KFR3

Specialty Series

Automatic Voltage Regulator

For Kohler Fast-Response Generators

The Power-Tronics KFR3 Automatic Voltage Regulator is designed as a true standalone voltage regulator for Kohler Fast-Response style generators to allow for replacement of obsolete, incompatible, or intentionally crippled control equipment and regulation controls on Fast-Response style generators.

The KFR3 is designed specifically for Professional Electrical Generator Service Technicians and the Electrical Generator Repair Industry. It incorporates an easily selectable frequency range for voltage roll-off during under-frequency operation and offers precise voltage regulation regardless of the connected load and ambient temperature. The KFR3 is a ruggedized design and is engineered to provide a lifetime of trouble-free, reliable operation.

Stability matching and regulation gain can be adjusted through patented electronic circuitry that matches the regulator's response time to the generator exciter. This greatly speeds response time of the AVR and allows tuning to achieve extremely tight voltage regulation across a variety of load conditions.

PLC and automated Genset control is possible with the KFR3 by simply adding an optional, inexpensive digital interface module. This capability makes the KFR3 suitable for automated or unattended installations, or large-scale parallel operations.

The KFR3 is based on time-tested regulation circuitry and provides an extremely reliable and flexible automatic voltage regulator solution for Kohler Fast-Response style generators.

Specifications

Input Voltage:	208-277vac
Battery Voltage:	12 or 24vdc
Frequency:	50 or 60hz
Voltage Regulation:	± 1% From NL to FL
Parallel Operation	Yes
Maximum Output Voltage:	1.5vdc
Under Frequency Protection:	Yes, VPH reduction
Physical Size:	5 x 3.5 x 1 in.
Weight:	8 oz
Fully Encapsulated:	Yes
External Voltage Adjustment:	Yes
System Operating Indicator:	Yes, 3
Optional External Controls:	Yes
Optional External Potentiometer:	100KΩ @ 2W
External Adjustment Range:	±10% of Terminal Voltage

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Introduction and Functional Description

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 regulator receives ample airflow
NEVER hold the regulator in your hand when energized
NEVER install the regulator in a place it can get wet or is exposed to the elements
NEVER mount the regulator over a screw, bolt, rivet, welding seam, or other fastener
NEVER remove the regulator cover while the unit is in operation
NEVER insert a screwdriver or other object under the regulator cover
NEVER install a switch in the DC portion of the regulator's wiring
NEVER USE A DIGITAL FREQUENCY METER (It *can give a false reading*!)

Functional Description

The KFR3 Automatic Voltage Regulator is the result of over 35 years of engineering efforts and offers high-demand features at a competitive price point. The KFR3 is a proven design and is engineered to greatly simplify setup while offering extreme reliability in demanding service conditions. When properly installed, the KFR3 Automatic Voltage Regulator is designed to provide a lifetime of service.

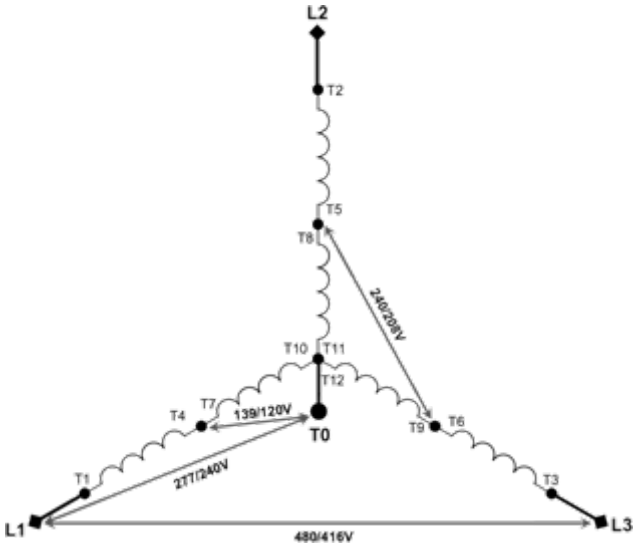
A Generator voltage regulator has several automated tasks it must perform in order to provide reliable, clean, and regulated electricity. It must build-up the generator, regulate the terminal voltage within its design specifications, and protect both itself and the generator should a fault situation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

The KFR3 contains a simple and extremely reliable circuit for build-up functionality. The patented circuitry contained in the KFR3 allows for adjusting the regulator to match the generator's response time, minimizing setup complexity while maximizing load acceptance and rejection performance. The KFR3 is a precision voltage regulator and is capable of regulating the terminal voltage of the generator within +/-1% of its initial set point.

