L-829/L-828
CONSTANT CURRENT REGULATOR MANUAL

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ETL Certified to FAA Specifications
AC 150/5345-10H

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Warranty

Astronics DME warrants products against mechanical, electrical, physical, and workmanship defects for a period of two years from the date of manufacture or one year from the date of installation, whichever occurs first.

This warranty, excludes consumable items such as batteries, filters, or lamps.

Astronics DME will repair or replace, at its option, equipment or parts, which fail because of mechanical, electrical, physical, or workmanship defects, provided the equipment or parts were installed operated or maintained in accordance with approved practice, and used for the intended purpose. Any product which has been repaired or altered in such a way, in Astronics DME's judgment, as to affect the product adversely will not be covered under warranty.

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In accordance with FAA requirements, Astronics DME warrants LED airfield lighting products against electrical defects for a period of four years from the date of installation.

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Astronics DME Customer Product Support
6830 NW 16th Terrace, Fort Lauderdale, FL 33309
DMEsupport@astronics.com
(954) 975-2206

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Proprietary Information

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1. SAFETY

1.1. Introduction

This section contains general safety instructions. Some safety instructions may not apply to the equipment in this manual. Specific warnings are included in the manual where appropriate. Follow all warnings, cautions and notes in the instructions carefully, as failure to do so may result in personal injury, death, or damage to equipment.

To use this equipment safely:

- 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. Always remove power prior to making any wire connections and touching any parts.
- Read and become familiar with the general safety instructions provided in this section of the manual before installing, operating, maintaining, or repairing this equipment.
- Read and carefully follow the instructions given throughout this manual for performing specific tasks and working with specific equipment.
- Keep this manual within easy access of 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.
- Obtain and read Material Safety Data Sheets (MSDS) for all materials used.

1.2. Safety Symbols

Become familiar with the safety symbols presented in this section. These symbols will alert you to safety hazards and conditions that may result in personal injury, death, or damage to equipment.

WARNING	May result in personnel injury or death.
CAUTION	May result in damage to equipment.
NOTE	Informational guidance.

1.3. Qualified Personnel

Qualified personnel are defined as personnel who thoroughly understand the equipment and its safe operation, maintenance, and repair. Qualified personnel are physically capable of performing the required tasks, are familiar with all relevant safety rules and regulations and have been trained to safely install, operate, maintain, and repair the equipment.

1.4. Intended Use

Astronics DME is not responsible for injuries or damages resulting from nonstandard, unintended applications of its equipment. This equipment is designed and intended only for the purpose described in this manual. Uses not described in this manual are considered unintended uses and may result in serious personal injury, death, or equipment damage.

Unintended uses may result from taking the following actions:

- Making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine Astronics DME replacement parts.
- Failing to make sure that auxiliary equipment complies with approval agency requirements, local codes, and all applicable safety standards.
- Allowing unqualified personnel to perform any task.

1.5. Installation

Read and understand the installation section of all system component manuals before installing the equipment.

- Failure to follow safety procedures may result in injury or death.
- Allow only qualified personnel to install the equipment.
- Use only approved equipment. Using unapproved equipment may create a safety hazard.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Follow all instructions for installing components and accessories.
- 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.

1.6. Operation

Only qualified personnel 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 using 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.
- 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.
- DO NOT touch exposed electrical connections on equipment while the power is ON.

1.7. Equipment Malfunctions

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 this manual.

1.8. Maintenance and Repair

Allow only qualified personnel to perform maintenance, troubleshooting, and repair tasks. Only properly trained personnel are permitted to service this equipment.

- Always use safety devices when working on this equipment.
- Follow the recommended maintenance procedures in your equipment 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 Astronics DME replacement parts. Using unapproved parts or making unapproved modifications to equipment may create safety hazards.

- Check 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 electrical equipment.

