CSF Constant Current Regulator
L-828/L-829, with ACE2, Air-Cooled, 2.5-30 kW, 6.6A / 20A

User Manual

96A0451, Rev. H, 2019/09/11

ADB SAFEGATE

A.0 Disclaimer / Standard Warranty

CE certification

The equipment listed as CE certified means that the product complies with the essential requirements concerning safety and hygiene. The directives that have been taken into consideration in the design are available on written request to ADB SAFEGATE.

ETL certification

The equipment listed as ETL certified means that the product complies with the essential requirements concerning safety and FAA Airfield regulations. The directives that have been taken into consideration in the design are available on written request to ADB SAFEGATE.

LED Product Guarantee

Where applicable, per FAA EB67 (applicable edition), ADB SAFEGATE L858(L) Airfield Guidance Signs are warranted against electrical defects in design or manufacture of the LED or LED specific circuitry for a period of 4 years. ADB SAFEGATE LED light fixtures (with the exception of obstruction lighting) are warranted against mechanical and physical defects in design or manufacture for a period of 12 months from date of installation; and are warranted against electrical defects in design or manufacture of the LED or LED specific circuitry for a period of 4 years per FAA EB67 (applicable edition).

Note

See your sales order contract for a complete warranty description. In some specific cases, deviations are (to be) accepted in the contract, which will supersede the standard warranty.

Standard Product Guarantee

Products of ADB SAFEGATE manufacture are guaranteed against mechanical, electrical, and physical defects (excluding lamps) which may occur during proper and normal use for a period of one year from the date of installation or 2 years from date of shipment and are guaranteed to be merchantable and fit for the ordinary purposes for which such products are made. ADB SAFEGATE L858 Airfield Guidance Signs are warranted against mechanical and physical defects in design or manufacture for a period of 2 years from date of installation per FAA AC 150/5345-44 (applicable edition).

Note

See your sales order contract for a complete warranty description.

All Products Guarantee

LED Products of ADB SAFEGATE, manufactured and sold by ADB SAFEGATE or its licensed representatives, meets the corresponding requirements of FAA, ICAO and IEC.

ADB SAFEGATE will correct by repair or replacement per the applicable guarantee above, at its option, equipment or parts which fail because of mechanical, electrical or physical defects, provided that the goods have been properly handled and stored prior to installation, properly installed and properly operated after installation, and provided further that Buyer gives ADB SAFEGATE written notice of such defects after delivery of the goods to Buyer. Refer to the Safety section for more information on Material Handling Precautions and Storage precautions that must be followed.

ADB SAFEGATE reserves the right to examine goods upon which a claim is made. Said goods must be presented in the same condition as when the defect therein was discovered. ADB SAFEGATE furthers reserves the right to require the return of such goods to establish any claim.

ADB SAFEGATE's obligation under this guarantee is limited to making repair or replacement within a reasonable time after receipt of such written notice and does not include any other costs such as the cost of removal of defective part, installation of repaired product, labor or consequential damages of any kind, the exclusive remedy being to require such new parts to be furnished.

ADB SAFEGATE's liability under no circumstances will exceed the contract price of goods claimed to be defective. Any returns under this guarantee are to be on a transportation charges prepaid basis. For products not manufactured by, but sold by ADB SAFEGATE, warranty is limited to that extended by the original manufacturer.

This is ADB SAFEGATE's sole guarantee and warranty with respect to the goods; there are no express warranties or warranties of fitness for any particular purpose or any implied warranties of fitness for any particular purpose or any implied warranties other than those made expressly herein. All such warranties being expressly disclaimed.

Liability

WARNING
Use of the equipment in ways other than described in the catalogue leaflet and the manual may result in personal injury, death, or property and equipment damage. Use this equipment only as described in the manual.

ADB SAFEGATE cannot be held responsible for injuries or damages resulting from non-standard, unintended uses of its equipment. The equipment is designed and intended only for the purpose described in the manual. Uses not described in the manual are considered unintended uses and may result in serious personal injury, death or property damage.

Unintended uses includes the following actions:

- Making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine ADB SAFEGATE replacement parts or accessories.
- Failing to make sure that auxiliary equipment complies with approval agency requirements, local codes, and all applicable safety standards if not in contradiction with the general rules.
- Using materials or auxiliary equipment that are inappropriate or incompatible with your ADB SAFEGATE equipment.
- Allowing unskilled personnel to perform any task on or with the equipment.

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1.0 Safety

Introduction to Safety

This section contains general safety instructions for installing and using ADB SAFEGATE equipment. Some safety instructions may not apply to the equipment in this manual. Task- and equipment-specific warnings are included in other sections of this manual where appropriate.

1.1 Safety Messages

HAZARD Icons used in the manual

For all HAZARD symbols in use, see the Safety section. All symbols must comply with ISO and ANSI standards.

Carefully read and observe all safety instructions in this manual, which alert you to safety hazards and conditions that may result in personal injury, death or property and equipment damage and are accompanied by the symbol shown below.

	WARNING Failure to observe a warning may result in personal injury, death or equipment damage.
	DANGER - Risk of electrical shock or ARC FLASH Disconnect equipment from line voltage. Failure to observe this warning may result in personal injury, death, or equipment damage. ARC Flash may cause blindness, severe burns or death.
	WARNING - Wear personal protective equipment Failure to observe may result in serious injury.
	WARNING - Do not touch Failure to observe this warning may result in personal injury, death, or equipment damage.
	CAUTION Failure to observe a caution may result in equipment damage.

Qualified Personnel

	Important Information The term **qualified personnel** is defined here as individuals who thoroughly understand the equipment and its safe operation, maintenance and repair. Qualified personnel are physically capable of performing the required tasks, familiar with all relevant safety rules and regulations and have been trained to safely install, operate, maintain and repair the equipment. It is the responsibility of the company operating this equipment to ensure that its personnel meet these requirements. Always use required personal protective equipment (PPE) and follow safe electrical work practice.

1.1.1 Introduction to Safety

CAUTION

Unsafe Equipment Use
This equipment may contain electrostatic devices, hazardous voltages and sharp edges on components

- Read installation instructions in their entirety before starting installation.
- Become familiar with the general safety instructions in this section of the manual before installing, operating, maintaining or repairing this equipment.
- Read and carefully follow the instructions throughout this manual for performing specific tasks and working with specific equipment.
- Make this manual available to personnel installing, operating, maintaining or repairing this equipment.
- Follow all applicable safety procedures required by your company, industry standards and government or other regulatory agencies.
- Install all electrical connections to local code.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current demand. All wiring must meet local codes.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment.
- Protect components from damage, wear, and harsh environment conditions.
- Allow ample room for maintenance, panel accessibility, and cover removal.
- Protect equipment with safety devices as specified by applicable safety regulations
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning prior to returning power to the circuit.

Failure to follow this instruction can result in serious injury or equipment damage

Additional Reference Materials

Important Information

- IEC - International Standards and Conformity Assessment for all electrical, electronic and related technologies.
- IEC 60364 - Electrical Installations in Buildings.
- FAA Advisory: AC 150/5340-26 (current edition), Maintenance of Airport Visual Aid Facilities.
- Maintenance personnel must refer to the maintenance procedure described in the ICAO Airport Services Manual, Part 9.
- ANSI/NFPA 79, Electrical Standards for Metalworking Machine Tools.
- National and local electrical codes and standards.

1.1.2 Intended Use

CAUTION

Use this equipment as intended by the manufacturer
This equipment is designed to perform a specific function, do not use this equipment for other purposes

- Using this equipment in ways other than described in this manual may result in personal injury, death or property and equipment damage. Use this equipment only as described in this manual.

Failure to follow this instruction can result in serious injury or equipment damage

1.1.3 Material Handling Precautions: Storage

CAUTION

Improper Storage
Store this equipment properly

- If equipment is to be stored prior to installation, it must be protected from the weather and kept free of condensation and dust.

Failure to follow this instruction can result in equipment damage

1.1.4 Material Handling: Heavy Equipment

DANGER

Unstable load
Use caution when moving heavy equipment

- Use extreme care when moving heavy equipment.
- Verify that the moving equipment is rated to handle the weight.
- When removing equipment from a shipping pallet, carefully balance and secure it using a safety strap.

Failure to follow this instruction can result in death, serious injury, or equipment damage

1.1.5 Material Handling Precautions: Fasteners

DANGER

Foreign Object Damage - FOD
This equipment may contain fasteners that may come loose - torque properly.

- Only use fasteners of the same type as the one originally supplied with the equipment.
- Use of incorrect combination of gaskets, bolts and nuts can create severe damages to the product installation and create safety risk .
- You need to know what base the light fixture will be installed in, in order to chose the correct gasket, bolts and nuts.
- Bolt type, length, and torque value are determined by type of base, height of spacers used, and clamp force required in FAA Engineering Brief No 83 (latest revision).
- Due to the risk of bolts vibrating loose, do not use any type of washer with the fixing bolts (such as split lock washers) other than an anti-vibration washer. Anti-vibration washers as defined in FAA EB 83 (latest edition) must be used. For installations other than FAA, use the base can manufacturer's recommendations.
- Always tighten the fasteners to the recommended torque. Use a calibrated torque wrench and apply the recommended adhesive type.
- Obey the instructions of the adhesives necessary for the fasteners.

Failure to follow these warnings may cause the fasteners to loosen, damage the equipment, potentially to loosen the equipment. This can lead to a highly dangerous situation of FOD, with potential lethal consequences.

Note

To minimize the risk of errors, the ADB SAFEGATE Sales Representative will have information on which gasket goes with which base. This information is also provided in the product Data sheets, the User Manuals and the Spare Part Lists.

CAUTION

Use of incorrect combination of gaskets, bolts and nuts can create severe damages to the product installation and create multiple safety risks.

To obtain a safe and watertight installation the O-ring and retaining bolt stated in the document must be used.

You need to know what base the light fixture will be installed in, in order to choose the correct gasket, bolts and nuts.

Failure to follow these cautions can result in equipment damage or aircraft FOD.

1.1.6 Operation Safety

CAUTION

Improper Operation

Do Not Operate this equipment other than as specified by the manufacturer

- Only qualified personnel, physically capable of operating the equipment and with no impairments in their judgment or reaction times, should operate this equipment.
- Read all system component manuals before operating this equipment. A thorough understanding of system components and their operation will help you operate the system safely and efficiently.
- Before starting this equipment, check all safety interlocks, fire-detection systems, and protective devices such as panels and covers. Make sure all devices are fully functional. Do not operate the system if these devices are not working properly. Do not deactivate or bypass automatic safety interlocks or locked-out electrical disconnects or pneumatic valves.
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment.
- Never operate equipment with a known malfunction.
- Do not attempt to operate or service electrical equipment if standing water is present.
- Use this equipment only in the environments for which it is rated. Do not operate this equipment in humid, flammable, or explosive environments unless it has been rated for safe operation in these environments.
- Never touch exposed electrical connections on equipment while the power is ON.

Failure to follow these instructions can result in equipment damage

1.1.7 Maintenance Safety

DANGER

Electric Shock Hazard

This equipment may contain electrostatic devices

- Do not operate a system that contains malfunctioning components. If a component malfunctions, turn the system OFF immediately.
- Disconnect and lock out electrical power.
- Allow only qualified personnel to make repairs. Repair or replace the malfunctioning component according to instructions provided in its manual.

Failure to follow these instructions can result in death or equipment damage

1.1.8 Material Handling Precautions, ESD

CAUTION

Electrostatic Sensitive Devices
This equipment may contain electrostatic devices

- Protect from electrostatic discharge.
- Electronic modules and components should be touched only when this is unavoidable e.g. soldering, replacement.
- Before touching any component of the cabinet you shall bring your body to the same potential as the cabinet by touching a conductive earthed part of the cabinet.
- Electronic modules or components must not be brought in contact with highly insulating materials such as plastic sheets, synthetic fiber clothing. They must be laid down on conductive surfaces.
- The tip of the soldering iron must be grounded.
- Electronic modules and components must be stored and transported in conductive packing.

Failure to follow this instruction can result in equipment damage

1.1.9 Arc Flash and Electric Shock Hazard

DANGER

Series Circuits have Hazardous Voltages
This equipment produces high voltages to maintain the specified current - Do NOT Disconnect while energized.

- Allow only qualified personnel to perform maintenance, troubleshooting, and repair tasks.
- Only persons who are properly trained and familiar with ADB SAFEGATE equipment are permitted to service this equipment.
- An open airfield current circuit is capable of generating >5000 Vac and may appear OFF to a meter.
- Never unplug a device from a constant current circuit while it is operating; Arc flash may result.
- Disconnect and lock out electrical power.
- Always use safety devices when working on this equipment.
- Follow the recommended maintenance procedures in the product manuals.
- Do not service or adjust any equipment unless another person trained in first aid and CPR is present.
- Connect all disconnected equipment ground cables and wires after servicing equipment. Ground all conductive equipment.
- Use only approved ADB SAFEGATE replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals and create safety hazards.
- Check the interlock systems periodically to ensure their effectiveness.
- Do not attempt to service electrical equipment if standing water is present. Use caution when servicing electrical equipment in a high-humidity environment.
- Use tools with insulated handles when working with airfield electrical equipment.

Failure to follow these instructions can result in death or equipment damage

2.0 Product Introduction

DANGER

Read the instructions in their entirety before starting installation.

This section describes the ADB Safegate Ferroresonant, L-828/L-829, constant current regulators (CCRs). These CCRs are manufactured according FAA specification AC 150/5345-10 (latest edition).

2.1 Introduction

CSF (Ferroresonant) L-828 / L-829 Constant Current Regulator

2.1.1 Constant Current Regulator

Compliance with Standards

FAA:	L-828/L-829 AC 150/5345-10 (Current Edition). ETL Certified.
ICAO:	Aerodrome Design Manual Part 5, para. 3.2.1.4 to 3.2.1.6.
Military:	UFC 3-535-01; NAVAIR 51-50AAA-2

Uses

FAA L-828/L-829 & ICAO Provides three or five precision output levels to power series lighting circuits on airport runways and taxiways.

Features

- Advanced CCR architecture produces minimal EMI, high efficiency, and near unity power factor for AC 150/5345-10 test conditions. Exceeds FAA and military requirements for power factor and efficiency.
- Complies with the conducted power line emission limits test listed in Table 4 of AC 150/5345-10 and as specified in the Code of Federal Regulations (CFR) Title 47, Subpart B, Section 15.107b. Also complies with the radiated emission test listed in Table 5 of AC 150/5345-10 and as specified in the Code of Federal Regulations (CFR) Title 47, Subpart B, Section 15.109b.
- Optional integrated ACE3 unit with 7-inch LCD touchscreen display provides state-of-the-art remote control and L-829 monitoring capability. The new touchscreen design allows all measurements – output True-RMS current and voltage, VA, watts, lamps-out, and series circuit insulation resistance value – to be displayed simultaneously. A visual indication is also provided for FAA-monitored parameters, including open circuit, overcurrent, loss of input power, loss of input voltage, low VA (drop in load VA of 10%), Remote/Local status, and incorrect output current.
- Interlock switch cuts power when the door is opened.
- Available in two classes and styles:

  Class 1 = 6.6 A maximum output current

  Class 2 = 20 A maximum output current (15-30 kW only)

  Style 1 = 3 Brightness Steps

  Style 2 = 5 Brightness Steps
- If input power loss occurs, operation will resume within five seconds after restoration of input power.
- Number of Brightness Steps can be changed in the field (between 3 and 5 Steps).
- Field upgradable from L-828 to L-829 with touchscreen LCD ACE3 unit.
- Input and output lightning protection included.

- A ferroresonant CCR is preferred for airports that require low output harmonic content (EMI) or that have varying loads, such as Runway Guard Lights using incandescent (tungsten-halogen) lamps, L-849 REILs using xenon flash lamps, or Runway Status Lights (RWSL).
- For 20 A, 50 and 70 kW CCRs, refer to data sheet 3013.

Theory of Operation

A ferroresonant transformer is used to supply constant current to the series circuit. Using a feedback current sensing transformer, the output is regulated to ensure that a constant current is delivered to the series field circuit per FAA regulations. The output is modulated by controlling the current flowing in the tank circuit of the ferroresonant transformer.

ACE3 Unit

The optional ACE3 unit provides L-829 monitoring and optional megging or CCR input monitoring capability.

- CCR input voltage
- CCR run-time by step
- CCR cycle count

Optional CCR input monitoring indicates the following:

- CCR input current
- CCR input volt-amps (VA)
- CCR input power (watts)
- CCR input power factor
- CCR % efficiency

The ACE3 unit is also a component of ADB SAFEGATE's distributed control and monitoring system. Each unit can be easily connected to an Airport Lighting Control & Monitoring System (ALCMS) by simply adding redundant communication wires. More information can be found on the ACE3 data sheet 3097.

Environmental Operating Conditions

Temperature:	-40 °C to +55 °C (-40 °F to +131 °F)
Humidity:	10 to 95%
Altitude:	0 to 6,600 ft (2,000 m)

CCR Kits

Various kits are available to customize CCRs for specific application requirements.

Current Sensing Relay Kit	94A0343
Provides a dedicated contact closure if CCR output current is present.	
Time Meter Kit[2]	94A0263/1GH
Provides CCR run-time information on L-828 CCRs.	
CCR Output Analog Voltmeter Kit[2]	Part No.
7.5 kW , 6.6 A; 20 kW, 20A 10-15 kW, 6.6 A; 30 kW, 20 A 20-30 kW, 6.6 A	94A0128 94A0129 94A0130
Time Meter & Output Analog Voltmeter Kit[2]	Part No.
7.5kW, 6.6A; 20kW, 20A	94A0128 & 94A0263/3GH

10-15kW, 6.6A; 30kW, 20A	94A0129 & 94A0263/3GH
20-30kW, 6.6A	94A0130 & 94A0263/3GH
Door Documentation Pocket Kit	94A0654
Provides a pocket for CCR documentation on the inside of the front door.	
Stacking Kit	94A0655
CSF regulators can be stacked to minimize the floor space required in a vault. Kit allows two 800 mm x 800 mm regulators to be stacked together. Regulators can only be stacked two high.	
Alternate Series Cutout Kit[1]	94A0341
Kit is used to install an internal SCO Series Cutout (PN 1475.92.030) instead of the standard internal Airfield Lighting Series Cutout (ALSC). Kit is only available with Output Range options 3 or 5.	

CCR Kit Notes

[1] Not ETL Certified if used with 20, 25, or 30 kW CCRs.

[2] Used only with Monitoring Option 0. When an L-829 is ordered, Time Meter and Output Voltage monitoring is integrated into the functionality of the ACE3.

