Sorensen

DC POWER SUPPLY

MODEL DCS 55-55 M62

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11-195-001-00

Safety Notice

Before applying power to the system, verify that the unit is configured properly for the user's particular application.

CE and UL recognition status of this series of power supplies is based on rack mounted application only. Use of the power supplies outside of a rack mount enclosure will expose the user to high voltage and/or high current sources. Extreme caution must be used under these circumstances.

The analog control inputs (connectors J1 and J2) on the rear panel are referenced to the negative output of the power supply. Grounding the positive output of the power supply or biasing the output of the supply above chassis potential will cause these inputs (along with the output of the supply) to have a potentially hazardous offset voltage. Exercise caution under these conditions. Under no circumstances should the output of the supply be biased more than 500 volts from chassis potential.

Installation and service must be performed only by properly trained and qualified personnel who are aware of dealing with attendant hazards. This includes simple tasks such as fuse verification.

Ensure that the AC power line ground is connected properly to the unit input connector or chassis. Similarly, other power ground lines including those to application maintenance equipment must be grounded properly for both personnel and equipment safety.

Always ensure that facility AC input power is de-energized prior to connecting or disconnecting the input/output power cables.

Warning: Lethal voltages may be present inside the power supply even when the AC input voltage is disconnected. Only properly trained and qualified personnel should remove covers and access the inside of the power supply.

During normal operation, the operator does not have access to hazardous voltages within the chassis. However, depending on the user's application configuration, HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY may be generated normally on the output terminals. Ensure that the output power lines are labeled properly as to the safety hazards and that any inadvertent contact with hazardous voltages is eliminated.

Due to filtering, the unit has high leakage current to the chassis. Therefore, it is essential to operate this unit with a safety ground.

This unit is designed to be permanently connected to the power source and as such must have a readily accessible disconnect device incorporated in the fixed wiring.

After the unit has been operating for some time, the metal near the rear of the unit may be hot enough to cause injury. Let the unit cool before handling.

These operating instructions form an integral part of the equipment and must be available to the operating personnel at all times. All the safety instructions and advice notes are to be followed.

Neither Sorensen nor any of the subsidiary sales organizations can accept responsibility for personal, material or consequential injury, loss or damage that results from improper use of the equipment and accessories.

SERVICE SAFETY NOTICES

WARNING!

HAZARDOUS VOLTAGES IN EXCESS OF 480 V RMS, 700 V PEAK MAY BE PRESENT WHEN COVERS ARE REMOVED. QUALIFIED PERSONNEL MUST USE EXTREME CAUTION WHEN SERVICING THIS EQUIPMENT. CIRCUIT BOARDS, TEST POINTS, AND OUTPUT VOLTAGES MAY BE FLOATING ABOVE CHASSIS GROUND.

WARNING!

TO GUARD AGAINST RISK OF ELECTRICAL SHOCK DURING OPEN COVER CHECKS, DO NO TOUCH ANY PORTION OF THE ELECTRICAL CIRCUITS. EVEN WHEN THE POWER IS OFF, CAPACITORS CAN RETAIN AN ELECTRICAL CHARGE. USE SAFETY GLASSES DURING OPEN COVER CHECKS TO AVOID PERSONAL INJURY BY ANY SUDDEN FAILURE OF A COMPONENT.

WARNING!

SOME CIRCUITS ARE LIVE EVEN WITH THE FRONT PANEL SWITCH TURNED OFF. SERVICE, FUSE VERIFICATION, AND CONNECTION OF WIRING TO THE CHASSIS MUST BE ACCOMPLISHED AT LEAST FIVE MINUTES AFTER POWER HAS BEEN REMOVED VIA EXTERNAL MEANS; ALL CIRCUITS AND/OR TERMINALS TO BE TOUCHED MUST BE SAFETY GROUNDED TO THE CHASSIS.

WARNING!

QUALIFIED SERVICE PERSONNEL NEED TO BE AWARE THAT SOME HEAT SINKS ARE NOT AT GROUND, BUT AT HIGH POTENTIAL.

FCC NOTICE

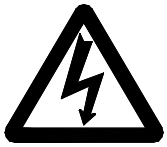
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

About This Manual

This manual has been written expressly for the Sorensen DCS Series of power supplies which have been designed and certified to meet the 1997 Low Voltage and Electromagnetic Compatibility Directive Requirements of the European Community. All units in this series comply with these directives.

Since the Low Voltage Directive is to ensure the safety of the equipment operator, universal graphic symbols (see below) have been used both on the unit itself and in this manual to warn the operator of potentially hazardous situations.

SAFETY SYMBOLS



CAUTION
Risk of Electrical Shock

Protective Conductor Terminal

CAUTION
Refer to Accompanying Documents

Alternating Current (AC)

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Chapter 1
DESCRIPTION OF EQUIPMENT

1.1 PURPOSE AND CAPABILITIES

The Sorensen DCS Series power supplies are general purpose power supplies designed specifically for laboratory test and systems applications requiring variable DC sources with good ripple and regulation characteristics. The power supplies are constant current/constant voltage supplies with an automatic crossover feature. The DCS Series models provides up to 3000 watts.

1.2 TECHNICAL CHARACTERISTICS

The physical, electrical and environmental characteristics for the DCS Series are listed in Tables 1-1 and 1-2.

Table 1-1
DCS Series Technical Characteristics

PARAMETERS	SPECIFICATIONS
PHYSICAL CHARACTERISTICS:	
Width	19.00 in.
Depth	18.00 in
Height	3.50 in.
Weight	45 lbs max.
ELECTRICAL CHARACTERISTICS:	
Input Power (Standard) Voltage	208-230 VAC (tested to 190-253 VAC)
Frequency	47 to 63 Hz
Phases	Single, 2-wire plus ground Three, 3-wire plus ground
Regulation (Line or Load) Voltage	0.1% of max. output voltage
Current	0.1% of max. output current
Transient Response	A 30% step load will recover to within 2% of original value within 10ms.
Stability	+0.05% of set point 8 hrs. after warm-up and at a fixed line, load and temp.
Remote Control/Monitor	On/Off control via contact closure, 6-120 VDC or 12-240 VAC, and TTL or CMOS switch, output voltage and current monitor, OVP limit set, and summary fault status
Power Factor	.75 min. at full load (three phase) .65 min. at full load (single phase)
Total Harmonics	2.5% max.

Table 1-1
DCS Series Technical Characteristics - Continued

PARAMETERS	SPECIFICATIONS
Remote Programming	
Resistive:	
Constant Voltage (0-100%)	0 - 5k ohms
Constant Current (0-100%)	0 - 5k ohms
Voltage:	
Constant Voltage (0-100%)	0 - 5/10 VDC
Constant Current (0-100%)	0 - 5/10 VDC
Current:	
Constant Voltage (0-100%)	0 - 1 mA
Constant Current (0-100%)	0 - 1 mA
Remote Sensing	Terminals are provided to sense output voltage at point of load.
ENVIRONMENTAL CHARACTERISTICS:	
Temperature Coefficient	0.02%/°C of max. output voltage rating for voltage set point. 0.03%/°C of max. output current rating for current set point.
Ambient Temperature	
Operating	0 to 50°C
Storage	-40° to 75°C
Cooling	Internal fans

Table 1-2
DCS Ratings

MODEL NUMBER	OUTPUT DC VOLTS	OUTPUT DC AMPS	OUTPUT RIPPLE (RMS)
55-55	0-55	0-55 (3 phase) 0-45 (1 phase)	10 mV

Chapter 2
INSTALLATION

2.1 INSPECTION

Inspect the shipping carton for possible damage before unpacking the unit. Carefully unpack the equipment. Save all packing materials until inspection is complete. Verify that all items listed on the packing slips have been received. Visually inspect all exterior surfaces for broken knobs, connectors or meters. Inspect for dented or damaged exterior surfaces. External damage may be an indication of internal damage. If any damage is evident, immediately contact the carrier that delivered the unit and submit a damage report. Failure to do so could invalidate future claims.

2.2 INPUT/OUTPUT CONNECTORS

Table 2-1 lists all external connections for the DCS Series models.

For permanently connected equipment, a readily accessible disconnect device shall be incorporated in the fixed wiring. For plugable equipment, the socket outlet shall be installed near the equipment and shall be easily accessible.

Take precautions to ensure that the concentration of ozone is limited to a safe value. The recommended long-term exposure limit for ozone is 0.1 PPM (0.2 mg/m^3).