2. DESCRIPTION

2.1. Introduction

This section describes the Astronics DME L-829/L-828 Constant Current Regulator (CCR). The CCR is shown in Figure 2-1

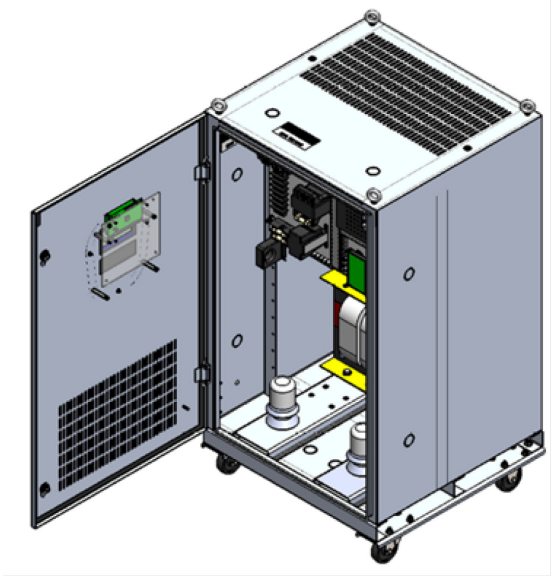


Figure 2-1 L-829/L-828 CCR

2.2. Equipment Description /Basic Theory of Operation

The L-829/L-828 Constant Current Regulator is used to provide power to airfield lighting systems. It provides a selectable AC constant current to change the airfield lighting intensity according to existing visibility conditions. The Astronics DME L-829/L-828 CCR complies with AC 150/5345-10H.

The CCR regulates the output current through the use of a ferroresonant transformer. The ferroresonant transformer allows for a low distortion sinusoidal output that is not easily affected by input line transients or disturbances. This style of transformer will also naturally regulate the output current without any controls at all, albeit a higher current than what is desired. Through the use of an auxiliary control winding, energy can be removed from the output, thus lowering the output current to the desired regulated value. A resonant tank circuit is formed between another set of transformer windings and an external capacitor bank. This tank circuit helps to maintain a sinusoid of a desired frequency as well as facilitate the transfer of energy away from the output.

A microcontroller module (DCMU) receives system feedback and provides closed-loop control of the transformer output through the Firing Card (FC) and a Solid-State Relay (SSR) via the control coil of the transformer. Output voltage is sensed through a transformer sense winding, while input and output current are sensed through chassis

mounted current sense transformers.

The Ferroresonant CCR has excellent regulation characteristics, and is minimally affected by power line fluctuations or load changes. It will provide a near-ideal sine wave output, with low EMI/harmonics, THD, and Crest Factor. It is not affected by small changes in input frequency, and may be supplied from a diesel generator. The output current and open circuit voltage are naturally limited by virtue of the transformer's ferroresonant design characteristics.

2.3. System Components

The regulator is comprised of the following components installed on the inside of the metal regulator enclosure (designators inside parentheses (DCMU, etc.) match designators on the cabinet wiring diagram and system front panel):

- Digital Control & Monitoring Unit (DCMU).
- Display Module (DC1, DS1) – display, controller, & keypad.
- Firing Card (FC1).
- Solid State Relay (SSR1).
- Ferroresonant transformer (T3).
- Capacitor bank (CAP BANK).
- Current Sense Transformer(s) (CT1, CT2).
- Circuit Breaker (CB1) (optional), contactor (K1).
- Stepdown power transformers (T1, T2) and fuses.
- Input surge protectors (MOVs).
- Output lightning arrestors (LA1, 2).
- Door Interlock Switch.
- Remote Control Terminal Block (TB1).
- Optional Megger card (MC1) and megger resistor (R2).

2.3.1. DCMU

The DCMU provides control of the ferroresonant transformer. It contains the microprocessor, input/output circuitry, and the power supply for the module. Terminal block connections are provided for inputs/outputs, and LEDs provide status indications and basic diagnostic data. All digital processing for the CCR is performed within this unit.

2.3.2. Firing Card

The Firing Card is the interface between the DCMU and the control and system feedback functions.

2.3.3. Solid State Relay

The Solid State Relay provides system output current control.

2.3.4. Ferroresonant Transformer & Capacitor Bank

The transformer and capacitor bank is designed to provide specified system power capacity for the circuit load requirements. The transformer has multiple input taps to allow for configuration for various input voltages. The capacitance required for a given CCR Power output is shown below.

The transformer also has feedback windings that provide system measurements to the DCMU; these may also be used to indirectly measure output voltage and capacitor bank voltage. Capacitor bank voltage is measured for control purposes, output voltage is measured to calculate power characteristics as well as for safety reasons.

