

Sorensen

**Instruction
Manual for**

**DCR-T Series
5 KW
Power Supplies**

Manual covers DCR-T models:

**4-800T
8-400T
16-310T
32-155T
55-90T**

**80-62T
110-45T
160-30T
300-16T
600-8T**

SECTION 1 INTRODUCTION

1.1 INTRODUCTION

This manual contains operation and maintenance data on the 5 kilowatt (5KW) units of the DCR-T Series Sorensen Power Supplies. It is intended to familiarize the user with the function of the unit, to introduce the varied applications to which the unit may be adapted, and to furnish sufficient maintenance data to assure long operating life.

Six major sections form the manual divisions. Section 1 contains a brief functional description of the DCR-T series power supplies along with complete unit specifications. Initial inspection and checkout procedures are outlined in Section 2. Operating instructions, including methods for adapting units to various applications, comprise Section 3. Sections 4 and 5 provide the principles of operation and maintenance procedures respectively. System drawings and the replacement parts list are included in Section 6.

1.2 DESCRIPTION

1.2.1 General

The DCR-T series is designed for either rack or floor mounting, and to provide stable, highly regulated dc outputs from a wide range of three phase input voltages and frequencies. (For complete unit specifications refer to Table 1-1.) The series exhibits excellent transient response and low ripple in both voltage regulating and current limiting modes. Other design features include: provisions for remote programming, remote sensing, and series and parallel operation. Increased versatility is also provided by the use of an industrial control technique for main power disconnect and line protection. This feature facilitates the remote control of the line power to the supply.

A variety of Sorensen power supply application notes are available through your Sorensen Service Representative. These notes detail many hook-up configurations available to meet most power supply applications.

1.2.2 Automatic Crossover

There are two basic operating modes: voltage and current. In the voltage mode, the voltage is held constant while the current varies with the load. In the current mode, the voltage varies and current is held constant. The automatic crossover feature enables the unit to switch operating modes as a function of load requirements. If, for example, load currents attempt to increase above a preset current limit, the unit will switch

operation automatically from the voltage to the current mode. In this mode, the current will be regulated at the value preset on the front panel. If load requirements are lowered, a return to the voltage regulating mode will occur automatically.

1.2.3 Remote Sensing

Terminals located on the rear-mounted connector (J-2) offer a means of extending a unit's regulating point from the output terminals to the load. This effectively compensates for variations in the load lead voltage drop. Section 3 outlines the connections for remote sensing.

1.2.4 Series Operation

For applications requiring output voltages higher than a single unit can provide, DCR-T power supplies may be connected in series (see Section 3). Regulation in series operation is the sum of the regulations for all units.

1.2.5 Parallel Operation

Parallel operation may be used to service those applications requiring an output current higher than a single unit can provide. DCR-T power supplies may be direct paralleled with no limit to the number of units which can be paralleled. However, the regulation will deteriorate, and will be the sum of the regulations for the individual settings plus the output voltage differences between units at no load.

1.2.6 Remote Programming

Output voltage or current of DCR-T power supplies may be remotely programmed in either the voltage or current mode by resistance or voltage signal. Details and consideration are given in Section 3.

1.2.7 Failure Protection

In addition to the constant limiting protection provided by automatic crossover and the current regulator, the DCR-T power supply incorporates several other protection systems. Loss of one input phase drops the output to zero and energizes an indicator lamp on the control panel. Thermal overload, usually resulting from a cooling fan failure, will also drop the output to zero and energize an indicator lamp on the front panel. In the event of an overvoltage condition at the output, such as a failure in the power supply or an externally induced condition, the adjustable overvoltage protection (OVP) will drop the output to zero and disconnect the AC power from the main power components. Protection against the effects of overloads and internal short circuits is also provided.

The main power components are protected by a thermal overload relay working in conjunction with a contactor to provide mechanical disconnect of the AC line to the main power components. (See Section 2 for complete input wiring requirements.) Control circuitry is protected by rear mounted fuses and an internal fuse.

1.3 OPTIONAL MODIFICATIONS

1.3.1 Chassis Slide Kit

The sides of the DCR-T have inserts which allow attachment of slide rails. Consult the factory for information on this optional Chassis Slide Kit.

1.4 SPECIFICATIONS

See Table 1-1 for complete specifications on the DCR-T 5KW series power supply.

Table 1-1 Specifications

DCR-T SPECIFICATIONS
5K WATT SERIES

DCR-T Model	OUTPUT POWER			Constant Voltage Mode				Temp. Coeff. Voltage mV/°C	Voltage Drift % Eo Max. (Typ.)	Programming Constants Voltage Mode			
	Voltage (Vdc)	Current (Adc)		Regulation Line & Load mV'	Ripple (PARD)		Resolution			Transient Response Time ms (Typ.)	Ohms/V	V/V	
		50°C	60°C		70°C	mV rms							mV p-p
4-800T1	0-4	800	680	440	2-4	30	100	Note 4	40	1.0	.05	2500	Note 4
8-400T1	0-8	400	340	220	4-8	30	100	Note 4	40	2.0	.05	1250	Note 4
16-310T1	0-16	310	266	188	8-16	30	100	Note 4	40	3.2	.05	625	Note 4
32-155T1	0-32	155	132	93	16-32	20	120	Note 4	40	6.4	.05	313	Note 4
55-90T1	0-55	90	74	54	27-55	20	120	Note 4	40	11.0	.05	182	Note 4
80-62T1	0-80	62	54	37	40-80	20	120	Note 4	40	16.0	.05	125	Note 4
110-45T1	0-110	45	38	27	55-110	40	140	Note 4	40	22.0	.05	91	Note 4
160-30T1	0-160	30	27	18	80-160	60	180	Note 4	40	32.0	.05	63	Note 4
300-16T1	0-300	16	14	10	150-300	100	300	Note 4	40	60.0	.05	33	Note 4
600-8T1	0-600	8	7	4.8	300-600	150	600	Note 4	40	120.0	.05	17	Note 4

NOTE 1: Regulation range as stated 0.1% of voltage or current, or stated range, whichever is greater.

NOTE 2: Line current at min. line voltage.

NOTE 3: Efficiency taken at max. power out and nominal ac volts input.

NOTE 4: Contact factory.

COMMON SPECIFICATIONS

DC OUTPUT CONSTANT VOLTAGE MODE:

Voltage Regulation: Line Load combined: All models 0.1% of the voltage setting or specification in table, whichever is greater.
Temperature Coefficient: 0.2%/°C of Eo max.
Voltage Signal Programming: 100 mV per 1% of rated output.
Resistive Programming: 100 ohms per 1% of rated output. (0-10) k ohms for 0-100% of rated output.)
Stability: 0.1% Eo max. for 8 hours after 30 minute warm up with fixed line, load and temperature.
Remote Sensing: 3 to 10V max. drop + line. 0.75V max. drop - line.
Transient Response: 40 ms (typical) to return to ±1% band for a step load change of 50% to 100% or 100% to 50% of full load.

INPUT:

T1 - 208 Vac ± 10% @ 60Hz.
T2 - 380 Vac ± 10% @ 50Hz.
T3 - 405 Vac ± 10% @ 50Hz.
T4 - 440 Vac ± 10% @ 60Hz.
T5 - 480 Vac ± 10% @ 60Hz.

OPERATING DATA:

Efficiency: 60% to 80% of full rated output depending on model.
Series Operation: 200 Vdc maximum; consult factory for series operation of more than 2 units.
Parallel Operation: Direct paralleling of any number of units.
Overvoltage Protection: Standard.
Ambient Operating Temperature Range: 0 to 70°C.
Storage Temperature Range: -45°C to +70°C.
Cooling: Forced Air.

DCR-T SPECIFICATIONS
5KW SERIES

DCRT Model	Constant Current Mode			Temp. Coeff. Current mV/°C	Current Drift % Eo Max. (Typ.)	Programming Constants Current Mode	Standard Input Power (3 phase, 60 ± 1 hz)		Power Factor (Typ.)		Case Size	
	Regulation mA ¹	Ripple (PARD) mA rms	Resolution (Typ.)				Voltage Vac	Current Aac (Max.) ²	Lead	Lag		Efficiency ³ %
4-800T1	400-900	3000	Note 4	320	.05	Ohms/V 12.5	Note 4	187-229	26.0	.9	.2	II
8-400T1	200-450	3000	Note 4	200	.05	25.0	Note 4	187-229	Note 4	.9	.2	II
16-310T1	155-310	1500	Note 4	200	.05	32.0	Note 4	187-229	Note 4	.9	.2	II
32-155T1	80-155	1000	Note 4	100	.05	64.0	Note 4	187-229	Note 4	.9	.2	II
55-90T1	48-90	600	Note 4	58	.05	111.0	Note 4	187-229	Note 4	.9	.2	II
80-62T1	30-62	600	Note 4	40	.05	161.0	Note 4	187-299	Note 4	.9	.2	II
110-45T1	22-45	500	Note 4	29	.05	222.0	Note 4	187-299	Note 4	.9	.2	II
160-30T1	15-30	330	Note 4	20	.05	333.0	Note 4	187-229	Note 4	.9	.2	II
300-16T1	8-16	200	Note 4	10	.05	625.0	Note 4	187-229	Note 4	.9	.2	II
600-8T1	4-8	100	Note 4	5	.05	1250.0	Note 4	187-299	Note 4	.9	.2	II

NOTE 1: Regulation range is 0.1% of voltage or current, or stated range, whichever is greater.

NOTE 2: Line current at min. line voltage.

NOTE 3: Efficiency taken at max. power out and nominal ac volts input.

NOTE 4: Contact factory.

COMMON SPECIFICATIONS

CONSTANT CURRENT MODE:

Current Regulation: Line and load combined: All models 0.1% Io max. of the output current setting or specification in table, whichever is greater.
Temperature Coefficient: 0.04%/°C of Io max.

Current Signal Programming: 100 mV per 1% of rated output.
(0-10V for 0-100% of rated output.)

Resistive Programming: 100 ohms per 1% of rated output. (0-10 kohms for 0-100% of rated load.)

Stability: 0.2% Io max. for 8 hours after 30 minute warm up with fixed line, load and temperature.

DCRT ACCESSORIES:

Chassis Slides: Part No. 1060247-1 (Optional).

Digital Programmer: Available for all models in DCRT Series. IEEE-488

Interface to GPIP Bus. Order Model 488 MICRO-DAP.

OPTIONAL EQUIPMENT:

OVP: OVP shutdown is standard.

Option: SCR crowbar M5.