NOTICE

For proper connection to the mains, a 100 amp or less circuit breaker or fuse is required.

2.3 LOCATION AND MOUNTING

The DCS models are intended for mounting in a standard 19.0-inch equipment rack. Four captive screws, two on each side of the front panel, are used to secure the unit in place.

NOTICE

The unit should be provided with proper ventilation. The rear and both sides of the unit should be free of obstructions.

Follow the instructions in Chapter 3 for setup and operation of the equipment.

Table 2-1
DCS Series Input/Output Connectors

CONNECTOR	FUNCTION	CONNECTS TO
FL1 - AC FL1 - AC FL1 - AC CHASSIS - GND	1 or 3 phase AC 1 or 3 phase AC 3 phase AC	190-253 VAC (Std) 47-63 Hz
Pos. Bus Bar Neg. Bus Bar	Output Power	User load(s)
J1	Control Interface	See Table 3-2 for a description

Chapter 3
OPERATING INSTRUCTIONS

3.1 CONTROLS AND INDICATORS

Front panel controls and indicators for the DCS are identified in Figure 3-1. Table 3-1 provides a description of all operator controls and indicators.

Figure 3-1
DCS Series Controls and Indicators

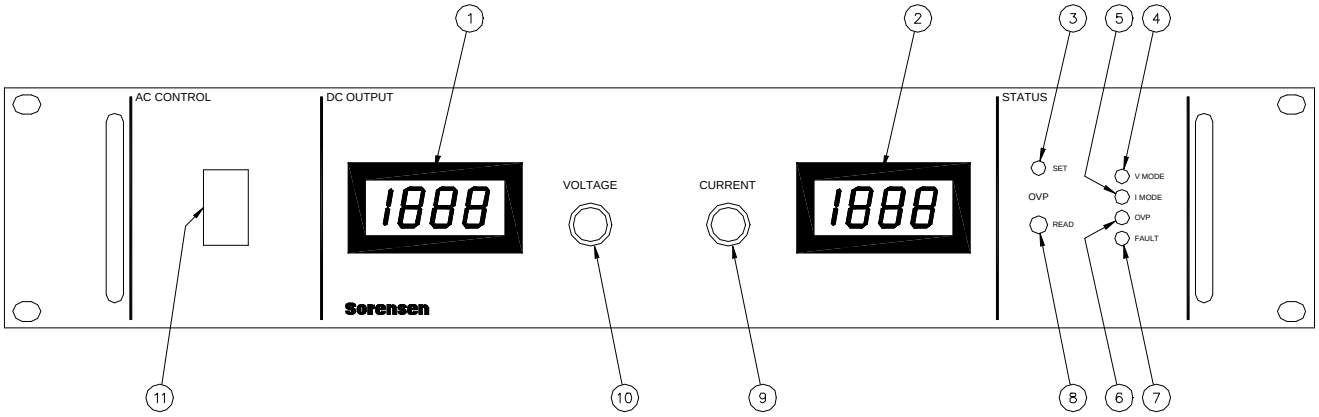


Table 3-1
DCS Series Controls and Indicators

FIGURE & INDEX NO.	CONTROL/INDICATOR	FUNCTION
3-		
-1	VOLTAGE Meter	Measures voltage output.
-2	CURRENT Meter	Measures current output.
-3	Overvoltage Potentio-meter	Adjusts overvoltage trip level.
-4	Voltage Mode Indicator	Indicates the power supply is operating in the voltage mode.
-5	Current Mode Indicator	Indicates the power supply is operating in the current mode.
-6	Overvoltage Indicator	Indicates output voltage has exceeded preset level, and power supply output is turned off.
-7	Fault Indicator	Indicates internal fault such as bias supply, thermal, or converter failure.
-8	Readback Overvoltage	Reads back the actual overvoltage trip level on the voltage meter display.
-9	Local Output Current Control	Adjusts current output to a desired level.
-10	Local Output Voltage Control	Adjusts voltage output to a desired level.
-11	ON/OFF Switch	Applies bias power to the power supply.

Table 3-2
Connector J1 Designations and Functions

J1 DESIGNATOR	SCHEMATIC SYMBOL	FUNCTIONAL DESCRIPTION
1	ISO ON/OFF	Isolated remote on/off. Externally supplied AC/DC voltage source for on/off control. A positive(+) voltage will turn on the supply. This input control is optically isolated from the power supply circuit up to 500 VDC.
2	ISO RTN	Isolated circuit return used with isolated on/off control J1-1 and J1-14.
3	REM OV SET	Remote overvoltage set. A remote signal sets the overvoltage trip level. 0-5 VDC = 0-100%.
4	VP RTN	Voltage programming return. Used with J1-9, J1-15 or J1-21 and must be referenced to or within ±3V of the circuit common.
5	ON/OFF	Remote on/off. Switch/relay contacts or a direct short between this terminal and circuit common turns on the unit.
6	COM	Common Circuit
7	I MON	Output current monitor. 0-10 VDC equals-100% rated current.
8	V SET	0-5 VDC local voltage control monitor
9	VP 5V	Remote voltage programming using a 0-5 VDC source.
10	IP 5V	Remote current programming using a 0-5 VDC source.
11	ISET	0-5 VDC local current control monitor.
12	VSNS-	Negative voltage sensing terminal.
13	VSNS+	Positive voltage sensing terminal.
14	ISO TTL/CMOS	Isolated TTL/CMOS on/off control. A high state TTL/CMOS voltage turns on the power supply, and a low state or open connection turns the supply off.

Table 3-2
D-Shell Connector J1 Designations and functions - Continued

J1 DESIGNATOR	SCHEMATIC SYMBOL	FUNCTIONAL DESCRIPTION
15	VP 10V	Remote voltage programming using a 0-10 VDC source.
16	IP 10V	Remote current programming using a 0-10 VDC source.
17	FAULT	Fault state. A high state indicates a converter, temperature or bias supply fault, and the LED on the front panel will illuminate.
18	S/D FAULT	Shutdown fault. This terminal goes to high state in the event a converter, temperature, overvoltage or bias supply fault.
19	V MON	Output voltage monitor. 0-10 VDC equals to 0-100% rated voltage.
20	VP RTN	Voltage programming return. Used with J1-9, J1-15 or J1-21 and must be referenced to or within ±3V of the circuit common.
21	VP RES	1 milliamp current source for remote voltage programming using resistance. 0-5k ohm resistor referenced to common will program the output voltage from 0-100%.
22	IP RES	1 milliamp current source for remote current programming using resistance. 0-5k ohm resistor referenced to common will program the output from 0-100%.
23	IP RTN	Current programming return. Used with J1-10, J1-16 or J1-22 and must be referenced to or within ±3V of the circuit common.
24	COM	Circuit common.
25	IP RTN	Current programming return. Used with J1-10, J1-16 or J1-22 for remote current programming and must be referenced to or within ±3V of the circuit common.

The following paragraphs provide setup and operating procedures for the DCS Series.

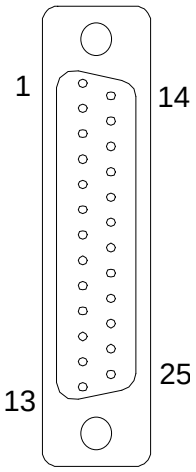


Figure 3-2
Pin-out for Connector J1

The power supply may be configured via connector J1 on the rear panel for different operating configurations: local and remote current programming, local and remote voltage programming, normal parallel, auto-parallel, normal series, auto-series, and auto-tracking. The use and operating requirements of each configuration are provided in the following paragraphs. Reference Table 3-2 for connector J1 designations and functions. See Figure 3-2 for pin-out diagram.

3.2 LOCAL OPERATION

Units are shipped from the factory configured for local voltage/current control and local voltage sensing. J1 is supplied with a mating connector with terminal 5 shorted to terminal 6. Prior to turning the unit on, rotate the voltage and current potentiometers fully counterclockwise (minimum output). Then, turn the power ON and adjust the voltage and current to the desired output.

3.3 REMOTE CURRENT PROGRAMMING

The remote current programming is used for applications that require the output current be programmed (controlled) from a remote source. An external resistance or external voltage source may be used as a programming device. When using remote current programming, a shielded, twisted-pair, hookup wire is recommended to prevent noise interference with programming signals.

