



Battery Fault Insertion Unit Installation Manual



Bloomy Controls, Inc.

Part Number 8900-00006 V1.1

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Bloomy Controls, Inc., (Bloomy) provides products and services for battery test and simulation, delivering enterprise solutions for EVs, grid storage, and battery manufacturers; including OEMs, contract manufacturers, researchers, and test labs. Bloomy allows companies and organizations to increase productivity, improve quality, and reduce costs with automation.

FCC STATEMENT:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE:

Do not open the enclosure. This product contains no user-serviceable parts. Opening the enclosure will void the warranty.

Important Information



This symbol identifies messages in this document related to safety.



DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

Failure to follow the instructions given will result in death or serious injury.



WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

Failure to follow the instructions given can result in death or serious injury



CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.

Failure to follow these instructions can result in personal injury.

NOTICE

NOTICE alerts you to practices unrelated to personal injury, such as those that can cause property damage.

Failure to follow these instructions can result in property damage.

IMPORTANT

IMPORTANT indicates additional information about making effective use of this product.

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1. Introducing the Battery Fault Insertion Unit

The Battery Fault Insertion Unit (FIU) provides intelligent switching of cell-simulation channels for the Battery Simulator 1200. The switching capability enables simulation of open-circuit and short-to-rail fault conditions on any cell channel for the purposes of battery management system (BMS) testing. Additionally, a three-wire digital multimeter (DMM) output allows you to connect an external DMM instrument to any cell channel for very high-accuracy bypass current and cell voltage measurements. Each FIU provides 24 independently-programmable cell-switching channels for one or two 12-cell Battery Simulator 1200 units. Additional Battery Simulator 1200 and FIU instruments can extend functionality up to 120 series-connected cell channels.

1.1 Features

- 24 independently-programmable cell-switching channels
- RS485 and high-speed CAN (ISO 11898 compliant) control communication
- 600V channel-to-channel and channel-to-ground isolation
- NI LabVIEW™ drivers
- Stackable up to 120 channels

