Voltage Regulators

COOPER
Cooper Power Systems

McGraw-Edison® Voltage Regulator Control Replacement Assembly (CRA) Installation Instructions and Service Information

Service Information

S225-40-1

Contents

Definition of Alerts

Please read the following carefully and heed the Warnings, Cautions and Notices herein.

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

! CAUTION
A CAUTION describes a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
A NOTICE describes a situation which, if not avoided, could result in damage to the equipment with no liklihood of personal injury.

Introduction

The McGraw-Edison Voltage Regulator Control Replacement Assembly (CRA) is designed to be used on single-phase regulators manufactured by *Siemens and General Electric, as well as Cooper Power Systems' McGraw-Edison type VR32 voltage regulators. The CRA utilizes the control signals common to all regulators, and incorporates special circuitry on non-Cooper Power Systems regulators to allow the proper interface between Cooper Power Systems' CL series of regulator controls and these regulators.

NOTICE
It is essential that the installer read this document in its entirety prior to the installation of the Control Replacement Assembly.
Review of this material prior to installation will help assure trouble-free installation.

This document has been prepared as a reference for the installation and operation of the CRA. If answers to specific questions cannot be found in this document, contact your Cooper Power Systems Representative for assistance.

CRA Applications

The CRA was designed for use on GE and Siemens single-phase voltage regulators that utilize the following circuits:

- Control voltage or **Load Side** voltage signal
- Motor raise and lower circuits
- Operations counter
- Common or ground
- CT current signal (optional)
- Source Side voltage signal (optional)
- Neutral light (optional)
- Drag hand reset (optional)

All of the signals listed are necessary for proper operation of the CRA unless otherwise noted as optional.

* Siemens and Siemens Energy and Automation are registered trademarks of Siemens-Aktiengesellschaft, Germany

Refer to these instructions for the definitions of warning and caution alerts. These instructions do not claim to cover all details or variations in the equipment, procedure, or process described, nor to provide directions for meeting every possible contingency during installation or maintenance. When additional information is desired to satisfy a problem not covered sufficiently for the users purpose, please contact your Cooper Power Systems Representative.

Before Getting Started

Before starting the CRA installation process, it is recommended that the installer know the following:

a. What manufacturer's regulator will this assembly be applied to?
b. What control settings are required?
c. Knowledge of the CL control setup procedures.
d. Will the assembly will be added in the field or in the shop?
e. Ratio correction requirements, if needed.

All of the questions above can be answered by a qualified individual trained in the proper installation and servicing techniques of single-phase voltage regulators and related equipment. Proper operation of the CRA is dependent on the correct installation and setup of the assembly. The instructions given in this document are specifically for those individuals with a working knowledge of installation and service techniques of this equipment. If there are any questions encountered during the installation process as outlined in this document, contact your Cooper Power Systems Representative for assistance.

It is recommended that the regulator be tested for normal operation with the existing control panel to verify proper operation of the tap changer mechanism prior to starting the change-out procedure.

CRA Components

The following is a list of the CRA components.

Figure 1;
• Long control box
• Universal Mounting bracket and associated hardware (items 016 through 020)
Figure 2;
• Backpanel with associated wiring (item 1) and DDR circuit board mounted in long control box
• CL series control frontpanel (unless box only ordered)
• Regulator Installation and Operating Instructions (example; S225-10-4C, S225-10-10)
• CRA Installation and Service document - S225-40-1
Figure 3;
• Universal terminal designation strip. This strip is the termination point for all regulators and is coded accordingly for all units. Use this figure for the installation procedures in subsequent chapters.

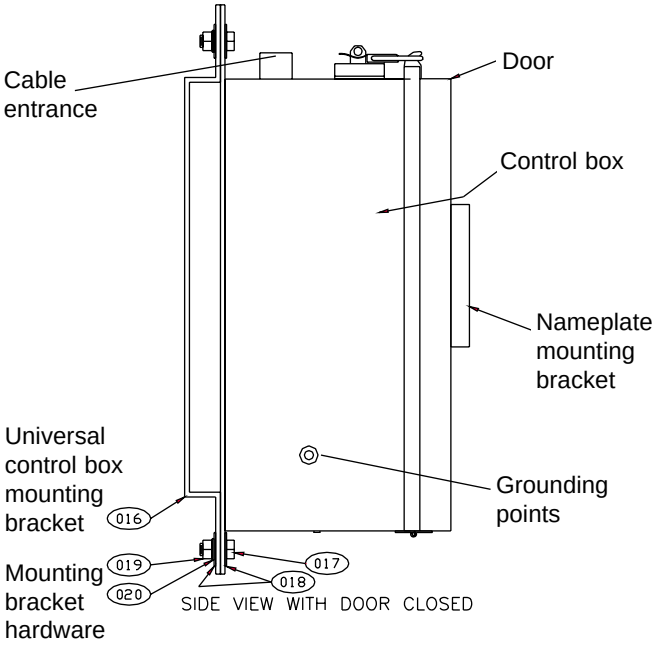


Figure 1. CRA external view

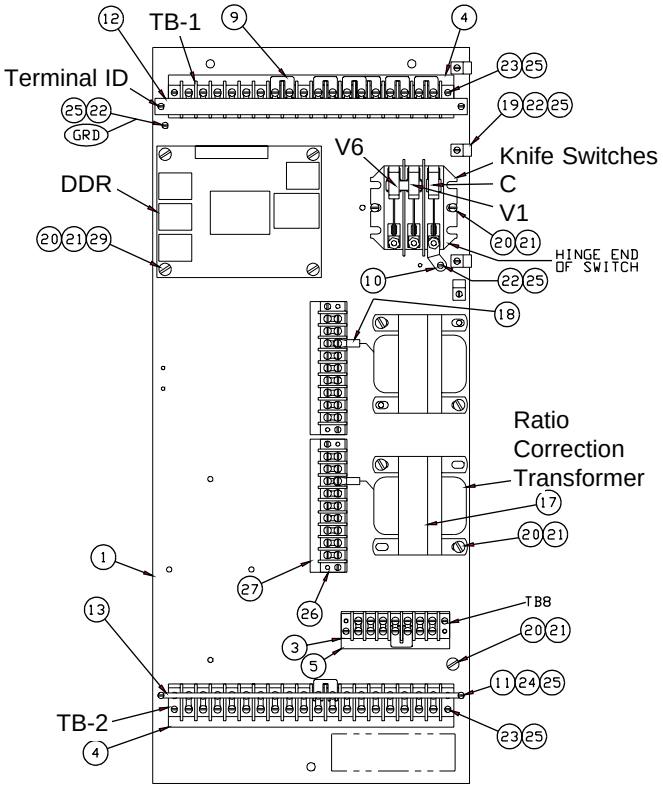


Figure 2. Backpanel, located inside box assembly

SIEMENS	E	J	K	U10	U11	U12		CPS		SOURCE	E	SOURCE	REG. SOURCE		REG. LOAD		CT HIGH		CAUTION:
G.E.	10	27	28	30	29	31		UNIT ONLY		CONN.	26 OR 10	CONN.	FROM RCT 2		FROM RCT 1		FOR ACCESSORY		DO NOT OPEN CT CIRCUIT UNDER LOAD
CPS	G	RAISE	LOWER	OPCNTR	DHR	NEUT. LT		HS		#2	G	#1	VRCT 2	V5	VRCT 1	V4	C2	C3	

