JST POWER EQUIPMENT

J3MAG™ Control Module

PRODUCT MANUAL

Revision E

Switchgear Solutions

Table of Contents

Safety Precautions

WARNING: FOLLOW BASIC PRECAUTIONS TO REDUCE ELECTRICAL SHOCK, FIRE, INJURY AND EXPLOSION HAZARDS:

- **DO NOT attempt to service, modify, or repair the module unless you are a qualified and properly trained professional.**
- **ALWAYS disconnect the power supply and verify zero voltage on the capacitor before servicing or handling the module.**
- **DO NOT expose the module to moisture, liquids, or flammable substances.**
- **AVOID contact with live components and wiring.**
- **ENSURE proper grounding and secure installation before operating the system.**
- **Failure to follow these precautions may result in electrical shock, burns, fire, or equipment damage.**

This Electrical Control Module contains high-voltage components, and circuits that pose a risk of severe injury or death if improperly handled.

1. Establish a Lockout/Tagout (LOTO) Program

- Implement Lockout/Tagout Procedures: Always use Lockout/Tagout when performing maintenance, troubleshooting, or repairs on the switchgear or control module. This ensures that the power cannot be accidentally restored while work is being performed, preventing electrical hazards.
- Train Personnel: Ensure that all personnel involved in operating or maintaining the system are trained in LOTO procedures and understand their importance.

2. Regular Inspection and Preventive Maintenance

- Routine Inspections: Conduct regular visual inspections of the control module and related equipment to detect signs of wear, corrosion, or damage.

- Environmental Conditions: Ensure that the control module is housed in a clean, dry, and well-ventilated area to avoid overheating, moisture buildup, and dust accumulation. Regularly clean surrounding area.

3. Power Isolation and De-Energization

- De-Energize the Equipment: Always de-energize the switchgear system before performing any maintenance, repair, or troubleshooting work. This minimizes the risk of electrical shock or arc flash incidents.
- Verify Absence of Voltage: After de-energizing, use appropriate testing tools (e.g., voltage detectors, multimeters) to verify that no voltage remains present at the switchgear or control module terminals before working on the equipment.

4. Personal Protective Equipment (PPE)

- Wear PPE: Ensure that all personnel interacting with the switchgear wear proper personal protective equipment. This includes:
  - Insulated gloves rated for the system voltage.
  - Arc flash-rated clothing (e.g., flame-resistant suits).
  - Safety goggles or face shields for protection from sparks or debris.
  - Hearing protection if working in high-noise environments.
- Inspect PPE: Regularly inspect PPE for damage or wear and replace it as needed to ensure it provides adequate protection.

5. Proper Grounding and Bonding

- Verify Grounding: Ensure that the switchgear and control module are properly grounded. A poor ground connection can lead to electrical shock or equipment damage.
- Check Bonding Connections: Confirm that all bonding connections are secure and that metal parts are adequately bonded to prevent potential electric shock hazards in the event of a fault, which can be determined by using a Ground and Testing device.

6. Monitor System and Protection Settings

- Set Protection Settings Correctly: Ensure that the protection settings on the customer's protection relay (such as overcurrent, undervoltage, and ground fault protection) are correctly configured based on the customer's requirements and the system's operational requirements.
- Test Protection Functions: Periodically test the protection functions of the control module to ensure that it responds correctly to simulated faults (e.g., overloads, short circuits). All testing should be done by a qualified individual.

- Alarm Monitoring: Monitor alarm indicators and ensure the system is configured to provide alerts in the event of a fault or abnormal condition.

7. Emergency Shutdown Procedures

- Know Emergency Protocols: Ensure that all personnel are familiar with the emergency shutdown and fault isolation procedures in case of an electrical fault, fire, or other safety hazards.
- Quick Access to Emergency Equipment: Make sure that emergency shut-off switches, fire extinguishers, and first-aid kits are easily accessible and that all personnel know their locations.

8. Proper Training for Personnel

- Training on Operation and Safety: Ensure that all personnel involved in operating or maintaining the switchgear and control module are properly trained in electrical safety, equipment operation, and emergency response procedures.
- Certification: Ensure that individuals who handle high-voltage switchgear or breaker control modules are appropriately certified or qualified to do so, in accordance with local regulations and industry standards.

