

NOVA™ three-phase, microprocessor-controlled recloser



Description

Eaton provides reliable, economical overcurrent protection, advanced metering, and automation systems for distribution circuits rated through 34.5 kV with its Cooper Power™ series NOVA™ three-phase, electronically controlled, vacuum-interrupting automatic circuit reclosers.

The NOVA recloser combines solid cycloaliphatic-epoxy polymer-encapsulated vacuum interrupters with a reliable, lightweight operating mechanism that utilizes a magnetic actuator to provide a lifetime of trouble-free operation. The solid polymer system does not rely on a gaseous, liquid, or foam dielectric. The NOVA recloser is highly resistant to ozone, oxygen, moisture, contamination, and ultraviolet light.

The NOVA recloser is available with two configuration options: control-powered interface and auxiliary-powered interface. Designed and tested to be compatible with Eaton's Cooper Power series three-phase controls, these automatic circuit reclosers offer superior coordination, protection, and application capabilities.

Recloser operations are programmed in an electronic control with accurate characteristics and a host of advanced features. Precise operating tolerances enable close coordination with other protective devices on the system. When system requirements change, program settings are easily altered with no sacrifice of accuracy or consistency.

Compact and lightweight, NOVA reclosers are easily installed on poles or in substations. Mounting equipment is available for both pole and substation applications.

Recloser and control accessories enable further tailoring of the protective program to achieve maximum system operating flexibility.

Eaton is strongly committed to improving the reliability of the electric power industry. Technological advances, including the newest microprocessor-based controls and solid insulation NOVA distribution switchgear products, represent our investment in the future.

The NOVA recloser is not only a technological breakthrough, but a valuable component that brings significant operational savings to the utility business unit, lowering the installation, operation, training, and maintenance costs on your power distribution system.

When needed, application expertise, backed by world-wide systems engineering knowledge and experience, is available. Customer-focused design capability, based on more than 65 years of recloser experience, has made Eaton the industry leader.

NOVA reclosers are designed and manufactured in accordance with IEEE Std C37.60™-2003 standard.

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Ratings and characteristic features

Three-phase protection on systems rated 2.4 through 14.4 kV is provided by NOVA15 reclosers. NOVA27 reclosers can be applied on systems rated through 27.6 kV. Higher-voltage system protection at 34.5 kV is provided by NOVA38 reclosers. A ratings summary for NOVA reclosers is shown in Tables 1–3. For ratings and basic application information of other Eaton's Cooper Power series reclosers, see Catalog Data CA280002EN.

Operation

Sensing current transformers, embedded in the recloser, supply fault-sensing information to the electronic control. Tripping and closing signals from the control energize the operating circuits in the recloser. Due to a single CT ratio for all ratings, minimum-trip values of the electronic control are independent of the continuous-current and interrupting ratings of the recloser.

Flexibility in coordination with other protective devices is provided by varied time–current characteristics from a choice of standard or customized curves, minimum trip values, reclosing and resetting time settings, and a selection of accessories.

Vacuum interruption

A single break on each phase is accomplished by separating contacts inside the vacuum interrupter. All arcing is contained within the vacuum envelope. The patented axial-magnetic vacuum interrupters, used in NOVA reclosers, offers extended and increased duty cycles compared with oil or radial-magnetic interrupters. The axial-magnetic field keeps the arc in a diffused mode, resulting in less arc power to be dissipated, resulting in low thermal stress, suitable for encapsulation.

Surge protection

Best operating results are achieved if reclosers are protected with surge arresters. On line applications, arrester protection is recommended on both sides of the recloser. (If protection is on one side only, it should be on the source-side. In substations, arresters should be on the load-side.) Eaton provides excellent protection with its Cooper Power series distribution-class arresters, available with mounting brackets to fit our reclosers (see Catalog Sections CA235005EN and CA235011EN).

Ordering information

All NOVA reclosers include a Form 6 microprocessor-based recloser control. The Form 6 control includes full protection, TCC Editor, metering, and diagnostics for your application needs.

To order a NOVA recloser, electronic control, and control cable:

1. **See the Constructing a Catalog Number** section to construct a catalog number that describes the required recloser.
2. From Tables 6–13, specify the catalog numbers that describe the required recloser accessories.
3. Order the required electronic recloser control (Base catalog number of the control must be included when ordering a NOVA recloser).



Figure 1. NOVA recloser.

Features and detailed description

NOVA microprocessor-controlled, three-phase reclosers protect systems operating through 34.5 kV (see **Ratings and Specifications** section of this catalog). These ratings and the wide range of programmable settings provided by Eaton's Cooper Power series electronic controls permit meeting a variety of application requirements.

Recloser operation

Fault currents are sensed by three 1000:1 ratio sensing current transformers embedded in the recloser. These CTs provide a continuous measurement of line current, monitored by the electronic control. When current level exceeds the programmed minimum trip level, the magnitude of the overcurrent is integrated with time, using a programmed time-current curve characteristic. The control then signals the trip in the recloser, opening the main contacts of all three phases.

