



**CIE SOLUTIONS**



**Lithium Block™ RP User Manual**

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# 1. Introduction

Thank you for your interest in the Lithium Block™ module from CIE Solutions. Prior to handling, we ask that you familiarize yourself with this manual in order to achieve a safe and successful integration.

## 2. Safety

Batteries are dangerous and must be installed, configured, and operated properly. Even though Lithium Block™ modules are proven to be in good working order prior to shipment, they may fail due to improper handling, installation, configuration, or usage. Battery failure may create a risk of property damage and serious to fatal injury. Failure to adhere to these policies may result in the system warranty being voided prematurely. For your safety, please adhere to the general safety guidelines that follow:

- Only appropriately trained personnel should operate, maintain, or configure batteries.
- Only operate the system within the specified temperature range. Operating the system outside of this range could permanently damage the cells. If the batteries meet or exceed this temperature range, external heating/cooling must be used to return the system to acceptable temperatures.
- Never assume that power has been disconnected to any portion of the system.
- Before beginning operation or service, inspect the working area for any possible environmental hazards such as puddles, ungrounded extension cords, or frayed wires.
- Remain vigilant for any signs of failure such as burning smells, unexpected noises or odors, or fault conditions.
- Do not alter or disassemble the battery module.
- Do not use the battery for any unintended purposes.
- Use caution when moving battery modules or enclosures.
- Be aware of high voltage connections; ensure all connections are secure.
- Do not allow uncertified individuals to handle battery modules.
- Dispose of system in accordance with all local, state, and federal laws and regulations

For this document the following hazard convention will be used:

**DANGER:** Indicates a hazardous situation or action which, if not avoided, will result in death or serious injury.

**WARNING:** Indicates a hazardous situation or action which, if not avoided, could result in death or serious injury.

**CAUTION:** Indicates a situation which, if not avoided, could result in minor or moderate injury.

If you require further assistance or have any questions, please contact the Customer Assistance Center at CIE Solutions:

Email: [info@cie-solutions.com](mailto:info@cie-solutions.com)

Phone: (720) 414-5502

## 2.1 General Hazards

**DANGER:** Never operate the device in standing water, submerged in water, or any other conditions that may introduce water into the system.

**DANGER:** Always wear appropriate PPE (Personal Protective Equipment) when working around high voltage systems. PPE can include but is not limited to insulated glasses or face shields, high voltage rated gloves, insulating equipment covers to minimize unintended contact with live surfaces, insulated tools, safety shoes, and/or gas masks in the event that battery modules are damaged to the point of potential vapor exposure.

**WARNING:** Maintenance should only be performed by an authorized technician. Visually inspect prior to each use to ensure no significant damage has been inflicted to the unit that may compromise safe operation.

**WARNING:** Device is considered general use and is not intended for use by underage children, supervised or otherwise.

**WARNING:** Do not operate the unit under the influence of alcohol, narcotic drugs, or other self-administered intoxicants or drugs.

**WARNING:** Do not sit on or place other objects on battery modules.

**CAUTION:** System should be installed on a level surface away from excessive moisture, dirt, dust, or corrosive liquids or vapors.

## 2.2 Electrical Hazards

**DANGER:** Ensure correct polarity with HV and LV connectors when interfacing with the system.

**DANGER:** When integrated into a system, this device produces lethal voltages. Do not attempt to insert any foreign objects such as fingers, tools, etc... near any conductive surfaces.

**DANGER:** Do not attempt to open, repair, or modify this device. Contact CIE Solutions for any repair requirements.

**WARNING:** Do not attempt to use this module without a battery management system.

# 3. General Module Information

## 3.1 Understanding Your Part Number

There are 36 different Lithium Block™ part numbers. The part number convention is as follows:

**LBG(n)-(xx)(y)RP**

**LB**= Lithium Block. These are the first two designators for all lithium block products.

**G(n)**= Lithium Block product generation designator. This will be G1 for legacy lithium blocks (without PCBs), G1.5 for legacy lithium blocks with thermistors included, or G2 for the second generation lithium blocks (with PCBs).

