XC14

Commercial Series

Automatic Voltage Regulator

(From Serial # 624893)

The Power-Tronics XC14 voltage regulator is a self-contained, highly integrated, heavy-duty voltage regulator designed for demanding applications and extremely flexible installations. Continuous output is rated at 32/63VDC @ 12ADC with forcing output up to 52/105VDC @ 20ADC!

The modern generator service technician is often presented with a variety of generator applications, all of which require different voltage regulators, features, or buildup considerations. The XC14 is explicitly designed with the service technician in mind, packing an impressive collection of features in a compact and reliable package with simple installation and setup instructions!

Standard integrated features of the XC14 include onboard fusing, heavy duty rectifier section, integrated 0-10V at 4-20mA control interface, built in paralleling provisions, and a durable voltage regulator.

Over 30 years of design refinement makes the XC14 a durable design, utilizing high-reliability components and a simple layout. Our products are designed to provide a lifetime of service and is specifically built to minimize failures and potential downtime!

The XC14 are capable of parallel operation with other generators or with a utility buss. The integrated 0-10VDC or 4-20mA interface allows a wide variety of VAR, PF, or other PLC controls to remotely control the unit for extreme accuracy and unattended installations.

A heavy duty rectifier section, oversized heatsink and flexible hookup design makes the XC14 an ideal aftermarket replacement AVR for applications such as Caterpillar, Leroy Somer, General Electric, EM BeMac, Onan Magnaciter, SDMO, Marelli, Mecc-Alte and many others!

Specifications

Input/Sensing Voltage:	100 - 277vac
Frequency:	50 or 60 Hz
Voltage Regulation:	± .5% From NL to FL
Parallel Operation:	Yes
Continuous Rated Output Voltage:	32vdc @ 120vac input 63vdc @ 240vac input
Maximum Forcing Output Voltage:	52vdc @ 120vac input 105vdc @ 240vac input
Rated Continuous Output Amps:	12adc
Minimum Field Resistance:	2.5Ω @ 120vac input 5Ω @ 240vac input
Min Residual Build up Voltage:	3.5vac
Under Frequency Protection:	Yes, VPH reduction
Physical Size:	7.25 x 4.75 x 3.5 in.
Weight:	1.5 lb.
Internal Protection:	Fuses, cartridge type
Fuse Type:	3AG 20A @ 250V
External Voltage Adjustment:	Yes
System Operating Indicator:	Yes
Integrated 0-10VDC / 4-20mA Interface:	Yes

POWER-TRONICS™
Electrical Power Controls

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Caution: Read This Installation Manual Carefully and Entirely!

Warning: Do not use digital equipment to read voltage, Hz, or amperage during this installation. Use only Analog sensing equipment! Failure to do so may result in damage to equipment or in personal injury!

ALWAYS perform all setup procedures off-line
ALWAYS wear eye protection
ALWAYS strip wire insulation properly or use insulated connectors
ALWAYS use analog metering equipment when setting up the regulator
ALWAYS ensure the voltage regulator receives ample airflow
ALWAYS use adequate fusing
NEVER hold the voltage regulator in your hand or lap when energized
NEVER install the voltage regulator in a place it can be exposed to the elements or moisture
NEVER mount the voltage regulator over a screw, bolt, rivet, seam, or other fastener
NEVER touch any exposed part of the XC14 during operation
NEVER install a switch in the DC portion of the voltage regulator's wiring
NEVER USE A DIGITAL FREQUENCY METER (*It can give a false reading*!)

Functional Description

The XC14 Voltage regulator is the result of over 30 years of engineering efforts and offers high-demand features at a competitive price point. The XC14 is a time and field-proven design, based upon the Power-Tronics XR8 and SEM250A, and is engineered to greatly simplify setup while offering extreme reliability. When properly installed, the XC14 Voltage regulator is designed to provide a lifetime of service.

A Generator voltage regulator has several automated tasks it must perform in order to provide reliable, clean, and regulated electricity. It must build-up the generator, regulate the terminal voltage within its design specifications, and protect both itself and the generator should a fault situation arise.

The XC14 Voltage regulator is designed to replace older obsolete voltage regulators or rotating exciters with a minimum of connections and a minimum of required installation space. It contains internal field-replaceable fusing and internal DC field noise suppression

Due to its extreme simplicity, the XC14 Voltage regulator is uncommonly reliable and offer features and regulation accuracy usually only offered by much more complicated and often much more expensive voltage regulators.

Determining Correct Application Sizing

The XC14 Voltage regulator is designed for use with 100-277VAC input. It contains internal suppression for use with brush-type generator sets. Before installation, it is necessary to verify that the XC14 is the correct product for your application.

To determine if the XC14 is the correct product for your generator you need to know any two of the following 3 specifications from the rating plate of your generator:

1: Exciter Field Voltage (in DC Volts) [Generally given in full load Voltage on nameplates]
2: Exciter Field Resistance (in Ohms) **[See Note Below]**
3: Exciter Field Amperage (in DC Amps) [Generally given in full load Amps on nameplates]

Using the specifications obtained from your generator exciter, verify that your generator fits the specifications below:

- **Exciter Field Resistance ≥2.5Ω & Exciter Full-Load Voltage ≤32VDC**
  Use 120V Connection (See Page 8)

- **Exciter Field Resistance ≥5Ω & Exciter Full-Load Voltage ≤63VDC**
  Use 240V Connection (See Page 9) or 277V Connection (See Page 10)

WARNING: BRUSH AND SLIP RING CONNECTION PROBLEMS ARE THE #1 SOURCE OF VOLTAGE CONTROL PROBLEMS AND FAILURE OF VOLTAGE REGULATORS!!! *DO NOT INSTALL THE XC14 IF THE BRUSHES AND/OR SLIP RINGS ARE NOT IN EXCELLENT CONDITION!!!*

STOP AND CORRECT BRUSH AND SLIP RING CONNECTION PROBLEMS IF ANY OF THE FOLLOWING CONDITIONS ARE PRESENT:

- **GROOVES IN SLIP RINGS**
- **ROUGH SLIP RING APPEARANCE OR GHOSTING (CHATTERING)**
- **OIL CONTAMINATION ON BRUSHES OR SLIP RINGS**
- **DULL, ROUGH, STRIPED, PITTED, OR METALLIC APPEARANCE OF BRUSH FACES**
- **FIELD RESISTANCE MEASURED BETWEEN SLIP RING BRASS AND FIELD RESISTANCE MEASURED BETWEEN FIELD LEADS EXCEEDS 1-2% DIFFERENCE**

Note about Field Resistance:

- When measuring field resistance on a brushless generator, simply measure the resistance of the exciter field through your field leads with a multimeter.
- When measuring field resistance on a brush-type generator, measure the resistance through both the field leads as well as directly on the slip rings themselves. **The readings you obtain should ideally be the same, but *no more than 1% difference.*** If you show more than 1% difference in reading your generator has brush and ring contact problems and will need cleaning or maintenance before installing the XC14. **Failure to correct brush and ring contact problems will result in severe damage to the voltage regulator as well as possible PERMANENT damage to the slip rings themselves! NEVER use emery cloth, carborundum stones, "comm sticks", or Tuner cleaner to dress or clean slip rings**. They will make a bad problem much, much worse! Only use Garnet or Flint sandpaper and clean with a clean rag soaked with Acetone for best results!

