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INSTRUCTIONS
FOR
VOLTAGE REGULATOR
AEC 42-7
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GENERAL INFORMATION

DESCRIPTION

The AEC 42-7 voltage regulator is designed for use on 50/60 Hz brushless generators. The regulator includes frequency compensation, overexcitation shutdown, a solid-state buildup circuit, and EMI filtering.

ELECTRICAL SPECIFICATIONS

DC Output Power

Maximum continuous:	7 Adc at 42 Vdc
10 second Forcing:	15 Adc at 90 Vdc (at 240 Vac supply voltage)

Exciter Field DC Resistance

Minimum:	6 ohms
Maximum:	105 ohms

AC Power Input

Operating Range:	220 to 260 Vac
Phase:	1-Phase
Frequency:	50/60 Hz
Burden:	<900 VA
Sensing Input:	200-252 Vac ±10% 2-phase, 50/60 Hz at <1 VA Burden
Voltage Adjust Range:	180 to 277 Vac
Regulation Accuracy:	<1% No-load to Full load, Average Sensing
Paralleling:	Input for 5 Vac from External CT / Burden Resistor to allow 10% Droop
Response Time:	Less than 1.5 cycles for ±5% change in sensing voltage. Link (T C) and Adjustable Stability to optimize response
EMI Suppression:	Internal EMI filter
Frequency Compensation Rate:	Twice volts per Hertz (See Figure 1 for curve)

Overexcitation Shutdown:

Time Delayed:	Inverse
Trip Range:	From no trip @ 50 Vdc to instantaneous at 100. (See Figure 2.) Disable link terminals (N D) provided for parallel operation.
Voltage Buildup	Internal provision for automatic buildup from 6 Vac, "SoftStart"
Power Dissipation	20 watts (typical)

PHYSICAL SPECIFICATIONS

Temperature:

Operating:	-20°C to 60°C (-4°F to 140°F)
Storage:	-40°C to 85°C (-40°F to 185°F)
Vibration:	Withstands 1.3 G's at 2 to 27 Hz.; 0.036" double amplitude at 27 to 52 Hz.; and 5 G's at 52 to 1000 Hz
Shock	Withstands up to 20 G's in each of three mutually perpendicular axes
Weight	0.68 kg. (1.5 lbs.)

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 removing the "50-50" external link.

OVEREXCITATION TIME DELAY

If exciter field voltage exceeds 52 ± 2 Vdc, the regulator automatically removes the field current, after a time delay. The time delay is inversely proportional to the magnitude of the detected field over voltage condition up to 95 ±5 Vdc point. Beyond 95 ±5 Vdc, the field voltage is removed at a much faster rate. This shutdown function may be disabled for parallel operation by linking terminals N and D together.

INSTALLATION

MOUNTING

The regulator may be mounted on the generator in any convenient position. Refer to outline drawing Figure 3. Figure 4 provides the drilling template.

NOTE

The ground terminal must be bonded either to a metal ground by the mounting screw or by means of a cable to the most suitable earthing point available close to the regulator.

EXCITER FIELD POWER CIRCUIT

Connect regulator + wire to the brushless exciter field F+ terminal, and the - wire to the field F- terminal. Refer to Figure 5.

CAUTION

The DC resistance of the exciter field must be equal to or greater than 6 ohms and less than 100 ohms.

If the exciter field resistance is less than 6 ohms, 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 6 ohms.

POWER INPUT

Connect wiring as shown in Figure 5. Power for the regulator is derived from the generator auxiliary winding, connected to wires 3 and 4. The operable power input range is 220-260 Vac.

SENSING INPUTS

For sensing, wires U and V are connected to the generator phase U and phase V respectively. Wires X and Y are connected to the opposite ends of the U and V phase coils, or commoned together at the neutral (star) point.

QUADRATURE DROOP INPUT

When paralleling is required, a current transformer (CT) and variable burden resistor (rheostat) should be connected to terminals A and B. The ratio of the CT and the maximum value of the burden must be chosen so that at maximum current the voltage applied to terminals A and B does not exceed 5 Vac rms. A suitable value of burden would be a rheostat adjustable from 0 - 5 ohms (10 Watts) for a CT with a 1 Aac secondary current at full load. These terminals may either be linked or left open when paralleling is not required.