Figure 3. Universal terminal strip

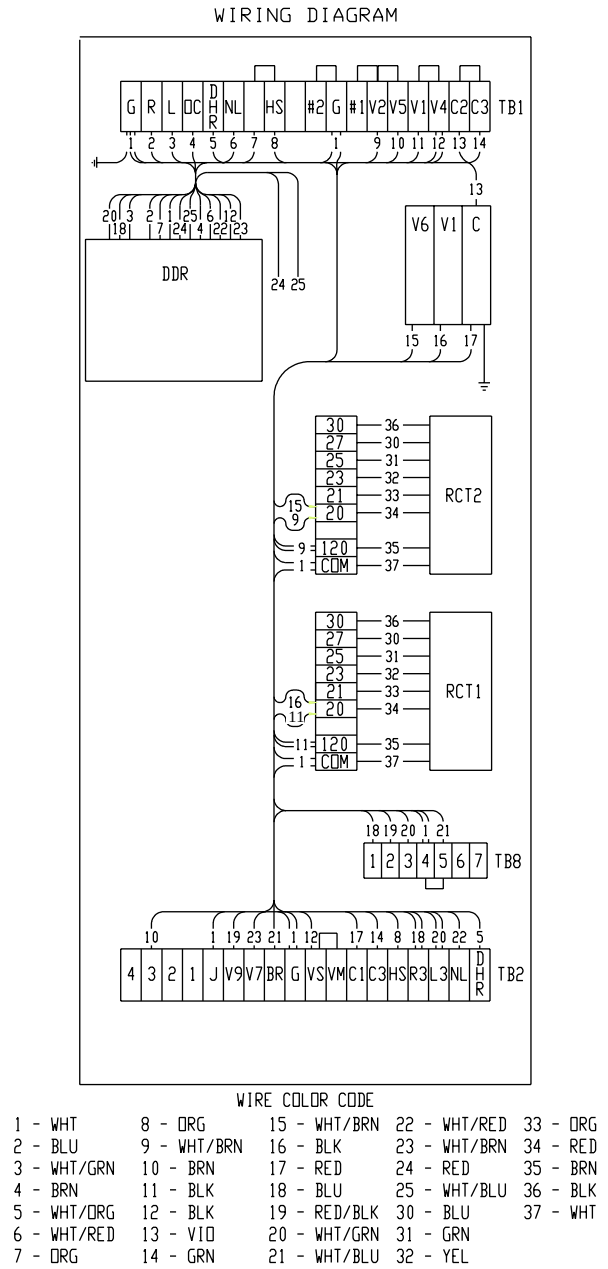


Figure 3. CRA Wiring Diagram with wire color codes

Verify that all components are included in your assembly upon receipt. If any component listed above is missing, contact your Cooper Power Systems Representative immediately.

Equipment Required

The following is a list of equipment recommended for installation. Most installations will not require use of all of the items listed, however it is advisable to have these items on hand in the event they are required.

- Long shank (9") screw holding screwdriver
- Long shank (9") standard screwdriver
- Socket set (including 1/2" and 3/4" sockets)
- 5/16" hex nut driver
- Standard lineman pliers or wire cutter/stripper
- Adjustable wrench
- Slip joint pliers
- Multimeter
- Electricians Tape
- TieWraps (9")
- Cable insulation cleaner
- Cleaning rag

S225-40-1 Installation Sections

This document has four "Installation Sections" describing the procedures for placing the Cooper Power Systems CRA on a Siemens, General Electric and Cooper Power Systems (McGraw-Edison) single- phase voltage regulator.

Section II, page 2-1, Siemens applications

Section III, page 3-1, General Electric applications

Section IV, page 4-1, Cooper Power Systems (McGraw-Edison) applications.

Section V, starting on page 5-1, reviews control setup, including ratio correction procedures, control calibration and operational testing.

Note: Although the CRA can be utilized on a Cooper Power Systems (McGraw-Edison) regulator, Cooper Power Systems recommends utilizing a standard control assembly for replacing or upgrading a Cooper Power Systems (McGraw-Edison) control since this is in the best economical interest of the customer. A standard control replacement assembly is available to the customer at less cost than the CRA. Contact your Cooper Power Systems Representative for pricing information.

SECTION II
SIEMENS APPLICATIONS

Replacement Procedure

The replacement procedure may be performed in the shop environment or the field. To facilitate field installation, the regulator must be *bypassed*. Bypassing is required for safety considerations, as the replacement procedure includes opening the CT circuit.

> **⚠ CAUTION — Field Installation Requires Bypassing The Regulator**
>
> Installation of the CRA in the field requires opening the CT circuit. Opening the CT circuit under load will produce high voltages in the control box and a hazard to Operations personnel. Always bypass the regulator when installing the CRA 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 purposes of instruction, it will be referred to as "control cable".

1. After bypassing the regulator, open the existing control box and swing out the control frontpanel.

2. Remove the frontpanel by disconnecting the jack plug and lifting the control off of its hinges.

3. If the incoming control cable leads are not marked or color coded, place appropriate wire markers on the control cable leads or mark to reference later.

4. Disconnect the incoming control cable leads from the female jack plug located on the back of the control box. If the tap changer motor capacitor is located in the control box, disconnect the leads from the capacitor and remove the capacitor for reinstallation in the Cooper box.

5. Remove the incoming control cable retaining nut and remove the cable from the control box. **If the regulator is fitted with a nonflexible conduit housing the control leads, it will be necessary to modify or replace this conduit with a flexible conduit to allow interface to the Cooper Power Systems box.** Remove the cable compression connector (cable grip) from the control box. RETAIN ALL PARTS AND HARDWARE.

6. **Remove the nameplate from the old control box assembly and retain with the hardware.** With the adjustable wrench (or appropriate socket wrench) remove AND RETAIN the bolts holding the control box on the regulator.
Remove the old control box assembly from the regulator.

7. Place the Cooper Power Systems supplied universal bracket (p.1-2, Figure 1, item 016) over the mounting bosses of the regulator and secure with bolts from the existing regulator.