If you do not have any of the specifications of your generator's exciter, or if you don't know where to start when trying to determine your exciter specs, please see the section below for instructions on measuring and calculating your exciter specifications.

- Measure your exciter field resistance using a multimeter on your field leads. Record this value. If you have a brush-type generator, also take a resistance reading on your slip rings: the value you obtain on the slip rings should be no more than 1% difference from the value you obtained through the field leads.

- Next, start and run the generator and apply 12V from a battery through your field leads and record the AC voltage produced by the generator. To determine your full load exciter field voltage, use the following formula:

$$E_{Exc.} = \frac{E_{Gen.Conf.}}{\left(\frac{E_{Gen.Output}}{E_{Battery}}\right)} * 2$$

Where $E_{Gen.Conf.}$ is your Generator's configured voltage (e.g.: 120, 208, 240, 480V, etc.), $E_{Gen.Output}$ is your recorded output voltage, and $E_{Battery}$ is your battery voltage (12V usually).

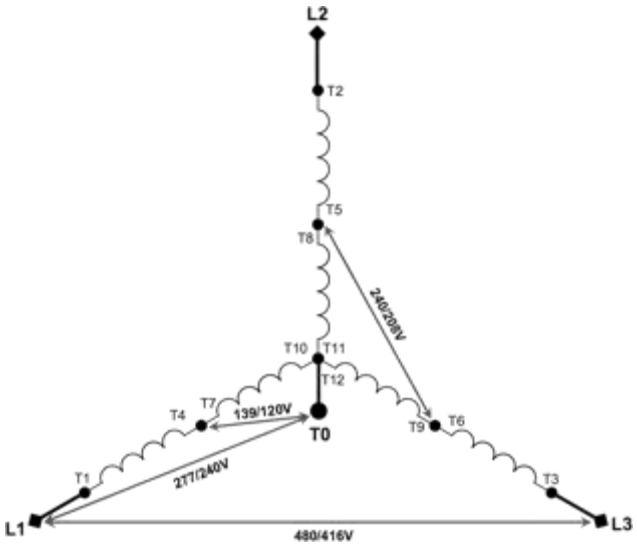
- Next, calculate your maximum exciter field amperage using your measured field resistance and your calculated exciter voltage using the following formula:

$$I = \frac{E}{R}$$

Where I is your maximum exciter field current, E is your calculated field voltage from the above formula, and R is your measured field resistance.

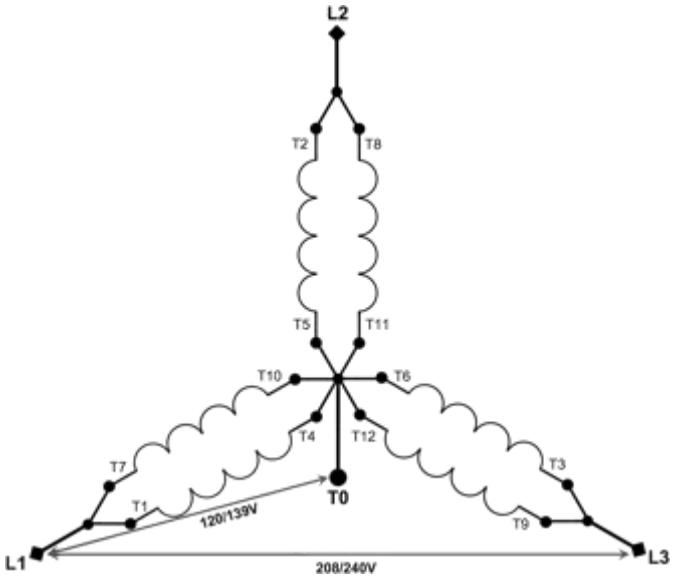
Using the values you just measured and calculated, see the specifications on the previous page to determine whether the XC14 is the correct product for your application.

Common 12-Lead Generator Wiring Diagrams



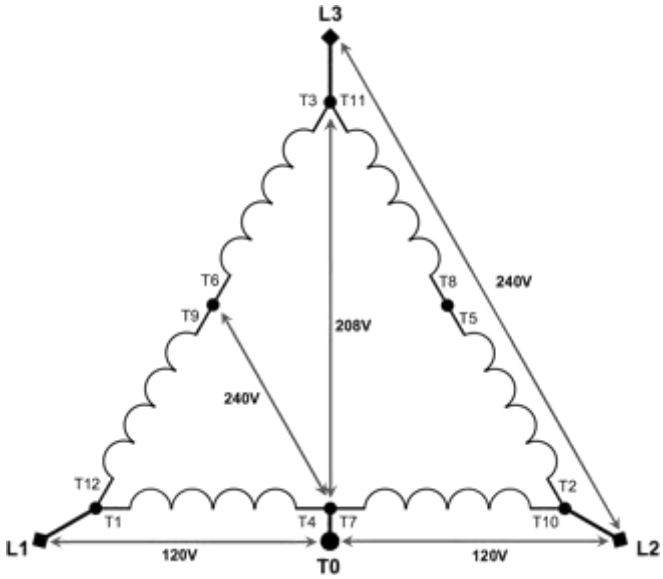
Series Wye (416/480V 3ø)

Voltage L-L: 416/480V
Voltage L-N: 240/277V
Voltage CT – N: 120/139V



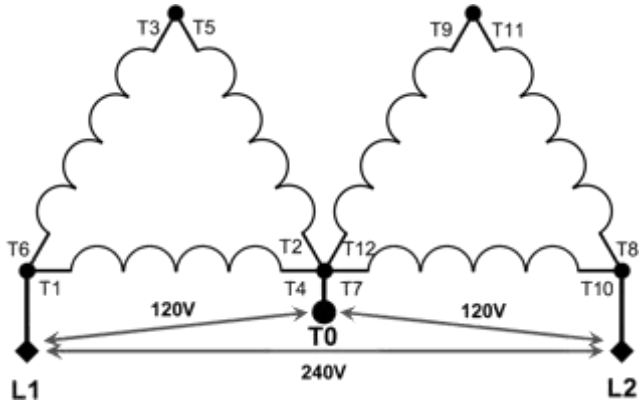
Parallel Wye (208/240V 3ø)

Voltage L-L: 208/240V
Voltage L-N: 120/139V
NOTE: 208V is Standard Voltage



Series Delta (240V 3ø)

Voltage L-L: 240V
Voltage L1/L2-N: 120V
Voltage L3 – N: 208V
NOTE: L3-N is a "High Leg"
208V instead of 120V!



Double-Delta (120/240V 1ø)

Voltage L-L: 240V
Voltage L-N: 120V
Preferred Single-Phase Connection.
Don't Use Zig-Zag if Possible.
NOTE: Derate generator by 1/3 rated capacity when using this connection!

