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The Leader in Airfield Lighting



Since 1946

INSTRUCTION MANUAL

30 KW/6.6A

LC-TYPE

L-828 Constant Current Regulators

Manufactured per FAA Specification

AC 150/5345-10E

ADB

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RECORD OF CHANGES

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SAFETY NOTICES

The operating and maintenance personnel should refer to FAA Advisory Circular AC 150/5340-26, "Maintenance of Airport Visual Aids Facilities" for instructions on safety precautions. Personnel must observe the safety regulations at all times. All operations on this unit shall be carried out by personnel qualified to work on high voltage equipment. While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS

Operating and maintenance personnel must at all times observe all safety regulations. Do not change plug-in components or make adjustments inside equipment with high voltage supply on. To avoid casualties, always remove power, then discharge and ground by use of a grounding rod, prior to touching any parts. See FAA Advisory Circular AC 150/5340-26 concerning safety.

RESUSCITATION

Operating and maintenance personnel should familiarize themselves with the technique for resuscitation found in the First Aid Instruction Manual.

WARRANTEE

ADB, Inc. warrants that the 30kW LC-Type L-828 Constant Current Regulators described herein, when sold by ADB, Inc. or its approved representatives, will perform in accordance with FAA specification AC 150/5345-10, L-828, and that any defect in design, materials or workmanship which may occur during proper and normal use during a period of one (1) year from date of installation or a maximum of two (2) years from date of shipment will be corrected by repair or replacement by ADB, Inc., f.o.b. factory. Damage resulting from improper installation does not constitute proper and normal use and is not covered by the warranty. Such corrections shall constitute the limit of all ADB, Inc. liabilities for the 30kW LC-type L-828 Constant Current Regulators.

1. GENERAL INFORMATION AND REQUIREMENTS

1.1 INTRODUCTION

The ADB, Inc. 30 kW L-828 “LC-Type” Constant Current Regulators are designed to supply either three or five precision output current levels (6.6 amp maximum) for series lighting circuits on airport runways and taxiways. The regulators are air cooled and designed to accurately regulate the output current to within $\pm 3\%$ of the adjustable nominal level from no load to full load and with input voltage variations of -5% to $+10\%$ of nominal (-40°C to $+55^{\circ}\text{C}$). The nominal output current levels are maintained even when 30 percent of the isolation transformers in the series lighting circuit supplied by the regulator have open secondaries. The ADB, Inc. “LC-Type” regulators have the exclusive feature of being the only true output “soft-start” current regulators available (see Figure 8-5). Also, the on/off circuitry in the LC-Type regulators eliminates the need for special “slow-acting” circuit breakers on the input power supply lines.

The regulators may be operated manually or by 120 V ac or +48 V dc remote control signals from a distant location (10,000 feet round-trip using AWG #18 control cable). The universal remote control used in the LC-Type CCR requires no circuitry changes between 120 V ac and +48 V dc remote control signals. Both 120 V ac and +48 V dc remote control source signals (CCI) are provided.

Protective circuits automatically shut down the regulators if an overcurrent or open-circuit occurs in the series lighting circuit. After an input power loss, operation automatically resumes at the same brightness level within 5 seconds after input power is restored. Output lightning and current-surge protection is provided on all units.

1.2 Scope

This manual covers 30 kW L-828 “LC-Type” Constant Current Regulators (CCRs) manufactured to FAA specification AC 150/5345-10 (current edition). Operation outside the design limitations of this specification may result in degradation of performance, damage or failure of regulator components or hazardous conditions.

1.3 Purpose

This manual describes procedures for the installation, operation, and maintenance of ADB, Inc. manufactured 30 kW L-828 “LC-Type” Constant Current Regulators.

Note: (1) The LC-Type CCR should not be used to power an L-849 REIL system unless the CCR is at least half loaded with steady burning lights. (2) The LC-Type CCR is not currently designed to be used with an ADB Mark II or MARK III (PC board) lamp-out monitor. Monitoring is accomplished using the ADB “Scanner” type monitor. See ADB Catalog Sheet #1228.

1.4 EQUIPMENT DATA

Table 1-1 gives the part numbers for the 30 kW "LC-Type" regulators manufactured by ADB, Inc. Reference data pertinent to the equipment is listed in Table 1-2. Table 1-3 lists equipment and accessories supplied. Information on items not supplied but which might be required for installation is given in Table 1-4. Table 1-5 gives the FAA-approved output current levels and tolerances, while Table 1-7 gives the input current. Recommended input power supply wire for the regulators is listed in Table 1-6.

1.5 PROTECTIVE DEVICES

The following protective devices are provided on each regulator:

1. Output open-circuit protection
2. Output overcurrent protection
3. Input power-line undervoltage protection
4. Lightning protection on output terminals
5. Fuse protection: remote control supply voltage (48 V dc and 120 V ac), and power supply for printed circuit board
6. Input breaker for supply voltage
7. W VA (load Wattage in excess of maximum available Volt-Amperes)

1.6 REGULATION

Current regulation is obtained under the following conditions:

1. Load variations of zero (short circuit) to full load with input voltage variations of -5% to +10%, at -40°C up to +55°C (-40°F to +131°F) ambient temperature.
2. With up to 30% of the series isolation transformers open-circuited.

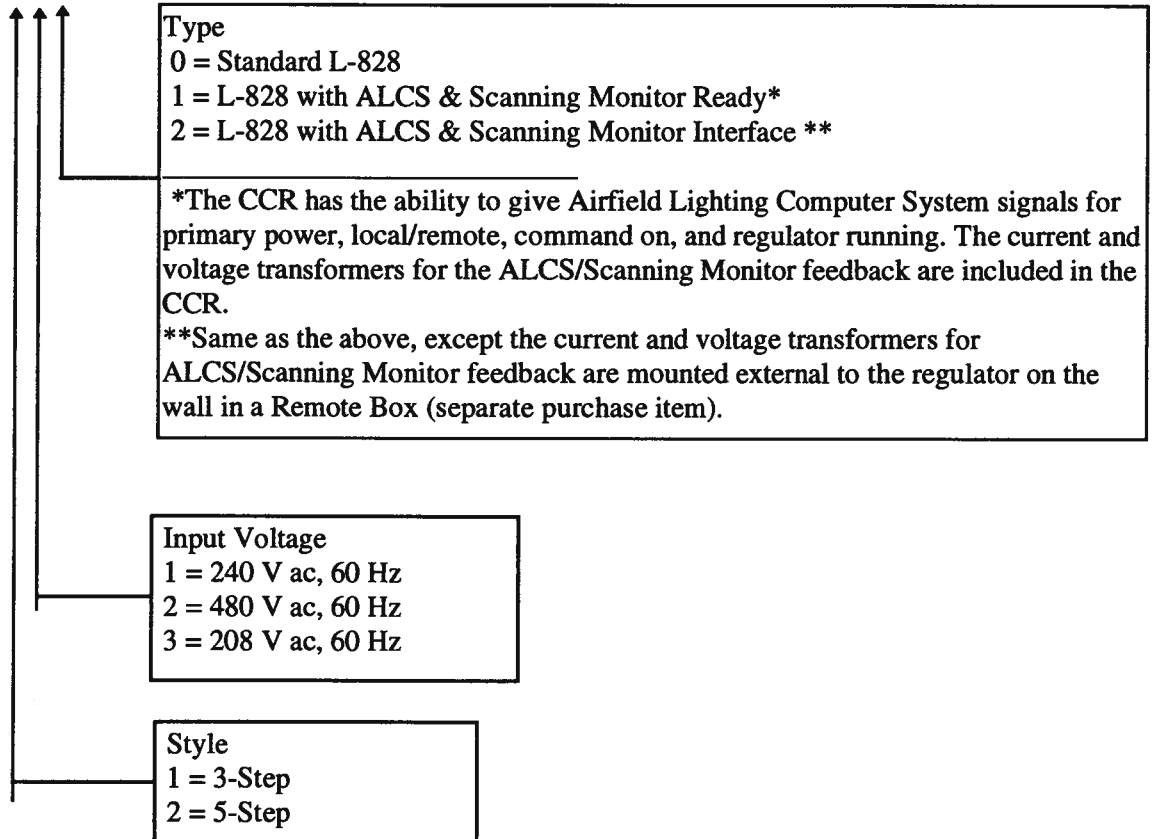
1.7 INDICATORS

1. A optional digital meter or analog voltmeter
2. W VA output LED
3. Regulator On (green) LED (system in normal operation)
4. Overcurrent LED
5. Open-circuit LED

1.8 INPUT VOLTAGE

The standard power transformer for the L-828 regulators is designed for an input voltage of either 208//240 V ac (using field-adjustable tap, see Section 7.6) or 480 V ac. See the nameplate on the regulator for the input voltage rating.