Application Notes

Monitoring Option	Description	Application
00	None	Standard L-828 supplied with analog ammeter
3X	L-829 Monitoring (ACE)	Includes FAA L-829 monitoring equipment (ACE2 and ACE3). Following options are for ACE2 only: • If application is for connection to ADB SAFEGATE L-890 ALCMS: Add a "/A" to end of Ordering Code. The ACE unit will then be programmed to provide monitoring data via redundant communication links. • If application is for a stand-alone L-829 CCR: Ordering Code is not changed. The ACE unit is programmed to deactivate a dry contact closure if a fault is present. The fault alarm can then be connected to any external monitoring system.
5X	L-829 Monitoring (ACE) and IRMS	Includes FAA L-829 and IRMS equipment (ACE2 and ACE3). Following options are for ACE2 only: • If application is for connection to ADB SAFEGATE L-890 ALCMS: Add a "/A" to end of Ordering Code. The ACE unit will then be programmed to provide monitoring data via redundant communication links. • If application is for a stand-alone L-829 CCR with Insulation Resistance Monitoring: Ordering Code is not changed. The ACE unit is programmed to deactivate a dry contact closure if a fault is present. The fault alarm can then be connected to any external monitoring system.
73	L-829 Monitoring (ACE3) with Input Monitoring	Includes FAA L-829 monitoring equipment (ACE3 only). ACE3 includes input voltage monitoring. Contact the sales department for input current monitoring availability.
83	L-829 Monitoring (ACE3) with Input Monitoring and IRMS	Includes FAA L-829 monitoring equipment. This option adds an IRMS (ACE3 only). ACE3 includes input voltage monitoring. Contact the sales department for input current monitoring availability.

Weights and Dimensions

CCR Size	CCR Weight lb (kg)	Shipping Weight lb (kg)
2.5 kW [1]	277 (125.65)	311 (141.07)
4 kW	443 (200.94)	483 (219.09)
5 kW [1]	505 (229.06)	545 (247.21)
7.5 kW	597 (270.79)	631 (286.22)
10 kW	663 (300.73)	703 (318.88)
15 kW [1]	755 (342.46)	795 (360.61)
20 kW	1048 (475.36)	1088 (493.51)
25 kW [1]	1201 (544.76)	1241 (562.91)
30 kW	1355 (614.62)	1395 (632.76)
CCR Size	H × W × D - inches	H × W × D - mm
All	44 [2] × 31.5 × 31.5 in	1,118 [2] × 800 × 800 mm

Notes
1 Estimated Weight
2 Height includes CCR feet.

Electrical Supply

Power Input:	50/60 Hz, single-phase, available in multiple voltages
Power Factor:	0.99 or more for 2.5 to 30 kW
Efficiency:	90% minimum for 2.5 to 25 kW 92% minimum for 30 kW
Remote Control:	120 VAC or +48 VDC, ±10%

2.1.2 Remote Control

120V AC, or +48V DC, ±10%

2.1.3 Total Harmonic Distortion* (THD)

Current THD: 10% maximum in highest step

Voltage THD: 1.9% maximum in all steps

* Tested with 100% resistive load according to FAA AC 150/5345-10 (Latest Edition).

2.1.4 Theory of Operation Introduction

Ferroresonant circuitry and a solid-state control system accurately regulate the output current to within the FAA-allowable range from no load to full load and with input voltage variations of -5% to +10% of nominal.

For more theory of operation see: Theory of Operation.

2.2 ACE Unit

The ace ™ unit provides L-829 monitoring and optional megging or CCR input monitoring capability. Each unit is installed locally at each CCR that requires remote control and/or monitoring within the airfield lighting electrical vault. Optional CCR input monitoring monitors the following:

- CCR input current
- CCR input voltage
- CCR input volt-amps (VA)
- CCR input power (watts)
- CCR input power factor
- CCR % efficiency

  The ACE unit is also a component of ADB Safegate's distributed control and monitoring system. Each unit can be easily connected to an Airport Lighting Control & Monitoring System (ALCMS) by simply adding redundant communication wires. See the ADB Safegate ACE catalog sheet for additional information. See www.adbsafegate.com .

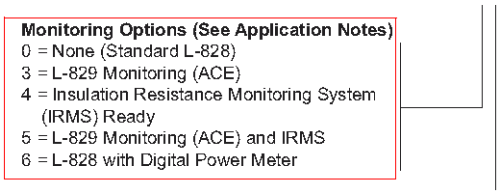
2.3 Environmental Operating Conditions

- Temperature: -40°C to +55°C (-40°F to +131°F)
- Humidity: 10 to 95%
- Altitude: 0 to 6,600 ft (2,000 m)

2.3.1 Monitoring Option

See Figure 1

Figure 1: CSF Ordering Codes



2.3.2 Application Notes

0 None Standard

L-828 supplied with analog ammeter

3 L-829 Monitoring (ACE ™)

Includes FAA L-829 monitoring equipment.

If application is for connection to ADB Safegate L-890 **ALCMS**: Add a "/A" to end of Ordering Code. The ACE unit will then be programmed to provide monitoring data via dual redundant communication links. If application is for a stand-alone L-829 CCR: Ordering Code is not changed. The ACE unit is programmed to deactivate a dry contact closure if a fault is present. The fault alarm can then be connected to any external monitoring system.

4 Insulation Resistance Monitoring System (IRMS) Ready

This option adds an IRMS board in the CCR. Application: connection to externally mounted ADB Safegate ACE unit.

5 L-829 Monitoring (ACE) Includes FAA L-829 and IRMS equipment and IRMS

- If application is for connection to ADB Safegate L-890 **ALCMS**: Add a "/A" to end of Ordering Code. The ACE unit will then be programmed to provide monitoring data via dual-redundant communication links.
- If application is for a stand-alone L-829 CCR with Insulation Resistance Monitoring: Ordering Code is not changed. The ACE unit is programmed to activate a dry contact closure if a fault is present. The fault alarm can then be connected to any external monitoring system.

6 L-828 with Digital Power Meter

This option replaces the analog ammeter with a Digital Power Meter. The Digital Power Meter is used on L-828 CCRs to indicate True RMS output current, voltage, VA, and watts. It can also be set to activate an alarm if there is a 10% or 15% drop in the load (Low VA).

2.4 Theory of Operation

This subsection describes the L-828 CCR theory of operation.

2.4.1 Power Circuit

See Figure 2. A Ferroresonant network consisting of T1, C1, and the SCRs draw from the input lines. This network is capable of drawing a limited amount of power. It can be routed to one of two places. The first is the output leads to the airfield. The second is a resonant tank comprised of Cx and part of T1.

As more power is allowed to flow into the resonant tank, less is available to flow to the field. It is by regulating the current in this tank that the SCRs regulate throughput current to the airfield. It is important to note that the output of the regulator will be the smallest when the SCRs are conducting 100% of the time. This is the opposite of what is seen in SCR type or thyristor regulators where the SCRs are used to directly control the regulator output current.

Note
Cx is actually a bank of capacitors located near T1.

The components of the Ferroresonant network are designed to deliver an output current slightly higher than 6.6 A/20 A for the minimum input voltage, while the SCRs are fully off.

2.4.2 Output Measurement

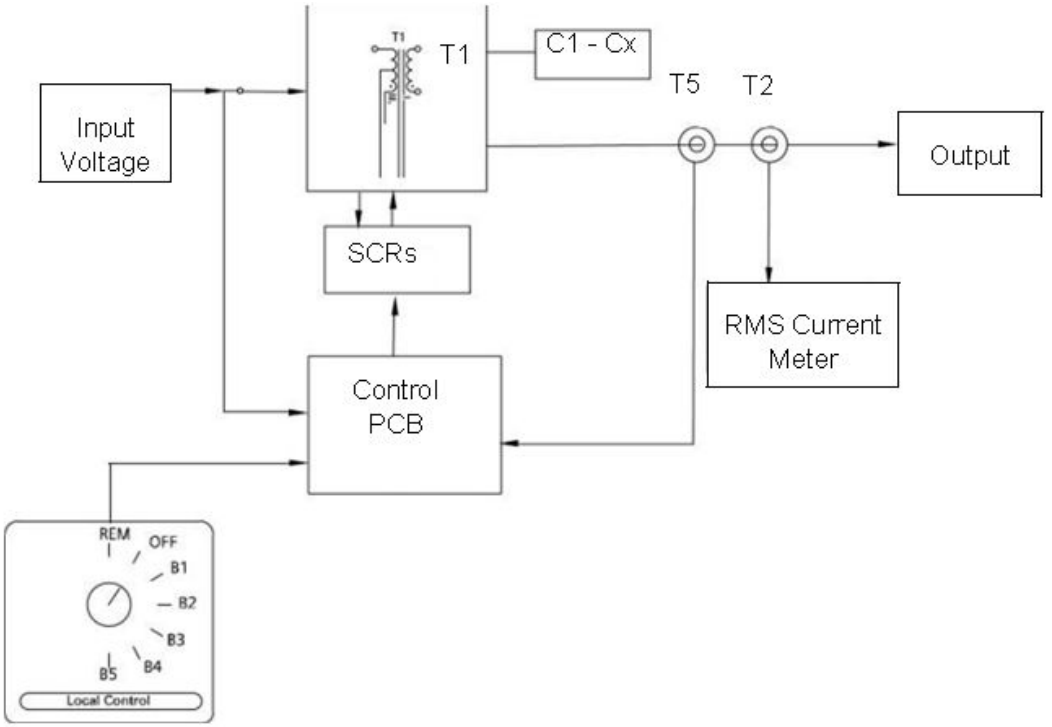
The output current flows through the high voltage current transformer T5. T5 provides feedback to the Control PCB on the actual current output to the airfield series circuit.

A second current transformer, T2, provides current to a true-rms-reading ammeter mounted onto the front panel to indicate output current.

2.4.3 Control PCB

See Figure 5. This subsection describes the board level circuitry found on the Control PCB.

Figure 2: L-828 CCR Power Circuit Block Diagram



2.4.3.1 Control PCB Inputs/Outputs

The Control PCB receives the inputs listed below. See Figure 5 in this section and "Wiring Schematics" on page 59.

- Local control signals from the front panel rotary switch.
- Remote control signals from a remote control terminal block located in the L-828 chassis (120Vac/48Vdc) (TB1).
- A current proportional to the output current from a current transformer (T5).
- Phase angle reference voltage derived from the input voltage.
- 24 Vac center tapped supply voltage from T4.

The Control PCB provides the outputs listed below.

- A contact to activate the input contactor K1 coil.
- A contact to enable the Remote CCI voltage at TB1.
- Gate drive signals to the SCR block used to regulate the output current.

2.4.4 Output Current Monitor Circuitry

The system output current is sensed by a current transformer (T5) whose secondary is connected to J8-3 and J8-4 on the Control PCB. This current signal is passed through a 15-ohm shunt resistor (R38), located on the Control PCB. For the 6.6 amp regulator, T5 provides a 100:1 step-down of the feedback current. For 20 A regulators, this ratio is 300:1. Output current steps 1-5 would correspond to voltage levels of 420, 510, 615, 780, and 990 millivolts respectively.

2.4.5 Local Control Position Detection

Local control position detection is accomplished by using a rotary switch mounted on the front door of the CCR. See Figure 3.

2.4.6 Contactor Drive

The contactor drive circuit on the Control PCB pulls in the main contactor K2 by connecting 120 Vac (present on J4-1) to J4-3.

2.4.7 Remote Control Position Detection

When the local control signal to the micro-controller indicates "remote" the remote control circuitry is active. Relay K1 on the Control PCB closes, providing 120VAC or 48 VDC to the CCI connection on TB2 via J3-1 and the door interlock switch. The remote control inputs incorporate surge suppression and are optically isolated from the rest of the PCB.

2.4.8 Fault Protection

This subsection describes CCR fault protection.

Overcurrent Protection

The micro-controller detects an over current condition by comparing the output current to a preset value. If the output current exceeds this value the controller will shut the regulator down by removing drive to the input contactor. This contactor will remain de-energized until the controller is reset either by selecting the OFF position (remotely or locally) or cycling the input power off for a minimum of 2 seconds and then back on. The control board will not recognize momentary over currents caused by load switching or other transient conditions.

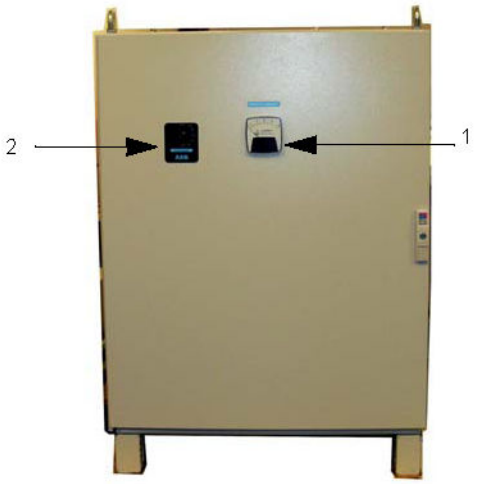
Open Circuit Protection

The micro-controller detects an open circuit by the absence of current in the regulator output (this will also detect an open or shorted current transformer). If the output current is less than 1.5 amps, the controller will shut the current regulator down within one second by removing drive to the input contactor. This contactor will remain de-energized until the controller is reset either by selecting the OFF position (remotely or locally) or cycling the input power off for a minimum of 2 seconds and then back on.

2.5 L-828 CCR

See Figure 3. This subsection describes the L-828 CCR. The L-828 uses a Control PCB to provide regulator and control functions.

Figure 3: L-828 CCR



1 Ammeter (shown) or Digital Power Meter
2 Rotary Switch

The L-828 CCRs are designed to:

- Supply three or five precision output current levels (6.6 A/20 A maximum) to power airport series lighting circuits on runways and taxiways.
- Accurately regulate the output current to within ±1% of the adjustable nominal levels from no load to full load and with input voltage variations of -5% to +10% of nominal.
- Maintain the nominal output current levels even when 30 percent of the isolation transformers in the series lighting circuit supplied by the regulator have open secondaries.

2.6 L-829 CCR

See Figure 4. This subsection describes the L-829 CCR. The L-829 uses a Control PCB to provide regulator and control functions. It also uses the Advanced Control Equipment (ACE™) for control and monitoring functions.

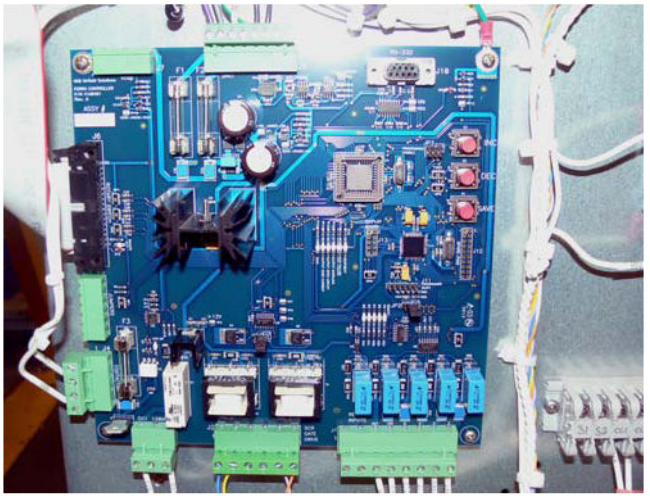
Figure 4: L-829 CCR with ACE

2.7 CCR Controller

See Figure 5 below. The CCR Controller is a PC board that is designed to provide all regulator and control functions for Ferroresonant L-828/L-829 CSF style manufactured by ADB Safegate. This is accomplished with a microcontroller and interface circuitry contained on a single 8 x 8 inch (203 mm x 203 mm) through-hole type printed circuit board. The regulator controller PCB performs the functions listed below.

- Produces SCR drive signals in accordance with the desired output current setting.
- Detects an over-current, or open circuit, and switches the constant current regulator off.
- When in Remote mode, enables the CCI to provide 120 Vac at 50 W. The CCI is the Remote power control source.

Figure 5: CCR Controller



2.7.1 L-829 Advanced Control Equipment (ACE)

See Figure 4 and Figure 6 . The L-829 ACE™ control and monitoring unit consists of an integrated control unit that is interfaced to each CCR either internally or within a small external enclosure. The ACE printed circuit boards are mounted inside a small and rugged environmental enclosure that is directly attached to the door of the L-829 CCR. The ACE consists of microprocessor-based module(s) that processes communication, control commands, input/output interface, and failsafe functionality for controlled elements in the airfield lighting vault.

Figure 6: ACE Control Board

For more information about the ACE, see:

- Advanced Control Equipment (ACE) manual.
- ACE Programming manual. See www.adbsafegate.com

2.8 L-828/L-829 CCR Monitoring Options

The L-829 CCR monitoring options include the Insulation Resistance Monitoring System (IRMS), and ALCMS PLC Interface.

2.8.1 Optional Insulation Resistance Monitoring System

The IRMS is used only on the L-829. It performs scheduled cable insulation resistance measurements and can also perform manually requested measurements. IRMS provides the ability for monitoring the long-term degradation of the airfield series circuit cabling and showing the results on the L-829 CCR front display panel.

> **CAUTION**
>
> **Electric Shock**
> When servicing a regulator equipped with an IRMS module, be sure that power to the IRMS is disconnected before touching the IRMS board, or any of the high voltage components or wires.
> **Failure to follow this warning may result in equipment damage, personnel injury or death.**

2.9 Optional Series Cutout Type SCO or ALSC

The series cutout Type SCO or ALSC is commonly used at airports to isolate the series circuit from the CCR during maintenance or testing operations. The SCO has a unique function in that it also allows manual measurement of resistance of the series circuit to ground without disconnecting the series cable. The SCO cutout has a nominal working voltage of 5 kV and a nominal carrying current capacity of 20 amps AC.

For more information refer to the SCO Cutout manual 96A0294 or ALSC Manual 96A0490.

2.10 Optional Current Clamp Test Point

Regulators without an optional Series Cutout Type SCO will have a current clamp test point installed to provide a location to attach an output current clamp when used to calibrate the output of the CCR.

2.11 L-828 CCRs Required Equipment

Refer to Table 1 for required equipment that is supplied.

Refer to Table 2 for required equipment that is not supplied.

Refer to “CSF Parts and Mechanical Drawings” on page 55 for ordering information.

Table 1: Required Equipment Supplied

Description	Quantity
L-828/L-829 constant current regulator	As Req'd on Order
Instruction manual	1 per CCR on Order

Table 2: Required Equipment Not Supplied

Description	Quantity
Input power wire. Refer to Table 4.	As required
Remote control wire, AWG 18 minimum, AWG 14 maximum	As required
Ground wire; AWG 6 minimum	As required
Output load wire, AWG 6, 5000 Vac, L-824 type	As required
Shorting jumper wire, AWG 6 minimum	As required
Disconnect switch or main circuit breaker	1
True RMS Multi-meter with current clamp (rated to measure up to 20 A alternating current)	1
Mounting bolts, %-13 x 1-1/2 in. long, % STD washers, and lockwashers	4

Note

The SCO, if present, can also be used to short the output of the CCR.

2.12 Input Wire Size

Table 3 refers to recommended input power supply wire size for each regulator power rating dependent on the input voltage. This recommendation is based on 75°C rated copper wire per NEC Table 310.16.

