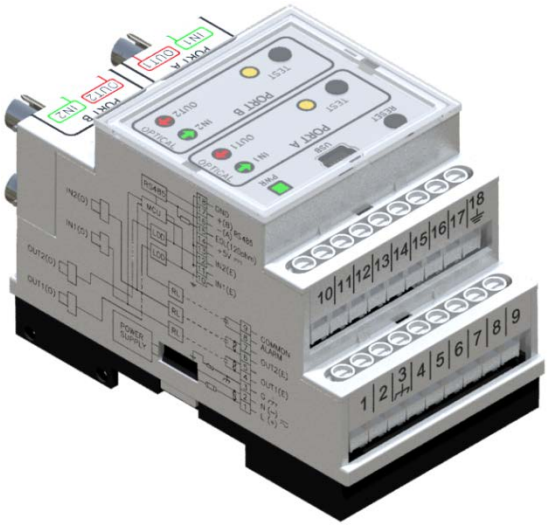
Operation Manual

Fiber Optic Interface (FOI)

Model: FOI-01-221



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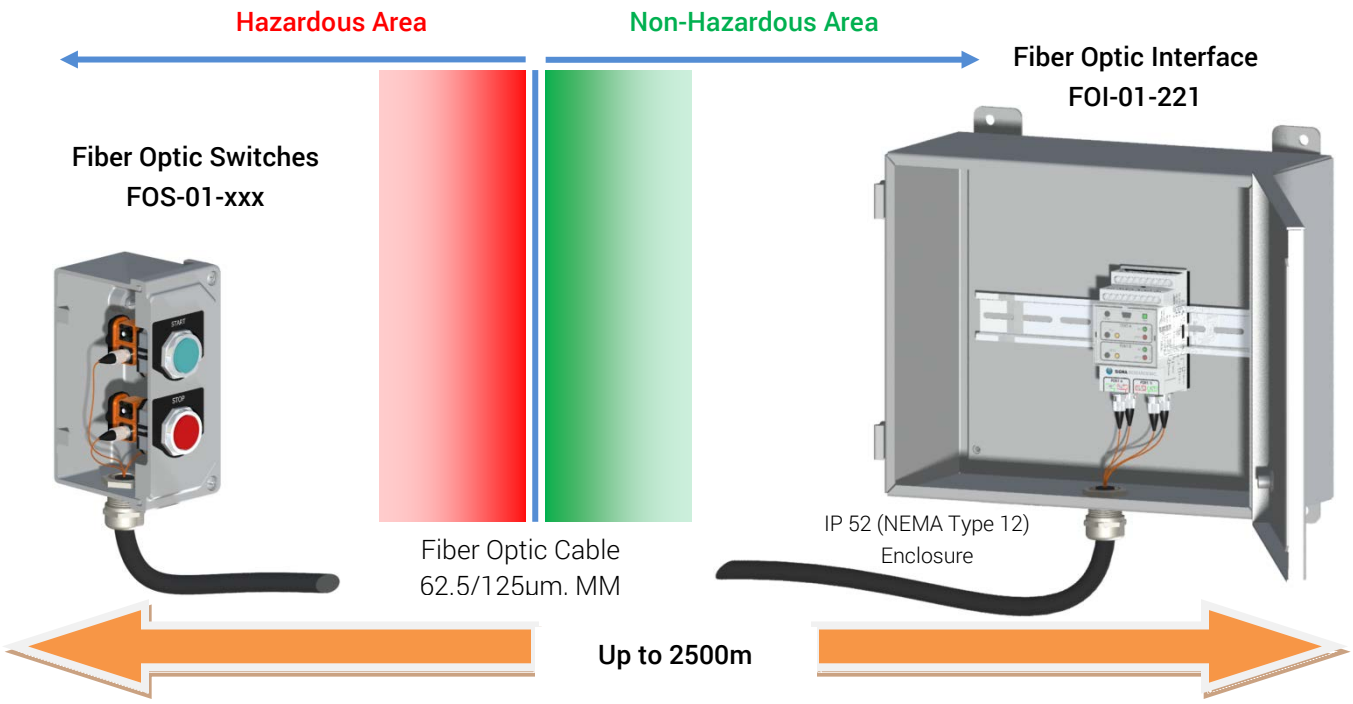
Index

1.0 Overview

The Fiber Optic Interface (FOI) allows bi-directional control between continuous wave fiber optic signals and electrical signals (see block diagram). It was primarily designed to interface Fiber Optic Switches to electrical circuits but it can also be used for many other applications (refer to Application Manual). Up to 32 FOI's can be connected in a network over RS485 (Modbus RTU) or Ethernet (Modbus TCP/IP) allowing 64 Fiber Optic Switches (2 switches/FOI) to communicate with a master over the networks mentioned above.
The FOI also has the capability to perform a fiber optic loop test to determine the fiber optic loop continuity and the optical power margin.



The system provides a safe optical signal (rated inherently safe **Ex op is**), which can be used in any type of hazardous environment or explosive atmosphere.

Features:

- ✓ Interfaces Fiber Optic Switches (FiberSwitch™) to electrical circuits
- ✓ Immune to EMI/RFI and High Voltage Power Lines.
- ✓ Provides a Safe Optical Signal Sent Into Hazardous Areas (IEC 60079-28)
- ✓ DIN Rail and Panel Mountable.
- ✓ Communicates via RS485 Modbus RTU
- ✓ Uses Standard Multimode 62.5/125µm Fiber Optic Cable with ST Connectors.
- ✓ Low Power Consumption (<2.0W)
- ✓ Long Distance Signal Transmission with no Interference.
- ✓ Equipped with 2 Independent Optical I/O Ports and 2 Electrical I/O Ports.
- ✓ Programmable via USB.

2.0 Technical Specifications

Supply Voltage: 100-240VAC or 120-250VDC
Max. Power: 1.6W@100-240VAC, 1W@120-250VDC & 5VDC
Input Frequency (for AC Input): 50/60Hz
Input Current (full load) 120/240VAC: 15mA/8mA
Operating Temperature Range: 0 - 50°C (32 - 122°F)
Storage Temperature Range: -20 - 70°C (-4 - 158°F)
Humidity: 20-80% RH (non-condensing)
Altitude: <2,000m
Enclosure: IP20
Impact Energy Level: 1J (1K06)
ANSI/ISA 60079-28 [AEx op is Ma] I (Mining)
& IEC 60079-28: [AEx op is T6 Ga] IIC (Gas)
[AEx op is T60°C Da] IIIC (Dust)
NEC 500,505,506 (CEC): [Class I, II, III, Div. 1, 2/ Zone 0 /Zone 20] Gr. A, B, C, D, E, F, G Temp. Code T6

Electrical Inputs

2 inputs - accept external dry contact or collector output (NPN) 10mA@5VDC
ESD protected (4kV contact discharge, 8KV air discharge as per IEC 61000-4-2)

Electrical Outputs

2 outputs
1 Form A (NO) contact per output (MOV protected)
Contact Rating: 5A@240VAC
3A@24VDC
0.4A@125VDC
0.2@250VDC
Min. Contact Rating: 10V/10mA

Optical Inputs

2 inputs - photodiode receiver with DC amplifier and Trigger-Schmitt
Sensitivity: min. -29dBm@850nm
Connector: ST®
MM Graded Fiber: 62.5/125µm, OM1

Optical Outputs

2 outputs - VCSEL diodes (Class 1 laser)
Optical power: min. 0.6mW (-2.2dBm)@850nm
max. 1mW (0dBm)@850nm
Connector: ST®
MM Graded Fiber: 62.5/125µm, OM1
Max Distance: 2500 meters
Optical Power Budget: min. 26.8dBm

Alarm

1 Form A(NO) contact
- 0.4A@200VAC
- 0.25A@24VDC
- 0.05A@125VDC

RS-485

- Modbus RTU
- ESD protected (4kV contact discharge, 8KV air discharge as per IEC 61000-4-2)

USB

- Mini type B female connector
- ESD protected (4kV contact discharge, 8KV air discharge as per IEC 61000-4-2)
- Used for programming
(PC programming - OptiLink software included)

Mounting

- 35mm DIN Rail
- Panel (mounting brackets included)

Overall Dimensions

99.5(3.91")L x 52.5(2.06")W x 58.0(2.28")H

Weight

185g (6.5oz)

Reliability

Non-redundant mode
MTBF - 395,078 hours (45 years) @ 25°C
Redundant mode
MTBF - 493,847 hours (56 years) @ 25°C

