MR361-1 Series
Fiber Optic Transmission Link
For Incremental Encoders

User Manual

Doc No: 98-0361-02
Revision A, Released 11/08/2022

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1. Revision History

Revision	Date	Notes
A	11/08/2022	Original Release (English)

File Name

98-0361-02_AS_MR361-1 Manual_DRAFT_08Nov2022.docx

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2.1 Fiber Optic Extender Link for Incremental Encoders

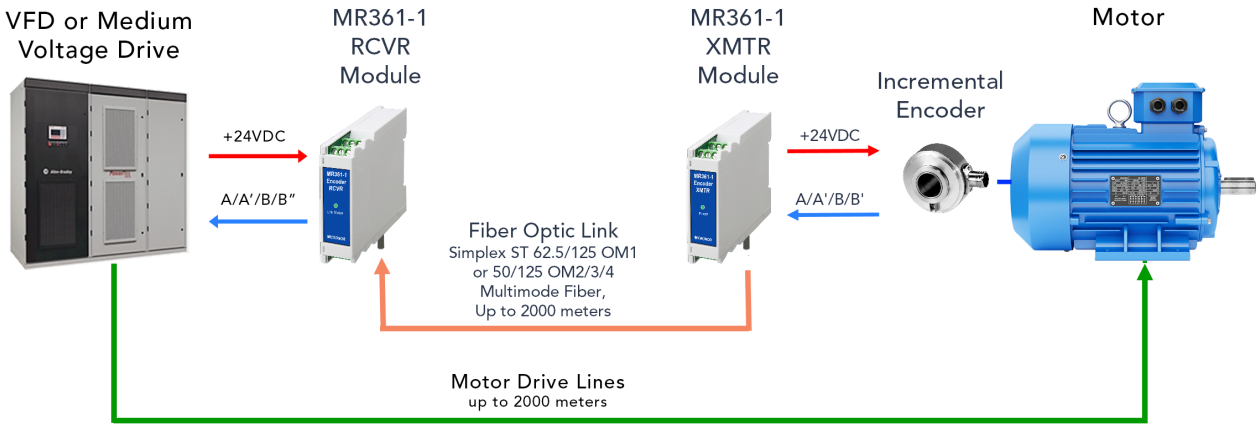

Figure 1. Typical VFD application using the MR361-1 Series FO Encoder Extender System

The MR361-1 series Fiber Optic Transmission Link System increases the reach of conventional electronics-based rotary and linear incremental encoders up to distances of 2000 meters via a fiber optic link. This solution allows clean optical transmission of sensitive encoder signals over long distances, through noisy electrical areas or when routed in parallel with noisy VFD or High Voltage motor drive lines. The system works with both optical and magnetic encoders and operates with complete transparency to the motion control or motor drive system.

The system consists of a fiber optic transmitter (XMTR) and fiber optic receiver (RCVR) module. The XMTR module multiplexes the user's encoder's quadrature output signals of the encoder into a light signal. A simplex multimode fiber optic link transports the optical signal to the RCVR module which then demultiplexes the optical signal back into the individual quadrature signals for connection to the encoder input of the motor drive or motion control system.

The Transceiver System offers 4 signal channels. These channels can be utilized in a variety of signal configurations, including:

- One Encoder with A/A'/B/B' quadrature pulses and index O/O'. This leaves one unused channel that can be utilized for transmitting another signal – limit switch, emergency stop status, etc.
- One Encoder with A/A'/B/B' quadrature pulses and no index. This leaves two unused channels that can be utilized for transmitting other signals – limit switch, emergency stop, etc.
- Two Encoders with A/A'/B/B' quadrature pulse connections only. This utilizes all 4 channels.

2.2 Applications

- Applications sensitive to interference
- Passing signals safely through explosive areas (dust, gas and chemical) – oil, gas, mining/extracting, refining, chemical and food processing
- Passing signals safely through high voltage fields – welding robots, switchgear, and arc furnaces
- Mines, conveyors, and other motion control applications extending long distances
- Variable Frequency Drive systems (VFD)
- Medical

2.3 Features

- 400 kHz bandwidth
- DIN rail mount XMTR and RVCR modules
- Models for +5 VDC or +10-30 VDC Encoders
- Models for RS422 (TTL) or HTL/Push-Pull line drive circuits
- Models for Wire Terminals only or DSub Encoder Connection
- EMI/RFI immune fiber optic transmission link
- Encoder Link can reach up to 2 km
- Wide System Loss Budget
- 4 signal channels – unused channels can be used for non-encoder signals

2.4 Product Views

Figure 2. All Views of a MR361-1 Module with Wire Terminals

2.5 How the MR361 Works

A functional block diagram is shown in *Figure 8*, showing the Encoder, XMTR module, optical link, RCVR module and Remote Motor Drive encoder input connections. The system can accommodate up to 4 channels (A/B/C/D) although most systems use just A/B or A/B/Index for encoder feedback. In addition, 2 encoders can be served by one link if only A/A'/B/B' signals are used.

