NOVA triple-single, electronically controlled recloser installation and operation instructions

NOVA-TS-15 - Applicable to Serial Numbers above 999 or beginning with CP57.
NOVA-TS-27 - Applicable to Serial Numbers above 275 or beginning with CP57.
NOVA-TS-38 - Applicable to Serial Numbers beginning with CP571197287.

Powering Business Worldwide

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Contents

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

Eaton's *Service Information MN280045EN* provides installation, operation, and service instructions for its Cooper Power™ series NOVA®-TS Triple-Single, electronically controlled recloser.

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 recloser is used in conjunction with Eaton's Cooper Power series Triple-Single recloser control. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions*.

Additional information

These instructions can not cover all details or variations in the equipment, procedures, or processes described nor provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, please contact your Eaton representative.

Acceptance and initial inspection

Each recloser 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 recloser 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 recloser to minimize the possibility of damage. If the recloser is to be stored for any length of time prior to installation, provide a clean, dry storage area.

Eaton recommends transporting NOVA reclosers in the closed position to maximize the operational performance of the unit.

Standards

NOVA-TS Triple-Single, electronically controlled reclosers are designed and tested in accordance with:

IEEE Std C37.60™–2012 standard

ANSI® C37.85–2002

Quality standards

ISO 9001 Certified Quality Management System

Description

The NOVA-TS Triple-Single recloser consists of three single-phase NOVA reclosers. Each recloser consists of an interrupting module, with an embedded current transformer, and mechanism mounted to an aluminum head casting. Each mechanism and interrupter assembly is mounted to a steel tank suitable for pole or substation mounting. The interrupter modules utilize outdoor cycloaliphatic-epoxy-encapsulated vacuum interrupters.

The three single-phase reclosers that make up the NOVA-TS are controlled by a single microprocessor-based recloser control that can be programmed for three operating modes.

- Single-phase trip, Single-phase lockout
- Single-phase trip, Three-phase lockout
- Three-phase trip, Three-phase lockout

Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions* for a description of the control operation.

Ratings and specifications

Check recloser ratings prior to installation

The recloser must be applied within its specified ratings. Check data plate ratings and compare with the system characteristics at the point of application prior to installation. Tables 1–5 list the ratings and specifications for the NOVA-TS triple-single recloser.

Table 1. Voltage and Current Ratings

Rating	15-8-400	15-12-630	15-12-800	27-8-400	27-12-630	27-12-800	38-8-400	38-12-630	38-12-800
Maximum Design Voltage (kV)	15.5	15.5	15.5	27.0	27.0	27.0	38.0	38.0	38.0
Nominal Operating Voltage (kV)	14.4	14.4	14.4	24.9	24.9	24.9	34.5	34.5	34.5
Basic Insulation Level (BIL**) (kV)	110	110	110	125	125	125	170	170	170
60 Hertz Withstand Voltage (kV)							70		
Dry, one minute	50	50	50	60	60	60	60	70	70
Wet, ten seconds	45	45	45	50	50	50		60	60
Max RIV at 1.0 MHz									
9.4 kV (µV)	100	100	100						
16.4 kV (µV)				100	100	100			
23.0 kV (µV)							100	100	100
Continuous Current Ratings (A)	400	630	800	400	630	800	400	630	800
Sym. Interrupting Current (A)	8,000	12,500*	12,500*	8,000	12,500*	12,500*	8,000	12,500	12,500
Overload Capability									
125% - 8 Hours (A)	500	788	None	500	788	None	500	788	None
150% - 4 Hours (A)	600	945	–	600	945	–	600	945	–
Cable Charging Current (A)	10	10	10	25	25	25	40	40	40
Line Charging Current (A)	2	2	2	5	5	5	5	5	5
Three-Second Current, Sym. (A)	8,000	12,500*	12,500*	8,000	12,500*	12,500*	8,000	12,500	12,500

* 16.0 kA option is also available. (Making Current is 40 kA Asymmetrical Peak).
**Extended BIL option available on 15.5 kV and 27 kV products.

Table 2. Mechanical Life

Minimum Operations	10,000

Table 3. Duty Cycle

Percent of Maximum Circuit Interrupting Rating	Minimum X/R Ratio	Number of Unit Operations at 12.5 kA	Number of Unit Operations at 16.0 kA
15-20	4	88	44
45-55	8	112	56
90-100	17	32	16
		Total 232	Total 116

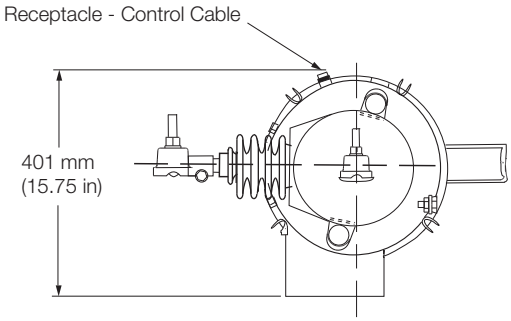
Table 4. Mass (Weight) per Mounted Triple-Single Cluster with Pole-Mounting Hanger

Recloser	NOVA-TS-15	NOVA-TS-27	NOVA-TS-38
kg (lbs)	200 (440)	206 (452)	211 (464)

Table 5. Mass (Weight) per Single-Phase Recloser

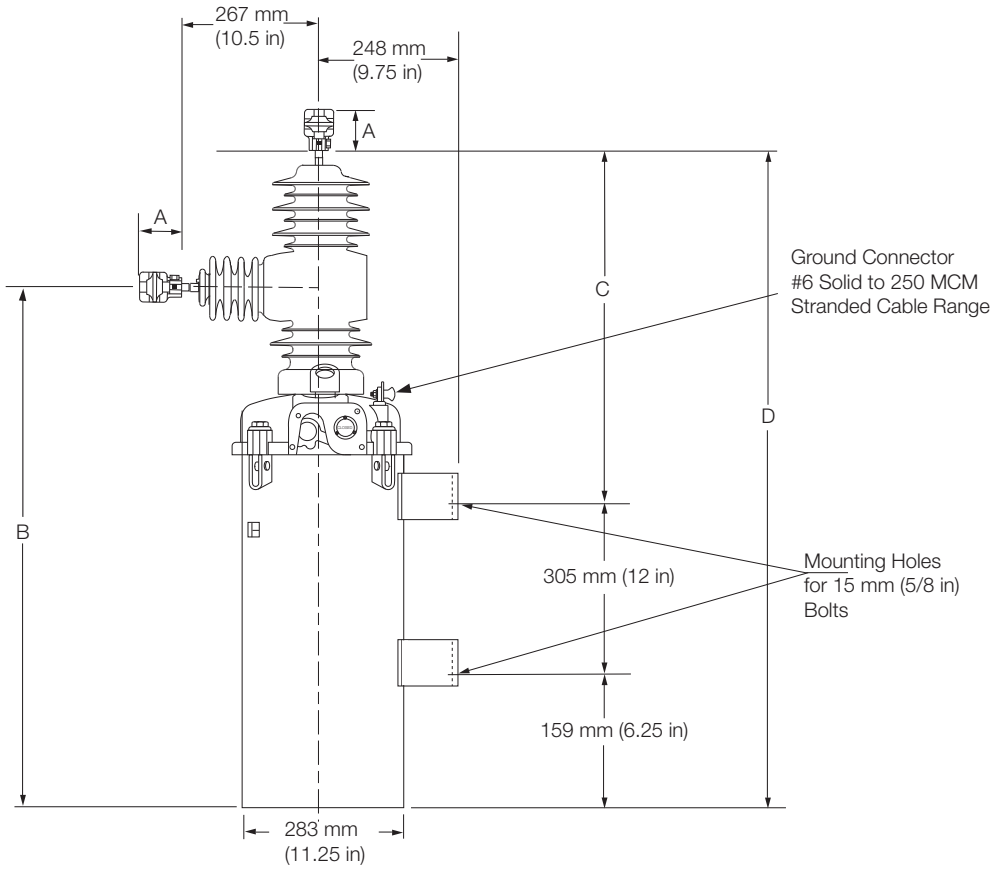
Recloser	NOVA-TS-15	NOVA-TS-27	NOVA-TS-38
kg (lbs)	52 (114)	54 (118)	56 (122)