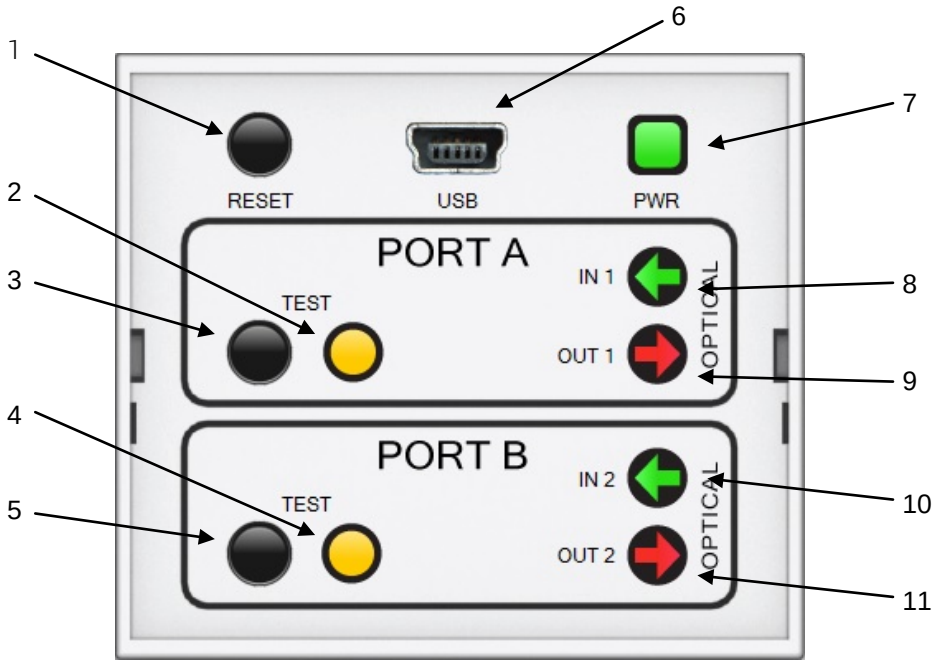
Standards

UL 61010-1, CSA 22.2 No.61010-1,
IEC 61000-6-2, IEC 61000-6-4, IEC 61010-1,
IEC 61000-3-2, IEC 60079-0, IEC 60079-28,
ANSI/ISA60079-28, IEC 60825-1,
RoHS, FCC, ICES-003

Patents

US 7,786,428 Aug 31/2010
CANADA 2,614,920 Feb 14/2012

3.0 Front Panel



1 - Reset pushbutton: Resets the microcontroller on the Fiber Optic Interface.

2 - Test LED Port A: ON if Port A has been tested, OFF if Port A has not been tested, Flashing slowly if testing is in progress, Flashing rapidly if testing has failed. [Fiber Optic Loop Test]

3 - Test Port A pushbutton: Performs fiber optic loop test on Port A. [Fiber Optic Loop Test]

4 - Test LED Port B: ON if Port B has been tested, OFF if Port B has not been tested, Flashing slowly if testing is in progress, Flashing rapidly if testing has failed. [Fiber Optic Loop Test]

5 - Test Port B pushbutton: Performs fiber optic loop test on Port B. [Fiber Optic Loop Test]

6 - Mini USB type B connector: Program with OptiLink Software. [Programming]

7 - Power LED: ON when either USB or main AC/DC power supply is connected. [Power Supply]

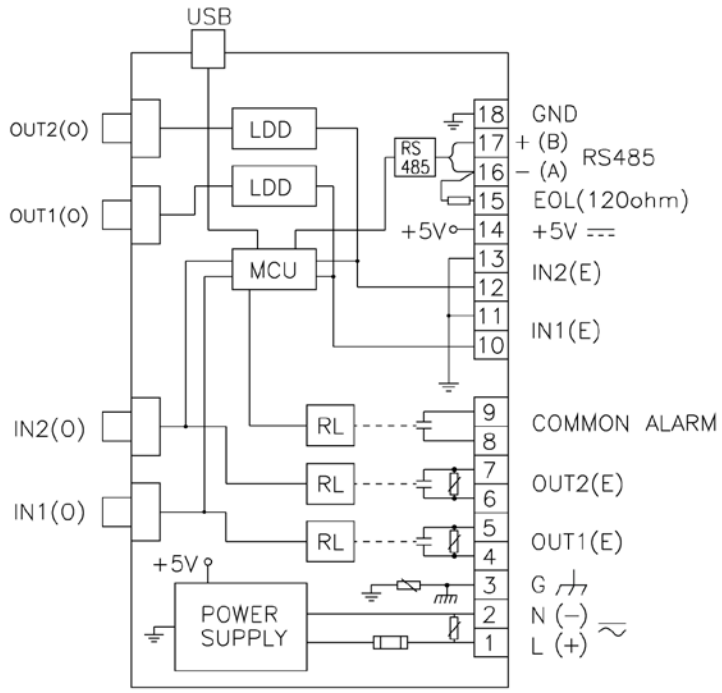
8 - Optical Input 1 LED: ON when Port A receives an optical signal (OUT1(E): relay contact on terminals 4 & 5 closes.

9 - Optical Output 1 LED: ON when Port A laser diode is transmitting (IN1(E): terminals 10 & 11 are shorted).

10 - Optical Input 2 LED: ON when Port B receives an optical signal (OUT2(E): relay contact on terminals 6 & 7 closes.

11 - Optical Output 2 LED: ON when Port B laser diode is transmitting (IN2(E): terminals 12 & 13 are shorted).

4.0 Internal Block Diagram



LEGEND

LDD - Laser Diode Driver

MCU - Microcontroller Unit

RL - Relay

EOL - End of Line Resistor (120 ohm)

(O) - Indicates Optical Input or Output

(E) - Indicates Electrical Input or Output

- Frame or chassis TERMINAL

- Earth (ground) TERMINAL

DANGER

Hazardous voltage.
Can cause death or serious injury.
Turn off and lock out all sources supplying power to this device before working on the device.

Tension dangereuse .
Peut causer la mort ou des blessures graves.
Arrêter et verrouiller toutes les sources alimentant cet appareil avant de travailler sur l'appareil.

If the equipment is used in a manner not specified in this operation manual, the protection provided by the equipment may be impaired.

Si l'équipement est utilisé d'une manière non spécifiée dans ce mode d'emploi, la protection fournie par l'équipement peut être altérée.

WARNING

Handle the fibre optic cables with care. When unplugging fiber optic cables always grab the connector, not the cable itself.

After unplugging fiber optic cables, always install the protective cap over the tip of the receptacle as well as the cable.

Do not touch the ends of the fibres with bare hands as the fibre is extremely sensitive to grease and dirt.

AVERTISSEMENT

Manipulez les câbles à fibres optiques avec soin. Lorsque vous débranchez les câbles de fibres optiques toujours saisir le connecteur, pas le câble lui-même.

Après avoir débranché des câbles de fibres optiques, toujours installer le capuchon de protection sur la pointe du récipient ainsi que le câble.

Ne touchez pas les extrémités des fibres avec les mains nues que la fibre est extrêmement sensible à la graisse et la saleté.

5.0 Connection & System Operation

Start-Up Check List

- Connect power (see Power Supply for details).
- Install jumpers to terminals 10 & 11 for Port A, terminals 12 & 13 for Port B, to activate laser diodes, the red OUT1 & OUT2 LEDs should turn on (see Optical & Electrical I/O Ports for details).
- Hook up fiber optic cables (MM 62.5/125µm) from each port laser diode (OUT1(O), or OUT2(O)), to the respective optical inputs (IN1(O), or IN2(O)). The green IN1 & IN2 LEDs should turn on.
- The Fiber Optic Interface is now fully functional and can be used in conjunction with Fiber Optic Switches or other FOIs.
- **(Optional)** Remove jumpers and perform a fiber optic loop test on each port by pressing the test buttons (see Fiber Optic Loop Test for details).
- **(Optional)** Hook up the USB cable to a computer and open the OptiLink Software to program Modbus RTU settings or Redundant Mode (see Programming for details, and refer to OptiLink software manual).
- **(Optional)** Hook up RS485 cables. Open OptiNet software to test Modbus communication (see RS485 Communication for details).

5.1 Operational Overview

The interface has an 8 bit microcontroller that supervises ports A and B but it does not control the operation of the two ports. The reason behind this approach was to increase the reliability of the FOI by keeping its critical functions as simple as possible and independent of the microcontroller reliability. Therefore a failure of the microcontroller will not affect the critical functions of the interface in any way (the laser diode will continue to send an optical signal to the fiber optic cable and the optical input will continue to read optical signals and control the output relay).

However, a microcontroller failure will affect the communication through the USB and RS485, output LED indication, common alarm and the fiber optic loop test function. If the interface is connected in a RS485 network using Modbus RTU and the microcontroller fails, the FOI will not be able to respond to the Modbus master requests and therefore the Modbus Master will generate a timeout alarm advising the operator of an interface malfunction.

5.2 Power Supply

The FOI accepts a wide range of single phase AC supply voltages between 100-240VAC@50/60Hz and DC supply voltages between 120-250VDC.

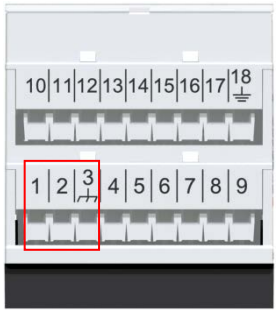
! Maximum supply breaker size: 15A@120VAC, 6A@240VAC
! La taille maximale du disjoncteur d'alimentation: 15A@120VAC, 6A@240VAC

Connect power as follows:

L(+) - Terminal 1

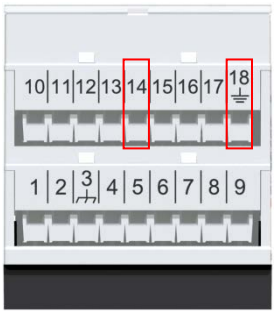
N(-) – Terminal 2

G – Terminal 3 ⏚



External wiring to terminals 1, 2, 3 shall be min. #14 AWG (1.5mm^2) and have a min. ratings of 300V @60^{0}C.
! Use ferrules to terminate stranded wires connected to the mains.
! Utiliser des embouts de mettre fin à torons connectés au réseau.

