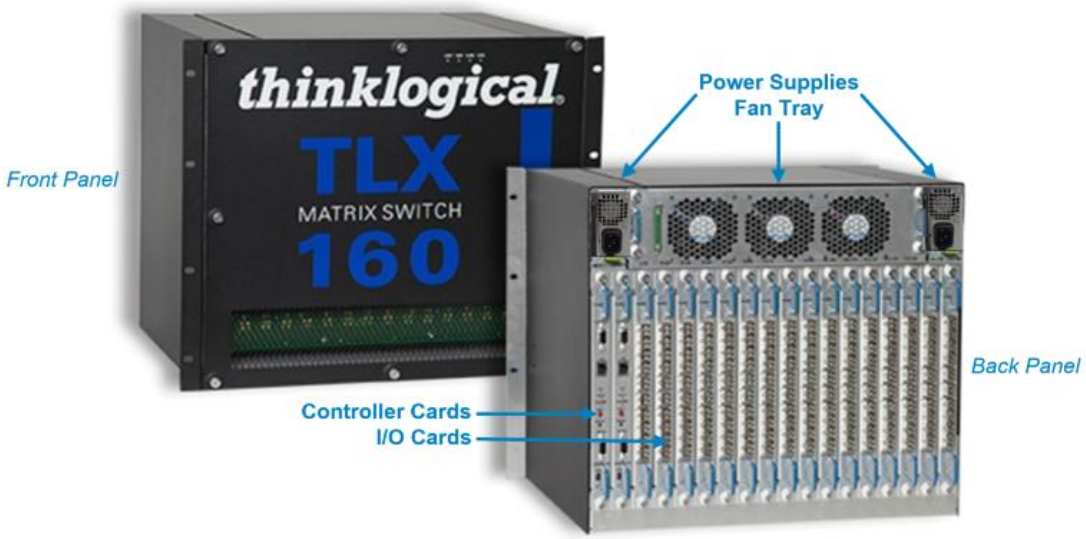
Resiliency

TLX Matrix Switches are designed to maximize system uptime. The modular approach allows users to **hot-swap all critical system components**, including Power Supplies (in dual supply models), Fan Tray, Control Cards, Annunciator Ports, 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**.

A variety of sensors and alarms provide real-time monitoring and diagnostics of critical Switch functions.

The TLX160 Matrix Switch Design

The rack-mountable design of the TLX160 10G Matrix Switch (sometimes referred to as a Switch or Router) supports up to 160 ports of full, uncompressed 4K video with full color depth at 60Hz frame rate in a 9 RU chassis for complete, end-to-end routing of video and peripheral signals over multi-mode or single-mode fiber-optic cable, or over 12G coax cable, thus minimizing critical rack space.



Features of the TLX160 Matrix Switch®

- Housed in a 9 RU Chassis
- Supports DVI, SDI, HD-SDI, Dual-link DVI, Dual-link SDI
- Up to 160 fiber ports - In and Out (10Gbps / 6.25 Gbps with re-clocking input)
- Up to 160 SDI fiber ports (12Gbps with re-clocking input)
- Up to 160 SDI coax ports (12Gbps with re-clocking input)
- Redundant, current sharing, hot swappable Power Supply Modules, pg. [7].
- 10 ports scalability for hot swappable Input/Output Cards, pg. [8].
  - Single-mode, multi-mode capability.
- Primary and Back-up Controller Cards, pg. [10].
  - Controllable via LAN or serial connection.
  - SNMP control protocol, pg. [13].
  - Failover/Power Off button (HALT button on Controller Cards), pg. [28].
- Single, hot swappable Fan Tray with Annunciator port (for alarms), pg. [14].
- Standard cable management bracket included. Other options available, pg. [19].
- Comprehensive system setup and control provided via Thinklogical's SMP software, pg. [23].
- Supports multicasting and macros.*

TLX Matrix Switches are compatible with the following Thinklogical® products:

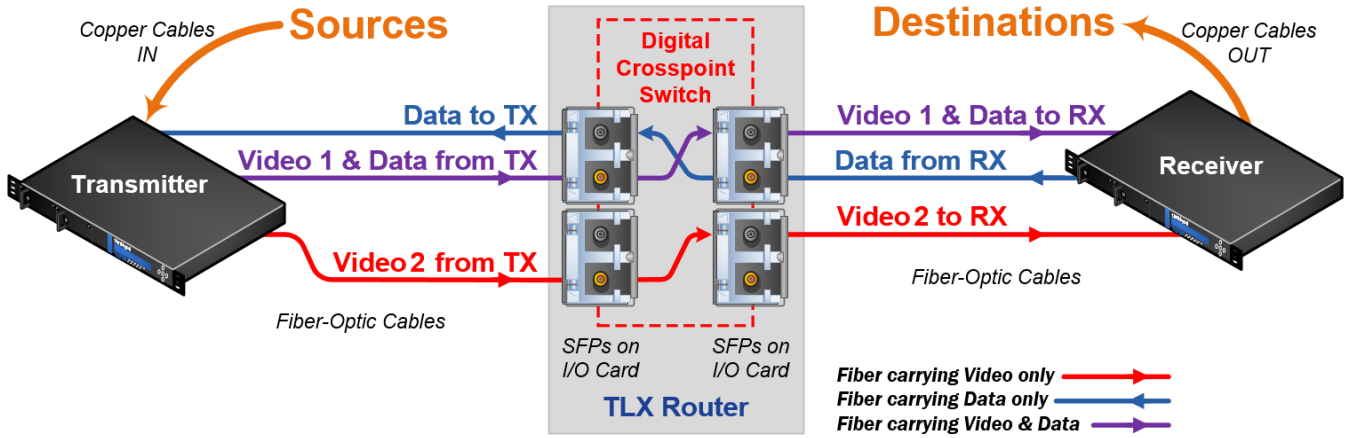
- Single & Multi-Mode **TLX 10G KVM and Video Extenders** (10G to 10G only)
- Single & Multi-Mode **Velocity 6G KVM and Video Extenders** (6G to 6G only)
- **SDI Xtreme 3G+ Extenders**
- **System Management Portfolio**
- **12G SDI, USB-C** and **Video Teleconferencing CODEC Extenders**

Note: Thinklogical does not support the use of non-Thinklogical extenders or non-approved devices with Thinklogical Matrix Switches.

For more on Multicasting and Macros, see the document:* **Manual_System_Management_Portfolio

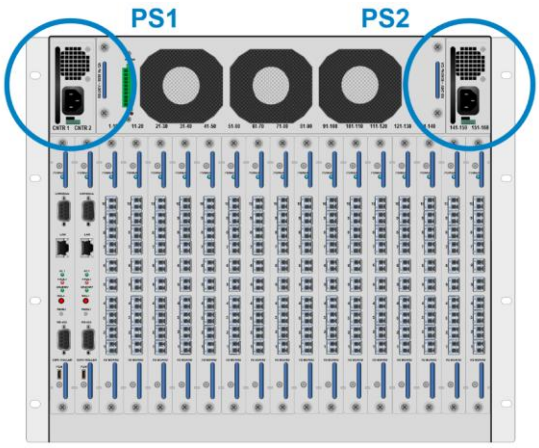
The Digital Crosspoint Switch

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.



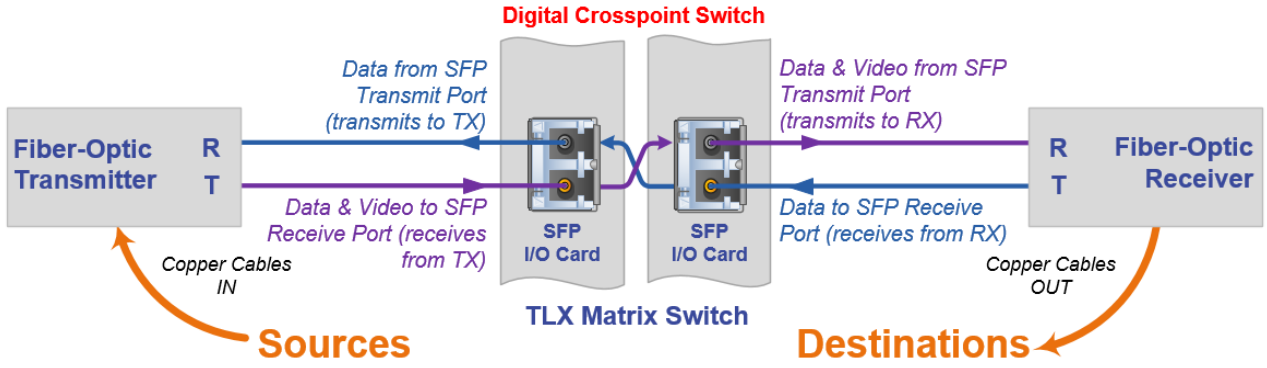
The Power Supply Modules

- The dual, redundant Power Supplies (PWR-000068) ensure continuous, uninterrupted power. The supplies, regardless of make or model, are current-sharing, which means the supplies equally share the load. **If a Power Supply fails, the redundant power supply can support the entire current load of one fully populated Card Cage.**
- Although the TLX Switch functions properly with one Power Module per Card Cage, it is recommended that both modules be used, preferably connected to two independent power sources for redundancy.
- Additionally, the hot-swappable feature allows easy replacement of a module without interrupting the Matrix Switch's system functionality. **Both power supplies should be on during normal use.**
- See *How to Remove and Replace a Power Supply Module* on pg. [30].

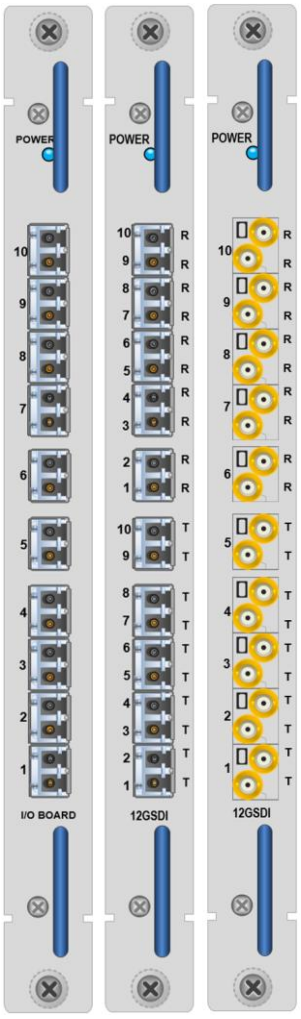


The Input/Output Cards

- The TLX160 Matrix Switch supports a maximum of sixteen 6G, 10G or 12G SDI I/O Cards.
- Each 6G or 10G Card supports up to 10 T/R ports, available with multi-mode or single-mode fiber.
- Each 12G SDI Card supports up to 10 Transmit Ports and 10 Receive Ports with coax cables or single-mode fiber.



6G/10G Fiber Transport



6G/10G FIBER 12G SDI FIBER/COAX

6G/10G

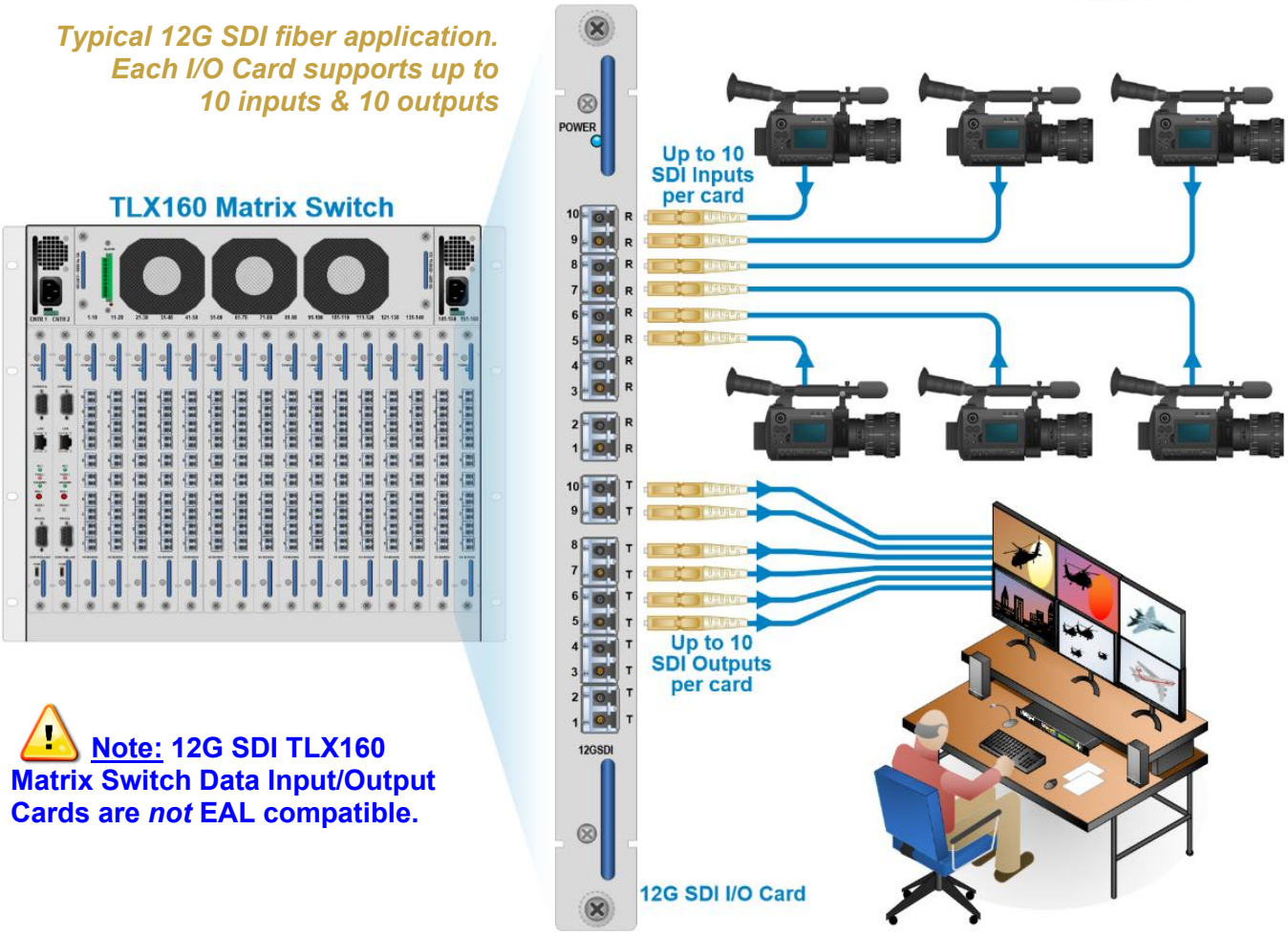
- Each 6G or 10G fiber SFP+ consists of one Transmit (T) and one Receive (R) optic per port.
- I/O Cards have LC-type fiber connectors and come with Single-mode or Multi-mode optics (SFP+). Each I/O Card lists the ports as 1 through 10.
- A blue LED on each I/O Card indicates when power is ON to that card.
- The TLX160 configuration can have a minimum of one (10 x 10) and a maximum of 16 (160 x 160) hot-swappable I/O Cards. When fully configured, the TLX160 will contain 16 I/O Cards, providing a total of 160 Optical Input/Output connections described as Ports 1-160.
- The switching matrix connects any 6G port's optical output (SFP+ T) to any other 6G port's optical input (SFP+ R).
- The switching matrix connects any 10G port's optical output (SFP+ T) to any other 10G port's optical input (SFP+ R). The 10G I/O Card also supports existing 6G/2G legacy Velocity extenders.