The Encoder connections to the XMTR module are electrically multiplexed and then transmitted optically over a simplex fiber optic link. The optical input signal to the RCVR is then converted back to the electrical domain and demultiplexed back into same 4-channel encoder signals. The RCVR outputs are then connected to the encoder inputs of the Motor Drive (or similar motion control system interface).

The end-to-end conversion and optical transmission process is completely transparent to the Remote Motor Drive. The MR361 system simply extends the reach of the Encoder using fiber optic transmission techniques.

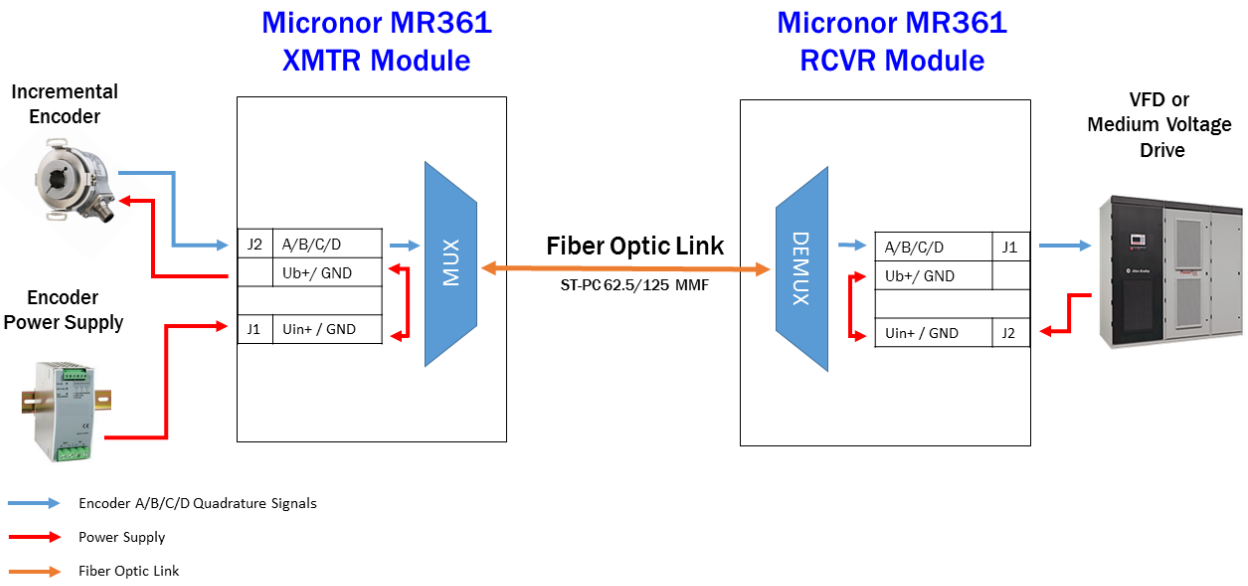

Figure 3. Theory of Operation of MR361 Fiber Optic Encoder Link System

3. Ordering Information and Contents

As shown in the reference drawings of Figure 4, there are two wiring versions of the MR361-1 transmission modules, Wire Terminals versus HD-Sub-D15 connector (also known as the VGA or Micro DSub-15 connector, has 3 rows of contacts in a compact D-Sub form factor).

