Grid Solutions

VOLTAGE REGULATORS

Robust, Maintenance Free Solutions

The voltage on modern distribution circuits is becoming increasing difficult to manage. New distributed energy resources, such as solar, combined with the growth of sophisticated loads creates voltage challenges on distribution network systems.

Existing voltage control devices cannot maintain a consistent voltage profile, especially when trying to manage the intermittency of these resources and loads. These new loads and intermittent resources tend to drive the voltage regulation beyond its designed capability.

These increased operations reduce the typical voltage regulator life expectancy and increases the ongoing maintenance cost for reliable operation. The ongoing maintenance requirement of most voltage regulators, along with the reliability cost associated with unit performance contribute significantly to the total cost of ownership for voltage regulators.

GE Vernova's Solution

GE Vernova's family of Voltage Regulators set the industry standard in terms of robust design and product reliability. The GE Vernova design fully complies with the strict requirements of IEEE® C57.15-2009 and NEMA® 4, and is independently certified by KEMA®.

GE Vernova Voltage Regulators can operate up to 2 million mechanical operations, providing years of reliable service without having to incur costly maintenance outages.

GE Vernova offers cost effective, robust solutions to regulate voltage on the network without comprising quality and reliability, providing a total cost of ownership that is nearly 20% better than other competing products.

Additionally, GE Vernova is one of the first in the market to incorporate measured Reverse Power Flow capability to the voltage regulator. The new feature provides precise synchronous operation of the tap changer and control during normal and reverse power flow, which is critical on today's distribution circuits where distributed generation is present.

Applications of Single Phase Voltage Regulation

- Fast Cycle Pole-mounted Voltage Regulator
- Traditional Pole-mounted Voltage Regulator
- Substation Voltage Regulator

Low Cost of Ownership

- 20 years maintenance free operation reduces total cost of ownership
- Only voltage regulator on the market that does not come with a required maintenance program
- Best in class Load Tap Changer (LTC) switch, with the longest switching mechanism life and proven 2 million mechanical operations
- Superior internal arrester provides less stress to the coil under lightning/impulse surge events

Standards Compliant

- Fully complies with ANSI® requirements and IEEE standards
- Design validated by KEMA to adhere to the latest IEEE C57.15-2009 standards
- Fast Cycle voltage regulator clamp type terminals, remote mount controller and 3 operating taps comply to IEEE requirements
- Traditional pole-mounted units designed to meet the full ANSI rating (40x rated current)
- Heavy duty lifting lugs on cover and tank

Flexible Design

- Standardized plug and play design provides flexibility to integrate multiple controllers
- Compatible with multiple state of the art, microprocessor programmable controls
- One cabinet fits most standard control modules
- Newly designed control cabinet configurable for most control/ communication options; meets NEMA 3R/4 and UL50 requirements
- Forward and reverse power flow measurements for proper volt/ var management

GE VERNOVA

Voltage Regulator Applications

Voltage regulation on electrical networks is a complex process. It involves a number of key assets working collaboratively to maintain a consistent voltage profile while the variable loads and distributed generation within the network are continually changing.

The transformers located within the substation, usually operate with a Load Tap Changer (LTC) and manage the voltage levels for the bus that may feed multiple circuits that are served from the substation. The transformer provides a baseline voltage level that all circuits need in order to operate within the specified operational range.