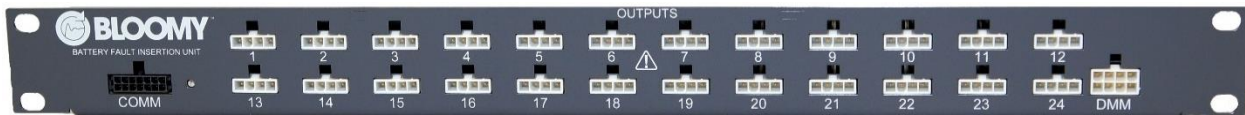


Figure 1: Front View of Battery Fault Insertion Unit

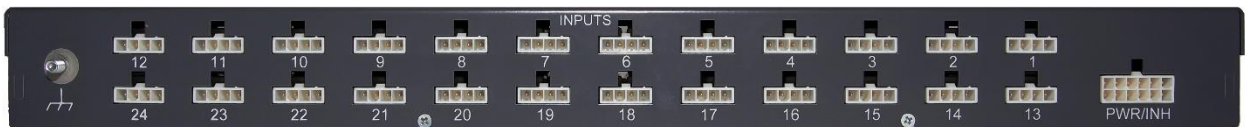


Figure 2: Rear View of Battery Fault Insertion Unit



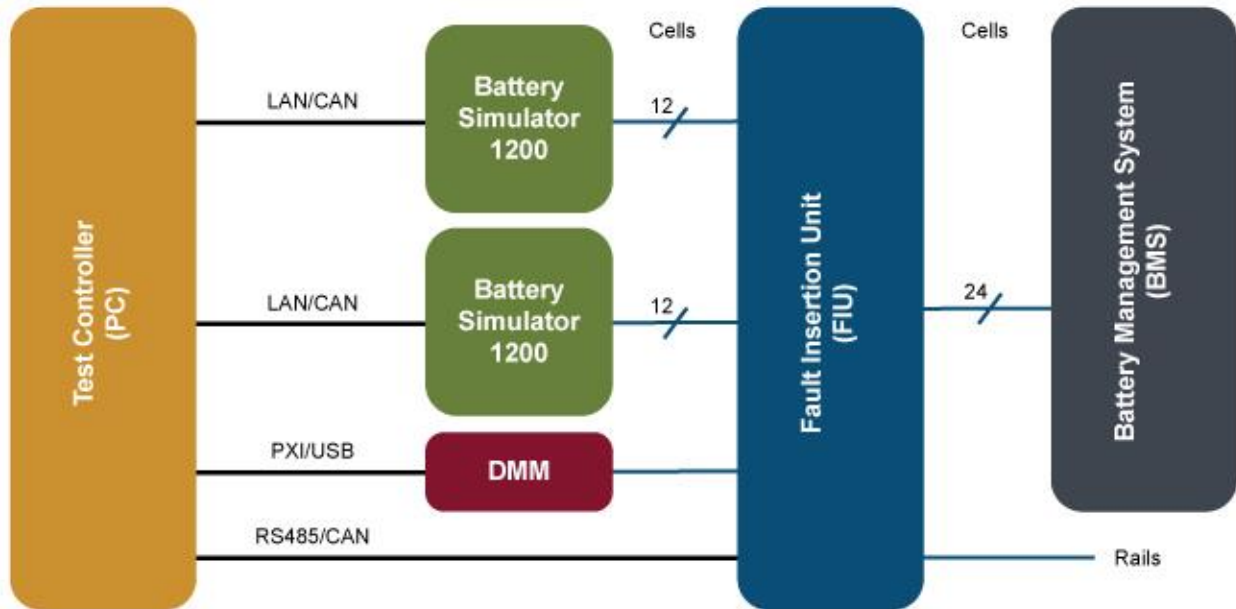
WARNING

Hazardous voltages can result from connecting outputs in series. Use extreme caution when connecting outputs in series.

Failure to follow the instructions given can result in death or serious injury

1.2 Application Example

Below is an example of integrating the FIU with two Battery Simulator 1200 units (24 channels) stacked together to simulate a multi-channel battery configuration capable of inserting open-circuit and short-circuit faults on each cell channel. Auxiliary IO is used to connect an external DMM for high-accuracy measurement, and a rail voltage for short-circuit fault insertion. A test controller provides communications to the unit and control of the hardware components.



Applications may include:

- Enhance Battery Simulator 1200 for automated BMS testing with fault insertion
- Connect external DMM for very high-accuracy cell measurements
- Perform open-circuit and short-circuit fault simulation
- Hardware-in-the-loop (HIL), validation, and end-of-line BMS testing

2. Installation

To install your Battery Fault Insertion Unit, follow the instructions below.

1. Mount the Battery Fault Insertion Unit in a 19-in. rack. It uses 1U of space. You can mount additional units above and below; no space is required between units.
2. Connect the chassis ground stud on the rear of the FIU to an appropriate system chassis ground point to ensure optimal EMC/EMI performance using 16AWG wire or greater.
3. Make wiring connections as needed (see Tables 1-5). The maximum recommended cable length for all cables is 3 meters (3.28 feet). **Note that the output pinouts (Table 2) are reversed relative to the input (Table 1 – which is also the same as the BS1200 pinouts) to provide a straight pass-through from the BS1200 through the FIU to the test equipment.**



CAUTION

DO NOT open the equipment enclosure. This product contains no user-serviceable components. Failure to follow these instructions can result in personal injury.

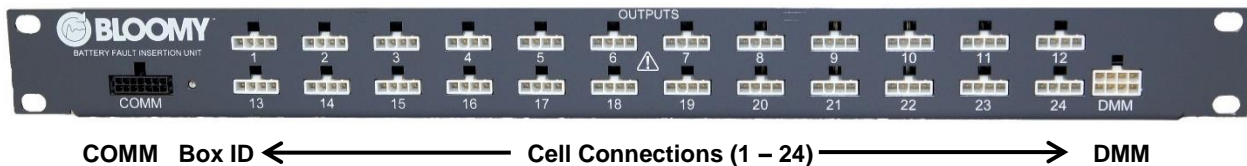


Figure 3: Front View of Battery Fault Insertion Unit

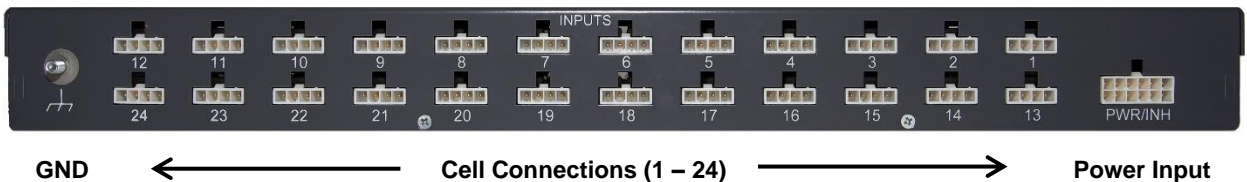


Figure 4: Rear View of Battery Fault Insertion Unit

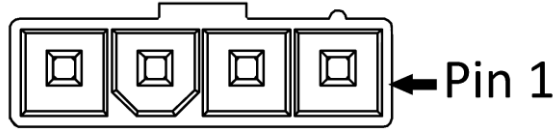


Table 1: Connections for Cells 1-24 (Front of Module)

