

INSTRUCTIONS

FOR

AUTOMATIC VOLTAGE REGULATOR VR6 (AVC63-12) AND AVC125-10



INTRODUCTION

The AVC63-12 and AVC125-10 Voltage Regulators are contained in encapsulated plastic cases. The regulators control the amount of dc excitation to the exciter field of conventional brushless synchronous generators.

Regulation is provided by sensing the generator output voltage, converting it to a dc signal and comparing the signal to a reference voltage signal. An error signal is developed and used to control the dc field power in order to maintain a constant generator output.

The regulator includes frequency compensation with selectable slope, inverse-time overexcitation shutdown, solid-state build-up circuitry, single-phase or three-phase voltage sensing, single-phase or three-phase shunt, or permanent magnet generator power input, parallel droop compensation, and an accessory input. The accessory input provides compatibility with accessories such as a var/power factor controllers or excitation limiters.

ELECTRICAL SPECIFICATIONS

Power Output

AVC63-12: 12 Adc @ 63 Vdc maximum continuous. 24 Adc @ 125 Vdc forcing for 10 seconds. Minimum field resistance: 5.25 S.

AVC125-10: 10 Adc @ 125 Vdc maximum continuous. 20 Adc @ 250 Vdc forcing for 10 seconds. Minimum field resistance: 12.5 S.

Input Power Requirements

Single- or three-phase, 50 to 400 Hz

AVC63-12: 90 to 153 Vac, 1092 VA maximum continuous burden.

AVC125-10: 180 to 264 Vac, 1750 VA maximum continuous burden.

See options section for Inrush Current Reduction Module.

Sensing Input Voltage and Frequency

Single- or three-phase. Sensing voltage option A: 90 to 139 Vac, sensing voltage option B: 180 to 264 Vac. Sensing frequency option 1: 50 or 60 Hz nominal, sensing frequency option 2: 400 Hz nominal. (For more style/option information see Table 4.)

Input Sensing Burden

Less than 1 VA.

Auxiliary Input

± 3Vdc for use with SCP250 VAR/PF Controller or EL200 Min/Max Excitation Limiter.

External Voltage Adjust Rheostat

10k ohm, 1/4 W minimum potentiometer.

Regulation Accuracy

±0.5% of voltage set point, average responding.

Voltage Drift

±0.5% voltage variation for a 40/C (104/F) change.

Response Time

< 4 milliseconds.

Frequency Compensation

One or two V/Hz jumper selectable with knee adjustable from 45 to 65 Hz for 50/60 Hz units and 300 to 430 Hz for 400 Hz units. Reference Figure 1 for 60 Hz and Figure 2 for 400Hz sensing models. (Figures are not in numerical order to conserve space in this document.)

EMI Suppression

Internal filter. (See CE Conformity below.)

Voltage Build-Up

Provisions for automatic voltage build-up from generator residual voltages as low as: 6 Vac for AVC63-12 and 12 Vac for AVC125-10 units.

Overexcitation Shutdown

Overexcitation shutdown protection reduces the output voltage to zero for the following voltages in the times shown. Other voltages and times are based on inverse time characteristic curves as shown in Figures 3 and 4.

AVC63-12:

125 Vdc ±10% in approximately 10 seconds.
210 Vdc ±10% in approximately 1 second or less.

AVC125-10:

250 Vdc ±10% in approximately 10 seconds.
370 Vdc ±10% in approximately 1 second or less.

Droop/Line Drop Compensation

<10 VA adjustable from 0 - 10% of rated input current, 0.8 power factor. (LDC compensates for voltage drop due to line reactance and reactive components of the load current only.)

Agency Approvals

UL Recognized per Standard 508, UL File No. E97035.

CSA Certified per Standard CAN/CSA-C22.2 No. 14-95, CSA File No. LR 23131

CE Conformity. Conforms to:

Radiated Emissions EN50081-2.

Radiated Immunity:

Electric field EN61000-4-3 (10 V/m).

Conducted EN61000-4-6 (10 VRMS).

Conducted Emissions EN50081-2.

(EN55011, Class A).

ESD Immunity EN50082-2

(4 KV contact, 8 KV air).

