

### Single-Phase Pad-mounted Step

#### GENERAL

McGraw-Edison® Single-Phase Pad-mounted Voltage Regulators add a dimension to underground system planning. They provide system planners freedom to improve the safety, reliability and power quality in existing and new underground distribution systems. The pad-mounted voltage regulator provides all the functionality of traditional round tank pole-mounted and substation-mounted regulators, with the convenience of pad-mounting.

The pad-mounted voltage regulator provides step-type voltage regulation in thirty-two (32) steps of approximately 5/8% each for a maximum of 10% regulation when used singly or in wye-connected banks. The voltage regulator is available in voltage ratings, 7620/7200 and 14,400 volt for 60 Hertz systems. Current ratings from 50 to 548 amperes are available.

Control of the voltage regulator is microprocessor-based, with a digital metering package of Class 1 accuracy. Instantaneous metering, time/date-stamped demand metering, and profile recording are provided. Features include voltage limiting capability, voltage reduction capability, reverse power flow operation, tap position tracking, and time/date stamped metering.

The pad-mounted voltage regulator provides state-of-the-art voltage regulation while reducing installation costs and preserving a more aesthetically pleasing environment.

The pad-mounted voltage regulator, in conjunction with pad-mounted transformers and switchgear, can be used to create a modular pad-mounted substation. This substation can be placed in areas that require a low profile installation. It can be placed in unobtrusive sites and possibly in shared rights-of-way.