External Current Programming Using Resistance. The resistance coefficient for remote current programming is 5k ohms/100% rated output with respect to terminal J1-23 (IP RTN). The programming current from terminal J1-22 (IP RES) is factory set for 1 milliamp. This yields a coefficient of 1.0% of rated output current for each 50 ohms. If multiple switches or relays are used to program different levels, make-before-break contacts are recommended. Note that if an external resistance is used for remote programming, the current programming return (IP RTN), terminal J1-23, must be connected directly to or within ±3 volts of the power supply common terminal, J1-24. See Figure 3-3 for connection requirements.

External Current Programming Using a 0-5 VDC or 0-10 VDC Voltage Source. A DC voltage source for remote current programming is connected between J1-10 (IP 5V) or J1-16 (IP 10V) and the return terminal J1-23 (IP Table 3-1. DCS

Series Controls and Indicators RTN). Note that the return terminal J1-23 (IP RTN) must be referenced directly to or within ±3V of the power supply common, J1-24. The voltage coefficient for 5V remote current programming is 50 millivolts = 1% of rated output, i.e., for a 300 amp model, each 50 millivolts of programming voltage equals 3 amps of output current. The voltage coefficient for 10V remote current programming is 100 millivolts = 1% of rated output, i.e., for a 300 amp model, each 100 millivolts of programming voltage equals 3 amps of output current. See Figure 3-4 for connection requirements.

3.4 REMOTE VOLTAGE PROGRAMMING

The remote voltage programming configuration is used for applications that require the output voltage be programmed (controlled) from a remote source. An external resistance or external voltage source may be used as a programming device. When using remote voltage programming, a shielded, twisted-pair, hookup wire is recommended to prevent noise interference with programming signals.

1. External Voltage Programming Using Resistance. The resistance coefficient for remote voltage programming is 5k ohms/100% of rated output voltage with respect to the VP RTN, J1-20. The programming current from terminal J1-21 (VP-RES) is factory set to 1 milliamp. This yields a coefficient of 1.0% of rated output voltage for each 50 ohms. If multiple switches or relays are used to program different levels, make-before-break contacts are recommended. Note that if an external resistance is used for remote programming, the voltage programming return (VP RTN), terminal J1-20, must be connected directly to or within ±3 volts of the power supply common terminal, J1-24 See Figure 3-5 for connection requirements.
2. External Voltage Programming Using a 5 VDC or 10 VDC Voltage Source. A DC voltage source for remote voltage programming is connected between J1-9 (VP 5V) or J1-15 (VP 10V) and the return terminal J1-20 (VP RTN). Note that the return terminal (VP RTN) must be referenced directly to or within ±3V of the power supply common, J1-24. The voltage coefficient for 5V remote voltage programming is 5 volts = 100% of rated output voltage. The voltage coefficient for 10V remote voltage programming is 10 volts = 100% of rated output voltage. To program voltage slightly above the rated output will not damage the unit, but degraded performance may result. See Figure 3-6 for connection requirements.

3.5 REMOTE SENSING

In applications where the load is located some distance from the power supply, or the voltage drop of the power output leads significantly interferes with load regulation, remote voltage sensing may be used. When remote sensing is used, voltage is regulated at the load versus the power supply output terminals. To connect the power supply for remote voltage sensing (see Figure 3-7 for connection requirements), perform the following procedure.

CAUTION

If the power supply is operated with load power lines disconnected and sensing line connected, internal power supply damage may occur. (Output current then flows through sensing terminals.)

Connect sensing leads from the load positive to J1-13 and the load negative to J1-12. A shielded, twisted-pair, hookup wire is recommended to avoid potential noise interference.

3.6 REMOTE OUTPUT ON/OFF CONTROL

Remote on/off control may be accomplished by contact closure or by an isolated external AC/DC or TTL/CMOS voltage source.

1. Remote on/off by contact closure. Output is on when contacts are closed. See Figure 3-8 for connection requirements.

2. Remote on/off control may be accomplished by an external 12 to 240 VAC or 6 to 120 VDC or TTL/CMOS source. Application of AC/DC or high state TTL/CMOS voltage will turn on the power supply. See Figures 3-9 and 3-10 for connection requirements.

3.7 REMOTE OVERVOLTAGE SET

A remote DC voltage source can be connected externally between terminals J1-3 (REM OV SET) and J1-6 (COM) to set the output overvoltage trip level. A 0-5 VDC signal = 100% of rated output voltage. See Figure 3-11 for connection requirements. Do not program the remote overvoltage set point greater than 10% (5.5V) above the power supply rated voltage as internal power supply damage may occur.

NOTE

The following modes of operation are used for applications requiring more current or voltage than is available from a single power supply. To meet the requirements for greater output voltage or current, two or more supplies may be connected in series or parallel.

3.8 AUTO-PARALLEL OPERATION

In the auto-parallel mode of operation, a master/slave configuration is established.

CAUTION

When using two or more supplies in parallel, damage may occur to slave(s) crowbar circuits if slave overvoltage level set is not higher than the master overvoltage level set. To prevent damage, apply a 6 VDC source between J1-3 (REM OV SET) and J1-6 (COM), or set all slave units overvoltage-set potentiometers fully clockwise; and set the master unit to the desired trip level. If overvoltage protection is not desired, set to trip at maximum rated voltage (less than fully clockwise).

To set up the auto-parallel mode of operation, connect all outputs in parallel to the load. Connect jumper from master J1-7 (I MON) to slave J1-16 (IP 10V), and the slave J1-6 (COM) must be connected to the slave J1-25 (IP RTN). Always set the slave overvoltage to maximum and the master to the desired trip level. Output currents will track automatically. If tracking is not close, perform the calibration procedures listed in Chapter 4. See Figure 3-12 for connection requirements.

3.9 AUTO-SERIES OPERATION

In the auto-series mode of operation, a master/slave configuration is established. With two or more supplies connected in series, one is established a master and the remaining units as slaves. The master supply must always be the most positive unit. Connect Rx between the master positive output and the slave J1-15 (VP 10V), and connect the slave J1-20 (VP RTN) to the slave J1-6 (COM). When operating in the auto-series mode, current control potentiometers of the slave units are active and should be set to maximum clockwise position. See Figure 3-13 for connection requirements and Rx value.

3.10 AUTO-TRACKING OPERATION

In the auto-tracking mode of operation, a master/slave configuration is established. In this configuration, two or more supplies may be connected with common negative outputs. The slave(s) output voltage is a percentage of the master as controlled by the value of Rx. Individual current controls on both master and slave(s) remain active. See Figure 3-14 for connection requirements.

For equal voltage supplies with volt-per-volt tracking, Rx = 0 ohms.

For other ratios or different voltage supplies, Rx can be calculated by using the following formulas:

Rx(kohms) = (10/SMR) - 10

SMR(Slave/Master Ratio) = (Slave Ratio)/(Master Ratio)
where Slave Ratio = slave desired Vout/rated Vout
Master Ratio = master desired Vout/rated Vout

Example: It is desired to have a slave power supply rated at 20 VDC and operated at 12 VDC, while the master power supply rated at 10 VDC is operated at 8 VDC.

The Slave Ratio = 12V/20V = .60
The Master Ratio = 8V/10V = .80

Then; The Slave/Master Ratio = .60/.80 = .75

And Rx(kohms) = (10/.75) - 10 = 13.33 - 10 = 3.33 kohms.

Note: The slave ratio must always be less than or equal to the master ratio.