12G SDI

- The 12G SDI Card provides direct SDI to SDI switching connectivity to the TLX160 without converting to a Thinklogical format, such as TLX or VX.
- The 12G SDI hot-swappable I/O Card provides ten individual 11.88Gbps SDI inputs and outputs.
- Also supports SDI rates of **6G, 3G** and **1.5G**.
  - On single-mode fiber up to 80km (type OS2 9/125).
  - On 75Ω coax cable lengths up to: 75m at 11.88 Gbps (4Kp60 UHD)
    120m at 5.94 Gbps (UHD)
    200m at 2.97 Gpbs (FHD)
    280m at 1.485 Gpbs (HD)
    600m at 270 Mbps (SD)

Ordering information on pg. [19].

Typical 12G SDI fiber application. Each I/O Card supports up to 10 inputs & 10 outputs



Note: 12G SDI TLX160 Matrix Switch Data Input/Output Cards are *not* EAL compatible.

Each 12G SDI fiber-optic or coax SFP+ has either 2 outputs (Tx) or 2 inputs (Rx).

12G SDI Coax Cable

Thinklogical recommends RG-6/U, 18 AWG, 75Ω coax cable. Maximum lengths:

BNC Male/HD-BNC Male (75Ω Coax, 12G SDI)

75m at 11.88Gbps (4Kp60 UHD)
120m at 5.94 Gbps (UHD)
200m at 2.97 Gpbs (FHD)
280m at 1.485 Gpbs (HD)
600m at 270 Mbps (SD)

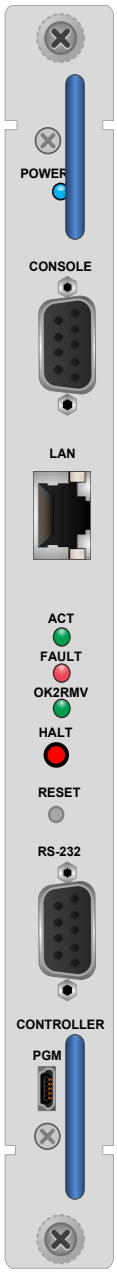
The Controller Cards

The hot-swappable Controller Card connects the Matrix Switch to an External CPU. The RS-232 Serial Port may also be used for 3rd party controller integration (such as Crestron, AMX or home-spun interfaces). Also, the System Management Software may be used to control the Switch via the LAN port.

Primary and Back-up:

The Primary Controller Card should always be in the left controller slot. *A Back-up Controller Card ensures uninterrupted functionality if the Primary Controller Card fails or needs to be replaced. The Back-up is sometimes referred to as a* Secondary.

The Back-up Controller must have a LAN connection that allows it to communicate with both the Primary Controller and the **S**ystem **M**anagement **P**ortfolio (or *SMP*, required for the Back-up Controller to take control of the Switch. See pg. [23]). Both Controller Cards must have the same CPU Module/Processor.



LED Definitions:

POWER: Blue = normal operation. Red = fault.

ACT: Informs which Controller Card (Primary / Back-up) is active.

FAULT: Informs of a Controller Card fault.

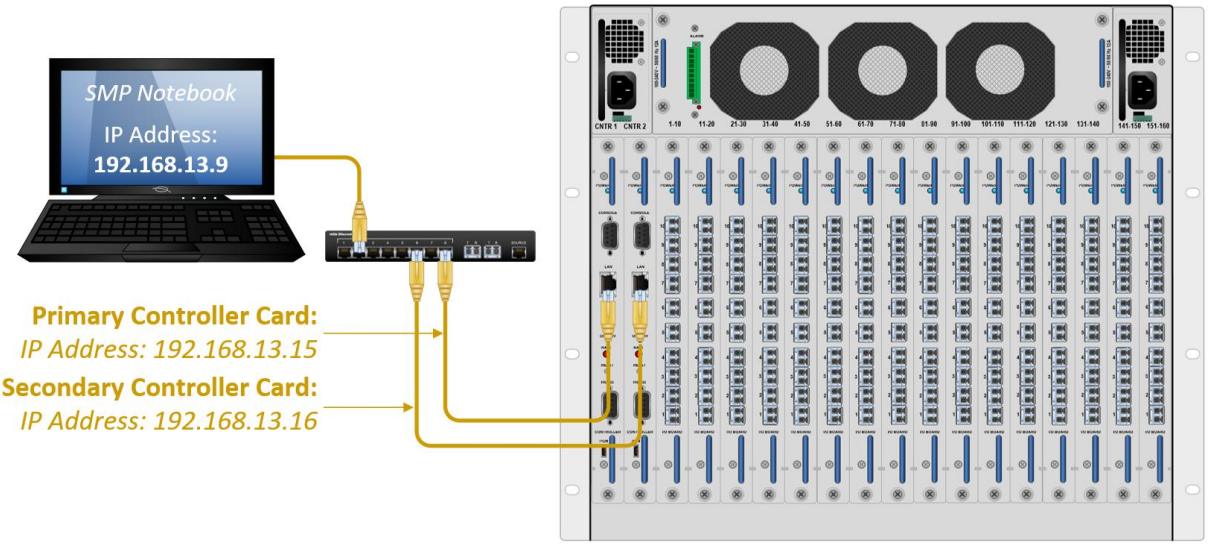
OK2RMV: Informs the operator if the CPU (iMX6) is halted. (**OK to ReMoVe**)

Push Button Operation:

HALT (Primary Controller): In a TLX160 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 TLX160 does not have a Back-up Controller, holding this button for >5 seconds will halt the CPU and power--down the IO. Note that the OK2RMV (**Ok**ay **to re**m**ov**e) LED will be lit and the ACT 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 TLX160 will also power-down the IO. If the Back-up Controller was not the active controller, the CPU will be halted and ready to be removed. The OK2RMV (**Ok**ay **to re**m**ov**e) LED will be lit and the ACT LED will not.

RESET (Recessed button, for test purposes only): Resets the CPU (IMX6).

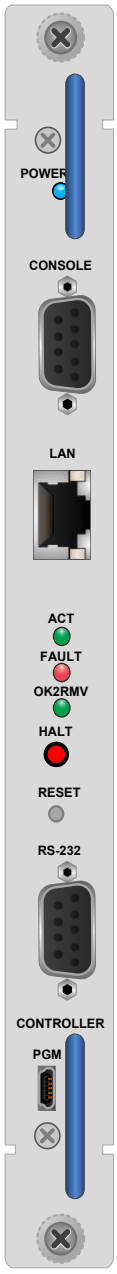


The Controller Cards are connected to the network via the LAN Ports

Controller Card Ports:

The Controller 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 RS-232*).*

If a Back-up Controller Card is installed, then its Linux Console Port is active, but only the RS-232 Port on the active Controller Card will function.



CONSOLE Port (Linux Command 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).

LAN: The CATx LAN Port is for Ethernet access. (*See diagram, previous page.*)

RS-232 Port (ASCII API)

- 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).

PGM: The Programming Port is for programming updates. (*See **Appendix B*** on pg. [35].)

For proper handling of the Control Card's on-board SD Card, see **Appendix C, SD Card Replacement for the TLX160 Controller Card**, on pg. [36]

The Processor – i.MX 6 Quad (Freescale)

The Processor platform key features:

- ARM Cortex-A9 Quad Core
- Memory Interfaces
  - 64-Bit DDR3-1066
  - SD (Memory Card Specification, v3.0 including high-capacity SDHC Cards up to 32 GB.
  - Serial NAND Flash (SPI)
  - EIM Bus (FPGA Parallel Bus I/F)
- UART (4 ports)
- Gigabit Ethernet Controller (RGMII)
- GPIO (32 bits)
- I2C Masters (3 ports)
- Internal 100 Megabit Ethernet Interface for Controller-to-Controller communications

The Network Interfaces

The TLX160 will use up to three IP addresses. The Primary Controller Card will use address X and address X+100. The Back-up Controller Card will use address X+1 and it will take over address X in the event of a failure in the Primary Controller Card. These addresses are set by an internal DIP Switch. See *TLX160 DIP Switch Settings* on pg. [18]. The Primary's IP address can be set from 15 to 45. The Switch's default subnet is 192.168.13.xxx. Users may switch to their own subnet by reconfiguring the Switch's network startup.

This is detailed in the document: **Manual_How_To_Change_A_TLX_Matrix_Switch's_IP_Address**

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

The TLX160 uses RS-232 serial and network LAN ports for control and status. Port 17567 accepts commands to control the Switch.

The command API 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, TLX160 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 17616, 1 port per I/O Card)

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

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

The TLX160 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 TLX160 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, TLX160'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 switch can be monitored via SNMP *Simple* *N**etwork* *M**anagement* *P**rotocol*** (supports version V2c and V3 USM). Please call our technical support staff at 1-203-647-8700 for downloadable MIB ***M**anagement* ***I**nformation* ***B**ase*** definition files.

➢ **There are three entries in the SNMP configuration file** (`/etc/snmp/snmpd.conf`) **that users typically modify:**

- `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. For more details about SNMP Traps, see the document **Manual_TLX_Matrix_Switch_SNMP_Traps**.

NTP Support

NTP, or *Network Time Protocol*, is used to keep the internal clock on the TLX160 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 Switch 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 TLX160 Controller Card has two RS-232 serial ports. One is for the Linux command line interface (labeled CONSOLE), and the other is for the Matrix Switch's ASCII command interface (labeled RS-232). If a Back-up Controller Card is installed, then its Linux console port is active. However, only the RS-232 port on the active Controller Card will function.

Linux Command Console (CONSOLE)

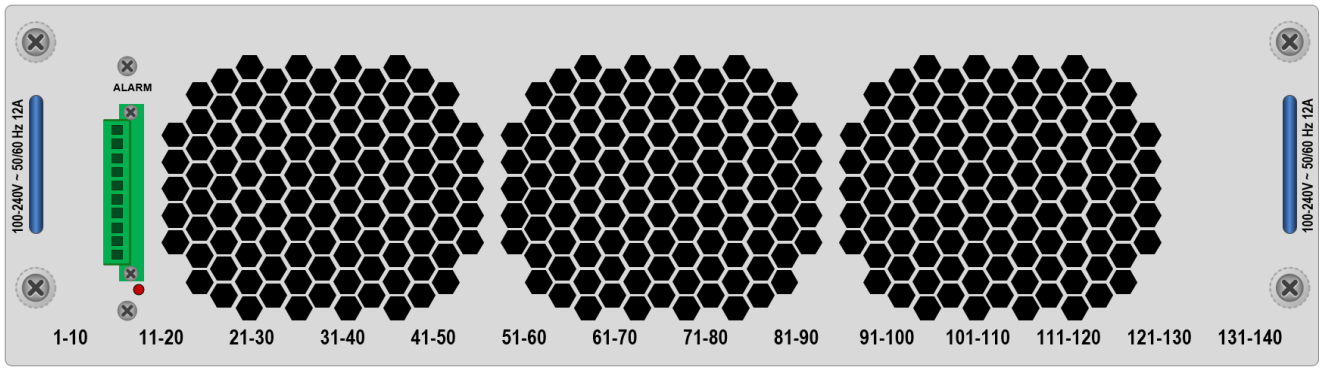
- Baud Rate: 115200
- Data Bits: 8
- Parity: none
- Stop Bits: 1
- Flow Control: none
- DB9 DCE
  - ➢ A straight cable is needed to connect to a PC (*not* a null-modem).