44D1380-XXX0



Note: ALCS and Scanning Monitor Interface—This L-828 is designed for connection to the ADB Airfield Lighting Computer System and the ADB Scanning Monitor. The ADB Scanning Monitor provides state-of-art accuracy in computer monitoring of the status of L-828 regulators and the series circuits powered by them. In addition to providing all the functional capability of an FAA L-827 airport lighting monitor, the ADB Scanning Monitor's software-controlled monitoring can be easily changed to provide additional monitoring information or updated to monitor new equipment installed on the lighting circuits. Contact ADB Sales Department for details and additional literature. See ADB Catalog Sheet #1041 for details on the ADB Airfield Lighting Computer System.

Table 1-1. Equipment Data

FAA Type: L-828 (air-cooled LC-Type) Constant Current Regulator (CCR)

Rating: 30 kW

Nominal Input Voltage: 208, 240 Vac (field-adjustable tap); 480 V ac

Class 1 (6.6 A maximum output current)

Style 1—3 step (4.8, 5.5 & 6.6 amp); Style 2—5 step (2.8, 3.4, 4.1, 5.2 & 6.6 amp)

Minimum Power Factor: 0.95

Minimum Efficiency: 95%

Soft-Start: The only true output “soft-start” current regulators produced by any manufacturer (see Figure 8-5) and eliminates the need for a special slow-trip circuit breaker on the input power lines.

Control:

- Local operation using front panel rotary switch S1;
- Universal remote operation using either +48 V dc or 120 V ac signals. Both +48 V dc or 120 V ac remote control source signals (CCI) are provided, but only one may be used.
- On/off switching under any load

Built-in True RMS-Reading Ammeter: 10 amps (maximum scale)

Optional Analog Voltmeter

Optional Digital Meter: Can be set to read output current or voltage or volt-amperes

Protection:

- Overcurrent
- Open-circuit
- Lightning and transient protection
- Output current-surge limitation (protects series incandescent lamps)
- Power-supply current is self-limited
(After an input power loss, operation resumes within 5 seconds after power is restored)

Output Current Level: Maintained within ± 0.1 amp at any intensity step.

Reactive Loading: The CCRs maintain the current within the limits of Table 1-5 for all brightness steps when the load is connected via isolating transformers, and secondaries of 30% of these transformers become open-circuited. The load before opening the isolation transformer secondaries may be any value from half to full load.

Optional Input Lightning Protection: ADB #94B0011-1 for 480 V ac input; #94B0011-2 for 208-240 V ac input.

Terminal Blocks: Pressure-type for external remote control wiring

Table 1-2. Equipment Data (continued)

Compatibility:

- Compatible with L-847 circuit selector switches
- The LC-type CCR should not be used to power an L-849 REIL system unless the CCR is at least half loaded with steady burning lights.
- The LC-type CCR is not currently designed to be used with an ADB Mark II or III (PC board) lamp-out monitor. Monitoring is accomplished using the ADB "Scanning Monitor". See Catalog Sheet #1228.

Environmental Operating Conditions: Designed for indoor use only in an area with adequate ventilation for cooling the constant current regulator.

Temperature Range: -40°C to +55°C (-40°F to +131°F)

Relative Humidity: 0 to 100%

Altitude: Sea level to 6,600 ft (2000 m)

Dimensions: 32 x 26 x 36 inches (H x W x D)

Footpad: 24.75 x 28 inches (W x D)

Weight: 908 lb approx.

Table 1-2. Equipment not Supplied but Which Might be Required

<u>Quantity</u>	<u>Description</u>
A/R	Wire, input power (see Table 1-6)
A/R	Wire, remote control, AWG 18 minimum, AWG 12 maximum
A/R	Wire, ground, AWG 4 minimum
A/R	Wire, output load, AWG 8, 5000 V dc, L-824 type
A/R	Wire, shorting jumper, AWG 8 minimum
1	Disconnect switch or main circuit breaker
2	Input lightning arrestor, can be ordered separately from ADB
1	Circuit breaker for input power lines (The soft-start feature eliminates the need for a special slow-trip circuit breaker on the input power lines.
1	Screwdriver
1	True rms voltmeter, 600 V ac scale
1	Voltmeter, 60 V dc full scale
1	Ammeter, true rms-reading , 10-amp maximum scale
1	Ohmmeter
A/R	Mounting bolts and washers

Table 1-3. Equipment Supplied

<u>Quantity</u>	<u>Description</u>
1	L-828 Constant Current Regulator
1	Instruction Manual

Table 1-4. FAA Output Current Levels and Tolerances

3-Step	Nominal Output Current	Allowable Current Range
B100	6.6A	6.40-6.70A
B30	5.5A	5.33-5.67A
B10	4.8A	4.55-4.94A

5-Step	Nominal Output Current	Allowable Current Range
B5	6.6A	6.40-6.70A
B4	5.2A	5.04-5.36A
B3	4.1A	3.98-4.22A
B2	3.4A	3.30-3.50A
B1	2.8A	2.72-2.88A

Table 1-5. Recommended Input Power Supply Wire

[Recommended input power supply wire (130°C, 600V minimum) for less than 100 feet between CCR and power source. For 100 to 250 feet, use the next larger (even) gage wire.]

kW Rating	208 V Input	240 V Input	480 V Input
30 kW	AWG 2, 600V	AWG 4, 600V	AWG 6, 600V

Note: It is recommended that the circuit breaker on the input power supply lines have a rating of 125% of the CCR's input current, as given in Table 1-7, unless local codes require a different rating technique. See the CCR's nameplate for the kW rating and input voltage to determine the input current from Table 1-7. If no standard size circuit breaker exists at the 125% value, use the next larger standard size circuit breaker.

Table 1-6. Input Current for L-828 Constant Current Regulators

kW Rating	208 V Input	240 V Input	480 V Input
30 kW	168 amps	146 amps	73 amps

2. THEORY OF OPERATION

2.1 Introduction

Current regulation is obtained by using SCRs to switch the supply power (varying the “on” duration of the AC cycle) to the power transformer and by using feedback circuitry to monitor the transformer’s output. The brightness level is selected from one of three or five preset values. When the load varies, the feedback circuit changes the control-voltage level, which changes the conduction angle of the AC voltage to the SCRs to allow power to flow into the power transformer. This changes the supply power flow to the main transformer to compensate for the load variation and maintain the output current at the preset level.

2.2 The SCRs

See Figures 8-6 & 8-7. When power is applied to the constant current regulator (CCR) and the contactor K1 and circuit breaker CB1 are closed, no current will flow in the primary of the power transformer T1 until the SCRs receive a triggering pulse. When this pulse occurs, the SCRs turn on, allowing current to flow into the primary of the power transformer T1 until the SCR is switched off by the zero crossing (+ to -) of the input power. The path of the current flow is from TB3-2 through the circuit breaker CB1, contactor K1, SCR terminals 1 and 3 to L2, L1 and primary of T1, and back to K1, CB1 and TB3-1. Since alternating current is used for the regulator operation, after zero-crossing the current flows in the opposite direction using the other SCR (see SCR terminals 1 and 2).

The power level in the primary of the power transformer is controlled by varying the phase of the conduction angle. If very low output current is desired, the conduction angle would be near zero degrees, i.e., the SCR is not triggered until the input voltage is near zero-crossing. Little power is then available to power transformer T1.