The KFR3 contains a unique frequency-selectable Volts-Per-Hertz circuit, which helps a turbo-charged engine accept a large load, and also helps to protect the generator rotor and exciter if the engine is idled with the regulator still energized.

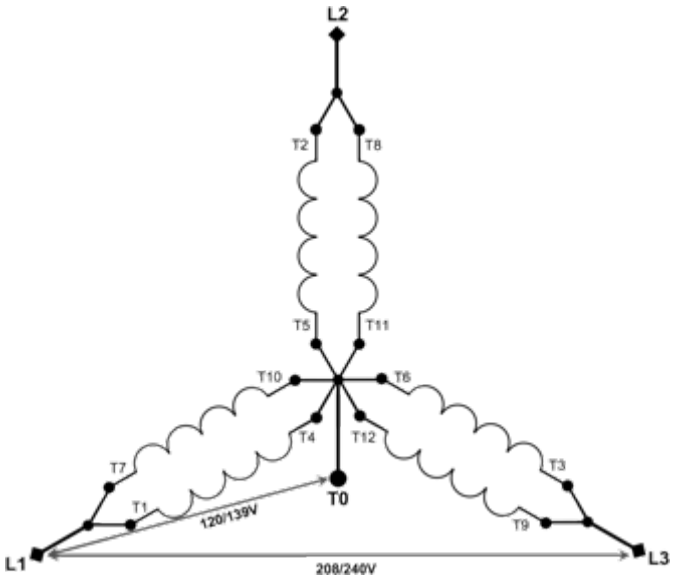
Due to its extreme simplicity, the KFR3 Automatic Voltage Regulator is uncommonly reliable and offers features and regulation accuracy usually only offered by much more complicated and often much more expensive regulators.

Common 12-Lead Generator Wiring Diagrams



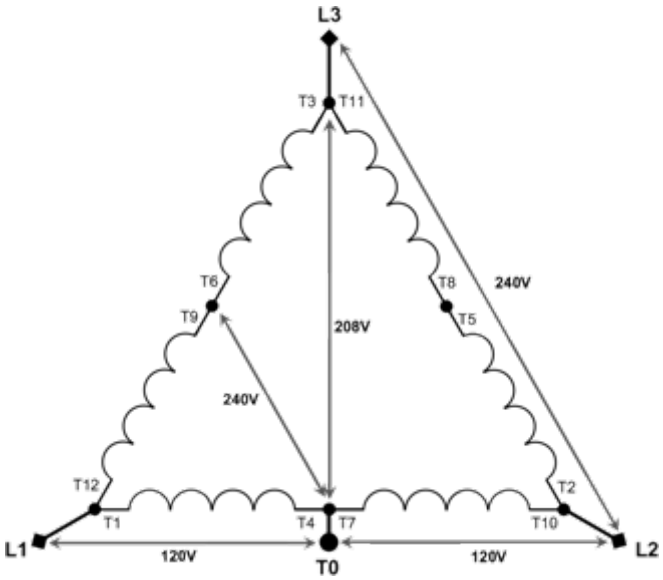
Series Wye (416/480V 3ø)

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



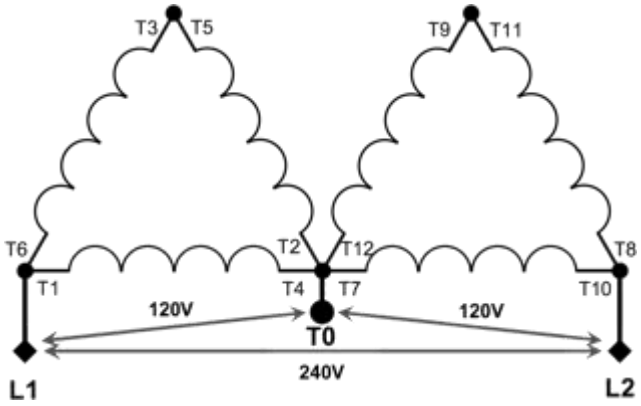
Parallel Wye (208/240V 3ø)