Recloser dimensions



Creepage Distances

Description	NOVA-TS-15	NOVA-TS-27	NOVA-TS-38
Terminal to Terminal	1040 mm 40.9 in	1040 mm 40.9 in	1040 mm 40.9 in
Lower Terminal to Ground	673 mm 26.5 in	772 mm 30.5 in	950 mm 37.5 in



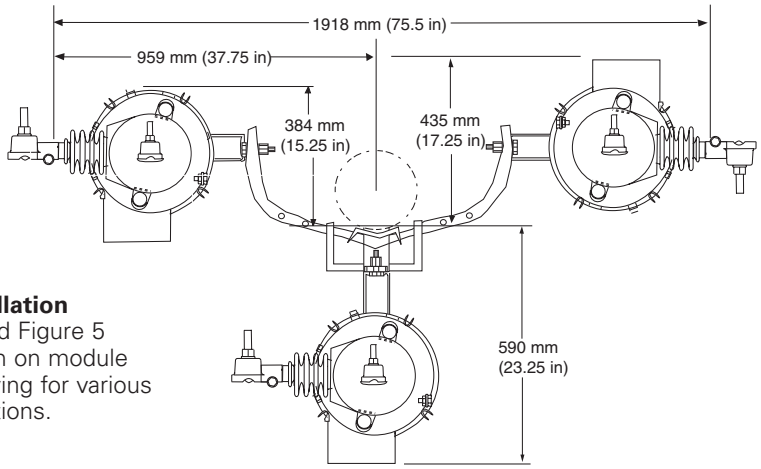
NOVA-TS Dimensions

	B	C	D
NOVA-TS-15	878 mm	693 mm	1157 mm
	34.5 in	27.5 in	45.5 in
NOVA-TS-27	933 mm	749 mm	1213 mm
	36.75 in	29.5 in	47.75 in
NOVA-TS-38	1033 mm	848 mm	1312 mm
	40.5 in	33.5 in	51.5 in

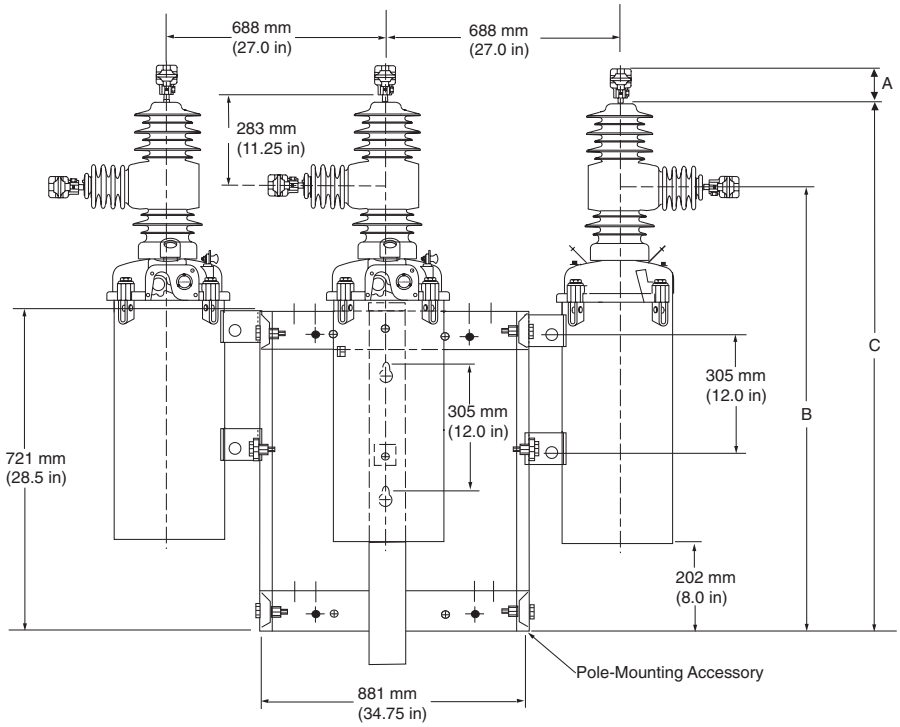
Terminal Option Type	Dimension A
Eyebolt - (630 A) 1/0 to 500 MCM Cable Range	80 mm/3.25 in
Eyebolt - (800 A) 4/0 to 1000 MCM Cable Range	108 mm/4.25 in
Flat Pad - 2 Hole (630 A max)	114 mm/4.5 in
Flat Pad - 4 Hole (800 A max)	121 mm/4.75 in
Stud Type - (800 A max) 1.125 - 12 threads	82 mm/3.25 in

Figure 1. NOVA-TS triple-single recloser dimensions.

Dimensions with pole-mounting accessory



Note: See the **Installation Procedure** and Figure 5 for information on module rotation, allowing for various line configurations.



NOVA-TS Dimensions with Pole-Mounting Accessory

	Dimension B	Dimension C
NOVA-TS-15	1079 mm (42.5 in)	1361 mm (53.5 in)
NOVA-TS-27	1140 mm (45.0 in)	1422 mm (56.0 in)
NOVA-TS-38	1235 mm (48.5 in)	1514 mm (59.5 in)

Terminal Option Type	Dimension A
Eyebolt - (630 A) 1/0 to 500 MCM Cable Range	80 mm/3.25 in
Eyebolt - (800 A) 4/0 to 1000 MCM Cable Range	108 mm/4.25 in
Flat Pad - 2 Hole (630 A max)	114 mm/4.5 in
Flat Pad - 4 Hole (800 A max)	121 mm/4.75 in
Stud Type - (800 A max) 1.125 - 12 threads	82 mm/3.25 in

Figure 2. NOVA-TS triple-single recloser dimensions with pole-mounting accessory.

Installation procedure

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

Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

All reclosers are carefully tested and adjusted at the factory to operate according to published data. Well-equipped test facilities, detailed testing procedures, and thoroughly trained personnel assure accurately calibrated equipment. Each recloser leaves the factory ready for installation—pending completion of the steps in this procedure.

Eaton recommends transporting NOVA reclosers in the closed position to maximize the operational performance of the unit.

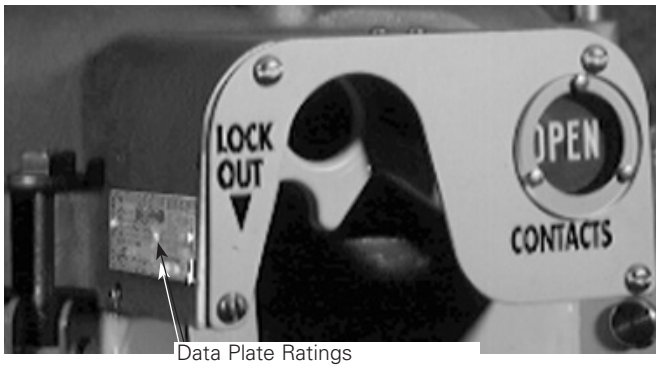


Figure 3. NOVA-TS triple-single recloser data plates are located on the sleet hood.

1. Check the data plate ratings. Make sure the ratings on each recloser data plate (see Figure 3) are correct for the planned installation.
2. Perform high-potential withstand tests. Prior to installing the NOVA-TS recloser, perform high-potential withstand tests on each of the three single-phase reclosers. Refer to the **High-Potential Withstand Testing** section of this manual for high-potential withstand test procedures. This test will help identify any shipping damage affecting the dielectric condition of the recloser or the vacuum integrity of the interrupter.

CAUTION

Personal injury. Sheds on epoxy encapsulation have sharp edges. Wear protective gloves when handling the unit. Failure to do so can result in cuts and abrasions. T258.1

WARNING

Falling equipment. Use the lifting lugs provided and follow all locally approved safety practices when lifting and mounting the equipment. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in severe personal injury, death, and/or equipment damage. G106.3

3. Mount the reclosers. Use the lifting lugs located on the head casting and follow approved procedures. At this point, the contacts are open, the bypass switches are closed, and the disconnect switches are open.

IMPORTANT

The default connections use the horizontal bushing as the source side and the vertical bushing as the load side. Also, the horizontal bushing may be used as the load side and the vertical bushing as the source side. Note that reversing the source and load bushings has no effect on overcurrent protection but may require setting or wiring changes to the control for correct metering.

If equipped with internal voltage sensors, the horizontal bushings must be connected to the source. The internal voltage sensors cannot monitor source-side voltage when the NOVA recloser is in the OPEN position if the horizontal bushings are connected to the load.

