

INTRODUCTION

The AEC63-7 voltage regulator is designed for use on low voltage, 50/60 Hz brushless generators. Regulator features include frequency compensation, overexcitation detection and output, a solid-state buildup circuit, and internal noise suppression.

SPECIFICATIONS

Power Input

Range: 190 to 277 Vac, $\pm 10\%$
1-phase
Frequency: 50 to 400 Hz
Burden: 1.1 kVA

Sensing Input

Configuration: 2-phase, transformer isolated with respect to neutral
Frequency: 50/60 Hz
Range: 400 Vac L-L nominal
Burden: <1 VA per phase

Power Output

Ratings

Maximum Continuous: 7.0 Adc, 63 Vdc*
One Minute Forcing: 12 Adc, 103 Vdc*
* 240 Vac supply voltage

DC Field Resistance Rating

Minimum: 9 Ω
Maximum: 100 Ω

Voltage Adjustment

240 Vac: 220-277 Vac, L-N, $\pm 10\%$
480 Vac: 380-480 Vac, L-L, $\pm 10\%$

Paralleling

Internal burden and adjustment for 0 to 10% droop at 1 Aac, 0 PF (from external CT).

Response Time

<1.5 cycles for a $\pm 5\%$ change in sensing voltage. Time constant jumpers and stability adjustment are provided to optimize response.

Noise Suppression

Internal filter for transient suppression

Voltage Buildup

Buildup is automatic from generator residual voltage as low as 6 Vac.

Frequency Compensation

At least two times V/Hz

Overexcitation

Inverse time delayed, fixed setting. Trip range from no trip at 65 Vdc to <1 second at >120 Vdc (see Figure 2).

Power Dissipation

20 W, typical

Current Boost Option

Output provided

Alarm Contacts

Voltage Rating: 12-280 Vac/Vdc (400 V Peak)
Current Rating: 150 mAac or 150 mAdc
(dc current latches output)

Temperature

Operating: -25 to 60°C (-13 to 140°F)
Storage: -40 to 85°C (-40 to 185°F)

Vibration

Withstands the following:
5 to 29 Hz: 1.5 G
29 to 52 Hz: 0.036 inch double amplitude
53 to 500 Hz: 5.0 G

Shock

Withstands 15 G in each of three mutually perpendicular planes.

Weight

2 lb (0.9 kg)

FUNCTIONAL DESCRIPTION

Frequency Compensation

The frequency compensation characteristic of Figure 1 is used to improve system load pickup performance by restraining voltage recovery until frequency has also started to recover. The regulator is shipped from the factory set at a 47-Hz corner frequency for 50 Hz systems. For 60 Hz systems, a 57-Hz corner frequency is achieved by moving the jumper wire from the 50 and HZ terminals to the 60 and HZ terminals.

Overexcitation Time Delay

If the regulator output voltage exceeds 65 Vdc ± 2 Vdc, the regulator automatically makes a connection across terminals A1 and A2 via an optically-isolated triac device. This occurs after a time delay which is inversely proportional to the magnitude of the regulator output overvoltage condition up to approximately 105 Vdc ± 5 Vdc (see Figure 2). Beyond this point, the field voltage is removed at a much faster rate. To avoid tripping due to the voltage provided by a separate current boost circuit, voltage measurement excludes any additional boost voltage term. The overexcitation circuit is reset by reducing the regulator input voltage to less than its buildup value for 5 seconds.

This feature is designed to protect the generator and regulator by allowing disconnection of the overloaded part(s) of the system. Should the regulator be allowed to run in excess of its rated current for any extended period of time after the protection output closes, failure of the recommended supply fuse will occur, but regulator damage may also take place.

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Overexcitation Shutdown

Overexcitation detection provides a single-pole solid-state contact closure across terminals A1 and A2, should the regulator output voltage exceed 65 Vdc \pm 2 Vdc for a sufficient time. For voltage above 105 Vdc \pm 5 Vdc, there is a second (shorter) inverse time curve. The total inverse time delay curve is shown in Figure 2.