FUSES

It is recommended that a fuse or fuses with high interruption capability be installed per the interconnection diagram. A suitable fuse type would be LittelFuse (type 3AG, rated 250 Vac, 6.3 A, "Slo-Blo." Dimensions are 6.3 mm x 32 mm (1 ¼" x ¼").

NOTE

Fuse(s) MUST be installed per the interconnection diagram to avoid interrupting field current directly.

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VOLTAGE ADJUST RHEOSTAT (V)

An internal screwdriver preset (V) provides coarse adjustment of generator output voltage. A clockwise adjustment of V increases voltage. The voltage regulator is shipped from the factory with a link across terminals P and Q. If a remote voltage adjust rheostat is used, the link should be removed and the rheostat connected to P and Q. A 1 kilo-ohm, 0.5 W potentiometer will provide a 'fine' voltage range adjustment of approximately ±10% over most of the coarse range of adjustment. See Figure 5, *Interconnection Diagram*.

V/HZ "CORNER FREQUENCY" SELECTION

For 50 Hz systems, the regulator is preset at the factory for a 47 Hz "corner frequency" with a link fitted across terminals “50". If operation at 60 Hz is required, this link should be removed; the "corner frequency" is now set to 57 Hz. Do not operate the system at 60 Hz with the 50 Hz link still in place.

OVEREXCITATION SHUTDOWN

Overexcitation shutdown is provided to remove output excitation should the regulator output voltage exceeds 52 ± 2 Vdc for a sufficient time. The inverse-time-delay curve is shown in Figure 2. For voltages above 95 ±5 Vdc, there is a second and much shorter inverse time curve.

After output power is removed, the regulator can be reset by decreasing the input voltage 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 a parallel mode, it is sometimes considered undesirable to allow the regulator to shut down, which may cause the generator to be ”motored.” Terminals N and D may be linked together to prevent overexcitation shutdown. Note, however, that continuous running at output levels greater than the continuous rating may result in eventual regulator failure, and that other means should be employed to protect the system.

OPERATION

GENERAL

The following system operation procedures provide instructions for adjusting the AEC 42-7 voltage regulator. Symptoms resulting from a faulty regulator and certain generator system problems are included, together with suggested remedies.

> **CAUTION**
> Meggers and high-potential test equipment must not be used. Incorrect use of such equipment could

Complete the following steps before proceeding with system startup.

PRELIMINARY SETUP

a. Verify that the voltage regulator specifications conform with the generator system requirements.

b. Ensure that the regulator links are fitted correctly where required, as follows.

   (1) If the remote voltage adjust rheostat is not required, ensure terminals P and Q are linked together.

   (2) If a 57 Hz corner frequency for 60 Hz systems is desired, ensure the"'50 - 50" link is removed. If a 47 Hz corner frequency for 50 Hz systems is desired, ensure the “50 - 50" link is connected.

   (3) If the system is to be run in parallel, consider whether shutdown of the generator's excitation is acceptable. If not, ensure that the link between terminals N and D is in place.

c. 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 winding supply. It is vital that the sensing connections are correctly made to all 4 wires U, V, X, and Y. Ensure that the metal ring tag at one mounting hole is bonded to ground via either a metal screw or short length of cable.

d. Install the fuses as directed in the previous section.

e. Set the regulator and external voltage adjust, if used, as follows:

Regulator Volts Adjust 'V'	Fully CCW
Remote Volts Adjust	Centered
Stability Adjust 'S'	Centered

SYSTEM STARTUP

a. Perform the preliminary setup procedure checking wiring carefully.

> **NOTE**
> All AC voltage readings are to be taken with an 'average' reading voltmeter rated speed.

b. Start prime mover and bring up to rated speed.