8. Place the CRA control box on the universal bracket and secure it to the regulator with bolt, washer, lock-washer and nut provided (Figure 1, page 1-2, items 017 through 020). **Reattach the nameplate to the front of the the CRA control box.**

9. Ground the control cabinet via the ground boss located on the side of the cabinet.

> **⚠ CAUTION — Solidly Ground Control Box**
>
> The control cabinet must be solidly grounded to the regulator. Failure to provide a solid ground connection may cause a potential difference between the control box and the regulator which could result in circulating currents hazardous to operating personnel and the control.

10. Examine the control cable. Allow approximately 12" of lead length to protrude past the end of the conduit. This will facilitate connection to the top terminal strip and knife switches located in the box.

11. Remove the 1" pipe plug from the cable entrance flange located in the top of the CRA

control box. Insert the regulator control cable through the cable compression connector (cable grip) into the flange, tighten securely.

When turning the cable into the CRA cable flange, be certain to turn the leads inside the control box to keep from twisting together.

Wiring Siemens

12. **If there is NO source side control signal: Verify the lack of a source side or auxilliary voltage control signal ("U" winding) by examining the Siemens nameplate.**
*A green lead for source side control signal may be present, but have no signal on it. Connect the control leads as shown in figure 4. In the case of no source or auxilliary winding, no connection of the "free hanging" RED (#24) and WHITE/BLUE (#25) leads from the DDR board is necessary.

Proceed to make the following connections:

a. connect the white/brown lead (fig.4 #15) located on the bottom of V6 knife switch **TO** the bottom of the V1 knife switch **AND**

b. substitute lead #10 (brwn) for #23 (wh/brwn) (located at points "3" and "V7" respectively on the bottom terminal strip, TB-2). Isolate lead #23 (wh/brwn) with electricians/insulated tape

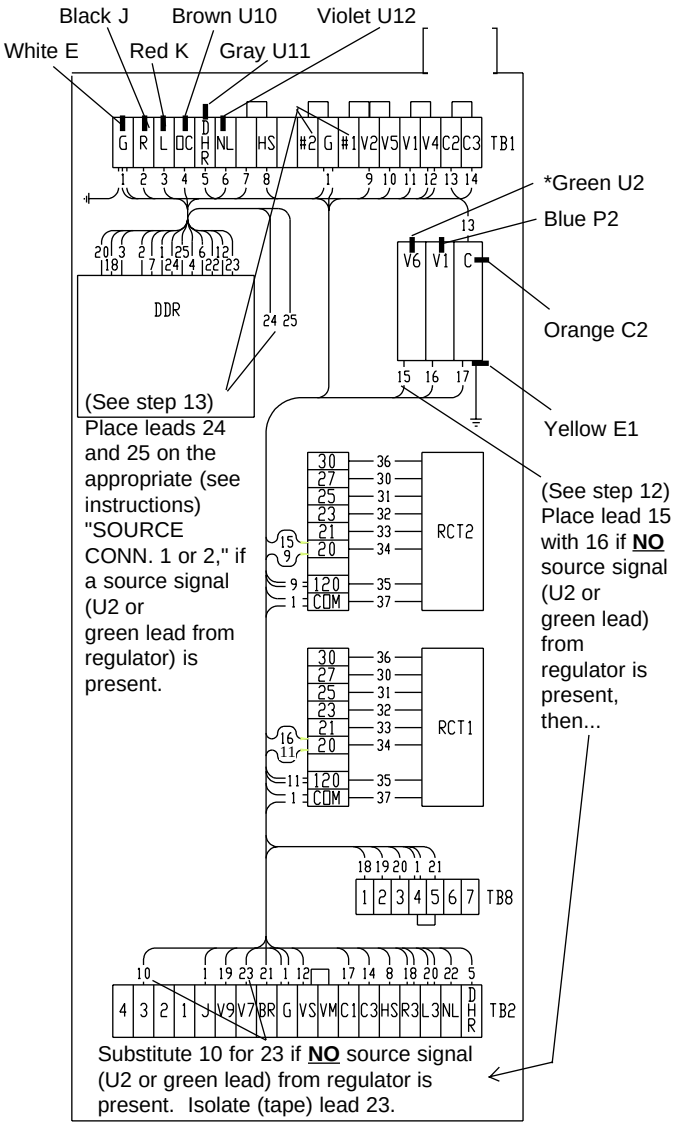
13. **If a source side control signal is present:** if the regulator does have a source side voltage signal (a green lead and/or a lead marked U2), determine the polarity of the source signal relative to the load side signal by examining the polarity marks of the source and load windings as shown on the regulator nameplate.

If the source and control windings are in phase (typical) PLACE RED LEAD #24 IN FIGURE 4 ON THE TERMINAL IDENTIFIED AS "SOURCE CONNECTION 1" AND THE WHITE/BLUE LEAD #25 ON "SOURCE CONNECTION 2".

If the source and control windings are NOT in phase (not typical) PLACE RED LEAD #24 IN FIGURE 4 OF THE TERMINAL IDENTIFIED AS "SOURCE CONNECTION 2" AND THE WHITE/BLUE LEAD #25 ON "SOURCE CONNECTION 1", (opposite from previous instructions).

Complete the wiring of the control cable leads as shown in figure 4.

Figure 4. Siemens Wiring Installation



WIRE COLOR CODE

1 - WHT	8 - ORG	15 - WHT/BRN	22 - WHT/RED	33 - ORG
2 - BLU	9 - WHT/BRN	16 - BLK	23 - WHT/BRN	34 - RED
3 - WHT/GRN	10 - BRN	17 - RED	24 - RED	35 - BRN
4 - BRN	11 - BLK	18 - BLU	25 - WHT/BLU	36 - BLK
5 - WHT/ORG	12 - BLK	19 - RED/BLK	30 - BLU	37 - WHT
6 - WHT/RED	13 - VIO	20 - WHT/GRN	31 - GRN	
7 - ORG	14 - GRN	21 - WHT/BLU	32 - YEL	

CAUTION

Incorrect polarity setup will cause high voltages on the DDR and control which will result in damage to these components. Be certain of polarity configuration before completing the installation wiring.

CAUTION

The P2 and U2 control signals must never be connected to the same point. Internal damage to the regulator will occur if these two signals are shorted together.

14. If the previous regulator control had the tap changer motor capacitor located in the control box, relocate the capacitor on the Accessory Shelf Assembly, located in the upper portion of the CRA control box. Swing the Accessory Shelf Assembly out, and secure the capacitor to the shelf via tie-wraps or other fastening device (not included). Reconnect the capacitor leads to the capacitor and close the Accessory Shelf Assembly.

15. Verify that
    a. the DDR is plugged into the cable harness
    b. that V1 and V6 knife blades are open and
    c. that C knife blade is closed (shorted).

    Install the Cooper Power Systems control frontpanel if it is not in place already.