EFT Immunity EN50082-2

(2 KV coupling clamp).

Magnetic Immunity EN50082-2

(30ARMS, 50 Hz).

Safety: EN61010-1.

Operating and Storage Temperature

-40/C to +70/C (-40/F to +158/F).

Relative Humidity

95% non-condensing

Shock

Withstands 20 g in each of three mutually perpendicular planes.

Vibration

Withstands the following accelerations at the

stated frequency: 4.5 g; 18 to 2000 Hz.

Weight

Approximately 1.1 kg (2.5 lbs.)

INSTALLATION

The regulator may be mounted in any position. Refer to the outline drawing (Figure 5). The regulator may be mounted directly on the generator set using UNF 1/4-20 or equivalent hardware. Select the proper hardware to withstand any expected shipping/transportation and operating conditions.

CONNECTIONS

Before connecting the AVC63-12 or the AVC125-10 into your system, review the terminal descriptions provided in Table 1, the internal adjustments provided in Table 2, and the diagrams shown in Figures 6 through 8.

Table 1. Terminal Descriptions

Term. #	Term. Description
Upper Term. Strip	
CH GND	Chassis ground connection
2	Auxiliary Input from var Power Factor Controller
3	Auxiliary Input from var Power Factor Controller
4	Connect to 7 to use internal voltage adjust, no connection for external voltage adjust
5	1 Amp Current Transformer
5a	5 Amp Current Transformer
6	Current Transformer Common
6a	Common connection for selectable features
7	Connect Remote Adjust from 7 to 6a, connect to 4 for internal voltage adjust
8	Connect to 6a to select 1v/Hz underfrequency slope
9	Connect to 6a to select 3 phase sensing
Lower Term. Strip	
20	Phase C sensing input
22	Phase A sensing input
24	Phase B sensing input
26	1-phase or 3-phase power input
28	3-phase power input
30	1-phase or 3-phase power input
F1	Field +
F2	Field -

Table 2. Internal Adjustments

Adjust.	Adjustment Description
DRP	Voltage Droop Adjust
FAC CAL	FAC CAL is a factory voltage adjust range calibration. No customer adjustment is required.
VLT ADJ	Multi-Turn Voltage Adjust
UF	Underfrequency Knee Adjust
STB	Stability Adjust

OPERATION

General

Table 3 provides system start-up procedures for the AVC63-12 and AVC125-10 Voltage Regulators. Symptoms of problems occurring during start-up that arise from incorrect regulator adjustment and certain generator system problems that resemble faulty regulation are included together with possible solutions. Simplifying the system by eliminating components, such as remote adjust potentiometers and other non-essential items can be helpful in the troubleshooting process. Adjustments, options, and an operational test are included in the paragraphs after the table.

Preliminary Set-Up

To prevent damage to the regulator, ensure that the regulator has been installed and connected in accordance with the paragraphs in *Installation* and *Connections* before proceeding with the system start-up.

System Start-Up

Refer to Table 3 for system start-up.

ADJUSTMENTS

Field Flashing

When the regulator is operated with the generator for the first time, the polarity of the residual magnetism may not be correct or of sufficient magnitude. If generator residual voltage is less than 6 Vac for the AVC63-12 or 12 Vac for the AVC125-10 at terminals 26,28 and/or 30 shut down the prime mover and proceed with the following steps:

CAUTION

Do not flash the field with the generator in motion. Regulator damage may result.

- With the prime mover at rest, apply a dc source (ungrounded), of not more than 24 Vdc, to terminals **F1** (positive) and **F2** (negative) in series with a limiting resistor. Use one (1) ohm of resistance for each volt from the dc power source with a power rating of least one (1) watt per ohm.
EXAMPLE: If using a 24 Vdc source, use a 24-ohm, 24-watt resistor.
- Allow the field to be flashed for approximately ten seconds before removing the dc source.
- If voltage build-up does not occur after performing steps (1) and (2), verify the polarity of the dc source used in steps (1) and (2) and re-perform.

