INSTRUCTION MANUAL

FOR

CAPACITOR CONTROL RELAY

BE1-CCR

Part Numbers
9248300100
9248300102

Basler Electric

Publication: 9248300990
Revision: C 06/02

INTRODUCTION

This instruction manual provides information about the operation and installation of the Capacitor Control Relay (CCR). To accomplish this, the following information is provided.

- General Information and Specifications
- Human-Machine Interface
- Functional Description
- Installation
- Testing and Calibration Procedures

WARNING!

To avoid personal injury or equipment damage, only qualified personnel should perform the procedures in this manual.

Lethal voltage is present at the rear panel when the unit is energized. Rear panel connections should be made only when the unit is de-energized.

NOTE

Be sure that the relay is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the relay case. When the relay is configured in a system with other protective devices, a separate lead is recommended for connecting each relay to the ground bus.

First Printing: September 1990

Printed in USA

June 2002

It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric.

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MANUAL REVISION HISTORY

The following information provides a historical summary of the changes made to the instruction manual. Revisions are listed in chronological order.

Manual Version and Date	Change
—, 09/90	Initial release
A, 07/92	Revised manual to reflect Logic circuit board change to obtain longer contact recognition time.
B, 02/01	Corrected various minor errors throughout the manual.
C, 06/02	Modified manual content to cover addition of part number 9 2483 00 102. Revised manual to reflect the current style.

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CONTENTS

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SECTION 1 • GENERAL INFORMATION

INTRODUCTION

The Capacitor Control Relay (CCR) is an automatic voltage controller. It is used to energize and de-energize capacitor banks used for power system voltage control. Var control is also achieved by switching on capacitor banks to decrease var flow and system losses at locations where var flow is excessive.

PART NUMBERS

Table 1-1 lists each CCR part number and the nominal power supply input voltage rating.

Table 1-1. CCR Part Numbers and Power Supply Voltages

Part Number	Operating Power Input
9 2483 00 100	125 Vdc, nominal
9 2483 00 102	48 Vdc, nominal

SPECIFICATIONS

Operating Power

9 2483 00 100

Nominal Input:	125 Vdc
Operating Range:	62 to 150 Vdc
Burden:	19.5 W (dc) 36.0 VA (ac)

9 2483 00 102

Nominal Input:	48 Vdc
Operating Range:	24 to 150 Vdc
Burden:	19.5 W (dc) 36.0 VA (ac)
Terminals:	3, 4

Voltage Sensing

Continuous Rating:	160 Vac
Frequency Range:	40 to 70 Hz
Maximum Burden:	1 VA
Measuring Accuracy:	±2% of pickup setting
Selection Range:	Continuously adjustable for open or close operation over the minimum range of 80 to 160 Vac or the Undervoltage Inhibit setting to 160 Vac.
Terminals:	5, 6

Contact Sensing Inputs

9 2483 00 100

Voltage Range:	62 to 150 Vdc
Burden:	0.8 W

9 2483 00 102

Voltage Range:	38 to 58 Vdc
Burden:	0.5 W

Contact Sensing Inputs—continued

Contact Recognition:	100 ms, each input

Terminals

Reset:	9, 10
Supervisory:	8, 10
52b:	7, 10

Output Contacts

Resistive

120/240 Vac:	Make 30 A for 0.2 s Carry 7 A continuously Break 7 A
125/250 Vdc:	Make and carry 30 A for 0.2 s Carry 7 A continuously Break 0.1 A
500 Vdc:	Make and carry 15 A for 0.2 s Carry 7 A continuously Break 0.1 A

Inductive

120/240 Vac and 125/250 Vdc:	Break 0.3 A (L/R = 0.04)

Terminals

Close:	1, 2
Open:	11, 12
Alarm:	19, 20

Time Delays

Accuracy:	±5% of time dial setting or 50 ms, whichever is less.
Repeatability:	±2% of setting at 25°C (77°F)

Time Delays—continued

Operation

Range:	10 to 1,000 s (00 = 1,000 s)
Increment:	10 s

Anti-Pump

Range:	10 to 1,000 s (00 = 1,000 s)
Increment:	10 s

Wait

Range:	Fixed at 5 min

Fail to Operate

Range:	Fixed at 10 s

Undervoltage Inhibit

Selection Range:	Internally adjustable over the range of 75 to 105 Vac

Environment

Temperature

Operating:	–40°C to 70°C (–40°F to 158°F)
Storage:	–65°C to 100°C (–85°F to 100°C

Type Tests

Isolation:	1,500 Vac at 60 Hz for 1 min
Surge Withstand Capability:	Qualified to IEEE C37.90a-1974
Shock:	In standard tests, the relay has withstood 15 G in each of three mutually perpendicular axes without structural damage or degradation of performance.
Vibration:	In standard tests, the relay has withstood 2 G in each of three mutually perpendicular axes swept over the range of 10 to 500 Hz for a total of six sweeps, 15 minutes each sweep, without structural damage or degradation of performance.

Physical

Weight:	13 lb (5.9 kg) maximum
Case Size:	S1

SECTION 2 • HUMAN-MACHINE INTERFACE

FRONT PANEL

Figure 2-1 shows the front panel controls and indicators for the Capacitor Control Relay. Table 2-1 describes each control and indicator and refers to the call-outs of Figure 2-1.