    Proceed to Section V of this manual for information on operational checks, control calibration and ratio correction.

SECTION III
GE APPLICATIONS

Replacement Procedure

The replacement procedure may be performed in the shop environment or the field. GE regulators incorporate a control cable disconnect device. The disconnect device has an internal CT short circuiting scheme that shorts the internal current transformer circuit when the control cable is disconnected. (See the GE regulator service guide for specific information.) If there is doubt as to whether or not the CT shorting device is functional, it is recommended that the regulator be bypassed to remove load current from the regulator which would render the CT circuit safe to open during installation of the CRA.

! CAUTION — Field Installation Requires Short Circuiting the CT circuit

Installation of the CRA in the field requires opening the CT circuit. Opening the CT circuit under load will produce high voltages and a hazard to Operations personnel. Disconnect the GE position indicator plug assembly from the regulator prior to working in the control box.

1. Disconnect the GE "position indicator plug assembly" from the bottom of the position indicator. This will short circuit the internal CT.

2. Open the existing control box and note the incoming control cable leads and associated color coding.

3. If the incoming control cable leads are not marked or color coded, place appropriate wire markers on the control cable leads or mark to reference later when reconnecting in the Cooper CRA box.

4. Disconnect the incoming control cable leads from the terminal strip(s) located on the back of the GE control box. If the tap changer motor capacitor is located in the control box, disconnect the leads from the capacitor and remove the capacitor for reinstallation in the Cooper box.

5. Remove the incoming control cable retaining nut and remove the cable from the control box. **If the regulator is fitted with a nonflexible conduit housing the control leads, it will be necessary to modify or replace this conduit with a flexible conduit to allow interface to the Cooper Power Systems box.**

6. **Remove the nameplate from the old control box assembly and retain with the hardware.** With the adjustable wrench (or appropriate socket wrench) remove AND RETAIN the bolts holding the control box on the regulator. Remove the old control box assembly from the regulator.

7. Place the Cooper Power Systems supplied universal bracket (p.1-2, Figure 1, item 016) over the mounting bosses of the regulator and secure with bolts from the existing regulator.

8. Place the CRA control box on the universal bracket and secure it to the regulator with bolt, washer, lock-washer and nut provided (Figure 1, page 1-2, items 017 through 020). **Reattach the GE nameplate to the front of the CRA control box.**

9. Ground the control cabinet via the ground boss located on the side of the cabinet.

! CAUTION — Solidly Ground Control Box

The control cabinet must be solidly grounded to the regulator. Failure to provide a solid ground connection may cause a potential difference between the control box and the regulator which could result in circulating currents hazardous to Operating personnel and the control.

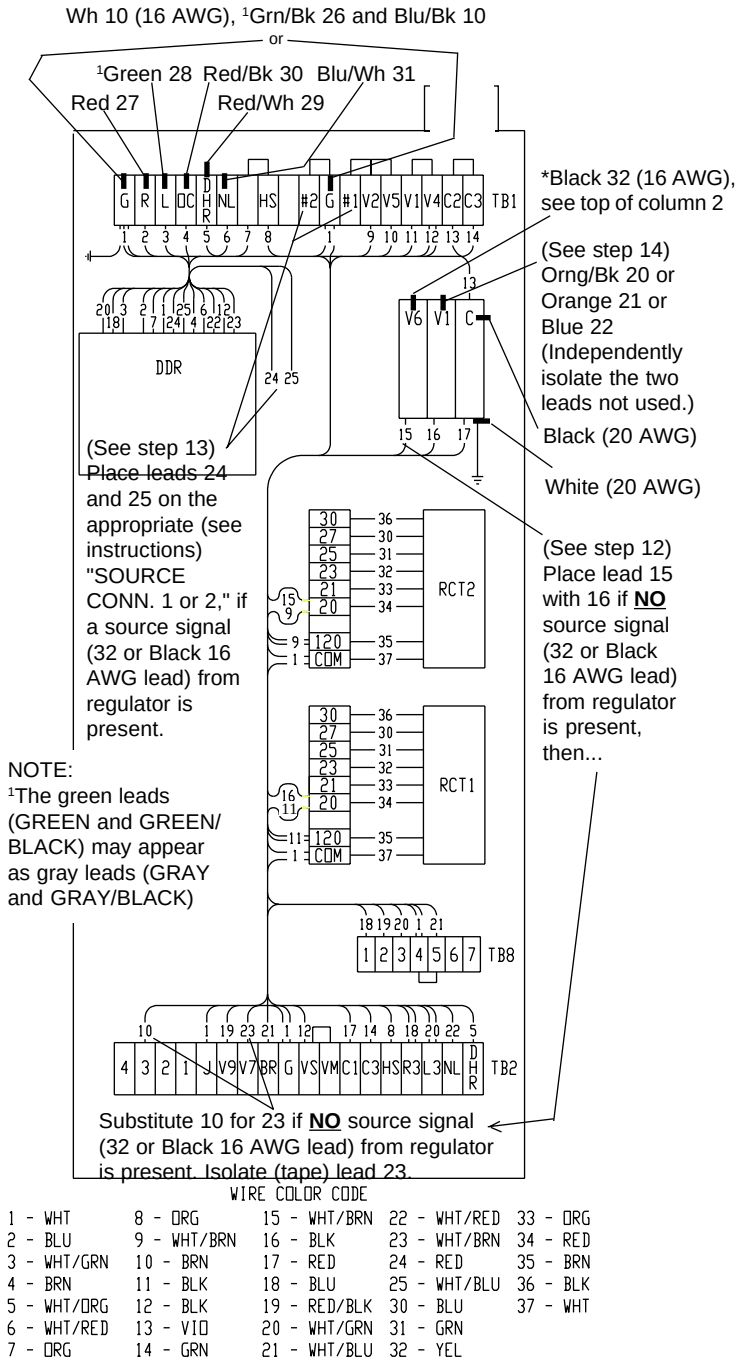
10. Allow approximately 12" of lead length to protrude past the end of the GE cable insulation and/or the threaded cable compression fitting. This will facilitate connection to the top terminal strip and knife switches located in the CRA box.

11. Remove the 1" pipe plug from the cable entrance flange located in the top of the CRA control box. Insert the GE control cable through this opening and tighten the threaded cable compression fitting into the cable entrance flange securely.

Wiring GE

12. **If there is NO source side control signal: Verify the lack of a source side voltage control signal by examining the GE nameplate.**
Connect the control leads as shown in figure 5.

Figure 5. GE Wiring Installation



*A black (32) 16AWG lead used for source side control signal may be present; however, there will be no signal on it. In this case, no connection of the CRA "free hanging" RED (#24) and WHITE/BLUE (#25) leads from the DDR board is necessary. Tape the leads.