METERING:

Digital: Standard

Analog: add M52

DCRT INPUT VOLTAGE

	T1	T2	T3	T5	STD. U.S. VOLTAGE	STD. CONTINENTAL EUROPE VOLTAGE	STD. BRITISH ISLES VOLTAGE	STD. U.S. VOLTAGE
60HZ	208V	380V	415V	480V				
50HZ								
60HZ								

CASE SIZE	DIMENSIONS IN. (mm)			WEIGHT lb. (kg)
	HEIGHT	WIDTH	LENGTH	
II	8.75(222.3)	19(482.6)	24(609.6)	185(407)
III	12.25(311.2)	19(482.6)	24(609.6)	310(682)

SECTION 2 INSTALLATION

2.1 GENERAL

After unpacking, general inspection and preliminary checkout procedures should be performed to assure that the unit is in proper working order. These consist of visually checking for damage, and performing an electrical check. If it is determined that the unit has been damaged, the carrier should be notified immediately. Repair problems should be directed to the nearest Sorensen representative, or to the factory.

2.2 INSPECTION

Proceed as follows to inspect for damage incurred during shipment:

- A. Check meter faces for cracked or broken glass. Check each meter for zero indication. Use zero adjust to bring indicator to zero, if necessary. Zero set is inside of the unit on the rear of the meter.
- B. Look for cracked or broken lenses on the indicator lights.
- C. Rotate the VOLTAGE and CURRENT potentiometers.
- D. Remove the top cover and check to make sure that all printed circuit card plugs are firmly in place.
- E. Remove the front panel (if already in place) and check that the controls and card plugs are firmly in place.
- F. Check remote plug (P1) to insure that the remote AC control jumpers are in place.

If any optional equipment (refer to Section 1.3) has been purchased with the unit, assure that all parts are accounted for and that no damage has occurred in shipment. (Optional parts are normally shipped loose in the packaging carton.)

2.3 OPTIONAL EQUIPMENT INSTALLATION

The unit is shipped in ready to use condition. If optional accessories have been purchased, however, they must be installed at destination. The following sections detail the installation of optional equipment.

2.3.1 Chassis Slide Kit

Extend the Slide Rail and mount the rail to the DCR-T side panel inserts (4 each) with the #10-32 screws provided. Note that all but one of the mounting holes are accessible when the slide rail is fully extended. Close the inner portion of the rail approximately halfway to access the remaining mounting hole. Make certain that all four mounting inserts are used.

2.4 MECHANICAL INSTALLATION

The DCR-T series power supply is shipped ready for floor or bench use. If the unit is to be rack mounted, the eye hooks on the top and the feet on the bottom must be removed. If chassis slides are used, they should be attached to the unit prior to mounting in the rack. To access the rack mounting flanges used for bolting the unit into the rack, remove the four allen-head screws and the front cover plate. Re-attachment of the front cover plate after rack mounting will hide the mounting hardware and give an attractive flush look to the installation. As these power supplies have a relatively large mass, they should be mounted at or near the bottom of the rack.

2.5 GENERAL PRECAUTIONS

WARNING

This unit requires a 3 pole, wall-mounted, fused disconnect switch with the proper current limiting fuse for safe operation.

DO NOT turn on the wall switch until AC and DC wires are attached to the DCR-T unit.

Accidental shorts or hand contact inside the DCR-T can cause burns or electrical shock.

All DCR-T units must be hard-wired for fixed installation. The following precautions should be taken when connecting power supplies to an AC main.

2.5.1 AC Line Protection

All Sorensen power supplies are designed with a mechanical disconnect and overload protection. The components most often used are circuit breakers or fused switches. With the DCR-T series, Sorensen has introduced a system of mechanical disconnect for ac protection which has been used for years in industrial controls. All Sorensen power supplies, including the DCR-T, require careful coordination of the AC mains connections with the AC line protection system within the unit. This will insure not only that a AC fault will be cleared, but that the AC line protection system will not be damaged by the fault.

The following components are required for a complete AC line protection system:

MAIN DISCONNECT SWITCH - Customer-installed 3 pole, wall-mounted fused disconnect switch. The main disconnect switch mechanically removes the AC lead wires and the unit from the AC mains.

MAINS SHORT CIRCUIT PROTECTION - Customer-installed main short circuit protection (usually a fuse). The ratings of the short circuit protection should be large enough to handle the units attached. The let-through current of the short circuit protection shall be below the lowest ratings of any one unit attached and below the rating of the unit lead-in wire.

UNIT AC OVERLOAD PROTECTION - Included in all Sorensen power supplies. Mechanically connects and disconnects as much of the wiring within the unit as is possible. Prevents the AC line (from the main AC disconnect to the unit) from causing damage within the unit should a fault occur. Acts as a safety feature preventing shock or burns due to a possible fault within the unit.

The following table specifies the maximum fault current which Sorensen three phase power supplies can safely clear. Use this table to size current limiting fuses for these supplies.

<u>UNIT</u>	<u>MAX. LET-THRU CURRENT</u>
DCR-T-5KW	2500 AMPS

2.6 ELECTRICAL INSTALLATION

CAUTION

Read wiring WARNING on page 2-2 before starting wiring. Unit is phase sensitive. Test input phase per para. 2.7.

Follow these steps in wiring:

1. Check phase rotation at the main disconnect switch (see Section 2.5). Mark terminals 2 - 3 - 4 to correspond to line A, line B and line C, respectively.

2. Identify the proper safety ground at the wall switch. (The neutral and/or a separate ground may be provided. Check the power company and local codes for a proper connection.)
3. Label four wires for the input connection. Wires 2 - 3 - 4 are connected to the three phase terminals, and wire 1 is connected to the safety ground terminal.
4. Connect the 4 wires to the DCR-T ac input terminals which are marked GND-0A-0B-0C.

IMPORTANT SAFETY PRECAUTION

Wire 1 must be connected to the CHASSIS GROUND terminal to provide a ground for the DCR-T chassis frame.

5. Connect the two dc output wires. Label these wires (+) and (-).

2.7 PHASE ROTATION CHECK

The DCR-T is a phase rotation sensitive unit. To check rotation, proceed as follows:

- A. Connect unit as indicated in paragraph 2.6.
- B. Turn CURRENT and VOLTAGE control pots fully counterclockwise (zero out).
- C. Turn ON/OFF switch to STAND-BY.
- D. Press START button.
- E. If unit makes sharp noises and voltmeter jumps, two lines are probably reversed. Reverse any two AC input lines.

2.8 INITIAL CHECKOUT

2.8.1 Voltage Mode

To perform a check of voltage mode operation, proceed as follows:

- A. Assure that proper input connections have been made. Refer to Section 2.5, 2.6 and 2.7.
- B. Turn VOLTAGE and CURRENT controls fully counterclockwise.

NOTE

See Figure 3-1 for location of controls and indicators.

- C. Set ON/OFF switch to STAND-BY mode. Amber STAND-BY lamp will be illuminated.
- D. Press START button, note sound of fan. Green ON lamp will be illuminated.
- E. Turn VOLTAGE and CURRENT control slowly clockwise and observe the unit voltmeter. The pointer should move upscale.
- F. Press STOP button. Unit will return to the STAND-BY mode.

2.8.2 Current Mode

To check operation of the unit in the current mode, proceed as follows:

- A. Turn VOLTAGE and CURRENT controls fully counterclockwise.
- B. Connect a heavy gauge wire across the output terminals. One of the intended output leads is recommended for this purpose.
- C. Set ON/OFF switch to STAND-BY. Amber STAND-BY light will be illuminated.
- D. Press START button, note sound of fan. Green ON lamp will be illuminated.

- E. Rotate VOLTAGE control about 30° from the left hand stop and observe output meters. Both should be zero.
- F. In small increments, raise CURRENT control while observing the ammeter. If current does not increase, rotate the VOLTAGE adjustment another 30°.
- G. Press STOP button. Unit will return to the STAND-BY mode.
- H. Remove shorting wire from the output terminals.

SECTION 3 OPERATION

3.1 GENERAL

This section provides a tabular listing of the unit's controls and indicators along with a brief description of their function. Physical location of the controls and indicators is shown in Figure 3.1. The physical location of the rear panel terminals and connectors is shown in Figure 3.2.

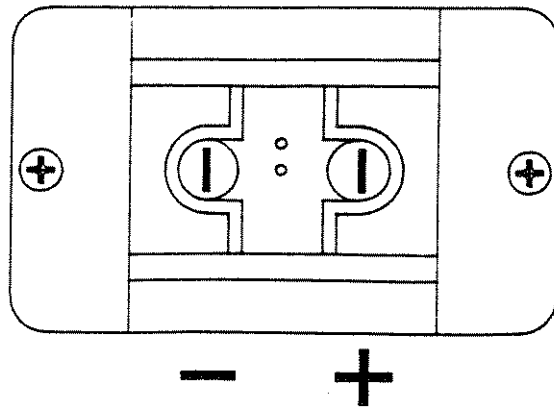
Table 3.1 CONTROLS AND INDICATORS.

Control/ Indicator	Function
On/Off Switch	Energizes control circuitry and provides power for contactor disconnect. Puts unit in Stand-By.
Stand-By Lamp	Indicates unit is in Stand-By.
STOP Button	Causes contactor to be pulled in. Contactor is held energized through the STOP button, the overload auxiliary contacts, the contactor auxiliary contact, and a fuse.
ON Lamp	Indicates Main Power ON.
Phase Indicator	Indicates loss of an ac line.
Thermal Indicator	Indicates an overtemperature condition.
OVP Indicator	Indicates that the OVP has activated.
Reset Button	Brings output to zero. Resets the unit after OVP or thermal shutdown without recycling.
OVP Adjust Button	OVP Adjustment control.
REM Indicator	Indicates unit is in remote operation. ON when in remote operation. Flashes if a remote line is open.
Voltage Control	Multi-turn pot to set output voltage.
Volt Mode Indicator	Indicates when unit is in the voltage regulating mode.
Current Control	Multi-turn pot to set output current.
Current Mode Indicator	Indicates when unit is in the current regulating mode.
Unit Ammeter	An ammeter connected to a shunt in the negative leg of the unit output. Indicates output current.



