MAGNAMAX^{DVR}

DIGITAL VOLTAGE REGULATOR

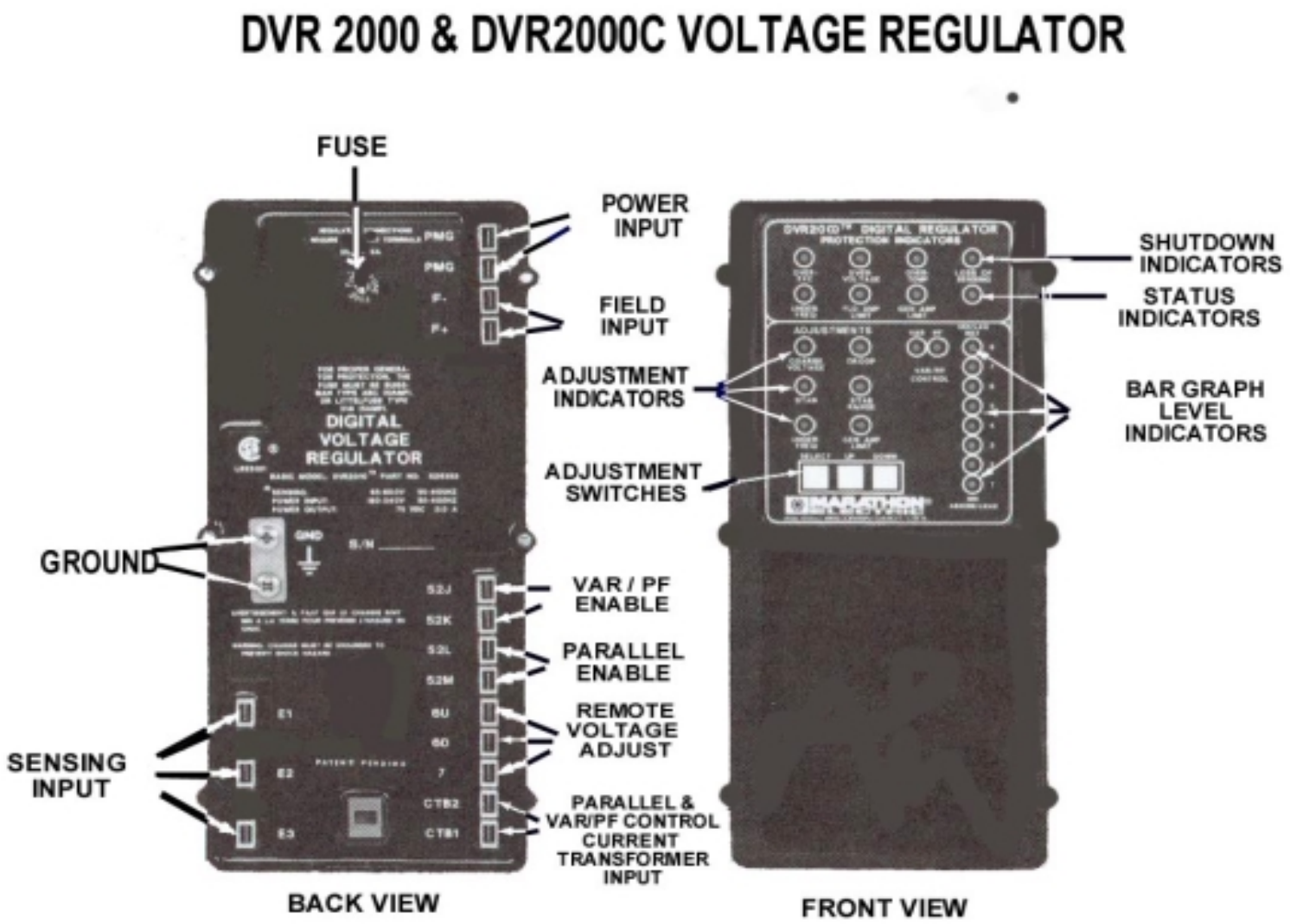
TECHNICAL MANUAL

MODEL DVR®2000 AND DVR®2000C

MARATHON® ELECTRIC

A Subsidiary of Regal-Beloit Corporation

FIGURE 1 - FRONT AND REAR VIEW OF VOLTAGE REGULATOR



SECTION 1- INTRODUCTION

GENERAL DESCRIPTION

The DVR2000 Automatic Voltage Regulator is a sealed electronic solid state microprocessor based digital voltage regulator, which control the output of a brush less ac generator by regulating the current into the exciter field. Unlike most regulators, the input power is from a multi-pole high frequency permanent magnet generator (PMG) incorporated within the main generator.

There is one basic model, the DVR2000 and one other model available, which is a DVR2000C.The "C" suffix indicates "VAR" or "PF" control is available.

SPECIFICATIONS

	DVR2000 & DVR2000C
Sensing	95-600v, 25-420Hz
Sensing Mode	RMS (1 or 3 Phase)
Input Requirements	180-240v, 250-300Hz
Continuous Output	75 Vdc at 3.0 Adc
Max Output 1-mm	150 Vdc at 7.5 Adc
Hot Field Resistance	18-25 Ohms
Regulation	0.25%
Response	Less than 7 msec
Operating Temp.	-40°C to +70°C
Storage Temperature	-40°C to +85°C
Size	10.4 L x 5.0 W x 2.8 D (26.4 x 12.7 x 7.l cm)
Weight	5.5 Lbs. (2.5 Kg)
Fuse Size and Type	25x 1.25 5-amp Littelfuse 314005 or Bussman ABC-5
Accessory Input	Not Available

FEATURES

-See Figure 1 for location of features on face of regulator

Sensing Voltage

The DVR2000 Digital Regulator is equipped for either 3-phase or 1-phase sensing. The sensing voltage is adjustable over the entire range of 95-600v without the need for resetting transformer taps.

Single phase sensing is achieved by connecting terminal E2 and E3 to the same generator terminal.

Parallel Operation

Provisions are included in the regulator to allow the paralleling of two or more generators using either reactive droop or reactive differential (cross current) compensation with the addition of an external 5 amp 5va current transformer.

Under Frequency Operation

The under frequency function allows the generator to operate with a constant volts per hertz characteristic (a linear relationship of voltage with respect to frequency). The transition frequency is adjustable from 40 Hz to 70 Hz.
See Figure 2 for typical characteristics.

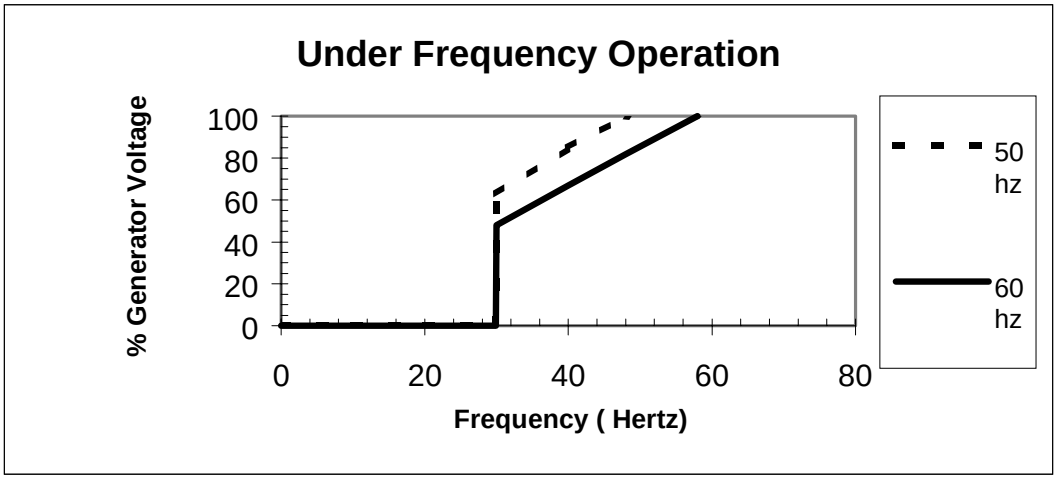


Figure 2 Under frequency operation.

FEATURES

Over-Excitation

The over excitation function monitors the regulator output voltage and causes the regulator to shutdown when the output voltage exceeds the preset trip level of 80 volts for 15 seconds.

Over-Voltage Protection

The over-voltage function monitors the regulator sensed voltage and causes the regulator to shutdown when this sensed voltage exceeds the preset trip level of 115% for 0.75 second.

Over-Temperature Protection

The regulator is equipped with a sensor that monitors the ambient temperature and will turn itself off when the temperature exceeds 70° C.

Loss of Sensing

The loss of sensing function causes the regulator to shutdown if an open circuit occurs in one or more of the sensing leads.

Field Current Limit

The field current limit function monitors regulator output current and limits this current should a heavy load or short circuit occur across the field output terminals.

Environmental Protection

The DVR2000 Digital Voltage Regulator is a totally encapsulated design to limit application problems in harsh environments. The ability of the regulator to withstand harsh environments has been verified through hundreds of hours of testing. This testing includes salt fog tests (ASTM B 17-73), humidity tests, (MIL-STD-705B Method 711-1C), thermal cycles (-40°C to +70°C), shock tests (20 G's in all three planes), and vibration tests (0.035 in. at 20-60 Hz).

EMI Suppression

The DVR2000 Digital Voltage Regulator meets MILSTD-461C Part 9 for electromagnetic conducted and radiated emissions and radiated susceptibility when mounted in the generator conduit box.

WARNING
READ AND UNDERSTAND THIS MANUAL COMPLETELY BEFORE OPERATING THE REGULATOR. BE SURE THE GENERATOR IS OFF BEFORE MAKING ANY REGULATOR CONNECTIONS. REGULATOR DAMAGE OR PERSONAL INJURY MAY RESULT FROM IMPROPER OPERATION.