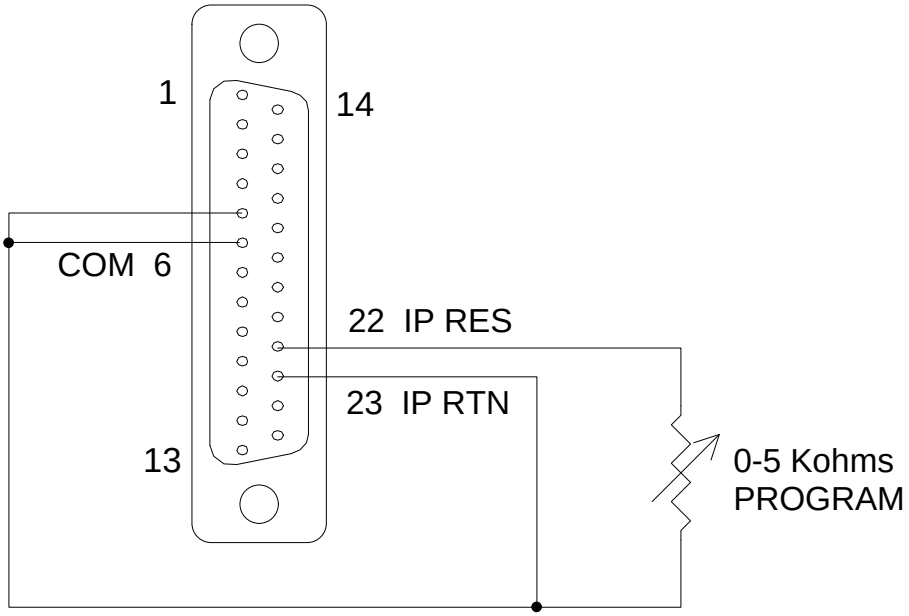


Figure 3-3
Remote Current Programming Using Resistance

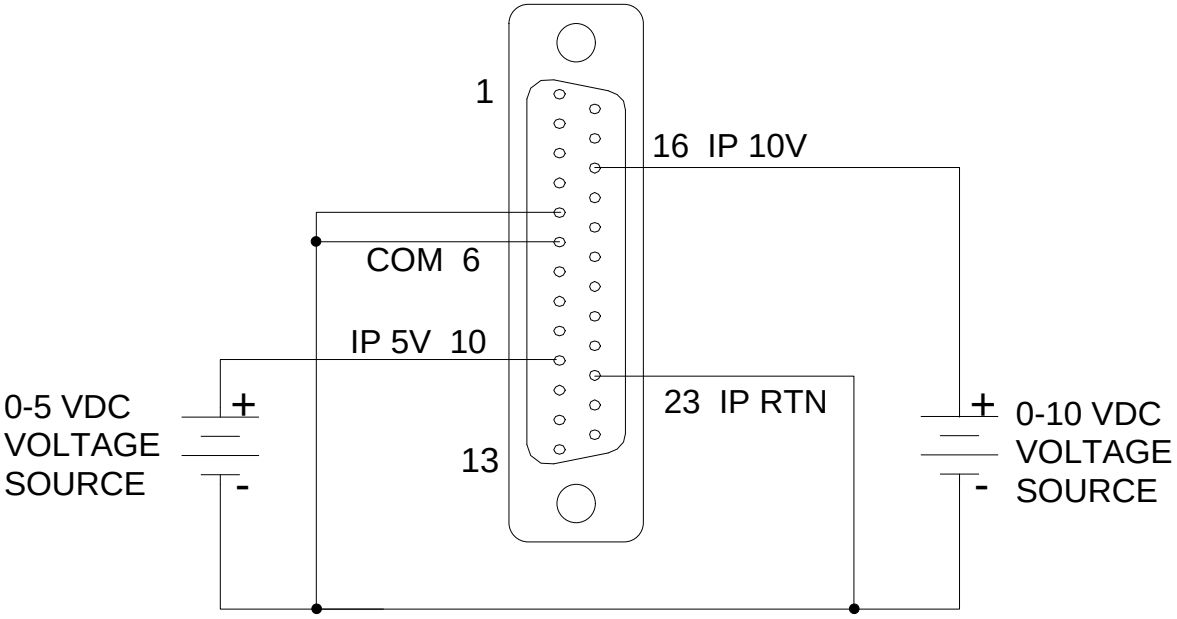


Figure 3-4
Remote Current Programming Using 0-5 VDC or 0-10 VDC Voltage Source

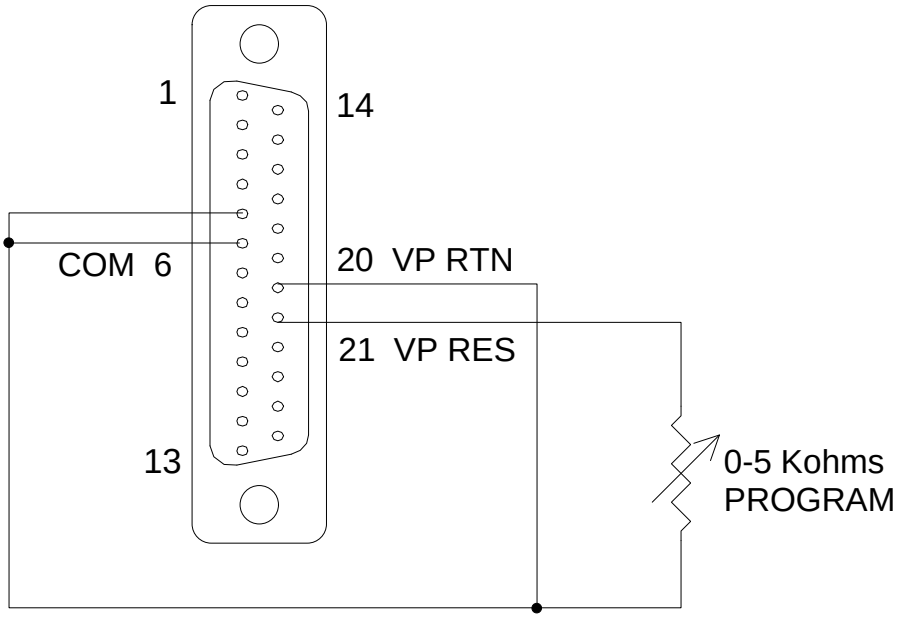


Figure 3-5
Remote Voltage Programming Using Resistance

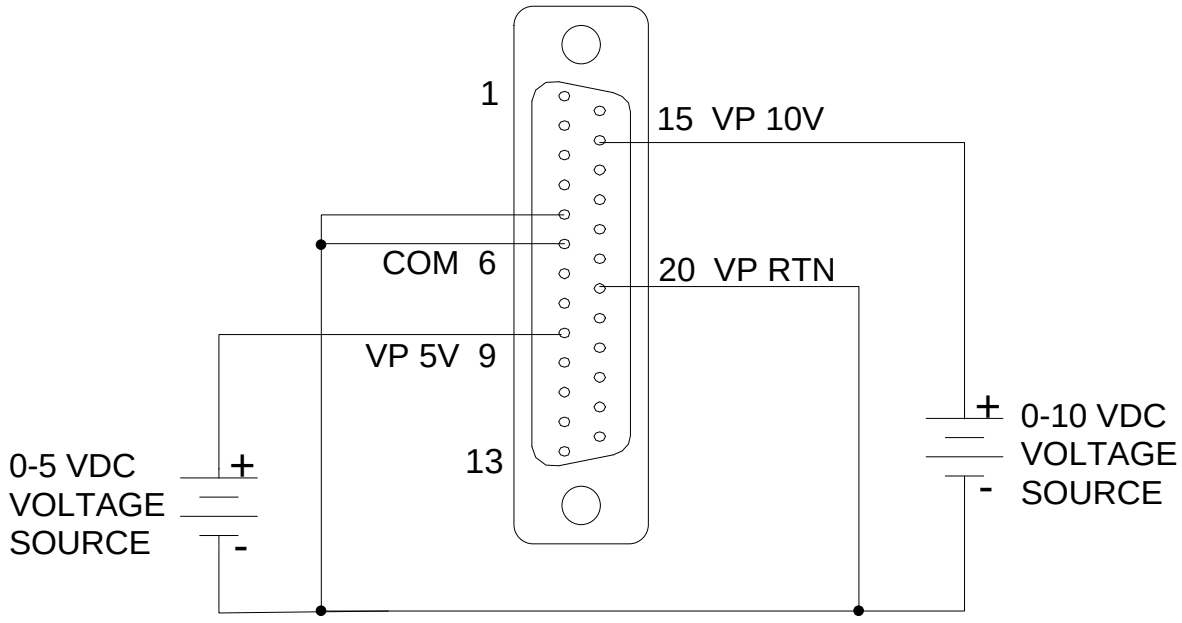


Figure 3-6
Remote Voltage Programming Using 0-5 VDC or 0-10 VDC Voltage Source

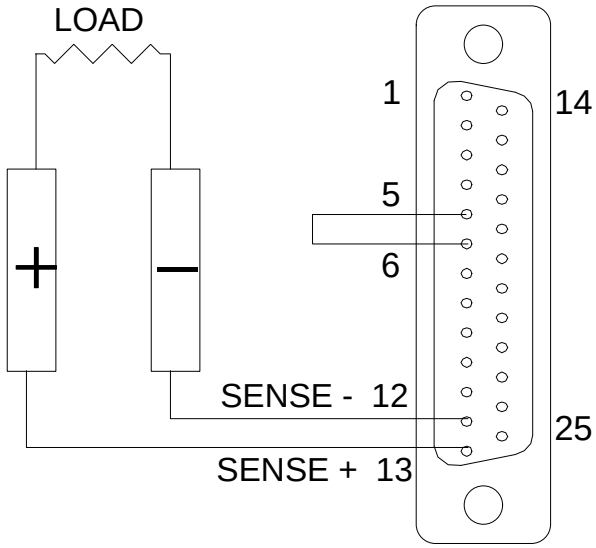


Figure 3-7
Remote Sensing Operation at the Load

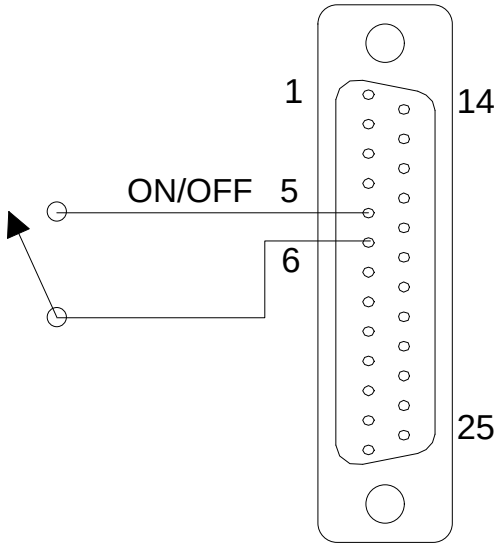


Figure 3-8
Remote On/Off Control by Contact Closure

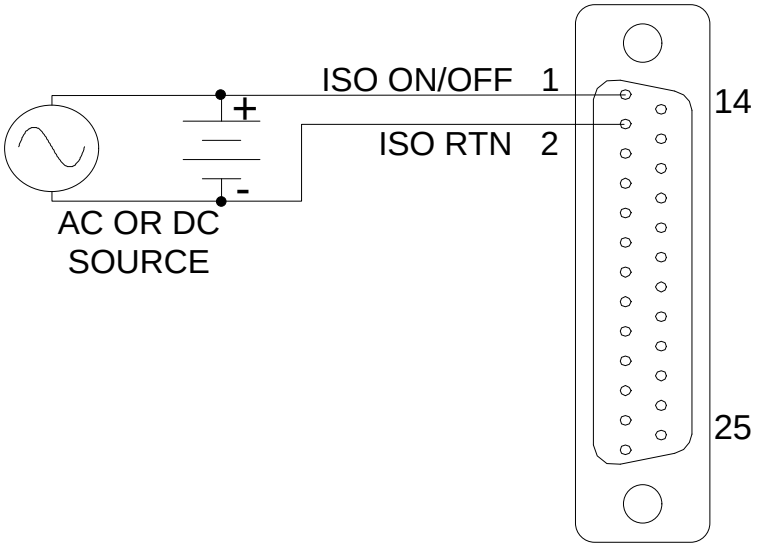


Figure 3-9
Remote On/Off Using Isolated AC or DC Voltage Source

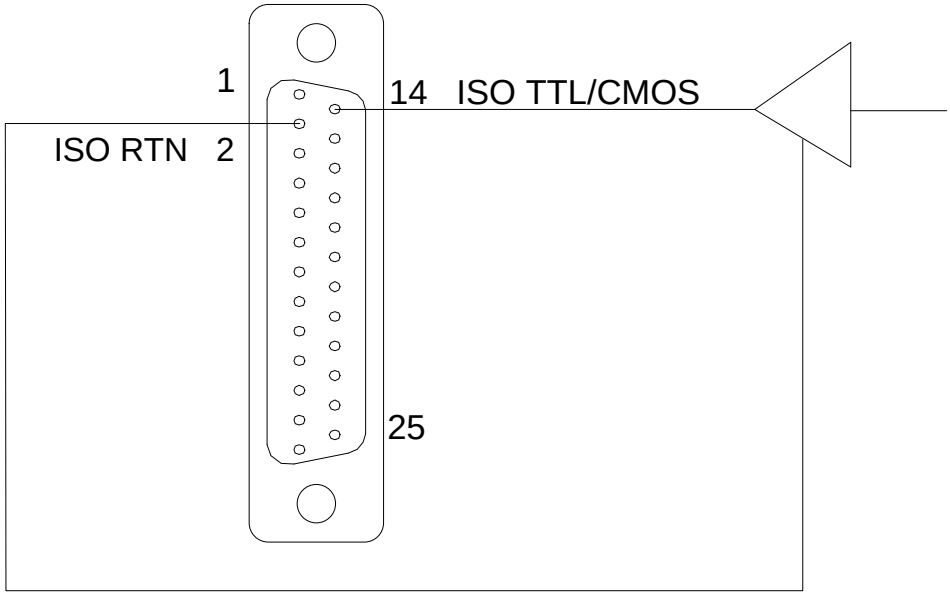


Figure 3-10
Remote On/Off Using Isolated TTL/CMOS Voltage Supply

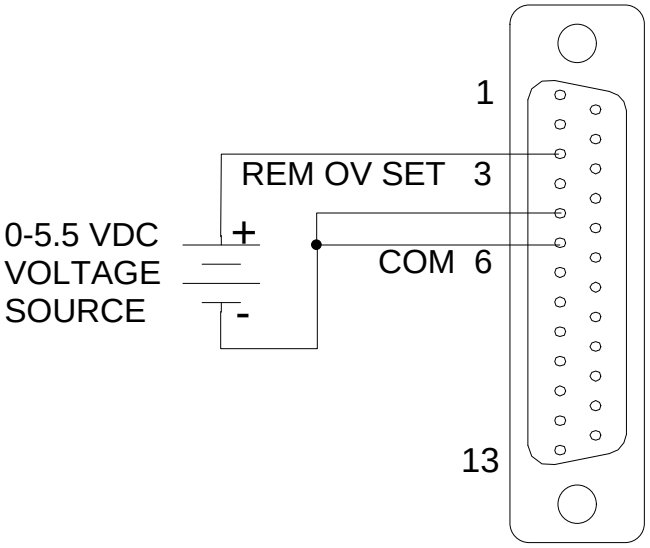


Figure 3-11
Remote Overvoltage Set Using DC Voltage Source

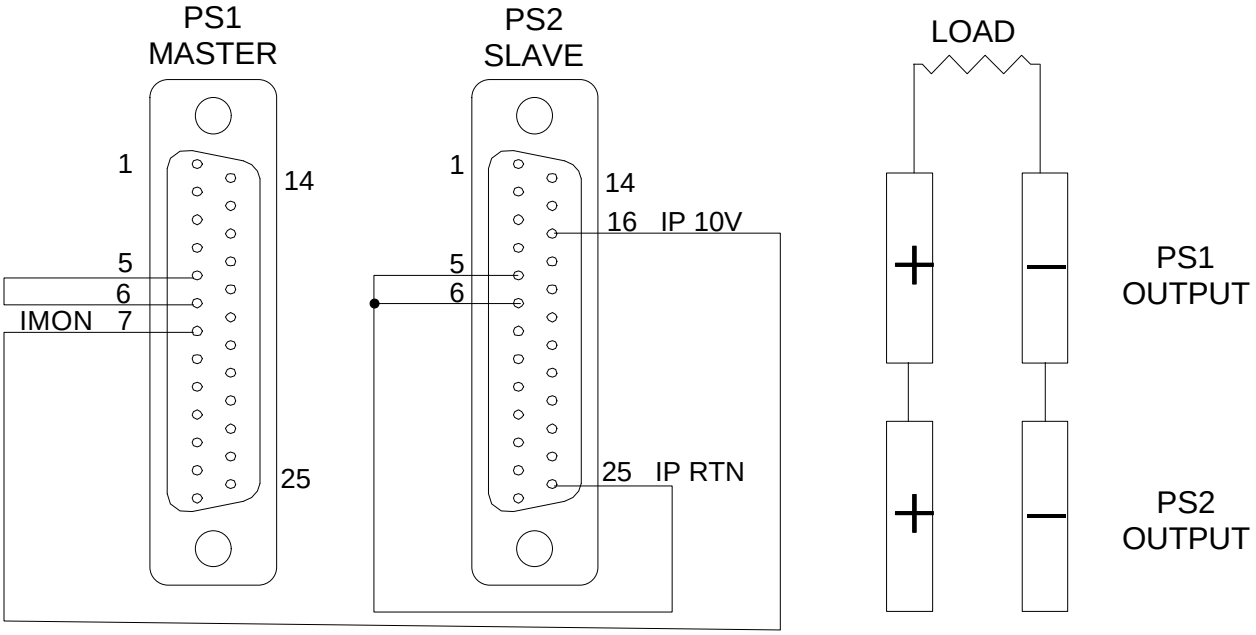
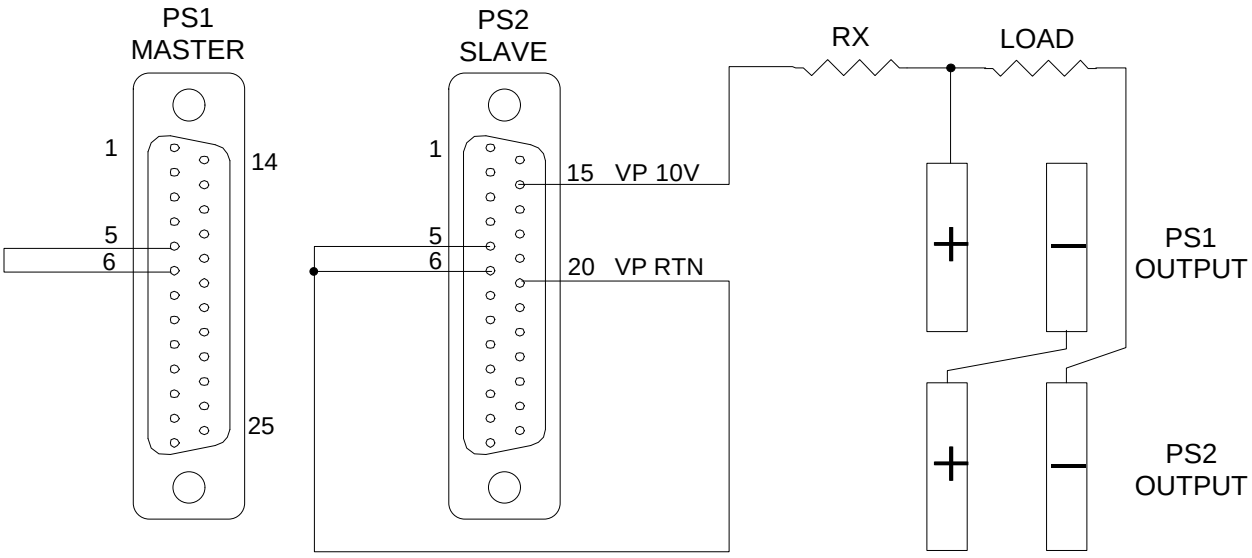


Figure 3-12
Auto-Parallel Operation



RX (K ohms) = (PS1 *RATED* Vout + PS2 *RATED* Vout) - 10
EXAMPLE: FOR A 20 VOLT RATED PS1 AND A 10 VOLT RATED PS2
RX = (20+10)-10 = 20K ohms

Figure 3-13
Auto-Series Operation

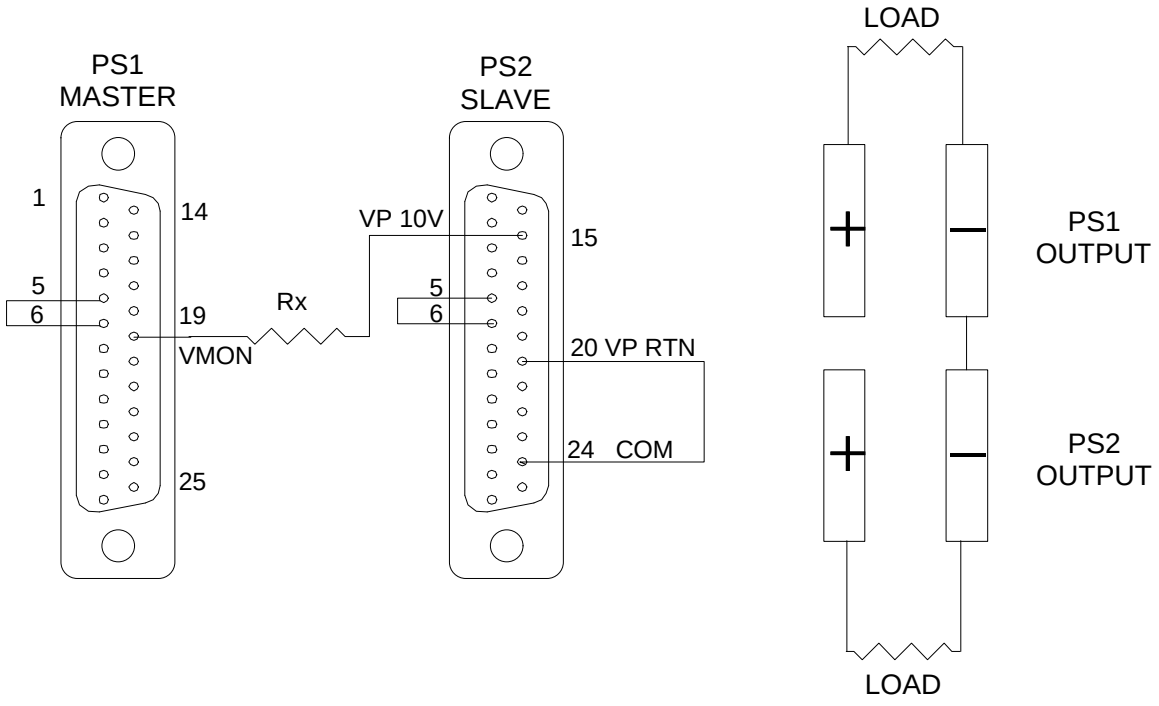