For Technical Support:
Visit our website at: www.power-tronics.com
Call Us at: (830) 895-4700

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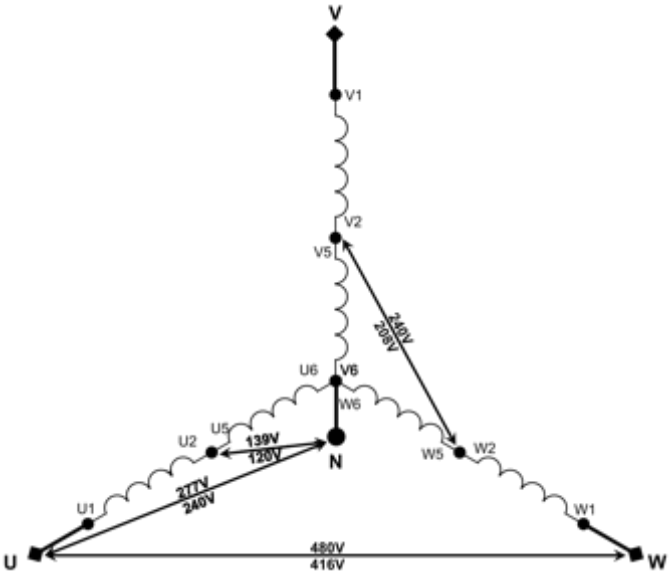
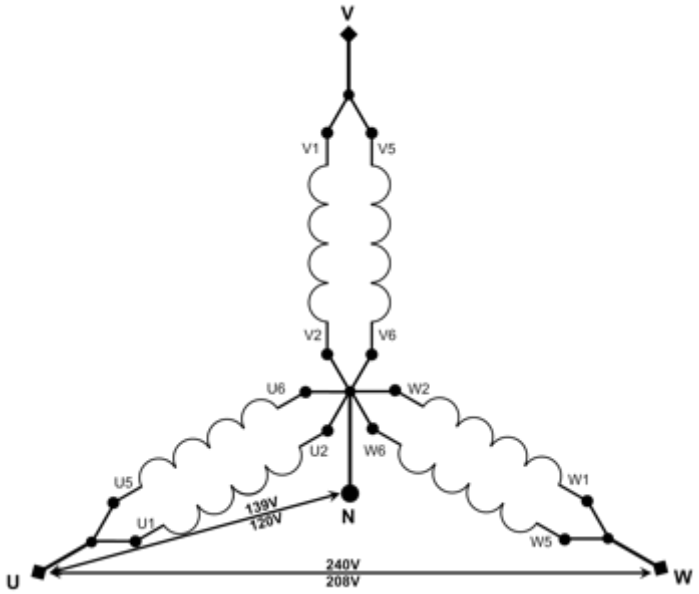
“ISO Standard” 12-Lead Generator Wiring Diagrams



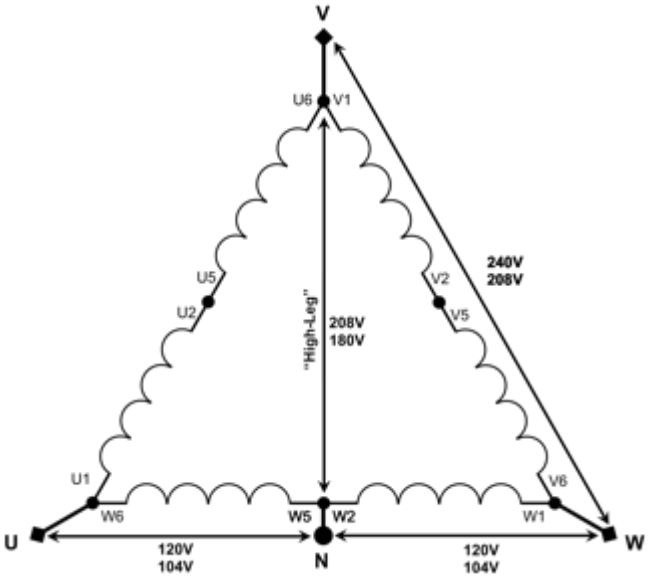
Series Wye (416/480V 3ø)

Voltage U-W: 416/480V
Voltage U-N: 240/277V
Voltage CT – N: 120/139V



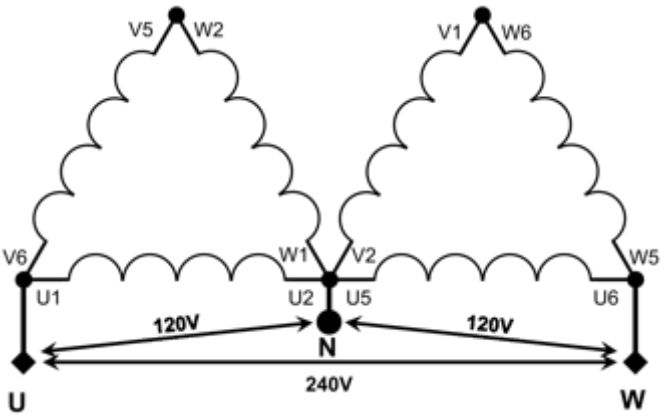
Parallel Wye (208/240V 3ø)

Voltage U-W: 208/240V
Voltage U-N: 120/139V
NOTE: 208V is Standard Voltage



Series Delta (240V 3ø)

Voltage U-W: 240V
Voltage U/W-N: 120V
Voltage V – N: 208V
NOTE: V-N is a “High Leg”
208V instead of 120V!



Double-Delta (120/240V 1ø)

Voltage U-W: 240V
Voltage U/W-N: 120V
Preferred Single-Phase Connection.
Don’t Use Zig-Zag if Possible.
NOTE: Derate generator by 1/3 rated capacity when using this connection!

120V Input Power & Field Connection Diagram

(**See pages 11-13** for control wiring information)

The XC14 is a Half-Wave rectified voltage regulator, which allows a maximum of 52VDC at 20 ADC with an input voltage of 120VAC.

This connection is typically used on generators with full load field voltages of 32VDC or less and full load exciter field amperage less than 12ADC.

Note that the maximum input voltage to the XC14 Voltage regulator in this connection is 139VAC! DO NOT input 208-240VAC into the XC14 in this connection! Regulation problems or damage to the unit may result! For use on 480V systems, use a **480-120V step-down transformer rated at 1KVA** or connect the regulator to the winding center taps T7 and T0 (**See Pages 6 and 7**).

Using a transformer to connect the input of the XC14 to 2 different phases of the generator will result in greater regulation accuracy than when connecting line-neutral.