The control signals tripping and closing. The recloser always maintains energy for a tripping operation following a closing operation.

The electronic recloser control provides determination of phase- and ground-trip sequences and operations to lockout and reclosing and resetting timing, adjustable with the control without de-energizing the recloser.

Construction

Recloser

Designed for long service life and no maintenance, the NOVA recloser has three solid-polymer interrupter modules with embedded current transformers and a standard aluminum mechanism housing; light gray is the standard color.

Cycloaliphatic-epoxy polymer encapsulation provides solid insulation and maintenance-free, environmentally safe operation. There is no monitoring or maintaining of gas pressure or oil levels; there are no toxic or environmentally unfriendly materials. There are no foam fillers or insulation seals, eliminating potential moisture ingress areas. The NOVA recloser module exhibits good absorption of elastic energy and resistance to cracking and crack propagation. Additionally, durable environmental properties make the solid polymer suitable for outdoor applications, including seacoasts, deserts, and areas of high pollution.

Surface tracking

The cycloaliphatic epoxy is highly resistant to contaminants and resists tracking and flashovers under extreme pollution levels to reduce both flashovers and the associated cost of repairs.

Hydrophobicity

The module maintains excellent hydrophobicity, a property characterized by water beading into isolated drops, and is highly resistant to moisture absorption. Hydrophobicity prevents continuous sheets of water from forming leakage current paths that deteriorate the creepage withstand level.

Ultraviolet resistance

The cycloaliphatic epoxy resists ultraviolet radiation damage even in harsh climates, maintaining a smooth, unblemished, self-cleansing surface with low-adhesion to contaminants.

Tensile strength

Outstanding tensile and flexural strength characteristics mean the NOVA recloser modules are tough and non-fragmenting, reducing shipment and handling charges.

Shed design

The shed design utilizes alternate-sized skirts. The major sheds shield and protect the minor sheds to enhance the hydrophobicity and ultraviolet resistance of the module, eliminate formation of microcracks, and ensure extra-protected creepage. Additionally, sharp edges direct water away from the unit. Water paths and ice formations are effectively eliminated.

Flashover recovery

Flashovers occur when an object, usually wildlife, contacts energized parts of the equipment. The NOVA recloser minimizes the effect of flashovers with remarkable physical resilience, arc-quenching properties, and a self-healing ability. NOVA recloser can withstand the enormous forces experienced during faults without wholesale damage and allows re-energizing after external flashover without cleaning.

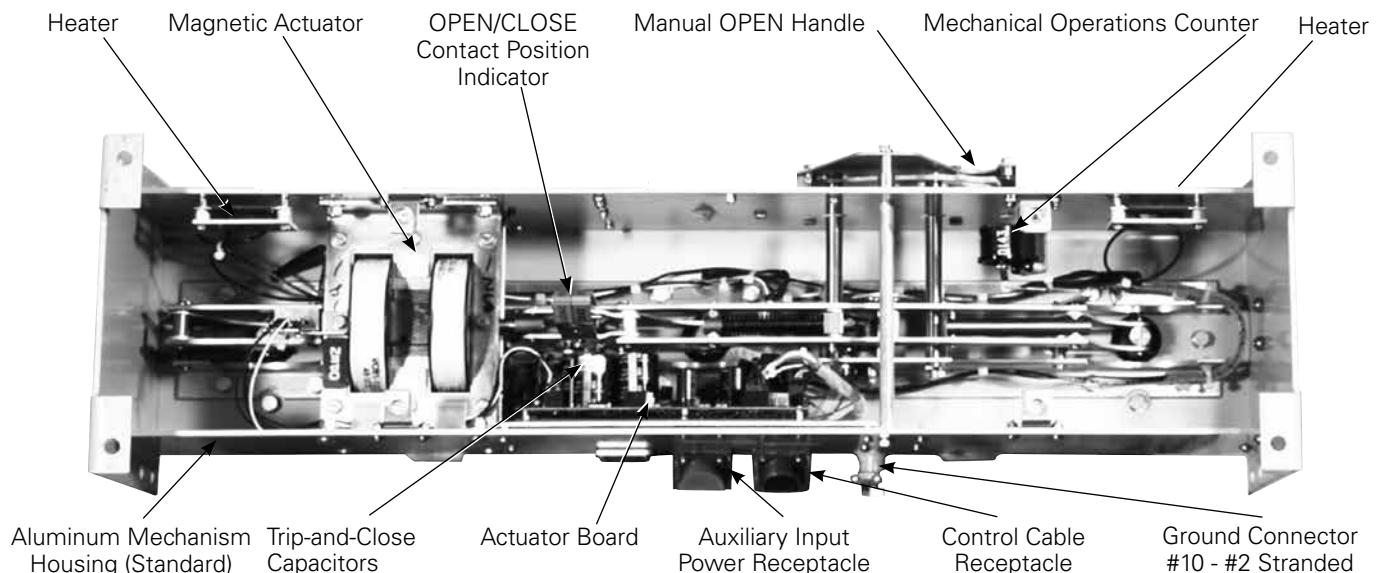


Figure 2. NOVA recloser Type B mechanism with auxiliary-powered interface (view from bottom of recloser with bottom cover and actuator board safety shield removed).

