Pyramid Technical Consultants, Inc.
135 Beaver Street
Suite 102
Waltham, MA 02452 USA

X22 - User Manual v2

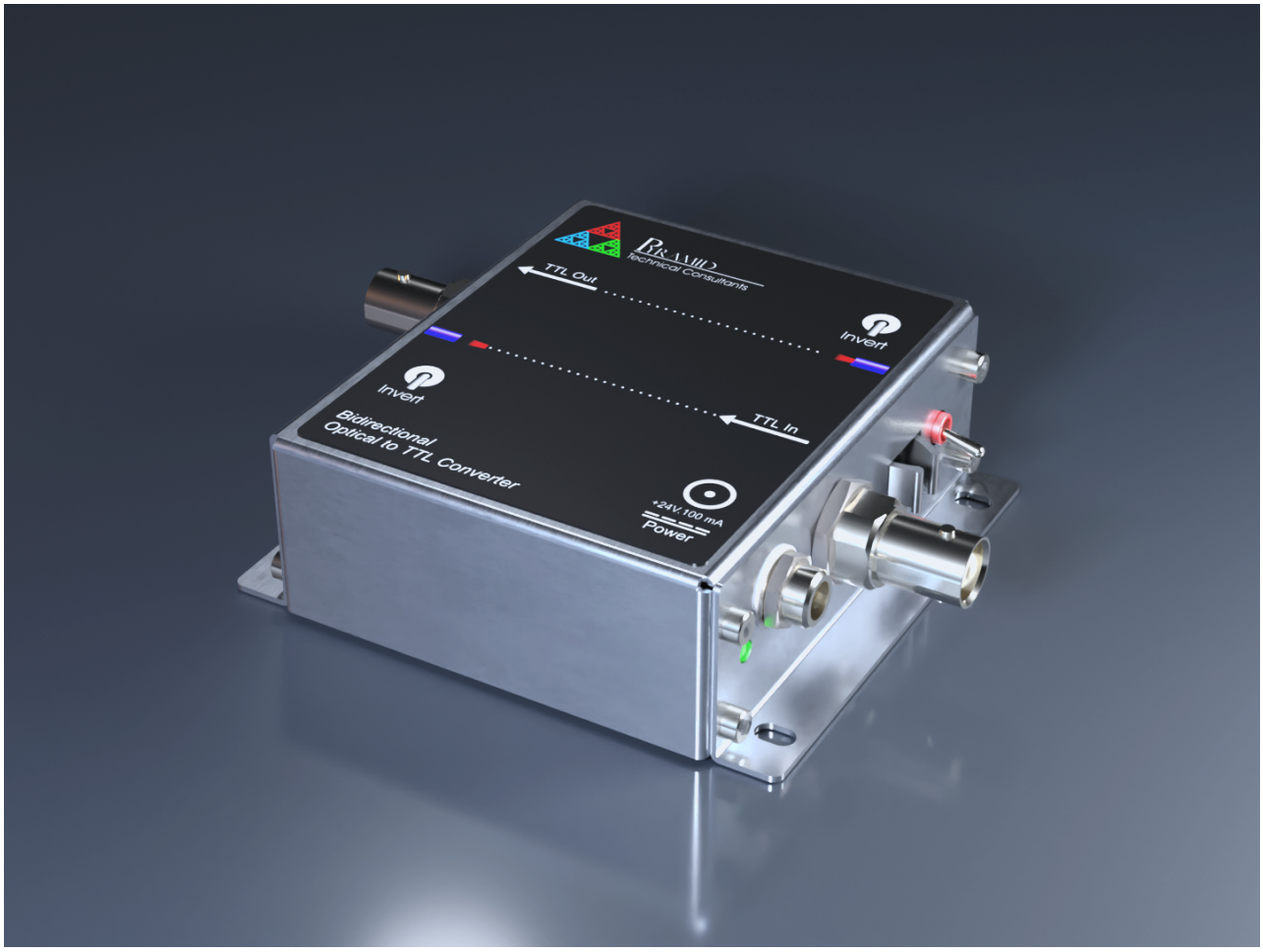
Introduction

Document ID: 2545582163

Author	G. Dart
Owner	Project Lead
Purpose	Provide instructions to the end user regarding intended use of the product.
Scope	X22 Operation and Usage.
Intended Audience	Owners of X22 device.
Process	https://pyramidtc.atlassian.net/wiki/pages/createpage.action?spaceKey=PQ&title=Standard%20Manual%20Creation%20Process
Training	NOT APPLICABLE

