

Universal voltage regulator control cable interface junction box installation instructions



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Safety for life



Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment, and support our “Safety For Life” mission.

Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as arc flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER

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

WARNING

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

CAUTION

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

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER

Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.

G103.3

WARNING

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.

G101.0

WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.

G102.1

WARNING

Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage.

G122.3

Product information

Introduction

Service Information MN225013EN provides installation instructions for the universal voltage regulator control cable interface junction box from Eaton's Cooper Power™ series. Before installing the junction box, carefully read and understand the contents of this manual.

Refer to *Service Information MN225003EN CL-7 Voltage Regulator Control Installation, Operation, and Maintenance Instructions* for more information on the Eaton's Cooper Power series voltage regulator controls. Refer to *Service Information MN225008EN VR-32 Voltage Regulator with Quick-Drive Tap-changer Installation, Operation and Maintenance Instructions* for more information on Eaton's Cooper Power series voltage regulators.

Be sure to consult the service document provided by the manufacturer of the any voltage regulator equipment on which the universal control cable interface junction box will be installed.

Read this manual first

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment. This universal control cable interface junction box is used in conjunction with a voltage regulator and voltage regulator control. Read and understand the appropriate voltage regulator and regulator control instruction manuals before utilizing this equipment.

Additional information

These instructions cannot cover all details or variations in the equipment, procedures, or processes described or provide directions for meeting every possible contingency during installation and utilization of the equipment. For additional information, please contact Eaton's voltage regulator support at (866) 975-7347.

Acceptance and initial inspection

Each universal voltage regulator control cable interface junction box is completely assembled, tested, and inspected at the factory. It is in good condition when accepted by the carrier for shipment. Upon receipt, inspect the shipping container for signs of damage. Unpack the junction box and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and storage

Be careful during handling and storage of the universal voltage regulator control cable interface junction box to minimize the possibility of damage. If the junction box is to be stored for any length of time prior to installation, provide a clean, dry storage area.

Standards

Eaton designs and tests its Cooper Power series voltage regulator equipment in accordance with the following standards:

IEEE Std C37.90.1™-2012 standard
IEEE Std C37.90.2™-2004 standard
IEEE Std C57.13™-2008 standard
IEEE Std C57.15™-2009 standard
IEEE Std C57.91™-2011 standard
IEEE Std C57.131™-2012 standard
EN 50081-2
EN 61000-4
IEC 60068-2
IEC 60214-1
IEC 60255-5

Quality standards

ISO 9001 Certified Quality Management System

Description

Eaton primarily designs its Cooper Power series universal voltage regulator control cable interface junction box to be used on single-phase regulators manufactured by Siemens® Corporation, General Electric®, Howard Industries®, Toshiba®, and ITB®. It can also be used on Eaton's Cooper Power series McGraw-Edison™ type VR-32 voltage regulators and older models which do not have a quick connect control cable.

The universal voltage regulator control cable interface junction box kit enables the creation of a junction between voltage regulators without an Eaton's Cooper Power series style quick-connect control cable and a voltage regulator with any existing control cable of up to 14 conductors. Once the junction box is installed, a standard quick-connect cable can be connected directly to the bottom of the junction box. The junction box simplifies connection of Eaton's Cooper Power series controls to non-Cooper Power series voltage regulators. It will also enable connection of an Eaton's Cooper Power series CL-7 multi-phase control to most any set of voltage regulators.

The universal control cable interface junction box is also equipped with a CT shorting device. This device allows for the disconnection of the control cable and control without opening the CT connections. The device will automatically short the CT when the CT circuit opens.

Installation procedures

Removal of the existing control box

To insure a smooth and safe installation of the new junction box and voltage regulator control, it is important to follow safe practices and take note of the existing installation.

 **DANGER**

Explosion Hazard. Voltage regulators are subject to high circulating current during bypass switching. Refer to Service Information MN225003EN CL-7 Voltage Regulator Control Installation, Operation, and Maintenance Instructions for information on the CL-7 Control, and refer to the instruction manual supplied by the voltage regulator manufacturer for specific safety procedures for bypass switching. Failure to comply will result in severe personal injury or death.

VR-T239.0

 **WARNING**

Arc Flash Hazard. Opening the CT circuit under load will produce high voltages in the control box. Always bypass the regulator when doing the work described in these procedures to prevent opening the CT circuit while the regulator is under load. Failure to comply can result in severe personal injury or death.

VR-T240.0

The removal of the existing control box and installation of the universal control cable junction box may be performed in the shop or the field. The regulator must be bypassed or removed from service prior performing this work. Always bypass the regulator when performing this work in the field to prevent opening the CT circuit while the regulator is under load.

Note: The control cable may be an actual cable or a flexible conduit. For these instructions, it will be referred to as "control cable".

