FIU
LabVIEW Driver Specification

Part Number: 8800-00009

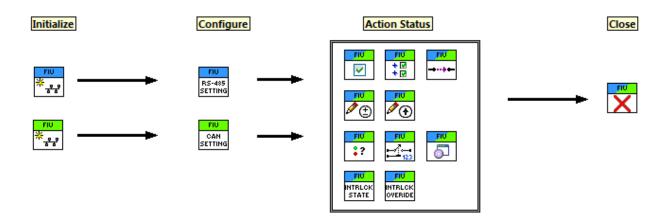| REV	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY
1.0	8/30/16	Initial Release	T. Henault	S. Hoenig
1.1	2/16/19	Added part number	P. Tortora	G. Gothing

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1. Overview

Bloomy's Fault Insertion Unit (FIU) allows users to set open circuit or ground faults when paired with the BS1200 in a battery simulation system. The FIU supports both RS-485 and CAN bus protocols.

Bloomy's LabVIEW drivers make communicating with the FIU simple and efficient. This driver set includes several checks that allow for safe use of multiple FIUs in a single system. The FIU drivers support NI LabVIEW 2014 and later.

A user must initialize an FIU session with a protocol-specific "Open" method. RS-485 methods have a blue header and CAN methods have a green header. Most other methods can be used by both protocols and can be seen in the VI tree below with multicolored headers. The class wire color corresponds to the type of session that has been initialized. If the session is not initialized, the class wire will appear red at edit time.

1.1. Driver Methods

Driver Method	VI Name	Description
	Open RS-485	Opens an RS-485 connection to the FIU.
	Configure RS-485 Settings	Set whether the system is using a shared DMM across multiple FIUs.
	Set Open Circuit Fault	Enable (disconnect) or disable (connect) an open circuit fault at a specified channel.
	Set Open Circuit Fault All	Enable (disconnect) or disable (connect) open circuit faults at all channels in the system.
	Set Short Circuit Fault	Sets a fault to ground at the specified channel. (Only one channel in the system can be set to ground fault at a time.)
	Set Voltage Measurement	Sets the specified channel to voltage mode for DMM cell voltage measurement. (Only one channel in the system can be set to measurement mode at a time.)
	Set Current Measurement	Sets the specified channel to current mode for DMM bypass current measurement. (Only one channel in the system can be set to measurement mode at a time.)
	Relay State	Returns the state for every channel in the FIU system.
	Relay Contact Cycle Count	Returns the number of cycles the relays on the specified channel have experienced.
	Software Version	Returns the current version of the software running on the FIU.
	Interlock State	Returns the state of the 24V interlock input on the FIU (Active or Inactive).
	Interlock Override	Sets the 24V interlock input on the FIU to active (enable) or inactive (disable).
	Close	Closes a connection to the FIU.

1.2.   Safe State Management

The FIU firmware provides most of the checks required to safely transition from one state to another. However, the LabVIEW drivers provide another level of protection against shorts within a multi-unit system.

The drivers keep track of the state of every channel in the system. An error will occur when trying to transition to an unsafe state, before ever reaching the FIU. This prevents unintentional damage to the system.

1.2.1. Shared DMM

When using multiple FIU modules with a single DMM, it is important to set "Shared DMM" to True in the configuration method. If there is only one FIU module or a separate DMM for each FIU, "Shared DMM" should remain False.

The modules themselves do not know of the states of other modules. Without the added driver protection, a user may unintentionally short multiple FIUs together. Bloomy's LabVIEW drivers contain a state manager that keeps track of the states of all channels in every FIU module in the system. When set to "Shared DMM", the drivers will ensure that, not only does each module have no more than one channel set to DMM measurement at a time, but also that the *entire system* has only one channel at a time.

1.2.2. Measurement and Fault States

It is important to note that the FIU cannot be set to a fault and a measurement mode simultaneously. When a new state command is sent to the FIU, the previous state is cleared. For example, if channel 1 is set to open circuit fault and then a voltage measurement command is sent to the FIU for channel 1, the channel will clear the fault and then be set to voltage measurement. The channel will not return to the fault state after the measurement is complete, unless explicitly told to.

1.3.   Input Values

Valid inputs for channel number are 1-24. Valid inputs for module number are 0-7 for RS-485 and 8-15 for CAN bus. Numbers outside of this range will result in an error and the command will be ignored. Also, if a module input does not match a box ID set in initialization, a similar error will occur.

2. Common Driver Functions

The following driver methods can be used by RS-485 or CAN bus protocols. The code adapts to the protocol used in initialization, however, the inputs and outputs of these functions are identical in either case.

2.1. Set Open Circuit Fault

When enabled, this method disconnects the specified channel, therefore creating an open circuit fault. Disabling a channel will connect the relay. (A channel will be put in a connected state before entering a measurement mode.)