Proceed to make the following connections:

a. connect the white/brown lead (fig.5 #15) located on the bottom of V6 knife switch **TO** the bottom of the V1 knife switch **AND**

b. substitute lead #10 (brwn) for #23 (wh/brwn) (located at points "3" and "V7" respectively on the bottom terminal strip, TB-2). Isolate lead #23 (wh/brwn) with electricians/insulated tape.

13. **If there is a source side control signal:** connect the control leads as shown in figure 5. If the regulator does have a source side voltage signal (a black, 16 AWG lead and/or a lead marked 32), determine the polarity of the source signal relative to the load side signal by examining the polarity marks of the source and load windings as shown on the regulator nameplate.

If the source and control windings are in phase (typical) PLACE RED LEAD #24 IN FIGURE 5 ON THE TERMINAL IDENTIFIED AS "SOURCE CONNECTION 1" AND THE WHITE/BLUE LEAD #25 ON "SOURCE CONNECTION 2".

If the source and control windings are NOT in phase (not typical) PLACE RED LEAD #24 IN FIGURE 5 OF THE TERMINAL IDENTIFIED AS "SOURCE CONNECTION 2" AND THE WHITE/BLUE LEAD #25 ON "SOURCE CONNECTION 1", (opposite from previous instructions).

! CAUTION

Incorrect polarity setup will cause high voltages on the DDR and control which will result in damage to these components. Be certain of polarity configuration before completing the installation wiring.

CAUTION

The Source and Load control signals must never be connected to the same point. Internal damage to the regulator may occur if these two signals are shorted together.

13.(continued)
Verify that ALL incoming lead connections and backpanel reconnections (as required) are completed by checking the field connections against figure 5.

14. Determine which load-side control signal wire is to be utilized (connected to the top of the V1 knife switch) by examining the nameplate. There are three wires that carry the load-side control signal. The wires are marked #20 (Orange/Black), #21 (Orange) and #22 (Blue). The wire that corresponds to the system voltage used as indicated on the nameplate should be terminated at the top of the V1 knife switch. *Independently* isolate (tape) the other two leads, i.e., **DO NOT** short them together.

15. If the previous regulator control had the tap changer motor capacitor located in the control box, re-locate the capacitor on the Accessory Shelf Assembly, located in the upper portion of the CRA control box. Swing the Accessory Shelf Assembly out, and secure the capacitor to the shelf via tie-wraps or other fastening device (not included). Reconnect the capacitor leads to the capacitor and close the Accessory Shelf Assembly.

16. Verify that
a. the DDR is plugged into the cable harness
b. that V1 and V6 knife blades are open and
c. that C knife blade is closed (shorted)
d. the two load signal leads NOT used (either GE incoming leads 20,21 or 22) are isolated (wire nut, electricians tape, etc.)

Install the control frontpanel if it is not in place already.

17. Position the GE control cable so that the position indicator plug lines up with the position indicator receptacle. With the Cooper Power Systems control POWER switch in the OFF position, plug the position indicator plug into the receptacle.

Proceed to Section V of this manual for information on operational checks, control calibration and ratio correction.

SECTION IV
COOPER POWER SYSTEMS APPLICATIONS

The CRA can be placed on a McGraw-Edison voltage regulator by following the procedure given in this section. However, the CRA is designed to accommodate a Siemens or GE regulator and therefore *additional setup effort is required* to place the CRA on a McGraw-Edison voltage regulator. For this reason, as well as economical benefits, we recommend using the CRA on non-McGraw-Edison voltage regulators only, and using a *standard replacement control assembly* for McGraw-Edison voltage regulators. Standard replacement control assembly pricing and availability may be obtained by contacting your Cooper Power Systems Representative.

Replacement Procedure

The replacement procedure may be performed in the shop environment or the field. To facilitate field installation, the regulator must be bypassed. Bypassing is required for safety considerations, as the replacement procedure includes opening the CT circuit.

> **! CAUTION — Field Installation Requires Bypassing The Regulator**
>
> Installation of the CRA in the field requires opening the CT circuit. Opening the CT circuit under load will produce high voltages in the control box and a hazard to Operations personnel. Always bypass the regulator when installing the CRA in the field to prevent opening the CT circuit while the regulator is under load.

1. Open the existing control box and swing out the existing control frontpanel.

2. Short the CT circuit using the appropriate method (C knife switch, etc.). Remove the existing frontpanel.

3. If the incoming control cable leads are not marked or color coded, place appropriate wire markers on the control cable leads or mark to reference later.

4. Disconnect the incoming control cable leads from the terminal strip(s) and/or knife switches located on the back of the control box.

5. Remove the incoming control cable retaining nut and remove the cable from the control box. Proceed to remove the cable compression connector (cable grip) from the control box and cable AND RETAIN these parts.

6. **Remove the nameplate from the old control box assembly and retain with the hardware.** With the adjustable wrench (or appropriate socket wrench) remove AND RETAIN the bolts holding the control box on the regulator.
   Remove the old control box assembly from the regulator.

7. Remove the supplied universal bracket (p.1-2, Figure 1, item 016) from the CRA control box. In the majority of installations on older McGraw-Edison regulators, the universal bracket will not be required. In the event the CRA control box does not mount directly to the McGraw-Edison regulator, the universal bracket may be altered to accomodate hole and/or drill patterns.

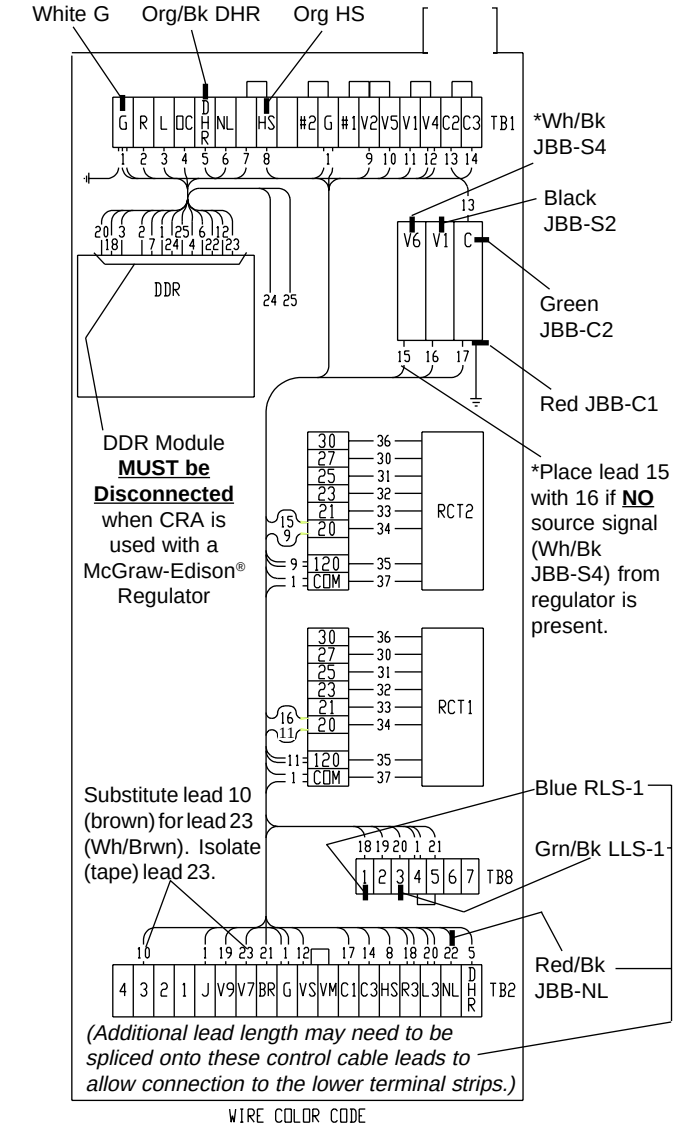
8. Place the CRA control box on the McGraw-Edison regulator and secure it to the regulator with the appropriate hardware. **Reattach the nameplate to the front of the the CRA control box.** The nameplate bracket may be removed and the McGraw-Edison nameplate affixed directly to the CRA control box.