5 kW Model

Figure 3.1 Typical Controls and Indicators



OUTPUT TERMINAL CONFIGURATION
(300 & 600 VOLT UNITS)

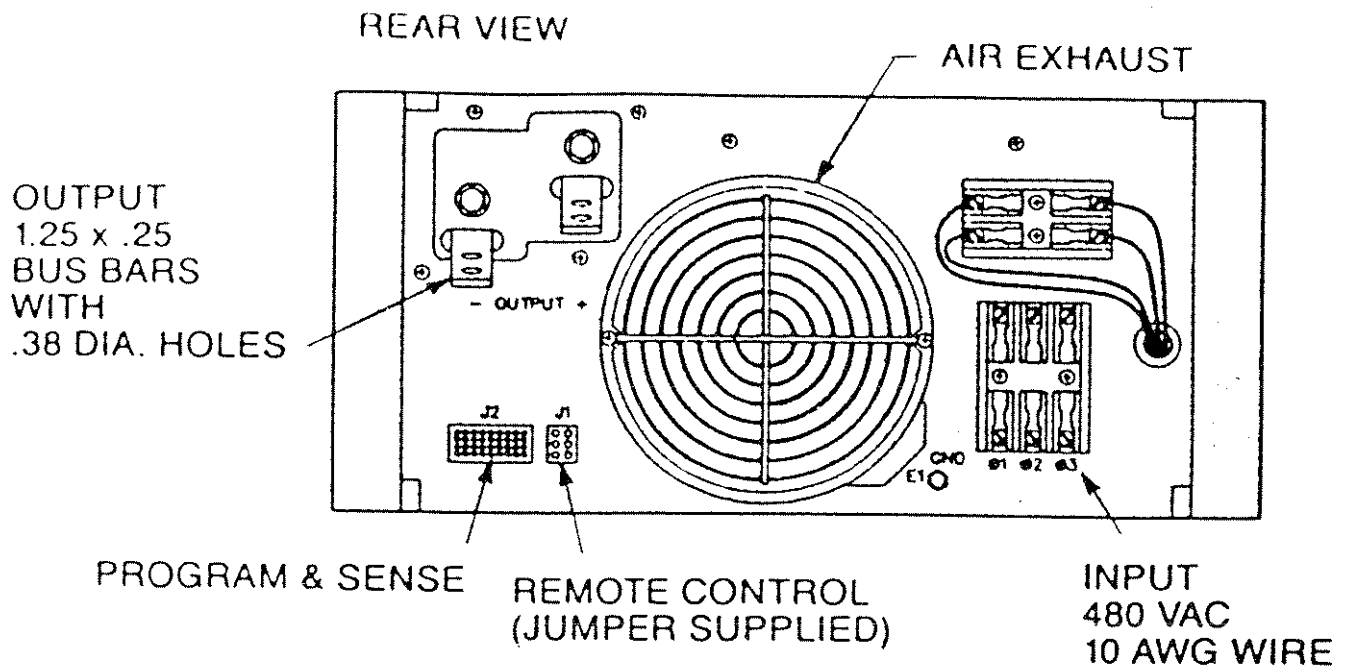


Figure 3.2 Rear Panel Terminals and Connectors

This section also provides instructions for adapting the supplies to many of their varied applications. Included are procedures to be followed for conversion to: remote sensing operation; voltage, current and programming modes; and series and parallel operation. Also included are procedures for use of the various remote control and remote indicator features of the power supply.

NOTE

Throughout the following discussion, voltage and current levels will be expressed in percentages of full scale label values. This is necessary due to the large variety of outputs available in the DCRT Series. Full scale label values are determined by the model number, (e.g.) DCR16-310T1 is 16 volts and 310 Amps full scale, DCR55-90T1 is 55 volts and 90 Amps, etc.

3.2 LOCAL SENSING

The supplies are shipped without the sense leads connected. The supplies are protected against open sense leads. To realize specified performance of the unit, however, the sense leads must be connected. Local sensing simply means that the sensing circuit is connected across the unit output terminals and not at the load. For applications where the voltage drop in the load wires is prohibitive, use remote sensing (paragraph 3.5). Figure 3.3 illustrates the local sensing configuration of remote connector (J-2). The mating connector housing, strain relief and connector pins are included with the DCRT unit. Connector pins will accept #18 through #24 AWG insulated wire.

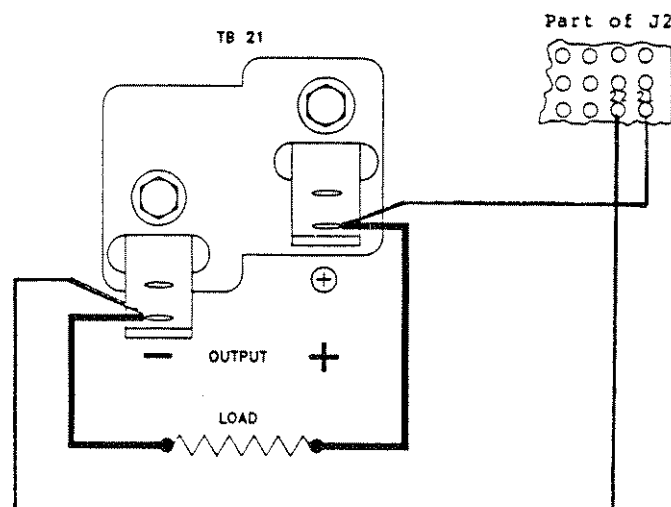


Figure 3.3 Local Sensing Configuration

3.3 VOLTAGE MODE

To put the unit in voltage mode operation, proceed as follows:

- A. Rotate the VOLTAGE and CURRENT control potentiometers fully counterclockwise.
- B. With the main disconnect switch OFF, connect the three phase input leads as indicated in Section 2.6
- C. Set ON/OFF switch to ON. Stand-By lamp should be illuminated.
- D. Press START button. ON lamp should illuminate.
- E. Rotate VOLTAGE control until the unit voltmeter indicates the desired output voltage.

NOTE

To prevent random firing of the SCR's, for voltage outputs below 5% of maximum rated output voltage, it is recommended that a bleeder resistor be connected across the output of sufficient value to draw approximately 10% of rated output current. For example, for a DCR16-310 below .8V use a bleeder to draw approximately a 31.0A load. This would be approximately .026 ohms (use a 100 watt rating).

-
- F. Set ON/OFF switch to OFF, and set the main disconnect switch to OFF.
 - G. Connect load to the unit terminals on the rear of the unit.
 - H. Set CURRENT control to a value at least 10% above the actual load current.

NOTE

Regulation falls off if output current is within 10% of limiting value. Current mode indicator begins to glow when current output is within approximately 10% of limiting value.

- I. Set the Main Disconnect switch to ON and the ON/OFF switch to ON.
- J. Press START button. The ON lamp will light and the unit will be in voltage operation mode.

NOTE

With the unit in the voltage mode, an increase in load current requirements above the value set in step H will cause an automatic crossover to current mode (current limiting) operation.

3.4 CURRENT MODE

To operate the unit in current mode, proceed as follows:

- A. Rotate the VOLTAGE and CURRENT controls fully counterclockwise.
- B. With the Main Disconnect switch OFF, connect three phase input as indicated in Section 2.6
- C. Set ON/OFF switch to ON. Stand-By lamp should illuminate.
- D. Press START button. ON lamp should illuminate.
- E. Rotate VOLTAGE control until unit voltmeter indicates a level 10% above the desired dynamic voltage.

NOTE

Current regulation falls off if the dynamic (compliance) voltage is within 5% of the voltage limiting value.

- F. Set ON/OFF switch to OFF, and set the Main Disconnect switch to OFF.
- G. Connect load lines to unit output terminals on the rear of the unit.
- H. Set the Main Disconnect switch to ON and the ON/OFF switch to ON.
- I. Press START button. ON lamp will light, and the unit is in voltage mode operation.

- J. Turn CURRENT control to desired current regulating value. CURRENT MODE lamp will light and the unit is in current mode operation.

NOTE

If dynamic (compliance) voltage rises above limit set in step "E", the unit automatically crosses over to voltage mode operation. (Current mode light goes off.)

3.5 REMOTE SENSE

In the remote sensing mode, voltage regulation is at the load rather than at the unit output terminals, thus correcting for voltage drops in the load leads.

NOTE

A 10% of E_o maximum voltage drop lead is the maximum for which remote sensing will compensate. To avoid exceeding the rated maximum unit voltage, the maximum load voltage (as read on the panel voltmeter) must be less than the rated maximum by the sum total of the drops. Example: If each load line drops 3 volts, (6 volts total), then on a 55 volt rated unit, the DCR55-90T, the voltmeter reading must not exceed $55 - 6 = 49$ volts.

To adapt a unit for remote sense operation, proceed as follows:

- A. Set unit ON/OFF switch to OFF and the Main Disconnect switch to OFF.
- B. Remove the local sense leads from both the output terminals and J2 mating connector, if already connected.
- C. Install the remote sense leads to plus and minus SENSE terminals in J2 using the J2 mating connector provided. Note which lead is connected to the plus terminal (remote sensing configuration is shown in Figure 3.4).

NOTE

Use a twisted or shielded pair of wires for the remote sensing leads. Sensing current is approximately 1.0 mA.

- D. Connect the lead from the positive sense terminal to the positive load terminal, and connect the negative sense lead to the negative load terminal.
- E. Reset current limit per paragraph 3.3.
- F. If the unit is being placed on-line for the first time or is being returned to service following a maintenance check, etc., proceed as outlined in paragraph 3.3 or 3.4. Otherwise, set the Main Disconnect switch to ON, set the unit ON/OFF switch to ON and press the START button. POWER ON indicator light will illuminate and the unit supplies the load.

3.6 OVERVOLTAGE PROTECTION (OVP)

The OVP circuit protects the load by limiting the output voltage to a preset value. Load protection is accomplished by bringing the output current and voltage to zero and opening the contactor which brings the unit to a Stand-By mode when the preset OVP value is reached. The unit is shipped with the OVP factory set at 10 to 15% of the maximum output voltage.

To set the OVP at another value, proceed as follows:

NOTE

To avoid nuisance tripping of the OVP circuit, the preset value should be set at 10% minimum above the operating output voltage.

- A. Set the unit for operation as outlined in paragraph 3.3 or 3.4.
- B. To read the OVP set value on the front panel voltmeter, simply press the OVP set switch.
- C. Set the desired OVP value using the front panel OVP Adjust Control while depressing the OVP set switch.
- D. At any time, the OVP set value may be read without affecting the normal operation of the unit.

3.7 RESET

The front panel RESET switch is used to clear those faults which latch the unit in the zero output state. These faults are: OVP shutdown, thermal shutdown and phase loss. The thermal indicator light will illuminate when the RESET is depressed and the unit output voltage and current will go to zero. When the RESET switch is released, the unit will soft start and return to the preset operating conditions.

