

thinklogical[®]

A **BELDEN** BRAND

TLX160

10G MATRIX SWITCH PRODUCT MANUAL



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

Rev. G, May 2021

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Subject: TLX160 10G Matrix Switch Product Manual
Revision: G, May 2021



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PREFACE

About Thinklogical A BELDEN BRAND



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

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

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



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

About this Product Manual

This product manual is divided into four sections: **TLX System Features, Set-Up & Installation, Regulatory & Safety Requirements** and **Thinklogical Support**. These are sub-divided to help you find the topics and procedures you are looking for. This manual also contains Appendices.

Section 1 – The TLX System Features: Pg. 1. Details the features and functions of your equipment.

Section 2 – Set-Up and Installation: Pg. 13. Contains all the requirements and procedures necessary to connect and install your equipment, including FPGA updates.

Section 3 – Safety & Regulatory Requirements: Pg. 23. Thinklogical® strongly recommends that you read this section prior to starting the hardware assembly.

Section 4 – Thinklogical Support: Pg. 25. Thinklogical provides the best customer support available. If you have any questions or need to contact us for any reason, please refer to this section of the manual.

Note and Warning Symbols

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



Note: Important Notes appear in blue text preceded by a yellow exclamation point symbol, as shown here.

A **note** is meant to call the reader's attention to **helpful or important** information at a point in the text that is relevant to the subject being discussed.



Warning! All Warnings appear in red text, followed by blue text, and preceded by a red stop sign, as shown here.

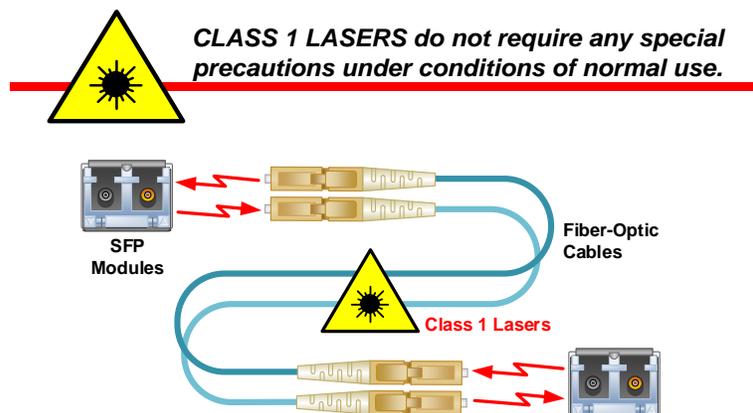
A **warning** is meant to call the reader's attention to **critical** information at a point in the text that is relevant to the subject being discussed.

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 Adobe Acrobat "PDF" files. If you do not have the Adobe Acrobat reader needed to view PDF files, visit www.adobe.com for a download.

Class 1 Laser Information

The TLX160, like all Thinklogical® products, is designed and identified as a **Class 1 LASER product**. 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 (e.g. magnifying glass, eye loupe).



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 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+ Transceivers (Tx & Rx) supporting up to 160 Thinklogical Transmitters and Receivers.

HYBRID SWITCHING SOLUTION

For Uncompressed, High Resolution Video & KVM Systems

Thinklogical's TLX Matrix Switches are *high performance, non-blocking switches* for complete end-to-end switching of video, audio and peripheral signals **over multi-mode or single mode fiber-optic cable**.

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

SECURITY

Creating physical separation between potential threats (users) and the target (secure data) is essential to a secure system design. Thinklogical's system permits users to **access sources up to 80 kilometers away, with no performance degradation**. 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).

PARTITIONED AND RESTRICTED SWITCHING

To protect data between multiple networks, partitioning allows the Matrix Switch resources to be divided to support more than one network without allowing switching between networks. Restricted switching allows the administrator to manage access on a port-by-port basis. Partitioned and restricted switching is enabled through the Matrix Switch's firmware, which means a threat would have to physically access the Matrix Switch to tamper with the settings. *See Appendix D, on pg. 30.*

RESILIENCY

TLX switches are designed to maximize system uptime. The modular approach of the TLX allows user to **hot-swap all critical system components**, including power supplies (in dual supply models), fan trays, control cards, input/output cards and pluggable optics. Furthermore, the system can be easily reconfigured, such as adding additional input/output cards for expansion, 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**. Enhanced diagnostics and alarms provide extensive real-time monitoring and diagnostics of critical functions of the switch.

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®

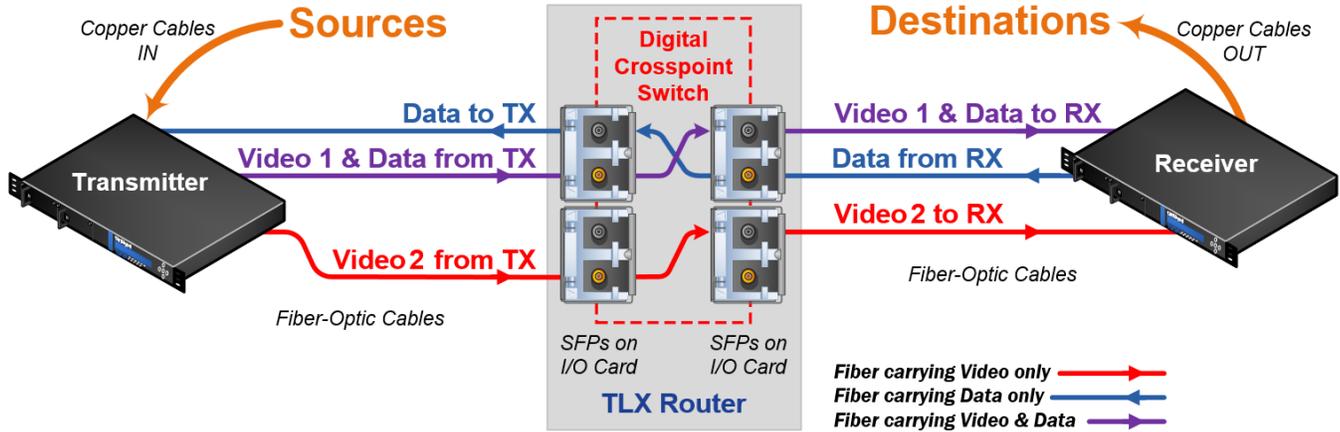
- Housed in a 9 RU Chassis
- Up to 160 fiber ports - In and Out (10Gbps / 6.25 Gbps with re-clocking input)
- Up to 160 SDI fiber ports (12Gbps with re-clocking input)
- Up to 160 SDI coax ports (12Gbps with re-clocking input)
- 10 ports scalability for hot swappable I/O Cards
- Redundant, current sharing, hot swappable power supply modules,
- Single-mode, multi-mode capability
- Comprehensive system setup and control provided via Thinklogical's SMP software
- Supports DVI, SDI, HD-SDI, Dual-link DVI, Dual-link SDI
- Supports multicasting and macros
- SNMP control protocol
- Controllable via LAN or serial connection
- Single, hot swappable fan tray with annunciator port (for alarms)
- Redundant Controller Card
- Failover/Power Off button (HALT button on Controller Cards)

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**
- Standard **VX Matrix Switch ASCII Interface** (via RS-232 port or via Network port)
- Standard **VX Matrix Switch IP Address Configuration Procedure**
- Standard **VX Matrix Switch SNMP Traps**
- **12G SDI Extenders**

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 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*, pg. 22.

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 should fail or need 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 SMP (required for the Back-up Controller to take control of the switch). 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.

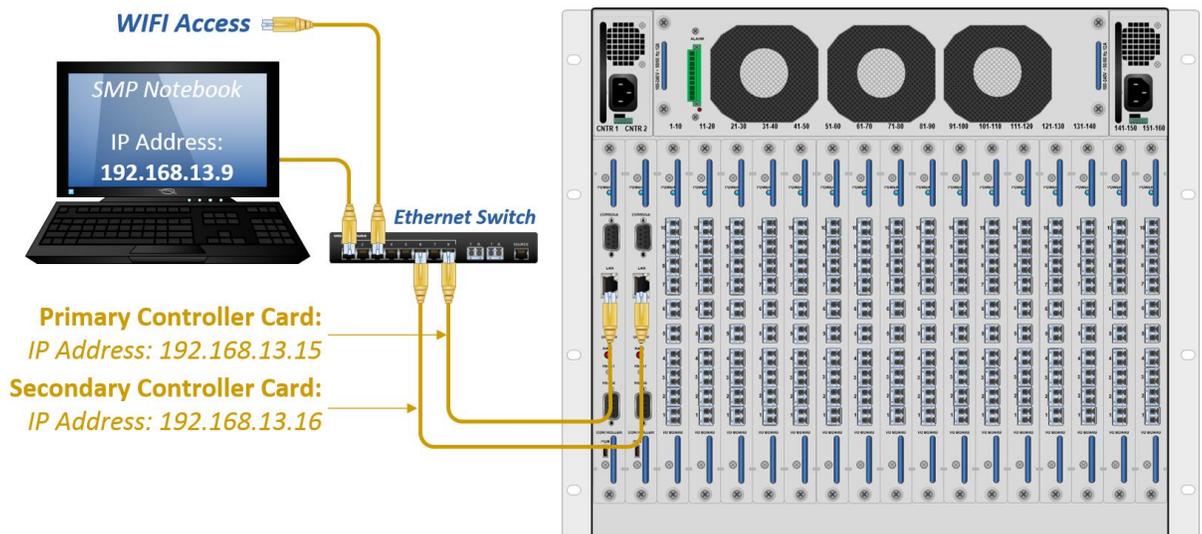
OK2RMV: Informs the operator if the CPU (IMX6) is halted. (**OK to ReMoVe**)

