

MUX-BC350-12

12 -Channel Analog to CAN Measurement System
For use with Quarter-Arm Strain Sensors

User Manual

Michigan Scientific

1 Technical Support

For technical support, contact Michigan Scientific Corporation.

Details and specifications provided in this document are purely for informational purposes and are subject to alterations. No liability is accepted for errors or omissions.

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3 Document Revisions

Number	Date	Description
1.0	12/25	Initial
1.1	04/26	Updated to match formatting of BC350 manual
1.2	08/26	1. Formatting, lower footer 2. Added revision section 3. Updated interface cable length to 6.4m standard 4. Updated Connector Section with added pinouts 5. Added parts to System Components Table
1.3	9/26	1. Added accessory part numbers, reorganized sections 2. Added cable part numbers

4 Introduction

4.1 Overview of the MUX System

Michigan Scientific's 12-Channel Analog to CAN Modules are designed for high-channel-count measurement applications. These MUX modules combine multiple sensor inputs into a single high-speed digital output, streamlining data acquisition for complex test environments. Each of the six radial connectors can mate with two sensor inputs. MUX modules are software configurable allowing for independent channel configuration. They can be connected for applications requiring higher channel counts. Up to 4 modules can be connected to provide 48 channels of synchronously sampled data. Additionally, the configuration software allows for real-time data viewing and recording to a PC.

Each module provides sensor excitation, amplification, and digitization of the signals. The digitized data is output to a controller area network (CAN) bus. The MUX uses four input/output connections: two for input power, and two for output data. The output data is software configured by the user for either CAN 2.0 or CAN-FD format. The CAN data bus is also used for configuring the device. Once configured, the software can be used to generate the corresponding database file (DBC) for use with data recorders.

The MUX module has twelve independent amplifiers that measure sensors. The MUX is designed to have low cross talk between channels and to be insensitive to temperature change. MUX modules designed for interfacing strain gauge sensors include integrated shunt resistors for sensor verification. The sensor verification procedure can be initiated at power-up or initiated by user with the MUX configuration software. Each MUX device contains non-volatile memory for storing user configuration settings. The memory contains all the calibration information, last Zero off-set values, and test set-up selections.

The MUX is designed for use in spinning and non-spinning applications. For spinning applications, the MUX is designed to be used with Michigan Scientific slip rings. Its compact size and rugged design allow it to be installed on rotating transducers in harsh environments.

5 Properties and Requirements

5.1 Properties at a Glance

5.1.1 MUX Modules

- 12-channel analog inputs to single digital output
- Modular design allows stacking 4 units for 48-channels
- Stacked units synchronize with each other to sample 48-channels
- Software-configure each channel independently
- Output data up to 8ksps (CAN-FD) / 2ksps (CAN 2.0)
- Pair with Michigan Scientific slip ring for spinning applications
- Use with absolute quadrature encoders to output position and speed
- Compact design for non-spinning and spinning applications
- Rugged design for use in harsh environments
- Galvanic isolation (sensor-to-power and data)

5.1.2 MUX-BC350-12 (Quarter-Arm Strain Measurement Module)

- Designed for use with 350 ohm quarter-arm strain-gauge–based transducers
- Provides 4.5 V excitation per channel
- Integrated shunt resistors for sensor verification
- Input range: ±36 mV, gain is software adjustable

5.2 Operation Requirements

- Power Supply in range of 10 to 36V

For configuration and recording to PC (both via CAN):

- Windows 11
- USB-to-CAN hardware adapter from PEAK-System (CAN-FD capability supported)
- CAN cabling between MUX module and USB-to-CAN adapter with proper termination (120 ohm on each end of the CAN bus)

6 Specifications

6.1 Quarter-Arm Strain Model Specifications

Model: MUX-BC350-12

12-Channel Analog to CAN Module

Measurement Inputs	
Type of Bridge and Connection	Quarter-arm, 3-wire
Input voltage range	+/-36 mV
Dynamic range	32:1 (62x-1984x)
Bridge Balancing	Software, up to input voltage range
Input impedance	> 10 Meg ohm
Time synchronization (max chan.-to-chan. skew)	5.5 us
Data out rate (max per channel)	8000 sps
Data out resolution	16-bit
Hardware input filter	Low-pass, single-pole, approx. 5 kHz
Software input filter	Low-pass, FIR type, 40 to 1600 Hz, selectable
Frequency Response	
Bandwidth to -0.1dB	500 Hz (@ 4 ksps or 8 ksps output rate)
Bandwidth to -3dB	1.6 kHz (@ 4 ksps or 8 ksps output rate)
Measurement Deviation	
Offset (@ 25degC), referred to input, max	50 uV
Offset drift, referred to input, max	0.5 uV per degC
Gain error (@ 25degC), max	0.2 %
Gain drift error, max	0.004 % per degC
Noise	
0.1-10 Hz, referred to input	typ. 250 nVpp
Density, referred to input	approx. 12 nV per sqrt(Hz)
Excitation	
Bridge Excitation Volts	4.5 Vdc (ratiometric)
Amps (max per channel)	13 mA
Integrated Bridge Completion	
Completion resistance	350 ohm
Completion resistor accuracy	0.01 %, 2 ppm/degC
Integrated Shunt Verification	Positive and Negative shunt verification
Shunt resistance	100k ohm (up to 10Meg ohm, emulated)
Shunt resistor accuracy	0.075 % 15 ppm

CAN Interface	CAN 2.0 or CAN-FD
Max Output Rate (with CAN-FD, 4Mbps)	8 ksps (12 channels)
Max Output rate (with CAN 2.0)	2 ksps (12 channels)
CAN bitrate, fixed	1 Mbps
CAN-FD bitrate, selectable	2 or 4 Mbps
Termination, fixed internal	2 kohm
Galvanic Isolation	(No safety isolation for high voltage) applications)
Channel to CAN, Channel to Power	200 V
Power Requirements	
Minimum volts	10 Vdc
Maximum volts	36 Vdc
Power Consumption (@12Vdc, with 12 bridges)	approx. 2 W typ.
LED indicators	
Single green	power / status / synchronization
Housing	
Diameter	D=86 mm (3.375 inch)
Height	H=25.4 mm (1 inch)
Mass	approx. 300 grams
Protection class (w/ stacking connectors)	IP67
Connectors	
Metric circular M8	6-pin, receptacle with sockets, code A
Interface Power/Data Cable Requirements	
Length, max	15 m (approx. 50 ft)
Impedance	100 or 120 ohm
Conductor	26 AWG min
Operating Temperature range	-40 to 85 degC (-40 deg to 185 degF)

6.2 Slip Ring Encoder Specifications

Model: SR10AW/WFT

10-slip ring with integrated absolute quadrature encoder

Encoder	
Accuracy (max cumulative error)	0.25 deg
Angular resolution	1024 ppr (4096 cpr)
Output type	0 to 5 V TTL
Maximum Speed	2000 rpm
Power Requirements	
Minimum input volts	5 Vdc
Maximum input volts	20 Vdc
Current amps	60 mAdc
Housing	
Diameter, base	D=54.6 mm (2.15 inch)
Height	H=89.4 mm (3.52 inch)
Mass	approx. 410 grams
Protection class (w/ stacking connectors)	IP67
Connectors	
Circular, 10-pin, male	Amphenol 38999-20TC98PN
Operating Temperature range	-40 to 100 degC (-40 deg to 212 degF)

7 System Components

7.1 Scope of Supply

7.1.1 Included Items

- MUX module (MUX-BC350-12)
- Cable assemblies for 12 sensors (1522299)
- Cable assembly for input power and data setup (MUX-IPDC-SC)
- Spare connector cover plate (M1069-006) with hardware assembly kit
- MUX Tool software for Windows (1.0.7)

7.1.2 Excluded (Optional) Items

- USB-to-CAN-FD hardware adapter (IPEH-004022)
- CAN Termination Plug (GC-CAN-TERM-GC)

7.2 Product Designation and Model Part Numbers

Product Designation	Model Part No.
MUX module, Quarter-Arm Strain model	MUX-BC350-12
Cable Assembly, Power/Data, Setup cable	MUX-IPDC-SC
Cable Assembly, Power/Data, for Spinning Apps, 6.4m	MUX-IPDC-6P4
Cable Assembly, Power/Data, for Non-Spinning Apps, 3m	MUX-IPDC-NS-3
Cable Assembly, Power/Data, Direct Connect, 0.45m	G125-FC11605F1-0450L
Cable assembly, Sensor, Quarter-Arm Strain type, 1.5m	1522299
Cable assembly, Sensor, Quarter-Arm Strain type, 3m	1522309
Cable assembly, Splitter, Quarter-Arm Strain type, 1m	MUX-SSC-BC
Cable assembly, Splitter to Sensor, Quarter-Arm Strain type, 1.5m	1521614
USB-to-CAN-FD adapter	IPEH-004022
USB-to-CAN 2.0 adapter	IPEH-002021
CAN Termination Plug	GC-CAN-TERM-GC
Connector Adapter Layer, Non-Spinning Apps	MUX-CON-ADA-NS
Slip ring with integrated encoder	SR10AW/WFT
Slip ring encoder adapter Layer, Spinning Apps	MUX-ENC-ADA
MUX bottom connector cover plate	M1069-006
MUX Configuration Software	1.0.7

7.3 MUX Module (MUX-BC350-12)

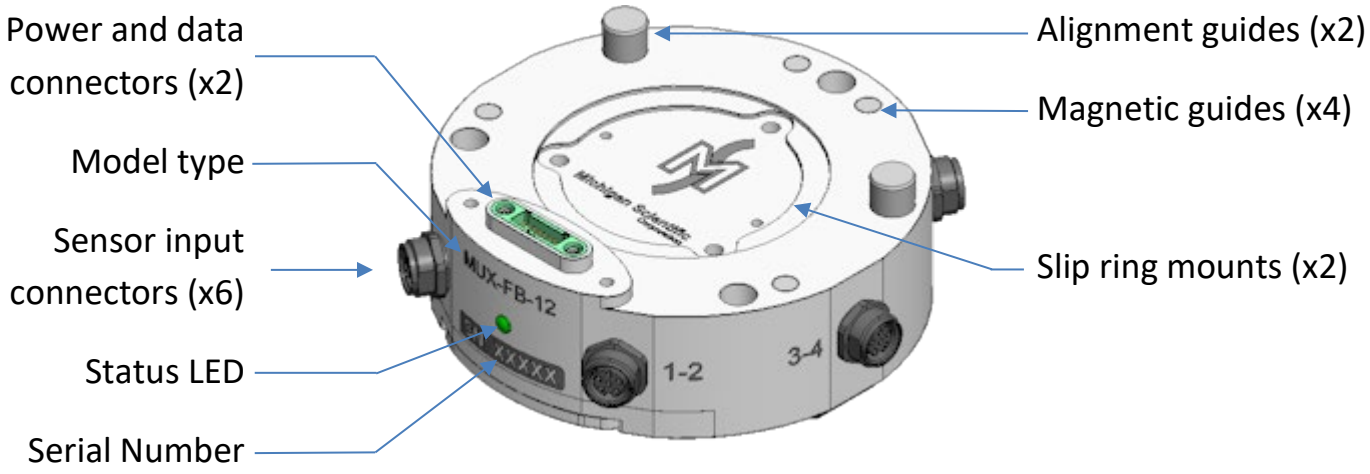


Figure 1: MUX (ISO) showing features.

The MUX module has 12 independently configured channels. The 12 channels are divided into six connectors: two channels per connector.

Each module has two 16-pin stacking type connectors for power, CAN data and MUX-to-MUX synchronization. The top and bottom connectors enable plug-and-play stacking of multiple modules without needing any daisy-chain cables.

A status LED is located below the top connector on the side of the module. The LED is multipurposed for power, data out sample rate, and synchronization status.

Modules have magnetic guides used for aligning multiple modules in a stack. Additional hardware is required to completely secure the modules together.

The top of the MUX modules have mounting features which are used with a variety of Michigan Scientific slip rings.

7.3.1 Status LED

The LED has the following status indications:

Configuration	LED (Green)	Indication
Single module	Blinking 1Hz	Status: Listening Mode
Single module	Blinking 2.5Hz	Status: Streaming or Config Mode
Multiple modules stacked	Blinking 2.5Hz synchronously	Synchrnoization: data input sampling sync in streaming mode
Multiple modules stacked	Blinking 2.5Hz asynchronously	Synchrnoization: data input sampling in config mode
Multiple modules stacked	Either module LED solid ON/OFF	Error: Modules assigned same layer number

7.4 MUX Accessories

7.4.1.1 Power/Data Cable Assembly, Setup Cable (MUX-IPDC-SC)

The MUX power and data setup cable provides power and data connection to a stack of MUX modules. For use with spinning and non-spinning applications.



Figure 2: Cable assembly for setup (MUX-IPDC-SC).

The cable assembly plugs directly into the top connector, has 0.45m long wires for connecting to power and data. The power connections are flyleads, and the data connection is with a 9-pin DSUB female (socket) connector.

The 4 CAN data bus pairs are combined into a single bus so a stack of modules can be configured over a single data bus. ***CAN data bus termination is integrated into the connector.*** Although not required, optional electrical shielding would be through the connector jack screws. See page - 33 - for wiring details.

7.4.2 Spinning Application Accessories

For spinning applications, accessories are available to connect the MUX through a slip ring to power source and data recorder. These accessories are shown below:

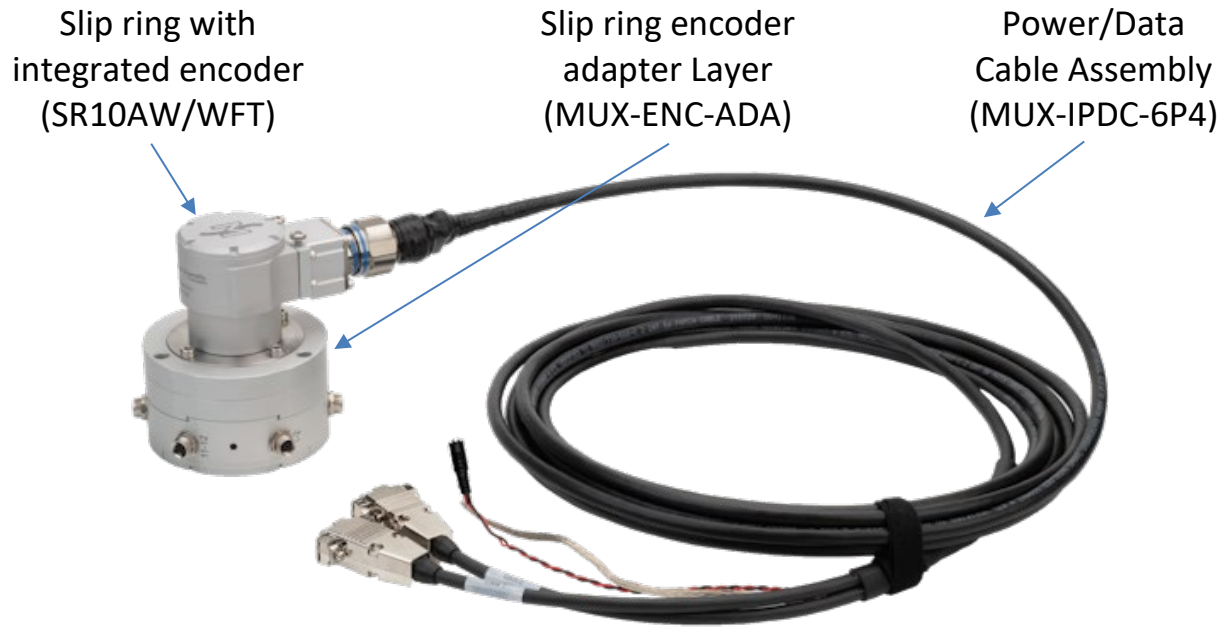


Figure 3: MUX shown with Spinning Application Accessories.

7.4.2.1 Spinning App Accessory: Slip ring with integrated encoder (SR10AW/WFT)



Figure 4: Slip ring with integrated encoder (Model SR10AW/WFT).

For spinning applications, a slip ring is used to transfer power and data signals to the data recorder. Michigan Scientific offers slip rings with integrated encoders for use with the MUX modules. The slip ring model SR10AW/WFT is suggested for use with the MUX modules in spinning applications. The slip ring comes with connectors for mating to the

spinning and non-spinning side. The spinning side has a Samtec 10-pin connector, and the non-spinning side has a 10-pin MIL-DTL-38999 Series III connector (Amphenol D38999/20TC98PN).

7.4.2.2 Spinning App Accessory: Slip Ring Encoder Adapter Layer (MUX-ENC-ADA)

For spinning applications, an encoder adapter layer is used to connect the MUX-BC350-12 to slip ring (model SR10AW/WFT). The encoder adapter layer is part number MUX-ENC-ADA.



Figure 5: MUX-ENC-ADA.

This adapter provides a plug and play solution which is rugged and weatherized. The adapter provides internal CAN bus termination for combining multiple MUX module data to a single CAN bus. Different configurations are available upon request to combine stack module CAN bus data as either 4-to-2 or 4-to-1.

A Power/Data Cable Assembly is available to connect from the slip ring to power supply and data acquisition, and is described below.

7.4.2.4 Spinning App Accessory: Power/Data Cable Assembly, 6.4m (MUX-IPDC-6P4)

For spinning applications, a Power/Data Cable Assembly is suggested to connect the Slip ring to power source and data recorder. The standard cable assembly is 6.4m long. The Power/Data Cable Assembly is part number MUX-IPDC-6P4.



Figure 6: MUX Interface cable assembly for spinning applications (MUX-IPDC-6P4).

The cable assembly connects the slip ring to power and data acquisition systems via a 10-pin Amphenol D38999/26TC98SN connector, terminating in a 5.5 mm OD power barrel jack, two 9-pin female D-sub data connectors, and a shield drain wire. The cable is a double shielded, twisted pair, Cat5e type with rugged polyurethane jacket.

The data connections are provided using two 9-pin DSUB female connectors. When multiple MUX modules are stacked, CAN data is combined from two modules to a single bus as shown in Figure 7.

The data from modules 1 and 4 are combined into a single CAN bus, and output on the cable assembly DSUB connector named CAN 1.

The data from modules 2 and 3 are combined into a single CAN bus, and output on the cable assembly DSUB connector named CAN 2.

