

SIEMENS

Installation / Operation / Maintenance

Instructions



JFR Distribution
Step Voltage Regulator

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For Emergency Service Call:
1-877-742-3309

Siemens Energy, Inc.

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INTRODUCTION

Type JFR single-phase step-voltage regulators are designed to give dependable service and to make installation, operation and maintenance as simple as possible.

Technology advances, especially in the realm of the control apparatus, make it efficient to provide a separate instruction manual for the Accu/Stat™ control provided with this JFR Regulator. For specific control information, refer to the Accu/Stat™ control manual included with the regulator.

DANGER

Hazardous Voltage. Death or serious injury from electrical shock, burns will result from misuse.

To prevent:

Do not service or touch until you have de-energized high voltage, grounded all terminals and turned off control voltage. Grounding terminals with line to ground capacitors may produce a small arc.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, instructions and maintenance procedures contained herein.

The successful and safe operation of this equipment is dependent upon proper handling, installation, operation and maintenance.

QUALIFIED PERSON

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE INSTALLATION, CONSTRUCTION AND OPERATION OF THE EQUIPMENT, AND THE HAZARDS INVOLVED. IN ADDITION, HE HAS THE FOLLOWING QUALIFICATIONS:

- (a) Is trained and authorized to de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- (b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- (c) Is trained in rendering first aid.

Distinctive signal words (**DANGER, WARNING, CAUTION**) are used in this instruction book to indicate degrees of hazard that may be encountered by the user. For the purpose of this manual and product labels these signal words are defined below.

- 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.

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INSPECTION FOR DAMAGE IN SHIPMENT


Check each item with the shipping manifest immediately upon receipt of the regulator. Make a thorough visual inspection of the regulator. Check for evidence of damage attributable to mishandling in shipment. Should any shortage or damage be found, notify the local agent of the carrier making the delivery and make appropriate notation on the freight bill. Any damage or shortage that is not noted on the freight bill becomes the recipients responsibility. A claim should be made immediately with the carrier. Please also notify your Siemens representative as soon as possible.

STORAGE PRIOR TO INSTALLATION



Assure that the control compartment enclosure is tightly closed, and regulator tank is sealed.

PHYSICAL CONSIDERATIONS

- Handling. Type JFR regulators are designed to be lifted either by a forklift at the base or by use of lifting hooks on the side of each tank. Each JFR regulator is provided with either 2 or 4 lifting hooks on the side of each tank. The number of hooks has been established to provide a margin of safety. Use all supplied lifting hooks when lifting.

 WARNING
Improper use of lifting provisions can cause death, serious injury, or equipment damage.
To prevent:
Do not use cover lifting eyes to lift complete unit. Cover lifting eyes are for un tanking only.

- Location. Type JFR regulators are designed for outdoor installation. Any regulator may be platform or pedestal mounted. Regulators provided with hanger brackets are suitable for pole mounting. When the regulator is to be installed in a substation on a pedestal it is recommended that a minimum elevation to the live connection be established, as required by applicable codes.

 DANGER

Hazardous voltage present at the line terminals of the bushings on the cover of the regulator.
Will cause serious injury or death.
To prevent:
De-energize the regulator before servicing.

Elevation. When the regulator will be used at an elevation above 1000 meters (3300 feet) the kVA rating must be de-rated per ANSI C57.15 to assure operating temperature limits are not exceeded.

LINE TERMINALS AND CONNECTIONS

Type JFR voltage regulators are routinely equipped with line bushing terminals per the following criteria.

Nameplate Line Current Rating	Conductor Size Range or Threaded Stud Size
50A to 300A	#2 to 477 MCM
301A to 668A	#2 to 800 MCM
669A to 1200A	1.125- 12 UNF-2A
1201 A to 2000A	1.500- 12 UNF-2A

Clamp type terminals for use through 668 ampere are capable of accepting an aluminum or copper conductor.

Tank grounding provision consists of a 0.5-13NC tapped hole in a steel pad for regulators rated to 300 amperes. Above 300 ampere ratings, a stainless steel pad with two 0.5-13NC tapped holes is provided.

ELECTRICAL CONSIDERATIONS

Type JFR regulators are commonly installed using any of four electrical configurations.

- One regulator in single-phase application. (Figure 4A)
- Three regulators in wye on a grounded-neutral three-phase system. (Figure 4D)
- Two regulators in open delta on a three-phase ungrounded system. (Figure 4B)
- Three regulators in closed delta on a three-phase ungrounded system. (Figure 4C)

Each of the four alternatives, when complete with switching provisions, will take the electrical configuration as shown on the next page.

The descriptions 'S', 'L', and 'SL' are embossed into the cover for user convenience at time of installation.

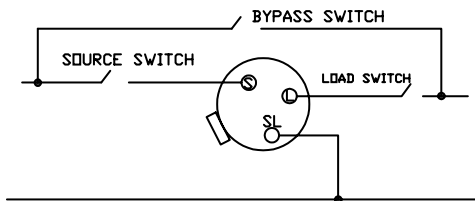
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INSTALLATION DIAGRAMS

Single Phase

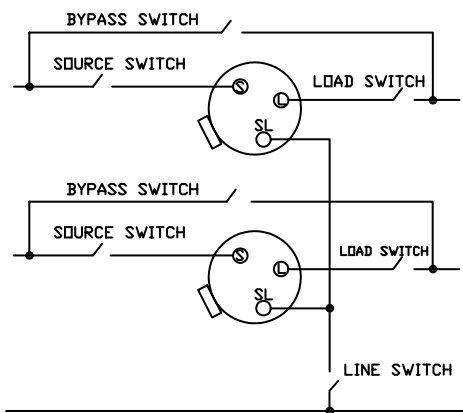
(FIGURE 4A)



Connection of one single phase JFR regulator on single phase line.

Open Delta

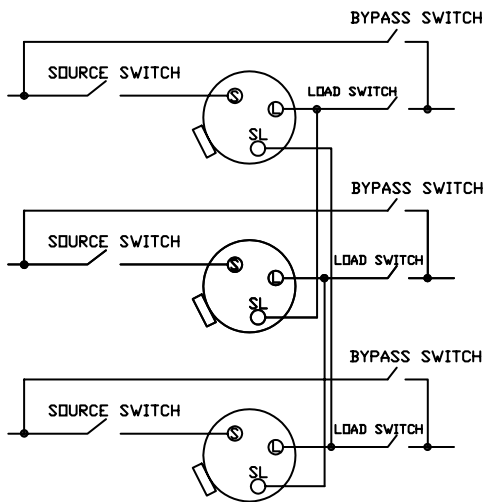
(FIGURE 4B)



Connection of two single phase JFR regulators in open delta on a three phase, ungrounded line.

Closed Delta

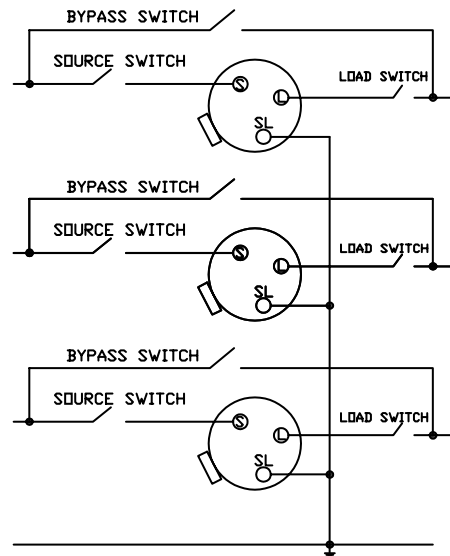
(FIGURE 4C)



Connection of three JFR regulators in closed delta on three phase, ungrounded system.

Wye Connected

(FIGURE 4D)



Connection of three single phase JFR regulators in wye on a three phase, grounded neutral system.

PROTECTIVE MEASURES

Bypass Arrester. All JFR regulators are equipped with a properly sized arrester, connected externally between the 'S' and 'L' line terminals. The arrester is provided to protect the series winding of the regulator from line surges. By itself, the bypass arrester does not provide lightning protection for the regulator.

Lightning Protection. The number of lightning arresters used will be a discretionary decision on the part of the user, considering such factors as iskeraunic level and degree of risk of damage to be accepted. The minimum recommended lightning protection consists of a properly sized arrester between the 'S' or 'L' bushing and ground on a single phase or a wye connected system. A delta connection system requires the use of two arresters to accomplish minimum protection levels. Additional protection can be obtained with the use of arresters at both the 'S' and 'L' terminals in single phase or wye systems and on all three terminals on a delta system.

For best results, install lightning arresters on the mounting lugs adjacent to the bushings near the top of the tank. The lugs are 0.5 - 13NC located on 2.5 inch centers. Ground the arrester(s) and the regulator tank solidly to the same ground connection. Be careful to keep the ground lead connections as short as possible.

Thru Fault. Type JFR regulators are rated under condition of thru-faults per ANSI C57.15.

The user is advised to provide for additional source impedance, bus sectionalizing or other means of limiting the available thru-fault current if these criteria are exceeded at the installation.

CONTROL CONNECTIONS

Many regulators can be used at several different nominal system voltages. It is therefore necessary to assure that the regulator is properly connected at the 19 pin upper terminal block for the system voltage on which the particular regulator will be used.