For maximum power to occur in the primary of the power transformer T1, the conduction angle will be near 180 degrees. Immediately after zero-crossing of the input-power sine wave, the SCR is triggered and operates continuously throughout the 180-degree duration of the input sine wave.

For 67% power from the power transformer, the conduction angle will be nearly 90 degrees. This occurs approximately at the voltage peak of the sine wave when the SCR switches into conduction. Switching the transformer on-line at this time creates a rather abrupt rise time, since the input sine wave is at its peak voltage. Choke L1 slows this rapid rise time from the conduction of the SCRs.

2.3 Contactor

In the event of an SCR failure, the contactor provides a means to break the current driving the primary of the power transformer T1. The contactor K1 (see Figures 8-6 & 8-7) has no making or breaking current across it, since the SCR is off when the contactor is opening and closing. This is accomplished by the coil-control circuitry and provides increased life for the contactor.

2.4 Transformers

- Transformer T2 provides current feedback from the CCR output.
- Transformer T3 provides 120 V ac remote-control source voltage at TB2 terminal 120VAC through fuse F3. Transformer T3 also provides power to the Control PCB and Digital Meter PCB.
- Transformer T5 provides current feedback from the SCR.
- Transformer T7 provides current feedback from the CCR output for scanning monitor ready.
- Transformer T8 provides voltage feedback from the CCR output (also for scanning monitor ready).
- Transformer T9 provides voltage feedback from the primary of T1 for digital meter.

3. OPERATION

3.1 Control

The rotary switch S1 on the front panel is used for local control of the regulator. This control switch has seven positions for 5-step CCR labeled: REM (remote), OFF, and brightness steps 1, 2, 3, 4 and 5 (or five positions for 3-step CCR: REM, OFF, 10, 30, 100). For regulator operation by +48 V dc or 120 V ac remote control signals, rotary switch S1 must be set to REM. Remote control is disengaged when switch S1 is set to any position other than REM.

3.1.1 Local Control

1. Rotary switch (S1), positions 1 through 5 (or 10, 30 and 100 for a 3-step CCR), provides local control of the CCR's output current level. For a three-step CCR, positions 10, 30 and 100 give an output current of 4.8, 5.5 and 6.6 amps, respectively. For a five-step CCR, positions 1 through 5 give an output current of 2.8, 3.4, 4.1, 5.2 and 6.6 amps, respectively.
2. When rotary switch S1 is set to the OFF position, the regulator is deenergized and cannot be remotely turned on.
3. When switch S1 is set to REM, operation of the regulator is by remote control signals.

Table 3-1. Rotary Switch S1 Position for 3- & 5-Step CCRs							
3-Step CCR							
S1 SET TO:	REM	OFF	10	30	100		
RESULT:	Operation of CCR by remote control signals	CCR off	4.8 A current output	5.5 A current output	6.6 A current output		
5-Step CCR							
S1 SET TO:	REM	OFF	1	2	3	4	5
RESULT:	Operation of CCR by remote control signals	CCR off	2.8 A current output	3.4 A current output	4.1 A current output	5.2 A current output	6.6 A current output

3.1.2 Remote Control

1. When the rotary switch S1 is set to position REM and remote control wiring is connected to remote control terminal block TB2 on the regulator, the output current of the regulator will correspond to the brightness setting energized by remote 120 V ac or +48 V dc control signals. When switch S1 is set to OFF, remote control signals will not operate the regulator, i.e., turn the regulator on to a particular brightness setting or turn the regulator off. Switch S1 must be set to REM for operation of the regulator by remote control.

2. When there are no remote control connections on terminal block TB2, the position REM becomes an additional OFF position, i.e., the regulator is deenergized when switch S1 is set to REM.
3. If more than one remote intensity is accidentally selected, the highest intensity will be selected.

3.2 Shutdown Procedure

Set rotary switch S1 to position OFF. Power to the output terminals is now off, and the regulator cannot be energized by remote control signals. Power is still present on the input power fuse block F1 and F2. To remove input power, disengage disconnect switch or external circuit breaker.

4. PREVENTIVE MAINTENANCE

4.1 GENERAL

This section establishes the maintenance procedures required for the constant current regulators. The maintenance tasks must be performed on a recurring basis to insure optimum performance, minimize service interruptions and avoid major breakdowns.

WARNING

Only personnel authorized to work on high-voltage equipment should perform maintenance on the regulator.

Operate regulator under local control (using rotary switch S1) when performing maintenance tasks on the regulator. This will prevent the regulator from accidentally being turned on and causing serious injury or death.

Always deenergize regulator by turning rotary switch S1 to OFF, and remove input power to regulator by turning off disconnect switch or main circuit breaker before opening access door to service regulator.

4.2 PREVENTIVE MAINTENANCE

The preventive maintenance checks for the regulator are listed in Table 4-1.

4.3 SHORT-CIRCUIT TEST

WARNING

Since high open-circuit voltages may result by opening the primary of a series lighting circuit, only personnel authorized to work on high-voltage equipment should be allowed to perform the short-circuit test.

1. Remove input power to regulator (turn off disconnect switch or main circuit breaker) and turn rotary switch S1 to OFF.
2. Remove leads from output terminals TB1, and short output terminals using AWG #8 or larger wire.
3. Energize regulator and turn rotary switch S1 to the lowest brightness step 1(10) and then to the remaining brightness steps. Check the output current on a true-rms-reading ammeter at each step. The output current should be within the tolerance given below.

<u>3-Step CCR S1 Position</u>	<u>Allowable Range (Panel Ammeter) Amperes</u>
10	4.55-4.94
30	5.33-5.67
100	6.40-6.70

<u>5-Step CCR S1 Position</u>	<u>Allowable Range (Panel Ammeter) Amperes</u>
1	2.72-2.88
2	3.30-3.50
3	3.98-4.22
4	5.04-5.36
5	6.40-6.70

4. If the output current is not within the above specified limits, check the input voltage to regulator. The supply voltage should be within -5% to +10% of the nominal input voltage shown on the regulator nameplate. If supply voltage is correct, readjust output current per Section 7.5.2.
5. Turn off disconnect switch or main circuit breaker to remove input power to regulator.
6. Disconnect the shorting jumper and reconnect output cables.
7. Close input-power disconnect switch or main circuit breaker.

4.4 OPEN-CIRCUIT TEST

WARNING

Since high open-circuit voltages may result by opening the primary of a series lighting circuit, only personnel authorized to work on high-voltage equipment should be allowed to perform the open-circuit test.

1. Remove input power to regulator (turn off disconnect switch or main circuit breaker) and turn rotary switch S1 to OFF.
2. Disconnect cables from the output terminals TB1.
3. Turn on input power to regulator.
4. Turn rotary switch S1 to the lowest brightness position 1(10). The open-circuit protective device should automatically deenergize the regulator in less than 2 seconds.
5. Turn rotary switch S1 to OFF. The open-circuit protective device should reset.
6. Turn rotary switch S1 to position 1(10). The regulator should turn on and then deenergize in less than 2 seconds.
7. If regulator operation is satisfactory, turn rotary switch to OFF, and turn off disconnect switch or main circuit breaker before reconnecting the load.
8. After the load has been reconnected, turn on input power to the regulator.

Table 4-1. Preventive Maintenance Tasks

INTERVAL	MAINTENANCE TASK	ACTION
Daily	(1) Check all control equipment for proper operation	(1) Check local and remote control (if used) on each brightness step.
Monthly	(1) Check input voltage (2) Check and record output current on each brightness step	(1) If input voltage is not within -5% to +10% of the nominal value specified on the nameplate of the regulator, notify power company to correct voltage. (2) Use true a rms-reading instrument. Adjust current levels if out of tolerance (see Table 1-5).
Annually	(1) Check wiring and insulation (2) Inspect housing for rust spots (3) Inspect lightning arrestor connections (4) Perform a short-circuit test (5) Perform an open-circuit test	(1) Make sure input and output connections are tight and that there are no damaged wires or frayed or burnt insulation. (2) Clean and touch-up rust spots with paint. (3) Tighten any loose connections. Replace charred or burnt wiring or broken arrestors. (4) See paragraph 4.3. (5) See paragraph 4.4.
Unscheduled	Check load on regulator	At installation and subsequent load changes make sure that the <i>output voltage times the output current does not exceed the rated load</i> on the nameplate of the regulator.