To RESET the unit after a fault has occurred, proceed as follows:

1. OVP SHUTDOWN: After an OVP fault, the unit will be in Stand-By mode and the OVP indicator lamp will be illuminated. Press the RESET switch. The OVP indicator lamp will go off, and the unit can be re-started by pressing the START switch.
2. THERMAL SHUTDOWN: Should the thermal shutdown circuit activate, check first to make sure the unit cooling fan is operating. Fan failure is the primary cause of a thermal shutdown fault. Allow approximately 10 minutes time with the cooling fan operating before resetting the unit. Press the RESET switch and release. The thermal indicator will go off and the unit output voltage and current will return to the preset operating conditions.
3. PHASE LOSS: The loss of one input phase line will latch the output voltage and current to zero. The unit can only be reset when the phase has been restored to the unit. When the lost phase has been restored, press and release the RESET switch. The PHASE indicator will go off and the unit output voltage and current will return to the preset operating conditions.

3.8 EXTERNAL RESISTANCE PROGRAMMING

The unit output voltage, current and OVP set points may be resistance-programmed remotely to a predetermined regulated value. Three 1 mA precision current sources are provided, one each for programming voltage, current and OVP set. External resistance programming is accomplished by connecting a resistance from the current source output to V_{GEN} (J2 pin 11).

External Resistance Programming Constants are:

- 10,000 Ohms for 100% Output Setting.
- 1,000 Ohms for 10% Output Setting.
- 100 Ohms for 1% Output Setting.

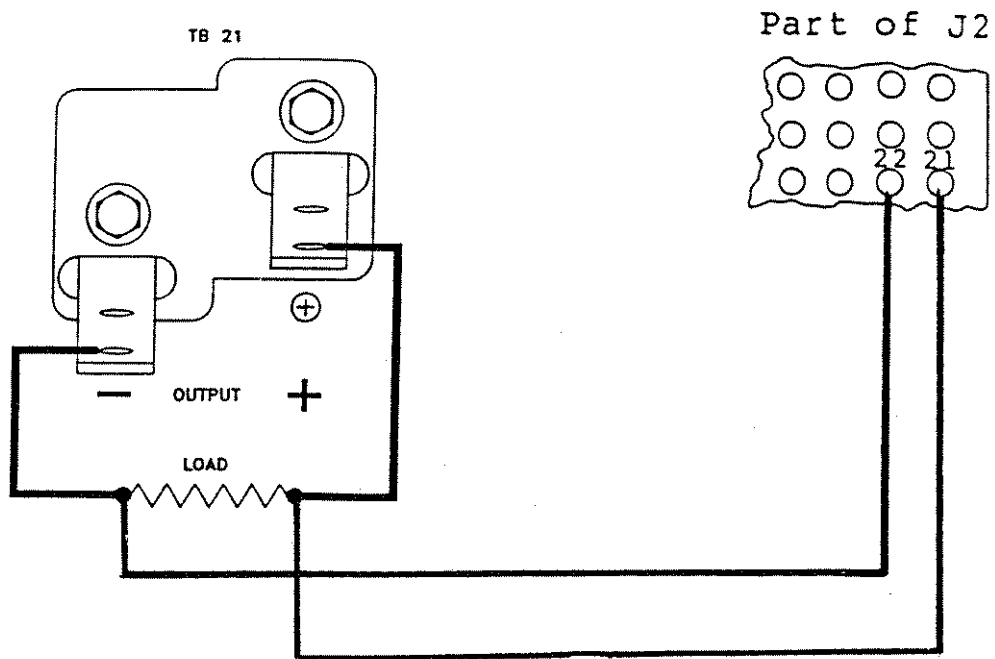


Figure 3.4 Remote Sensing Configuration

NOTE

When unit is set for external programming, both voltage and current settings must be externally programmed. Both front panel output adjustment controls are disabled. If either programming line is open, the unit output will go to zero and the front panel Remote Indicator Lamp will flash. The OVP is unaffected.

3.8.1 Voltage and Current Mode

Remote programming sensitivity varies according to the full scale voltage and current output of the unit. Table 1-1 lists the proper ohms/volt and ohms/amp for each model. For example, a DCR32-310T has a 32 volt full scale output. The ohms/volt sensitivity from Table 1-1 is 313 ohms/volt. For a certain voltage output, therefore, the voltage value to be programmed must be multiplied by the ohms per volt sensitivity to arrive at the correct value for programming resistance.

Example for programming a 25 volt output from a 32 volt full scale unit: $(25) \times (313 \text{ ohms}) = (7825 \text{ ohms})$

Current output programming is accomplished in the same manner. For example, the DCR32-310T has a 310 Amp full scale output. The ohms/amp sensitivity from Table 1-1 is 32 ohms/amp.

Example for programming a 300 amp output: $(300) \times (32 \text{ ohms}) = (9600 \text{ ohms})$

NOTE

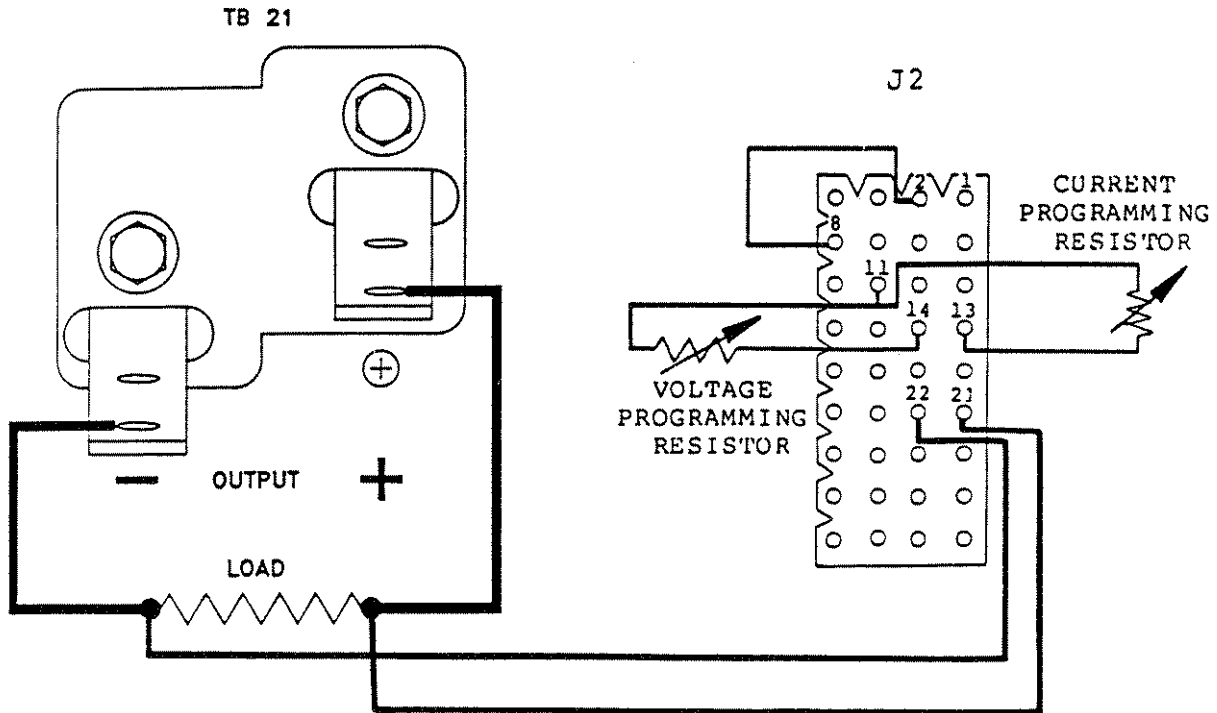
The resistor used should have a low temperature coefficient (± 30 PPM) to maintain the units rated temperature characteristics as well as stability. Programming current is about 1 mA. Use a 1% resistor with a wattage rating of 1/8W or larger.

To adapt the unit to external resistance programming, proceed as follows:

- A. Set unit ON/OFF switch to OFF and Main Disconnect switch to OFF.
- B. Connect jumper wire from J2 pin 2 (Logic Ground) to J2 pin 8 (Remote/Local).
- C. Connect both voltage and current programming resistors. (See Figure 3.5 for diagram of programming connections.) The voltage programming resistor is connected from J2 pin 14 (Remote Voltage Set) to J2 pin 11 (Virtual Ground). The current programming resistor is connected from J2 pin 13 (Remote Current Set) to J2 pin 11.
- D. Set the Main Disconnect switch to ON and set the ON/OFF switch to ON. The Remote Indicator Lamp on the front panel will illuminate. Press the START button. The unit will regulate to the values set by the external programming resistors.

NOTE

If remote programming is to be discontinued, remove the programming device, and disconnect the jumper from J2 pin 2 to J2 pin 8.



**Figure 3.5 External Resistance Programming
(Without Remote Sense)**

3.8.2 OVP Set

The unit OVP Trip Point may be externally resistance programmed. This would be desirable in those applications where one or more OVP Trip Points are required (different than the front panel OVP Trip Set adjustment).

NOTE

External OVP set programming is independent of external voltage and current mode programming. The jumper from J2 pin 2 to J2 pin 8 is not required to remote program the OVP Trip Set Point.