After the overexcitation solid-state contact has been made, the regulator overexcitation circuit can be reset by decreasing the supply voltage on terminals 3 and 4 to less than 6 Vac for a minimum of 2 seconds. This may be accomplished by stopping the prime mover or interrupting the regulator input by means of a reset switch. In cases where the generator is operating in parallel mode, it may not be desirable to allow the regulator alone to shut down which may cause the generator to be motored. However, continuous operation at output currents greater than the continuous rating after the overexcitation contact has been made may result in failure of the ac supply fuse or may eventually cause regulator failure. If this kind of operation will take place, an alternative external means should be employed to protect the system.

A1 and A2 are optically isolated and floating. Any supply, 12 to 250 Vac or dc may be used, provided that current is limited to 150 mA. Use of a dc supply to terminals A1 and A2 will cause the solid-state device to latch after tripping. In this case, the supply must also be removed to unlatch the device.

Current Boost Logic

The Current Boost Logic, provided at terminals CB+ and CB-, allows the regulator to enable and disable an external Current Boost System. The interface is designed to operate with Basler Current Boost models CBS305 and CBS212A.

If the sensing voltage drops about 10% below the voltage setpoint, then the Current Boost Logic will enable the Current Boost System. Once the sensing voltage increases to about 5% below the voltage setpoint, the Current Boost System will be disabled.

When the Current Boost interface is not required, then no connections should be made at terminals CB+ and CB-.

INSTALLATION

Mounting

The regulator may be mounted on the generator in any convenient position (optimum cooling occurs with the long side of the regulator vertical). Refer to the outline drawing of Figure 4.

Exciter Field Power Circuit

Connect regulator terminal F+ to the brushless exciter field terminal F+, and terminal F- to terminal F-.

Caution

The dc resistance of the exciter field must be greater than or equal to 9 Ω and less than 100 Ω .

If the exciter field resistance is less than 9 Ω , and if the full-load field current does not exceed the maximum continuous current rating of the regulator (7 Adc), a resistor of sufficient wattage must be added in series with the field to bring the total resistance to at least 9 Ω .

Power Input

Connect wiring as shown in Figures 5, 6, and 7. Power for the regulator is derived from a suitable generator winding, auxiliary winding, transformer, or permanent magnet generator (PMG) of suitable frequency, connected to terminals 3 and 4. The operable power input range is 190 to 277 Vac at 50 to 400 Hz.

Sensing Inputs

For sensing, terminal E1 is connected to the generator A-phase terminal and terminal E3 is connected to the generator C-phase terminal. Terminals N1 and N3 are connected to the opposite ends of the A and C phase coils, or commoned together at the neutral (star) point. Single-phase sensing may be achieved by paralleling the inputs. In this case, the voltage range will not be the same as for 2-phase sensing with respect to neutral.

Quadrature Droop Input

When paralleling is required, a 1 A secondary CT should be connected to terminals 1 and 2. The ratio of the CT must be chosen so that the maximum current applied to terminals 1 and 2 does not exceed 1 A rms. The value of the internal burden is 4.7 Ω . These terminals may either be linked or left open when paralleling is not required. The amount of droop is adjusted by the droop potentiometer. Observe the correct phase relationship for the CT (normally this is in the phase which is not being sensed). If only a 5 A CT is available, then a 1 Ω , 50-watt resistor should be used in parallel with CT input terminals 1 and 2. See Figures 5, 6, and 7 for interconnections. Basler part number 9284100100 may be used for this function.

Fuses

It is recommended that fuses with sufficiently high interruption capability be installed per the interconnection diagram. A suitable fuse type would be Bussmann® type FNQR, rated 300 Vac, 6.25 A, time-delay. Dimensions are 10 mm by 38 mm (13/32" by 1 1/2").

Caution

Fuses must be installed per the interconnection diagram to avoid interrupting field current directly.

Voltage Adjust Potentiometer

An internal screwdriver preset (VOLT) provides coarse adjustment of generator output voltage. Adjusting the VOLT control clockwise increases voltage.