5. TROUBLESHOOTING

5.1 Troubleshooting Table

Preliminary troubleshooting information is given in Section 5.2. The troubleshooting guide for the LC-type L-828 constant current regulator is given in Table 5-2.

WARNING

Only personnel authorized to work on high-voltage equipment should perform troubleshooting on the regulator.

Deenergize regulator by turning rotary switch S1 to OFF, and remove input power to regulator by turning off disconnect switch or main circuit breaker. Ground output terminals by using a grounding rod prior to touching any parts.

If regulator deenergizes suddenly, the output circuit could be interrupted by an overcurrent, open-circuit, or undervoltage condition. Before inspecting the output circuit, place rotary selector switch S1 in the OFF position and turn off disconnect switch or main circuit breaker. Without this precaution, a dip in the power line may produce an on-cycling and reenergize the regulator, resulting in an output voltage of several hundreds or thousands of volts which can cause serious injury or death.

5.2 Preliminary Troubleshooting

The following is a check list of steps to perform:

1. Check all LED indicators, fuses, and circuit breakers. See Table 5-1.
2. Visually examine all areas of the CCR. Are there any burnt or loose connections/parts?
3. Is the input voltage present and within +10% to -5% of nominal? Is Regulator ON (green) LED lit?
4. If CCR works in local but not in remote, check voltage on remote control lines. Check fuse F3 if 120 V ac or fuse F4 (on Control PCB) if +48 V dc remote control source voltage is used. If correct, replace Control PCB.
5. Can the CCR be reenergized by turning rotary switch S1 from OFF to step 1(10)? If it can be, problem is due to open circuit (open-circuit LED lit?) or overcurrent (overcurrent LED lit?).
6. Short the output of the CCR with an AWG 8 (2000 V, minimum) wire and turn CCR on. If the regulator operates normally, problem may be load related.

Table 5-1. Fuses

Circuit Breaker CB1		Protects K1 (contacts), SCR, L1, L2, and main transformer T1
Fuse F1, F2	90A, 600V for 480 V CCRs 200A, 600V for 208 & 240 V CCRs	Protects transformer T3
Fuse F3	2A, 250 V , for 208 & 240 V CCRs 1A, 500V for 480V CCRs	Protects internal 120 V ac CCI source
Fuse F4	2A, 250 V , for 208 & 240 V CCRs 1A, 500V for 480V CCRs	Protects the internal +48 V dc (on Control PCB) CCI source circuitry on the Control PCB

7. If the CCR turns on for a few seconds and then shuts off and the ammeter indicates 0 amps, the problem is either an open circuit (open-circuit LED lit?) or current transformer T2 is open. T2 can be checked by comparing the primary and secondary current readings.
8. If the CCR turns on and then shuts off after a few seconds and there is a high current reading on the ammeter, the problem is an overcurrent (overcurrent LED lit?). Adjust the output current accordingly. If this does not work, replace Control PCB and then SCR.
9. If the CCR does not energize at all (Regulator ON (green) LED lit?), check for undervoltage. If correct, replace Control PCB.

Table 5-2. Troubleshooting Guide

Problem: Regulator does not turn on using control switch S1	
Test	Repair
(1) Turn off CCR using local control switch S1. Then turn CCR on. Verify that nothing happens and that green LED labeled REGULATOR ON is unlit.	Circuit breaker CB1 is tripped. Reset CB1 by switching CB1 on. If CB1 trips again, check and replace fuses F1 and F2.
(2) Use an AC voltmeter to probe signals. Connect black lead on meter (common) to earth ground lug on CCR.	
Probe J3 terminals 4 and 6. Each should read approximately 60 V ac.	Replace T3.
(3) Using the AC voltmeter, probe J3 terminals 1 and 3. Each should read approximately 18 V ac.	Replace T3.
(4) If these voltages are normal, failure is in Control PCB, ribbon cable or Switch PCB.	Replace Control PCB, ribbon cable or Switch PCB, in that order.
Problem: Regulator does not turn on using remote control but operates using local control switch S1.	
Test	Repair
<input checked="" type="checkbox"/> Note: When remote control signals enter TB2, green LEDs #1 to #5 will light—indicating operation of remote inputs CC, B2, B3, B4 and B5. On a 3-step CCR, LED #2 stays off and LEDs #1 and #3 will light with a CC input signal.	
(1) Test signals to remote control TB2.	Repair external remote control switch or wiring.
(2) Is CCI is connected to TB2 terminal 48V for +48 V dc remote control signals?	Check and replace fuse F4 (on Control PCB).
(3) Is CCI is connected to TB2 terminal 120V for 120 V ac remote control signal?	Check and replace fuse F3 (on panel) with new 1/4A, Slo-Blo fuse.
(4) Check to see if the LEDs #1 to #5 for a 5-step CCR (or LEDs #1 and #3 for a 3-step CCR) are lit and there still is no remote operation.	If none of the LEDs #1 to #5 for 5-step CCR (or LEDs #1 and #3 for a 3-step CCR) are lit, replace Control PCB.

Table 5-1. Troubleshooting Guide

Problem: Regulator repeatedly trips circuit breaker CB1 on start up.	
Test	Repair
(1) Turn control switch S1 to OFF. Reset CB1. While observing the CCR's output ammeter, turn CCR on. If meter moves, go to TEST "(b)". If meter does not move, feedback transformer T2 or main transformer T1 may have failed.	Replace feedback transformer T2/main transformer T1.
(2) With CB1 and control switch S1 off, remove connector J4 (by pulling) from PC board. Then turn on control switch S1. If CB1 still trips, SCR is probably shorted.	Replace SCR.
(3) If CB1 does not trip after J4 is removed, Control PCB has failed.	Replace Control PCB.
Problem: Regulator shuts down from overcurrent protection (red LED lit).	
Test	Repair
(1) Test the operation of the overcurrent protection (red LED on). With CCR off, connect a jumper across TP7 to TP9 on Control PCB (see Figure 8-4). Turn on CCR to an output of 6.6 A, and time how long it takes for the overcurrent protection to shut the CCR off. Green REGULATOR ON LED will turn off when the overcurrent circuitry operates. The time period will be 20 ±10 s for proper operation. If time period is less than 10 s or more than 30 s, CCR may be improperly calibrated. If CCR will not calibrate properly, then with main circuit breaker and control switch S1 off, remove connector J4 (by pulling) from Control PC board. Then turn on main circuit breaker and then control switch S1.	See calibration instructions in Section 7.5.
(2) If overcurrent indicator (red LED) does not light, then SCR is good and Control PCB has failed.	Replace Control PCB.
(3) If overcurrent indicator (red LED) lights, then SCR or Control PCB has failed.	Replace Control PCB and/or SCR.

Table 5-1. Troubleshooting Guide

Problem: Regulator shuts down from open-circuit protection (red LED lit).	
Test	Repair
(1) Test load for open-circuit condition. Also, short CCR's output RV2/3 and check for normal operation. See calibration instructions in Section 7.5.	Repair lighting loop.
(2) Inspect contacts of contactor K1.	Replace contactor K1 if defective.
(3) Inspect transformer T5 and R5 (on panel).	Replace T5 or R5.
(4) Turn CCR on and off repeatedly. If green LED indicator for REGULATOR ON lights but contactor K1 does not click on, coil of contactor K1 has failed.	Replace contactor K1.
(5) If turning CCR on and off will not light REGULATOR ON LED, then Control PCB has failed.	Replace Control PCB.
Problem: Incorrect CCR output current.	
Test	Repair
(1) CCR may be improperly calibrated.	See calibration instructions in Section 7.5.
(2) If CCR will not calibrate properly, then Control PCB may have failed.	Replace Control PCB.

Table 5-1. Troubleshooting Guide

Problem: W VA indicator (red) LED lit.

Test

Repair

Note: The W VA indicator (red) LED is not intended to show a regulator failure. It is a warning that the load demand has exceeded the CCR's output current (as adjusted), and a lower than normal output current may result from an excessive load being present.