WARNING

Hazardous voltage. If terminal connections are reversed, the internal voltage sensing option may indicate zero voltage with the contacts open. Do not rely on internal voltage sensing to ensure that the voltage is zero and the line has been de-energized. Always follow proper safety practices and use a separate detection method to verify a de-energized condition. Failure to do so can result in contact with high voltage, which will cause death or severe personal injury. T365.0

To allow various mounting arrangements, such as substation or pole-mounting applications, the module may be rotated in two of the four positions illustrated. See Figure 4. Position A provides standard connections for substation mounting. Position B is used for pole-mounting application on the outside phases. Positions C and D do not allow adequate clearance and are not acceptable module rotations.

IMPORTANT

If the module is rotated, it must be properly reattached to the tank. Center the module over the tank lip and tighten the four bolts that secure the module to 34–54 Nm (25–40 ft•lbs).

(continued on next page)

The factory-recommended pole mounting consists of the outside modules rotated in Positions B while the middle NOVA recloser maintains Position A. See Figures 4 and 5. This allows for the maximum clearance for source connections to the horizontal bushings and provides consistent source/load alignment.

Figure 6 illustrates the factory-recommended mounting for substation applications.

Note: Position A is used throughout.

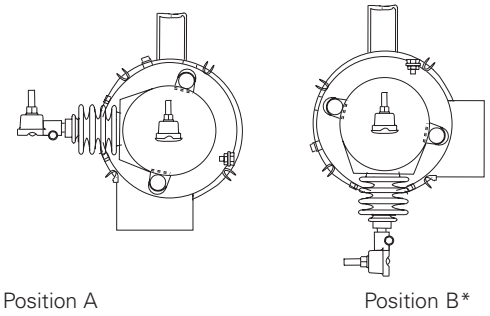
⚠ WARNING

Hazardous voltage. Recloser and control must be solidly grounded. Follow all locally approved procedures and safety practices when grounding this equipment. Improper grounding can result in contact with high voltage, which will cause death or severe personal injury. G115.1

4. Ground the reclosers. Make ground connections to each recloser head ground connector. It will accommodate #8 solid to 2/0 stranded conductors.

   This recloser is used in conjunction with a Cooper Power Systems Triple-Single control. Refer to *Service Information S280-70-7 Form 6 Triple-Single Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single Recloser Control Installation and Operation Instructions* for comprehensive recommended grounding instructions.

5. Ground the mounting hanger. Make ground connections in accordance with approved utility standards.



*Position B is the factory shipment assembly.

Figure 4. Module rotations.

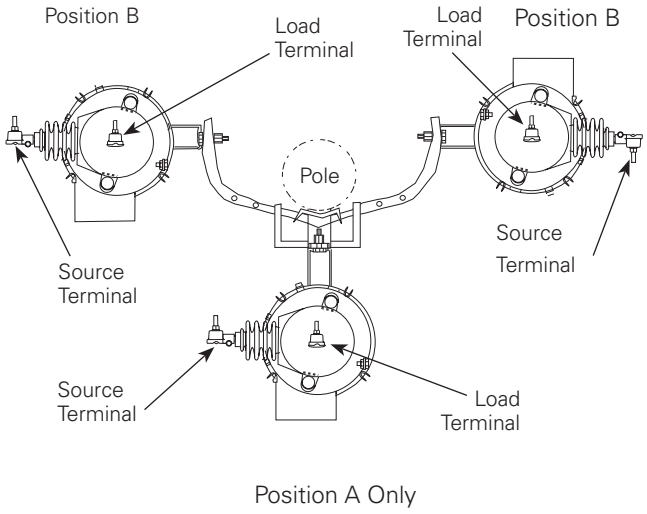


Figure 5. Rotation of NOVA-TS triple-single recloser head to comply with 90° mounting requirements.

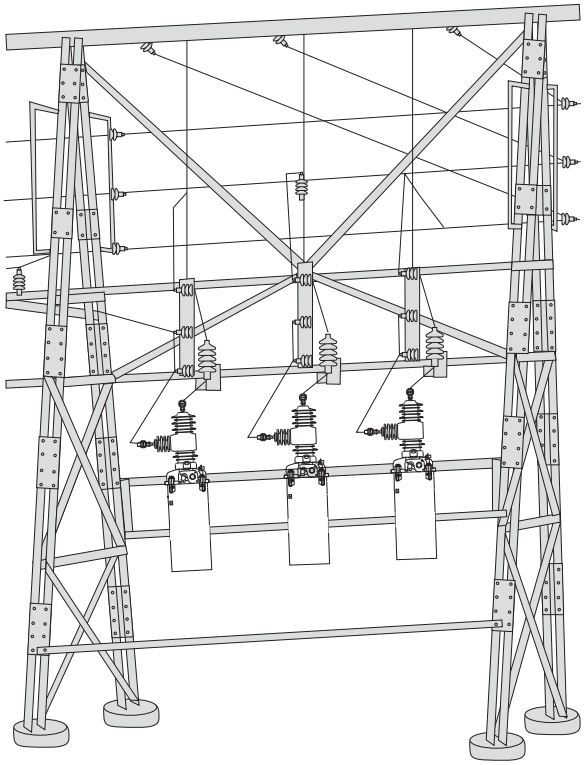


Figure 6. Substation mounting.

6. Install the control. Refer to *Service Information S280-70-7 Form 6 Triple-Single Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single Recloser Control Installation and Operation Instructions*. Connect the control cable between the control and the junction box. Connect the recloser cables between the junction box and each recloser. Make sure the control is grounded and properly programmed for the planned installation.

   To ensure proper installation of this cable, securely fasten the aluminum cable coupler ring (Figure 7).

Figure 7. Cable with aluminum cable coupler ring.

7. Make the high-voltage line connections. See Figure 8.

Note: Disconnect switches and bypass switches are recommended to facilitate switching and isolation.

A. Provide surge protection to both sides of each recloser.

Note: The horizontal bushing is the source side and the vertical bushing is the load side. See Figure 5.

IMPORTANT

The horizontal source and vertical load bushing designations must be the same for all three phases of the Triple-Single recloser. Each phase consists of one single-phase NOVA recloser.

CAUTION

Equipment damage. Do not adjust or rotate bushing terminals without first removing power line leads and loosening pinch bolt to release clamp tension. Failure to remove tension between the clamp and the interrupter stud prior to rotating the terminal will damage the encapsulated interrupter assembly resulting in equipment damage. T347.0

CAUTION

Equipment damage may occur if torque values are exceeded. T370.0

B. Connect high-voltage lines to recloser bushing terminals. The recommended torque value for bushing terminal-to-line connection is 45-50 ft•lbs.

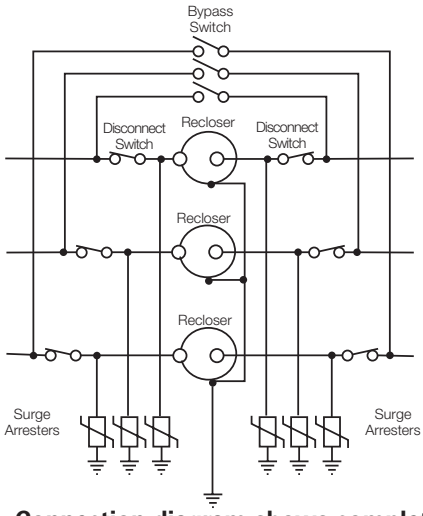


Figure 8. Connection diagram shows complete surge protection and illustrates bypass and disconnect switches.

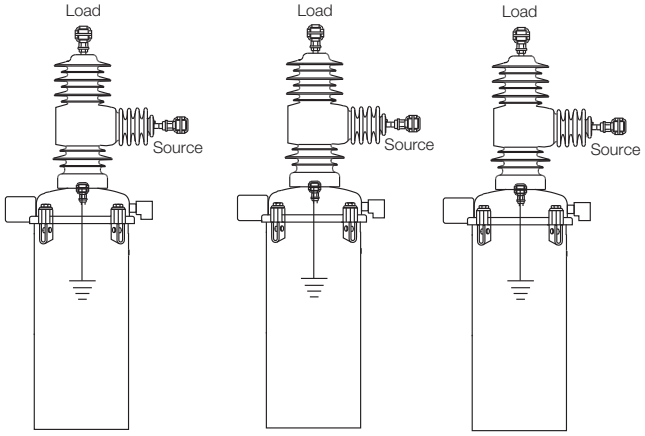


Figure 9. Terminal identification of Type NOVA recloser.