Pin number	Signal
Pin 1	Sense+
Pin 2	Vout+
Pin 3	Vout-
Pin 4	Sense-

Cell Connection	Function
Vout +/-	Cell simulator output capable of both sourcing and sinking current
Sense +/-	Remote sensing of the Vout +/-signals

Connector: Molex 39-01-4041

Contact: Molex 39-00-0429 (18-24AWG, many other options available)

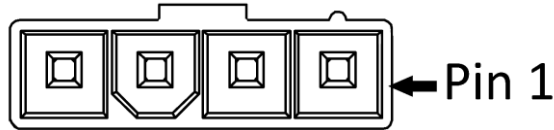


Table 2: Connections for Cells 1-24 (Back of Module)

Pin number	Signal
Pin 1	Sense-
Pin 2	Vout-
Pin 3	Vout+
Pin 4	Sense+

Cell Connection	Function
Vout +/-	Cell simulator output capable of both sourcing and sinking current
Sense +/-	Remote sensing of the Vout +/-signals

Connector: Molex 39-01-4041

Contact: Molex 39-00-0429 (18-24AWG, many other options available)

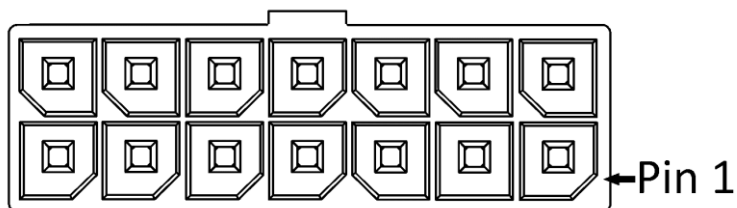


Table 3: COMM Connection

Pin number	Connection	Pin number	Connection
Pin 1	RS485 RX+	Pin 8	RS485 RX+
Pin 2	RS485 RX-	Pin 9	RS485 RX-
Pin 3	RS485 TX-	Pin 10	RS485 TX-
Pin 4	RS485 TX+	Pin 11	RS485 TX+
Pin 5	GND	Pin 12	GND
Pin 6	CAN+	Pin 13	CAN+
Pin 7	CAN-	Pin 14	CAN-

Cell Connection	Function
RS485 RX +/-	RS485 receiving connections
RS485 TX +/-	RS485 transmitting connections
CAN +/-	Controller area network connections
GND	Ground

NOTE: The duplication of pins 1-7 and pins 8-14 allow for multiple units to be daisy-chained together. If you are using a single unit, only pins 1-7 should be used.

Connector: Molex 43025-1400

Contact: Molex 43030-0008 (20-24AWG, many other options available)

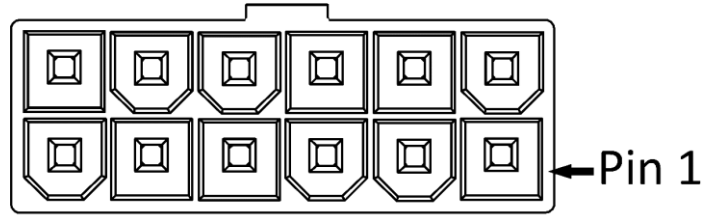


Table 4: PWR/INH Connection

Pin number	Connection	Pin number	Connection
Pin 1	24V Return	Pin 7	24V
Pin 2	Safety Out 1A	Pin 8	Safety Out 1B
Pin 3	Safety 2 GND	Pin 9	Safety 1 GND
Pin 4	Safety Out 2A	Pin 10	Safety Out 2B
Pin 5	Safety Return	Pin 11	Safety Return
Pin 6	Safety 24V	Pin 12	Safety 24V

Cell Connection	Function
24V	FIU Unit Power
24V Return	FIU Unit Power
Safety Out	Contact Bloomy for application usage details
Safety GND	Contact Bloomy for application usage details
Safety Return	Contact Bloomy for application usage details
Safety 24V	Contact Bloomy for application usage details

Connector: Molex 39-01-2125

Contact: Molex 39-00-0074 (18-24AWG, many other options available)

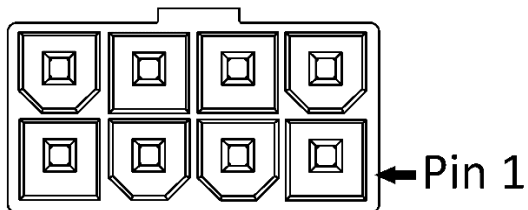


Table 5: DMM Connection

Pin number	Connection	Pin number	Connection
Pin 1	Rail Ref	Pin 5	Rail Ref
Pin 2	DMM HI(V)	Pin 6	DMM HI(V)
Pin 3	DMM LO	Pin 7	DMM LO
Pin 4	DMM HI(I)	Pin 8	DMM HI(I)

Cell Connection	Function
Rail Ref	A reference to the rail for short circuit faults
DMM HI(V)	DMM high for voltage measurements
DMM LO	DMM low
DMM HI(I)	DMM high for current measurements

NOTE: The duplication of pins 1-4 and pins 5-8 allow for multiple units to be daisy-chained together. If you are using a single unit, only pins 1-4 should be used.