Vacuum interrupters

NOVA reclosers use vacuum as the interrupting medium. Vacuum interrupters (Figure 3) provide fast, low-energy arc interruption with long contact and interrupter life, low mechanical stress, and maximum operating safety. With arc interruption taking place in a vacuum, contact and interrupter life are several times greater than with interruption in oil, virtually eliminating interrupter maintenance.

Eaton designs its Cooper Power series vacuum interrupters with a metal and ceramic housing for maximum strength and long-term vacuum integrity. Oxygen-free, high-conductivity copper, stainless steel, and a nickel-copper alloy are used in the vacuum interrupters. The high-alumina ceramic has more than five times the strength of glass, which permits a higher processing temperature to develop maximum purity of the assembly, and is impervious to helium penetration, maintaining the vacuum level. Additionally, it provides wear resistance, chemical resistance, and a high dielectric strength.

Enclosed in the interrupter are a stationary and a moving contact assembly. The moving contact has a travel of approximately one-half inch, its shaft passing through a flexible bellows that maintains vacuum integrity. Contacts consist of a high purity copper sintered with aluminothermic chromium.



Figure 3. Cross section of a vacuum interrupter used in NOVA reclosers.

Because the smallest amount of internal contamination can significantly shorten the life of a vacuum interrupter, special care is taken to avoid even minute contamination from any source, including dust particles, machining oils, or human body salts. No paraffinic oils are used in the machining process, all machined parts are put through a cleaning/degreasing process, and then all components are electro-polished in a positive-pressure, air-filtered area. A Class 100 clean room facility is used for the final interrupter production. The furnaces employ a custom-designed, three-stage pumping system to yield high levels of vacuum. Every vacuum interrupter is then tested and tracked with individual serial numbers.

Electronic control

NOVA15, NOVA27, and NOVA38 reclosers are controlled by an Eaton's Cooper Power series three-phase electronic recloser control. A choice of microprocessor-based controls are available to use in conjunction with these reclosers.

Control-powered interface

The Type D NOVA recloser mechanism (see Figure 4) with the control-powered interface is fully operational with Form 5 and Form 6 VTC-ready, microprocessor-based controls equipped with the required dc-to-dc converter, interface circuit, and a fully shielded 19-pin cable. It is not compatible with the Types F3A nor FXB controls. The control-powered interface includes a 19-pin receptacle on the recloser and an internal heater (for humidity control) powered from the control input power supply (ac or dc). The dc-to-dc converter board converts the control's 24 Vdc battery supply to 53 Vdc to charge the trip/close capacitors in the NOVA recloser mechanism. The dc-to-dc converter board also houses voltage monitoring and conditioning circuits that protect the battery from failure and provide trip/close operations without ac power. In the absence of ac power to the electronic control, the control battery will provide the trip and close operations. A complete four-trip sequence with minimal reclose intervals as configured for each control is obtainable without ac power. The recloser and control system is capable of exceeding over one thousand operations on battery power only.

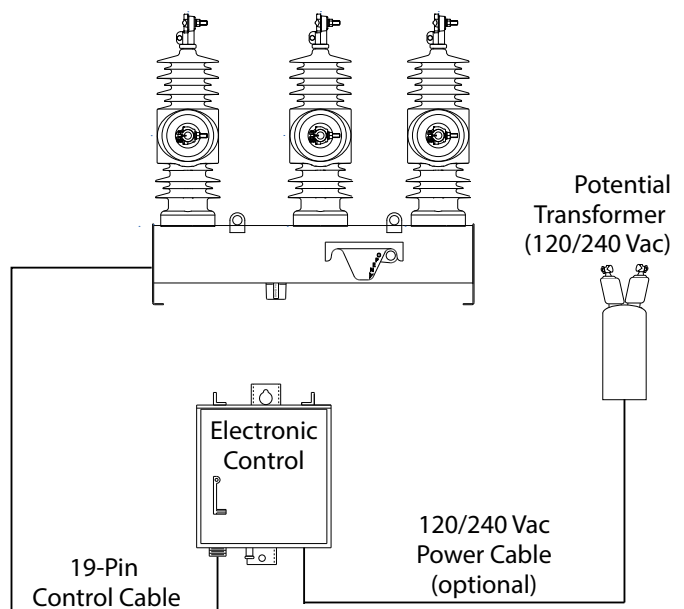
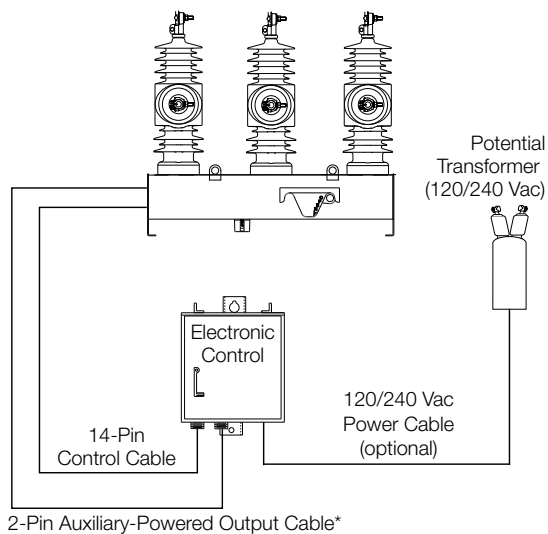