See Section 2 for detailed description and operation of the features.

SECTION 2 - OPERATION INSTRUCTIONS

MAIN REGULATOR

Front Panel

The DVR2000 Digital Voltage Regulator panel is divided into two (2) areas. The upper area displays the protection indicators and the lower area displays the adjustment indicators. The protection indicators are divided into two (2) rows. The upper row of indicators has protection features that, if activated, will cause the regulator to shutdown either instantaneously or after a time delay. (See "PROTECTIVE FEATURES" in this section of the manual for a more detailed description of each feature.) The lower row of indicators has protection features that do not shutdown the regulator. The DVR2000 has two (2) unmarked protection indicators in the lower row. These indicators are not used on the DVR 2000 regulator.

The lower, or adjustment, area of the regulator panel has three groups of indicators. There are eight (8) indicators that comprise the bar graph, six (6) indicators that identify the standard adjustments and two (2) indicators associated with the VAR/PF feature. The bar graph indicates the relative level of adjustment. When none of the adjustment indicators are lit, the bar graph shows the relative level or setting of fine voltage adjustment. When one of the adjustment indicators is lit, the bar graph shows the relative level or setting of that particular adjustment.

Of the six (6) indicators comprising the standard adjustments the DVR2000 has one (1) unmarked indicator. This indicator is not used on this model. As the select button is pressed, the individual adjustment indicators will be sequentially lit skipping over any unmarked indicator. With the last indicator lit, the next press of the select button will turn off all of the adjustment indicators leaving only the bar graph indicator lit. This again is the mode for fine voltage adjustment. If none of the buttons are pressed (Select, Up, or Down), after one (1) minute, the regulator will automatically switch to the fine voltage adjustment mode.

The VAR/PF adjustment indicators are only used on the "C" model. This model has the VAR/PF control feature available. Unless a "C" model regulator is used, VAR control or PF control is not available and these indicators will not light. With a "C" model regulator, when the VAR or PF adjustment is selected, that indicator will blink when the control feature is not active, and that indicator will be on steady when the control feature is active.
VAR or PF control is not active when regulator terminals 52J and 52K are shorted. VAR or PF control is active when regulator terminals 52J and 52K are open.

Power-up Self Test

Upon applying power to the DVR2000, along with the controlled voltage buildup, the Digital Voltage Regulator performs a self-diagnostics test. This test is completed with the sequencing of the LED display panel. The visual sequencing occurs about 5-6 seconds after power is applied.
If during start-up this LED sequencing does not occur, see Section 5 of this manual.

Once the LED's have sequenced, all of the LED's will be off for a period of 1 second. After that time one (1) LED on the bar graph will be lit. This LED indicates the relative setting of the fine voltage adjustment.

If the regulator was shutdown from a protective feature, when restarted, during the 1 second time period, the LED of the protective feature that commanded shutdown will be lit before indicating the fine voltage setting. The regulator remembers a protective shutdown and indicates the cause of the shutdown during the next start-up.

Parallel Operation

The regulator is equipped with provisions to allow the paralleling of two or more generators using either reactive droop or reactive differential (cross current) compensation with the addition of an external 5 amp 5va current transformer. The paralleling input terminals are labeled CTB1 and CTB2.

PROTECTIVE FEATURES

Over-Excitation

The over-excitation protection feature monitors the regulator output voltage and activates when the output voltage exceeds 80vdc. When activated, the over-excitation LED will light. If the output voltage exceeds this level for 15 seconds, the regulator will turn off. The generator voltage will go to a residual level and the over-excitation LED will remain lit. The generator must be stopped or the input power must be removed for a minimum of 10 seconds to reset the circuit and restore normal operation. Upon start-up, after the LED sequence scan, the over-excitation LED will turn on for one (1) second before entering the fine voltage adjust mode as an indication that the regulator over-excitation function commanded a shutdown.

Over-Voltage

The over-voltage protection feature monitors the regulator-sensed voltage and activates when the sensed voltage exceeds 115% of the adjusted voltage. When activated, the over-voltage LED will light. If the regulator sensed voltage remains above this level for .75 seconds, the regulator will turn off. The generator voltage will go to a residual level and the over-voltage LED will remain lit. The generator must be stopped or the input power must be removed for a minimum of 10 seconds to reset the circuit and restore normal operation. Upon startup, after the LED sequence scan, the over-voltage LED will turn on for one (1) second before entering the fine voltage adjust mode as an indication that the regulator over-voltage function commanded a shutdown.

Over-Temperature

The over-temperature protection feature monitors the regulator temperature and activates when the ambient temperature exceeds 70°C. When activated, the over-temperature LED

will light and the regulator will turn off. The generator voltage will go to a residual level and the over-temperature LED will remain lit. The generator must be stopped or the input power must be removed for a minimum of 10 seconds to reset the circuit and restore normal operation. Upon start-up, after the LED sequence scan, the over-temperature LED will turn on for one (1) second before entering the fine voltage adjust mode as an indication that the regulator over-temperature function commanded a shutdown.

Loss-Of-Sensing

The loss-of-sensing protection feature monitors the continuity of the sensing circuit. If an open circuit occurs in one of the sensing leads, the regulator will shut down and the loss-of-sensing LED will light. The generator voltage will go to a residual level and the loss-of-sensing LED will remain lit. The generator must be stopped or the input power must be removed for a minimum of 10 seconds to reset the circuit and restore normal operation. Upon start-up, after the LED sequence scan, the loss-of-sensing LED will turn on for one (1) second before entering the fine voltage adjust mode as an indication that the regulator loss-of-sensing function commanded a shutdown.

The loss of sensing function will not activate under a generator short circuit condition but rather the regulator will turn full on and deliver maximum forcing power for a minimum of 10 seconds.

CAUTION: Whenever a potential transformer is used for sensing, a break on the primary side of the transformer will cause maximum forcing from the regulator, and the loss of sensing function will not activate.

Under Frequency Operation

The under frequency function allows the generator to operate with a constant volts per hertz characteristic (a linear relationship of voltage with respect to frequency). When not in the under frequency mode, the regulator has flat regulation, constant voltage independent of frequency. The transition frequency is adjustable from 40 Hz to 70 Hz. When in the under frequency mode the under frequency protection indicator will be lit. Adjusting the bar graph down towards minimum reduces the transition frequency.

Field Current Limit

The regulator output is protected with a field current limit feature. Should a heavy load or short circuit occur across the field output terminals, the regulator will limit the output current to 7.5 amps, and the field limit LED along with the over-excitation LED will light. The limiting current automatically resets itself when the output current drops below 7.5 amps. This current limit set point is not adjustable. If the output current does not drop below the current limit set point in 15 seconds the regulator will shutdown. The generator voltage will go to a residual level and the field amp limit and over-excitation LED will remain lit. The generator must be stopped, or the input power must be removed for a minimum of 10 seconds to reset the circuit and restore normal operation. Upon startup, after the LED sequence scan, the field amp limit and over-excitation LED will turn on for one (1) second before entering the fine voltage adjust mode as an indication that the regulator over-excitation function commanded a shut down.

SECTION 3 - INSTALLATION

MOUNTING

The DVR2000 Voltage Regulator is normally located in the generator conduit box, but is also designed to operate in remote switch gear cabinets with convection cooling. When remote mounting, the regulator may either be mounted on the cabinet door with the regulator panel accessible from the front of the cabinet or on the inside panel with the optional remote panel mounting kit, (Part Number BS526434). See Figure 4.

WARNING
THE REGULATOR MUST BE PROPERLY CONNECTED TO A SUITABLE POWER SYSTEM GROUND TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK HAZARD AND PROPER OPERATION

CAUTION: DO NOT megger or hi-pot the generator with the regulator connected. DO NOT megger or hi-pot the regulator.

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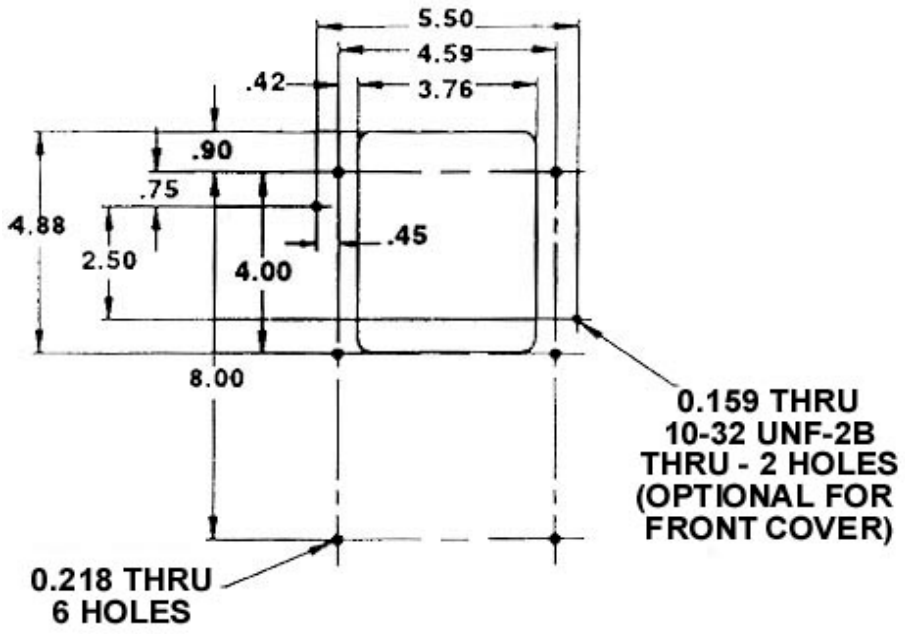


FIGURE 4 - REGULATOR MOUNTING DIMENSIONS

INTERCONNECTIONS

WARNING
BE SURE GENERATOR IS STOPPED AND ALL POWER IS OFF BEFORE MAKING ANY CONNECTIONS.