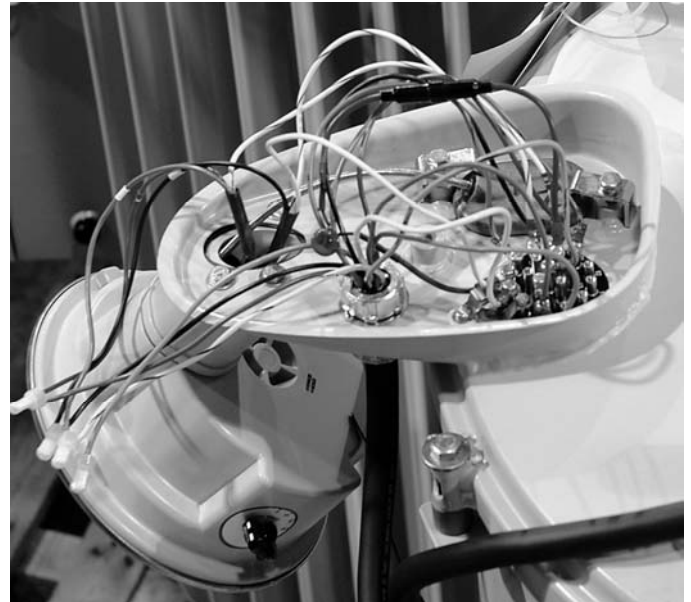


Figure 5A

For this purpose, it is necessary to use the nameplate drawing and control diagram found in the control enclosure.

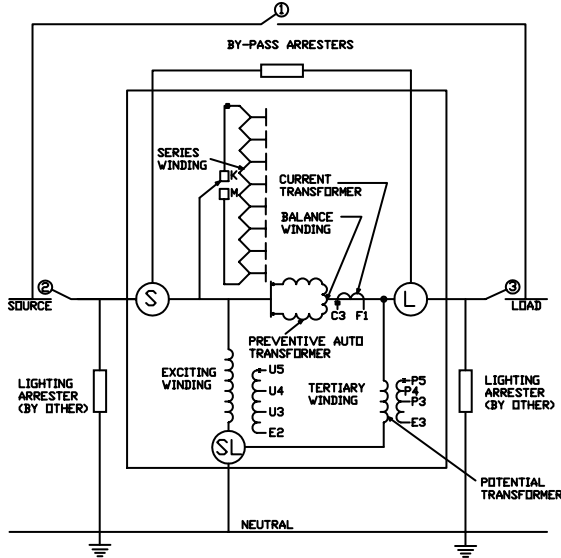
1. Refer to the Nameplate. The P2 column indicates the correct connection for lead P2 based on the system voltage. Using the applicable control diagram, the terminal designation of the nameplate can be cross referenced to the proper terminal on the 19-pin terminal block.
2. Depending on the regulator, there may be a second nameplate column indicating that lead U2 should also be connected. If so, the U2 column indicates the correct connection for lead U2 based on the system voltage. Using the applicable control diagram, the "U" terminal designation of the nameplate can be cross referenced to the proper terminal on the 19-pin terminal block.
3. For regulator equipped with fans for forced-air cooling, another set of connections will be shown.

NOTE Matters specifically relating to the **Accu/Stat™** control used in conjunction with the regulator are not included in this manual. Refer to the appropriate control instruction manual.

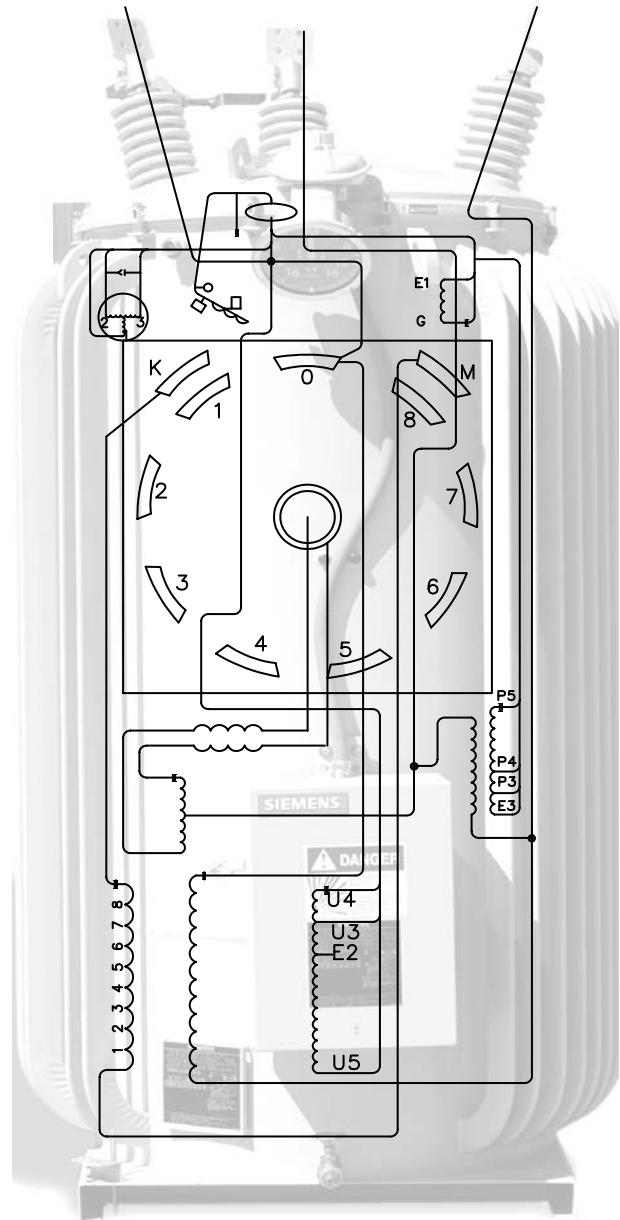
CONNECTION DIAGRAMS

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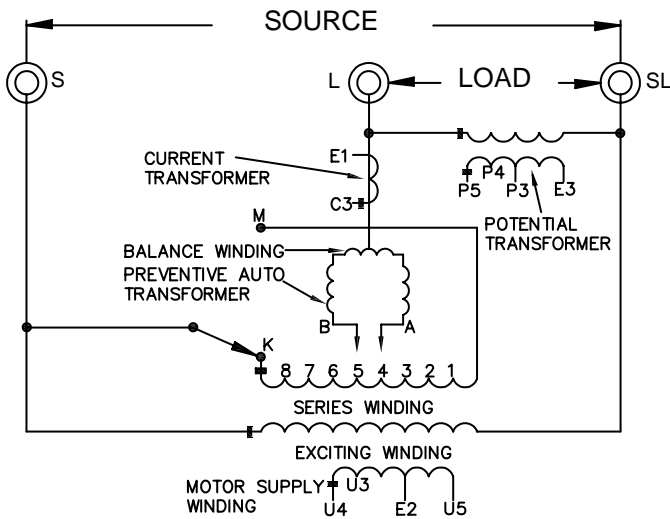
STRAIGHT DESIGN (ANSI TYPE A)



Wiring diagram of a typical Type "A" regulator showing both internal and external connections without fan power.



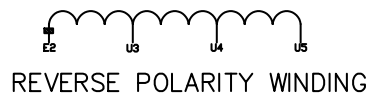
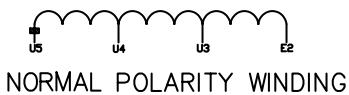
Typical arrangement of windings and connections of Type "A" JFR regulators.



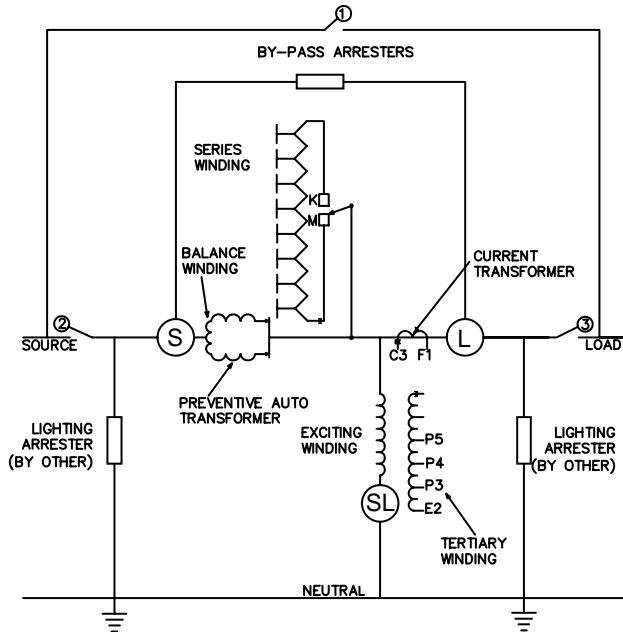
Schematic diagram of a typical Type "A" JFR regulator with fan power circuit U3-U5.

Note: Other typical motor supply configurations below.

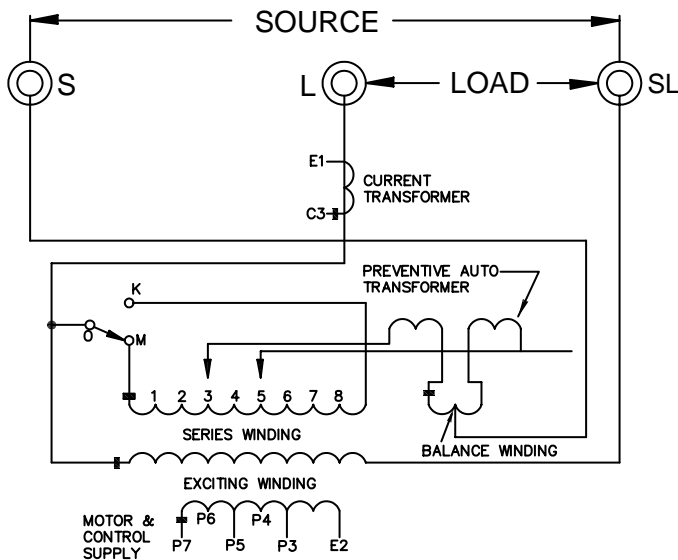
Note: Straight design units may or may not be equipped with a balance winding. Refer to regulator nameplate.