The voltage regulator is shipped from the factory with a jumper wire across terminals 6 and 7. If a remote voltage adjust potentiometer is used, the jumper wire should be removed, and the Voltage Adjust Rheostat connected to terminals 6 and 7. A 1 k Ω , 0.5-watt potentiometer provides a fine voltage range adjustment of approximately \pm 10% over most of the coarse range of adjustment. See Figures 5, 6, and 7 for interconnection diagrams. Basler part number 17727 (Figure 3) may be used for this function.

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V/Hz Corner Frequency Selection

For 50 Hz systems, the regulator is preset at the factory for a 47-Hz corner frequency, and a jumper wire connected to the 50 and HZ terminals. If operation at 60 Hz is required, this jumper wire should be connected to the 60 and HZ terminals. The corner frequency is now set to 57 Hz. Do not operate the system at 60 Hz with the jumper programmed for 50 Hz operation.

The underfrequency function is independent of the input power frequency.

OPERATION

The following procedures are provided for AEC63-7 setup and adjustments.

Caution

Meggers and high-potential test equipment must not be used. Incorrect use of such equipment could damage the semiconductors contained in the regulator.

Preliminary Setup

1. Verify that the voltage regulator specifications conform with the generator system requirements.
2. Ensure that the regulator jumper wires are fitted correctly where required, as follows.
 - a. If the remote voltage adjust rheostat is not required, ensure terminals 6 and 7 are jumpered together.
 - b. If a 57-Hz corner frequency for 60 Hz systems is desired, ensure that jumper wire is across the 60 and HZ terminals. If a 47-Hz corner frequency for 50 Hz systems is desired, ensure the jumper wire is across the 50 and HZ terminals.
 - c. If the system is to be run in parallel, consider whether the overexcitation output A1 and A2 should be used to disconnect the generator and/or the regulator.
3. Ensure that the voltage regulator is correctly connected to the generator system; F+ to field positive, F- to field negative, and terminals 3 and 4 to the auxiliary power supply. It is vital that the sensing connections are correct at terminals E1, E3, N1, and N3.
4. Install the fuse(s) as per the *Fuses* paragraph under *Installation*.
5. Set the Regulator Voltage Adjust (VOLT) fully CCW.
6. Center the Remote VOLT Adjust and Stability Adjust (STAB).

System Startup

Note

All ac voltage readings are to be taken with an average reading (rectifier-type) voltmeter.

Note

Incorrect matching of either time-constant may worsen the speed of response and/or reduce stability.

1. Perform preliminary setup, and verify wiring.
2. Start the prime mover and bring up to rated speed.
RESULT: Voltage builds up to less than nominal value. If not, refer to the paragraphs under the *Adjustments* heading.
3. Slowly adjust the regulator voltage adjust preset VOLTS until the generator output voltage reaches the nominal value. Should a low frequency oscillation or hunting be present on the generator output voltage, adjust stability control STAB to cause this to be damped out. In general, turning CW increases the stability but in some cases, too far CW may start to reduce stability again, and will invariably slow the response of the generator to load changes. An approximate method of setting is to adjust the STAB control slowly CCW until the generator voltage just starts to become unstable, then back off ¼ turn CW from that position.

If used, adjust the external voltage adjust rheostat to fine-trim the voltage to the exact value desired.

RESULT: Voltage should now have built up and be stable at the desired value. If voltage does not build up to rated value, check that there is no short-circuit or excessive load present on the generator lines. If a minimum residual voltage of 6 Vac is not present, perform the field flashing process according to the procedures under *Adjustments*.

4. Check the regulator under normal operating and loading conditions.
RESULT: Voltage regulation should be better than $\pm 1\%$ no-load to full-load. If regulation is not within this range, perform the following steps.
 - a. Voltage reduction under loads of power factor much greater than 0, may be due to speed reduction due to loading of the prime mover. This can cause the frequency compensation (V/Hz) circuit to reduce voltage at a speed less than the corner frequency.
 - b. Replace the voltage regulator.
5. Additional time-constant jumper wires can be connected across T1 to C1 and T2 to C2 to improve regulator response or stability for different sizes and characteristics of generators. In general, these jumpers should only be required for some large and/or slow generators. In some cases, speed of response and/or stability may be enhanced by fitting a jumper from T1 to C1 and/or from T2 to C2. Jumpering T1 to C1 increases the integral time-constant for large/slow machines, while jumpering T2 to C2 increases the derivative time-constant which can increase the speed of response for large or slow machines.