Removal of the existing control cabinet

1. Before removing the original control it is a good idea to confirm that all voltage regulator functionality is working properly. If problems are found with the voltage regulator, takes steps to make repairs before proceeding with the installation of new control equipment.
2. Bypass the regulator or remove it from service.
3. Open the existing control cabinet and swing out the control panel. Remove the control panel by disconnecting the plug or leads and lifting it off of its hinges.
4. If the incoming control cable leads are not marked or color-coded, place appropriate wire markers on the control cable leads and mark the leads for later reference.

5. Disconnect the incoming control cable leads from the terminals located on the back of the existing control cabinet.

If the tap-changer motor capacitor is located in the existing control cabinet, disconnect the leads from the capacitor and remove the capacitor for later installation in the new control box.

6. Remove the control cable from the control box.

If the control leads are housed in a non-flexible conduit, it may be necessary to modify or replace the conduit with a flexible conduit to allow for an interface with the universal control cable junction box.

7. Remove the nameplate from the existing control box and retain for later attachment to the new control box.
8. Remove the existing control cabinet from the regulator and retain the hardware for later use.

Universal control cable interface junction box installation

Junction box mounting options

There are two available mounting options for the universal voltage regulator control cable interface junction box:

1. Mounting the junction box onto a voltage regulator tank when the control cabinet will be mounted remotely.
2. Mounting the junction box directly onto the top of an Eaton's Cooper Power series control cabinet.

Select the option that meets your requirements for each voltage regulator. When using a CL-7 multi-phase voltage regulator control, it is likely that on one regulator, Option 2 will be used and on the remaining two regulators, Option 1 will be used.

Option 1 – Mounting junction box on voltage regulator with control mounted remotely.

Junction box bracket assembly

The junction box brackets consist of two metal plates with a slight bend. They are attached to the junction box to enable mounting of the box on the universal regulator mounting bracket which is mounted to the voltage regulator tank.

Review the list of required parts and Figure 1 below for proper assembly.

Table 1. Parts List for Option 1

Item No.	Description	Qty.
1	Junction box assembly	1
2	Junction box bracket	2
3	Machine screw, SS, 10-24 x 1.25"	4
4	Flat washer, SS, #10	4
5	Lock nut, SS, #10	4

1. Identify the parts as noted in Table 1.
2. Remove the cover from the junction box assembly (item 1 in Table 1).
3. Mount the two junction box brackets (Item 2 in Table 1) to the box using the provided hardware (Items 3, 4 and 5 in Table 1). Make sure to orient the brackets with the bend in the bracket pointing away from the junction box as shown in Figure 1.
4. Replace the cover onto the junction box.

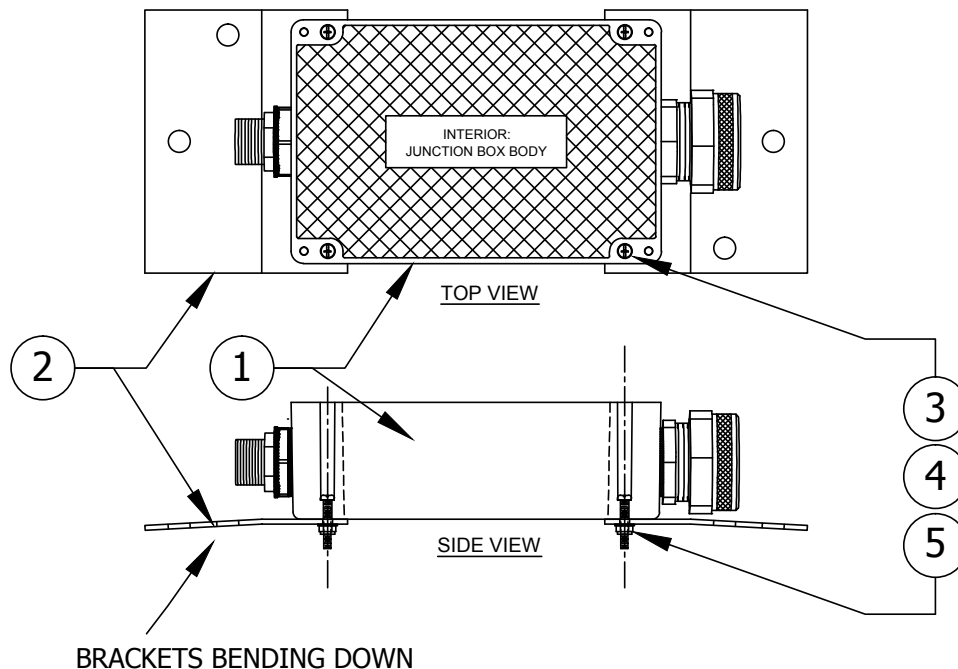


Figure 1. Junction box bracket assembly for Option 1.

