Instructional Booklet **IB013003EN** Effective June 2023

Instructions for installation, operation, and maintenance of Magnum MR2 (integral racking)

Contents

Powering Business Worldwide

Notices and warnings

⚠ NOTICE

ALL USERS OF THIS PRODUCT SHOULD READ AND FOLLOW THE INSTRUCTIONS PROVIDED HEREIN; HOWEVER, THIS INSTRUCTION BOOK SHOULD NOT BE CONSIDERED ALL INCLUSIVE REGARDING INSTALLATION OR MAINTENANCE PROCEDURES. IF FURTHER INFORMATION IS REQUIRED, YOU SHOULD CONSULT EATON'S ELECTRICAL SERVICES & SYSTEMS.

READ AND UNDERSTAND THIS AND OTHER SUPPLIED INSTRUCTIONS AND DRAWINGS IN THEIR ENTIRETY BEFORE INSTALLING OR OPERATING THIS DEVICE. ADJUSTMENT, REPAIR OR MAINTENANCE, OTHER THAN THOSE DESCRIBED HEREIN, MUST BE PERFORMED BY QUALIFIED PERSONNEL. A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED.

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IMPROPER USE OR MAINTENANCE OF THIS PRODUCT, OR OPERATING IT IN A MANNER FOR WHICH IT WAS NOT INTENDED, MAY RESULT IN DEATH, SERIOUS PERSONAL INJURY, OR PROPERTY DAMAGE.

READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE ATTEMPTING ANY OPERATION OR MAINTENANCE OF THE CIRCUIT BREAKERS OR AUXILIARIES TO BE OPERATED BY THIS DEVICE.

ALL SAFETY CODES, SAFETY STANDARDS, AND/OR REGULATIONS AS THEY MAY BE APPLIED TO THIS TYPE OF EQUIPMENT MUST BE STRICTLY ADHERED TO.

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THE DANGER, WARNING, AND CAUTION MESSAGES INCLUDED AS A PART OF THE PROCEDURAL STEPS IN THIS MANUAL ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE THIS PARAGRAPH TO FAMILIARIZE PERSONNEL WITH THIS TYPE OF PRESENTATION. THIS WILL HELP ASSURE THAT PERSONNEL ARE ALERT TO THESE TYPES OF MESSAGES. IN ADDITION, THESE MESSAGES ARE ALL UPPERCASE AND BOLDFACE.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment are not encompassed by these instructions. If further information is desired by the purchaser regarding particular installation, operation, or maintenance of particular equipment, contact an Eaton sales or service representative.

⚠ DANGER

WHEN SWITCHGEAR IS CERTIFIED TO BE ARC-RESISTANT PER ANSI/IEEE® STD. C37.20.7, THE ARC-RESISTANT RATING IS ONLY VALID WHEN ALL DOORS ARE CLOSED AND PROPERLY LATCHED OR BOLTED, AND ALL COMPONENTS ARE INSTALLED AND WORKING PROPERLY. IN ADDITION, REMOVAL OF ANY BREAKER FROM ITS CELL WITHOUT REINSTALLING A BREAKER OR ARC-RESISTANT PROVISION COVER WILL VOID THE ARC-RESISTANT RATING.

Eaton contact information

Eaton provides technical support for the Magnum PXR and Power Defense SB circuit breakers and trip units. You can contact us via several methods. This link: www.eaton.com/eatoncare will take you to the on-line portal where you can contact Technical Support via phone, e-mail, or view FAQs.

For support via phone, you can call EatonCare at 877-ETN-CARE (877-386-2273) and navigate the menu by selecting:

- Option 2 for the Technical Resource Center
- Option 2 for Circuit Protection Products
- Option 3 for Low-voltage and Medium-voltage Power Circuit Breakers

Eaton Electrical Services and Systems (EESS) can be reached at 1-800-498-2678.

If further information is desired regarding this particular installation or application information, contact the local Eaton sales office, reference the equipment documentation, or the appropriate industry standards.