Frequency Roll-Off (UF Knee) Adjustment

The underfrequency knee (roll-off) is typically set below the nominal system frequencies. When the generators speed falls below the knee set point of the regulator, generator

voltage is reduce proportional to the speed of the machine. To adjust the underfrequency knee, follow the steps below:

- Adjust the generator frequency for nominal frequency (50, 60, or 400 Hz).
- Adjust the underfrequency potentiometer (UF) CCW.
- Adjust the Voltage Adjust potentiometer for nominal generator voltage.
- Adjust the underfrequency potentiometer (UF) CW until the voltage begins to decrease.
- Adjust the underfrequency potentiometer (UF) CCW until the voltage just returns to the value set in Step 3.
- The underfrequency knee is now set just below the nominal operating frequency. Further rotation in the CCW direction will lower the knee frequency set point at which underfrequency compensation begins.
- Connecting a jumper from terminal 8 to terminal 6a will provide an underfrequency slope of 1 P.U. V/Hz. No connection to terminal 8 will result in an underfrequency slope of 2 P.U. V/Hz. The slope can also be selected on the 400Hz models. However, the actual V/Hz curve is approximately 1 P.U. or 2 P.U. depending if the terminal 8 is jumpered to 6a or not.

Stability (STB) Adjustment

An oscilloscope or other voltage-recording device should be used if an optimal stability setting is desired. **Adjust the stability setting with the generator at no load.** Good response can be obtained with the following procedure.

- Rotation of the front panel **STB** control in the clockwise (CW) direction will slow response time.
- Rotation of the front panel **STB** control in the counter-clockwise (CCW) direction will speed response time. If rotated too far CCW, the generator voltage may oscillate (hunt).
- Rotate the front panel **STB** control CCW until the system just begins to oscillate and then rotate CW just past the point where oscillation occurred. Apply various amounts of loads to determine proper stability performance.

Voltage (VLT ADJ) Adjustment

- Installation of a jumper across terminals 4 and 7 allows the internal (front panel) **VLT ADJ** adjustment to vary the generator nominal voltage over the operating range.
- Remove the jumper between terminals 4 and 7 and connect a 10k ohm external voltage adjust potentiometer across terminals **6a** and **7** to allow operation of the external voltage adjust potentiometer. The internal voltage adjustment should be set fully CW for proper operation of the external adjustment. It should be noted, as the external potentiometer resistance increases, generator voltage also increases.

Factory Calibration (FAC CAL) Adjustment

CAUTION

The factory calibration (FAC CAL) adjustment is intended for use by factory technicians only. The following procedure can be used if the factory calibration has been disturbed.

- With the voltage regulator operating on a generator, adjust the calibration potentiometer

fully CCW and the external voltage adjust potentiometer fully CW. Adjust the FAC CAL potentiometer CW until the generator voltage reaches the desired maximum voltage setting. The unit is calibrated and the calibration potentiometer can be sealed.

Parallel Droop Compensation

Variable parallel droop compensation levels can be obtained by adjusting the droop potentiometer. CW rotation increases the amount of droop for a given condition.

Line Drop Compensation

When the sensing input CT connections are swapped to provide LDC, the droop adjustment becomes the LDC adjustment.

OPTIONS

The AVC63-12 and AVC125-10 may be equipped with the following options to enhance operational characteristics. Characteristics of these options are defined in the following paragraphs.

Remote Voltage Adjust

Connect a 10 k ohm, 2 watt potentiometer from terminals 6a to 7, remove the jumper from terminal 4 to 7 and adjust the internal voltage adjust potentiometer fully CW to allow operation of a remote voltage adjust.

Inrush Current Reduction Module

An ICRM-15 (Inrush Current Reduction Module) is required when energizing the AVC63-12 and AVC125-10 from a source that is already at the regulators input power ratings. This module minimizes the amount of inrush current that could be seen when power is applied.

Excitation Disable

This option provides for disabling of the excitation system by removal of power from the voltage regulator. A switch removing voltage from terminals 26, 28 and/or 30 will remove power.

Excitation Limiter

This EL200 option provides an initial fast acting limit of the field current at a pre-selected level. Once the field current has changed to the selected level, the output provides a signal to the regulator to change the excitation.