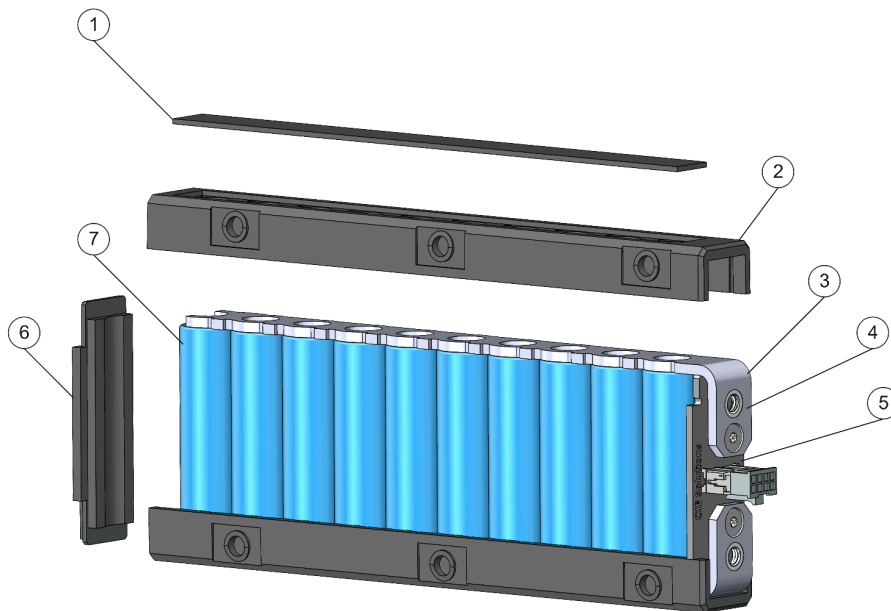
(xx)= The parallel configuration designator. Lithium blocks are available in 5p-10p configurations. For example, these two figures would be “06” for a 6p module.

(y)= Cell type designator. E for energy modules and P for power modules.

As an example, the module pictured on page 1 of this manual is a second generation module with 10 energy cells in parallel . That module’s part number is LBG2-10ERP. If you are unsure of your part number. Contact CIE Solutions with your module serial number for clarification.

### 3.2 General Module Information

For the purpose of this manual, the subcomponents of the Lithium Block™ module will be referred to by the terms outlined below in Figure 3.21.



ID	Description	PN	Qty per Module	Matl
1	Black Bond Cover	22105008	2	UL94 V-0 ABS (~34 kV/mm Dielectric Strength)
2	Black Side Cover	22105004	2	UL94 V-0 ABS (~34 kV/mm Dielectric Strength)
3	Collector Plate	22102096	2	EN Plated Alu
4	Bus Bar Mounting PEM		2	300 Series SS
5	PCBa	23048003	1 for Gen II 0 for Gen I	FR4 PCB
6	Bottom Cover	22105005	1	UL94 V-0 ABS (~34 kV/mm Dielectric Strength)
7	Battery Cell		5-10	n/a

Figure 3.21: Lithium Block™ Subcomponent Identification

When ordering a Gen II Lithium Block™, you will also receive the opposing end of the electrical connector and the necessary contacts with your shipment. Bus bars and bus bar fasteners are not included with a Lithium Block™ purchase and must be purchased separately. More general information about the Lithium Block™ can be found in Table 3.22 below.

Table 3.22: General Module Information

	Power RP	Energy RP
<b>Battery Cell PN</b>	Molicel P28a	Molicel M35a
<b>Bonding Wire</b>	500µm >99.997% Alu	300µm >99.997% Alu
<b>PCB Conformal Coating</b>	Urethane	Urethane
<b>Construction Material</b>	UL94 V-0 ABS	UL94 V-0 ABS
<b>Thermal Gap Filler</b>	<1mm 3M DP 125	<1mm 3M DP 125
<b>Electrical Conductor Spacing Standard</b>	IEC 60664	IEC 60664
<b>PCB Standards (where applicable)</b>	IPC Class II	IPC Class 2
<b>Cell Jacket Material</b>	PET	PET
<b>Cell Insulator Ring Material</b>	PC	PC
<b>Maximum System Voltage</b>	500VDC	500VDC
<b>Approximate Wire Bond Fuse Rating</b>	58A	30A