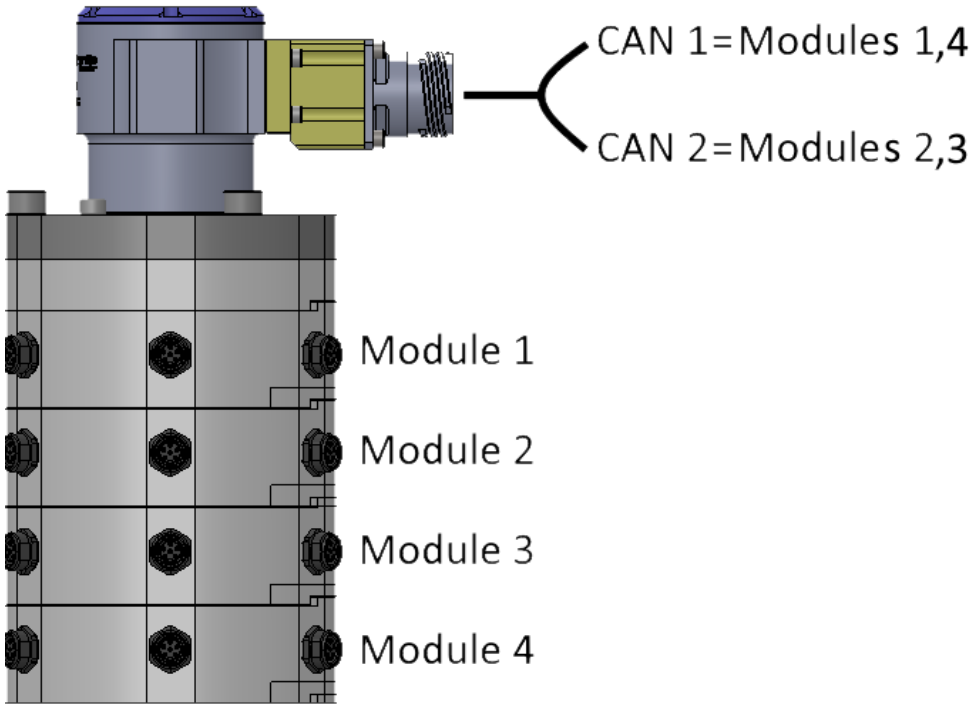


Figure 7: Stacked MUX modules output CAN data to 2 connectors

7.4.3 Non-Spinning Application Accessories

For non-spinning applications, accessories are available to connect the MUX to a power source and data recorder. These accessories are shown below:

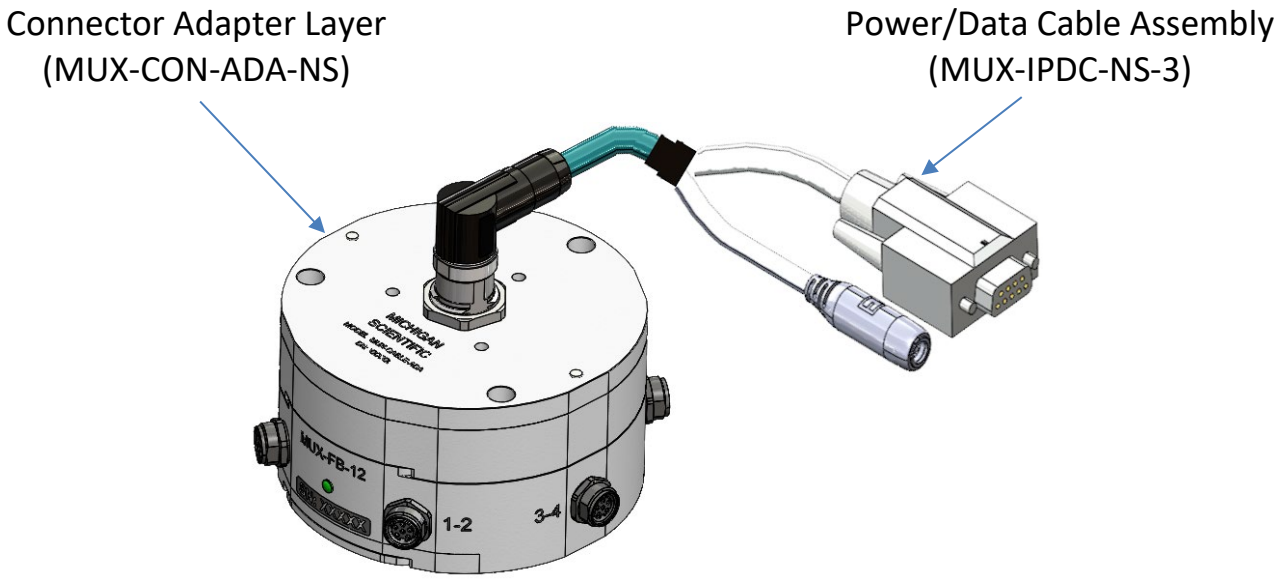


Figure 8: MUX shown with non-spinning accessories.

7.4.3.1 Non-Spinning App Accessory: Connector Adapter Layer (MUX-CON-ADA-NS)

For non-spinning applications, a Connector Adapter Layer is used to connect the MUX-BC350-12 to a power/data cable assembly. The Connector Adapter Layer is part number MUX-CON-ADA-NS.

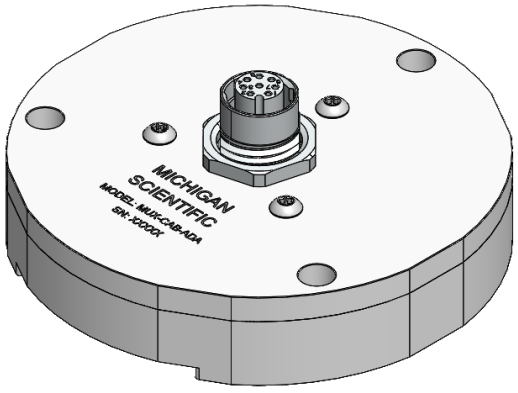


Figure 9: MUX-CON-ADA-NS.

This adapter provides a plug and play solution which is rugged and weatherized. The adapter provides internal CAN bus termination for combining multiple MUX module data to a single CAN bus. Different configurations are available upon request to combine stack module CAN bus data as either 4-to-2 or 4-to-1.

A Power/Data Cable Assembly is available to connect from the adapter layer to power supply and data acquisition, and is described below.

7.4.3.2 Non-Spinning App Accessory: Power/Data Cable Assembly (MUX-IPDC-NS-3)

For non-spinning applications, a Power/Data Cable Assembly is used to connect the connector adapter layer to power source and data recorder. The standard cable assembly is 3m long. The Power/Data Cable Assembly is part number MUX-IPDC-NS-3.



Figure 10: MUX Interface cable assembly for non-spinning applications (MUX-IPDC-NS-3).

The cable assembly connects the connector adapter layer to power and data acquisition systems via an 8-pin M12 metric circular style female (sockets) connector, terminating in a 5.5 mm OD power barrel jack, two 9-pin female D-sub data connectors, and a shield drain wire. The DSUB connectors are for data, and barrel jack is for input power. Refer to “Figure 7: Stacked MUX modules output CAN data to 2 connectors” on page - 20 - for identifying which module data bus outputs on corresponding connector.

7.4.5 Spinning or Non-Spinning Application Accessories

7.4.5.1 Power/Data Cable Assembly, Direct Connect (G125-FC11605F1-0450L)

Direct connect to MUX power and data using a basic fly-lead style cable assembly. For use with spinning and non-spinning applications. Additional assembly is required.



Figure 11: Cable assembly for direct connection (G125-FC11605F1-0450L).

The cable assembly plugs directly into the top connector, and has 0.45m long wires for connecting to power and data. ***External CAN data bus termination is required.*** Although not required, optional electrical shielding would be through the connector jack screws. See "Flylead Cable Assembly (G125-FC11605F1-0450L)" on page - 33 - for wiring details.

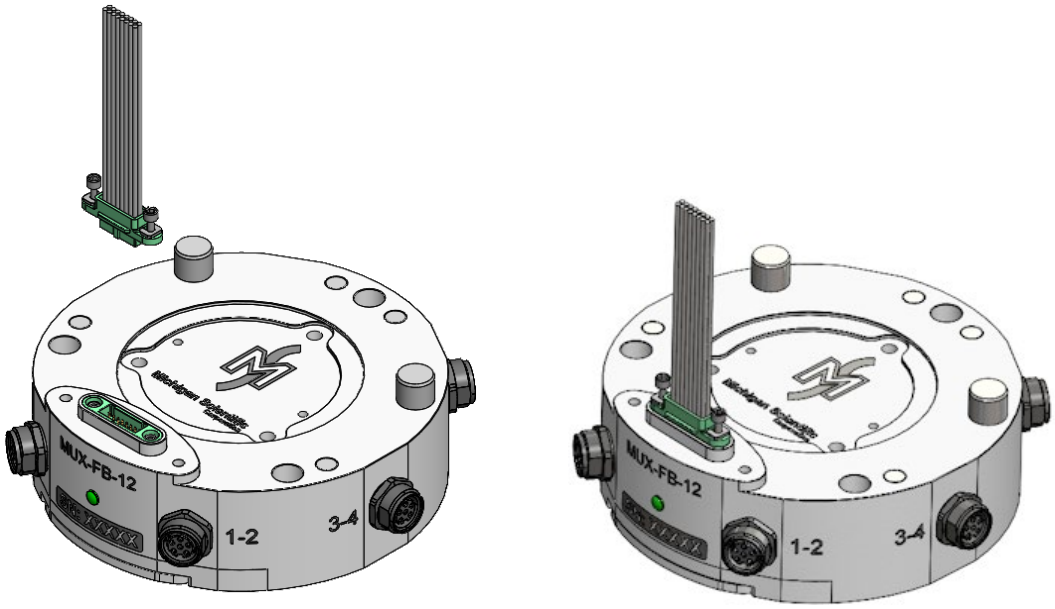
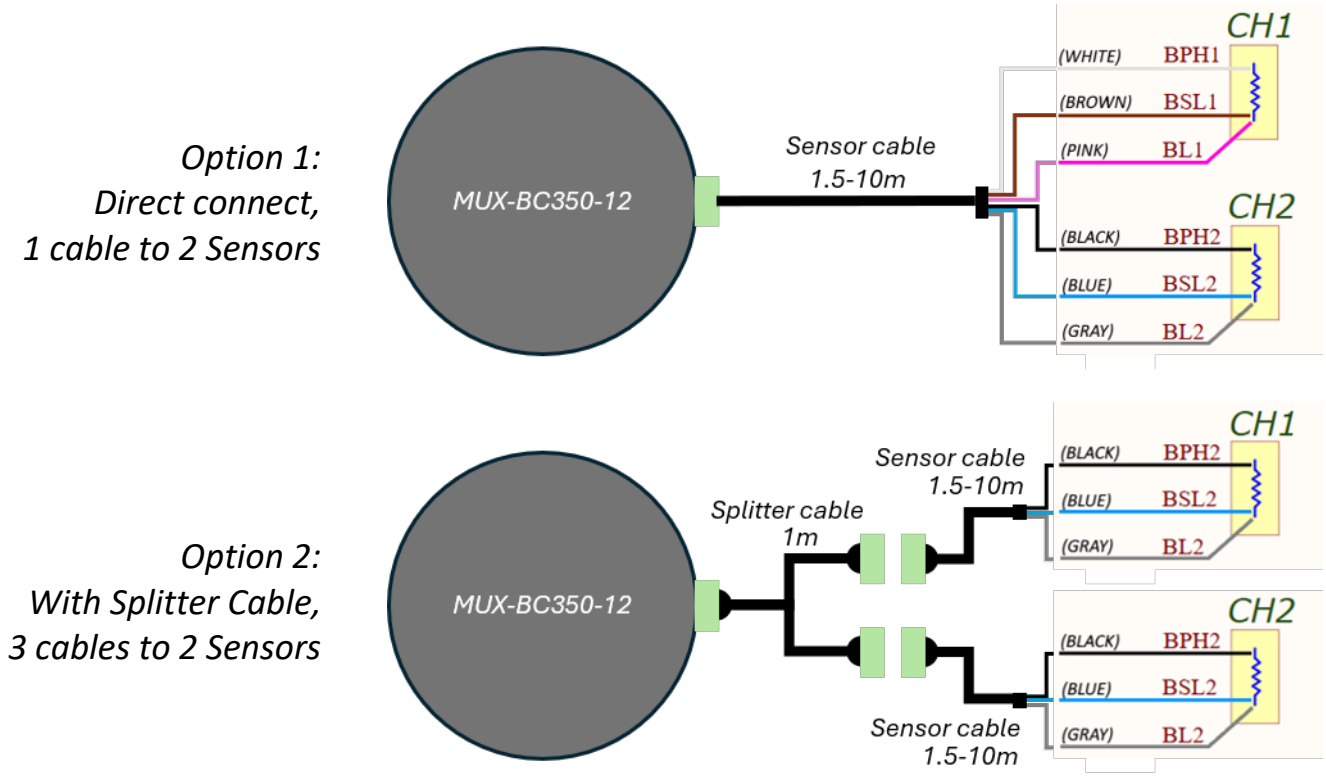


Figure 12: MUX interface cable, shown with direct connect flylead option.

7.5 Sensor Input Cable Assemblies

The MUX has 6 input connectors for 12 sensors: 2 sensors per connector. Different sensor input cable accessories are available and described below.

Figure 13: Sensor Connection options, direct versus splitter.



7.5.1 Sensor Cable, Direct Connect to sensor for quarter-arm (1522299)



Figure 14: Input Sensor Cable for MUX-BC350-12.

Input sensor cable connects directly from 2 sensors to a MUX connector. The standard cable length is 1.5m (4.92ft). Cable lengths up to 10m (32.81ft) are available. The cable has

a polyurethane jacket, over molded connector and multi-colored fly leads. See page - 28 - or - 35 - for wire colors and sensor connection details.

7.5.2 Sensor Cable, Splitter for quarter-arm (MUX-SSC-BC)

Input channel splitters are available to breakout a MUX modules 2-channel single 6-pin connector to 2 individual 3-pin connectors.



Figure 15: Channel splitter (1-to-2) cable assembly for MUX-BC350-12.

Splitter lengths are typically 1m (3.28ft). The channel splitter cable assembly includes circular metric M8 connectors on each end. The splitter cable includes 3 connectors: one 6-pin plug connector attaches to the MUX, and two 3-pin receptacle connectors for sensor cable inputs.

7.5.3 Sensor Cable, Splitter to sensor for quarter-arm (1521614)

Splitter to sensor input cables are used to connect from this splitter to individual quarter-arm sensors. An example 1.5m long cable is Phoenix 1521614.



Figure 16: Splitter to quarter-arm strain sensor cable (e.g. 1521614).

The sensor-to-splitter cable includes a 3-pin connector and fly lead wires: one 3-pin plug connector attaches to the splitter, and fly lead wires to sensor. The shielded cable is made

with an over molded connector and polyurethane jacket. Sensor-to-splitter cable lengths are available from 1.5m to 10m.

7.6 USB to CAN-FD converter tool (IPEH-004022)

The MUX device is software configurable using its multiplexed CAN data bus. A USB-to-CAN converter is a hardware interface that connects the MUX to a PC and translates CAN bus data into a format that can be processed by the computer.

The MUX configuration is entirely done using CAN 2.0 format. The MUX module can be configured to output data in either CAN 2.0 or CAN-FD format. Two types of converter tools are available: USB-to-CAN 2.0 or USB-to-CAN-FD.



Figure 17: USB to CAN 2.0 [IPEH-002021] shown left, or FD variant converter (IPEH-004022) shown right.

Either converter type shown can be used to configure a MUX. The CAN-FD version is useful for recording data at highest data rate to a PC. Additionally, the CAN-FD version combines all of a single MUX modules 12-channel data into a single message. Otherwise, the MUX modules 12-channels of data require 3 messages with CAN 2.0.

Detailed configuration instructions start on page - 49 -. Software to configure each MUX device, view data in real-time and record to PC is included with each MUX device.

7.7 CAN Bus terminator (GC-CAN-TERM-GC)



Figure 18: CAN bus termination inline plug (GC-CAN-TERM-GC).

A CAN bus terminator plug is used to terminate the end of a CAN bus. The CAN Bus terminator part number is GC-CAN-TERM-GC.

When configuring a MUX using a USB to CAN converter accessory, be sure to include this termination plug as shown in section “Data Input: Configuring the MUX” on page - 37 -.

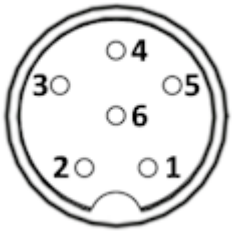
When connecting the MUX to a data recorder, this termination plug is only used when the recorder does not already include termination. Users should verify whether their data recorder has termination since including this would overload the CAN bus and potentially result in CAN bus errors.

~ Do NOT use this item if the data acquisition already includes termination. ~

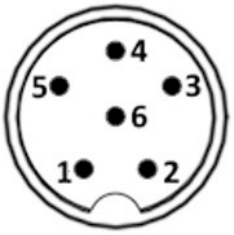
8 Connector Pinout and Cable Wiring Detail

The MUX has 6 input connectors for sensors, and a single connector for input power and CAN data. Sensor connectors are a M8-6 female (socket) type. The input power and data are through 16-pin shrouded header.

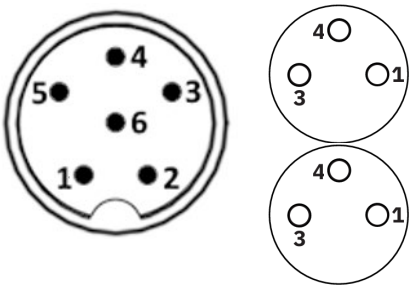
8.1 Sensor Connector Pinout (MUX-BC350-12)

Function	Pin	6-pin Receptacle (on MUX)
CH1, Signal -	1	
CH1, Excitation +	2	
CH1, Sense -	6	
CH2, Signal -	3	
CH2, Excitation +	4	
CH2, Sense -	5	

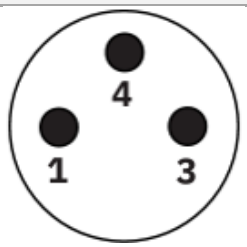
8.2 Sensor Cable Wiring Detail (1522299)

Function	Pin	6-pin Plug	Wire Color
CH1, Signal -	1		Brown
CH1, Excitation +	2		White
CH1, Sense -	6		Pink
CH2, Signal -	3		Blue
CH2, Excitation +	4		Black
CH2, Sense -	5		Gray

8.3 Splitter Cable Wiring Detail (MUX-SSC-BC)

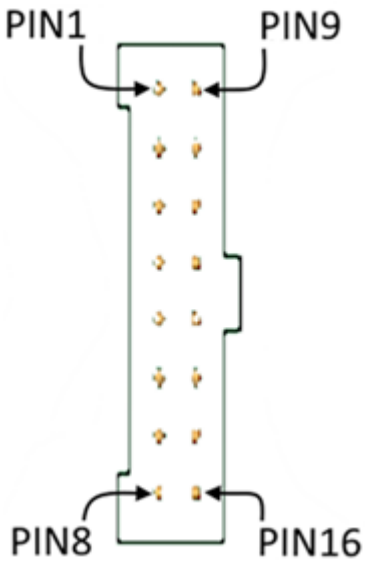
6-pin Plug (to MUX)			3-pin Receptacles (to Sensors)	
Function	**Pin**	**3-Connectors**	**Pin**	**Function**
CH1, Signal -	1		3	CH1, Signal -
CH1, Excitation +	2		1	CH1, Excitation +
CH1, Sense -	6		4	CH1, Sense -
CH2, Signal -	3		3	CH2, Signal -
CH2, Excitation +	4		1	CH2, Excitation +
CH2, Sense -	5		4	CH2, Sense -

8.4 Splitter Sensor Cable Wiring Detail (1521614)

Function	Pin	Connector	Wire Color
CHx, Signal -	3		Blue
CHx, Excitation +	1		Brown
CHx, Sense -	4		Black

8.5 Stacking Connector Pinout (MUX)

The MUX has connectors on top and bottom to allow stacking of up to 4 modules. The top connector (shown) is a 16-pin male type (Harwin G125-MV11605M2P). The bottom has a female type (Harwin G125-FV11605F1P).