Connector: Molex 39-01-2085

Contact: Molex 39-00-0074 (18-24AWG, many other options available)

Table 6: Box ID Reset Switch

Position	Description
0-7	Available Box IDs for RS-485 Communication
8-F	Available Box IDs for CAN Bus Communication

NOTE: To change the box ID of a unit, the unit must first be disconnected from power. The box ID position on power up will be the effective unit ID until the system is reset.

IMPORTANT

- Battery Fault Insertion Unit does not contain a CAN bus termination resistor.
- If needed, add CAN bus termination between the CAN signals at the COMM input.
- Provide a dedicated CAN network for your Battery Fault Insertion Units to avoid addressing conflicts.
- Battery Fault Insertion Unit does not contain an RS485 bus termination resistor.
- If needed, add RS485 bus termination between the RS485 signals at the COMM input.
- Provide a dedicated RS485 network for your Battery Fault Insertion Units to avoid addressing conflicts.

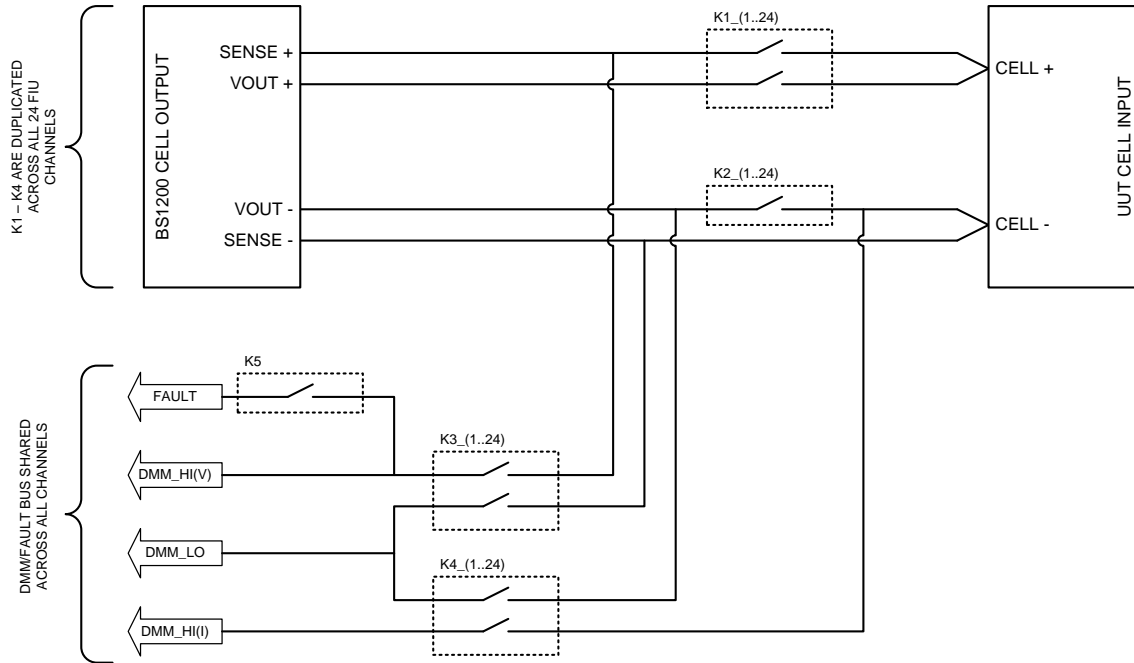
2.1 Wiring Remote Sense

When used with the BS1200, the wiring on the front of the FIU is the same as the wiring from the Battery Simulator. Please refer to the BS1200 Installation Manual for information about wiring the remote sense.