Motorized remote racking (MR2)

Magnum PXR or Power Defense SB (PD-SB) drawout breakers with the MR2 integral racking option allow an operator to remotely rack a Magnum breaker from a distance of 30 feet (9 .14 m) or greater depending on the communication option installed. The MR2 helps to mitigate electrical arc flash exposure by allowing the operator to work from outside the arc flash boundary. The integral racking system consists of a breaker with integral motorized racking assembly, wired cassette, controller, and a customer provided user interface (see Figure 1). The racking assembly contains safety and component position sensing features located on the racking mechanism of the breaker. The controller accepts 120 Vac and supplies power to a motor based on the user input. The position of the Magnum breaker is detected by three limit switches located internal to the racking mechanism. Circuit breakers equipped with MR2 have a layer of Magnalube applied to primary disconnects. For additional lubrication information, refer to Appendix or "Section 7: Importance of Maintenance" in MN013016EN.

Control power requirements:

- Input voltage, nominal: 120 Vac; 10 A,
- Input voltage range: ±10% nominal.

The MR2 integral racking system is shown below (see Figure 1). Breakers equipped with MR2 can be identified by the blue colored levering fascia. The user can control the system by means of a pendant, Modbus master (such as the Eaton Power Distribution Monitoring and Control system), or separately wired I/O buttons. Controller can be mounted to the left side (preferred) or right side of the cassette. If placed in other areas of the switchgear, extension wires can be added with the existing terminal blocks. The eight MR2 tertiary wires connect the controller to the MR2 levering device thru the breaker/cassette secondary connectors. The wire description is as follows:

Grey	= Racking position switch – Common;
Green	= Racking position switch – Disconnect;
Yellow	= Racking position switch – Test;
Red	= Racking position switch – Connect;
Blue	= Permissive switch circuit;
Blue	= Permissive switch circuit;
Black	= Motor DC (+);
White	= Motor DC (-).

Customer will need to supply the 120 Vac input to the controller.

Figure 1. MR2 integral racking system.

Secondary connectors

The MR2 wired connections (tertiaries) pass through the breaker and cassette's secondary connectors. The eight tertiary contacts are connected when the breaker is placed in the disconnect position and remain connected through test and connect (see Figure 2).

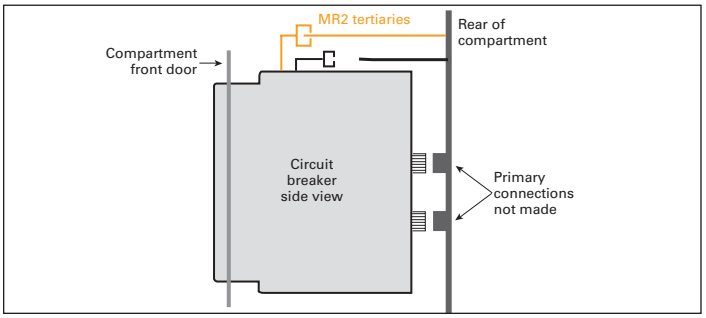


Figure 2. Breaker in disconnect position.

Pushing on the top of the breaker cover (see Figure 3) will ensure good electrical connection of the tertiary contacts in the disconnect position.

Figure 3. Tertiary connection in disconnect.

The eight MR2 tertiary contacts are located in the middle of the secondary connectors. The breaker side and cassette side are shown in Figure 4 and Figure 5.

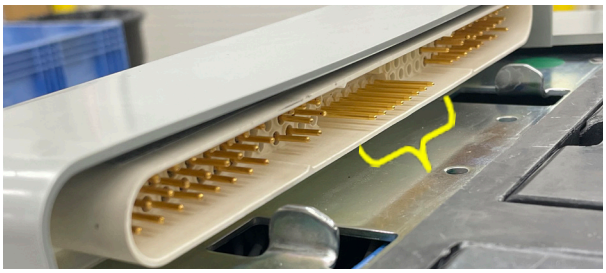


Figure 4. Breaker side secondary connector.