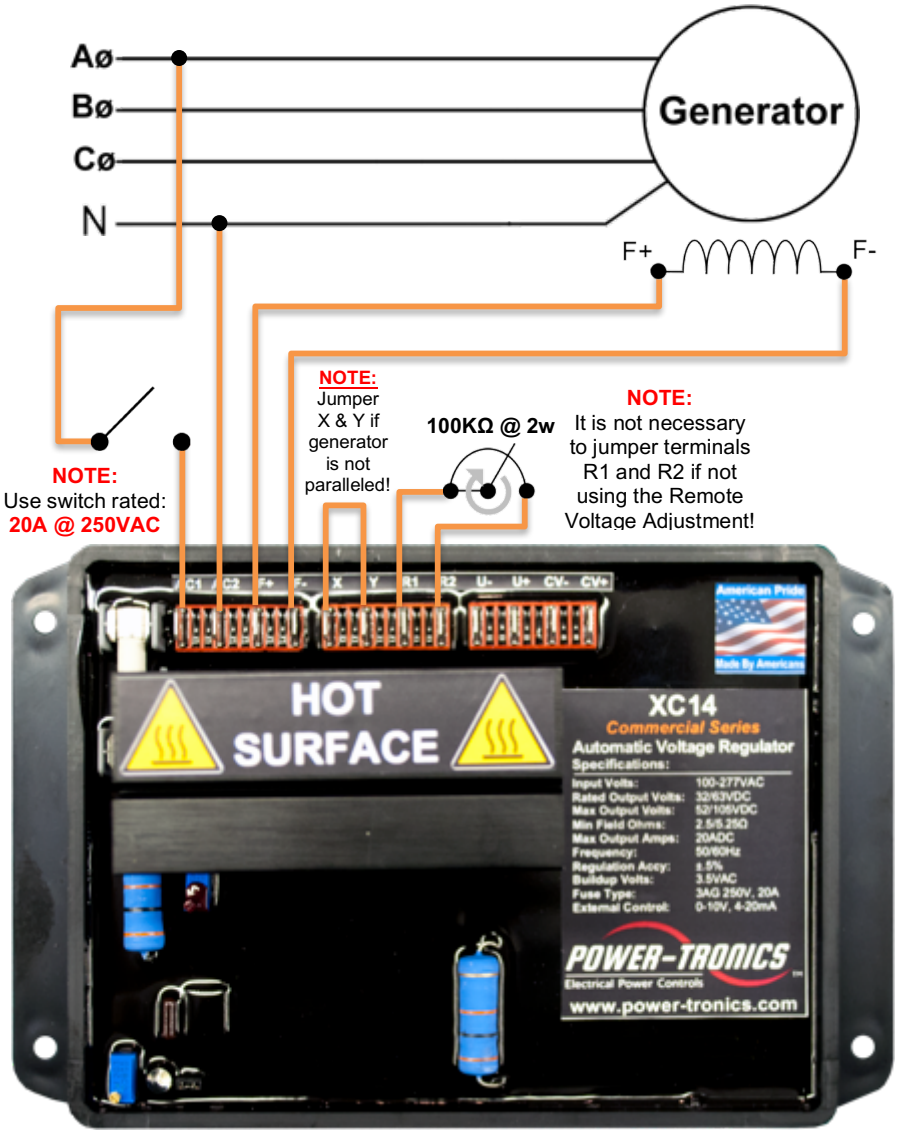


Diagram Assumes a 208-240V Generator
For 480V Generators, use a 1KVA (or larger) **Transformer** with a **120V Secondary** *OR* Connect to the Generator winding center taps at **T7 and T0.**

NEVER install a switch or breaker on the DC or Exciter side of the voltage regulator!

Only install a switch or disconnect on the AC Side of the regulator!

See Page 11 for Paralleling Wire Diagram

See Pages 12-13 for External Control Wiring Diagrams

240V Input Power & Field Connection Diagram

(**See pages 11-13** for control wiring information)

The XC14 is a Half-Wave rectified voltage regulator, which allows a maximum of 105VDC at 20 ADC with an input voltage of 240VAC.

This connection is typically used on generators with full load field voltages of 63VDC or less and full load exciter field amperage less than 12ADC.

Note that the maximum input voltage to the XC14 Voltage regulator in this connection is 240VAC! DO NOT input 480VAC into the XC14 in this connection! Regulation problems or damage to the unit may result! For use on 480V systems, use a **480-240V step-down transformer rated at 1.5KVA** or connect the regulator to the winding center taps T7 and T9 (**See Pages 6 and 7**).

Connecting the input of the XC14 to 2 different phases of the generator will result in greater regulation accuracy than when connecting line-neutral.

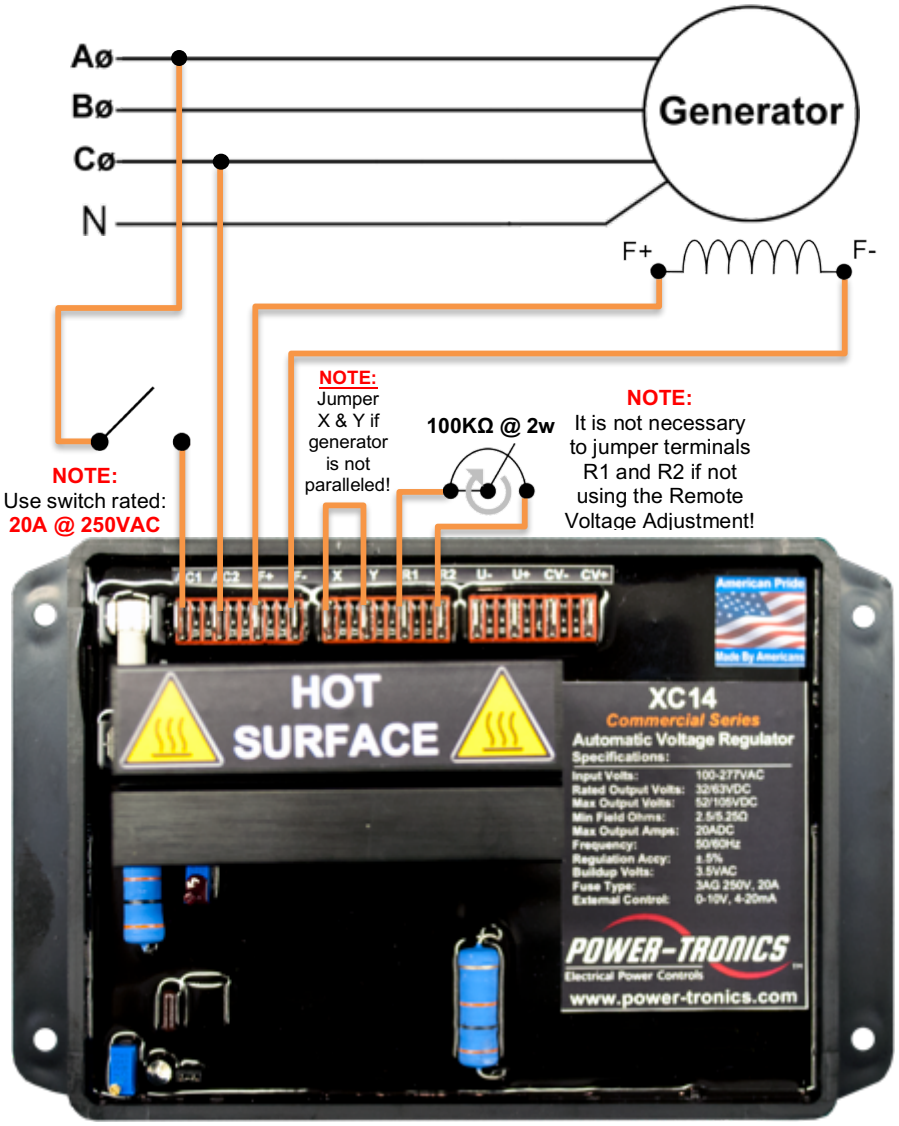


Diagram Assumes a 208-240V Generator
For 480V Generators, use a 1.5KVA (or larger) **Transformer** with a **240V Secondary** *OR* Connect to the Generator winding center taps at **T7 and T9.**

NEVER install a switch or breaker on the DC or Exciter side of the voltage regulator!