Example for setting the OVP Trip Set point to 8 volts on a DCR16-625T:

To determine the External Programming resistor value, proceed as follows:

- A. First, determine OVP Trip Voltage needed for Section B.
Note: 0-10 volts corresponds to the 0 to full scale output of the unit to be programmed.

$$\frac{8 \text{ volts}}{\text{(desired OVP Point)}} \times \frac{10\text{V (full scale programming voltage)}}{16 \text{ volts full scale}} = 5 \text{ volts}$$

- B. To determine the value of the program resistor, use a voltage from 0 to 10 volts, calculated above, in the following formula:

$$R_p = \frac{(X \text{ volts}) (10,909)}{10,909 - (X \text{ volts})} = \frac{(5 \text{ volts}) (10,909)}{10,909 - (5 \text{ volts})} = 9,231 \text{ ohms}$$

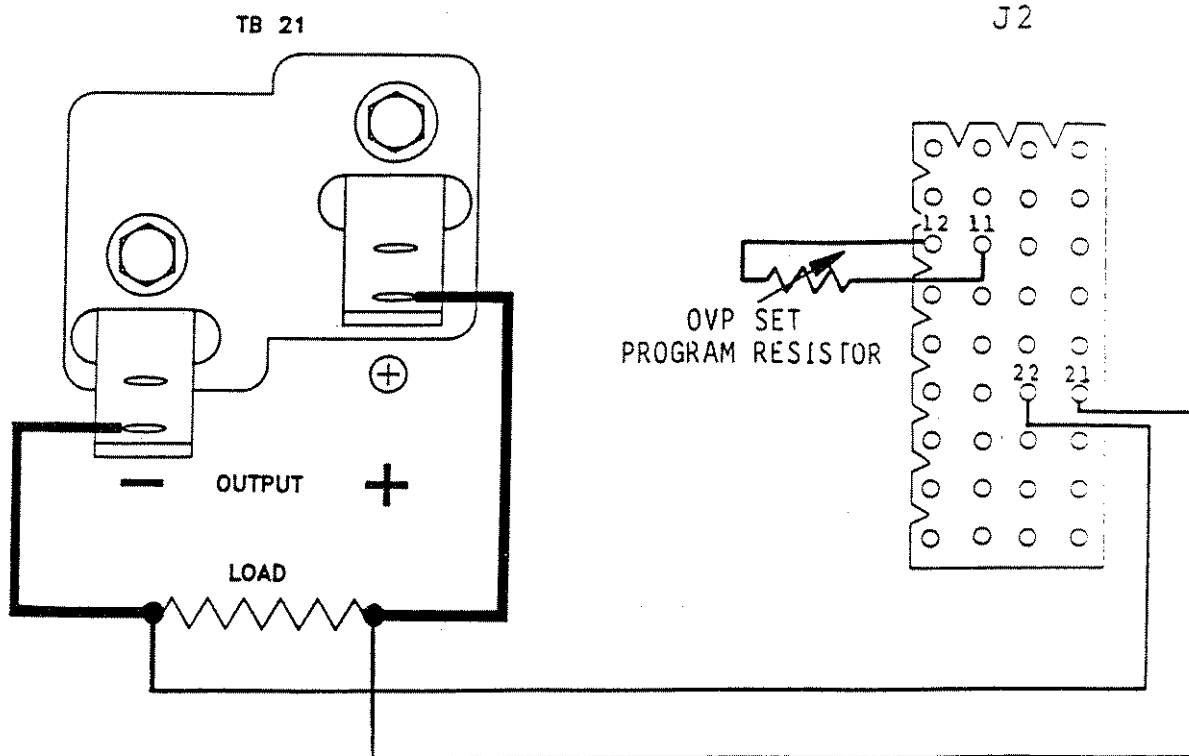
This value (9,231 ohms) would externally program the 16 volt full scale unit OVP Trip Set Point to 8 volts.

To adapt the unit to external resistance programming of the OVP Trip Point, proceed as follows:

- A. Set unit ON/OFF switch to OFF and the Main Disconnect switch to OFF.
B. Set the front panel OVP set adjustment fully clockwise.
C. Connect the program resistor from J2 pin 12 (Remote OVP Set) to J2 pin 11 (Virtual Ground). See Figure 3.6 for diagram of OVP set programming connections.

NOTE

The remote programmed OVP set point may be read on the front panel voltage meter by depressing the OVP Set switch (see paragraph 3.6).



**Figure 3.6 External OVP Resistance Programming
(With Remote Sense)**

3.9 EXTERNAL SIGNAL PROGRAMMING

The unit output voltage, current and OVP set point, may be externally programmed to provide a variable output as a function of an input voltage signal. This is done by introducing the external signal to the current source outputs provided for programming voltage, current, and OVP set.

External Signal Programming Constants are as follows:

- 10 volts for 100% Output Setting.
- 1 volt for 10% Output Setting.
- 0.1 volt for 1% Output Setting.

NOTE

When unit is set for external programming, both voltage and current settings must be externally programmed. Both front panel output adjustment controls are disabled. If either programming line is open, the unit will go to zero and the front panel remote indicator lamp will flash. The OVP is unaffected.

3.9.1 Voltage and Current Mode

Remote signal programming sensitivity is 0 to 10 volts for 0 to full scale output for all models in both voltage and current mode.

In selecting a signal source, the following should be considered:

1. The source must be capable of sinking approximately 1 mA (the Programming Current).
2. A floating (ungrounded) source must be used. All signal programming voltages will, however, have a common return.
3. To obtain a full scale voltage or current output range, the source provides a 0 to 10 volt signal.

To adapt the unit to external programming, follow the procedure as outlined in paragraph 3.6.1, with one exception.

EXCEPTION: When Step C calls for connection of a resistor across the programming terminals on J2, instead connect the signal source. See Figure 3.7 for connections and observe the program signal polarity.

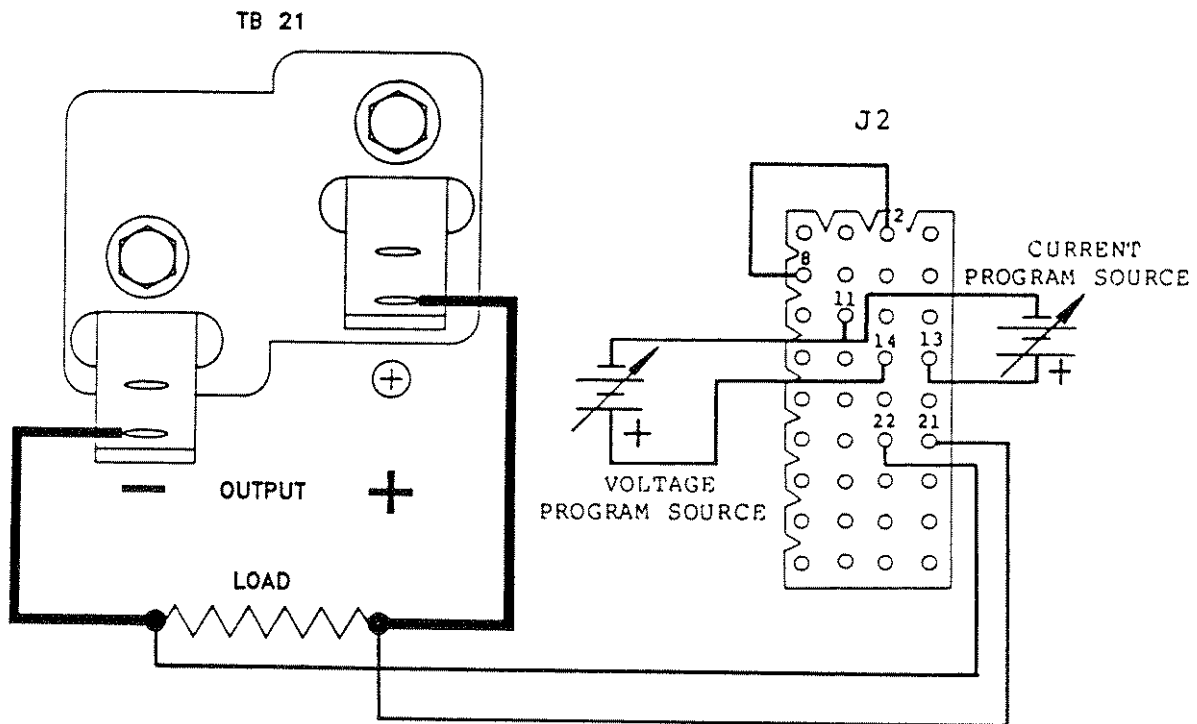


Figure 3.7 External Signal Programming
(With Remote Sense)

3.9.2 OVP Set

The unit OVP Trip Point may be externally signal programmed. This would be desirable in those applications where one or more OVP Trip Points are required to be different from the OVP Trip Set Adjustment.

NOTE

External OVP Set programming is independent of external voltage and current mode programming. The jumper from J2 pin 2 to J2 pin 8 is not required to remote program the OVP Trip Set Point.

The OVP Trip Set signal programming sensitivity is 0 to full scale output for all models. The signal source requirements are the same as for the voltage and current mode signal programming source (see paragraph 3.7.1), with one exception.

EXCEPTION: The signal source value must go to 11 volts for applications where the unit is operating at Full Scale output. This allows the OVP Trip to be set to approximately 110% of the Full Scale output voltage to avoid nuisance tripping.

To adapt the unit to external signal programming of the OVP Trip point, follow the procedures outlined in paragraph 3.6.3, with one exception.

EXCEPTION: Where step C calls for connection of a resistor across the programming terminals of J2, connect the signal source instead. See Figure 3.8 for connections and observe the program signal polarity.

NOTE

The remote programming OVP set point may be read on the front panel voltage meter by depressing the OVP Set switch.