Refer to Figure 9 for terminal identification of the NOVA recloser.

Terminal connection to copper conductors only are recommended.

To rotate a flat-pad or eyebolt bushing terminal prior to connecting power line leads, loosen the pinch bolt on the terminals. After rotating the terminal, retighten the pinch bolt as follows: torque 3/8-16 pinch bolts to 20—23 Nm (15—17 ft•lbs); torque 1/2-13 pinch bolts to 39—42 Nm (29—31 ft•lbs).

8. Block ground sensing via the control panel.
9. Close source and load disconnect switches.
10. Close reclosers via control signal.
11. Open bypass switches.
12. Enable ground sensing, if applicable.

Removing recloser from service

⚠ WARNING

Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

⚠ WARNING

Hazardous voltage. Do not rely on the open position of the yellow operating handle or the contact position indicator; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G114.1

1. Block ground tripping via the control panel. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions*.

CAUTION

Equipment misoperation. Disconnect all control power sources prior to disconnecting or reconnecting the control cable from the control. Failure to comply can result in recloser misoperation at the time of disconnection or reconnection of the control cable to the control. T311.1

2. Close all three bypass switches.

Note: If only one bypass switch is closed and the recloser is opened via the yellow operating handle, it is possible all three phases will trip based upon mode selection.

3. Pull down the yellow operating handle with a hotstick. The yellow operating handle is located under the recloser sleet hood.

- If the recloser is set in single-phase trip/single-phase lockout mode, only one phase will open.
- If the recloser is set in single-phase trip/three-phase lockout mode or three-phase trip/three-phase lockout mode, all three phases will open.

The control will sense that the recloser(s) are open.

4. Open the source and load disconnect switches.

IMPORTANT

Disconnect switches for AC sensing and power connections are necessary to isolate the control for testing and servicing.

5. Disconnect the control battery.

⚠ CAUTION

Hazardous voltage. Open CT secondaries can generate high voltages. Contact with CT pins of the disconnected cable can cause electric shock and may result in personal injury. Open recloser contacts and open disconnect switches before disconnecting control cable. T204.3

⚠ CAUTION

Hazardous voltage. Cable conductors attached to controls will remain at 53 Vdc and 120 Vac potential while connected to the control. Contact with any pins at the end of the cable directly or indirectly connected to a control can result in personal injury or equipment damage. Disconnect battery and external power sources in the control then remove control cable at control end before disconnecting from recloser end. T312.2

6. Remove the control AC sensing and power connections from the control using a separate disconnect switch.

7. Disconnect the control cable from the recloser.

Note: Do not disconnect any of the three recloser control cables from the reclosers or junction box unless all of the above steps have been completed. The triple-single control in 1-phase trip/3-phase lockout mode or 3-phase trip/3-phase lockout mode will lock out all three reclosers if one control cable is disconnected.

8. Follow standard utility procedures regarding removal of recloser from service.

- Eaton recommends transporting NOVA reclosers in the closed position to maximize the operational performance of the unit.

Recloser operation

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

Hazardous voltage. Do not rely on the open position of the yellow operating handle or the contact position indicator; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G114.1

A current transformer senses line current from each Triple-Single NOVA recloser and inputs this information to the Triple-Single microprocessor-based recloser control. The recloser responds to trip and close commands from the control, per the settings programmed in the control. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions* for control operation information.

Vacuum interrupter

Arc interruption takes place within the sealed vacuum interrupter. Eaton's vacuum interrupters employ axial-magnetic field contacts. Slots are machined into the contact support structure producing a magnetic field along the axis of the interrupter. This axial-magnetic field keeps the arc in an easier-to-interrupt diffuse mode, resulting in less power in the arc that needs to be dissipated, resulting in extended operating duty.

Mechanism tripping and closing

The NOVA-TS recloser is comprised of three single-phase NOVA reclosers. Each recloser utilizes a magnetic actuator for fast, efficient latching. A rare-earth neodymium magnet provides latching forces in excess of 240 pounds, eliminating the need for mechanical latches.

While in the closed position, the magnetic field established by the magnet is coupled with the iron assembly to provide a latching force for the movable plunger. The magnetic force is concentrated at the plunger-assembly interface and provides the latching force required to keep the mechanism closed. The assembly also houses the trip and close coils that provide the energy to operate the mechanism.

To open the main contacts, the trip coil is pulsed with electrical current, which cancels the magnetic field. A compression spring in the center of the coil moves the plunger assembly to the open position. As the plunger moves, the magnetic field strength decreases as the air gap increases, due to the difference in the relative permeability of free space and the ferrous plunger. Once in the open position, the compression spring keeps the unit open.

A trip and close capacitor stores the necessary energy for operating the recloser. As a result, trip energy is available following any close operation. This capacitor is charged by the control nominal 24 V battery and/or power supply.

Junction box

One compatible junction box, which includes three interconnecting cables to the NOVA-TS reclosers and one receptacle, provides easy access to Eaton's Cooper Power series Form 6 or Form 5 Triple-Single control cable.

Refer to *Service Information S280-70-7 Form 6 Triple-Single Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single Recloser Control Installation and Operation Instructions* for junction box information.

Electronic control

Refer to *Service Information S280-70-7 Form 6 Triple-Single Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single Recloser Control Installation and Operation Instructions* for control operation information.

Manual Operation of Energized Recloser

The yellow manual operating handles on each single-phase

WARNING

Hazardous Voltage. Do not rely on the open position of the yellow operating handle; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G116.0

unit in the Triple-Single recloser are used to open and lock out each unit and disable the electrical and supervisory closing.

The recloser mode of operation determines which units open and close. The Triple-Single control initiates the close signal. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions* for control operation information.

WARNING

Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

The manual operating handle is designed to be operated with a hotstick. See Figure 10. Pulling down the handle trips and locks open the main contacts of the recloser. Contact position is indicated by the OPEN flag of the contact position indicator. The yellow operating handle will remain down in the OPEN position and not return upward under the sleet hood.

Note: When the recloser electronically operates to lockout, the yellow operating handle will not drop down from under the sleet hood. The yellow operating handle remains in the OPEN position only after manual operations are performed.

The yellow operating handle must be returned up to the CLOSED position for the recloser to respond to a close signal from the Triple-Single control. All close operations are initiated by the control.

IMPORTANT

Pushing the yellow operating handle to the CLOSED position will not close the recloser. All close operations are initiated by the Form 6 or Form 5 Triple-Single control.

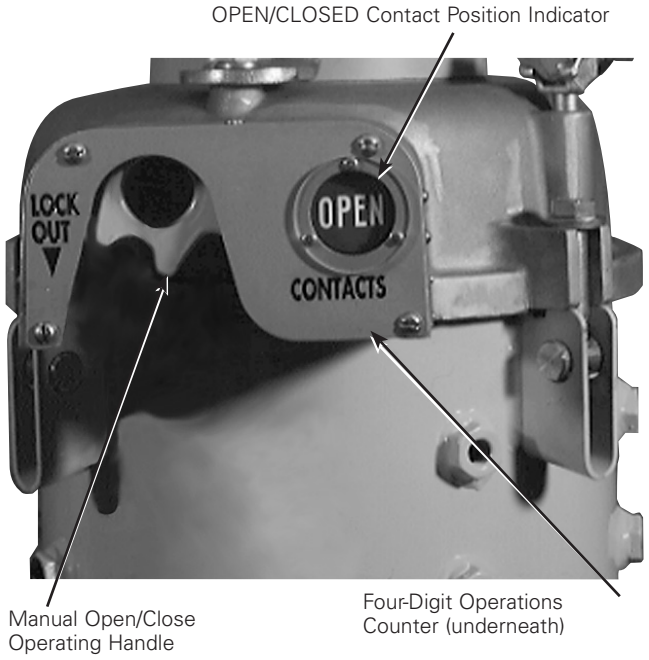


Figure 10. NOVA-TS triple-single recloser operating levers and indicators.

3-phase trip/3-phase lockout or 1-phase trip/3-phase lockout

If the control is in Three-Phase Trip/Three-Phase Lockout or Single-Phase Trip/Three-Phase Lockout mode, all three units will lock out when the yellow operating handle on one unit is pulled down to the OPEN position.