Mounting the universal junction box on a voltage regulator

The universal regulator mounting bracket consists of a metal bar and formed bracket. The formed bracket is designed to mount on the control box mounting provisions on most voltage regulator tanks; the metal bar is bolted to the formed bracket.

Review the list of required parts and Figure 2 below for proper assembly of the junction box onto the universal regulator mounting bracket.

Table 2. Parts List for Junction Box Mounting and Universal Regulator Bracket Assembly for Option 1

Item No.	Description	Qty.
1	Formed universal bracket for regulator	1
2	Mounting bar	1
3	Junction box and bracket assembly	1
4	Hex Bolt: ½"-13 x 1.5"	4
5	Flat washer: ½"	8
6	Lock washer: ½"	4
7	Hex nut: ½"-13	6

1. Identify the parts as noted in Table 2.
2. Attach the formed universal bracket (Item 1 in Table 2) to the voltage regulator tank using the hardware retained earlier.
3. Attach the mounting bar (Item 2 in Table 2) to the formed universal bracket at two locations using the hardware provided (Items 4, 5, 6 and 7 in Table 2). See Detail B in Figure 2.
4. Attach the universal junction box and bracket assembly (Item 3 in Table 2) to the mounting bar in two places using the provided hardware (Items 4, 5, 6 and 7 in Table 2). See Detail A in Figure 2.
5. Attach the nameplate retained earlier to the control box that is to be mounted remotely to this voltage regulator.
6. Proceed to the section in this manual, **Control cable connections to the universal control cable interface junction box**.

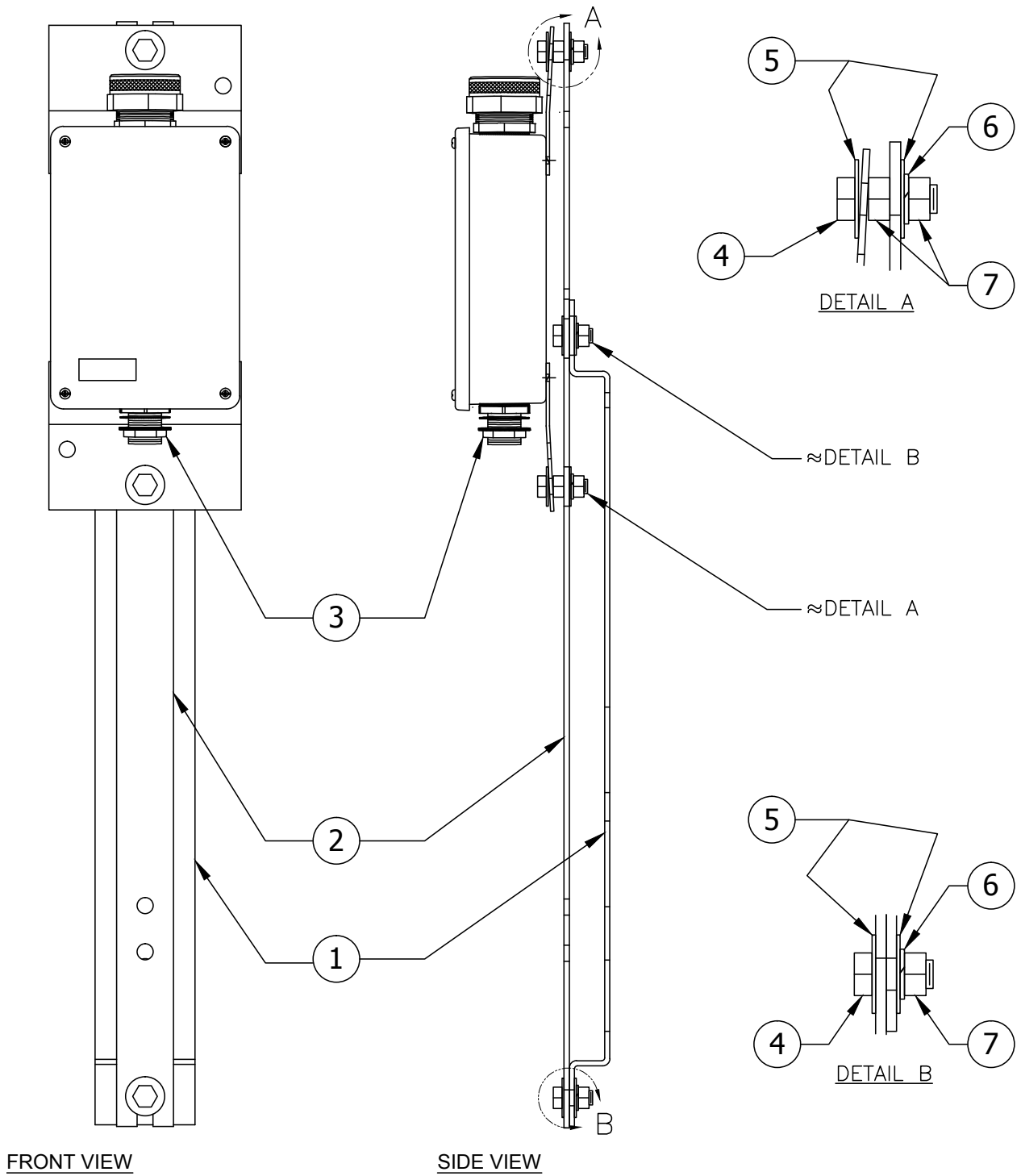


Figure 2. Universal junction box mounted on universal regulator mounting bracket for Option 1.