(1) The lighting loop has too many burned-out lamps

Replace burned-out lamps.

(2) The load demand is greater than 4% over -5% input voltage and 12% of nominal input voltage.

Reduce load or obtain a CCR with a higher kW rating.

(3) The half-power tap CT was selected on TB6 and the load demand requires more than 1/2 of the CCR's rated output power.

Move wire #201 from TB6-CT to TB6 terminal 4.

(4) The input voltage is low for the required voltage, as selected on the CCR's TB5. Measure voltage at input of CCR's TB3 terminals 1 to 2 with CCR in operation.

Provide required voltage to CCR.

(5) CCR's output current may be improperly calibrated.

See calibration instructions in Section 7.5.

(6) If input voltage is normal, verify wire connections on TB5 correspond with Table 2 (see Figs. 8-6 & 8-7).

If CCR's TB5 is wired to wrong voltage, correct as shown in Table 2 (see Figs. 8-6 & 8-7). If 480 Vac connection has been made for 208 and 240 V ac CCR input, or vice-versa, contact ADB Sales Department.

WARNING: A CCR wired for 480 V ac must not be changed to 208 or 240 V ac. A CCR wired for 208 or 240 V ac must not be changed to 480 V ac.

6. PARTS LIST

6.1 Parts List

Table 6-1 provides data on all replaceable parts for each repairable or replaceable component or assembly. Table 6-2 lists recommended spare parts.

NOTE

Substitution of electrical components may be done only if substitution is the exact physical equivalent (body or case size) and equal, or better electrical characteristics with respect to tolerance, failure rate and/or reliability.

Table 6-1. Parts List

General Assembly—30kW/208 & 240 VAC LC		
Item	Description:	ADB Part No.
A1	Snubber Network Assy.	44B2213
F1,2	Fuse, 200A, 600V	47A0141
F3,4	Fuse, 2A, 250V	47A0113
F5	Fuse, 1/4A, 250V, Slo-Blo	47A0117
K1	Contactor, 3P, 200A, 170A, 120 V ac coil	53A0331
L1	Choke	33A0024
L2	Inductor	33A0027
M1	Ammeter, 10A scale	52A0107
PCB1	Control PCB Assembly	44D1475
S1	Switch PCB Assembly (3-Step CCR)	44D1476-1
S1	Switch PCB Assembly (5-Step CCR)	44D1476-2
SCR	SCR Network	44C2026P
T1	30 KW Power Transformer	35A0321
T2	Transformer, Current, 6.6A/66mA	35A0290
T3	Transformer, 240/480 Vac pri., multi. sec.	35A0439
T5	Transformer, 6:1 Ratio	35A0343
VR1,2	Lightning Arrestor	32A0024

Table 6-1. Parts List

General Assembly—30kW/480 VAC LC		
Item	Description:	ADB Part No.
A1	Snubber Network Assy.	44B2213
CB1	Circuit Breaker 100A, 2P, 480VAC,	57A0057
F1,2	Fuse, 1A, 500V	47A0108
F3	Fuse, 1/4A, 250V, Slo-Blo	47A0117
K1	Contact, 3P, 100A, 75A, 120Vac Coil	53A0330
L1	Choke	33A0024
L2	Inductor	33A0027
M1	Ammeter, 10A scale	52A0107
PCB1	Control PCB Assembly	44D1475
S1	Switch PCB Assembly (3-Step CCR)	44D1476-1
S1	Switch PCB Assembly (5-Step CCR)	44D1476-2
SCR	SCR Network	44C2026P
T1	30 KW Power Transformer	35A0321
T2	Transformer, Current, 6.6A/66mA	35A0290
T3	Transformer, 240/480 V ac pri., multi. sec.	35A0439
T5	Transformer, 6:1 Ratio	35A0343
VR1,2	Lightning Arrestor	32A0024

Table 6-2. Parts List—Optional Components

Item	Description	ADB Part No.
Digital Meter for 30 kW, 480 V (94A0116-2)		
T9	Transformer, 240/10 Vac	35A0323
M1	Digital Meter	44D2434
Digital Meter for 30 kW, 208 V or 240 V (94A0116-4)		
T9	Transformer, 240/10 Vac	35A0323
M1	Digital Meter	44D2434
Analog Voltmeter (94A0130)		
T8	Transformer, 5000/50 Vac, 50/60 Hz	35A0346
M2	Analog Voltmeter (0-2500 Vac scale)	52A0111
Input Lightning Protection (94B0011-2 for 208-240V; 94B0011-1 for 480 V)		
RV6, RV7	Lightning Arrestor	32A0028
Scanning Monitor Interface		
KS1, KS4	Relay, 4 PDT, 1A, 120 Vac	53A0284
KS2, KS3	Relay, 4 PDT, 5A, 12 Vdc	53A0301
Scanning Monitor Ready		
KS1, KS4	Relay, 4 PDT, 1A, 120 Vac	53A0284
KS2, KS3	Relay, 4 PDT, 5A, 12 Vdc	53A0301
RS1-4	Resistor, 10W, 180 ohm, 1%	15A0085
RS5	Resistor, 10W, 500 ohm, 1%	15A0086
FS1	Fuse, 1/4A, 250 V, Slo-Blo	47A0117
T7	Current Transformer, 6.6/0.13A	35A0264
T8	Step-Down Transformer, 5000/50 V, 50/60 Hz	35A0346
Current Sensing Relay		
K2	Current-operated AC Switch	53A0283

Table 6-3. Recommended Spare Parts

<u>Description: (30 kW/208 & 240 V ac LC)</u>	<u>ADB P/N</u>
Fuse (F3/F4) 2A, 250 V	47A0113
Fuse (F1/F2), 200A, 600V	47A0141
Fuse (F5) 1/4A, 250 V, SLO-BLO.....	47A0117
Control PCB Assembly	44D1475
Switch PCB Assembly (3-step)	44D1476-1
Switch PCB Assembly (5-step)	44D1476-2
Varistor (VR1,2)	32A0024
<u>Description: (30 kW/480 V ac LC)</u>	<u>ADB P/N</u>
Fuse (F1/F2) 1A, 500 V, SLO-BLO.....	47A0108
Fuse (F3) 1/4A, 250 V, SLO-BLO.....	47A0117
Control PCB Assembly	44D1475
Switch PCB Assembly (3-step)	44D1476-1
Switch PCB Assembly (5-step)	44D1476-2
Varistor (VR1,2)	32A0024

7. INSTALLATION

7.1 Introduction

This section provides instructions for the installation of the L-828 LC-Type Constant Current Regulators. Refer to the airport project plans and specifications for the specific installation instructions.

7.2 Unpacking

Unpack crate upon receipt and examine regulator to insure that no damage has occurred during shipment. Note any exterior damage which might lead to detection of equipment damage. When handling the regulator, care should be taken to maintain the unit in an upright position.

7.2.1 Damage

If damage to any equipment is noted, a claim form should be filed with the carrier immediately. Inspection of equipment by the carrier may be necessary.

7.3 INSTALLATION

The regulator can be lifted using a forklift on the bottom of the regulator or with a portable hoist using the four 3/8-inch ID eyebolts on top of cabinet. Place regulator inside a well ventilated room with sufficient clearance for personnel to inspect and maintain the unit. The ambient temperature of the room must be between -40°C and +55°C (-40° to +131°F).

The regulator can be placed directly on the floor without the use of bolts. However, if the regulator must be bolted to the floor, the contractor should drill holes in the bottom 2 channels and use bolts and lead mollies to secure regulator to the floor. See Figure 8-1.

7.4 WIRING CONNECTIONS AND STARTUP

See Figures 8-2 and 8-8. The regulator is delivered ready to operate when properly connected and should not require any electrical adjustments. The contractor responsible for installation will be required to supply all necessary wire, conduit, connectors, mounting hardware, etc.

WARNING

Installation and operation of the CCR should be performed by personnel qualified to work on high voltage equipment. The high voltage involved with the unit makes it potentially dangerous and may be lethal if contacted by operating personnel.