3. Topology

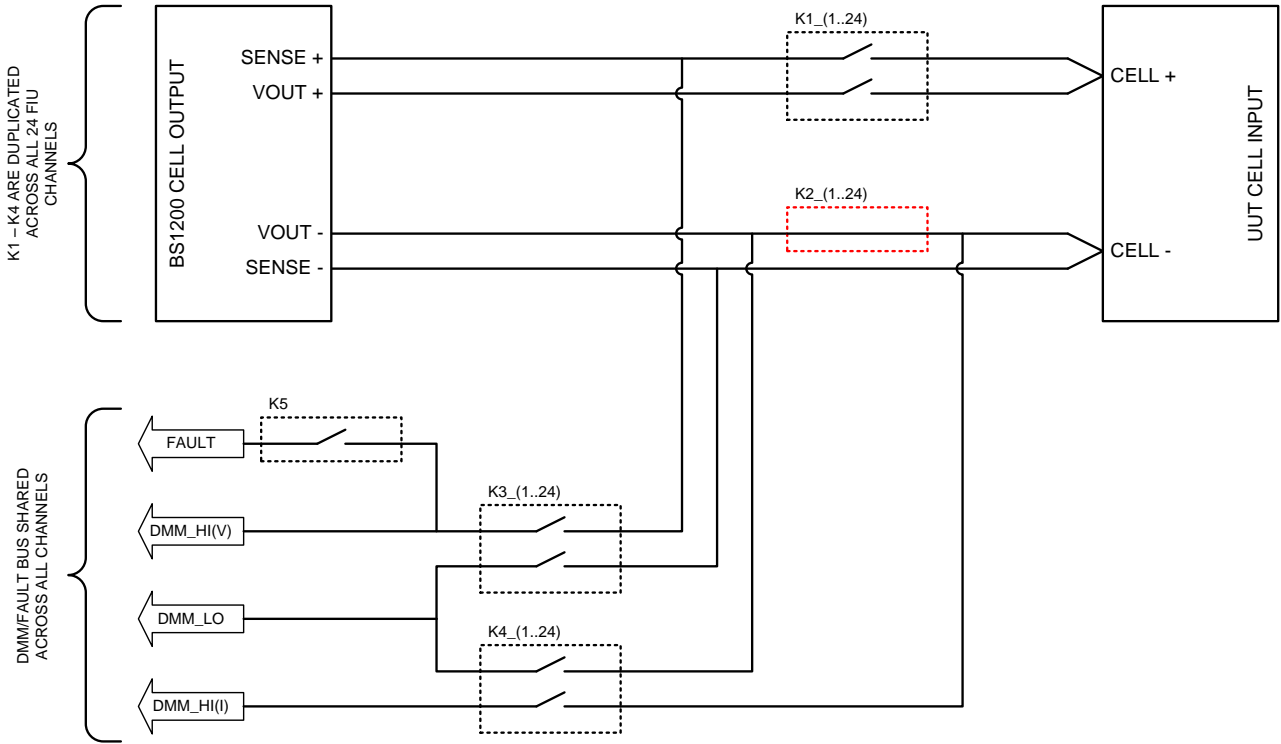
3.1 Reset State

At power-up, all relays contained in the FIU are in the open state as shown below. A short time later, all channels will be configured to “Disconnected” state. Relays K1 – K4 are present for each channel while relay K5 is a shared resource from the measurement bus. Total relays in the system is 97 ((K1 – K4 x 24) + K5).