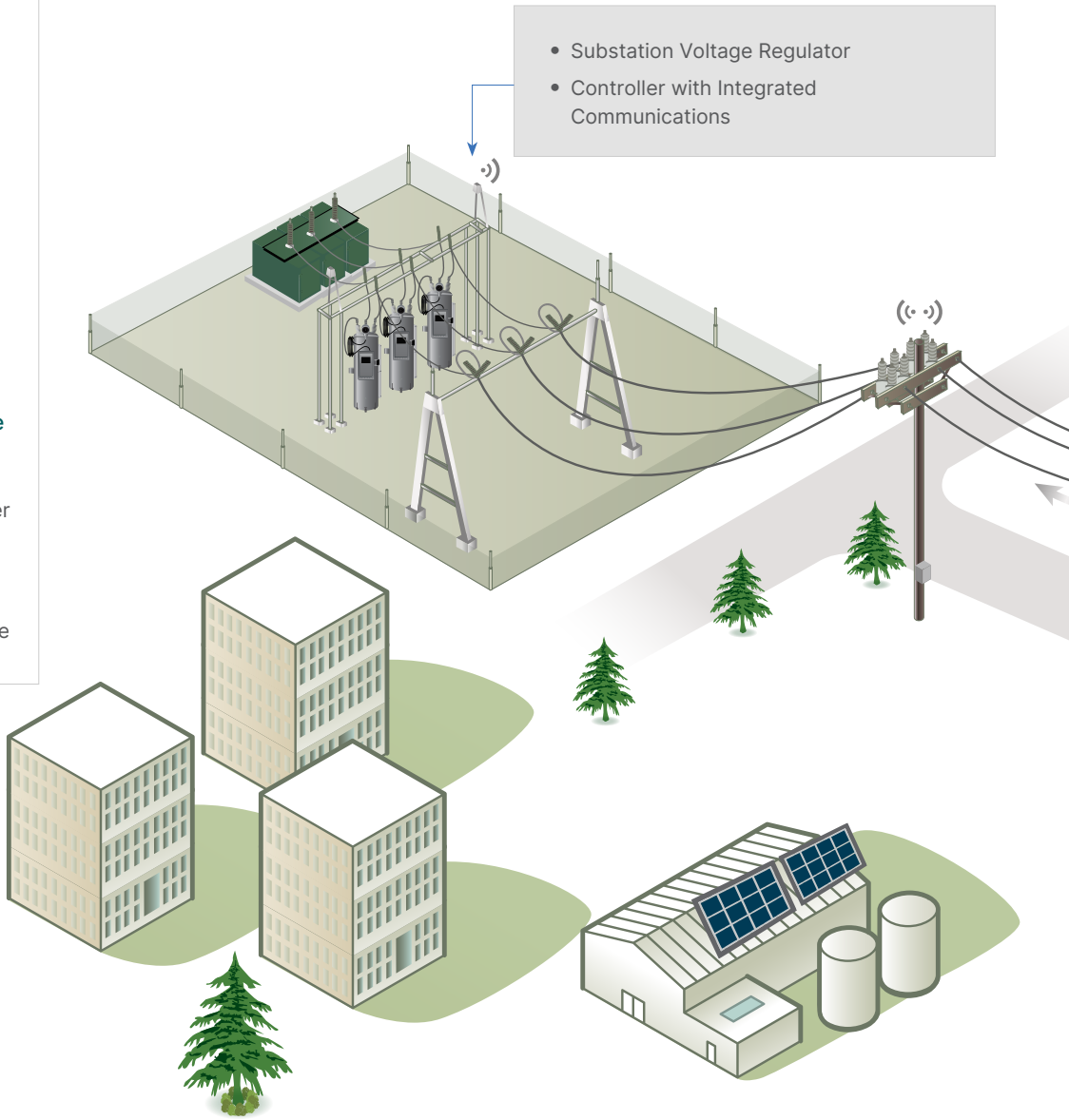
Feeder Regulation Within The Substation

There are instances where the various feeders may have significantly different loads and cannot maintain voltage regulation between circuits on the same transformer. In these circumstances, a substation voltage regulator is used to adjust the voltage level of a specific feeder so that all the loads served from the transformer can safely operate at their intended voltage level. The substation voltage regulator is typically controlled and adjusted in conjunction with the transformer's LTC.

GE Vernova's Voltage Regulation Solutions

GE Substation Voltage Regulator (VR-SS)

- Increased reliability and performance over 3-phase units
- Lowest total cost of ownership (TCO)
- 20 years maintenance free operation



Regulation For Specific Loads on a Feeder

There are instances where the entire feeder does not need to be adjusted. An example is an industrial complex, with a large number of motors and other inductive loads. In these circumstances, a pole-mounted voltage regulator is used within the circuit to adjust the voltage level to adequately serve that end user.

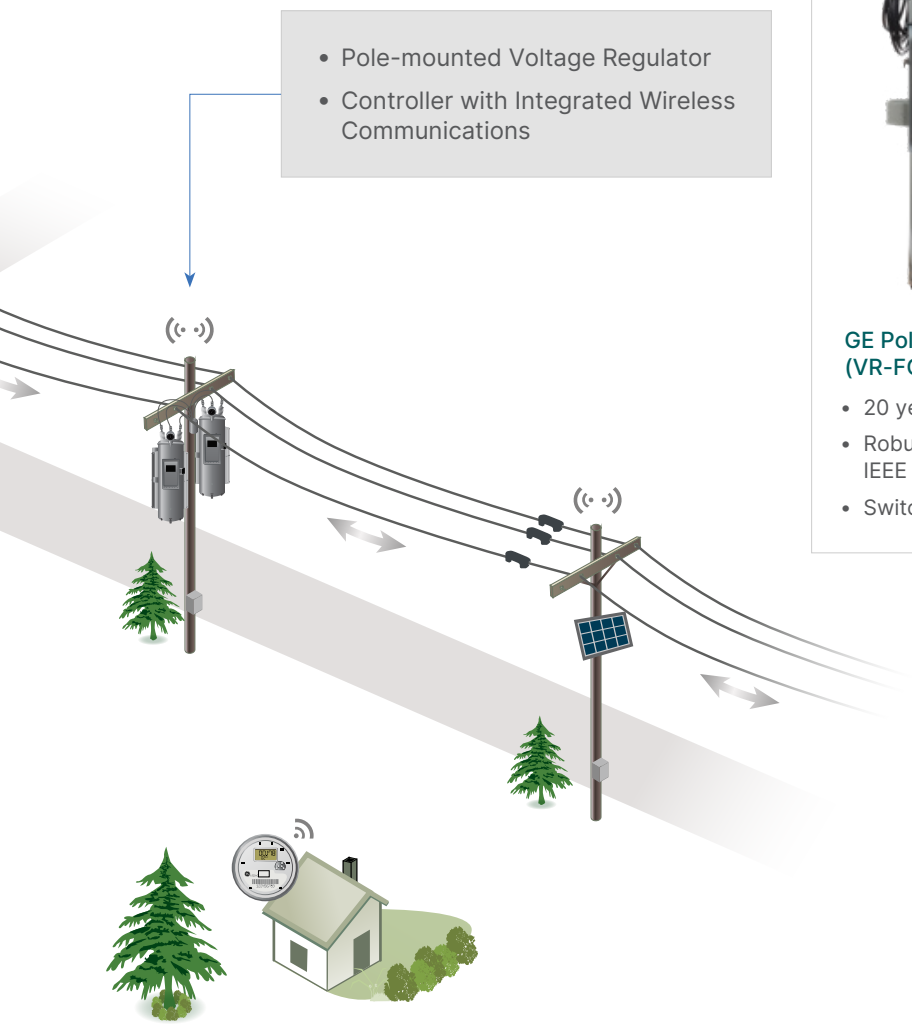
The pole-mounted voltage regulator is typically adjusted automatically, and must operate in conjunction with the substation voltage regulator and the substation transformer.

Benefits of Voltage Regulation

Managing voltage profiles with voltage regulator devices is a cost effective option for utilities, and provides precise control of the voltage profile at specific locations within the circuit where voltage regulation is needed most.

The addition of smart integrated controllers, as well as communications capability enhances the coordinated control of these devices minimizing system losses and enhancing profitability.

GE Vernova's family of Voltage Regulator products, along with their dedicated controllers, supports both of the applications described above.



GE Pole-mounted Voltage Regulator (VR-FC, VR-PM)

- 20 years maintenance free operation
- Robust design tested and certified to comply with IEEE C57.15-2009
- Switch verified to deliver 2 million operations

GE Vernova's Fast Cycle Voltage Regulator

The Fast Cycle Voltage Regulator (VR-FC) is a new edition to GE Vernova's portfolio of pole-mounted voltage regulators and is based on the most popular utility configurations. The VR-FC is manufactured with a standard design, providing an optimized feature set, with short-cycle lead times at a competitive based price point.

The new optimized VR-FC Voltage Regulator maintains all of the robust design features that the industry has come to associate with GE Vernova Voltage Regulators, including meeting the ANSI short circuit rating of 25x rated current. The load tap changer switch is certified to reliably operate beyond 2 million tap operations, one of the highest operations in the industry. As with all GE Vernova Voltage Regulators, there is no required maintenance plan for the VR-FC Regulator, resulting in one of the lowest total costs of ownership in the industry.

The VR-FC is ideal for utilities who want to establish a simpler ordering structure or require a standardized product configuration. GE Vernova's stocking program of this product supports emergency ordering and short cycle requirements.