Table 2-1 Required Capacitance

CCR Power (kW)	Capacitance, 60Hz	# of 50uF capacitors
4	150uF	3
7.5	250uF	5
10	300uF	6
15	450uF	9
20	600uF	12
30	850uF	17

Table 2-2 Feedback Winding Voltage Ratios

CCR Power (kW)	Output Current	Output Volts Max 30 VAC	Cap Volts Max 18 VAC
4	6.6	21.0 : 1	22.9 : 1
7.5	6.6	37.0 : 1	25.0 : 1
10	6.6	47.6 : 1	26.3 : 1
15	6.6	79.2 : 1	25 : 1
20	6.6	96.4 : 1	26.7 : 1
30	6.6	135 : 1	27 : 1

2.3.5. Display Module

The Display Module provides a user interface to control and monitor the CCR. A keypad is provided for input, and a display controller card provide a visual output for all CCR functions.

2.3.6. Current Transformers

Current transformers (CTs) measure the input current and output loop current. The turns ratios of the CTs are as follows:

Table 2-3 Current Transformer I/V Chart

kW Rating	Input Current Transformer # of Turns	Output Current Transformer # of Turns
4	3 turns	9 turns
7.5	2 turns	9 turns
10	1 turn	9 turns
15	1 turn	9 turns
20	1 turn	9 turns
30	1 turn	9 turns

2.3.7. Circuit Breaker & Contactor

The circuit breaker (optional) provides an internal power switch, and also disconnects power if there is an input overcurrent event. The contactor switches input power to the output transformer, and interrupts it when a system fault is detected. The contactor operation is controlled by the DCMU.

2.3.8. Stepdown Power Transformers

Internal transformers provide power for the control circuitry, taking the input 208/240/480VAC and outputting the 120VAC & 13VAC required by the control circuitry.

2.3.9. Input Surge Protectors

Metal-oxide varistors provide protection from transients on the input power lines.

2.3.10. Output Lightning Arrestors

Large distribution-type MOV assemblies are designed to protect the system from lightning-induced transients on the airfield lighting circuit.

2.3.11. Door Interlock Switch

This safety switch signals the DCMU to disable the output whenever the door is opened.

2.3.12. Remote Control Terminal Block

This terminal block provides inputs to the CCR from the airfield control system. Provision is also made to provide power from the CCR for the control signals.

2.3.13. **Megger Card & Megger Resistor**

The megger card is an available option that measures the resistance between the airfield lighting circuit and earth ground. Combined with the 2 MΩ precision megger resistor, the system can measure a resistance within a range of zero to 2 GΩ. The megger resistor mounts to the inside of the CCR and is insulated within its own housing, providing 5KV of dielectric resistance.

2.4. Electrical Requirements

Regulators are configurable for standard input voltages according to site power. Available input voltages are 208/240/480VAC, 60 Hz.
Standard output power ratings are 4kW, 7.5kW, 10kW, 15kW, 20kW and 30kW / 6.6A.

2.5. Environmental Ratings

Temperature range, operational: -40 °C to +55 °C; 0-100% relative humidity; 0-10,000 feet (3000 meters) altitude.
Regulator enclosure is rated NEMA 1, to be installed indoors only.
Enclosure has provisions for floor mounting, and 4kW & 7.5kW are stackable.

2.6. Control Configurations

System may be operated locally (from keypad) or remotely (from tower control system). Output is configurable for one, three or five brightness steps.

Remote control accepts 24VDC/48VDC, or 120VAC depending on which model of DCMU is ordered; control power may be supplied internally from CCR or externally from control system.

2.7. Monitoring Availability

CCR may be configured for last-state-return or default brightness step upon return from input power interruption/failure.

Status indications include control source, selected and actual current, warnings, and faults (output overcurrent and open circuit shutdowns).

Display may monitor output power, input voltage, input current, output voltage, output current, VA, load VA changes, power factor, efficiency, number of failed lamps, programmable warning and alarm levels., and field circuit insulation resistance to earth ground (automatic megger option). The display also optionally shows accumulated operating time.