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)

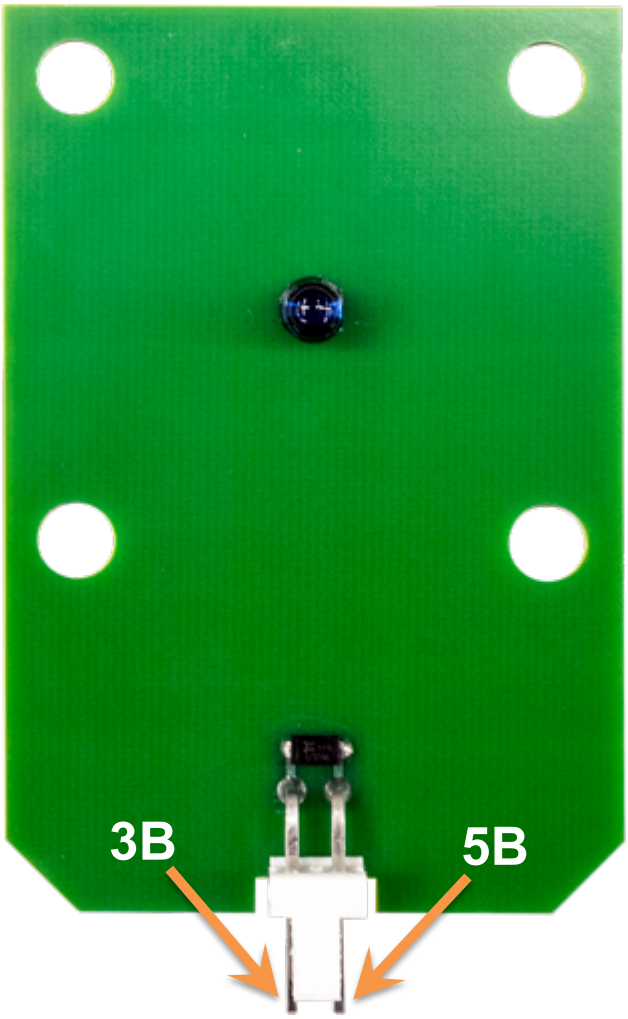
Voltage L-L: 240V
Voltage L-N: 120V
Preferred Single-Phase Connection.
Don't Use Zig-Zag if Possible.
NOTE: Derate generator by 1/3 rated capacity when using this connection!

KFR-EB Emitter Board

Kohler Fast-Response style generators operate in a very different way compared to every other brushless generator on the market. These generators use a rotating electronic exciter that is controlled via an infrared light beam from a light-proof cover on the end bell of the generator. There is no traditional exciter or exciter field for the AVR to control, instead it controls the intensity of the infrared emitter board to optically control the rotating electronic exciter on the main shaft of the machine.

The emitter boards on these units can sometimes fail when the original AVR fails and testing can be extremely difficult due to the inability to see or test the operation of the emitter board.

Power-Tronics includes our own KFR-EB emitter board with every KFR3 Voltage Regulator as a service item. The KFR3 is designed to operate both our own KFR-EB board and the OEM Kohler component. The KFR-EB uses the same connector and has the same bolt pattern as the OEM component for a drop-in replacement should the OEM part be bad.