9. Ground the control cabinet via the ground boss located on the side of the cabinet.

⚠ CAUTION **Solidly Ground Control Box**

The control cabinet must be solidly grounded to the regulator. Failure to provide a solid ground connection may cause a potential difference between the control box and the regulator which could result in circulating currents hazardous to Operating personnel and the control.

Figure 6. McGraw-Edison Wiring Installation



WIRE COLOR CODE

1 - WHT	8 - ORG	15 - WHT/BRN	22 - WHT/RED	33 - ORG
2 - BLU	9 - WHT/BRN	16 - BLK	23 - WHT/BRN	34 - RED
3 - WHT/GRN	10 - BRN	17 - RED	24 - RED	35 - BRN
4 - BRN	11 - BLK	18 - BLU	25 - WHT/BLU	36 - BLK
5 - WHT/ORG	12 - BLK	19 - RED/BLK	30 - BLU	37 - WHT
6 - WHT/RED	13 - VIO	20 - WHT/GRN	31 - GRN	
7 - ORG	14 - GRN	21 - WHT/BLU	32 - YEL	

Wiring McGraw Edison

10. Allow approximately 12" of lead length to protrude past the end of the cable insulation. This will facilitate connection to the upper terminal strip, lower terminal strips and knife switches located in the box. If there is insufficient lead length, it will be necessary to **splice** the appropriate additional lead length onto the incoming control cable.

11. Remove the 1" pipe plug from the cable entrance flange located in the top of the CRA control box. Insert the regulator control cable through, and the cable compression connector (cable grip) into the flange and tighten securely.

12. CAREFULLY disconnect the DDR harness plug from the DDR Module. When a CRA is utilized on Cooper Power Systems' McGraw-Edison voltage regulator, **the DDR module must be disconnected.**

13 substitute lead #10 (brwn) for #23 (wh/brwn) (located at points "3" and "V7" respectively on the bottom terminal strip, TB-2). Isolate lead #23 (wh/brwn) with electricians/insulated tape

14. **Examine Nameplate. If there is NO source side control signal (white/black JBB-S4 lead) perform the following:**
connect the white/brown lead (fig.6 #15), located on the bottom of V6 knife switch, to the bottom of the V1 knife switch.

15. **Examine Nameplate. If there is a source side DIFFERENTIAL control signal (a white/black, lead identified as JBB-S4) perform the following:**
Place this lead on the top of the V6 knife switch. No movement of the V6 bottom lead is required.

If in doubt whether or not your McGraw-Edison regulator is equipped with a DIFFERENTIAL source winding, contact your Cooper Power Systems Representative with the CATALOG and SERIAL number from the regulator nameplate.

16. Verify that
a. the DDR is unplugged from the cable harness and taped with electricians tape,
b. the V1 and V6 knife blades are open and
c. the C knife blade is closed (shorted).
Install the control frontpanel if it is not in place.

Proceed to Section V of this manual.

SECTION V
CONTROL SETUP

Ratio Correction

It may be necessary to **"ratio correct"** the control voltages from the regulator. Ratio correction is a fine adjustment to either the load side voltage signal, the source side voltage signal or both. This adjustment involves getting the load and the source control signals to a 120 volt base. The magnitude of the voltage signal(s) coming to the control is dependant upon the system voltage applied to the regulator (such as 7200 volts) and the regulators internal potential transformer ratio (such as 60:1). The CRA is designed to work with a 120 volt signal from the load side of any regulator, a 120 volt signal from the source side of a Siemens or GE regulator and a DIFFERENTIAL source voltage signal from McGraw-Edison regulator.

> **NOTICE**
>
> The CRA is shipped from the factory set for NO ratio correction. Examine the regulator nameplate to determine if ratio correction is required in your application.

If the regulator nameplate indicates that the load and source control signals are something other than 120 volts, such as 115, 125, etc., it will be necessary to utilize the ratio correcting transformers (RCT) located on the backpanel of the CRA. (see figure 7)
Ratio correction is achieved by simply applying the load and/or the source control signals to the RCTs (auto-transformers) so that their output of 120 volts is what the control references. How much ratio correction is necessary is determined by the internal PT ratio which can be found by examining the regulator nameplate.

Procedure:

Source control signal (sometimes present)

If the regulator is supplied with a source side signal (Siemens green "U2"; GE #16AWG black 32; McGraw-Edison white/black JBB-S4) the appropriate lead will be terminated on the top of the V6 knife switch (fig. 8).

1. If the regulator nameplate identifies the source control signal as 120 volts for the system voltage used, no ratio correction is necessary for the source signal. Proceed to **Load control signal** section.