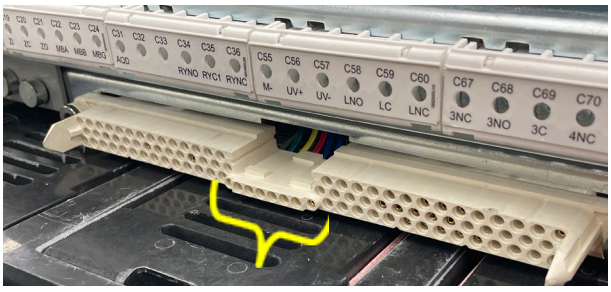


Figure 5. Cassette side secondary connector.

Permissive interlocks

Operational interlock features

There are multiple permissive interlock features built into the system. These features, when activated, will prevent electrical racking and display an E5 error code on the pendant. See Diagnostics/troubleshooting section for more information. There are three standard permissive interlock switches wired in a single circuit for every breaker with integral racking.

Breaker specific interlocks

1. Permissive switch driven by the breaker mechanism to indicate if the breaker is open or closed.
   a. If the circuit breaker is closed, this switch will open and the integral racking motor will not run.
2. Permissive switch driven by the racking mechanism door to indicate if the door is raised or lowered.
   a. If the racking mechanism door is raised, this switch will open and the integral racking motor will not run.
3. Permissive switch driven by the padlock slider to indicate if the levering mechanism is locked out.
   a. If the padlock slider is pushed in towards the levering door, this switch will open and the integral racking motor will not run.

In addition to the permissive contacts mentioned above, the controller will accept any additional normally closed permissive contacts wired in series with the blue permissive wires shown (see Figure 6).

Figure 6. MR2 controller.

Restricting operation

Using the MR2 system, there are three methods to restrict racking a Magnum circuit breaker.

Option 1 (lockout-tagout): This option prevents both electrical and manual operation. Push the padlock slider forward (towards the breaker) aligning two holes on the left side and insert a ¼" padlock (see Figure 7). The MR2 will be disabled via the permissive circuit, and manual racking is blocked as well. The label on the levering door will show red, indicating that no racking is permitted. For a multi-lock hasp, Eaton recommends Master Lock 418 with a ¼" diameter shackle.

Figure 7. Padlock slider permissive actuated (no racking allowed).

Option 2: This option prevents electrical operation. Raise the racking door and insert a ¼" padlock in the upper padlock hole. This will keep the door raised, and permits a user to manually insert a levering tool, allowing breaker racking. The MR2 will be disabled via the permissive circuit and electrical racking will be blocked (see Figure 8). Note that the breaker cannot be closed while in this state. For a multi-lock hasp, Eaton recommends Master Lock 418 with a ¼" diameter shackle.

Figure 8. MR2 racking prevented (manual racking allowed).

Figure 9. Door lifting is blocked (MR2 racking allowed).

Option 3: This option prevents manual operation. Inserting a sealing wire through the holes on the right side of the padlock slider and racking door prohibits a user from lifting the door. This prevents a user from inserting a levering tool and racking manually, but allows electrical operation (see Figure 9). A user can break the wire seal for manual racking in an emergency. The padlock slider can be pushed in to lockout all racking while sealing wire is installed (refer to Option 1).

Refer to equipment instruction booklet for acceptable LOTO options.

Manual racking

⚠ CAUTION

DO NOT USE AN ELECTRIC OR PNEUMATIC DRIVER TO RACK THE BREAKER.