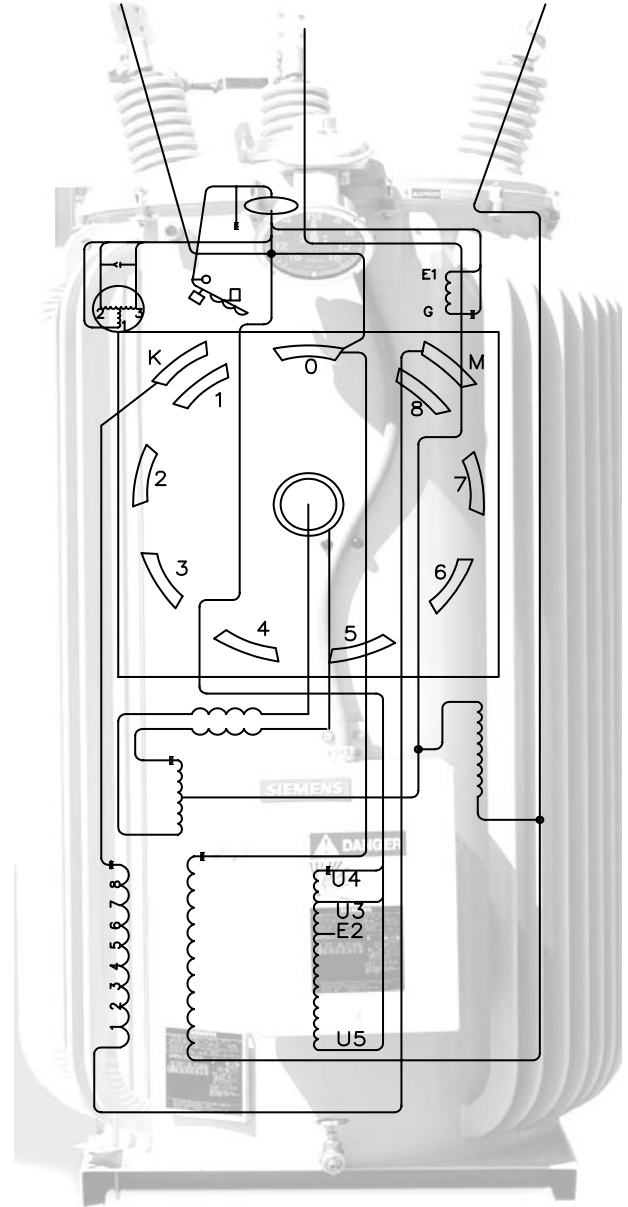
INVERTED DESIGN (ANSI TYPE B)



Wiring diagram of a typical Type "B" regulator showing both internal and external connections.



Schematic diagram of a typical Type "B" JFR regulator utilizing single potential source for motor and control circuit.



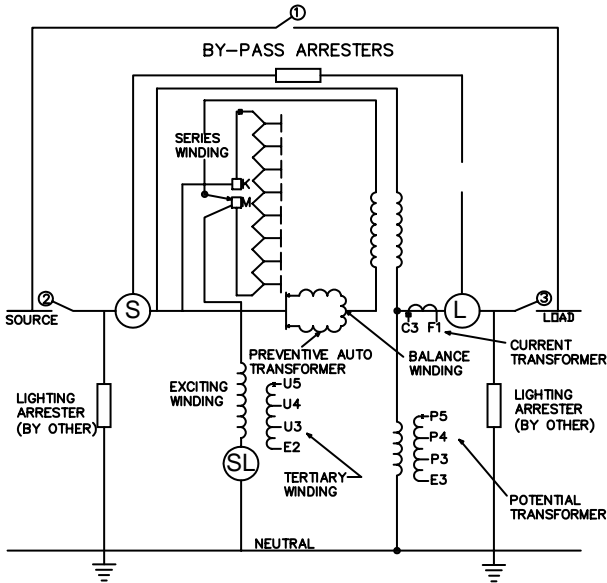
Typical arrangement of windings and connections of Type "B" JFR regulators.

Note: Inverted design units may or may not be equipped with a balance winding. Refer to regulator nameplate.

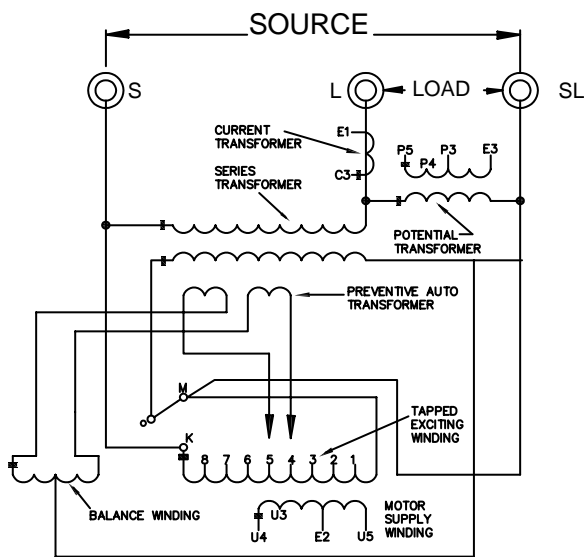
CONNECTION DIAGRAMS

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SERIES TRANSFORMER DESIGN

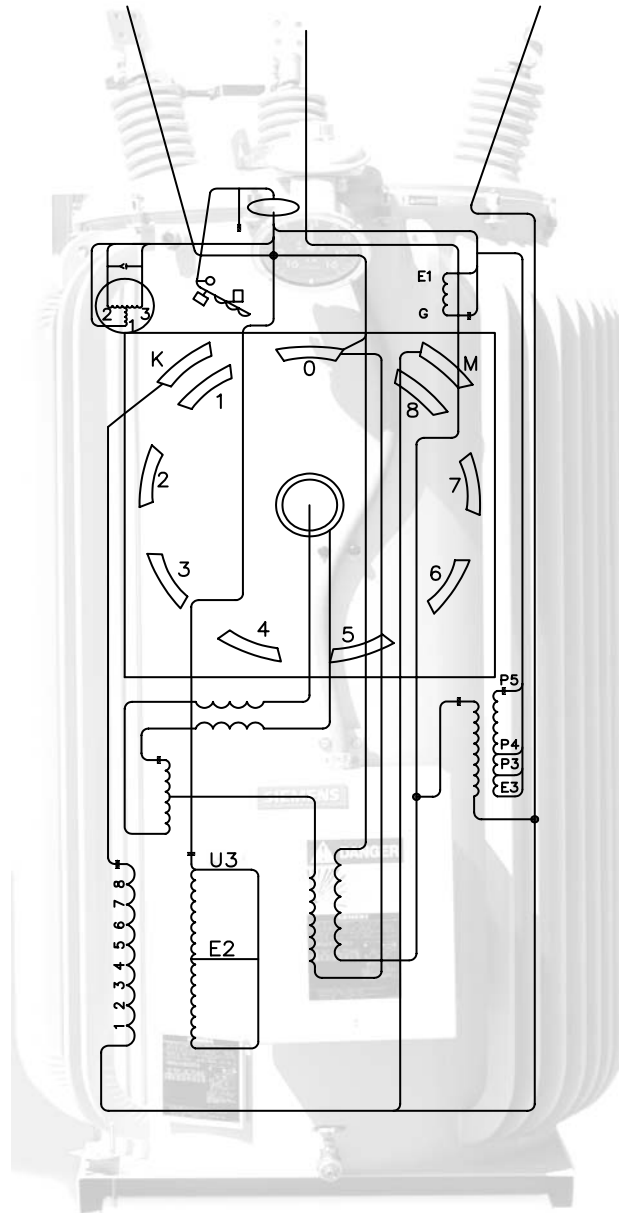


Wiring diagram of a typical regulator with series transformer showing both internal and external connections.



Schematic diagram of a typical regulator with series transformer with fan power U3-U5.

*Note: Exciting Winding may not be fully tapped.
Refer to regulator nameplate.



Typical arrangement of windings and connections of Series JFR regulators, without fan power.

Note: Series Transformer design units may or may not be equipped with a balance winding.
Refer to regulator nameplate.

PLACING THE REGULATOR IN SERVICE

The following checks will be useful in assuring the regulator is ready for use. The list cannot be all inclusive; careful attention on the part of a qualified operator remains imperative.

BEFORE CONNECTING


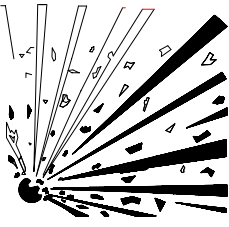
- Check oil level at oil sight window. If low, add sufficient oil (ASTM D-3487 Type II) to bring to desired level.
- Check oil dielectric strength per ASTM D 877. If found below 25kV, oil should be changed or reconditioned. Reference ANSI C57.106-2002. Note: Oil tests are not required for new equipment.
- Perform insulation power factor test per ANSI C57.15. Maximum value is 2.0%.
- Verify from the nameplate that the unit is connected for the proper output voltage, motor voltage and control panel voltage.
- Assure that the regulator is on the neutral tap position. This should be accomplished by observing the position indicator pointer **and** by powering the control from a 120V external source and observing the **Neutralite™** to be illuminated.

BEFORE CONNECTING

- Identify 'S', 'L' and 'SL' bushings on the cover. Make electrical connections per the appropriate installation diagrams, page 4, first connecting 'SL' bushing.
- Set **Vari-Amp™** limits on position indicator, if necessary. See Page 11.
- Set **Accu/Stat™** Control as desired. See **Accu/Stat™** instruction manual.

SWITCHING "ON-LINE"

- **Improper by-pass operation will result in explosion and fire hazard. Will cause serious injury, death or equipment damage.**
- **Do NOT place into service unless tap-changer is in neutral position AND control panel is properly disabled.**

 DANGER	
	Improper By-Pass operation will result in explosion and fire hazard. Will cause serious injury, death or equipment damage.
	To Prevent: Do NOT install OR remove from service unless Tap Changer is in neutral position AND Control Panel is properly disabled to prevent tap changes while in By-Pass configuration. Read Operators Manual before attempting to By-Pass this Regulator.
Follow instructions to place into service:	
<ol style="list-style-type: none">1. Place the Auto/Manual switch in the By-Pass position2. Place the Raise/Lower switch in "Off"3. Make certain regulator is in neutral (N) position4. Turn voltage power source switch to "Off"5. Remove power fuse6. Close, sequentially, the source and load switches7. Open the bypass switch8. Visually observe that bypass circuit has opened9. Replace power fuse10. Place voltage power source switch to "Normal."	