ASCII API (RS-232)

- 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

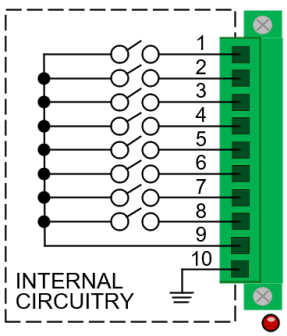
The TLX160 Switch uses 3 DC fans located in one modular, hot-swappable Fan Tray designed for easy replacement without interrupting system functionality. The Fan Tray forces air into the chassis through air baffles in the front door. This cools the vertically mounted I/O Cards, the integrated circuits on the Controller Cards and the Backplane, and removes any heat generated by the Power Supply modules.



The Fan Tray Module

Alarms

The Fan Tray is equipped with an annunciator port for system alarms that can be configured to trigger an external control system. 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.



TLX160 Matrix Switch Critical Hardware Alarms:

POWER SUPPLY 1 (LEFT): *Fan failure, temp. spikes, DC voltage/current range, AC pwr interruption, module removed*
POWER SUPPLY 2 (RIGHT): *Fan failure, temp. spikes, DC voltage/current range, AC pwr interruption, module removed*
FANS: *Individual fan monitoring*
TEMPERATURE WARNING: *Chassis over temperature, multiple sensors*
TEMPERATURE SHUTDOWN: *Chassis over temperature causing shutdown*
CPU: *Card failure*
INPUT/OUTPUT CARDS: *SFP+ failure, laser output fault*
ANY OF THE ABOVE
COMMON
GROUND

Red LED lit for "ANY OF THE ABOVE" alarm condition

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

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

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 **55°C** (131°F) by default.
- (Pin 5) **Temperature Shutdown** – The upper limit is **60°C** (140°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:

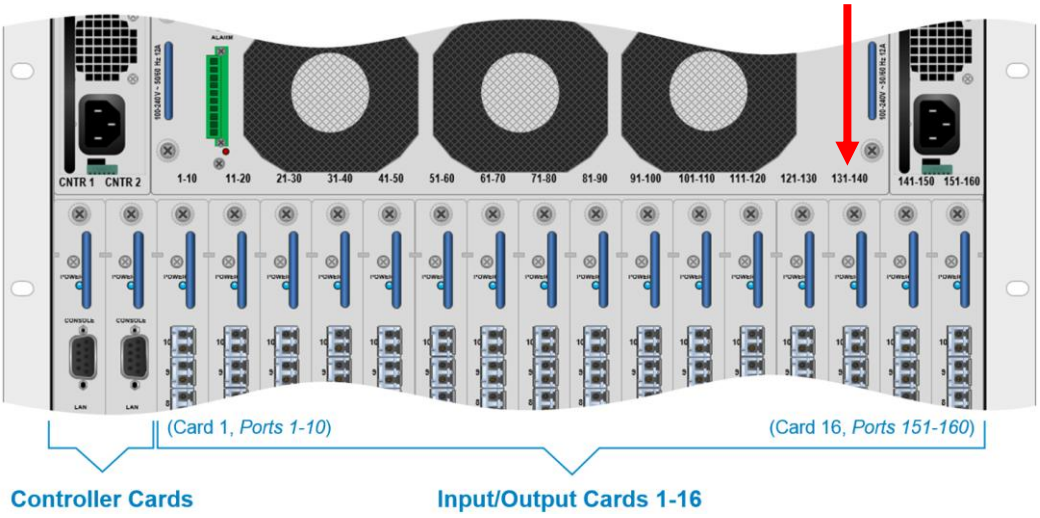
Add `--enable-high-temp-shutdown` to `TLXCNTL_ARGS=`

Power-cycle the TLX160 or use command `systemctl restart tlxcntl`.

Port Numbering

SFP numbering starts with Port 1 on the bottom of Card 1 on the left side of the chassis. Each port on each Card has a number designation, 1 through 10, bottom to top, printed to its left, for easy reference. There are sixteen 10-Port I/O Cards for a total of 160 Transmit Ports and 160 Receive Ports per Chassis.

The port numbers for each I/O Card are shown on the Fan Tray, just above each individual card.



Section 2: Set-Up & Installation

Contents

When you receive your Thinklogical® TLX160 KVM Matrix Switch, you should find the following items in the quantities specified in your order:

- TLX160 Chassis *(includes 2 Power Supply Modules),* pg. [7]
- Controller Card(s) 1 or 2, pg. [10]
- Input/Output Card(s) 1 to 16, pg. [8]
- Cable Management Bracket, pg. [39]
- Power Cords – PWR-000056-R (International connections may differ) – Qty 2

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

Unpacking the TLX160

The TLX160 Matrix Switch is 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 red-striped tape. The stripes 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 TLX160 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 thumbscrew retainers. **Ensure that all thumbscrews 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 the retaining latch is secure.

5) Verify that the Fan Tray is fully seated in the chassis and the thumbscrews are secure.

6) When the TLX160 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).

If any of the sensors detect an over temperature condition, power will be removed from all sensitive components and the system will shut down. All failure conditions send out notifications prior to shut-down. For a detailed list of the alarm functions, see pg. [14]: ***Alarm Descriptions for the TLX160.***

Technical Specifications

PHYSICAL	
TLX160 Chassis	**Dimensions:** Rack Size: **EIA 19"** Height: **9 RU-15.72"** (399.3 mm) Depth: **15.1"** (383 mm) *including handles* Width: **17.16"** (435.9 mm) *excluding mounting hardware* Weight (Matrix Switch): **49 lbs.** (23 kg) Shipping Weight: **67.5 lbs.** (31 kg)
Fiber Ports	**10 x 10 min. /160 x 160 max.**
Coax Ports	**10 x 10 min. /160 x 160 max.**
ENVIRONMENTAL	
Temperature	Operating: **0° to 50°C** Storage: **-20°C to 70°C**
Humidity	Operating: **5% to 95%, non-condensing** Storage: **Unlimited**
Altitude	Operating: **Thinklogical products are rated for operation to 1000m elevation without degradation of performance. Maximum operating temperature derates by 1% for every 110m above 1000m.** Storage: **Unlimited**
ELECTRICAL	
Alarm Relay Contacts	Maximum DC: **1A at 30VDC** Maximum AC: **0.3A at 125VAC**
Input Rating	**100-240VAC, 9A, 50-60Hz**
Maximum Power Consumption	**850 Watts, fully loaded**
Thermal Load	**2900 BTU/Hr.**
WARRANTY	**One year from date of shipment. Extended warranties available.**

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:
06-250019 indicates the unit was built in the **6**th month of **2025** and is unit number **19**.

Ethernet Control

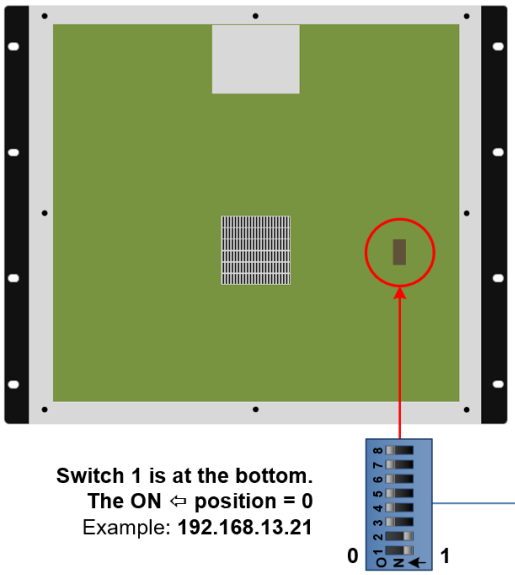
If the TLX160 Matrix Switch is to be controlled via Ethernet, it will require a **static IP address**. This value can be set via the DIP Switch located on the Switch's backplane. The front door panel must be removed to access the DIP Switch. The factory default setting is: **192.168.13.15** (00000000).

TLX160 DIP Switch Settings

The simplest network connection is an isolated network with only the TLX160, the control server, and any control clients, using static IP addresses. The TLX160 can be set to any of the above settings. The **External Control CPU** must be at the default **192.168.13.9** setting. 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 default static address **192.168.13.9** and dedicated to the TLX160 KVM Matrix Switch(s), while the other network interface can be configured as required by the facility's network administrator.

8-Position DIP Switch located on the TLX160 Backplane (shown with front cover removed).



Switch 1 is at the bottom.
The ON ⇦ position = 0
Example: **192.168.13.21**

1	2	3	4	5	6	7	8	Active Controller IP Addresses	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

Ordering Information

Part numbers and the various components of the TLX160 Matrix Switch are as follows:

PART NUMBERS	FEATURES
TLX160 Matrix Switch	
TLX-MSC-000160	**TLX**160 Matrix Switch Chassis, 2 Power Supplies, 1 Controller, up to 16 I/O Cards
TLX160 Matrix Switch Data Input/Output Modules – 10G	
TLX-MSD-M00010	**TLX**160 Matrix Switch Data Input/Output Card **10** Multi-Mode Fiber Ports, **10**G
TLX-MSD-S00010	**TLX**160 Matrix Switch Data Input/Output Card **10** Single-Mode Fiber Ports, **10**G
TLX-MSD-MV0010	**TLX**160 Matrix Switch Data Input/Output Card **10** Multi-Mode Fiber Ports, **6**G
TLX-MSD-SV0010	**TLX**160 Matrix Switch Data Input/Output Card **10** Single-Mode Fiber Ports, **6**G
TLX-MSD-000010	**TLX**160 Matrix Switch Data Input/Output Card **10** 10G unpopulated
TLX160 Matrix Switch Data Input/Output Modules – 12G SDI *(See note below.)*	
TLX-MSD-S12G10	**TLX**160 Matrix Switch Data Input/Output Card **10** 12G SDI **S**ingle-Mode Fiber
TLX-MSD-C12G10	**TLX**160 Matrix Switch Data Input/Output Card **10** 12G SDI **C**oax cable
TLX-MSD-012G10	**TLX**160 Matrix Switch Data Input/Output Card **10** 12G SDI unpopulated
TLX160 Matrix Switch Spare Modules	
TLX-MSM-C00160	**TLX**160 Matrix Switch Module, **C**ontroller Card
TLX-MSM-F00160	**TLX**160 Matrix Switch Module, **F**an Tray
TLX-MSM-P00160	**TLX**160 Matrix Switch Module, **P**ower Supply

Cable management options are also available:

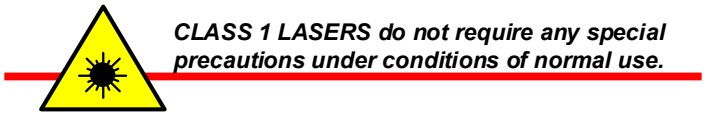
https://www.thinklogical.com/products/fiber-harnesses-and-cable-management-for-matrix-switches/

Speak with a sales representative about your specific needs at **1-203-647-8700**.

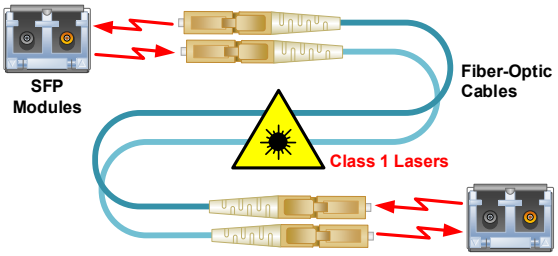
Note: 12G SDI TLX160 Matrix Switch Data Input/Output Cards are *not* EAL compatible.

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.



Pluggable SFP Modules

Each fiber-optic TLX160 I/O Card contains a row of ten Multi-Mode or Single-Mode **S**mall **F**orm-factor **P**luggable transceiver modules (commonly called SFP or SFP+) that serve as the fiber-optic couplers for the fiber cables to and from the Thinklogical Transmitter and Receiver Extenders. Each SFP 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.

A bale provides a handle for inserting and removing each module. **Arrows on the bale indicate input and output.**

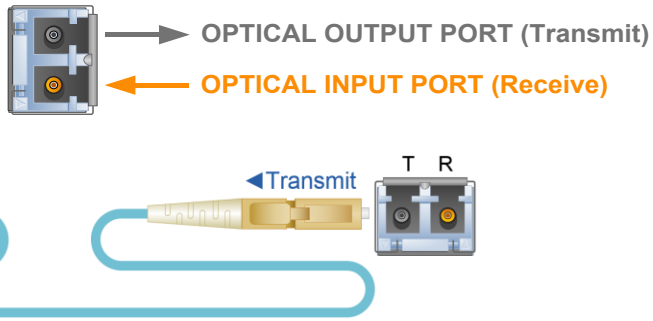
Always use **dust plugs** to protect against dust and damage when a fiber-optic connector is not attached to a device. All Thinklogical SFPs are fully populated with appropriate dust plugs upon shipment.

Dust plug installed

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

LC-Type Fiber-Optic Cables

On TLX Extenders and Matrix Switches, fiber-optic cables connect an SFP's output port (Transmit) to any other SFP's input port (Receive).



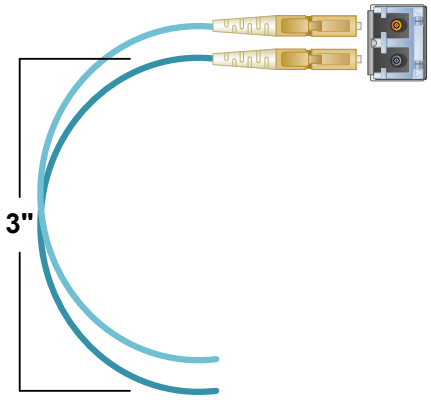
Requirements: Thinklogical recommends connecting the Transmitters, Receivers and Matrix Switches with OM3 (up to 300 meters) or OM4 (up to 400 meters) fiber-optic cable terminated with LC-type connectors. Single-mode fiber can extend up to 80km (50 miles).