Adjustments (Field Flashing)

When the regulator is operated with the generator for the first time, the polarity of residual magnetism may be reversed or too small to achieve the necessary buildup voltage for the regulator. If reversing the field connections does not induce buildup, and the residual voltage is still less than the specified value of 6 Vac, shut down the prime mover and proceed with the following steps.

1. With the prime mover at rest and the F+ and F- connections to the regulator disconnected, apply a dc source (not grounded) of not more than 24 Vdc with Positive to F+ and Negative to F-, in series with a current-limiting resistor of 3 to 5 ohms. (The generator set battery may be a suitable source.)
2. Allow approximately three seconds before removing the dc source.
3. With the voltage regulator supply disconnected (wires 3 and 4), start the prime mover and measure the residual voltage available at the auxiliary winding. If this voltage is greater than 6 Vac, reconnect the voltage regulator, and voltage buildup should be successful. If less than 6 Vac is measured, repeat the field flashing procedure.
4. If repeating steps 1 and 2 does not result in generator buildup, and the residual is greater than 6 Vac, replace the voltage regulator.

OPERATIONAL TEST

1. Connect the test setup as shown in Figure 8. Do not apply power. Ensure that the light bulb is rated for 240 V and less than 100 W. Alternatively, two 120 V bulbs may be used. If a glass fuse is used, it is advisable to enclose it for safety.
2. Adjust the internal (VOLT) and external voltage adjust potentiometers fully CCW.
3. Apply 240 Vac, 50/60 Hz power to the regulator.
4. Slowly turn the internal voltage adjust (VOLT) in the CW direction.

RESULTS:

- a. Before fully CW is reached, the light bulb should reach full brightness to signify the regulator is controlling correctly. The CBS LED should light.
- b. At this regulating point, a small change in either of the adjustments should result in the light bulb turning fully on or off.
- c. Overexcitation operation can be tested if the output voltage exceeds the voltage-time curve of Figure 2, using a supply and indicator taking no more than 150 mA, connected to A1, A2. Be aware that filament resistance is low when cold.