For typical wiring diagrams see “Outline Drawings and Diagrams” (Section 7).

CAUTION: For use on generator with output voltages greater than 600v, An external potential transformer must be used.

Whenever a potential transformer is used for sensing, an open circuit on the primary side of the transformer will cause maximum forcing from the regulator, and the loss of sensing circuit will not activate. Assure that all connections on the primary side of the transformer are tight and secured from possible vibration.

REMOTE VOLTAGE ADJUST

If a remote voltage adjust is required, a single pole double throw spring return center off toggle switch rated for 240v 1 amp is best suited as a remote adjust. To connect this switch for operation, the center pole or common terminal must be connected to regulator terminal 7. The other two (2) poles or terminals are connected to regulator terminals 6U and 6D. Care is required because “Input Power” voltages are present between 6U, 6D, and 7. This connection can be made using any wire gauges from 12 AWG-22 AWG. The remote voltage adjust can be mounted up to l50 ft from the regulator.

SENSING VOLTAGE

The DVR2000 Digital Voltage Regulator comes equipped for 3-phase sensing as standard. It can optionally be used with single phase sensing by connecting generator terminal T1 to regulator sensing terminal El and generator terminal T3 to regulator terminals E2 & E3.

POWER OUTPUT

The power output terminals of the regulator are labeled F+ and F-. These terminals are connected to the generator field leads respectively. Power Input

The two power input terminals of the regulator are labeled PMG. The leads of the Permanent Magnet Generator are connected to these terminals.

PARALLELING INPUT

The DVR2000 Digital Voltage Regulator comes equipped with parallel provisions as standard. The Paralleling input terminals are labeled CTB1 and CTB2. If paralleling is desired, connect the leads from a standard 5 amp 5va current transformer to these terminals.

The standard generator phase rotation is A-B-C to T1 -T2-T3 with CCW rotation when facing the conduit box or opposite drive end.
With this phase rotation and 3-phase sensing, connect generator lead

T1 to regulator terminal El,
T2 to regulator terminal E2, and
T3 to regulator terminal E3

The paralleling transformer must be in the generator T2 lead with the H1 towards the generator and the XI to regulator terminal CTB2.

With single phase sensing, connect the generator sensing leads:

T1 to regulator terminal El,
T3 to regulator terminal E2, and, E3

The paralleling transformer must be in the generator T2 lead with the H1 towards the generator and the Xl to regulator terminal CTB1.

CAUTION: The polarity and phasing of the current transformer and sensing connections must be observed or improper operation will result.
See Section 7 for typical connection diagrams.

To determine if the paralleling function is operating properly, see Section 4.

If a paralleling switch is desired, this switch or contacts are connected to regulator terminals 52L and 52M. Paralleling is activated when regulator terminals 52L and 52M are open. Paralleling is deactivated when regulator terminals 52L and 52M are shorted.

CAUTION: “Power Input” voltages are present between 52L and 52M.
The paralleling switch **DOES NOT** short the CT terminals.
Note: Regulator terminal 52M is internally common with terminal 7.

The current transformer used for paralleling may also be used for generator current metering.

FIELD FLASHING

A permanent magnet generator powers the "DVR2000 Digital Voltage Regulator" and field flashing is not required or necessary.

SECTION 4 - ADJUSTMENTS AND START-UP PROCEDURE

CAUTION: Read and understand this section completely before attempting any adjustments and starting the generator. If the adjustments do not produce the specified results, proceed to the "Troubleshooting" section.

GENERAL

The new DVR2000 Digital Voltage Regulator is designed such that all adjustments are made outside of the conduit box.

In the adjustment section there are eight (8) LED's that indicate the adjustment feature, eight (8) LED's that comprise the bar graph level indicator, and three (3) push buttons.

The three, (3), push buttons are:
1.) "Select" - Systematically selects the adjustment feature by successive presses of the button.
2.) "Up" - Increases the level of the selected adjustment feature.
3.) "Down" - Decreases the level of the selected adjustment feature.

Successive presses of the "Select" button will step through the various adjustment features. Once the desired adjustment feature is lit the "Up/Down" buttons will increase or decrease the level of the adjustment feature indicated. Once the proper level is reached, the "select" button must be pressed once more in order to save the new level in memory.

While in the "Select" mode, if no button is pressed for a period of one (1) minute, the regulator will automatically save the new level in memory. However, if regulator power is interrupted before the automatic save feature is commanded, that level of adjustment will be lost and the regulator will recall the last previously stored level.
The "Select" button must be pressed in order to step through the adjustment features. The "Up! Down" buttons may be successively pressed to increase or decrease the level, or if held down, the level will automatically increase or decrease at a rate of 2-increments per second. If at any time both the "Up" and the "Down" button are pressed simultaneously the "Up" button takes precedence.
When stepping through the adjustment features, only those features available can be selected. Only regulators with a "C" in the model number will allow the VAR Control or PF Control to be selected. Those models without a "C" in the model number will not allow the VAR Control or PF Control to be selected, and they will be skipped over.

There are up to eight (8) adjustments available on the DVR2000 Digital Voltage Regulator. They are:

1.) Fine Voltage
2.) Coarse Voltage
3.) Stability Range
4.) Stability
5.) Under Frequency
6.) Droop
7.) Power Factor Control
8.) VAR Control

INITIAL ADJUSTMENTS

CAUTION: Read and understand the operation of the individual adjustments before attempting any initial adjustments.

Before starting the generator, the following should be done ;
Remove the 5-amp fuse before starting the generator the first time. Perform all preliminary engine governor adjustments without the regulator energized.

After initial governor adjustments are complete, reinstall the 5-amp fuse and connect only the power input leads or PMG leads to the regulator. Remove all other regulator connections that may be present and temporarily insulate them.

Start and run the generator at rated speed. The regulator will perform the self-test and enter a shut down mode. At this time initial adjustments can be made. To do this, step through each adjustment using the “select” button. For each adjustment press the “up” or “down” button to obtain the level of the LED bar graph as shown in Table 1.

Table 1- LED settings

Adjustment	Voltage	Frequency	Frame	LED
Fine Voltage	All	60/50	All	5
Coarse Voltage	600	60/50	All	7
	480-415	60/50	All	5
	380	60/50	All	3
	240-208	60/50	All	2
	120	60/50	All	1
Stability Range	All	50	430	*1*
	All	60/50	430	2
	All	50	570	3
	All	60/50	570	4
	All	50	740	5
	All	60/50	740	6
	All	60/50	360	7
	Reserved for future use			8
Stability Initial value	Set from “Stability range”			
Droop	All	60/50	All	1
Under Frequency	All	60	All	5
		50	All	3
VAR/PF Control	All	60/50	All	5

After the initial adjustments are made, shut down the generator and connect the remaining regulator leads. The generator may be started and final adjustments may be performed on the regulator.

FINE VOLTAGE ADJUSTMENT

When none of the adjustment features are selected, the “Up/Down” buttons act as the “Fine Voltage” adjustment and the bar graph is a relative indication of that adjustment. Every Up/Down adjustments of the fine voltage adjust feature will increase or decrease the sensed voltage about 0.5 volts. The range of the “Fine Voltage” adjustment is +/- 60v or 120v (min. to max.) of the sensed voltage (See Table 2). After adjustment is made, the “Select” button must be pressed in order to save new level. If no button is pressed for a period of one (1) minute, the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.

COARSE VOLTAGE ADJUSTMENT

To select “Coarse Voltage” press the “Select” button until the “Coarse Voltage” LED is lit. When selected, the “Up/Down” buttons act as the coarse voltage adjustment and the bar graph is a relative indication of that adjustment. Every Up/Down adjustments of the "Coarse Voltage" adjust will increase or decrease the sensed voltage about 6 volts. The range of the coarse voltage adjustment is 95 - 600v (See Table 2). After adjustment is made, the “Select” button must be pressed in order to save new level. If no button is pressed for a period of one (1) minute, the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.

REMOTE VOLTAGE ADJUSTMENT

There is a third voltage adjustment, which is not located on the front panel. It is the remote voltage adjustment. The remote voltages adjust functions by remotely changing the fine voltage adjustment setting at the rate of 1 volt / sec. of switch contact. Unlike the regulator pushbuttons, the remote voltages adjust only functions when none of the adjustment features are selected. When any of the adjustment features are selected the remote voltage adjust is disabled. After adjustment is made, the “Select” button must be pressed in order to save the new level. If no button is pressed for a period of one (1) minute, the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.

The remote voltage adjust is connected to terminals 6U, 6D and 7, respectively. A single pole double throw spring return, with center off, toggle switch rated for 240v lamp is best suited as a remote adjusts. To connect this switch for operation, the center pole or common terminal must be connected to regulator terminal 7. The other two (2) poles or terminals are connected to regulator terminals 6U and 6D. Care is required because “Input Power” voltages are present between 6U & 7 and 6D & 7.

STABILITY RANGE ADJUSTMENT

The “Stability Range” selects the proper control parameters for the frame size generator and excitation system used. There are eight possible ranges. With the “Stability Range” LED lit every push of the “Up” or “Down” button will increase or decrease the bar graph one (1) LED.