Revisions

Version	Description	Saved by	Saved on	Status
v2	Updated to include X22-VL-650 Rev 0 information	Harvey Jules Nett	Sep 6, 2024 7:44 PM	APPROVED
v1	Rev 1	Harvey Jules Nett	Sep 8, 2023 2:23 PM	OUTDATED



Document Approvals

This document has been reviewed and approved as follows.

Document Control

Current document version: v.1

No reviewers assigned.

Signatures

for most recent document version

Friday, Sep 6, 2024, 07:45 PM UTC

Greg Dart signed (meaning: **Approval**)

Friday, Sep 6, 2024, 07:45 PM UTC

Harvey Jules Nett signed (meaning: **Approval**)

X22 Quick Start

Remove the X22 and 24VDC power supply from packaging. Plug the power supply into a wall socket. Plug the power cable into the X22 and screw it in place to ensure electrical connection. The X22 power LED will light up when correct power is connected.

To convert TTL signal to fiber optic, plug a coaxial cable into the BNC connector labeled “TTL In”. Plug a fiber optic cable into the Fiber transmitter connector.

To convert fiber optic to TTL, plug a fiber optic cable into the Fiber Receiver connector. Plug a coaxial cable into the BNC connector labeled “TTL Out”.

The X22 has two toggle switches. For normal operation, ensure both switches are in the up (non-inverted) position. The signal pathways are normally low in this state. To switch one or both of the pathways to normally high (fiber on or 5V TTL output), push the relative toggle switch in the down (inverted) position.

Note: Exercise caution with the position of the toggle switches. Leaving a switch in the wrong position may lead to unexpected behavior.

The BNC Input connector is only meant for 5V TTL signals. Do **NOT** connect anything other than a TTL source into the input BNC connector, or anything other than a TTL input with minimum impedance 5 kohm into the output BNC. The X22 is already forward terminated with 50 ohm, so the cable should not require any terminating resistor.

For installation, the X22 is housed in a compact stainless-steel chassis with flanges, compatible with M3 metric fasteners. Up to 5 X22s can be mounted in parallel in a 1U 19” rack. There are also DIN rail adapters available for purchase.

For more information on fiber optic cables, please refer to the following technical note: TN0018.pdf

Operating the X22

Key Features

- X22-ST-850
  - 820/850nm fiber transmitters and receivers.
  - High speed operation up to 50MHz (square wave).
  - Minimal signal propagation delay (<15ns) in each direction.
- X22-VL-650
  - 650/660nm fiber transmitters and receivers.
  - High speed operation up to 5MHz (square wave).
  - Minimal signal propagation delay (<50ns) in each direction.
- Discrete hardware solution, no software involved.
- Isolated, independent signal pathways - TTL to fiber isolated from fiber to TTL.
- 2 toggle switches to invert the signal on either pathway independently.

Connectors

- X22-ST-850
  - 1x ST-bayonet Fiber Optic Receiver
  - 1x ST-bayonet Fiber Optic Transmitter
  - 2x BNC Connectors (TTL Input, TTL Output)
- X22-VL-650
  - 1x Versatile Link Fiber Optic Receiver
  - 1x Versatile Link Fiber Optic Transmitter
  - 2x BNC Connectors (TTL Input, TTL Output)