Option 2 – Mounting junction box directly on control box

Junction box bracket assembly

The junction box bracket consists of a metal plate with a slight bend. It is attached to the junction box to enable mounting of the box to the universal bracket which is mounted on the voltage regulator tank.

Review the list of required parts and Figure 3 below for proper assembly.

Table 3. Parts List for Junction Box Bracket Assembly for Option 2

Item No.	Description	Qty.
1	Junction box assembly	1
2	Junction box bracket	1
3	Machine screw, SS, 10-24 x 1.25"	2
4	Flat washer, SS, #10	2
5	Lock nut, SS, #10	2

1. Identify the parts as noted in Table 3.
2. Remove the cover from the junction box assembly (Item 1 in Table 3).
3. Mount one of the junction box brackets (Item 2 in Table 3) to the universal junction box (Item 1 in Table 3) as shown in Figure 3. Use the provided hardware (Items 3, 4 and 5 in Table 3). Make sure to orient the bracket with the bend in the bracket pointing toward the junction box as shown in the figure.
4. Replace the cover onto the junction box.

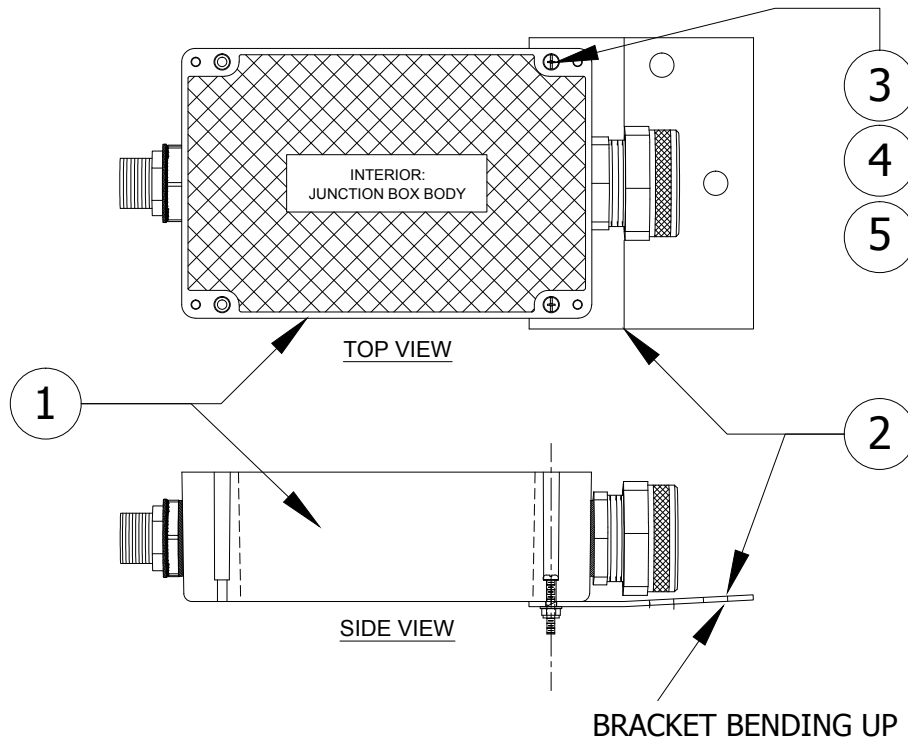


Figure 3. Junction box bracket assembly for Option 2.

Mounting a control cabinet and universal junction box onto a voltage regulator

With mounting Option 2, the universal junction box will be attached directly to the top of the voltage regulator control box. The control box and universal junction box assembly will be mounted to the universal regulator mounting bracket. The universal regulator mounting bracket consists of a metal bar and formed bracket. The formed bracket is designed to mount to the control box mounting provisions on most voltage regulator tanks and the metal bar is bolted to the formed bracket.

Review the parts list and Figure 4 below for proper assembly of the junction box onto the control box and universal regulator mounting bracket.