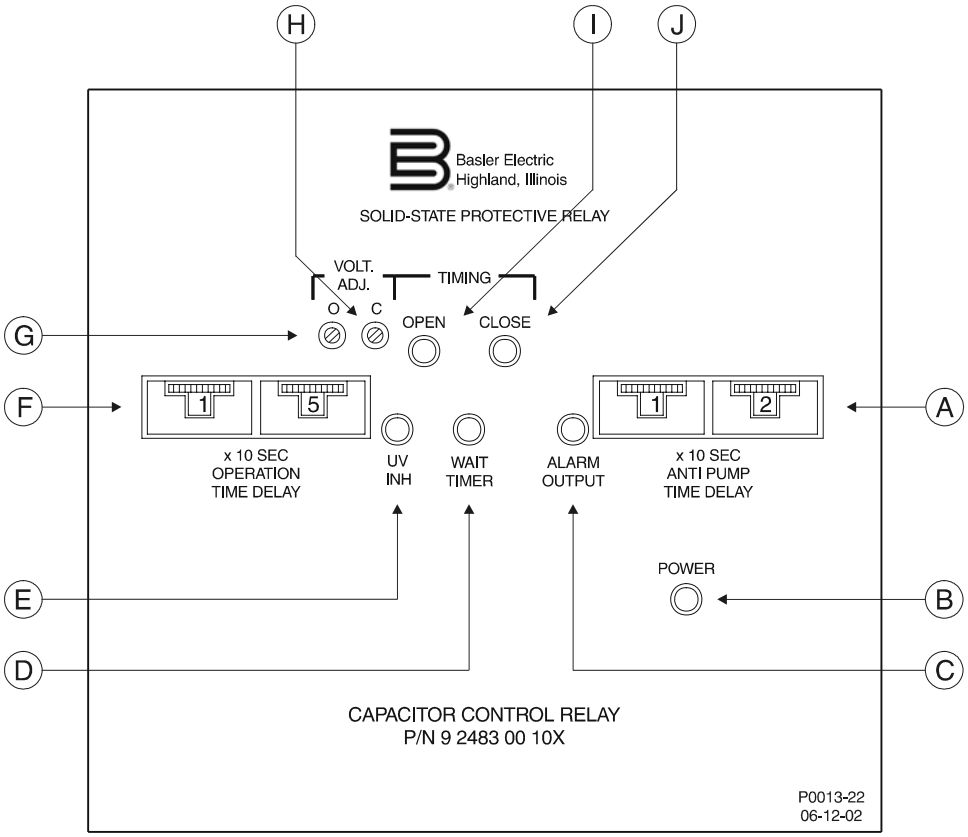

Figure 2-1. CCR Front Panel

Table 2-1. CCR Front Panel Control and Indicator Descriptions

Call-Out	Description
A	*Anti-Pump Time Delay Control.* These thumbwheel controls adjust the time delay of the Anti-Pump Timer. If the capacitor bank control breaker changes state three times before the Anti-Pump Time Delay expires, the Alarm Output LED lights and the Alarm contacts close.
B	*Power Indicator.* This LED is lit when operating power is applied to the CCR.
C	*Alarm Output Indicator.* This LED lights when the Fail to Operate Timer expires after the CCR determines that the capacitor bank control breaker has failed to respond to an Open or Close command. The LED also lights when the monitored voltage decreases below the Undervoltage Inhibit threshold. A lit Alarm Output LED indicates closed Alarm contacts.
D	*Wait Timer Indicator.* This LED lights during an Open or Close operation time delay. (The time delay for an Open or Close operation is determined by the Operation Time Delay control.

Call-Out	Description
E	*Undervoltage Inhibit Indicator.* This LED lights when the sensing voltage decreases below the internally-set undervoltage threshold. The CCR is delivered with an undervoltage threshold setting of 80 Vac.
F	*Operation Time Delay Control.* These thumbwheel controls adjust the time delay between when an Open or Close condition is detected and the Open or Close contacts change state.
G	*Open Voltage Adjustment Control.* This multi-turn potentiometer adjusts the sensing voltage level that initiates an Open command from the CCR.
H	*Close Voltage Adjustment Control.* This multi-turn potentiometer adjusts the sensing voltage level that initiates a Close command from the CCR.
I	*Open Indicator.* This LED lights when the sensing voltage increases above the Open threshold set by the Open Voltage Adjustment Control.
J	Close Indicator. This LED lights when the sensing voltage decreases below the Close threshold set by the Close Voltage Adjustment Control.

CASE TERMINALS

Figure 2-2 shows the CCR terminals located at the rear of the case and Figure 2-3 illustrates the function associated with each terminal. Table 2-2 lists the CCR terminals and describes their function.