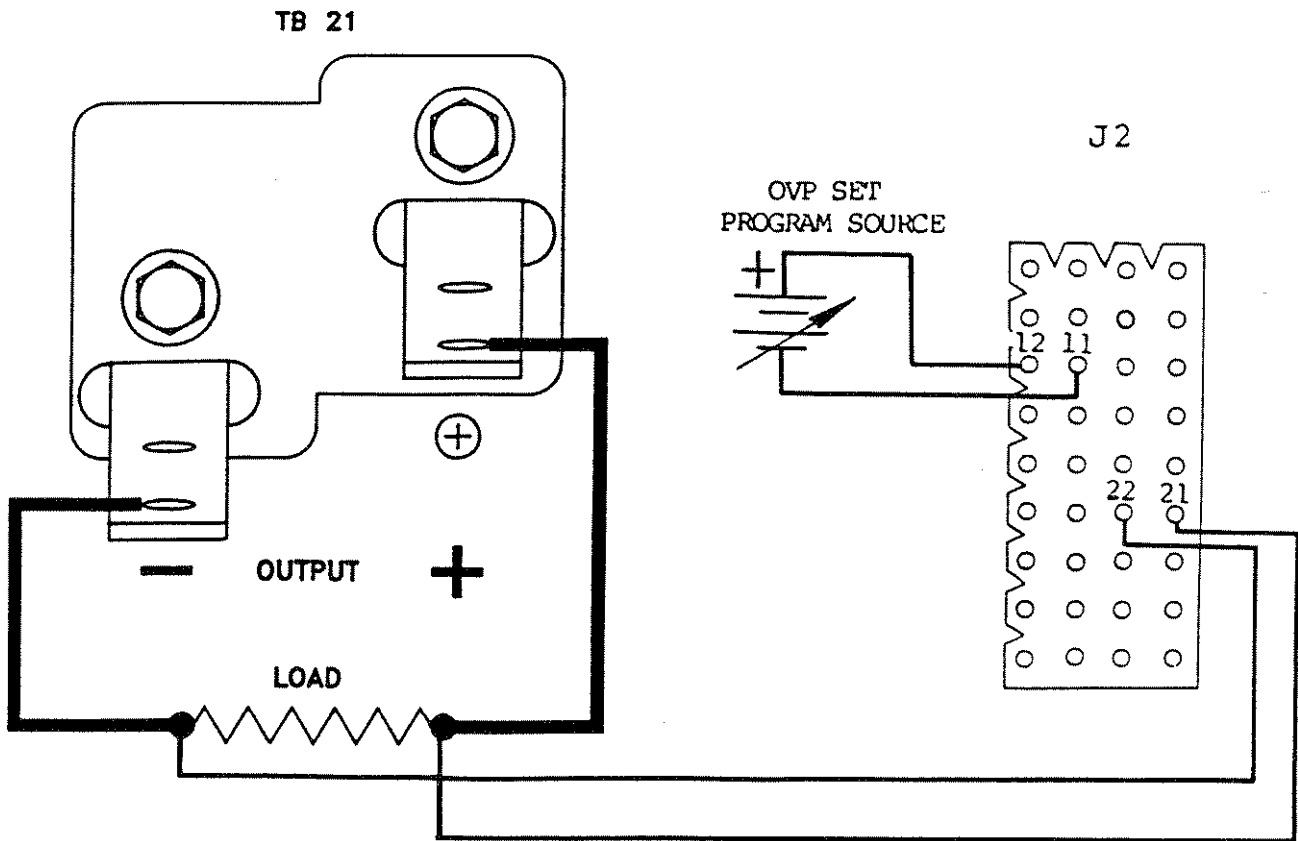


Figure 3.8 External OVP Signal Programming
(With Remote Sense)

3.10 PARALLEL OPERATION

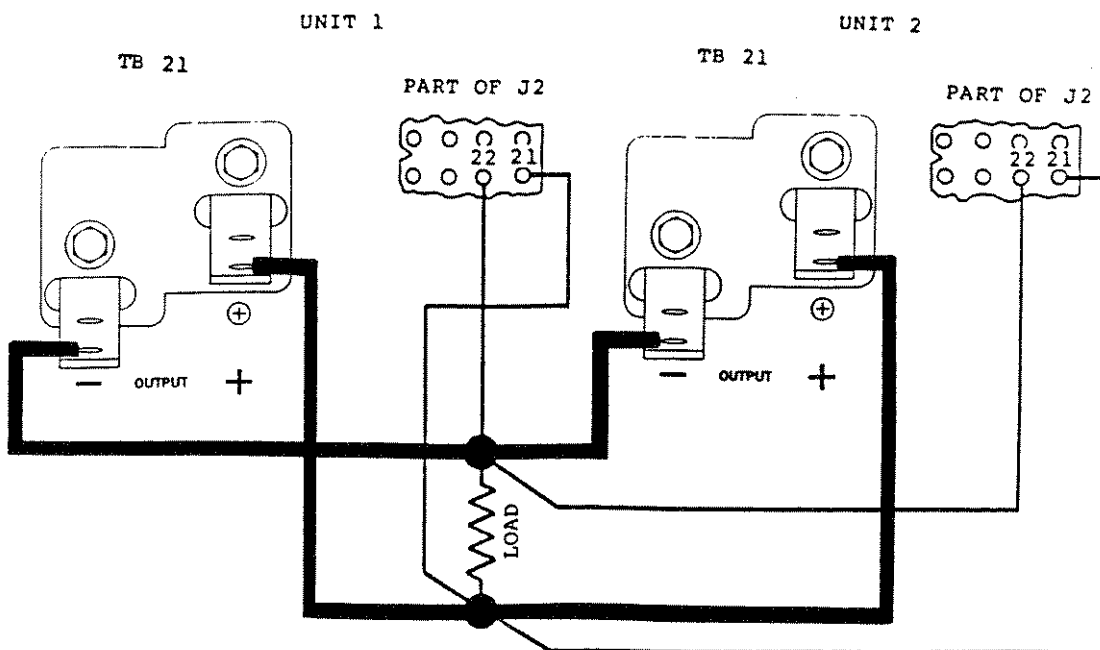
Paralleling of three-phase DCR-T units is accomplished directly by connecting the individual supplies to the load. Using this method, no current derating due to composite tolerances of wire resistance, components, etc., is required. There are no restrictions on the number of units that may be paralleled. However, paralleling units does result in lower overall regulation.

NOTE

The paralleled units may be adapted for remote sensing as illustrated in Figure 3.9. They may also be adapted for resistance programming. None of these are required for paralleled operations, however.

The following lists the procedures to be followed in directly paralleling two units. The procedure is applicable to any number of units, however. (See Figure 3.9 for connections.)

- A. Set the ON/OFF switch of both units to OFF. Disconnect main power to both units by setting the Main Power Disconnect switch to OFF.
- B. If applicable, disconnect output lines and sensing leads to both units.
- C. Re-energize the units.
- D. Rotate the VOLTAGE ADJUST control of one unit to the desired output. Repeat the procedure for the other unit. Match the two unit outputs as close as possible.
- E. Set CURRENT ADJUST AMPS control on each unit to one-half of the total desired limiting current; (e.g.) if desired, to limit load current at 15A, set each control to 7.5A, etc.
- F. Set the ON/OFF switch of both units to OFF. Disconnect main power to both units by setting the Main Disconnect switch to OFF.
- G. Connect output cables from each unit to load. If desired, connect the remote sensing leads of each unit to load.
- H. Re-energize both units. POWER ON indicators light. The unit which is supplying the highest voltage (it is possible to identically match the output voltages) will supply load. If the load requirements exceed the setting on CURRENT ADJUST AMPS control, this unit will automatically crossover to current mode operation, and its output voltage will drop. The second unit will assume that portion of the load rejected by the first. Any further increases in load will be supplied by the second unit up to its current limit setting. Regulation, therefore, will be the sum of the regulation of the two units plus the difference in the voltage settings. Set each current limit as needed to limit current to 100% of rated.



**Figure 3.9 Parallel Operation
(With Remote Sense)**

3.11 SERIES OPERATION

Series operation allows the user to connect as many as five 10 or 32 volt DCR-T units in series. Only three of the 55, 80 and 110 volt units and only two of the 160 volt units may be connected in this manner, while the 300 and 600 volt units may not be connected in series configuration. No derating is inherent in series operation and regulation is the sum of the regulation of all units.

NOTE

Series units may be connected for remote sensing as indicated in Figure 3.10, or they may be adapted to resistance or signal programming. None of these, however, are required for series operation.

The following outlines procedures for connecting two units in series. The same procedure may be used for series connecting up to five units. (See Figure 3.10 for schematic of connections.)

- A. Set desired voltage output of each unit at no load using VOLTAGE ADJUST. Select current limiting value.
- B. Set the ON/OFF switch of both units to OFF. Disconnect main power to both units by setting the Main Disconnect switch to OFF.
- C. Connect an output lead from the positive output terminal of one unit (for the sake of clarity, call this unit 1) to the negative output terminal of unit 2.
- D. Connect an output lead from unit 1 (negative terminal) to the load; connect the other output lead from unit 2 (positive terminal) to the load.

CAUTION

In series operation, rectifiers must be connected across each set of output terminals as shown in Figure 3.10. Failure to do so may result in damage to output capacitors. See paragraph 3.11.1 for information on rectifier selection.

- E. If remote sensing is desired, proceed as follows:
 - 1. Connect a sensing lead from the (- SENSE) terminal on unit 1, remote connector J2, to the load termination of unit 1 negative output lead.
 - 2. Connect a sensing lead from the (+ SENSE) terminal on unit 1, remote connector J2, to the negative output terminal of unit 2.
 - 3. Connect a sensing lead from the (- SENSE) terminal on unit 2, remote connector J2, to the negative output terminal of unit 2.
 - 4. Connect a sensing lead from the (+ SENSE) terminal on unit 2, remote connector J2, to the load termination of unit 2 positive output lead.

- F. Re-energize both units. POWER ON indicator lights. Each unit operates as a separate entity, with the output of each independently adjustable. Each may be turned ON and OFF separately. (The rectifiers protect the OFF unit.)

3.11.1 Series Operation Rectifier

When operating units in series, connect rectifiers across the individual unit outputs. Assure the diodes have current and voltage capability at least equal to its associated supply. Adequate heatsinking must be used. (See Figure 3.10.)

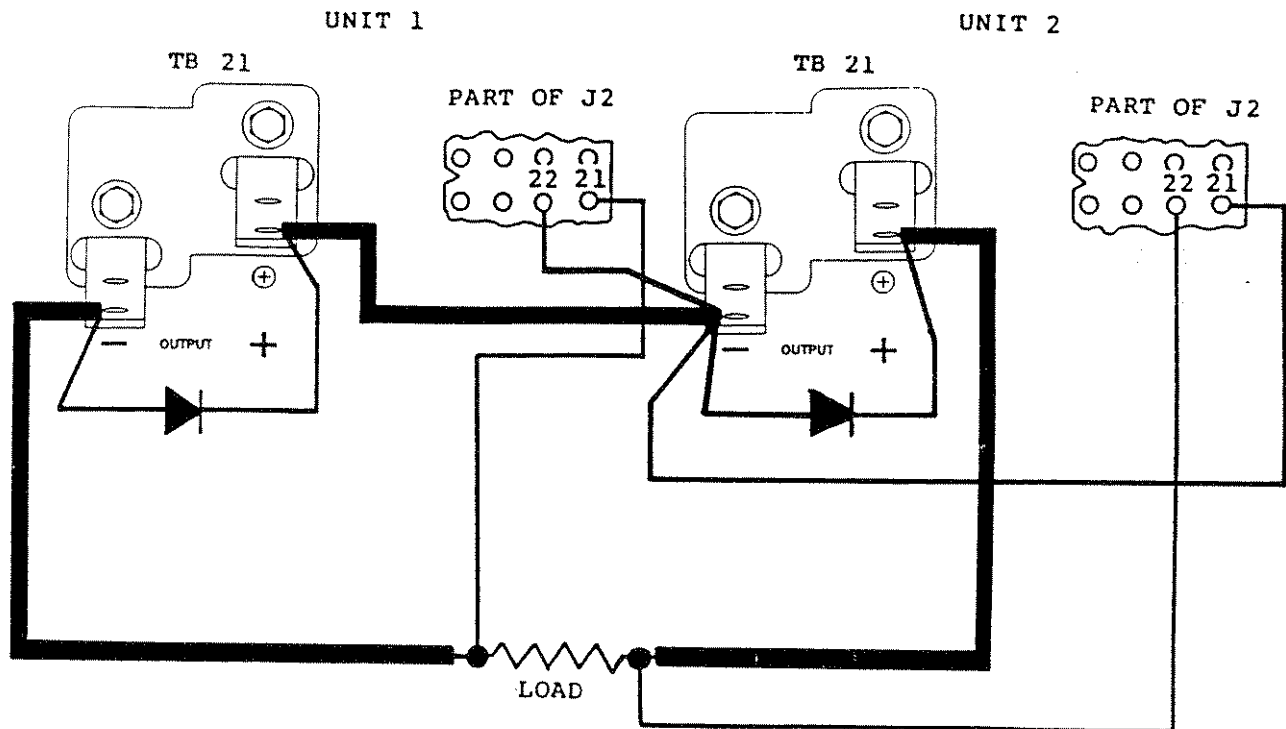


Figure 3.10 Series Operation
(With Remote Sensing)

3.12 REMOTE SHUTDOWN

The unit output voltage and current may be remotely shutdown without putting the unit into the Stand-By mode. The shutdown circuit is activated by connecting J2 pin 15 (SHUTDOWN) to J2 pin 18 (MODE PLS). This connection may be made by means of a switch or relay. A transistor switch may also be used. (See Figure 3.11 for typical remote shutdown configuration.)