CHECKING REGULATOR OPERATION


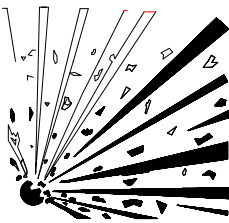
1. Refer to applicable **Accu/Stat™** Control instruction manual.) Turn the Tap Control switch to MANUAL.
2. Run the tapchanger in the lower direction, at least until the control is observed to go out of band "LOW".
3. Turn the Tap Control switch to AUTO. After a time delay, the regulator will return to an "IN" band condition.
4. Turn the Tap Control switch to MANUAL.
5. Run the tapchanger in the raise direction, at least until the control is observed to go out of band "HIGH".
6. Turn the Tap Control switch to AUTO. After a time delay, the regulator will return to an "IN" band condition.

REMOVING THE REGULATOR FROM SERVICE

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SWITCHING "OFF LINE"

- **Improper by-pass operation will result in explosion and fire hazard. Will cause serious injury, death or equipment damage.**
- **Do NOT remove from service unless tap-changer is in neutral position AND control panel is properly disabled.**
- **If the regulator being removed is in a closed delta bank, it is necessary to bypass and isolate all regulators in the bank.**

 DANGER	
	<p>Improper By-Pass operation will result in explosion and fire hazard. Will cause serious injury, death or equipment damage.</p> <p>To Prevent:</p> <p>Do NOT install OR remove from service unless Tap Changer is in neutral position AND Control Panel is properly disabled to prevent tap changes while in By-Pass configuration. Read Operators Manual before attempting to By-Pass this Regulator.</p>
<p>Follow instructions to remove from service:</p> <ol style="list-style-type: none">1. Place the Auto/Manual switch in the By-Pass position2. Place the Raise/Lower switch in "Off"3. Make certain regulator is in neutral (N) position. If independent checks of the position indicator and Neutralite™ indicator do not confirm the neutral position, bypassing must not be attempted. In such event, de-energize the system to remove the regulator from service4. Turn voltage power source switch to "Off"5. Remove power fuse6. After assuring the voltage regulator is on neutral, close the bypass switch7. Open sequentially, the load and source switches8. (a) For a single phase or grounded wye connection, make sure that the high voltage disconnect switches are opened (b) For a closed delta connection, be sure all regulators in the bank are bypassed and isolated9. Exercise appropriate care in the removal of the regulator. High voltage will still be present at the bypass switch and the source and load switch terminals. Remove the ground connection last.	

MAINTENANCE

GENERAL INSTRUCTIONS

This manual does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the regulator. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales representative.



WARNING

Failure to properly maintain the regulator can result in serious injury, death, or equipment damage. The instructions contained herein should be carefully reviewed, understood and followed.

To prevent:

The following maintenance procedures should be performed regularly:

1. Operational checks.
2. Periodic inspection.



DANGER



Hazardous voltages. Will cause serious injury, death, or equipment damage.

To prevent:

Always de-energize and ground the equipment before maintenance requiring access to high voltage parts.



WARNING

The use of unauthorized parts in the repair of the equipment, tampering by unqualified personnel, or faulty repair and adjustments can result in dangerous conditions which can cause serious injury, death, or equipment damage.

To prevent:

Follow all safety instructions contained herein, and contact your local Siemens sales representative for replacement parts.

OPERATIONAL CHECKS

Basic regulator operation can be checked while the regulator remains in service. The output voltage can be monitored from the control panel display under the <METER> menu on the "VId" screen.

- Check the calibration by following the steps in the Basic Troubleshooting section of the Accu/Stat control panel instruction manual.
- Run the tapchanger several steps in one direction in the manual mode until the output voltage is outside of the bandwidth. Return the control to automatic mode. After the predetermined time delay, the tapchanger motor will be observed to return the output voltage in-band. Repeat this operation, running the tapchanger in the opposite direction.
- Check the **Vari-Amp™** limit switches by attempting to run the tapchanger beyond the position to which the switches are set. The limit switches should function to open the circuit. Note: If the limit switch is set at the maximum 10% range and fails to function, the tapchanger will stall against a mechanical stop. The motor is designed to stall continuously without damage.



CAUTION

Operation of the regulator at extreme tap positions could produce line voltages outside of operating limits that could result in property damage.

To prevent:

Operate the regulator only to judiciously determined voltage extremes.



WARNING

Regulator may have High Internal Pressure. Can cause serious injury, death, or equipment damage.

To prevent:

Use pressure relief valve to vent regulator before un tanking.

MAINTENANCE

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PERIODIC INSPECTION

A sample of oil from the regulator should be subjected to dielectric breakdown test, per ASTM D-877. If found below 25kV, the oil should be changed or reconditioned. Refer to ANSI C57.106-2002. Other tests, especially Neutralization Number, Interfacial Tension and Power Factor are also useful and may be preferred by particular users.

The oxidation inhibitor in the oil will be depleted over a period of a few years and should be replaced. The inhibitor is 2, 6-ditertiary-butyl-para-cresol (DBPC) at a concentration level of 0.2 to 0.3%.

The time interval between internal inspections will depend upon frequency of tapchanger operation and the load on the regulator. Regulators subjected to numerous overloads and a high load factor may require more frequent inspections than those carrying normal loads. While internal inspection is not a necessity, preventive maintenance inspections will help assure the continuity of service.

To untank a JFR regulator, proceed as follows:

1. Remove the regulator from service as described on Page 10.

DANGER

Hazardous voltages. Will cause serious injury, death, or equipment damage.

To prevent:

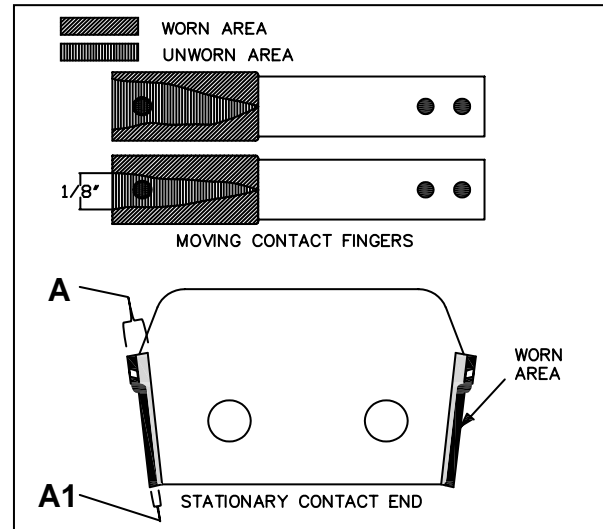
Always de-energize and ground the equipment before maintenance requiring access to high voltage parts.

2. Place the regulator in a position where energized overhead lines will not interfere.
3. Operate pressure relief valve to vent regulator before un-tanking
4. Remove the mounting bolts holding the control box onto the main tank.
5. Remove all cover bolts.
6. The regulator can now be pulled from the main tank by the cover lifting eyes.

When inspecting, check to be certain all hardware and connections are tight. The principal point of the internal inspection will be the condition of the arcing contacts on the tapchanger. Since numerous factors influence the rate of contact tip wear, no one criteria can be stated to recommend when a contact should be changed.

The following figure shows the possible condition of contact wear after a period of operation. If the contact surface is less than 1/8 inch wide, the contact should be replaced. (See the Figure below)

Contacts, both movable and stationary, show normal burning and wear once placed in service. If for any reason A1 dimensions exceed 4/5 of A, the stationary contact should be replaced. (See the Figure below)



• UPPER FILTER PRESS SEALING

If cover top cap is removed, make certain the cap is properly sealed when replaced on cover. Siemens recommends applying pipe sealant (Loctite PST or equivalent) around the threads of the adapter. Furthermore, it is recommended that the seal be tested by applying 5 psig pressure through the pressure relief valve fitting for 5 minutes, with no loss in pressure. Failure to assure seal may allow moisture to be pulled into the unit during a cool-down cycle.

• FAN MAINTENANCE

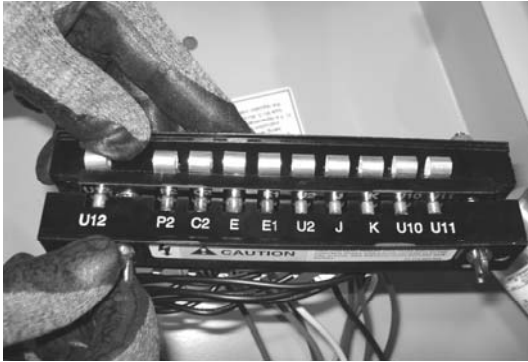
Cooling fans (if equipped), require minimum attention. Fans with plain sleeve bearings or *Oil-Lite* sleeve bearings should be oiled at least once a year with SAE 10-W engine oil which does not thicken in cold weather. Oil must be added to sleeve bearings before starting motor for the first time after installation.

Fans equipped with ball bearing motors are packed with grease before shipment and should be greased at least once a year with a soda-soap, ball-bearing grease of medium consistency furnished by a reliable supplier.

POLARIZED DISCONNECT SWITCH (JACK PLUG) AND HINGED CONTROL PANEL

The **Accu/Stat™** control panel is hinged and may be removed completely from the regulator control box by removing the wing nuts on the polarized jack plug and pulling the jack from its fixed position. This will automatically de-energize the control. It is not necessary to bypass or de-energize the regulator to remove the control.

A spring-loaded shorting bar in the plug automatically short circuits the current transformer secondary when the jack is removed.



REMOTE MOUNTING OF CONTROL EQUIPMENT

The **Accu/Stat™** control may be remotely mounted. Remote cable is available in standard lengths of 18, 25 and 30 feet incorporating oil and moisture resistant, color-coded conductors.