Key Benefits of the VR-FC:

- Design efficiency requires less cooling panels, resulting in a smaller footprint and reduced radiation.
- Sealed position indicator design eliminates complicated fittings which reduces the risk of leaks and water entry.
- Single Molex™ quick connect harness to easily interface to most controller options.
- Heavy duty lugs both on the cover and tank.
- Multiple grounding provisions under the source, load and source load bushings.

GE Vernova's Fast Cycle Voltage Regulator (VR-FC) installed in a distribution network

The Fast Cycle Voltage Regulator (VR-FC)

Short Order Cycle

Reduced Radiation

IEEE C57.15-2009

Standards Compliant

Technical Specifications

	STANDARD OFFERING	OPTIONAL OFFERING
Power Ratings	76, 114, 167 & 72, 144, 288 kVA (Single Phase Only)	
Voltage Ratings	• Primary Voltages from 7.62kV through 14.4kV • Type B	
BIL Ratings	Primary BIL ratings 95kV to 150kV BIL	
Thermal Rating	Thermal rating of 55°C/65°C rise	
Frequency	60 Hz frequency	50 Hz frequency
Special Ratings	N/A (special ratings are not “standard”)	
Insulating Fluid	ANSI Type 2 Mineral Oil	
Tank & Features	• Steel construction per C57. 15, C57.12 & C57.90 • Round, sealed carbon steel tank with durable weather-resistant powdercoat-finish (ANSI No. 70 Gray) • Three cover bushings (S, L, SL) with ANSI clamp-type terminals • Two heavy duty lifting lugs on tank and cover • Black diagrammatic anodized aluminum nameplate on tank and control cabinet • Universal, waterproof, 3/8 inch lockable pad lock, and heavy duty constructed NEMA 3R carbon steel control cabinet with Handle • Control cabinet equipped with universal connector for simple control replacement • Beckwith M6200A • 18” (7,620V) and 26.5” (14,400V) GE Vernova designed creep procelain bushings	• NEMA 4 hole spade terminals • Adjustable control cabinet heater for condensation removal • One control simplifies stocking (highest volume control) • Bird guard for bushings and lightning arresters
Internal Features	• Load Tap Changer (LTC) Switch with expected life beyond 2,000,000 operations • 65°C rated oven-bonded, patterned, epoxy-coated insulation paper for core and coil assembly • Superior short circuit withstand ability (25x rated current in accordance with latest ANSI C57.15-2009 requirements) • Center-tapped, internally mounted, zinc-oxide series winding bypass arrester with very low failure rate provides superior distribution of voltage stresses across the series winding and protests arrester from physical damage during transportation and service	
Gauges & Valves	• Liquid level sight gauge • 45 Degree Dial-type position indicator with drag hand and load bonus adjustment for additional current carrying ability at reduced regulation • 1” brass oil drain valve, brass minimum oil sight gauge and upper fillter press connection for cycling oil • Pressure relief valve (10 psig vent pressure)	

GE Vernova's Pole-mounted Voltage Regulator

The Pole-mount/platform mount Voltage Regulator (VR-PM) is GE Vernova's premium product for voltage control outside the substation and has established the benchmark in the industry for robust design and operational reliability.

The only voltage regulator on the market that is guaranteed to support 2 million switch operations and adheres to the latest IEEE C57.15-2009 and C57.131 standards of 40x rated short circuit current.

Why does this matter? Voltage stability is an increasing challenge to utilities. The economic benefits of voltage management are becoming better understood, especially given the adoption of technologies that can adjust the voltage profiles dynamically. Distributed generation, an increase of loads with variable speed and customer expectation of power quality all contribute towards voltage regulating devices needing to operate more often to keep the voltage in the targeted operational range.

The engineering design, material selection and strict manufacturing processes of the VR-PM Voltage Regulator allow it to be operated in this manner to best serve the operational and economic, interests for the utility.

Unlike other competitive products, the VR-PM Voltage Regulator does not have a required maintenance plan, resulting in one of the lowest total costs of ownership in the industry.

Key Benefits of the VR-PM:

Robust design and low total cost of ownership

- Best in class Load Tap Changer (LTC) switch life, with up to two million operations resulting in up to 20 years of maintenance free usage.
- Superior internal arrester provides optimum surge protection against abnormal voltage surges by leveling the internal stresses in the winding during surge and fault events. Compared to externally mounted arresters, this results in higher reliability and a more stable design as it extends the service life of the unit.
- Forward and reverse power flow measurements for volt/var management on distributed generation feeders.

Validated design against Industry standards

- Adheres to the latest IEEE.C57.15-2009 Standards (40x rated current). GE Vernova performs short circuit testing every year to validate performance.
- Newly designed control cabinet configurable for most control and communications options; meets NEMA 3R and UL50 requirements and testing.
- Seismic certified and can be installed in most applications around the world.
- Rural Utilities Service (RUS) certified.

GE Vernova's Pole Mount Voltage Regulator (VR-PM) installed on a platform in a distribution network

The Pole-mounted Voltage Regulator (VR-PM)