Var/PF Control

This option allows the AVC63-12 and the AVC125-10 to regulate the var and power factor while the generator is connected to an infinite or utility bus. The var/PF option (Model Number SCP250G-50 for 50-hertz operation or SCP250G-60 for 60-hertz operation) supplies a dc signal into the AVC63-12 and AVC125-10 terminals **2** and **3** to regulate the SCP250 var or power factor setting. (See Figure 7 for inter-connection diagram.)

Current Boost System

With this CBS212 option, if the generator output voltage drops below the preset operation point due to a short or large motor starting, the current boost function detects the voltage drop. The function then provides full current boost to the generator exciter until the voltage returns to a level just above the operation point.

Manual Voltage Control

This option provides a manual back-up channel for manually controlling the generator output during generator start-up and commissioning or in the unlikely event that the voltage regulator should fail. Manual voltage controller model MVC-112 is suitable for use with either the AVC63-12 or the AVC125-10 voltage regulator.

Table 3. System Start-Up

- Perform the preliminary set-up.
- Start prime mover and bring up to rated speed.
If the voltage does not build up:
 - Flash Field
 - Remove power for 1 minute to allow the overexcitation circuit to reset.
- Slowly adjust **VOLT** adjustment or external voltage adjust rheostat until voltage reaches nominal.
If the voltage does not build up to the rated value, check the generator output for a shorted or excessive load.
- Apply and remove load to check stability.
If the generator response is too slow or is hunting (oscillating):
 - Check generator output for shorted or excessive load. Adjust **STB** with no load applied.
 - Check stability of governor system.
- Check regulation under normal operating conditions.
If the regulation is poor:
 - Check that the prime mover is up to rated speed.
 - Check that the voltmeter is connected at the same point as the regulator sensing.
 - Use an average sensing voltmeter (not an RMS sensing voltmeter).

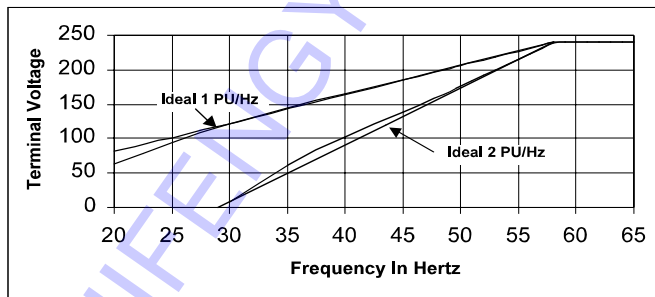


Figure 1. 60 Hertz Frequency Compensation

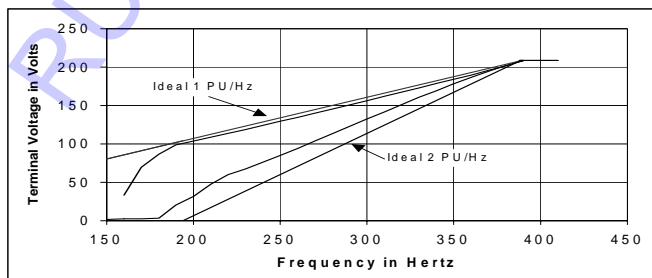


Figure 2. 400 Hertz Frequency Compensation

Table 3. System Start-Up (Continued)

- Reduce generator frequency. Generator output should decrease from this point. If the generator output voltage does not decrease at desired frequency:
 - Check that all the wiring is in accordance with the connection diagrams provided in these instructions.
 - Adjust **FREQ** control.

OPERATIONAL TEST

This test is designed to test all eight models of the AVC63-12 and AVC125-10. See Table 4 for appropriate testing voltages and frequencies.

- To operationally test any AVC63-12 or AVC125-10, perform the following steps.
- Connect the voltage regulator as shown by Figure 9 and apply appropriate voltages.
 - Adjust the front panel **VLT ADJ** control fully counterclockwise (CCW).
RESULT: Observe that the lamp is OFF.
 - Adjust the front panel **VLT ADJ** control clockwise (CW).
RESULT: Observe that the lamp is now ON.
 - Adjust the front panel **VLT ADJ** control until the lamp just goes out.

Regulator operation is satisfactory if the above results are obtained. Stability, however, must be tested with the generator and regulator in operation.