Table 3: Recommended Input Wiring Rating

SIZE	208 V	220 V	230 V	240 V	347 V	380 V	400 V	480 V	600 V
2.5 kW	AWG 10	AWG 10	AWG 10*	AWG 10*	AWG 12	AWG 12*	AWG 12*	AWG 12	AWG 12
4 kW	AWG 10	AWG 10	AWG 10*	AWG 10*	AWG 12	AWG 12*	AWG 12*	AWG 12	AWG 12
5 kW	AWG 10	AWG 10	AWG 10	AWG 10	AWG 12*	AWG 12*	AWG 12*	AWG 12	AWG 12
7.5 kW	AWG 6	AWG 8	AWG 8	AWG 8	AWG 8	AWG 8	AWG 8	AWG 10*	AWG 10*
10 kW	AWG 4	AWG 6	AWG 6	AWG 6	AWG 8	AWG 8	AWG 8	AWG 10	AWG 10
15 kW	AWG 3	AWG 3	AWG 3	AWG 4	AWG 6	AWG 6	AWG 6	AWG 8	AWG 8
20 kW	AWG 2/0	AWG 1/0	AWG 1/0	AWG 2	AWG 4	AWG 4	AWG 4	AWG 6	AWG 6
25 kW	AWG 2/0	AWG 1/0	AWG 1/0	AWG 2	AWG 4	AWG 4	AWG 4	AWG 6	AWG 6
30 kW	AWG 3/0	AWG 3/0	AWG 2/0	AWG 2/0	AWG 2	AWG 2	AWG 2	AWG 4	AWG 4

*Increased 1 wire size to comply with small conductor limits in NEC 240.4(E) through (G)

2.13 Input Power Breaker Sizing

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 4, unless local codes require a different rating technique. Refer to the CCR's nameplate for the kW rating and input voltage to determine the actual input current from Table 4. If no standard-size circuit breaker exists at the 125% value, use the next larger standard-size circuit breaker.

Note

The currents listed in Table 4 represent actual input currents assuming the worst case limits of AC 150/5345-10 for power factor, efficiency, and number of required lamps out. Worst case occurs when 30% of the isolation transformer secondaries are in an open circuit.

Table 4: CCR Input Voltage and Current for the CCR Power Ratings

SIZE	208 V	220 V	230 V	240 V	347 V	380 V	400 V	480 V	600 V
2.5 kW	17 A	16 A	15 A	15 A	10 A	10 A	9 A	8 A	6 A
4 kW	27 A	26 A	24 A	23 A	16 A	15 A	14 A	12 A	10 A
5 kW	34 A	32 A	30 A	29 A	20 A	19 A	18 A	15 A	12 A
7.5 kW	50 A	47 A	45 A	43 A	30 A	28 A	26 A	22 A	18 A
10 kW	67 A	63 A	60 A	58 A	40 A	37 A	35 A	29 A	23 A
15 kW	100 A	94 A	90 A	86 A	60 A	55 A	52 A	43 A	35 A
20 kW	133 A	125 A	120 A	115 A	80 A	73 A	69 A	58 A	46 A
25 kW	166 A	157 A	150 A	144 A	100 A	91 A	86 A	72 A	58 A
30 kW	195 A	185 A	177 A	169 A	117 A	107 A	102 A	85 A	68 A

2.14 Specifications

This subsection provides specifications for L-828/L-829 CCR (6.6 A/20 A).

Table 5: Class, Style and Power Ratings

Class	L-828/L-829 CCR Max Output Current	Style	Brightness Steps	Nominal Output Current	Power Ratings
1	6.6 A	1	3	4.8 A, 5.5 A, 6.6 A	2.5 - 30 kW
		2	5	2.8 A, 3.4 A, 4.1 A, 5.2 A, 6.6 A	
2	20 A	2	5	8.5 A, 10.3 A, 12.4 A, 15.8 A, 20 A	15 - 30 kW

Table 6: Power Factor

CCR	Power Factor
2.5 - 10 kW	0.90 minimum
15 -30 kW	0.95 minimum

2.14.1 Efficiency

The efficiency of the regulator operated with rated input voltage into a full load having unity power factor is not less than the value shown in Table 7.

Table 7: Efficiency

CCR	Efficiency
2.5 - 25 kW	90% minimum
30 kW	92% minimum

2.14.2 Reactive Loading

The CCR maintains the output current within the limits of Table 8 for all brightness steps when the load is connected via isolating transformers, and the secondaries of 30 percent of the transformers become open-circuited. The load before opening the isolation transformer secondaries may be any value from half to full load. For regulators less than 10 kW loaded as specified above, the current remains below 6.8 amperes for the 100 percent brightness step.

Table 8: Output Current and Limits

Class	Style	Step	Nominal output amperes (A) root mean square (RMS)	Allowable range (A RMS)
1	1	B100	6.6	6.5 - 6.7
		B30	5.5	5.4 - 5.6
		B10	4.8	4.7 - 4.9
1	2	B5	6.6	6.5 - 6.7
		B4	5.2	5.1 - 5.3
		B3	4.1	4.0 - 4.2
		B2	3.4	3.3 - 3.5
		B1	2.8	2.7 - 2.9
2	2	B5	20.0	19.7 - 20.3
		B4	12.8	15.5 - 16.1
		B3	12.4	12.1 - 12.7
		B2	10.3	10.0 - 10.6
		B1	8.5	8.2 - 8.8

2.14.3 Resistive Loading

The regulator maintains the output current within the limits of Table 9 while powering any load between no load (or short circuit) and full load. For regulators 10 kW or larger, the regulation is maintained over the full range of environmental conditions specified in this section and for the input voltages specified in Table 5. For regulators less than 10 kW, the regulation is provided at nominal input voltage for all brightness steps.

2.14.4 Regulation

Refer to Table 9 for output current limits. Current regulation is obtained under the environmental conditions, see Table 10.

2.14.5 Environmental Operating Conditions

The L-828 CCRs are designed for indoor use only in an area with adequate ventilation for cooling the constant current regulator. The environmental operating conditions include temperature range, relative humidity, and altitude.

Table 9: Environmental Operating Conditions

Temperature Range			
Without monitoring circuitry	**With monitoring circuitry**	**Relative Humidity**	**Altitude**
-40 to +55 °C (-40 to +131 °F)	0 to +55 °C (-18 to +131 °F)	10 to 95% (non-condensing)	Sea level to 6,600 ft (2000 m)

2.14.6 Protection Devices

L-828 CCRs have the following protection devices:

- Output open-circuit protection.
- Output overcurrent protection.
- Lightning arrestors on output terminals and bushings.
- Lightning arrestors on input terminals.
- Fuse protection of AC supply voltage of the Control PCB and brightness control voltage for Remote control.

2.14.6.1 Open-Circuit Protection

The regulator includes an open-circuit protective device to open the primary switch within 2 seconds after an open circuit occurs in the secondary. The device resets within 2 seconds after the control switch is turned off and re-energized, and cannot be tripped by switching the load circuits or other transients.

2.14.6.2 Overcurrent Protection

Regulators include an overcurrent protective device that opens the primary switch when the output current exceeds the 100 percent current (6.6 A or 20 A) by 5 percent. The device operates within 5 seconds after an overcurrent of 5 percent and within 1 second after an overcurrent of 25 percent. The device resets within 2 seconds after the control switch is turned off and reenergized. The overcurrent protection cannot be activated by a momentary (0.25 second) overcurrent caused by switching the load circuits and other transients.

2.14.7 Input Voltage

Input voltage is single phase 50/60 Hz AC. Regulators operate as required (see subsections *Resistive Loading* and *Reactive Loading* in this section) when the input voltage is anywhere between 95 and 110 percent of the nominal value. The regulator is designed to withstand momentary voltages up to 120 percent of nominal input voltage without shutting off or being damaged by such overvoltage so long as the duration of overvoltage excursions are not longer than 50 milliseconds and do not occur more than once per minute.

2.14.7.1 Built-In True-rms-Reading Ammeter, L-828 only

For the L-828 only, a flush-mounted analog true-rms-reading ammeter mounted on the front of the input module PCB indicates the output current. The meter accuracy is ±3.0 percent of the maximum output current.

2.14.8 Temperature Rise

The temperature rise of the transforming portion of the regulator is in accordance with ANSI C57.12.91 for air-cooled regulators.

2.15 Weights

Table 10: Weights

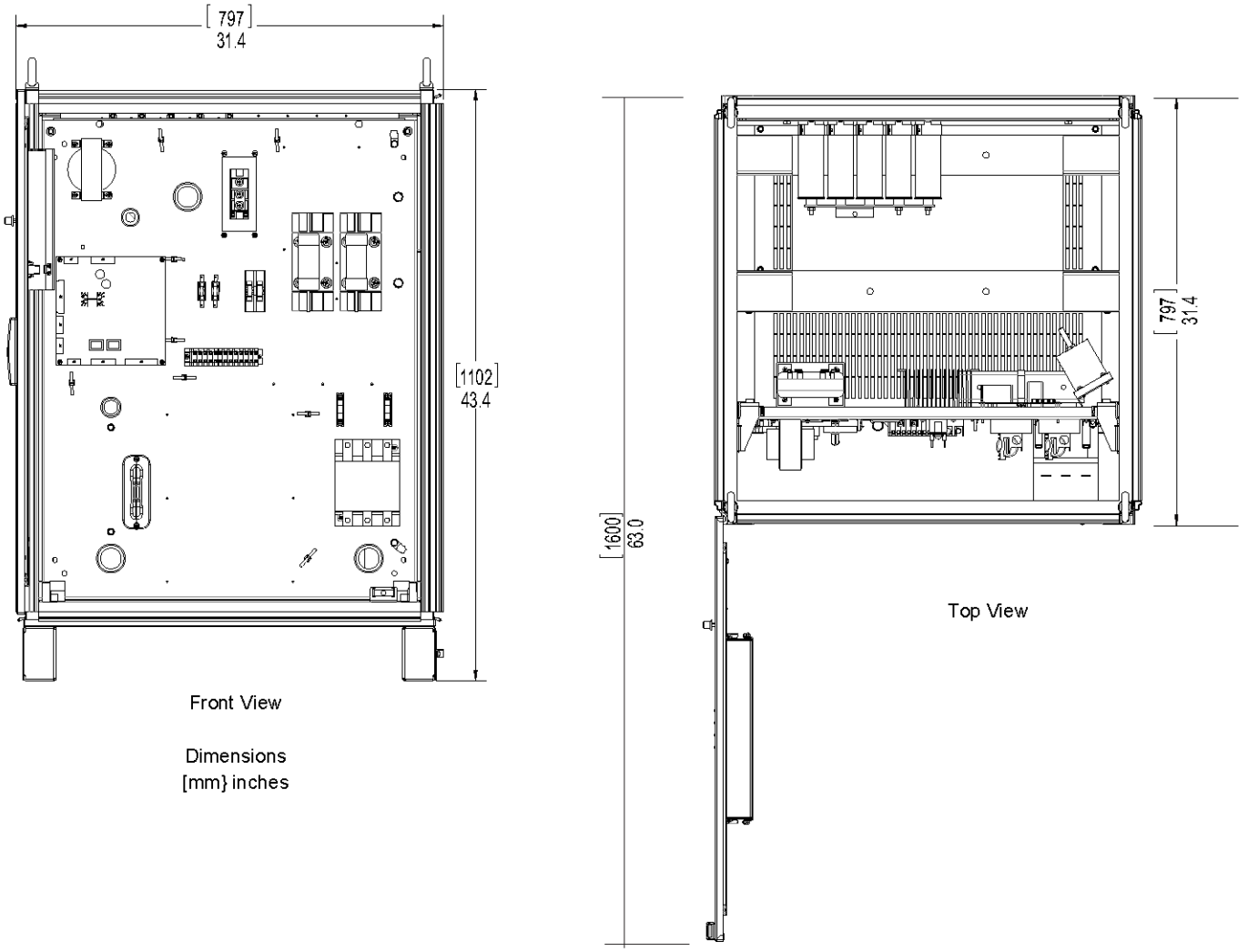
CCR	Weight - lb (kg) [3]								
Size	**208 V**	**220 V**	**230 V**	**240 V**	**347 V**	**380 V**	**400 V**	**480 V**	**600 V**
2.5kW									
4kW	434 (196.9)	427 (193.7)		467 (211.8)				502 (227.7)	
5kW									
7.5kW	556 (252.2)	480 (217.7)		514 (233.1)				600 (272.2)	
10kW	783 (355.2	749 (339.7)		770 (349.3)				826 (374.7)	
15kW	960 (435.4)	872 (395.5)		826 (374.7)				906 (411)	
20kW	1290 (585.4)	1150 (521.6)		1187 (538.4)				1097 (497.6)	
25kW									
30kW	1410 (639.6)	1350 (612.3)		1381 (626.4)				1302 (590.60)	

Notes

[3] Contact your ADB Safegate representative for weights not shown.

2.16 Dimensions

Figure 7: Ferroresonant CCR Dimensions - Typical of 2.5-30 kW



2.17 Installation

L-828 / L-829 CCR Installation

Warning

Read installation instructions in their entirety before starting installation.

- Refer to the FAA Advisory Circular AC 150/5340-26, Maintenance of Airport Visual Aids Facilities, for instructions on safety precautions.
- Observe all safety regulations. To avoid injuries, always disconnect power before making any wiring connections or touching any parts.
- Become familiar with the general safety instructions in this section of the manual before installing, operating, maintaining or repairing this equipment.
- Read and carefully follow the instructions throughout this manual for performing specific tasks and working with specific equipment.
- Make this manual available to personnel installing, operating, maintaining or repairing this equipment.
- Follow all applicable safety procedures required by your company, industry standards and government or other regulatory agencies.
- Control PCB is static-sensitive. Must be grounded when handling PCB.
- Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment.
- Protect components from damage, wear, and harsh environment conditions.
- Allow ample room for maintenance, panel accessibility, and cover removal.
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning prior to returning power to the circuit.

This section provides instructions for installing L-828/L-829 constant current regulators (CCRs). Refer to the airport project plans and specifications for the specific installation instructions.

2.17.1 Unpacking

The equipment is shipped ready for installation. Handle equipment very carefully to prevent component damage. Unpack the carton upon receipt and check the contents and their condition. Note any exterior damage to the carton that might lead to detection of equipment damage.

If you note any damage to any equipment, file a claim with the carrier immediately.

The carrier may need to inspect the equipment.

Note

Take care to maintain the unit in an upright position when handling the regulator.

3.0 Installation

The recommend lifting method for the regulators is to use a forklift from underneath the CCR frame. Four 3/4-inch ID lifting eye- bolts on the top corners of the CCR frame are provided per FAA specifications. If lifting eye-bolts are used, use either a portable hoist and sling(s) or sling(s) attached from forks on forklift. See Table 11 (dimensions and weights) before lifting.

Warning

Read installation instructions in their entirety before starting installation.

- If lift points (eye-bolts) are used, lift straight up. Side loading on the eye-bolts may cause them to bend.

Note

Place the regulator inside a well ventilated room with sufficient clearance for personnel to inspect and maintain the unit.

Note

Maintain a good air flow around the CCR.

3.1 Wiring Connections and Startup

Warning

Read installation instructions in their entirety before starting installation.

- 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.
- Place wiring for output, input, and remote control only on the right side of the CCR to prevent damage to the PCB that is located on the front Left side of the enclosure. If output, input, and remote control wiring must enter from the left side of the enclosure then wiring must be then routed through conduit where it passes the PCB area.

See Figure 8.

To install wiring, perform the following procedure:

1. Verify the input supply voltage corresponds to the voltage rating on the nameplate of the regulator.
2. Make sure the front panel rotary selector switch is set to the OFF position.
3. Ground the regulator by making an adequate ground wire (AWG 6 or larger) connection to the external earth ground lug on the regulator.

4. An appropriate disconnect-type cutout or circuit breaker shall be provided outside the regulator for the input power supply lines.

Table 11: Input/Output Connections

CCR Size	Input Location	Output Location
2.5 thru 30kW with SCO	Top of each Fuse Block on the front of the component plate on the right hand side	Bottom of SCO
CSF 20kW/208 V CSF 30kW/208 V		Lightning Arrestors (VR1 and VR2) on back of the component plate
CSF 2.5, 4, 5, 7.5, 10 kW	Terminal Block (black) Front of the component plate on the right hand side	Lightning Arrestors (VR1 and VR2) on back of the component plate
CSF 15, 20, 25, 30 kW	Terminal Block (white) Front of component plate right hand side. Top of each Fuse Block in front of the component plate on the right hand side	Lightning Arrestors (VR1 and VR2) on back of the component plate

5. Short-circuit the output terminals TB2-1, TB2-2 using 6 AWG minimum wire to avoid lamp destruction in case of excessive current output. The SCO cutout or ALSC, if present, may be also used for shorting the output.
6. Refer to Table 4 for the recommended input wire. Connect the power supply lines from the disconnect switch or main circuit breaker to the CCR input fuse block F1/F2. Tighten all connections.

Figure 8: Wiring on Right Side of CCR

7. Engage main circuit breaker or disconnect switch to energize the regulator.
8. Turn front panel rotary selector switch locally to all brightness steps, and verify that current values on the panel ammeter correspond to those in Table 12 for each brightness step.
9. Disengage the main current breaker or disconnect switch to de-energize the regulator.
10. Turn the rotary selector switch to OFF.
11. Connect remote control lines, if required, to remote control terminal block TB1.
    Use AWG 14 max - 18 min, 300 V wire or larger. See Wiring Schematics for remote control connections.

Note

If the ADB Safegate Advanced Control Equipment (ACE) is used with the Ferroresonant L-828 CCR, refer to the Advanced Control Equipment manual for remote control wiring connections. Table 12 through Table 14 provide the necessary connections for the remote control (either 120 Vac or, +48Vdc). Terminal B1 (B10) does not need to be wired. Brightness step B1 (B10) is automatically activated when CCI (source of remote control power) is connected to CC (ON command).

Table 12: Remote Control Connections (3-Step/6.6 A)

For this remote intensity step...	Connect CCI to...
B10 (4.8 A)	CC
B30 (5.5 A)	CC, B30
B100 (6.6 A)	CC, B100
OFF	Not applicable

Table 13: Remote Control Connections (5-Step/6.6 A)

For this remote intensity step...	Connect CCI to...
B1 (2.8 A)	CC
B2 (3.4 A)	CC, B2
B3 (4.1 A)	CC, B3
B4 (5.2 A)	CC, B4
B5 (6.6 A)	CC, B5
OFF	Not applicable

Table 14: Remote Vac Control Connections (5-Step/20 A)

For this remote intensity step...	Connect CCI to...
B1 (8.5 A)	CC
B2 (10.3 A)	CC, B2
B3 (12.4 A)	CC, B3
B4 (15.8 A)	CC, B4
B5 (20 A)	CC, B5
OFF	Not applicable

Note

If more than one intensity command is connected, the CCR will activate at the highest intensity selected.

12. Make sure wiring connections are tight and no wires are shorting across each other.

CAUTION

Read installation instructions in their entirety before starting installation.