Required Inputs: Channel (U32), Module (U32), Enable(T)/Disable(F) (Boolean)

Outputs: None

2.2. Set Open Circuit Fault All

This method connects or disconnects all channels in the FIU system. If using a single module, all 24 channels will be set to open circuit fault when enabled. If using multiple modules, all channels in every module in the system will be set to fault.

Required Inputs: Enable(T)/Disable(F) (Boolean)

Outputs: None

2.3. Set Short Circuit Fault

This method sets the specified channel to ground fault. It is important to note that only a single channel in the system can be set to ground fault or a measurement mode at a time. If the user attempts to set a ground fault while there is another channel on the bus, the driver will produce an error and the command will be ignored.

Required Inputs: Channel (U32), Module (U32)

Outputs: None

2.4. Set Voltage Measurement

This method connects the specified channel to a DMM for a cell voltage measurement. As with the short circuit fault, the drivers will not allow multiple channels to be set to ground or measurement at a time. If

attempting to connect multiple channels to the bus, the driver will error and the command will be ignored. It is also important to note that entering a measurement mode will clear any open circuit faults currently set on that channel. Previous faults will **not** be restored after using measurement mode.

Required Inputs: Channel (U32), Module (U32)

Outputs: None

2.5. Set Current Measurement

This method connects the specified channel to a DMM for bypass current measurement. As mentioned above, only a single channel can be set to ground or measurement mode in the system at a time. Attempting to set multiple channels to the bus will result in an error and the command will be ignored. Entering current measurement mode will clear the previous state of the channel. Previous faults will **not** be restored after using measurement mode.

Required Inputs: Channel (U32), Module (U32)

Outputs: None

2.6. Relay State

This method returns the state of all channels in an FIU module. The possible states are: Connected, Disconnected, Voltage Measurement, Current Measurement, and Fault to Ground. The values are returned as an array of enums.

NOTE: The channel numbers start at one, but the array indices are zero based. For example, to get the state of channel one, the user should index zero from the state array.

Required Inputs: Module (U32)

Outputs: System Status (Enum array)

2.7. Relay Contact Cycle Count

This method will return the number of cycles that each relay has undergone in a specified channel. Each channel has five relays, K1-K5.

Required Inputs: Channel (U32), Module (U32)

Outputs: Relay Count (Cluster of five U32 values)

NOTE: This function is not currently supported.

2.8.   Software Version

This method returns the version number of the software currently running on the specified FIU module. The version number follows the format XX.XX.

Required Inputs: Module (U32)

Outputs: Version (String)

2.9.   Interlock State

This method returns the state of the 24V interlock on the FIU. The default state is active. When active the interlock is controlling relays at 24V and when inactive it is set to 0V.

Required Inputs: Module (U32)

Outputs: Active(T)/Inactive(F) (Boolean)

2.10.   Interlock Override

This method allows the user to override the default interlock state. When override is enabled, the interlock is set to inactive. In the inactive state the interlock relays are forced to closed, therefore enabling BS1200 outputs. When interlock override is disabled (default), the relays are controlled by the 24V interlock signal.

Required Inputs: Enable(T)/Disable(F) (Boolean), Module (U32)

Outputs: None

3. RS-485

When using RS-485, the initialization and configuration functions are specific to this protocol. All action status functions are common and adapt to the initialized protocol.

3.1.   Open RS485

In order to initialize an RS-485 connection to the FIU you need to enter the VISA resource (i.e.- COM1) and an array of the box IDs in the system.

Required Inputs: VISA Resource Name, Box IDs (Array of U8)

Outputs: None

3.2.   Configure RS485 Settings

The settings method for RS-485 allows users to enable the "Shared DMM" safety feature for an FIU system. If using a single DMM across multiple FIU modules, Shared DMM should be set to true. This feature protects the system from shorting multiple FIU modules together. If using a single FIU module or have a dedicated DMM for each module, Shared DMM should be set to false. The shared DMM setting disables some state transitions when using multiple FIUs and should not be used unless necessary.

Required Inputs: Shared DMM (Boolean)

Outputs: None

3.3.   Close

This method can be used with RS-485 or CAN bus protocols. When using RS-485, the close method disconnects all channels and closes the VISA resource used to communicate with the FIU.

Required Inputs: None

Outputs: None

4. CAN

When using CAN, the initialization and configuration functions are specific to this protocol. All action status functions are common and adapt to the initialized protocol.

4.1. Open CAN

Loads the database file and specifies the CAN interface used to communicate with the FIU.

Required Inputs: CAN Interface (XNET Interface), XNET Database (XNET Database), Box IDs (Array of U8)

Outputs: None

4.2. CAN Settings

Set the FIU baud rate and specify whether a shared DMM is being used.

Required Inputs: Baud Rate (U64), Shared DMM (Boolean)

Outputs: None

4.3. Close

This method can be used with RS-485 or CAN bus protocols. When using CAN, the close method disconnects all channels before ending communication with the FIU.

Required Inputs: None

Outputs: None