Function	Pin	Connector
Power IN+	1	
Power IN-	2	
CAN1_H	3	
CAN1_L	4	
CAN4_H	5	
CAN4_L	6	
ENC_A	7	
ENC_B	8	
SYNC_P	9	
SYNC_N	10	
CAN2_H	11	
CAN2_L	12	
CAN3_H	13	
CAN3_L	14	
ENC_GND	15	
ENC_I	16	

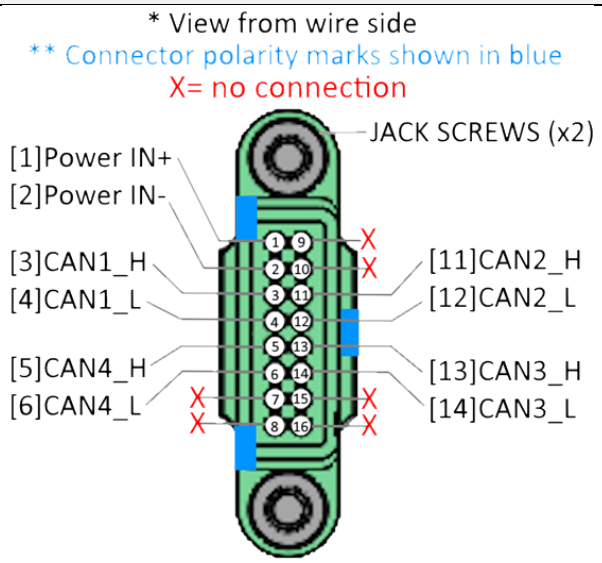
8.6 Power/Data Cable Assembly Pinout (MUX-IPDC-SC)

8.6.1 MUX Connector

The connector to MUX is a 16-pin female (sockets) type (Harwin G125-FC11605F1-0450L).

Function	Pin
Power IN+	1
Power IN-	2
CAN1_H	3
CAN1_L	4
CAN4_H	5
CAN4_L	6
CAN2_H	11
CAN2_L	12
CAN3_H	13
CAN3_L	14

Connector



8.6.2 Power Input

Power is provided with labeled flyleads:

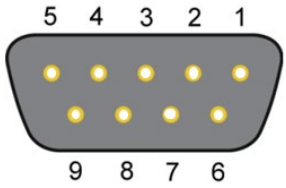
Function	Label
Power IN +	+ + +
Power IN -	- - -

8.6.3 Data Input/Output Connector: CAN bus 1 and bus 2

CAN data is input/output on 9-pin DSUB female (sockets) connector with pinout shown. A 120 ohm CAN termination resistor is integrated into the connector backshell.

Function	Pin
CAN Low	2
CAN High	7

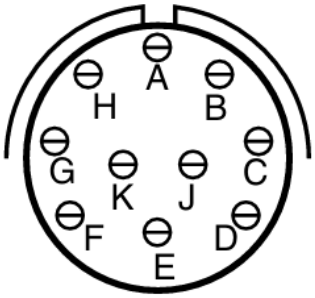
Connector



8.7 Power/Data Cable Assembly Pinout (MUX-IPDC-6P4)

8.7.1 Slip Ring Connector

The slip ring mating connector is a 10-pin female (sockets) MIL-spec type (Amphenol D38999/26TC98SN).

Function	Pin	Connector
Power IN +	A	
Power IN -	F	
CAN1_H	G	
CAN1_L	H	
CAN2_H	D	
CAN2_L	B	
SHIELD	F	

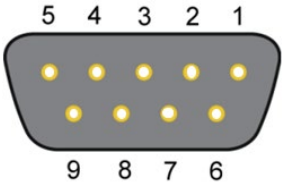
8.7.2 Power Input Connector

Power is provided with a 5.5mm OD barrel jack connector as shown:

Function	Wire Color	Connector
Power IN +	Red	Center
Power IN -	Black	Outer

8.7.3 Data Input/Output Connector: CAN bus 1 and bus 2

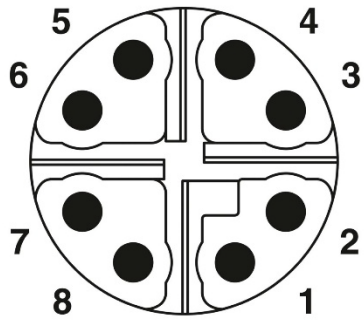
CAN data is input/output on 9-pin DSUB female (sockets) connectors with pinout shown. Integrated CAN termination resistors are not included, but available upon request.

Function	Pin	Connector
CAN Low	2	
CAN Ground	3	
CAN High	7	

8.8 Power/Data Cable Assembly Pinout (MUX-IPDC-NS-3)

8.8.1 Connector mating to Adapter Layer Connector

The adapter layer cable assembly uses an 8-pin male (pins) connector with pinout shown:

Function	Pin	Connector	Wire Color
Power IN +	1		WHT/ORG
Power IN -	2		ORG
CAN1_H	3		WHT/GRN
CAN1_L	4		GRN
CAN2_H	5		WHT/BRN
CAN2_L	6		BRN
SHIELD	SHELL		

** Assembly uses shielded twisted pair cable (e.g. Phoenix 1080718)*

*** Pins 7,8 are unused*

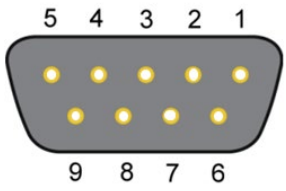
8.8.2 Power Input Connector

Power is provided with a 5.5mm OD barrel jack connector as shown:

Function	Wire Color	Connector
Power IN +	Red	Center
Power IN -	Black	Outer

8.8.3 Data Input/Output Connector: CAN bus 1 and bus 2

CAN data is input/output on 9-pin DSUB female (sockets) connectors with pinout shown. Integrated CAN termination resistors are not included, but available upon request.

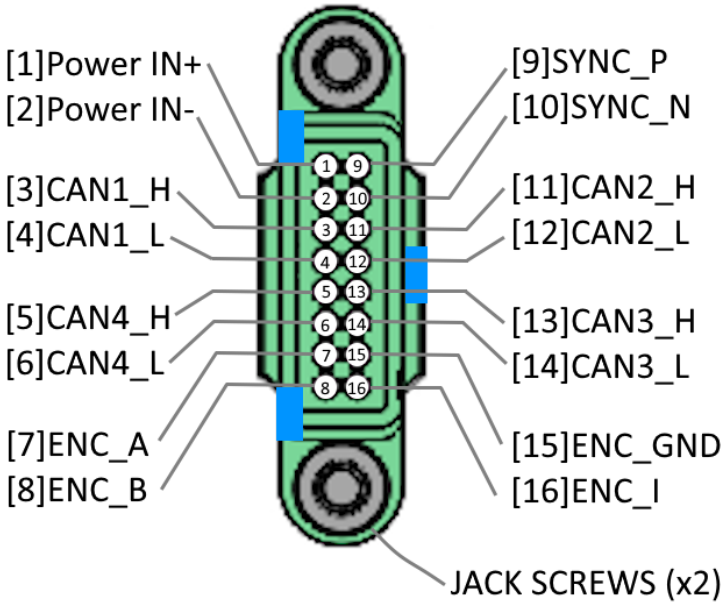
Function	Pin	Connector
CAN Low	2	
CAN Ground	3	
CAN High	7	

8.9 Flylead Cable Assembly (G125-FC11605F1-0450L)

Function	Pin
Power IN+	1
Power IN-	2
CAN1_H	3
CAN1_L	4
CAN4_H	5
CAN4_L	6
ENC_A	7
ENC_B	8
SYNC_P	9
SYNC_N	10
CAN2_H	11
CAN2_L	12
CAN3_H	13
CAN3_L	14
ENC_GND	15
ENC_I	16

Connector

Flylead Cable Assembly
(PN: G125-FC11605F1-0450L)
* View from wire side
** Connector polarity marks shown in blue



9 Hardware Installation

Secure the MUX modules to the application test piece using M6 bolts (not included). Some bolt lengths are suggested below, but the actual length may vary per application. The bolt torque specifications vary per application.



Figure 19: MUX stacked with installation bolts.

Number MUX modules	*Recommended bolt length (mm)*
1	*35*
2	*60*
3	*85*
4	*110*

10 Electrical Connections

The MUX is designed for simple plug and play operation:

1. Connect sensors to MUX
2. Connect MUX to DC power supply
3. Connect MUX to a PC or data recorder

10.1 Sensor Connection

Each MUX-BC350-12 module can be used with up to (x12) 350 ohm quarter arm strain sensors. The module has six M8-6 female (socket) type input connectors for 12 sensors: 2 channels per connector, and each connector uses 3-wire hook-up connection [1]:

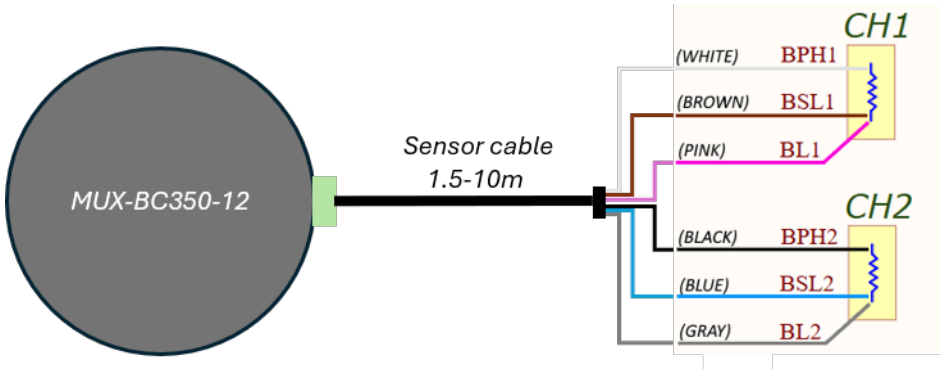


Figure 20: Sensor Connection Wiring Details.

For higher speed spinning applications (> 1000rpm), ensure the cables and sensors are sufficiently secured to minimize any chance of damage to sensors, cables or MUX.

10.2 Power and Data Connections

Input power and data connections to the MUX are made through the top stacking connector (Harwin G125-MV11605M2P). Accessories are available to simplify installation. See section "MUX Accessories" on page - 16 - for more details about available accessories.

10.2.1 Power

The MUX can be powered from a voltage source in range of 10 to 36 VDC. Physical connections vary depending on the application and accessory chosen. See section "MUX Accessories" on page - 16 - for accessory details. The following accessories use power connector types shown:

Accessory part no.	Connector type	Pinout, see page
G125-FC11605F1-0450L	Wire flyleads	- 28 -

[1] Micro-Measurements app note (TT-612), "The Three-Wire Quarter-Bridge Circuit", provides detailed information on benefits of the 3-wire connection method.

MUX-IPDC-6P4	5.5mm OD barrel jack	- 31 -
MUX-IPDC-NS-3	5.5mm OD barrel jack	- 31 -

10.2.2 Data

The MUX data is configurable as either CAN 2.0 or CAN-FD format. Physical connections vary depending on the application accessory chosen. See section “MUX Accessories” on page - 16 - for accessory details. The following accessories use connector types listed:

Accessory part no.	Connector type	Pinout, see page
G125-FC11605F1-0450L	Wire flyleads	- 28 -
MUX-IPDC-6P4	9-pin DSUB female (x2)	- 31 -
MUX-IPDC-NS-3	9-pin DSUB female (x2)	- 31 -

With the G125-FC11605F1-0450L accessory, the CAN data from each module is directly accessible through wires with connector pinouts shown on page - 28 -.

With either of the Power/Data Cable Assembly accessories, data is available on 9-pin DSUB female connectors. Refer to section “Data Input/Output Connector: CAN bus 1 and bus 2” on page - 31 - for pinout details. For applications with stacked modules, the data is available as shown in Figure 7: Stacked MUX modules output CAN data to 2 connectors on page - 20 -.

10.2.2.1 Data Input: Configuring the MUX

To configure a MUX module, connect a USB-to-CAN converter shown on page - 26 -, along with an inline CAN termination plug, to the MUX accessory chosen.



Figure 21: USB to CAN adapter with inline terminator plug.

Once connected, install USB drivers, and configure the MUX device using instructions found in the section named *Software Configuration Instructions* starting on page - 49 -.

10.2.2.2 Data Output: to Data Recorder or PC

Once the MUX is configured, the MUX data can be recorded by a data recorder or PC.

When a PC is used to collect data from a MUX module, the same hardware USB-to-CAN adapter tool can be used along with the MUX configuration software.

When a data recorder is used to collect data from a MUX module, disconnect the USB-to-CAN adapter and inline CAN terminator plug. Replace the USB-to-CAN adapter with the data recorder. Ensure the data recorder has integrated CAN bus termination and that it is enabled. If the data recorder does not have integrated bus termination, an external inline CAN bus terminator plug is recommended.

10.2.3 CAN Bus Termination

A 120 Ohm CAN termination resistor should be installed at each end of the CAN bus. The resistor is external to the MUX device and is either integrated into the supplied interface cabling or encoder adapter layer. The CAN Bus should also be properly terminated at the data acquisition side.

10.3 MUX Module Stacking

MUX modules are designed to be stacked together for higher channel count applications. Up to 4 MUX modules can be stacked together for 48 channels. The housing has a magnetic feature designed to guide the devices into alignment. Once stacked, secure with hardware.

The modules have connectors on top and bottom so no cables are required to interconnect modules. Once stacked, electrical power and data connections for up to 4 modules are available on the upper most module top connector per pinout on page - 29 -.

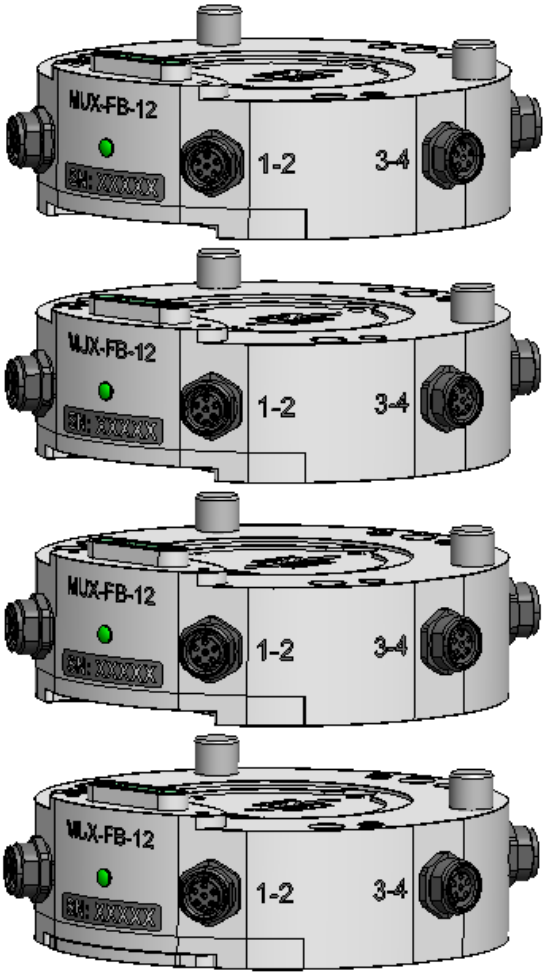


Figure 22: MUX modules stacking, side view.

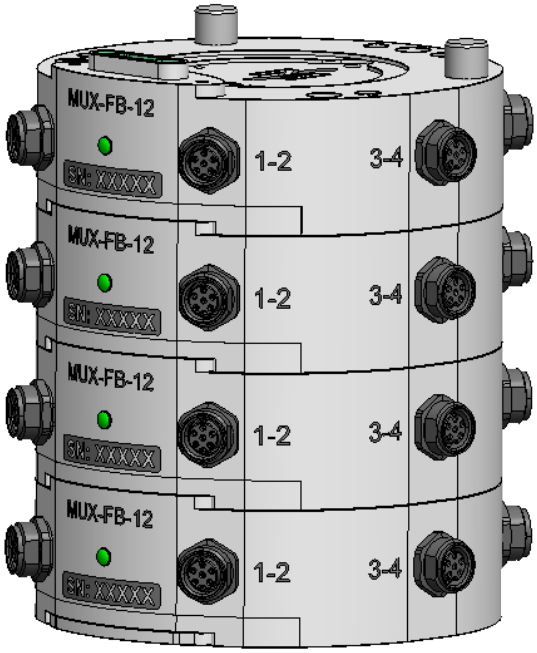


Figure 23: MUX modules (ISO) stack of 4.

The bottom connector of each module is designed to stack onto the top connector of another module below it.

The bottom connector is protected with a cover plate (M1069-006) which needs to be removed (see Figure 24) for stacking configurations. To reveal the bottom connector, use a 2mm wrench to remove two screws holding the cover.

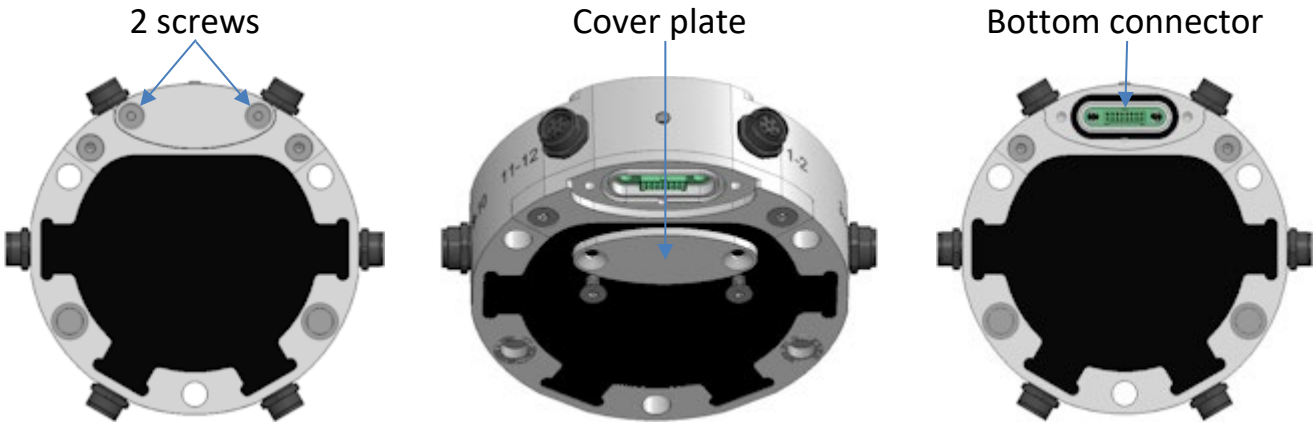


Figure 24: MUX bottom view showing connector cover removal to expose bottom connector.

When MUX modules are stacked, they communicate with each other through the stacking connectors to ensure synchronous data sampling of up to 48 sensors.

The CAN data from each MUX module can either be recorded on its own individual CAN bus, or combined with others in the stack. When combined, configure each module with a unique layer number as detailed on page - 42 -.

- **When highest output data rate is a priority**, record each of the stacked MUX modules data on separate CAN busses.
- **When data recording hardware is limited**, combine data stacked modules to a single CAN bus. Combining reduces the max data sample rate as shown on page - 43 -.

When configuring MUX modules that are stacked together, the software allows the user to choose which MUX is actively being configured. When a particular MUX in a stack is selected for configuration, its data can be viewed and recorded in real-time. Only the active MUX data can be recorded. A separate data recorder is required to record data from an entire stack simultaneously.

When MUX modules are stacked, ensure the CAN bus is terminated as close as possible to the module using 120 ohm resistor. Note, some cable accessories (MUX-IPDC-xxx) have integrated termination resistors. The direct connection (G125-FC11605F1-0450L) requires the user to add termination externally as close as possible to the stacking connector.

11 Operation & Device Modes

11.1 Data Viewing and Recording Options

Each MUX outputs its data on a CAN bus which can be recorded to a PC or separate data recorder. Additionally, data can be viewed in real-time when using the MUX software.

Realtime data can be plotted and recorded. Recording data to a PC is done at the MUX user configured sample rate. The data will be stored in your Documents folder, in an .RSP file (MTS RPC-III format).

If recording MUX data with a separate device, the data must be decoded by the recorder using a CAN database file (.dbc). The MUX software can create the CAN database file for either a single, or stack of, modules to be used by the data recorder. Details are provided below. The Baud Rate of the Data recorder must be set to 1 Mbps for CAN 2.0. The CAN-FD data bit rate can either be 2Mbps or 4Mbps. This is the amount of data that can be transferred on a standard CAN Bus.