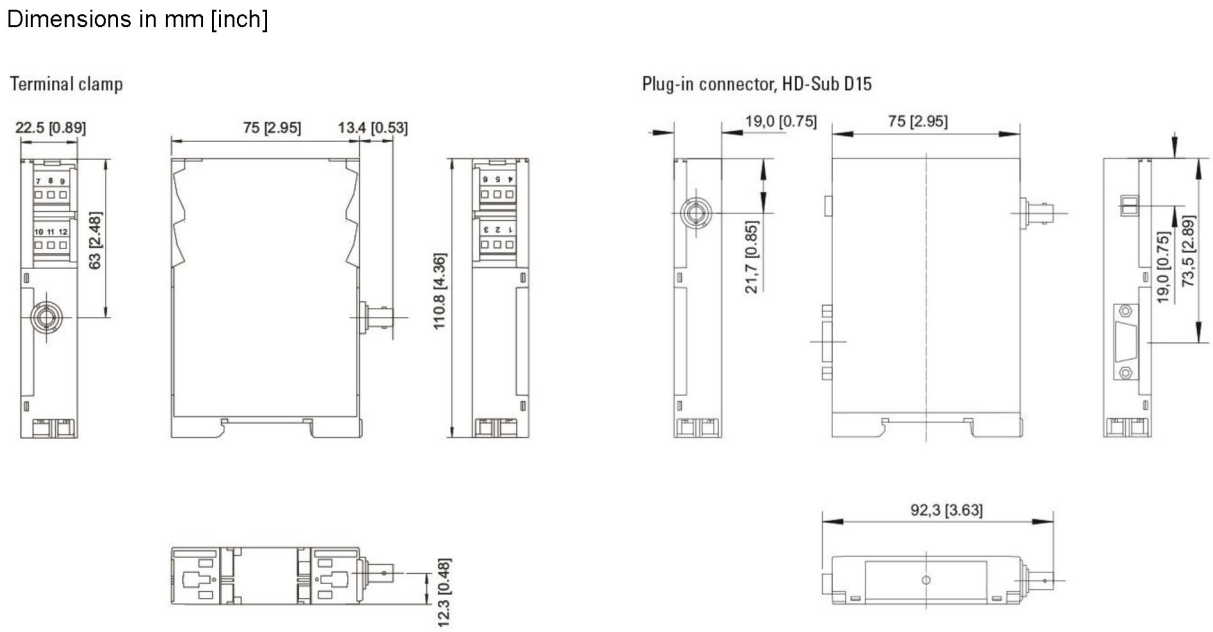

Figure 4. Two versions of the MR361-1 Modules - Wire Terminals vs. HD-Sub-D15 Connection

3.1 Model Numbers

Encoder Types	XMTR Modules		RCVR Modules	
	With Terminal Clamps (SAP P/N)	With D-Sub Receptacle (SAP P/N)	With Terminal Clamps (SAP P/N)	With D-Sub Receptacle (SAP P/N)
Encoder Type 0 +10-30 VDC Input Power RS422 Differential Line Driver Outputs	MR361-1-0-0-0 (9760.00.000)	MR361-1-0-0-1 (9760.00.100)	MR361-1-1-0-0 (9760.10.000)	MR361-1-1-0-1 (9760.11.100)
Encoder Type 2 +5 VDC Input Power RS422 Differential Line Driver Outputs	MR361-1-0-2-0 (9760.02.000)	MR361-1-0-2-1 (9760.02.100)	MR361-1-1-2-0 (9760.12.000)	MR361-1-1-2-1 (9760.12.100)
Encoder Type 3 +10-30 VDC Input Power HTL/Push-Pull Complementary Outputs	MR361-1-0-3-0 (9760.03.000)	MR361-1-0-3-1 (9760.03.100)	MR361-1-1-3-0 (9760.13.000)	MR361-1-1-3-1 (9760.13.100)

Note: The XMTR and RCVR modules do not have to be for the same encoder type. Specifying a different RCVR module allows adapting signals to mismatched equipment/encoder interfaces. This

is not a recommended practice but is a solution for those applications where the actual Encoder is incompatible with the downstream Encoder Interface on the motor drive.

Commercial grade ST-to-ST simplex fiber optic cable assemblies may be specified using the ordering code MR398-T16-AAxxx where xxx is the length in meters.

3.2 Standard Contents

For a complete transmission system, be sure to order both XMTR and RCVR modules:

- XMTR module as ordered
- RCVR module as ordered
- Instruction Manual (this document, one hard copy per shipment contain both XMTR and RCVR modules)

Optional Accessories:

- MR320A ST Bulkhead Adapters for interconnecting ST Extension Cables, if required
- MR398-T16-AAxxx ST Extension Cables for extended links, if required

3.3 Damaged In Shipment

In the event of a damaged instrument, write or call your nearest MICRONOR office in the USA or Europe. Please retain the shipping container in case reshipment is required for any reason.
If you receive a damaged instrument you should:

1) Report the damage to your shipper immediately.
2) Inform MICRONOR
3) Save all shipping cartons.