1-phase trip/1-phase lockout

When the control is in Single-Phase Trip/Single-Phase Lockout mode, only the unit with the yellow handle pulled down to the OPEN position will lock out. The other two units will not be affected and their yellow operating handles will remain in the CLOSE position.

Lockout indication

Lockout is indicated by the Triple-Single control.

Note: When the recloser is locked out, the yellow manual operating handle will not drop down from under the sleet hood.

Automatic operation

The NOVA-TS recloser, in the CLOSED position, operates automatically per the control-programmed settings.

Contact position indicator

Located on the outboard side of the sleet hood, this indicator displays the word OPEN (Green) when the recloser contacts are open and CLOSED (Red) when the recloser contacts are closed. See Figure 10.

Operations counter

A four-digit mechanical counter, located under the sleet hood, cumulatively records each time the recloser operates. See Figure 10.

Internal voltage sensing option

⚠ 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

Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

⚠ WARNING

Hazardous voltage. Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T223.2

IMPORTANT

Disconnect switches for AC control power are necessary to isolate the control for testing and servicing.

⚠ WARNING

Hazardous voltage. If terminal connections are reversed, the internal voltage sensing option may indicate zero voltage with the contacts open. Do not rely on internal voltage sensing to ensure that the voltage is zero and the line has been de-energized. Always follow proper safety practices and use a separate detection method to verify a de-energized condition. Failure to do so can result in contact with high voltage, which will cause death or severe personal injury. T365.0

The NOVA-TS triple-single recloser is available with internal voltage sensing when specified at time of order with the Form 6 Triple-Single control. Refer to the **Installation** section of this manual for information on the NOVA-TS triple-single recloser installation procedure. Refer to Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions for further information on installing the Form 6 Triple-Single pole-mount control.

Verify the correct load-side and source-side terminal connections. This is required for correct operation of the internal voltage sensors.

Verify correct ground of the NOVA-TS reclosers and control prior to making any high-voltage connections and before high-potential testing. A proper ground connection consists of a good electrical ground connection to the surge ground connector located on the mechanism housings. Provide a good electrical ground connection to the control cabinet ground.

Note: Painted surfaces of the mechanism housing may prevent a ground connection to the recloser housing. Always provide a good electrical connection to the mechanism surge ground connector.

Poor grounding of the mechanism housing may result in the presence of high voltage on the mechanism housing associated with the high-voltage resistor connections used with internal voltage sensing.

⚠ CAUTION

Hazardous voltage. Do not touch the receptacle connections of the control/voltage-sensing cable. If the recloser is energized and the control/voltage-sensing cable is disconnected from the recloser or the control, a voltage clamped at 250 Vac will be present at the receptacle. Contact with this voltage can result in personal injury. T346.1

The reclosers utilize the standard 14-pin junction-box cables and 26-pin control cable to carry the internal voltage sensing signal from the recloser to the control. The appropriate junction box is identified by a decal specifying "THIS JUNCTION BOX COMPATIBLE WITH INTERNAL VOLTAGE SENSOR OPTION." There are no additional custom connections required.

CAUTION

Equipment misoperation. Verify all connector pins and both mating interface surfaces are clean and dry before connecting cables. Voltage sensing errors can result from contamination. Failure to comply can result in control and recloser misoperation. G142.0

The electrical connectors of the recloser, control, and cable must be clean and dry. Contaminated surfaces may be cleaned with denatured alcohol and wet connector surfaces may be dried with a heat gun. Dry surfaces are particularly important for the internal voltage sensor connections. The accuracy of the sensors can be influenced by moisture contamination.

Connect control cables and power cables to the control; refer to Figure 11. Verify that the proper cable/receptacle connections are made. Improper cable connections can result in damage to the recloser and/or control.

Complete the control programming before making the high-voltage line connections. See the Operation section of this manual.

The Form 6 Triple-Single control must be programmed with a PT ratio and a phase angle adjustment; refer to Tables 6 and 7. These are entered in the System Configuration screen; see Figure 12.

When programming the Form 6 Triple-Single control, the PT connection must be set for a wye connection. Also, the Phantom Phase feature must be disabled. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* for more information on installing the Form 6 Triple-Single control.

Table 6. PT Ratio

Description	Form 6 T-S PT Ratio
NOVA-TS-15	1100:1
NOVA-TS-27	2200:1
NOVA-TS-38	2200:1

Table 7. Phase Angle Adjustment

Description	Form 6 T-S Phase shift, 3.05 m (10 ft.) 26-pin control cable and 3.05 m (10 ft.) 14-pin junction box cable
NOVA-TS-15	-177.5° (See Note 1)
NOVA-TS-27	-176.1° (See Note 2)
NOVA-TS-38	-173.5° (See Note 3)

Note 1: For each additional 3.05 m (10 ft.) of control cable, a correction of +0.5° must be added.

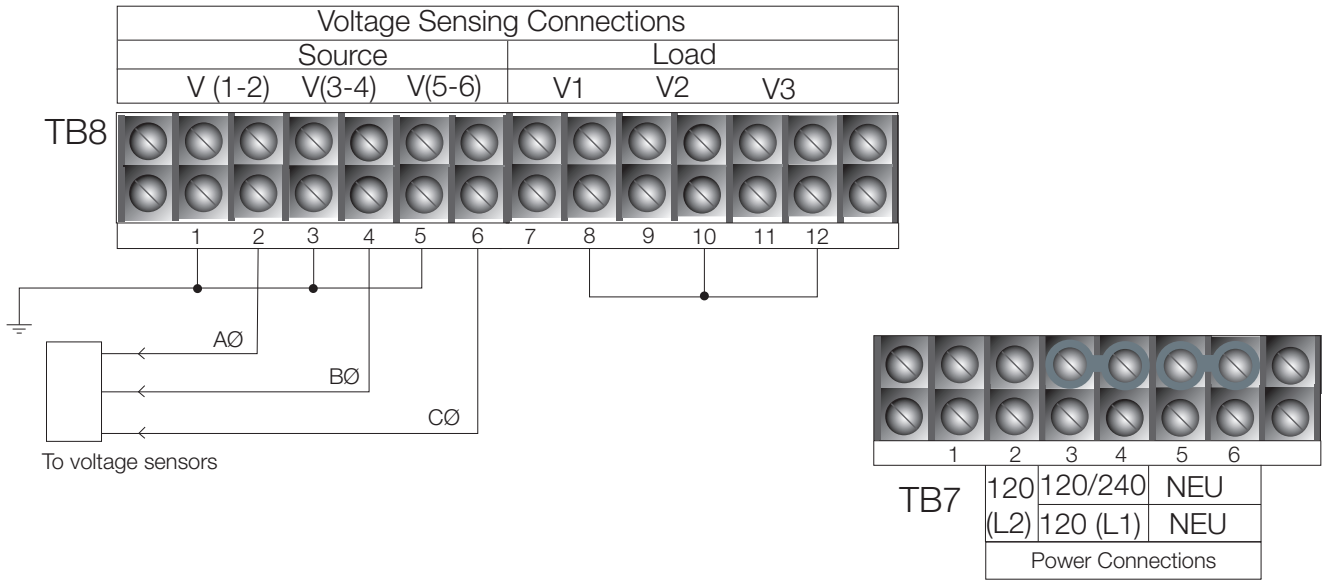
For each additional 3.05 m (10 ft.) of junction box cable, a correction of +1.0° must be added.

Note 2: For each additional 3.05 m (10 ft.) of control cable, a correction of +0.6° must be added.

For each additional 3.05 m (10 ft.) of junction box cable, a correction of +1.0° must be added.

Note 3: For each additional 3.05 m (10 ft.) of control cable, a correction of +0.4° must be added.

For each additional 3.05 m (10 ft.) of junction box cable, a correction of +0.6° must be added.



Note: Terminal block positions TB7-3 and TB7-4 are factory-jumpered together.
Terminal block positions TB7-5 and TB7-6 are factory-jumpered together.

Figure 11. Default factory wiring for internal voltage sensor option.

CAUTION

Equipment misoperation. Do not connect this control to an energized recloser until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and recloser misoperation, equipment damage, and personal injury. G110.3

Make appropriate electrical connections to the terminals of the reclosers. Energize reclosers and confirm the voltage outputs in the control.