The FOI can also be powered from the USB port. This allows the user to conveniently program the interface without the need of an AC or DC main power supply.
When both power supplies are connected (USB and main AC/DC) the FOI will draw power from the main AC/DC power supply only.



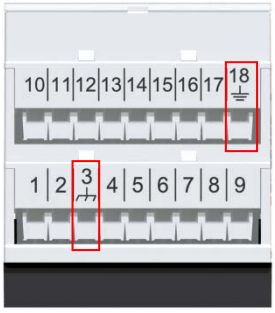
The FOI can also be powered from a 5VDC power supply applied between terminals 14(+) and 18(-).

! Do not connect both 5VDC and AC/DC main power supply simultaneously. This may damage the FOI.
! Ne pas raccorder 5VDC et AC/DC alimentation principale simultanément. Cela pourrait endommager le FOI.

The power LED is ON when at least one of the power supplies is present (USB, 5VDC or AC/DC main).

5.3 Grounding

The FOI has two grounding connections. One is the isolated internal ground or functional ground (terminal 18) and the other is the equipment frame (chassis) ground (terminal 3). The isolated ground at terminal 18 can remain unconnected or it can be connected to the sensitive equipment isolated ground like PLC, DCS, SCADA, RS485, etc.

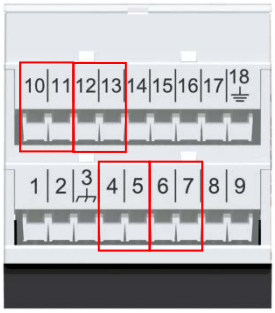


However, to avoid a high potential difference between the two grounds, a MOV was provided inside the FOI between the two grounds (terminals 3 & 18). The MOV limits the potential difference to approx. 30V and also discharges the electrostatic charges that may occur on the isolated ground (terminal 18).

! For grounding connection please follow the standards and/or regulations imposed by the local electrical authority having jurisdiction.
! Pour la connexion de mise à la terre se il vous plaît suivre les normes et/ou réglementations imposées par l'autorité électrique ayant juridiction locale.

5.4 Optical & Electrical I/O Ports

There are two identical ports identified as A and B.



Each port consists of an optical output (laser diode OUT1(O) & OUT2(O)) connected to an electrical input that can be externally controlled by a dry contact or by an open collector NPN transistor (terminals 10 & 11 for Port A, terminals 12 & 13 for Port B).

Each port also has an optical input (photodiode IN1(O) & IN2(O)) that controls a relay with an NO contact (terminals 4 & 5 for Port A, terminals 6 & 7 for Port B).

For more details see block diagram. For typical wiring diagrams refer to Application Manual.

5.5 USB Port

This port is a mini type B USB female connector and is used to connect the FOI to a PC for programming. A Windows based software called OptiLink is provided for FOI programming. For more details see OptiLink software manual.

5.6 RS485 Communication

The FOI can communicate over a RS485 network using the Modbus RTU protocol. For the Modbus register map and settings see OptiLink software manual. Up to 32 interfaces can be connected to a RS485 network.

The following data is sent over RS485:

Digital 1 bit registers

-Status of each electrical and optical inputs and outputs
-Redundant mode status
-Enabled/disabled port status

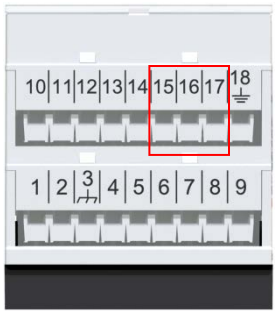
-Optical port failure alarm
-Redundant mode failure alarm
-Low and high temperature alarms
-Loop test status
-Common alarm

Analog 8 bit registers

-Laser diode voltage of each port
-Output optical power of each port (from the monitoring photodiode installed on the laser diode chip).
-Temperature inside the interface.
-Firmware version

A very useful application that can be implemented over RS485 is “networkable switches”. Up to 64 Fiber Optic Switches can be connected to a RS485 network using 32 interfaces to communicate their statuses (ON/OFF) to a PLC, DCS, PC, SCADA, etc. Using a RS485 to Ethernet converter, the 64 fiber optic switches status can also be sent over an Ethernet network using Modbus TCP/IP protocol.

A demo Modbus RTU/TCP master software (OptiNet) is provided for this application. Users can also develop their own applications. For details see OptiNet software and FOI Application Manual. The FOI includes a 120 ohm "End of Line" resistor to terminate the RS485 network. The EOL is connected between terminals 15 & 16. Connect a jumper between terminals 15 & 17 if the FOI is the last one in a RS485 network.



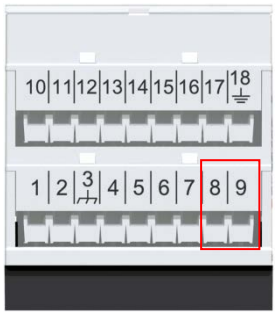
5.7 Common Alarm

1. Optical port failure

The microcontroller monitors the laser diode voltage and its optical power output using the monitoring photodiode installed on the laser diode chip. In case of an abnormal laser diode voltage or an optical power outside the normal operating range, an alarm will be generated by opening the common alarm relay contact between terminals 8 & 9. At the same time the output LED of the respective port will start flashing rapidly. An alarm is also sent via the RS485 using the Modbus RTU protocol (refer to Modbus register map in OptiLink software manual).

The analog values of the laser diode voltage and the output optical power are also sent via RS485 giving the user the possibility to monitor and trend them over time to determine when a laser diode or other components controlling the laser diode are about to fail.

2. Loss of power



When the interface is de-energized, the common alarm contact* connected between terminals 8 & 9 is open. When the FOI is energized the contact closes and remains closed until a loss of power occurs, or an alarm is generated by an optical port failure, or a redundant mode failure.

* the alarm contact between terminals 8 & 9 can drive a PLC input or a relay coil with a rated power less than 7W@24VDC, 125VDC or 80VA@200VAC.

3. Redundant Mode Alarm

When the redundant mode is enabled, the FOI will generate a redundant mode alarm if the ports do not receive identical optical and electrical signals. The redundant mode alarm automatically triggers the common alarm which opens the relay contact between terminals 8 & 9.

5.8 Programming

(refer to OptiLink software manual)

- Modbus RTU (programmed through OptiLink software only)

User can set the slave ID(1-247) and parity (none, odd, even). All the other parameters are pre-defined and cannot be changed.

- Enable/Disable ports

Press and hold the test button for more than 10s. The output LED of the disabled port will start flashing briefly once every two seconds.
To enable the port, press and hold the test button again for more than 10s.

Ports can be also be disabled and enabled from the OptiLink software (refer to OptiLink software manual).

This feature can be used when a port fails and activates the common alarm. By disabling the faulty port, the common alarm no longer sees alarms from the faulty port but it continues to receive alarms from the healthy port.

- Redundant Mode (programmed through OptiLink software only)

When higher reliability is required, both ports (A & B) can be used to perform the same function. For example, both ports can be connected to an optical switch with two identical optical contacts (both NC or NO) that are operated simultaneously. If one of the optical contacts fails, the FOI will continue to operate without interrupting the electrical device that it controls.

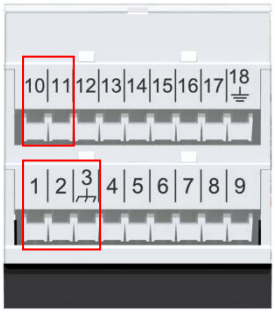
Similarly, if one of the FOI ports fails (faulty laser diode, faulty photodiode, etc) or a fiber optic cable is disconnected or broken. For redundant mode wiring diagram see Application Manual - "Typical Applications".

By activating the redundant mode, the FOI will generate an alarm if the ports do not receive identical optical and electrical signals. The alarm will open the common alarm contact between terminals 8 & 9 and it will also send a notification to the Modbus master through RS485.

! In order to activate the redundant mode, the fiber optic loop test must be performed on both ports and both tests must be successful (both test LED's must be ON).
! Pour activer le mode redondant, le test de boucle de fibre optique doit être effectué sur les deux ports et deux tests doit être réussi (deux essais de LED doit être ON).

5.9 Fiber Optic Loop Test

The FOI can perform a fiber optic loop test to determine the continuity and the optical power margin of the fiber optic loop. In order to perform the test the FOI must be pre-configured as follows:



1. Connect the main power supply (terminals 1,2,3). Do not perform the test while the FOI is energized from the USB port only. Doing so, may alter the test accuracy.

2. Connect all fiber optic cables and make sure that the fiber optic loop is continuous: the light from the optical output (laser diode) must return to the optical input (photodiode) of the same port.

3. Electrical input is not connected to ground. Make sure that any wires (jumpers) connected between terminals 10-11 for port A and 12-13 for port B are removed. The red output LED of the port that is to be tested, must be off prior to start the test.

For pre-test configuration diagrams see ANNEX B.

Press the test button. Both output LED and test LED of the port being tested will start flashing for approx. 10s. At the end of the test, the output LED will turn off and the test LED will turn ON and remain ON if the test was successful (power margin > 4dB). If the test failed (power margin <4dB) the test LED will start flashing rapidly.

! Do not operate the FOI with an optical power margin less than 4dB. This may lead to nuisance tripping.
! Ne pas faire fonctionner le FOI avec une marge de puissance optique moins de 4dB. Cela peut conduire à déclenchement intempestif.