Failure to follow this procedure may affect your claim for compensation.

3.4 Warranty

MICRONOR AG warrants this product to be free from defects in material and workmanship for a period of (one) year from date of shipment. During the warranty period Micronor AG will, at their option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local MICRONOR AG representative or contact MICRONOR AG directly. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made, and the instrument returned transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitations of Warranty
This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to Fiber Optic Connector interfaces, fuses,

power supplies or AC line cords. This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability of fitness for a particular use. MICRONOR shall not be liable for any indirect, special or consequent damages.

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4. Installation and Operation

4.1 Mounting Modules on DIN Rail

Figure 5. Modules mount on standard 35mm DIN rail

Per detail shown in Figure 6, first clip the fixed (white side) mount into one side of DIN rail. Then snap the black, spring-loaded end into place.

Figure 6. Close up of DIN rail adapter on module

4.2 Electrical Connections to the Modules

There are two versions of the modules based on type of electrical connections provided:

- MR361-1-X-X-0 series, Wire Terminals Only
- MR361-1-X-X-1 series, D-Sub (for Encoder) and Wire Terminals (for Power Supply)

Figure 7. All Views of a MR361-1 Module with Wire Terminals

The following common guidelines should be followed for all electrical connections:

- Electrical connections should be limited to maximum length of 10m.
- As a principle, the input and output lines must always be routed as a pair, i. e. both wires of a signal must be routed in twisted pair cables. The use of bundle wires (called control cables) is not allowed, since this could not guarantee the correct transmission of the signal, nor the EMC features.
- The cable shield must be connected at both ends, at the encoder **and** at the optical fiber transmitter, and at the optical fiber receiver **and** at the signal processing device. To that purpose, the optical fiber transmitter and receiver are equipped with the additional ground contacts 11 and 12.
- For the modules with RS-422 output, make sure that the signal receiver has a differential input with an input resistance of 100 – 120 Ω.
- For the modules with HTL output, the signal receiver should have a differential input resistance of 2 kΩ.
- If there are no specific requirements for the output signals of the receiver modules (low transmission frequencies in the low kilohertz range), the outputs may be operated as single-pole TTL or HTL outputs. However, the correct operation of this application must be checked on a case-by-case basis, and it is not supported by the manufacturer.