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. Fibers must be loosely rolled to avoid sharp bends in the cable.

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.

Dust cap installed on the ferrule

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

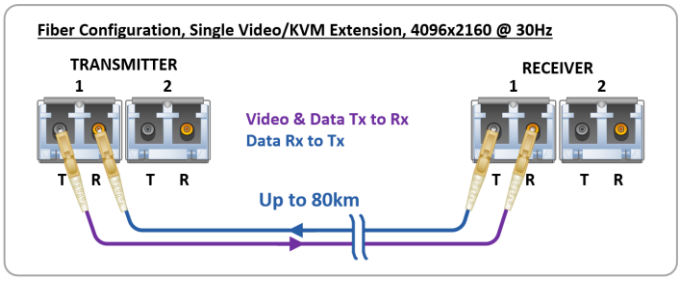


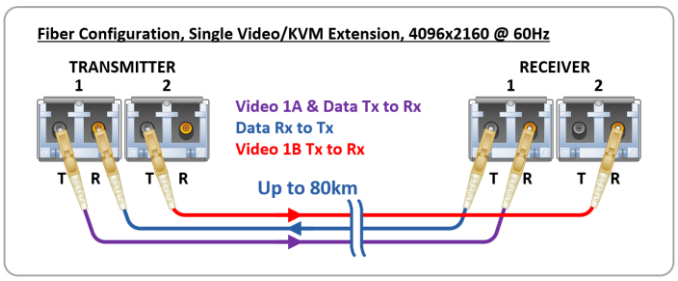
Multi-Mode: Up to 33 meters with Type OM1
Up to 82 meters with Type OM2
Up to 300 meters with Type OM3
Up to 400 meters with Type OM4
Single-Mode: Up to 80km with Type OS2 9/125

Thinklogical recommends OM3 or OM4 fiber-optic cables terminated with LC-type connectors.

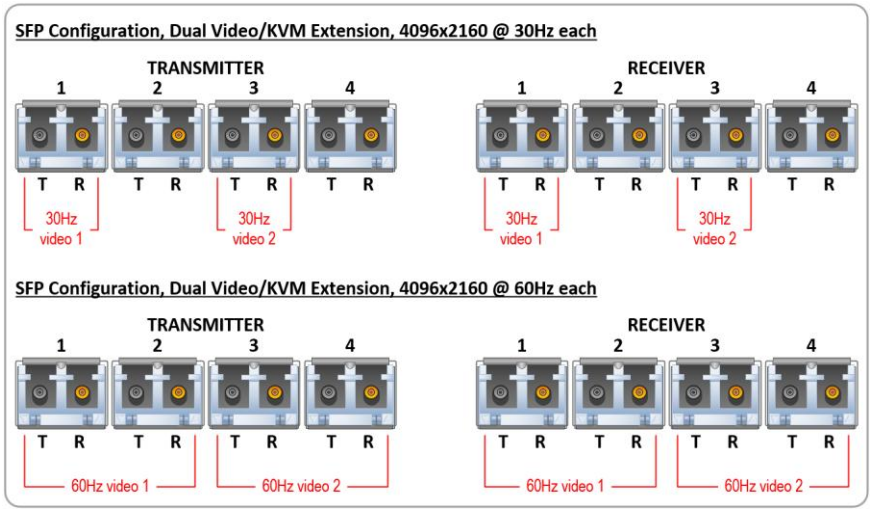
TLX Extender Fiber Configurations

Single Video Modules

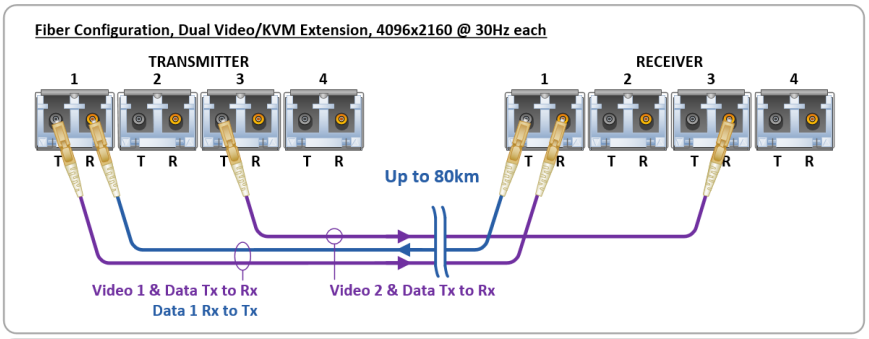


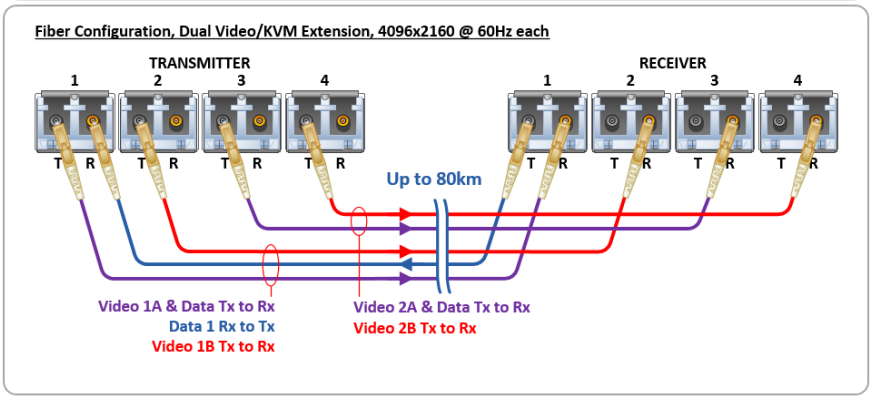


Dual Video Modules



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

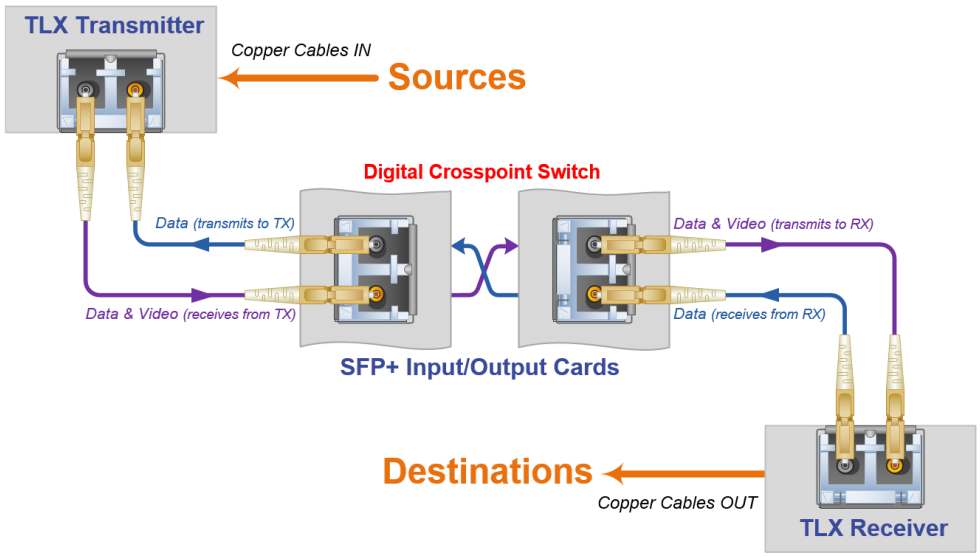




Routing Thinklogical Extenders through the TLX160

Comprised of a fiber-in, fiber-out **KVM Matrix Switch** and of fiber-optic **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.

Note: Thinklogical does not support the use of non-Thinklogical extenders or non-approved devices with Thinklogical Matrix Switches.



Matrix Switch Transmit & Receive 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 TLX160 using fiber-optic cable (Multi-mode fiber for distances up to 400m; Single-mode fiber for distances beyond 400m).

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 E, pg. [40].

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 (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 TLX160 Transmitter ports using fiber-optic cables (Multi-mode fiber for distances up to 400m; Single-mode fiber for distances beyond 400m).

Connecting to a Control CPU

The TLX160 is controlled via a dedicated external Control CPU. This allows for customization and ease of control and administration. Access is provided via a LAN connection or serial RS-232 port.

Note: The Control CPU (Computer) **is supplied separately. For CPU minimum requirements, refer to the document Manual_TLX_Matrix_Switch_ASCII_API_V5.**

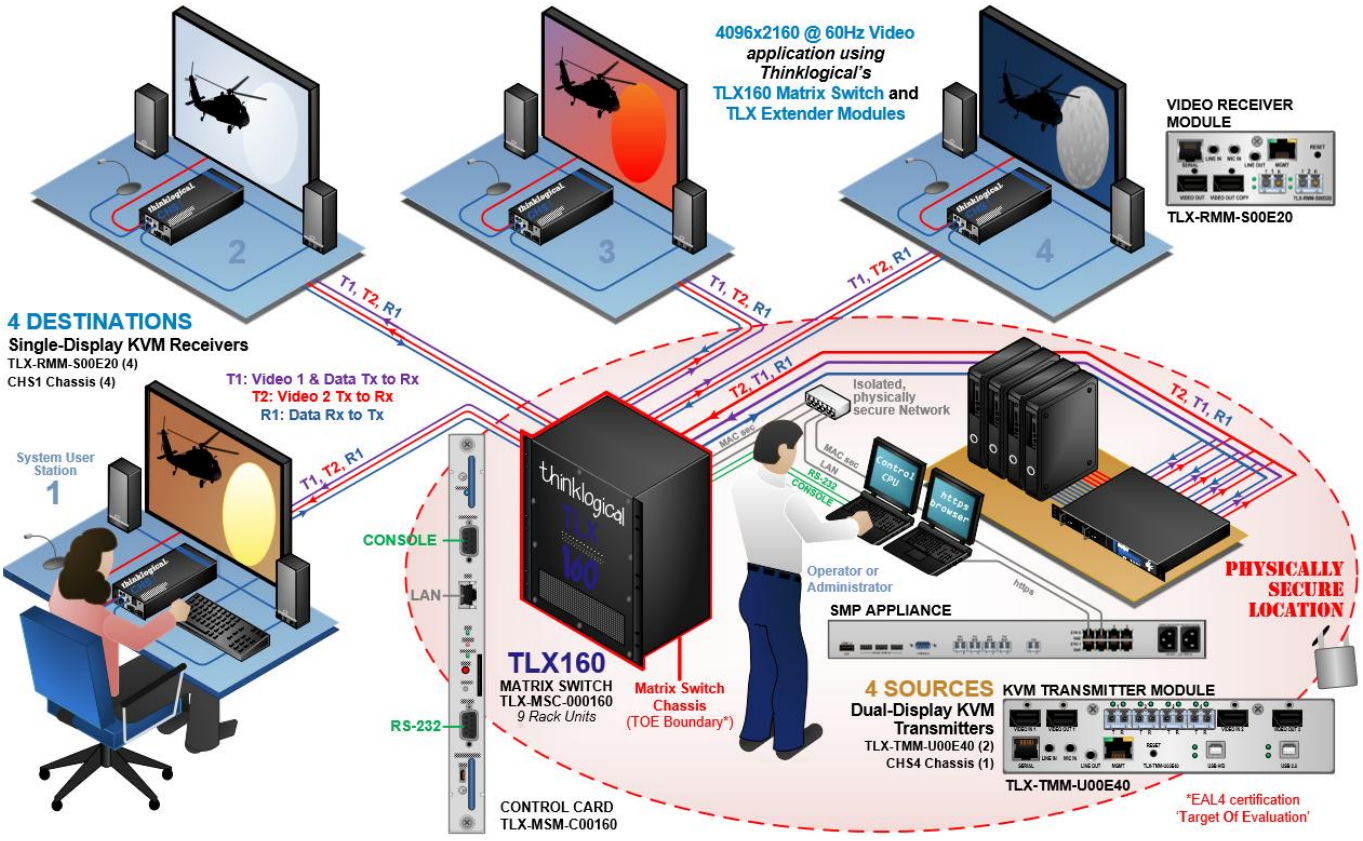
The LAN and serial RS-232 connection both use the same low-level ASCII API syntax. This command syntax is defined in the document: **Manual_TLX_Matrix_Switch_ASCII_API_V5**. Each line contains only one command and must end with a carriage return (CR) and line feed (LF), or just a line feed (LF). The 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 (**T**ransmission **C**ontrol **P**rotocol) port **17567**. It accepts the same commands as the serial interface. You may use telnet to manually open a connection and control the TLX Matrix Switch using port 17567.

Third-party controllers will control the Matrix Switch by connecting to the LAN or RS-232 serial port. Using the network is the only means to take advantage of our automatic fail-over facility.

The System Management Portfolio

Thinklogical offers a web-based control program called 'SMP.' This program is described in greater detail in the document: **Manual_System_Management_Portfolio**, available on the Thinklogical web site.