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

13. Energize regulator and set rotary selector switch to REM. Operate the CCR by remote control, and verify correct current levels are obtained on all brightness steps.
14. Turn rotary selector switch to OFF and de-energize regulator (disengage disconnect switch or main circuit breaker). Remove short-circuit link between output terminals TB-2-1 and TB2-2.

15. Connect the 6.6 A or 20 A series lighting circuit to the output terminals/ bushings and tighten all connections.

Note

See Table 14 for the location to connect the output wires. If a SCO or ALSC is present, see manual

16. Energize the regulator and re-verify that the current levels are correct in all steps.

4.0 Operation

Warning

Read installation instructions in their entirety before starting installation.

- Refer to the FAA Advisory Circular AC 150/5340-26, Maintenance of Airport Visual Aids Facilities, for instructions on safety precautions.
- Observe all safety regulations. To avoid injuries, always disconnect power before making any wiring connections or touching any parts. Refer to FAA Advisory Circular AC 150/5340-26.
- Become familiar with the general safety instructions in this section of the manual before installing, operating, maintaining or repairing this equipment.
- Read and carefully follow the instructions throughout this manual for performing specific tasks and working with specific equipment.
- Contents are static-sensitive. Must be grounded when handling PCBs.

Introduction

This section provides the operational procedures listed below for the L-828/L-829 constant current regulator (CCR).

- CCR control procedures
- CCR shutdown procedures
- CCR adjustment procedures
- SCO Cutout working positions

4.1 CCR Control Procedures

This subsection describes the regulator operations in local and remote controls.

Local Control

See Figure 9. Refer to Table 15 through Table 17 for output current when using local control. The front panel rotary selector switch is used for regulator local control. The rotary switch for the 3-step CCR has five positions; the rotary switch for the 5-step has seven positions. The regulator automatically maintains the output current within ±1% of the nominal value for the brightness position selected.

Operation

Figure 9: Switch (3-Step/5-Step)

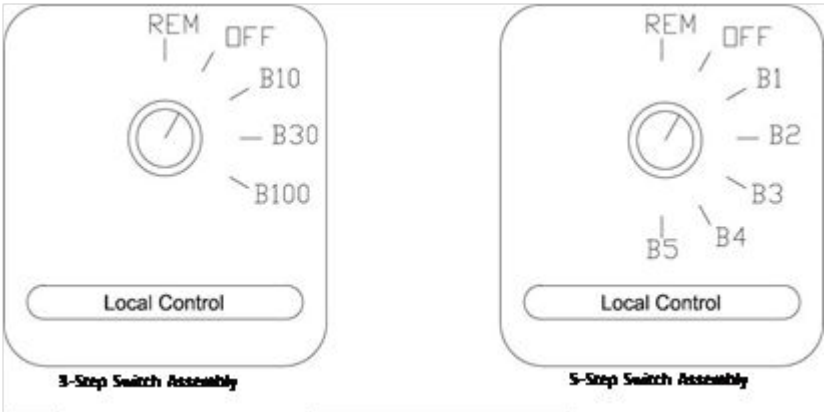


Table 15: Output Current from Rotary Switch (3-Step/6.6A)

If you set the rotary switch to the following...	The result is...
B10	4.8 A current output
B30	5.5 A current output
B100	6.6 A current output

Table 16: Output Current from Rotary Switch (5-Step/6.6 A)

If you set the rotary switch to the following...	The result is...
B1	2.8 A current output
B2	3.4 A current output
B3	4.1 A current output
B4	5.2 A current output
B5	6.6 A current output

Note
CCR Door Interlock 3/8/13

Table 17: Output Current from Rotary Switch (5-Step/20 A)

If you set the rotary switch to the following...	The result is...
B1	8.5 A current output
B2	10.3 A current output
B3	12.4 A current output
B4	15.8 A current output
B5	20 A current output

Remote Control

See Figure 9. Refer to Table 18 for instructions on how to set up and use remote control.

Table 18: Remote Control

If...	Then...
The rotary switch is set to position REM and remote control wiring is connected to remote control terminal block TB1 on the regulator	Remote control of the regulator is possible. The output current of the regulator will correspond to the brightness setting energized by remote 120 Vac or 48 Vdc control signals.
Switch is set to OFF	Remote control signals will not operate the regulator; that is, turn the regulator on to a particular brightness setting or turn the regulator off.
No remote control connections exist on terminal block TB1 (switch is set to REM)	The position REM becomes an additional OFF position; that is, the regulator is de-energized.

4.2 CCR Door Interlock

The door interlock disables remote and local control of the CCR when the door is opened. If the door is opened while the CCR is running, the CCR will shut OFF.

This is to protect personnel from coming into contact with high voltage electronics.

Note

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 terminals and on the internal control circuitry.**

To bypass the interlock, pull out the plunger of the interlock switch. This will allow remote and local control of the CCR with the door open.

4.3 CCR Shutdown Procedure

To shut down the CCR, set the rotary switch to position OFF.

The door interlock removes power to the CCR when the door is opened. Pull out the plunger fully to bypass.

Note

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 terminals and on the internal control circuitry.

To remove input power, disengage disconnect switch or external circuit breaker.

4.4 CCR Adjustment Procedures

This subsection provides regulator adjustment procedures.

Note

The regulator has been adjusted at the factory to provide the nominal output current levels as given in Table 16. If the current level settings need to be adjusted, read the following warning statement before proceeding.

Warning

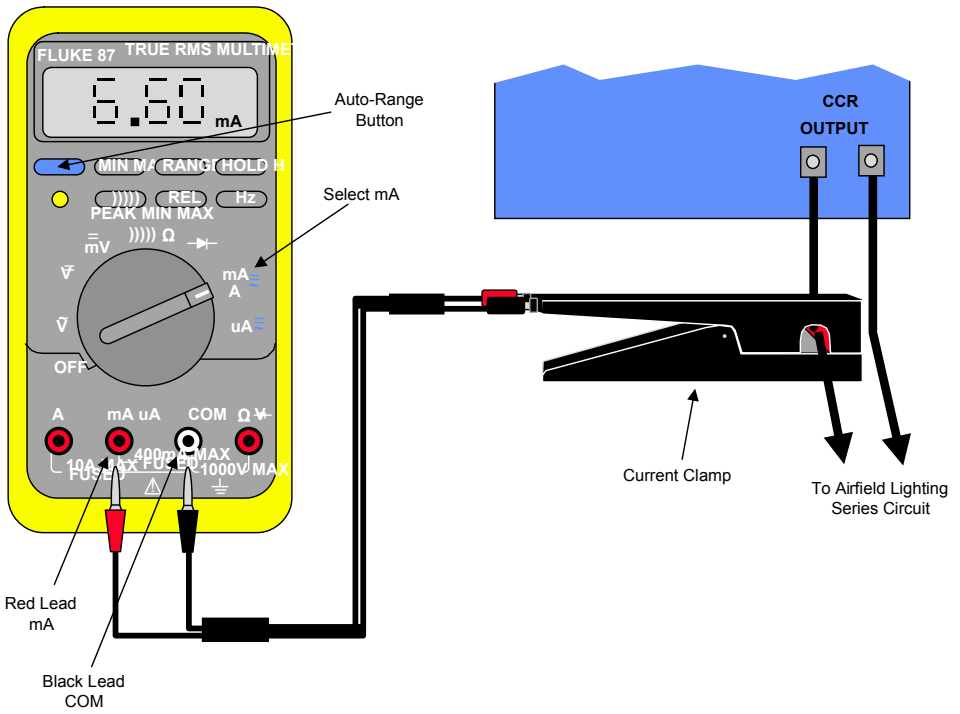
- Read the instructions in their entirety before starting installation.
- Only personnel qualified to work on high voltage systems should attempt to make any adjustments on the constant current regulator.
- Turn the rotary selector switch on the front panel of the regulator to position OFF. Remove input power before servicing control circuitry.
- Never service the regulator when it is in protective shutdown mode, Remote controls or power fluctuations can restart the regulator.

CCR Adjustment Procedure Start

To adjust the output current, perform the following procedure:

1. Connect a clamp-on true rms-reading instrument (such as a Fluke 87 multimeter with a current clamp) around one of the output current leads. See Figure 11.
2. If the optional current clamp test point is present the clamp-on instrument on the CCR component plate should be utilized.

Figure 10: Output Current Clamp



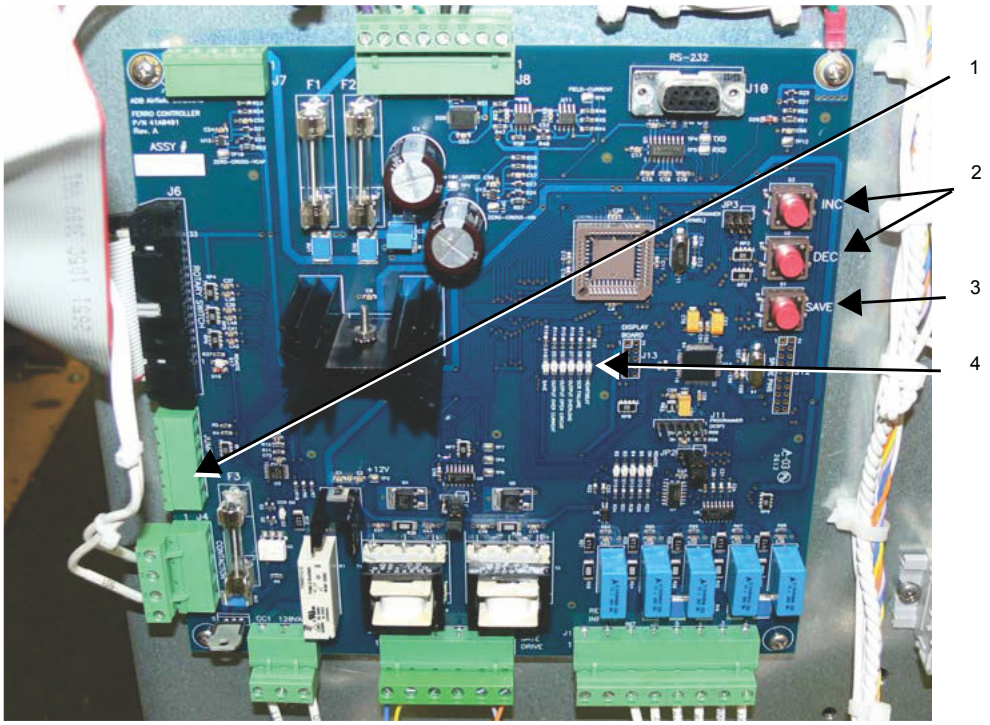
Operation

Note
Make sure the meter is set on the AC current scale.
The Black Lead is COMMON

Because the output current waveform is not a true sine wave, the ammeter must be of the true-rms (root mean squared) type. Field instruments such as clamp-on ammeters and Simpson voltmeters will give erroneously low readings.

Adjusting Output Current

Figure 11: Regulator Control PCB (44A7293)



To adjust the output current of Regulator Control Board, perform the following procedure:

1. For 3-step operation, verify that the jumper is in place between J5 pins 5 and 6, (Figure 12 item 1). No jumper is required for 5-step operation.
2. Turn on the CCR and set local control switch to the highest intensity step, B5 for 5-step CCR, B100 for a 3-step CCR.
3. The external True-RMS ammeter should read 6.60 ±0.1 amps. If the reading is outside of this range, adjust the output current with buttons INC and DEC (Figure 12, Item 2) on the Control PCB until the correct current is obtained. Press and hold the SAVE button (Figure 12, Item 3) for two seconds to save the setting.
4. Turn off the CCR. Remove the short from the output and apply the field load.
5. Again, turn on the CCR and set local control switch to the highest intensity step, B5 for 5- step CCR, B100 for a 3-step CCR.
6. The external True-RMS ammeter should read 6.60 ±0.1 amps. If the reading is outside of this range, adjust the output current with buttons INC and DEC (Figure 12, Item 2) on the Control PCB until the correct current is obtained. Press and hold the SAVE button (Figure 12, Item 3) for two seconds to save the setting.

   NOTE: Each CCR output current step is independently adjustable and must be independently saved.
7. Set the local switch to next to the lowest brightness step, and verify that the True-RMS ammeter reading corresponds to Table 16 thru Table 18.
8. If the reading is not in the current value range given in the Tables, adjust the appropriate step until the correct current value is obtained.
9. Repeat Step 2 for the remaining lower brightness step(s).

When the output current adjustment has been completed, turn off the CCR.

Adjusting Overcurrent Control Board

Adjusting the CCR over current detection level

Before adjusting the Over Current Detection level, set up the regulator and adjust the output current per the **ADJUSTING THE CCR OUTPUT CURRENT** section of this section.

Note

The Over Current setting is pre-set and should normally not need adjusted. To adjust the overcurrent, perform the following procedure:

1. Short the output of the CCR so the field load cannot be damaged by an over current situation during the adjustment.
2. Turn the local switch to the highest brightness step, B5 for 5-step CCR, B100 for a 3-step CCR. The true-RMS ammeter should read 6.6 amps.
3. Press and hold for three seconds both the INC and DEC buttons (Figure 12, Item 2). The SAVE LED (Figure 12, Item 4) will light when you are in the Over Current Adjustment Mode.

   Note

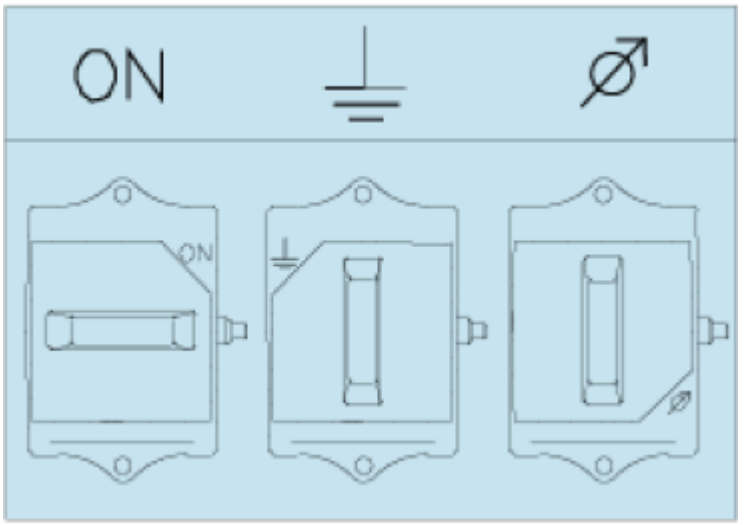
   The CCR output current will increase to the level previously set as the Over Current level. This will be above 6.6 amps.

4. Press the INC or DEC buttons (Figure 12, Item 2) until you reach the desired Over Current detection level.
5. Press and hold the SAVE button for two seconds. The SAVE LED (Figure 12, Item 4) will go out and the CCR output will go back to the top step setting of 6.6 amps.
6. Remove the short from the CCR output and apply the field load.

4.5 SCO Cutout Working Positions

See Figure 6 and Figure 7. The SCO cutout can be plugged in three orientations.For additional information on the SCO cutout, refer to manual 96A0294, SCO Cutout.

Figure 12: SCO Cutout Handle Orientations

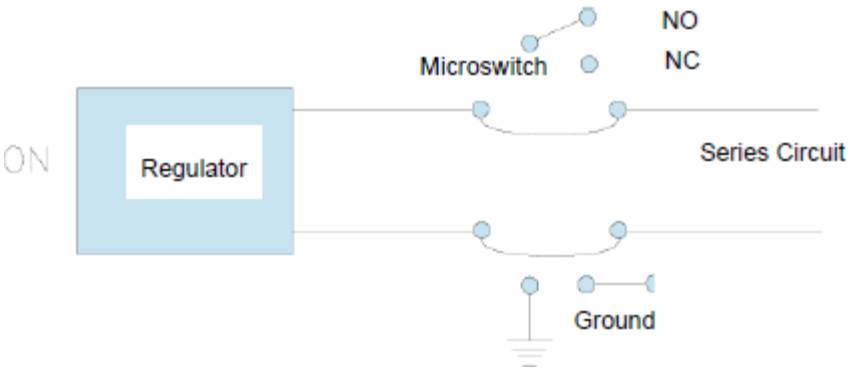


In the operation position, the regulator is connected to the series circuit, and the micro switch is activated.

Note

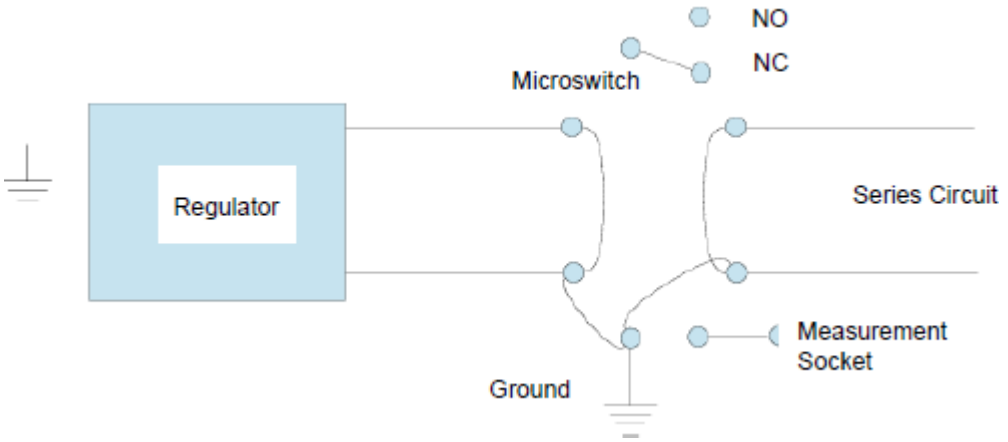
An activated micro switch means that the normally open contact is closed and that the normally closed contact is open. For interlocking with the CCR, only the normally open contact is used. When the cover is removed, the micro switch is not activated.

Figure 13: SCO Cutout Operation Position



See Figure 8. In the maintenance position, the regulator and the series circuit are both shorted and grounded. The micro switch is not activated.

Figure 14: SCO Cutout Maintenance Position

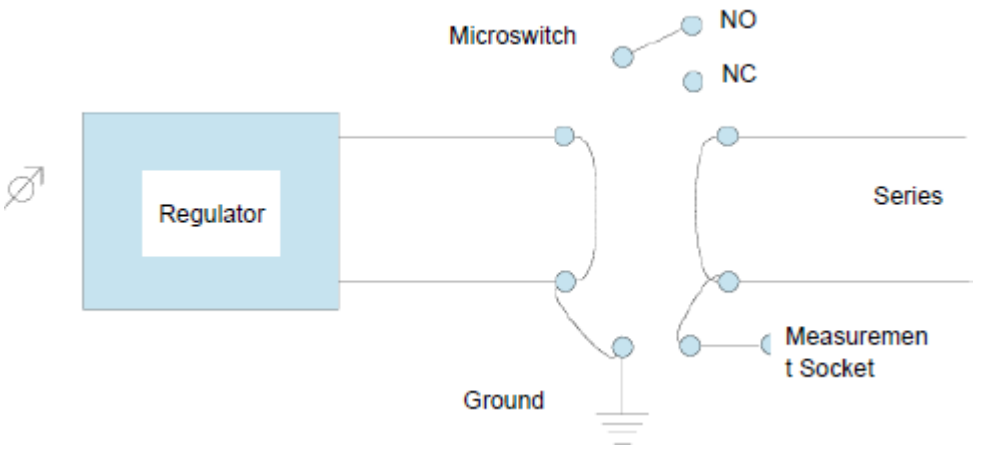


You can determine the current orientation by observing the cutoff corner of the handle.