In the case where electrical racking is not available, the breaker can be manually racked using a standard 3/8-inch square drive and ratchet (not provided). **Do not use an electric or pneumatic driver to rack the breaker.** Raise the racking door to gain access to the levering screw. (Electrical operation will be disabled when door is open.) Insert the levering tool into the square socket to unlock the internal mechanical clutch. You may need to forcefully "pop" the end of the ratchet in some cases. You will not be able to rotate the levering tool until this occurs (see Figure 10). Once "un-locked", the levering tool can be rotated clockwise to rack into test and connect. It can be rotated counter-clockwise to rack to test and disconnect (see Figure 11). Do not exceed 25 ft-lb (33.9 N·m) of torque. The clutch will automatically re-engage once inward force on the tool is released.

Figure 10. "Un-locking" the clutch.

Figure 11. Manual racking.

Racking indication

While electrical or manual racking, there exists three discrete colored positions which are disconnect (green), test (yellow), and connect (red) (see positions A, B, and C in Figure 12). At these positions, the breaker can be closed when the racking door is fully lowered.

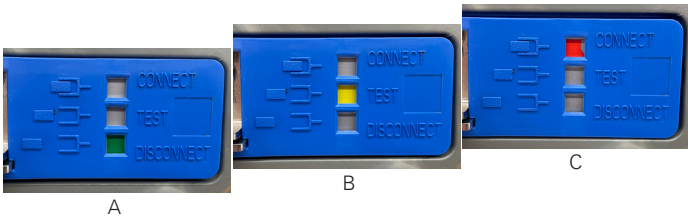


Figure 12. Discrete colored positions.

If racking is stopped (electrically or manually) in between disconnect /test or test/connect positions, there is no complete single colored block in these mid-positions (see Figure 13). At these positions, the breaker will not be allowed to close. If the racking door is lifted, electric racking will be disabled and the door will be "held up" providing additional indication that breaker is not in a discrete position (see Figure 14).

Figure 13. Mid-positions.

Figure 14. Door lifted and held up.

Once the door is "held up", you can release the door 2 ways. Option 1 is to insert a racking tool and manually rack to a discrete colored position, until the door is allowed to drop. Option 2 is to insert a small tool through the door latch release hole, and "push in" to release the internal door latch. With the tool in, you can push down on the racking door (see Figure 15 and Figure 16). You can resume electrical racking by clearing the E4 error code. See Diagnostics/ troubleshooting section for more information.

Figure 15. Door latch release hole.

Figure 16. Release door.

Setting the breaker type

⚠ CAUTION

SETTING THE WRONG BREAKER TYPE CAN CAUSE THE BREAKER TO NOT FULLY RACK IN. BREAKER TYPE IS CELL SPECIFIC. IF A CONTROL BOARD IS MOVED TO A NEW CELL ONE MUST VERIFY BREAKER TYPE.

⚠ CAUTION

THE BREAKER TYPE WILL BE SET BY ASSEMBLY MANUFACTURER BASED ON APPLICATION.

All Magnum breaker types are included in the firmware. The breaker type is set from the factory on the General 01 setting.

Table 1.

Breaker types	
01	General
02	General (enhanced protection)
03	6 pole/8 pole double standard frames
04	6 pole/8 pole double standard frames (enhanced protection)

The breaker type is set by turning the breaker type dial on the control board (see Figure 17). The "enhanced" options (types 02 and 04) provide more sensitive overcurrent protection for the motor.

Setting the Modbus address

The Modbus address of a controller board is set using the pendant. The available Modbus addresses are 01 to 99 for one RS485 network.

To set the Modbus address, follow the steps below.

1. Connect pendant to the controller to be programmed.
2. Hold down the "Intermediate" button and within three seconds press and hold the "Connect" button until the two-digit LED display begins to flash "##", at the same time the "Connect" LED will begin to flash.
3. Now the "Test" and "Disconnect" buttons can be used to scroll up and down (01 to 99) until the desired address number is reached. While scrolling, the "Connect" LED will continue to flash to let the user know that the address is not set.
4. Once the desired address number is reached, press the "Connect" button to connect to the Modbus address displayed.
5. Press "Disconnect" to return to operation mode.
6. At this time the address can be verified using the controller diagnostic display described above.

The Modbus address can be modified after being set using the same sequence.