Figure 4. Control-powered NOVA recloser configuration with potential transformer input power.



*Note: Control receptacle ordered separately.

Figure 5. Auxiliary-powered NOVA recloser mechanism configuration with potential transformer input power.

Auxiliary-powered interface

The Type B NOVA recloser mechanism (see Figure 5) with the auxiliary-powered interface is fully operational with standard Form 6 microprocessor-based controls and standard 14-pin control cables. The auxiliary-powered interface includes a 14-pin receptacle on the recloser and an internal heater (for humidity control) powered from the auxiliary input power supply.

The Type B NOVA recloser mechanism, with the auxiliary-powered interface, requires a voltage source of 48 Vdc, 125 Vdc, 250 Vdc, 120 Vac, or 240 Vac, which must be specified at the time of order. The auxiliary-powered interface is connected to a 2-pin male receptacle located next to the 14-pin female control receptacle. The voltage source is used to maintain power to the trip-and-close capacitors in the recloser and to power the heaters.

DC auxiliary input

The trip-and-close capacitors are maintained from the dc source. Upon loss of the dc power, the trip-and-close capacitors will maintain trip and close power for several minutes. If the trip-and-close capacitors are discharged, the recloser is inoperative until dc power is resumed.

AC auxiliary input

The trip-and-close capacitors are charged through both the ac auxiliary input power and the recloser control. Upon loss of ac power, the capacitors will be continuously charged from the control battery to allow tripping and will also be trickle-charged to allow for back-up closing. The charge on the capacitors will be maintained for the duration of the control battery power. Allow one minute between back-up close operations to recharge the capacitors. However, the NOVA recloser is ready to trip immediately after performing a back-up closing. Should the battery power discharge to the disconnect level, back-up closing is disabled until ac auxiliary power is resumed. Apply ac auxiliary input power to the NOVA recloser to recharge the capacitors.

Manual operation

The recloser can be opened manually with a hotstick to pull down the yellow manual OPEN handle under the sleet hood. With the handle in the OPEN position, the control cannot close the recloser.

The recloser is closed, following a manual open, by pushing the yellow handle back under the sleet hood and then using the microprocessor control to close the recloser.

Similarly, the recloser can be operated from the manual control switch on the electronic control panel, provided the manual operating handle is up. A red contact position indicator flag, adjacent to the manual operating handle, shows recloser contact position.

Internal voltage sensor option

The NOVA recloser is available with internal voltage sensors at time of order. Using a high-voltage resistor within each interrupter module with source-side connections, the sensing option, cable, and control support a magnitude accuracy of 2% or better and a phase degree accuracy of $\pm 1.5^\circ$. The internal voltage sensing option is compatible with a Form 5 or Form 6 pole-mount controls.

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" (follow state of recloser contacts) and "b" (opposite recloser contacts) positions. The switch contacts are insulated for 600 V and have a continuous current rating of 10 A. Their interrupting ratings are shown in Table 5.

Terminals

The standard terminal is an eyebolt, 1/0–500 MCM (630 A). Eyebolt 4/0–1000 MCM (800 A), 2-hole and 4-hole, flat-pad terminals, and stud-type terminals are available as an accessory.

Pole-mounting hanger

A pole-mounting hanger, which bolts directly to the recloser frame, is available for pole-mounting installation.

Arrestor-mounting brackets

The arrestor-mounting bracket accessory can be bolted to the recloser frame and pole-mounting hanger for the addition of inboard and outboard arresters. The arresters are not included with the brackets.

Substation-mounting frame

A substation-mounting frame accessory is available for substation-mounting applications.