11.2 DBC file creation

A CAN database (.dbc) file is needed by the data acquisition to de-code the digital data sent by the MUX. A .dbc file is created by the MUX, by clicking the 'DBC File' button. A window should pop-up enabling you to save the file to your computer. If browser is not up to date or pop-ups have been disabled, this button may not work properly. Once created, the .dbc can be imported to the data acquisition.

11.3 Sensor Verification with Shunting

This section describes how to perform a shunt routine during operation.

The MUX has integrated fixed 100k ohm shunt resistors per channel. Different shunt values, up to 10Meg ohm, can be emulated per channel.

In CONFIG mode, a shunt process can be enabled at any time with a radio button. Additionally, the MUX can be programmed to perform the shunt operation at power ON every time. To enable this feature, select the box to shunt at power ON. Be sure to press the "Write Config" button to save this setting to the MUX memory.

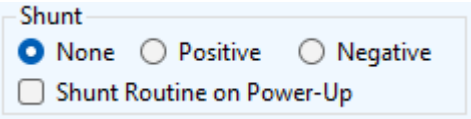


Figure 25: Shunt options on software screen.

11.4 MUX Stacking Requirements

11.4.1 Layer Assignments

Up to 4 MUX modules can be stacked for higher channel counts. Each MUX in a stack must have a unique layer number to enable synchronous communication and data sampling across all modules. Use the MUX configuration software to assign one MUX as the 'leader' and others as followers. The leader is independent of the physical stack location. To begin, press the button named adjust layers.

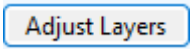


Figure 26: Adjust layers button.

A new window pops up allowing the user to configure the layers. Note the serial number is labeled on the side of the MUX module below the main power/data connector.

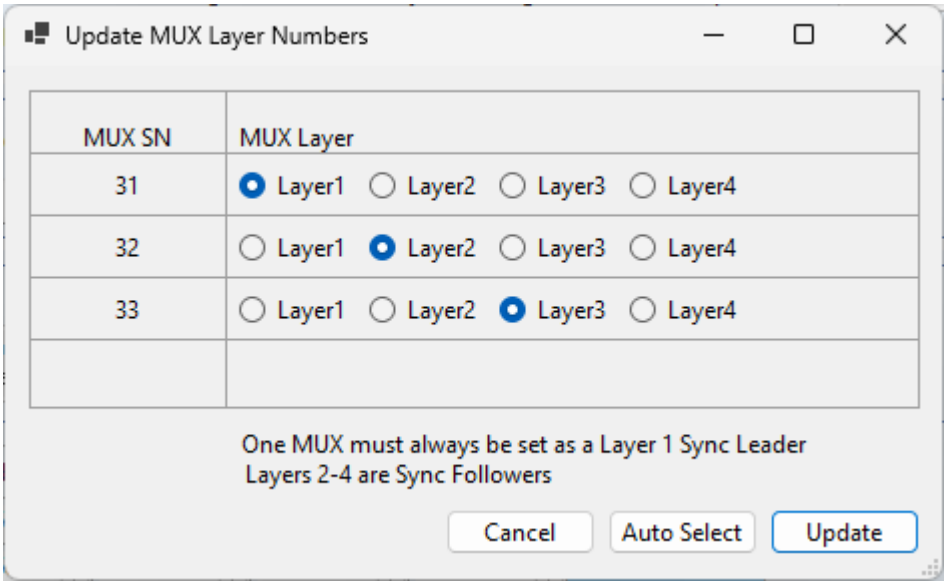


Figure 27: MUX stack synchronization layer select window shown with 3 modules.

11.4.2 Stacked Module Data Output Options

The data from each module in a stack can either be recorded independently or combined to a common CAN bus. Combining data is useful for applications with limited CAN recording ports. When combined, the CAN mode (CAN 2.0 or CAN-FD) and bit rates (1, 2, or 4Mbps) of the modules must be configured the same.

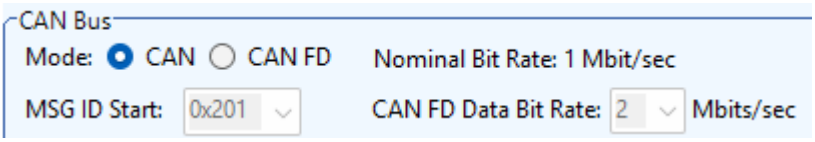


Figure 28: CAN mode and bit rate.

11.5 Data Output

11.5.1 Maximum Data Rates

The following output sampling rate limitations apply:

	CAN 2.0 1Mbps nominal (no encoder)	CAN 2.0 1Mbps nominal (with encoder)	CAN-FD 1Mbps nominal 2Mbps Data	CAN-FD 1Mbps nominal 4Mbps Data
1 Mux / 12 ch	2000	1000	4000	8000
2 Mux / 24 ch	1000	500	2000	4000
3 Mux / 36 ch	500	500	1000	2000
4 MUX / 48 ch	500	500	1000	2000

Figure 29: MUX Max Output Rates on a Single Dedicated Bus. CAN-FD rates are shown with or without an encoder.

11.5.2 Signal Delays

There is signal delay caused by filtering performed by the MUX to decimate the data down to the selected output rate. The delay varies with the chosen sample rate and signal bandwidth. The delay times are listed in the chart below for the corresponding selected bandwidth. The times shown are the typical milliseconds for data from analog input to CAN output.

Selected -3dB Bandwidth (Hz)	1600	800	400	200	80	40
Delay (milliseconds)	1.15	2.90	4.90	8.90	16.90	51.90

Figure 30: MUX filter delays.

11.5.3 Filter Magnitude Response

The MUX input data is digitally filtered using a Finite Impulse Response (FIR) filter which can be configured for different sampling rates. The filter characteristics are provided for the magnitude response below.

Selected -3dB Bandwidth (Hz)	1600	800	400	200	80	40
Fin (Hz)	Attenuation (dB)					
0	0	0	0	0	0	0
10	0	0	0	0	0	0
20	0	0	0	0	0	-0.04
30	0	0	0	0	-0.02	-0.53
40	0	0	0	0	-0.1	-2.64
50	0	0	0	0	-0.31	-7.97
60	0	0	0	0	-0.77	-18.47

Figure 31: Filter Attenuation for Signals with frequency 0 to 60Hz.

Selected -3dB Bandwidth (Hz)	1600	800	400	200	80	40
70	0	0	0	0	-1.59	-37.68
80	0	0	0	-0.01	-2.88	-83.53
90	0	0	0	-0.03	-4.77	
100	0	0	0	-0.06	-7.37	
150	-0.01	-0.01	-0.01	-0.68	-37.26	
200	-0.01	-0.01	-0.07	-2.99	-112.05	
250	-0.02	-0.02	-0.25	-8.36		
300	-0.03	-0.03	-0.69	-18.3		
350	-0.04	-0.05	-1.55	-35.61		
400	-0.06	-0.09	-3	-72.71		
450	-0.07	-0.15	-5.2			
500	-0.09	-0.25	-8.32			
550	-0.11	-0.41	-12.54			
600	-0.14	-0.65	-18.14			
650	-0.16	-0.98	-25.47			
700	-0.2	-1.44	-35.21			
750	-0.24	-2.04	-48.81			
800	-0.28	-2.82	-71.94			
850	-0.34	-3.8				
900	-0.4	-5.01				
950	-0.48	-6.47				
1000	-0.56	-8.22				
1050	-0.66	-10.28				
1100	-0.78	-12.69				
1150	-0.91	-15.5				
1200	-1.06	-18.76				
1250	-1.23	-22.53				
1300	-1.42	-26.9				
1350	-1.64	-31.99				
1400	-1.88	-37.98				
1450	-2.15	-45.13				
1500	-2.44	-53.95				
1550	-2.77	-65.51				
1600	-3.13	-83.77				

Figure 32: Filter Attenuation for Signals with frequency 70 to 1600Hz.

Selected -3dB Bandwidth (Hz)	1600	800	400	200	80	40
1700	-3.94					
1800	-4.9					
1900	-6.02					
2000	-7.3					
2100	-8.77					
2200	-10.42					
2300	-12.29					
2400	-14.37					
2500	-16.7					
2600	-19.3					
2700	-22.18					
2800	-25.39					
2900	-28.96					
3000	-32.94					
3100	-37.42					
3200	-42.5					
3300	-48.33					
3400	-55.18					
3500	-63.55					
3600	-74.68					
3700	-94.92					
3800	-98.69					

Figure 33: Filter Attenuation for Signals with frequency 1700 to 3800Hz.

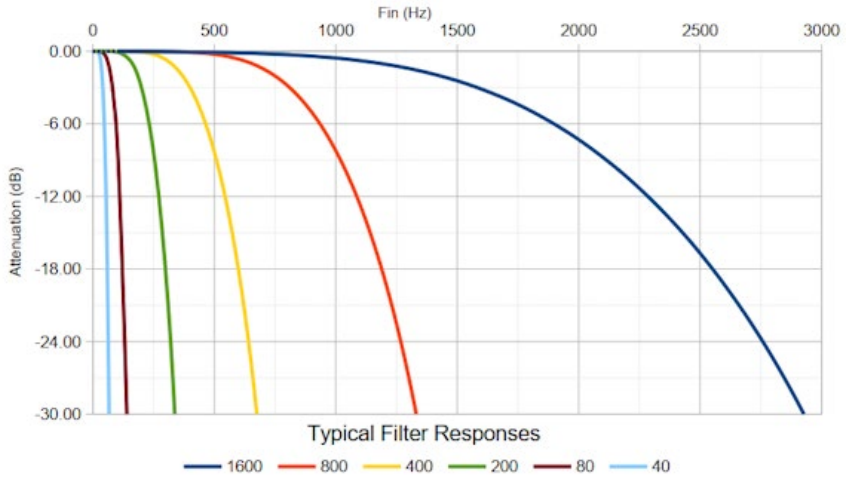


Figure 34: MUX Filter Magnitude Response, shown to 3000Hz.

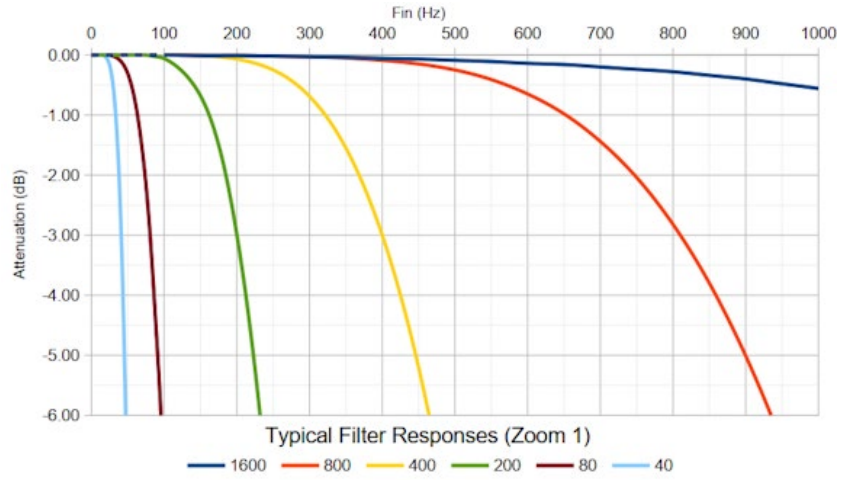


Figure 35: MUX Filter Magnitude Response plot, shown to 1000Hz.

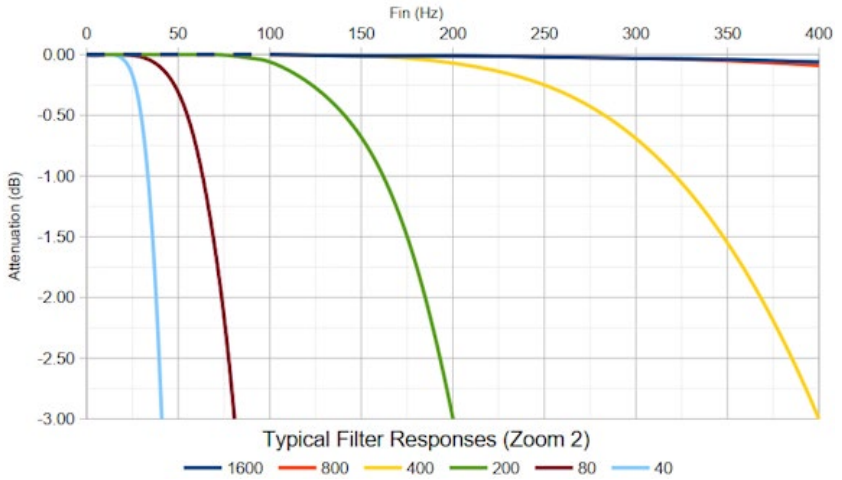


Figure 36: MUX Filter Magnitude Response plot, shown to 400Hz.

11.6 Operating Modes

MUX devices operates in 5 different modes:

1. Listening
2. Streaming_ack_required
3. Streaming_listen_only
4. Config_mode
5. Bootloader

11.6.1 Listening Mode (Initial Power-On Behavior)

At power ON, the MUX device is in Listening mode. By default, the device will remain in listening mode for 20 seconds without any user interaction. After 20 seconds, the device automatically changes state to streaming mode. In listening mode, the MUX device sends a health status once per second using CAN 2.0 messages. During Listening mode, the user may enter configuration mode by pressing the Read Config button.

11.6.2 Streaming Modes

In streaming mode, the device is outputting sensor data at the rate configured. With Single MUX Listen Only Streaming Disabled (acknowledgement enabled), the device is in Streaming_ack required mode. With Single MUX Listen Only Streaming Enabled, the device enters Streaming_listen_only mode.

11.6.3 Config Mode

Configuration mode is used to setup the sensors and the device. With acknowledge enabled, at any time, the user may enter configuration mode by pressing the Read Config button. ***When listen only mode is enabled***, configuration mode can only be entered within the first 20 seconds of power ON. If the device is in Streaming_listen_only mode, power cycle the MUX device to be able to enter configuration mode within 20 seconds of Power ON.

11.6.4 Bootloader Mode

Bootloader mode is entered briefly at start-up of normal operation, as well as used for device recovery and firmware update operations.

12 Software Configuration Instructions

MUX modules are configured through their CAN interface, using a USB-to-CAN converter and the Michigan Scientific MUX Software Tool.

12.1 Software requirements

For configuration and firmware update (both via CAN):

- Windows 11
- Michigan Scientific MUX Software Tool (version 1.0.7, or later)
  - Available to download **www.michsci.com/mux-software/**
  - Use password **muxtool**
- USB-to-CAN converter hardware drivers (Ensure the drivers[2] are installed and verify the device is functioning properly.)

NOTE: MUX modules are configured with CAN 2.0. Therefore, all PC-CAN interfaces from PEAK-System will work for configuration purposes. A PC-CAN-FD device is only required to ***view and record*** data of devices that are configured for streaming data using CAN-FD. ‘

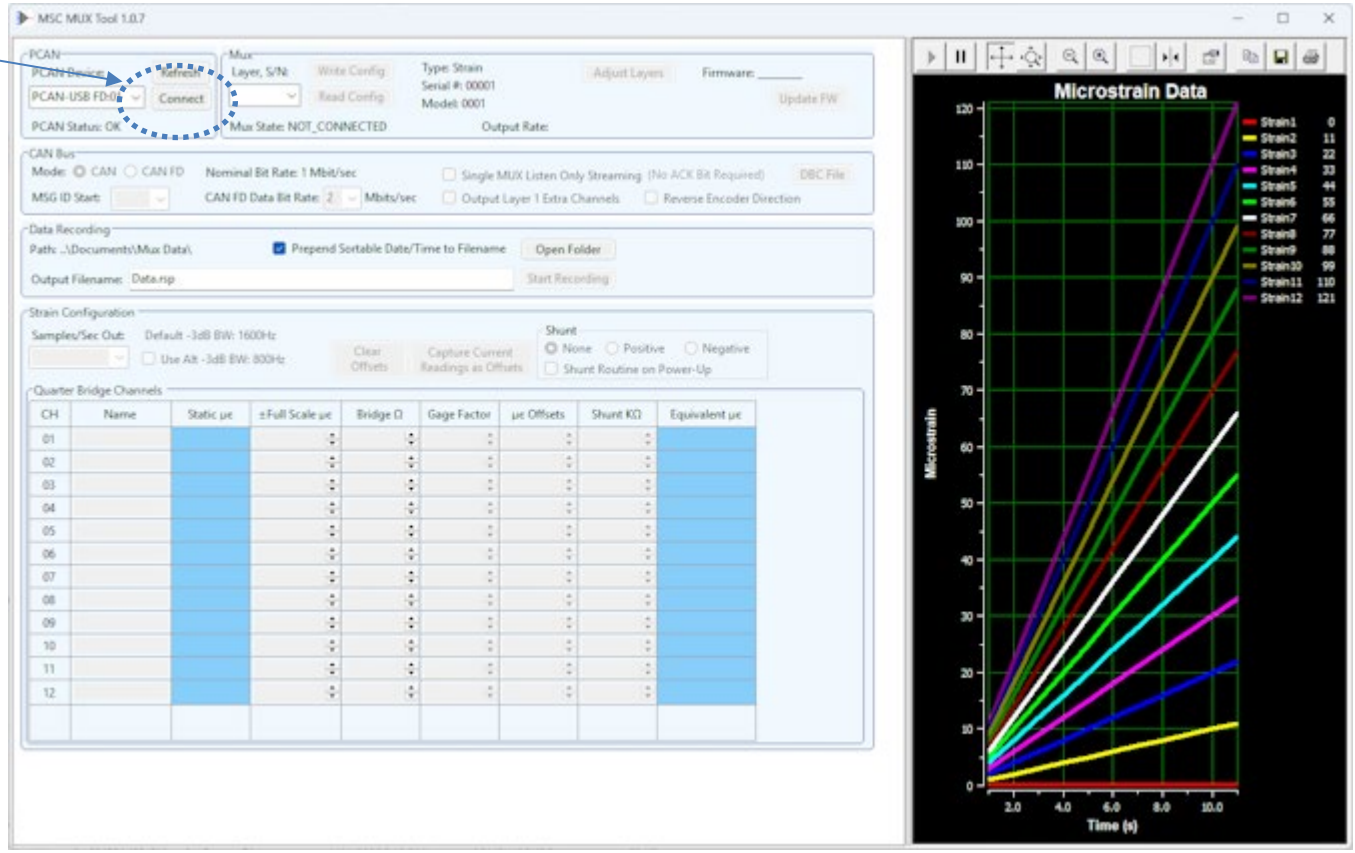
12.2 Configuration Instructions

To configure the MUX module using the software, first verify hardware requirements:

1. Connect MUX <--> sensors
2. Connect MUX <--> USB-to-CAN converter <--> PC
3. Connect MUX <--> Power from voltage supply in range 10 to 36Vdc
4. Verify USB-to-CAN converter drivers are installed
5. Verify CAN bus termination
6. Power ON the MUX module
7. Open the MUX Software