2.8. Available Options

Table 2-4 Available Options

Type	L-828 (No Monitoring) ☐			L-829 (Monitoring) ☐		
Output Power	4kW ☐	7.5kW ☐	10kW ☐	15kW ☐	20kW ☐	30kW ☐
Input Voltage	208V ☐		240V ☐		480V ☐	
S1 Cutout	None ☐		External ☐		Internal ☐	
Frequency	60Hz ☐			50Hz ☐		
Megger Option	Megger ☐			No Megger ☐		
Remote Control Voltage	120V ☐			24V/48V ☐		
Circuit Breaker Option	Circuit Breaker ☐			No Circuit Breaker ☐		
Caster Option	Casters ☐			No Casters ☐		
Step	1-Step ☐		3-Step ☐		5-Step ☐	

3. INSTALLATION

WARNING

Allow only qualified personnel to perform the following tasks. Observe and follow the safety instructions in this document and all other related documentation.

3.1. Introduction

This section of the manual contains general instructions for installation of an L-829/L-828 CCR at a typical site. Refer to the airport project plans and specifications for the specific installation instructions.

3.2. Uncrating the CCR

The regulator is shipped ready for installation. Unpack the equipment upon receipt and visually check externally and internally. Note any exterior damage to the carton that may lead to detection of equipment damage.

3.3. Installation

Follow all local and national electrical codes as well as all site-specific requirements. When installing the CCR in the vault, it may be placed on the floor, or any elevated mounting arrangement suitable for the size and weight of the regulator. Anchor to the floor if required to meet local or site requirements, or if they are being stacked. See site plans for any specific installation requirements.

3.4. Input Power Wiring

Knock-outs for input power are located on the top and side of the enclosure. Install conduit of the appropriate size between the regulator and the breaker panel.

Connect the assigned breaker in the panel to the input side of the internal circuit breaker (optional) or input terminal block (TB3) as indicated in the wiring diagram; follow all local and national codes regarding wire sizes. Connect a ground wire to the enclosure's internal ground stud.

3.5. Field Circuit Wiring

Knock-outs for field circuit wiring are located on the side and bottom of the enclosure. Connect the field circuit to either the internal field circuit isolator (S1 Cutout) or to the lightning arrestors if an external S1 is used. This connection must be made with #8 AWG Airfield Lighting cable. Astronics DME recommends using crimp lugs rather than bare wire wrapping for the lightning arrestor connections.

3.6. Control Wiring

For remote control wiring from the control system, install conduit as required between the control system location and regulator. After routing either multi-conductor cable or individual wires (#18 to #22 AWG) through the conduit, make the connections to the regulator as indicated on the wiring diagram. Use heavier-gauge wire on longer runs.

3.7. Remote Control Setup

To set up Remote Control Operation using parallel lines first connect the common of whichever power source is being used, internal power from the DCMU or external power, to the 'NEUT' pin of TB1. Internal DCMU power can be 24V or 120V, depending on which remote control voltage option was installed. To turn on the regulator apply the remote control voltage between N and CC, this will activate current step B1. To active B3, for instance, apply the control voltage between N and CC, and also to B3. If multiple current outputs are commanded, the highest one will be activated.

3.8. Verification Testing

If testing of the CCR is necessary, begin by verifying that the regulator is turned off and power is locked out before testing.

Ensure that the power connectors TB1 (13VAC) and TB2 (24VDC) to the DCMU are disconnected.

Ensure that all wiring to the regulator and internal connections are properly secured and installed correctly per the provided wiring diagrams and site drawings.

Step 1) Enable input power to the regulator and check that 12-15 VAC is present on connector TB2 pins 1 & 2.

Step 2) Plug in connectors TB1 and TB2. Verify that the DCMU energizes and the correct LEDs illuminate on the DCMU.

Step 3) Cycle to local mode by pressing the REMOTE button on the keypad. Local mode corresponds to the LED being off.

Step 4) Press the ON button. Scroll through brightness levels with the Local Up/Down buttons, checking that all brightness levels operate correctly.

Step 5) Check that calibration settings are correct with an accurate true RMS meter and current clamp; recalibrate if calibration settings are incorrect (see Section 6).

Step 6) Test for all warnings and faults listed in Section 4.3 and check that they show correctly on the display.

Step 7) Verify that the remote control system is connected correctly using parallel cables per wiring diagrams. Cycle to remote mode by pressing the REMOTE button on the keypad until its LED turns on.

Step 8) Test control system operation by checking that the regulator turns on and operates properly at all brightness levels; check that no warnings or faults are displayed.

4. OPERATION

4.1. Keypad Operation

4.1.1. ON & LOCAL Buttons

The ON button is used to enable or disable the regulator output, and the LOCAL Up/Down buttons are used select the brightness step. The ON LED illuminates when the CCR output is enabled.