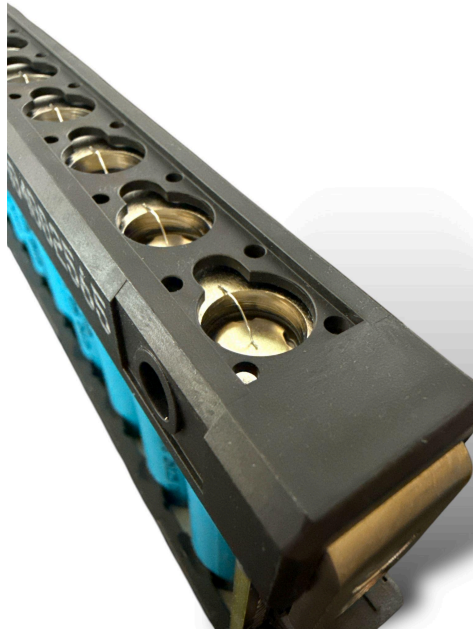


Figure 3.23: Image of Bonded Cell Connections

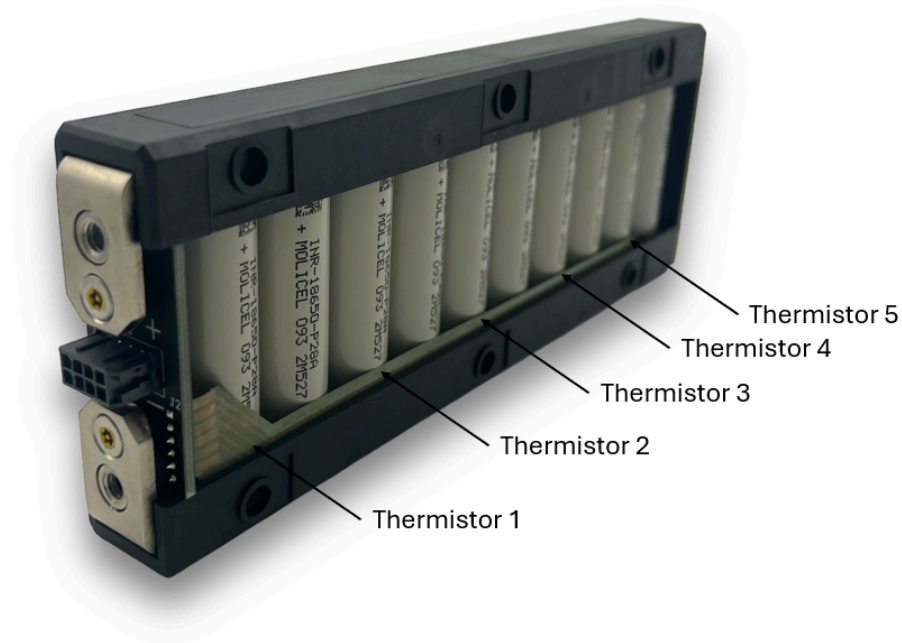


Figure 3.24: Image of Thermistor Locations

### 3.3 More Information on Cell-Level fusing

Cell-level fusing is achieved in every Lithium Block via ultrasonic wire bonds. Each cell is ultrasonically wirebonded on both the cathode and anode. The average fusing current for power modules is 57.8A and the median fusing current is 58.8A. These figures are experimentally derived. These fuses are not voltage-rated. Due to this, formula SAE teams are advised to size the pack fuse at  $\frac{1}{3}$  of the cumulative fusing current for the module ( $58A * \text{number of cells}$ ) as noted in EV.6.6.5 in the fSAE rulebook.