MAINTENANCE

Preventive Maintenance

A periodic inspection should be made of the voltage regulator to ensure that it is clean and free from accumulations of dust and moisture. Be sure that all connections are clean and tight.

Troubleshooting

In case of failure/defective operation of the unit, simplifying the system by eliminating components, such as remote adjust potentiometers and other non-essential items can be helpful in the troubleshooting process.

Table 4. Testing Parameters

Model	Input		
	Power	Sensing	
		Vac	Freq.
AVC63-12A1	120	120	50/60
AVC63-12A2	120	120	400
AVC63-12B1	120	240	50/60
AVC63-12B2	120	240	400
AVC125-10A1	240	120	50/60
AVC125-10A2	240	120	400
AVC125-10B1	240	240	50/60
AVC125-10B2	240	240	400
VR6	120	240	50/60

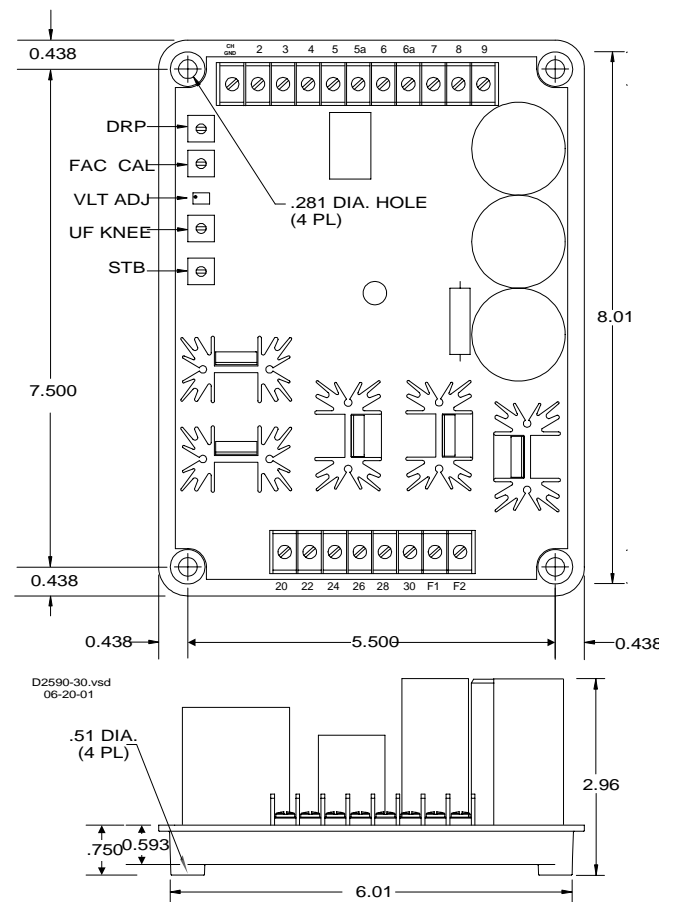


Figure 5. Outline Drawing

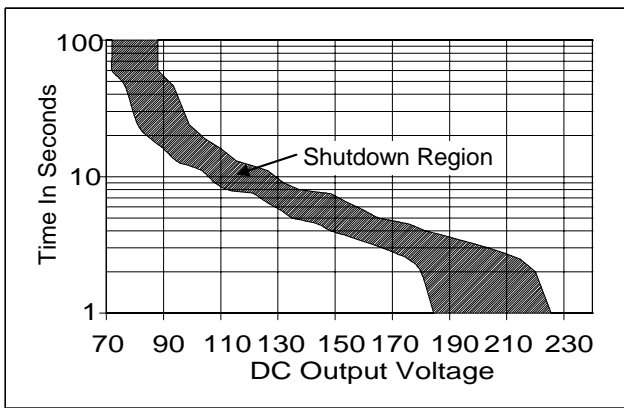


Figure 3. AVC63-12 Overexcitation Shutdown Characteristics

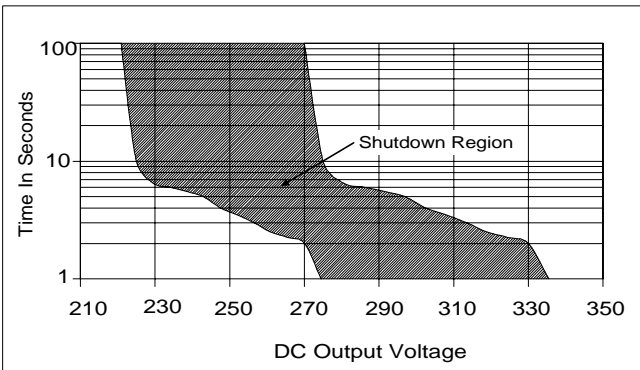


Figure 4. AVC125-10 Overexcitation Shutdown Characteristics

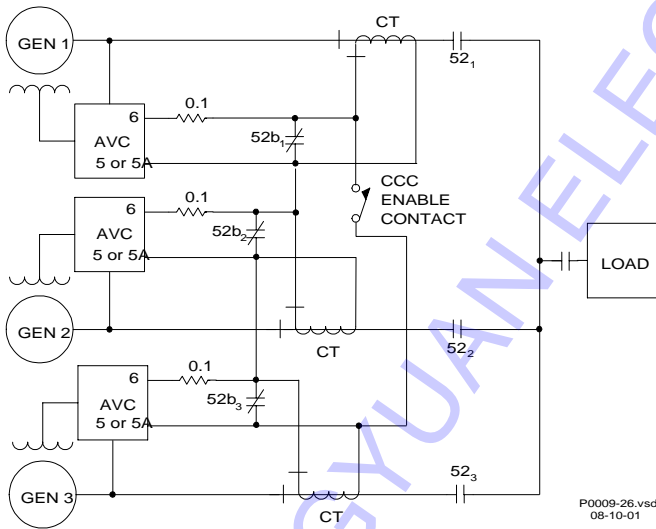


Figure 8. Cross-Current Compensation

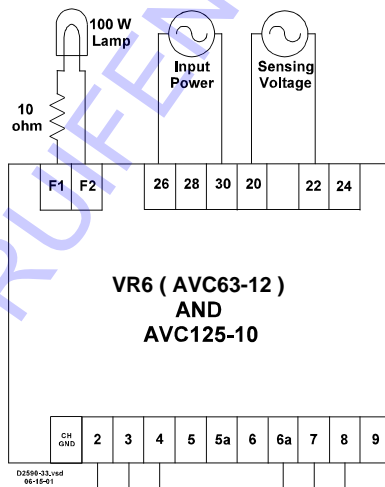
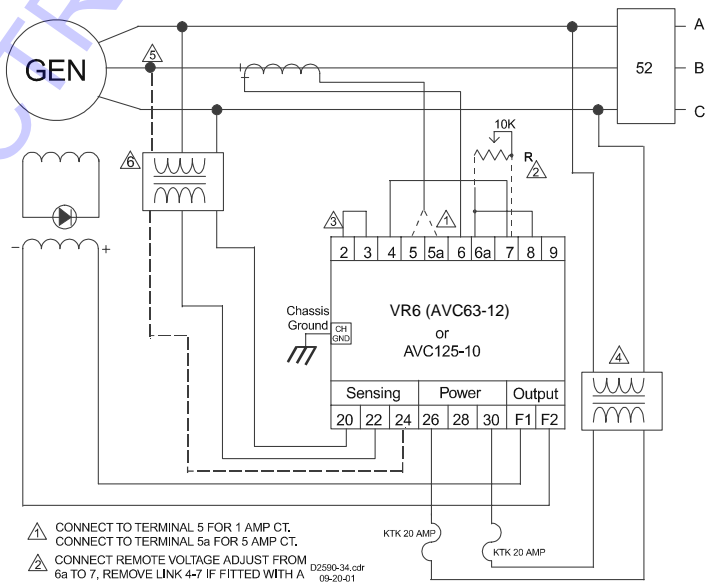
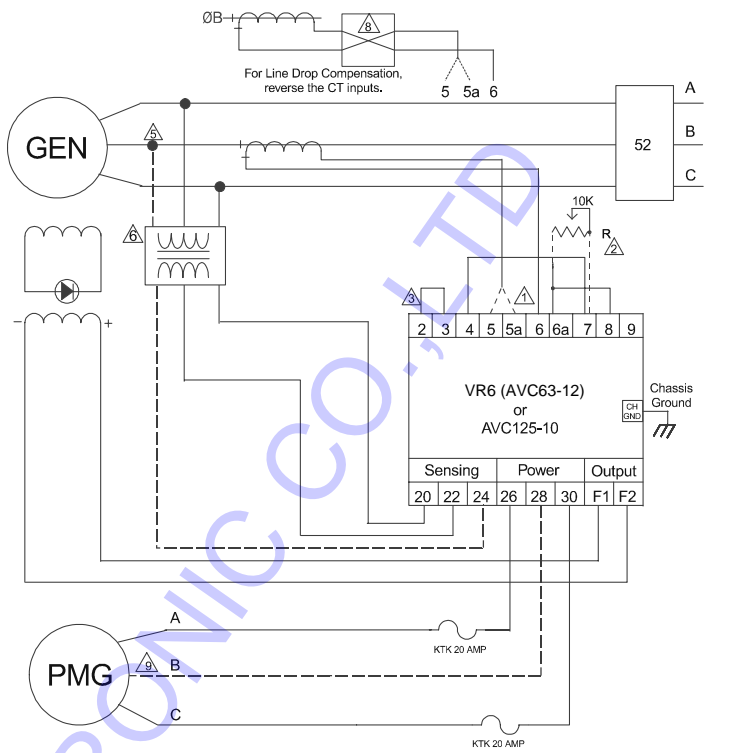
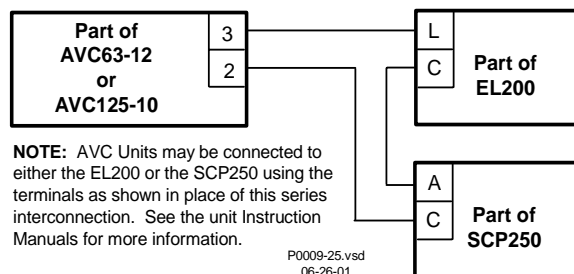