FIGURES

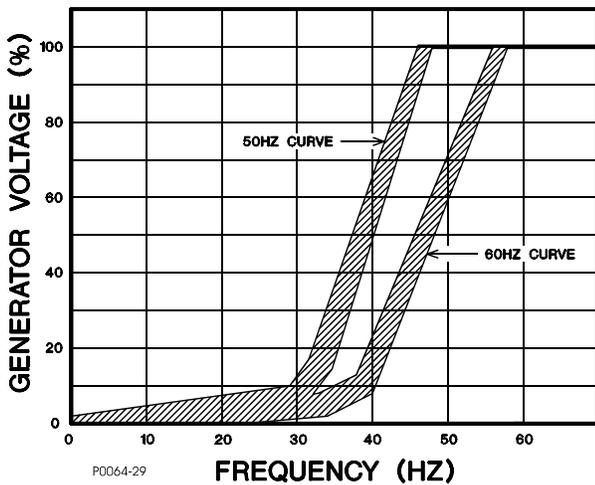


Figure 1. Frequency Compensation Curves

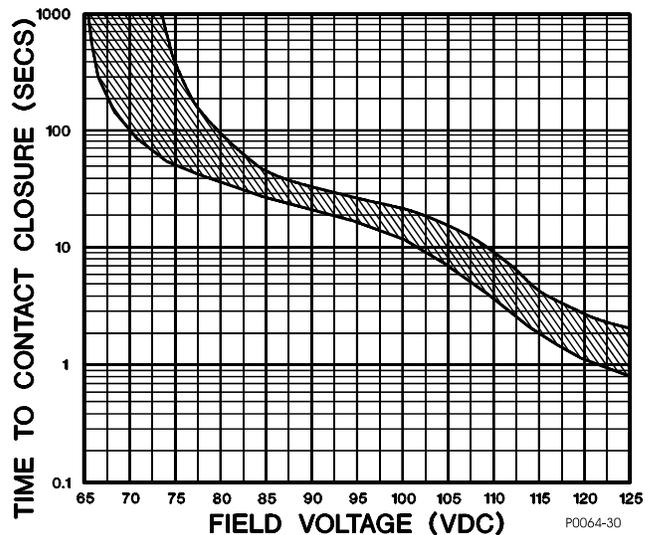
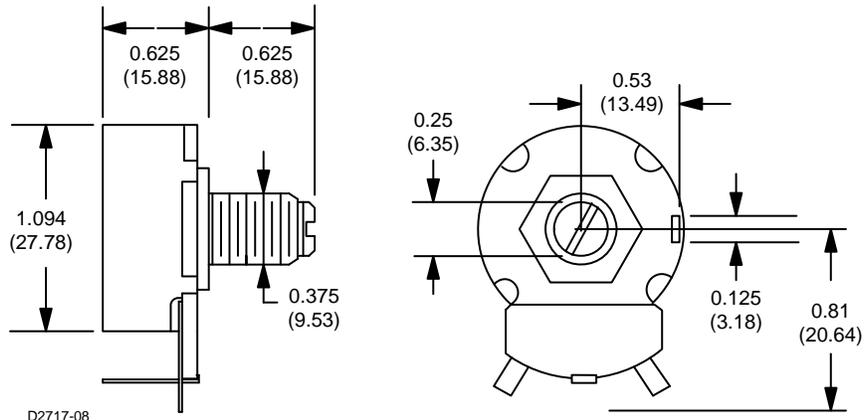


Figure 2. Inverse Time Delay Characteristic Curve



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NOTE: All dimensions are in inches (millimeters).