RESULT: The voltage should build up to less than nominal value.

c. Slowly adjust the regulator voltage adjust V 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 S to cause this to be damped out. In general, clockwise 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 optimum setting method is to adjust S slowly CCW until the generator voltage just starts to become unstable. Then turn it up to ¼ turn CW from that position.

d. 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 of 6 Vac is not present, perform “Field Flashing” as ex-plained later.

e. Check regulator under normal operating and loading conditions.

RESULT: Voltage regulation should be better than ±1.0% no-load to full-load. If regulation is not within this range, check the following:

   (1) Voltage reduction under loads of cosq > 0.0 may be due to speed reduction due to loading of the prime mover. This may be causing the frequency compensation (V/Hz) circuit to reduce voltage at a speed which is less than the "corner frequency".

   (2) Replace voltage regulator.

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 less than the specified value of 6 Vac, shut down the prime mover and proceed with the following steps:

a. With the prime-mover at rest and the regulator field output wires disconnected, apply a DC source (NOT ground-ed) of not more than 24 Vdc with Positive to F+ and Negative to F-, in series with a current-limiting resistor of 3-5 ohms. (The set battery is a suitable source.)

b. Allow approximately 3 seconds before removing the DC source.

c. With the voltage regulator 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 voltage regulator, and voltage buildup should be successful. If less than 6 Vac is measured, repeat field flashing procedure.

d. If repeating steps a and b does not result in generator voltage buildup, and residual is greater than 6 Vac, replace voltage regulator.

MAINTENANCE

PREVENTIVE MAINTENANCE

A periodic inspection of the unit should be made to ensure it is kept clean and free from accumulations of dust and moisture. It is vital to ensure that all the wire and terminal connections are kept sound, secure and free of corrosion.

OPERATIONAL TEST

a. Connect the test setup as shown in Figure 6. Do NOT apply power. Ensure the light bulbs are rated 120 volts and less than 100 watts. Alternatively a single 240 V bulb may be used.

> **WARNING!**
> If a glass fuse is used, it should be enclosed for safety.

b. Adjust the internal (V) and external voltage adjust potentiometers fully CCW.

c. Apply 240 Vac, 50/60 Hz power to the regulator.

d. Slowly turn the internal voltage adjust V in the CW direction.

RESULT:

(1) Before fully CW is reached, the light bulb should reach full brilliance to signify the regulator is controlling correctly.
(2) At this regulating point, a small change in either of the adjustments should result in the light bulb being turned full on or off.