Figure 3-14
Auto-Tracking Operation

Chapter 4
MAINTENANCE AND CALIBRATION

4.1 INTRODUCTION

This chapter contains preventive maintenance information and calibration procedures for the DCS Series.

4.2 PREVENTIVE MAINTENANCE

Preventive maintenance for the DCS Series consists of scheduled inspection and cleaning.

1. Schedule. Table 4-1 lists the preventive maintenance routines and the recommended performance intervals.

2. Inspection. Table 4-2 lists the visual inspection checks to be performed. It also indicates the corrective action to be taken.

3. Cleaning. Cleaning requirements are based on the need established during inspection. If cleaning is required, follow the instruction listed in the corrective action column of Table 4-2.

Table 4-1
Preventive Maintenance Schedule

PREVENTIVE MAINTENANCE ROUTINE	RECOMMENDED PERFORMANCE INTERVAL
Inspection	Annual
Cleaning	As Required

Table 4-2
Inspection and Corrective Action

ITEM	INSPECT FOR	CORRECTIVE ACTION
Connector plugs and jacks	Looseness, bent or corroded contacts, damage or improper seating in mating connector	Clean contacts with solvent moistened cloth, soft bristle brush, small vacuum or low compressed air. Replace connectors damaged, deeply corroded, or improperly seated in mating connector.
Chassis, blower & extruded heatsinks	Dirt and Corrosion	Clean with cloth moistened with soapy water.
Electrical Wiring	Broken, burned or pinched wire; frayed, worn or missing insulation	Repair or replace defective wires.
Soldering Connections	Corrosion, loose, cracked, or dirty connections	Clean and resolder connections.
Dirt and moisture buildup	Short circuits, arcing, corrosion, overheating	Clean as required.
Front panel controls and meters	Dirt and corrosion	Clean with cloth moistened with soapy water. Use a Kimwipe tissue and GTC glass cleaning compound to clean the meter faces.

4.3 CALIBRATION AND ADJUSTMENTS

To perform the following calibration and adjustment procedures, the cover must be removed from the power supply. Because removal of the cover allows access to potentially hazardous power voltages (up to 253 VAC or 450 VDC) and because of the importance of accurate readings to performance, only technically trained personnel should perform calibration procedures.

WARNING

Hazardous voltages (up to 253 VAC or 450 VDC) during equipment operations. Press switch to OFF position and disconnect power cord from power source. Allow a minimum of 3 to 5 minutes for discharge of storage capacitance before removing the cover or performing any maintenance function.