Table 4. Parts List for Junction Box Mounting and Universal Regulator Bracket Assembly for Option 2

Item No.	Description	Qty.
1	Formed universal bracket for regulator	1
2	Mounting bar	1
3	Junction box and bracket assembly	1
4	Hex Bolt: ½"-13 x 1.5"	3
5	Hex Bolt: ½"-13 x 1.25"	1
6	Flat washer: ½"	9
7	Lock washer: ½"	4
8	Hex nut: ½"-13	4
9	Rubber gasket: 0.09 x 1.75 OD x 1.313 ID	1
10	Washer, SS: 0.063 x 1.813 OD x 1.313 ID	1
11	Hex jam nut: 1.25"-18	1

1. Identify the parts as noted in Table 4.
2. Attach the formed universal bracket (item 1 in Table 4) to the voltage regulator tank using the hardware retained earlier.
3. To the mounting bar (item 2 in Table 4), loosely attach hardware (items 5, 6 and 8 in Table 4) as shown in Detail C in Figure 4.
4. Loosely attach the mounting bar (item 2) to the formed bracket (item 1) as shown in Detail B in Figure 4. Use hardware items 4, 6, 7 and 8 listed in Table 4.
5. Attach the bottom of the mounting bar (item 2) to the bottom of the formed bracket as shown in Detail D in Figure 4. Use hardware items 4, 6, 7 and 8 listed in Table 4.
6. It is recommended that two people work together to perform this step. Attach the control box to the mounting bar (item 2) using these steps:
 - A. Insert the bottom control cabinet mounting tab behind the loosely tightened flat washer shown in Detail C.
 - B. While the control cabinet is supported by the lower tab, remove the hardware that is loosely holding

the mounting bar (item 2) to the top of the formed bracket (item 1). Reinsert that hardware through top tab on the control cabinet, the mounting bar and formed bracket.

- C. Firmly tighten all hardware holding the control box onto the mounting bar.
7. Attach the universal junction box to the top of the control box using the following steps:
 - A. Carefully place the rubber gasket (item 9 in Table 4) over the access hole on the top of the control cabinet.

CAUTION

Equipment Damage. Make sure that as the junction box is attached to the top of the control cabinet that the rubber gasket remains properly placed. Failure to properly place the gasket could result in a water leak and damage to equipment.

VR-T241.0

- B. Carefully so as to not move the gasket out of place, insert the lower cable connection on the universal junction box (item 3 in Table 4) through access hole on top of the control cabinet.
- C. Inside the control box, secure the washer (item 10 in Table 4) and the hex jam nut (item 11 in Table 4) onto the cable connection as shown in Detail B of Figure 4.
- D. Firmly secure the hex jam nut using a large adjustable wrench. The size is 1-3/4 inches.
8. Attach the junction box bracket to the mounting bar (item 2) as shown in Detail A in Figure 4.
9. Attach the nameplate retained earlier to the control box.

Proceed to the section in this manual, **Control cable connections to the universal control cable interface junction box.**