Ratings and specifications

Table 1. Voltage Ratings (kV)

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Maximum Voltage	15.5 kV	15.5 kV	29.2 kV	29.2 kV	38.0 kV
Rated Basic Impulse Level	110.0 kV	125.0 kV	125.0 kV	150.0 kV	170.0 kV
Radio Noise Limit (µV)	100 @ 9.4 kV	100 @ 9.4 kV	100 @ 16.4 kV	100 @ 16.4 kV	100 @ 23.0 kV
Power Frequency Withstand, Dry	50 kV	50 kV	60 kV	60 kV	70 kV
Power Frequency Withstand, Wet	45 kV	45 kV	50 kV	50 kV	60 kV

Table 2. Current Ratings (Amperes)

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Rated Continuous Current	630 A*	630 A*	630 A*	630 A*	630 A*
Short Circuit Current, Symmetrical	12.5 kA**	12.5 kA**	12.5 kA**	12.5 kA**	12.5 kA
Making Current, Asymmetrical Peak	31.0 kA	31.0 kA	31.0 kA	31.0 kA	31.0 kA
Cable Charging Current	10 A	10 A	25 A	25 A	40 A

* 800 amp accessory is also available.

** 16.0 kA option is also available. (Making Current is 40.0 kA Asymmetrical Peak.)

Table 3. Mechanical Ratings

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Min. Mechanical/Electrical Operations Without Maintenance (C-O)	10,000	10,000	10,000	10,000	10,000
Mass (Weight) - kg (lbs)	89 (196)	94 (206)	94 (206)	104 (229)	104 (229)

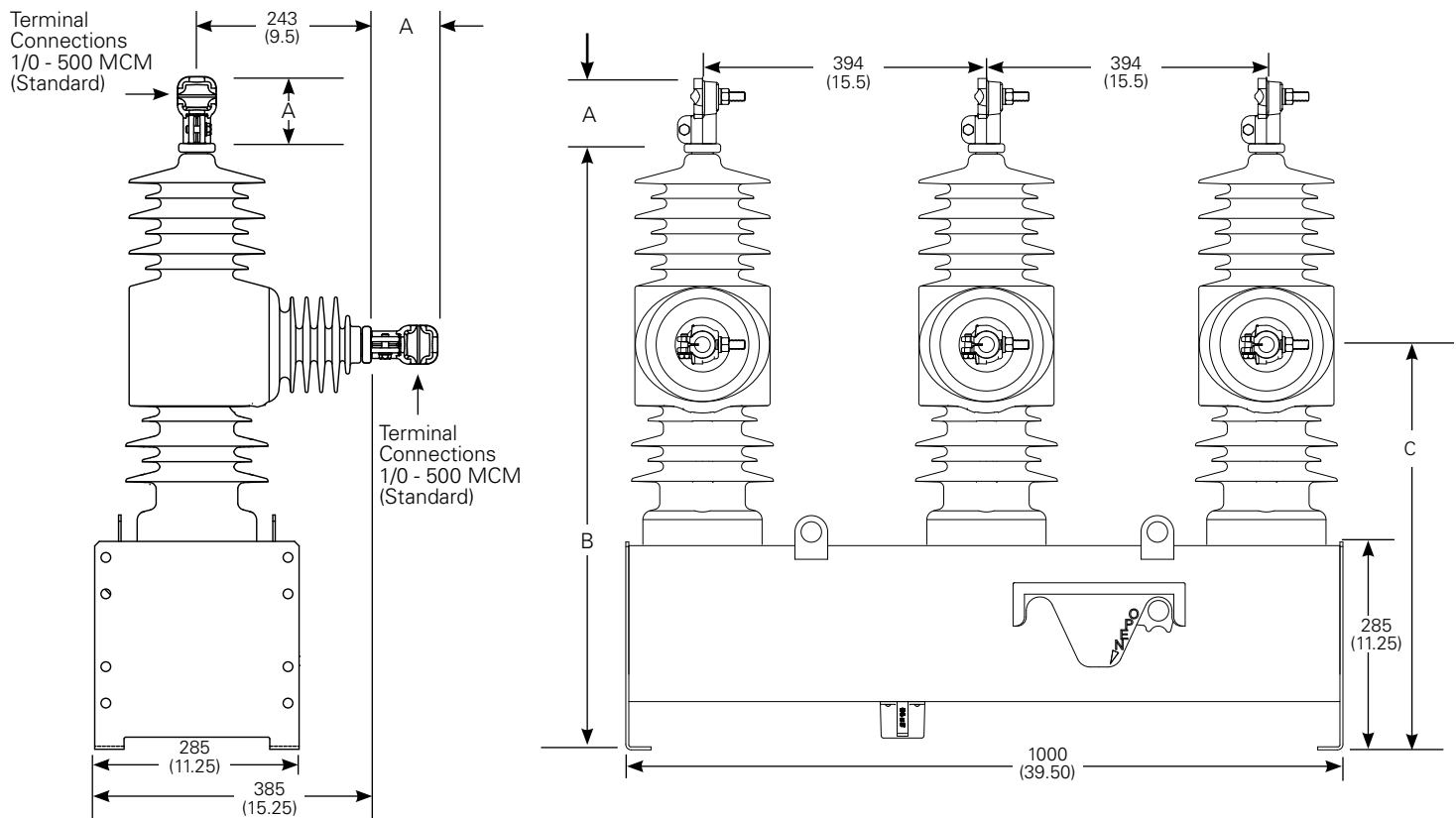
Table 4. Duty Cycle

Type	Percentage of Interrupting Rating	Number of Unit Operations	Minimum Circuit X/R Value
NOVA	15-20	88	4
	45-55	112	8
	90-100	32	15
	Total 232		