The calibration Test Setup procedures require the following: remove prime power, then connect the power supply to a resistive load capable of full-rated voltage and current. Connect a precision current shunt in series with either the positive or negative output between the power supply and the resistive load. Two digital multimeters are required to perform the calibration procedures.

In this section refer to Figure 4-1 for locations of assemblies in the DCS.

1. 5V Reference Calibration. The 5V reference for the front panel voltage and current control must be calibrated first. Refer to Figure 4-2 for locations of components on the control assembly.

    a. With prime power removed, remove jumper J9 on the converter assembly.

    b. Connect a digital multimeter (DMM) between E1 and E3 of the current control potentiometer R32 on the control assembly.

    c. Apply prime power to the power supply, and push the front panel switch to the ON position.

    d. Adjust potentiometer R29 until DMM across E1 and E3 indicates 5.000 VDC.

    e. Remove prime power from power supply and wait 3 minutes (minimum) for filter capacitors to discharge.

2. Converter Assembly Calibration. For proper results, converter assembly A2 must be calibrated prior to the calibration of control assembly A1. Refer to Figure 4-3 for component locations on the DCS converter assembly.

Current Limit Calibration.

a) With prime power removed, install jumper J9 on the converter assembly.

b) Connect a load of minimum 5% heavier than full-rated power and a DMM across external current shunt.

c) Rotate front panel voltage control fully clockwise.

d) Rotate front panel current control fully counterclockwise.

e) Apply prime power to power supply, and push the front panel switch to the ON position.

f) Rotate front panel current control fully clockwise or until DMM across external current shunt indicates a maximum of 5% above the converter assembly rated output current. Adjust potentiometer R64 until the supply puts out 5% over the rated current when the front panel current pot is fully clockwise.

g) If the fault light lights before the output reaches 5% over the maximum rating, adjust the internal current limit. To adjust the internal current limit set R73 so the fault light just goes off at 5% over maximum rating.

h) Once the converter is delivering 105% of rated current and the current mode indicator on the front panel is illuminated, rotate R73 counterclockwise until the current mode indicator just extinguishes. Do not adjust beyond this point.

i) Remove prime power from the power supply, and wait three minutes (minimum) for the filter capacitors to discharge.

Current Feedback Amplifier Zero Calibration.

a) Remove jumper J9 on the converter board.

b) Connect a DMM between the output of U8, pin 1, and the common return (on converter assembly A2).

c) Apply prime power to power supply, and push the front panel switch to the ON position.

d) Adjust R68 for zero null (minimum voltage on DMM).

e) Remove prime power from the power supply, and wait 3 minutes (minimum) for filter capacitors to discharge.

f) Replace jumper J9.

Current Feedback Amplifier Full-Scale Calibration.

a) Remove prime power to the power supply, and leave jumper installed on J9.

b) Connect DMM between the output of the current feedback scalar U8, pin 1, and the common circuit. Set DC voltage scale to read 5.0 volts.

c) Connect a second DMM across the external current shunt.

d) Rotate front panel voltage control fully clockwise.

e) Rotate front panel current control fully counterclockwise. This changes the operation of the power supply from the voltage to the current mode.

f) Apply prime power to power supply, and push the front panel switch to the ON position.

g) Rotate front panel current control clockwise until DMM indicates 5.000 VDC between U8, pin 1, and common.

h) Adjust converter assembly potentiometer R64 until DMM across external current shunt indicates full-rated output current.

i) Remove prime power from power supply and wait 3 minutes (minimum) for filter capacitors to discharge.

3. Control Assembly Calibration. For proper results, calibrate the converter assembly prior to calibrating control assembly A1. Refer to Figure 4-2 for locations of components on the control assembly.

Voltage Reference

The voltage reference is provided by an adjustable current regulator Q1 and associated components. To calibrate for the 1 mA programming coefficient (constant voltage), the following sequence is recommended. J1 refers to the D-shell connector on the rear panel.

a) Set front panel current control fully counterclockwise.

b) Connect a precision DMM to J1-21 (VP RES) with reference to J1-24 (COM). Set DMM to DC milliamps and 2 milliamps range.

c) Apply power to power supply, and push the front panel switch to the ON position.

d) Adjust R47 for 1.000 milliamps on DMM.

e) Remove power from power supply.

Current Reference

The current reference is a precision current source consisting of Q2 and associated components. Calibration is accomplished by adjusting R50.

The following sequence is recommended. J1 refers to the D-shell connector on the rear panel.

a) Set front panel voltage control fully counterclockwise.

b) Connect a precision DMM to J1-22 (IP RES) with reference to J1-24 (COM). Set DMM to DC milliamps and 2 mA range.

c) Apply power to power supply, and push the front panel switch to the ON position.

d) Adjust R50 for 1.000 milliamps on DMM.

e) Remove power from power supply.

Voltage Zero Calibration

The voltage control circuit (U11-A) zero is calibrated by adjusting R39. The following sequence is recommended. J1 refers to the D-shell connector on the rear panel.

a) Connect a jumper (short circuit) between J1-8 (V SET) and J1-6 (COM).

b) Connect DMM across CR7 of the control assembly. Set DMM to read DC volts and approximately 200 millivolt range.

c) Set front panel current control fully clockwise.

d) Set front panel voltage control fully counterclockwise.

e) Apply power to power supply, and push the front panel switch to the ON position.

f) Adjust R39 until DMM reads zero. Do not continue adjustment once the DMM reads zero millivolts.

g) Remove power from power supply.

h) Remove DMM from CR7 of the control assembly.

i) Remove jumper between J1-8 and J1-6.

Current Zero Calibration

The current error amplifier circuit (U10-D) zero is calibrated by adjusting R26. The following sequence is recommended. J1 refers to the D-shell connector on the rear panel.

a) Connect a jumper (short circuit) between J1-11 (I SET) and J1-6 (COM).

b) Connect any resistive load and DMM across the output terminals of the power supply. Set DMM to read DC volts and approximately 200 millivolt range.

c) Set front panel voltage control fully clockwise.

d) Set front panel current control fully counterclockwise.

e) Apply power to power supply, and push the front panel switch to the ON position.

f) Adjust R26 until the power supply output voltage starts to increase in the normal polarity. Reverse adjustment direction of R26 until output voltage decreases to zero reading on the DMM. Do not continue adjustment when output reads zero volts.

g) Remove power from power supply.

h) Remove DMM from power supply output terminals.

i) Remove jumper between J1-11 and J1-6.

Voltage Full-Scale Calibration

Full-scale voltage calibration is calibrated by adjusting R37. The following sequence is recommended. J1 refers to the D-shell connector on the rear panel.

a) Connect any resistive load and DMM across the output terminals of the power supply. Set DMM to read maximum rated power supply output voltage.

b) Connect a second DMM between J1-8 (V SET) and the common return J1-6. Set DMM to DC volts and scale to read 5.00 volts.

c) Rotate front panel current control fully clockwise.

d) Apply power to power supply, and push the front panel switch to the ON position.

e) Rotate front panel voltage control clockwise until DMM indicates 5.000 VDC between J1-6 and J1-8.

f) Adjust R37 until output voltage reading is 100% of rated output voltage between the output terminals of the power supply.

g) Remove power from power supply.

h) Remove DMM from power supply terminals.

Meter Calibration

a) Meter Zero Calibration. If zero calibrations in the converter and control assemblies are set properly, the zero set for both voltage and current front panel meters is automatic.

b) Meter Full-Scale Calibration. The full-scale adjustment for the digital panel meters U1 and U4 is adjusted by R6 and R11, respectively. R6 is for full-scale voltage meter calibration and R11 is for full-scale current meter calibration. Both resistors are accessible from inside the power supply with the cover removed.

   To calibrate for full-scale voltage or current, adjust the power supply to maximum rated output voltage (or current) using external calibrated meters and adjust the appropriate meter to correspond to the rated output voltage or current.

Overvoltage Trip Level Calibration

The overvoltage trip level is calibrated by adjusting potentiometer R43 on the control assembly A1. This setting can be viewed on the voltage display monitor by pressing the front panel switch S1. The factory setting for the overvoltage trip level is approximately 10% above the rated output voltage.