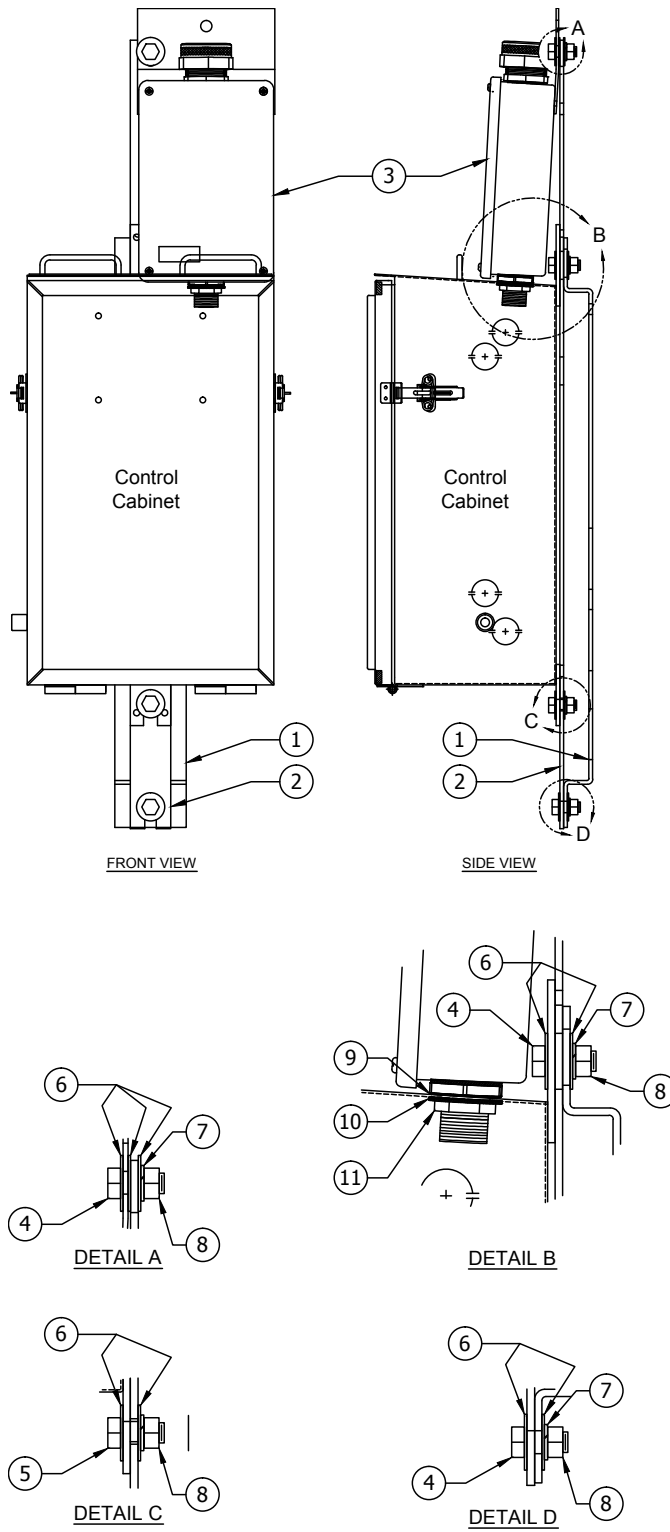


Figure 4. Universal junction box mounted on universal regulator mounting bracket and control box for Option 2.

Electrical connections to the universal junction box

Connecting the existing control cable to the universal junction box

Control cable connections to the universal junction box are made to the terminal block inside the box. Figure 5 provides a wiring chart by voltage regulator manufacturer as a guide to making the connections for a 12-conductor control cable. The wiring chart is also affixed to the inside of the junction box cover.