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 (**OKay to remove**) LED will be illuminated 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 is ready to be removed. Note that the OK2RMV (**OKay to remove**) LED will be illuminated 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:

CONSOLE/RS232: 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.*)

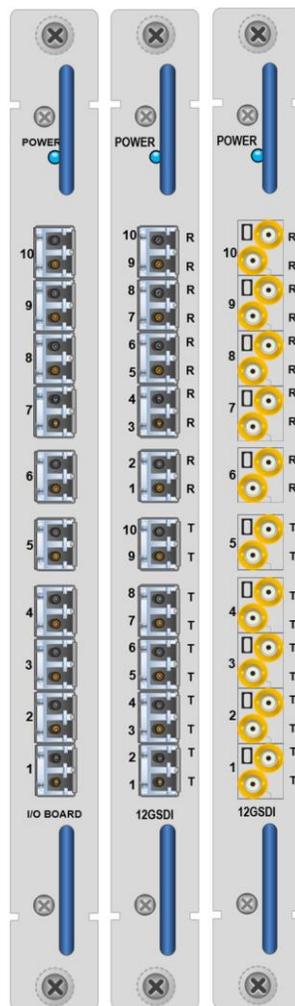
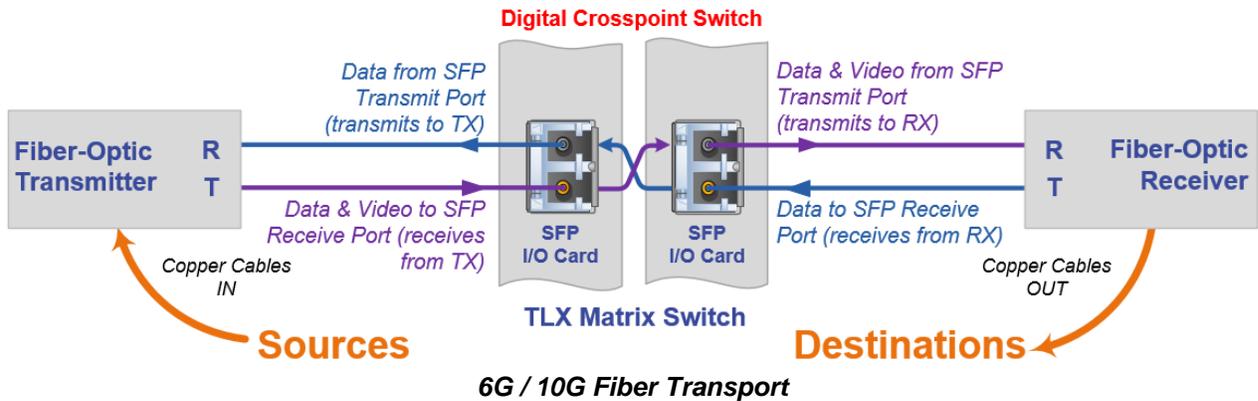
RS-232 Port (ASCII API)

- 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, pg. 27.*)

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

- 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 located 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

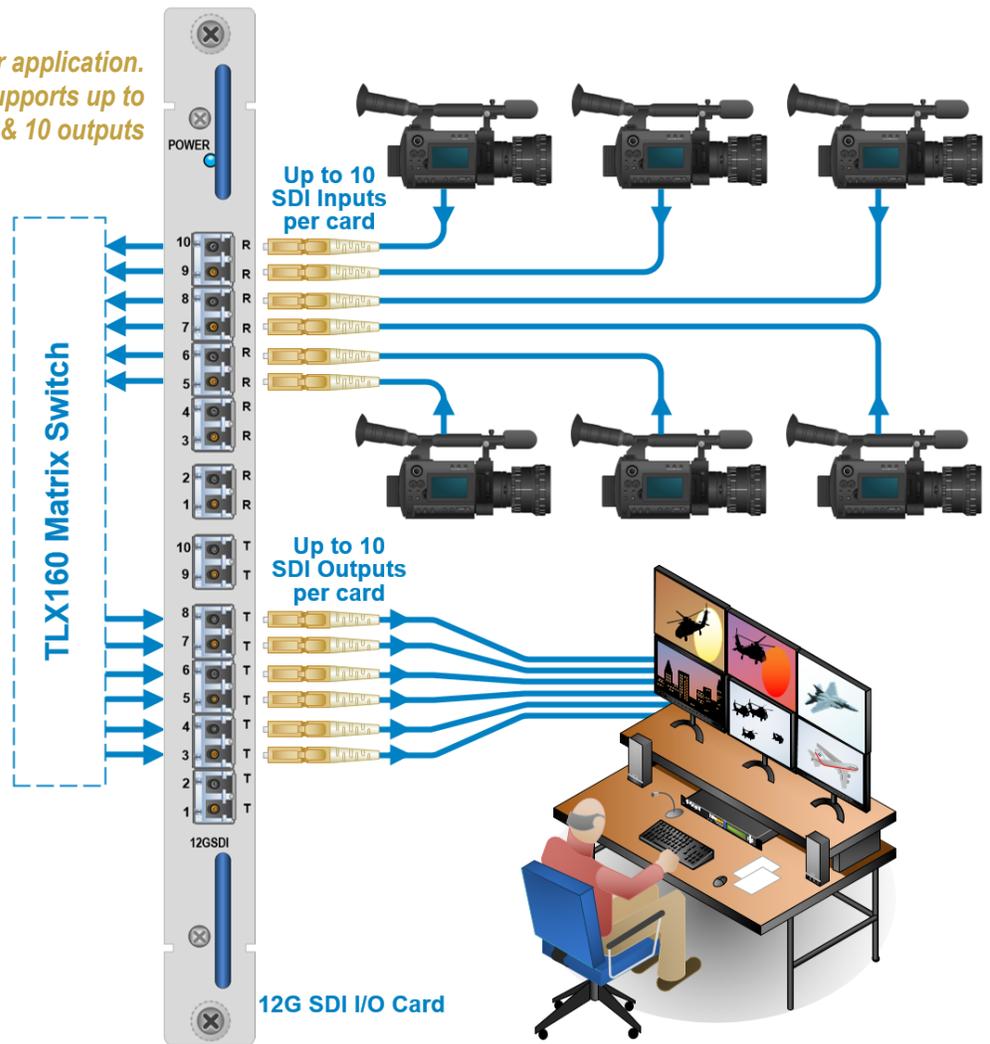
- The board provides direct SDI to SDI switching connectivity to the TLX160 without converting to a Thinklogical format, such as TLX or VX.
- The 12G SDI hot-swappable I/O Card provides ten individual 11.88Gbps SDI inputs and outputs.
- Also supports SDI rates of **6G**, **3G** and **1.5G**.
 - On single-mode 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 Gbps (FHD)
 - 280m at 1.485 Gbps (HD)
 - 600m at 270 Mbps (SD)

6G/10G
FIBER

12G SDI
FIBER/COAX

Ordering information on pg. 11.

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

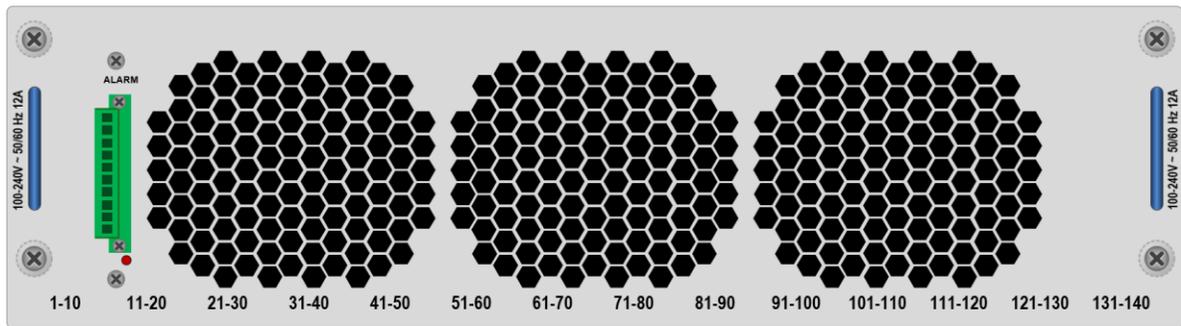


Each 12G SDI fiber-optic or coax SFP+ has either 2 outputs (Tx) or 2 inputs (Rx).



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 removing any heat generated by the Power Supply modules.

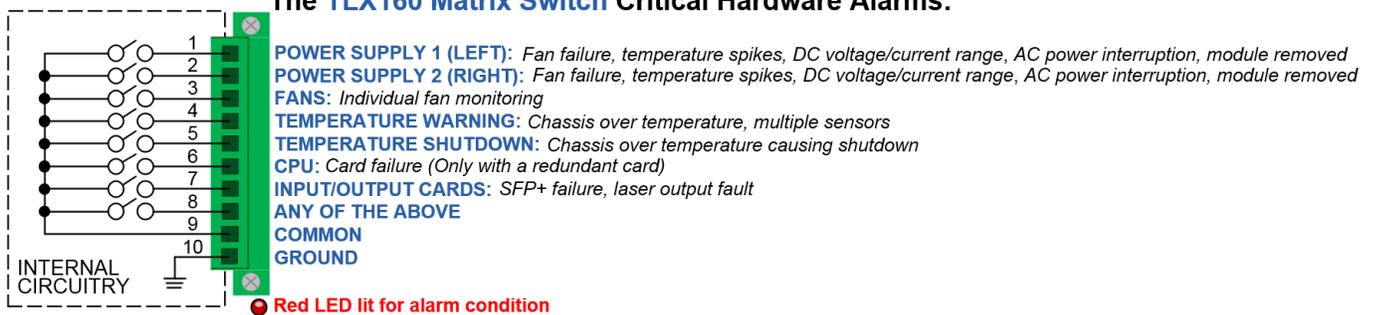


The Fan Tray Module

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.