Routing *Thinklogical*® TLX Extenders through the TLX160

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 Ubuntu 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. [40] for *Dual-Level Authentication.*

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 Users / Passwords

TLX Matrix Switch Operating Systems: **Ubuntu**
Installed on V5.10.XX

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

Linux Command Console (CONSOLE Port)

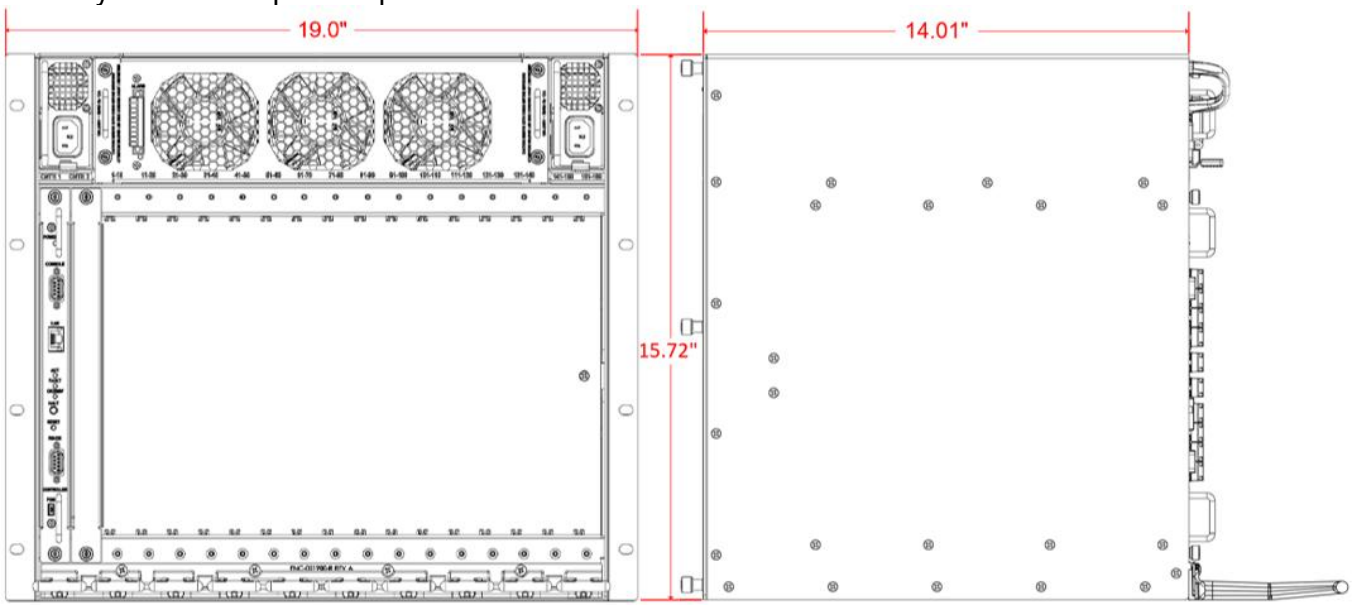
- Baud Rate: 115200
- Data Bits: 8
- Parity: none
- Stop Bits: 1
- Flow Control: none
- DB9 DCE
  - A straight (NOT a null-modem) cable is needed to connect to a PC.

ASCII API Settings (RS-232 Port)

- 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 TLX160 for the First Time

After the TLX160 has been successfully unpacked, inspected and installed in the desired location, it will be ready for its initial power-up.



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.
- Cable Management Bracket (if applicable) is installed. See Appendix D, pg. [39].
- Adequate input power is available. See *Technical Specifications*, *pg.* [17].
- 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 passwords to replace the default passwords, pg. [24].
- The Ethernet's static IP address is set via the DIP Switch located on the back panel, pg. [18].

Power-Up Procedure

After meeting the requirements in the above checklist, follow the steps below to power-up the TLX160 Matrix Switch and verify that it completes initialization and self-test. After completing this procedure, the Matrix Switch is ready to be configured.

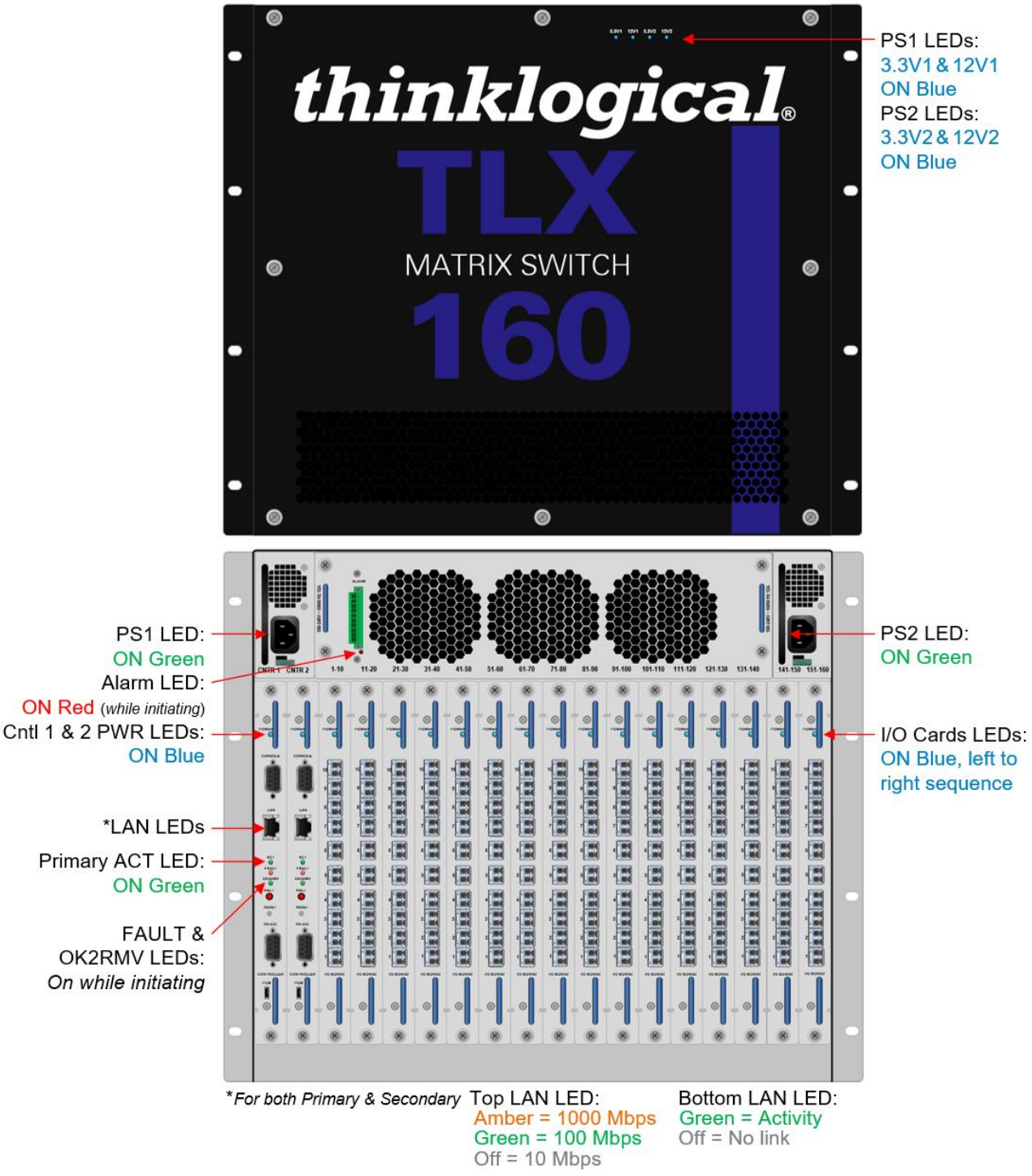
- Plug in the power supply(s).
- Verify the information presented on the power-up com screen indicates OK on each scrolling line.
- Verify front and back panel LEDs are as described in **Initialization** on the following page.

For detailed instructions refer to the **Quick Start Guide** available as **Appendix A**, pg. [34].

Initialization

Upon system power-up, look for the following between initialization and system-ready:

- The LEDs of each Power Supply will be ON.
- The PWR, ACT, FAULT & OK2RMV LEDs on both Controllers will be lit while initiating. Then PWR and ACT will be lit on the Primary and only PWR will be lit on the Back-up.
- I/O Card PWR LEDs will light in a left-to-right sequence.
- Both Controller's connected LAN port LED(s) will be lit following initiation. See key, below.
- The ALARM LED will be lit until initialization is complete.



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 thumbscrews 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 pg. [14].

The TLX160 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/`

Post Initialization Software and FPGA Firmware Checks

Upon system power-up/initialization, the system will be ready for verification of software and FPGA firmware. This will require Administrator access to run the tlxid command at the command prompt, as shown with the following commands:

- user *(default user name)*
- user *(default user password)*
- su *(administrative access)*
- root *(default administrative password)*
- tlxid *(system information command)*

All pertinent information about the system will be on the console screen, including software and FPGA version. Verify that software and FPGA versions match the system's shipping Sales/Work Order.

Built-in System Test (BIST) Results Check

Upon system power-up/initialization, the BIST function will automatically run and generate an entry in the `bist.log` file. The Administrator should always check the file for errors that must be corrected prior to system deployment. The log file can be found in the `/var/log/bist.log` file.

A BIST is non-intrusive and can be run during deployed system operation. This will require Administrator access and running the bist.sh command at the command prompt as shown with the following commands. This test may take several minutes to complete. The Administrator should always check the `bist.log` file for errors that must be corrected:

- user *(default user name)*
- user *(default user password)*
- su *(administrative access)*
- root *(default administrative password)*
- bist.sh *(built-in system test command)*

Safely Remove an Active Control Card

During normal, non-maintenance operation, the **Primary Control Card (CTRL 1, left 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, left 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 within 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.

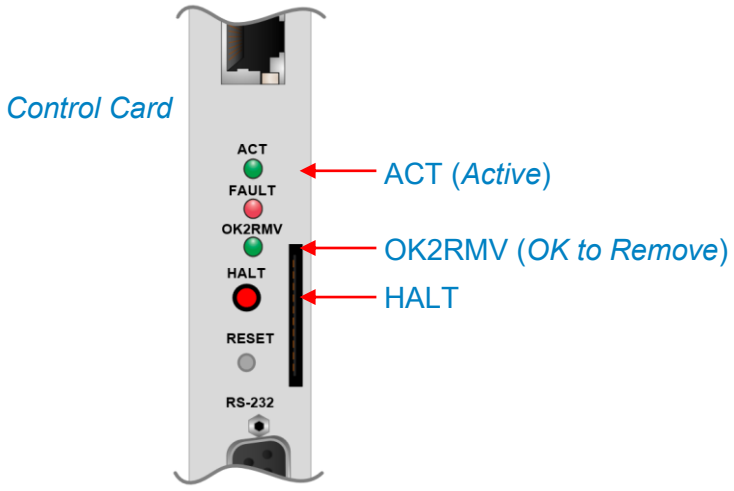
Note: I/O Card slot power cannot be turned off on the TLX160.

- 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 previous page.)
- Reinstall the external cables. Upon turn-on, the Control Card in the left slot will become the Primary and the Card in the right slot will be the Back-up.

The HALT Button

HALT (Primary Controller): In a TLX160 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 TLX160 does not have a Back-up Controller, holding this button for >5 seconds will halt the CPU and power-down the I/O Cards. The OK2RMV (**OK to ReMoVe**) LED will be lit and the ACT (**ACT**ive) LED will not.

HALT (Back-up Controller): Holding this button for >5 seconds will halt the CPU (iMX6). If the Back-up Controller is the active controller, the TLX160 will also power-down the I/O Cards. If the Back-up Controller is not the active controller, the CPU will be halted and ready to be removed. The OK2RMV (**OK to ReMoVe**) LED will be lit and the ACT (**ACT**ive) LED will not.



Firmware Updates

See **APPENDIX B: FPGA Program Code Update Procedure** on pg. [35].

Firmware updates are available through Thinklogical®. For technical assistance, please call us at **1-203-647-8700**.

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!

How to Remove and Replace an Input/Output Card

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

1) Remove any external cables.

2) Turn the card's two thumbscrews counterclockwise until they disengage from the chassis. Pull the card straight out using both handles. **Do not pull on the thumbscrews when removing the module – damage may occur! Use the handles!**

3) Hold the replacement module by the handles and place it into the slot vertically with the POWER LED on top. The card should slide freely until it reaches the backplane connector. Use just enough force to firmly engage the card with the mating connector. **If the module does not slide into the connector, do not force it! Damage may occur. Remove the card and start over.**

4) Hand-tighten the thumbscrews. **Do not tighten the thumbscrews with a screwdriver.**

5) Reinstall any external cables.

How to Remove and Replace a Fan Tray

The TLX160 uses three DC fans to move air vertically through the enclosure. Be sure not to block the air vents on the front of the unit and below the Card Cage on the rear panel. Leave at least 2" of space on both sides.

Note: Leave adequate ventilation space on both sides of the units (2" minimum), especially if devices are being stacked above or below the TLX160 KVM Matrix Switch.

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

1) Remove any external Alarm cables.

2) Turn the four thumbscrews counter-clockwise until they disengage from the chassis.

3) Pull the Fan Tray module straight out using the two handles on either side.

4) Place the new tray so that the alarm is toward the left. Hold the Fan Tray by the handles and slide the aluminum housing into the 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 into the connector, do not force it! Damage may occur. Remove the tray and start over.**

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

5) Hand-tighten the thumbscrews. **Do not tighten the thumbscrews with a screwdriver.**

6) Reinstall any external Alarm cables.

How to Remove and Replace a Power Supply Module

Each Power Module has a universal input of 100-240VAC, 50-60Hz. Use the proper power cords for your region. (Two PWR-000056-R power cords are supplied with the unit).

Warning! Disconnect the power cord before proceeding!

Note: If only ONE power supply is installed, shutdown IS required. If TWO power supplies are installed and only one is being replaced, shutdown IS NOT required.

All TLX160 Power Modules, regardless of make or model, use a universal input of 100-240VAC, 50-60Hz. Use the proper power cords for your region (PWR-000056-R, supplied with the unit). **Although the TLX160 functions properly with one Power Module, it is recommended that the Primary and Back-up be connected to two independent power sources for redundancy.**

1) Lift the green latch tab.