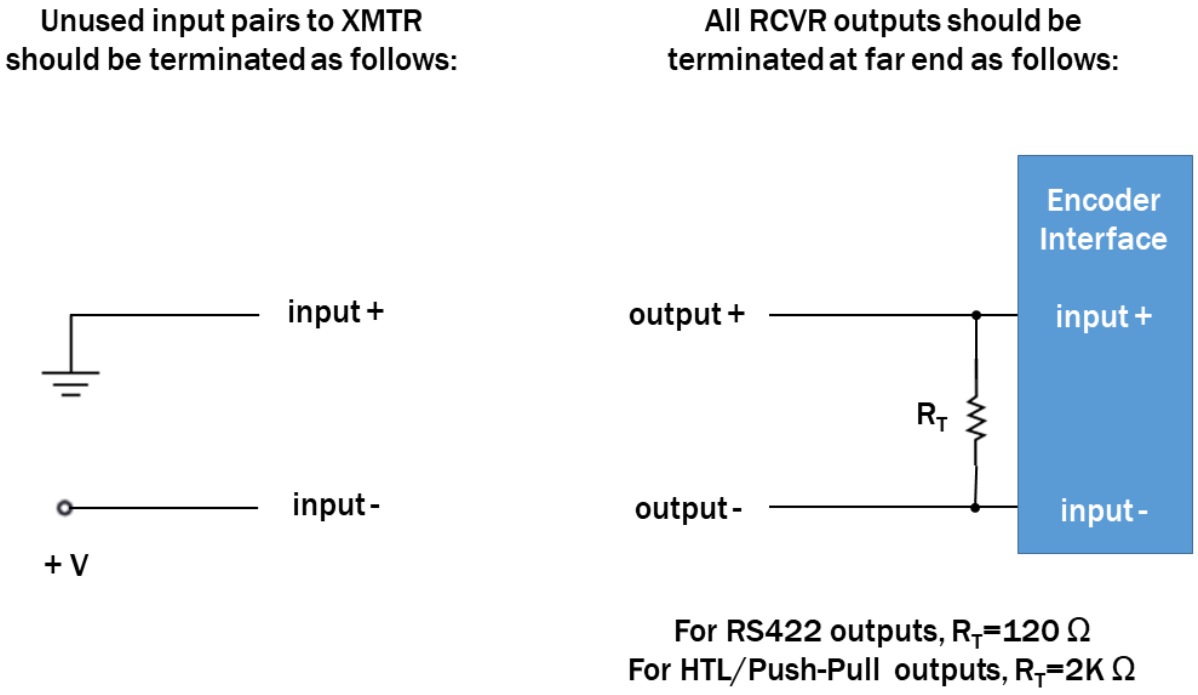

Figure 8. How to terminate XMTR inputs or RCVR outputs

4.2.1 Electrical Connections for Modules with Wire Terminals

Figure 2 shows top, bottom and side views of the transmission modules with WIRE TERMINALS ONLY, part numbers XMTR Module MR361-1-0-X-X and RCVR modules MR361-1-1-X-X. Wire Terminals 1-6 on located on the top with Terminals 7-12.

- Wire length should not exceed 10m
- Maximum conductor diameter to Wire Terminal is 2.5mm^2
- Differential Inputs to Drive Encoder Interface should be terminated with proper clamping resistor, 100Ω-120Ω for RS422 inputs and 2KΩ for HTL inputs.
- Cable shield to be connected to 0V on both ends
- All signal Inputs and outputs should be terminated as shown in Figure 8.
- All modules are protected against reversed polarity, which can avoid any damage in case of wrong polarity.
- The outputs of the modules are only short-circuit-proof in certain conditions; avoid imperatively short-circuits between modules or with the earth.

The following table shows wiring connections to both XMTR and RCVR modules:

Connector	Pin	XMTR Module Signal Description	RCVR Module Signal Description
Terminals 1-6 located on Top	1	A- (from Encoder)	A- (to Drive)
	2	B- (from Encoder)	B- (to Drive)
	3	C- (from Encoder, usually Index-)	C- (to Drive)
	4	A+ (from Encoder)	A+ (to Drive)
	5	B+ (from Encoder)	B+ (to Drive)
	6	C+ (from Encoder, usually Index+)	C+ (to Drive)
Terminals 7-12 located on Bottom	7	D- (from Encoder)	D- (to Drive)
	8	+V Supply	+V Supply
	9	0V Supply (Gnd, all linked internally)	0V Supply (Gnd, all linked internally)
	10	Channel D+ (from Encoder)	Channel D+ (to Drive)
	11	0V Supply (Gnd, all linked internally)	0V Supply (Gnd, all linked internally)
	12	0V Supply (Gnd, all linked internally)	0V Supply (Gnd, all linked internally)

4.2.2 Electrical Connections for Modules with HD-Sub-D15 Connector

The righthand reference drawing of Figure 4 shows the location of the D-Sub connector (for encoder signals) and Wire Terminals 1-2 (for power supply connection), both along the top of the module. This configuration corresponds to part numbers XMTR Module MR361-1-0-X-1 and RCVR modules MR361-1-1-X-1. The following tables show wiring of the two connectors.

- Wire length should not exceed 10m
- Maximum conductor diameter to Wire Terminal is 2.5mm^2
- Differential Inputs to Drive Encoder Interface should be terminated with proper clamping resistor, 100Ω-120Ω for RS422 inputs and 2KΩ for HTL inputs.
- Cable shield to be connected to 0V on both ends
- All signal Inputs and outputs should be terminated as shown in Figure 8.
- All modules are protected against reversed polarity, which can avoid any damage in case of wrong polarity.
- The outputs of the modules are only short-circuit-proof in certain conditions; avoid imperatively short-circuits between modules or with the earth.