VARI-AMP™ POSITION INDICATOR

The **Vari-Amp™** feature provides a method of operating the regulator at increased load by decreasing the range of operation. It provides operator flexibility by allowing the range of regulation to be adjusted in 1¼ percent increments. The various regulation ranges together with the corresponding current capacities for standard regulators are listed on the next page. All that is necessary to adjust the range of regulation anywhere from ±5 percent to ±10 percent is to turn the adjusting knobs until the proper range of regulation is shown on the side of the position indicator. The upper and lower limits need not be the same.

It is not necessary to remove the regulator from service to make this adjustment. The switches are, however, in the motor power circuit so the motor should not be running while the switches are being set.



SPECIAL FEATURES

OPERATION AT LESS THAN RATED VOLTAGE

JFR regulators may be operated at less than the voltage for which they were designed. All system voltages for which control system taps have been provided are shown on the nameplate. When this is to be accomplished it may be necessary to reconnect particular leads at the upper 19-pin terminal block as illustrated on page 5. When operating the regulator at reduced voltage it must be noted that the regulator carries a maximum current rating which rules regardless of the voltage (see table at right). It may therefore be necessary to operate the regulator at less than its nameplate kVA rating.

Units with catalog number starting with:
 10 are self cooled
 11 are forced-air cooled

Regulators can be modified at factory for 50 Hz operation with appropriate de-rating of voltage.

*Capable of carrying current corresponding to rated kVA when operated at 7200/12470 volts ground wye.

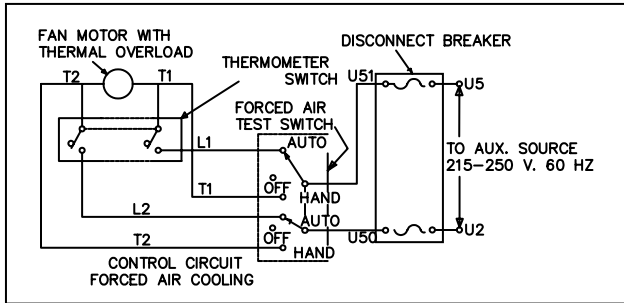
	VARI-AMP™ RANGE AND CURRENT RATINGS AVAILABLE				
	±10%	±8 3/4%	±7 1/2%	±6 1/4%	±5%
10-02.5-050.0	200	220	240	270	320
10-02.5-075.0	300	330	360	405	480
10-02.5-100.0	400	440	480	540	640
10-02.5-167.0	668	668	668	668	668
10-02.5-250.0	1000	1000	1000	1000	1000
10-02.5-333.0	1332	1332	1332	1332	1332
11-02.5-416.3	1665	1665	1665	1665	1665
10-05.0-050.0	100	110	120	135	160
10-05.0-100.0	200	220	240	270	320
10-05.0-167.0	334	367	401	451	534
10-05.0-250.0	500	550	600	668	668
10-05.0-333.0	668	668	668	668	668
11-05.0-416.3	835	835	835	835	835
10-07.6-038.1	50	55	60	68	80
10-07.6-057.2	75	83	90	102	120
10-07.6-076.2	100	110	120	135	160
10-07.6-114.3	150	165	180	203	240
10-07.6-167.0	219	241	263	296	351
10-07.6-250.0*	328/347	361/381	394/416	443/468	525/555
10-07.6-333.0*	437/463	481/509	524/556	590/625	668/668
10-07.6-416.3*	546/578	601/636	656/668	668/668	668/668
10-07.6-500.0	656	668	668	668	668
10-07.6-667.0	875	875	875	875	875
11-07.6-889.0	1167	1167	1167	1167	1167
10-13.8-069.0	50	55	60	68	80
10-13.8-138.0	100	110	120	135	160
10-13.8-207.0	150	165	180	203	240
10-13.8-276.0	200	220	240	270	320
10-14.4-072.0	50	55	60	68	80
10-14.4-144.0	100	110	120	135	160
10-14.4-288.0	200	220	240	270	320
10-14.4-333.0	231	254	277	312	370
10-14.4-432.0	300	330	360	405	480
10-14.4-576.0	400	440	480	540	640
11-14.4-720.0	500	550	600	668	668
10-14.4-833.0	578	636	668	668	668
10-19.9-100.0	50	55	60	68	80
10-19.9-200.0	100	110	120	135	160
10-19.9-333.0	167	184	201	226	268
10-19.9-400.0	200	220	240	270	320
10-19.9-667.0	335	368	402	452	536
11-19.9-833.0	418	459	502	565	668

FORCED AIR COOLING

Certain regulators may be equipped for forced-air cooling and include fans mounted on the radiators. The fans are usually automatically controlled by means of the change in oil temperature (see Connection Diagram). The thermometer located in the top transformer oil contains two identical switches which control fan operation when fan control switch is in "Auto" position.

The switches are normally set to start the fans at 65°C and to stop them at 55°C top oil temperature, but may be adjusted plus or minus 5°C.

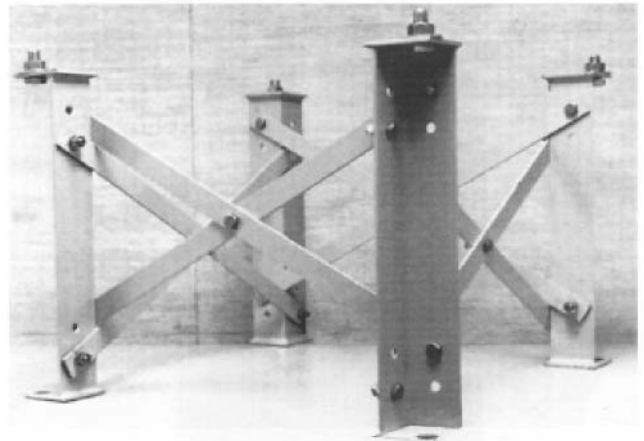
A thermal overload relay is mounted on each fan motor. Any fan that develops trouble will be automatically disconnected from the line without affecting the other fans of the system. One fan can be removed from the radiators without affecting the operation of the others. When fans are out of service, care must be exercised to prevent overloading the regulator.



Control circuit forced air cooling

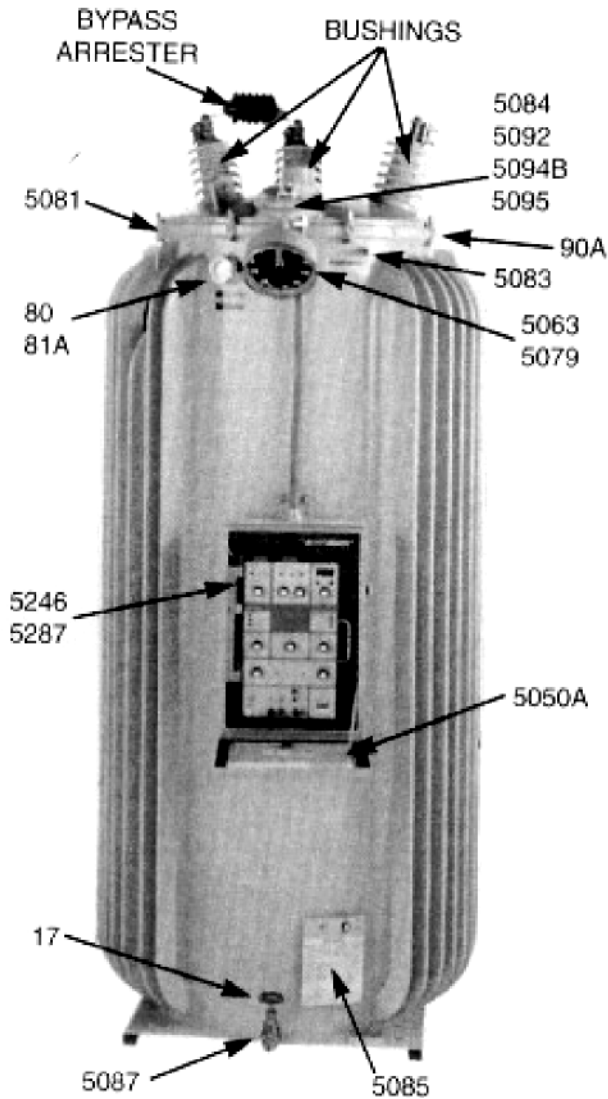
SUBBASE ASSEMBLY

Subbase assemblies are available in 4-inch high increments from 21 through 49 inches for most JFR regulators. The proper height is selected by picking the elevation that will provide required clearance from foundation to the live part of the regulator bushing.