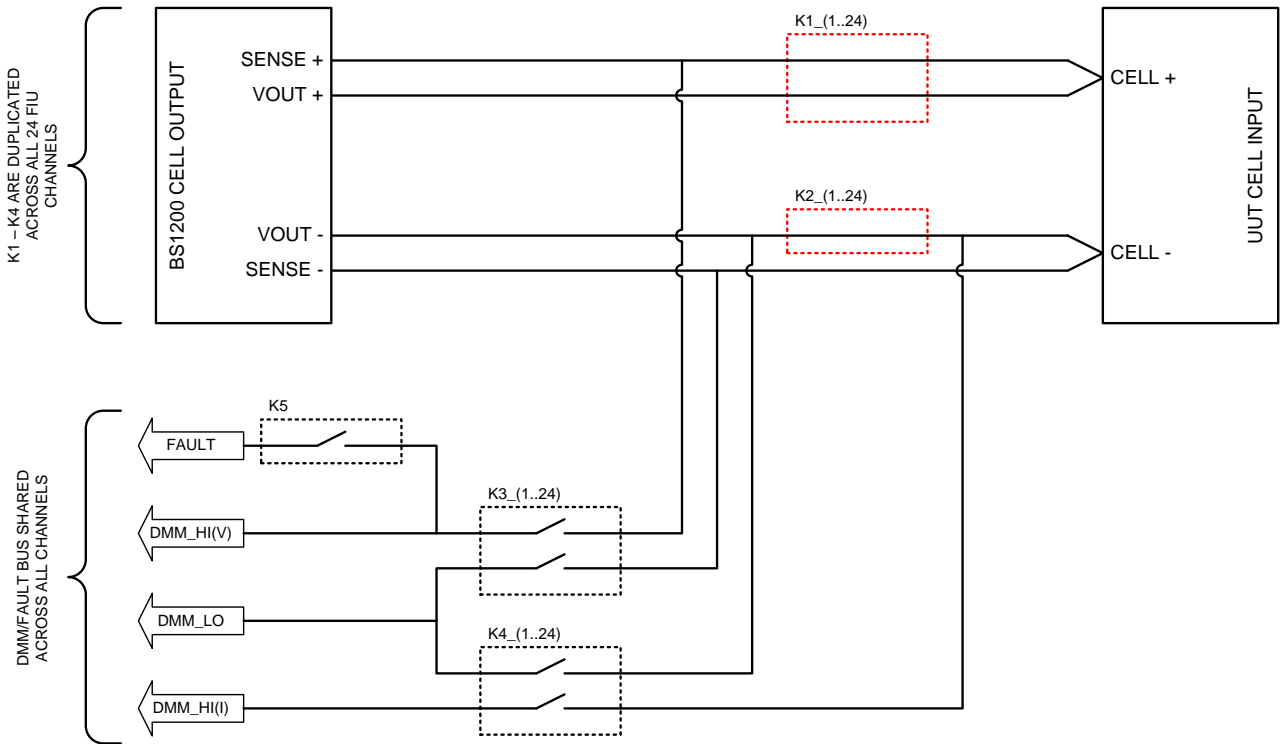
3.2 Disconnected State

In the disconnected state, the negative side of the BS1200 cell output is connected through the FIU while the positive side is disconnected. The diagram below shows how the relays are configured when in this state. As K5 is a shared resources, it may be closed if currently in use by a different channel.



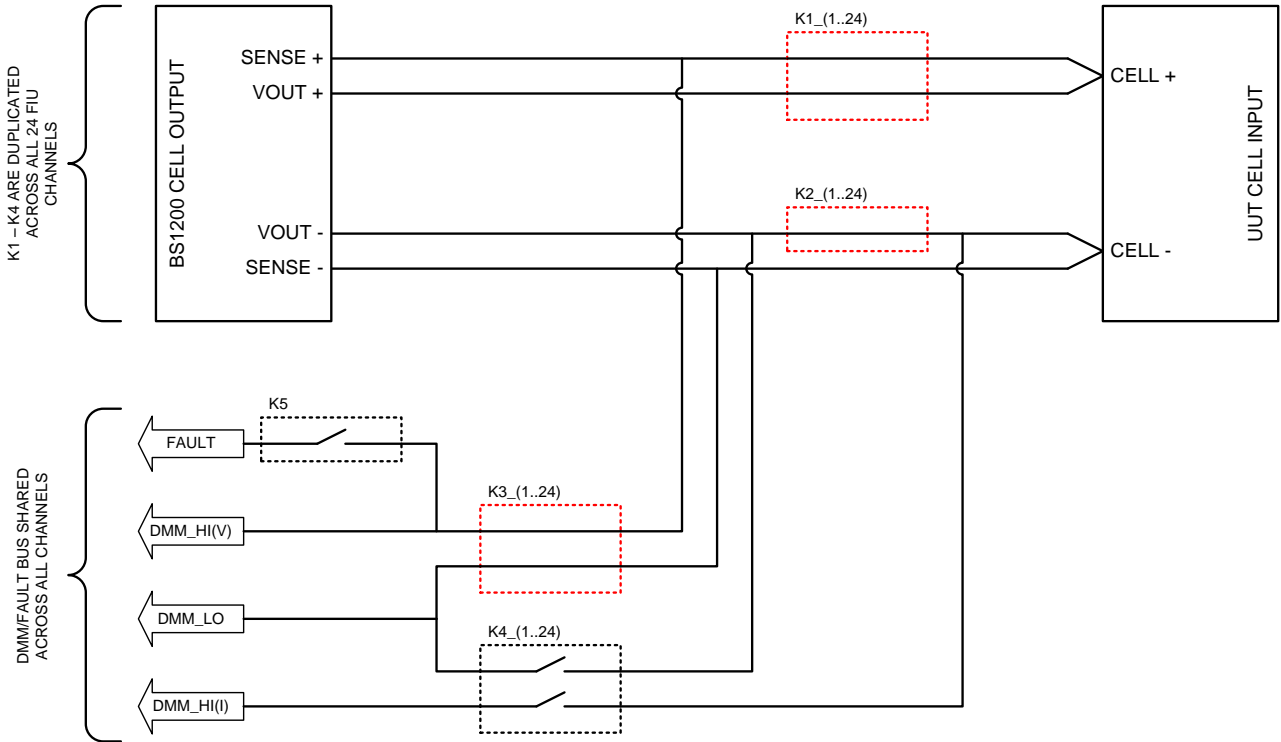
3.3 Connected State

In the connected state, both the positive and negative sides of the BS1200 are connected through the FIU. The diagram below shows how the relays are configured when in this state. As K5 is a shared resources, it may be closed if currently in use by a different channel.