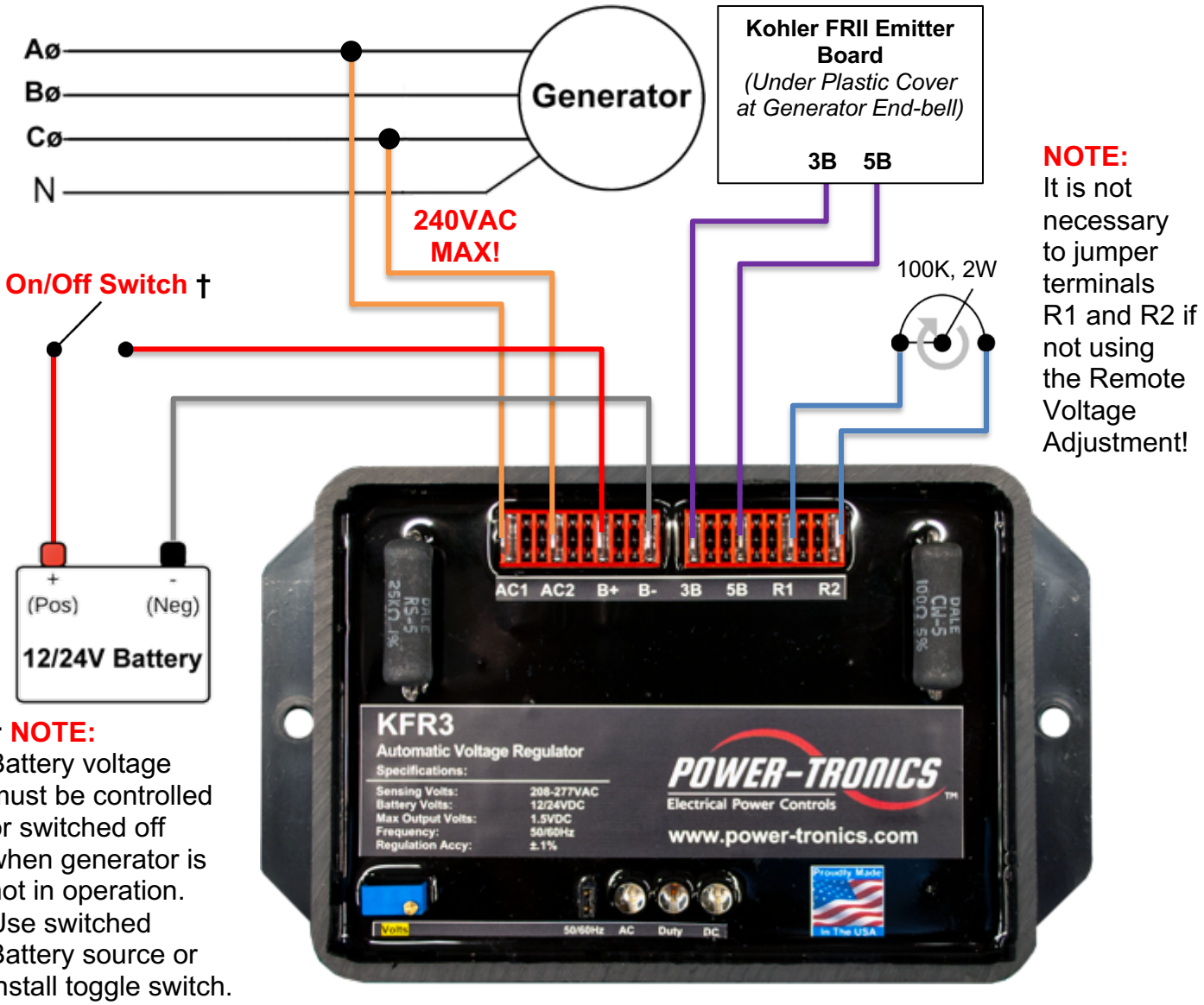
208-240V Hookup Connection

(**See page 7** if the generator is to be paralleled)

This is the default and preferred wiring connection for the KFR3 Automatic Voltage Regulator. This wiring mode provides the best voltage regulation and phase balance and allows for paralleling.

Battery power ***MUST*** be switched either by a manual switch or by a controlled relay.