Figure 3. External Voltage Adjust, Basler P/N 17727

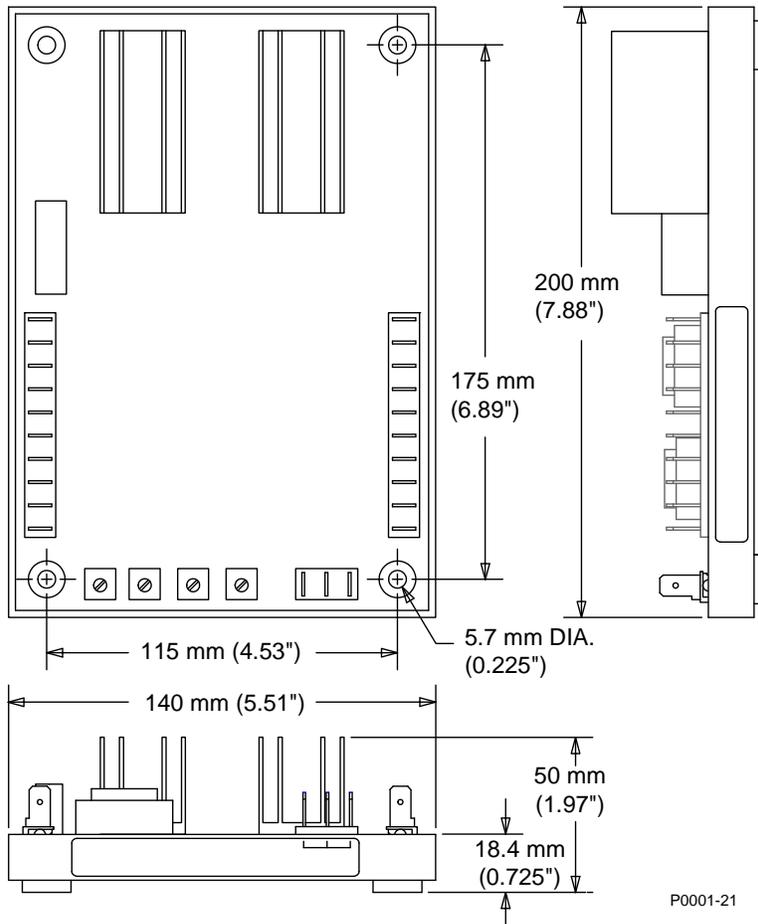


Figure 4. Excitation Controller Outline Drawing

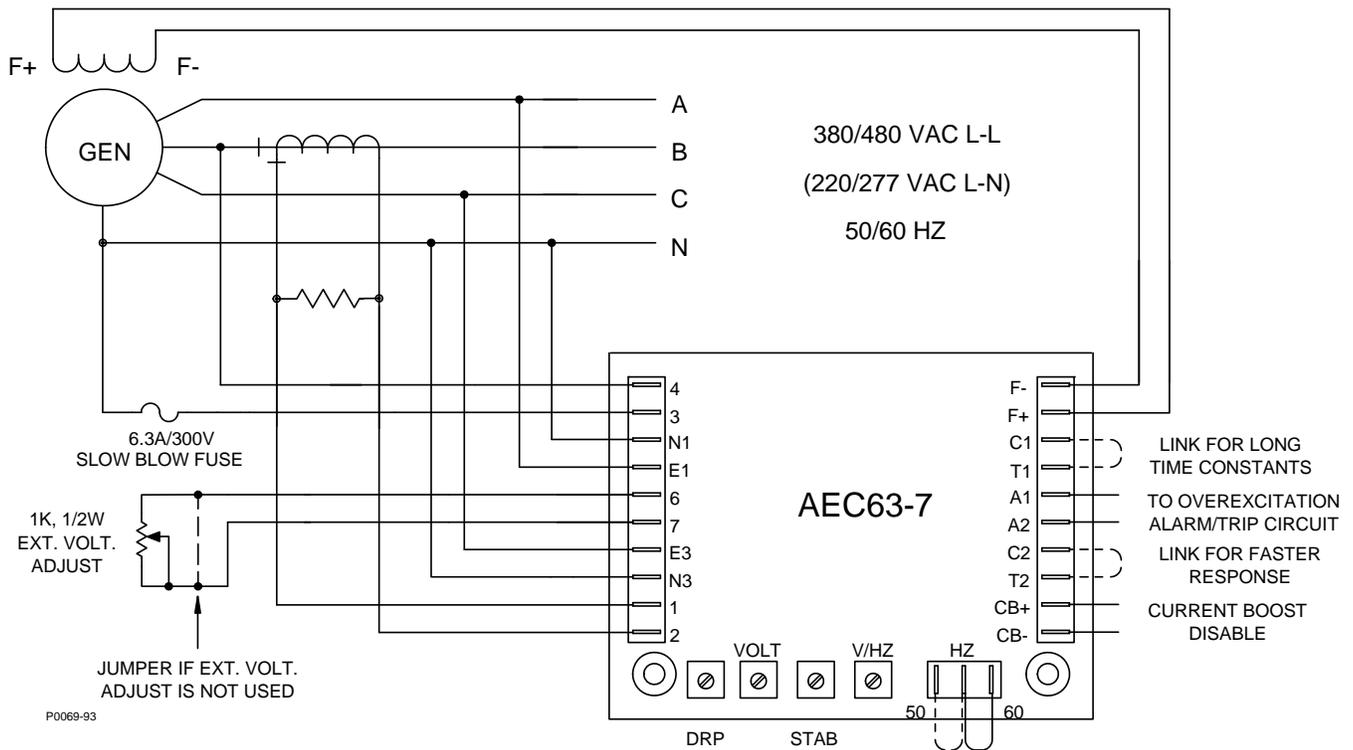