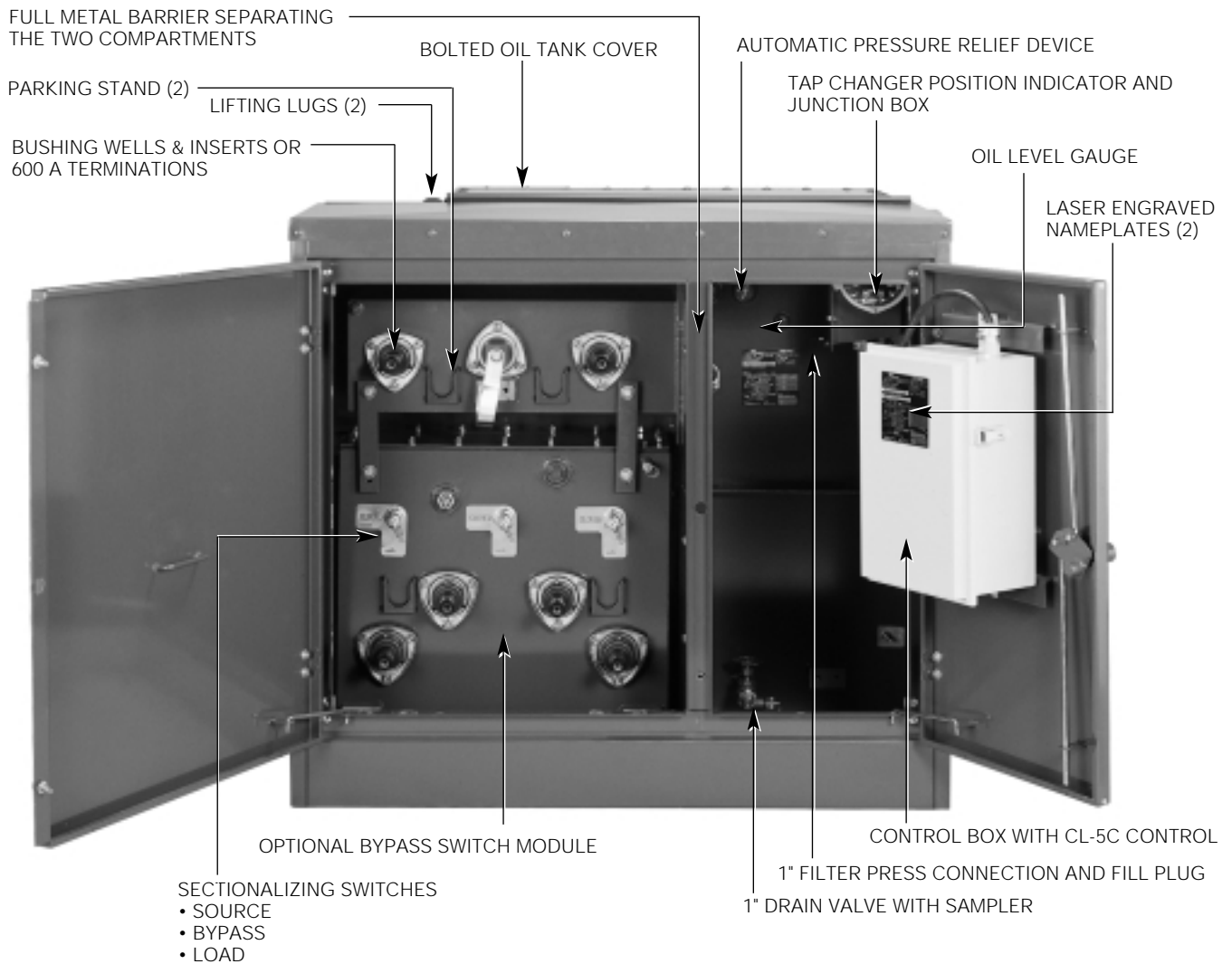


**Figure 1.**  
Single-phase pad-mounted voltage regulator.

#### STANDARD FEATURES

A sealed tank construction combined with a 65°C average winding rise insulation system provides a proven design for long life installations. Additional capacity is available through the ADD-AMP feature.

Internal construction allows easy removal of the interior assembly. A bolted cover also provides a large area to perform maintenance with the assembly in the tank.



**Figure 2.**  
**The pad-mounted voltage regulator is delivered fully-equipped, ready for your application.**

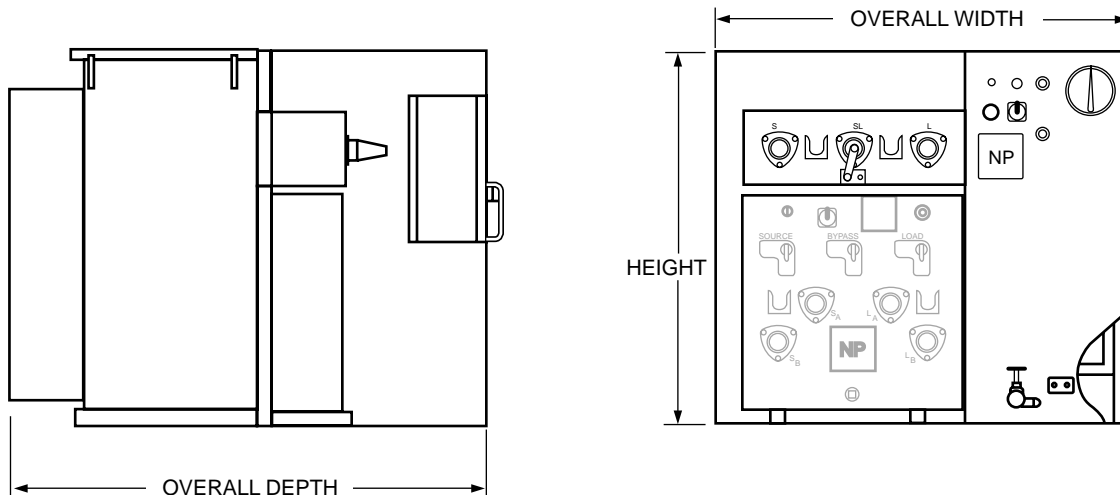
**STANDARD FEATURES**

- Full metal barrier separating the two compartments
- Two parking stands
- Three bushing wells & inserts or 600 A terminations
- Standard “padmounted green” paint (Munsell 7GY3.29/1.5)
- Ground pads
- Bolted oil tank cover
- Nameplates (2)
- Deep (31”) removable cabinet
- Automatic pressure relief device
- Lifting lugs
- Under-oil series arrester (3 kV)

- Provisions for pressure/vacuum gauge & thermometer
- 1” filter press connection and fill plug
- Control box with CL-5 control
- Oil level gauge
- Junction box and position indicator
- 1” drain valve with sampler
- Control cable disconnect at junction box and control box
- Line-side lift-off door secured with two captivated bolts
- Pad-lockable lift-off control-side door with three-point latching
- Door position-retention rods

**OPTIONAL ACCESSORIES**

- Bypass switch module
- Internal differential PT
- Alternate top coat color
- Face plate-mounted tap changer for PT taps
- No barrier
- Pressure/vacuum gauge
- Dial-type thermometer (with or without alarm contacts)
- Under-oil shunt arresters (10 or 18 kV)
- Control heater assembly



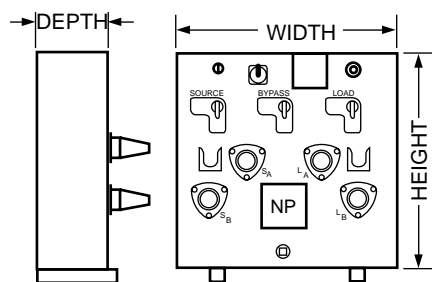
**Figure 3.**  
Single-phase pad-mounted voltage regulator and optional bypass switch module.