Note: See Instruction Booklet IB022022EN for information on the Modbus interface to Magnum controllers.

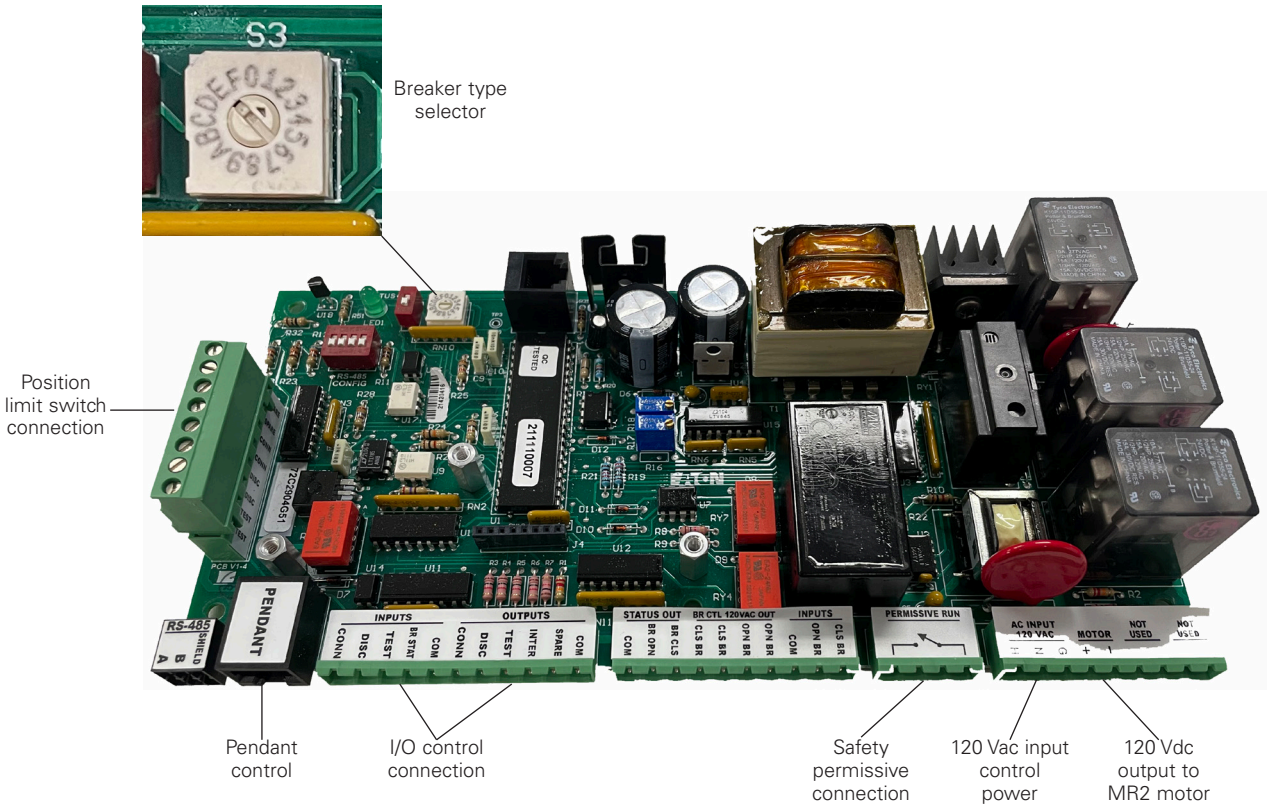


Figure 17. MR2 controller.

Control options

There are three modes of operations available to interface with the integrated racking controller:

1. Handheld pendant (see Figure 18);
2. Discrete I/O;
3. Modbus communication.

Option 1

The handheld pendant can operate the integral racking device using up to 30 ft. (9.14 m) of Cat 5 /6 cable (installers may mount a RJ-45 jack on the front panel of the switchgear - see Figure 19). The Magnum breaker can be racked to the connect, test, or disconnect positions by pressing the desired button while depressing the enable button on the pendant. Magnum breaker position and error codes are indicated on the pendant. **With the pendant plugged in, discrete I/O and Modbus control are disabled.** This is a feature that does not allow someone to operate the system remotely while an operator is in close proximity of the switchgear.