CAUTION

Hazardous voltage. Do not touch the receptacle connections of the control/voltage-sensing cable. If the recloser is energized and the control/voltage-sensing cable is disconnected from the recloser or the control, a voltage clamped at 250 Vac will be present at the receptacle. Contact with this voltage can result in personal injury. T346.1

When the reclosers are energized, the recloser control input impedance to the voltage sensors lowers the voltage to 6 V during normal operation. If the recloser is energized and the control/ voltage-sensing cable is disconnected at any point (the control, the reclosers, or the junction box), the voltage sensing output signal of 250 Vac will be present at the receptacle: Do not touch the male receptacle connections of the control/voltage-sensing cable.

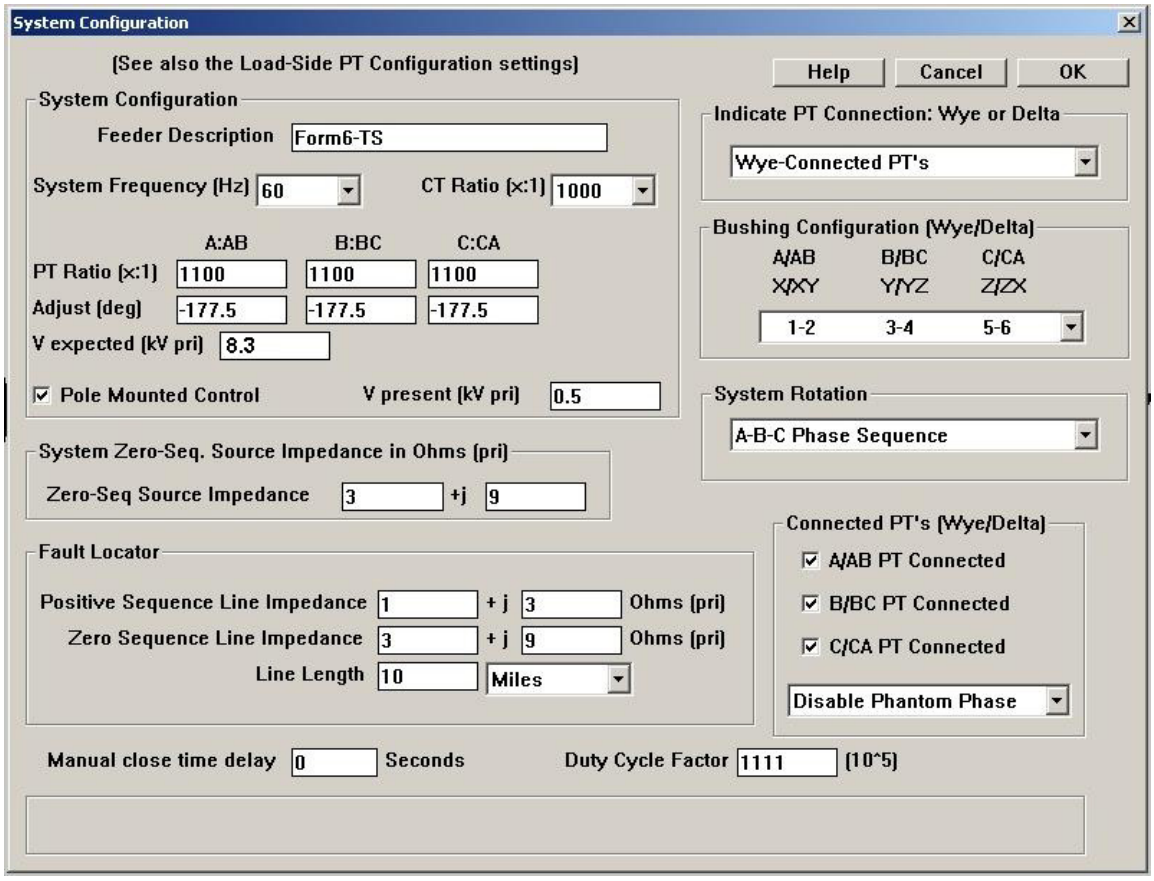


Figure 12. Form 6 Triple-single system configuration screen representation for a 15 kV system.

Accessories

Auxiliary switch

A three-stage auxiliary switch can be provided as an accessory. Each stage has two independent contacts that permit any desired combination of "a" and "b" contacts, allowing for remote monitoring of the recloser.

The switch contacts are insulated for 600 V and have a continuous current rating of 10 A. Their interrupting ratings are shown in Table 8.

Table 8. Auxiliary Switch Interrupting Ratings

Volts	Non-Inductive AC (A)	Non-Inductive AC (A)	Inductive DC (A)	Non-Inductive DC (A)
24	–	–	15.0	20.0
48	–	–	7.5	10.0
120	60	80	–	–
125	–	–	1.5	2.0
240	30	60	–	–
250	–	–	0.45	0.5

Table 9. Auxiliary Switch Pin Contacts and Cable Wire Colors

Contact Type	Wire Color *	Pin
a	black	A
	white	B
b	red	C
	green	D
a	orange	E
	blue	F
b	white/black	G
	red/black	H
a	green/black	J
	orange/black	K
b	blue/black	L
	black/white	M
unused	unused	N, P

* Wire color of the factory-supplied cable accessory.

Auxiliary switch junction box

An auxiliary switch junction box can be provided as an accessory. This provides one common, easily accessible connection point for the auxiliary switch contacts.

Terminal options

NOVA-TS reclosers can be specified with eyebolt terminals (630 A and 800 A), two-hole (630 A) or four-hole (800 A) flat-pad terminals, or stud-type terminals (800 A).

The eyebolt, flat-pad, and stud terminals are made of copper alloys. Eaton recommends terminal connection to copper wires to optimize the electrical connection. Aluminum cables may produce aluminum oxide sufficient to compromise the electrical connections.

Anti-oxide coatings for temporary protection of wire-brushed, aluminum cable connections to flat-pad or stud terminals must be maintained at intervals determined by the customer based on load current, climate, and other installation conditions.

Eyebolt terminals are recommended for copper conductors only.

Mounting hangers

Pole-mounting accessory

A pole-mounting, cluster-style bracket is available for pole-mounting installation. Refer to Figure 2 for a representation of this bracket.

Crossarm mounting hanger

A crossarm mounting hanger is available for crossarm installation. These are available in sets of two; one set is needed for each recloser.

Service information

Service requirements

The NOVA-TS recloser has been designed with a minimum mechanical life of 10,000 operations. The NOVA-TS recloser requires minimum routine inspection to check for physical damage and verify proper operation.

It should not be necessary to access the mechanism of the NOVA-TS recloser. If entry is required, the trip and close capacitor must be discharged prior to any contact with the mechanism. The capacitor retains an electrical charge, even with the control cable disconnected.

⚠ CAUTION

Personal injury. The trip and close capacitor retains an electrical charge. Always discharge the trip and close capacitor prior to performing any service on the mechanism. Contact with a charged capacitor can result in skin burn or electrical shock. T389.0

Discharge trip and close capacitor

To discharge the trip and close capacitor:

1. Remove the recloser from service. Refer the **Remove Recloser from Service** section of this manual.

CAUTION

Equipment damage. Always unplug the control cable from the control prior to discharging the capacitor. Failure to do so can result in resistor damage. T267.0

2. Unplug the control cable from the control.

⚠ WARNING

Falling equipment. Use the lifting lugs provided and follow all locally approved safety practices when lifting and mounting the equipment. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in severe personal injury, death, and/or equipment damage. G106.3

IMPORTANT

When the head casting and mechanism are removed from the tank, the center of gravity changes. Secure an additional strap to the horizontal side arm to prevent the module from tipping.

3. Loosen bolts that secure head casting and remove mechanism from tank.
4. Locate the white Discharge button on the actuator circuit board. See Figure 13.
5. Push and hold in the Discharge button. The Discharge LED will light up and gradually dim as capacitor energy is discharged. This will take approximately 45 to 60 seconds.
6. When the light completely dims, release the button.
7. The capacitor is now discharged.