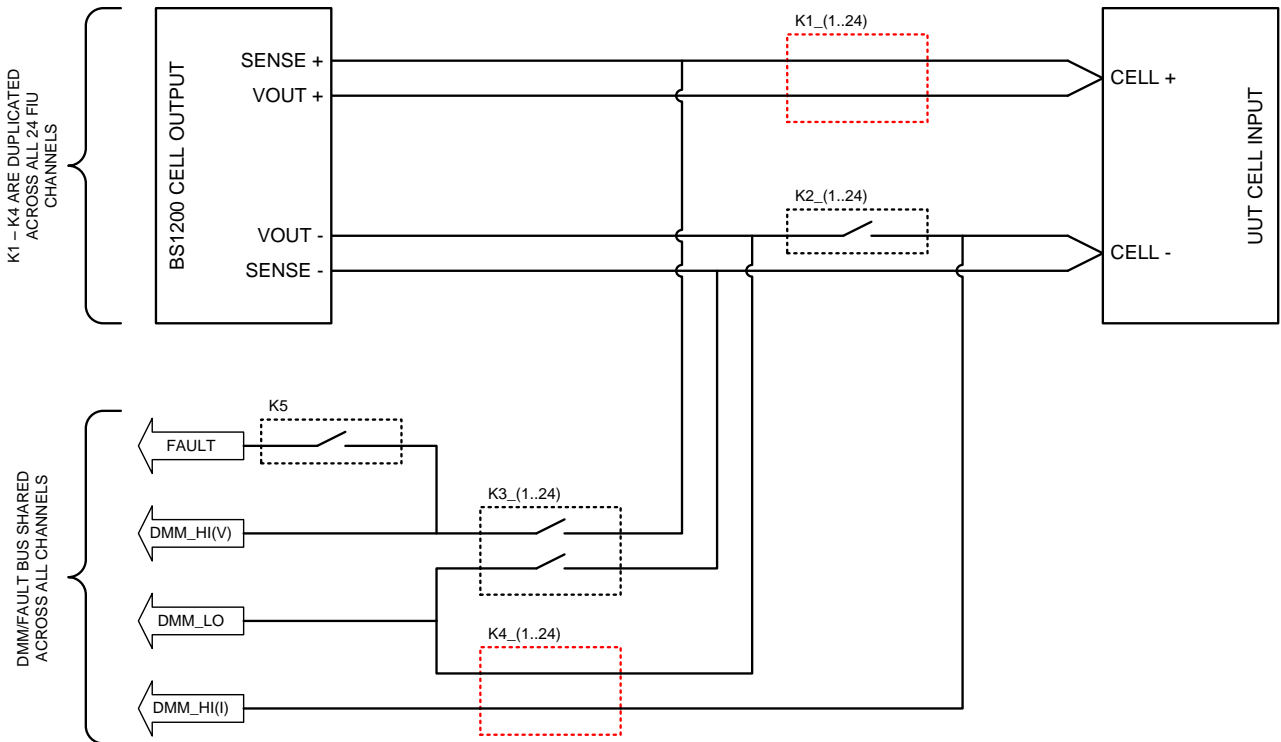
3.4 DMM Voltage Measurement State

In this measurement state, K3 is used to switch the sense lines from the selected channel to the DMM connector. Care must be taken to ensure no other channels are using the DMM or K5/Fault line in order to prevent cells from being shorted together.