Figure 18. Handheld pendant.

Option 2

Discrete I/O control allows the user to operate the integral racking device via pushbuttons or PLC. These systems can be wired to a central control room or to a remote panel located a safe distance away from the switchgear equipment. If an error occurs while under I/O control, all I/O breaker position indication lights will flash. The pendant can then be plugged into a RJ-45 jack located on the front panel of the switchgear (if included - see Figure 19) to read the error code. Once the pendant is plugged in, I/O control is disabled until the pendant is unplugged.

Table 2. Indication and control requirements

Indicating LEDs	Open/close interposing relays	Pushbuttons
24 Vdc, 20 mA	120 Vac coil	24 Vdc, 5 mA

Option 3

Modbus communication control allows the user to operate the integral racking device via a SCADA system or multiple Modbus interface communication systems. These systems can be wired to a central control room or to a remote panel located a safe distance away from the equipment. Error codes can be read with the Modbus communication system. This would be a feature of the assembly as a whole, not an individual breaker (for Modbus Interface details, refer to "1C19667 Modbus interface .txt").

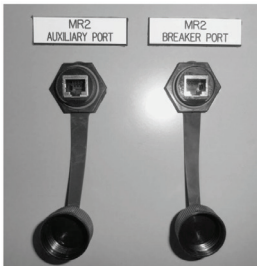


Figure 19. RJ-45 pendant jack.

Sequence of operations

Below is the basic sequence of operations to use the integrated racking system. The operation steps are the same for each of the control options (Pendant, I/O, and Modbus).

The "Enable" button must be held to operate the pendant.

1. Insert the breaker into the breaker cell.
   a. The breaker is now in the disconnect position.
   b. The solid green disconnect LED will be illuminated.
   c. To proceed further and rack the breaker to the connected position, the breaker must be open. If the breaker is closed, you will see an E5 code. Refer to the Diagnostics/ troubleshooting section for more details.
      1. It is recommended to close the door but not mandatory if door safety switch is not included.
2. Press the "Test" button while depressing the "Enable" button.
   a. The buttons can be released after the operation is selected.
   b. The breaker will then move to the test position.
3. The green disconnect LED will turn off and the yellow test LED will be illuminated.
   a. The secondary plugs will mate and the breaker will now have control power.
   b. At this time the breaker open and close operations can be electrically tested.
   c. To proceed further and rack the breaker to the connected position, the breaker must be open. If the breaker is closed you will see an E5 code. Refer to the error code section for more details.
      1. It is recommended to close the door but not mandatory if door safety switch is not included.
4. Press the "Connect" button while depressing the "Enable" button
   a. The buttons can be released after the operation is selected.
5. The yellow test LED will turn off and the intermediate LED will flash as the breaker is in motion.
6. Once the breaker reaches the connect position, the solid red connect LED will illuminate.
   a. The breaker is now in the connect position and can be energized.
7. To rack the breaker out, the breaker must be open. If the breaker is closed you will see an E5 code. Refer to the error code section for more details.
8. Press the "Connect" or "Test" button while depressing the "Enable" button to rack the breaker to the connect or test position (respectively).
   a. The buttons can be released after the operation is selected.
9. The red connect LED will turn off and the intermediate LED will flash as the breaker is in motion.
10. Once the breaker reaches the test or disconnect position, the solid yellow test LED or a solid green disconnect LED will illuminate.
    a. If the breaker is in the test position, there is still control power on the breaker and the open and close operations can be electrically tested.
    b. If the breaker is at the disconnect position, the secondary plugs will be disconnected and there will not be any power on the breaker. The eight tertiary points will still be connected to allow further MR2 racking operations.