PARTS LIST

MAJOR COMPONENTS PARTS LIST



Instructions For Ordering Part

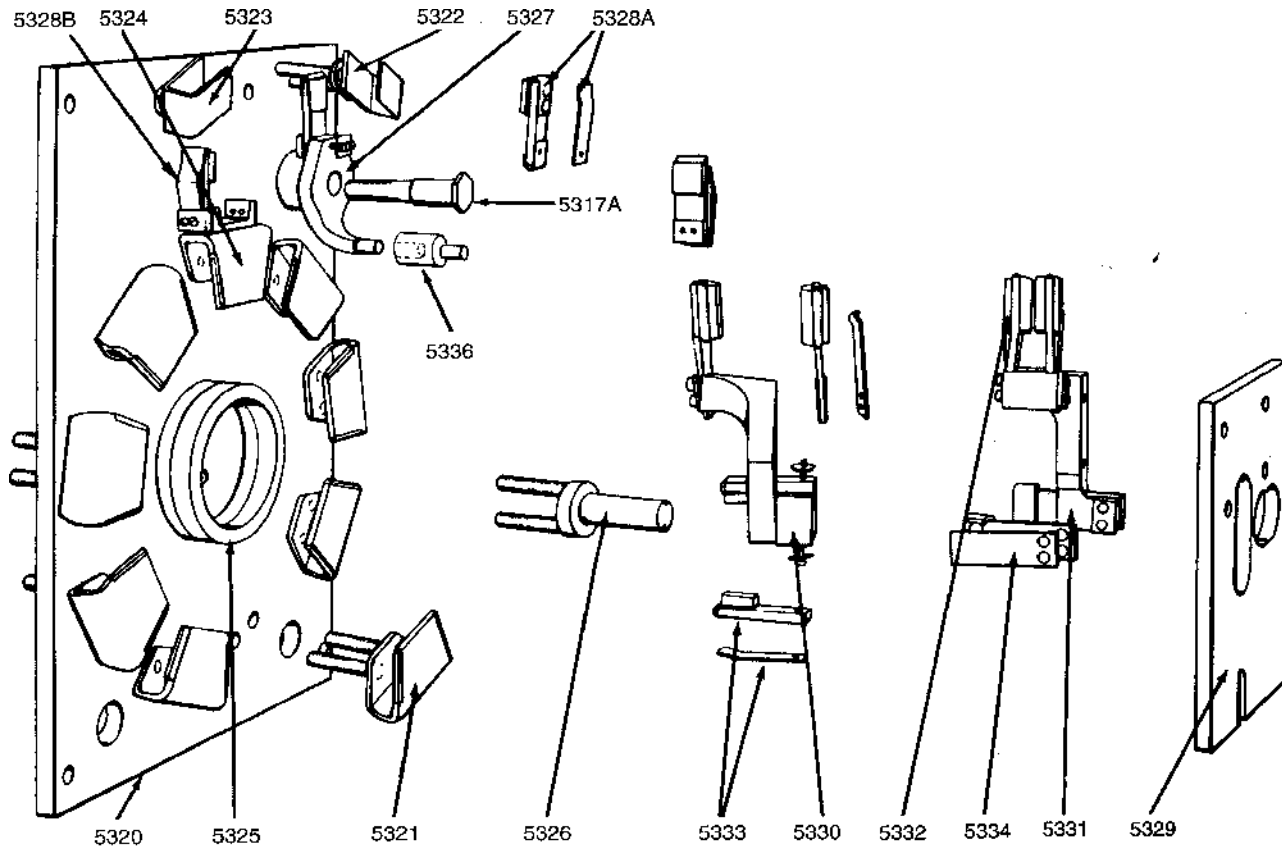
When ordering parts give the quantity of parts required, the regulator serial number, parts list item number, complete description, and method of shipping. State whether for emergency repair, maintenance, spare part, etc. All shipments will be made F.O.B Factory

Item 01-11	Description
5050A	Control Compartment Gasket
5079	Position Indicator
5081	Main Cover Gasket
5083	Pressure Relief Valve
5084	Terminal Box Gasket
5085	Nameplate
5087	Sampling Device
5088	Grounding Lug Terminal (not shown)
5092	Terminal Block Clamp
5094B	Terminal Block Studs
5095	Terminal Block Gasket
5246	Motor Capacitor TLG
5287	Motor Capacitor TLF
17	Drain Valve
80	Oil Sight Glass
81A	Oil Sight Gauge Gasket
90A	Bolts - Stainless Steel

Figure 16A

PARTS LIST

TYPE TLG DIAL SWITCH



204661-A1

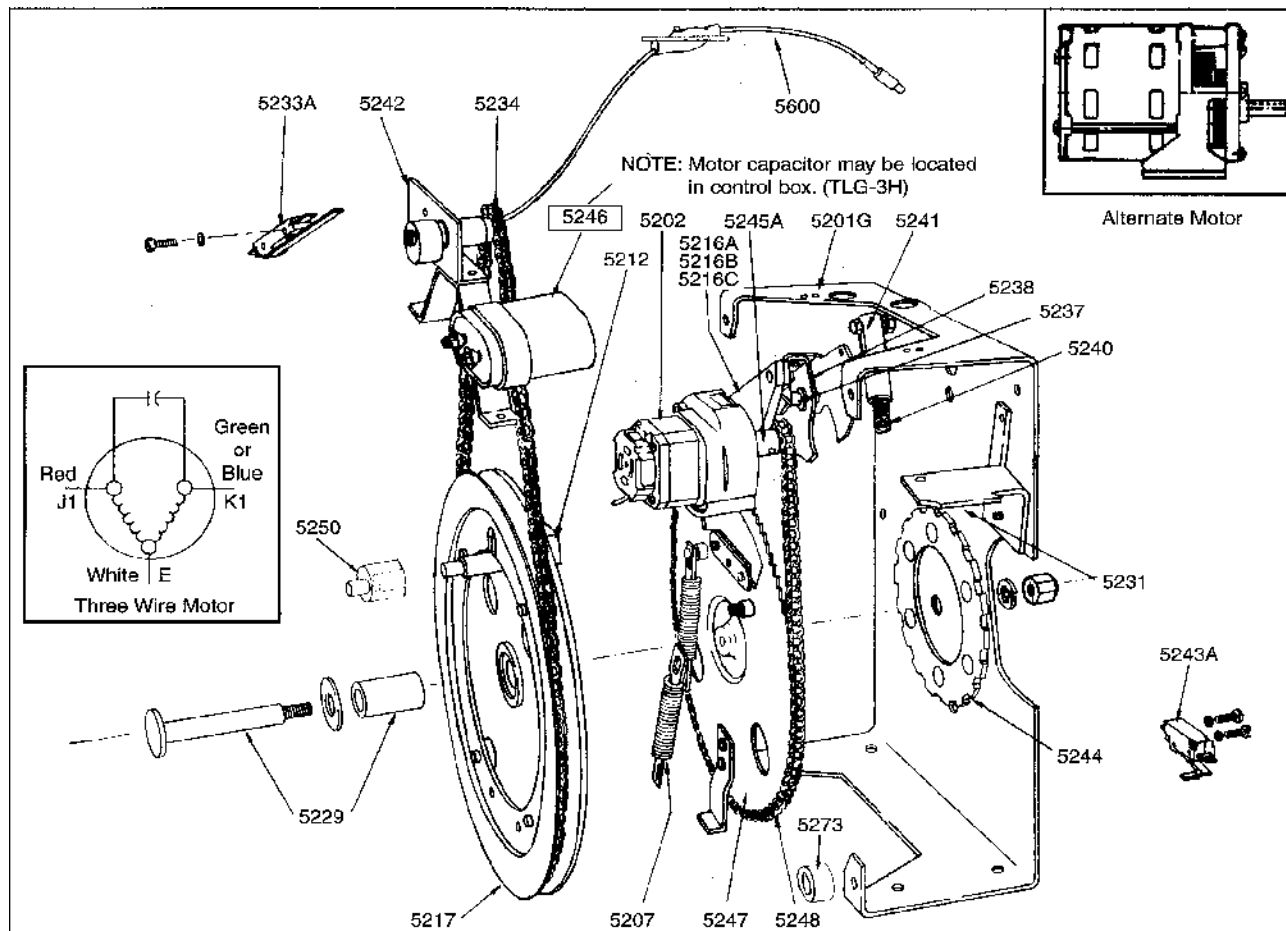
Item 01-11	Description
5320	Panel
5317A	Reversing Main Shaft
5321	Main Stationary Contacts
5322	Reversing Stationary Contact R
5323	Reversing Stationary Contact L
5324	Neutral Stationary Contact
5325	Collector Ring
5326	Collector Hub
5327	Reversing Switch Arm

Item 01-11	Description
5328A	Reversing Switch Finger Assembly
5328B	Reversing Switch Hub Finger Assembly
5329	Drive Arm
5330	Hub Finger Support
5331	Ring Finger Support
5332	Main Moving Finger Assembly
5333	Hub Finger Assembly
5334	Ring Finger Assembly
5336	Phenolic Drive Pin

PARTS LIST

Page 18

TYPE TLG QUICK BREAK MECHANISM



Item 01-11	Description
5201G	Mounting Frame Assembly
5202	Motor
5207	Drive Spring Assembly
5212	Latch Assembly
5213	Latch Spring (not shown)
5214	Latch Pin (not shown)
*5216A	Reversing Switch Drive Arm - Phenolic
*5216B	Reversing Switch Drive Arm - Phenolic
*5216C	Rev. Switch Drive Arm - Glass Phenolic
5217	Interlock Disk And Drive Assembly
5229	Main Shaft w/Sleeve Bearing
5231	Motor Mounting Bracket
5233A	Operation Counter Switch Assembly
5234	Roller Chain Position Indicator
5237	Reversing Switch Shaft

Item 01-11	Description
5238	Reversing Switch Assembly
5240	Spring
5241	Spring Tube
5242	Position Indicator Drive Mechanism
5243A	Neutral Switch
5244	Index Plate
5245A	Motor Sprocket
5246	Capacitor for Motor
5247	Sprocket Assembly
5248	Main Drive Chain Assembly
5250	Drive Pin
5273	Phenolic Spacer
5600	Flexible Shaft
5600A	Flexible Shaft O-Ring