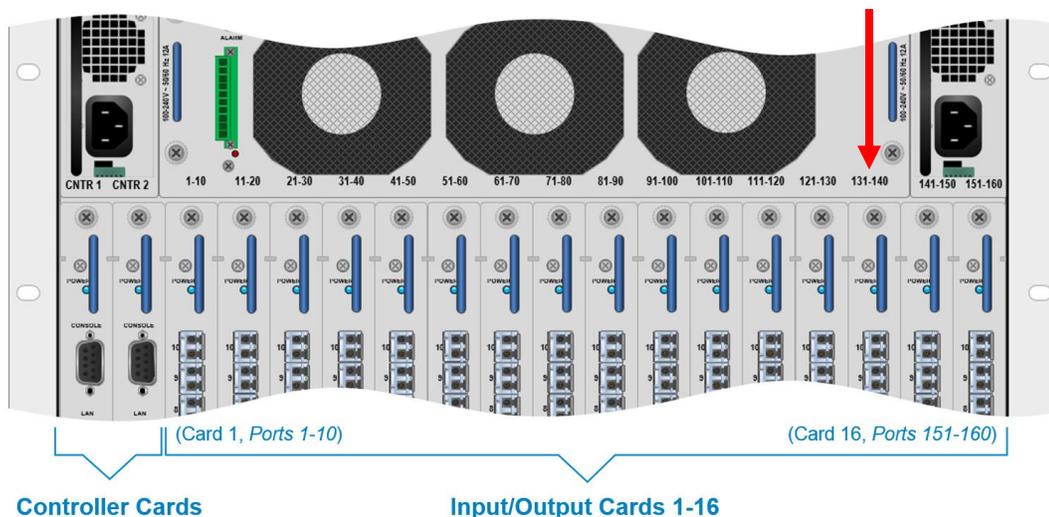
The TLX160 Matrix Switch Critical Hardware Alarms:



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.



THE PROCESSOR – i.MX 6 QUAD (Freescale)

The Processor platform key features:

- ARM Cortex-A9 MPCore 4 x CPU
- 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)
 - SATA II, 3.0 Gbps HDD
 - EIM Bus (FPGA Parallel Bus I/F)
- HDMI 1.4 port
- USB 2.0 Host (2 ports)
- 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*, pg. 14). The primary's IP address can be set from 15 to 45. The default subnet used by the switch 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](#)

The TLX160 uses several network 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
- First port number in this block
- Last port number in this block
- 'N' port number values

2. Port settings (UDP port 17565, matrix switch 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. Inventory and Power Supply Status (TCP port 17600)

- Card Inventory
- Power Supply Status (internal TL use only)
- Switch card temperature readings

5. I/O data (TCP ports 17601 through 17320, 1 port per I/O card)

Refer to the document: [Manual_TLX_Matrix_Switch_Interfaces](#)

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

The TLX160 10G Matrix Switch 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 switch 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, switch's primary IP address
- 16-bits, 0 for the Upper (or only) switch chassis, 1 for the Lower switch chassis
- 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 Network Management Protocol (supports version V2c and V3 USM). Please call our technical support staff at 1-203-647-8700 for downloadable MIB *Management Information Base* definition files.

There are certain entries in the SNMP configuration file (</etc/snmp/snmpd.conf>) that users may wish to 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. Users may have multiple trap2sink entries in the configuration file to specify multiple trap destinations.

Descriptions of the switch's SNMP traps may be found in the document:

[Manual_TLX_Matrix_Switch_SNMP_Traps](#)

NTP SUPPORT

NTP, or Network Time Protocol, is used to keep the internal clock on the switch set to the correct time. By enabling this service, users keep the switch's clock synchronized to an external time reference. To use the service users 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>

By default, NTP is configured to use a time server at '`timeserver1`'. This is defined in </etc/hosts> as 192.168.13.9.

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 rsyslogd program. Redirection is enabled by entries in **rsyslog** configuration files that are in </etc/rsyslog.d/00-remote.conf>

The default configuration has rsyslog sending (UDP) log messages to a system named '`remotelogger1`'. This name is defined in the file </etc/hosts> and is defined as 192.168.13.9.

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).

Ordering Information

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

PART NUMBERS FEATURES

TLX160 Matrix Switch

TLX-MSC-000160 TLX160 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 TLX160 Matrix Switch Data Input/Output Card, 10 Multi-Mode Fiber Ports, 10G
TLX-MSD-S00010 TLX160 Matrix Switch Data Input/Output Card, 10 Single-Mode Fiber Ports, 10G
TLX-MSD-MV0010 TLX160 Matrix Switch Data Input/Output Card, 10 Multi-Mode Fiber Ports, 6G
TLX-MSD-SV0010 TLX160 Matrix Switch Data Input/Output Card, 10 Single-Mode Fiber Ports, 6G
TLX-MSD-000010 TLX160 Matrix Switch Data Input/Output Card, 10 10G unpopulated

TLX160 Matrix Switch Data Input/Output Modules – 12G SDI

TLX-MSD-S12G10 TLX160 Matrix Switch Data Input/Output Card, 10 12G SDI Single-Mode Fiber
TLX-MSD-012G10 TLX160 Matrix Switch Data Input/Output Card, 10 12G SDI unpopulated
TLX-MSD-C12G10 TLX160 Matrix Switch Data Input/Output Card, 10 12G SDI coax cable

TLX160 Matrix Switch Spare Modules

TLX-MSM-C00160 TLX160 Matrix Switch Module, Controller Card
TLX-MSM-F00160 TLX160 Matrix Switch Module, Fan Tray
TLX-MSM-P00160 TLX160 Matrix Switch Module, Power Supply

TLX160 TECHNICAL SPECIFICATIONS

PHYSICAL	
TLX160 Chassis	Dimensions: Rack Size: EIA 19" Height: 9 RU-15.75" (400.1 mm) Depth: 15.1" (383 mm) Width: 17.16" (435.9 mm) 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.

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 Modules*)
- Controller Card(s) 1 or 2
- Input/Output Card(s) 1 to 16
- Power Cords – PWR-000056-R (International connections may differ) – Qty 2
- Product Manual CD
- Product Quick Start Guide

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 remove the TLX160 from its shipping package and inspect it to make certain that it is in good condition.
- 2** Ensure that all the SFP modules are sealed with a removable dust plug.
- 3** Verify that the power supply modules are fully seated in the chassis and that the locking latch is secure.
- 4** When the device has been inspected and found to be in suitable condition, the installation process can begin.

Connecting to the TLX160

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

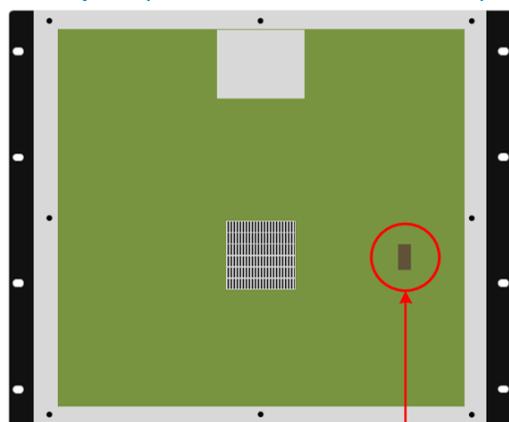
TLX Matrix Switches are compatible with the following Thinklogical® products:

- 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**
- Standard **VX Matrix Switch ASCII Interface** (via RS-232 port or via Network port)
- Standard **VX Matrix Switch IP Address Configuration Procedure**
- Standard **VX Matrix Switch SNMP Traps**
- **12G SDI Extenders**

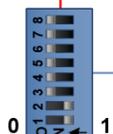
Ethernet Control

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).

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



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

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 **Control Server** must be at **192.168.13.9**, and the **Control Clients** can then be set to any other addresses in the **192.168.13.X** subnet.

If static IP addresses for the control server and its clients are not possible, then the control server will require two (2) network interfaces, with one interface set to the static address **192.168.13.9** and dedicated to the TLX160 KVM Matrix Switch(s), while the other network interface can be configured as required by the facility's network administrator

External Control CPU Minimum Requirements

The External Control CPU must meet the following minimum requirements (including requirements for using Thinklogical's System Management Portfolio):

- **RAM** (minimum): **Linux:** 1GB **Windows:** 4GB **OSX:** 4GB
- **VIDEO:** Works with all video adapters. (Not required if the computer is used as a headless server.)
- **KEYBOARD/MOUSE:** Works with any keyboard/mouse/touchpad. (Not required if the computer is used as a headless server.)
- **NETWORK:** One port minimum, although two ports are recommended for security considerations.
- **DISK SPACE:** Thinklogical programs typically use less than 40 MB.
- **SERIAL PORT:** 1 optional RS-232 serial port (Crestron/AMX serial access)

Fiber-Optic SFP+ Modules (10G, 6G)

Each 10G or 6G Fiber-optic Input / Output Card contains rows of SFP+ modules that serve as the fiber-optic couplers for the fiber cables to and from the Thinklogical transmitter and receiver extenders. Individual cards can be removed for easy access to the SFP+ modules.