Note that the maximum input voltage to the KFR3 Automatic Voltage regulator is 240VAC! **DO NOT input 480VAC into the KFR3!** Severe damage to the unit will result! For use on 480V systems, either connect the sensing leads to the winding center taps T7 and T9 (**See Page 4**), use the 277V connection (Page 8) or use a **480-240V step-down transformer rated at 50VA.**



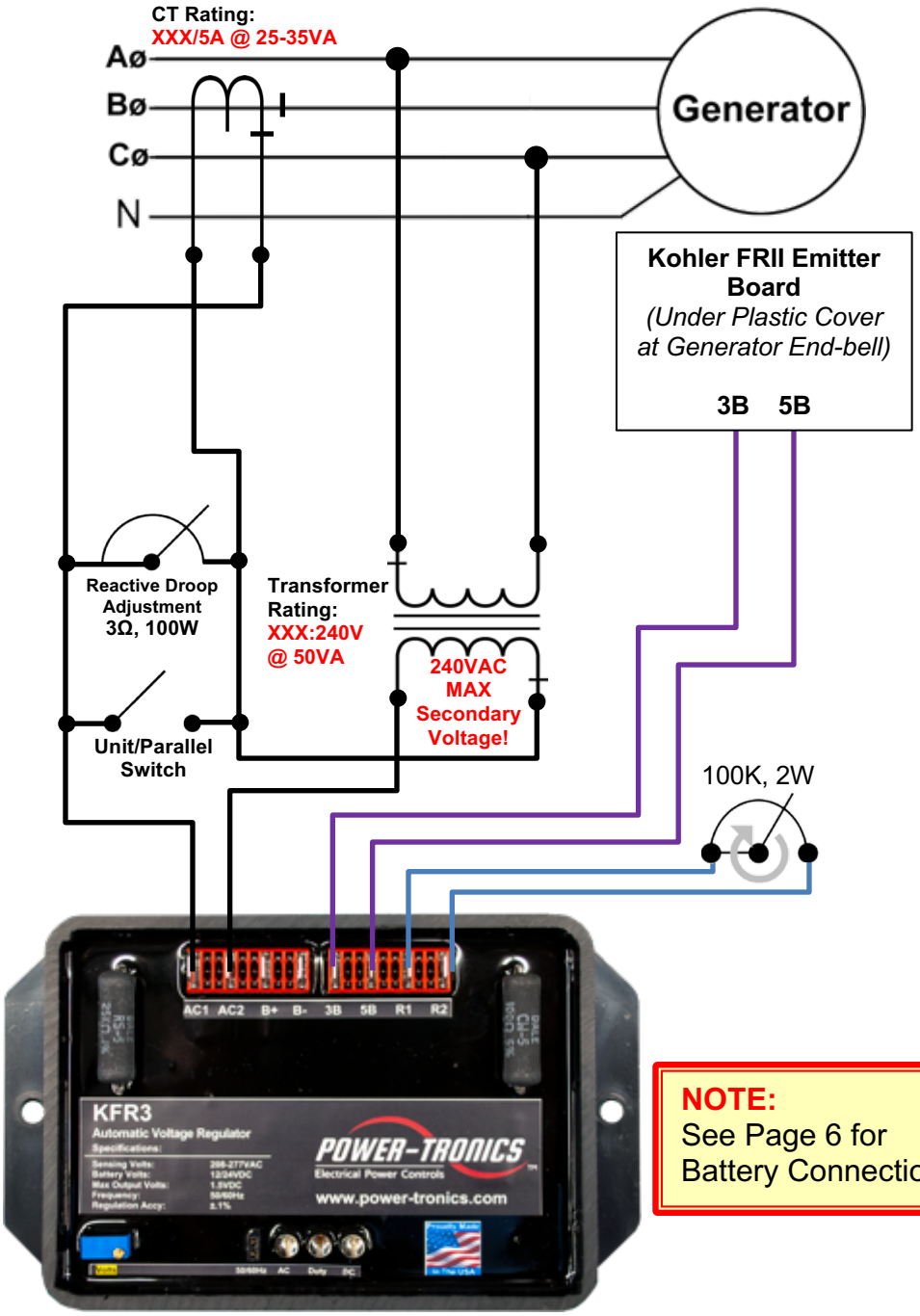
† **NOTE:**
Battery voltage must be controlled or switched off when generator is not in operation. Use switched Battery source or install toggle switch.