## 4. Specifications

### 4.1 Mechanical

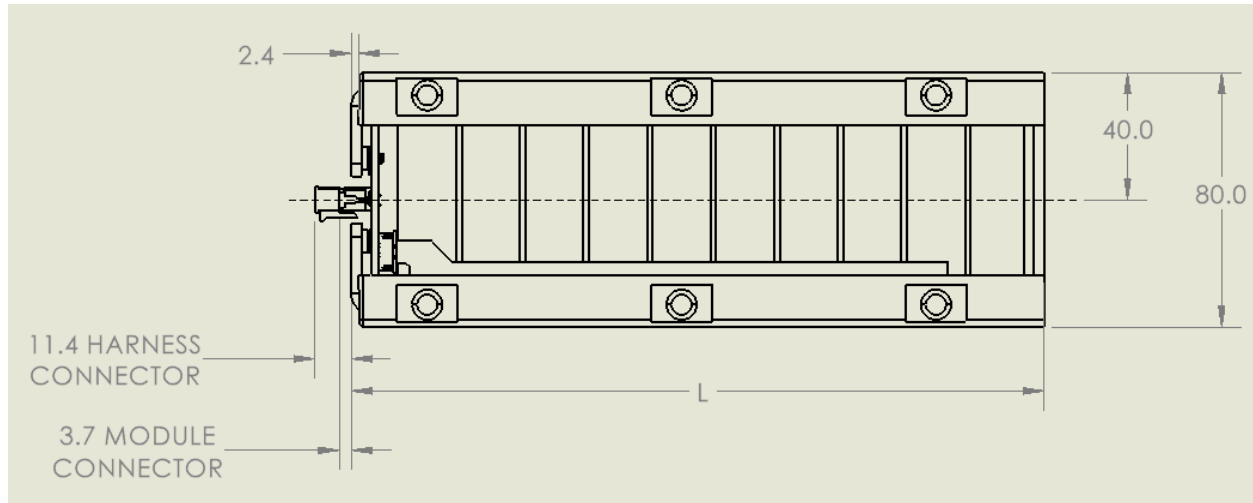


Figure 4.11: Lithium Block Gen II Mechanical Drawing

	5P	6P	7P	8P	9P	10P
<b>Dim L [mm]</b>	118.4	138.4	158.5	178.5	198.6	218.7

\*STEP files of each module variation can be downloaded at the CIE Solutions website.

### 4.2 Electrical Specifications for Energy Module

Table 4.21: Energy Module Electrical Specifications

	5PE	6PE	7PE	8PE	9PE	10PE
<b>Energy Capacity (nom) [Wh]</b>	63.0	75.6	88.2	100.8	113.4	126.0
<b>Charge Capacity (nom) [Ah]</b>	17.5	21.0	24.5	28.0	31.5	35.0
<b>Charge Capacity (min)</b>	15.8	18.9	22.1	25.2	28.4	31.5
<b>V(max) [VDC]</b>	4.2	4.2	4.2	4.2	4.2	4.2
<b>V(nom) [VDC]</b>	3.6	3.6	3.6	3.6	3.6	3.6
<b>V(min) [VDC]</b>	2.5	2.5	2.5	2.5	2.5	2.5
<b>Max Charge Current [A]</b>	8.5	10.2	11.9	13.6	15.3	17
<b>Max Discharge Current [A]</b>	50	60	70	80	90	100
<b>Charge Temperature Range [°C]</b>	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60	0 to 60
<b>Discharge Temperature Range [°C]</b>	-40 to 60	-40 to 60	-40 to 60	-40 to 60	-40 to 60	-40 to 60

Note that the nominal performance data above is an extrapolation of nominal cell performance values. Values in the field may differ due to temperature and discharge characteristics or system



inefficiencies. Typical field capacity is expected to be 94%~98% of the above values. To achieve maximum performance, conduct a qualified charge of the module by using a CC-CV charging profile that charges to 4.2V with a charge cutoff at 100mA/cell. More cell-level performance information is available in the figures below.