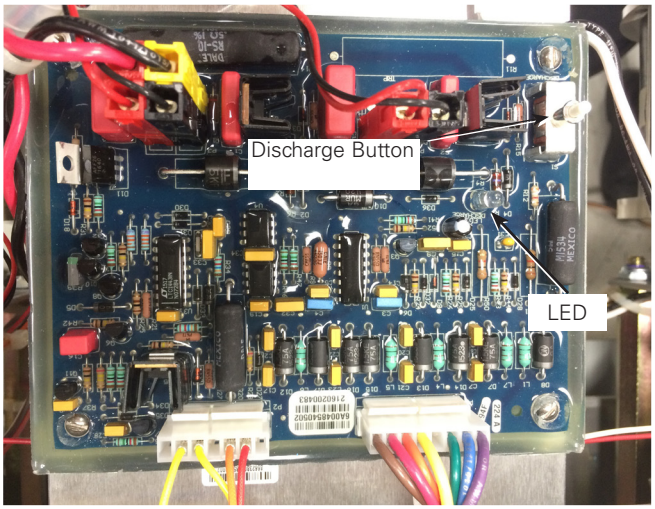


Figure 13. Location of white discharge button and LED discharge indicator on actuator circuit board.

Note: After approximately twenty minutes, the discharged capacitor may have recharged up to 7 V. If this occurs, the discharge LED will light up if the discharge button is pushed. Press the discharge button to discharge.

8. Reinstall the module: center it over the tank lip and tighten the four bolts that secure the module to 34–54 Nm (25–40 ft•lbs)

Frequency of inspection

Because these reclosers are applied under widely varying operating and climatic conditions, service intervals are best determined by the user based on actual operating experience. However, solid-insulated, vacuum-interrupting reclosers should be inspected every ten years.

High-potential withstand tests

NOVA-TS reclosers are carefully tested and adjusted at the factory to operate according to the published data. Each recloser leaves the factory ready for installation, but to ensure there was no damage during transportation, Eaton recommends high potential withstand tests before installation.

To verify the dielectric integrity of the recloser, the following tests and equipment are recommended:

High-voltage test set – Must be capable of supplying suitable voltages for determining the dielectric withstand capability of the recloser. Sensitive circuit breakers should be included to prevent damage in the event of a flashover.

Note: Test results for NOVA reclosers equipped with the internal voltage sensing option will be influenced by the source-to-ground connected sensing resistor, especially if DC high-potential testing is performed.

⚠ WARNING

Hazardous voltage. The switchgear (apparatus and control) and high-voltage transformer must be in a test cage or similar protected area to prevent accidental contact with the high-voltage parts.

Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T221.5

⚠ CAUTION

Radiation. At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However, above these voltages, radiation injurious to personnel can be emitted. See Service Information S280-90-1, Vacuum Interrupter Withstand Test Voltage Ratings Information for further information. G109.2

Use the following procedures to perform high-potential withstand tests at 75% of the rated low-frequency withstand voltage for 60 seconds. See Table 10 for test voltages and Figure 14 for test connection diagrams.

Table 10. NOVA-TS Triple-Single Recloser Withstand Test Voltage Ratings Information

75% of Rated Low-Frequency Withstand Voltage (1 minute dry) (kV rms)

Description	AC	DC
NOVA-TS-15	37.5	53.0*
NOVA-TS-27	45.0	63.6**
NOVA-TS-38	52.5	74.2***

* Approximately 0.53 mA additional leakage current per phase with internal voltage sensors.

** Approximately 0.32 mA additional leakage current per phase with internal voltage sensors.

*** Approximately 0.37 mA additional leakage current per phase with internal voltage sensors.

Test results for NOVA Triple-Single reclosers equipped with the internal voltage sensing option will be influenced by the source-to-ground connected sensing resistor, especially if DC high-potential testing is performed.

The following tests should be applied to each of the three single-phase NOVA reclosers that comprise the NOVA-TS Triple-Single recloser system:

Closed-contacts high-potential test

1. Close the recloser contacts.
2. Ground the recloser using the grounding lug on the head casting.
3. Apply proper test voltage to one of the bushing terminals.
4. The recloser should withstand the test voltage for 60 seconds.

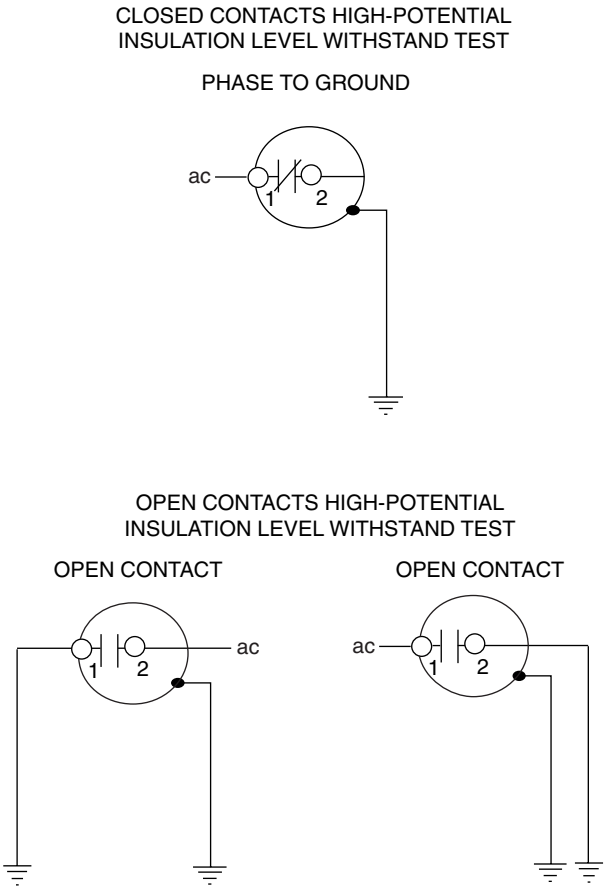


Figure 14. Connection diagrams for high-potential withstand testing for each single-phase NOVA recloser that comprises the NOVA-TS Triple-Single recloser.

Open-contacts high-potential test

1. Open the recloser contacts.
2. Ground the recloser using the grounding lug on the head casting.
3. Ground the bushing terminal on one side of the recloser.
4. Apply proper test voltage to the ungrounded bushing terminal.
5. The recloser should withstand the test voltage for 60 seconds.
6. Reverse the test and ground connections on the bushing terminals.
7. Apply the proper test voltage to the ungrounded bushing terminal.
8. The recloser should withstand the test voltage for 60 seconds.

Withstand test results

The high-potential withstand tests provide information on the dielectric condition of the recloser and the vacuum integrity of the interrupters.

If the recloser passes the closed-contacts tests but fails the open-contacts test, the cause is likely to be in the interrupter assembly.

If a recloser fails the closed-contacts test, the cause is likely to be a diminished electrical clearance or failed insulation.

If the recloser does not pass either the Open or Closed High-Potential Test, contact an authorized service center or your Eaton representative.

Note: Test results for NOVA Triple-Single reclosers equipped with the internal voltage sensing option may be influenced by the source-to-ground connected sensing resistor, especially if DC high-potential testing is performed.

Module flashover service

If a NOVA recloser module was exposed to an external flashover, an inspection process is recommended to assure proper operation of the recloser. Should the NOVA recloser exhibit external flashover attributes (carbon tracking or discoloration), the following procedure is recommended:

1. Bypass and remove the recloser from service as described in this manual.
2. Confirm the dielectric strength of the recloser by performing high-potential withstand test. Refer to the **High-Potential Withstand Testing** section of this manual.
3. Inspect the housing and lifting lugs for damage that may affect electrical and/or mechanical performance. If there is damage to either the housing or lifting lugs they must be replaced or repaired.
4. Inspect module for damage to the terminals. Remove any damaged terminals and replace.
5. Inspect module for damage to the module conductor rods (0.63" diameter threaded rods on top and side of module for affixing terminals). If there is damage to the module rods, the module must be replaced. Contact an authorized service center or your Eaton representative.
6. Inspect the operating rod for damage. Check the module surface and major and minor sheds for cracks, holes, and major chips. If damage is present, the module must be replaced. Contact your Eaton representative.
7. If no damage is found, clean the module with isopropyl alcohol and a scratch-free, nylon scouring pad to remove any carbon deposit.
8. Before returning to service confirm electrical operation by opening and closing the recloser with a control. Confirm the dielectric strength of the recloser by performing a high-potential withstand test. Refer to the **High-Potential Withstand Testing** section of this manual.

Troubleshooting

If the NOVA-TS recloser does not perform as described in the **Recloser Operation** section of this manual, the following information may assist in troubleshooting:

Unit will not close

- Make sure the yellow manual operating handle is completely up (returned to the CLOSED position).
- Check all cables for proper connection.
- Check the condition of the battery located in the control cabinet. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions* for the battery testing procedure.