4.1.2. REMOTE Button

The REMOTE button is used to choose between remote or local operation. Remote operation allows for operation from the Control System, while Local operation allows for operation directly from the built-in keypad. The LED illuminates when the CCR is in Remote mode.

4.1.3. Scroll & Select Buttons

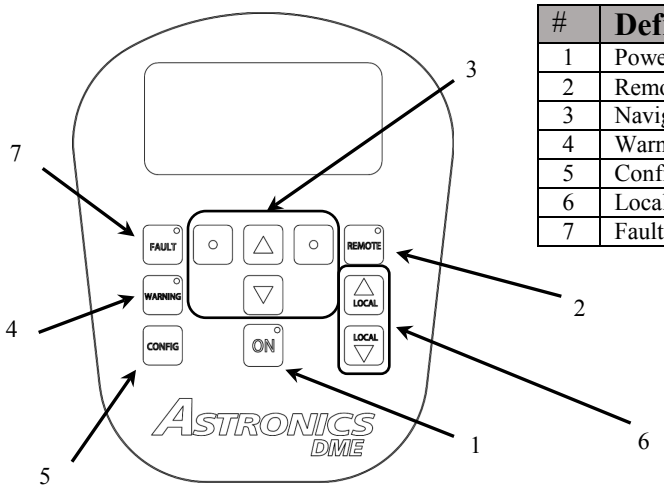
The two center Up and Down arrow buttons serve as navigational buttons to maneuver through menu items and adjust calibration values. The "Dot" buttons are soft keys whose functions are dynamic and dependent upon the prompts shown on the display.

4.1.4. FAULT & WARNING Buttons

The FAULT and WARNING buttons are used to cycle through and view any faults or warnings. LED indicators illuminate when Faults or Warnings are present.

4.1.5. CONFIG Button

The CONFIG button opens the Configuration Menu (default password: 9999) when pressed. Configuration sub-menus are described in Section 6.



#	Definition
1	Power ON button
2	Remote Button
3	Navigation Buttons
4	Warning Button
5	Configuration Button
6	Local Buttons
7	Fault Button

Figure 4-1 Display & Keypad

4.2. Display Functions

The top display line indicates the selected brightness step and current CCR operating mode (Local or Remote).

4.2.1. Informational Displays

The other three lines of the display show additional performance metrics about the operational state of the CCR. Pressing the center Up (△) and Down (▽) navigational buttons cycles through these parameters.

Display	Function
Vin	Input (line) voltage (Volts)
Iin	Input current (Amps)
Vout	Output voltage (Volts)
Iout	Output current (Amps)
KVAo	Output volt amps (KVA)
kWo	Output power (kW)
KVAi	Input volt amps (KVA)
kWi	Input power (kW)
P.F. In	Input power factor
P.F. Out	Output power factor
Lamps Out	Number of failed lamps
Hz	Input frequency (Hz)
Temp	DCMU internal temperature (°C)
Mgr	Megger insulation resistance (kilohms)
HwVer	DCMU hardware version number
SwVr	DCMU software (firmware) version

4.2.2. Warning and Fault Messages

When a warning or fault occurs, the top display line will report the type of warning or fault. See Section 4.3.

4.2.3. Diagnostic Displays

After pressing the CONFIG button to open the configuration menu (default password: 9999), the CONFIG button can be pressed repeatedly to rotate through several displays, including the diagnostics menu.

4.2.3.1. Command Log

The command log displays a history of the last 10 commands received by the DCMU.

4.2.3.2. Warning Log

The warning log displays a history of the last 10 warning conditions detected by the DCMU. The warnings are sequentially ordered from 1 to 10, starting from the most recent.

4.2.3.3. Fault Log

The fault log displays a history of the last 10 faults detected by the DCMU. The faults are sequentially ordered from 1 to 10, starting with the most recent.

4.2.3.4. Operations Display

The Operations display shows the total number of times the CCR has been turned on and the total accumulated time the CCR has been operating at each of the brightness steps.

4.2.3.5. Raw Values

The Raw Value display shows the various measured system parameters in Raw, RMS and Average values.