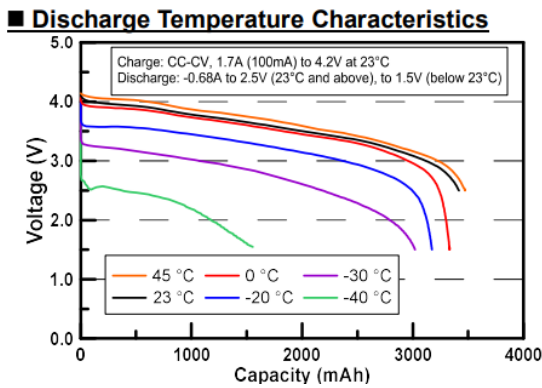


Figure 4.22: Discharge Temperature Characteristics of MoliceL M35A

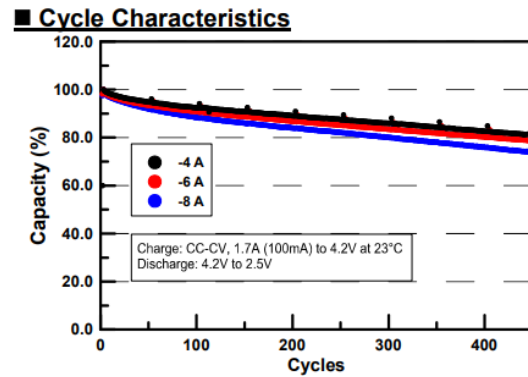


Figure 4.23: Cycle Characteristics of MoliceL M35A

### 4.3 Electrical Specifications for Power Module

Table 4.22: Power Module Electrical Specifications

	5PP	6PP	7PP	8PP	9PP	10PP
<b>Energy Capacity (nom) [Wh]</b>	50.4	60.5	70.6	80.6	90.7	100.8
<b>Charge Capacity (nom) [Ah]</b>	14.0	16.8	19.6	22.4	25.2	28.0
<b>Charge Capacity (min)</b>	12.6	15.1	17.6	20.2	22.7	25.2
<b>V(max) [VDC]</b>	4.2	4.2	4.2	4.2	4.2	4.2
<b>V(nom) [VDC]</b>	3.6	3.6	3.6	3.6	3.6	3.6
<b>V(min) [VDC]</b>	2.5	2.5	2.5	2.5	2.5	2.5
<b>Max Charge Current [A]</b>	30	36	42	48	54	60
<b>Max Discharge Current [A]</b>	100	100	100	100	100	100
<b>Charge Temperature Range [°C]</b>	0°C-60°C	0°C-60°C	0°C-60°C	0°C-60°C	0°C-60°C	0°C-60°C
<b>Discharge Temperature Range [°C]</b>	-40°C-60°C	-40°C-60°C	-40°C-60°C	-40°C-60°C	-40°C-60°C	-40°C-60°C

Note that the nominal performance data above is an extrapolation of nominal cell performance values. Values in the field may differ due to temperature and discharge characteristics or system inefficiencies. Typical field capacity is expected to be 94%~98% of the above values. To achieve maximum performance, conduct a qualified charge of the module by using a CC-CV charging profile that charges to 4.2V with a charge cutoff at 100mA/cell. More cell-level performance information is available in the figures below.

■ Discharge Temperature Characteristics

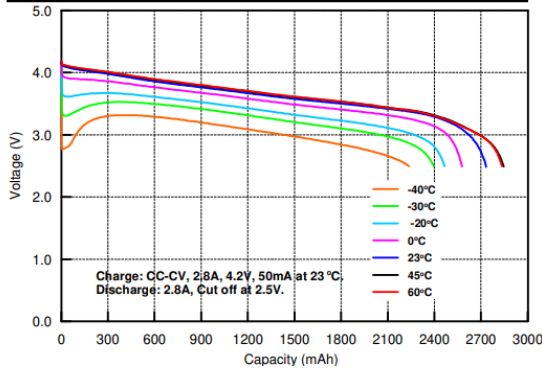


Figure 4.32: Discharge Temperature Characteristics of Molicel P28A

■ Cycle Characteristics

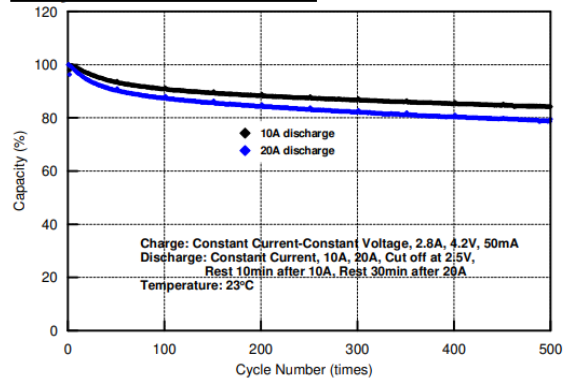


Figure 4.33: Cycle Characteristics of Molicel P28A

## 5. System Integration

### 5.1 Mechanical Integration

In order to ensure safety in the field, only integrate Lithium Block™ modules into applications according to the following integration requirements. Lithium Block™ modules can be integrated into a system in any orientation. For ease of assembly, it is generally recommended to orient the bus bar interface up. Bus bars should be installed using threadlocker 243 (stick not liquid). Bus bars are to be torqued to 5.5Nm.

### 5.2 CIE Module Assembly Kit

It is a recommendation of CIE, but not a requirement, to purchase our segment assembly kit. This kit has been engineered to ensure ease of integration and success in the field. An example of a segment kit can be found below in figure 5.21.