See Figure 9. In the test and measure position, the insulation resistance of the series circuit can be measured. The regulator operation can be tested under short-circuited output conditions.

In the test and measure position, the regulator is shorted and grounded, the series circuit is shorted and connected to the measurement socket. The micro switch is activated.

Figure 15: SCO Cutout Test and Measure Position



5.0 Maintenance and Repair

This section provides maintenance and repair instructions for the L-828 and L-829 CSF Air-cooled CCRs.

Warning

Read the instructions in their entirety before starting installation.

- Only personnel authorized to work on high-voltage equipment should perform maintenance on the regulator.
- Operate regulator under local control (using rotary switch) when performing maintenance tasks on the regulator. This will prevent the regulator from accidentally being turned on and causing serious injury or death. De-energize regulator by turning rotary switch to OFF, and remove input power to regulator by turning off disconnect switch or main circuit breaker before opening access door to service regulator.
- If the regulator experiences an over-voltage or an over-current fault, it will enter protective shutdown mode. In this mode, the regulator turns off until either power to the regulator is cycled, or the regulator is turned off with either the rotary switch or the remote controls.

5.1 Maintenance Schedule

To keep the L-828/L-829 CCRs operating efficiently, follow a preventive maintenance schedule. Refer to Table 19.

Table 19: L-828/L-829 CCR Maintenance

Interval	Maintenance Task	Action
Daily	Check all control equipment for proper operation.	Check local and remote control (if used) on each brightness step.
Monthly	Check input voltage.	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.
	Check and record output current on each brightness step.	Use a true-rms reading instrument. Adjust current levels if out of tolerance. Refer to Output Measurement. Refer to Reactive Loading for the current range for the 3-Step and 5-Step CCRs.
Annually	Check relays, wiring and insulation.	Replace contacts that are excessively burned or pitted.
		Operate the local control switch to check for proper operation of relays and contactors.
		Make sure input and output connections are tight and that no damaged wires or damaged insulation exists.
	Inspect housing for rust spots.	Clean and touch-up rust spots with paint.
	Inspect lightning arrestor connections.	Tighten any loose connections. Replace charred or burnt wiring or broken arrestors.
	Perform a short-circuit test.	Refer to *Short-Circuit Test* in this section.
	Perform an open-circuit test.	Refer to *Open-Circuit Test* in this section.
Unscheduled	Check load on regulator.	At installation and subsequent load changes make sure that the output rms-voltage times the output true-rms current does not exceed the regulator size.

5.1.1 Short-Circuit Test

Warning

Read the instructions in their entirety before starting installation.

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

To perform the short-circuit test, perform the following procedure:

1. Remove input power to the regulator (turn off disconnect switch or main circuit breaker) and turn the rotary switch to OFF.
2. Remove the output field wiring from the output terminals. Use AWG 6 or larger wire to short output terminals. You may also use the SCO or ALSC. Place the SCO in the "maintenance position" to short the output.
3. Energize the regulator and turn the rotary selector switch to the lowest brightness step (B1 or B10) and then to the remaining brightness steps. Check the output current on the ammeter or, display on the CCR front panel, at each step.

Note

The output current should be within the tolerance given in Table 9 .

Any calibrations should be performed with a calibrated true-rms current meter.

4. If the output current is not within the limits specified in Table 9 check the input voltage to the regulator. The supply voltage should be within -5% to +10% of the nominal input voltage given on the regulator nameplate.

   Refer to Control PCB.
5. Turn the rotary switch to the OFF position.
6. Turn off the disconnect switch or main circuit breaker to remove input power to regulator. Also you may place the SCO cutout back into the "operation position."
7. Disconnect the shorting jumper and reconnect output cables.
8. Reconnect the input-power disconnect switch or main circuit breaker and restore the regulator to operation..

5.1.2 Open-Circuit Test

Warning

Read the instructions in their entirety before starting and procedures.

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

Since high open-circuit voltages may result by opening the output of the regulator, only personnel authorized to work on high-voltage equipment should be allowed to perform the open-circuit test

To perform the open-circuit test, perform the following procedure:

1. Remove input power to regulator (turn off disconnect switch or main circuit breaker) and turn the rotary switch to OFF.
2. Remove the field wiring from the output terminals of the regulator. Note that even if an SCO cutout is present, remove the wires from only the regulators output terminals.
3. Turn on input power to the regulator.
4. Turn the rotary switch to the lowest brightness position (B1 or B10). The open-circuit protective device should automatically de-energize the regulator in less than 2 seconds.
5. Turn the rotary switch to OFF. The open-circuit protective device should reset.
6. Turn the rotary switch to position B1 or B10. The regulator should turn on and then de-energize 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.
8. Reconnect the field wiring to the regulator.
9. Reconnect the input-power disconnect switch or main circuit breaker and restore the regulator to operation.

6.0 Troubleshooting

Warning

Read the instructions in their entirety before starting and procedures.

- Only personnel authorized to work on high-voltage equipment should perform maintenance on the regulator.
- Allow only qualified personnel to perform the following tasks. Observe and follow the safety instructions in this document and all other related documentation.
- De-energize regulator by turning the rotary switch to OFF, and remove input power to regulator by turning off disconnect switch or main circuit breaker.
- Discharge capacitors and ground output terminals bushings by using a grounding rod prior to touching any parts.
- If the regulator de-energizes, the output circuit could be interrupted by an overcurrent, open-circuit, or undervoltage condition. Before inspecting the output circuit.
- Place the rotary selector switch in the OFF position and turn off disconnect switch or main circuit breaker. Without this precaution, a dip in the power line may reset the regulator and turn it on, resulting in an output voltage of thousands of volts which can cause serious injury or death.
- The control board is static-sensitive. The PCB must be grounded when handling.
- Short the output terminals before switching the regulator on. The wire should be AWG 6 or larger. You may also use the SCO cutout to short the regulator output.

6.1 Preliminary Troubleshooting

The following is a check list of initial steps to perform.

- Visually examine all areas of the CCR. Do burnt or loose connections/parts exist?
- Is the input voltage present and within +10 to -5% of nominal?
- Check all the fuses.
- Are the wire harness connectors to the control board fully seated? Tighten only the wire connection screw within the regulator to insure that there are no potential issues with loose wiring.
- Have the PCBs been adjusted in accordance with the instruction manual?
- If the CCR works in local but not Remote, check the voltage on the Remote control lines.
- Can the CCR be re-energized by turning the rotary switch from OFF to Step B1 (B10)?
- Short the output of the CCR, and turn on the CCR. If the regulator operates normally, the problem is probably load related.
- If the CCR turns on and then shuts off after a few seconds and the ammeter has a high current reading, the problem is overcurrent. Adjust the output current accordingly. If the output current is not adjustable, replace the control board and restart the regulator.

Note

If the CCR still fails in over-current, replace the SCR and restart this procedure.

Check the LED indicator on the PCB.

Consider replacing the PCB and then the SCR as this replaces most of the active components within the regulator.

6.2 Troubleshooting Control Board

Figure 16: The Control Board

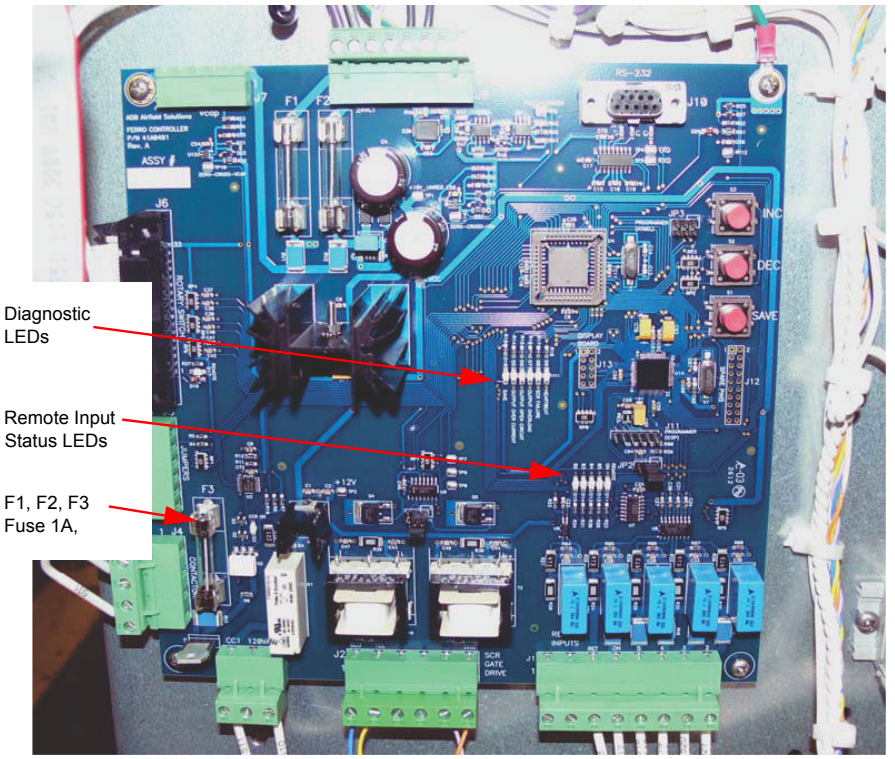


Table 20: Diagnostic LEDs on the Conttrol Board

LED	Indication	Description
D9	Heartbeat	Will flash continuously in normal operation
D8	SCR Failure	Indicates that the SCR has failed
D7	Output Overload	CCR is overloaded
D6	Output Open Circuit	CCR has detected an open circuit
D5	Output Over Current	CCR has detected and over current condition
D10	Save	Indicates the step current has been saved during calibration

Table 21: Remote Input Status

LED	Indication	Description
D11	ON	CC is active
D12	ON	B5 is active
D13	ON	B4 is active
D14	ON	B3/B100 is active
D15	ON	B2/B30 is active

6.3 Troubleshooting Fuses

This subsection provides information for troubleshooting fuses.

Amp rating as a function of input voltage and CCR kW rating for input power fuses F1 and F2 on the L-828 and L-829 CCRs.
Input Power Fuses, F1 and F2, per CCR Input Voltage and CCR kW Rating

Table 22: L-828/L-829 Input Power Fuses F1 and F2.

SIZE	208	220	230 V	240 V	347 V	380 - 400 V	480 V	600 V
2.5 kW	47A0228	47A0228		47A0175	47A0223	47A0223	47A0226	47A0222
4 kW	47A0092	47A0092	47A0069	47A0069	47A0191	47A0191	47A0090	47A0223
5 kW	47A0229	47A0229		47A0092	47A0191	47A0191	47A0190	47A0090
7.5 kW	47A0093	47A0093		47A0070	47A0193	47A0085	47A0091	47A0191
10 kW	47A0094	47A0094	47A0071	47A0071	47A0086	47A0086	47A0085	47A0091
15 kW	47A0099	47A0099	47A0096	47A0083	47A0087	47A0087	47A0088	47A0086
20 kW	47A0230	47A0072	47A0072	47A0072	47A0097	47A0217	47A0087	47A0224
25 kW	47A0101	47A0101		47A0230	47A0227	47A0097	47A0217	47A0087
30 kW	47A0102	47A0102	47A0101	47A0101	47A0106	47A0106	47A0097	47A0225

PART NUMBER	DESCRIPTION
47A0069	Fuse 25A, 250V Time Delay
47A0070	Fuse 45A, 250V
47A0071	Fuse 60A, 250V
47A0072	Fuse 125A, 250V
47A0083	Fuse 90A, 250V
47A0085	Fuse 30A, 600V
47A0086	Fuse 40A, 600V
47A0087	Fuse 60A, 600V
47A0088	Fuse 50A, 600V
47A0090	Fuse 12A, 600V
47A0091	Fuse 25A, 600V
47A0092	Fuse 30A, 250V
47A0093	Fuse 50A, 250V
47A0094	Fuse 70A, 250V
47A0096	Fuse 80A, 250V
47A0097	Fuse 90A, 600V
47A0099	Fuse 110A, 250V
47A0101	Fuse 175A, 250V
47A0102	Fuse 200A, 250V
47A0106	Fuse 125A, 600V
47A0175	Fuse 15A, 250V
47A0190	Fuse 17A, 600V
47A0191	Fuse 20A, 600V
47A0193	Fuse 35A, 600V
47A0217	Fuse 80A, 600V
47A0222	Fuse 6A, 600V

PART NUMBER	DESCRIPTION
47A0223	Fuse 10A, 600V
47A0223	Fuse 10A, 600V
47A0224	Fuse 45A, 600V
47A0225	Fuse 70A, 600V
47A0226	Fuse 8A, 600V
47A0227	Fuse 100A, 600V
47A0228	Fuse 20A, 250V
47A0229	Fuse 35A, 250V
47A0230	Fuse 150A, 250V

Table 23: Input Fuse Blocks

SIZE	208 V	220 V	230 V	240 V	347 V	380 - 400 V	480 V	600 V
2.5 kW	72A0091	72A0091	72A0091	72A0091	49A0081	49A0081	49A0081	49A0081
4 kW	72A0091	72A0091	72A0091	72A0091	49A0081	49A0081	49A0081	49A0081
5 kW	72A0098	72A0098		72A0091	49A0081	49A0081	49A0081	49A0081
7.5 kW	72A0098	72A0098	72A0098	72A0098	49A0082	49A0081	49A0081	49A0081
10 kW	72A0091	72A0091		72A0098	49A0082	49A0082	49A0081	49A0081
15 kW	72A0099	72A0099		49A0091	49A0085	49A0085	49A0082	49A0082
20 kW	72A0099	72A0099	72A0099	72A0099	49A0085	49A0085	49A0082	49A0082
25 kW	72A0099	72A0099	72A0099	72A0099	49A0085	49A0085	49A0085	49A0082
30 kW	72A0099	72A0099	72A0099	72A0099	49A0097	49A0097	49A0085	49A0085

PART NUMBER	DESCRIPTION
49A0081	Fuse Block, 10-30A, 600V
49A0082	Fuse Block, 31-60A, 600V
49A0085	Fuse Block, 61-100A, 600V
49A0097	Fuse Block, 100-200A, 250V
72A0091	Fuse Block, 2P, 30A, 250V
72A0098	Fuse Block, 31-60A, 250V
72A0099	Fuse Block, 100-200A, 250V

Fuses F3 and F4 on the L-828/L-829 CCRs protect transformer T4, which supplies 110 Vac and 24 Vac to the universal regulator control card. Transformer T3 Fuses F3 and F4 Ratings

Table 24: L-828 / L-829 Step-Down T4 Transformer Fuses F3 and F4

SIZE	208-347 V	380 V	400 V	480 V	600 V
2.5 kW				47A0108	
4 kW	47A0113			47A0108	
5 kW	47A0113			47A0108	
7.5 kW	47A0113			47A0108	
10 kW	47A0113			47A0108	
15 kW	47A0187	47A0187	47A0187	47A0187	

Table 24: L-828 / L-829 Step-Down T4 Transformer Fuses F3 and F4 (continued)

SIZE	208-347 V	380 V	400 V	480 V	600 V
20 kW	47A0187	47A0187	47A0187	47A0187	
25 kW	47A0187	47A0187	47A0187	47A0187	
30 kW	47A0187	47A0187	47A0187	47A0187	

PART NUMBER	DESCRIPTION
47A0108	Fuse 1A 500V
47A0113	Fuse 2A 250V
47A0187	Fuse 3A 500V
49A0084	Fuse Holder (Double) (4, 20-30 kW)

Universal regulator power supply transformer fuse F5 protects the remote control circuitry on the URC. Fuse F6 protects the 120 Vac power supply to the ACE. Fuses F5 and F6 Ratings

Table 25: L-829 Power Supply Transformer Fuse F5 and ACE Power Supply Fuse F6

CSF/XXXX ACE Fuses F5, F6	
47A0119	Fuse .5A 250V
47A0061	Fuse Block (single)

Table 26: 44A7293 Control Board Fuses F1, F2, F3

PART NUMBER	DESCRIPTION
47A0017	Fuse 1A, 250V Slow Blow (3AG)

Table 27: Current Transformer T2

6.6 A	20 A
35A0263	35A0308

35A0263 Current Transformer 6.6/6.6A (Only required if analog current meter used)

35A0308 Current Transformer 20/6.6A (Only required if analog current meter used)

Table 28: CSF CCR Contactors

SIZE	208-240 V	347 V	380 - 400 V	480 V	600 V
2.5 kW	53A0412/25	53A0412/25	53A0412/25	53A0412/25	53A0412/25
4 kW	53A0412/30	53A0412/25	53A0412/25	53A0412/25	53A0412/25
5 kW	53A0412/40	53A0412/25	53A0412/25	53A0412/25	53A0412/25
7.5 kW	53A0412/50	53A0412/40	53A0412/40	53A0412/40	53A0412/25
10 kW	53A0412/70	53A0412/40	53A0412/40	53A0412/40	53A0412/25
15 kW	53A0412/120	53A0412/60	53A0412/60	53A0412/50	53A0412/40
20 kW	53A0412/150	53A0412/90	53A0412/90	53A0412/60	53A0412/50
25 kW	53A0412/150	53A0412/90	53A0412/90	53A0412/90	53A0412/60
30 kW	53A0331	53A0412/150	53A0412/150	53A0412/90	53A0412/75

PART NUMBER	DESCRIPTION
53A0331	Contactor 3P 200A 170A 120VAC Coil
53A0412/120	Contactor 2P 120 FLA
53A0412/150	Contactor 2P 150 FLA
53A0412/175	Contactor 2P 175 FLA
53A0412/25	Contactor 2P 25 FLA
53A0412/30	Contactor 2P 30 FLA
53A0412/40	Contactor 2P 40 FLA
53A0412/50	Contactor 2P 50 FLA
53A0412/60	Contactor 2P 60 FLA
53A0412/70	Contactor 2P 70 FLA
53A0412/75	Contactor 2P 75 FLA
53A0412/90	Contactor 2P 90 FLA

Table 29: Dual SCR Blocks

SIZE	208 - 600 V
2.5 kW	28A0056
4 kW	28A0056
5 kW	28A0056
7.5 kW	28A0056
10 kW	28A0056
15 kW	28A0057
20 kW	28A0055
25 kW	28A0054
30 kW	28A0054

PART NUMBER	DESCRIPTION
28A0054	Dual SCR Module (25 - 30 kW)
28A0055	Dual SCR Module (20 kW)
28A0056	Dual SCR Module (2.5 - 10 kW)
28A0057	Dual SCR Module (15 kW)