To select “Stability Range” press the “Select” button until the “Stability Range” LED is lit. The LED bar graph will indicate the present stability range level. If this is the proper range for the frame size as shown in Table I, then proceed on to the next adjustment. If another stability range level is desired then press the “Up” or “Down” button until the proper LED of the bar graph is lit. Press the “Select” once more to exit “Stability Range” and save the new value. If no button is pressed for a period of one (1) minute the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed the new setting will be lost.
After selecting “Stability Range” as indicated, the regulator will automatically select a stability level that is acceptable for most applications (See “Stability Adjustment”)

See Table 2 for range and resolution of the “Stability Range” adjustment.

TABLE 2

Adjustment	Range	Resolution	Increments per LED
Fine Voltage	128v	0.5v	32
Coarse Voltage	95 to 600v	6.0v	12
Stability Range	1 to 8	1	1
Stability	—	—	32
Droop	0 to 10%	0.25%	5
Under Frequency	40 -70 Hz	0.15 Hz	28
VAR Control	-30% to 100%	1.0%	28
PF Control	-70% to 60% (-45 to 60)	1.0% Max (0.5)	30

Adjusting the stability up or down decreases or increases the gain of the voltage regulator which in turn increases or decreases the response time of the system. Increasing the level of stability will increase the response time. Decreasing the level of stability will decrease the response time.

To select “Stability” press the “Select” button until the “Stability” LED is lit. The LED bar graph will indicate the present stability level. If another stability level is desired, press the “Up” or “Down” button until the proper LED of the bar graph is lit.

Instability is best observed by monitoring the generator output voltage. DO NOT try to monitor stability by monitoring the DC field voltage. Even when stable, a DC voltmeter will show a small amount of fluctuation in the field voltage. If instability is seen in the generator output voltage, press and hold the “Up” button until the generator is stable again. Apply load. If the generator remains stable, no further adjustment is needed. If the generator is unstable, press and hold the “Up” button until the generator is stable again. Reject and apply the load one (1) to two (2) more times. The generator should remain

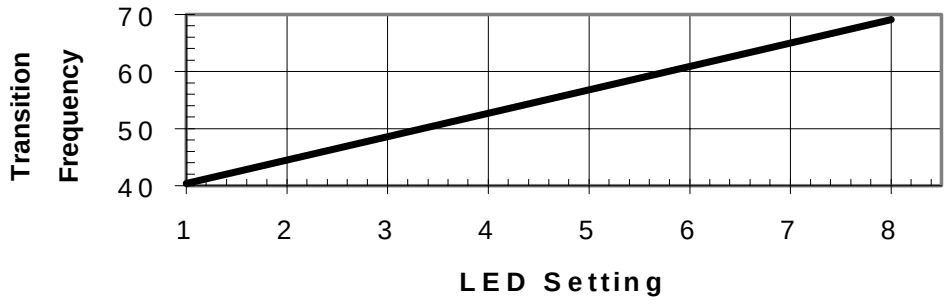
stable. If the generator is not stable or if the response is too slow, then either increase or decrease the stability level as desired one (1) to two (‘2) increments at a time applying and rejecting load between each adjustment until optimum performance is achieved. Press the “Select” once more to exit “Stability” and save the new value. If no button is pressed for a period of one (1) minute, the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.

UNDER FREQUENCY ADJUSTMENT

The “Under Frequency” adjustment changes the frequency at which the regulator begins to operate on a constant volts/hertz ramp. Increasing this adjustment increases the transition frequency. Decreasing this adjustment decreases the transition frequency.

To select “Under Frequency” press the “Select” button until the “Under Frequency” LED is lit. The LED bar graph
will indicate the present transition level. If another transition level is desired, then press the “Up” or “Down” button until the proper LED of the bar graph is lit (See Figure 5).

Figure 5
Under Frequency Adjustment



To set the transition level to a known frequency, either of two (2) methods of adjustment may be used.

The first method is to:

A.) Select the “Under Frequency Adjust mode”.
B.) Slow the engine speed down until the generator output frequency is the transition frequency.
C.) Adjust the under frequency level until the “Under Frequency” LED in the “Protection Indicators” section of the front panel just lights.
D.) Press the “Select” button to save the new value. If no button is pressed for a period of one (1) minute, the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.
E.) Restore the generator to normal operating speed.

The second method is to:

A.) Select the “Under Frequency Adjust mode”:
B.) Adjust the under frequency level until the “Under Frequency” LED in the “Protection Indicators” section of the front panel just lights.
C.) Adjust the under frequency level one (1) increment down. The “Under Frequency” LED in the “Protection Indicators” section of the front panel should turn off. If the LED does not turn off, keep adjusting the under frequency down one (1) increment at a time until the LED does turn off.
D.) Determine the transition frequency, and subtract it from the running frequency.
E.) Divide the difference by 0.15.
F.) Round the answer to the nearest whole number.
G.) Press the “Down” button the number of times calculated in step F.
H.) Press the “Select” button to save the new value. If no button is pressed for a period of one (1) minute, the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.

See Table 2 for range and resolution of the “Under Frequency” adjustment.

DROOP ADJUSTMENT

The “Droop” control feature is used when paralleling generators. Increasing the level of the “Droop” adjustment increases the amount of generator voltage droop with application of reactive load. A five amp signal from a 5a 5va CT into terminal CTB1 and CTB2 will give at least 10% voltage droop with the application of a 0.8 PF load and the adjustment level set to maximum.
Two (2) states or conditions exist with the “Droop” control feature. They are:

1.) Inactive - The feature is available but not functioning.
2.) Active - The feature is available and functioning.

The “Droop” control is activated when regulator terminals 52L and 52M are open. The Droop control is de-activated when regulator terminals 52L and 52M are shorted.

CAUTION: “Power Input” voltages are present between 52L and 52M.

NOTE: Regulator terminal 52M is internally common with terminal 7.

To select “Droop” press the “Select” button until the “Droop” LED is lit. The LED bar graph will indicate the relative level of droop adjustment. If another level is desired, press the “Up” or “Down” button until the proper LED of the bar graph is lit.

The best way to set the droop is to run each generator individually, and apply rated or near rated current at 0.8 PF. The amount of droop can then be set directly.

There is an alternate method of adjusting the generator droop. With the droop CT installed in the generator T2 lead (See Section 7), temporarily connect generator-sensing lead
El to generator lead T2
E2 & E3 to generator lead T1.

WARNING: BE SURE GENERATOR IS STOPPED AND ALL POWER IS OFF BEFORE MAKING ANY CONNECTIONS.

Run each generator individually and apply rated or near rated current at unity PF. The amount of droop can then be set by adjusting the "Droop" adjustment as needed for the application

If when adjusting generator droop the generator output voltage does not decrease with application of load, recheck the CT polarity and the sensing lead connections.

After the adjustments are complete, reconnect the regulator sensing leads as outlined in Section 7. When the generators are operated in parallel they will share load equally. If no reactive load is present, the generator voltage should not droop. If it does droop, recheck sensing connections, CT connections, and CT polarity. If necessary repeat the adjustment procedure.

Droop can also be set by adjusting to the LED level shown in Figure 6 for the amount of droop required.

See Table 2 for range and resolution of the Droop" adjustment.

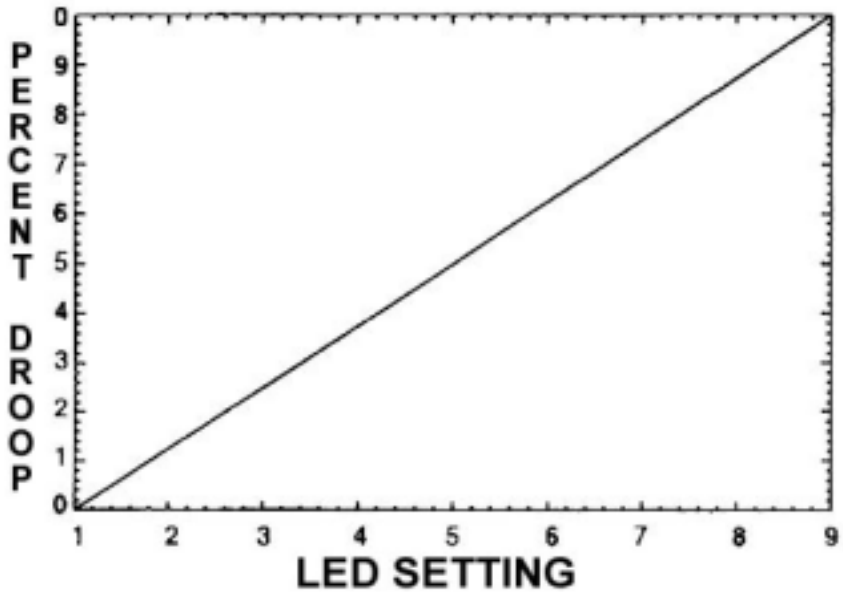


FIGURE 6 - DROOP ADJUSTMENT

After the droop adjustment is complete, press the "Select" button to save the new value. If no button is pressed for a period of one (1) minute the regulator will automatically save the setting. If regulator power is interrupted before one (1) minute has passed, the new setting will be lost.

REACTIVE DIFFERENTIAL (CROSS CURRENT) ADJUSTMENT

With the cross current loop disabled, set up the generators for satisfactory simple droop operation. Then reconnect the cross current loop retaining all settings. Operate the system to verify satisfactory performance.

When operating in parallel reactive differential mode (cross current), attention must be paid to the use of the burden resistor shown on the connection diagram. The burden resistor should have a value approximately ten (10) times the cross current loop resistance for proper differential operation. The value of 0.1 ohm is a suggested minimum value. The volt-ampere (VA) capacity of the paralleling Current Transformers should be considered after sizing the burden resistor.

VAR/PF ADJUSTMENT

The “VAR/PF” control feature is used when paralleling a generator to utility. “VAR” or “PF” control is only available on “C” model regulators. Increasing the level of the “VAR” or “PF” adjustment increases the amount of field excitation. Decreasing the level of the “VAR” or “PF” adjustment decreases the amount of field excitation.