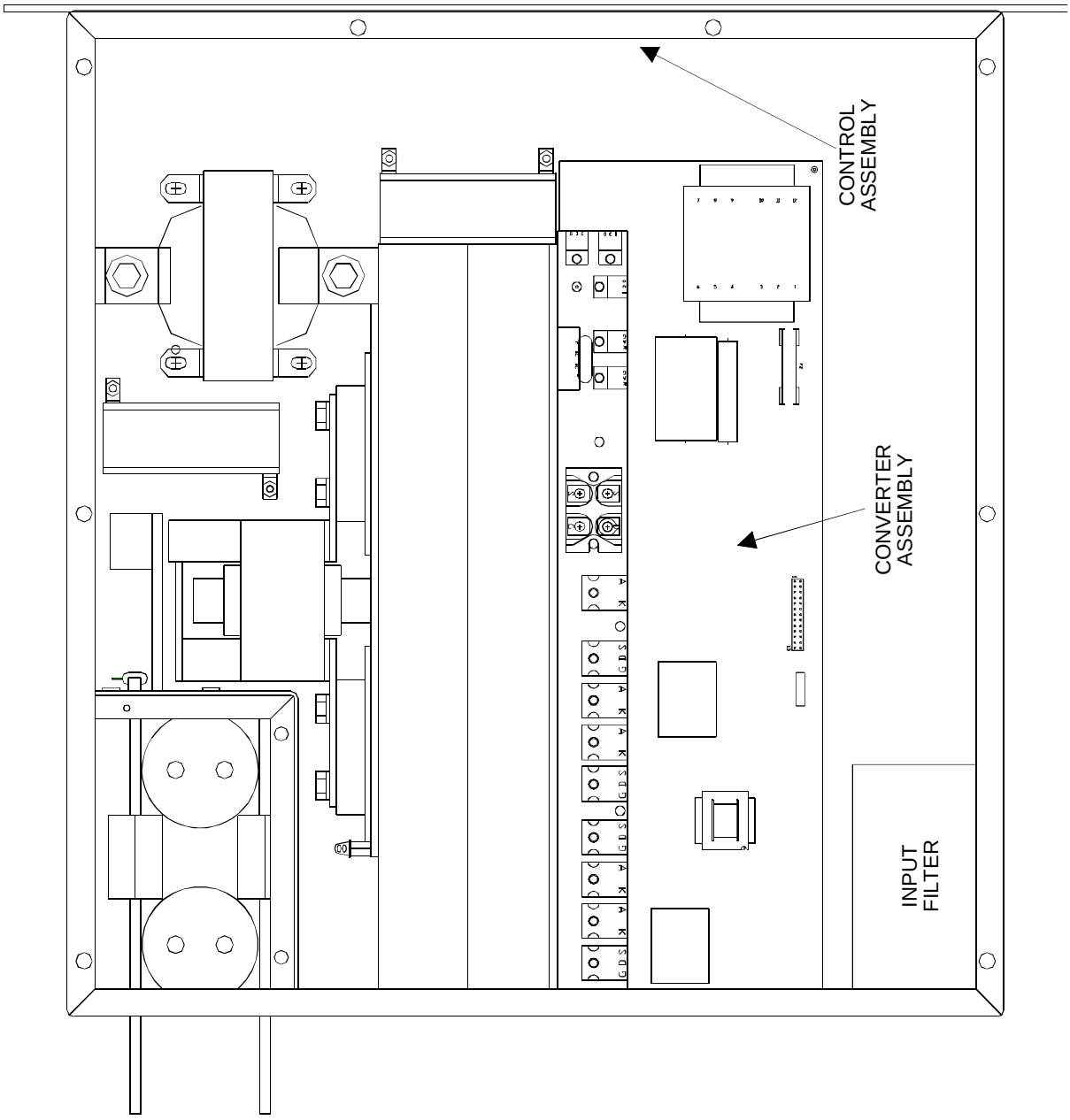


Figure 4-1 DCS Internal Layout

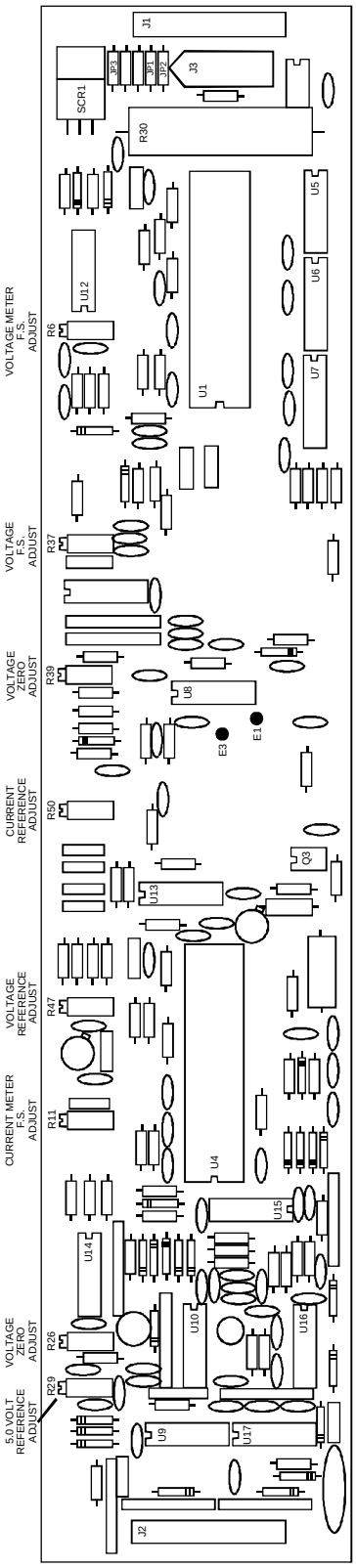


Figure 4-2 Control Assembly

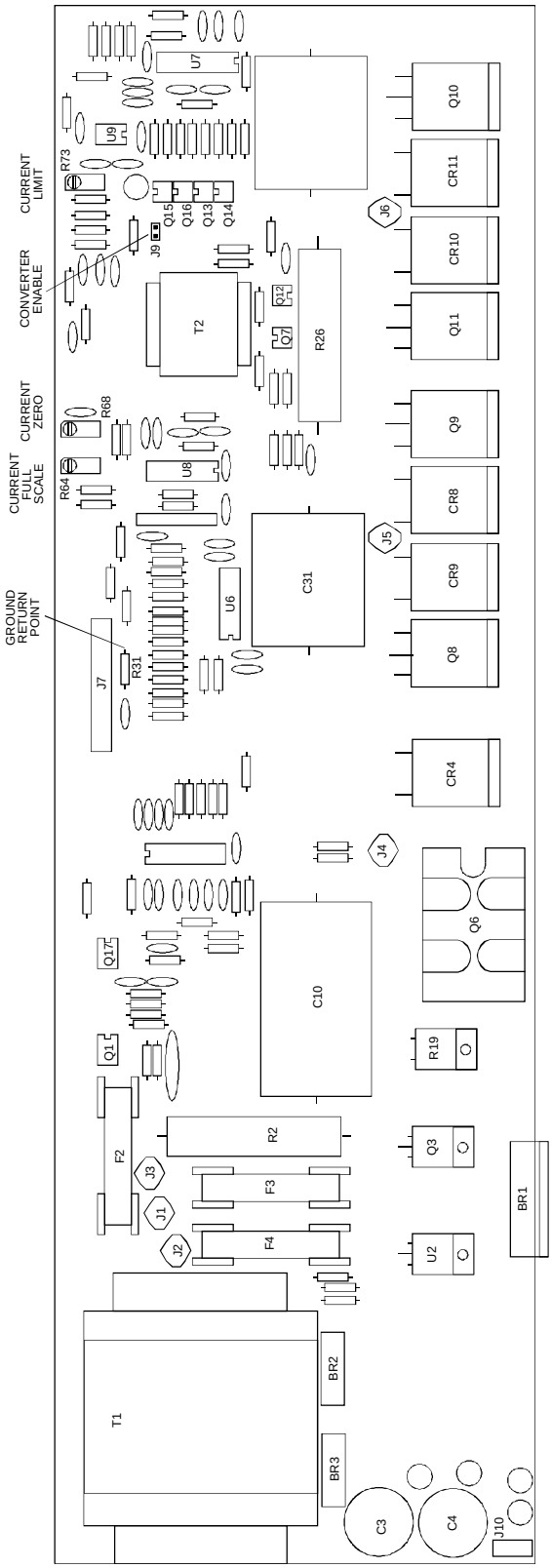


Figure 4-3 DCS Converter Assembly