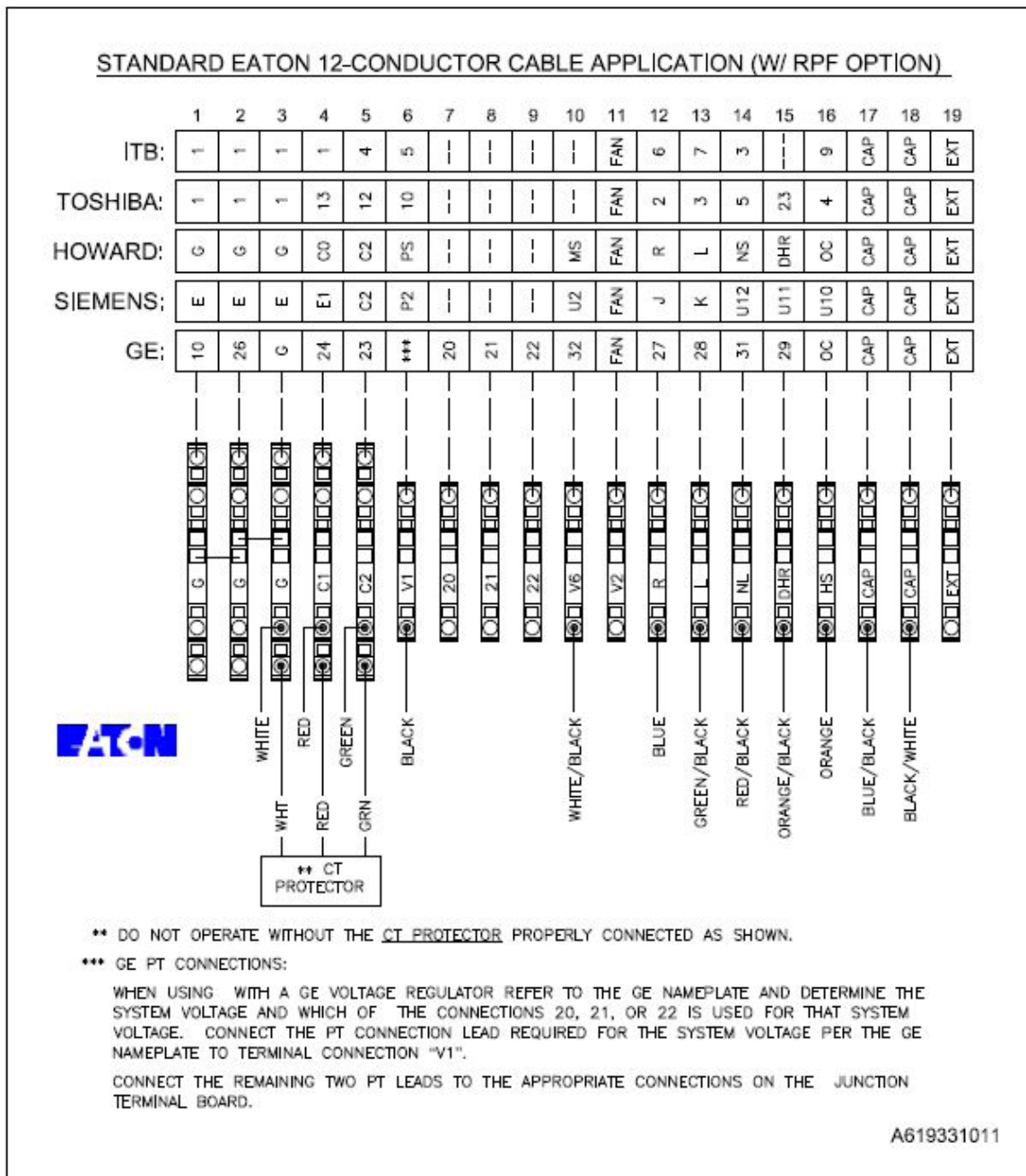


Figure 5. Universal junction box wiring chart by manufacturer for a 12-conductor control cable.

Connecting the existing control cable to the universal junction box

1. Examine the existing control cable. Determine a route for the cable and cut the cable to such a length that it will allow approximately 8 inches of lead length to protrude past the end of the conduit nut once the cable is installed into the top of the junction box.
2. Strip back the control cable casing:
 - A. If the control cable is encased in a conduit, cut the conduit to such a length that it will protrude just past the conduit nut inside the box leaving 8 inches of control cable wire.
 - B. If the cable is rubber encased, strip back the casing to expose 8 inches of control cable wire.
3. Remove the cable grip nut, washer and rubber grommet from the cable entrance of the junction box, see Figure 6.



Figure 6. Cable grip nut and rubber grommets.

4. Place the cable grip nut and washer over the existing control cable. Select one of the two supplied cable grommets that best fits the existing cable and slide that grommet over the control cable.
5. Insert the control cable into the top of the junction box and tightly secure the cable-grip nut until the grommet seals around the cable, see Figure 7.



Figure 7. Control cable protruding into the junction box.

6. Determine the proper connection point for each control cable wire using the wiring chart inside the junction box cover.
7. Cut each wire to the length required to allow easy connection to the proper terminals and strip away approximately 5/16 inch of the insulation.

8. Insert the wire insertion tool provided into the square hole next to the connection hole and press firmly. This will open the connection and allow for the wire to be inserted into the round hole (see Figure 8). Once the wire is fully inserted, remove the tool and tug on the wire to make sure it is firmly connected.

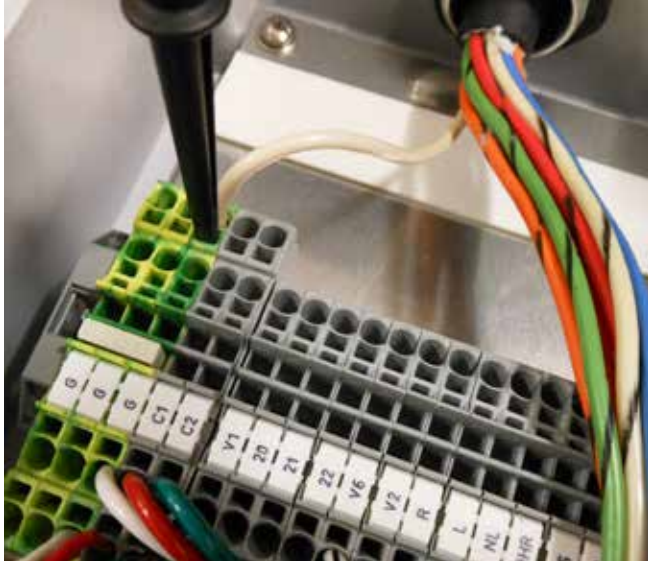


Figure 8. Using the wire insertion tool to connect a wire to the terminal board.

9. Complete the process by connecting all required wires.

Completing the connections to the new control box

Once the junction box is installed, a connection point is now available to directly connect an Eaton's Cooper Power series control box pigtail or control cable.

1. Ground the control cabinet to the tank or system ground using the ground lug on the side of the cabinet, see Figure 9.

⚠ WARNING

Hazardous Voltage. The regulator control cabinet must be solidly earth grounded. Failure to comply can cause severe personal injury and equipment damage. VR-T242.0



Figure 9. The control cabinet with ground cable connected.

2. Connect the control box to the quick connector for installation option as applies:
 - A. For option 1, remove the unused gasket, washer and nut. Connect the control cable from the control box directly to the quick connector, see Figure 10.
 - B. For option 2, connect the pigtail to the quick connector, see Figure 11. For the multi-phase control, there will be three such connections in the control cabinet.



Figure 10. Connecting a quick connect control cable to the universal junction box.



Figure 11. Connecting the control box pigtail to the universal junction box.