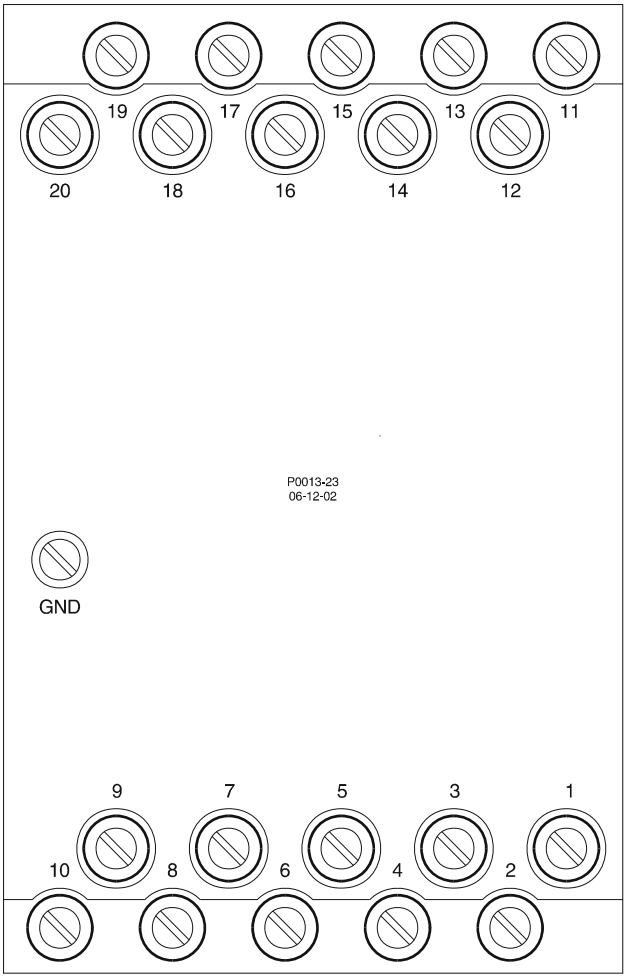

Figure 2-2. CCR Case Terminals

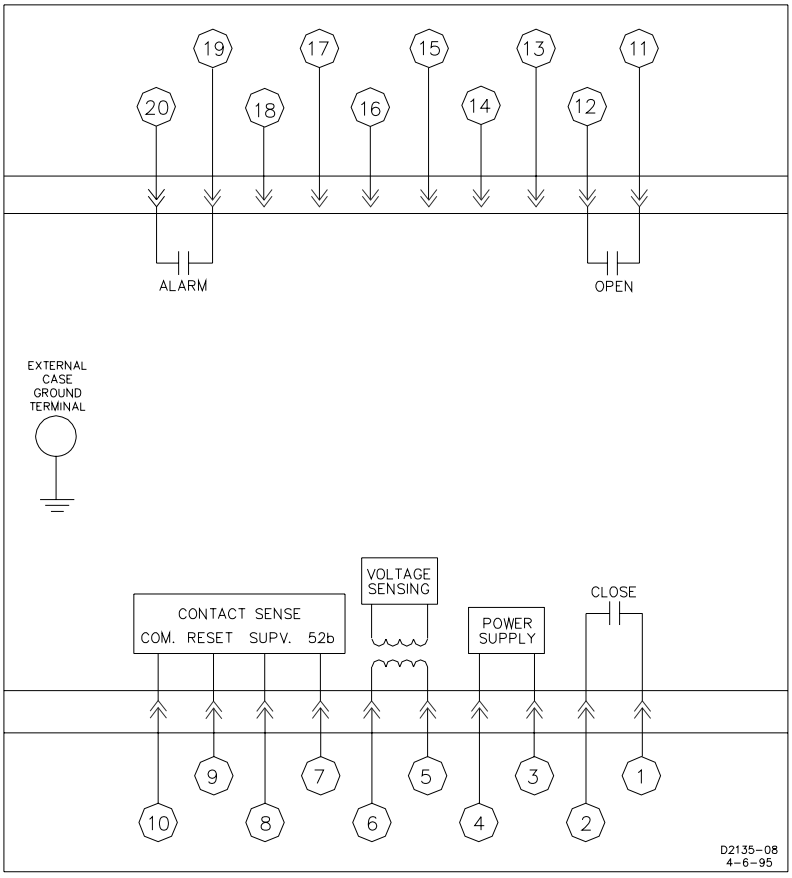

Figure 2-3. CCR Terminal Functions

Table 2-2. CCR Terminal Descriptions

Terminal Numbers	Description
1, 2	*Close Output Contact Terminals.* The contacts at these terminals close when the CCR issues a Close command to the capacitor-bank control breaker.
3, 4	*Operating Power Input Terminals.* Nominal operating power for the CCR is applied to these terminals. Refer to Section 1, *General Information, Specifications* for the acceptable range of voltage that can be applied to these terminals.
5, 6	*Voltage Sensing Input Terminals.* These terminals accept a nominal voltage of 120 Vac from a single-phase, potential transformer. The CCR issues Open commands, Close commands, and Alarm indications according to the level of voltage monitored at these terminals.
7–10	*Contact Sensing Input Terminals.* These terminals connect the three CCR contact sensing inputs: 52b, Supervisory, and Reset. Terminals 7 (+) and 10(–) connect to the 52b contact sensing inputs, terminals 8 (+) and 10 (–) connect to the Supervisory contact sensing input, and terminals 9 (+) and 10 (–) connect to the Reset contact sensing input. An external dc voltage of the proper polarity is required to energize each contact sensing input. Refer to Section 1, General Information, Specifications for the acceptable range of voltage that can be applied to these terminals.

Terminal Numbers	Description
11, 12	*Open Output Contact Terminals.* The contacts at these terminals close when the CCR issues an Open command to the capacitor-bank control breaker.
13–18	These terminals are not used.
19, 20	*Alarm Output Contact Terminals.* The contacts at these terminals close when the Fail to Operate Timer expires after the CCR determines that the capacitor-bank control breaker has failed to respond to an Open or Close command. Contact closure at these terminals also occurs when the sensed voltage decreases below the Undervoltage Inhibit threshold.
GND	*Ground Terminal.* This terminal provides the connection for grounding the CCR. Be sure that the relay case is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the relay case. When the relay is configured in a system with other protective devices, it is recommended to use a separate lead to the ground bus from each relay.

SECTION 3 • FUNCTIONAL DESCRIPTION

INTRODUCTION

The Capacitor Control Relay provides closing and opening of a capacitor-bank control breaker by monitoring the system voltage and the state of the control breaker. CCR circuit functions are illustrated in Figure 3-1 and are described in the following paragraphs.

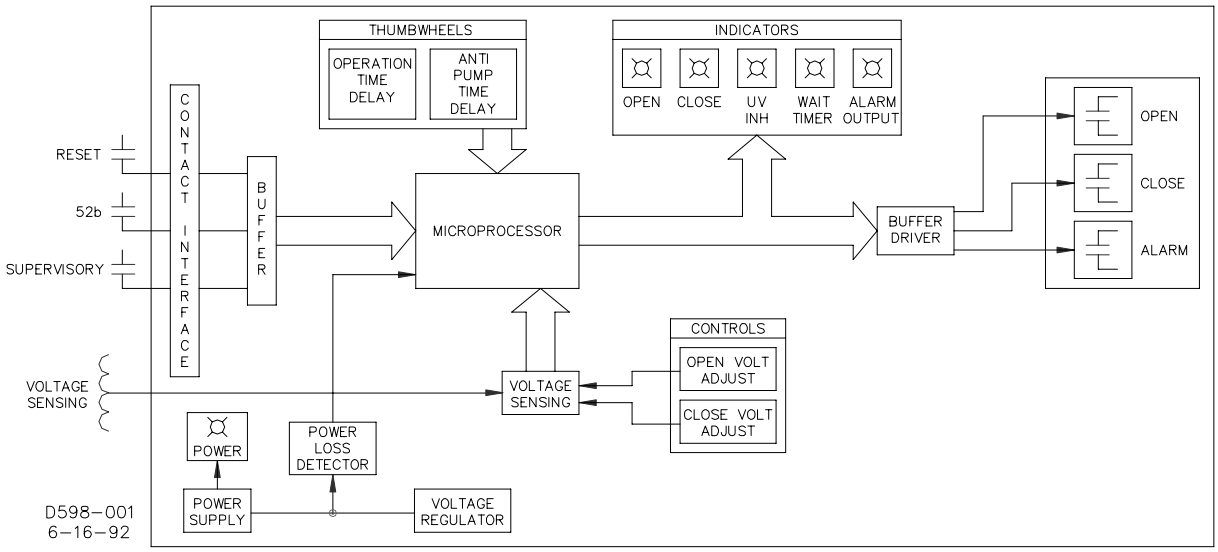

Figure 3-1. CCR Function Block Diagram

CCR OPERATION

The CCR operates according to conditions monitored at the voltage sensing input and contact sensing inputs. The following paragraphs describe CCR operation and features. The flow chart of Figure 3-2 illustrates CCR operation.