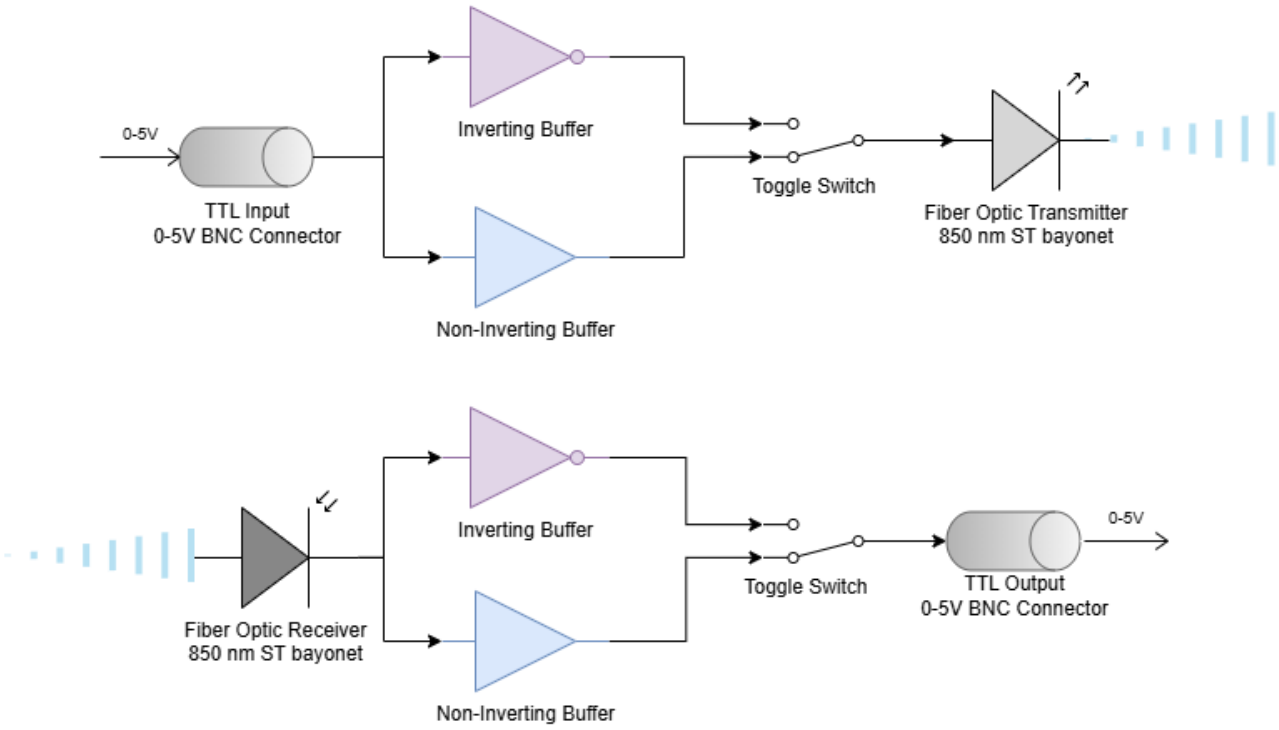
Power

Typically, a 25W 24VDC power supply (PSU24-25-1) is included with the X22, unless opted out. The power supply line includes a standard US adapter plug, but this line cord is removable and can be substituted to any line cord terminated with IEC C7/C8 on the PSU end and the local wall adapter plug on the other end.

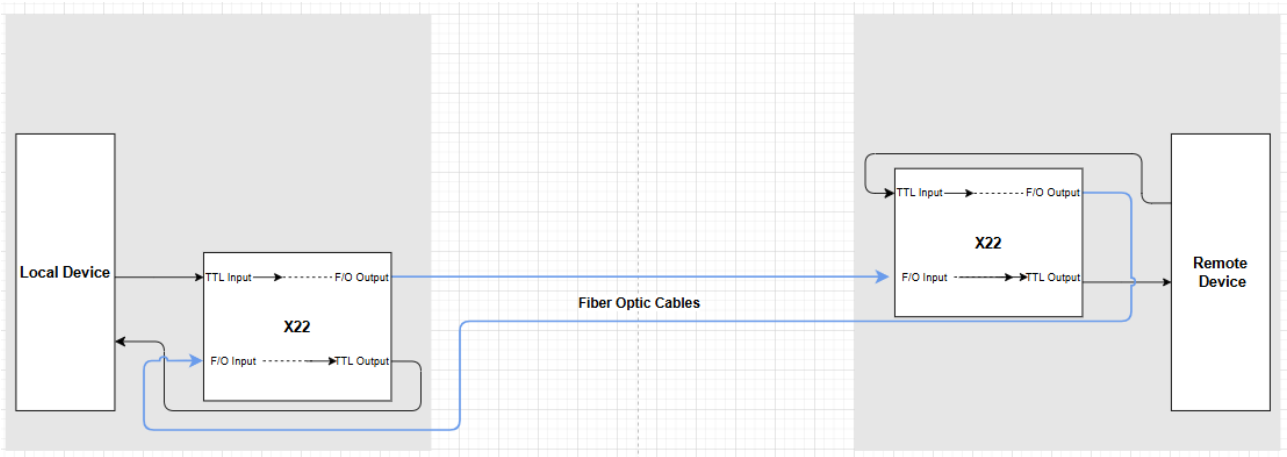
An alternative 40W 24VDC power supply (PSU24-40-1) is also available. This power supply has a removable line cord with IEC C13/C14 termination on the PSU end.