For optical power budget and power margin calculations see ANNEX A.

The result of the test is stored in the microcontroller EEPROM. To clear the test result, press and hold the test button for at least 5s.

If the FOI is not pre-configured as described above and the test button is pressed, both test LED and output LED will flash five times indicating that the test cannot be performed. The fiber optic loop test can be performed directly from the interface or from a PC connected to the FOI through USB and running the OptiLink software.

6.0 Installation & Environmental Considerations

The FOI can be installed on a standard 35mm DIN rail or directly on the back panel of a metallic or non-metallic enclosure with a min. rating of IP 52 (NEMA Type 12). The FOI was designed to be used in weather protected locations, where the temperature is controlled. Heating or cooling may be switched off for periods, but occurrence of extremely low or high temperatures is prevented (e.g. electrical substations, control rooms, etc.).

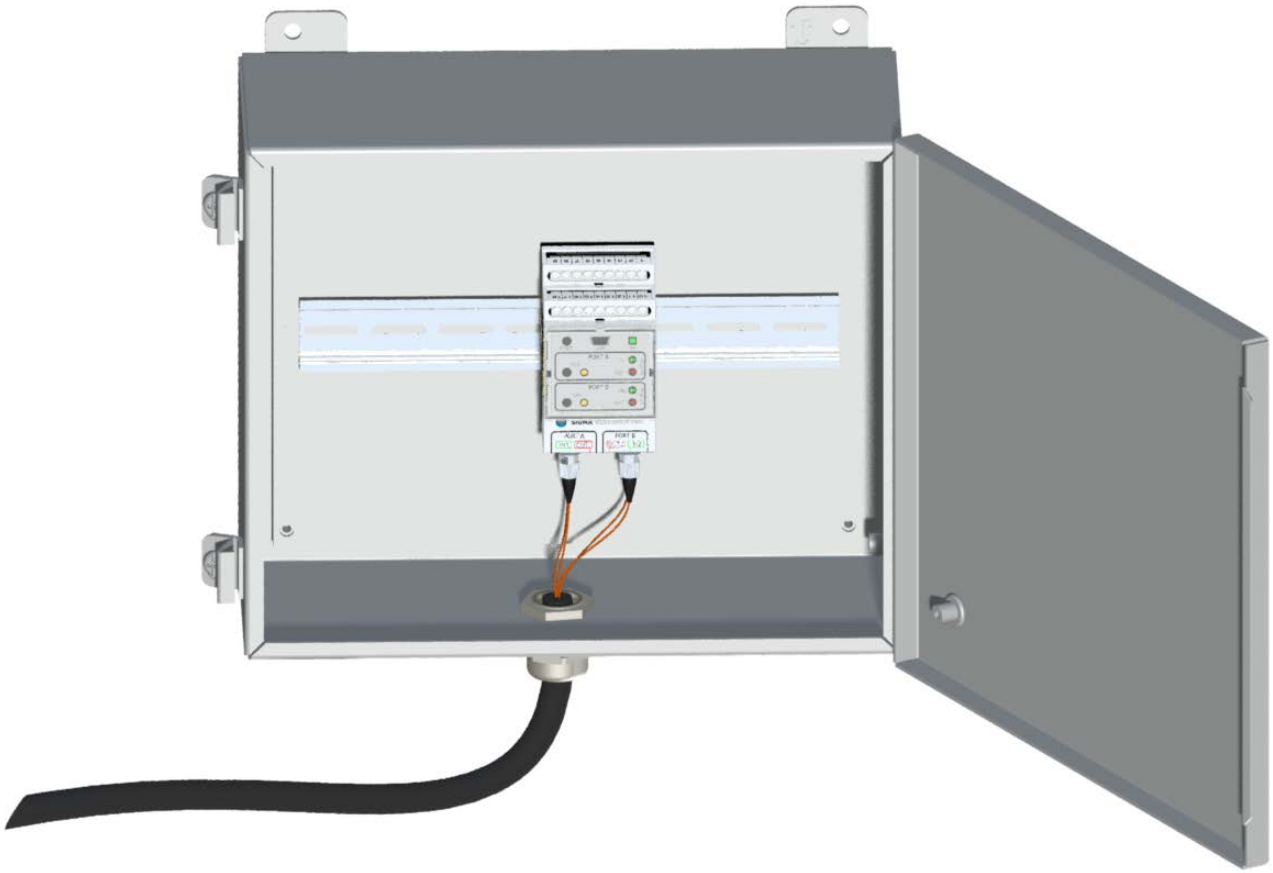
The FOI was also designed to withstand strong magnetic field at 50Hz and 60Hz (higher than required by IEC 61000-4-8) making it suitable to be installed in high current distribution equipment like MCC's, switchgears, manual motor starters, etc.

Environmental pollution level: Pollution Degree 1

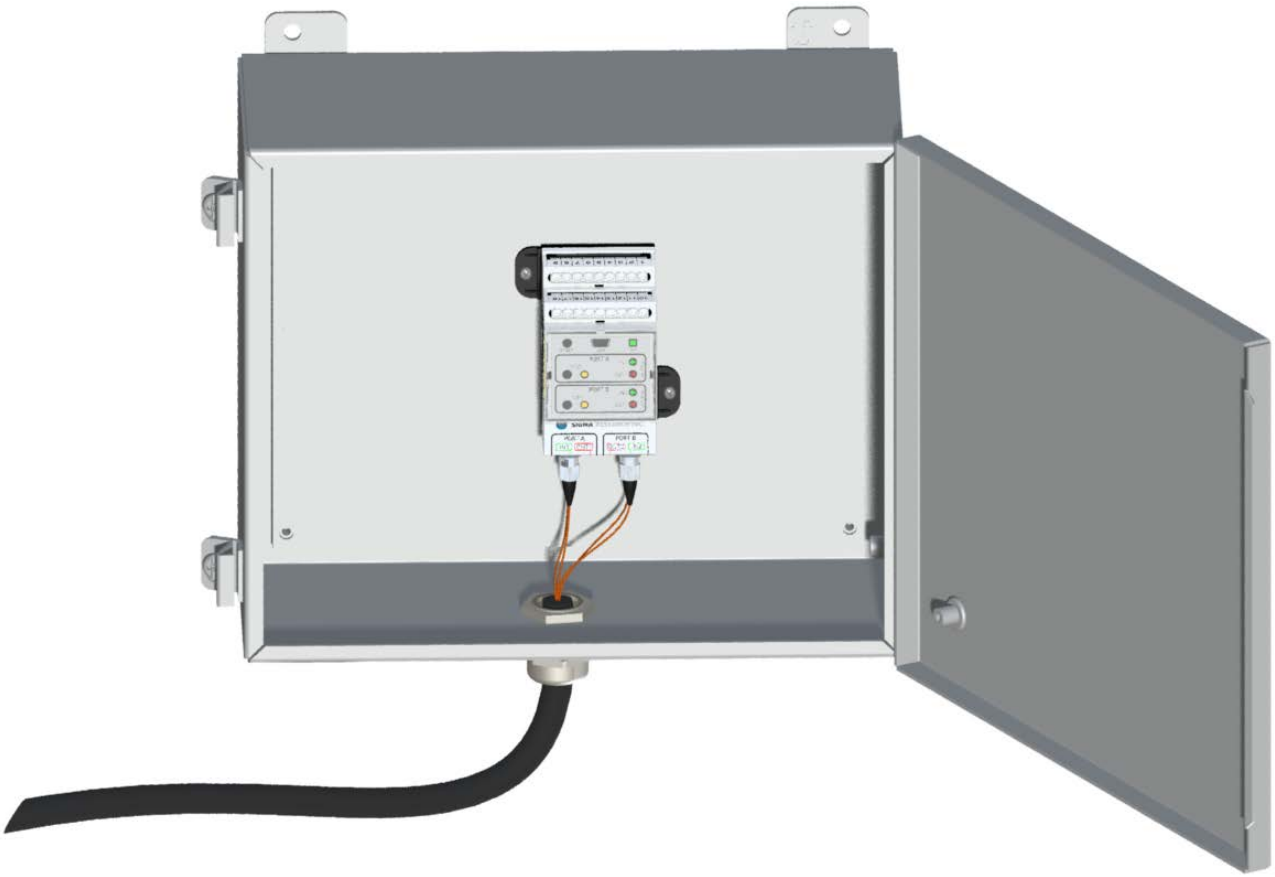
Transient overvoltage rating: Overvoltage Category II

FOI impact energy protection level as per IEC 61010-1 = 1J (IK06) Impact energy = 1 Joule

35mm DIN Rail Installation



Back Panel Mounting Installation



Mounting brackets and screws are provided with each Fiber Optic Interface.