The SFP+ Optical Module is an 8Gbs Short-Wavelength Transceiver designed for use in bi-directional Fiber-optic Channel links. The modules have LC-type connectors, are hot-pluggable and operate on 3.3VDC.

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



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

Each fiber-optic I/O Card has **10 SFP+ Modules**, each mounted within a grounded metal enclosure. Each SFP is locked into its enclosure with a built-in latch handle that can be opened for removal or locked for installation (right).

The latch handle spans the two LC ports. Arrows printed on the handle indicate which port is an INPUT (▶) and which is an OUTPUT (◀). 12G SDI SFPs have two inputs or two outputs.



SFP+ Latch Closed



SFP+ Latch Open



LC-Type Fiber-Optic Cable (12G, 10G, 6G)

Installing Fiber-optic Cable: The TLX160 switching matrix connects any SFP's optical output port (Transmit) to any other SFP's optical input port (Receive) with LC-type connectors.



Requirements: Thinklogical recommends SX+ Laser Enhanced (50µm) fiber with LC-type connectors for your TLX KVM Matrix Switch and Extension System. Multi-mode fiber can extend up to a maximum of 400m and Single-mode fiber can extend up to 80km.



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



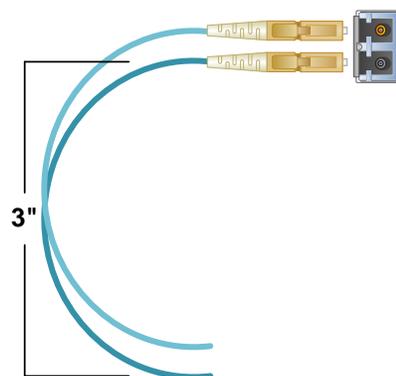
Warning! The ends of the connectors (the ferrule) should never come in contact with any foreign object, including fingertips. Always install a dust cap immediately on the ferrule of any unused fiber to protect the tip.



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.



Thinklogical recommends SX+ Laser Enhanced Fiber-optic Cable, 50 or 62.5 microns, terminated with LC type connectors.

- 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

12G SDI Coax Cable

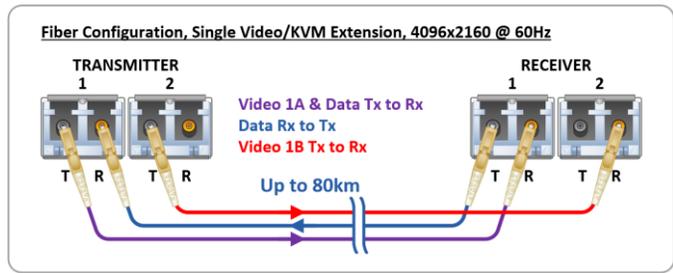
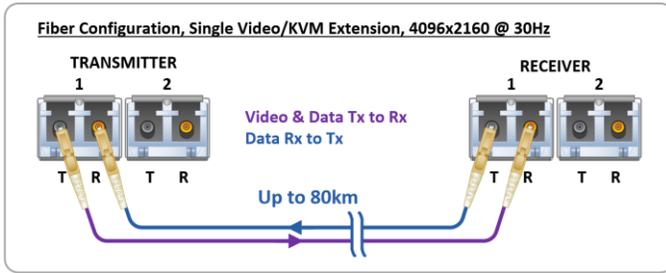
Thinklogical recommends RG-6/U, 18 AWG, 75Ω coax cable. Maximum lengths:



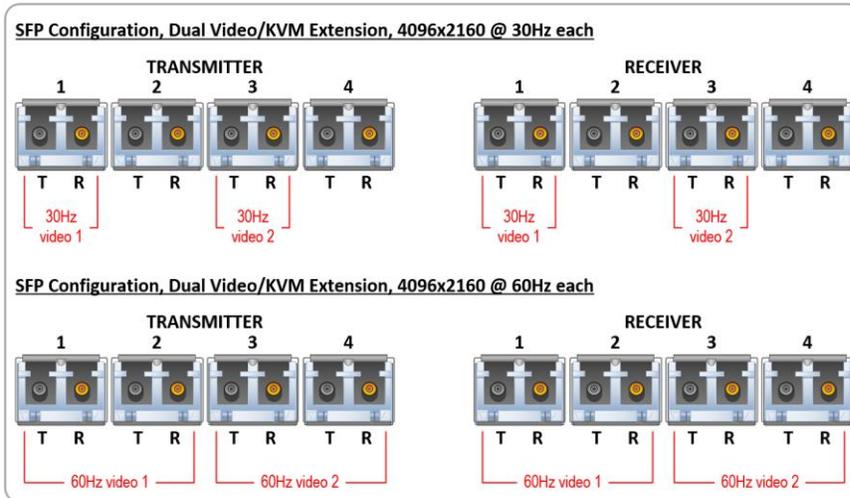
- 75m at 11.88Gbps (4Kp60 UHD)
- 120m at 5.94 Gbps (UHD)
- 200m at 2.97 Gbps (FHD)
- 280m at 1.485 Gbps (HD)
- 600m at 270 Mbps (SD)

TLX Extender Fiber Configurations

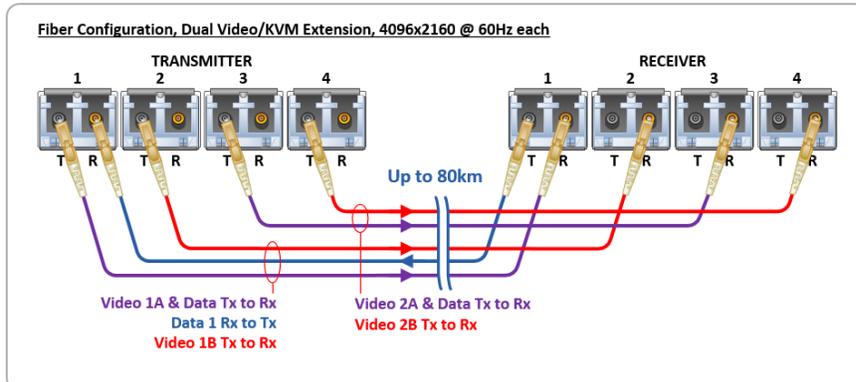
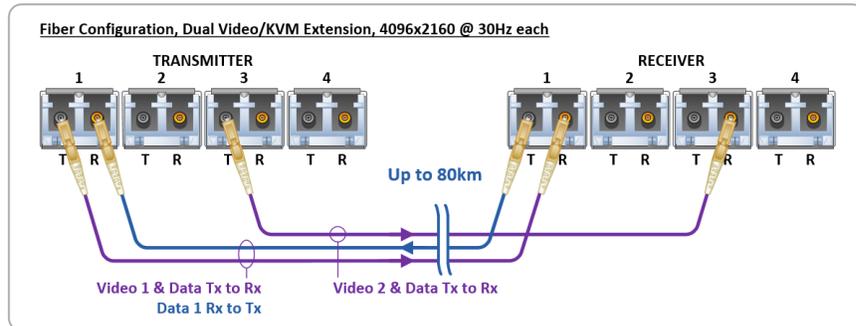
SINGLE VIDEO MODULES



DUAL VIDEO MODULES

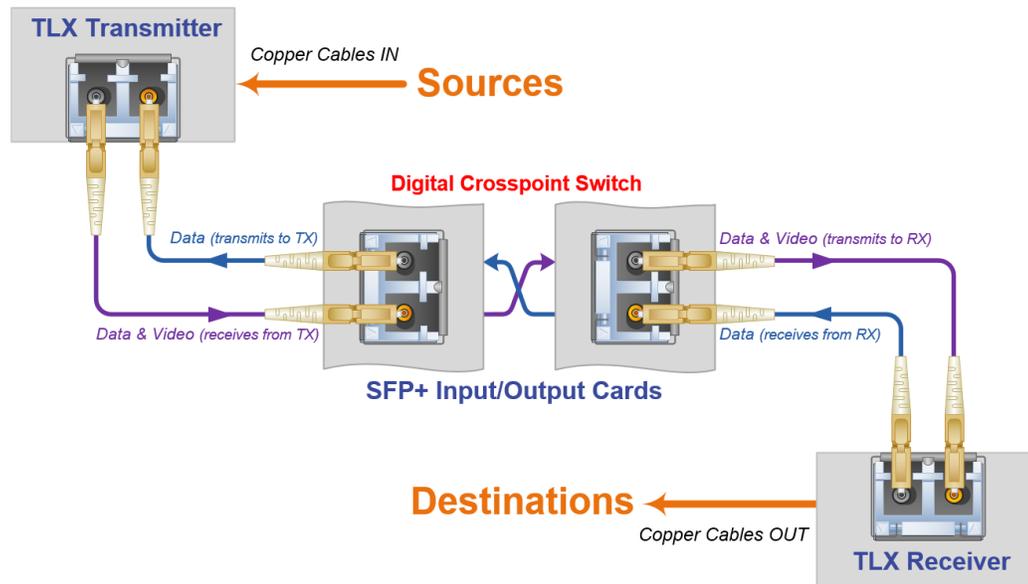


Note: On Dual Video models, SFPs 1 & 2 are Video 1 and SFPs 3 & 4 are Video 2.



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.