20 YEARS

Maintenance Free Usage

2 MILLION

Switch Operations

40x Rated Current

Technical Specifications

	STANDARD OFFERING	OPTIONAL OFFERING
Power Ratings	38 - 333kVA (Single Phase Only)	Type A and B Designs
Voltage Ratings	Primary Voltages from 2.5kV through 19.9kV	
BIL Ratings	Primary BIL ratings 60kV to 150kV BIL	110kV BIL
Thermal Rating	Thermal rating of 55°C/65°C rise	
Frequency	60 Hz frequency	50 Hz frequency
Special Ratings		• Designs for elevations higher than 3300 feet • Low loss designs availabie in all ratings
Insulating Fluid	ANSI Type 2 Mineral Oil	
Tank & Features	• Steel construction per C57.15-2009, C57.12 & C57.90 • Round, sealed carbon steel tank with durable weather-resistant powdercoat-finish (ANSI No. 70 Gray) • Three cover bushings (S, L, SL) with ANSI clamp-type terminals • Two heavy duty lifting lugs on tank and cover • Black diagrammatic anodized aluminum nameplate on tank and control cabinet • Universal, waterproof, 3/8 inch lockable pad lock, and heavy duty constructed NEMA 3R carbon steel control cabinet with Handle • Control cabinet equipped with universal connector for accepting various control options without modifications • 18” to 36” GE Vernova designed creep procelain bushings • 15” radiator panels, 2 bank maximum • Removable, sealed hand-hole cover • One cabinet available control modules by all suppliers • Square base - unit can be used in sub station or on above platform mounting. Hanger Brackets included for pole mounting. Tank grounding (Qty 2 - diagonal opposite on all bases)	• Stainless • Zinc primer and epoxy topcoat finish for corrosive enviornments. • NEMA 2 or 4 hole spade, SEFCOR 2 or 4 hole, clamp type terminals, 1.00 threaded stud, & H&J vertical or horizontal terminals. • Laser-etched stainless steel namplate • Adjustable control cabinet heater for condensation removal. Bottom entry control cable. • Bird guard for bushings and lightning arresters • Ability to integrate most control modules within the Flex-Connect cabinet. (M6200A, GE Vernova 2011B, C, & E, SEL and ICMI) • Seismic certified galvanized adjustable sub-base; heights available from 15.5” to 42.5”
Internal Features	• Load Tap Changer (LTC) Switch with expected life of 2,000,000 operations • 65°C rated oven-bonded, patterned, epoxy-coated insulation paper for core and coil assembly • Superior short circuit withstand ability (40x rated current in accordance with latest ANSI C57.15-2009 requirements) • Center-tapped, internally mounted, zinc-oxide series winding bypass arrester with very low failure rate provides superior distribution of voltage stresses across the series winding and protests arrester from physical damage during transportation and service	• 668 Amperage Max • Reverse power flow measurement
Gauges & Valves	• Liquid level sight gauge • 15 to 45 Degree Dial-type position indicator with drag hand and load bonus adjustment for additional current carrying ability • 1” brass oil drain valve, brass mimimum oil sight gauge and upper fillter press connection for cycling oil • Pressure relief valve (10 psig vent pressure)	• Stainless steel drain valves and oil sampling valves • Temperature gauge (0 to 160°C)

GE Vernova's Substation Voltage Regulator

A common challenge for network utilities is managing voltage profiles within operating limits along the feeder. This can be extremely difficult to do with substation unit transformers, especially in substations that were built and designed for lower and more static load profiles.

In today's environment, the average load profiles have radically increased and are more dynamic. In this scenario, the unit transformers alone can no longer efficiently support voltage profiles across the circuits. A substation based voltage regulator is a cost-effective solution to solve this problem without bearing new infrastructure costs.

The GE Vernova Substation Voltage Regulator (VR-SS) is a single phase voltage regulator that is intended to support this type of application within a substation. The advantages of single phase units are twofold; they provide the ability to manage each phase independently in the event of unbalanced loads, and they provide redundancy when compared to an individual 3-phase unit.

As with all GE Vernova Voltage Regulator products, the VR-SS regulator provides best-in-class total cost of ownership and the robust design does not require maintenance, allowing for years of reliable operational service.

Key Benefits of the VR-SS:

- One of the lowest total costs of ownership when compared to other single phase or 3-phase voltage regulators.
- Best in class Load Tap Changer (LTC) switch life, with up to two million operations resulting in up to 20 years of maintenance free usage.
- Superior internal arrester provides optimum surge protection against abnormal voltage surges by leveling the internal stresses in the winding during surge and fault events. Compared to externally mounted arresters, this results in higher reliability and a more stable design as it extends the service life of the unit.
- Adheres to the latest IEEE C57.15-2009 standards (40x rated current). GE Vernova performs Short Circuit testing every year to validate performance.
- Newly designed control cabinet configurable for most major control and communications options; meets NEMA 3R/4 and UL50 requirements and testing.
- Seismic certified and can be installed in most applications around the world.
- Forward and reverse power flow measurements for volt/var management on distributed generation feeders.

GE Vernova's Substation Voltage Regulator (VR-SS) installed on a distribution network

The Substation Voltage Regulator (VR-SS)

Lowest Total Cost of Ownership

Maintenance Free Usage

Global Installations

Technical Specifications

	STANDARD OFFERING	OPTIONAL OFFERING
Power Ratings	100 - 833kVA (Single Phase Only)	Type A and B Designs
Voltage Ratings	Primary Voltages from 2.5kV through 19.9kV	
BIL Ratings	Primary BIL ratings 60kV to 150kV BIL	110kV BIL
Thermal Rating	Thermal rating of 55°C/65°C rise	
Frequency	60 Hz frequency	50 Hz frequency
Special Ratings		• Designs for elevations higher than 3300 feet • Low loss designs available in all ratings
Insulating Fluid	ANSI Type 2 Mineral Oil	
Tank & Features	• Steel construction per C57.15-2009, C57.12 & C57.90 • Round, sealed carbon steel tank with durable weather-resistant powdercoat-finish (ANSI No. 70 Gray) • Three cover bushings (S, L, SL) with ANSI clamp-type terminals • Two heavy duty lifting lugs on tank and cover • Black diagrammatic anodized aluminum nameplate on tank and control cabinet • Universal, waterproof, 3/8 inch lockable pad lock, and heavy duty constructed NEMA 3R carbon steel control cabinet with handle • Control cabinet equipped with universal connector for accepting various control options without modifications • 18” to 36” GE Vernova designed creep procelain bushings • 15” radiator panels, 3 and 4 bank maximum • Removable, sealed hand-hole cover • One cabinet available control modules by all suppliers • Square base - unit can be used in sub station or on above platform mounting. Hanger brackets included for pole mounting. Tank grounding (Qty 2 - diagonal opposite on all bases)	• Stainless • Zinc primer and epoxy topcoat finish for corrosive enviornments • NEMA 2 or 4 hole spade, SEFCOR 2 or 4 hole, clamp type terminals, 1.00 threaded stud, & H&J vertical or horizontal terminals. • Laser-etched stainless steel namplate • Standard communications available with the control module, and located in the same cabinet • Adjustable control cabinet heater for condensation removal. Bottom entry control cable. • Bird guard for bushings and lightning arresters • Ability to integrate most control modules within the Flex-Connect cabinet. (M6200A, GE Vernova 2011B, C, & E, SEL and ICMI) • Seismic certified galvanized adjustable sub-base; heights available from 15.5” to 42.5”
Internal Features	• Load Tap Changer (LTC) Switch with expected life of 2,000,000 operations • 65°C rated oven-bonded, patterned, epoxy-coated insulation paper for core and coil assembly • Superior short circuit withstand ability (40x rated current in accordance with latest ANSI C57.15-2009 requirements) • Center-tapped, internally mounted, zinc-oxide series winding bypass arrester with very low failure rate provides superior distribution of voltage stresses across the series winding and protects arrester from physical damage during transportation and service	• 668 Amperage Max • Reverse power flow measurement
Gauges & Valves	• Liquid level sight gauge • 15 Degree Dial-type position indicator with drag hand and load bonus adjustment for additional current carrying ability • 1” brass oil drain valve, brass mimimum oil sight gauge and upper fillter press connection for cycling oil • Pressure relief valve (10 psig vent pressure)	• Stainless steel drain valves and oil sampling valves • Temperature gauge (0 to 160°C)

Adjustable Height Sub Base

Long-Lasting, Portable Platform

Sub-bases are elevating structures used to raise the voltage regulator to meet safe operating clearances from ground to the lowest live part in the substation per National Electric Safety Council (NESC) requirements. In addition, they are used to ensure that the regulators are the same height.