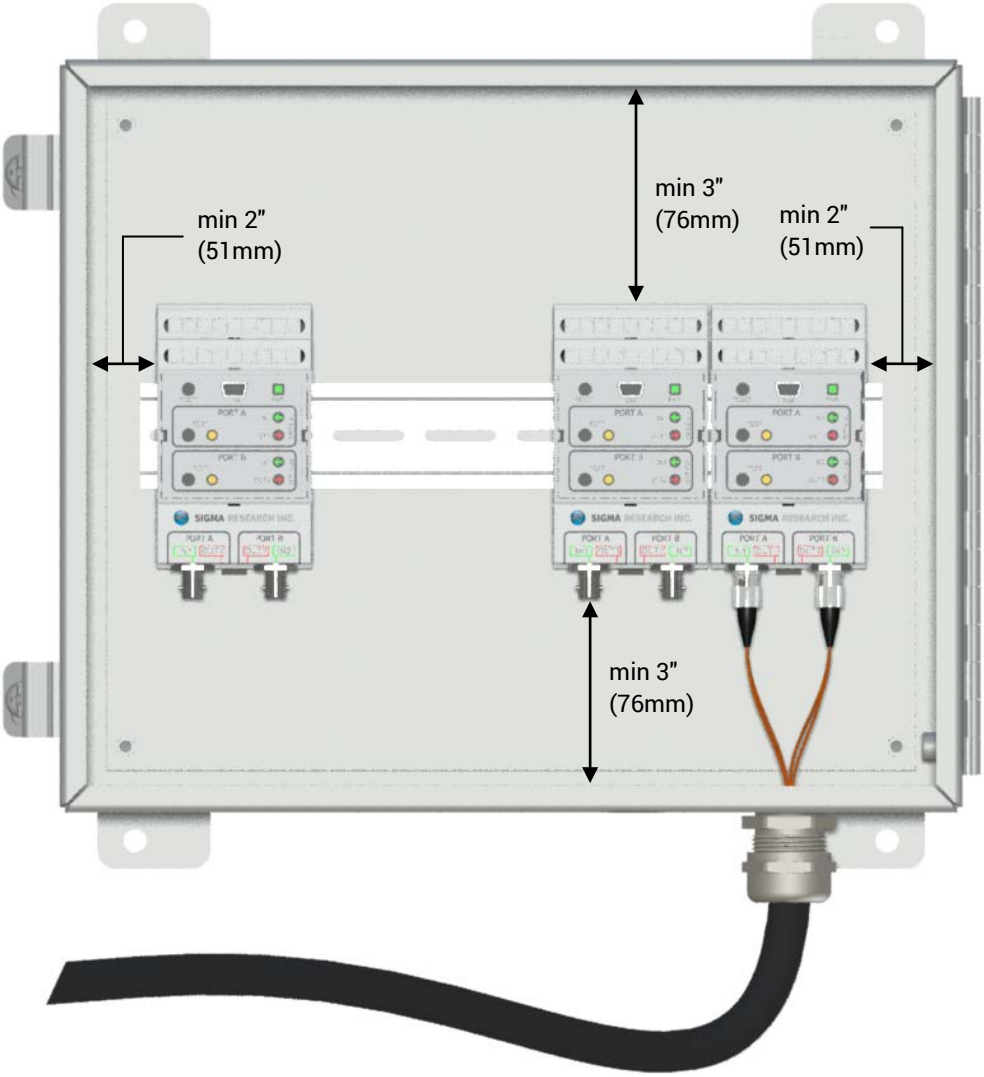
⚠ *Always install the FOI in a protective enclosure or inside an electrical equipment enclosure (MCC, Switchgear, etc) with a min. rating of IP 52 (NEMA Type 12) and an energy protection level >5J (IK08) as per IEC 62262.*

Toujours installer le FOI dans un boîtier de protection ou à l'intérieur d'un boîtier électrique de l'équipement (MCC, commutation, etc) avec un min. cote de IP 52 (NEMA 12) et un niveau de protection de l'énergie > 5J (IK08) selon la norme IEC 62262.

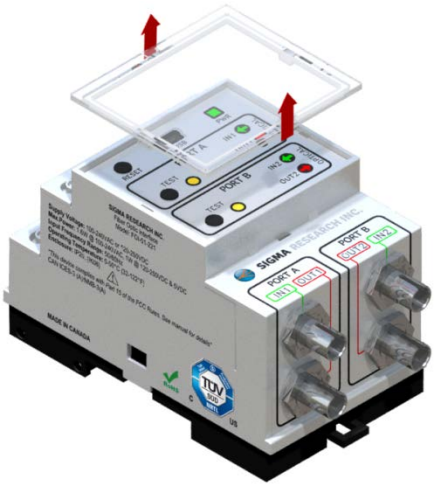
⚠ *Do not install the FOI in locations where it can be exposed to mechanical damage.*

Ne installez pas le FOI dans des endroits où il peut être exposé à des dommages mécaniques.

Clearance Details



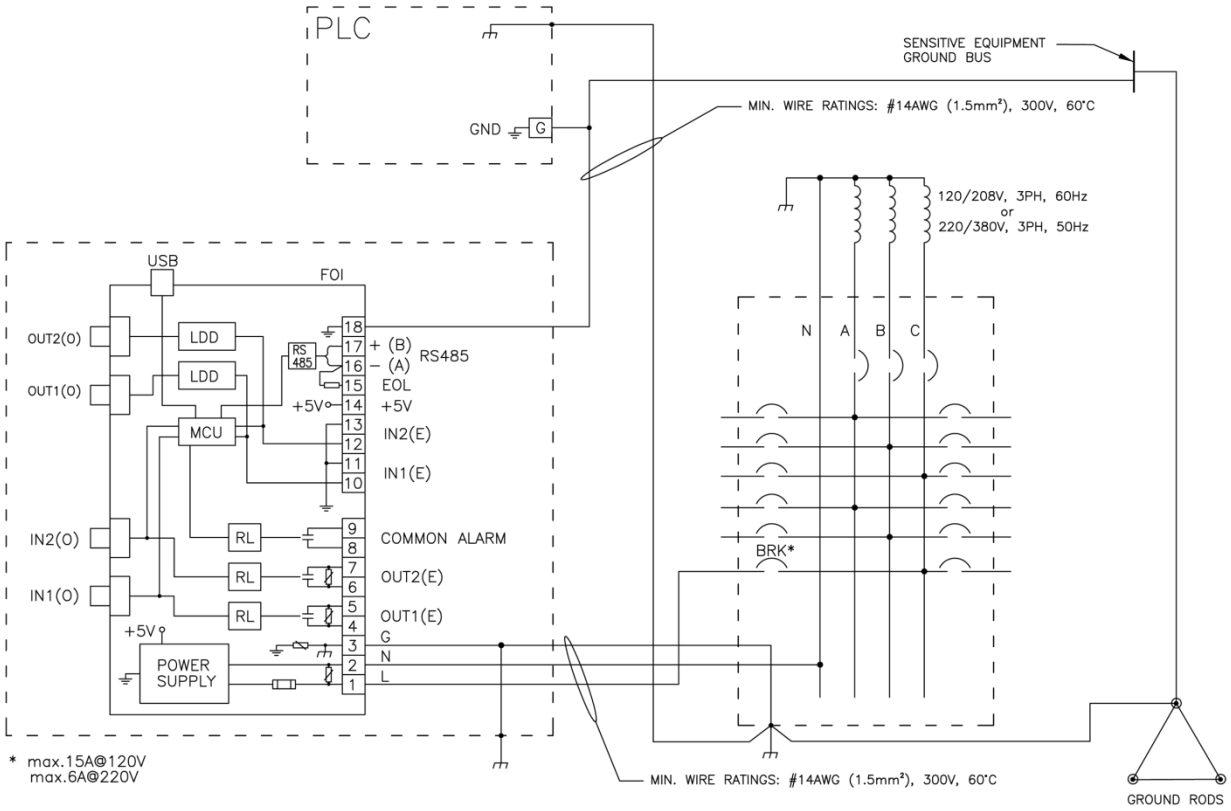
Metallic or non-metallic enclosure with a min. rating of IP 52 (NEMA Type 12) and energy protection level >5J (IK08) as per IEC62262.



Removing Transparent Lid

Grab the lid at the center of each side (indicated by red arrows), and pull up to remove it.

7.0 Power and Grounding Connections



POWER AND GROUNDING DETAILS

! The FOI shall be installed as close as practical to the distribution panel that contains the supply breaker (BRK).*

*! Le FOI doit être installé aussi près que possible au panneau de distribution qui contient le disjoncteur d'alimentation (BRK *).*

! Open and lock the breaker (BRK) before installing wires to power terminals 1&2. The supply breaker shall be lockable in open position.

! Ouvrez et verrouiller le disjoncteur (BRK) avant d'installer les fils aux bornes d'alimentation 1&2. Le disjoncteur d'alimentation doit être verrouillé en position ouverte.

! The breaker (BRK) must be marked as the disconnecting device for the equipment.

! Le disjoncteur (BRK) doit être marqué comme le dispositif de déconnexion de l'équipement.

! For power and grounding connections please follow the standards and/or regulations imposed by the local electrical authority having jurisdiction. The power and grounding detail above is an example only and it might not be in accordance to the local standards and regulations.

! Pour les connexions d'alimentation et de mise à la terre se il vous plaît suivre les normes et/ou réglementations imposées par l'autorité électrique ayant juridiction locale. La puissance et la terre détail ci-dessus ne est qu'un exemple et il pourrait ne pas être conformes aux normes et réglementations locales.

! If the FOI is operated on the same circuit with switching inductive loads (contactors, solenoids, motors, etc.), it is highly recommended to install a surge protective device close to FOI power terminals L(1) and N(2).

! Si le FOI est exploité sur le même circuit avec commutation de charges inductives (contacteurs, solénoïdes, moteurs, etc.), il est fortement recommandé d'installer un dispositif de protection de surtension près de bornes d'alimentation FOI L(1) et N(2).