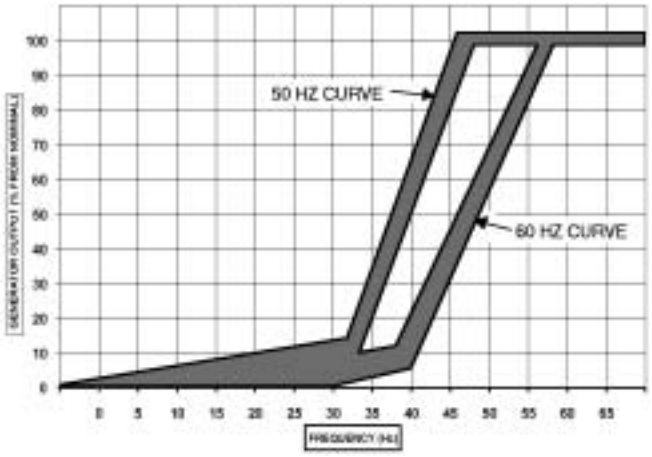

Figure 1. Frequency Compensation Curves

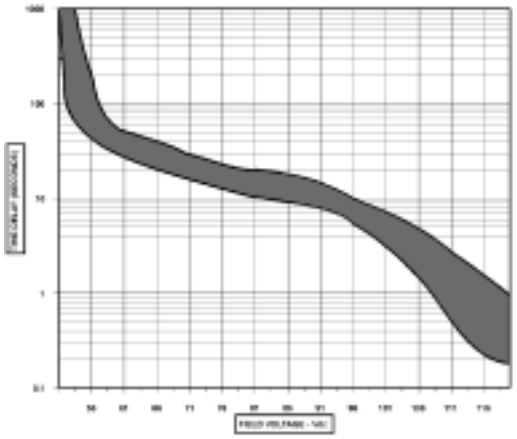

Figure 2. Typical Inverse Time Delay Characteristic Curve

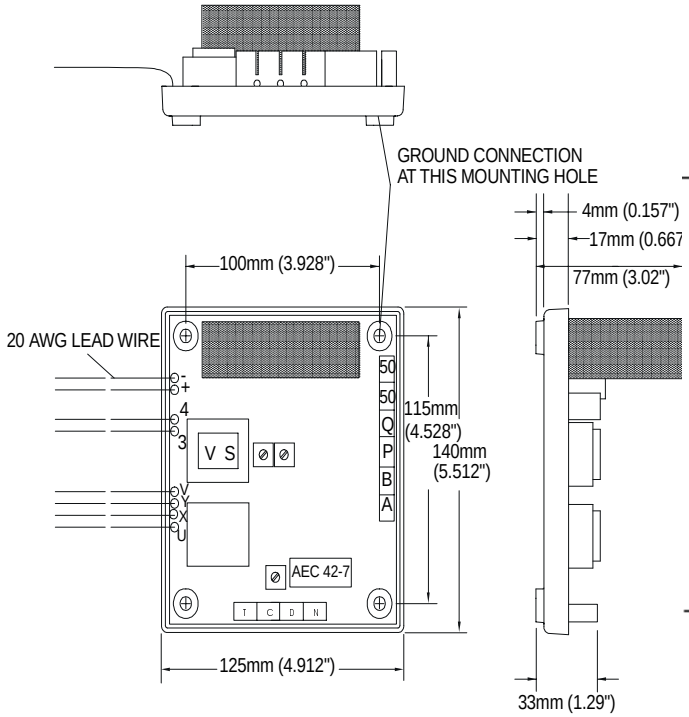

Figure 3. AEC 42-7 Outlined Diagram