Only install a switch or disconnect on the AC Side of the regulator!

See Page 11 for Paralleling Wire Diagram

See Pages 12-13 for External Control Wiring Diagrams

277V Input Power & Field Connection Diagram

(**See pages 11-13** for control wiring information)

Note that regulation at 277V is inferior to using 240V. 277V operation is provided for convenience and ease of installation.

This connection is typically used on generators with full load field voltages of 63VDC or less and full load exciter field amperage less than 12ADC.

Note that the maximum input voltage to the XC14 Voltage regulator in this connection is 277VAC! DO NOT input 480VAC into the XC14 in this connection! Regulation problems or damage to the unit may result! For use on 480V systems, connect the regulator from Line to Neutral T7 and T0 (**See Pages 6 and 7**), or use a **480-240V step-down transformer rated at 1KVA**.

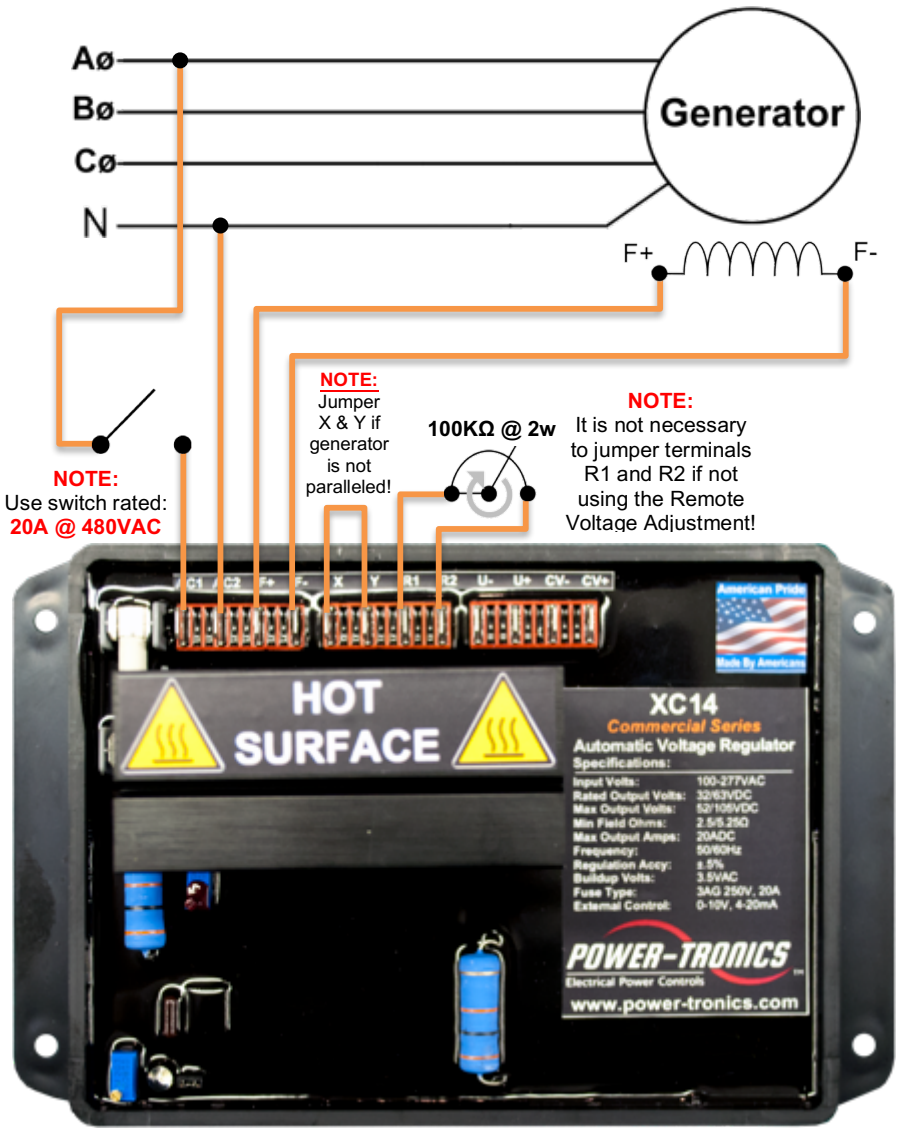


Diagram Assumes a 480V Generator
For other voltages, use a 1KVA (or larger) **Transformer** with a **240V Secondary**.

NEVER install a switch or breaker on the DC or Exciter side of the voltage regulator!

Only install a switch or disconnect on the AC Side of the regulator!

See Page 11 for Paralleling Wire Diagram

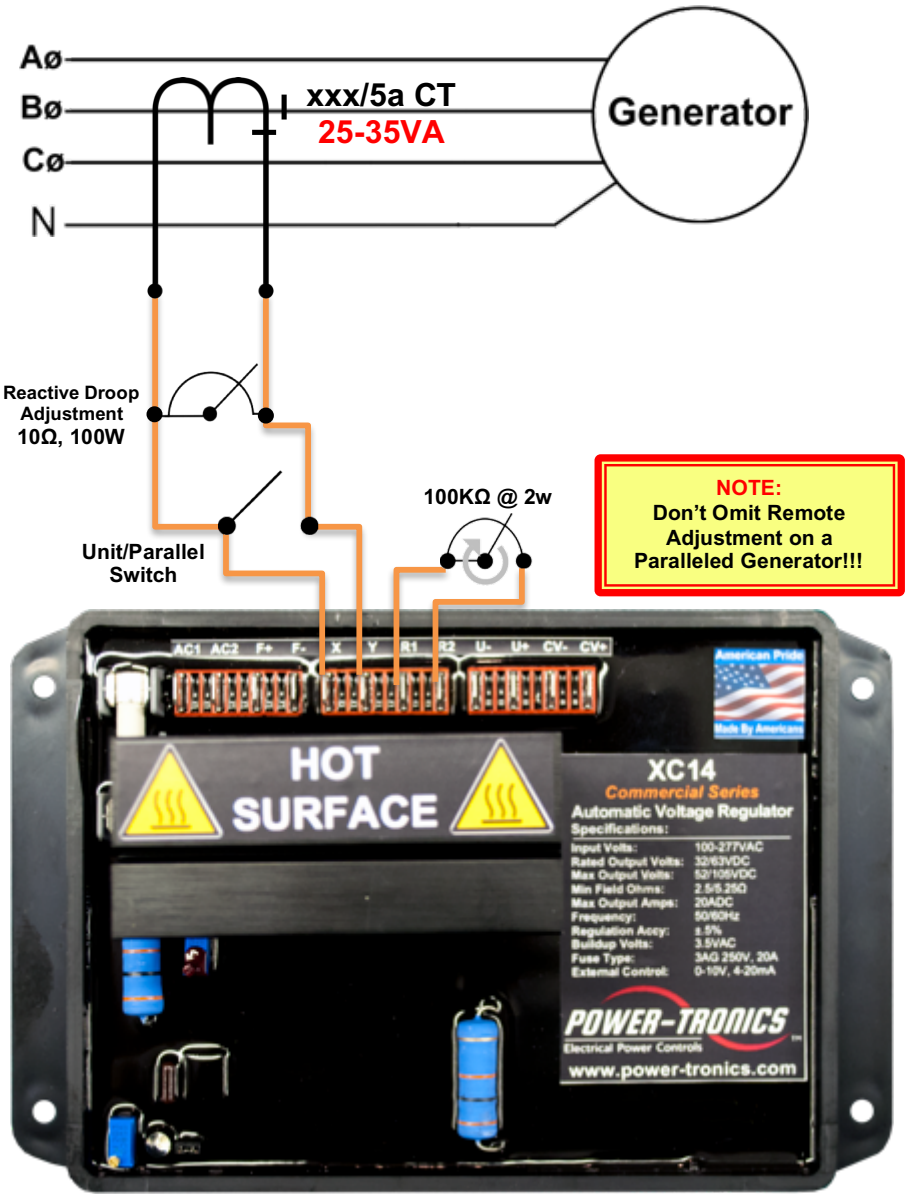
See Pages 12-13 for External Control Wiring Diagrams