Parallel Configuration for 208-240V Hookup

To use the KFR3 Automatic 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 KFR3 operating with 208-240V sensing voltage.

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 2Ω 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 burden!



Setup Tips:

- Isolation Transformer is recommended for best results, but is optional if 208/240V is present on generator.
- Size CT as closely to rated generator output amperage as possible for best paralleling results. **An oversized CT will result in poor paralleling or loss of control!**
- If generator terminal voltage rises, or if generator exports VARS excessively under load, reverse CT leads.
- If the reactive droop resistor/rheostat gives erratic results or inconsistent resistance, lightly sand the exposed wire with 400 grit sandpaper to improve connection between wire and slider.

NOTE:
See Page 6 for Battery Connection

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

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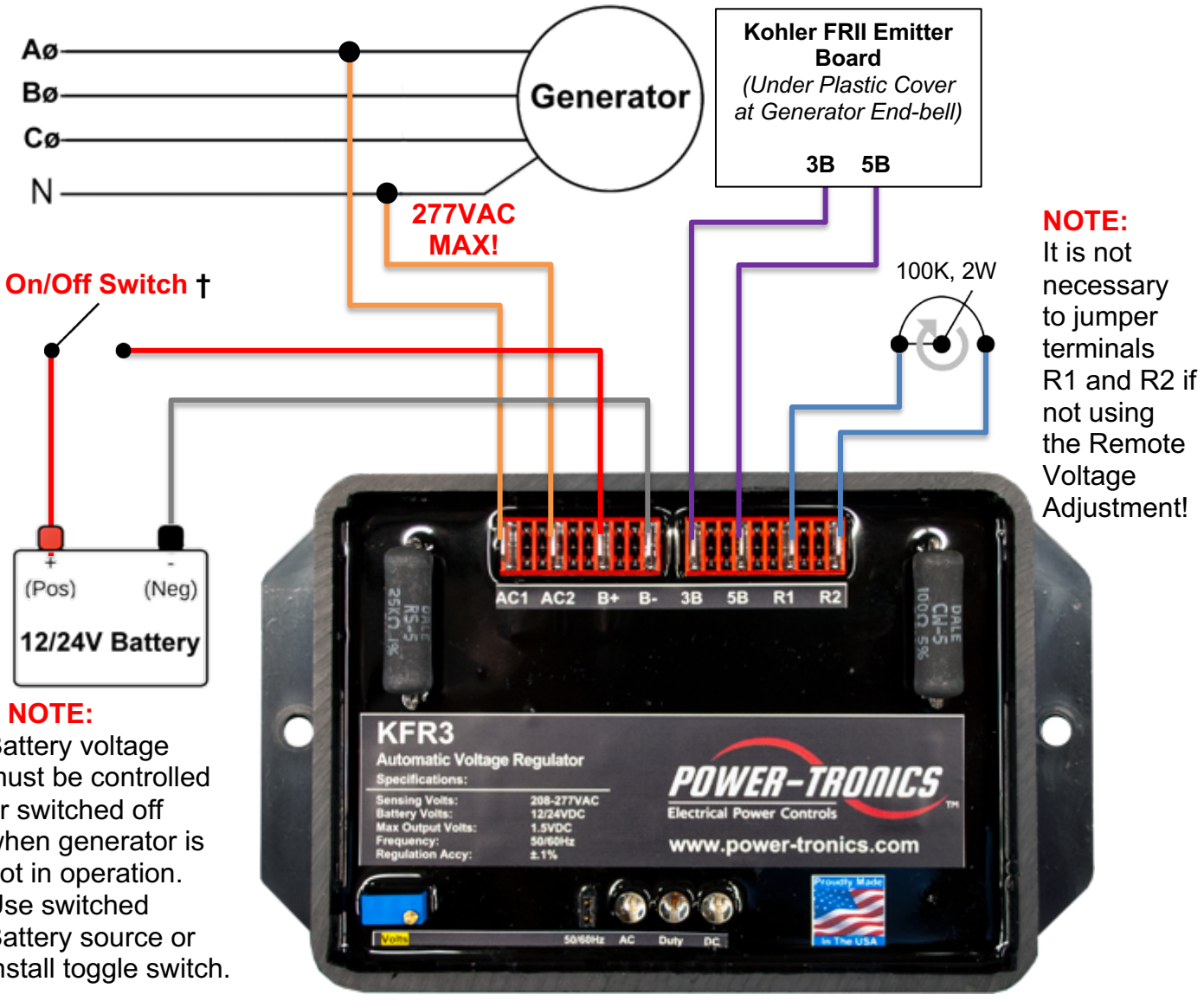
277V Hookup Connection