High Voltage (Open) Condition

A high voltage condition occurs when the single-phase voltage monitored at the voltage sensing input increases above the threshold set by the front panel Open Voltage Adjustment Control. This condition lights the front panel Open indicator and initiates an Operation time delay. The Operation timer is set by two front panel thumb wheels and operates only while the high voltage condition exists. When the Operation time delay expires, the Open output contacts close and initiate opening of the capacitor-bank control breaker. Once the breaker opens, a Wait timer (fixed at 5 minutes) starts timing down and the front-panel Wait Timer Indicator lights. During Wait timer operation, closing of the breaker is inhibited. A Close condition or Supervisory input will not close the control breaker. When the Wait timer expires, the Wait Timer Indicator turns off.

Low Voltage (Close) Condition

A low voltage condition occurs when the single-phase voltage monitored at the voltage sensing input decreases below the threshold set by the front panel Close Voltage Adjustment Control. This condition lights the front panel Close indicator. If the Wait timer is still active following an Open condition, the CCR will not take action to correct a low voltage condition and the Supervisory input cannot close the control breaker. If the Supervisory input is energized while the Wait timer is active, the Alarm output closes and the front panel Alarm Output Indicator lights. When the Wait timer expires, the Alarm condition resets automatically. If the Supervisory input is still present, the Close output contacts will close and initiate closure of the control breaker.

If the Wait timer is inactive, the Operation time delay starts timing down. When the Operation timer expires, the Close output contacts close and initiate closing of the capacitor-bank control breaker.

Undervoltage Condition

The Undervoltage Inhibit function is internally set at 80 Vac to limit the bottom range of the Open and Close conditions. Sensing voltage below the undervoltage inhibit level lights the front panel Undervoltage Inhibit Indicator and closes the Alarm output contacts.

Alarm Conditions

If the capacitor-bank control breaker fails to change state upon receiving an Open or Close command from the CCR, a 10 second Fail to Operate time delay starts. If the breaker fails to change state by the end of the time delay, the front panel Alarm Output Indicator lights and the Alarm output contacts close. During this alarm condition, all relay functions are disabled until a Reset input is received.

An alarm condition also occurs if the Supervisory input is energized while the Wait timer is active. This alarm condition will reset automatically when the Wait timer expires.

Closure of the Alarm output contacts occurs if the sensing voltage decreases below the level of the internally-set under-voltage inhibit threshold.

Anti-Pump Protection

The Anti-Pump time delay eliminates pumping of the capacitor-bank control breaker and is set by the Ati-Pump Time Delay Control thumb wheels on the front panel. If three breaker operations occur while the time delay is active, the front-panel Alarm Output Indicator lights and the Alarm output contacts close. The Reset input must be energized to return the relay back to a normal state.

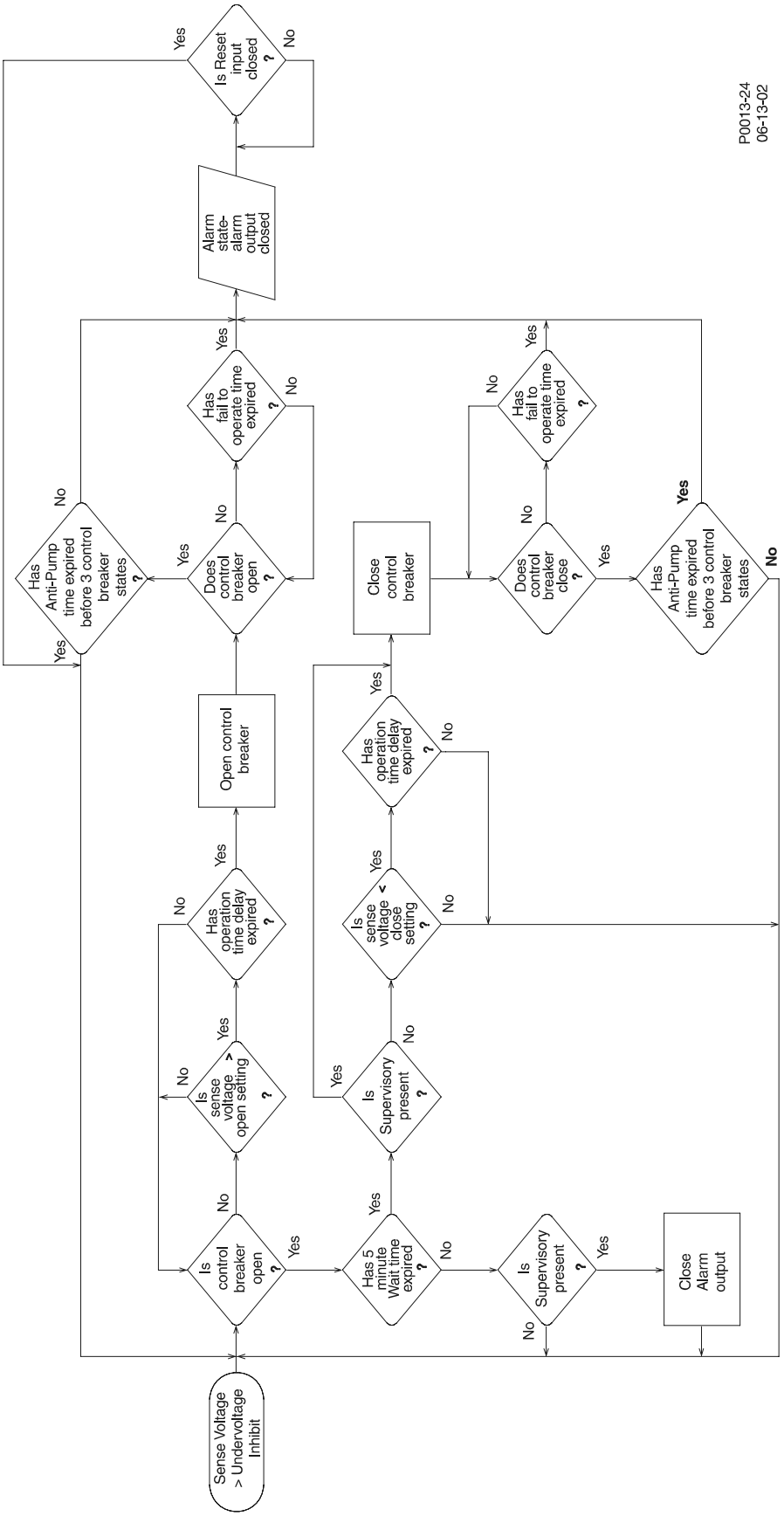

Figure 3-2. CCR Flow Chart

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SECTION 4 • TESTING AND MAINTENANCE

INTRODUCTION

This section provides procedures for verifying proper CCR operation and information about maintenance, repair and storage of the CCR.