TLX160 Matrix Switch Transmit & Receive Concept

Connecting to the Receiver

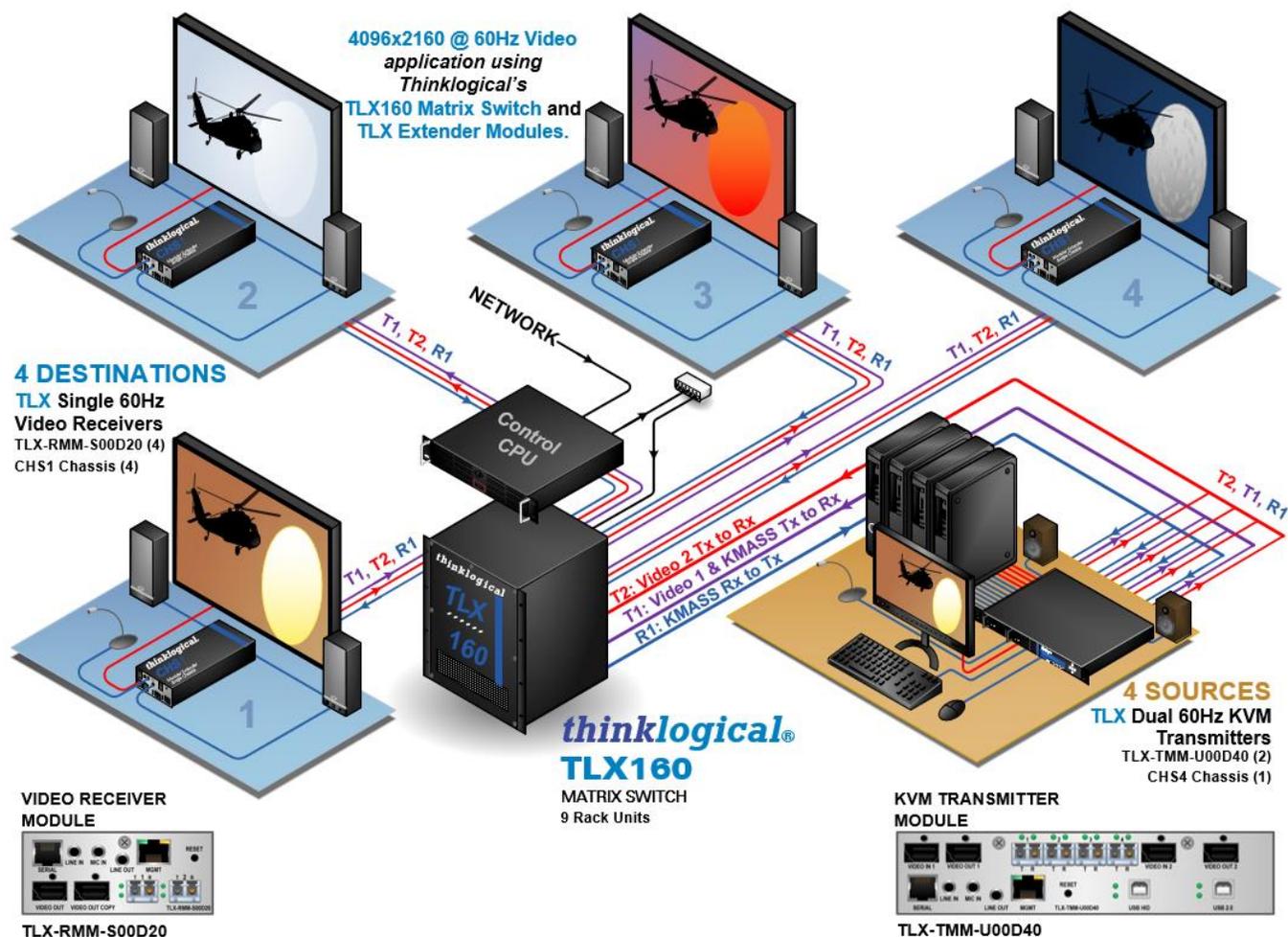
The Receiver serves as the Destination (desktops, theaters, conference rooms, editing suites, control consoles, video walls, etc).

- 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).

Connecting to the Transmitter

The Transmitter serves as the Source (computer and video entities).

- If the source includes a workstation, depending on your configuration, your local KMASS devices (audio, keyboard, mouse, etc.) should be connected first.
- The video sources (e.g. computers, tape decks, etc.) are connected next, followed by any local video devices.
- Power can then be applied to the unit.
- The Transmitter connects to the TLX160 Transmitter ports using fiber-optic cables (Multi-mode fiber for distances up to 400m; Single-mode fiber for distances beyond 400m).



Routing Thinklogical® TLX Extenders through the TLX160

Connecting to a Control CPU

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



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

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

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

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

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.

Operating System Default Users / Passwords

TLX Matrix Switch Operating Systems:

Debian 7

Installed on V5.07.XX (and earlier)

- OS default username/password
 - debian/temppwd
 - root/root

Debian 8

Installed on V5.08.XX

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

Centos 7

Installed on V5.09.XX

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

Linux Command Console (Console)

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

ASCII API (RS-232) Settings

- 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

Order of Installation Events

Please refer to the **Quick Start Guide** included with your products for detailed instructions. The **TLX160 Quick Start Guide** is also available in **Appendix A** on pg. 26.

Firmware Updates

See **APPENDIX B: FPGA Program Code Update Procedure**, pg. 27.

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



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



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

How to Remove and Replace Modules

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

How to Remove and Replace an Input / Output Card



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

- 1** 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!**
- 2** 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.**
- 3** Hand-tighten the thumbscrews. **Do not tighten the thumbscrews with a screwdriver.**

How to Remove and Replace a Fan Tray

The TLX160 uses three DC fans to move air vertically through the enclosure. Be sure to not 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** Turn the four thumbscrews counter-clockwise until they disengage from the chassis.
- 2** Pull the Fan Tray module straight out using the two handles on either side.
- 3** 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 without a Fan Tray installed.

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

How to Remove and Replace a Power Supply Module

Each Power Module is universal input 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.

The Power Modules are universal input 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, reseal it, and start over.**



How to Safely Remove an Active Controller Card or Shut Down the System

During normal, non-maintenance operation, the **Primary Control 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 methods allow the safe removal of one or both Control Cards.



Note: During normal operation, the Primary Control 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 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.
- The Controller Cards' 3.3V stand-by voltage remains on, even after issuing a **pwroff**.
- For a complete system shut-down, remove the AC power cord(s) from the Matrix Switch or from the AC source.

In addition to the **PWROFF** command, the system can be safely shut down by pressing the HALT buttons.

The HALT Button

- Each Controller Card has a HALT button for controlled shut-down. (See pg. 4 for specific operation of one or both HALT buttons.)



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.

Section 3: Regulatory & Safety Requirements

Symbols Found on Our Products

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



Regulatory Compliance

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

North America

Safety

UL 62368-1:2014Ed.2

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

LASER Safety

CDRH 21 CFR 1040.10

Class 1 LASER Product

Canadian Radiation Emitting Devices Act, REDR C1370

IEC 60825:2001 Parts 1 and 2

Class 1 LASER Product

Electromagnetic Interference

FCC 47CFR Part 15 Subpart B: 2013 Class A

Industry Canada ICES-003: 2016 Ed. 6

Australia & New Zealand

This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user 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 exigences du Règlement sur le matériel brouilleur du Canada.*
- This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take corrective action.
- This equipment has been tested and found compliant with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications in which case the user 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.

Product Serial Number

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

05-210029 indicates the unit was built in the **5th** month of **2021**, and is unit number **29**.

Connection to the Product

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

Section 4: How to Contact Us

Customer Support

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

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

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

Email: <mailto:support@thinklogical.com>

For product support, technical issues or questions, product repairs and request for Return Merchandise Authorization.

Telephone: [1-203-647-8700](tel:1-203-647-8700)

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

Fax: [1-203-783-9949](tel:1-203-783-9949)

Please indicate the nature of the fax on your cover sheet and provide contact information.

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 time of purchase on most products. Thinklogical and its suppliers disclaim all other warranties. Please refer to your product invoice for the Warranty Terms & Conditions.

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

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

Return Authorization

If you must return a product to Thinklogical directly, please contact us at **1-203-647-8700**. Customer Support will ask you to describe the problem and will issue you a **Return Merchandise Authorization number** (RMA#). Pack the device in its original box, if possible, and return it with the RMA# printed on the outside of the box. **DO NOT return a product to Thinklogical without a Return Merchandise Authorization.**

Our Address

If you have any product issues or questions or need technical assistance with your Thinklogical system, please call us at **1-203-647-8700** and let us help. If you need to write us or return a product, please use the following address:

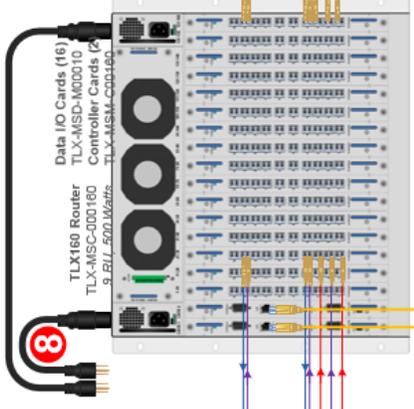
Please include the Return Merchandise Authorization number: **Thinklogical, A BELDEN BRAND**
100 Washington Street
Milford, CT 06460 USA
Attn: RMA#

Appendix A: TLX160 QUICK START GUIDE

QUICK-START GUIDE TLX160 10G Fiber-Optic MATRIX SWITCH

As used with Thinklogical's TLX KVM Extension System With TLX-HD10 & TLX-UD40 Transmitter & Receiver Modules

Maximum Fiber-Optic Cable Lengths
Multi-Mode: OM3: 33 meters OM2: 32 meters
Single-Mode: OS2: 3125- 80 kilometers (pl distance)



RECEIVER SIDE:

STEP 1: Connect the TLX Receivers to the TLX160 using multi-mode fiber-optic cables. On the Matrix Switch, connect fiber R1 to any SFP's Transmitter Port and fiber T1 to the same SFP's Receive Port. Connect fiber R2 to any other SFP's Transmitter Port.