3. **If the universal junction box is being installed on non-Cooper Power series voltage regulators, proceed to the section Operations Counter Connections.**
4. Once the control cabinet and control are connected, proceed to programming the control. Information on the CL-7 control can be found in the document *MN225008EN, CL-7 Voltage Regulator Control Installation, Operation, and Maintenance*.

Operations counter connections

Eaton uses a holding switch circuit to seal in motor power to the tap-changer motor and enable the control to properly track tap position and operations in its Cooper Power series voltage regulators. Other voltage regulator manufacturers instead use timing and an operation counter circuit for these purposes. In order for the CL-7 control to operate a non-Cooper voltage regulator correctly, the holding switch connections in the control box must be reconnected to the general purpose inputs (GPIs) of the control. The GPI connections are located in the lower terminal board on the back panel and marked as follows:

- GPI 1 – Contact point 5
- GPI 2 – Contact point J
- GPI 3 – Contact point BR

There are two procedures below, one for the single phase control and the other for the multi-phase control. Use the procedure that applies.

Single-phase control holding switch reconnection (Figure 12)

1. Disconnect the orange wire connected to **terminal HS** on the terminal board at the bottom of the back panel. The black wire insertion tool is pressed firmly into the square hole below the wire connection to open the connection point.
2. Reconnect the orange wire to the **terminal 5**.

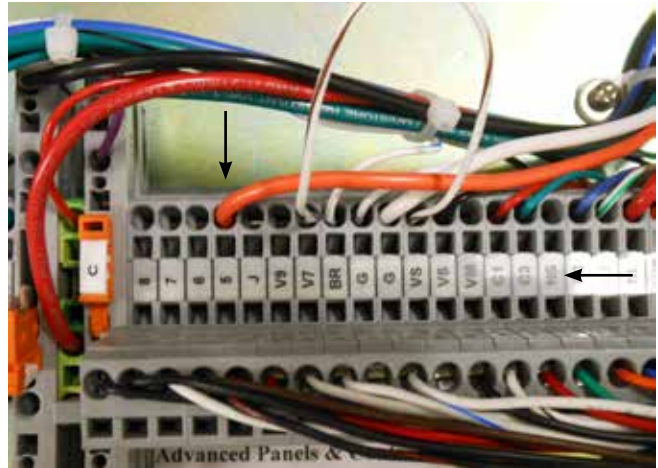


Figure 12. Orange wire moved from terminal HS terminal to terminal 5.

Multi-phase control holding switch reconnection (Figure 13)

1. Disconnect the orange wire connected to **terminal HS** on the terminal board in the center of the back panel; reconnect this orange wire to the **terminal 5**. The black wire insertion tool is pressed firmly into the square hole below the wire connection to open the connection point.
2. Disconnect the orange wire connected to **terminal HSB**; reconnect this orange wire to the **terminal J**.
3. Disconnect the orange wire connected to **terminal HSC**; reconnect this orange wire to the **terminal BR**.



Figure 13. Orange wires moved from terminals HS, HSB, and HSC to terminals 5, J, and BR respectively.

Motor capacitor connections

There are a few different scenarios that will be seen regarding the motor capacitor placement and connections.

Motor capacitor is located in the voltage regulator tank

There are connection points and wires available for connecting the motor capacitor in the control box. If the motor capacitor is located in the tank, the connection points in the universal junction box will remain unused. In the control box, the wires for connecting the motor capacitor will be blue/black and black/white. These wires should remain unconnected and be tied off securely with plastic ties.

Motor capacitor is located in the control box (single-phase control)

1. In the universal junction box, connect the motor capacitor leads to the terminals marked **CAP**.
2. Connect the motor capacitor wires in the new control box to the motor capacitor retained earlier. The motor capacitor wires will be hanging freely and will have colored blue/black and black/white.
3. Mount the motor capacitor to the stud in the top of the new control box using a metal band as shown in Figure 14.
4. Place a rubber boot over the capacitor terminals.



Figure 14. An example of motor capacitor installation in a single-phase voltage regulator control box.

Motor capacitor is located in the control box (multi-phase control)

1. In the universal junction box for each voltage regulator, connect the motor capacitor leads to the terminals marked **CAP**.
2. In the new multi-phase control box, connect the motor capacitor wires for each regulator to the appropriate motor capacitors retained earlier. The motor capacitor wires will be hanging freely and will have colored blue/black and black/white.
3. Mount the motor capacitors behind the metal bands or in the loop band as required. Figures 15 and 16 show two examples of motor capacitor mounting.
4. Place a rubber boot over the terminals on each capacitor.



Figure 15. An example of motor capacitor installation in a multi-phase voltage regulator control box.



Figure 16. Another example of motor capacitor installation in a multi-phase voltage regulator control box.

For additional technical support contact the Eaton's Cooper Power series Voltage Regulator Support Group: (866)975-7347 or VRsupport@Eaton.com.

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