CALIBRATION/TEST PROCEDURE

1. Connect the variable power source, latching relay, and switches as shown in Figure 4-1.

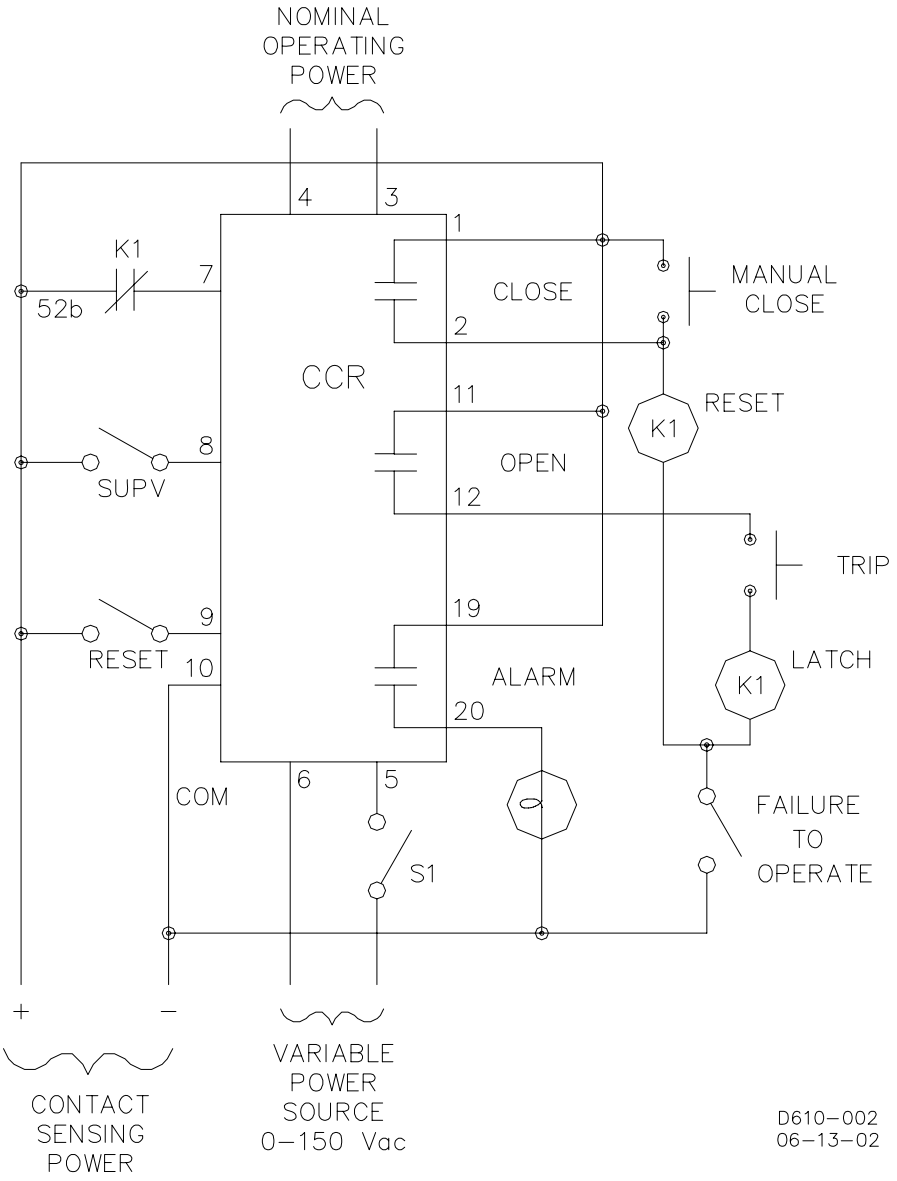

Figure 4-1. Calibration/Test Circuit

2. Adjust the front-panel Open Voltage Adjustment control fully clockwise and the Close Voltage Adjustment control fully counterclockwise.
3. Apply nominal operating power to the CCR. the Alarm output contacts pulse for 250 milliseconds and remain closed. The Alarm Output Indicator will be lit.