GE Vernova's adjustable height sub base is constructed of galvanized steel providing a standard base to fit most voltage regulators from 3000 to 6000 pounds in weight. The sub base is easily adjustable in 3" increments and supports the NESC requirements for the lowest level of live parts. This sub base was designed and tested to meet the stringent requirements for seismic certification.

The combination of standard features that fit most voltage regulators and portability allows ease of ordering and lower total cost as one part can be used to support almost any voltage regulator fleet.

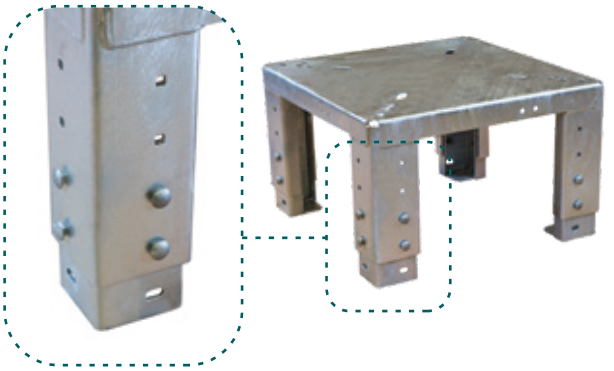
Key Benefits of GE Vernova's Sub Base

This galvanized steel adjustable height sub base fits most voltage regulators allowing easy transport and height adjustment in a long-lasting, portable design.

- Sturdy galvanized steel construction with a 40+ year life expectancy
- Designed and tested for seismic certification
- Fits voltage regulators up to 6000 pounds
- Allows customer with voltage regulators to meet NESC regulations for lowest level of live parts
- Weighs less than 300 pounds, allowing for easy portability
- Assembly time less than 15 minutes
- Standard design allows for ease of ordering

Heavy Duty Product Design

The telescoping slotted structural channel design with four (4) heavy duty corrosion resistant galvanized carriage bolts allows for locking the inner and outer legs together, maximizing the structure's moment of inertia when wind and seismic loads are applied from all sides of the regulator.



Telescoping slotted structural channel

This galvanized steel adjustable height sub base fits most voltage regulators allowing easy transport and height adjustment in a long-lasting, portable design.

21 and 25 Inch Tanks

SUB BASE GROUP NUMBERS	ADJUSTABLE HEIGHT OPTIONS (INCHES)			
7025B108G01	24.5	27.5	30.5	33.5
7025B108G02	15.5	18.5	21.5	24.5
7025B108G03	33.5	36.5	39.5	42.5

28 Inch Tanks

SUB BASE GROUP NUMBERS	ADJUSTABLE HEIGHT OPTIONS (INCHES)			
7025B108G06	24.5	27.5	30.5	33.5
7025B108G07	15.5	18.5	21.5	24.5
7025B108G08	33.5	36.5	39.5	42.5

Substation Voltage Regulator

Flex-Connect Control Cabinet

Module to NN Terminal Connector, RC Transformer

GE Vernova 2011B-E Controller Integrated in Flex-Connect Cabinet

Terminal, Terminal Covers, and Independent Ground Plate Back Plan

Flex-Connect

Flexible and Seamless Controller Integration

Who wants to be told, "You have to use my controller!" The majority of utilities have already made investments in people and training to get operationally proficient with a controller technology. Being able to maintain this standard and investment is an important consideration for any utility when making a decision to implement additional assets onto their network. With GE Vernova's Flex-Connect control cabinet design, utilities can utilize their existing assets and seamlessly integrate with major brands of controllers without risking any integration or programming concerns.

All functions and voltage settings are done within the control assembly as opposed to a separate junction box located near the high voltage bushings as on some competitive units. This approach provides for safer operation and maintenance of the unit, and ensures no water entry into the tank interior or the control cabinet.

The standard controls and voltage source requires no correction factor as the GE Vernova units provide a true 120Vac signal to the NN terminal block and the controller.

GE Vernova can provide optional voltage taps utilizing a ratio correction transformer located in the cabinet.

Key Benefits of Flex-Connect

- Flexible design with one cabinet that fits most standard control modules
- Newly designed control cabinet is configurable for most control and communication options
- Cabinet is NEMA 3R certified and meets all UL50 requirements
- One cabinet fits most industry standard control modules including:
  - GE Vernova 2011B,C & E
  - SEL 2431
  - Beckwith M6200A
  - ICMI UVR-1
- All functions and voltage settings are within the control assembly
- GE Vernova Voltage Regulators do not require voltage adjustment in the control's software. The input voltage from the PT, the display voltage on the control, and the voltage on the meter-out terminals will all match as configured
- Control Options
  - Multiple communication ports as specified
  - Control cable in 5'-50' lengths for remote mounting
  - Stainless steel control cabinet
  - Bottom or top entry cable
  - Thermostatically controlled cabinet heater
  - Ratio correction transformer
- Design Features
  - Large knockouts standard on bottom and side of cabinet
  - New gasket type for superior sealing and weatherproofing
  - Large vent with screen for better protection from condensation
  - Rain shield protects top gasket seal
  - Sloped cabinet top for rain/snow runoff
  - Increased door depth for storage
  - Adjustable latch design to maintain seal

Voltage Regulation Solutions

With more than 100 years of experience in the transmission and distribution industry, GE Vernova continues to be one of the world's leading companies in understanding electrical networks today and what will make them more efficient and reliable for tomorrow.

With the introduction of distributed generation, roof-top solar, and the proliferation of complex variable speed drives, the electrical network is experiencing new dynamics that have to be managed. All of these adoptions in technology create a significant challenge for stabilizing the voltage on the network.