**TABLE 1**  
Pad-mounted Voltage Regulator Weights and Dimensions, 60 Hertz<sup>2</sup>

Voltage (Volts)	Current (Amperes)	kVA	Height (in.)	Overall Width (in.)	Overall Depth (in.)	Oil (gal.)	Weight (lbs.) Untanking	Total Weight (lbs.)
7620	50	38	51	56	54	170	500	3100
7620	75	57	51	56	54	170	600	3175
7620	100	76	51	56	54	170	650	3225
7620	150	114	51	56	64 <sup>1</sup>	170	750	3325
7620	200	152	58	56	64 <sup>1</sup>	200	900	3925
7620	328	250	65	64	66 <sup>1</sup>	280	1440	4525
7620	438	333	65	64	70 <sup>1</sup>	355	1500	5650
7620	548	416	65	64	70 <sup>1</sup>	355	1800	6025
14400	50	72	51	56	54	170	775	3325
14400	100	144	58	56	66 <sup>1</sup>	230	1000	4125
14400	200	288	58	56	66 <sup>1</sup>	245	1400	4850
14400	300	432	64	64	70 <sup>1</sup>	355	1855	5965
14400	347	500	64	64	72 <sup>1</sup>	395	2245	6650
14400	400	576	68	64	72 <sup>1</sup>	395	2280	6800
14400	463	667	68	64	72 <sup>1</sup>	425	2350	7070

<sup>1</sup> Includes cooling corrugate.

<sup>2</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Cooper Power Systems for exact dimensions.



**Figure 4.**  
Bypass switch module (optional).

**TABLE 2**  
Bypass Switch Module Weights and Dimensions<sup>1</sup>

Voltage (Volts)	Current (Amperes)	Height (in.)	Width (in.)	Overall Depth (in.)	Oil (gal.)	Weight (lbs.)
7620	200	30	30	12	30	400
7620	400	36	36	12	45	525
14400	200	30	30	12	30	400
14400	400	36	36	12	45	525

<sup>1</sup> Weights, gallons of fluid and dimensions are for reference only, and not for construction. Please contact Cooper Power Systems for exact dimensions.

**TABLE 3**  
**Product Scope, 60 Hertz**

Volts	Amperes	kVA	Bushing	BIL
7620	50, 75, 100, 150, 200	38, 57, 76, 114, 152	200 A well & 15 kV 200 A insert	95
7620	328, 438, 548	250, 333, 416	600 A integral bushing	95
14400	50, 100, 200	72, 144, 288	200 A well & 25 kV 200 A insert	125
14400	300, 347, 400, 463	432, 500, 576, 667	600 A integral bushing	125

Ratings: 65°C Average winding rise. Short circuit capability is 25 times for 2 seconds.  
Note: The 125 kV BIL rating is only limited by the bushing; all internal connections are designed and constructed to 150 kV BIL. The 7620 volt units rated 200 amperes or less are available with optional 25 kV class inserts.

**TABLE 4**  
**Voltage Ratings, 60 Hertz**

Voltage	Standard Nameplated Voltages
7620	8000, 7970, 7620, 7200, 6930, 4800, 4160, 2400
14400	14400, 13800, 13200, 12000, 7970, 7620, 7200, 6930

## EASE OF OPERATION

The McGraw-Edison single-phase pad-mounted voltage regulator has all the functionality of traditional round tank regulators, with the convenience of pad mounting.

The control box is mounted on the door of the operational side of the cabinet for easy access. As the operator uses the control, the position indicator is in clear view.

The junction box has a removable side door which permits access to the terminal block for the connections from the tank to the control cable. The control is connected from the control box to the junction box with a quick-disconnect control cable, which enables easy removal. The current transformer is automatically shorted when the cable is removed.



**Figure 5.**  
**Control box is mounted for easy access.**

## Position Indicator and ADD-AMP Capability

The position indicator is mounted on a junction box on the frontplate of the regulator, and is directly connected to the tap changer by a flexible drive shaft passing through the junction box and terminal board via a sealing gland.

The indicator face is graduated in steps, numbered 1 through 16 on each side of zero. Zero designates neutral. Drag hands indicate the maximum and minimum positions attained during raise and lower operations. The drag hands are reset around the position indicator hand by operating the drag hand reset switch on the control front panel.