4. Close switch S1 and increase the variable power source voltage until the Undervoltage Inhibit Indicator turns off. The Alarm output contacts open and the Alarm Output indicator turns off. The Undervoltage Inhibit level may be adjusted using potentiometer R64 on the Analog circuit board.
5. Increase the variable power source voltage to the desired Close voltage level. Adjust the front-panel Close Voltage Adjustment control clockwise until the Close Indicator turns off. Vary the applied voltage to verify the Close setting.
6. Increase the variable power source voltage to the desired Open voltage level. Adjust the front-panel Open Voltage Adjustment control counterclockwise until the Open Indicator lights. Vary the applied voltage to verify the Open setting.
7. Increase the variable power source voltage so that the Open Indicator is lit. Open switch S1.
8. Adjust the front-panel Operation Time Delay and Anti-Pump Time Delay thumb wheels to a value of 01.
9. Connect start input of a timer/counter to CCR terminals 20 (Alarm output) and 10 (Common). Connect the stop input to CCR terminals 12 (Open output) and 10 (Common).
10. Close the Failure to Operate switch and ensure that the CCR 52b input is de-energized by pressing the momentary-action Manual Close switch.
11. Close switch S1 and measure the time from when terminal 20 (Alarm output) goes low until terminal 12 (Open output) goes high. The time should be 10 seconds, plus or minus 5 percent. This interval is the Operation time delay.
12. Press the Manual close pushbutton momentarily to open the CCR 52b input.
13. Open the Failure to Operate switch and switch S1.
14. Connect the counter/timer start input to CCR terminal 12 (Open output) and terminal 10 (Common). Connect the stop input to CCR terminal 20 (Alarm output) and terminal 10 (Common).
15. Close switch S1and allow the Operation time delay to expire. Measure the time from when terminal 12 (Open output) goes high until terminal 20 (Alarm output) goes high. The time should be 10 seconds, plus or minus 5 percent. The Open Indicator will be off, the Alarm Output Indicator will be on, and the Alarm output contacts will be closed. This interval is the Fail to Operate time delay.
16. Connect the timer/counter start input to CCR terminal 7 (52b input) and terminal 10 (Common). Connect the stop input to CCR terminal 2 (Close output) and terminal 10 (Common).
17. Close the switch connected to CCR terminal 9 (Reset input). The Alarm output contacts will open, the Alarm Output Indicator will turn off, and the Open Indicator will light.
18. Adjust the variable power source voltage until the Close Indicator lights. Energize the 52b input by pressing the momentary-action Trip switch. Measure the time from when terminal 7 (52b input) goes high until terminal 2 (Close output) goes high. The time should be 5 minutes, plus or minus 5 percent. This interval is the Wait time delay.
19. Adjust the variable power source voltage until both the Open Indicator and Close Indicator are off.
20. Press the Trip switch, then the Manual Close switch, then the Trip switch again within a span of 10 seconds. The Alarm output contacts will be closed and the Alarm Output Indicator will be lit.
21. Close the switch connected to CCR terminal 9 (Reset input). The Alarm output contacts will open and the Alarm Output Indicator will turn off.
22. Repeat Step 20, but allow more than 10 seconds to elapse from when the Trip switch is first pushed until when the Trip switch is pushed the second time. The Alarm output contacts will remain open and the Alarm Output Indicator will remain off.
23. Open switch S1 and remove CCR operating power. Restore the front-panel thumb wheel settings to their normal service values and return the CCR to service.

QUICK TEST

The following steps can be performed to verify CCR functionality.

1. Place the Normal/Test switch (located on the Logic circuit board) in the Test position.
2. Adjust the Operation Time Delay thumb wheels to any setting except 00. (A setting of 00 will cause all output relays and LED indicators to sequence on and off.)
3. Apply nominal operating power. The Alarm output will pulse for 250 milliseconds and remain closed. The Alarm Output Indicator will be lit.

> **NOTE**
> The Close and Alarm outputs will be closed to indicate that the CCR is in Test mode.

4. Apply the variable power source output to terminals 5 and 6. Vary the applied voltage to verify Open and Close conditions. Each condition will also close the corresponding relay output contacts.
5. Energize any contact sensing input (Reset, Supervisory, or 52b). The Wait Timer indicator will light when the input is energized.
6. Energize the 52b input. The Anti-Pump time delay will start timing using the value of the front-panel anti-Pump Time delay thumb wheel setting. The Open output contacts will close when the Anti-Pump time delay expires.
7. De-energize the 52b input and energize the Reset input. The Open output contacts will open.
8. Energize the Supervisory input. The Operation time delay starts timing using the value of the front-panel Operation Time Delay thumb wheel setting. The Open output contacts will close when the Operation time delay expires.
9. De-energize the Supervisory input and energize the Reset input. The Open output contacts will open.
10. Remove the voltage applied to terminals 5 and 6. The Undervoltage Inhibit indicator, Alarm Output indicator, and Close indicator will light. The Alarm output contacts and Close output contacts will close.
11. Remove CCR operating power and place the Normal/Test switch (Logic circuit board) in the Normal position.
12. Restore the front-panel thumb wheel settings to their normal service values and return the CCR to service.

MAINTENANCE

Capacitor Control Relays require no preventive maintenance. If desired, periodic testing may be performed using the test and calibration instructions of this section.

REPAIR

Capacitor Control Relays are manufactured using state-of-the-art technology. As such, Basler Electric recommends that no repair procedures be attempted by anyone other than Basler Electric personnel. If the relay fails to function properly, contact the Customer Service Department of Basler Electric for a return authorization number prior to shipping.

STORAGE

The CCR contains aluminum electrolytic capacitors which generally have a life expectancy in excess of 10 years at storage temperatures less than 40°C (104°F). Typically, the life expectancy of the capacitor is cut in half for every 10°C (50°F) rise in temperature. Storage life can be extended if, at one-year intervals, power is applied to the relay for a period of 30 minutes.

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SECTION 5 • INSTALLATION

GENERAL

Capacitor Control Relays are delivered in sturdy cartons to prevent damage during transit. Upon receipt of the relay, check the part number against the requisition and packing list for agreement. Inspect for damage, and if there is evidence of such, immediately file a claim with the carrier and notify the Basler Electric Regional Sales Office, your Sales Representative, or a Sales Representative at Basler Electric, Highland, Illinois.

If the relay is not installed immediately, store it in the original shipping package in a moisture and dust-free environment.

PRECAUTIONS

Before installing or operating the relay, note the following precautions.

- The CCR is an electronic device. If a wiring insulation test is required, remove the connection plugs and withdraw the cradle from its case.
- When the connection plugs are removed, the relay is disconnected from the operating circuit and will not provide system control. Always be sure that external operating conditions are stable before removing a relay for inspection, testing, or service.
- Be sure that the relay case is hard-wired to earth ground using the ground terminal on the rear of the unit. It is recommended that a separate ground lead be used to connect each relay to the ground bus.

MOUNTING

Because the relay is of solid-state design, it does not have to be mounted vertically. Any convenient mounting angle may be chosen. The CCR is supplied in an S1 case. Case dimensions are shown in Figure 5-1. Cutout dimensions for the case are shown in Figure 5-2.

CONNECTIONS

Incorrect wiring may result in damage to the relay. Be sure to use the correct input power for the power supply and the correct input voltage for the contact inputs. Except as noted below, connections should be made with a minimum wire size of 14 AWG.

NOTE

Be sure the relay case is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the relay case. When the relay is configured in a system with other protective devices, a separate lead is recommended for connecting each relay to the ground bus.

A rear view of the CCR case showing the terminal connections is provided in Figure 2-2. Figure 5-3 shows typical sensing input connections for the CCR. Figure 5-4 shows typical control connections for the CCR.