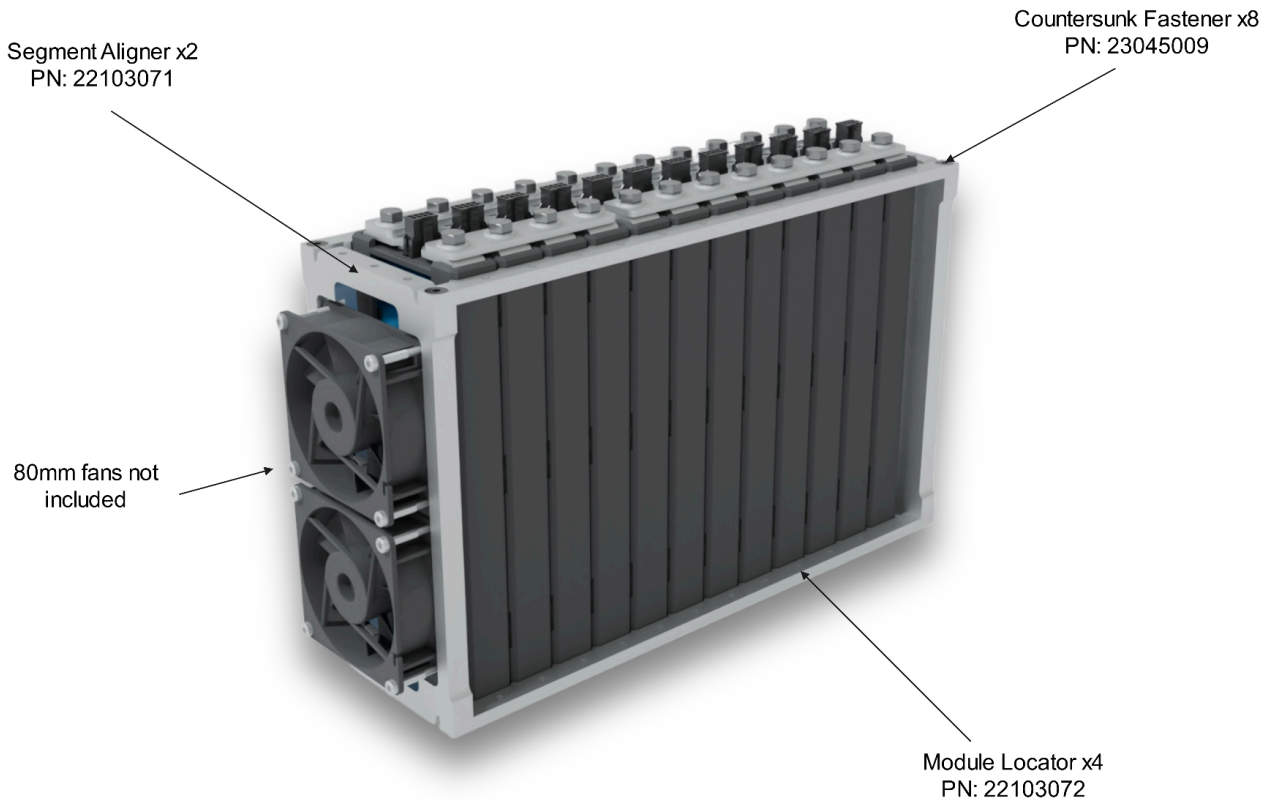


Figure 5.21: Lithium Block™ Segment Assembly

## Design Considerations for Custom Pack Assemblies

If you do, however, choose to design and manufacture your own segment assembly, the following recommendations need to be considered. The standard bus bar hole spacing is 25.5mm as seen below in Figure 5.12.

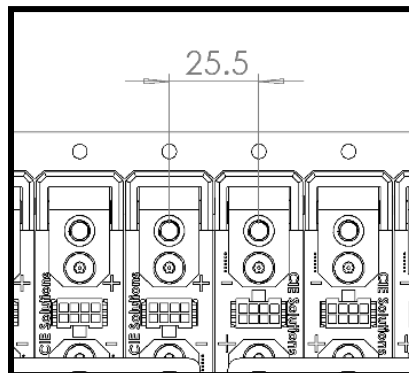


Figure 5.12: Standard busbar hole spacing

### Creepage and Clearance

When designing your battery pack system, it is important to ensure proper conductor spacing.