Table 5. Auxiliary Switch Interrupting Ratings

Volts	Inductive AC (amps)	Non-Inductive AC (amps)	Inductive DC (amps)	Non-Inductive DC (amps)
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

Dimensions



Note: All dimensions are mm (inches).
Dimensions shown are approximate.

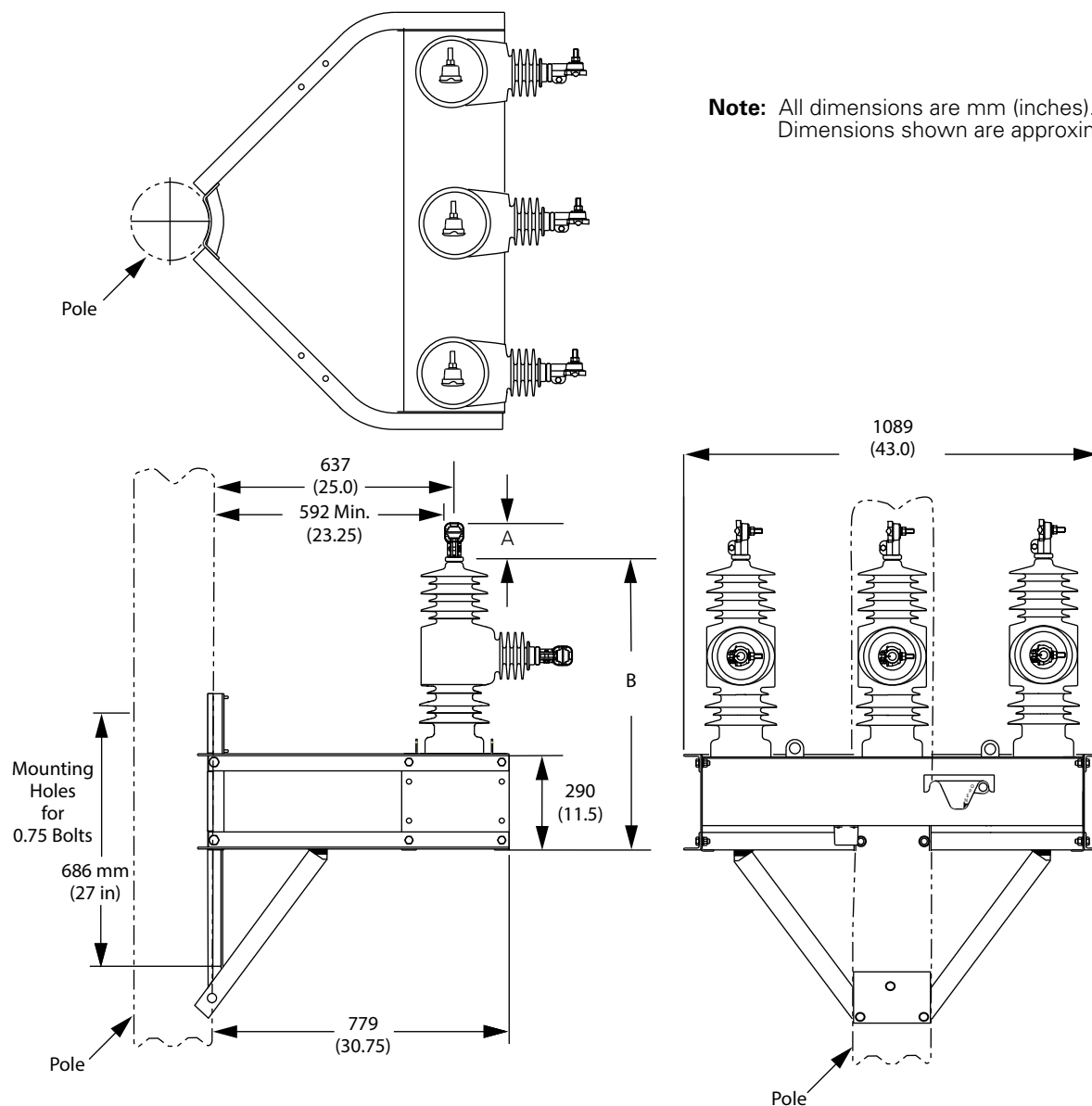
Terminal Options*	A mm (in.)	B mm (in.)	C mm (in.)
Eyebolt , 1/0 - 500 mcm Cable Range (630 A maximum)	93 (3.65)	NOVA15 110 kV BIL 789 (31.0)	508 (20)
Eyebolt , 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)	NOVA15 125 kV BIL 845 (33.25)	564 (22.25)
Flat Pad , 2-hole (630 A maximum)	118 (4.65)	NOVA27 125 kV BIL 845 (33.25)	564 (22.25)
Flat Pad , 4-hole (800 A maximum)	121 (4.75)	NOVA27 150 kV BIL 944 (37.25)	663 (26.0)
		NOVA38 170 kV BIL 944 (37.25)	663 (26.0)

* Bushings are equipped with M24 x 2.0 (2 mm pitch) threaded studs.