To prevent an inductive overload of the relay output contacts, break the trip circuit externally through the 52a contacts of the control breaker (refer to Figure 5-4).

System wiring connects to the case terminals through a connection plug. Removing the connection plug opens all normally open contacts before opening the power and sensing circuits.

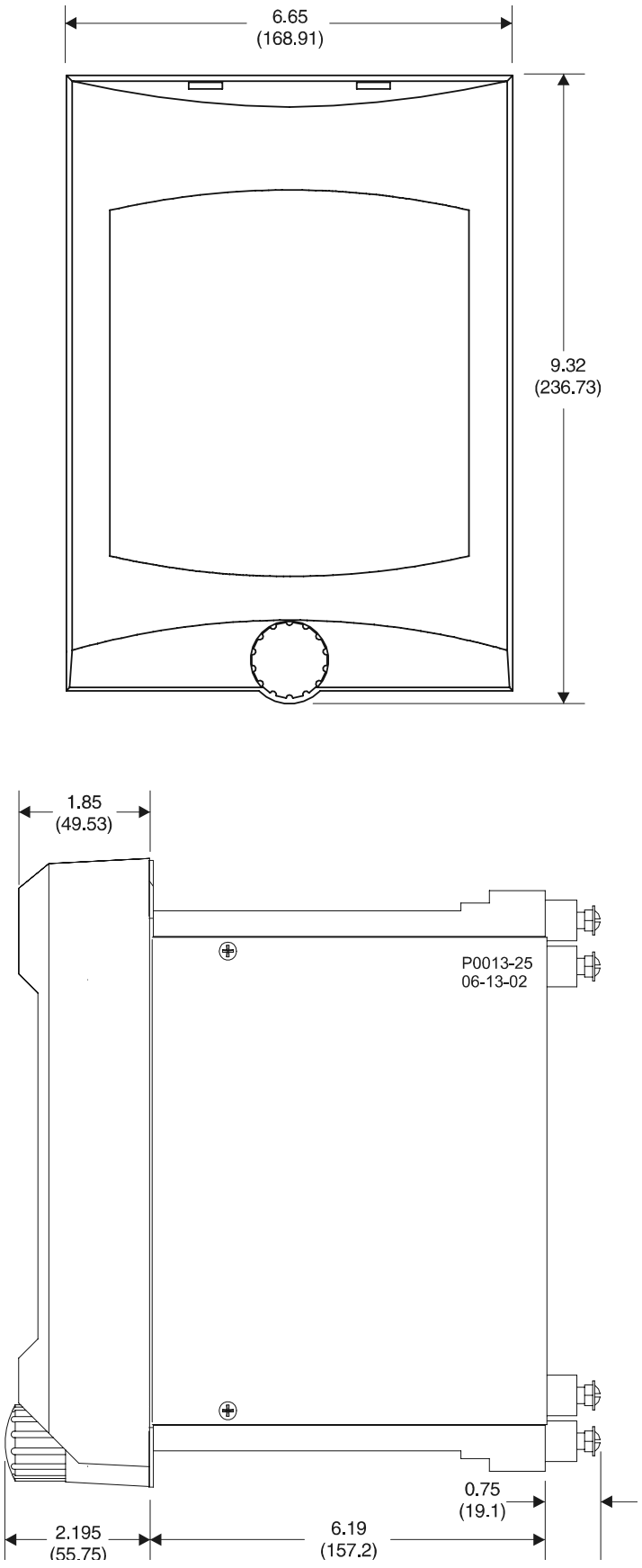