Figure 9. Operational Test Set-Up



- ⚠ CONNECT TO TERMINAL 5 FOR 1 AMP CT. CONNECT TO TERMINAL 5a FOR 5 AMP CT.
- ⚠ CONNECT REMOTE VOLTAGE ADJUST FROM 6a TO 7. REMOVE LINK 4-7 IF FITTED WITH A REMOTE ADJUST.
- ⚠ CONNECT 6a TO 8 FOR 1 V/Hz. REMOVE FOR 2 V/Hz UNDERFREQUENCY SLOPE. CONNECT 6a TO 9 FOR 3-PHASE SENSING. OPEN FOR 1-PHASE SENSING.
- ⚠ CONNECT 2 AND 3 TO SCP250 VAR/PPF AND EI200 CONTROLLERS AS SHOWN IN FIGURE 7. SHORT WHEN NOT USED.
- ⚠ POWER STEPDOWN TRANSFORMER REQUIRED IF GENERATOR VOLTAGE DOES NOT MATCH THE REGULATOR INPUT POWER RANGE.
- ⚠ REQUIRED FOR 3-PHASE SENSING. ALSO REFERENCE NOTE 2.
- ⚠ SENSING STEPDOWN TRANSFORMER REQUIRED IF GENERATOR VOLTAGE DOES NOT MATCH THE VOLTAGE REGULATOR'S STYLE NUMBER. REFERENCE STYLE CHART.
- 7 ABC ROTATION SHOWN.
- ⚠ LDC COMPENSATES FOR VOLTAGE DROP DUE TO LINE REACTANCE AND REACTIVE COMPONENTS OF THE LOAD CURRENT ONLY.
- ⚠ SHOWN WITH 3-PHASE PMG. FOR SINGLE PHASE PMG, OMIT B-PHASE CONNECTION TO TERMINAL 28.

Figure 6. Typical Interconnection Diagram



NOTE: AVC Units may be connected to either the EL200 or the SCP250 using the terminals as shown in place of this series interconnection. See the unit Instruction Manuals for more information.

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Figure 7. AVC Interconnection Diagram