Connector	Terminal	XMTR Module Signal Description	RCVR Module Signal Description
Wire Terminals	1	0V In (power supply, linked internally)	0V In (power supply, linked internally)
	2	+V In (power supply, linked internally)	+V In (power supply, linked internally)

Connector	Pin	XMTR Module Signal Description	RCVR Module Signal Description
HD-Sub-D15	1	D- (from Encoder)	D- (to Drive)
	2	D+ (from Encoder)	D+ (to Drive)
	3	C- (from Encoder, usually Index-)	C- (to Drive, usually Index-)
	4	C+ (from Encoder, usually Index+)	C+ (to Drive, usually Index+)
	5	---	---
	6	B- (from Encoder	B- (to Drive)
	7	B+ (from Encoder)	B+- (to Drive)
	8	A- (from Encoder)	A- (to Drive)
	9	A+ (from Encoder)	A+ (to Drive)
	10	---	---
	11	0V for Shield (linked internally)	0V Supply (Gnd, all linked internally)
	12	0V for Shield (linked internally)	0V Supply (Gnd, all linked internally)
	13	0V to Encoder (linked internally)	0V (linked internally)
	14	---	---
	15	V+ Out to Encoder (linked internally)	+V Out (power supply, linked internally)

4.3 Fiber Optic Connections to the Modules

The MR361-1 modules feature a bayonet-style ST-PC optical interface located on the bottom. Be sure that the ST plug end face is clean before being installed into the ST receptacle. To prevent potential interface damage, be sure to align the key on the plug with the slot on the receptacle before beginning to insert the connector.

Figure 9. Location of ST optical interface on XMTR and RCVR Modules

- Keep the dust protection covers of the optical tramsitters and receivers, and put them back in place when no optical fiber is connected to the modules.
- Dust build-up on the optical interface can inhibit operation.
- ST connectors should be cleaned and visually inspected with an Inspection Microscope before connecting to optical interface.

4.4 System Start-Up & Performance Check

With all optical and electrical connections made to both XMTR and RCVR modules, the green LED on the front of each module displays status. Figure 10 illustrates the meaning of the status LED for both XMTR and RCVR modules.

The status LEDs do not indicate if encoder signals are active. The system transmits exactly what it sees at the inputs of the XMTR module. Best encoder wiring and cabling practices must be followed to make sure that the encoder signal inputs are clean and properly grounded. Signal integrity should be verified with an oscilloscope.

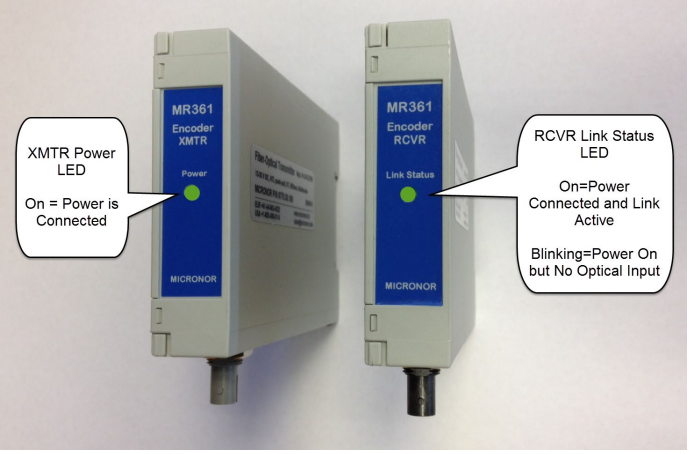

Figure 10. Green status LED on XMTR and RCVR Modules

- CLEANING: When switched off, the device can be cleaned using a dry cloth or cloth moistened with a soapy solution. In no case, use aggressive or solvent-containing substances to clear the device.
- MAINTENANCE: The modules are maintenance-free. It is forbidden for the user to carry out and repair work in case of damages due to transportation or storage or operation.
- WARRANTY: The warranty is void if the device is opened.

5. Troubleshooting

The following are potential issues and recommended solutions when troubleshooting the MR361 Fiber Optic Encoder Link system. For issues not listed, please contact Micronor Sales.

5.1 Potential Issues & Solutions

5.1.1 XMTR Power Green LED not ON when controller powered

- Verify solid electrical connection between wires and screw terminal for both +Uin/+Vin and GND.
- Verify that external power supply is rated correctly for the encoder being used and connected
- Contact Micronor Sales for further assistance.

5.1.2 RCVR Link Status LED not ON when controller powered

- Verify solid electrical connection between wires and screw terminal for both +Uin/+Vin and GND.
- Verify that external power supply is rated correctly for the drive inputs.
- Contact Micronor Sales for further assistance.

5.1.3 RCVR Link Status LED Blinks

- Verify optical link cabling is properly connected and undamaged. A visual fault finder is an inexpensive tool for verifying continuity.
- Measure RCVR end of link with an optical power meter. Should read at least -24 dBm.
- Verify that the entire fiber optic system does not exceed system loss margin specifications. Use either an optical power meter or OTDR to trace the link.
- Clean all fiber optic connector surfaces using appropriate cleaning materials.
- Contact Micronor Sales for further assistance.