Figure 5-1. CCR Case Dimensions

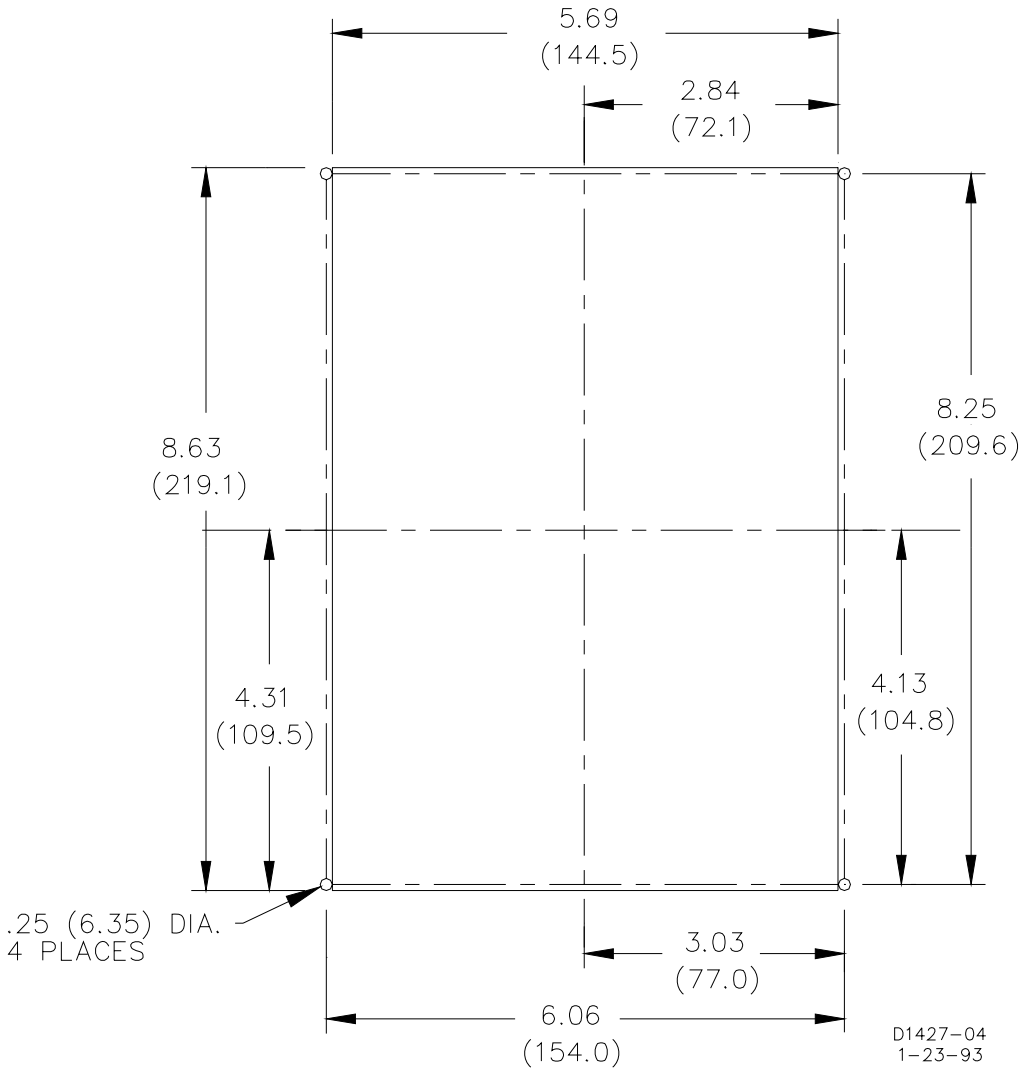

Figure 5-2. Cutout and Drilling Dimensions for S1 Case

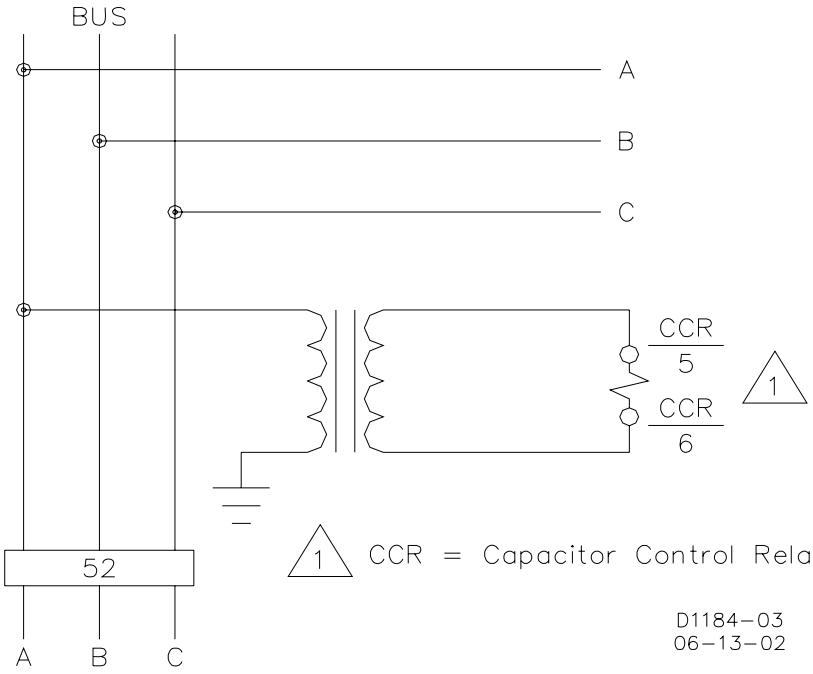

Figure 5-3. Typical Sensing Input Connections

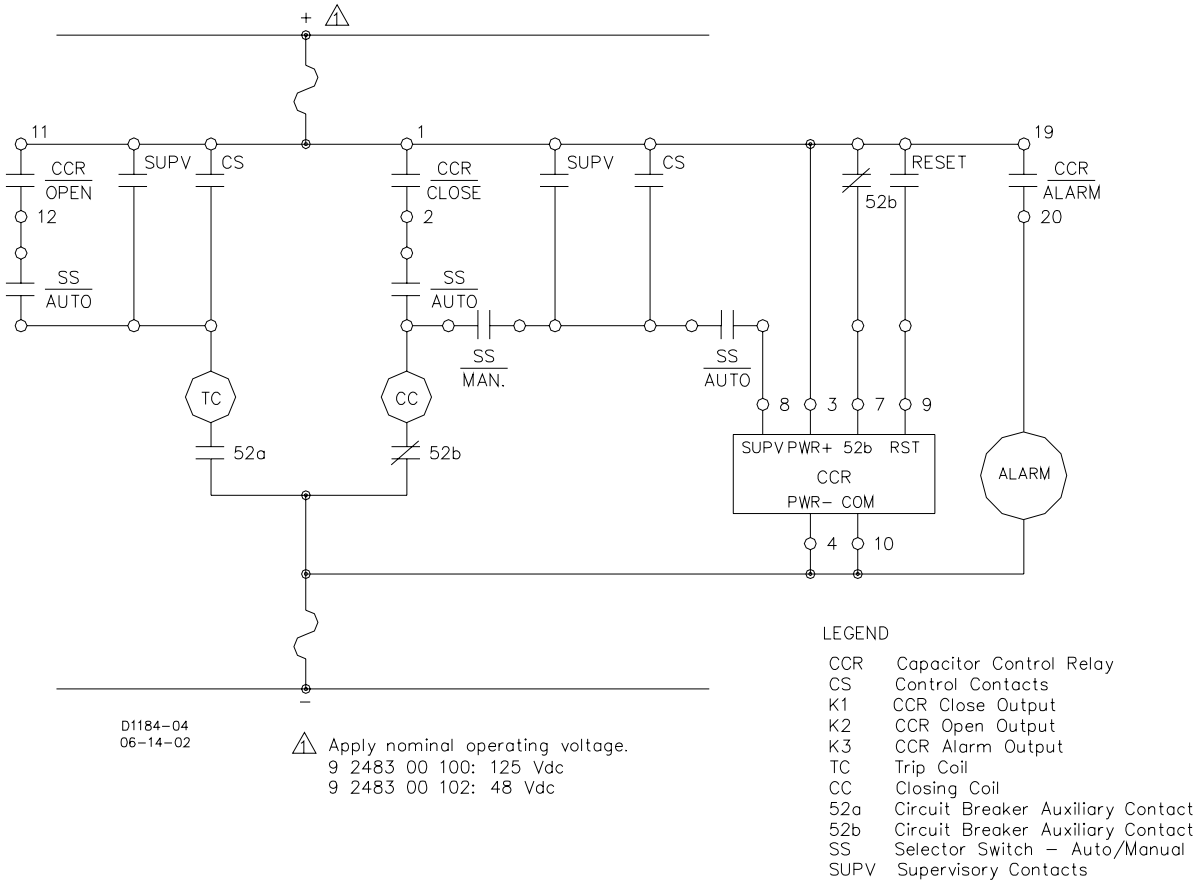

Figure 5-4. Typical Control Connections

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