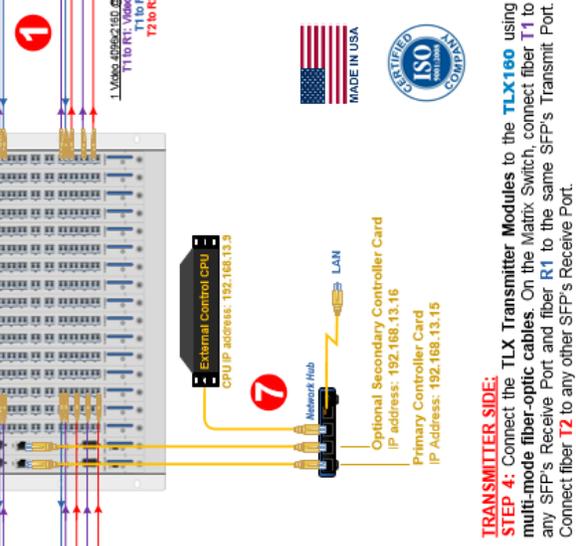
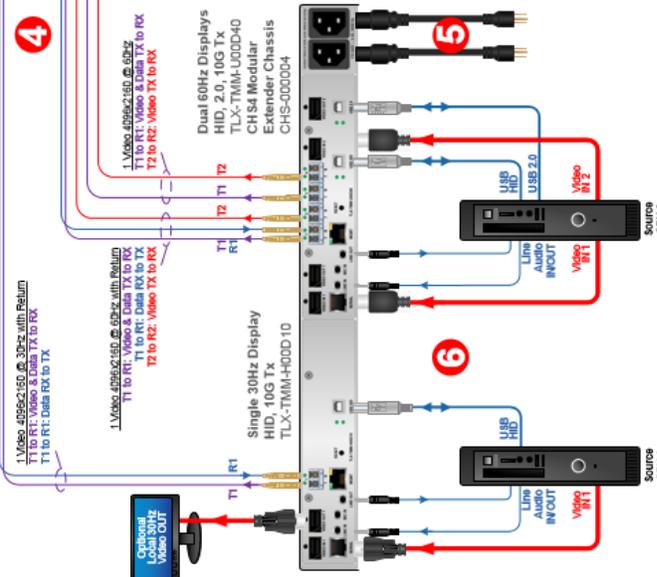
STEP 2: Ensure the Chassis Power Supply switches on the front panel are in the OFF position. Install the Right Power Supply Module AC Power Cord (left receptacle) and the Left Power Supply Module AC Power Cord (right receptacle) into the Receiver chassis. Plug each cord into a standard AC source. On the front of the chassis, turn ON the Right and Left Power Supply Modules.

STEP 3: Connect the peripheral devices (monitors, audio, USB, etc.) to the Receivers using standard copper cables as shown in the examples below. Turn all the devices ON.

MATRIX SWITCH:

STEP 7: Connect the TLX160 Controller Card(s) LAN Port(s) to your Controller CPU with CAT5 cables. (CPU IP address: 192.168.13.9)

STEP 8: (Final step) Connect the two supplied AC Power Cords (PWR-0000056-R) to the receptacles located on the TLX160's power supplies. Plug both into standard AC sources. Verify that all system functions are operating properly.



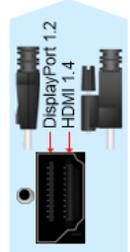
TRANSMITTER SIDE:

STEP 4: Connect the TLX Transmitter Modules to the TLX160 using multi-mode fiber-optic cables. On the Matrix Switch, connect fiber T1 to any SFP's Receive Port and fiber R1 to the same SFP's Transmitter Port. Connect fiber T2 to any other SFP's Receive Port.

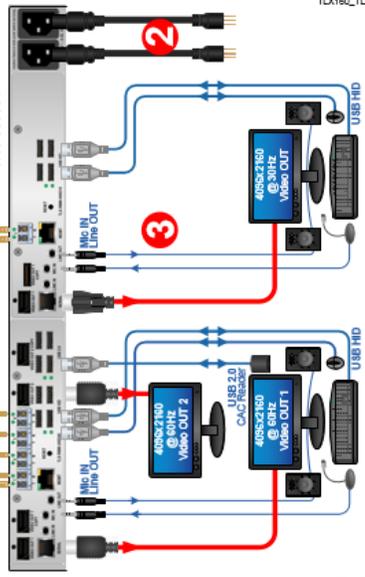
STEP 5: Ensure the Chassis Power Supply switches on the front panel are in the OFF position. Install the Right Power Supply Module AC Power Cord (left receptacle) and the Left Power Supply Module AC Power Cord (right receptacle) into the Transmitter chassis. Plug each cord into a standard AC source. On the front of the chassis, turn ON the Right and Left Power Supply Modules.

STEP 6: Connect Video cables from the Source CPU(s) to the Video IN ports of each TLX Transmitter Module. Use DisplayPort 1.2 for 4K/60Hz video. Use HDMI 1.4 for 4K/30Hz video. Connect the peripheral device sources to each Transmitter Module with standard copper cables. Ensure the CPUs are turned ON.

SOURCES



DESTINATIONS



Appendix B: FPGA Program Code Update Procedure

thinklogical TLX160 KVM Matrix Switch FPGA Program Code Update Procedure

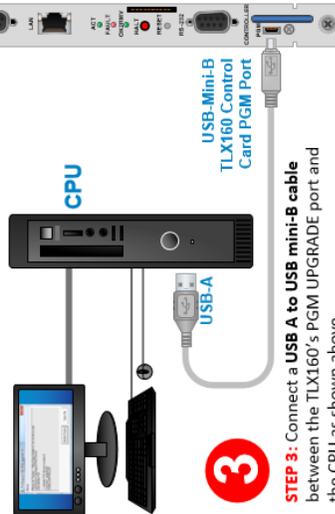
The following procedure documents the steps necessary to update the FPGA program code on a TLX160 10G KVM Matrix Switch using a Windows-based computer.

STEP 1: FPGA Update Preparation:
Please contact your *thinklogical* Sales Representative or Customer Service (1-203-647-8700) for access to the FPGA Download Update application.

Perform steps 1-8 as described:



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.



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

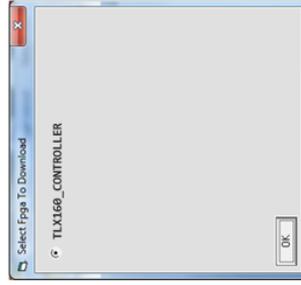
STEP 4: Run the Thinklogical FPGA Upgrade application. You will see the following window. Click on *Identify Product*.



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



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



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.



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 FGM Update Port and exit the application.



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

TLX160_FPGA_Update_Installer_Guide



Appendix C: SD Card Replacement Procedure for the TLX160 Controller Card

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



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

1. Connect a Linux Command Line Interface serial cable to the Controller Card via the serial CONSOLE port. Datacomm parameters are: 115200, 8, N, 1, None.
2. Connect a Linux Command Line Interface serial cable to the Back-up Controller Card via the serial CONSOLE port and issue a `poweroff` command. Wait until the OK2RMV (*OK to remove*) message appears.
3. Remove the Back-up Controller and replace the SD card.
4. Install the Back-up Controller Card into the chassis with a CONSOLE serial connection. Do not connect the network cable.
5. When the Controller Card boots up, wait for the `crng init done` message, then verify the IP settings with the `ipconfig` utility.
6. Check the 'date/time/time zone' with a `date` command.*
7. Perform other site-specific operations as necessary (*password, hostname, gateway, NTP, etc.*)
8. On the Back-up Controller, issue a `poweroff` command and wait for the `system halted` message to appear.
9. Disconnect the Back-up Controller from the chassis backplane, wait 5 seconds, then reconnect it.
10. Wait for the `crng init done` message, then 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 and the ACTIVE LED on the Back-up will come on. On the Primary, the ACTIVE LED will be off and the FAULT LED on.
13. Test the Back-up Controller's function by performing a switching operation.
14. On the Primary Controller, issue a `poweroff` command and wait for the OK2RMV (*OK to remove*) message to appear.
15. Remove the Primary Controller Card and replace the SD card.
16. Install the Primary Controller with a CONSOLE serial cable. Do not connect the network cable.
17. When the Controller Card boots up, wait for the `crng init done` message, then verify the IP settings with the `ipconfig` utility.
18. Check the 'date/time/time zone' with a `date` command.*
19. Perform other site-specific operations as necessary (*password, hostname, gateway, NTP, etc.*)
20. On the Primary Controller, issue a `poweroff` command and wait for the OK2RMV (*OK to remove*) message to appear.
21. Disconnect the Primary Controller from the chassis backplane, wait 5 seconds, then reconnect it.
22. Wait for the `crng init done` message, then connect the network cable to the Primary Controller.
23. Fail-over from the Back-up Card occurs automatically; The ACTIVE LED will come on.
24. Test the Primary Controller's function by performing a switching operation.

*To check and change the 'date, time & time zone,' see **Tech Support Bulletin 19-009B**, next page.