Two (2) states or conditions exist with the “VAR” or “PF” control feature. They are:

1.) Inactive - The feature is available but not functioning.
2.) Active - The feature is available and functioning.

The VAR or PF control is activated when regulator terminals 52J and 52K are open.
The VAR or PF control is de-activated when regulator terminals 52J and 52K are shorted.
CAUTION: “Power Input” voltage are present between 52J and 52K.
NOTE: Regulator terminal 52K is internally common with terminal 7.

To select "VAR" control or "PF" control, press the "Select" button until the proper LED is lit. The led bar graph will indicate the relative level of adjustment. If another level is desired, press the "Up" or "Down" button until the proper LED of the bar graph is lit. See Figure 7A or 7B for adjustment settings.

To switch or toggle between "VAR" Control and "PF" Control select and **HOLD** the “Select” button down. While holding the select button, successive pressing of the “Up” button will alternate control between "VAR" and "PF". When the proper control is selected, release the “Select” button. With the “Select” button released, the level of control can be adjusted using the “Up” “Down” buttons. After the control level is djusted, pressing the “Select” button once more will store the selection and adjustment level in memory.
The “VAR/PF” control feature is the only feature where the adjustment LED does indicate more than just a selected or deselected function.
When not selected, the “VAR/PF’ LED's are always “OFF”.

When “VAR/PF” control feature is not available, the “VAR/PF” LED's cannot be selected. Only when "VAR" or "PF" control is available can the “VAR/PF” LED's be selected.
When selected but not active, the “VAR” or “PF” LED will blink and the bar graph will indicate the relative level of control.
When selected and active, the “VAR” or “PF” LED will be on steady and the bar graph will indicate the relative Level of control.

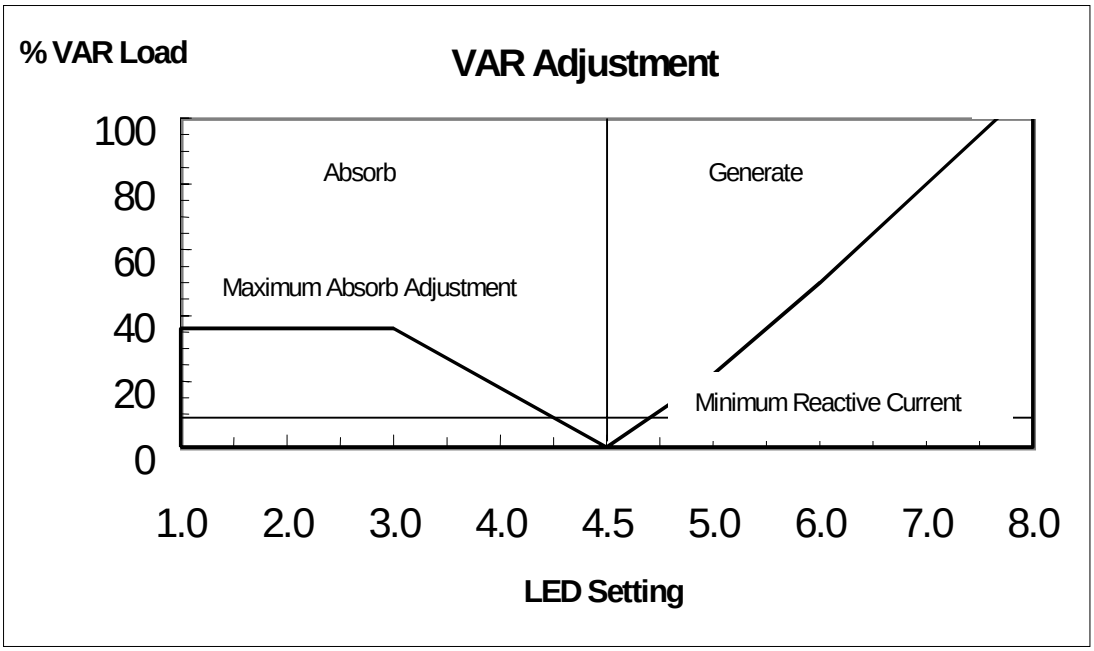


FIGURE 7A- VAR ADJUSTMENT

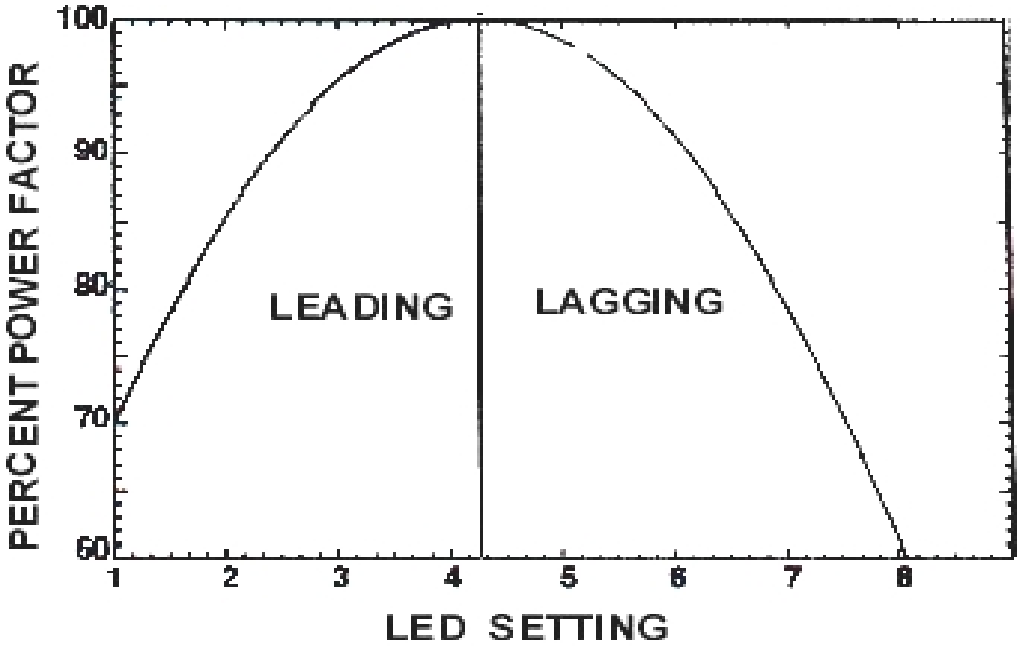


FIGURE 7B - POWER FACTOR ADJUSTMENT

SECTION 5 - TROUBLE SHOOTING

Symptom	Cause	Action
No voltage buildup	F1, F2 leads not connected	Connect field leads Fl and F2.
	Input Power leads not connected.	Connect PMG leads.
	No PMG voltage- Possible shorted 7.5uf capacitor or defective PMG. (Refer to generator manual for PMG replacement procedure)	Check PMG voltage. Normally 180-200v with 7.5uf capacitor connected and 150-160v without capacitor connected.
	Fuse blown.	Replace fuse with Littelfuse type 314005 or Bussman type ABC-5.
	Generator is not up to speed.	Increase generator speed (Consult prime mover manual).
	Coarse voltages adjust set to minimum.	Increase coarse voltage adjust (See Section 4).
	Over-excitation LED on.	Exciter field voltage exceeds 80v. Check generator and/or load conditions. Interrupt input power to regulator or shut down generator for a minimum of 10 seconds.
	L.O.S. LED on.	Loss of sensing - check sensing leads for proper connections. Interrupt input power to regulator or shut down generator for a minimum of 20 seconds.
	Over-voltage LED on.	PMG and field leads grounded. Isolate both PMG and field leads from ground. Generator voltage exceeded 115% for 3/4 sec. Interrupt input power to regulator or shut down generator for a minimum of 10 seconds.
	Over-temperature LED on.	Regulator temperature too high. Increase cooling air to regulator or let ambient cool down. Interrupt input power to regulator or shut down generator for a minimum of 10 seconds.
	Defective generator.	Consult generator manual.