Note: Do not use the LC-Type CCR to power an L-849 REIL system unless the CCR is at least half loaded with steady burning lights.

1. Verify the input supply voltage corresponds to the voltage rating on the nameplate of the regulator.
2. Make sure the rotary switch S1 on the front panel is set to the OFF position.
3. Ground the regulator by making an adequate ground wire (AWG 4 or larger) connection to the earth ground lug on the regulator.
4. An appropriate disconnect-type fuse cutout or circuit breaker shall be provided for the input power supply lines. For installations requiring load switching during regulator operation, the regulator may be connected to an L-847 circuit selector switch.
5. Install appropriate external lightning arrestors on the input power supply lines as close as possible to the CCR's input fuse block F1,F2. If optional lightning arrestors are ordered with regulator, they are factory installed.

Note: Since lightning is a phenomenon that varies in intensity and frequency with geographical locations, it is recommended that each installation evaluate the need for additional lightning protection.

6. Short-circuit the output terminals of TB1 using AWG 8 (minimum) wire.
7. Connect the voltage supply lines (see below for recommended input wire) from the disconnect switch or main circuit breaker to the CCR input fuse block F1,F2. Tighten all connections.

[Recommended input power supply wire (130°C, 600V minimum) for less than 100 feet between CCR and power source. For 100 to 250 feet, use the next larger (even) gage wire.]

kW Rating	208 V Input	240 V Input	480 V Input
30 kW	AWG 2, 600V	AWG 4, 600V	AWG 6, 600V

Note: Do not route output cable in the vicinity of other wiring sensitive to EMI or RFI.

8. Energize regulator (engage main circuit breaker or disconnect switch). Turn CB1 to the ON position and regulator's rotary selector switch S1 to all brightness steps. Verify current values on the panel ammeter correspond to those below for each brightness step.

S1 Position for 3-Step	Nominal Output Current	Allowable Current Range
10	4.8A	4.55-4.94A
30	5.5A	5.33-5.67A
100	6.6A	6.40-6.70A

S1 Position for 5-Step	Nominal Output Current	Allowable Current Range
1	2.8A	2.72-2.88A
2	3.4A	3.30-3.50A
3	4.1A	3.98-4.22A
4	5.2A	5.04-5.36A
5	6.6A	6.40-6.70A

9. Deenergize regulator (disengage main circuit breaker or disconnect switch) and turn rotary switch S1 to the OFF position.
10. Connect remote control lines, if required, to remote control terminal block TB2 (use AWG 18, 300 V wire or larger) as indicated in Table 7-1 for +48 V dc control signals or in Table 7-2 for 120 V ac control signals. See Figure 8-8 for remote control connections.

Note: Tables 7-1 and 7-2 give the necessary connections for remote control. Terminal B1 (or B10) does not need to be wired. Brightness step B1 (or B10) occurs when the regulator is switched on.
11. Make sure efficiency-adjustment wire #200 on TB5 is set to terminal 1 for full output load or terminal 2 when the load on the output is up to one-half the rated load.
12. Make sure all wiring connections are tight and no wires are shorting across each other.

CAUTION

Incorrect wiring can damage the regulator. Double check all connections.

Table 7-1. Remote Control Connections

<u>Terminal Block TB2 Label</u>	<u>Function</u>
N	Remote Control Common
CCI	Remote Control Power
CC	Remote On-Command Voltage
B10, B30, B100	Brightness Control (3-Step CCR)
B1, B2, B3, B4, B5	Brightness Control (5-Step CCR)

Table 7-2. Remote 120 Vac Control Connections

<u>3-Step CCR Remote Intensity Step</u>	<u>Connect CCI to:</u>
High (6.6 A)	CC, B100
Medium (5.5 A)	CC, B30
Low (4.8 A)	CC, B10
Off	nothing
<u>5-Step CCR Remote Intensity Step</u>	<u>Connect CCI to:</u>
6.6 A	CC, B5
5.2 A	CC, B4
4.1 A	CC, B3
3.4 A	CC, B2
2.8 A	CC, B1
Off	nothing

13. Energize regulator and set CB1 to ON position. Set rotary switch S1 to the REM position. Operate the CCR by remote control. Verify correct current levels are obtained on all brightness steps.
14. Turn rotary switch S1 to OFF and deenergize regulator (disengage disconnect switch or main circuit breaker). Remove short-circuit link from the output terminals of TB1.
15. Connect the 6.6 A series lighting circuit to the output terminals of TB1 and tighten all connections.
 - Note:** Do not route output cable in the vicinity of other wiring sensitive to EMI or RFI.
16. Check if the *input current x input voltage x CCR efficiency* (CCR efficiency = .95) is larger than the kilowatt rating on the CCR nameplate. If it is, either reduce the load or replace the CCR with one having a larger kilowatt rating.
17. Check current output on regulator in all steps in both remote and local control.

Note: The regulator has been preset at the factory to the calibrated values given in Section 7.4, par. #8. If the regulator is not providing the correct current, it will have to be calibrated as given below in Section 7.5.

7.5 Calibration

A separate true-rms-reading ammeter (minimum accuracy of 1%, such as a Beckman "Tech 360" multimeter with model CT-231 current clamp or equivalent) is required to carry out the calibration of the regulator. Do not use the ammeter on the front panel of the regulator.

7.5.1 Set-Up Procedure

The following initial steps are required prior to proceeding with the calibration of the regulator.

1. Check to insure the proper input voltage is supplied to CCR at fuse block F1 and F2.
2. Make sure that the efficiency-adjustment connection (wire #200) is connected to TB5-1. This is for full output power.
3. On the output terminal block TB1 connect a true rms-reading ammeter, such as a Bechman "Tech 360" multimeter, and a lamp load equal to one-half of the CCR's rated load. If the load is greater than one-half of the CCR's rated load, short output terminals 1 and 2 on terminal block TB1.
4. Set CCR's local control switch, S1, to the highest intensity step (S1 position fully clockwise), "5" for 5-step CCR or "100" for a 3-step CCR.
5. Turn the overcurrent-adjustment potentiometer, R48, (see Figure 8-4) on the Control Printed Circuit Board (Control PCB) fully counterclockwise.
6. Turn CCR on. Observe normal operation for a minimum of 2 minutes during which time the output should not vary and only the green LED marked "REGULATOR ON" should be lit. No red alarm LEDs should be lit.

7.5.2 Adjustment of Output Current

After set-up procedure in Section 7.5.1 has been completed, proceed with the following steps to set the output current adjustment level of the CCR.

1. Turn CCR on and set the local control switch, S1, to the highest intensity step, "5" for 5-step CCR or "100" for a 3-step CCR. The external true-rms ammeter should read 6.60 ± 0.1 amps. If the reading is outside of this range, adjust potentiometer R47 (see Figure 8-4) on the Control PCB to obtain 6.60 amps.

Note: Potentiometer R47 is the master reference adjustment. Changing this potentiometer changes the adjustment of potentiometers R48, R46, R45, R44, and R43.

2. Set switch S1 to next lowest brightness step, and verify that the true-rms ammeter reading corresponds to Table 7-3. If the reading is not in the current value range given in Table 7-3, adjust the appropriate potentiometer listed in the table until the correct current value is obtained.
3. Repeat Step 2 for the remaining lower brightness step(s).

Note: Potentiometers R43, R44, R45, R46 have independent circuits, so any adjustments made on these potentiometers will not effect the adjustment of the other three potentiometers.

4. When the output current adjustment has been completed, turn the CCR off. Remove shorting cable on output terminals, if used.

Table 7-3. Potentiometers for Setting Output Current Levels

<u>3-Step CCR S1 Position</u>	<u>Ammeter Reading</u>	<u>Potentiometer</u>
30	5.50	R46
10	4.80	R45
<u>5-Step CCR S1 Position</u>	<u>Ammeter Reading</u>	<u>Potentiometer</u>
4	5.20	R46
3	4.10	R45
2	3.40	R44
1	2.80	R43

Note: Potentiometers R44 and R43 are used only on 5-step CCRs. R44 and 43 have no function on a 3-step CCR.