Figure 5. Typical AEC63-7 Interconnection, Two-Phase Sensing, Shunt Excitation

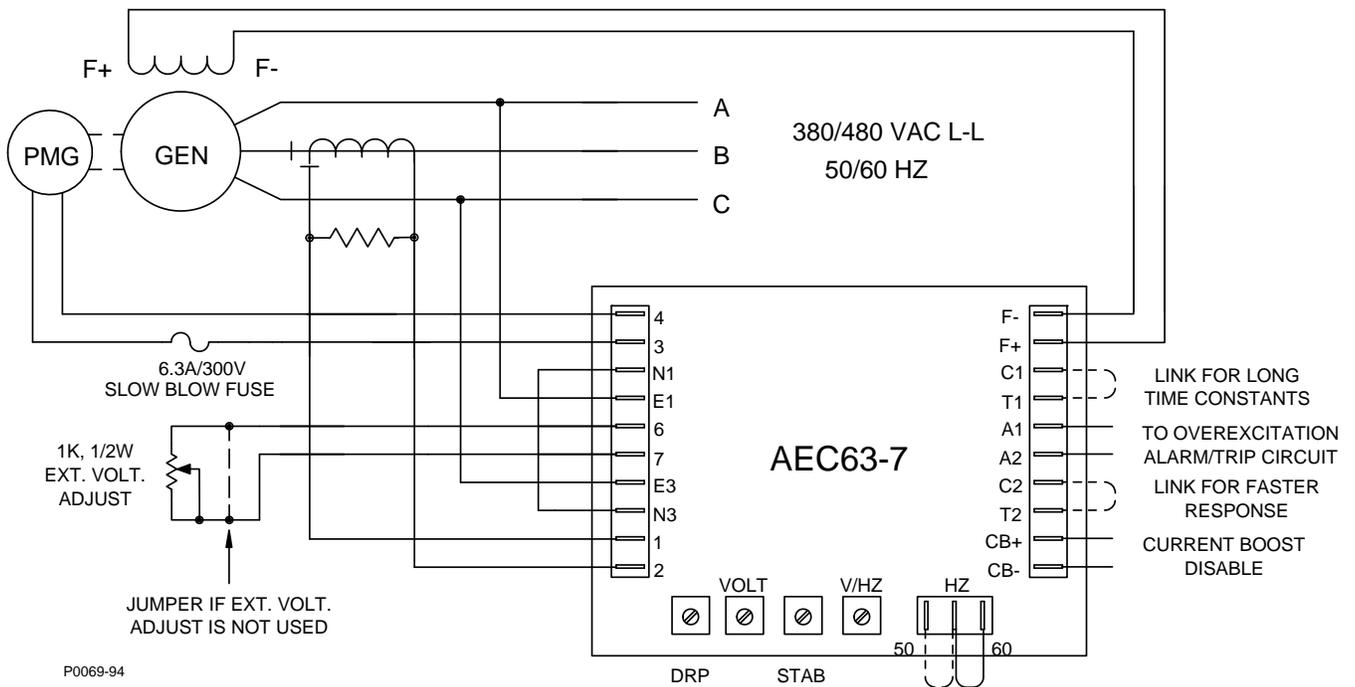


Figure 6. Typical AEC63-7 Interconnection, Single-Phase Sensing, PMG Excitation

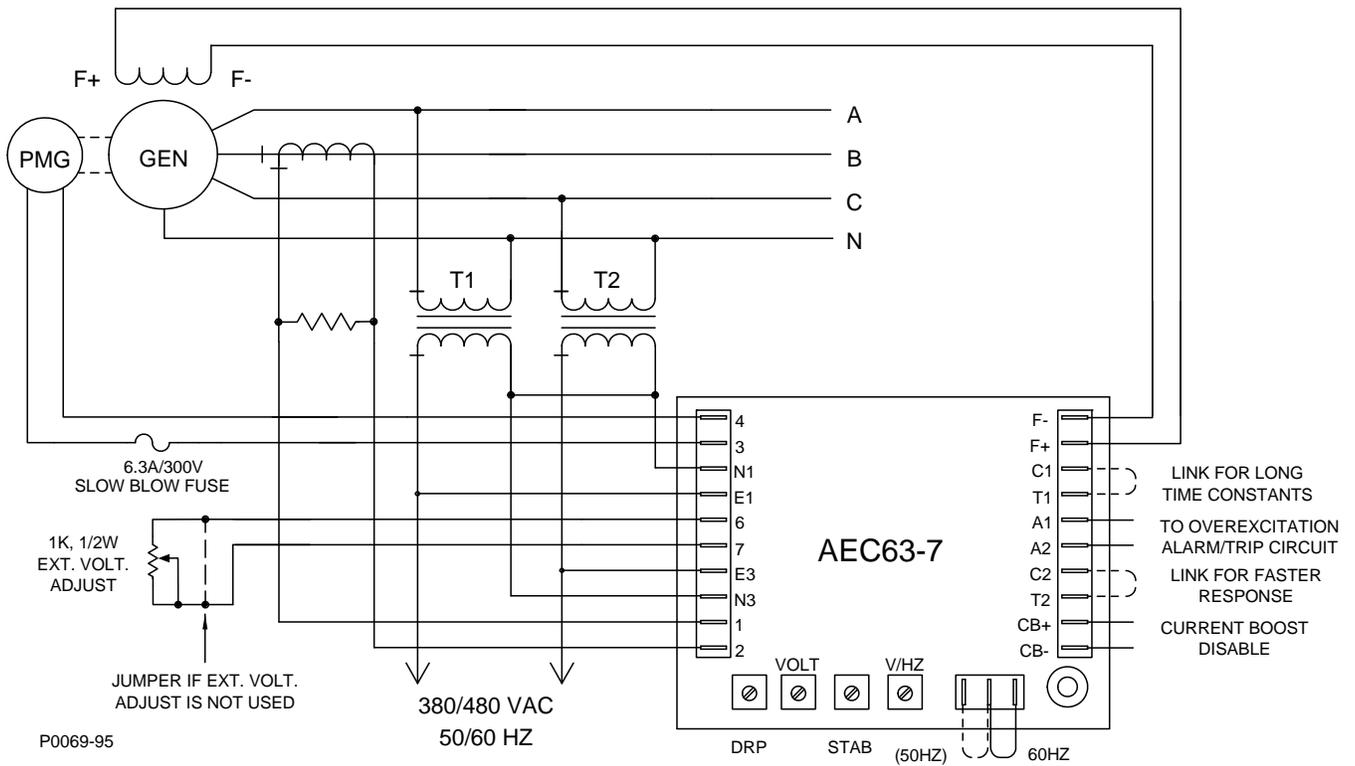