Current Transformer Wiring Diagram
For Paralleled Generators

To use the XC14 Voltage regulator in a parallel configuration either with another generator or with a buss such as a utility, use the diagram below for proper hookup with the XC14. **Power and field wiring is shown on Pages 8-10.**

This diagram assumes a paralleled operating environment with manual remote adjustment.

NOTE: Power-Tronics products parallel using the Reactive Droop compensation method. This allows our products to parallel with existing systems easily while also allowing islanded operation with the flip of a switch. **When initially installing the droop resistor, set it for approximately 7Ω before final adjustment later.** If the droop is excessive when load testing, reduce the resistance a bit at a time until satisfactory droop is achieved. **CT should be sized at 25-35VA capacity!**

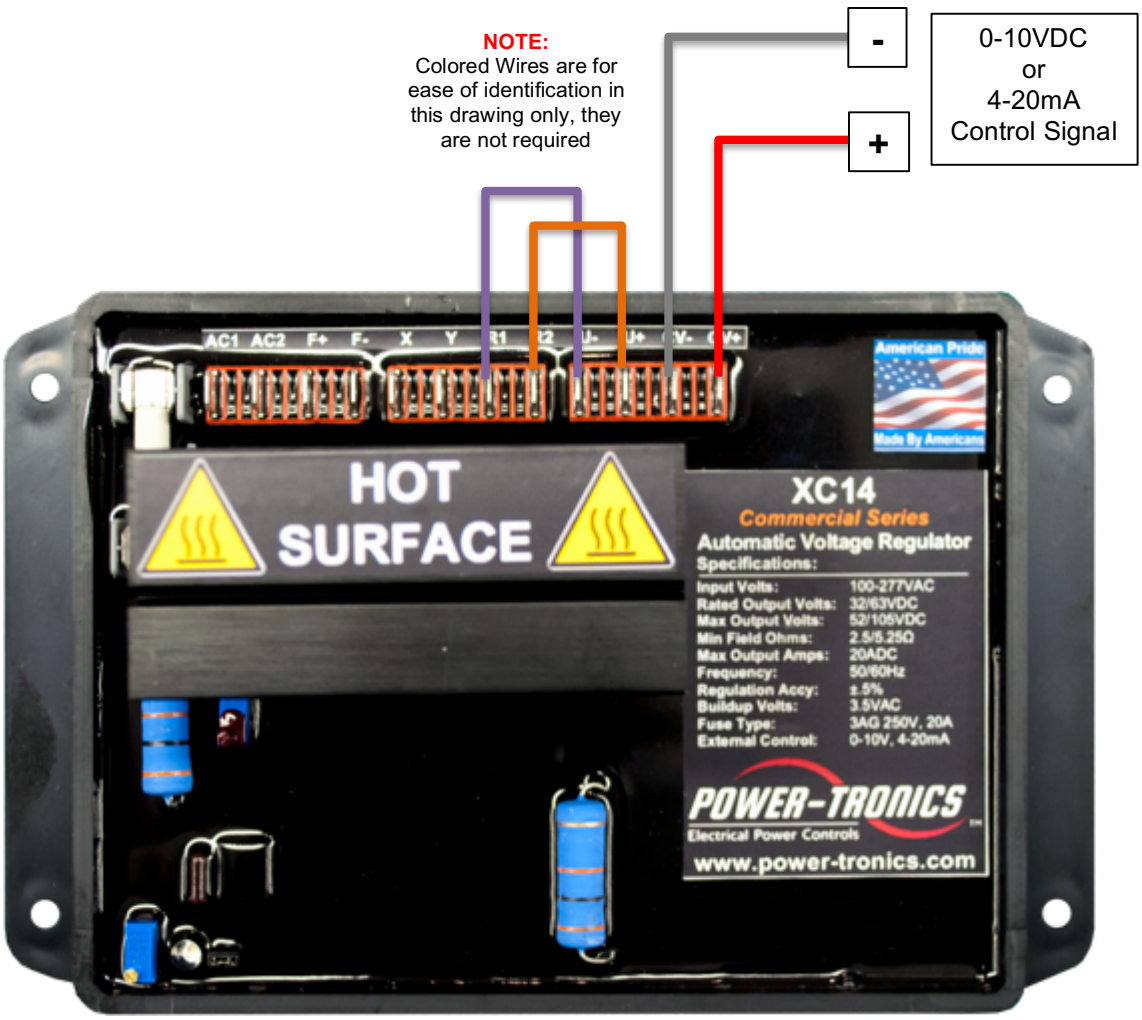


NOTE:
Don't Omit Remote Adjustment on a Paralleled Generator!!!

If using the internal 0-10VDC Interface module, See Pages 12-13 for Control Wiring Diagrams