The ADD-AMP feature of the pad-mounted voltage regulator allows increased current capacity by reducing the regulation range. This is accomplished by setting limit switches in the position indicator to prevent the tap changer from traveling beyond a set position, in either raise or lower directions. The limit switches have scales graduated in percent regulation, and are adjustable to specific values of 5, 6-1/4, 7-1/2, 8-3/4, and 10% regulation to alter the regulation range. The five possible load current ratings associated with the reduced regulation ranges are summarized in Table 5. At each setting, a detent stop provides positive adjustment. Settings other than those with stops are not recommended. The raise and lower limits need not be the same value, except for locations where reverse power flow is possible.



**Figure 6.**  
**Position Indicator.**

**TABLE 5**  
**ADD-AMP Capabilities of 60 Hz Ratings**

Rated Voltage	Rated kVA	Load Current Rating (Amperes)				
		Regulation Range				
		±10%	±8.75%	±7.50%	±6.25%	±5%
7620	38.1	50	55	60	68	80
7620	57.2	75	83	90	101	120
7620	76.2	100	110	120	135	160
7620	114.3	150	165	180	200 <sup>1</sup>	200 <sup>1</sup>
7620	152	200	200 <sup>1</sup>	200 <sup>1</sup>	200 <sup>1</sup>	200 <sup>1</sup>
7620	250 <sup>2</sup>	328/347	361/382	394/417	443/469	525/556
7620	333 <sup>2</sup>	438/464	482/510	526/557	591/600	600 <sup>1</sup>
7620	416 <sup>2</sup>	548/580	600 <sup>1</sup>	600 <sup>1</sup>	600 <sup>1</sup>	600 <sup>1</sup>
14400	72	50	55	60	68	80
14400	144	100	110	120	135	160
14400	288	200	200 <sup>1</sup>	200 <sup>1</sup>	200 <sup>1</sup>	200 <sup>1</sup>
14400	432	300	330	360	405	480
14400	500	347	382	416	468	555
14400	576	400	440	480	540	600 <sup>1</sup>
14400	667	463	509	556	600 <sup>1</sup>	600 <sup>1</sup>

<sup>1</sup> Limited by the bushing interface.

<sup>2</sup> Regulators are capable of carrying current corresponding to rated kVA when operated at 7200 volts.

### BYPASS SWITCH MODULE (OPTIONAL)

As with round tank regulators, bypassing a pad-mounted voltage regulator is an option in system operation. Installing or removing the pad-mounted voltage regulator from the circuit is accomplished with a stand-alone bypass switch module. This switch module fits inside the secure

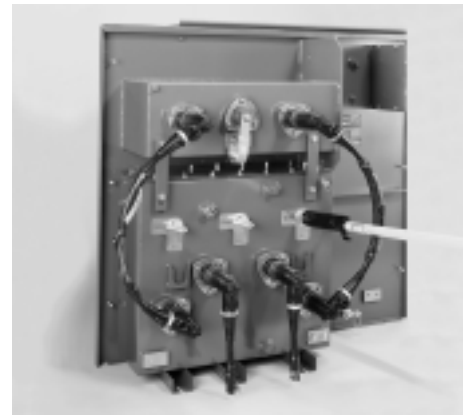
regulator cabinet during normal operation. When the regulator needs to be removed for normal servicing, the bypass module provides hot stick operable sectionalizing switches to disconnect the regulator from the system without causing interruption to the downstream load.