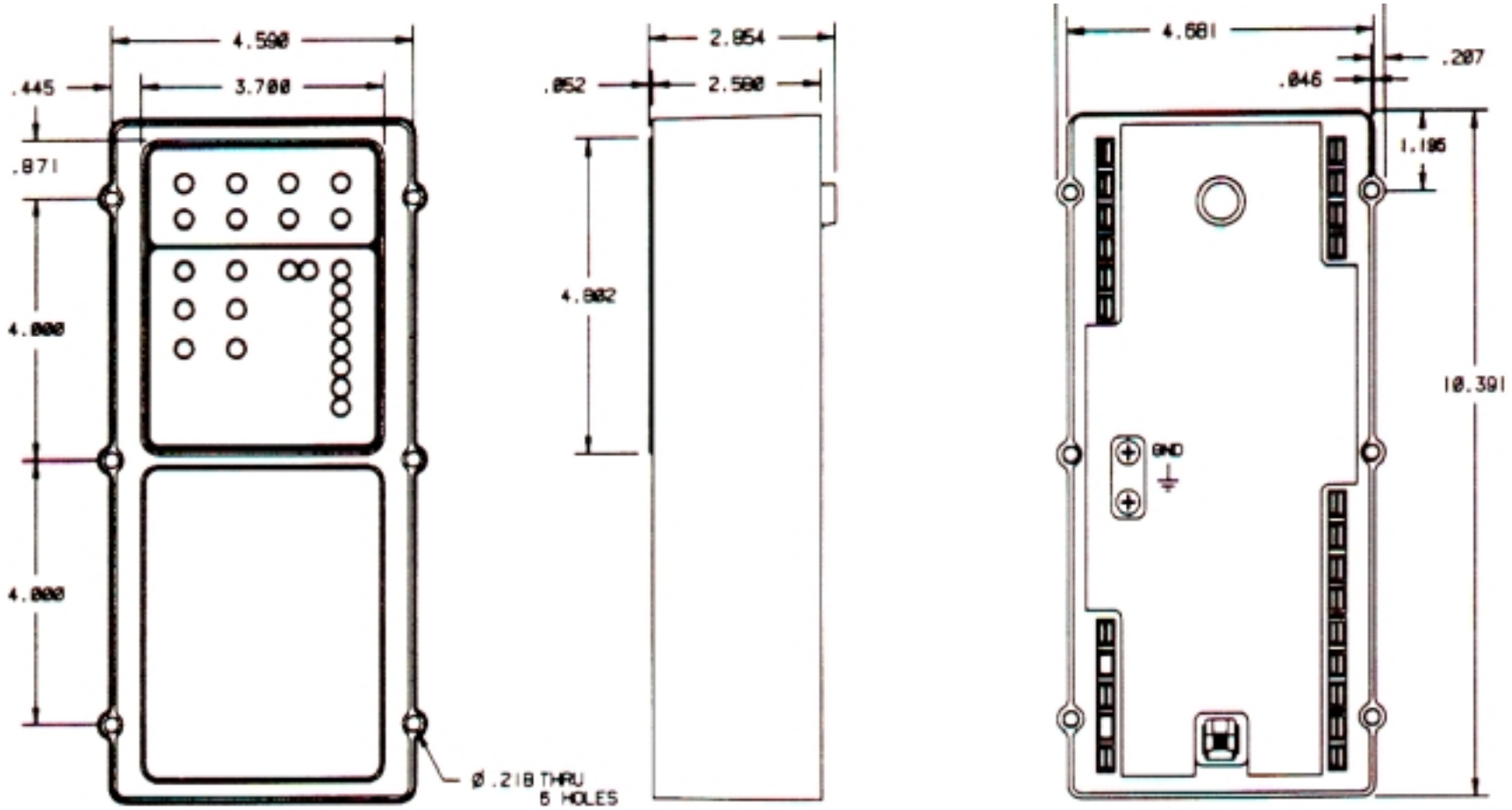
Symptom	Cause	Action
Output Voltage Low	Coarse Voltage Adjust set low. Fine Voltage Adjust set low.	Increase Coarse Voltage Adjustment (Section 4). Increase Fine Voltage Adjustment (Section 4).
Output Voltage High	Coarse Voltage Adjust set high. Fine Voltage Adjust set high.	Decrease Coarse Voltage Adjustment (Section 4). Decrease Fine Voltage Adjustment (Section 4).
Generator does not respond as adjustments are made.	Regulator software is locked.	Reset regulator. Interrupt input power to regulator or shut down generator for a minimum of 10 seconds.
Poor Voltage Regulation	Regulator not properly grounded. Field leads grounded. PMG leads grounded.	Ground regulator. Check field leads and isolate from ground. Check PMG leads and isolate from ground.
Remote Voltage Control Operates Backwards.	Control wired backwards.	Reverse the wiring on the remote voltage control (Section 3).
Remote Voltage Control functions in one direction only.	Center terminal reversed with end terminal, One terminal not wired. Both “6U” and “6D” are being connected to “7” at the same time.	Recheck the wiring on the remote voltage control (Section 3).
Generator Voltage Hunting	Stability Range not set properly. Stability not set properly. Intermittent connection to PMG terminals. Intermittent connection to sensing terminals.	Adjust Stability Range Adjust Stability (Section 4). Check wiring to PMG terminals. Check wiring to sensing terminal

Symptom	Cause	Action
Under Frequency LED on.	Operating at reduced speed. Under Frequency incorrectly adjusted. Intermittent connection to PMG terminals.	Increase generator speed. Adjust Under Frequency (Section4). Check wiring to PMG terminals.
Over-excitation LED on.	Generator overloaded. Generator defective.	Reduce generator load. Check exciter rotor winding resistance. (See generator manual). Check exciter field winding resistance. (See generator manual) Check rotating rectifier for shorted diodes. (See generator manual) Check main rotor winding resistance. (See generator manual)
Field Limit LED on. **(Over-excitation LED on).**	Regulator operating in field current limit.	Check for F+ F- short. Check exciter field winding resistance. (See generator manual) Check exciter rotor winding resistance. See generator manual) Check rotating rectifier for shorted diodes. (See generator manual) Check main rotor winding resistance. (See generator manual)
No Droop Control or Negative Droop (Generator does not share load).	Open connection to terminals CTB1& CTB2. Droop transformer connected back-wards. Droop transformer is in the wrong phase Sensing connections incorrect.	Check connection to terminals CTBI & CTB2 and paralleling transformer. Reverse connections to terminals CTBI & CTB2. Refer to Section 3 and Section 7 for proper installation. Refer to Section 3 and Section7 for proper sensing connections

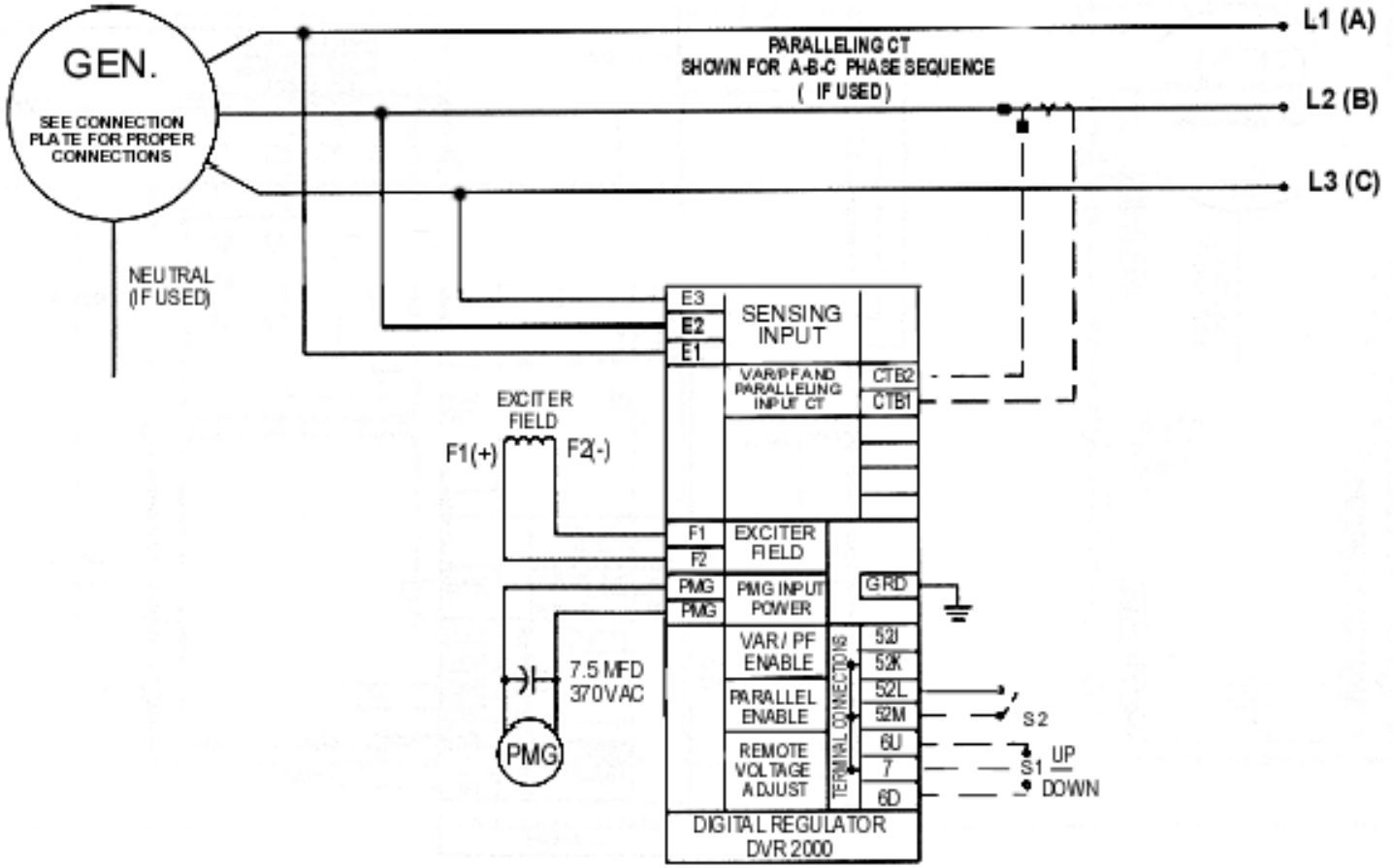
Symptom	Cause	Action
No LED scans during power up or long time for LED scans to be accomplished.	Regulator improperly connected.	Check connections to regulator.
All LED's off but regulator working.	Regulator software is locked.	Reset regulator. Interrupt input power to regulator for minimum of 10 seconds.
Long time for LED scan to be accomplished,	Exciter field (F-, F+) circuit is open, or has high resistance.	Check exciter field terminals and resistance.
Voltage does not build up after engine is idled.	Regulator software locks up during engine idle.	Add additional contacts to idle/run switch to open PMG power during idle.
Regulator fails immediately after replacement	Shorted diode on exciter.	Check and replace shorted diode.