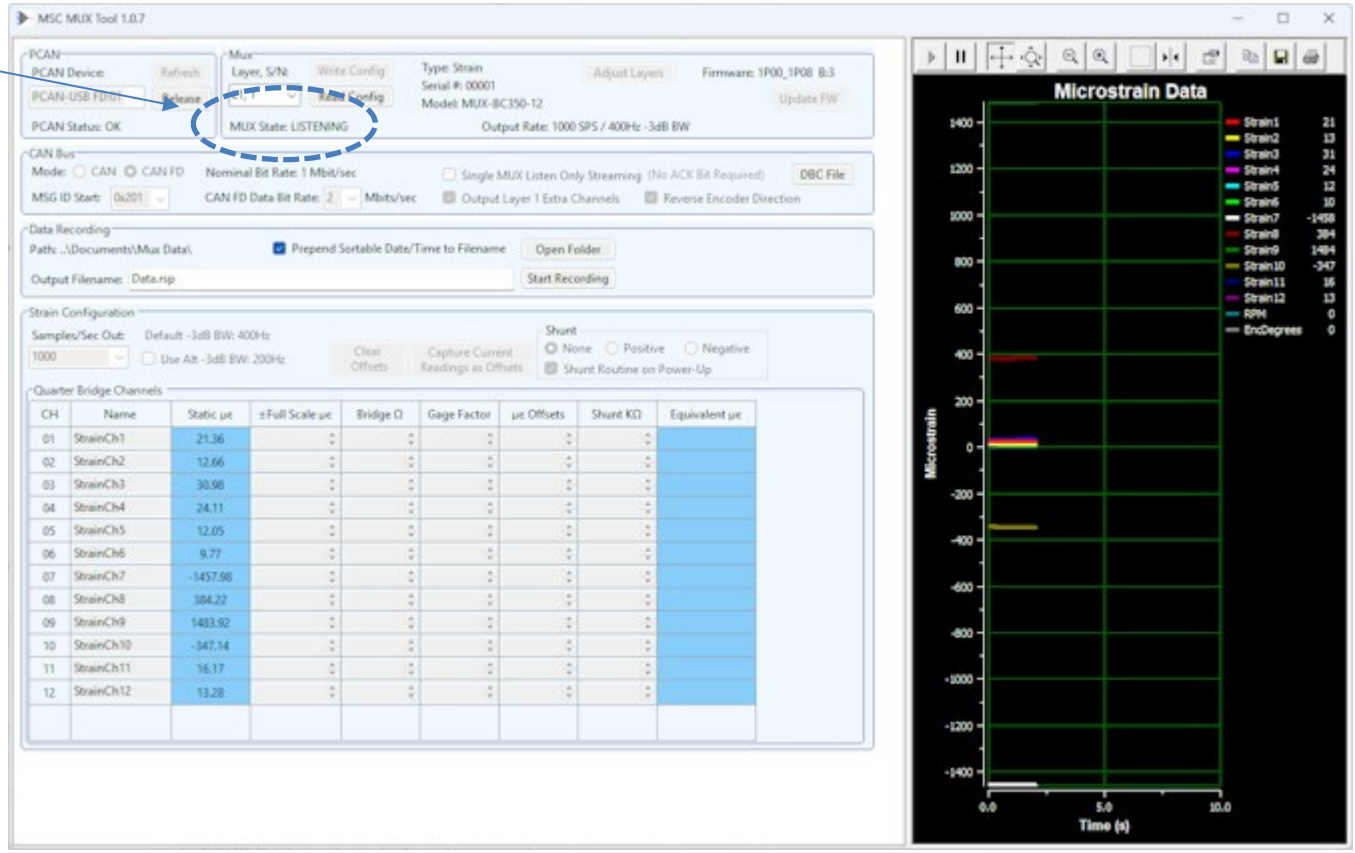
[2] USB-to-CAN hardware drivers are available from the manufacturer, PEAK System, https://www.peak-system.com/

1) Once software opens, press “Connect” button.



2) Verify MUX state changes to Listening.

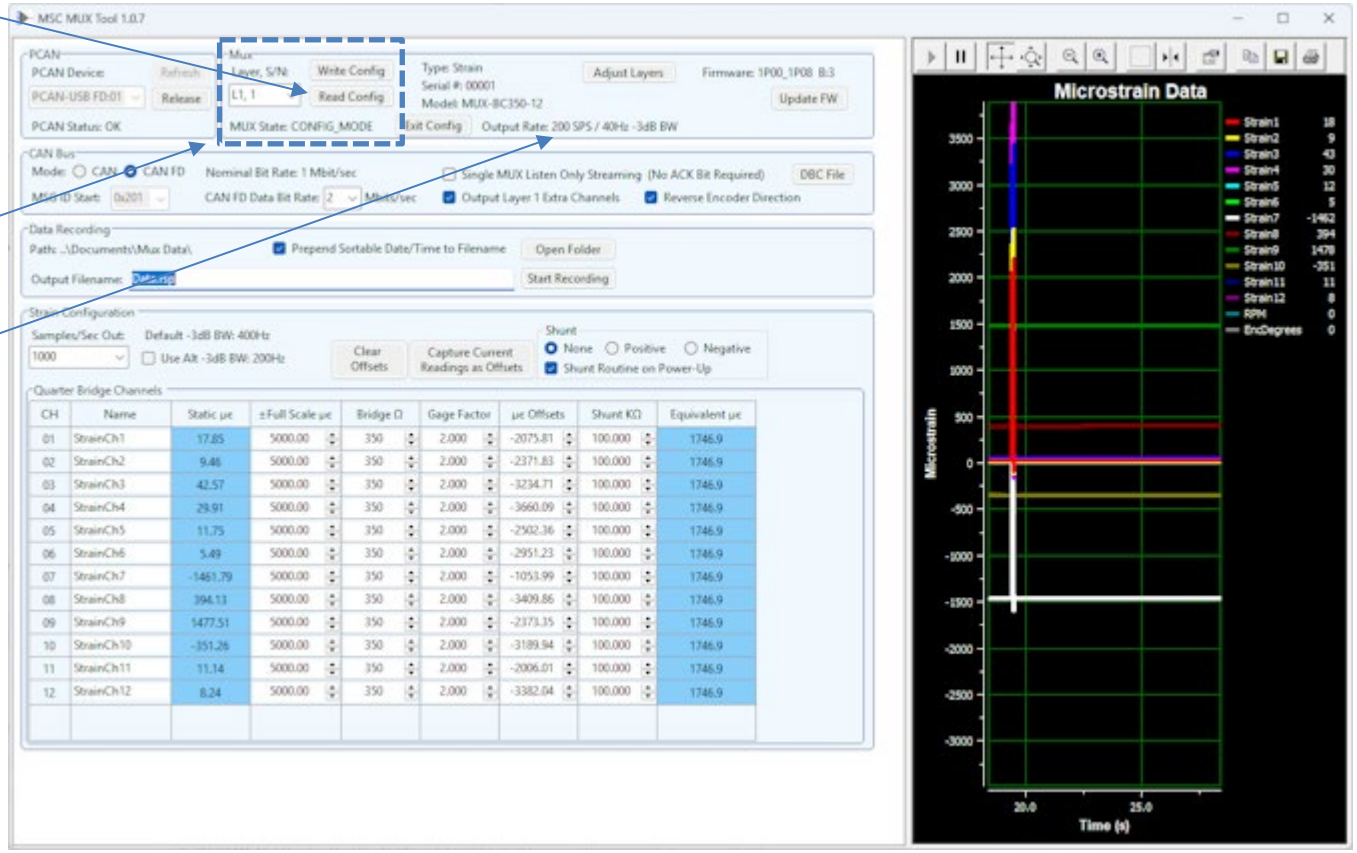
3) Verify ~ 20 seconds later, mode changes from listening to streaming



4) Press “Read Config” button to view and edit device settings.

5) Verify MUX state changes to CONFIG_MODE.

6) Verify Output Rate is 200sps while in config mode.

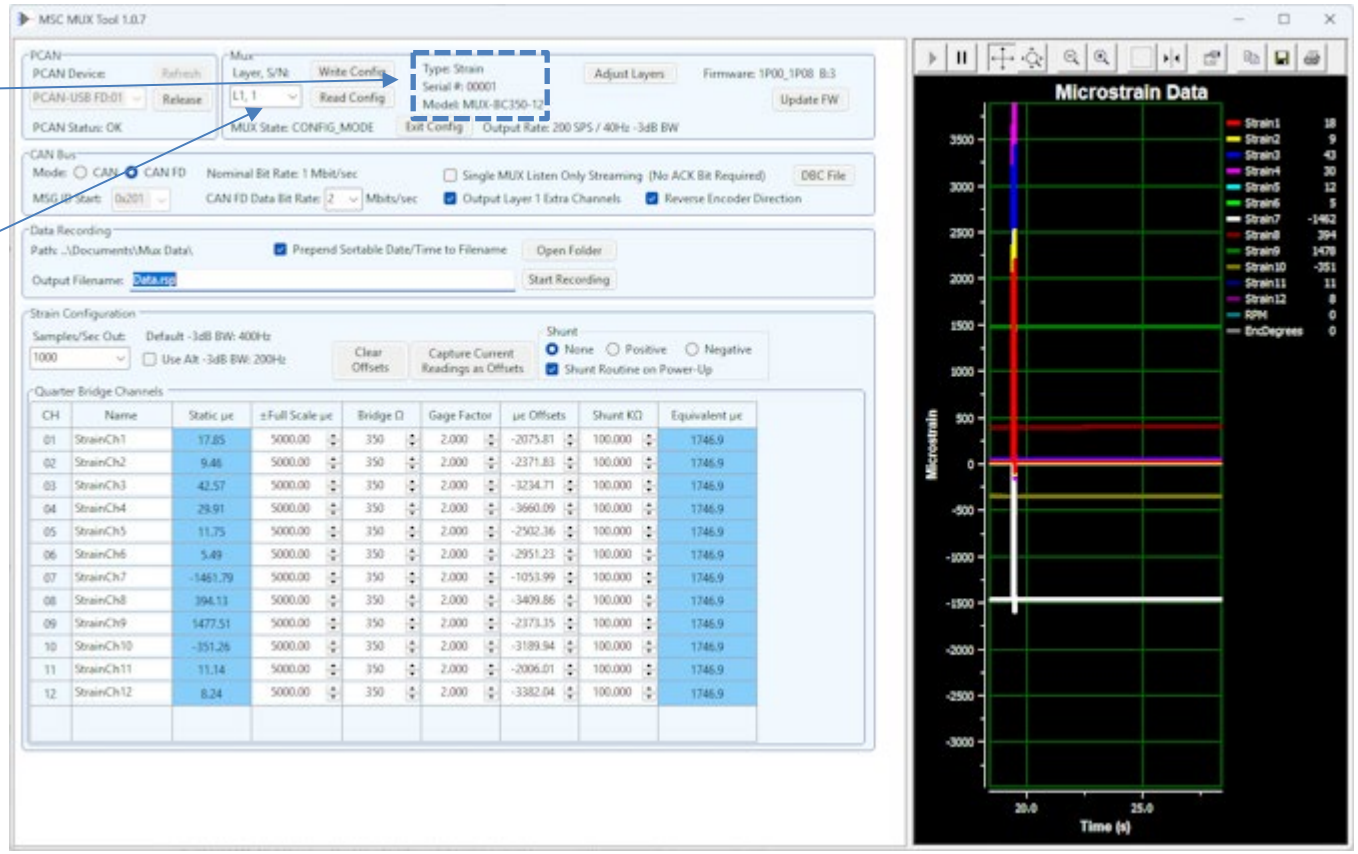


7) Verify the MUX model and serial numbers

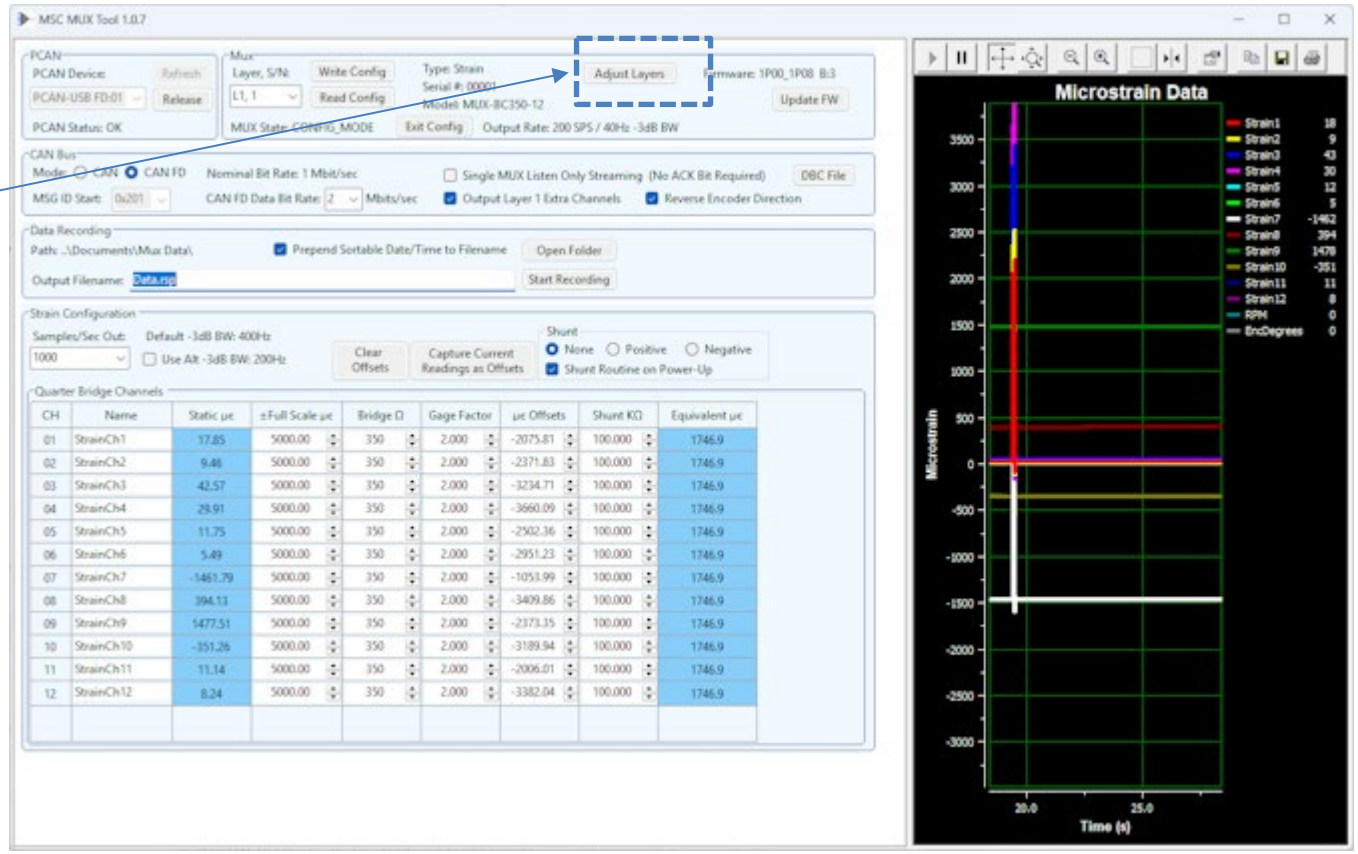
8) If multiple MUX modules are on a shared CAN bus, select the MUX layer to configure.

9) Once layer is selected, wait for data to refresh on the screen.

Note, each MUX device within a stack must be assigned a unique layer number. If not, CAN data errors will result.



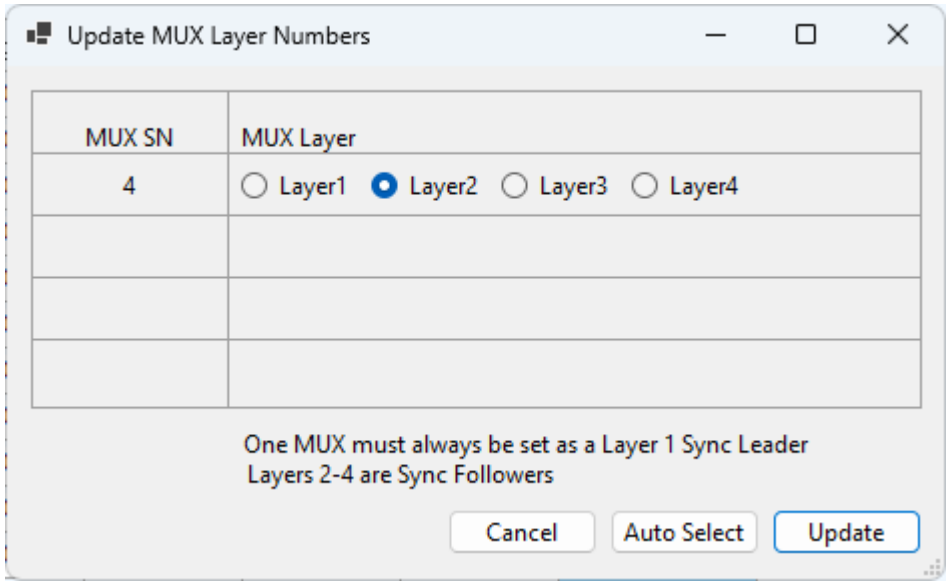
10) When MUX modules share a CAN bus, assign each a unique layer number by pressing the ‘Adjust Layers’ button.



11) Pressing the ‘Adjust Layers’ button opens a new window for the user to select numbers.

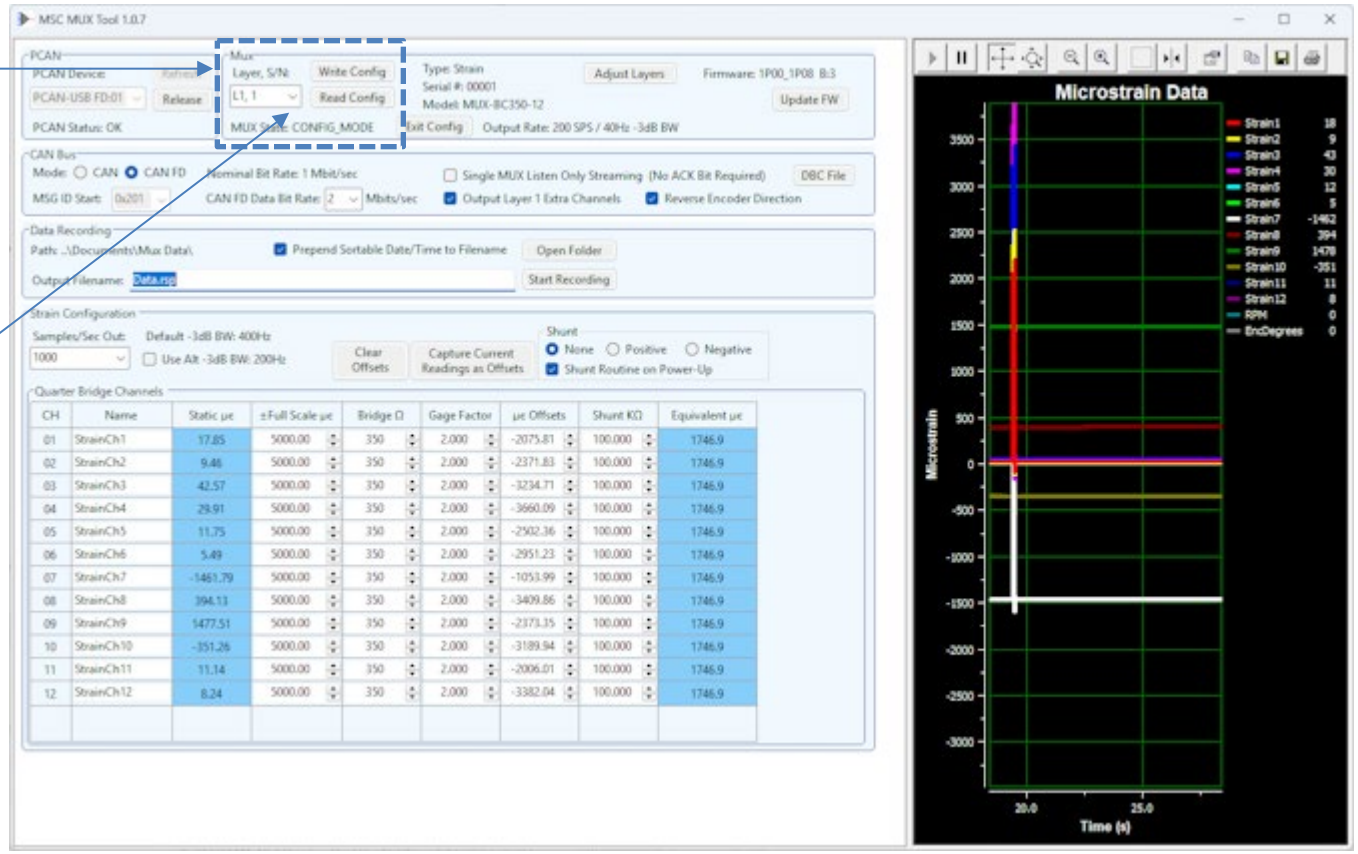
12) Assign each layer as 1 to 4, and then press the ‘Update’ button.