Diagnostics/troubleshooting

The integrated racking controller programming has built-in diagnostics and error detection. If an error occurs, "E1" to "E8" will appear on the pendant display (see Figure 20). On the back of the pendant there is a label that explains the error code and what to do if the error occurs (see Figure 22).

Figure 20. Pendant with open/close.

Figure 21. Pendant without open/close.

Figure 22. Pendant error code descriptions.

⚠ CAUTION

THERE ARE NO SERVICEABLE PARTS INSIDE THE CASE OF THE PENDANT. ATTEMPTING A MODIFICATION OR REPAIR OTHER THAN THOSE EXPLAINED IN THIS SECTION COULD EXPOSE PERSONNEL TO SHOCK HAZARD FROM INTERNAL CAPACITORS. OPENING THE CASE OF THE PENDANT TO ATTEMPT A REPAIR WILL VOID THE WARRANTY.

E1: Motor overcurrent

Condition when motor current is in excess of allowed value. E1 error codes may occur if there is an obstruction in the cell. Operator should shut off power to the MR2 controller by tripping the circuit breaker or fuse protecting the controller and manually rack out the Magnum breaker. The operator should inspect the Magnum breaker, cassette, levering system subassembly, and controller card for obvious damage or abnormal conditions. If no obvious issues are found, check for Magnalube on the primary disconnects and then reinstall the Magnum breaker.

E2: Open motor circuit

Can occur due to an excessive duty cycle (more than three consecutive full racking cycles in quick succession without stopping. one cycle=rack in and rack out). Once limit is reached, the E2 code will be displayed for two minutes, allowing the motor to cool. After the cool down period, the controller can be reset by pressing the "Enable" and "Disconnect" buttons on the pendant, or over Modbus RTU communications.

E3: Motor timed out

Condition when motor continues to run in excess of the normal required time to reach the desired position. This error state condition can be caused from a malfunction of the MR2. Operator should shut off power to the MR2 controller by tripping the circuit breaker or fuse protecting the controller and manually rack out the Magnum breaker. Once the Magnum breaker is removed from the compartment, the operator can replace the damaged devices.

E4: Magnum breaker position "unknown"

Controller does not know the location of the Magnum breaker in the breaker compartment. The operator must press the "Enable" and the "Disconnect" buttons on the pendant as the other buttons will not function. Once the breaker has reached the disconnect position, the "Disconnect" LED will illuminate and the operator can start the Magnum breaker racking process again by pressing the "Connect" or "Test" button and the "Enable" button.

E5: Open permissive

This state is due to a permissive contact being open. It could be a standard permissive such as the racking door is lifted, the circuit breaker being closed, or the padlock slider being pushed in. This could also be a customer supplied permissive such as a door interlock or a cell switch from another cell to provide interlocking. In this case, press the "Enable" and "Disconnect" buttons to reset the controller. Once the permissive switch is closed, any operation will work.

E6: Communication error

This state may result from damaged communication cable or wiring. Check all areas of communication wiring (e.g., discrete, CAT5, or Modbus controller wiring). This state may also occur when a breaker is not inserted into the compartment. Check to make sure the breaker is fully pushed into the disconnect position and the tertiaries make good electrical connection (see Figure 3).

E8: Position switch error

This state occurs when a breaker is not inserted into the compartment. Check to make sure the breaker is fully pushed into the disconnect position and the tertiaries make good electrical connection (see Figure 3).

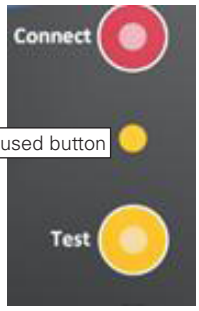
Controller diagnostic display

This feature can be used for diagnostic and troubleshooting purposes. The operator will press and hold down the "Enable" button while pressing and holding down the unused button under the "Intermediate" indicator LED on the pendant for three seconds. The gear type, controller firmware version, pendant firmware version, rack-in count, rack-out count, overcurrent count and "test" verification will scroll across the display.