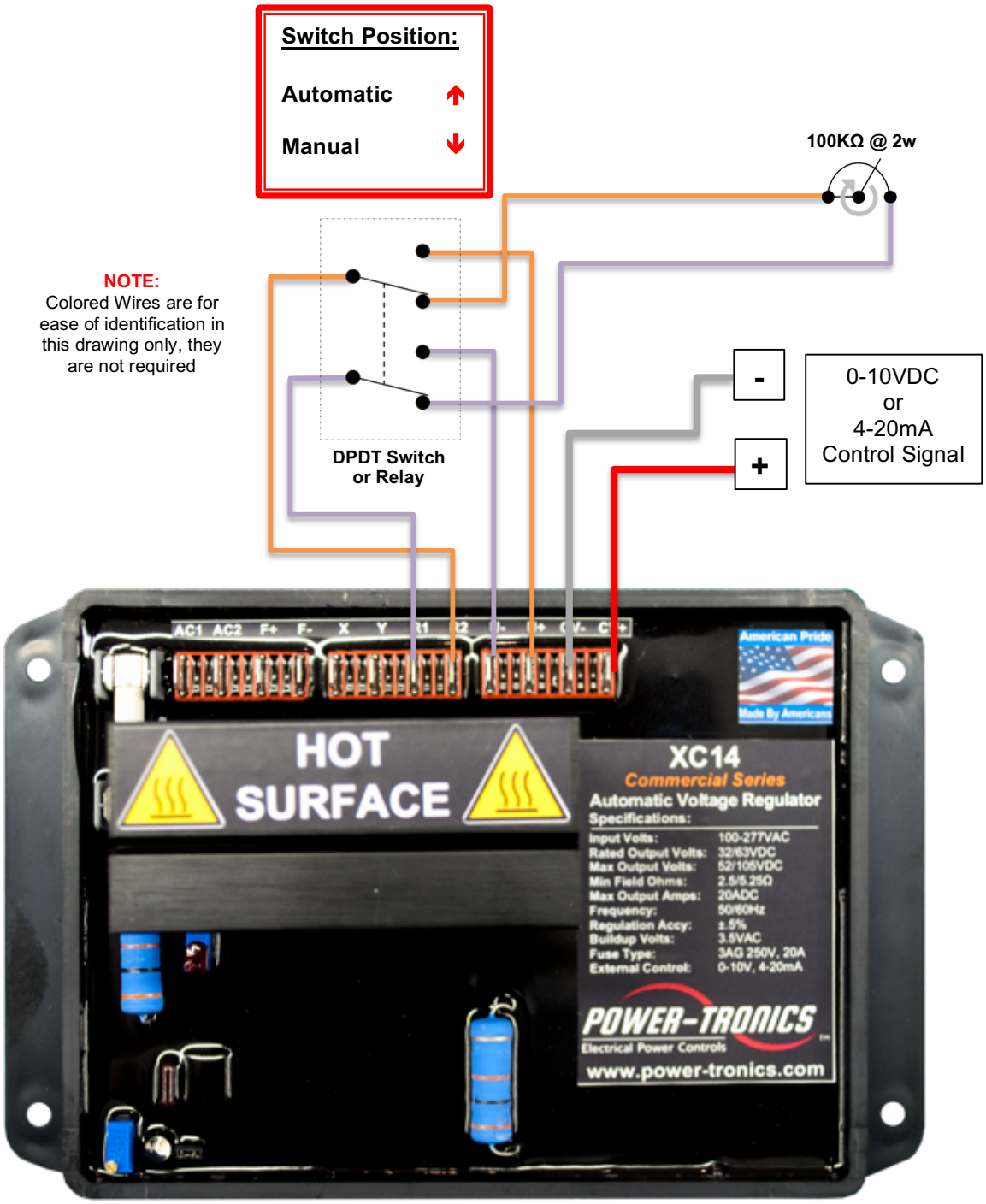
Fully Automatic Remote Adjustment Wiring Diagram

This wiring diagram shows ONLY the control wiring configuration for fully-automatic Remote Control of the XC14. **Power wiring is shown on Pages 8-10.**



Automatic / Manual Selectable Remote Adjustment Wiring Diagram

This wiring diagram shows ONLY the control wiring configuration for fully-automatic Remote Control of the XC14. **Power wiring is shown on Pages 8-10.**



Initial Setup and Commissioning

1. Install the XC14 and wire according to the correct wiring diagram and control wiring diagram **(Pages 8-14)**. **Make sure the unit is mounted where it can receive fresh air.** *Air circulation by natural convection or forced ventilation is crucial for a long service life!*

2. If installing the XC14 on a brush-type generator, verify that the brushes and brush riggings are isolated, ungrounded, and connected ONLY to the XC14. Remove any ground straps from the brush holders, if present.

3. If operating on a 50Hz generator, remove the 50/60Hz Selection Jumper (next to voltage adjustment potentiometer).

4. Turn the internal voltage control (blue potentiometer) 15 or more turns counter clockwise (left) or until you hear the screw click. This procedure is necessary in case the original factory settings have been altered.

5. If you are using a remote voltage adjustment, set it at 50% of adjustment.

6. If the generator is to be paralleled, set the droop resistor between 6Ω and 10Ω.

7. Start up the prime mover and bring up to operating speed and turn on the regulator switch (if used).

8. Set the internal voltage adjustment to the desired voltage setting for the generator output by turning the adjustment screw clockwise (right).
Note that the voltage adjustment is a 25-turn pot!

9. Place the generator on line and observe the frequency and voltage.

10. If the generator is being paralleled, measure the droop during loading and adjust the droop resistor as necessary. Reducing droop resistor resistance will reduce droop.
NOTE: Loading the generator with a purely resistive load-bank may cause undesirable droop characteristics such as no droop, very slight droop, or even rising terminal voltage. Measure droop with a mixed load for best results.

11. If paralleling and the terminal voltage rises or excessive amperage exportation occurs during loading with a mixed load connected, reverse the CT leads and try again.

12. If using the internal 0-10VDC interface module, manually vary the input voltage signal to observe the behavior of the exciter in response to a control voltage change. By default the unit ships factory preset for full range from 0-10VDC (Effective range +/-25VAC from 240VAC setpoint).
NOTE: If your external control device uses a +/-9V or +/-10V control signal, you can still use it with the internal interface module by manually setting a +5V offset in your control scheme. The unit will recognize 0-10V control signals and will ignore any negative control signals.

13. Observe voltage regulation during no-load and full-load conditions. Once the voltage is set and regulating characteristics are satisfactory the installation procedure is complete.

Application Troubleshooting

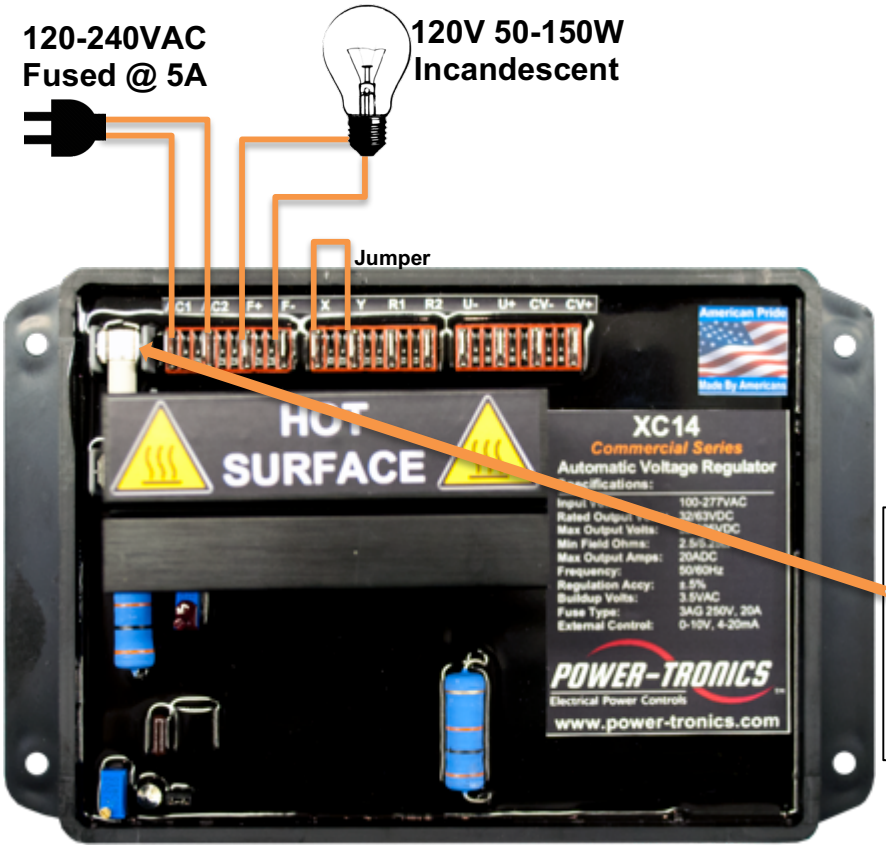
Problem:	Possible Cause
No Voltage	1 3 5 7 9 11 13 15 20 21
Pulsating Voltage	4 5 6 12 16
Flickering Voltage	4 6 7 14 21 22
High Voltage	6 7 8 9 12 13 17 18 20 21 22
Voltage Drop on Load	5 8 10 12 16 23 24
Low Voltage	5 8 12 13
Poor Voltage Regulation	2 4 10 12 13 16 23 24
No Voltage Control	13 19 20 21 22 23 24