Alternately, press the ‘Auto Select’ button to have the layer numbers assigned automatically.



13) After assigning layer numbers, press the ‘Write Config’ button to store the settings into the MUX device memory.

14) Verify the newly assigned layer number, and serial number are as expected by selecting the drop-menu.



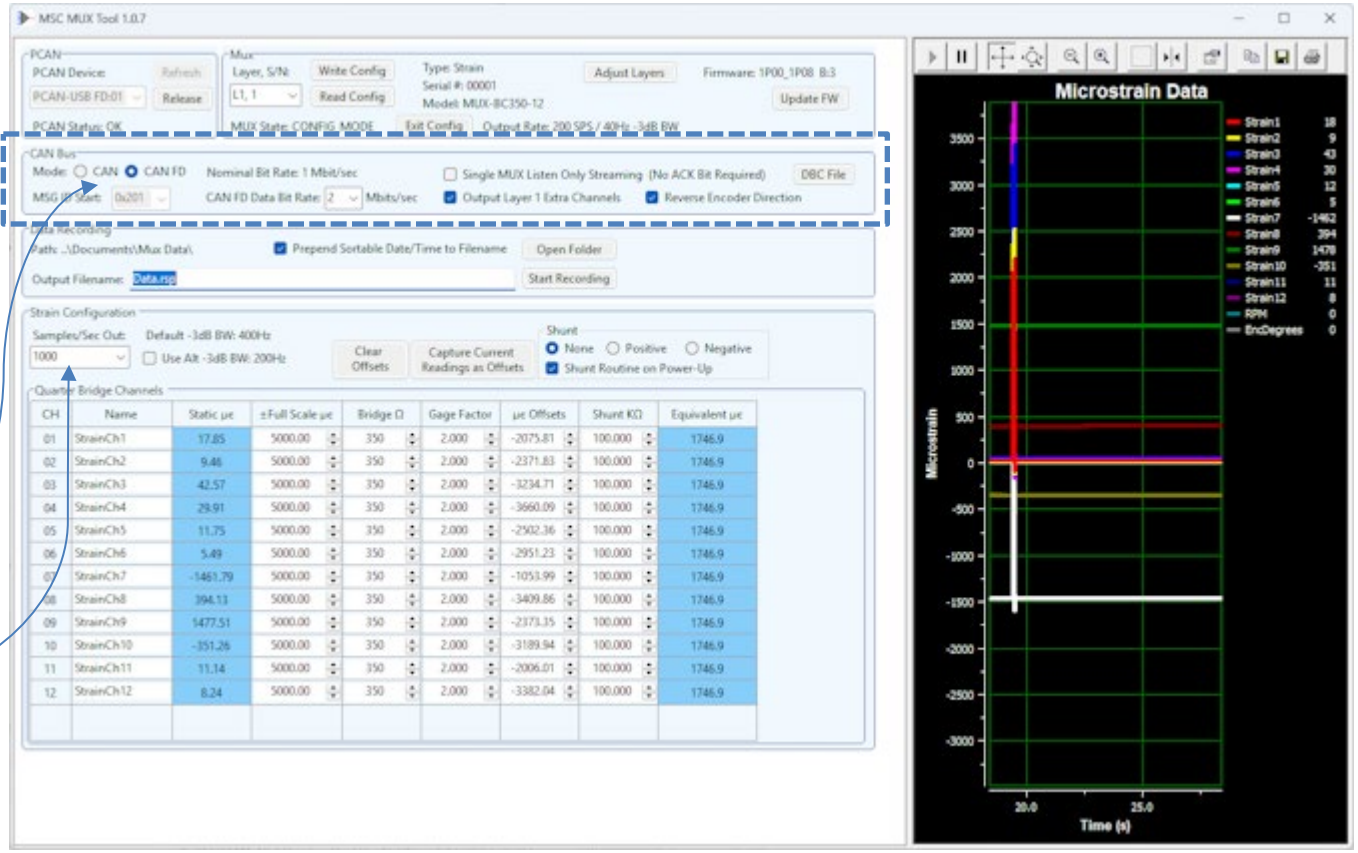
12.2.1.1 Set Parameters: Output Rate

1) Configure the CAN Bus mode: CAN or CAN-FD

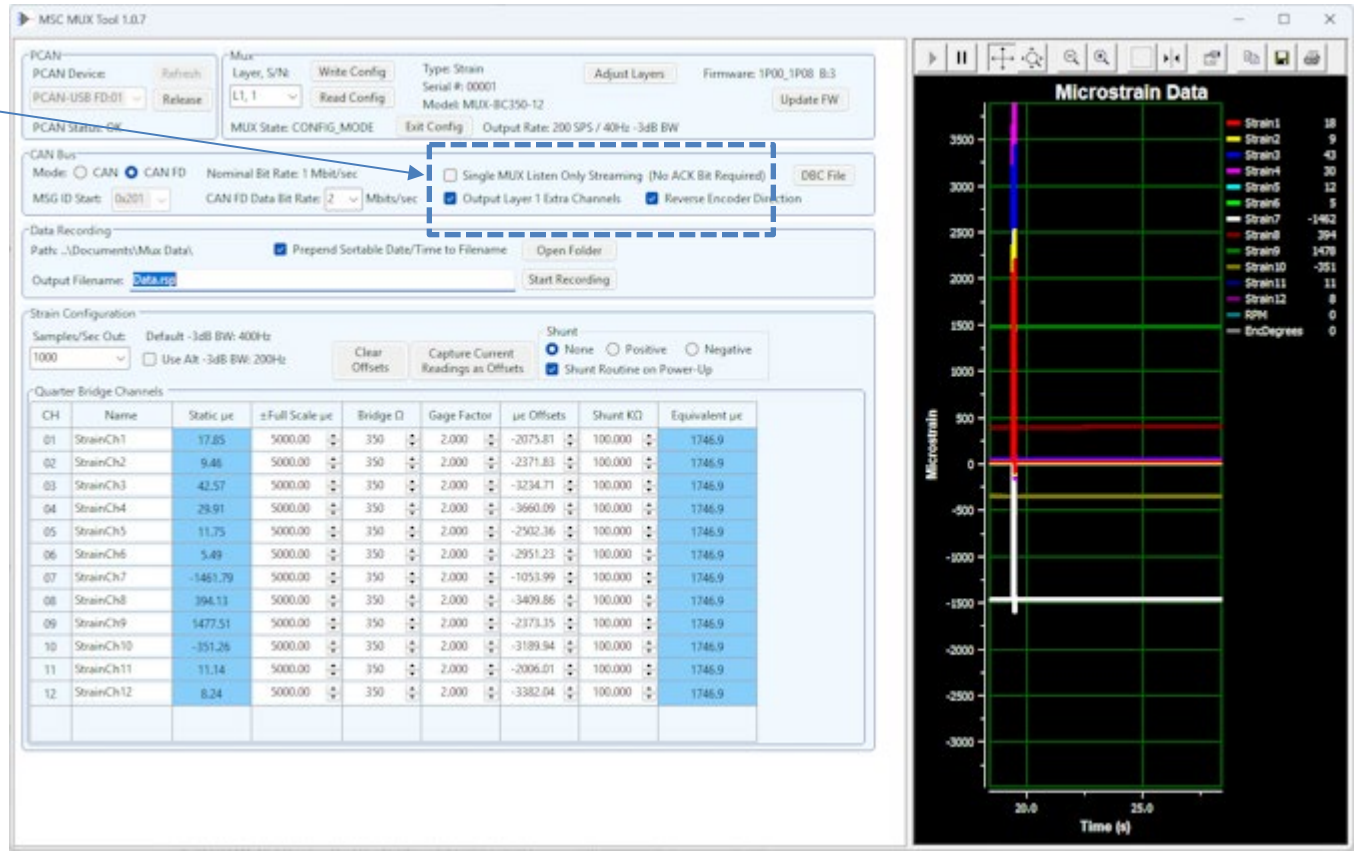
   For CAN, the bit rate is fixed 1Mbps. For CAN-FD, choose the bit rate: 2 or 4Mbps

Modules on a shared bus

- ***must have <u>same mode and bitrate.</u>***
- ***can have <u>different sample rates.</u>***



2) Verify ‘Single MUX Listen Only Streaming’ is NOT checked.



Checking this box causes the MUX to output data independent of CAN bus errors and does not require data recorder acknowledgement. Do NOT enable when multiple MUX modules share a CAN bus.

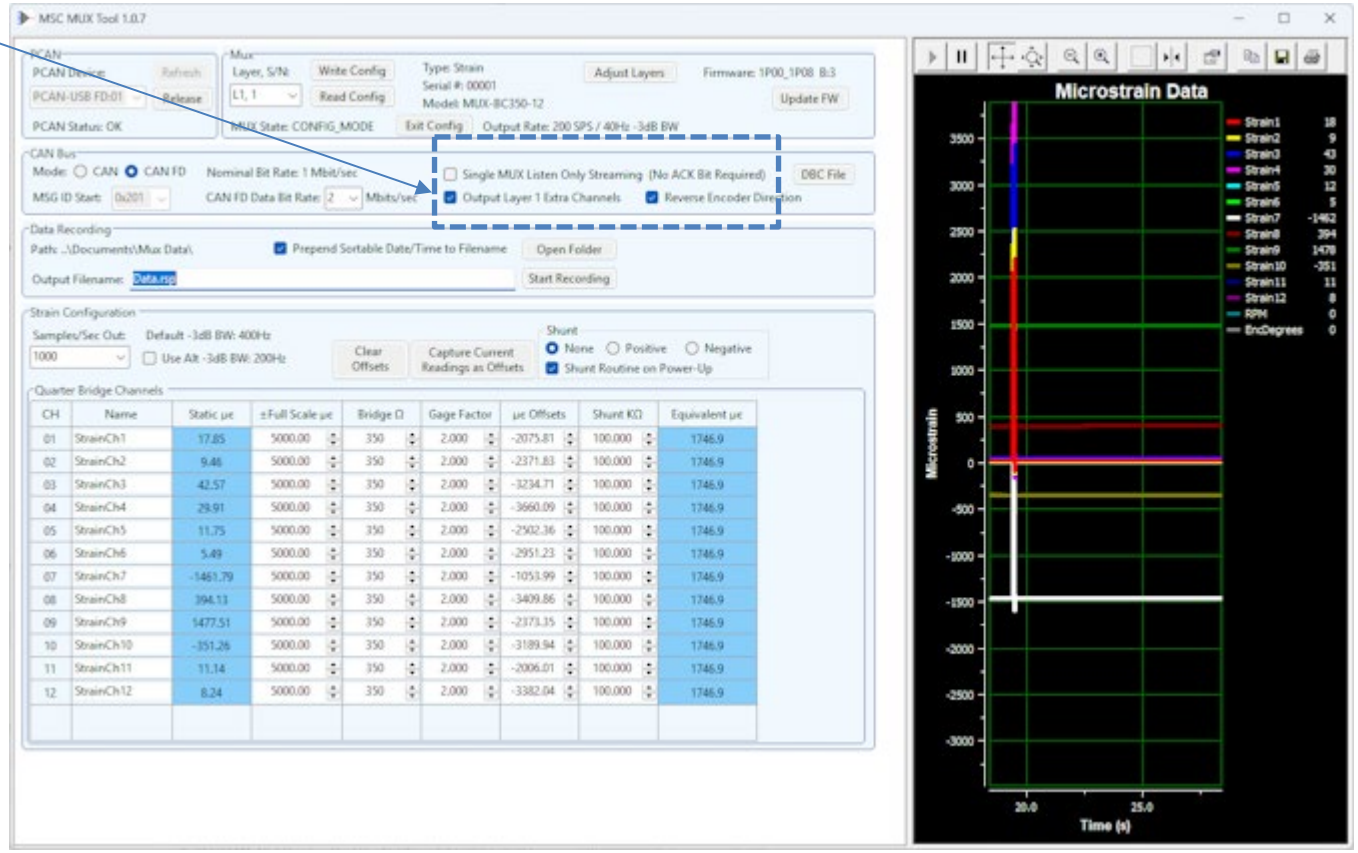
Press the ‘Write Config’ button to store the new settings in the MUX device memory.

12.2.1.2 Set Parameters: Extra (Encoder and Temperature) Channels

3) Check the box for ‘Output Layer 1 Extra Channels’ for devices which include a slip ring with encoder.

Enabling this option will output the encoders velocity, position and MUX internal temperature.

4) Check the box named ‘Reverse Encoder Direction’ as necessary. See Appendix for direction polarity information.



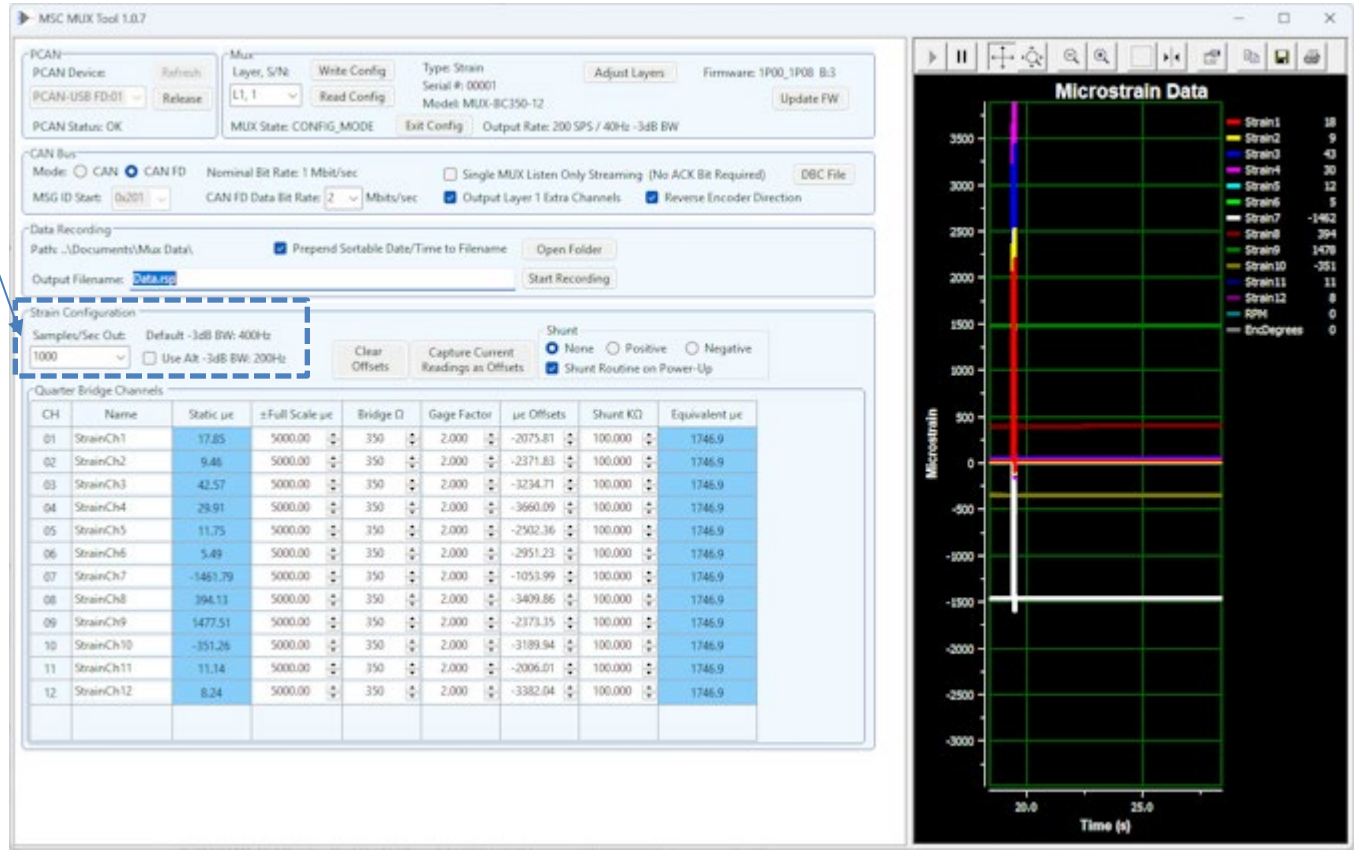
12.2.1.3 Set Parameters: Sample Rate

5) Use drop-down menu to configure the Sample rate to one listed in Figure 29.

6) Check the box ‘Use Alt -3dB BW’ to enable a more aggressive low pass filter.

7) Press the ‘Write Config’ button to store the new settings in the MUX device memory.

   Note, signal delays vary with sample rate. See page - 44 - for more details.