Table 30: Input Lightning Arrestor VR7, VR8

CSF/XXXX Input Lightning Arrestor VR7, VR8	
32A0028	Input Power Lightning Assestor (All sizes and input voltages)
	(Kit used is 94B0011)

Table 31: CSF/XXXX Output Lightning Arrestor VR1, VR2 (6.6 Amp)

SIZE	208-600 V
2.5 kW	32A0115
4 kW	32A0115
5 kW	32A0115

Table 31: CSF/XXXX Output Lightning Arrestor VR1, VR2 (6.6 Amp) (continued)

SIZE	208-600 V
7.5 kW	32A0115
10 kW	32A0115
15 kW	32A0114
20 kW	32A0114
25 kW	32A0114
30 kW	32A0114

PART NUMBER	DESCRIPTION
32A0114	Surge Arrestor 6kV (Kit is 94A0433-6)
32A0115	Surge Arrestor 3kV (Kit is 94A0433-3)

Table 32: CSF/XXXX Output Lightning Arrestor VR1, VR2 (20 Amp)

SIZE	208-400 V	480-600 V
15 kW	94A0433-3	94A0433-6
20 kW	94A0433-3	94A0433-6
25 kW		94A0433-6
30 kW	94A0433-6	94A0433-6

PART NUMBER	DESCRIPTION
94A0433-3	Surge Arrestor Kit 3kV (32A0115)
94A0433-6	Surge Arrestor Kit 6kV (32A0114)

Table 33: CSF/XXXX Current Sensing Transformer (T5)

CSF/XXXX Current Sensing Transformer (T5)		
SIZE		
6.6A	35A0548	Transformer, Current Sensing, 6.6A to 66mA
20A	35A0528	Transformer, Current Sensing, 20A to 66mA

Table 34: CSF/XXXX Power Transformer (T4)

PART NUMBER	DESCRIPTION
35A0539	240/347/480 to 120/24 .5A (2.5 - 10 kW)
35A0546	240/347/480 to 120/24 .5A (15 - 30 kW)

Table 35: CSF/XXXX Other Parts

PART NUMBER	DESCRIPTION
44A7293-00	CSF Control Board
44A6397	IRMS-LI Board (Option)
44A6178	Rotary Switch (3 Step)
44A6178-5	Rotary Switch (5 Step)
1475.92.030	SCO Series Circuit Cutout (Option)

Table 35: CSF/XXXX Other Parts (continued)

PART NUMBER	DESCRIPTION
70A0624	Fiber Optic Cable (M-M) (Grey) (Option with ACE)
70A0625	Fiber Optic Cable (M-M) (Blue) (Option with ACE)
42A0525-3	Rotary Switch Label (3 Step)
42A0525-5	Rotary Switch Label (5 Step)
94A0425	Digital Power Meter Kit (Option)
45A0303	Door Interlock Switch

Table 36: Current / Voltage Monitor Assembly (CVM)

CSF/XXXX Current / Voltage Monitor Assembly (CVM) (Option)	
44A6326/10	Current / Voltage Monitor Assembly (6.6A)
44A6326/11	Current / Voltage Monitor Assembly (20A)

Table 37: Ammeters

CSF/XXXX Ammeter	
52A0099	Analog Ammeter (6.6A)
52A0098	Analog Ammeter (20A)

Note

Refer to ACE Manuals for Optional L-829 Monitoring and Control

Table 38: CSF/XXXX Capacitor Plate Assembly (6.6 A 60 Hz)

SIZE	208 - 480 V	600 V
2.5 kW	44A7306/026	
4 kW	44A7306/046	
5 kW	44A7306/056	
7.5kW	44A7306/076	
10 kW	44A7306/106	
15 kW	44A7306/156	
20 kW	44A7306/206	
25 kW	44A7306/256	
30 kW	44A7306/306	

PART NUMBER	DESCRIPTION	capacitor 68 µf 525v	capacitor 34 µf 525v
44A7306/026	Capacitor Plate (2.5 kW, 6.6 A, 60 Hz)	1	1
44A7306/046	Capacitor Plate (4 kW, 6.6 A, 60 Hz)	2	0
44A7306/076	Capacitor Plate (7.5 kW, 6.6 A, 60 Hz)	3	1
44A7306/106	Capacitor Plate (10 kW, 6.6 A, 60 Hz)	4	1
44A7306/156	Capacitor Plate (15 kW, 6.6 A, 60 Hz)	6	1

PART NUMBER	DESCRIPTION	capacitor 68 µf 525v	capacitor 34 µf 525v
44A7306/206	Capacitor Plate (20 kW, 6.6 A, 60 Hz)	9	0
44A7306/256	Capacitor Plate (25 kW, 6.6 A, 60 Hz)		
44A7306/306	Capacitor Plate (30 kW, 6.6 A, 60 Hz)	12	1

Table 39: CSF/XXXX Capacitor Plate Assembly (6.6 A 50 Hz)

SIZE	220 - 400 V
2.5 kW	44A7306/025
4 kW	44A7306/045
5 kW	44A7306/055
7.5kW	44A7306/075
10 kW	44A7306/105
15 kW	44A7306/155
20 kW	44A7306/205
25 kW	44A7306/255
30 kW	44A7306/305

PART NUMBER	DESCRIPTION	capacitor 68 µf 525v	capacitor 34 µf 525v
44A7306/025	Capacitor Plate (2.5 kW, 6.6 A, 50 Hz)		
44A7306/045	Capacitor Plate (4 kW, 6.6 A, 50 Hz)	3	0
44A7306/075	Capacitor Plate (7.5 kW, 6.6 A, 50 Hz)		
44A7306/105	Capacitor Plate (10 kW, 6.6 A, 50 Hz)	5	0
44A7306/155	Capacitor Plate (15 kW, 6.6 A, 50 Hz)	8	0
44A7306/205	Capacitor Plate (20 kW, 6.6 A, 50 Hz)	10	1
44A7306/255	Capacitor Plate (25 kW, 6.6 A, 50 Hz)		
44A7306/305	Capacitor Plate (30 kW, 6.6 A, 50 Hz)	14	1

Table 40: CSF/XXXX Power Transformer T1 (6.6 Amp, 60 Hz Core)

SIZE	208, 220, 240 V 6.6 A	347, 380 V 6.6 A	480 V 6.6 A	600 V 6.6 A
2.5 kW	35A0774/11	35A0774/31	35A0774/31	35A0774/41
4 kW	35A0775/11	35A0775/31	35A0775/31	35A0775/41
5 kW	35A0794/11	35A0794/31	35A0794/31	35A0794/41
7.5 kW	35A0776/11	35A0776/31	35A0776/31	35A0776/41
10 kW	35A0777/11	35A0777/31	35A0777/31	35A0777/41
15 kW	35A0778/11	35A0778/31	35A0778/31	35A0778/41
20 kW	35A0779/11	35A0779/31	35A0779/31	35A0779/41
25 kW	35A0795/11	35A0795/31	35A0795/31	35A0795/41
30 kW	35A0780/11	35A0780/31	35A0780/31	35A0780/41

PART NUMBER	DESCRIPTION
35A0774/11	CSF Power Transformer, 2.5 kW 6.6A 208 220 240V
35A0774/21	CSF Power Transformer, 2.5 kW 6.6A 347 380V
35A0774/31	CSF Power Transformer, 2.5 kW 6.6A 480V
35A0774/41	CSF Power Transformer, 2.5 kW 6.6A 600V
35A0775/11	CSF Power Transformer, 4 kW 6.6A 208 220 240V
35A0775/21	CSF Power Transformer, 4 kW 6.6A 347 380V
35A0775/31	CSF Power Transformer, 4 kW 6.6A 480V
35A0775/41	CSF Power Transformer, 4 kW 6.6A 600V
35A0776/11	CSF Power Transformer, 7.5 kW 6.6A 208 220 240V
35A0776/21	CSF Power Transformer, 7.5 kW 6.6A 347 380V
35A0776/31	CSF Power Transformer, 7.5 kW 6.6A 480V
35A0776/41	CSF Power Transformer, 7.5 kW 6.6A 600V
35A0777/11	CSF Power Transformer, 10 kW 6.6A 208 220 240V
35A0777/21	CSF Power Transformer, 10 kW 6.6A 347 380V
35A0777/31	CSF Power Transformer, 10 kW 6.6A 480V
35A0777/41	CSF Power Transformer, 10 kW 6.6A 600V
35A0778/11	CSF Power Transformer, 15 kW 6.6A 208 220 240V
35A0778/21	CSF Power Transformer, 15 kW 6.6A 347 380V
35A0778/31	CSF Power Transformer, 15 kW 6.6A 480V
35A0778/41	CSF Power Transformer, 15 kW 6.6A 600V
35A0779/11	CSF Power Transformer, 20 kW 6.6A 208 220 240V
35A0779/21	CSF Power Transformer, 20 kW 6.6A 347 380V
35A0779/31	CSF Power Transformer, 20 kW 6.6A 480V
35A0779/41	CSF Power Transformer, 20 kW 6.6A 600V
35A0780/11	CSF Power Transformer, 30 kW 6.6A 208 220 240V
35A0780/21	CSF Power Transformer, 30 kW 6.6A 347 380V
35A0780/31	CSF Power Transformer, 30 kW 6.6A 480V
35A0780/41	CSF Power Transformer, 30 kW 6.6A 600V
35A0794/11	CSF Power Transformer, 5 kW 6.6A 208 220 240V
35A0794/21	CSF Power Transformer, 5 kW 6.6A 347 380V
35A0794/31	CSF Power Transformer, 5 kW 6.6A 480V
35A0794/41	CSF Power Transformer, 5 kW 6.6A 600V
35A0795/11	CSF Power Transformer, 25 kW 6.6A 208 220 240V
35A0795/21	CSF Power Transformer, 25 kW 6.6A 347 380V
35A0795/31	CSF Power Transformer, 25 kW 6.6A 480V
35A0795/41	CSF Power Transformer, 25 kW 6.6A 600V

Table 41: CSF/XXXX Power Transformer T1 (20 Amp, 60 Hz Core)

SIZE	208, 220, 240 V 20 A	347, 380 V 20 A	480 V 20 A	600 V 20 A
15 kW	35A0778/12	35A0778/22	35A0778/32	35A0778/42
20 kW	35A0779/12	35A0779/22	35A0779/32	35A0779/42
25 kW	35A0795/12	35A0795/22	35A0795/32	35A0795/42
30 kW	35A0780/12	35A0780/22	35A0780/32	35A0780/42

PART NUMBER	DESCRIPTION
35A0778/12	CSF Power Transformer, 15 kW 20A 208 220 240V
35A0778/22	CSF Power Transformer, 15 kW 20A 347 380V
35A0778/32	CSF Power Transformer, 15 kW 20A 480V
35A0778/42	CSF Power Transformer, 15 kW 20A 600V
35A0779/12	CSF Power Transformer, 20 kW 20A 208 220 240V
35A0779/22	CSF Power Transformer, 20 kW 20A 347 380V
35A0779/32	CSF Power Transformer, 20 kW 20A 480V
35A0779/42	CSF Power Transformer, 20 kW 20A 600V
35A0780/12	CSF Power Transformer, 30 kW 20A 208 220 240V
35A0780/22	CSF Power Transformer, 30 kW 20A 347 380V
35A0780/32	CSF Power Transformer, 30 kW 20A 480V
35A0780/42	CSF Power Transformer, 30 kW 20A 600V
35A0795/12	CSF Power Transformer, 25 kW 20A 208 220 240V
35A0795/22	CSF Power Transformer, 25 kW 20A 347 380V
35A0795/32	CSF Power Transformer, 25 kW 20A 480V
35A0795/42	CSF Power Transformer, 25 kW 20A 600V

Table 42: CSF/XXXX Power Transformer T1 (6.6 Amp, 50 Hz Core)

SIZE	220, 230, 240 V 6.6 A	380, 400 V 6.6 A
2.5 kW	35A0774/51	35A0774/61
4 kW	35A0775/51	35A0775/61
5 kW	35A0794/51	35A0794/61
7.5 kW	35A0776/51	35A0776/61
10 kW	35A0777/51	35A0777/61
15 kW	35A0778/51	35A0778/61
20 kW	35A0779/51	35A0779/61
25 kW	35A0795/51	35A0795/61
30 kW	35A0780/51	35A0780/61

PART NUMBER	DESCRIPTION
35A0774/11	CSF Power Transformer, 2.5 kW 6.6A 220 230 240V 50 Hz
35A0774/21	CSF Power Transformer, 2.5 kW 6.6A 380 400V 50 Hz
35A0775/11	CSF Power Transformer, 4 kW 6.6A 220 230 240V 50 Hz

PART NUMBER	DESCRIPTION
35A0775/21	CSF Power Transformer, 4 kW 6.6A 380 400V 50 Hz
35A0776/11	CSF Power Transformer, 7.5 kW 6.6A 220 230 240V 50 Hz
35A0776/21	CSF Power Transformer, 7.5 kW 6.6A 380 400V 50 Hz
35A0777/11	CSF Power Transformer, 10 kW 6.6A 220 230 240V 50 Hz
35A0777/21	CSF Power Transformer, 10 kW 6.6A 380 400V 50 Hz
35A0778/11	CSF Power Transformer, 15 kW 6.6A 220 230 240V 50 Hz
35A0778/21	CSF Power Transformer, 15 kW 6.6A 380 400V 50 Hz
35A0779/11	CSF Power Transformer, 20 kW 6.6A 220 230 240V 50 Hz
35A0779/21	CSF Power Transformer, 20 kW 6.6A 380 400V 50 Hz
35A0780/11	CSF Power Transformer, 30 kW 6.6A 220 230 240V 50 Hz
35A0780/21	CSF Power Transformer, 30 kW 6.6A 380 400V 50 Hz
35A0794/11	CSF Power Transformer, 5 kW 6.6A 220 230 240V 50 Hz
35A0794/21	CSF Power Transformer, 5 kW 6.6A 380 400V 50 Hz
35A0795/11	CSF Power Transformer, 25 kW 6.6A 220 230 240V 50 Hz
35A0795/21	CSF Power Transformer, 25 kW 6.6A 380 400V 50 Hz

Table 43: CSF/XXXX Power Transformer T1 (20 Amp, 50 Hz Core)

SIZE	220, 230, 240 V 20 A	380, 400 V 20 A
15 kW	35A0778/52	35A0778/62
20 kW	35A0779/52	35A0779/62
25 kW	35A0795/52	35A0795/62
30 kW	35A0780/52	35A0780/62

PART NUMBER	DESCRIPTION
35A0778/52	CSF Power Transformer, 15 kW 20A 220 230 240V 50 Hz
35A0778/62	CSF Power Transformer, 15 kW 20A 380 400V 50 Hz
35A0779/52	CSF Power Transformer, 20 kW 20A 220 230 240V 50 Hz
35A0779/62	CSF Power Transformer, 20 kW 20A 380 400V 50 Hz
35A0780/52	CSF Power Transformer, 30 kW 20A 220 230 240V 50 Hz
35A0780/62	CSF Power Transformer, 30 kW 20A 380 400V 50 Hz
35A0795/52	CSF Power Transformer, 25 kW 20A 220 230 240V 50 Hz
35A0795/62	CSF Power Transformer, 25 kW 20A 380 400V 50 Hz

6.4 L-828 General Troubleshooting

This subsection provides general troubleshooting procedures for the L-828 CCR.

Warning

Read the instructions in their entirety before starting installation.

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

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.

Operating a regulator for long periods of time while seriously overloaded may cause the regulator to overheat.

Table 44: CSF Troubleshooting

Problem	Possible Cause	Corrective Action
1. Regulator not turning on	Main power supply off	Verify presence of input voltage.
	Switched off due to overcurrent	Switch regulator off in local. Wait for 2 seconds and check to see if the regulator now operates correctly.
	Incorrect external wiring	If the regulator works correctly in local but not in Remote, check the Remote control signals.
	Blown fuse	Replace any blown fuse. Check the input supply voltage and make sure that it is between -5% and +10% of the nominal value listed on the CCR nameplate.
	Defective Control PCB	Replace Control PCB.
2. Regulator turns on but de-energizes suddenly	Output circuit interrupted	Apply a short to the regulator output. Turn the regulator on. If the regulator works correctly, repair the lighting circuit. Follow all safety precautions in this manual.
	Defective printed circuit board	Replace regulator controller.
	Overcurrent condition	Verify that SCR is triggering by replacing the PCB.
		Check feedback transformer T5 for damage and proper connections. Polarity does not affect operation. Compare input voltages across J8-4 to J8-3 with those in "Output Current Monitor Circuitry" on page 5. If the voltage at the terminals is correct for the selected step and the output is not correct, and the difference cannot be corrected by calibrating the regulator as specified in *Output Current Adjustment* in the Operation section.
		Check SCRs and wiring.
		Replace SCR.
		Refer to Problem #11 in this table.
3. Output Current always 6.6 A/20 A or more	Universal regulator controller not calibrated	Calibrate the CCR as shown in "CCR Adjustment Procedures" on page 24.
		Check remaining steps to verify the values from "Output Current and Limits" on page 12.
	Overcurrent condition	Refer to problem #2 in this table, *Regulator turns on but de-energizes suddenly.*
4. Output Current always 4.8 A or less for 3-Step CCR or 2.8 A or less for 5-Step CCR or 8.5 or less on 20 A	Defective control board	If problem exists in Remote and local control, replace regulator controller.
	SCRs always conducting	Verify SCR is triggering by replacing PCB. Check SCRs and wiring for shorts in SCR circuitry.
		Replace SCR.
	Defective Ferroresonant resonant circuit (transformer or capacitor)	Visually inspect capacitors for damaged housing or wire connections. Visually inspect transformer for damaged coils, connections, and/or wiring.
		Faulty capacitors will exhibit a bulging case.
	CCR overload	Remove section of load.
5. More than 2 seconds required for CCR to deenergize on open-circuit load	Faulty overcurrent protection	Replace Control PCB .