If supplying your own power supply, be sure to adhere to the specs of the device, listed in the datasheet.

System Diagram



Intended Use



As shown above, place an X22 nearby the local device, using the shortest possible Coax cable to minimize EMI and signal loss. Bridge the gap between the local and remote devices with a fiber optic cable. Similarly, use a 2nd X22 at the opposite end to convert the signal back into TTL for the remote device. Return the signal output from the remote to local device using a 2nd fiber optic cable.

TTL to Fiber Optic Conversion for Optical Isolation

The X22 is designed to facilitate the transformation of TTL (Transistor-Transistor Logic) signals into Fiber Optic signals. This conversion has a twofold purpose:

Optical Isolation: Optical isolation is a method used to prevent high voltage or transient voltage (such as spikes or surges) from damaging the receiving end of the circuit. By converting TTL signals into Fiber Optic signals, the X22 ensures that there is no direct electrical connection between the input and output, thus providing safety and protection to the connected equipment and systems.

Mitigation of Electrical Interference: Converting TTL signals into Fiber Optic signals can also reduce the susceptibility to electromagnetic interference (EMI) and radio frequency interference (RFI). This ensures a cleaner, noise-free communication.

Long-Distance Communication

Fiber optics are renowned for their ability to transmit data over long distances without significant loss of signal strength. Using the X22 to convert TTL signals to Fiber Optic signals has the following benefits:

Immunity to Interference: Fiber optics are immune to electromagnetic interference (EMI) and radio-frequency interference (RFI). This makes them ideal for environments with high levels of electrical noise.

Improved Data Integrity: Fiber optic transmission has a lower attenuation rate compared to copper-based transmission methods. This means signals are less likely to degrade, ensuring that data remains intact and reliable over longer distances.

Fiber Optic to TTL Conversion

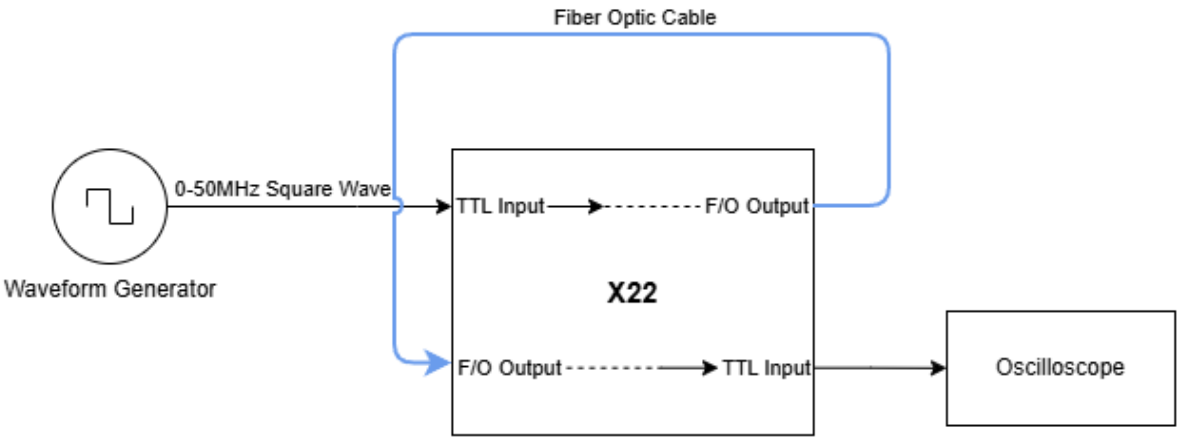
While the primary role of the X22 is converting TTL signals into Fiber Optic ones, it is also engineered to perform the reverse:

a) **Versatility:** This bidirectional capability ensures that the X22 is versatile and can be used in diverse setups where the conversion between Fiber Optic and TTL signals is essential.

b) **Consistency:** Converting from Fiber Optic back to TTL using the X22 ensures that the original TTL signals are consistently regenerated, maintaining data integrity and ensuring accurate information transfer.