7.5.3 Overcurrent Adjustment

Complete the steps in Sections 7.5.1 and 7.5.2 before proceeding with the overcurrent adjustment.

Overcurrent Adjustment Steps:

1. With power off, connect a test lead across TP7 and TP9 (see Figure 8-4) on the Control PCB. This will move the trip level for the overcurrent detection threshold from the normal operating point of 6.93 amps to 6.6 amps.
2. Turn switch S1 to the highest brightness step, “5” for 5-step CCR or “100” for a 3-step CCR. Ammeter should read 6.60 amps.

Note: Do not change the adjustment of R47, since this not only will affect the output current of the CCR but the potentiometer adjustment levels for all other current levels.

3. Physically center the overcurrent potentiometer R48 (see Figure 8-4). While viewing the red overcurrent LED on the Control Panel, slowly turn R48 clockwise until the LED begins to glow. Then quickly turn control switch S1 to the next lower intensity step. This will turn the LED off because the current level is less.

Note: If the potentiometer R48 is turned too far, the CCR will shut down. If this should occur, return potentiometer R48 to the centered position (\approx 3 o'clock position) and reset the CCR by momentarily turning the CCR off and then back on.

4. While watching the overcurrent LED, return S1 to the highest intensity step, and time how long it takes for the overcurrent LED indicator to start to glow. It should take 3 ± 1 s.

Note: If the LED comes on in less than 2 seconds, turn potentiometer R48 a slightly counterclockwise. If more than 4 seconds are required for the LED to light, turn R48 slightly clockwise. Repeat step 4 until the correct time period (3 ± 1 s) is obtained.

5. Turn off the CCR and remove test leads from TP7 and TP9. The trip level for the overcurrent threshold is now calibrated for 6.93 amps.

7.6 Changing Input Voltage

The input voltage has been factory set for the input voltage given on the regulator's name tag. If it is desired to change the input voltage, the input voltage can be changed only on 208 and 240 V ac CCRs by changing the wiring connections to transformer T1 via terminal block TB5 (see Figures 8-6 and 8-7).

Note: On 480 V ac CCRs the input voltage can not be changed. If a different input voltage is desired, contact ADB Sales Department.

The schematic/wiring diagram (Figure 8-6) shows the wiring connections on TB5 for 240 V ac input. Note 1 on Figure 8-6 shows the wiring connections for 208 V ac input voltages.

WARNING

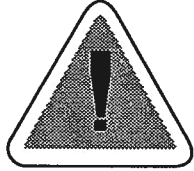
Deenergize CCR by turning rotary switch S1 to OFF and turn off disconnect switch or main circuit breaker. Ground output terminals prior to making any adjustments.

- For 208 V ac input, connect wire #607 to TB5-1 and connect jumper #515 across TB5-1 and TB5-2. See note 1 on Figure 8-6.
- For 240 V ac input, connect wire #607 to TB5-5 and connect jumper #515 across TB5-5 and TB5-6. See note 1 on Figure 8-6.

7.7 Current Sensing Relay Adjustments

The CSR assembly is factory set to trip at 2.5A. If the current-operated switch is not closing, follow the procedures below to adjust the trip amps.

1. First, inspect the current sensing relay and make sure that the input current range is set for 1-6 amps. The range jumper should be removed.
2. Turn the regulator on to step 1. The switch status LED should stay lit if the switch did not trip.



CAUTION: Be extra careful when adjusting the trip amp potentiometer. Adjustments are performed while the 120VAC power is present at the current sensing relay. Use an insulated screwdriver and do not touch the input and output terminals of the relay.

3. Slowly turn the trip amp potentiometer (4 turn pot.) in the clockwise direction to decrease the amount of amps to trip the switch. Continue to turn the potentiometer until the switch status LED should turn off.
4. If the switch status LED does not turn off after 4 turns, verify with an ammeter that at least 1 amp is flowing through the current sensing relay.

If the CSR assembly is used to monitor other airfield equipment, this equipment must draw at least 1 amp through the CSR. *It may be necessary to loop the control wire multiple times through the CSR in order to increase the amount of current through the relay.*

For example, suppose the CSR was used to monitor the ON/OFF status of a Beacon whose control wire only pulls .25A. In order to increase the current through the relay to 1 Amp, loop the control wire four (4) or five (5) times through the relay.

If the CSR assembly still does not function correctly, it may be necessary to replace the current sensing relay.

30 KW LC Regulator

Dimensions: Height = 30 inches
Width = 26 inches
Depth = 36 inches

Weight: 895 lbs.