This is an alternative wiring connection for the KFR3 Automatic Voltage Regulator for use on 480V systems. *This wiring mode prevents paralleling and can lead to poor regulation of unbalanced loads.*

Battery power ***MUST*** be switched either by a manual switch or by a controlled relay.

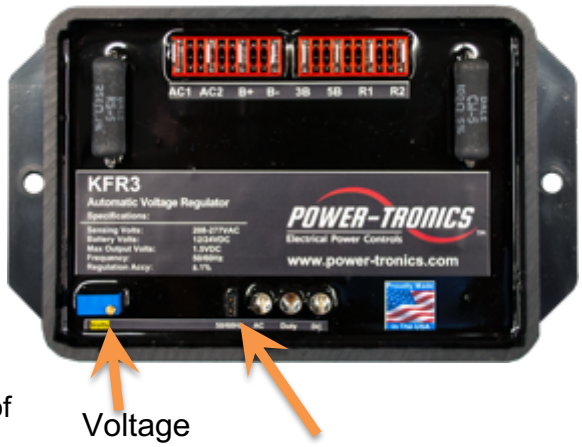
Note that the maximum input voltage to the KFR3 Automatic Voltage regulator is 277VAC!
DO NOT input 480VAC into the KFR3! Severe damage to the unit will result!



† **NOTE:**
Battery voltage must be controlled or switched off when generator is not in operation. Use switched Battery source or install toggle switch.

Initial Setup and Commissioning

1. Verify operation of the rotating rectifier assembly on the generator by performing the "flashlight test" (See Kohler Service Data for procedure) and looking for a large increase in AC output voltage. The KFR3 Automatic Voltage Regulator relies on a functional Kohler receiver assembly and rotating rectifier assembly. **IF THE "FLASHLIGHT TEST" FAILS, THE KFR3 CANNOT OPERATE YOUR GENERATOR!!**



Voltage Adjustment **(25 Turn!)**

50/60Hz FF Selection **REMOVE JUMPER for 50Hz!**

2. Install the KFR3 according to the suitable wiring diagram on previous pages.

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

4. If the generator is to be paralleled, set the droop resistor between 2Ω and 3Ω.

5. Start up the prime mover and bring up to operating speed and verify battery power is being sent to the KFR3. **NOTE: The KFR3 should automatically flash the generator and come up to somewhere between 200-220VAC**
NOTE: If buildup fails to occur, *verify proper polarity to terminals 3B and 5B* on the Kohler Emitter board inside the plastic cover on the generator end bell.

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

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

8. 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.

9. 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.

10. 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.

Optional Power-Tronics Add-On Modules

Power-Tronics offers a wide array of optional add-on modules for the KFR3 Automatic Voltage Regulator. For more information on any of the modules below, visit our online catalog at:

www.power-tronics.com

MOP1224HD
Motorized Potentiometer

Allows the KFR3 to be externally controlled by older automated controllers using pulsed signals or dry contacts for control!

EIM1020VM
External Interface Card

Allows the KFR3 to be controlled externally by virtually any digital load-sharing controller, VAR controller, genset controller, automatic transfer switch, or digital governor controller!

KFR-EB
Fast-Response Emitter Board

Included with every KFR3 Voltage Regulator. Replaces the OEM part when needed to save a return service call if the OEM part is faulty!

HVD2
High Voltage Disconnect

Adds passive protection for your generator and connected equipment from runaway and high voltage conditions! Disconnects power to the voltage regulator instantly in the event of high voltage!

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

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!!!):	

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

For Technical Support:
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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, at its discretion, 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(s) 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.