NOTE

The voltage magnitude on J2 pin 18 is +15 VDC referenced to J2 pin 2 (LOGIC GND).

3.13 REMOTE AC CONTROL

The front panel START and STOP functions may be remotely controlled through the J1 connector on the rear panel. This would be useful in those applications where the unit could be cycled between the Stand-By and ON modes.

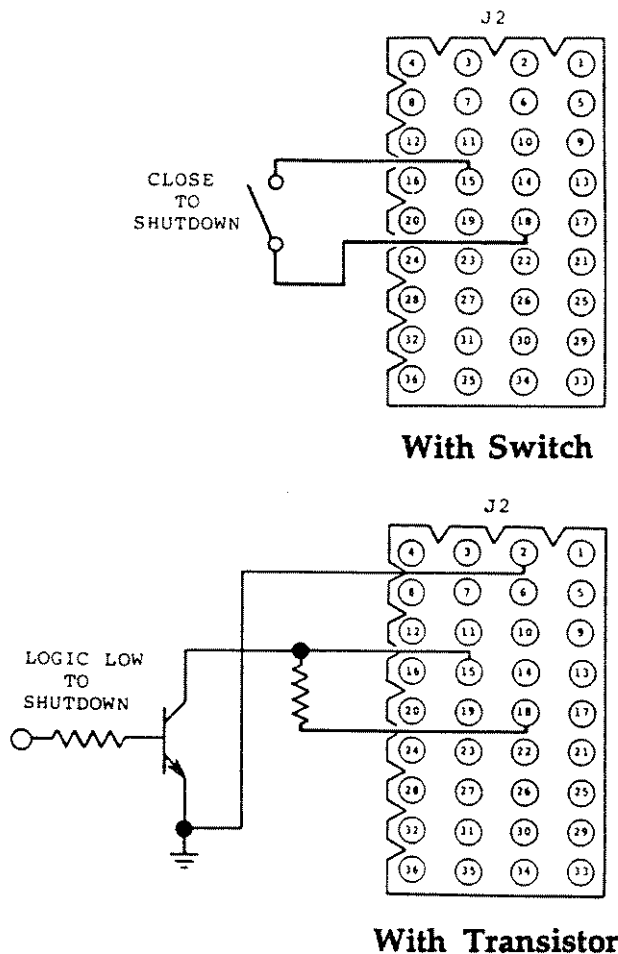


Figure 3.11 Remote Shutdown

3.14 REMOTE INDICATORS

The front panel status, voltage mode and current mode indicators, may be remotely accessed on the J2 connector. The indicator drivers may be used to turn on a remote indicator lamp or activate a remote circuit.

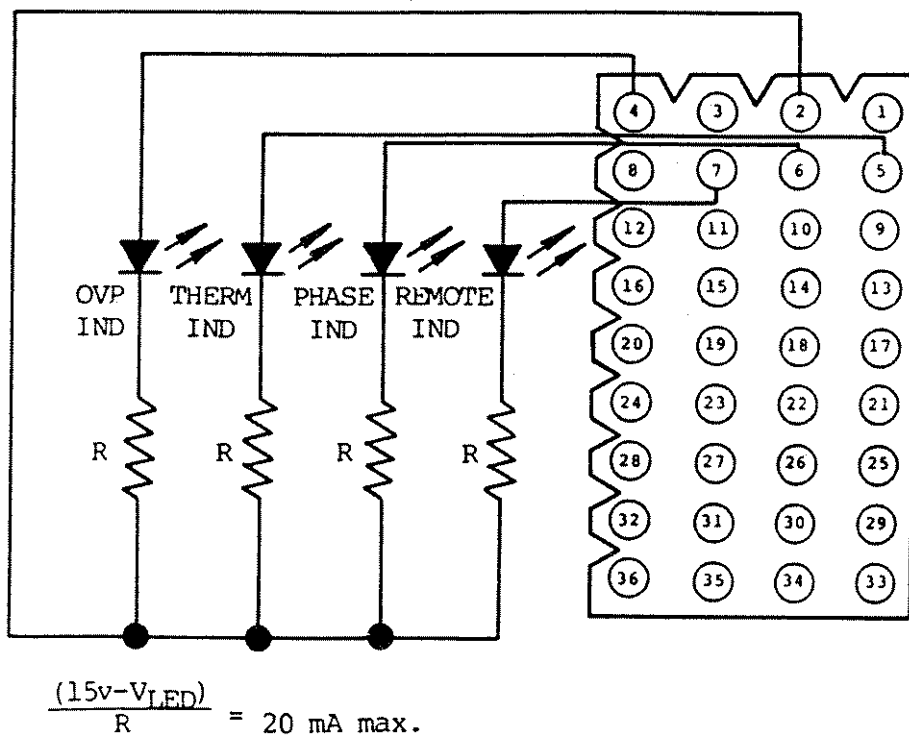
3.14.1 Status Indicator Drivers

The following indicator drivers are available on the J2 connector:

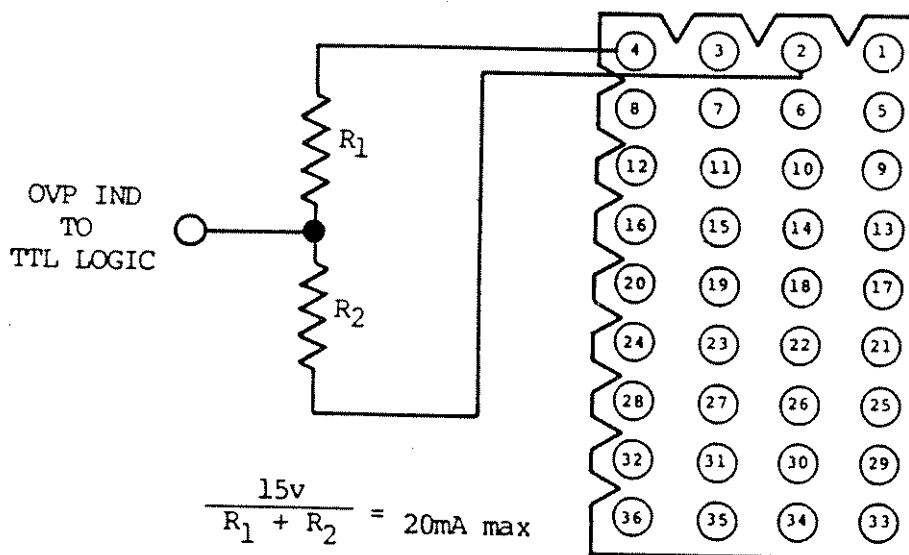
INDICATOR	J2
OVP	Pin 4 (OVP IND)
THERM	Pin 5 (THERM IND)
PHASE	Pin 6 (PHASE IND)
REMOTE	Pin 7 (OPERATE REMOTE IND)

NOTE

All status indicator driver voltage levels are +15 VDC when activated. The maximum load current per driver is 20 mA, therefore, a current limiting resistor must be used. The circuit common for all status indicators is J2 pin 2 (LOGIC GND). (See Figure 3.12 for typical remote status indicator configurations).



With Remote Led Indicators



Interface to TTL

Figure 3.12 Remote Status Indicators

3.14.2 Mode Indicator Functions

Two voltage and current mode indicator functions are available on the J2 connector. The first is a mode indicator driver on J2 pin 19 (MODE DRIVE) and the second is an open collector mode flag on J2 pin 20 (MODE IND). The same precautions observed for the Status Indicator Drive (paragraph 3.14.1) also applies to the Mode Indicator Functions. (See Figure 3.13 and 3.14 for typical mode indicator configurations).