Figure 7. Typical AEC63-7 Interconnection, Two-Phase Sensing, PMG Excitation

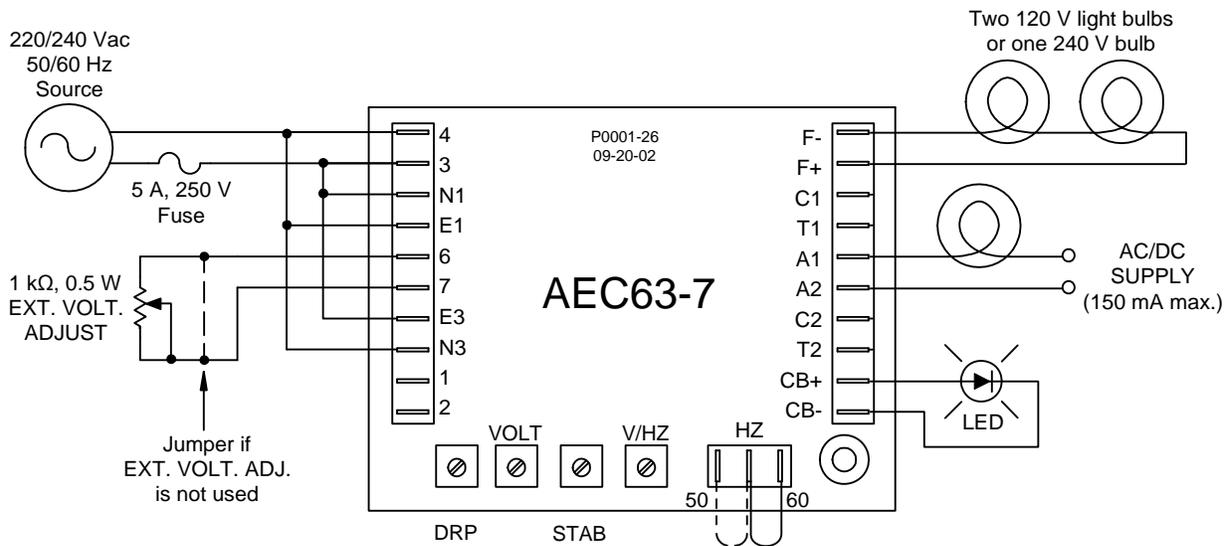


Figure 8. Operational Test Setup



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