Technical Support Bulletin

A BELDEN BRAND

May 21, 2019
Page 1 of 1

SUBJECT: TSB #: TSB-19-009, Rev. B
Setting the Date, Time & Time Zone – Linux Devices

PRODUCT(S) AFFECTED:
Matrix Switches, SMP2 Module, SMP2 Appliance and SMP Client

PROBLEM:

Having an incorrect date/time setting may cause system problems. These range from; incorrect log file data to Linux not booting properly.

Note: This is not a bug in Debian Linux; it's an intentional security feature.

For example: In the case of a TLX matrix switch, it may boot into a "maintenance" mode which precludes the use of the ipconfig utility. This mode is indicated by: "login incorrect, type root password for maintenance, or type control-D to continue." If this should occur, login as root and set the date & time as below.

SOLUTION:

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 "dpkg-reconfigure tzdata" command. A menu will appear allowing you to easily update the time zone.
4. To set the date and time, issue the command in the format "date mmddhhmmyy" for month, day, hour, minute, year. For example: "date 0128162019" will set the module for January 28, 2019, 4:20PM. This sets the Linux clock. However, this will be lost after repowering the unit.
5. Check the date, time and time zone again to make sure it is correct.
6. Set the permanent hardware clock with the following command: "hwclock --systohc". Note there is a space and double hyphen between the parameters. Now when Linux boots it will read the H/W clock correctly.

Warning:

Make sure you double check your date & time setting after configuring it. Accidentally changing the date too far in the past will prevent Linux from booting at all. If this should ever happen, remove and replace the RTC battery to reset the date/time to a known state and then correct it.

Additional benefit:

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

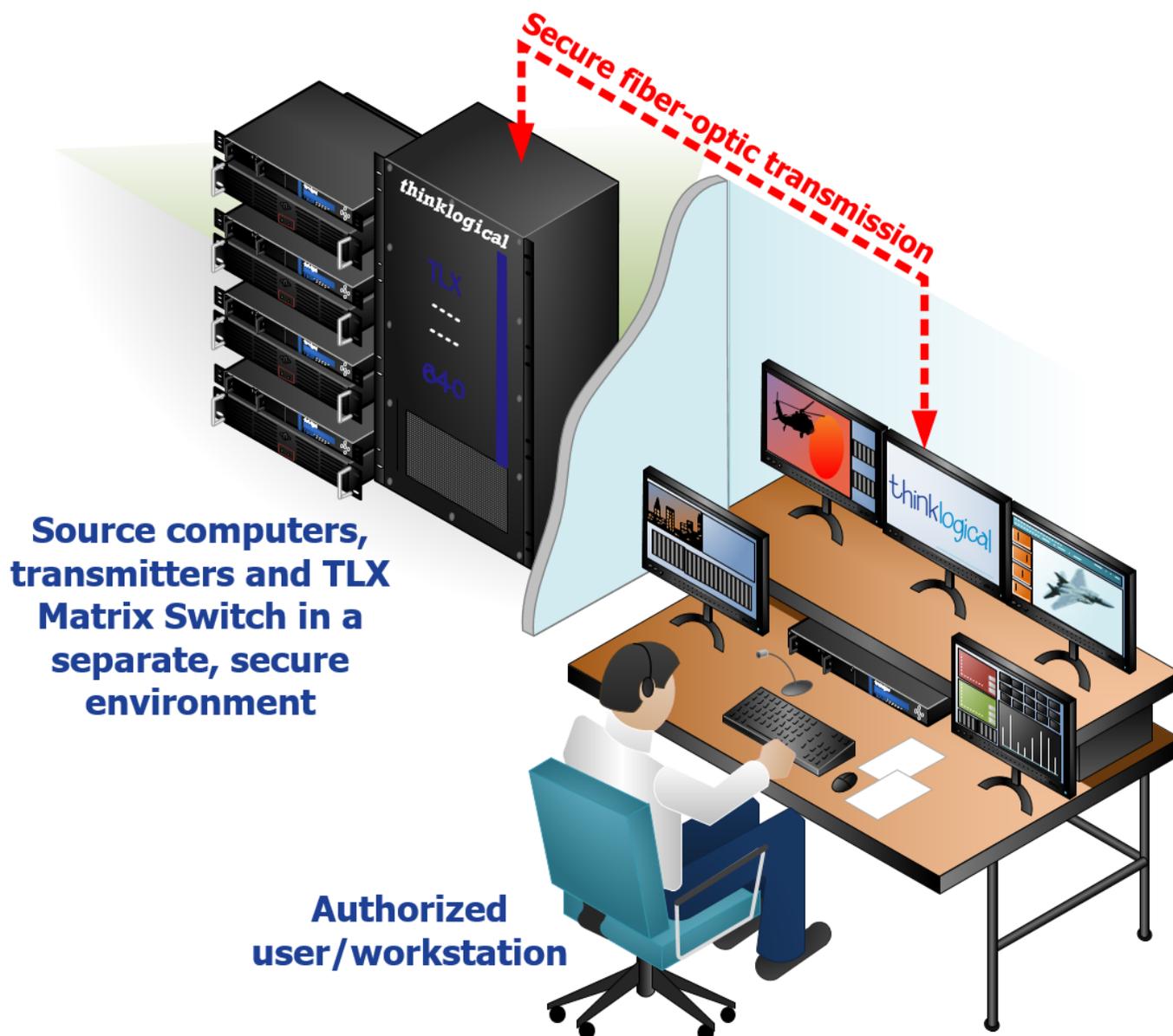
INITIATOR(S):
DATE:
5/21/2019

APPROVALS:
Project Engineer:
DATE:
5/21/2019

Appendix D: Secure Applications

TLX Matrix Switch Control

When used in a secure application, the Matrix Switch and External Computer (server) 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.



Thinklogical's TLX, VX and MX Matrix Switches use two methods for secure routing. One is known as **Restricted Switching** and the other is known as **Partitioning**. These methods can be deployed singularly or jointly, depending on security requirements.

Restricted Switching

Restricted Switching 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 user 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:

```
root@imxswitch:/var/local/router/restrict# cat upstream.csv
"i", 1, 1
"i", 2, 2
"i", 3, 3
"i", 4, 1
"i", 5, 3
"o", 1, 1
"o", 2, 3
"o", 3, 2
"o", 4, 4
"o", 5, 1
```

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

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)

The Restricted Switching Table files are stored on the controller card at:

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

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 rather when a switchover occurs from Primary Active to Back-Up Active. If an **upstream.csv** file is found, a log entry to the **daemon.log** file is made indicating "Restricted Switching ENABLED." If no file is found, then a log entry of "Restricted Switching DISABLED" is made.

The inactive Back-Up Controller Card will not verify its Restricted Switching Table (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 as "error" with a *field and line invalid* identifier. The **daemon.log** file will be at the following location on the controller card: **`/var/log/daemon.log`**.

For access to the *daemon.log* file via SSH, refer to THE NETWORK INTERFACES section of this document (pg. 9) for correct IP addresses of Controller Cards when in Primary Active or Back-Up Active mode.

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

- 1) Review the **daemon.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 test 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 **daemon.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 test 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. 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 (pg. 22).

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 active Primary Controller Card. The table will not take affect at this time.
- 2) Update the Restricted Switching Table of the inactive Back-Up Controller Card with the same table used for the Primary Controller Card.
- 3) Take the Primary Controller Card out of service by typing 'halt' at the command line. This will make the Back-Up Controller Card active and evaluate its Restricted Switching Table. Thinklogical recommends verifying the changes to the Back-Up Controller Card.
- 4) Ensure that the LAN connection to the Primary Controller Card is connected. Extract the Primary Controller Card, wait 10 seconds, then re-insert the Primary Controller Card back into the chassis, allowing the system to make the Primary Controller Card the active controller and begin using the updated Restricted Switching Table.



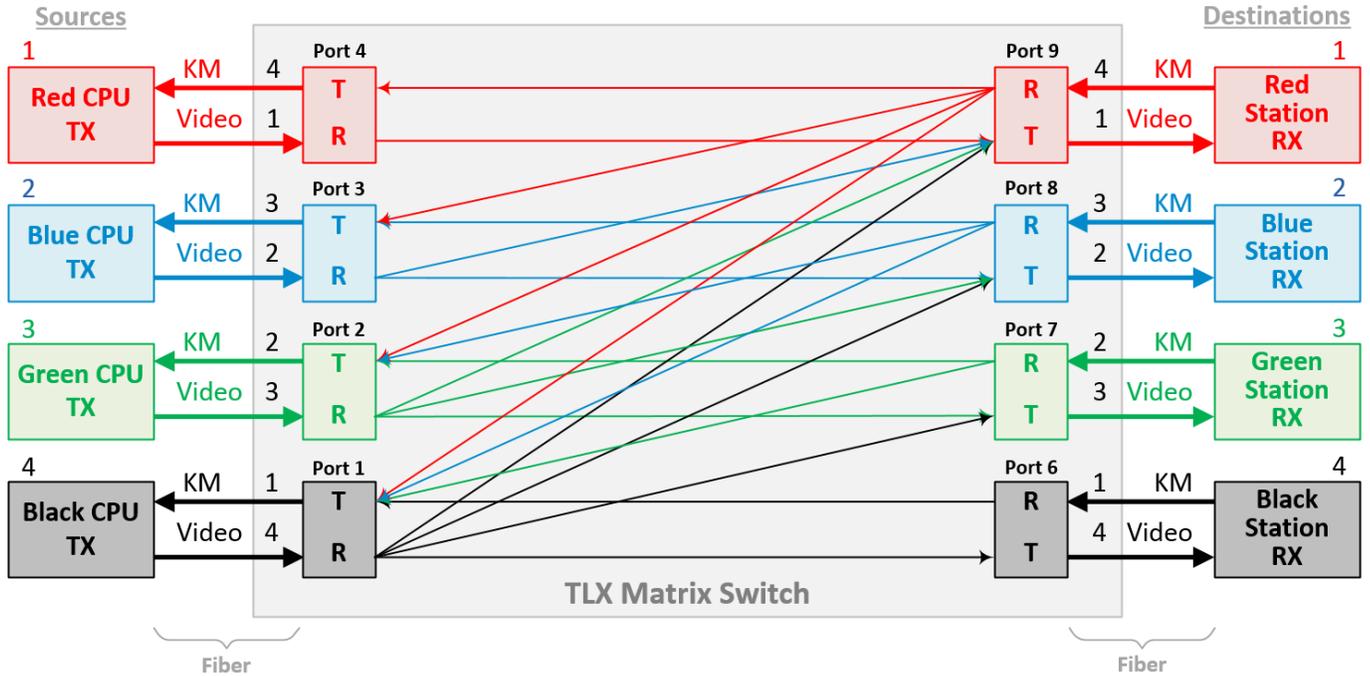
Note: When using a Back-Up Controller configuration, both controllers must have the same Restricted Switching Table file(s) to maintain the security of the system.