9. Ensure Proper Communication for Remote Operations

- Verify Communication Lines: If the control module is connected to a remote monitoring or control system, ensure that the communication lines are secure and not subject to electrical interference.
- Remote Control Safety: When using remote control capabilities, ensure that only authorized personnel can access and control the breaker operations to prevent accidental tripping or closing.

10. Handle Faults and Alarms Promptly

- Respond to Alarms: In the event of alarms or fault indicators, promptly assess the cause of the issue and take appropriate action. This may include checking the control module diagnostics, inspecting the switchgear components, and addressing any identified faults.
- Consult Technical Support: If a fault cannot be resolved in-house, contact the manufacturer’s technical support team for further assistance or to schedule an on-site visit with a qualified technician.

11. Ensure Proper Documentation

- Maintain Records: Keep accurate records of all maintenance activities, inspections, settings changes, and fault history. This documentation can be valuable for troubleshooting future issues, ensuring compliance with safety standards, and tracking equipment performance.
- Review User Manuals: Regularly review the manufacturer's user manual, installation guide, and safety documentation for updates, new features, or safety precautions that may affect the operation of the switchgear and control module.

12. Fire Safety

- Fire Prevention: Be aware of the potential for fires, especially in high-voltage electrical equipment. Ensure that fire extinguishers are available and that all personnel are trained in their use.
- Heat Monitoring: Keep an eye on temperature monitoring systems for signs of overheating in the control module or switchgear. Overheating can be a precursor to failure or fire.

13. Environmental Considerations

- Avoid Excessive Moisture: Prevent moisture or water ingress into the switchgear and control module as it can cause short circuits, corrosion, or other failures.
- Temperature Control: Ensure the environment where the switchgear is installed is within the acceptable temperature range specified by the manufacturer to avoid overheating or freezing.

14. System Documentation and Configuration Backup

- Backup Settings: Keep a backup of the system's configuration, including protection settings and control logic, in case the control module requires resetting or replacement.
- Regular Audits: Periodically review and audit system settings and configurations to ensure they remain compliant with operational needs and safety standards.

15. Power Surge or Lightning Strikes

- Power surges or lightning strikes can cause catastrophic damage to the J3MAG control module and connected devices, resulting in complete failure. Install surge protectors at the power entry point of the control system to protect the module and other equipment from power spikes. Use lightning protection systems such as grounding rods or surge arrestors, especially in areas prone to lightning storms.
- Electrical surges can overwhelm the module's internal circuitry and components. Ensure the system is properly grounded to safely dissipate any electrical surges.

16. Corrosion from Environmental Factors

- Corrosion due to moisture, chemicals, or dust in the environment can lead to poor electrical connections and short circuits within the control module. This often occurs on metal contacts, connectors, and exposed circuit boards, impairing the module's function. Use corrosion-resistant materials for connectors and components when operating in harsh environments.
- Install the module in sealed enclosures to prevent exposure to corrosive elements and regularly inspect the system for signs of corrosion and clean affected areas with appropriate solvents.

Control Module (J3MAGCM-2)

1. Product Range

- J3MAGCM-2 module is designed for applications with AC and DC power supply and for many types of relay protection.
- The J3MAGCM-2 control module is capable of (48 VDC, 125 VDC, 120 VAC) rated supply voltage ranges and the corresponding rated control voltage ranges. See table 1.1

Module Type	Rated Control Range	Rated Control Voltage Range
J3MAGCM-2	120 VAC	114 - 127 VAC
	125 VDC	70 - 140 VDC
	48 VDC	28 - 56 VDC

Table 1.1: Control Module Input Voltage Range

NOTE: Only one voltage range setting can be selected at a time. A control module set to operate with a control voltage of 48 VDC will accept a 28 - 56 VDC control voltage.

2. DIP Switch Configuration

- **DIP Switch 1: <u>Breaker Fail Trip</u>**
  - Function: Enable breaker fail trip function. Control module will perform a trip operation if breaker poles are not in agreement (all closed or all open).
  - Switch ON: Enable breaker trip fail function.
  - Switch OFF: Breaker fail trip function disabled

- **DIP Switch 2: 120 VAC Control Voltage Selection**
  - Function: Selects 120 VAC as incoming signal voltage for remote operation.
  - Switch ON: Enables 120 VAC remote signals.
  - Switch OFF: Disables 120 VAC remote signals.