The GE Vernova family of products below are all uniquely designed for ultimate reliability to help optimize the voltage levels and stability, especially in areas with a high penetration of renewable generation where reverse power flows can occur.

Our voltage regulator products can now be ordered with GE Vernova's reverse power flow feature. Reverse power flow provides precise synchronous operation of the tap changer and control during normal and reverse power flow, eliminating unnecessary equipment and control adjustments.

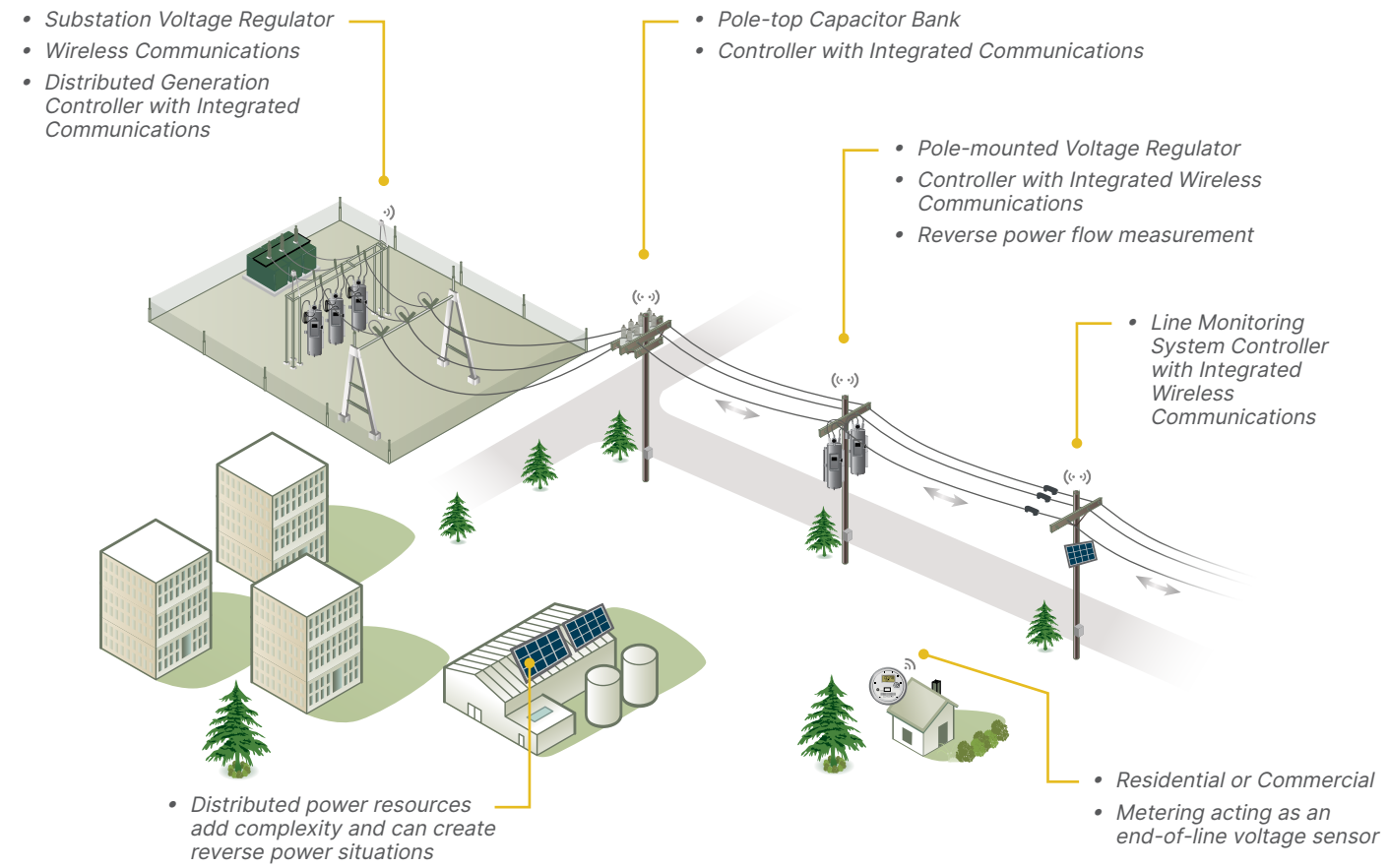
Reverse power flow benefits include:

- Measured source side control & addition of source side PT
- Redesign of coil winding
- Tap switch tolerances and position tolerances reduced by 80%
- More ridged and accurate mechanical connection from switch to position indicator

Incorporation of this feature into utility volt/var schemes can increase revenue, reduce operational costs and increase lineman safety.

Changing load types, along with the intermittency of distributed generation, will drive an unprecedented number of operations for the voltage control equipment. In anticipation of this, and to provide a product that can withstand an increase number of operations, GE Vernova offers the VR-1 switch mechanism in our voltage regulators, one of the most robust in the industry.

GE Vernova's Portfolio of Volt-Var Control Solutions



VR-1 Switch Mechanism

With the increase of new distributed energy resources, the voltage profile on feeders is more dynamic than ever before. To support this new dynamic, voltage control devices need to operate much more frequently.