Ex. of entire sequence:

PG ##	GR ##	CF ##	PF ##	RI ## ##	RO ## ##	OC ## ##	AD ##
1	2	3	4	5	6	7	8

1. Product group
2. Gear type (will always be 02 for Magnum)
3. Controller firmware version
4. Pendant firmware version
5. Rack-in count
6. Rack-out count
7. Overcurrent count
8. Modbus address (01 to 99)



Controller mounting

The controller can be mounted to the left side or right side of the cassette. If placed in other areas of the switchgear, extension wires can be added with the existing terminal blocks. This section will cover installing to the left side of the cassette, which is preferred.

Thread four standoffs onto the four corner screws (see Figure 23).

Figure 23. Installing standoffs.

Locate four mounting holes on cassette sidesheet. Align controller standoffs with holes and secure using four supplied machine screws and lockwashers (see Figure 24 and Figure 25).

Figure 24. Mounting holes.

Figure 25. Securing.

Appendix

Circuit breakers equipped with MR2 have a thin layer of Magnalube applied to the primary disconnects, which is shown below (See Figure 26). If Magnalube is not present, please contact Eaton Technical Support and order with style # shown in Table 3. Magnalube can be added to the leading edges and surfaces on all primary disconnects that make contact with the cassette stabs.

Table 3. Greases used on Magnum PXR and PD-SB

Grease type	Desription
Magnalube®-G	
Eaton standards	#53701AI
Color	Green
Manufactured by	Saunders Enterprises inc. 11-51 44th Road, Long Island City, New York 11101 Phone (718) 729-2690 www.magnalube.com

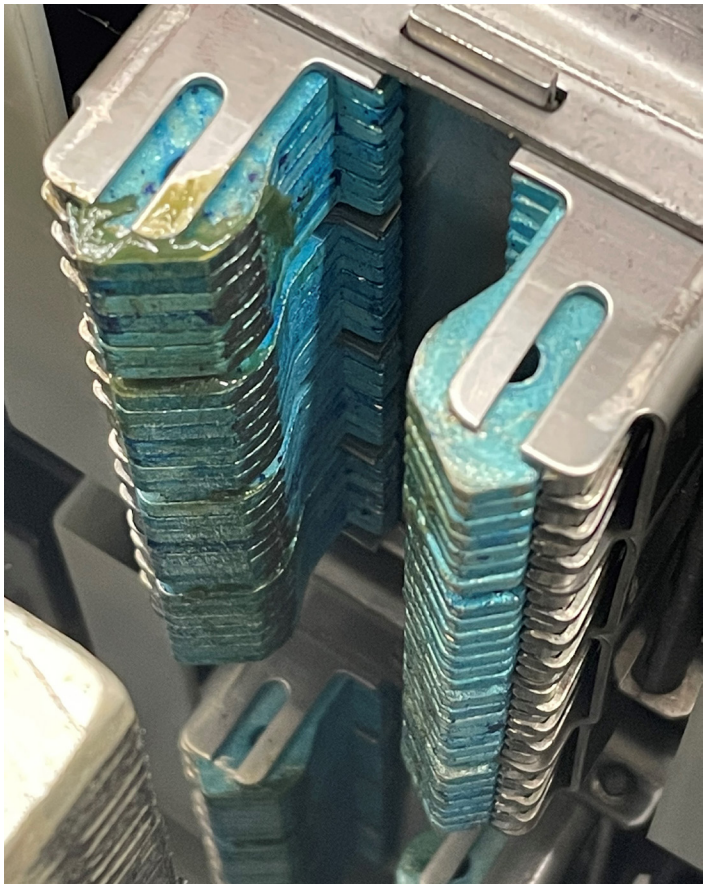


Figure 26. Magnalube applied to the primary disconnects.

Notes:

Instructions for installation, operation, and maintenance of Magnum MR2 (integral racking)

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