Display	Function
Iin	Input current (Amps)
Vin	Input (line) voltage (Volts)
Iout	Output current (Amps)
Vout	Output voltage (Volts)
Vcap	Capacitor voltage (Volts)
Megger	Megger Insulation resistance (kOhms)
Phase	Phase Angle
Inductance	Field Circuit Inductance

4.2.3.6. Firing Parameters

The Firing Parameters display shows the following data that could be useful for troubleshooting difficult problems:

- Period, Top Half, Bottom Half
- Sync Count, Spikes
- High Tap, Low Tap
- Period

4.2.3.7. Display Diagnostics

The Display Diagnostics display shows diagnostic information including:

- Status (Online/Offline)
- Version

4.2.4. Calibration Values

The Calibration Values display shows the zero and span values for each parameter saved during the calibration process.

Vin	Input (line) voltage
Iin	Input current
Vout	Output voltage
Iout	Output (field circuit) current
Vcap	Capacitor voltage
Megger	Field circuit insulation resistance

4.2.5. Auto Megger Display

After pressing the CONFIG button to open the configuration menu, the CONFIG button can be pressed iteratively to rotate through several displays, including the Auto Megger Control Display. This display allows the user to take a manual megger reading and view the status of the megger 500VDC power supply. If the automatic megger option has not been installed, this display will not appear. The display will show the user the Megger status and last megger reading.

4.3. Warnings and Faults

4.3.1. Warning Messages

The CCR is able to alert the operator with a variety of warning messages on the display. The LED embedded into the Warning key will turn on to signal a warning condition. If more than one Warning condition is detected, the most important warning will be displayed. The user can scroll through each active warning by pressing the Warning key.

4.3.1.1. System Warnings

Monitoring System Warnings	
Source	**Description**
Door Open	Terminals 1 and 2 of TB7 indicate an open circuit due to an open door. The CCR will de-energize if operating and fail to energize if not already operating.
Low Input Voltage	The input voltage is not meeting the low level warning threshold while the Input Voltage Monitor is activated.
High Input Voltage	The input voltage is exceeding the high level warning threshold while the Input Voltage Monitor is activated.
No Input Voltage	TB2 on the power supply card does not exhibit an input voltage at the 13 VAC input. Check that the main breaker supplying the CCR has not been switched to off. This message will not be displayed if the DCMU does not have an external 24 VDC power source connected to TB1 of the power supply.
Tolerance Warning	The output current is outside the lower or upper limit for the current monitor warning condition.
Tolerance Alarm	The output current is outside the lower or upper limit for the current monitor alarm condition.
Wrong Brightness	Actual output current is outside the lower or upper limit for the brightness step selected. Commanded and Actual Brightness will be displayed after pressing the Warning button.
Off Current High	The output current exceeds the configured value when the CCR is commanded off. Calibrating the output current is usually necessary in this situation.
VA Low	VA Changes are outside the lower limit of the VA Changes low alarm. This is likely caused by a field circuit problem.
VA High	VA Changes are outside the upper limit of the VA Changes high alarm. This is likely caused by a field circuit problem, or the CCR is overloaded.
Output Shorted	The output voltage is close to zero while the CCR is supplying current. Check that any safety cutouts are not left in a shorted position.
Lamp Warning	The number of failed lamps in the circuit is beyond the upper limit of the lamp outage warning.
Lamp Alarm	The number of failed lamps in the circuit is beyond the upper limit of the lamp outage alarm.
Megger Warning	The measured insulation resistance between the field circuit to ground has exceeded the lower limit of the Megger warning level.
Megger Alarm	The measured insulation resistance between the field circuit to ground has exceeded the lower limit of the Megger alarm level.

4.3.1.2. Hardware Warnings

Hardware Warnings	
Source	**Description**
High Temperature	The temperature within the DCMU has exceeded the upper limit for high temperature.
Firing Card Warning	The firing card circuit board or its measured signals have a fault.
Megger Fault	The megger circuit board or its measured signals have a fault.
Input Card Error	The input card is missing or has failed a self-test during power on.
Output Card Fault	The output card is missing or has failed a self-test during power on.
Unknown Warning	The CCR has encountered a warning code that does not have an associated warning message. This warning is not generated under common circumstances.

4.3.2. Fault Messages

A fault will open the contactor and disable the output if the regulator is ON, and the embedded LED on the Fault button will turn ON. Faults remain active on the display until an action is taken. Either the regulator must be turned off (input power off) or the Fault button must be pressed to actively recognize and clear the fault. If the Fault button is pressed after the fault state has ceased, the regulator will return to normal operation. If the Fault button is pressed before the fault state has ceased, the display will indicate the fault message again, and the regulator will revert back to a disabled output state.