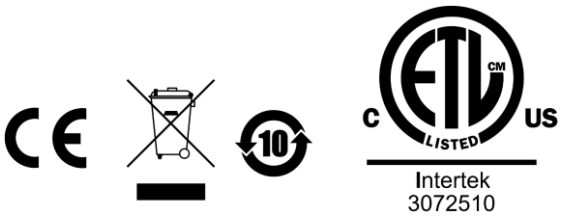
2) While holding the tab up, pull the Power Module straight out of the chassis by the handle.

3) Insert the new Power 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 rear mating connector. **If the module does not slide easily into the connector, do not force it! Damage may occur. Remove the module, reseat it, and start over.**

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 with 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 for 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 party responsible 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 & Interrupts 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 exigencies du Règlement sur le matérial brouilleur du Canada*.
- This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the party responsible may be required to take corrective action.
- This equipment has been evaluated and found to be 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 party responsible 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

Customer Support

- **Website:** https://www.thinklogical.com/downloads/

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

- **FPGA Update Guides**
- **Quick-Start Guides**
- **User Manuals** (for viewing online or for download)
- **Visio Stencils**
- **Chat Live** with a Technical Support Representative.

Technical Support

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

- **Email:** support@thinklogical.com – (preferred)
- **Telephone: 1-203-647-8700** or **1-800-291-3211 -** Monday-Friday, between 8:30am and 5:00pm, Eastern Time Zone.

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.

Return Merchandise Authorization

If you wish to return your device, contact the Thinklogical-authorized dealer where you purchased the device.

Or -

If you need to return a product to Thinklogical directly, please use the support email above. Support will need the device's serial number and a description of the issue. You will then be assigned a **R**eturn **M**erchandise **A**uthorization (RMA) number. Pack the device in its original box, if possible, and return it with the RMA number printed on the outside of the box. **Please DO NOT return a product to Thinklogical without a *Return Merchandise Authorization*.**

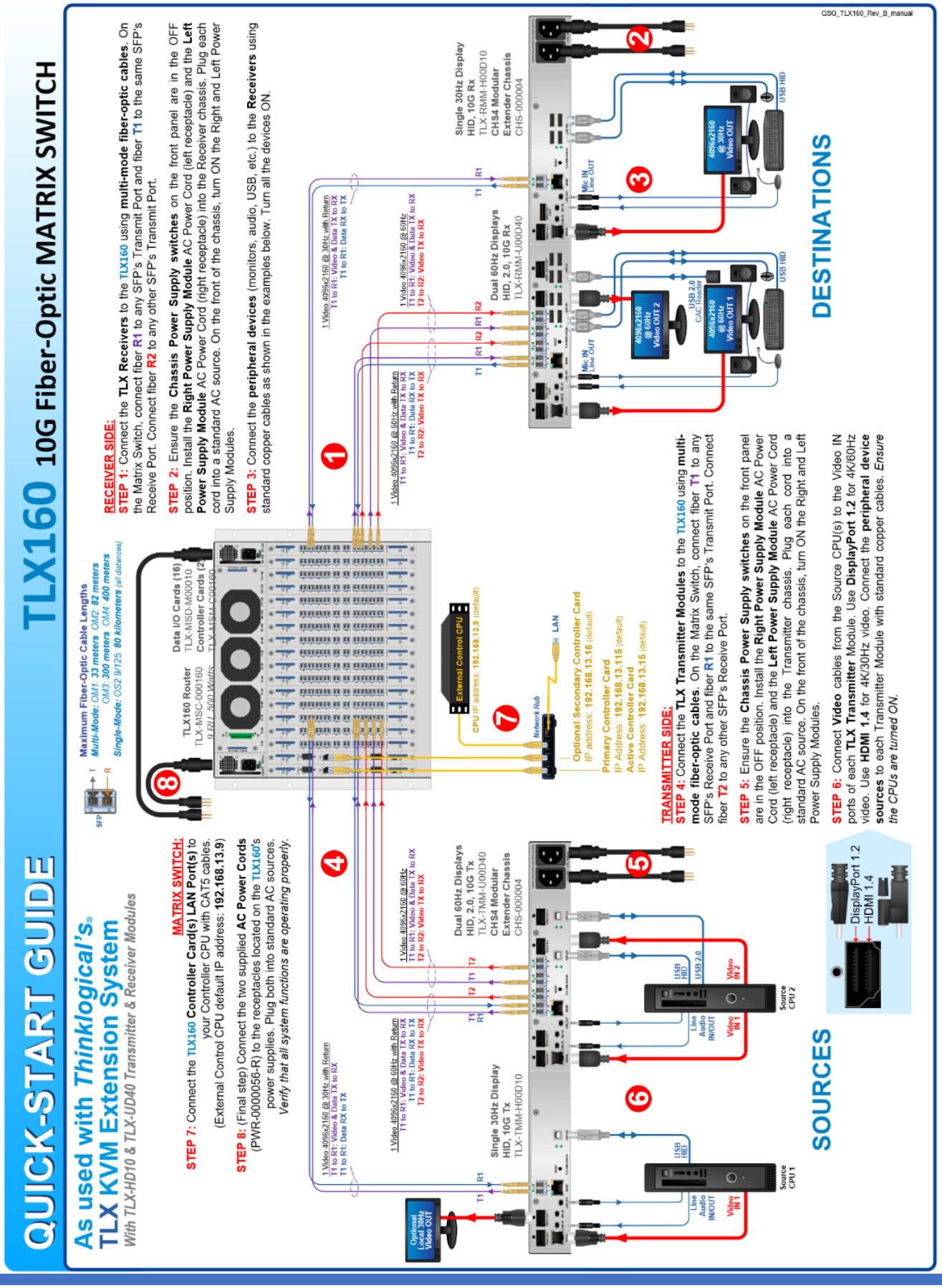
Our Address

If you need to write to us or return a product, please use the following address:

Thinklogical, A **BELDEN** BRAND
100 Washington Street
Milford, CT 06460 USA
Attn: *RMA#*

Please include the Return Merchandise Authorization number.

Appendix A: TLX160 Quick Start Guide



The following procedure documents the steps necessary to update the FPGA program code on a TLX160 10G KVM Matrix Switch using a Windows-based computer.

Perform steps 1-8 as described:

thinklogical® TLX160 KVM Matrix Switch FPGA Program Code Update Procedure

1 **STEP 1: To receive updated FPGA firmware for the TLX160 Matrix Switch Controller Card:**

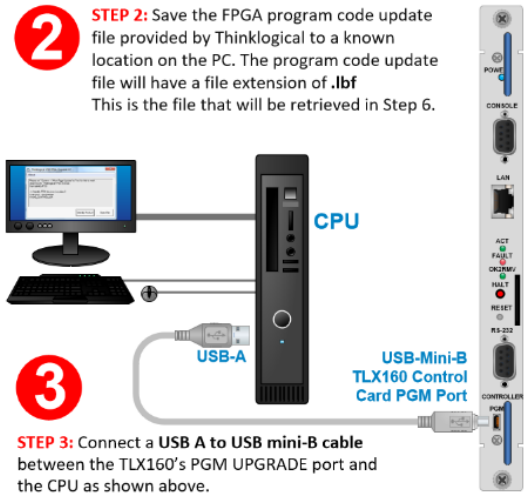
A. Contact ***thinklogical*** Technical Support at **1-203-647-8700** for a link to access the **"FPGA Upgrade"** application and the FPGA firmware.

B. Thinklogical will then provide, via email, a cryptographically-hashed checksum file of the FPGA firmware.
An example of the checksum file FPGA_firmware_checksum.txt may look like this:
f7e8a599d2d423d094cdc97395e74bbe986005dc05257dc50bf67805f3cfc09a *\FPGA_firmware.lbf

C. Once the FPGA firmware is downloaded, run a **sha256 hash** on that file.
Example of running a sha256 hash in Windows:
At the command prompt, type the following: certutil -hashfile C:\path\to\the\FPGA_firmware.lbf SHA256
This will output a checksum of the downloaded FPGA_firmware.lbf.

D. The two checksums should be compared and confirmed that they match. The FPGA firmware can then be considered valid and the programing process can begin.

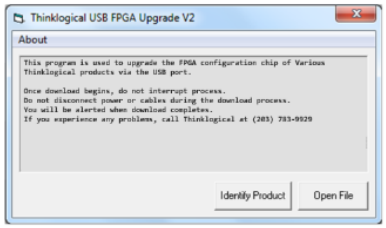
2 **STEP 2:** Save the FPGA program code update file provided by Thinklogical to a known location on the PC. The program code update file will have a file extension of **.lbf**
This is the file that will be retrieved in Step 6.



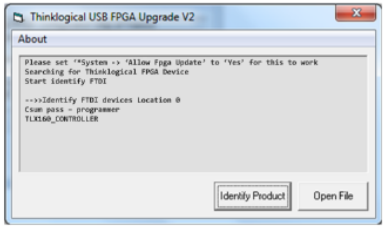
3 **STEP 3:** Connect a **USB A to USB mini-B cable** between the TLX160's PGM UPGRADE port and the CPU as shown above.

MADE IN USA

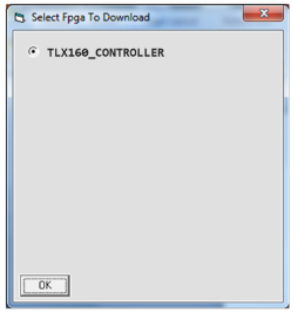
4 **STEP 4:** Run the Thinklogical **FPGA Upgrade** application. You will see the following window. Click on *Identify Product*.



5 **STEP 5:** You may see a window similar to this, identifying the desired file name. Click *Open File.*

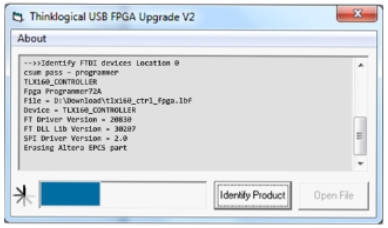


6 **STEP 6:** Select OK. A dialog box similar to this will open.

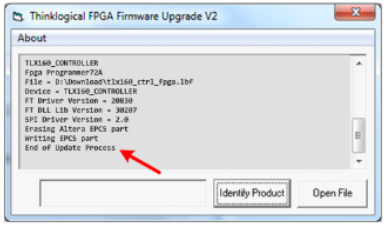


Browse to and select the file: **tlx160_ctrl_fpga.lbf** (This is the file saved in Step 2.) and press OPEN to begin.

7 **STEP 7:** Verify the response below during the process. The spinning bar to the left of the progress bar will stop when the download is complete.



8 **STEP 8:** When **FPGA download is complete,** you will see the window below. The Upgrade Procedure is now complete. Remove the USB cable from the PGM Update Port and exit the application.

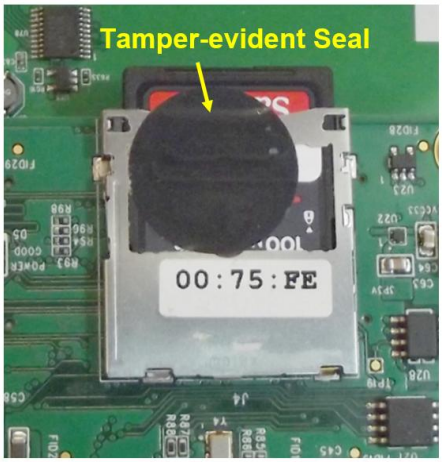


Appendix C: SD Card Replacement for the TLX160 Controller Card

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

Note: If using Partitioning, Restricted Switching or P2P, 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. If there is a tamper-evident seal over the SD Card, verify that the seal has not been compromised. If any part of the seal has been lifted, the entire seal will display a VOID warning, indicating the device may have been compromised. If the SD Card has a non-tamper-evident seal, simply remove it.



SD Card properly sealed

Evidence of tampering

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*.

4. Install the replacement SD Card. (*See instructions, next page*.)
5. Install the Back-up Controller Card into the chassis with a CONSOLE serial connection. Do not connect the network cable.
6. When the card boots up, verify the IP settings with the ADM utility (pg. [41]). Refer to the document **Manual_TLX_Matrix_Switch_ADM,** available here; https://www.thinklogical.com/downloads/ when verifying IP settings.
7. Check the 'date/time/timezone' with a `date` command. To set or change either, see pg. [38].
8. Perform other site-specific operations as necessary (*password, NTP, etc.*).
9. Issue a `reboot` command.
10. When `reboot` is ready, connect the network cable to the Back-up Controller Card and wait ~10 seconds.
11. Unplug the network cable from the Primary Controller Card.
12. 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.
13. Verify the Back-up Controller's function by performing a switching operation.
14. On the Primary Controller, issue a `poweroff` command. When the ACTIVE LED goes off, pull the Controller out and replace the SD Card. (*See instructions, next page*.)
15. Install the Primary Controller with the serial cable only. Do not connect the network cable.