SECTION 7 - DRAWINGS

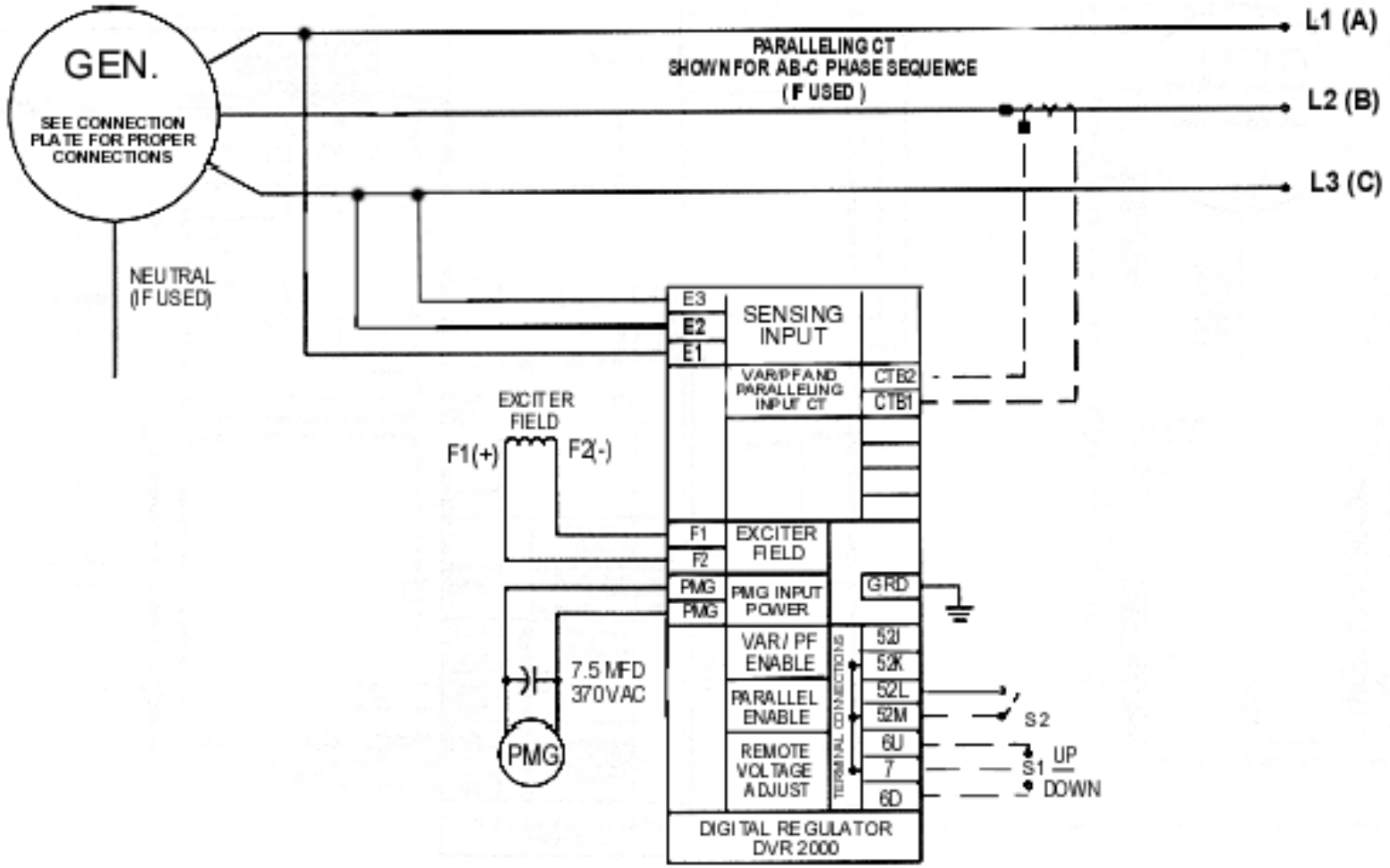
DIMENSIONS OF THE DVR2000 & DVR2000C



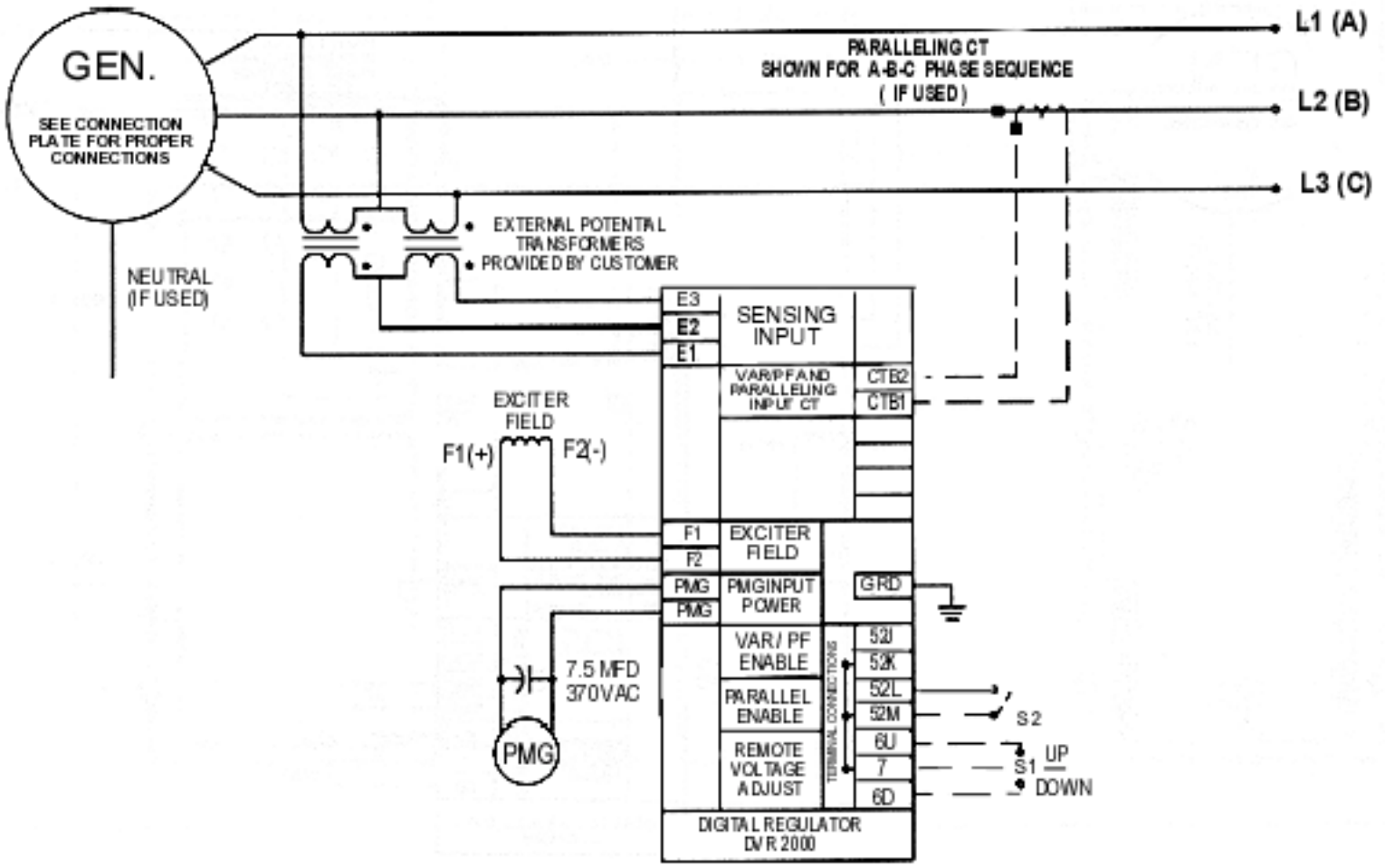
TYPICAL CONNECTION - THREE PHASE SENSING (95-600 VOLTS)



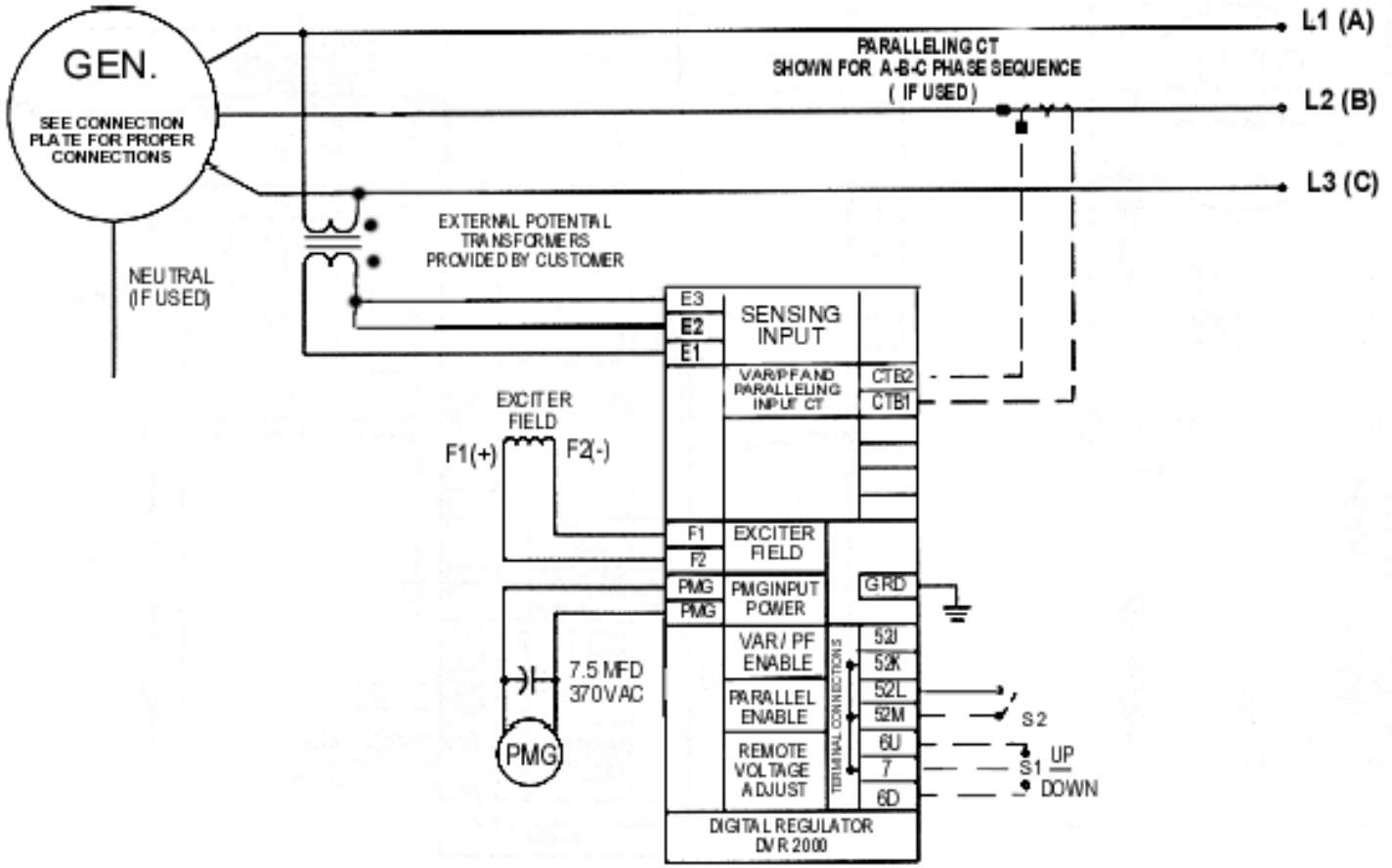
TYPICAL CONNECTION - SINGLE PHASE SENSING (95-600 VOLTS)