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

Restricted Switching with TLX, VX and MX Matrix Switches

Restricted Switching Priority Scheme

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



VIDEO:

Destination Workstation Network
 RED
 BLUE
 GREEN
 BLACK

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

KEYBOARD/MOUSE:

Destination Workstation Network
 RED
 BLUE
 GREEN
 BLACK

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

Restricted switching is configured via firmware loaded into the Matrix Switch. The configuration file for this scenario will appear like the table at right. →

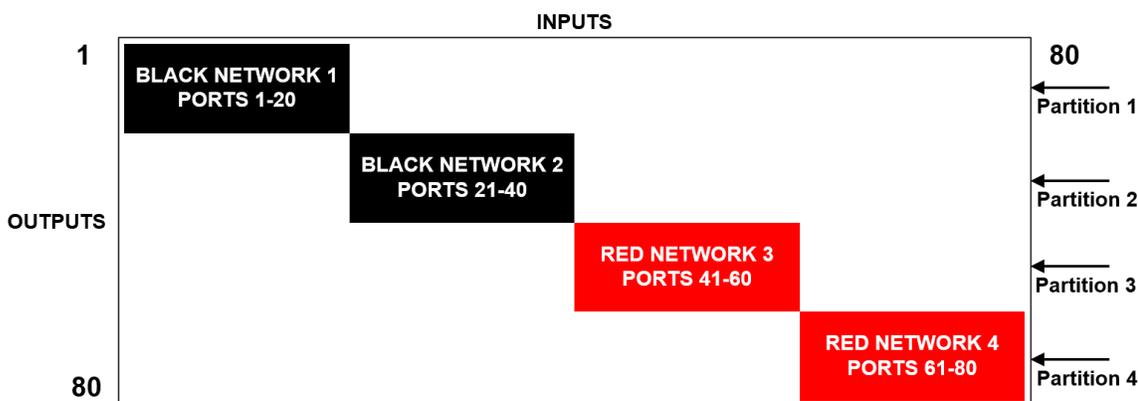
I/O	Number	Priority
"i"	1	4
"i"	2	3
"i"	3	2
"i"	4	1
"i"	6	1
"i"	7	2
"i"	8	3
"i"	9	4
"o"	1	1
"o"	2	2
"o"	3	3
"o"	4	4
"o"	6	4
"o"	7	3
"o"	8	2
"o"	9	1

Partitioning

Partitions allow TLX, VX and MX Matrix Switch sources and destinations to be segregated. Therefore, destination work stations 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. This table is in the form of a Comma Separated Value (CSV) file located in `/var/local/router/partition` on the Switch. This file contains the port number and the partitions to which it belongs.

Example: TLX80 Matrix Switch with four distinct partitions:

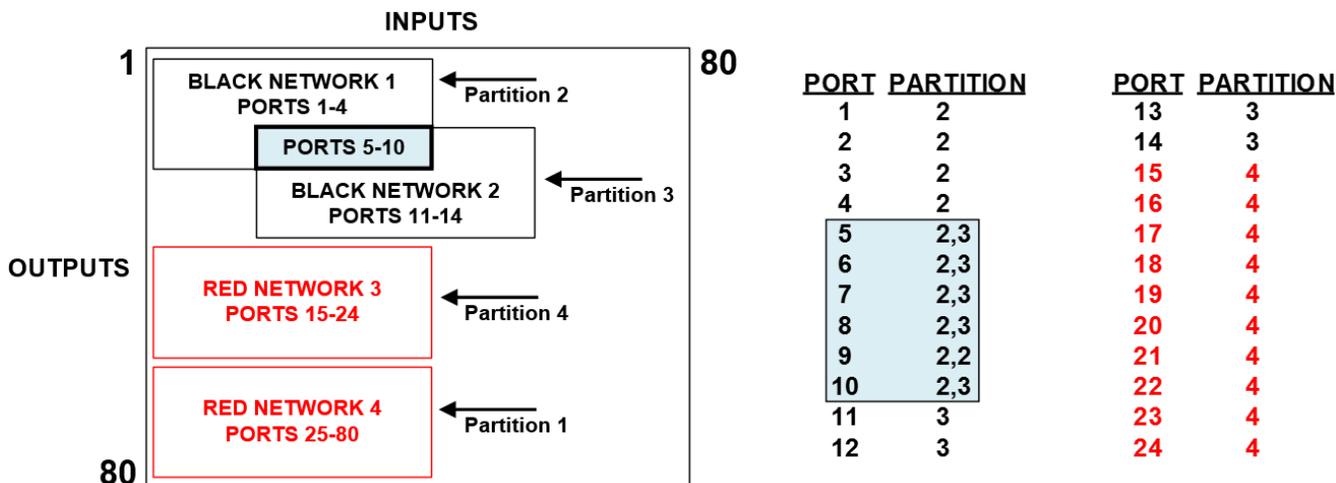


Four partitions set up for secure routing and extension applications. Signals are only capable of transmitting and receiving within a single partition and not across partitions

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

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

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



The Partition Table files are stored on the controller card at:
`/var/local/router/partition/upstream.csv`

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 rather when a switchover occurs from Primary Active to Back-Up Active. If an **upstream.csv** file is found, a log entry to the **daemon.log** file is made indicating "Partition ENABLED." If no file is found, then a log entry of "Partition DISABLED" is made.

The inactive Back-Up Controller Card will not verify its Partition Table (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 as "error" with a *field and line invalid* identifier. The **daemon.log file** will be at the following location on the controller card: **/var/log/daemon.log**.

For access to the *daemon.log* file via SSH, refer to THE NETWORK INTERFACES section of this manual (pg. 9) for correct IP addresses of controller cards when in Primary Active or Back-Up Active mode.

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

- 1) Review the **daemon.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 test the **Partitioning** 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 **daemon.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 test the Back-Up Controller Card's **Partitioning 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 guidelines in the "Safely Remove an Active Controller Card" section of this document (pg. 22).

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 active Primary Controller Card. The table will not take affect at this time.
- 2) Update the Partition Table of the inactive Back-Up Controller Card with the same table used for the Primary Controller Card.
- 3) Take the Primary Controller Card out of service by typing 'halt' at the command line. This will make the Back-Up Controller Card active and evaluate its Partition Table. Thinklogical recommends verifying the changes to the Back-Up Controller Card.
- 4) Ensure that the LAN connection to the Primary Controller Card is connected. Extract the Primary Controller Card, wait 10 seconds, then re-insert the Primary Controller Card back into the chassis, allowing the system to make the Primary Controller Card the active controller and begin using the updated Partition Table.



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

Administration Access

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

1. **The Serial Console directly connected to the Switch.** (It should be noted that, while no administrator password is required to use the Serial Console, physical access to the Switch is required. Therefore, the Switch should be stored in a physically secure location to avoid unauthorized access.)
2. **SSH access.** The Switch allows SSH connections to the Switch for management purposes. SSH sessions are authenticated using an encrypted password file.

Password Security

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

Creating Strong Passwords:

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

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

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

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

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

Secure Application Examples

The Diagram on pg. 38 shows the TLX160 Matrix Switch in a secure application. **The highly secure components are described as the Red Network and the other, lower security components are described as the Black Network.** The Red Network, containing the computers (sources), is shown in a physically secure environment along with the TLX Matrix Switch, the computer server used to manage the Switch, and the Network Hub. The Network Hub is a dedicated network used only to connect the TLX Switch to the computer server. This dedicated network does not connect to any other components and does not extend beyond the physically secure environment. The dedicated network connection may be replaced by a direct serial connection (RS-232) between the TLX Switch and the computer server.

The TLX Matrix Switch can be configured to prevent accidental connection from the Red Network to the Black Network using the Restricted Switching feature. For example, the TLX Matrix Switch Network Diagram should be configured with the following csv file:

Direction	Number	Priority
I	1	2
I	2	2
O	2	2
I	42	2
O	41	2
O	42	2
I	5	1
O	5	1
I	45	1
O	45	1

The following connection rules apply:

- SOURCE 2 can be connected only to DESTINATION 2
- SOURCE 1 can be connected to both DESTINATION 1 and DESTINATION 2



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

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

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



TLX160 Matrix Switch Secure Application