8.0 Maintenance

No regular maintenance is required as none of the FOI components need replacement or maintenance for the entire life span of the FOI.

! Visually inspect the enclosure and the terminals of the FOI for cracks, burns, etc.

! Inspectez le boîtier et les bornes de le FOI pour les fissures, brûlures, etc.

! Defective FOI's shall be returned to manufacturer for repair or replacement. Do not attempt to open and/or repair the device.

! FOI défectueux de doivent être renvoyés au fabricant pour réparation ou remplacement. Ne essayez pas d'ouvrir et/ou de réparer l'appareil.

! Install dust caps (provided) when optical ports are not in use, to prevent dust ingress.

! Installez capuchons de protection (fourni) lorsque ports optiques ne sont pas en cours d'utilisation, pour empêcher la pénétration de poussière.

! Use cleaning swabs (provided) to clean the optical ports if dust contamination occurs.

! Utilisez tampons de nettoyage (fourni) pour nettoyer les ports optiques si la contamination de la poussière se produit.

9.0 Hazardous Locations (Explosive Atmospheres)

The FOI was designed to meet the requirements of IEC 60079-28 and ANSI/ISA 60079-28 : 2013 (Explosive atmosphere - Protection of equipment and transmission systems using optical radiation). This standard explains the potential ignition hazard from equipment producing optical radiation that is sent in explosive atmospheres. It covers equipment, which itself is located outside explosive atmosphere but its emitted optical radiation enters such atmospheres.

! The FOI cannot be installed in hazardous locations, but its optical radiation transmitted through fiber optic can safely enter in hazardous locations.
! Le FOI ne peut pas être installé dans des endroits dangereux, mais son rayonnement optique transmis par la fibre optique peut entrer en toute sécurité dans des endroits dangereux.

The FOI is classified [AEx op is] per ANSI/ISA 60079-28 and [Ex op is] per IEC 60079-28.
This standard specifies the use of brackets "[...]" to identify the apparatus as not suitable for installation in a hazardous area.

FOI is rated as follows:

ANSI/ISA 60079-28: [AEx op is Ma] I (Mining)
[AEx op is T6 Ga] IIC (Gas)
[AEx op is T60°C Da] IIIC (Dust)

IEC 60079-28: [Ex op is Ma] I (Mining)
[Ex op is T6 Ga] IIC (Gas)
[Ex op is T60°C Da] IIIC (Dust)

NEC 500,505,506 (CEC): [Class I, II, III, Div. 1, 2/Zone 0/Zone 20] Gr. A, B, C, D, E, F, G Temp. Code T6

! FOR INSTALLATION IN NON-HAZARDOUS LOCATIONS ONLY
! POUR INSTALLATION DANS DES ENDROITS NON DANGEREUX

10.0 Laser Radiation

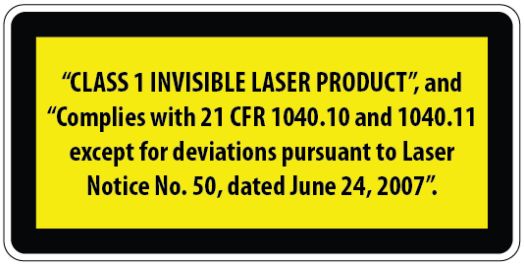
The FOI includes two identical 850nm infrared VCSEL laser diodes classified as Class 1 according to IEC60825-1:2007/03 and Class I according to CDRH section 1040.10(US)).

The laser radiation of Class 1 is considered safe during use, including long-term direct intrabeam viewing, even when exposure occurs while using optical viewing instruments (eye loupes or binoculars).

The maximum power measured according to IEC60825-1 is below the acceptable emission level (AEL) of Class 1 (Class I) of 0.778mW@850nm.

Visual warning of the optical laser radiation is indicated by the two red OUT 1 & 2 LED's installed on the front panel.

Explanatory label:



11.0 Electromagnetic Emissions (FCC and ICES-003)

Warning: 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 adequate measures.

Avertissement: Ce est un produit de Classe. Dans un environnement domestique, ce produit peut provoquer des interférences radio, auquel cas l'utilisateur peut être tenu de prendre les mesures adéquates.

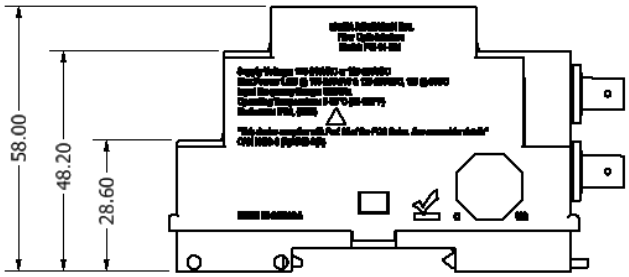
FCC Part 15 Subpart B:2012:

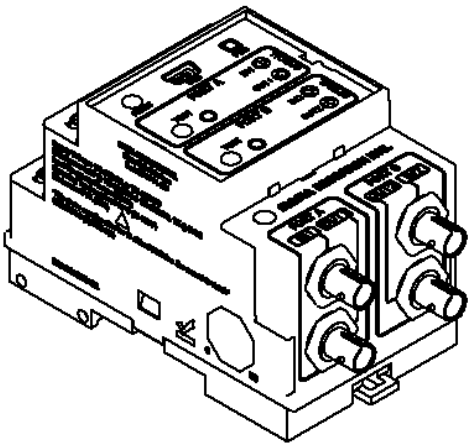
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

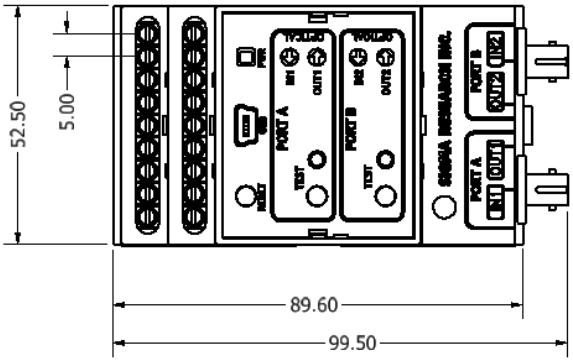
ICES-003:2012:

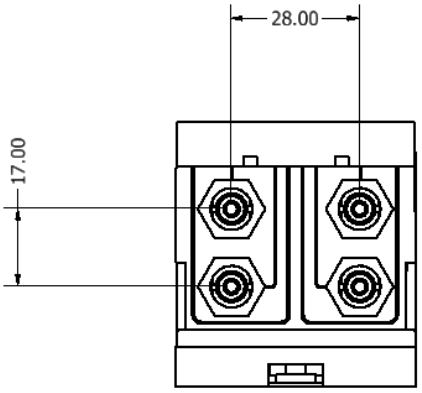
CAN ICES-3 (A)/NMB-3(A)

12.0 Dimensions





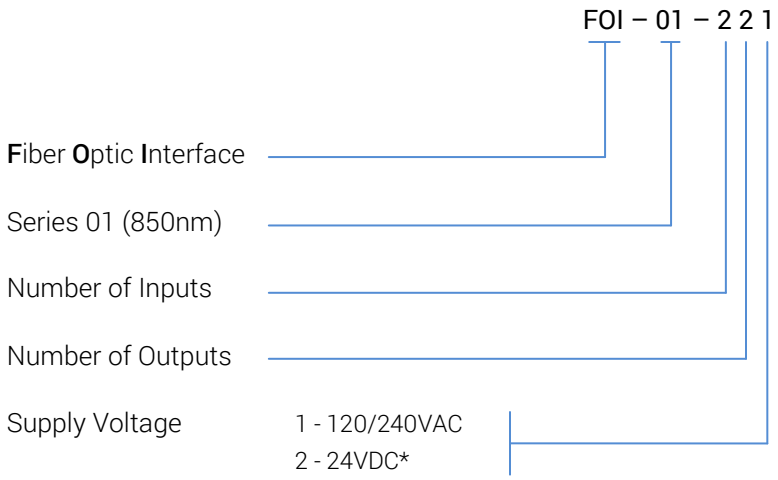




All dimensions in mm

13.0 Ordering Number & Contents

Catalog Number



*Not yet available

Standard Contents

- Fiber Optic Interface FOI-01-221
- 2 Mounting Brackets
- 2 Jumper Wires connected to Terminals 10 & 11 (Port A), and 12 & 13 (Port B)
- USB stick with digital copies of:
    1. Application Manual, Operation Manual, & Datasheet
    2. OptiLink Software & OptiLink manual
    3. OptiNet Software & OptiNet manual
- Hard copy of Datasheet

Accessories & Additional Contents

Contact us for supplementary products:

- Fiber Optic Cable, MM Graded Fiber: 62.5/125µm. Any length required.
- ST & FC connectors
- Cable glands
- USB 2.0 A Male to USB Mini Type B Male Cable 6ft/10ft

14.0 Warranty

This product has been manufactured and tested to the highest quality standards by SIGMA RESEARCH Inc. This warranty offered by SIGMA RESEARCH Inc. covers defects in material or workmanship in SIGMA RESEARCH Inc. products for a period of 1 year from the date of shipment. This warranty extends to the original purchaser only and is non-transferable.

During the warranty period SIGMA RESEARCH Inc. will replace at no charge for parts only or, at its option, replace any product or part of the product that proves defective because of improper workmanship and/or material, under normal installation, use, service and maintenance.