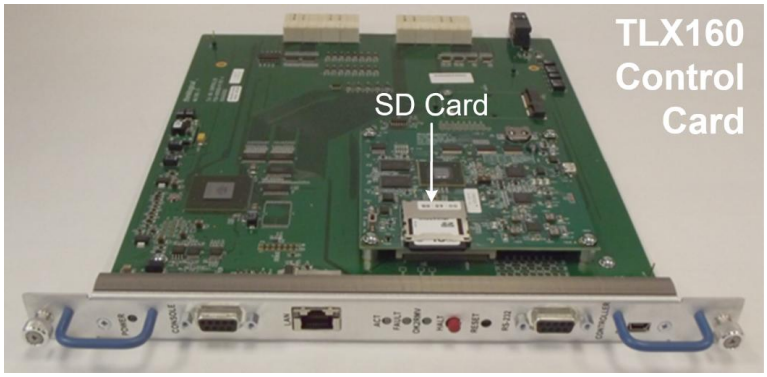
16. When the Controller Card boots up, check the IP settings and make any needed changes using the ADM utility (pg. [41]). Refer to the document **Manual_TLX_Matrix_Switch_ADM,** available here; https://www.thinklogical.com/downloads/
17. Check the 'date/time/time zone' with a `date` command. To set or change either, see the next page.
18. Perform other site-specific operations as necessary (*password, NTP, etc.*).
19. Connect the network cable to the Primary Controller.
20. 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.
21. Verify the Primary Controller's function by performing a switching operation.

Remove an Installed SD Card

- *Remove the uncompromised tamper-evident seal (see Step 3, above) or other seal type.*
- *Gently press in on the top of the installed SD Card to release the spring latch.*
- *Once released, pull the card straight out of the receptacle.*
- *See the proper packing & shipping instructions below.*

Install an SD Card

▪ *Gently insert the Card into the receptacle and press in until the latch catches.*
▪ *Release the Card. It is now locked into the receptacle.*
▪ *Affix the provided tamper-evident seal LBL-001006-R as shown on the previous page. Be sure not to cover the MAC address label on the receptacle and be sure there are no over-hanging edges. Once the seal is in place, no part of it can be lifted or the VOID warning will appear.*



Packaging and Shipping of SD Cards

Special precautions are necessary for shipping EAL4 (**E**valuation **A**ssurance **L**evel) 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 has a 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 1201163825**" will set the module for **December 1, 4:38PM, 2025**. This sets the Linux clock. However, this will be lost after repowering the unit.

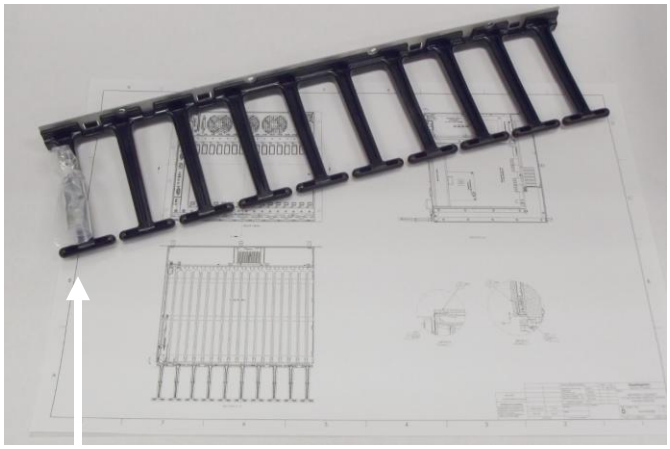
5. Check the date, time and time zone again to verify that it is correct.

6. Set the permanent hardware clock with the following command: "**hwclock --systohc**". *Note that there is a space and double hyphens between the parameters.* When Linux boots it will read the H/W clock correctly.

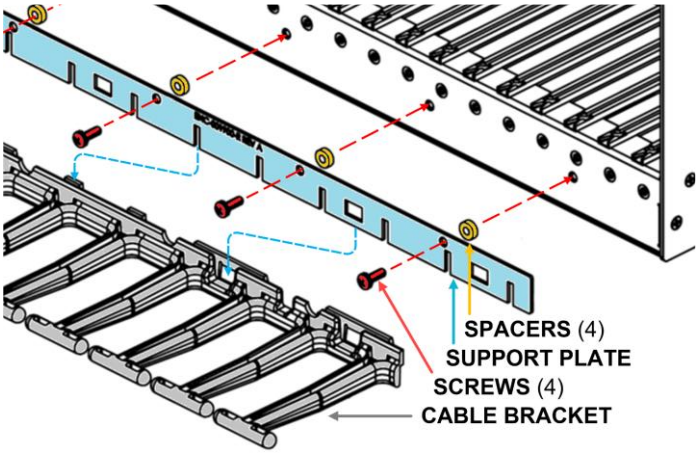
Verify the date & time setting after configuring it. Changing the date too far in the past will prevent Linux from booting at all. If this happens, remove and replace the 3V RTC (**R**eal **T**ime **C**lock) battery to reset the date/time to a known state, then correct it.

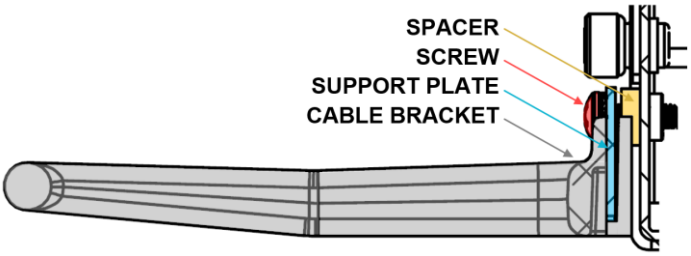
Note: Following this procedure as described will NOT void any valid warranty applied to this product.

Appendix D: Cable Management Bracket Installation



*The supplied **Cable Management Bracket Assembly ENC-001349** arrives partially assembled. A package containing four mounting screws and spacers is attached.*





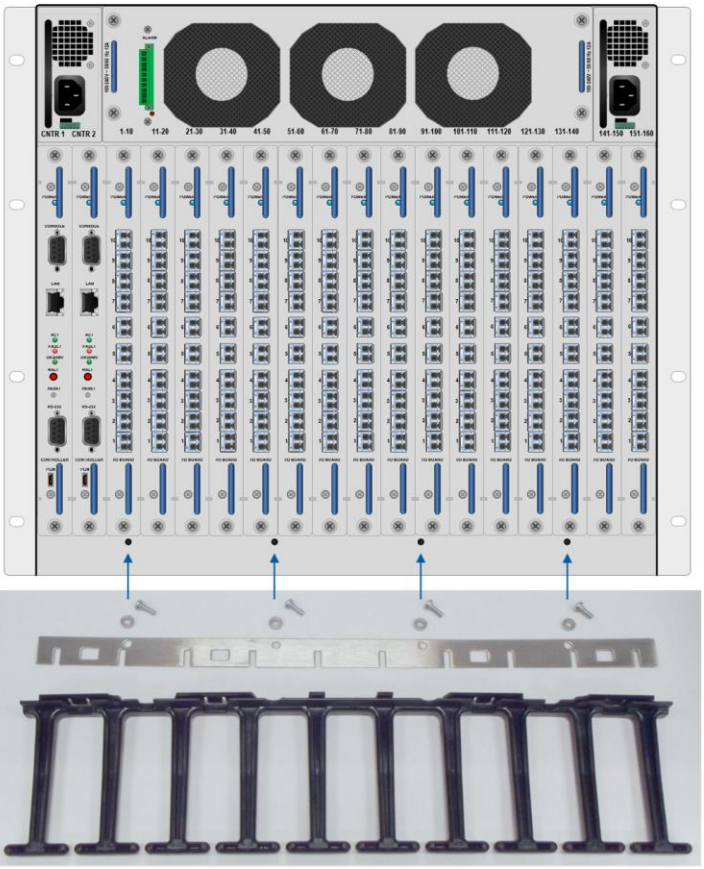
Install the supplied *Cable Management Bracket Assembly* into the four mounting holes on the lower, rear back panel of the chassis, in the orientation shown, before installing the fiber-optic cables.

1.Install a spacer behind each of the four mounting holes of the Support Plate.

2. Install one of the provided mounting screws into each of the four mounting holes. Torque each to 14 in/lb.

3. Install fiber-optic cables into the TLX160 as required.

4. Pass the fibers into the bracket slots directly below to keep them neat, organized and secure.



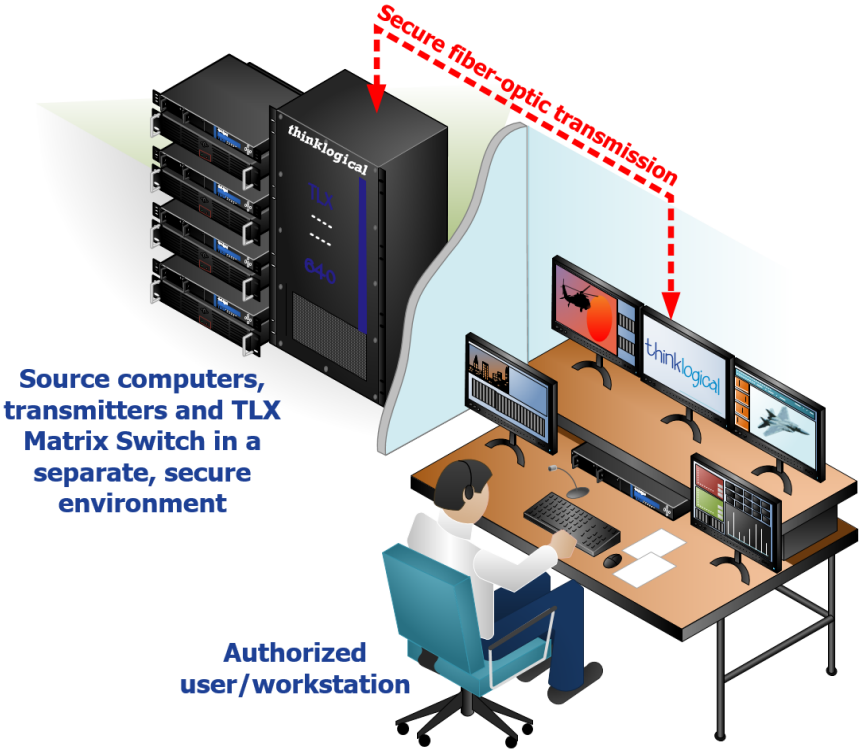
Other cable management options are also available:

https://www.thinklogical.com/products/fiber-harnesses-and-cable-management-for-matrix-switches/

Appendix E: 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 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 trusted administrators have access.



Note: The Matrix Switch does not mitigate vulnerabilities in attached devices, so vulnerabilities associated with attached devices and/or connections to the Matrix Switch, shall be a concern of the application scenario and not of the Matrix Switch.

Warning! Updating the FPGA firmware version to another version will result in an invalid Common Criteria certificate.

Dual-Level Authentication

All configuration files associated with security management, configuration control and connection security policy (see ***Modes of Operation**; Restricted, Partition, and Point-to-Point*, next page) are owned by the System Controller at root level, are writable only by root and are viewable only by root and the operator.

The System Controller is configured for *Dual-Level Authentication*. This requires that an operator be first to login. Once the operator has logged into the System Controller, only then can the administrator log into the System Controller and escalate system access to root level. The operator, even though logged in first, does not have root level access in the Matrix Switch.

Two Dual-Level Authentication methods by which the administrator or operator can access the Matrix Switch's System Controller Ubuntu command line are *direct* and *LAN*:

- **Direct** connects to the Matrix Switch by using the *Serial Console Interface* on the System Controller.
- **LAN** uses SSH access by connecting to the *LAN Port* on the System Controller.

Because the authentication is done on one interface, both the administrator and operator must be co-located. **This system of authentication requires that two individuals be present to authenticate the System Controller**, with each being a witness to the login escalation to root level.

For additional documentation about secure operation and configuration, please refer to the document: **Military_Unique_Deployment_Guide_for_TLX_Matrix_Switching_Solution_5c**, available through Thinklogical.

Note: It is recommended that all passwords must be kept confidential and stored in separate secure locations. For example, the root password and the operator password should be stored in separate safes.

ADM Authentication and Configuration

Access to the System Controller, without dual-level authentication, can only be done locally through the **adm**inistration tool **ADM** (Thinklogical ADMIN), a web service loaded onto the System Controller of the Matrix Switch that allows for limited system configuration, management, and monitoring over a wired 10/100/1000BASE-TX LAN to a TLS/ https (FIPS 140) compliant web browser.

Note: Connection management or access to Restrict, Partition, or P2P Tables (see *Modes of Operation*, below) is not available through this interface.

Authentication is single level, requiring a user name and password. The ADM web service runs as root.

The Linux tab of the ADM "USERS" screen allows the administrator to add and modify Linux user accounts. Once the system is configured, it is recommended, for security reasons, that the Linux tab of the ADM "USERS" screen be permanently removed upon system deployment. This is done by clicking the "DISABLE LINUX USER ACCOUNT MANAGEMENT" radio button, then hitting APPLY. This will ensure that, post-deployment, an administrator cannot create an operator account for which that administrator will have the password.

For more information, refer to the ADM document **TLX_Matrix_Switch_ADM_Product_Manual**, available here: https://www.thinklogical.com/downloads/

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 most important thing you can do to protect the Matrix Switch is to 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 L3TTeR5 and NuM8ER5 within the password to enhance its strength.
- Include NoN-ALPH@NUmER!C CH@RAcTER$. Special characters (& # % >) and punctuation marks (? " - !) greatly increase the strength of a password.

Secure NTP and SNMP

To maintain security, an NTP server or SNMP agent must be connected to the same private LAN as the Matrix Switch.

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 of Operation 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 **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 tlxcntl[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. [12] 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 **tlxcntl.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 **tlxcntl.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. [27].
3) Power-cycle the system by following the **Power-up Procedure** on pg. [25].