PARTS LIST

TYPE TLF DIAL SWITCH

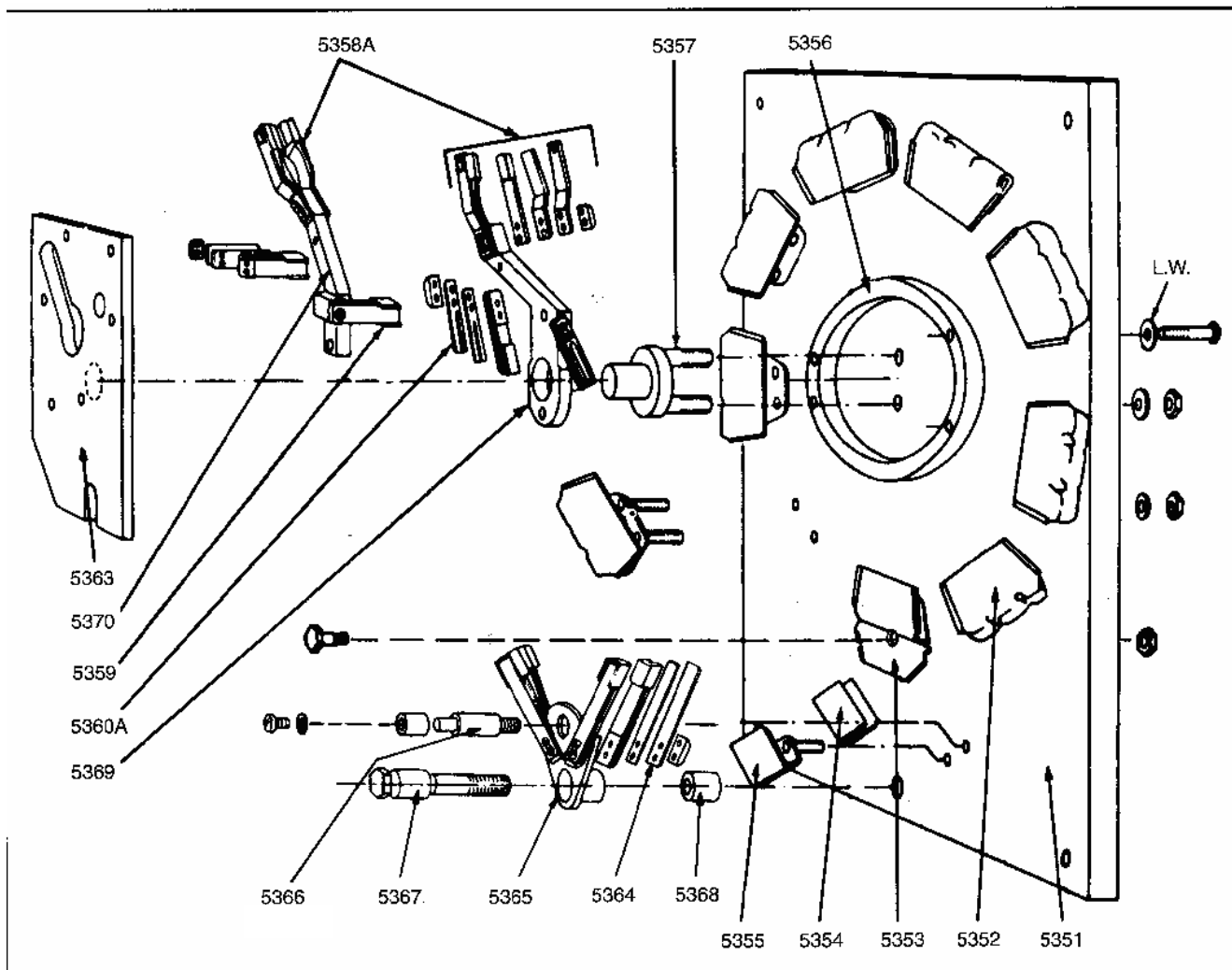


FIGURE 20A

Item 01-11	Description
5351	Panel
5352	Stationary Contact
5353	Neutral Stationary Contact
5354	Stationary Contact - LH
5355	Stationary Contact - RH
5356	Collector Ring
5357	Shaft Assembly
5358A	Main Finger Assembly (each)
5359	Contact Finger Assembly Collector Ring
5360A	Contact Finger Assembly Collector Hub

Item 01-11	Description
5363	Drive Plate
5364	Contact Finger Assembly - Rev. Switch
5365	Contact Support Assembly
5366	Reversing Drive Pin
5367	Reversing Shaft
5368	Spacer
5369	Contact Finger Support
5370	Contact Finger Support
5373	Reversing Switch Stop

PARTS LIST

TYPE TLF QUICK BREAK MECHANISM

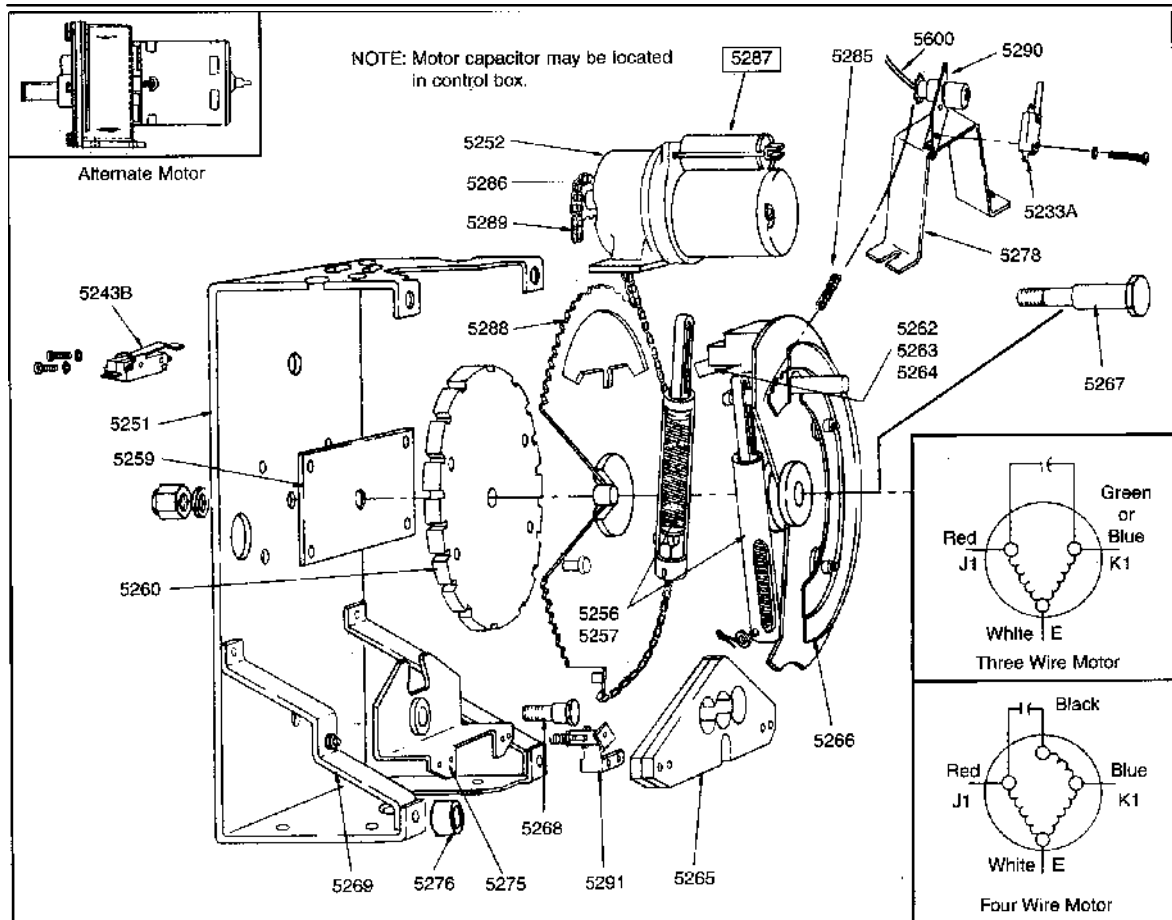


Figure 21A

Item 01-11	Description
5233A	Counter Switch Assembly
5243B	Neutral Switch
5251	Mounting Frame
5252	Motor
5256	Drive Spring Tube
5257	Drive Spring
5259	Spacer
5260	Notched Index Plate
5262	Latch
5263	Latch Spring
5264	Latch Pin
5265	Reversing Switch Drive Arm

Item 01-11	Description
5266	Interlock Disc and Drive Sprocket Assembly
5267	Quick Break Mechanism Shaft
5275	Actuating Arm Assembly
5276	Spacer
5278	A-Frame
5285	Drive Chain for Position Indicator
5286	Motor Sprocket
5287	Motor Capacitor (may be located in control box)
5288	Actuating Disc and Sprocket
5289	Main Drive Chain
5290	Position Indicator Drive Mechanism
5291	Reversing Switch Spring Assembly
5600	Flexible Shaft
5600A	Flexible Shaft O-Ring

PARTS LIST

BYPASS ARRESTERS

Item 01-11	Description	Volts
5423	Bypass Arrester Assembly 3 kV MOV	2,500, 5,000, 7,620
5425	Mounting Bracket Assembly	
5423	Bypass Arrester Assembly, 3 kV MOV	12,000-13,800-14,400
5425	Mounting Bracket Assembly	
5428	Bypass Arrester Assembly, 6 kV MOV	19,920
5429	Mounting Bracket Assembly	