Unit will not open

- Check all cables for proper connection.
- Check the condition of the battery located in the control cabinet. Refer to *Service Information S280-70-7 Form 6 Triple-Single, Microprocessor-Based Pole Mount Recloser Control Installation and Operation Instructions* or *Service Information S280-42-3 Form 5 Triple-Single, Microprocessor-Based Recloser Control Installation and Operation Instructions* for the battery testing procedure.

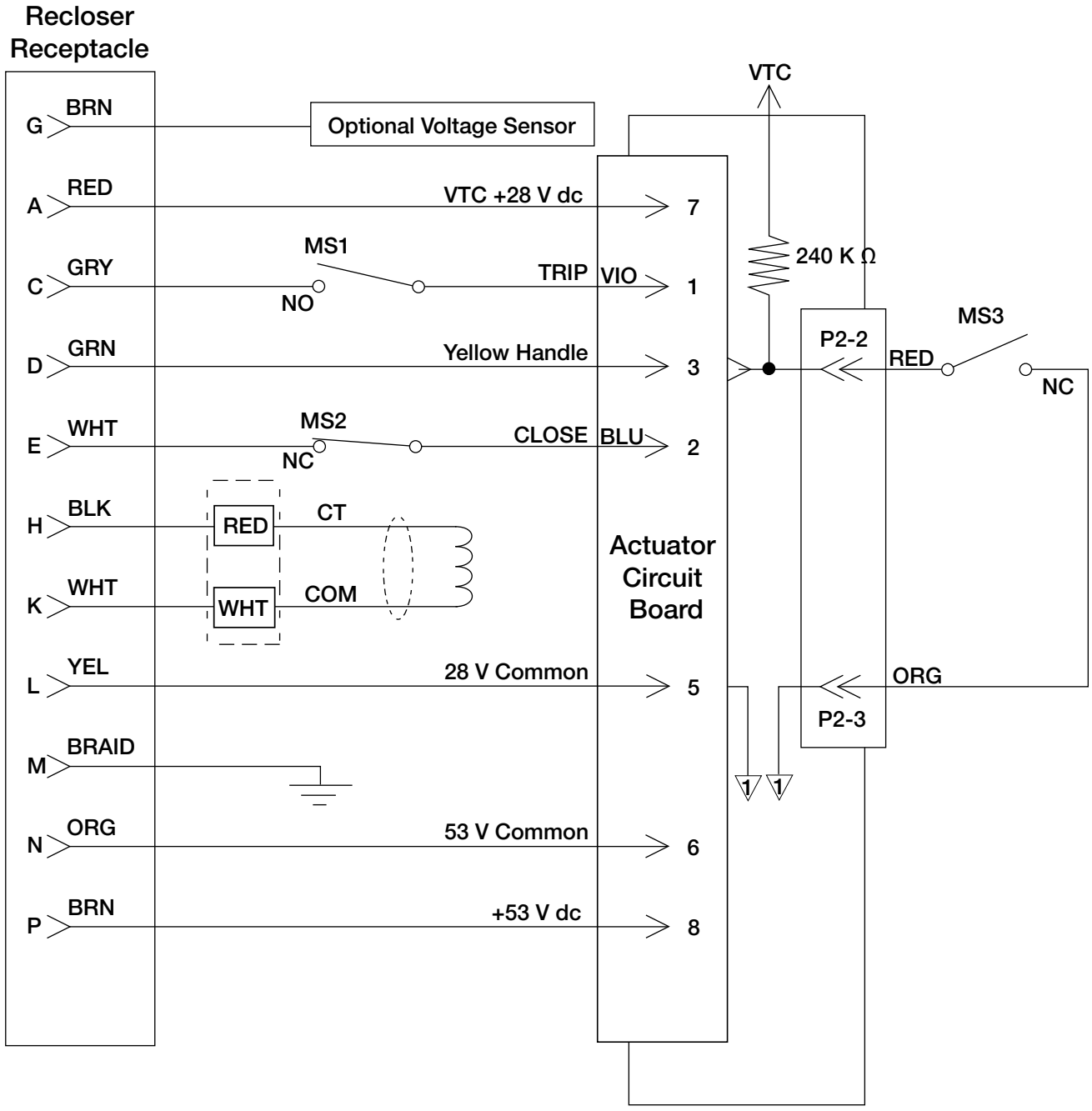


Figure 15. NOVA-TS recloser internal wiring.

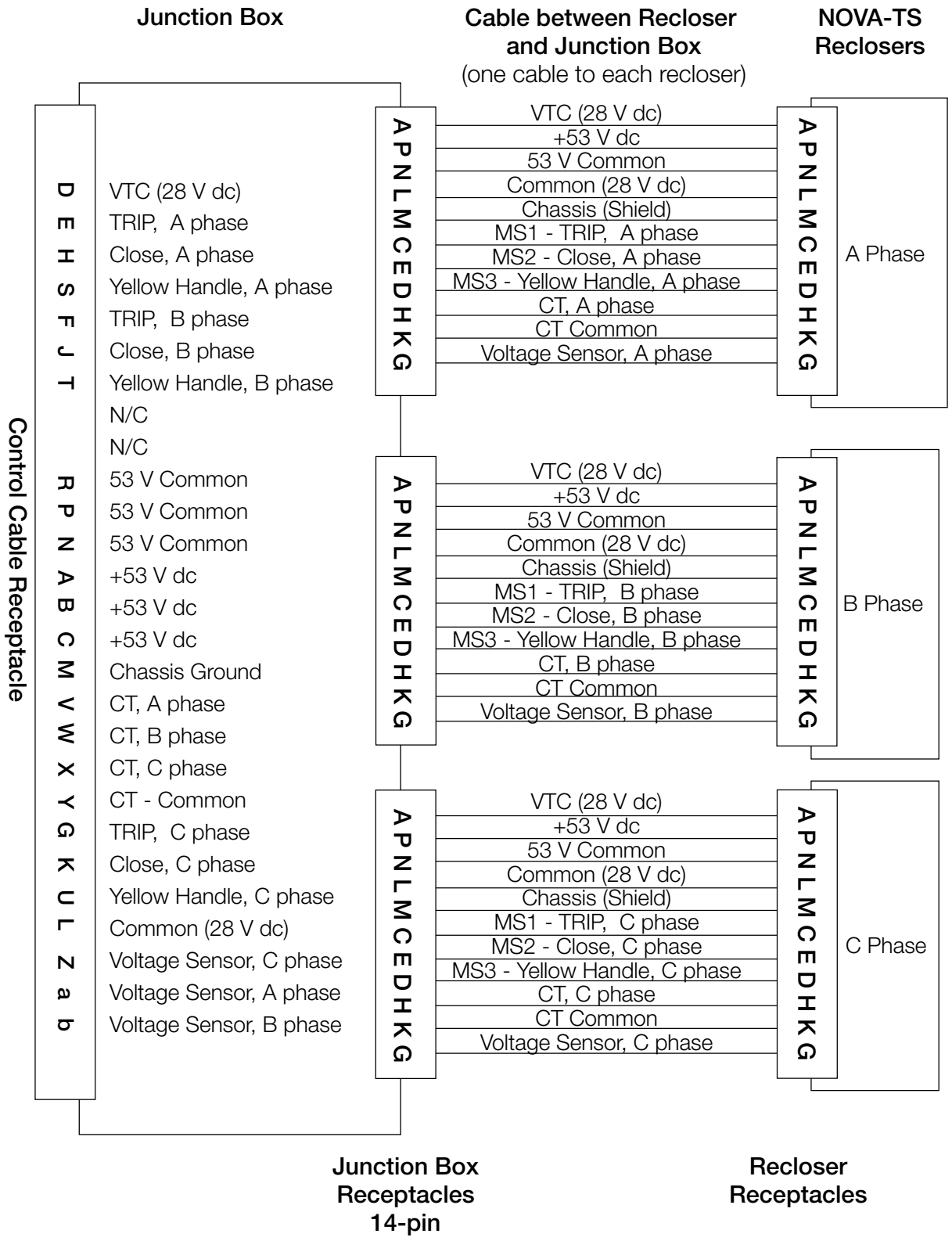


Figure 16. NOVA-TS recloser, junction box, and control connections.

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