Faults	
Source	**Description**
No Input Voltage	TB2 on the power supply card does not exhibit an input voltage at the 13 VAC input. Check that the main breaker supplying the CCR has not been switched to off. This message will not be displayed if the DCMU does not have an external 24VDC power source connected to TB1 of the power supply.
Over Current	An overcurrent fault will trip the regulator if the current exceeds 5% beyond maximum for at least 5 seconds or if the current exceeds 25% above maximum for at least 1 second. The output current will typically remain within 1% accuracy during operation. Turning off a circuit selector switch can cause a current spike which may, in turn, induce an overcurrent fault. Issues with hardware or wiring within the regulator can also cause an overcurrent fault. A non-operating solid state control relay in a ferroresonant CCR will cause the regulator to produce maximum current.

Faults	
Source	**Description**
Open Circuit	An output current below 1A usually indicates that the airfield lighting series circuit is open. The CCR will trip if the current output drops below this value while there is adequate voltage.
Over Voltage	An output voltage above 15% of nominal for greater than 3 seconds will trip the CCR. This typically indicates that the field circuit is deteriorated, but not completely open (current is arcing over a connector or leaking to earth ground).
No Current	An output current below 1A for greater than 3 seconds along with a low output voltage will trip the CCR. This indicates a CCR issue (blown fuse, no firing command, etc.).
Door Open Trip	The CCR will trip and a fault message will be shown on the display if the access door is opened during operation.
Current Asymmetry	Current Asymmetry indicates an inequality between the RMS integral of the positive output waveform half and the negative output waveform half. Large inequalities will lead to the main power transformer output winding overheating and, if left unresolved, eventual failure. The CCR will trip and a fault message will be shown on the display if the Current Asymmetry threshold is exceeded for the determined amount of time.
Time Asymmetry	The time asymmetry fault is triggered when there is an asymmetry between the lengths of time of the two halves of the sine wave. When the threshold has been exceeded a fault will be displayed and the regulator turned off. Asymmetry can be caused by poor calibration, component failures, or power supply noise.
No Cap Voltage	This fault indicates that the firing card and DCMU are not receiving cap sense feedback.
SCR/SSR Fault	This fault indicated a problem with the Solid State Relay.
Unknown Fault	The CCR has encountered a fault code that does not have an associated fault message. This fault is not generated under common circumstances.

4.4. Power Save mode

For more energy efficient operation, a Power Save Mode is included with the regulator. If there is no interaction with the regulator for a user-configurable amount of time, the display will time out. The time out duration can be set with the Configurator software. The FAULT, REMOTE, WARNING, and ON LEDs will remain on as applicable. The REMOTE LED will continually flash if the regulator is not on, and no warning or faults are active, but the DCMU is still receiving power in Power Save Mode and in local control.

The screen will wake by pressing any button other than the ON button. Pressing the ON button will turn the regulator **OFF** or **ON**. Pressing any button (other than ON) once to wake the screen will not activate the command of the button.

5. CONFIGURATION

5.1. CONFIG Menu

The Configuration Menu is accessed by pressing the CONFIG button on the keypad. To prevent unauthorized access, the display will ask the user to enter a 4 digit password. This prompt will not show if passwords are disabled; however, this is not recommended. The first time that the configuration menu is accessed, the factory default password 9999 must be used (this can be changed later). Each number can be changed with the Up and Down navigational buttons. Pressing the right Dot soft key button will advance to the next number. After the password has been completely entered, press the left Dot soft key button to Accept.

5.2. Menu Navigation

Three main sub-menus are available within the Configuration Menu: CCR CONFIG, MONITOR CONFIG, and SYSTEM COMMANDS. In the sub-menus, an arrow points to the selected menu item. If additional menu items beyond those immediately shown on the display are available, an up or down arrow will reside next to the other menu items on-screen. The Up and Down navigational buttons can be used to maneuver through these menu items. Each sub-menu provides options to move backwards or forwards through the hierarchy of sub-menus. These options are exercised via the two Dot soft key buttons below the display prompts. The Dot soft key button associated with the Select prompt is used to move forward in the sub-menu or to select the menu item which is being pointed to. The Dot soft key button associated with the Exit prompt is used to move backward in the sub-menu.