Warning! 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*):

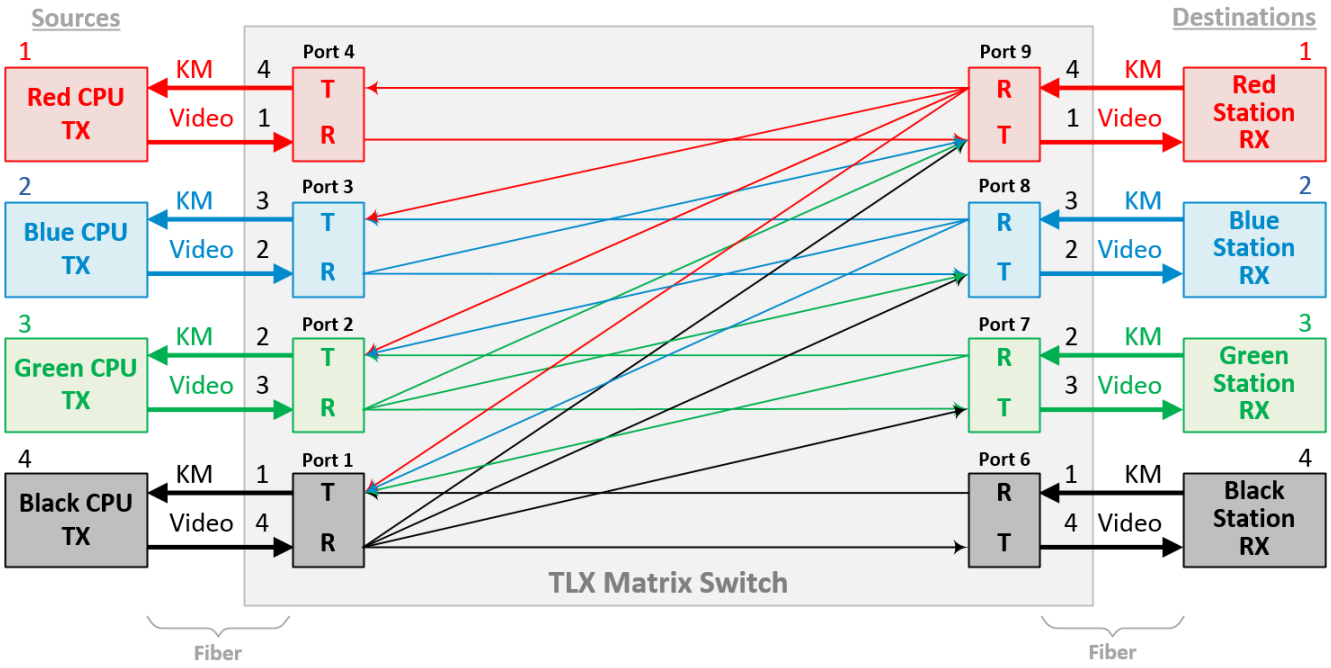
1) Update the Restricted Switching Table of the inactive Back-up Controller Card.
2) Take the Primary Controller Card out of service by following guidelines in the "Safely Remove an Active Controller Card" section of this document on pg. [27]. This will cause the Back-up Controller Card to become active 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 promptly restored.

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	Source Computer Network Transmissions That Can Be Seen
RED	BLACK, GREEN, BLUE, RED
BLUE	BLACK, GREEN, BLUE
GREEN	BLACK, GREEN
BLACK	BLACK

KEYBOARD/MOUSE:

Destination Workstation Network	Source Computer Networks That Can Be Controlled
RED	BLACK, GREEN, BLUE, RED
BLUE	BLACK, GREEN, BLUE
GREEN	BLACK, GREEN
BLACK	BLACK

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 on the right, with values in three columns:

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

"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

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 user must provide a table defining the partitions required in the Matrix Switch. This table is in the form of a **C**omma **S**eparated **V**alue (CSV) file. This file contains the port number and the partition number to which it belongs.

Example:

"Port", "Partition"

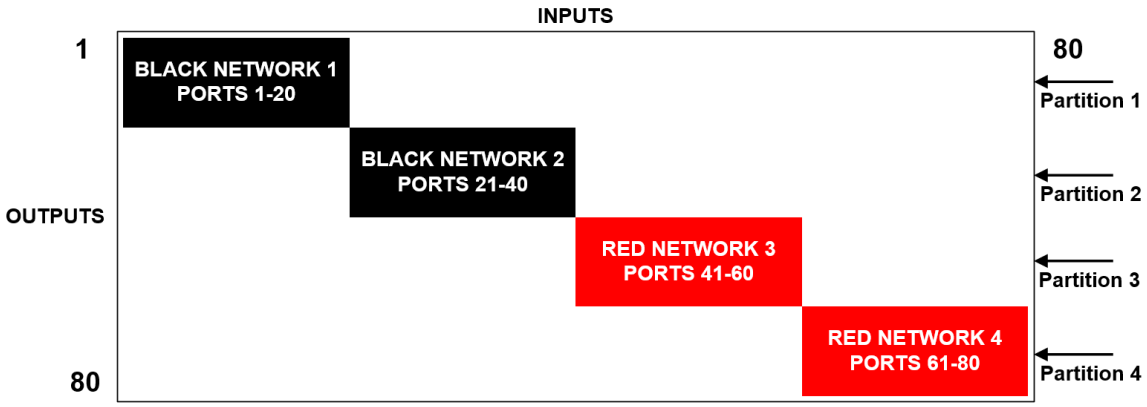
1, 2	Port 1 is part of Partition 2
2, 2	Port 2 is part of Partition 2
3, 2	Port 3 is part of Partition 2
4, 2,3	Port 4 is part of Partition 2 and 3
5, 3	Port 5 is part of Partition 3

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:**

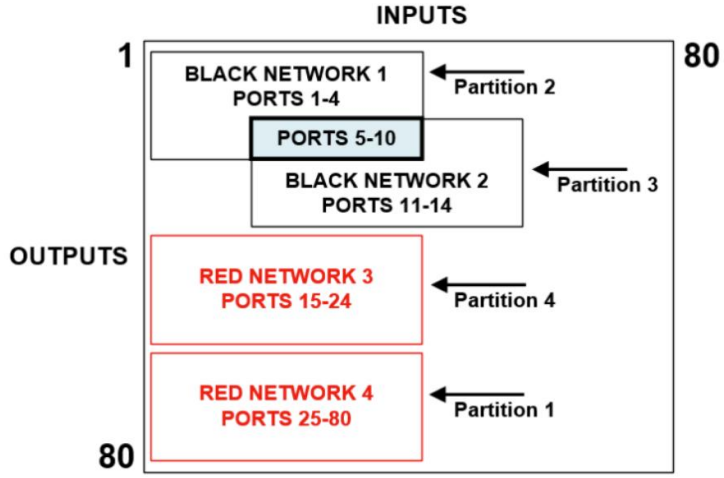


Four partitions are set up for secure routing and extension applications. Signals are only capable of transmitting and receiving within a single partition and not across partitions

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 partitions, 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:



PORT	PARTITION
1	2
2	2
3	2
4	2
5	2,3
6	2,3
7	2,3
8	2,3
9	2,3
10	2,3
11	3
12	3

PORT	PARTITION
13	3
14	3
15	4
16	4
17	4
18	4
19	4
20	4
21	4
22	4
23	4
24	4

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 user must be at the administrative level of the system and 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. [12] 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. [27].
  3) Power-cycle the system by following the **Power-Up Procedure** on pg. [25].

Warning! 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. [27]. 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-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 Partition Table. Ensure that the LAN connection to the Primary Controller Card is promptly restored.

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 entries per line is allowed. Blank lines are also allowed. The only characters allowed in the file are 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:	**Ex. 2:**	**Ex. 3:**	**Ex. 4:**	**Ex. 5:**
1,2,3	1	1		1,2
	2,3	2		
		3	1,2,3	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 **Ubuntu 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]: vxASCIIapi.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. [12] 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 **Ubuntu 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.

- 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 **Ubuntu 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.
- 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 **Ubuntu 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. [27].
3) Power-cycle the system by following the **Power-up Procedure** on pg. [25].

Warning! 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. [27]. 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 promptly restored.

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 user must be at the **administrative level** of the system, 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. [27].

Note: When implementing the Restore function, it requires a cold startup (system completely powered down and then powered up).

Power-cycle the system by following the **Power-Up Procedure** on pg. [25].

Warning! This procedure WILL be disruptive to system connections.

To enable the Restore Mode in a **redundant** system the user must be at the **administrative level** of the system, 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. [27].

Power-cycle the system by following the **Power-Up Procedure** on pg. [25].

Warning! This procedure WILL be disruptive to system connections.

To verify that the restore file has been detected by the system, the user must be at the **administrative level** of the system and run the **tlxid** command. To do this, issue 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. [27].

Power-cycle the system by following the **Power-up Procedure** on pg. [25].

Warning! 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. [27].

Power-cycle the system by following the **Power-up Procedure** on pg. [25].

Warning! 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. [12] for correct IP addresses of Controller Cards when in Primary Active or Back-up Active mode.

Note: The user should review the `errors.log` file regularly and 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 configuring the Switch to use this service at 192.168.13.xxx.
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 Examples

The diagram on the following page shows the TLX Matrix Switch in a secure application. The highly-secure components are described as the Red Network and the 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 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 Matrix Switch and the computer server.

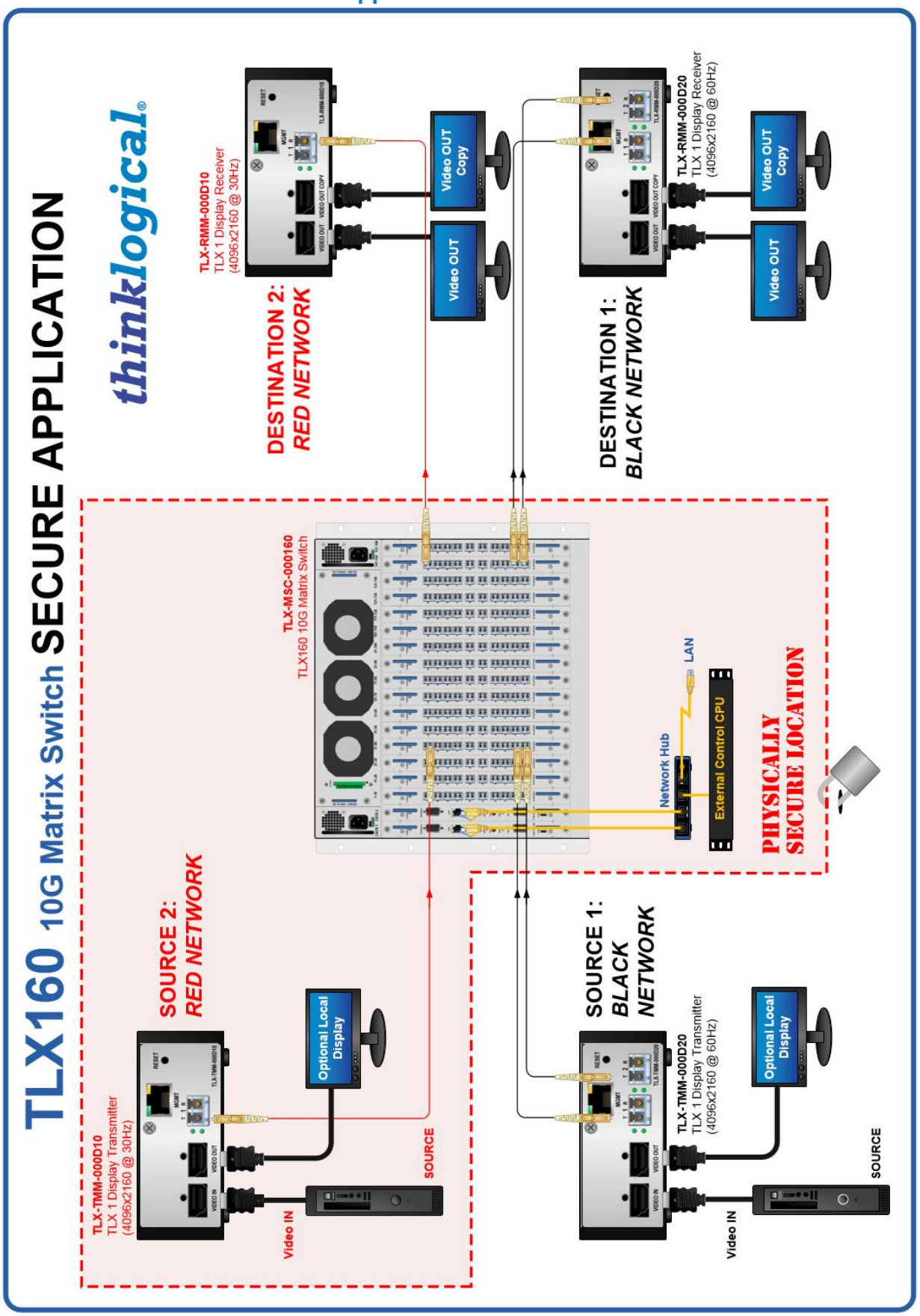
Note: The TLX Matrix Switch and the computer server used to manage the Switch must be protected according to the highest security classification of any component in the entire network application. The optical connections and destination receiver, designated as *Red Network,* must be kept in a physically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

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

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 organizational security policies.
- Changes in the threats presented by non-trusted network interfaces.
- Changes in administration, operation staff or the physical environment.

TLX160 Matrix Switch Secure Application



About Thinklogical, A BELDEN BRAND

thinklogical, A BELDEN BRAND
100 Washington St.
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Thinklogical, a Belden Brand, is the leading manufacturer and provider of fiber-optic 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.

Thinklogical is headquartered in Milford, Connecticut, USA 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.

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