5.1.4 RCVR Encoder Outputs not working but both LEDs On

- If accessible, verify outputs of Encoder using oscilloscope
- Verify A/B/C/D inputs to XMTR module using oscilloscope
- Verify A/B/C/D outputs of RCVR module using oscilloscope
- Contact Micronor Sales for further assistance.

6. Specifications

Encoder Compatibility	RS422 Encoders	HTL/Push-Pull Encoders
Encoder Inputs	*Differential Line Driver Outputs* *A+/A-/B+/B-/C+/C-/D+/D-*	Complementary Line Drive Outputs *A+/A-/B+/B-/C+/C-/D+/D-*
Encoder Signals	RS422 Differential Line Driver	HTL/Push-Pull Line Driver With Inverted Outputs
Input Frequency	Up to 400 kHz (Input Sampling Rate=10MSamples/s)	Up to 400 kHz (Input Sampling Rate=10MSamples/s)
Power Supply Requirements	5V ±5% VDC or 10-30 VDC, depending on model DSub models have a +Vout for passing power to the encoder	10-30 VDC DSub models have a +Vout for passing power to the encoder
Optical Interface	**Eye Safe, Inherently safe optical radiation**	
Optical Interface	ST-PC receptacle, located on bottom of module	
Optical Fiber Compatibility	OM1, 62.5/125µm Graded Index MMF or OM2/OM3/OM4 50/125 Graded Index MMF	
Link Distance	Lesser of 6 dB or 2 km	
Optical Transmitter	850nm, LED	
Optical Transmission Rate	120 Mbit/s	
Optical Synchronization	Indicated by LED on RCVR	
Electrical Interface	**Specification**	
Wire Terminal	Max conductor diameter, 2.5mm^2	
HD-Sub-D15	15pin, Micro DSub Connector (also called VGA connector)	
Power Supply Requirements	Depending on model, 5V ±5% VDC or 10-30 VDC, <2 Watts NOTE There is an internal for protecting overvoltage to the modules For 5V models (exceeding 6V) or 10-30V models (exceeding 33V), exceeding this voltage leads to the destruction of the fuse located inside of the device and must thus be avoided. The fuse must be replaced by the manufacturer's factory. Any attempt to repair the device will void the warranty.	
Environmental Specifications	**Specification**	
Temperature Range	-10°C to +60°C (+14°F to +140°F)	
Humidity	0% to 90% RH (non-condensing)	
Ingress Protection	IP40, terminals IP20	
Physical Specifications	**Specification**	
Mounting	35mm DIN Rail	
Housing	22.5 x 110.8 x 75 mm (0.89 x 4.36 x 2.95 inches)	
Weight	85 g (3.0 oz)	

Specifications subject to change without notice

7. Applications

7.1 Using unused XMTR inputs for other signals.

Traditional encoders have only A/B or A/B/Index outputs. That leaves 1 (D) or 2 (C & D) unused input channels that could be used for routing additional signaling inputs as shown in the example of Figure 11 .

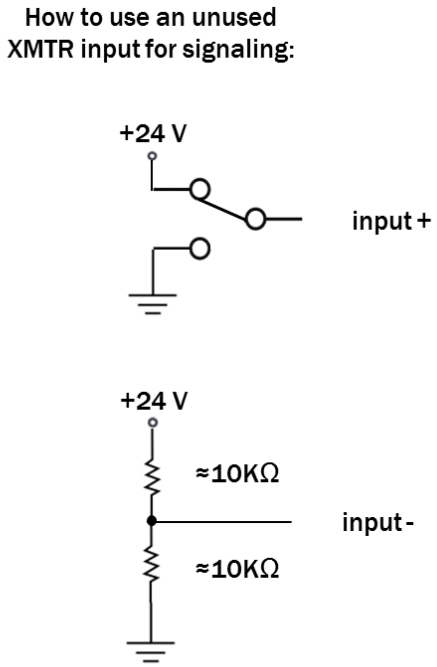

Figure 11. How to use unused XMTR inputs for signaling inputs

8. Mechanical Reference Drawings

The XMTR and RCVR modules are the same size and dimensions.

Dimensions in mm [inch]