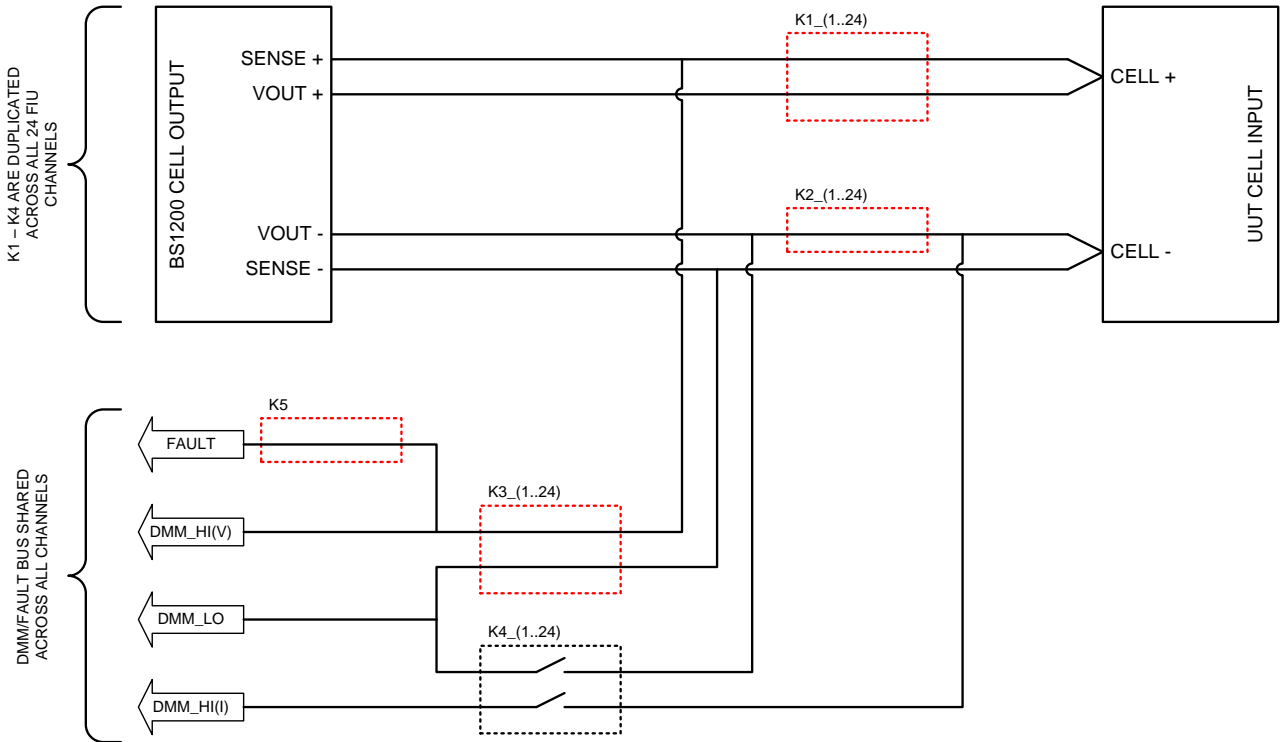
3.5 DMM Current Measurement State

In this measurement state, K2 is opened and K4 is closed in order to route current through an external DMM. The FIU sequences these relays in order to prevent the UUT from seeing an open/disconnected state. When entering this state K4 will be closed prior to K2 opening. The reverse process takes place when leaving this state. Care must be taken to ensure no other channels are using the DMM or K5/Fault line in order to prevent cells from being shorted together.



3.6 Ground Fault State

In this state, the relays are configured in a fashion similar to the “DMM Voltage Measurement State” with the exception of K5 that is closed. This allows the user to generate a short to GND or other reference by connecting the fault line externally as needed. Care must be taken to ensure no other channels are using the DMM or K5/Fault line in order to prevent cells from being shorted together.



4. Specifications



CAUTION

If the Battery Fault Insertion Unit is used in a manner inconsistent with the instructions or specifications listed by Bloomy Controls, the FIU may operate improperly and the protective features of this product may be impaired.

Note: All specifications subject to change.

4.1 Electrical Specifications

Input Power	24 VDC, 2A
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4.2 Fault Insertion and Switching

Number of Channels	24
Current per channel	500 mA
Relay Type	Reed / Non-latching
Voltage Isolation	600 VDC
Maximum Switch Power per Channel	100 W
Fault Path Resistance	100 Ω

4.3 Control Specifications

Communication	RS485 and CAN
Drivers	NI LabVIEW™

4.4 Physical Specifications

Dimensions	19" W x 1.75" H x 4.5" D (1U) (482.6 mm W x 44.5 mm H x 114.3mm D)
Weight	4 lb (1.8 kg)
Operating Temperature	0 to 35° C
Altitude	9842 ft (3000 m), maximum
Pollution Degree	PDX1

5. Maintenance

5.1 Cleaning Instructions

To clean your Battery Fault Insertion Unit, follow these steps:

1. Disconnect the unit from power.
2. Clean with a damp cloth.

6. Revisions

Rev	Date	Description	Originator	Approver
1.0	10/31/2016	Initial Release	Taylor Donahue	S. Hoenig
1.1	6/28/2019		Paul Tortora	G. Gothing