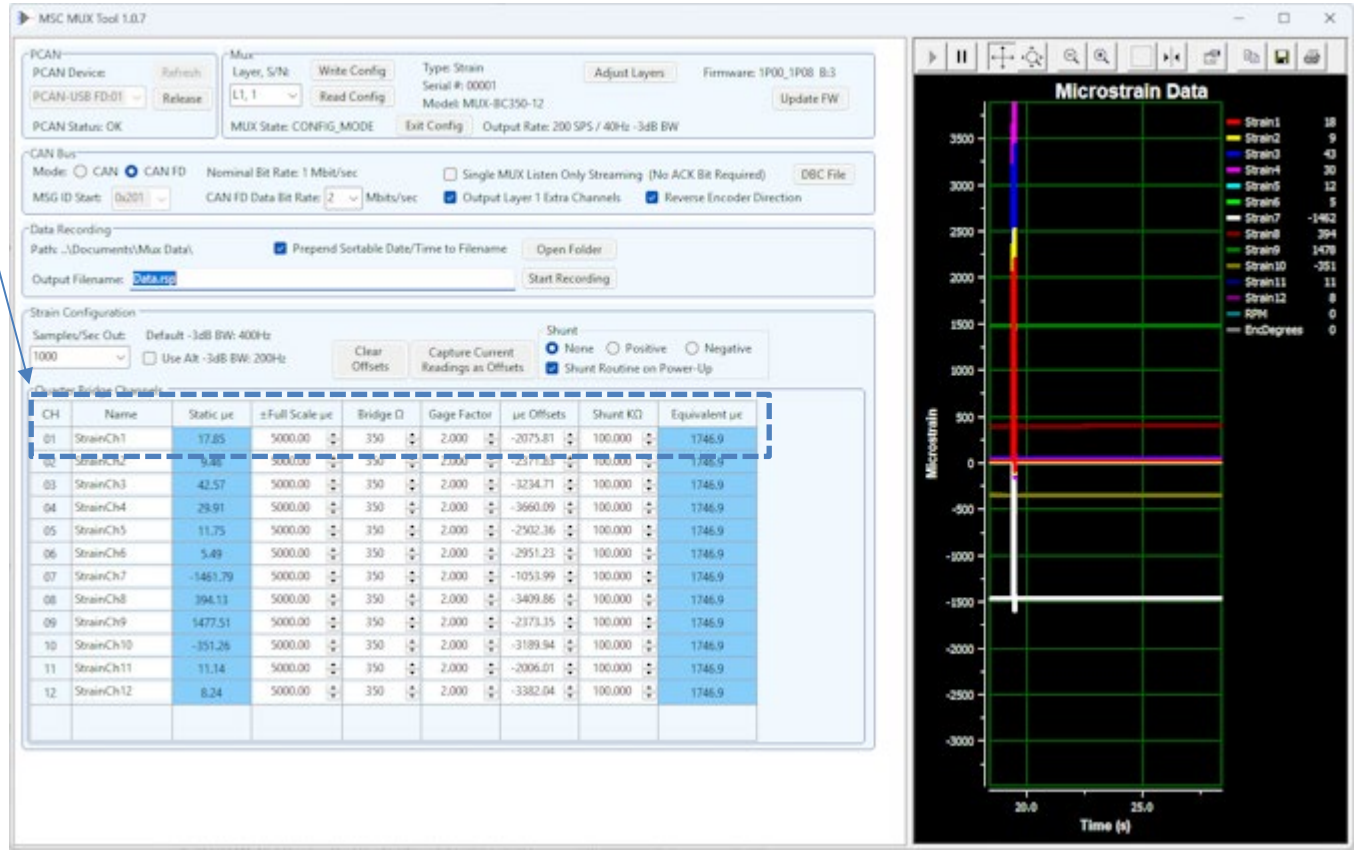


12.2.1.4 Set Parameters: Channel Info

8) Configure Channel:
   - Name
   - Full Scale
   - Gage Factor

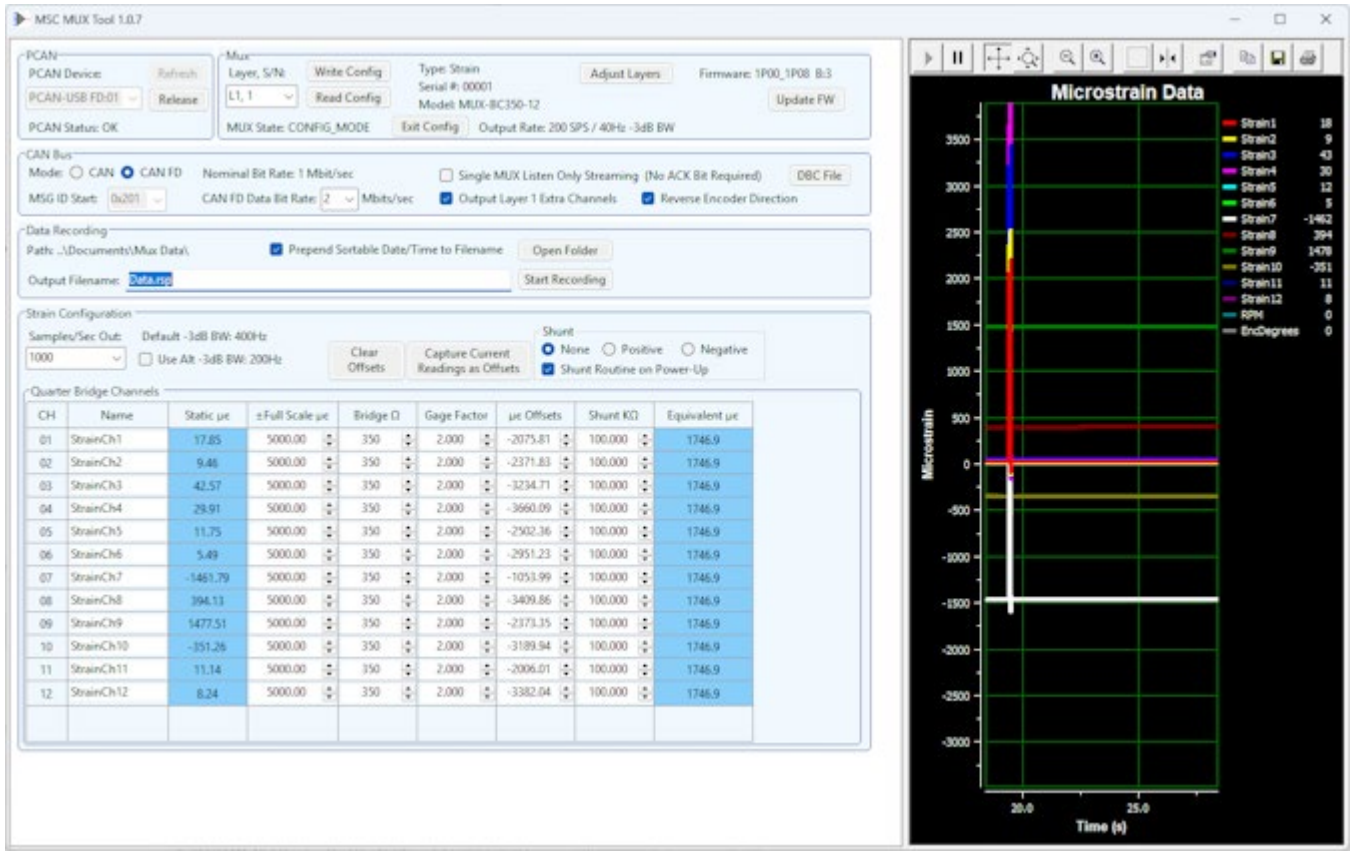
9) Click the Name field and type a new value. New values entered, but not saved to MUX memory are highlighted yellow.

10) Press 'Write Config' to save new values to memory.



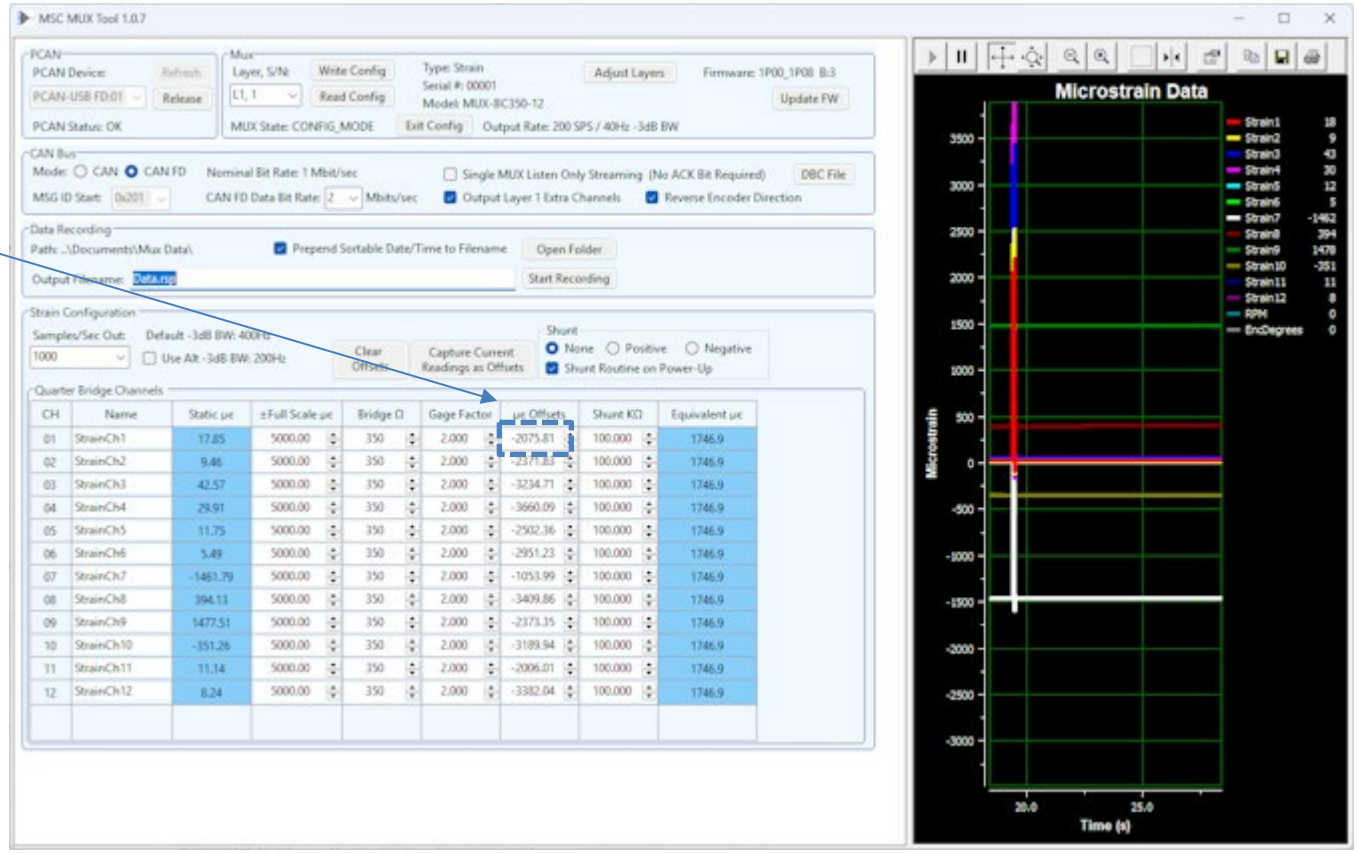
11) Update the Full Scale, and gage factor values for each channel as needed.

12) Press ‘Write Config’ to save new values to memory.



12.2.1.5 Zero the Sensors

1) Place the sensor in balanced condition to null out any offset.
2) Next, right-click on the specific channel field in the column named “ue offset”. A pop-up dialogue appears.
3) Left-click the pop-up to capture the current reading as offset. **Offsets may also be entered manually.**
4) Press “Write Config” to store the captured offset value into MUX memory.



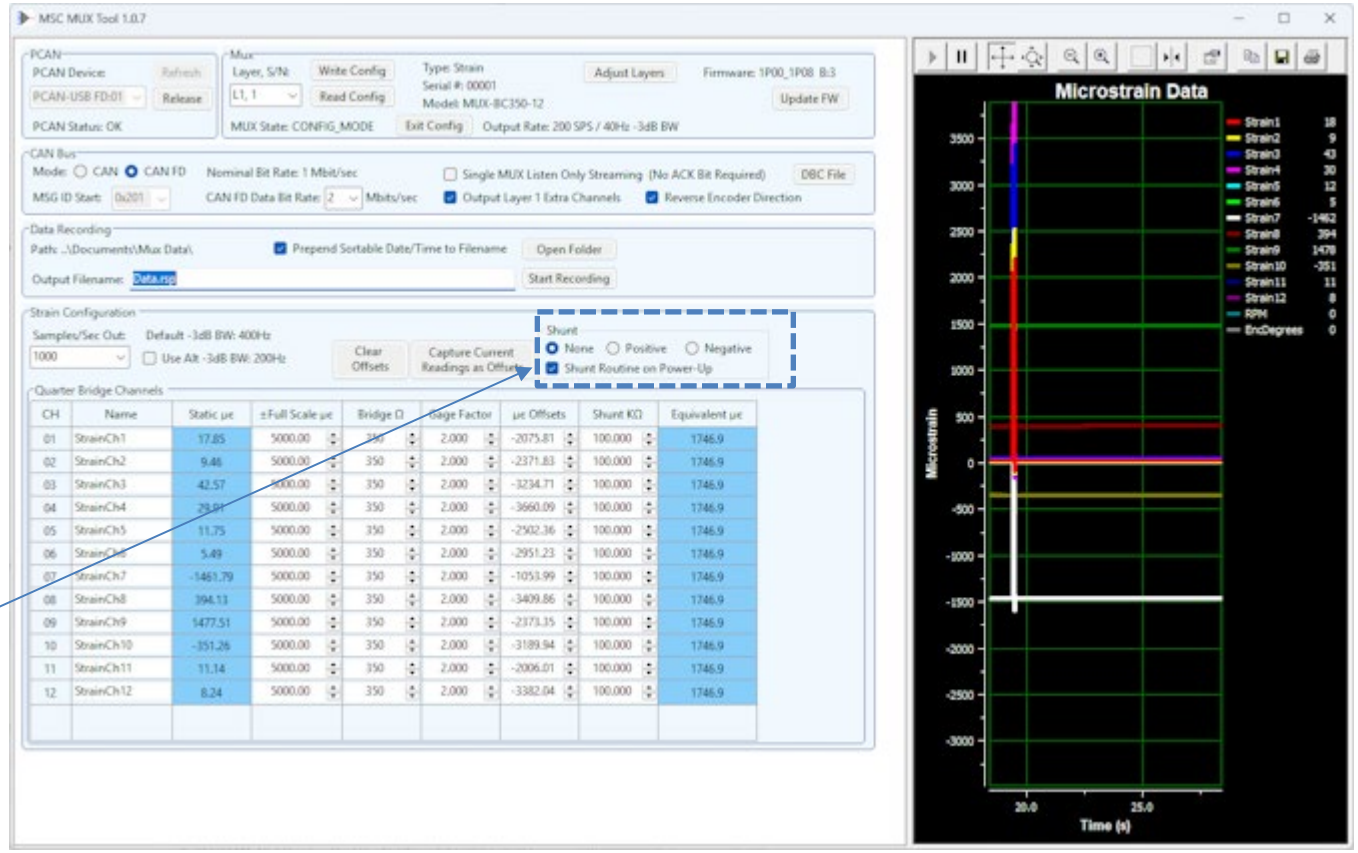
12.2.1.6 Verify the Sensors are Working

The MUX includes internal shunt resistors for sensor verification, with shunt testing performed either manually or automatically at power-on. Shunt data can be viewed in the plot window while verifying the sensor is working.

1) **To enable shunt process manually**: while in config mode, press the corresponding radio button for either a positive or negative shunt respectively.

2) **To enable shunt process at power ON**: check the corresponding box.

3) Press the 'Write Config' button to retain this setting.



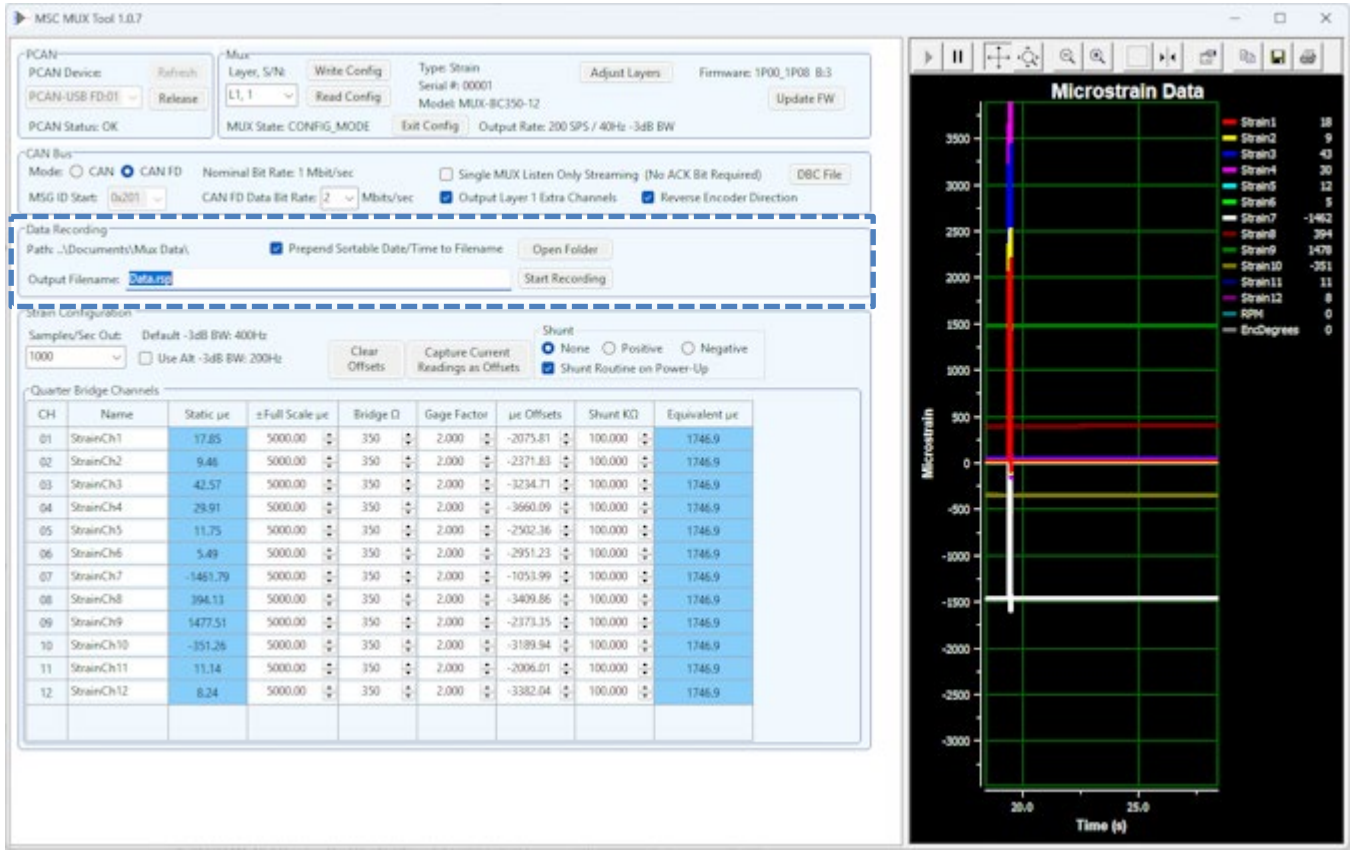
12.2.1.7 Data Collection Options

MUX data can be viewed with the software. The data can also be recorded to a PC, or a separate data recorder.

1) **Data To PC**: specify the output filename, and press the button to Start Recording.

To stop recording, press the button named Stop Recording.