- **DIP Switch 3: 48VDC Control Selection.**
  - Function: Selects 48 VDC as incoming signal voltage for remote operation.
  - Switch ON: Enables 48 VDC remote signals.
  - Switch OFF: Disables 48 VDC remote signals.

- **Note: The default remote operation voltage is 125 VDC if both dip switch 2 and 3 are disabled. Select only one switch if 120 VAC or 48 VDC is required. See Table 1.1.**

- **DIP Switch 4: 5-cycle Trip Delay**
  - Function: Trip operation triggers after (5) 60 Hz cycles have passed since the remote trip request was received and processed.
  - Switch ON: Enables 5-cycle trip delay.
  - Switch OFF: Enables default 3-cycle trip delay.

- **DIP Switch 5: Unused**

- **DIP Switch 6,7,8: Loss of Control Power (LOP) Trip Timing**
  - Function: Selection of any switches enable the LOP trip function. A trip operation will be performed when control power is lost at the input of the control module. The combination of enabled switches determines the delay time between power loss and trip operation according to the following table:

Time	Dip 6	Dip 7	Dip 8
No LOP Trip	OFF	OFF	OFF
260 ms*	ON	OFF	OFF
1 s	OFF	ON	OFF
2 s	ON	ON	OFF
20 s	OFF	OFF	ON
40 s	ON	OFF	ON
120 s	OFF	ON	ON
180 s	ON	ON	ON

  - *** Note: 260 ms timing is currently not recommended as it can lead to unstable operation, and will be removed in future control module software revisions. 1 s timing or higher is recommended for use.**

Figure 1: DIP Switch Location

Figure 2**: **Control Module (Exterior)

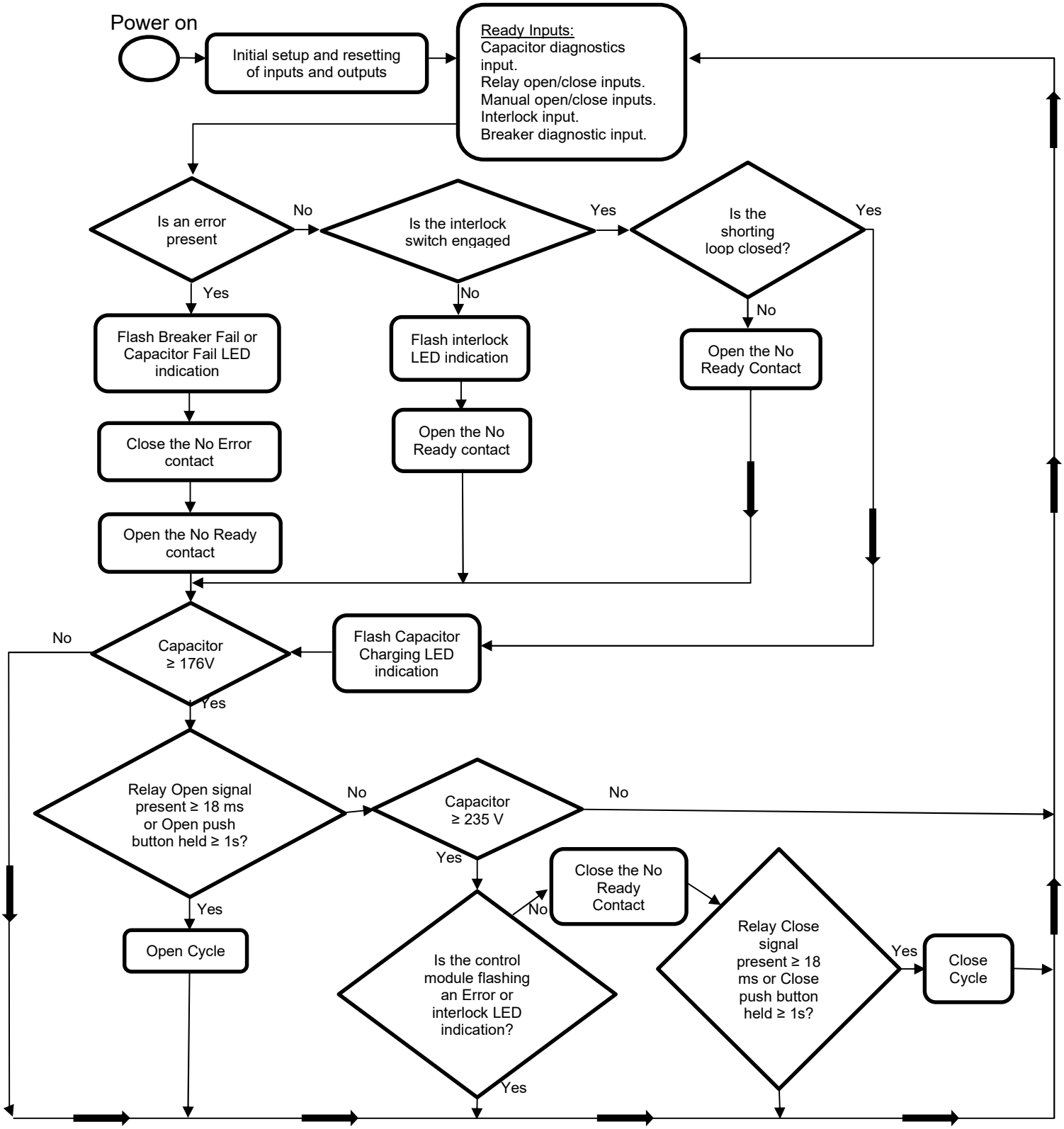
Figure 3: Control Module (Interior)