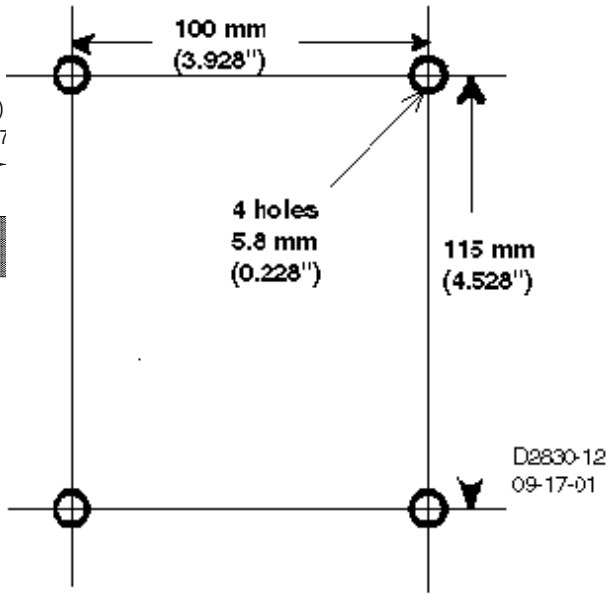

Figure 4. Drilling Template

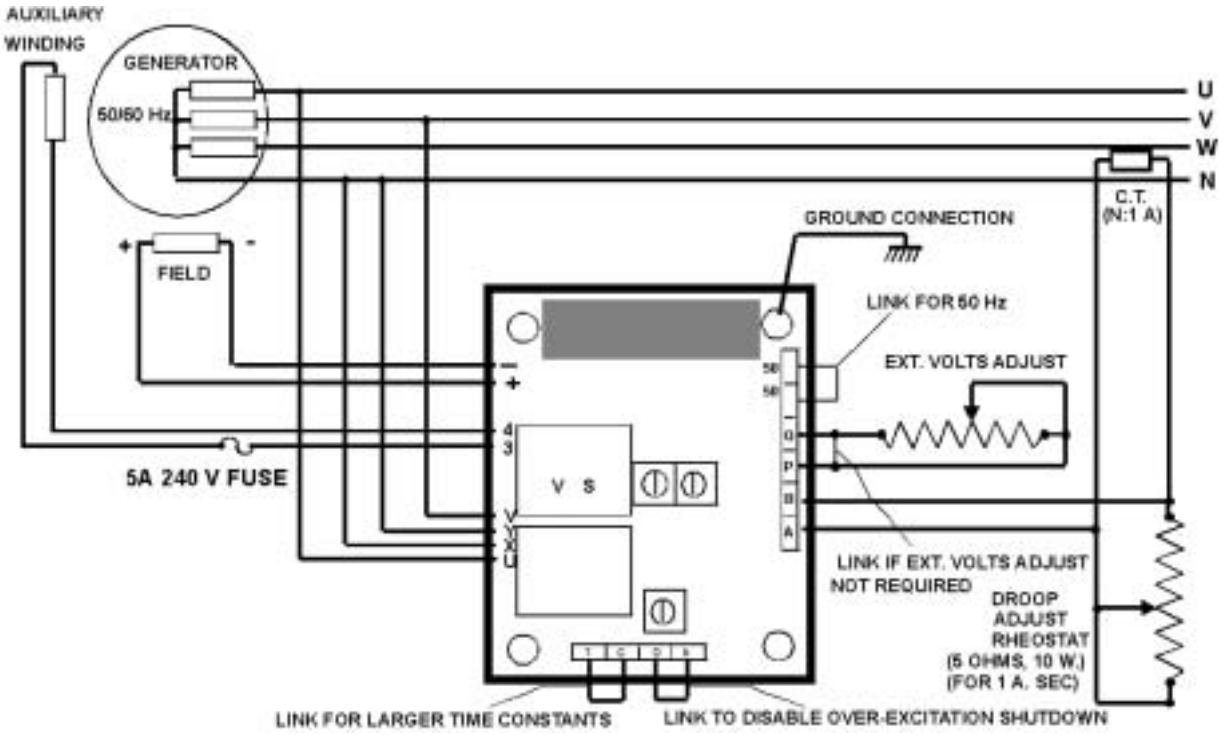

Figure 5. Interconnection Diagram, 480 Vac Generator

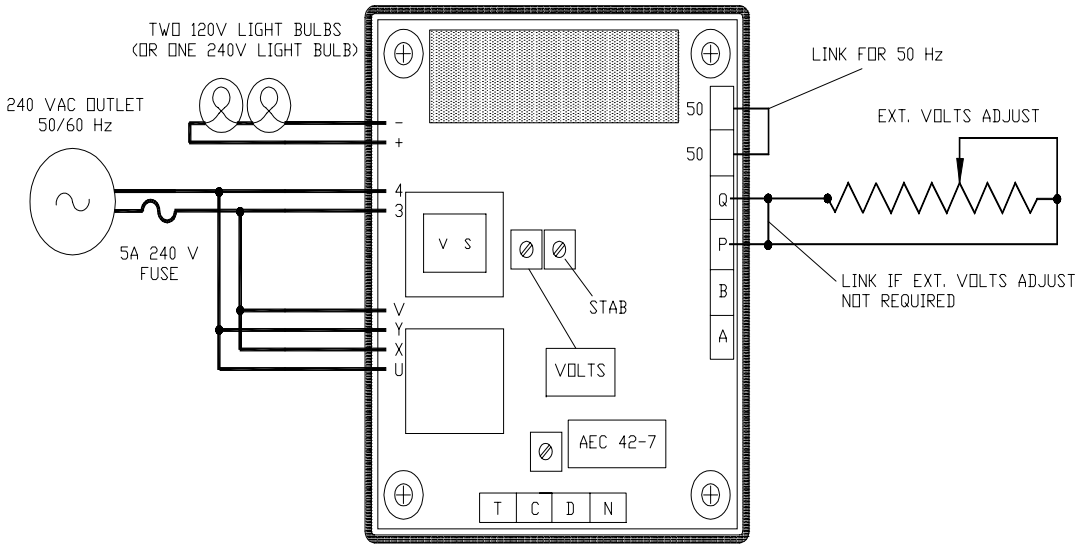

Figure 6. Test Setup Diagram