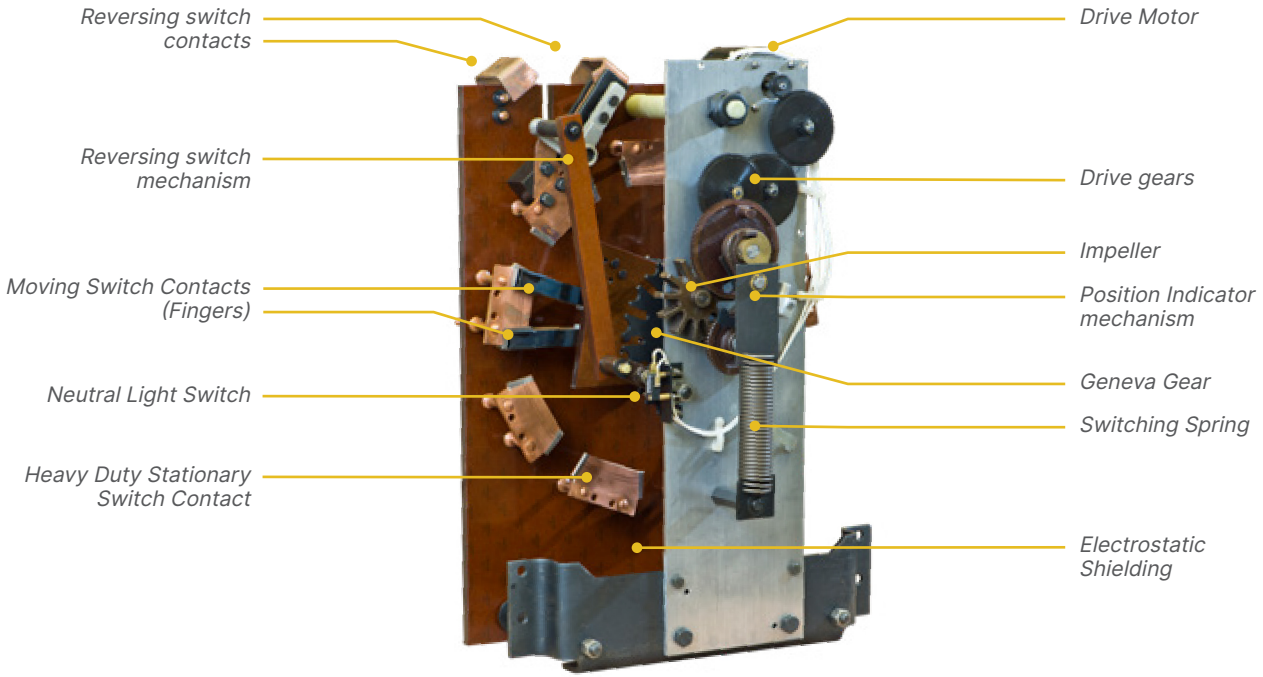
The load tap changer is the critical component in the voltage regulator that must be durable enough to allow this type of operational performance. GE Vernova's Voltage Regulator switch mechanism (VR-1) is the most robust load tap changer in the industry, with proven capability to operationally support over 2 million operations.

GE Vernova's Load Tap Changers (LTC) are provided with a mechanical stop for all the ratings per the latest C57.131 standard and does not utilize electronic holding or limit switches that could potentially fail. Additionally, the stationary and moving switch contacts are optimally designed in size and material properties to maximize the current density per cross sectional area.

Key Benefits

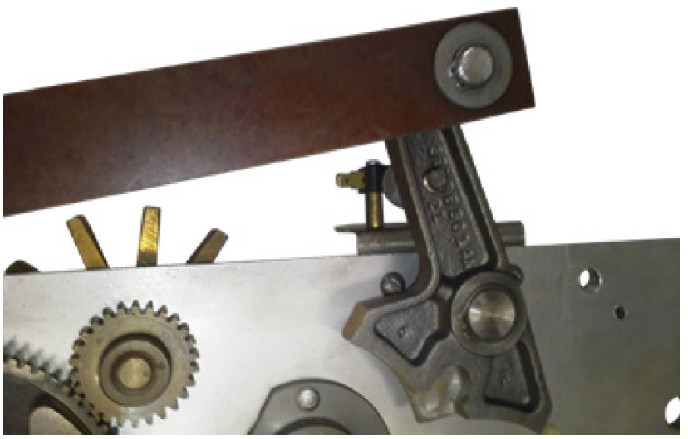
Best in class Load Tap Changer (LTC) Switch

- Proven 2,000,000 operation life mechanism
- 20 years of maintenance free operation
- 3 Amperage ratings available: 300A, 668A, & 668A High Voltage
- Heavy duty and proven stationary and moving switch contacts



VR-1 switch mechanism

Moving switch contacts



Mechanical stop per C57.131

GE Vernova's Manufacturing Facility

GE Vernova designs, manufactures and tests to the highest standards in the industry at its state-of-the-art manufacturing facilities. GE Vernova has an excellent track record in safety and is dedicated to the research, application and development of an extensive range of technology solutions for customers in the utility and energy industries.

Exceptional Quality and Reliability

- Third-party product certifications, including KEMA and other internationally recognized testing facilities
- Multiple checkpoints in the production, assembly and inspection process yield high quality products
- Rigorous electrical, oil quality, and leak testing

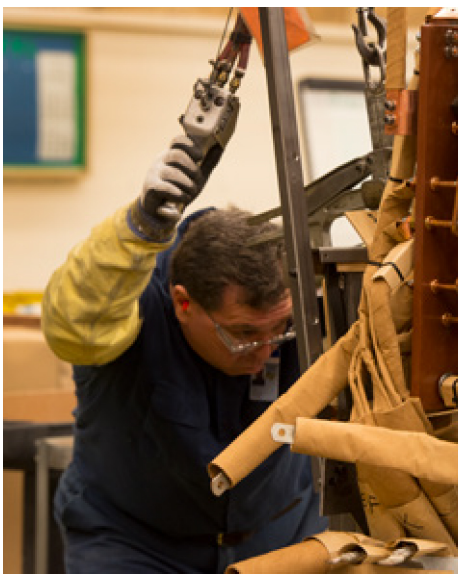
Advanced Technology and Manufacturing

- State-of-the-art 600,000 square-foot manufacturing facility comprised of operations such as metal fabrication, welding, cold welding, core assembly and coating
- The manufacturing site is ISO® 9001 certified
- Robust product technology
- Quality inspections for purchased and outsourced materials
- 3D dimensional modelling

The manufacturing facility is located in Shreveport, Louisianna and serves customers around the world.

Customer prep

Cooling panel welding



Interior assembly

External fabrication

Voltage Regulator Testing

All GE Vernova Voltage regulators adhere to rigorous testing and certification to meet industry standards and provide robust, maintenance free, long life cycle products.

All GE Vernova Voltage Regulators are tested in accordance with the latest IEEE/ANSI C57.15-2009 standards including:

- Resistance measurements of all windings
- Ratio tests on full windings
- Polarity test
- No load loss at rated voltage and rated frequency
- Excitation current at rated voltage and rated frequency
- Impedance and load loss at rated current and rated frequency
- Applied potential
- Induced potential
- Insulation power factor test
- Standard voltage impulse testing (BIL)
- Paint testing
- Oil power factor testing
- LTC life cycle test
- Polychlorinated Biphenyl testing