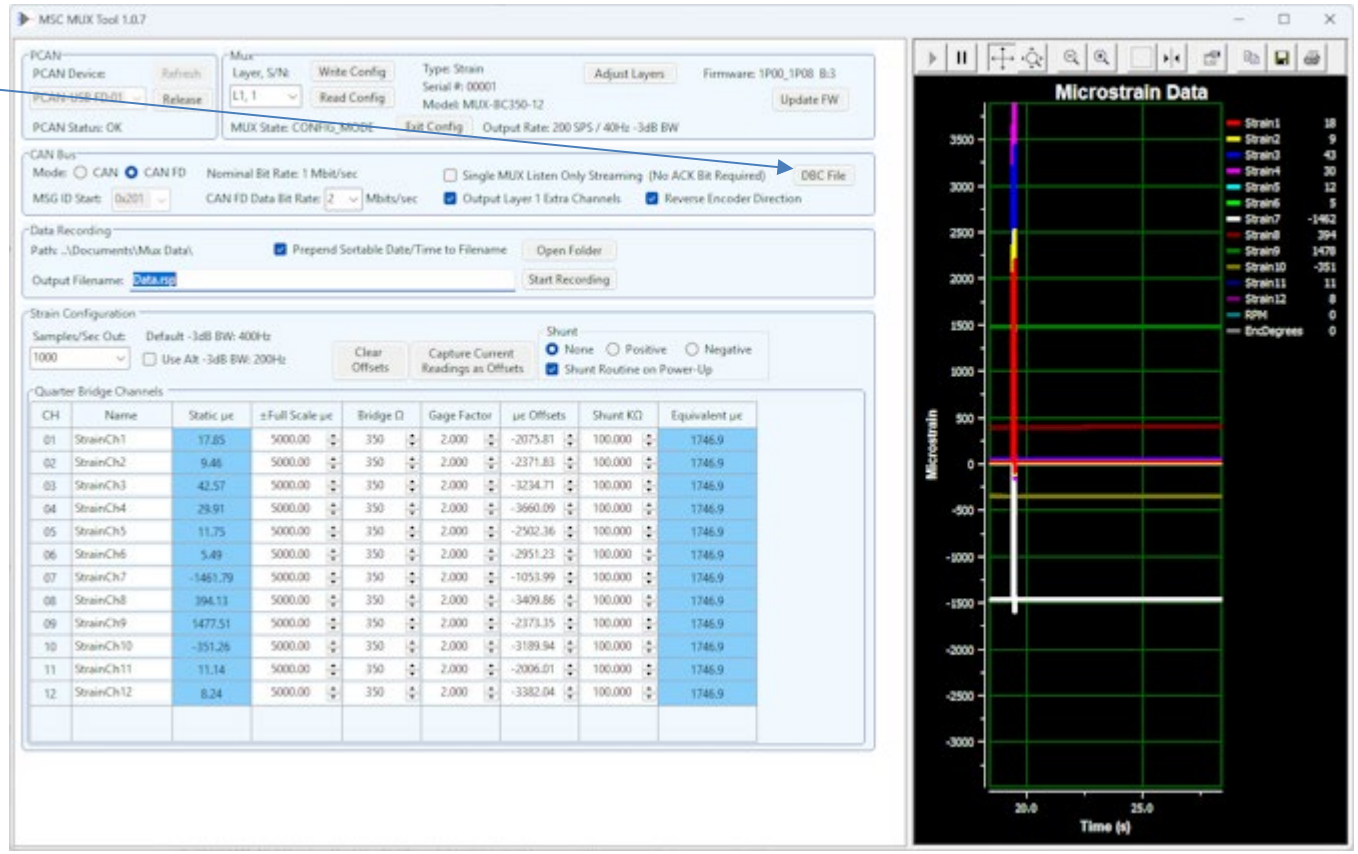
The default location for data storage is in the Documents folder named “MUX Data.” The data format is MTS RPC-III.



2) **Data to recorder**: press the ‘DBC File’ button to generate a file for use with the separate data recorder.

If browser is not up to date or pop-ups have been disabled, this button may not work properly.

See section “DBC file creation” on page - 40 - for more information.



13 Firmware Updates

The MUX software tool allows the user to easily update firmware without having to send the device back to the factory. Current MUX firmware is available upon request. With a MUX connected, the version is displayed in the top right corner:

Firmware version

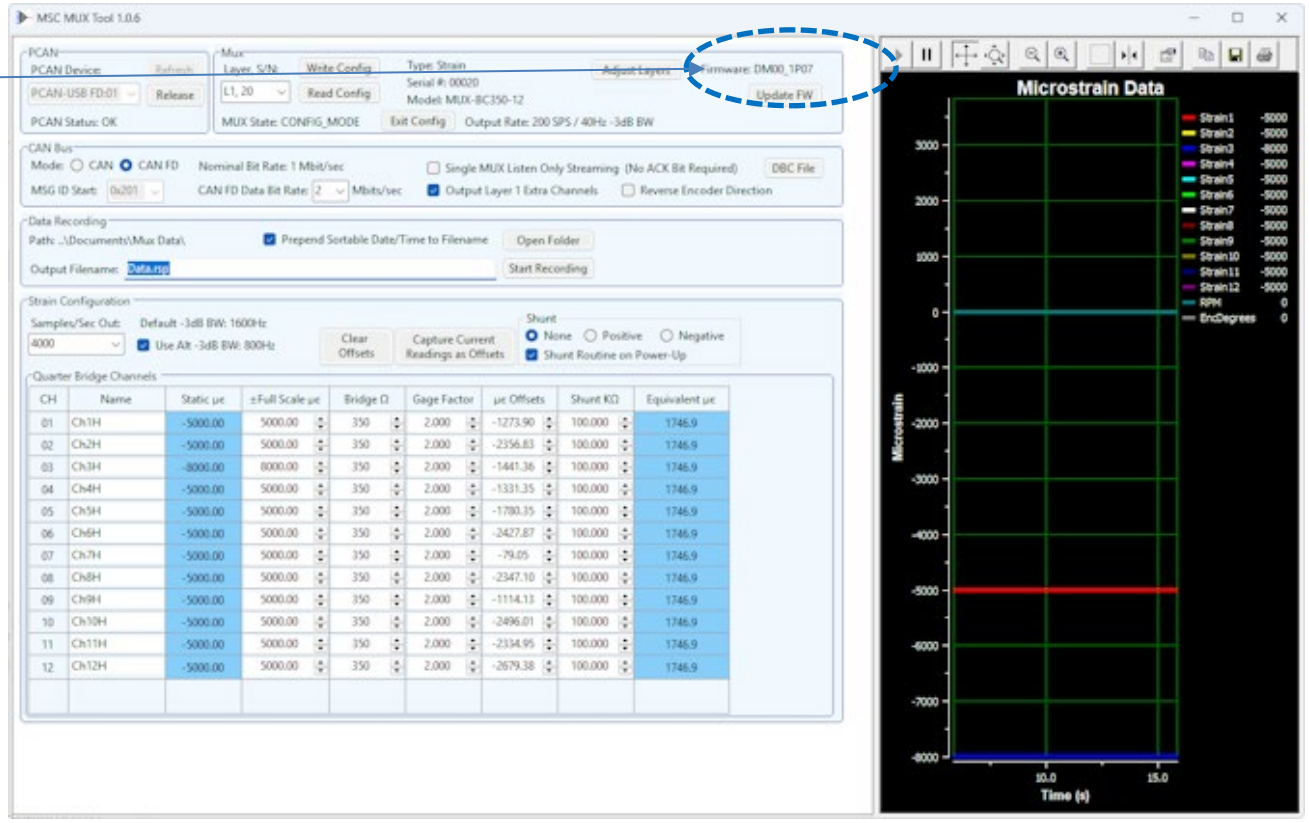


Figure 37: MUX Software Main Screen showing Firmware version.

If a firmware update is available, Michigan Scientific will provide an installation file. Save this file onto your laptop. To update the MUX:

- Connect the MUX to computer using the USB-to-CAN tool
- Click 'Connect'
- Select the layer to update, one layer at a time
- Click ‘Update FW', and a new pop-up window is displayed to browse for the file
- Press the Browse button and select the installation file.
- Press the Open button
- The file will be uploaded. Follow the prompts on the screen.
- Once complete, you will be prompted to cycle power on the MUX.
- Once power has been cycled, the new firmware is ready to be used.

Caution: Do not disconnect the MUX or power down the computer or MUX during the update.

Note: Only the MUX connected, and layer selected in a stack, will be updated. Each MUX device must be updated separately.

Note: Update all MUX electronics with the same version of firmware before using them in a stacked configuration.

14 Weatherproofing

MUX modules are designed to be used in harsh environments. When sensor cables and adapter layers are connected, the system meets IP67 specifications.

Some available cable assemblies are not designed for rugged use, including:

Cable Assembly, Power/Data, Setup cable	(MUX-IPDC-SC)
Cable Assembly, Power/Data, Direct Connect, 0.45m	(G125-FC11605F1-0450L)

15 Troubleshooting

Symptom	Possible Causes	Solution
MUX does not power ON when power is applied	Power supply voltage is too low. Power supply polarity is incorrect. Internal overload circuit is tripped.	Check that supplied voltage is in range, and the supply is not current limited. Check polarity. If incorrect, reverse leads and try again. Inspect for shorted wires on input.
MUX does not communicate with computer	USB-to-CAN device is not working. Another device is connected. Hardware connection problem	Verify the USB-to-CAN device is working. Use other software to verify. Verify no other software is open which may be trying to communicate with the USB to CAN tool. Verify all connections are secure. Verify total resistance across CAN bus is near 120 ohms. Verify no short from CAN signal to shield or ground.

MUX lights not blinking	MUX modules in stack may be configured with different CAN bus modes and bit rates.	Dissemble modules from the stack. Connect power and data to one module at a time in order to configure it with the same CAN mode and bit rate. **Note, it is acceptable to configure the modules with different output sample rates.** Once each module is configured, reassemble the stack and try again.

16 Appendix

16.1 Appendix A: Wiring and Shielding

16.1.1 Galvanic Isolation

- MUX sensor inputs are galvanically isolated from the input power and CAN data.
- MUX sensor inputs are NOT galvanically isolated from each other.
- The MUX enclosure is galvanically isolated from sensor inputs, input power, and CAN data.

16.1.2 Shielding

For the sensor input wiring, it's preferred to use a shielded cable. The sensor input connectors are electrically connected to the MUX enclosure. Do not electrically connect the sensor input cable shield to the transducer at the sensor end of cable.

16.2 Appendix B: Dimensional Drawing, Slip ring SR10AW/WFT

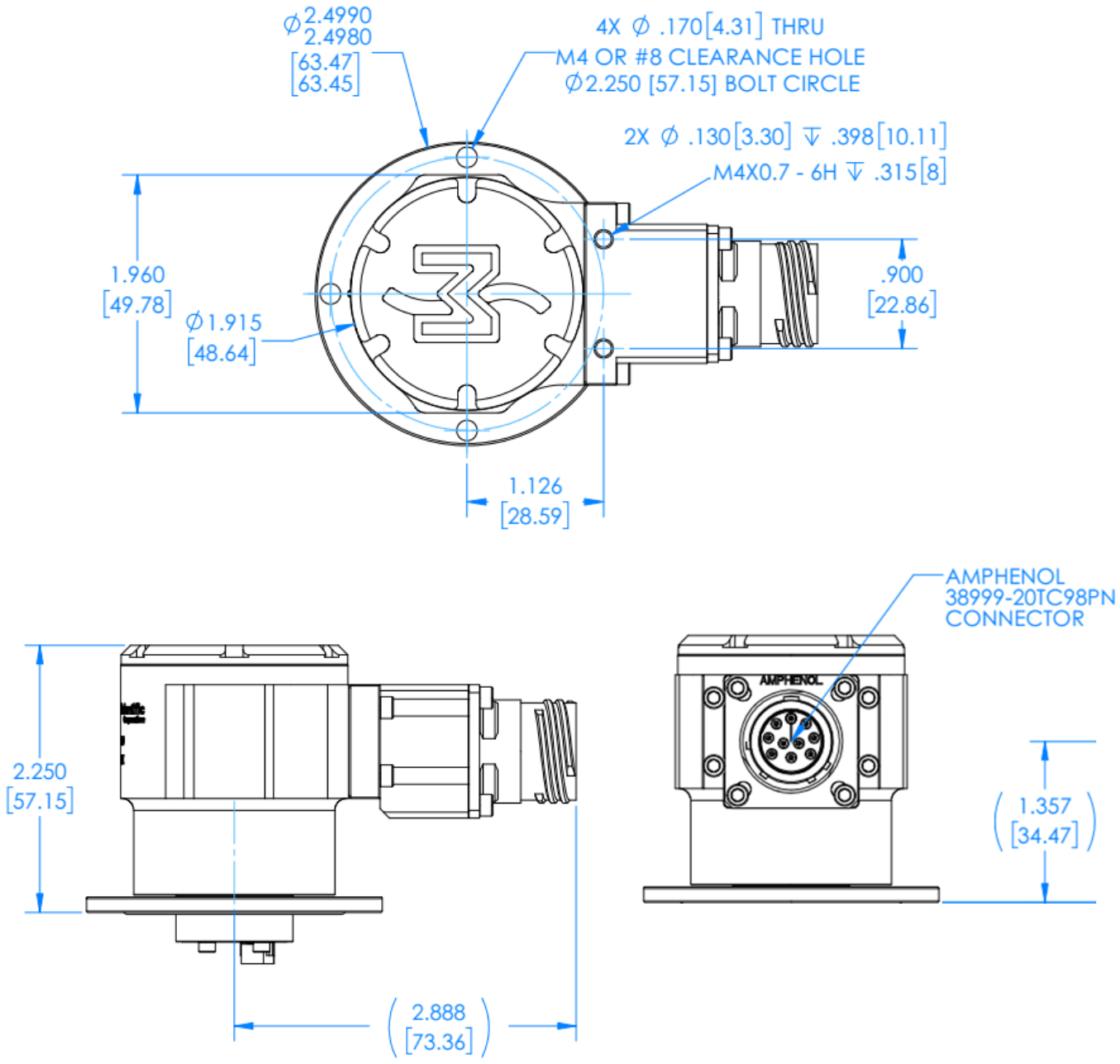


Figure 38: Dimensioned Drawing for Slip Ring Model SR10AW/WFT with units shown as inches [mm].

16.3 Appendix C: Dimensional Drawing, MUX with Slip ring and adapter

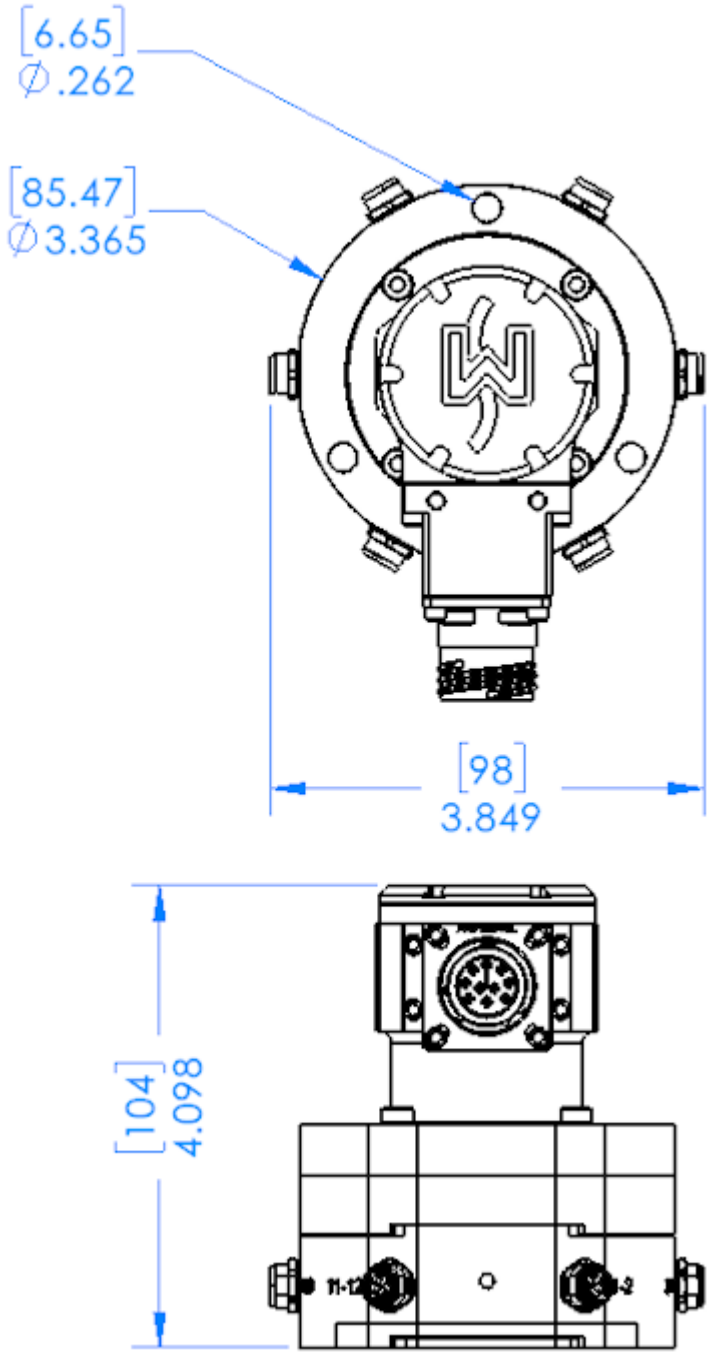
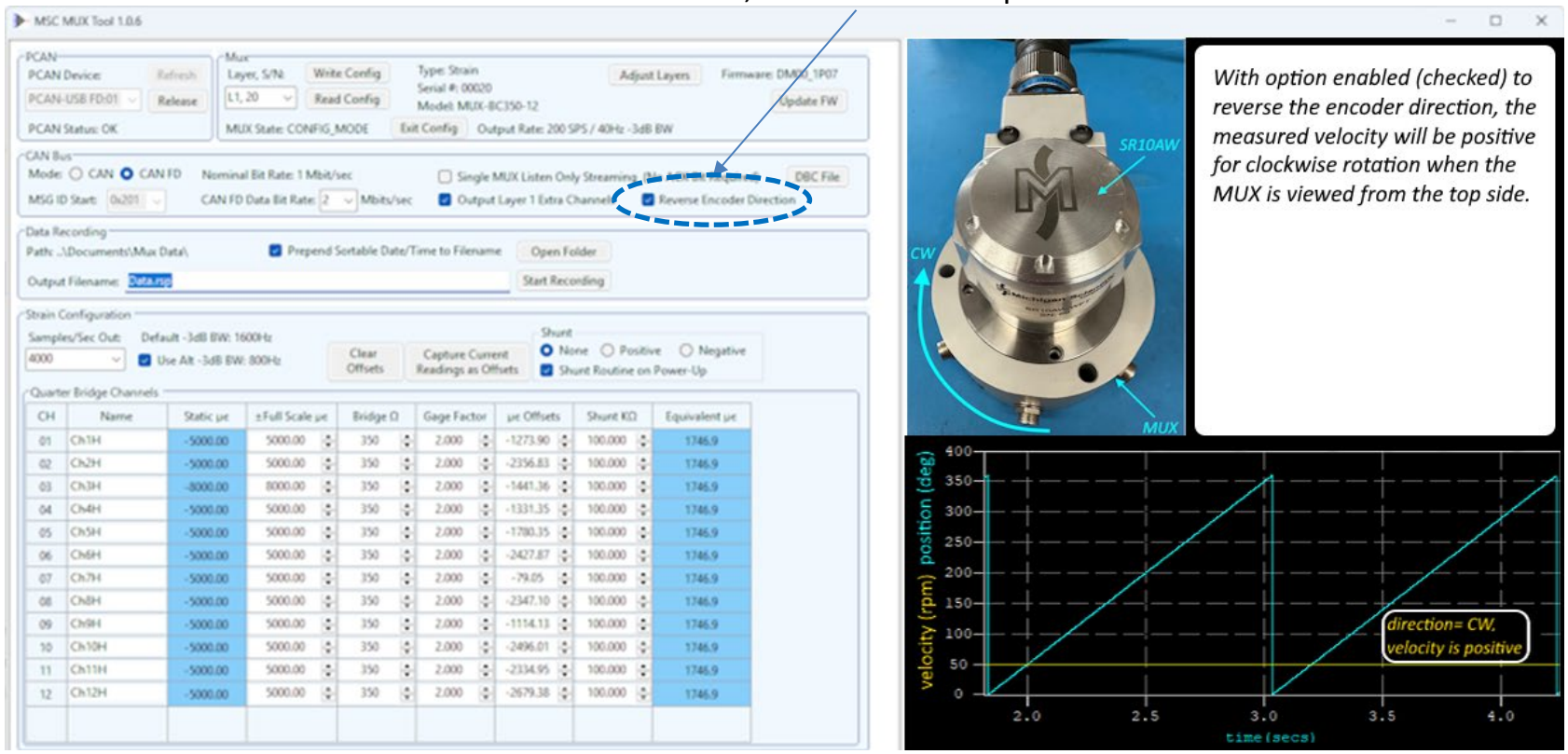


Figure 39: Dimensioned Drawing with units shown as inches [mm].

16.4 Appendix D: Encoder Direction

The MUX software can interface with data from absolute quadrature encoders. The user can choose whether the encoder outputs a positive or negative velocity with corresponding clockwise or counterclockwise spinning direction.

Encoder Direction, Enable Reverse option



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