Table 44: CSF Troubleshooting (continued)

Problem	Possible Cause	Corrective Action
6. Short lamp life and/or high output current reading on panel ammeter	Incorrect output current adjustment	Calibrate the CCR as shown in "CCR Adjustment Procedures" on page 24.
	Faulty overcurrent protection	Replace Control PCB .
7. Regulator not indicating proper current	Incorrect output current adjustment	Refer to Output Current Adjustment in the Operation section. Refer to Problem #11 in this table.
	Current meter not calibrated or faulty	Turn the regulator to the top step (6.6 A/20 A). Verify the current with a true-rms current meter. If the meter is not accurate, adjust the meter with the screw on the front cover. For systems equipped with ACE, refer to: • Advanced Control Equipment (ACE) manual 96A0287 or • Advanced Control Equipment (ACE2) manual 96A0357 for display calibration procedures. Refer to Problem #11 in this table.
8. Regulator operates by the local control switch but not by Remote control	The rotary switch on the input module not set to REM	Set the rotary switch to REM.
	Blown fuse	Check fuse F5.
	Loose or broken Remote control wires	Check connections on Remote terminal block TB1. If 120 Vac Remote control signals are used, use an AC voltmeter (300 Vac scale) to verify correct signals are received at the CCR.
	Incorrect wire connections	Refer to Table 12 through Table 14.
9. Ammeter on CCR oscillates and loud noise occurs	SCR drive not working properly	Check connections at SCR module. Replace Control PCB Refer to Problem #11 in this table.
10. Output current not able to be adjusted up to 6.6 A/20 A	Regulator load too large	Either reduce the load or replace the regulator with a larger kW CCR. When overloaded, the regulator may make a faint bouncing sound as the controller bounces against the upper control limits. **Note** This problem can also be verified by shorting the output of the CCR and verifying output current can be adjusted correctly in each step.
11. 5-Step regulator (in Steps 1 or 2) emitting loud hum, not indicating proper current, and operating erratically	Light inductive load (for example, signs)	Increase load on regulator. If you cannot increase the load, verify that you are dealing with the right problem by placing a current clamp on the output of the regulator and measuring the frequency of the output. Investigate to see if the problem occurs in Highest Step

6.5 Additional L-829 General Troubleshooting Procedures

For additional L-829 CCR general troubleshooting procedures, refer to the Troubleshooting section in manuals:

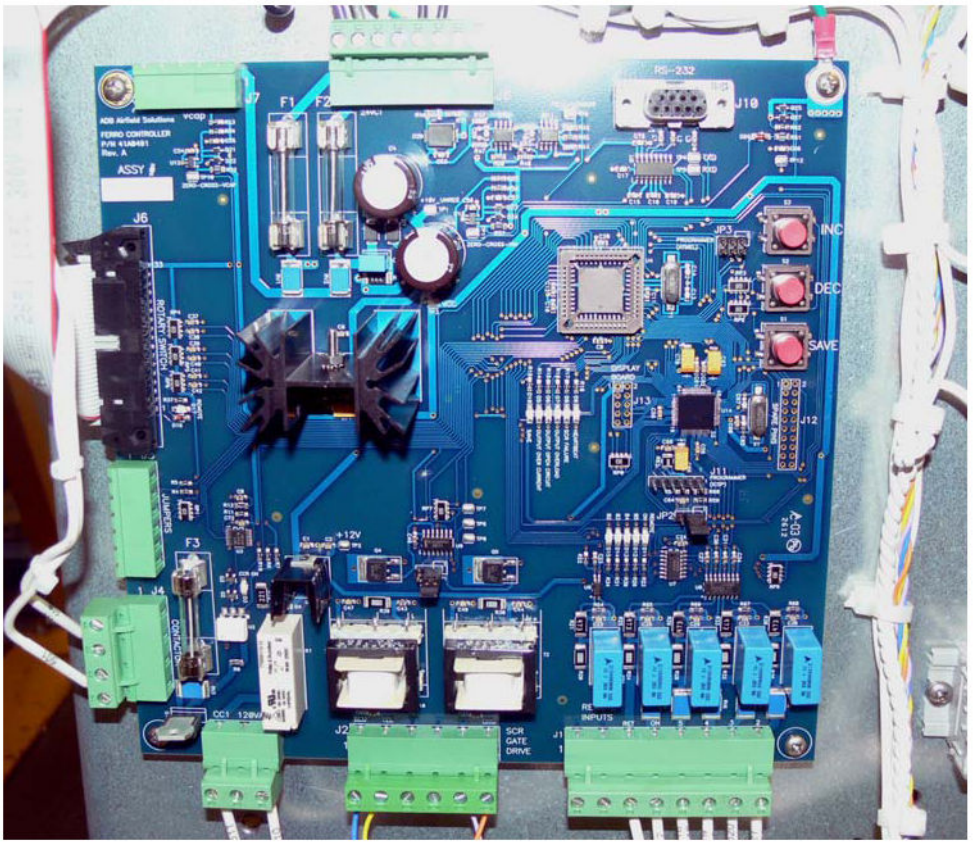
- Advanced Control Equipment (ACE™). See www.adbsafegate.com.

6.6 Component Replacement Procedures

6.6.1 Removing and Replacing Control PCB

1. Turn CCR local switch to the OFF position.

Figure 17: Control PCB



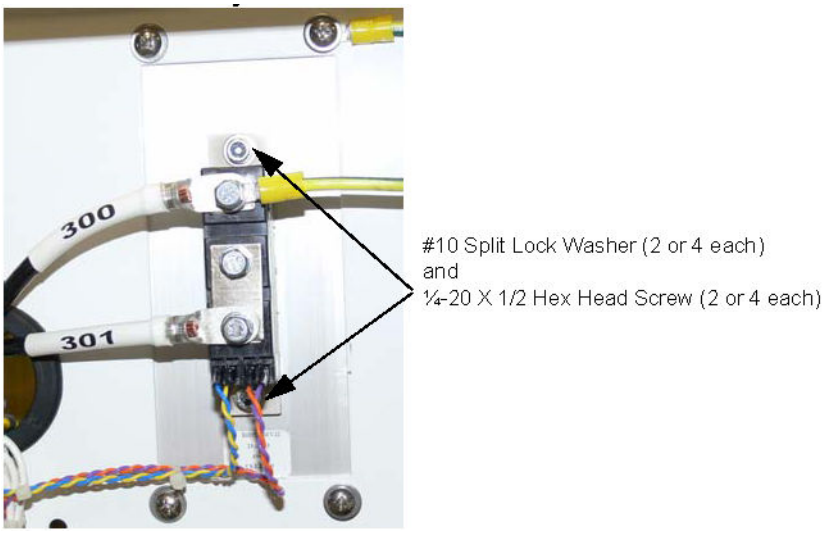
2. Remove and lock out/tag out primary power to the CCR at the breaker panel.
3. Lock out/tag out the SCO in the maintenance position.
4. Loosen the door latch screws and open the CCR door.
5. Unplug green connectors J8, J1, J2, J3, J4, and J5 from the PCB.
6. Disconnect the ribbon cable from J6 by pressing out on the tabs at both sides of the ribbon connection and pull the cable away from the board.
7. Remove the 4 screws at the 4 corners of the PCB. Remove the ground wire from the top right corner. Remove and label the ground wire from the top left corner of the PCB.
8. Mount the new PCB by replacing the 4 screws at the corners of the PCB including the ground wire on the top right corner.
9. Plug the ribbon cable back into J6 by pressing it in. It is keyed and will only go in one way. Also verify the tabs on the side have locked into place.
10. Plug in all of the green connectors to the board. J8, J1, J2, J3, J4, and J5.
11. Close the CCR door and loosen the door latch screws.

12. Restore the SCO to the ON position.
13. Restore primary power to the CCR at the breaker panel.
14. Turn the CCR local switch to the REM position.

6.6.2 Removing and Replacing Dual SCR Module Assembly

See Internal Wiring Schematic, 43A4028.dwg in "Wiring Schematics" on page 59.

Figure 18: Dual SCR Module Assembly

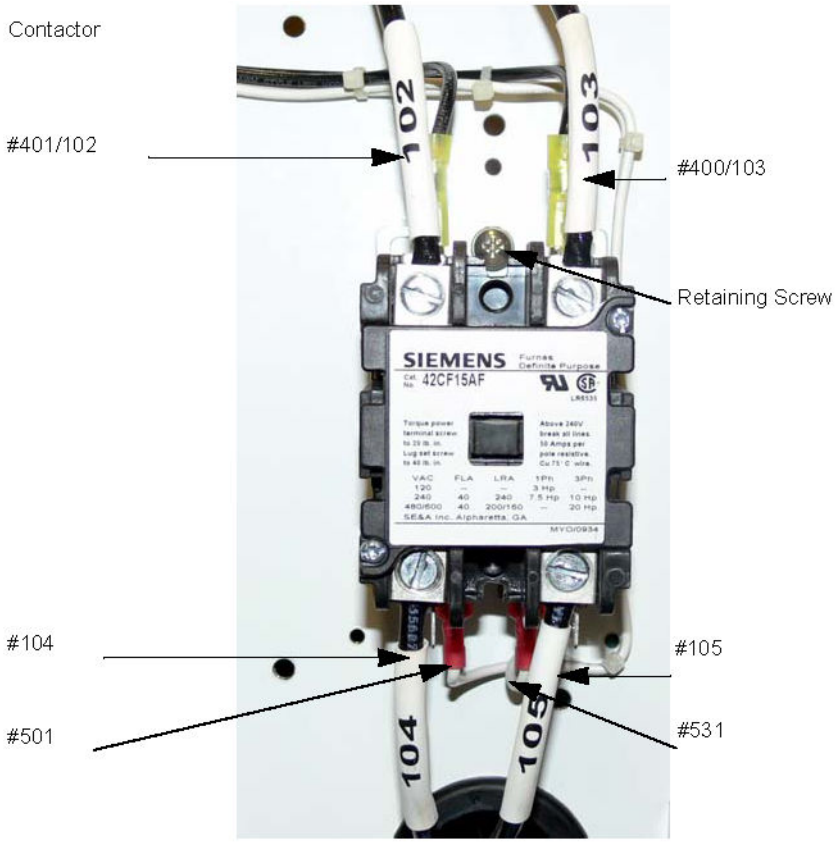


1. Turn CCR local switch to the OFF position.
2. Remove and lock out/tag out primary power to the CCR at the breaker panel.
3. Lock out/tag out the SCO in the maintenance position.
4. Open the CCR front door by loosening the 3 door screws.
5. Remove wire 300 and the ground wire from the top lug of the SCR using a 11/16-inch socket. *note: There are different versions of this SCR so hardware may vary.
6. Remove wire 301 from the bottom lug of the SCR using a 11/16-inch socket.
7. Pull the 4 colored gate wires from the bottom of the SCR.
8. Remove the SCR from the regulator by removing the (2) 5/32-hex mounting screws.Clean the heat-sink surface with a dry rag.
9. The replacement SCR will arrive mounted to a rectangular metal plate.
10. Remove the SCR from the attached plate by removing the (2) 5/32-hex mounting screws from the new SCR and the mounting it to the existing plate in the front of the regulator. Place a thin layer of thermal paste on the heat-sink prior to attaching the SCR.
11. Once the SCR is mounted in the CCR, connect wire 300 and the ground wire to the top lug of the SCR.
12. Connect wire 301 to the bottom lug of the SCR.
13. Connect the colored gate wires according to the documentation supplied with the replacement SCR. Different versions of the SCR require these gate wires to be connected in a different order, refer to the documentation shipped with the replacement SCR.
14. Close all doors and replace all panels.
15. Restore the SCO to the ON position.
16. Restore primary power to the CCR at the breaker panel.
17. Turn the CCR local switch to the REM position.

6.6.3 Removing and Replacing Contactor

1. Turn CCR local switch to the OFF position.

Figure 19: CCR Power Contactor



2. Label the wires.
3. Remove and lock out/tag out primary power to the CCR at the breaker panel.
4. Lock out/tag out the SCO in the maintenance position.
5. Open the CCR front door by loosening the 3 door screws.
6. Loosen the wire retaining lugs for 102, 103, 104 and 105 and disconnect. See Internal Wiring Schematic, 43A4028.dwg in "Wiring Schematics" on page 59.
7. Label any wires not labeled prior to disconnecting them.
8. Remove wires 400 and 401 from the top connectors of the contactor.
9. Remove the wires 531 and 501 from the contactor coil connections at the bottom of the contactor.
10. Remove the 3 mounting screws until the contactor is free.
11. Replace the contactor. Tighten the contactor retaining screws on the contactor plate.
12. Connect wires 531 and 501 to the contactor coil connections at the bottom of the contactor.
13. Connect wires 400 and 401 to the top connectors of the contactor.
14. Connect the wires for 102, 103, 104 and 105 and tighten retaining lugs.
15. Close the CCR front door by tightening the 3 door screws.
16. Restore the SCO to the ON position.
17. Restore primary power to the CCR at the breaker panel.
18. Turn the CCR local switch to the REM position.

6.6.4 Removing and Replacing Input Lightning Arrestors (front of Component Mounting Plate)

1. Turn CCR local switch to the OFF position.
2. Remove and lock out/tag out primary power to the CCR at the breaker panel.
3. Lock out/tag out the SCO in the maintenance position.
4. Open the CCR front door by loosening the 3 door screws.
5. Loosen the wire retaining screws for 100, 402, 101, 403, 802 and 803 and disconnect. See Internal Wiring Schematic, 43A4028.dwg in "Wiring Schematics" on page 59.
6. Remove the top two of (4) #10 x 32 pan-head screws and loosen the bottom two screws until the arrestors are free.
7. Replace the Input Lightning Arrestor assembly. Replace the two top screws on the assembly plate and tighten all four until the arrestors are secure.
8. Connect the wires for 100, 402, 101, 403, 802 and 803 and tighten retaining screws.
9. Close the CCR front door by tightening the 3 door screws.
10. Restore the SCO to the ON position.
11. Restore primary power to the CCR at the breaker panel.
12. Turn the CCR local switch to the REM position.

6.6.5 Removing and Replacing Output Lightning Arrestors

(Front of Component Mounting Plate)

1. Turn CCR local switch to the OFF position.
2. Remove and lock out/tag out primary power to the CCR at the breaker panel.
3. Lock out/tag out the SCO in the maintenance position.
4. Remove the side panel of the CCR, by removing the 8 mounting screws. Be careful as you will also need to disconnect the ground wire attached from the frame to the panel.

Figure 20: Output Lightning Arrestors

5. Loosen the 11/16-inch wire retaining nuts for 200, 201, 203, ST1, ST2 and 202 and disconnect.
6. Remove the (4) #10 x 32 pan-head screws and retain until later.
7. Replace the Input Lightning Arrestor assembly. Replace and tighten the screws on the assembly plate.
8. Connect the wires for 200, 201, 203, ST1, ST2 and 202 and tighten retaining nuts.
9. Connect the ground wire from the frame to the side panel.
10. Put the side panel back on the CCR with the 8 screws.

11. Restore the SCO to the ON position.

12. Restore primary power to the CCR at the breaker panel.

13. Turn the CCR local switch to the REM position.

6.7 Wiring Schematics

This section provides wiring schematics for the ADB Safegate L-828/L-829 Ferroresonant constant current regulators (CCRs) (4-70 kW/6.6 A/20 A) with Control PCB cards.

Note

For the ACE to Control PCB internal wiring diagram for Ferroresonant CCRs (3 and 5 Step), refer to the Wiring Schematics section in Advanced Control Equipment (ACE) manual.

Figure 21: CSF, 4-30kW, 6.6A - 20A Internal Wiring Schematic (43A4028 1 of 3)

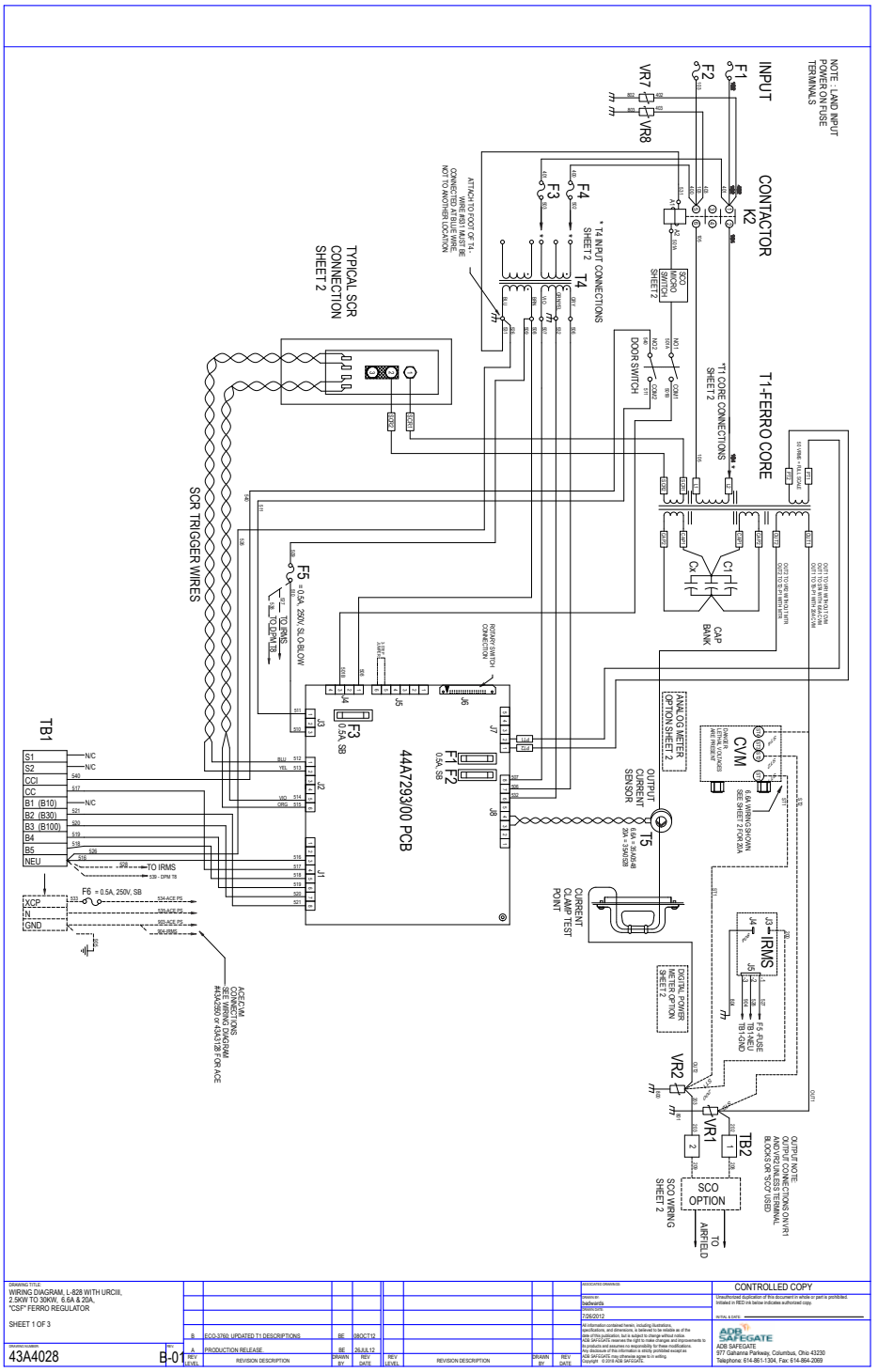


Figure 22: FCSF, 4-30kW, 6.6A - 20A , Internal Wiring Schematic (43A4028 2 of 3)