Creepage Distances

Description	15 kV 110 kV BIL mm (in.)	15 kV 125 kV BIL mm (in.)	27 kV 125 kV BIL mm (in.)	27 kV 150 kV BIL mm (in.)	38 kV 170 kV BIL mm (in.)
Terminal to terminal	1052 (41.5)	1052 (41.5)	1052 (41.5)	1052 (41.5)	1052 (41.5)
Lower terminal to ground/earth	673 (26.5)	760 (30.0)	760 (30.0)	950 (37.5)	950 (37.5)

Figure 6. NOVA recloser dimensions, NOVA27 shown.

**Terminal Options***

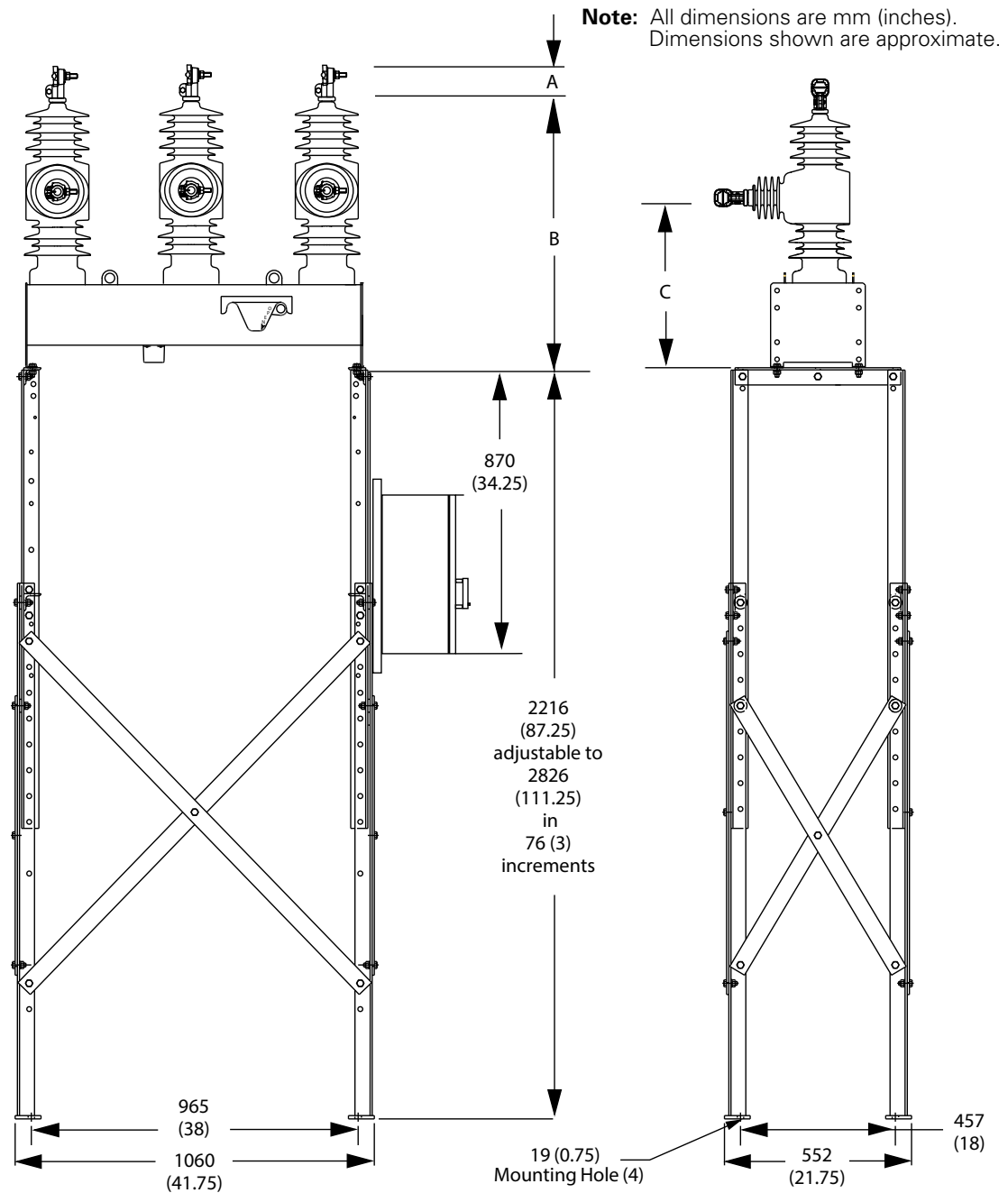
	A mm (in.)
Eyebolt , 1/0 - 500 mcm Cable Range (630 A maximum)	93 (3.65)
Eyebolt , 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad , 2-hole (630 A maximum)	118 (4.65)
Flat Pad , 4-hole (800 A maximum)	121 (4.75)

* Bushings are equipped with M24 x 2.0 (2 mm pitch) threaded studs.