TYPICAL CONNECTION - THREE PHASE SENSING (601-6600 VOLTS)

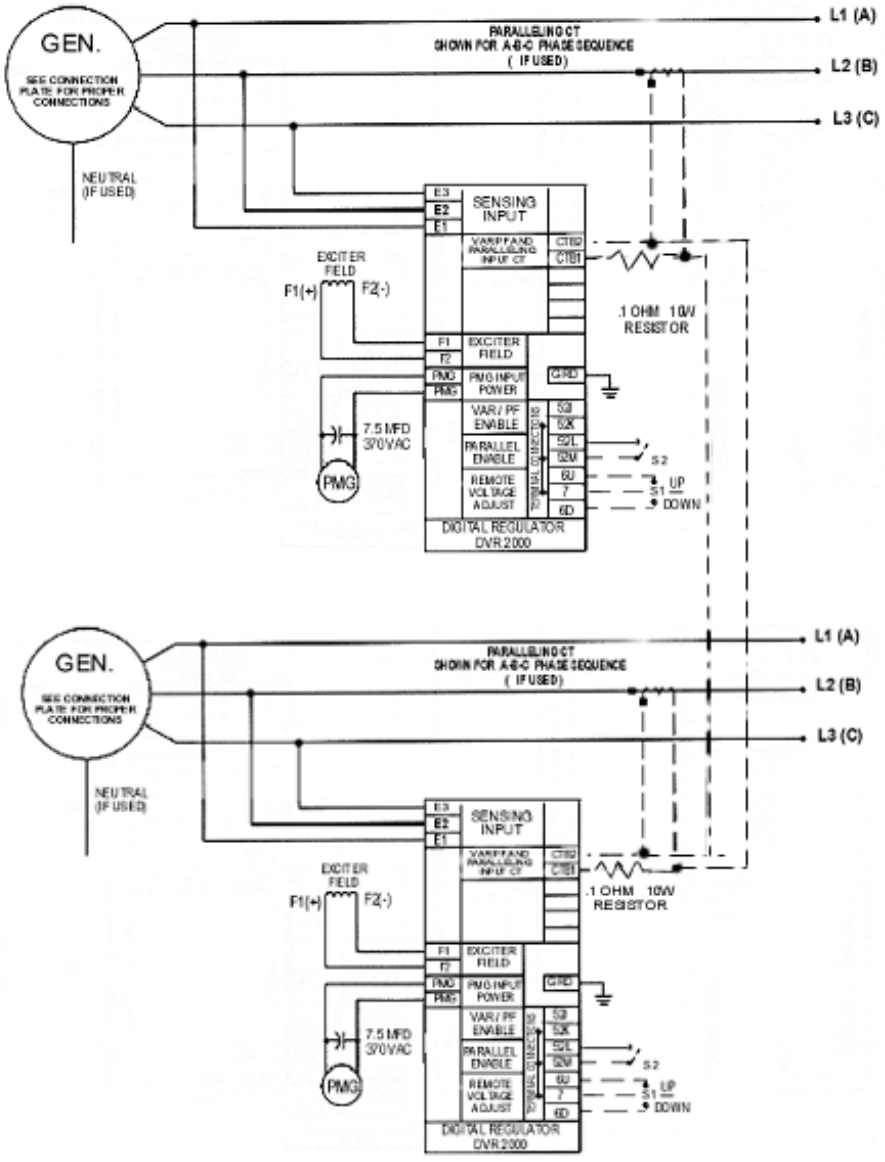


TYPICAL CONNECTION - SINGLE PHASE SENSING (601-6600 VOLTS)



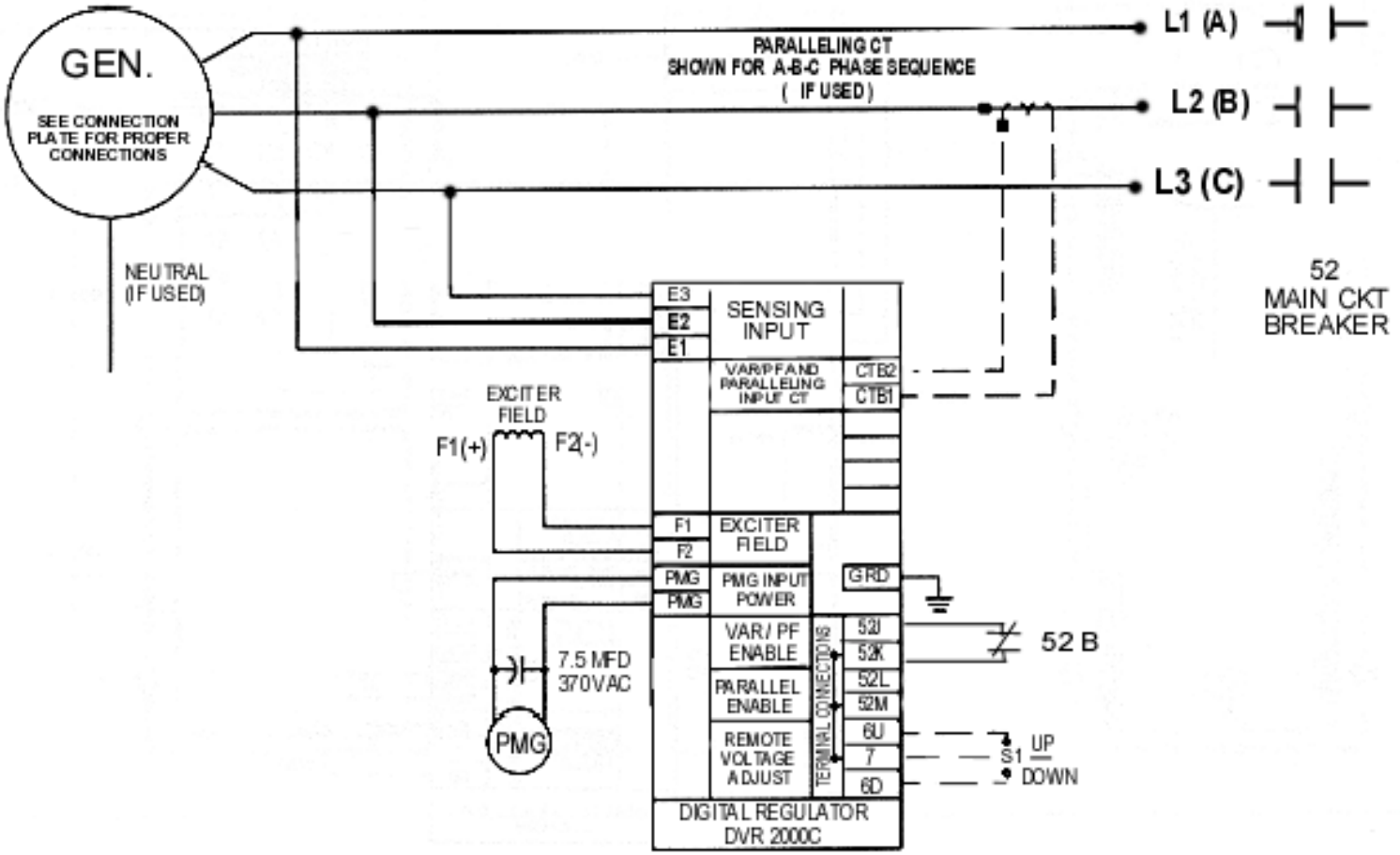
TYPICAL CONNECTION WITH REACTIVE DIFFERENTIAL PARALLELING

THREE PHASE SENSING (95-600 VOLTS)



TYPICAL CONNECTION WITH VAR / PF CONTROL

THREE PHASE SENSING (95-600 VOLTS)



TYPICAL CONNECTION WITH VAR / PF CONTROL

SINGLE PHASE SENSING AND ISOLATION TRANSFORMER