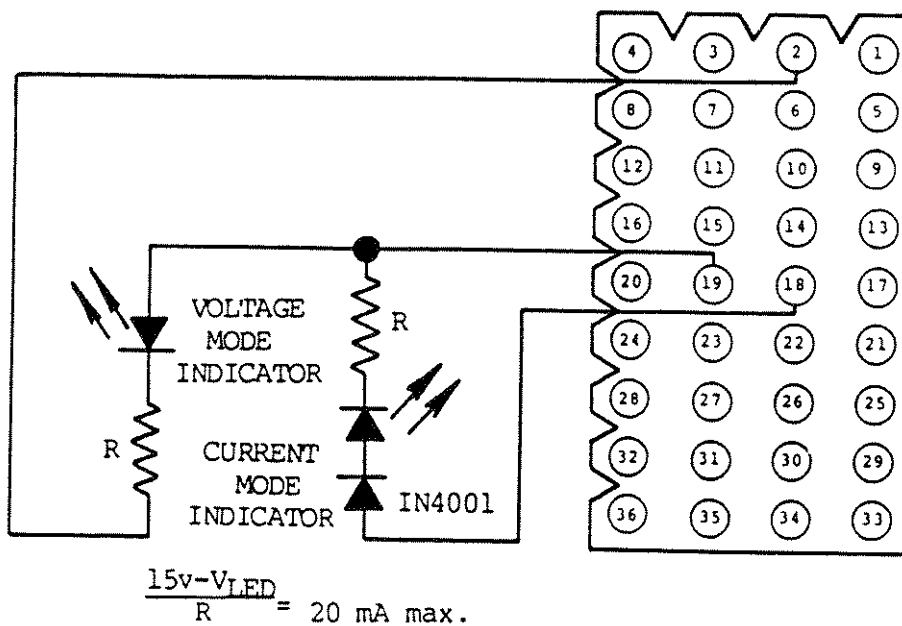


Figure 3.13 Remote Led Mode Indicators

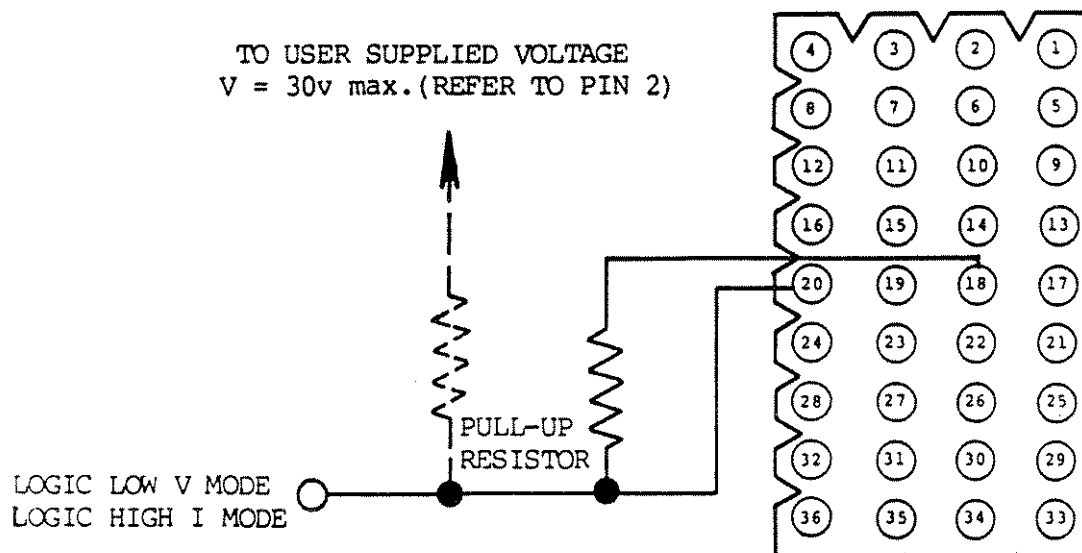


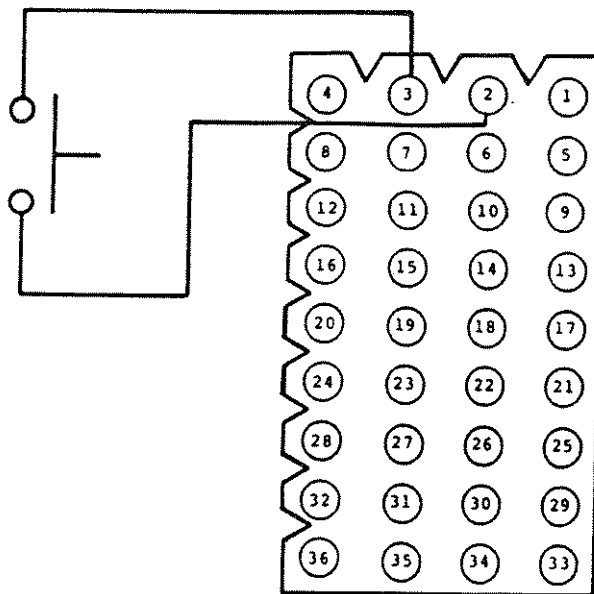
Figure 3.14 Mode Flag

3.15 REMOTE RESET

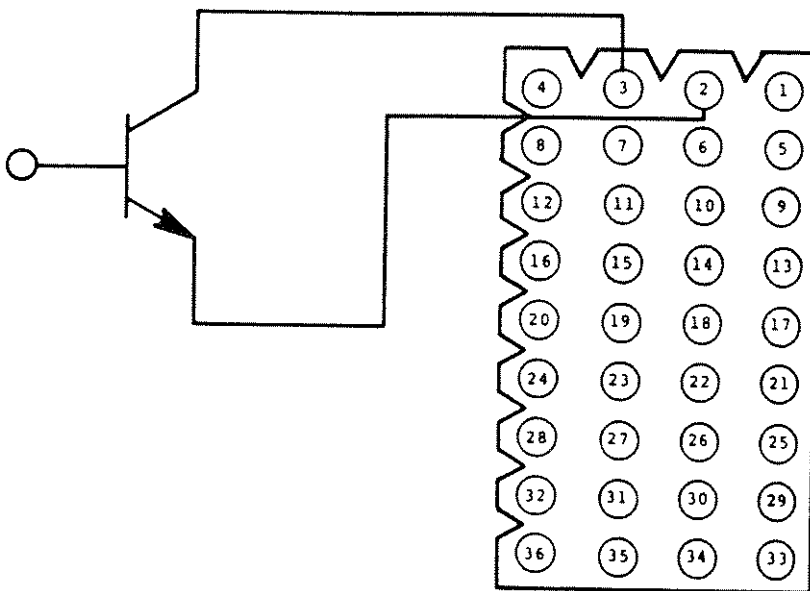
The front panel RESET function may be remotely activated. See paragraph 3.7 for details on the RESET function. The RESET function is activated by momentarily connecting J2 pin 3 (RESET) to J2 pin 2 (LOGIC GND). A momentary switch or transistor circuit may be used. (See Figure 3-15 for typical remote RESET configurations).

NOTE

The RESET current is approximately 1 mA when connected to J2 pin 2. Use a switch or transistor rated for 15 VDC minimum.



With Momentary Switch



With Transistor Switch

Figure 3.15 Remote Reset

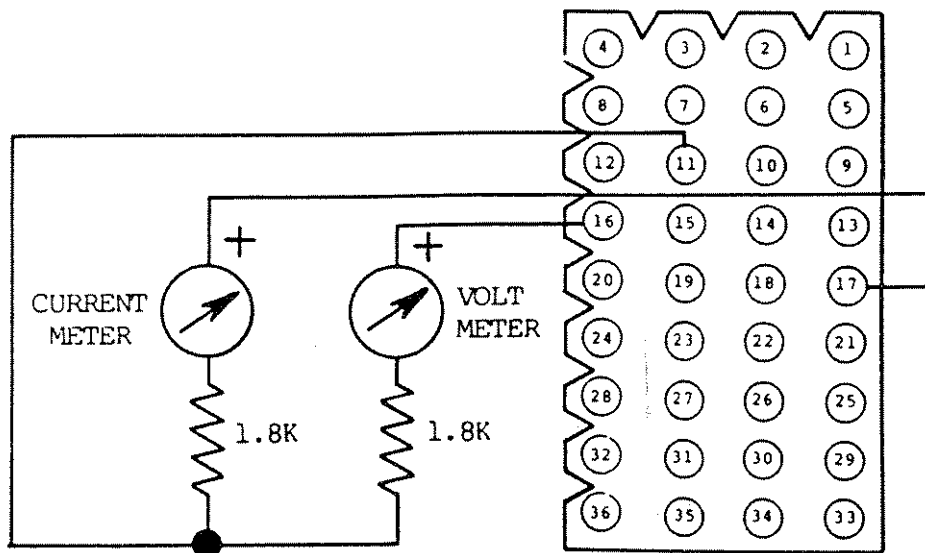
3.16 REMOTE VOLTAGE AND CURRENT MONITOR

The output voltage and current may be monitored from the J2 connector. Two 0 to 1 mA proportional current sources are provided. One each for voltage and current monitoring.

NOTE

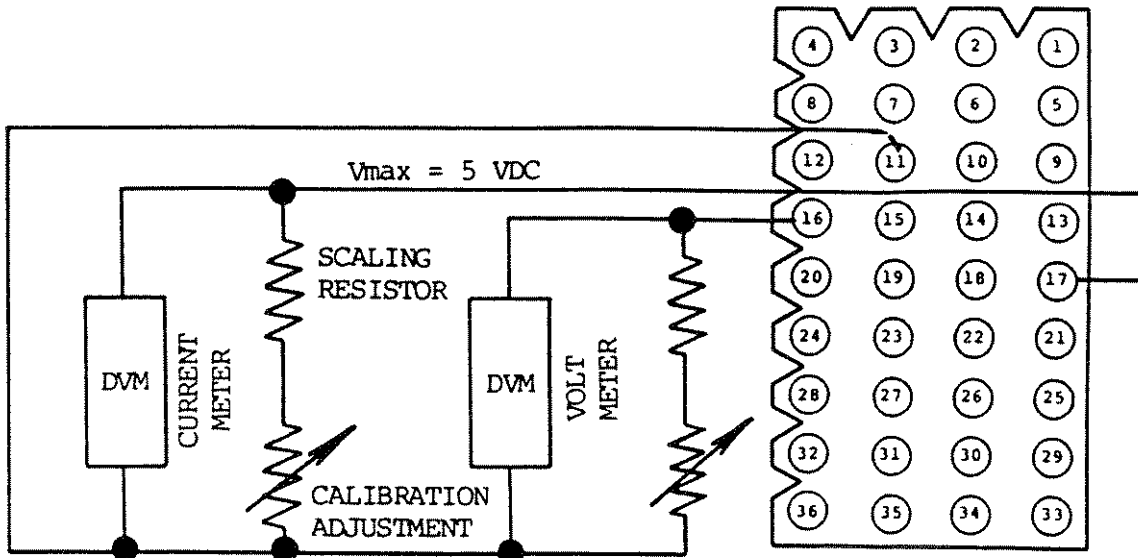
The remote monitor current source levels are identical to the internal current sources used to drive the front panel meters. These meters are 1 mA full scale meters. Since the full output ratings of the unit are approximately 80% of the front panel meter full scale, the actual remote monitor current sources are 0 to approximately 0.8 mA for 0 to full scale voltage and current output. Some method of externally calibrating the remote meters must be provided.

The remote voltage monitor current source output is on J2 pin 16 (REMOTE VOLTAGE MTR). The remote current source output is on J2 pin 17 (REMOTE AMP MTR). The remote monitor circuit return is to J2 pin 11 (VIRTUAL GND). (See Figure 3.16 for typical remote voltage and current monitoring configurations.)



With Remote 1 mA Current Meters

Figure 3.16 Remote Voltage and Current Monitoring



With Remote Digital Voltmeters

Figure 3.16 Cont'd Remote Voltage and Current Monitoring

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