Hardware

Power Module: Supports a wide range of input voltages to power all module functions. Capable of drawing energy from the capacitor if the incoming main power is not present.

- Control and Signaling Interface:
  - Outputs: Binary outputs for Control Module Error and Control Module Ready signals. These are dry relay contacts that are powered by the system control voltage. These outputs are not affected by dip switches 2 and 3.
  - Inputs: Voltage inputs for Protection Relay TRIP and CLOSE commands, along with additional inputs to monitor breaker status.
  - Indicators: LED indicator for operational status.
  - Manual Controls: Membrane switch for manual TRIP and CLOSE operations and diagnostic status.
  - Counter: Output for triggering an electromechanical counter showing the number of TRIP operations performed.
  - High-power Mosfet H-bridge: Provides current impulses to drive the actuator coil for TRIP and CLOSE operations.
  - Capacitor Charging: Includes fast charging for the capacitor and safe discharging functionality.
  - Capacitor: Stores energy for performing both CLOSE and TRIP operations and backup power storage up to 3 minutes.

Functional Flowchart



Operation

1. **Normal Operation LED Indication**
   - The control module uses LED light to indicate various operational states. Below are the LED patterns that can be observed during normal operation of the control module:

     - Power On: Upon providing power to the control module, the LED light will illuminate with a fading-in effect for 5 seconds. This occurs when the microcontroller is reset, or the machine starts up.
     - Charging: There are three different LED light patterns indicating the charge level of the capacitor:
       - Slow Blinking (on-off, with no pauses): the capacitor is low on voltage.
       - Fast Blinking (on-off, with no pauses): the capacitor has enough voltage for an OPEN operation but not a CLOSE.
       - Solid light: the capacitor is fully charged and ready for operation. Wait 30 seconds after a solid light before performing an OPEN or CLOSE operation.

2. **Ready**
   - Solid LED light (same as full capacitor charge). The control module is ready to operate.

If LED patterns or blinking are observed that are not described here or that persist unexpectedly, refer to Troubleshooting for further guidance.

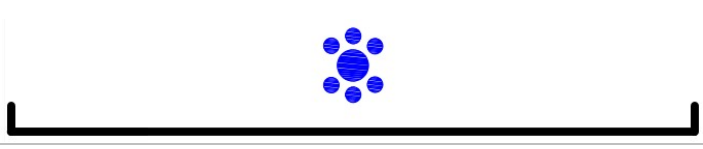
Condition	Pictogram	Meaning
Low Capacitor Charge		LED blinks slowly. The capacitor voltage is low and is still charging.
Sufficient Charge for OPEN Only		LED blinks quickly. The capacitor is charged enough for an OPEN operation.
Fully Charged and Ready		LED remains solid. The capacitor is fully charged and ready for operation.