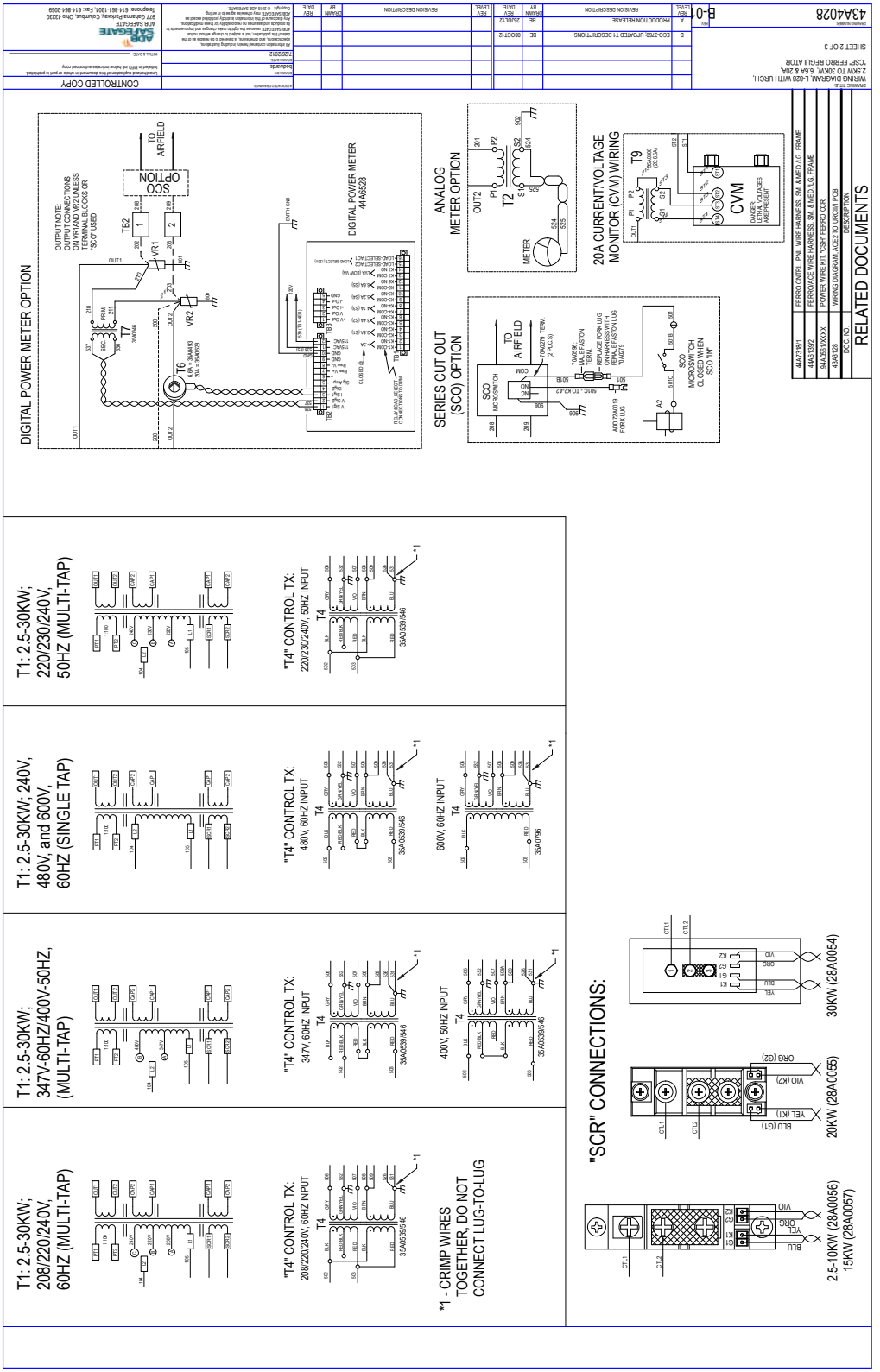
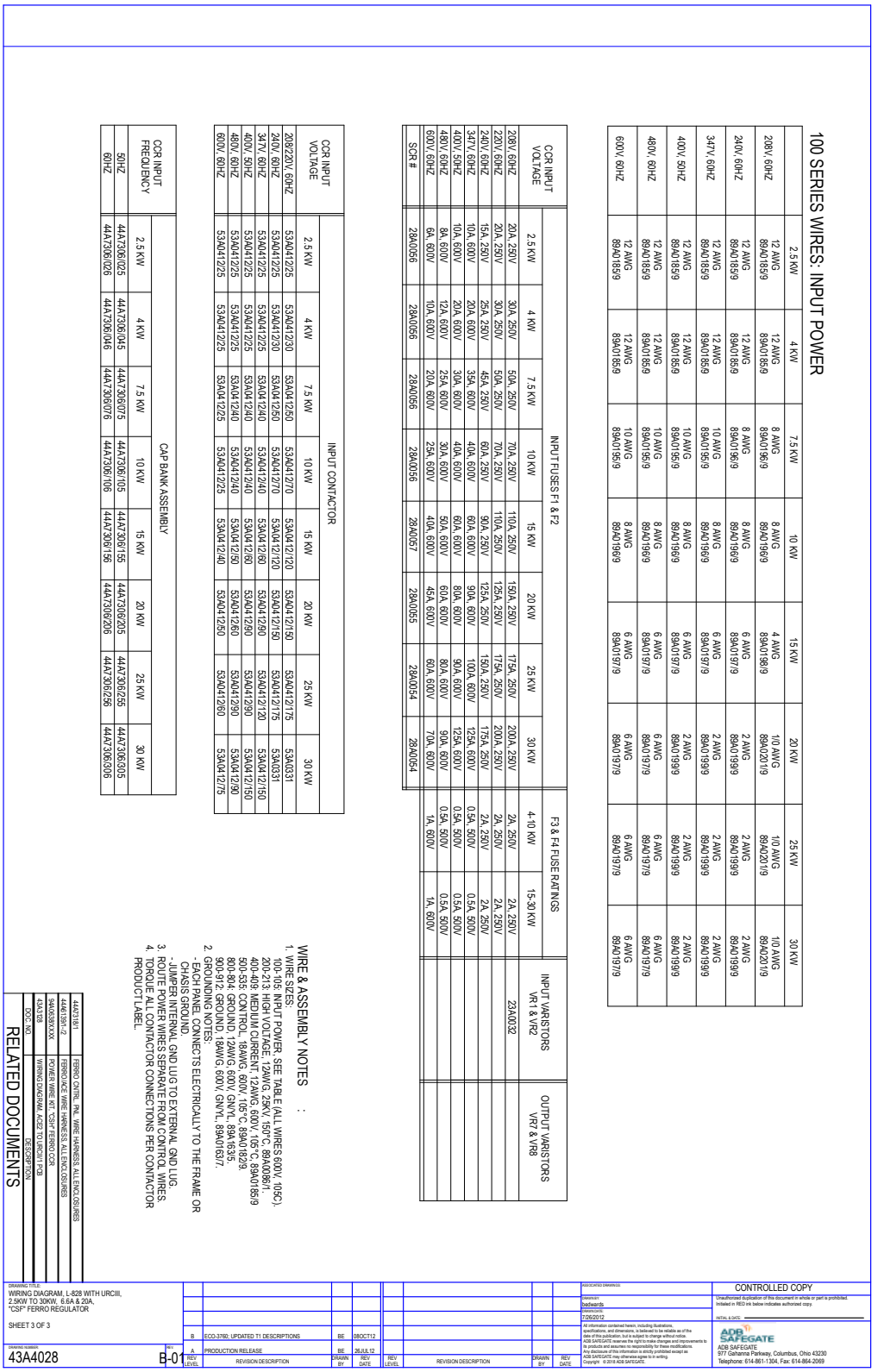


Figure 23: CSF, 4-30kW, 6.6A - 20A, Internal Wiring Schematic (43A4028 3 of 3)



7.0 CSF Parts

7.1 Product Major Components

Table 45: Spare Components

Description	Part No.
Control PCB assembly	44A7293-00
Dual SCR Block (2.5-10 kW)	28A0056
Dual SCR Block (15 kW)	28A0057
Dual SCR Block (20 kW)	28A0055
Dual SCR Block (25, 30 kW)	28A0054
Fuse 25 A 250 V Time Delay	47A0069
Fuse 45 A 250V	47A0070
Fuse 60 A 250V	47A0071
Fuse 125 A 250V	47A0072
Fuse 90 A 250V	47A0083
Fuse 30 A 600V	47A0085
Fuse 40 A 600V	47A0086
Fuse 60 A 600V	47A0087
Fuse 50 A 600V	47A0088
Fuse 12 A 600V	47A0090
Fuse 25 A 600V	47A0091
Fuse 30 A 250V	47A0092
Fuse 50 A 250V	47A0093
Fuse 70 A 250V	47A0094
Fuse 80 A 250V	47A0096
Fuse 90 A, 600V	47A0097
Fuse 110 A 250V	47A0099
Fuse 175 A 250V	47A0101
Fuse 200 A 250V	47A0102
Fuse 125 A, 600V	47A0106
Fuse 15 A, 250V	47A0175
Fuse 17 A, 600V	47A0190
Fuse 20 A, 600V	47A0191
Fuse 35 A, 600V	47A0193
Fuse 80 A, 600V	47A0217
Fuse 6 A, 600V	47A0222
Fuse 10 A, 600V	47A0223
Fuse 45 A, 600V	47A0224
Fuse 70 A, 600V	47A0225
Fuse 8 A, 600V	47A0226

Table 45: Spare Components (continued)

Description	Part No.
Fuse 100 A, 600V	47A0227
Fuse 20 A, 250V	47A0228
Fuse 35 A, 250V	47A0229
Fuse 150 A, 250V	47A0230
Fuse 2 A 250 V (4-10 kW 208-347 V) (Fuses F3, F4)	47A0113
Fuse 1 A 500 V (4-10 kW 480 V) (Fuses F3, F4)	47A0108
Fuse 3 A 500 V (15-70 kW) (Fuses F3, F4)	47A0187
Fuse 0.5 A 250 V (Fuses F5)	47A0119
Fuse 1 A 250 V (Control Board)	47A0017
Input Lightning Arrestor	32A0028
Output Lightning Arrestor (2.5-10kW 6.6A, 15-20kW 20A)	32A0115
Output Lightning Arrestor (15-30kW 6.6A, 30kW 20A)	32A0114
Interlock Switch Bracket, CSF	60A4426
Ground Lug	72A0010
Ribbon Cable Assy,34-POS W/Conns, 24"	89A0209-24
Power Wire Kit, "CSF" Series Reg's, (KW/Volt)	94A0638-XXXX
Interlock Switch SPST 0.1A ON-OFF	45A0303
L-828 Meter Kit, Signature Series Regulators	44A7050/S66

Table 46: Input Fuses F1, F2

Size	208 V	220 V	230 V	240 V	347 V	380-400 V	480 V	600 V
2.5 kW	47A0228	47A0228		47A0175	47A0223	47A0223	47A0226	47A0222
4 kW	47A0092	47A0092	47A0069	47A0069	47A0191	47A0191	47A0090	47A0223
5 kW	47A0229	47A0229		47A0092	47A0191	47A0191	47A0090	47A0090
7.5 kW	47A0093	47A0093		47A0070	47A0193	47A0085	47A0091	47A0191
10 kW	47A0094	47A0094	47A0071	47A0071	47A0086	47A0086	47A0085	47A0091
15 kW	47A0099	47A0099	47A0096	47A0083	47A0087	47A0087	47A0088	47A0086
20 kW	47A0230	47A0072	47A0072	47A0072	47A0097	47A0217	47A0087	47A0224
25 kW	47A0101	47A0101		47A0230	47A0227	47A0097	47A0217	47A0087
30 kW	47A0102	47A0102	47A0101	47A0101	47A0106	47A0106	47A0097	47A0225

7.2 CCR Kits

Various kits are available to customize CCRs for specific application requirements.

Current Sensing Relay Kit Provides a dedicated contact closure if CCR output current is present.	94A0343
Elapsed Time Meter Kit Provides CCR run-time information on L-828 CCRs.	94A0263

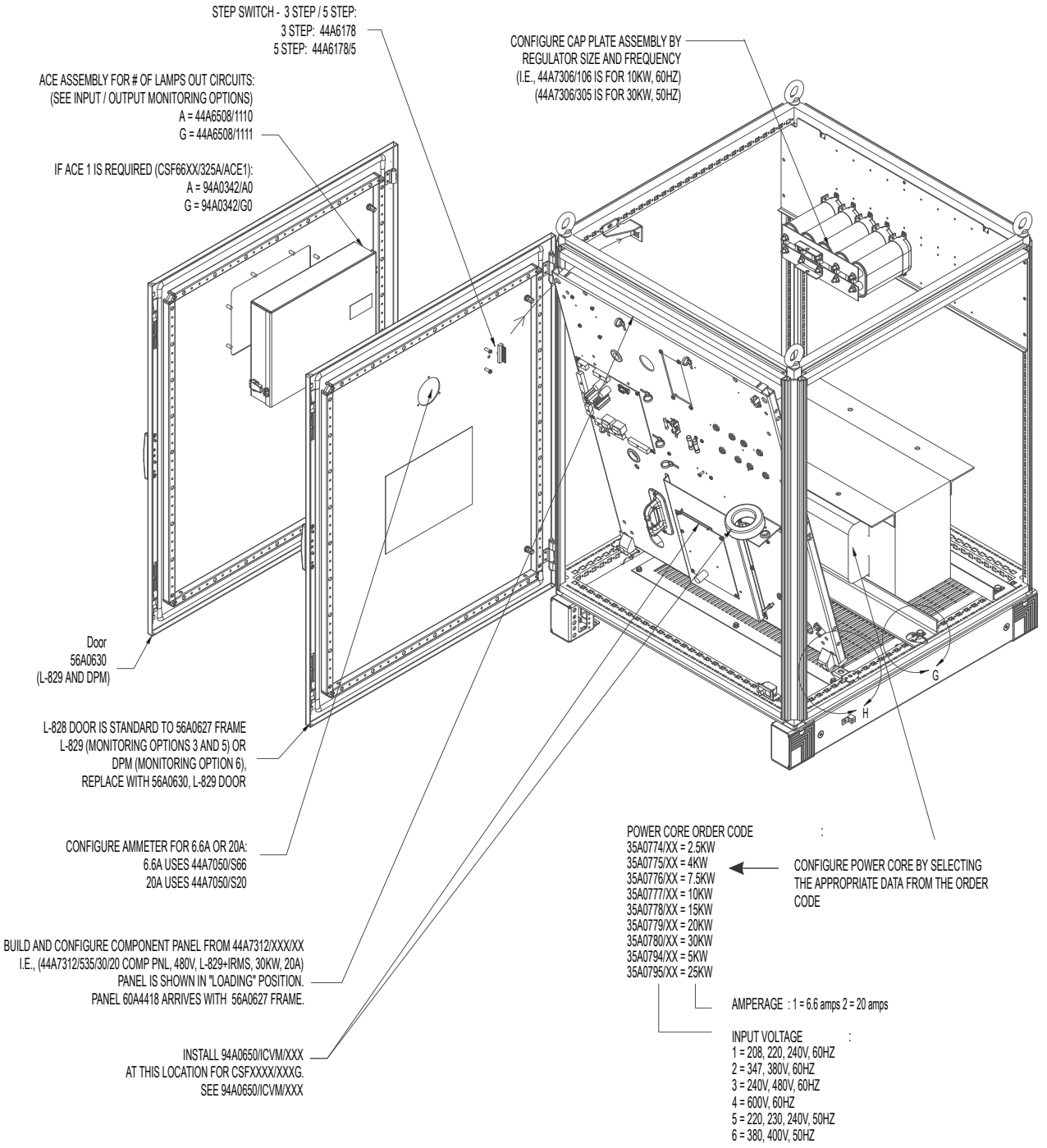
Auxiliary ACE Monitoring Provides CCR Run Time, which displays total hours in each CCR step setting, and CCR Cycle Count, which displays the total number of times the CCR has been turned on/off.	94A0512

	Part No.
CCR Output Analog Voltmeter Kit 7.5 kW, 6.6 A; 20 kW, 20 A 10-15 kW, 6.6 A; 30 kW, 20 A 20-30 kW, 6.6 A	94A0128 94A0129 94A0130

Door Documentation Pocket Kit Provides a pocket for CCR documentation on the inside of the front door.	**94A065**4

Stacking Kit ADB Safegate CSF regulators can be stacked to minimize the floor space required in a vault. Kit allows two 800 mm x 800 mm regulators to be stacked together. Regulators can only be stacked two high.	94A0655

7.3 CSF Configuration Chart



Appendix A: SUPPORT

Our experienced engineers are available for support and service at all times, 24 hour/7 days a week. They are part of a dynamic organization making sure the entire ADB SAFEGATE is committed to minimal disturbance for airport operations.

Table 47: ADB SAFEGATE Support

Live Technical Support - Americas
If at any time you have a question or concern about your product, just contact ADB SAFEGATE's technical service department. Trained in all areas of system issues, troubleshooting, quality control and technical assistance, our highly experienced Technical support specialists are available 24 hours a day, seven days a week to provide assistance over the phone.
ADB SAFEGATE Americas Technical Service & Support (US & Canada): +1-800-545-4157
ADB SAFEGATE Americas Technical Service & Support (International): +1-614-861-1304
During regular business hours, you can also Chat with a Service Technician. We look forward to working with you!
Before You Call
When you have an airfield lighting or system control system problem it is our goal to support airfield maintenance staff as quickly as possible. To support this effort we ask that you have the following information ready before calling.

- The airport code
- If not with an airport, then company name (prefer customer id number)
- Contact phone number and email address
- Product with part number preferable or product number
- Have you reviewed the product's manual and troubleshooting guide
- Do you have a True RMS meter available (and any other necessary tools)
- Be located with the product ready to troubleshoot

Note
For more information, see www.adbsafegate.com, or contact ADB SAFEGATE Support via email at support@adbsafegate.com or
Brussels: +32 2 722 17 11
Rest of Europe: +46 (0) 40 699 17 40
Americas: +1 614 861 1304. Press 3 for technical service or press 4 for sales support.
China: +86 (10) 8476 0106

A.1 ADB SAFEGATE website

The ADB SAFEGATE website, www.adbsafegate.com, offers information regarding our airport solutions, products, company, news, links, downloads, references, contacts and more.

A.2 Recycling

A.2.1 Local authority recycling

The disposal of ADB SAFEGATE products is to be made at an applicable collection point for the recycling of electrical and electronic equipment. The correct disposal of equipment prevents any potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling. The recycling of materials helps to conserve natural resources. For more detailed information about recycling of products, contact your local authority city office.

A.2.2 ADB SAFEGATE recycling

ADB SAFEGATE is fully committed to environmentally-conscious manufacturing with strict monitoring of our own processes as well as supplier components and sub-contractor operations. ADB SAFEGATE offers a recycling program for our products to all customers worldwide, whether or not the products were sold within the EU.

ADB SAFEGATE products and/or specific electrical and electronic component parts which are fully removed/separated from any customer equipment and returned will be accepted for our recycling program.

All items returned must be clearly labelled as follows:

- For ROHS/WEEE Recycling
- Sender contact information (Name, Business Address, Phone number).
- Main Unit Serial Number.

ADB SAFEGATE will continue to monitor and update according for any future requirements for EU directives as and when EU member states implement new regulations and or amendments. It is our aim to maintain our compliance plan and assist our customers.

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