Dimension B mm (in.)

NOVA15 110 kV BIL	789 (31.0)
NOVA15 125 kV BIL	845 (33.25)
NOVA27 125 kV BIL	845 (33.25)
NOVA27 150 kV BIL	944 (37.25)
NOVA38 170 kV BIL	944 (37.25)

Figure 7. Dimensions of NOVA recloser with pole-mounting hanger and arrester-mounting bracket accessories.

**Terminal Options***

	A mm (in.)
Eyebolt , 1/0 - 500 mcm Cable Range (630 A maximum)	93 (3.65)
Eyebolt , 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad , 2-hole (630 A maximum)	118 (4.65)
Flat Pad , 4-hole (800 A maximum)	121 (4.75)

* Bushings are equipped with M24 x 2.0 (2 mm pitch) threaded studs.

	B mm (in.)	C mm (in.)
NOVA15 110 kV BIL	789 (31.0)	508 (20)
NOVA15 125 kV BIL	845 (33.25)	564 (22.25)
NOVA27 125 kV BIL	845 (33.25)	564 (22.25)
NOVA27 150 kV BIL	944 (37.25)	663 (26.0)
NOVA38 170 kV BIL	944 (37.25)	663 (26.0)

Figure 8. Dimensions of NOVA recloser with substation-mounting frame accessory.

Constructing a catalog number

To order a basic NOVA recloser with eyebolt terminals, for use with 120 Vac closing and a 14-pin control cable, the catalog number would be constructed like this:

KNOVA Basic letters for a NOVA recloser with base Form 6 recloser control*

15A Recloser Type:

15A for 15 kV, 630 A continuous, 12.5 kA interrupting

27A for 27 kV, 630 A continuous, 12.5 kA interrupting

38A for 38 kV, 630 A continuous, 12.5 kA interrupting

1 Bushing Terminals:

1 for eyebolt terminal, 1/0 to 500 MCM, 630 A max.†

3 for 2-hole flat pad terminal, 630 A max.

4 for 4-hole flat pad terminal, 800 A max.

5 for stud-type terminal, 800 A max.

1 Interface:

1 for NOVA AP, with auxiliary-powered interface 120 Vac closing (14-pin & 2-pin receptacles)

2 for NOVA AP, with auxiliary-powered interface 240 Vac closing (14-pin & 2-pin receptacles)

3 for NOVA CP, with control-powered interface (19-pin receptacle), 120 Vac Heater

4 for NOVA CP, with control-powered interface (19-pin receptacle), 240 Vac Heater

5 for NOVA AP, with auxiliary-powered interface 125 Vdc closing (14-pin & 2-pin receptacles)

6 for NOVA AP, with auxiliary-powered interface 250 Vdc closing (14-pin & 2-pin receptacles)

7 for NOVA AP, with auxiliary-powered interface 48 Vdc closing (14-pin & 2-pin receptacles)

KNOVA 15A 1 1

KNOVA15A11 is the catalog number for the required basic NOVA recloser.

* Include the base catalog number of the selected control when ordering a NOVA recloser.

† Standard terminal, included when ordering a NOVA recloser.

Table 6. BIL Options

Description	Catalog Number
15 kV 125 kV BIL	KNOVA28-1
27 kV 150 kV BIL	KNOVA25-1

Table 7. Interrupting Rating*

Description	Catalog Number
16 kA Maximum Interrupting	16 kA

* Applicable to KNOVA15A/27A only

Table 8. Continuous Current Options*

Description	Catalog Number
15 kV 800 A option	KNOVA22-1
27 kV 800 A option	KNOVA24-1
38 kV 800 A option	KNOVA27-1

* When ordering the standard eyebolt terminal in conjunction with the 800 A option, eyebolt terminals suitable for 4/0 – 1000 mcm conductors will be provided.

Table 9. Internal Voltage Sensing Option*

Description	Catalog Number
Internal Voltage Sensing option, 15.5-38 kV	KNOVA-848
Internal Voltage Sensing Cable (basic cable, no length)	KA97ME
Internal Voltage Sensing Cable, maximum 50 feet Replace X with number of feet.	KA97ME-X

* Available with Form 5 and Form 6 Controls only.