Bottom View of Regulator Frame

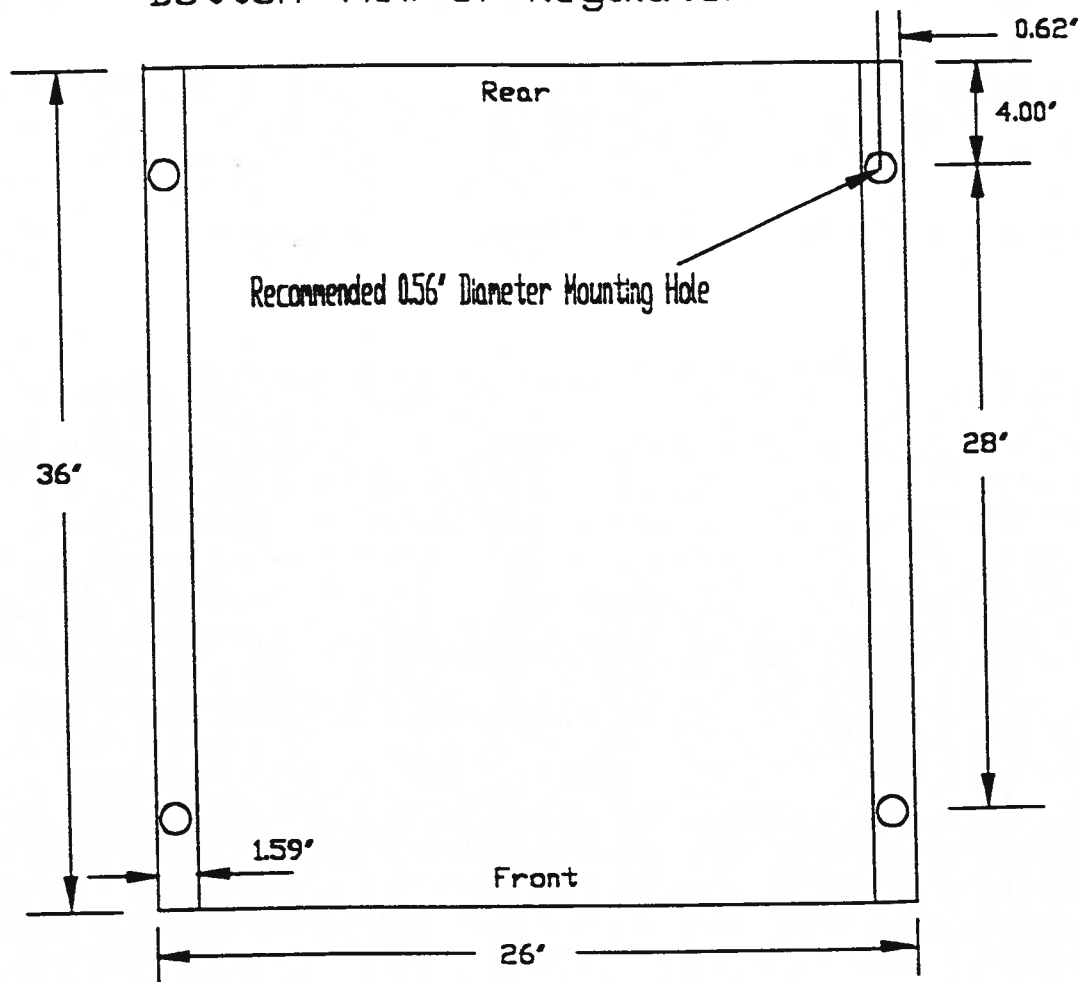


Figure 8-1. Dimensions and Weight

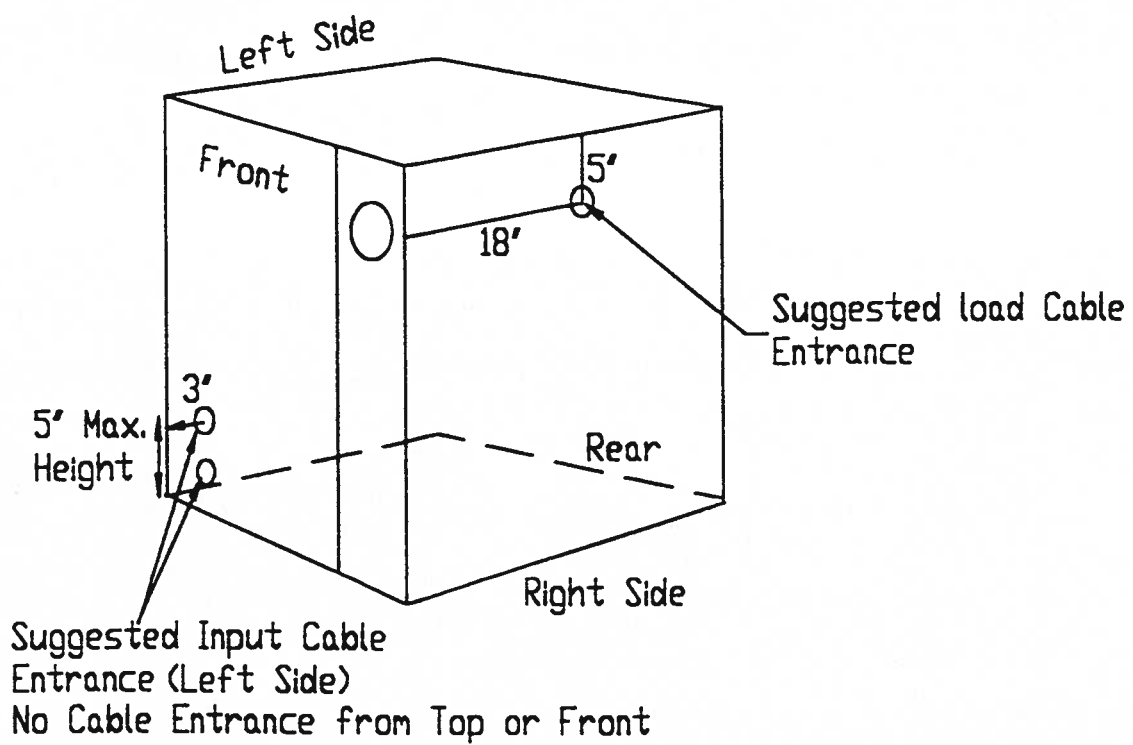


Figure 8-2. Recommended Input/Output Cable Entrance

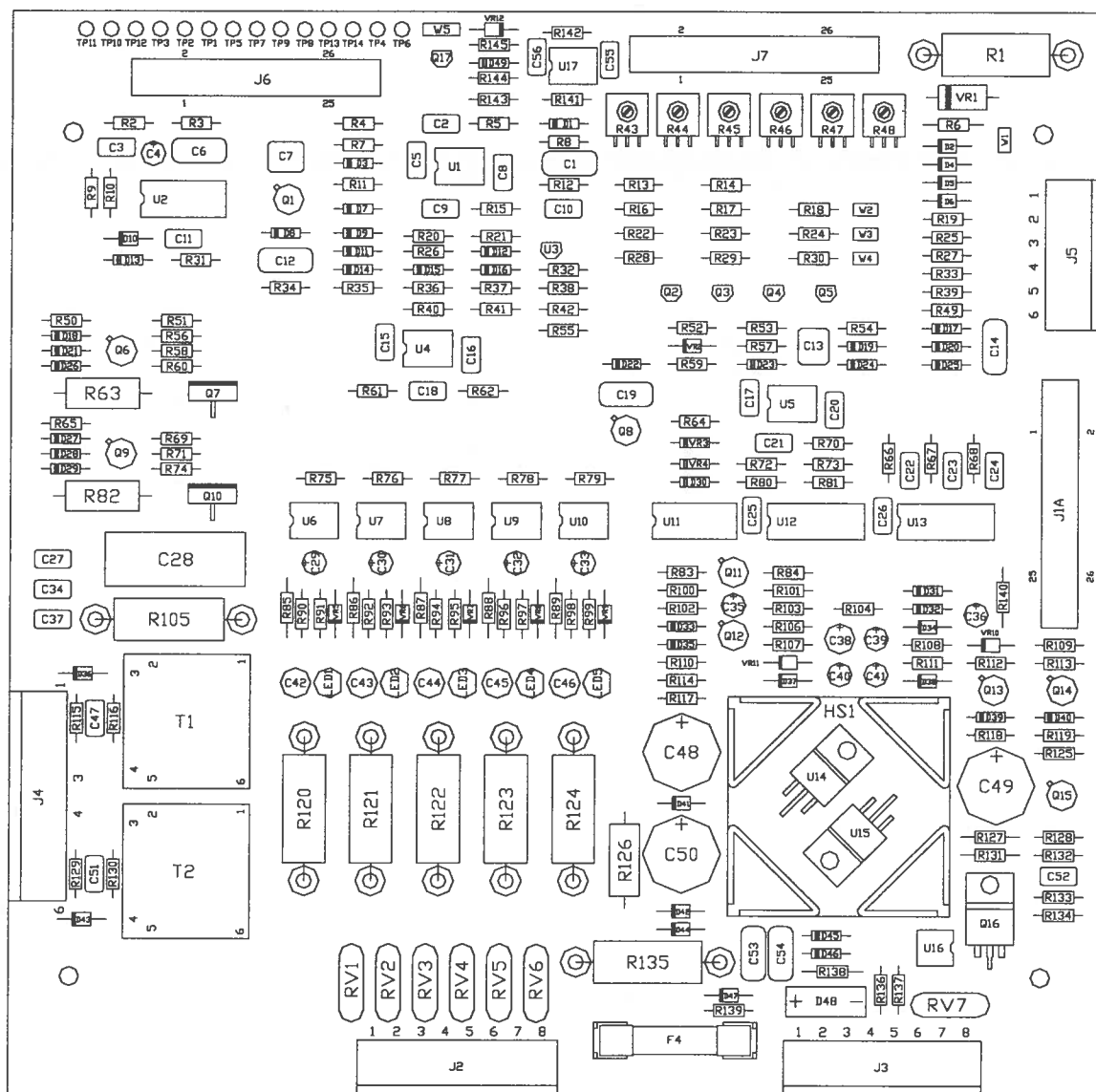
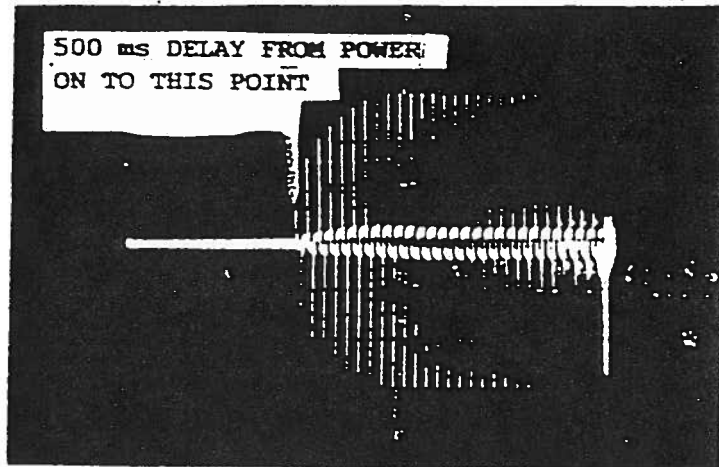


Figure 8-4. Control PCB
Page 8-4



LC CCR
6.6 A OUTPUT CURRENT
5A/DIV, 67 ms/DIV

NOTES: Waveform shows CCR being turned from OFF to ON.
CCR's input voltage is 240 V ac.

Figure 8-5. Output Soft-Start Waveform