**TABLE 6**  
Bypass Switch Ratings

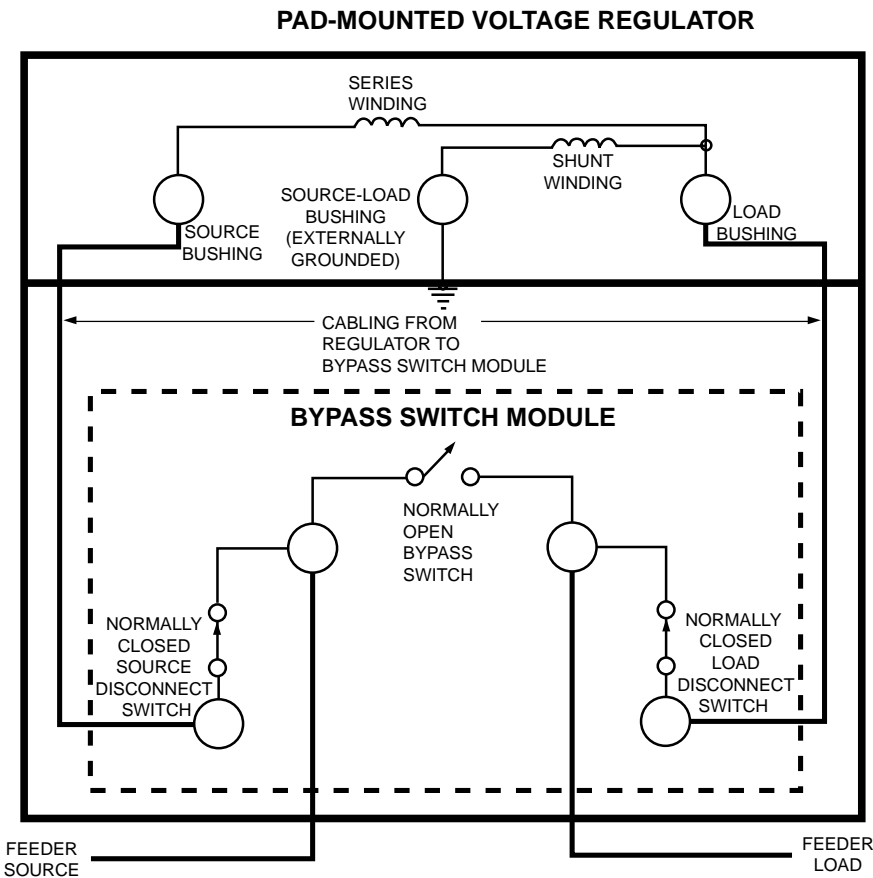
Voltage (Volts)	Current (Amperes)	Bushings
7620	200	200 A wells and 15 kV inserts
7620	400	600 A integral bushings
14400	200	200 A wells and 25 kV inserts
14400	400	600 A integral bushings



**Figure 8.**  
Bypass switch module.



**Figure 9.**  
Voltage regulator bypassing operation.



**Figure 7.**  
One-line diagram of pad-mounted regulator with bypass switch module for grounded-wye applications.

## CL-5 Control

- Source side voltage calculated from tap position
- Internal-external voltage source switch
- Automatic/manual control switch
- Manual raise/lower toggle switch
- Position indicator drag hand reset switch
- Supervisory ON-OFF switch (for use with SCADA)
- Neutral indicating light
- Six-digit operations counter
- Panel-mounted fuses
- Band edge indicators
- Voltage test terminals
- External voltage source terminals
- Set voltage adjustment
- Bandwidth adjustment
- Time delay adjustment
- Line drop compensator settings
- Resistance and reactance reverse polarity switch
- Digital metering package (including instantaneous, demand, and time-tagged demand)
- Profile recorder
- Tap position indication tracking capability
- Voltage limiting ("First house protection")
- Voltage reduction with 3 modes
- Reverse power flow detection
- Provisions to allow remote override of regulator operation via discrete (analog) supervisory control
- Digital communications capability
- Resident communications protocol (DATA 2179)
- Data port for data reader or personal computer attachment

## CONSTRUCTION

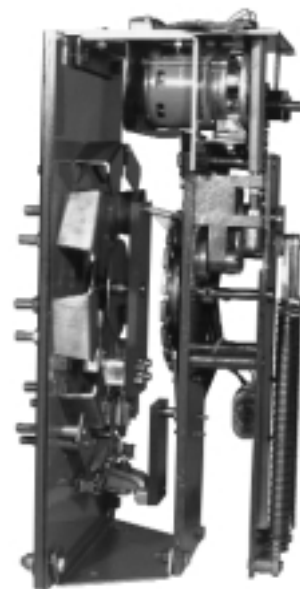
### Core and Coil Assembly

The coil assembly features aluminum strip in the series winding that achieves the optimum in ampere turn balance for exceptional strength under through-fault conditions.

Grain-oriented steel is used in the core, with a low reluctance butt joint. The rugged core clamp assembly secures the coil effectively and positions the core for the optimum in quiet operation and low core loss.

### Tap Changers

Spring-drive tap changers are typically used in regulators rated 14.4 kV and below, 200 A and below. A spring-drive tap changer is shown in Figure 10. In the larger sizes, the tap change is accomplished by a direct-drive mechanism. A direct-drive tap changer is shown in Figure 11. Smooth tap changes and long contact life are assured through careful design of speed controlling components.



**Figure 10.**  
Spring-drive tap changer.



**Figure 11.**  
Direct-drive tap changer.