Complete electrical testing

Controls programming and testing

VR-PM & VR-SS 60Hz Voltage Regulator Catalog Ratings

kVA	CATALOG NO.	LOAD Amps AT RAISE & LOWER 10% REGULATION	APPROX. Wt. (lbs.) INCLUDING OIL		APPROX. GALLONS OIL (1) NET @ 7.45 lbs PER Gal.	APPROXIMATE STANDARD DIMENSIONS OVER-ALL INCHES		TYPE
			SHIP	NET		PROJ. FLOOR SPACE	LLP (10)	
2500 VOLTS - 60 kV BIL (for 2500/4330Y, 2400/4160Y volt circuits)								
50	33D3050 (2)(3)	200	1300	1200	66	29 X 36	67.2	Pole/Platform/Sub-Station
75	33D3075 (2)(3)	300	1480	1380	74	29 X 42	69.1	Pole/Platform/Sub-Station
100	33D3100 (2)(3)	400	2100	2000	116	30 X 46	74.2	Pole/Platform/Sub-Station
167	33D3167 (2)(3)	668	2390	2290	118	43 X 49	74.7	Pole/Platform/Sub-Station
5000 VOLTS - 75 kV BIL (for 5000/8660Y, 4800/8310Y, 2500/4330Y volt circuits)								
50	33D4050 (2)(4)	100	1630	1530	75	29 X 41	74.2	Pole/Platform/Sub-Station
100	33D4100 (2)(4)	200	1680	1580	75	29 X 41	74.2	Pole/Platform/Sub-Station
167	33D4167 (2)(4)	334	2080	1980	78	39 X 44	74.7	Pole/Platform/Sub-Station
250	33D4250 (4)	500	2910	2810	126	48 X 47	83.8	Platform/Sub-Station
333	33D4333 (4)	666	3110	3010	136	48 X 47	83.8	Platform/Sub-Station
7620 VOLTS - 95 kV BIL (for 7960/13,800Y, 7620/13,200Y, 7200/12470Y volt circuits)								
38.1	33D5038 (2)	50	1700	1600	69	29 X 35	74.1	Pole/Platform/Sub-Station
76.2	33D5076 (2)(6)	100	1750	1650	69	29 X 35	74.1	Pole/Platform/Sub-Station
114.3	33D5114 (2)(6)	150	1720	1620	74	29 X 41	74.1	Pole/Platform/Sub-Station
167	33D5167 (2,6,7)	219/232	2070	1970	80	39 X 44	74.6	Pole/Platform/Sub-Station
250	33D5250 (2,6,7)	328/347	3060	2960	134	43 X 48	83.8	Pole/Platform/Sub-Station
333	33D5333 (2,6,7)	437/463	3300	3200	131	46 X 50	83.8	Pole/Platform/Sub-Station
416	33D5416 (6)(7)	546/579	3750	3650	148	51 X 48	89	Platform/Sub-Station
509	33D5509 (6)	668	4040	3940	147	55 X 50	89	Platform/Sub-Station
13,800 VOLTS - 95 kV BIL (suitable for 13,800, 13,200 or 12,000 Volt Circuits at Rated Amperes)								
69	33D6069 (2)	50	1630	1530	79	29 X 39	74	Pole/Platform/Sub-Station
138	33D6138 (2)	100	2660	2560	126	29 X 39	83.6	Pole/Platform/Sub-Station
207	33D6207 (2)	150	2750	2650	131	32 X 45	83.6	Pole/Platform/Sub-Station
276	33D6276 (2)	200	3300	3200	136	46 X 50	83.8	Pole/Platform/Sub-Station
14,400 VOLTS - 150 kV BIL(9) (for 14,400/24940Y volt circuits, also 7200/12,470 GRDY circuits at rated amperes)								
72	33D7072 (2)(8)	50	2680	2580	110	29 X 39	83.9	Pole/Platform/Sub-Station
144	33D7144 (2)(8)	100	2880	2780	118	29 X 39	83.9	Pole/Platform/Sub-Station
288	33D7288 (2)(8)	200	3440	3340	141	44 X 50	88.9	Pole/Platform/Sub-Station
333	33D7333 (8)	231	3940	3840	172	43 X 46	92.8	Platform/Sub-Station
416	33D7416 (8)	289	4180	4080	180	50 X 50	92.9	Platform/Sub-Station
432	33D7432 (8)	300	4320	4220	184	54 X 52	92.9	Platform/Sub-Station
500	33D7500 (8)	347	4890	4790	178	47 X 49	99.2	Platform/Sub-Station
576	33D7576 (8)	400	5250	5150	190	58 X 54	99.2	Platform/Sub-Station
667	33D7667 (8)	463	5500	5400	199	56 X 48	99.2	Platform/Sub-Station
720	33D7720 (8)	500	5670	5570	205	59 X 49	99.2	Platform/Sub-Station
833	33D7833 (8)	578	6240	6140	216	59 X 49	104.4	Platform/Sub-Station

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			SHIP	NET		PROJ. FLOOR SPACE	LLP (10)	
19,920 VOLTS - 150 kV BIL(9) (for 34,500 GRDY/19,920 volt circuits)								
100	33D8100 (2)	50.2	3200	3100	140	38 X 45	92.9	Pole/Platform/Sub-Station
200	33D8200 (2)	100.4	3250	3150	146	38 X 45	92.9	Pole/Platform/Sub-Station
333	33D8333	167	4130	4030	171	47 X 48	92.9	Platform/Sub-Station
400	33D8400	201	4370	4270	175	50 X 49	99.2	Platform/Sub-Station
500	33D8500	251	4910	4810	177	47 X 47	99.2	Platform/Sub-Station
667	33D8667	335	5630	5530	203	59 X 48	99.2	Platform/Sub-Station
833	33D8833	418 (65C)	6030	5930	216	66 X 54	99.2	Platform/Sub-Station

NOTE:

1. All regulators are shipped oil-filled.
2. These regulators have provisions for direct-to-pole (Type B and Type Changer brackets), platform, or crossarm mounting. For crossarm mounting, suspension hooks will be required and may be obtained from hardware manufacturer.
3. These regulators are furnished with taps in the control circuit to operate at 2500V and 2400V.
4. These regulators are furnished with taps in the control circuit to operate at 5000V, 4800V and 2500V.
5. 150 KV BIL on S, L and SL are available for 14,000V and 19920V.
6. These 7620V regulators can be operated at 7960V, 7620V, 7200V, 5000V, 4800V, 4330V, 4160V, 2500V and 2400V. Units shipped connected for 7200V operation.
7. Can apply currents up to the current determined by the rated kVA and the voltage level for voltage levels below 7200V.
8. These regulators are furnished with taps in the control circuit to operate at 14,400V and 7200V.
9. 150 kV BIL on S and L, 95 kV BIL on SL.
10. Lowest Live Part.

For more information, visit
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