### Cell Failure Considerations

Cell failures can be caused by many factors such as external puncture and overheating. In the case of a cell failure, it is important to ensure that a single cell is able to vent without propagating the failure to any neighboring cells. In order to ensure this, please consider the following:

1. Vent path spacing: The segment assembly design above allows for ~11.5mm of vent gas spacing above the side cover of the module. Allow a minimum of 11.5mm of unimpeded vent gas expansion area above each cell.

## 5.3 Electrical Integration

### High Voltage System

It is recommended, but not required, by CIE solutions to purchase bus bar kits to ensure materials compliance. In the case that you don't purchase the CIE solutions bus bar kit, be sure to consider the following:

1. Materials Compliance: Be aware that interfacing with dissimilar materials along the high voltage current pathway can lead to corrosion, and eventually, increased conductor resistance.
2. Fastener Preload: Ensure that the fasteners connecting the bus bars to the module are able to compensate for thermal expansion and maintain proper preload.
3. Conductor Cross-Section: To keep conductor heating below a safe threshold, be sure to consider material ampacity and cross-sectional area.

**WARNING:** Lithium Block™ modules are never to be used in a system without the presence of an additional, pack-level fuse. The maximum fuse rating of the pack-level fuse must be less than 120% of the cumulative parallel module rating.

### Low Voltage System

The pinout for the module connector is below.

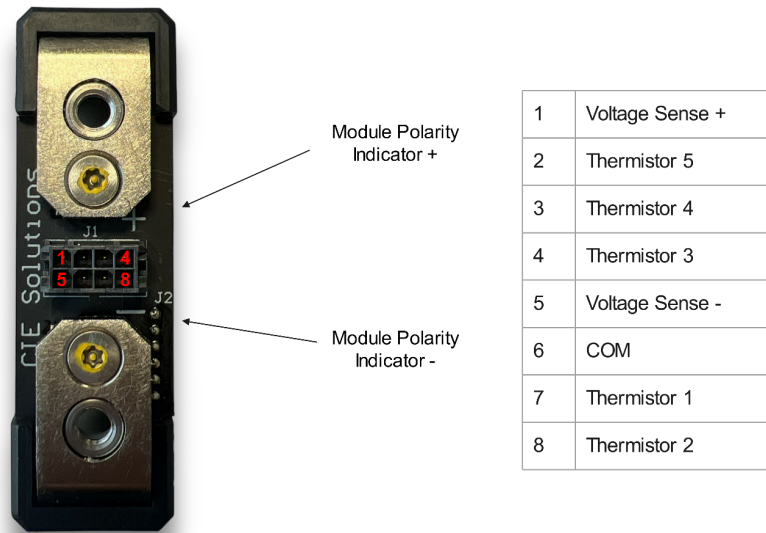


Figure 5.13: Module Polarity and I/O Pinout

Table 5.22: Gen II PCB specifications

Thermistor Resistance	10kΩ NTC
Thermistor β Value	3380 K
Thermistor Tolerance	0.5%
Maximum Thermistor Voltage	5V
Voltage Sense Fuse	200mA (resettable) [PN: 0ZCK0020FF2G]
Connector PN	Molex 430450812
Mating Connector PN	Molex 43025-0800
Crimp PN for Mating Connector	43030-0007
Bus Bar Mounting Thread Class	M6 x 1mm
Voltage Sense unfused lead length	<10mm

## 5.4 Operation

Lithium Block™ should never be used without a battery management system. All systems must be able to monitor cell temperature, monitor cell voltage, monitor current, and modulate current based on monitored cell values.

## 6. FAQ

### 1. I have accidentally short-circuited my module and I am now reading 0V. What should I do?

If your module is reading 0V, this is an indication that the ultrasonic wire bonds have been blown due to the short circuit event. Unfortunately, Lithium Block™ modules are not reworkable. In this case, you will need to order another module to replace the damaged module.

### 2. I am building a pack with Gen II Lithium Blocks. What is included in my order?

Your order will come with the module as pictured in Figure 3.01. Included in your delivery will also be the opposing connector and contacts. To make a complete system, you will need to either purchase or segment chassis, bus bars, and all of the necessary electrical components such as BMS, connectors, MSD, etc.

### 3. Can I use this module to replace my 12V/24V battery system in my vehicle?

Yes, but be aware that these modules must be used in conjunction with a battery management system.