Damage in Shipment

If a product is received damaged, e-mail or call SIGMA RESEARCH Inc. Please be as specific as possible in outlining all the details of the damage and include pictures if possible. You must also inform the shipper immediately, and retain all the shipping containers in case reshipment is required. Failure to follow these steps may affect our response time and your claim for compensation.

Limitations of Warranty

This warranty does not cover any problem that is caused by:

A. Conditions, malfunctions or damage not resulting from defects in material or workmanship.
B. Conditions, malfunctions or damage resulting from normal wear and tear, improper installation, improper maintenance, misuse, abuse, negligence, accident or alteration.
C. Accessories, connected materials and products, or related products not manufactured or sold by SIGMA RESEARCH Inc.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability of fitness for a particular use. SIGMA RESEARCH Inc. shall not be liable for any direct, indirect, special, incidental or consequential damages, whether based on contract or any other legal theory.

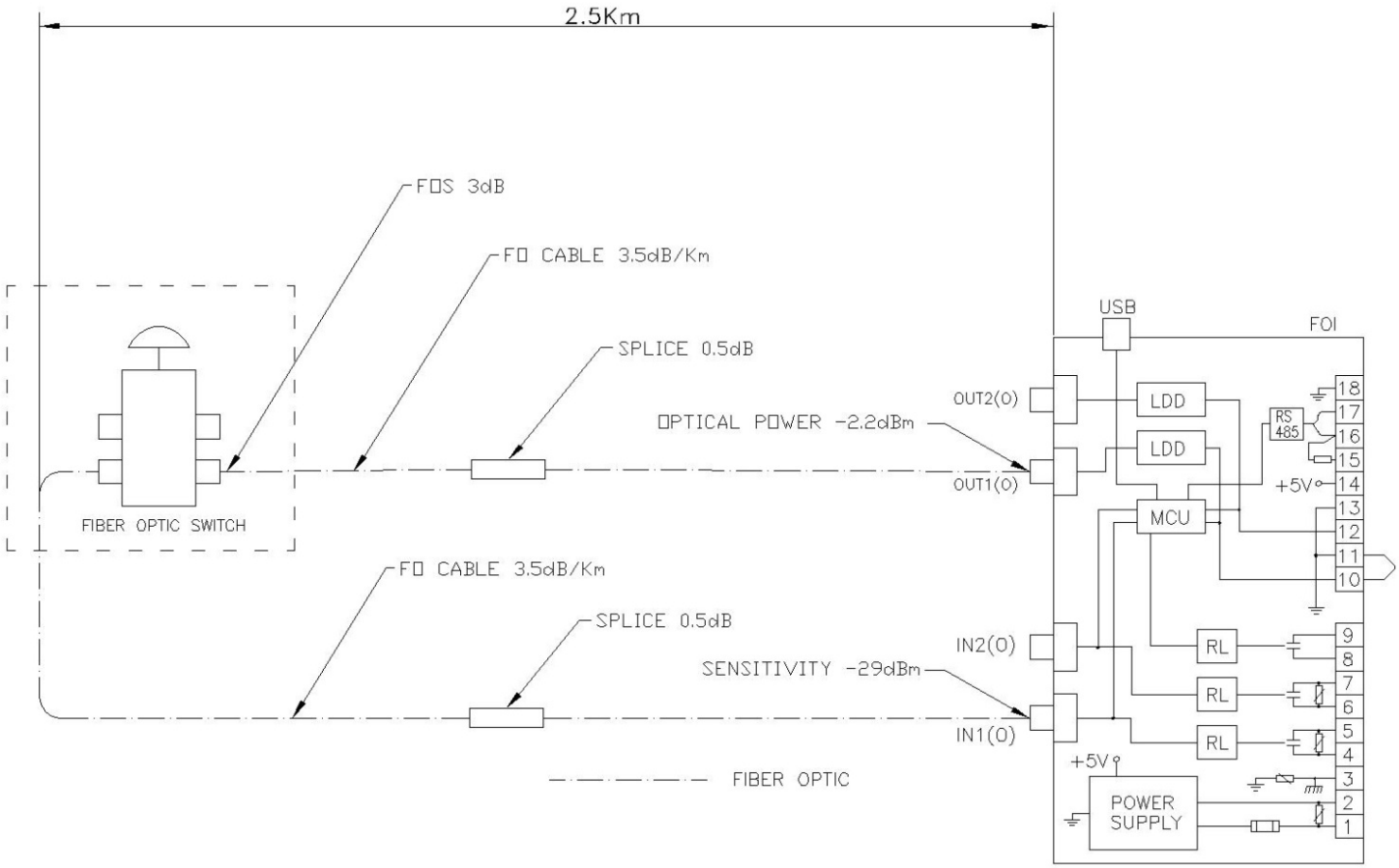
Contact Information:

To exercise this warranty, e-mail or call SIGMA RESEARCH Inc. You will be given specific instructions and assisted through the return process. This warranty requires the product to be delivered to the SIGMA RESEARCH Inc. service facility intact for examination with the serial number unremoved and all shipping charges prepaid. SIGMA RESEARCH Inc. will determine in its sole discretion if such defect exists and when repairs can be made. Once repaired, the product will be returned or replaced and the transportation prepaid, unless the shipment needs to be expedited in which case the customer will pay for return shipment. Repaired products are warranted for the remaining balance of the original warranty period, or at least 90 days.

Address:
259 Edgeley Blvd, Unit #2
Vaughan, Ontario, Canada L4K 3Y5

Contact:
Tel: +1 (905) 669-6888
Fax: +1 (905) 669-6444
info@sigmaresearch.ca
www.sigmaresearch.ca

ANNEX A Optical Budget and Power Margin Calculation



Optical power budget (OPB) Calculation

OPB = optical power - sensitivity = -2.2dBm - (-29dBm) = 26.8dBm

Optical power margin (OPM) Calculation

OPM = OPB -FO cable loss/Km x Distance - Splice loss x Number of splices - FOS Loss

OPM = 26.8dBm - 3.5dB/Km x 5Km - 0.5dB x 2 - 4dB = 4.3dB

A power margin higher than 4dB is recommended. Operating the system with a power margin lower than 4dB might lead to nuisance tripping.

When calculating the OPB and OPM, always consider the worst case scenario when the optical power is -2.2dBm (typ. is -1dBm), sensitivity -29dBm (typ. is 30dBm), fiber optic* loss is 3.5dB/Km (typ. is 3.2dB/Km), fiber optic switch loss is 4dB (typ. is 3dB) and similar for the other devices that introduce loss in the fiber optic loop.

*The fiber optic cable considered for the calculation above is: multimode 62.5/125um @ 850nm, OM1

ANNEX B Pre-test Configuration Diagrams

Fig. 1: Fiber Optic Loop Test Connection Diagram – Port A (Interface to FO Switch)