Table 2 Capacitor charging LED indicator.

Troubleshooting

1. Power Supply Issues

- Issue: An unstable or inadequate power supply can lead to unexpected shutdowns, failure to initialize, or erratic behavior in the J3MAG control module.
  - Voltage Fluctuations: Variations in voltage, such as power surges or brownouts, can damage the module.
- Solution:
  - Install a UPS (Uninterruptible Power Supply) to maintain stable voltage and protect against power interruptions.
  - Use surge protectors and power conditioning equipment to stabilize voltage and protect against spikes or fluctuations.
  - Regularly check the power source for consistent voltage and ensure it matches the module's input specifications.

2. Electromagnetic Interference (EMI)

- Issue: Electromagnetic interference from nearby equipment (e.g., motors, high-voltage cables, and industrial machines) can disrupt the control module's signals, leading to miscommunication or faulty behavior.
  - Electromagnetic fields: This can induce unwanted currents in signal lines, corrupting data transmission.
- Solution**:**
  - Use shielded cables and filters should be for signal wiring to protect against EMI.
  - Use proper grounding of the control module and all connected devices can help mitigate EMI.
  - Use electromagnetic shielding (e.g., Faraday cages or enclosures) around the control module and sensitive wiring.

- Relocate the control module and wiring away from sources of high electromagnetic noise, such as large motors or power transformers.
- Ferrite beads or core filters can be added to power and communication lines to filter high-frequency interference.

3. Environmental Conditions

- Issue: Harsh environmental conditions, such as excessive temperature, humidity, dust, and vibrations can adversely affect the control module's performance.
  - Temperature Extremes: High or low temperatures can cause thermal shutdown or component degradation.
- Solution:
  - Ensure that the ambient temperature is within the specified operating range of the module.
  - Humidity: High humidity can lead to condensation, corrosion, or short circuits.
- Solution**:**
  - Install dehumidifiers or moisture-resistant enclosures in humid environments to prevent condensation inside the module.
- Solution**:**
  - Regularly clean the module and its surroundings to avoid dust buildup and use air filters where appropriate.
  - Vibration: Excessive vibrations can lead to mechanical failure or loose connections.

4. Incorrect Wiring or Loose Connections

- Issue: Incorrect wiring, loose connections, or poor contact can cause intermittent failures, communication errors, or failure to operate.
  - Disconnected or poorly connected wires: This can lead to open circuits, shorts, or false readings from connected sensors or actuators.
- Solution**:**
  - Inspect wiring for secure connections, especially on power, input, and output terminals.
  - Use properly rated cables and connectors to ensure reliable electrical contact.
  - Tighten loose connections and periodically inspect them for wear and tear.
  - Use wire markers or labels to ensure correct identification of each connection.

5. Communication Failures

- Issue: External communication issues, such as loss of connection or errors in data transmission, can lead to system malfunctions or failure to operate as expected.
  - Cable Issues: Damaged, poorly connected, or incompatible cables can cause communication breakdowns.
- Solution**:**
  - Check all communication cables for proper connections and signs of wear or damage.
  - Test and verify signal integrity with diagnostic tools like an oscilloscope
  - Replace cables.

6. External Load Issues (Overload)

- Issue: If the system overloaded, it could cause the control module to shut down or behave erratically. Overcurrent or excessive load can lead to overheating or internal faults.
  - Excessive load conditions: This can trigger overcurrent protection, leading to module shutdown.
- Solution:
  - Use current monitoring and protection circuits to detect overload conditions and prevent damage.
  - Set current limiters or overload protection parameters in the software configuration.