## 7. Warranty

### 1. Warranty Coverage

CIE Solutions (“CIE”) warrants that each Lithium Block battery module (“Product”) will be free from defects in workmanship under normal use for a period of one (1) year from the original purchase date (“Warranty Period”). This warranty covers the workmanship and assembly of the module only and does not extend to the individual battery cells contained within the module, which are covered under the respective Original Equipment Manufacturer’s (OEM) warranty. This warranty is extended only to the original purchaser of the Product and is not transferable.

### 2. Warranty Limitations and Exclusions

This Warranty does not cover:

- OEM Battery Failures: Defects, malfunctions, or performance issues related to the individual battery cells must be addressed with the respective OEM. CIE assumes no liability for cell performance or lifespan and advises customers to review the OEM’s specific warranty terms.
- Operation Without Battery Management System (BMS): This warranty is void if the Lithium Block module is operated without an appropriate battery management system (BMS) capable of monitoring cell temperature, voltage, and current, as well as modulating current as needed based on monitored values.
- Environmental Conditions: This warranty does not cover damages resulting from the operation of the Product in environments with excessive moisture, dirt, dust, corrosive

liquids, or vapors. Additionally, the Product must not be operated in standing or submersed water. Operation outside of the specified temperature range (0°C–60°C for charging and -40°C–60°C for discharging) will void this warranty.

- High-Stress or Competitive Use: This warranty does not cover damages resulting from high-stress or competitive usage scenarios that exceed recommended operational conditions, including any form of experimental or abusive testing.
- Improper Use or Unauthorized Modifications: Any misuse, tampering, or unauthorized modifications invalidate this Warranty. This includes subjecting the Product to extreme temperatures, over-voltage, or over-current conditions beyond the recommended specifications.
- Unauthorized Repairs or Alterations: Any attempt to open, repair, or modify the Product by anyone other than an authorized technician will void this warranty. For any repair requirements, please contact CIE.
- Improper Installation or Maintenance: Damage due to installation, handling, or maintenance inconsistent with CIE's guidelines, whether by professional or non-professional personnel are excluded. External Causes and Acts of Nature: Damages resulting from external causes, including accidents, impacts, fire, flood, or other acts of nature, are not covered.

### **3. Usage Requirement for Certified Personnel**

This warranty is valid only if the Product is operated, maintained, and configured by appropriately trained personnel. Any use by uncertified individuals voids this warranty.

### **4. Adherence to Safety Guidelines**

Users must adhere to all safety guidelines specified in the Lithium Block™ User Manual. Failure to comply with safety warnings, including proper handling of high-voltage connections, ensuring correct polarity, and avoiding foreign objects near conductive surfaces, will void this warranty.

### **5. Warranty Claim Process**

To make a warranty claim, the original purchaser must contact CIE at [sales@cie-solutions.com](mailto:sales@cie-solutions.com) and provide proof of purchase. The Product must be returned to CIE, shipping prepaid, for inspection. CIE is not responsible for any costs associated with removal, reinstallation, or shipping of the Product.

### **6. Disclaimer of Warranties**

This Warranty is the sole and exclusive warranty provided by CIE. Except as expressly stated, CIE disclaims all other warranties, express or implied, including, without limitation, implied warranties of merchantability, fitness for a particular purpose, and non-infringement. No oral or written information or advice given by CIE or its representatives shall create any other warranty or extend the terms of this Warranty in any way.

### **7. Limitation of Liability**

To the fullest extent permitted by law, CIE shall not be liable for any indirect, incidental, special, consequential, or punitive damages of any kind, including but not limited to loss of profits,

business, use, or other economic advantage, regardless of the form of action, whether in contract, tort (including negligence), strict liability, or otherwise, even if advised of the possibility of such damages. CIE's total liability under this Warranty shall not exceed the purchase price paid for the Product.

**8. Indemnification**

The purchaser agrees to indemnify, defend, and hold harmless CIE, its affiliates, officers, directors, employees, and agents from any and all claims, damages, liabilities, losses, and expenses (including attorneys' fees) arising out of or in connection with the purchaser's failure to adhere to the operational and safety guidelines as outlined in the Lithium Block™ User Manual.

**9. Governing Law and Venue**

This Warranty and any disputes arising under it shall be governed by and construed in accordance with the laws of the State of Colorado. The venue for any legal proceedings related to this Warranty shall be exclusively in the state or federal courts located in Denver, Colorado.

Previous Version (Release Date)	G (03/24/2025)
Current Version (Release Date)	H (04/09/2025)