In summary, the X22 device provides an essential bridge between traditional TTL systems and advanced Fiber Optic networks, offering both protection from electrical hazards and enabling long-distance communication with maintained signal integrity.

Bench Testing the X22



To test the capabilities of the X22, use a waveform generator on the TTL input, loop the fiber optic output to input, then readout on an oscilloscope. This can also be useful for determining if the cables used are functional. The most common issues are damaged or improperly terminated fiber optic cables.

Optional Items and Related Products

Related Products

- TF1 | Self-powered BNC TTL to Fiber-optic Converter (ptcusa.com)

For unidirectional TTL to fiber applications that can drive 30mA, consider the TF1 as a simpler alternative.

The TF1 is an efficient solution for converting TTL signals to ST fiber. This self-powered device utilizes the TTL level itself to power the optical output, eliminating the need for an external power supply. The TF1 is compatible with any TTL signal designed to drive a 50-Ohm terminated load.

- X14 | 1:4 Fiber-Optic Trigger Fanout (ptcusa.com)

To fan out fiber optic signals to multiple fiber outputs, the X14 device is recommended.

The X14 is a one-to-four fiber-optic fan-out type device. It receives a single optical level and repeats that signal to 4 separate outputs with minimal latency added. The X14 is intended to help system designers spread out a single trigger or synchronization signal to multiple destinations.

DIN rail mount

Part Number	
MTG-DIN35-7662	DIN rail mounting kit

Fiber Optic Cables

Pyramid fiber optic cable assembly order codes	
CAB-ST-HCS-xx-ST	200µm HCS simplex fiber optic cable, xx feet long*, ST bayonet terminated
CAB-HCS-1000	200µm HCS simplex fiber optic cable, 1km, unterminated
CAB-2ST-HCSD-xx-2ST	200µm HCS duplex fiber optic cable, xx feet long*, ST bayonet terminated

Pyramid fiber optic cable assembly order codes	
CAB-HCSD-1000	200µm HCS duplex fiber optic cable, 1km, unterminated

*Divide by 3.281 for length in meters

BNC Cables

Pyramid coaxial cable assembly order codes	
CAB-BNC-5-BNC	Coaxial cable, RG-58, 5 feet long*
CAB-BNC-10-BNC	Coaxial cable, RG-58, 10 feet long*
CAB-BNC-25-BNC	Coaxial cable, RG-58, 25 feet long*
CAB-BNC-50-BNC	Coaxial cable, RG-58, 50 feet long*
CAB-BNC-COLN-3-BNC	Low Noise coaxial cable, RG-58, 3 feet long*
CAB-BNC-COLN-10-BNC	Low Noise coaxial cable, RG-58, 10 feet long*
CAB-BNC-COLN-20-BNC	Low Noise coaxial cable, RG-58, 20 feet long*

*Divide by 3.281 for length in meters

Troubleshooting Guide

If the X22 is not performing as expected, please see the following instructions:

1. **Check Position of Toggle Switches:** The X22 has two toggle switches which, if in the wrong position, will cause unexpected behavior. If either switch is in the down position, it will invert the polarity of the signal on that pathway.
2. **Check Power Supply:** Ensure that the device is receiving power. Confirm that the power source is functioning properly. The power jack on the X22 is threaded and the power cable should be screwed in place to ensure electrical connection. The X22 power LED shall light up when powered on.
3. **Inspect the X22 in isolation:** With the X22 powered on and no cables plugged in, push the Fiber Transmitter toggle switch in the down (inverted) position. The Fiber Transmitter shall emit a red light. Return the toggle switch into the up (non-inverted) position. Do the same with the Fiber Receiver. Use a multimeter to measure the voltage across the TTL output connector. It shall measure +5V when the switch is inverted.