Include regulator serial number when ordering replacement parts

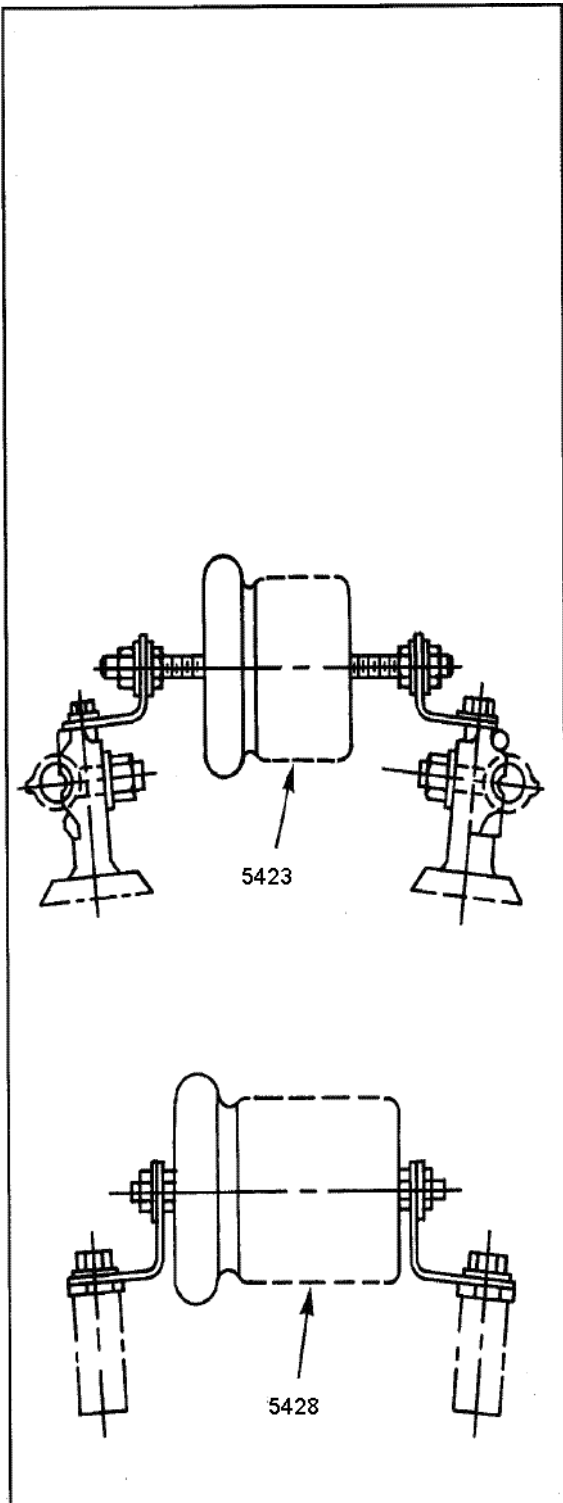


Figure 22A



Figure 22B

Polymer arresters now used on voltage regulators. Supersedes previous porcelain arresters.

PARTS LIST

BUSHINGS

Item 01-11	Description	kVA	Volts
5400P	Bushing Assembly for 15 kV	50	5000
		38.1 thru 76.2	7620
		69 thru 138	13,800
5400R	Bushing Assembly for 15 kV	50	2500
		100	5000
		114.3 thru 167	7620
5400S	Bushing Assembly for 15 kV	75	2500
		414	13,800
5401P	Bushing Porcelain for 15 kV	50	5000
		38.1 thru 76.2	7620
		69 thru 138	13,800
5401R	Bushing Porcelain for 15 kV	50	2500
		100	5000
		114.3 thru 167	7620
5401S	Bushing Porcelain for 15 kV	114.3 thru 167	7620
5410	Clamping Ring for 5400 and R Ratings	75	2500
5419	Clamping Ring for 5400S Rating	414	13800
5411	Cushion Spring		
5418	Cap Screw		
5426	Bushing Cap Line Terminal for 5400P Rating		
5430	Bushing Cap Line Terminal for 5400R and S Ratings		
5427	Gasket		
4034	Gasket		

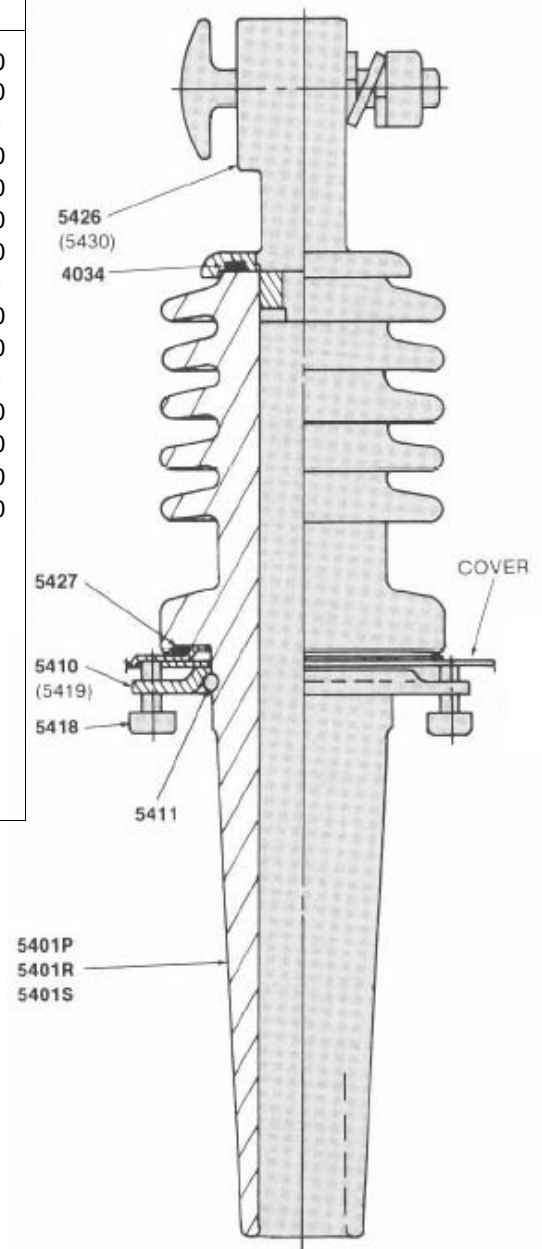
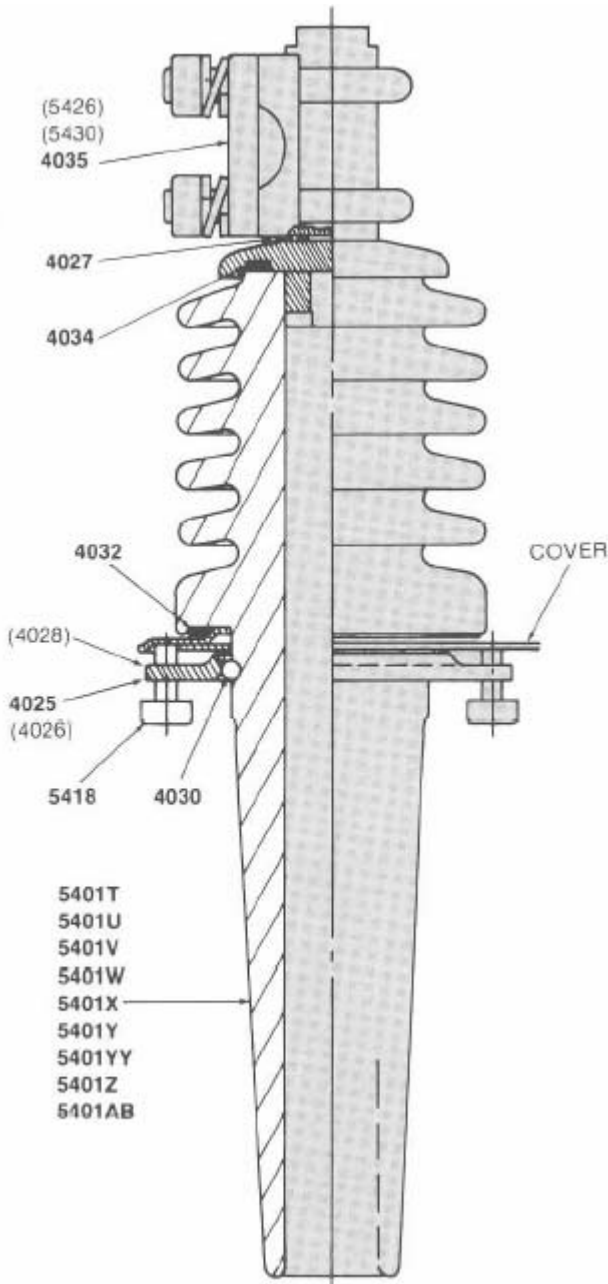


Figure 23A

PARTS LIST

BUSHINGS



Item 01-11	Description	kVA	Volts
5400T	Bushing Assembly 15 kV	100 thru 167	2500
		167	500
		250 thru 509	7620
5400U	Bushing Assembly, 15 kV	207-276	13,800
5400V	Bushing Assembly, 23 kV	72 thru 144	14,400
		100 thru 200	19,920
		333 thru 416.3	2500
5400W	Bushing Assembly 15 kV	250 thru 416.3	5000
5400X	Bushing Assembly, 23 kV	576 thru 833	14,400
		288	14,400
5400Y	Bushing Assembly, 23 kV	333 thru 400	19,920
		333	12,000
5400YY	Bushing Assembly, 15 kV	333 thru 432	14,400
5400Z	Bushing Assembly, 23 kV	667 thru 833	19,920
5400AB	Bushing Assembly, 23 kV	667-889	7620
5400AC	Bushing Assembly, 15 kV	100 thru 167	2500
		167	5000
		250 thru 509	7620
5401U	Bushing Porcelain, 15 kV	207-276	13,800
5401V	Bushing Porcelain, 23 kV	72 thru 144	14,400
		100 thru 200	19,920
		250 thru 416.3	2500
5401W	Bushing Porcelain, 15 kV	250 thru 416.3	5000
5401X	Bushing Porcelain, 23 kV	576 thru 833	14,400
		288	14,400
5401Y	Bushing Porcelain, 23 kV	333 thru 400	19,920
		333	12,000
5401YY	Bushing Porcelain, 15 kV	333 thru 432	14,400
5401Z	Bushing Porcelain, 23 kV	667 thru 833	19,920
5401AB	Bushing Porcelain, 15 kV	667 thru 833	7620
5401AC	Bushing Porcelain, 15 kV		
4025	Clamping Ring for 5400T X, Z and AB Ratings		
4026	Clamping Ring for 5400U V, W (SL Bushing only), Y and YY Ratings		
4028	Clamping Ring for 5400W Rating S and L Bushings only		
4030	Cushion Spring		
4027	Gasket		
4032	Gasket		
4034	Gasket		
4035	*Bushing Cap Line Terminal for 5400T X, YY and AB Ratings		
5430	*Bushing Cap Line Terminal for 5400U, Y and Z ratings		
5426	*Bushing Cap Line Terminal		
5418	for 5400V Rating Cap Screw		

*Units rated 250 kVA and above, 2500 and 5000 volts are not supplied with line terminals

SIEMENS

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