Possible Causes:

1. Residual input voltage to the exciter is below 3.5vac, main or battery fuses blown, dead battery.
2. Unbalanced generator load.
3. Open exciter field or defective generator.
4. Non-linear load or defective connection in exciter field.
5. Open diode in exciter or shorted rotor in generator.
6. Loose component in voltage regulator.
7. Loose wiring connections.
8. Input voltage to regulator is too low.
9. Exciter field is grounded.
10. Non-linear load or wrong selection for regulator hookup.
11. Exciter fields are reversed.
12. Wrong selection of regulator wiring configuration.
13. Defective voltage regulator.
14. SCR or Inverter drive effecting generator waveform.
15. Regulator needs battery flashing circuit.
16. Isolation transformer is too small.
17. Isolation transformer is needed.
18. Exciter fields are not isolated from other circuits.
19. Input and field circuit are being fed by a common cable or conduit.
20. Incorrect hookup or wiring.
21. Poor brush contact to commutator or sliprings.
22. Damaged, pitted, or grooved slip ring surface.
23. Current transformer has reversed polarity or is not shorted during non-parallel operation.
24. Input to regulator is from an auxiliary winding and not the generator main stator.

Bench Check Procedures

1. Wire the XC14 as shown in the figure below.
2. Connect up one 120 volt 50 to 150 watt incandescent light bulb to the F+ and F- Terminals.
3. Install a temporary jumper wire between terminals X and Y.
4. Turn the internal voltage adjustment (blue potentiometer) fully Counter-Clockwise (Left) before beginning the testing procedures below.
5. Input 120-240VAC fused at no more than 5A into the XC14. **The test light should be OFF**.
6. ***Slowly*** turn the internal voltage adjustment Clockwise (Right) until the light glows. **The test light should light to *HALF* Brightness.** ***NOTE: It may take several turns of the adjustment screw before the lights illuminate!***
7. Slowly turn the internal voltage adjustment Counter-Clockwise (Left) until the lights go dark. **The test light should be OFF**. ***NOTE: It may take several turns of the adjustment screw before the lights go dark!***
8. Turn off AC power and disconnect the XC14 from your AC power source.
9. **If you were able to successfully perform all of these tests, the XC14 is good.**



Fuse Replacement Information:

XC14 Main:
Rating: 20A @ 250VAC
Qty: 1
PTI Part # 5R3-628
Littelfuse Part # 0314020.MXP

Installation Warranty Form

It is very important that you fill out this form completely when installing a voltage regulator. This form serves as a history record on the application. This form also contains the information needed by Power-Tronics, Inc., for repair and troubleshooting of any product you may be having problems with.

Failure to fill out this form during installation will result in a cancellation of your warranty coverage! Filling out this form takes only minutes but will save hours or days later on if your product should require service!

Submit Online at: www.power-tronics.com/warranty

Submit Online at: www.power-tronics.com/warranty

Product Model:	Additional Module(s) or Options:
Serial #:	
Date of Installation:	
This Section for Brushless Generators Only	
Exciter Field Voltage:	Exciter Field Resistance:
This Section for Brush-Type Generators Only	
Shunt-Field Voltage:	Shunt-Field Resistance:
Rotor Resistance @ Brush Leads:	Rotor Resistance on Slip-Rings:
Rotor Excitation Voltage:	
Generator Wiring/Usage Information	
Generator Leads (Check One:) ☐12 ☐10 ☐6 ☐4 (3ø) ☐4 (1ø) ☐3	
Generator Wiring Mode (Check One:) ☐High-Wye ☐Low-Wye ☐Series Delta ☐Zig-Zag ☐Double-Delta ☐Single-Phase ☐Other	
Terminal Voltage:	Residual AC Voltage:
Rated KW:	Rated KVA:
Primary Load (Please Explain):	
Repair/Warranty Request Information	
Company Name:	
Contact Person:	
Telephone Number:	
Email Address:	
Ship-To Address (City, State, Zip, Country):	
Problem Description/History (Please be detailed!!!):	

PRODUCT WARRANTY

Power-Tronics, Inc., assumes no liability for damages due to incorrect voltage or other voltage related damages resulting from either output of the generator or input to the generator exciter system. These problems should be protected with external devices provided by the customer such as ***fuses, surge suppressors, over/under voltage and frequency controls.***

Power-Tronics, Inc., warranties **only parts and workmanship** of this product for a **period of 1 year from the original date of purchase from Power-Tronics, Inc.** Under warranty, Power-Tronics, Inc. will replace, exchange or repair the defective product **without labor or parts cost to the customer.** Remaining warranty of the original product will be transferred to the replaced or repaired product. To obtain warranty, a copy of the original Installation Warranty Form must be sent in with the defective product, which clearly shows the purchase date and serial number of the defective part. A repair request form must be sent in with the product before repairs will begin. You can obtain this form by contacting Power-Tronics, Inc.

Send repairs to: Power-Tronics, Inc., 2802 Cobbler Ln., Kerrville Texas USA 78028.

Send in repairs only by UPS or FedEx. **USPS will NOT deliver to our facility!**

Any *one* of the following conditions will void the warranty:

- Overheating of the power supply resistor on the printed circuit card.
- Overheating of the SCR or freewheeling diode.
- Physical damage to the printed circuit card, housing or components.
- Unauthorized repair or alteration of printed circuit card.
- Installation by anyone other than a qualified professional generator service technician.
- Conductive or corrosive contamination of the circuit card.
- Removal of our company identification from the product.
- Removal of any conformal coating of the printed circuit card or components.
- Overheating of foil on the printed circuit card.
- Inappropriate or infeasible application.
- Use with any external device other than manufactured by Power-Tronics, Inc.
- Failure to fill out the attached warranty card during installation

No other warranty is expressed or implied.