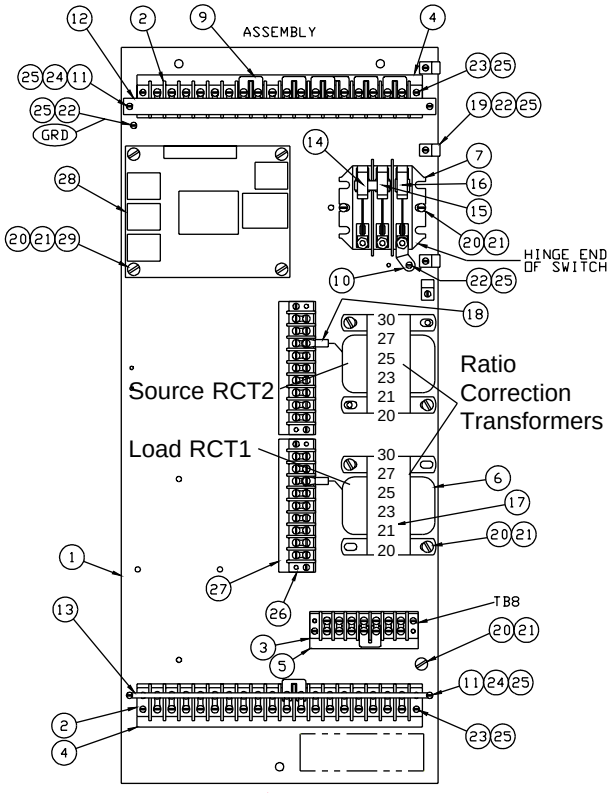


Figure 7. CRA backpanel showing RCTs

2. Example 1. If the regulator nameplate identifies the SOURCE control signal as a value less than 120 volts for the system voltage used, example 113 volts, set the ratio correction through RCT 2 by:

   a. calculate 113 - 120 = -7 volts
   b. obtain a -7 difference by placing lead # 15 (flanged spade terminal) on RCT2 - 20 and place lead # 9 (straight spade terminal) on RCT2 - 27. (20 - 27 = -7 volts).

   Example 2. If the regulator nameplate identifies the source control signal as a value more than 120 volts, for example 127 volts, set the ratio correction through RCT2 by:

   a. calculate 127 - 120 = +7 volts
   b. obtain a +7 difference by placing lead # 15 (flanged spade terminal) on RCT2 - 27 and place lead # 9 (straight spade terminal) on RCT2 - 20. (27 - 20 = +7 volts).

Load control signal (always present)

The regulator is supplied with a load side signal (Siemens blue "P2"; GE 20 org/bk or 21 orange or 22 blue; McGraw-Edison black JBB-S2). The appropriate

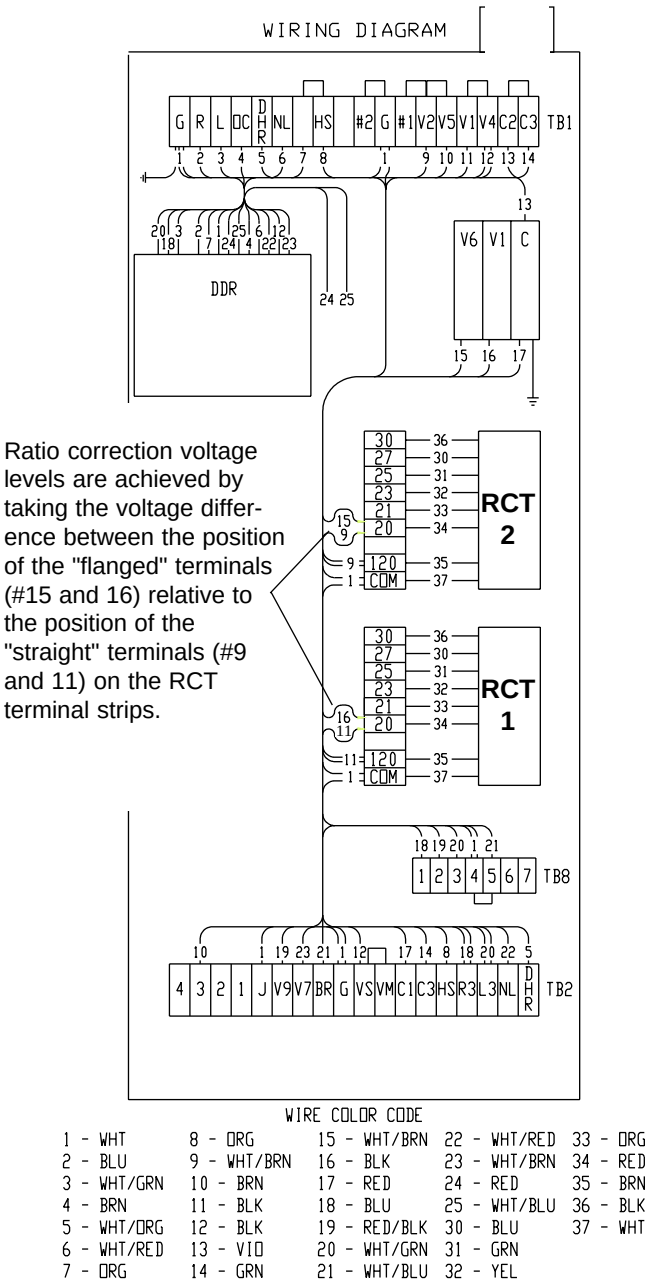


Figure 8. Ratio Correction Reference

lead will be terminated on the top of the V1 knife switch (fig. 8).

1. If the regulator nameplate identifies the load control signal as 120 volts for the system voltage used, no ratio correction is necessary for the source signal. Proceed to **Control Setup** section.

2. Example 1. If the regulator nameplate identifies the load control signal as a value than than 120 volts for the system voltage used, example 115 volts, set the ratio correction through RCT 1 by:
   a. calculate 115 - 120 = -5 volts
   b. obtain a -5 difference by placing lead # 16 (flanged spade terminal) on RCT1 - 20 and place lead # 11 (straight spade terminal) on RCT1 - 25. (20 - 25 = -5 volts).

   Example 2. If the regulator nameplate identifies the load control signal as for example 125 volts, set the ratio correction through RCT 1 by:
   a. calculate 125 - 120 = +5 volts
   b. obtain a +5 difference by placing lead # 16 (flanged spade terminal) on RCT1 - 25 and place lead # 11 (straight spade terminal) on RCT1 - 20. (25 - 20 = +5 volts).

Control Setup

Once the control is installed, complete the following.
If the regulator is in the field, perform the following:

1. All control switches in the off position. Remove the 6 Amp motor fuse from the frontpanel. With the regulator still in NEUTRAL, energize the regulator using the by-pass switch.

2. Close the CRA knife switches V1 and V6 and OPEN the C knife switch.

3. With the CONTROL FUNCTON switch in the OFF position, move the POWER switch to the INTERNAL position. This will energize the control.

If the regulator is in the shop perform the following:

1. All control switches in the off position. Place 120 volts to the EXTERNAL SOURCE terminals located on the control frontpanel. BE CERTAIN THE VOLTAGE POLARITY IS CORRECT WHEN APPLYING TO THE CONTROL. HIGH SIDE TO THE RED TERMINAL, NEUTRAL TO THE WHITE TERMINAL.

2. With the CONTROL FUNCTON switch in the OFF position, move the POWER switch to the EXTERNAL position. This will power-up the control.