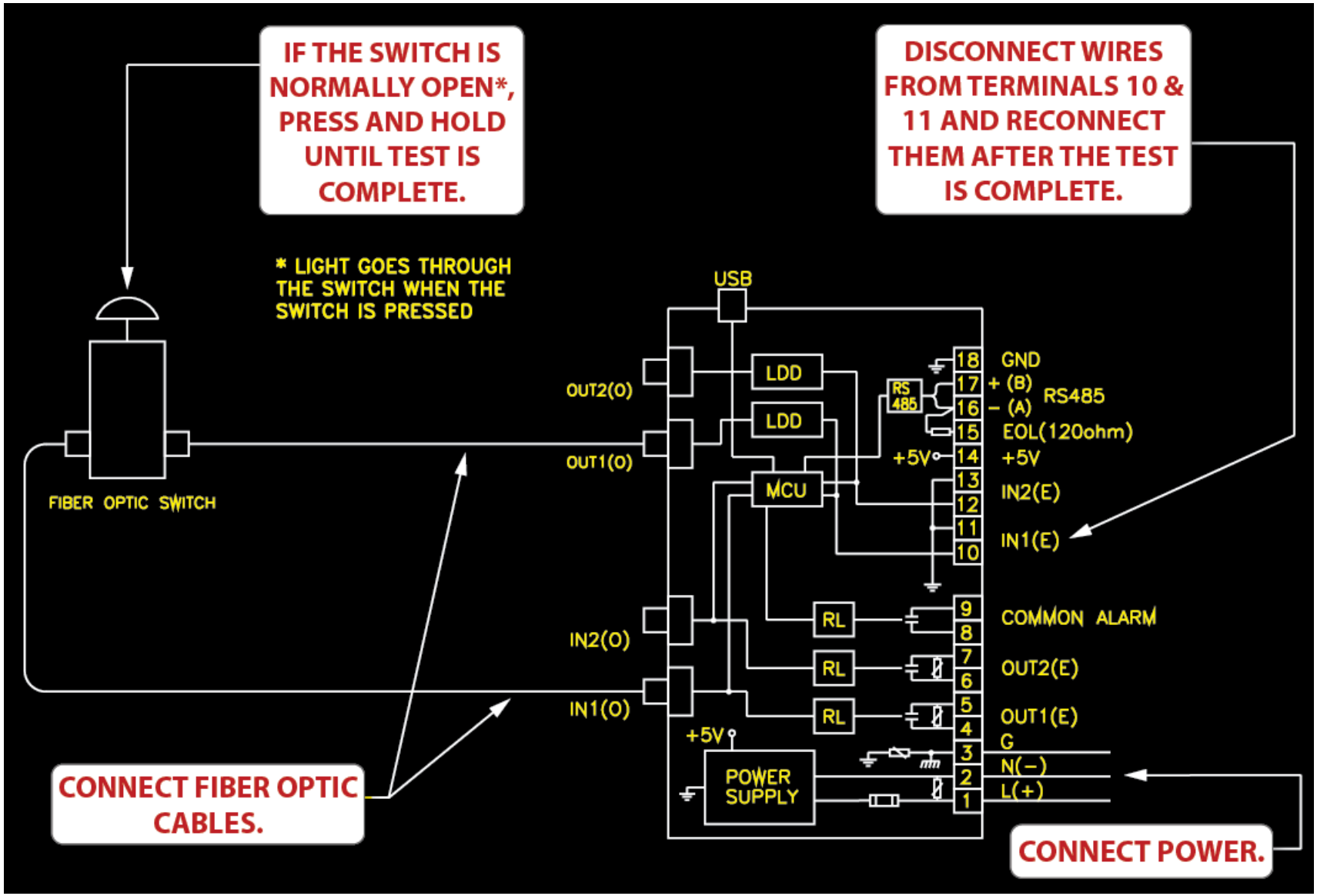


Fig. 2: Fiber Optic Loop Test Connection Diagram – Port B (Interface to FO Switch)

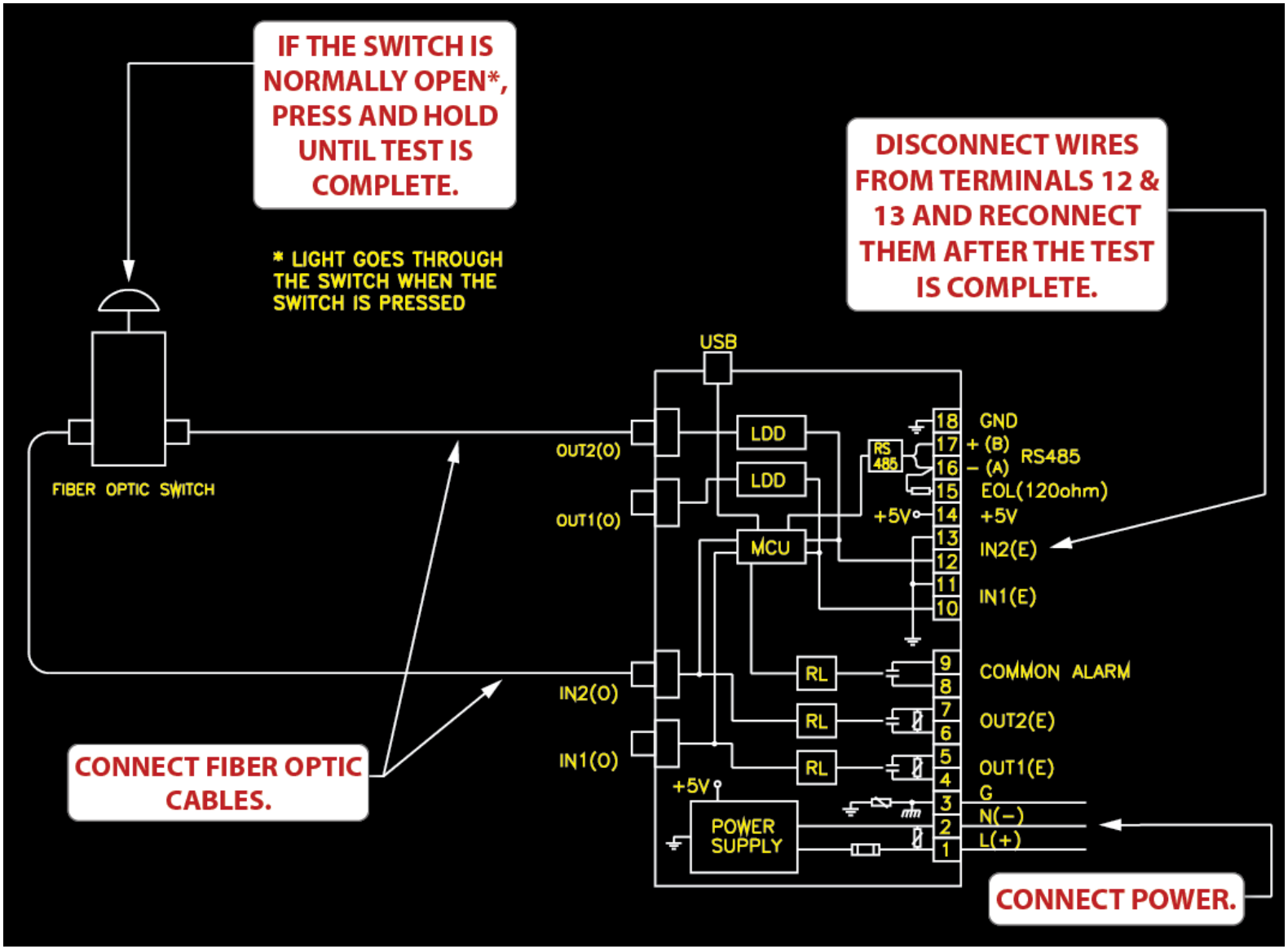


Fig. 3: Fiber Optic Loop Test Connection Diagram – Port A (Interface to Interface)

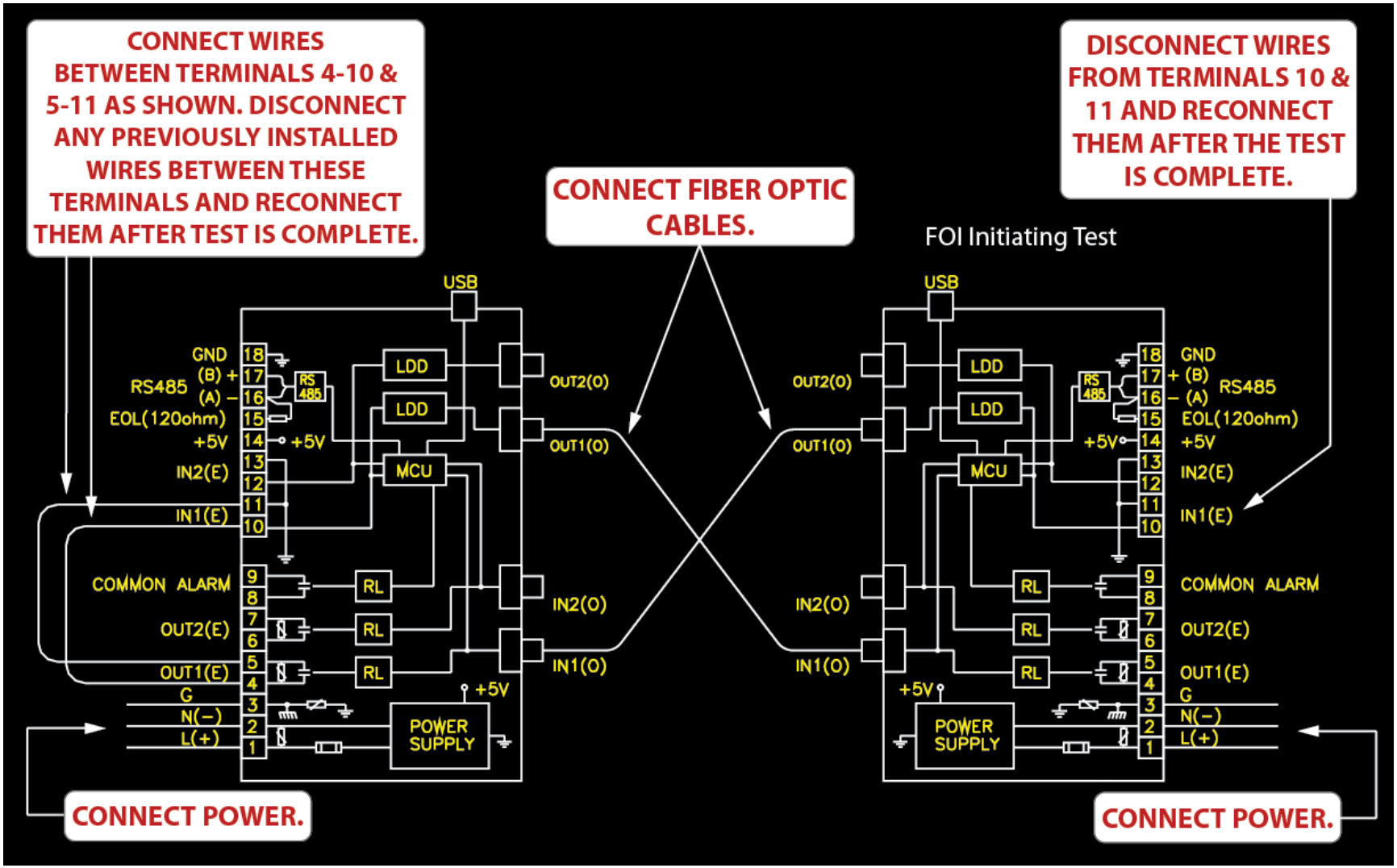


Fig. 4: Fiber Optic Loop Test Connection Diagram – Port B (Interface to Interface)