Do **NOT** stare directly into the fiber transmitter, this may cause eye damage. The light emitted from the X22 does not look particularly bright with the 850nm transmitter because most of the light is in infrared.

4. **Inspect Physical Connections:** Examine all cables, connectors, and plugs for loose or damaged connections. BNC and Fiber terminations have a bayonet style locking mechanism, be sure to fasten the cables on properly.
5. **Check Termination Resistance:** The X22 incorporates a forward 50 ohm termination on its TTL (Transistor-Transistor Logic) output. This design choice ensures a controlled impedance environment, minimizing reflection issues and maintaining signal integrity, especially in high-frequency applications. Users should pay attention to the following factors:
    a. **Device Compatibility**: Ensure that any device you're connecting to the TTL output is compatible with a 50 ohm termination. Most high-speed and RF devices are designed with this in mind.
    b. **Use Proper Cabling**: Always use cables that have a characteristic impedance of 50 ohms to maintain the impedance matching throughout the system.
    c. **Avoiding Double Termination**: If the connected device also has its own 50 ohm termination, it might lead to double termination, which can attenuate the signal. Be sure to check the specifications of any equipment you connect.
6. **Inspect Cables:** If the X22 is working in isolation and the physical connections are secure, it is likely an issue with the cables themselves. Coaxial cables are easy to troubleshoot and cheap to replace if damaged. The most common failure mode is poor installation of the ST connectors on cables, check the device operation with a known good fiber. Fiber optic cables are more difficult to inspect and may be damaged if not handled properly. See the following guidelines to avoid problems with fiber optic cables:
    a. **Avoid Bending Beyond Minimum Bend Radius:**
        - Fiber optic cables have a specified minimum bend radius. Bending the cable beyond this limit can cause signal loss or even breakage. Always follow the manufacturer's recommendations for bend radius.
        - Sharp bends can lead to signal loss or cable damage. Use proper cable management techniques to maintain smooth bends and curves.
    b. **Cable Tension:**
        - Do not apply excessive tension to fiber optic cables during installation or routing. Tension can affect signal quality and cause cable stress.
    c. **Handle with Care:**
        - Fiber optic cables are fragile and can be easily damaged by excessive pulling, twisting, or crushing. Handle them gently and avoid any unnecessary strain.
    d. **Clean Environment:**
        - Work in a clean and dust-free environment when installing or handling fiber optic cables. Dust and dirt particles can interfere with signal transmission.
    e. **Labeling and Documentation:**
        - Properly label and document the installation locations and connections of fiber optic cables. This will aid in troubleshooting and maintenance.
    f. **Use Proper Tools:**

- Use appropriate tools for cutting, splicing, and terminating fiber optic cables. Improper tools or techniques can damage the cable ends.

g. **Connector Handling:**
   - When connecting or disconnecting fiber optic connectors, hold the connector body and not the cable itself to avoid stressing the cable.

h. **Check for Compatibility:**
   - Ensure that the fiber optic cables, connectors, and equipment are compatible with each other and designed for the intended use. The X22 uses ST-style bayonet connectors, compatible with single or multimode fiber optic cables.

For more information on fiber optic cables, please refer to the following technical note: TN0018.pdf

Returns and Support

Returns Procedure

Damaged or faulty units cannot be returned unless a Returns Material Authorization (RMA) number has been issued by Pyramid Technical Consultants, Inc. If you need to return a unit, contact Pyramid Technical Consultants at support@ptcusa.com, stating

- model
- serial number
- nature of fault

An RMA will be issued, including details of which service center to return the unit to.

Support

Manual updates are available for download from the Pyramid Technical Consultants website at http://www.ptcusa.com . A secondary site can be found at http://www.ptceurope.com . Technical support is available by email from support@ptcusa.com. Please provide the model number and serial number of your unit, plus relevant details of your application.

Disposal

We hope that the X22 gives you long and reliable service. The X22 is manufactured to be compliance with the European Union RoHS Directive 2002/95/EC, and as such should not present any health hazard. Nevertheless, when your X22 has reached the end of its working life, you must dispose of it in accordance with local regulations in force. If you are disposing of the product in the European Union, this includes compliance with the Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC. Please contact Pyramid Technical Consultants, Inc. for instructions when you wish to dispose of the device.