Once power is applied to the control, setup of the control can be accomplished. The setup of the CRA control frontpanel is covered in the Service literature that shipped with the CRA. The standard control sent with a CRA is the McGraw-Edison CL-4C control. If a CL-4C frontpanel is used, consult S225-10-4C, page 2-32 *"Setting the CL-4C Control For Service".*
If a CL-2A frontpanel is used with the CRA, consult S225-10-5, page 2-3, *"Setting the CL-2A Control For Service".* If a CL-5A frontpanel is used with the CRA, consult S225-10-10, page 1-4, *"Setting the CL-5A Control For Service".*
Once the control is set to its proper values, **a pre-installation check** (if regulator is in the shop environment) or an **operational check** (if regulator is in the field and on the line) should performed.

Operational Check

Once the controls are set to their proper values an Operational Check should be performed to *confirm correct function of the CRA.* The operational check can be performed on the regulator while in the shop (Pre-Installation Operational Check) or in the field (In-Service Operational Check). **To perform the In-Service Operation Check, the regulator must NOT be in the system circuit *and* bypassed.**

! WARNING Regulator Will Step Off of NEUTRAL when Performing Operational Check

Stepping off of NEUTRAL **with the regulator in the system circuit and bypassed** will result in short circuiting the series winding. This will result in violent failure of the regulator and pose an injury hazard to Operation personnel.

The SOURCE and LOAD bushings of the regulator may be energized from the line through two disconnect switches (one for the SOURCE and one for the LOAD) or through one bypass type switch, i.e., McGraw-Edison Type B switch. The McGraw-Edison Type B switch isolates or opens the source and load bushing lines while bypassing the regulator with one hotstick operation. If a Type B switch is utilized, it will be necessary to use a "stinger", i.e., a conductor cable with hotstick operable line clamps, one end placed by hotstick on the source bushing of the regulator and the other end placed by hotstick on the energized line. This places line voltage on the source bushing only, and powers up the control through the regulator.

SITUATION A (no bypass switch present)
To power the control through the regulator, if the regulator-to-line wiring scheme uses a separate SOURCE and LOAD isolating disconnect switch, perform the following:

1. Verify regulator is in NEUTRAL.
2. Bypass the regulator.
3. Open the LOAD bushing disconnect as this will isolate the regulator from the system circuit.
4. Leave SOURCE bushing disconnect closed, as this will provide power to the control winding in the regulator.
5. Continue with FIELD Operational check.

SITUATION B (bypass switch utilized)
To power the control through the regulator if the regulator-to-line wiring scheme uses a bypass switch, perform the following:

1. Verify regulator is in NEUTRAL.
2. Bypass the regulator by opening the bypass switch.
3. Verify no potential between S and L bushings.
4. Clamp one end of "stinger" onto the SOURCE bushing/cable.
5. CAREFULLY clamp other end of "stinger" onto the energized line. This will provide power to the control winding in the regulator.
6. Continue with FIELD Operational check.

FIELD Operational check

1. Control POWER switch to INTERNAL.
2. CONTROL FUNCTION switch to MANUAL.
3. On the CL-4C press "0" on the keypad, i.e. Operation Counter.
4. While monitoring the operations counter, lower the regulator by pressing the LOWER control switch. The operations counter will increment and the regulator will lower one tap position. Lower the regulator until the LOW out of band indication is observed.
5. Place the AUTO/MANUAL switch into the AUTO mode. The regulator will time-out per the value entered at function code 3, then will tap up until back into band.

6. Return the regulator to NEUTRAL tap position by pressing the appropriate RAISE or LOWER control switch. The NEUTRAL LIGHT will illuminate.

7. Check the drag hand reset circuit by depressing the DRAG HAND RESET switch. The drag hands located in the position indicator will reset to the position indicator pointer position.

SHOP Operational check

The shop operational check is essentially identical to the field check except that it is performed in the shop using a 120 volt power supply instead of using line voltage through the regulator to power the control. With a properly functoning control panel, the high voltage bushings on the regulator will NOT be energized via a backfed control signal. However, it is recommended that the bushings be connected to ground as a safety precaution when performing any control panel powered testing.

It is necessary to maintain proper polarity when connecting 120 volts AC to the Cooper Power Systems frontpanel control. Incorrect polarity applied to the control could result in a shock hazard to Operating personnel as well as damage to the control and the users 120 volt source.

! CAUTION **Maintain Correct Polarity to Frontpanel**

Correct polarity must be maintained when applying 120 volts to the control frontpanel. Failure to do so will cause the users 120 volt line voltage being shorted to ground. This will result in a possible shock hazard to Operators and damage to the control and users power system.

With 120 volts applied to the external source terminals, perform the following:

1. Control POWER switch to EXTERNAL.

2. CONTROL FUNCTION switch to MANUAL.

3. When applicable, press "0" on the control keypad, i.e. Operation Counter.

4. While monitoring the operations counter, lower the regulator by pressing the LOWER control switch. The operations counter will increment and the regulator will lower one tap position.

5. While monitoring the operations counter, return the regulator to its original tap position by pressing the RAISE control switch.

6. Check the drag hand reset circuit by depressing the DRAG HAND RESET switch. The drag hands located in the position indicator will reset to the position indicator pointer position.

7. Check the neutral light circuit by manually raising or lowering the regulator to the NEUTRAL position. The NEUTRAL LIGHT will illuminate.

If any problems are encountered during the operational check, contact your Cooper Power Systems Representative for assistance.

Control Voltage Calibration (CL-4C/5A)

To assure that the CL-4C/5A is displaying accurate voltages, the control should be calibrated in the field once the regulator is back on line, in NEUTRAL with the CONTROL FUNCTION switch in the OFF position. Do this by:

1. Verify correct load and source (if available) ratio correction.

2. Place an RMS voltmeter at the terminals of the CL4C and read the voltage.

3. Activate level 3 security by entering 32123 at FC99.

4. Press FC 47 (voltage calibration). The voltmeter and the control display should read nearly identical or identical.
Correct for tolerance discrepancies *greater* than 0.4 volts by entering the voltage shown on the voltmeter at FC 47. Press "Change Reset" key followed by the value on the voltmeter, followed by the "Enter" key.

Before Closing the CRA Door

At this point, the CRA has passed its operational checks and is setup properly for operation on the system. Prior to completion of the replacement process, the following steps are recommended:

1. Verify all control settings, including switch positions.

2. Note the number of operations on the controls operations counter.

3. With a CL-4C or CL-5A control, perform a "DEMAND MASTER RESET" (FC 38). This will reset all of the demand values in the control.

4. If possible, obtain a Datareader. With a CL-4C or CL-5A control, perform a datareading. This will generate a report that can serve as a startpoint for control monitoring.

If you have questions regarding the control replacement process or troubleshooting the CRA after installation, contact your Cooper Power Systems Representative.

COOPER
Cooper Power Systems
2300 Badger Drive, Waukesha, WI 53188-5951