7. Incorrect or Incompatible External Devices

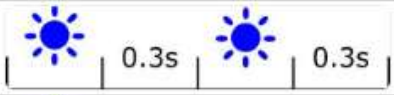
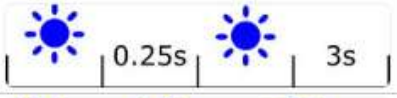
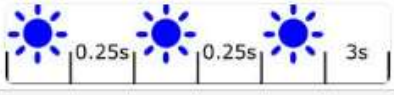
- Issue: The control module may fail if connections to external devices are incompatible or malfunctioning. Improper configuration or incorrect input signals can also cause issues.
  - Device compatibility: If external devices require different operating conditions (e.g., voltage, current, communication protocols), they may cause erratic behavior or failure of the control module.
- Solution**:**
  - Ensure device compatibility by matching the input and output specifications of the connected components with those of the control module.
  - Verify that external devices are properly calibrated and function correctly before connecting them to the control module.

- Follow the manufacturer's guidelines for wiring, configuration, and integration of all connected devices.

8. Improper Grounding

- Issue: Inadequate or improper grounding can lead to electrical noise, ground loops, or safety issues.
  - Ground loops: This can cause noise or voltage fluctuations that affect the performance of the control module.
- Solution**:**
  - Ensure that all equipment, including the J3MAG control module and associated devices, is properly grounded according to the manufacturer's specifications.
  - Use dedicated ground lines for sensitive equipment and avoid sharing ground connections with high-power devices.
  - Implement grounding and shielding practices in line with industry standards to reduce the impact of ground loops and electrical noise.

Below is a list of all possible LED sequences that indicate a potential concern. Always ensure that safety protocols are followed, and if issues persist, consult the manufacturer's manual or technical support for further assistance.

Status LED	Description	Meaning
	LED fades in for 5 seconds.	Voltage input has been applied or CM is reset.
	LED stays on.	CM is ready with no errors and capacitor at full charge.
	LED blinks continuously every second (slow).	Capacitor is charging, low voltage.
	LED blinks continuously every 0.3 seconds (fast).	Capacitor is charging, high voltage.
	LED blinks once and then pauses for 3 seconds.	Capacitor did not charge to full voltage in 90 seconds.
	LED blinks twice and then pauses for 3 seconds.	Breaker 52A/52B contacts indicate breaker failure.
	LED blinks three times and then pauses for 3 seconds.	Breaker is not in test or connect position.

1 Issue: Breaker will not close.
- a. Check that a remote trip signal is not already present in the trip remote control input.
- b. Check wiring and control voltage.
- c. Check breaker position (may already be closed) and wiring feedback to control module 52A and 52B.

2. Issue: Breaker will not trip.
- a. Check that a remote trip signal is not already present in the trip remote control input.
- b. Check wiring and control voltage.
- c. Check breaker position (may already be open).

3. Issue: LED blinks 1 every 3 seconds.
- a. Capacitor did not fully charge within 90 seconds. Capacitor may be disconnected or faulty. Remove control power and **safely discharge capacitor** before attempting to remove or replace capacitor.

4. Issue: LED shows breaker fail condition, 2 blinks and then 3 seconds pause.
- a. Check breaker poles position.
- b. Check control module 52A/52B contacts wiring.
- c. Check breaker 52A/52B contacts wiring.

5. Issue: LED shows breaker is not in test or connect position. (3 blinks, 3 second pause)
- a. Check interlock lever is fully seated.

b. Check breaker racking position.
c. Check integral racking wiring.

6. Issue: Membrane switch does not operate trip or close, but LED is on.
    a. Check that a remote trip signal is not present in the trip remote control input.
    b. Check membrane switch flex cable is not broken.

7. Issue: Membrane switch LED does not light up.
    a. Check control power.
    b. Check membrane switch flex cable is not broken.

Warranty and Disclaimer.

Failure to follow the guidance set forth in this Product Manual will void the warranty and/or potentially create dangerous conditions for your employees, your property and third parties. If there is injury, death, property or other damages because of this failure, JST is not liable. Please follow the guidance set forth herein.

Notes

JST Power Equipment Inc.
30 Skyline Drive **|** Lake Mary, FL 32746, USA
Website JSTPower.com **|** *Email* sales@jstpower.com
Phone +1 (407) 632-4050 **|** *Toll Free* +1 (844) 631-9046
Fax +1 (407) 982-1153