5.3. Saving Changes

Configuration or calibration values that are changed are automatically saved to memory. A suspension in power may prevent changes from saving to memory. To save changes permanently in non-volatile memory, first exit out of the menu structure to the main display. There will be a prompt as to whether you would like to record the changes, select yes to permanently store them. Selecting no will result in the changes not being stored.

5.4. CCR CONFIG

Menu Features

The following table lists the features that can be selected under the CCR Config Menu. Items in boldface "**Set at factory**" should not be changed, as they may require physical configuration changes to the system as well.

CCR Config Menu	
Menu	**Description**
Input Voltage	Select the input (power) voltage to the regulator. **Set at factory.**
On Threshold	Minimum input power required for DCMU to acknowledge that input power is sufficient for the regulator to turn on. The default setting is 85% of nominal.
Off Threshold	Minimum input power required for DCMU to acknowledge that input power is sufficient for continued operation. The default setting is 75% of nominal.
Input Frequency	An input line frequency of 50 Hz or 60 Hz may be selected. **Set at factory.**
Input CT	Enable if an input CT is installed. Default = Enabled.
Ferro	Defaults: Min= 4.2 Max= 7.3, Damp= 20%
SCR (4)	Not Used.
SCR	Not Used.
Number of Steps	Setting for the number of steps (1, 3, 5, and 7). Default setting is 5 Steps.
Maximum Current	Input value for maximum output current rating of the CCR. **Set at factory.**
Asymmetry Trip	Input values for Asymmetry Threshold and Duration. Defaults values are 10% and 30 cycles.
Temp Adjust	Input value for temperature compensation in low temperature operating environments of -20 °C or less. Default value is 0%.
B1 Dwell Time	Input value for the duration in milliseconds for the regulator to stay at B1 before increasing to the commanded brightness step. Default value is 0 milliseconds.
Step Period	Input value for the duration in milliseconds for the regulator to stay at each brightness step when stepping up through soft start mode. Default value is 0 milliseconds.
B1 to B7 Current	Current setpoints are automatically set when the number of steps and maximum current are input. 1 Step - 5.5A 3 Step - 4.8A, 5.5A, 6.6A 5 Step - 2.8A, 3.4A, 4.1A, 5.2A, 6.6A For unique field settings, individual steps can be adjusted manually.

Output Power	Input the regulator's kW Rating (4 kW, 7.5 kW, 10 kW, 15 kW, 20 kW or 30kW). **Set at factory.**
Parallel Inputs	Enable Standard to operate CCR using separate wires for each step. Enable BCD to use a binary coded decimal system, which will result in less wires. Step — Input B3 — Input B1 — Input CC Off — 0 — 0 — 0 B1 — 0 — 0 — 1 B2 — 0 — 1 — 0 B3 — 0 — 1 — 1 B4 — 1 — 0 — 0 B5 — 1 — 0 — 1
Relay Feedback	Not used.
Output Voltage Flip	To account for installation errors in the field, this setting can be activated to reverse the voltage signal with respect to the current. Default setting is Disabled.
Contactor Delay	Input number of input line voltage cycles to delay the contactor when set to on. The default setting is 60 cycles (1 second for 60Hz).
Fault Relay	The states in which the fault relay will open can be selected. The states can be a warning, fault, local mode or remote mode. Multiple states are selectable. The default value is Fault.
Calibrate	Calibrate measurements. See Section 6.

5.5. Critical CCR Settings

The regulator is designed to be adaptable to various operational setups. As such, the critical settings of the CCR can be adjusted specifically for the field it is powering. The following settings are critical to proper operation.

5.5.1. CCR Types

The DCMU can control three different regulator types: Ferroresonant (Ferro), Thyristor with 4 SCRs (SCR4) and Thyristor with 2 SCRs (SCR). This is set at the factory; DO NOT CHANGE THIS SETTING.

5.5.2. Min Delay

The Min Delay setting designates the minimum amount of time that the Solid State Relay (SSR) will remain off after crossing zero. The earliest time at which the SSR can turn on is determined by this setting.

5.5.3. **Max Delay**

The Max Delay setting designates the maximum amount of time that the SSR will turn on after a zero crossing. The latest time at which the SSR can turn on is determined by this setting.

5.5.4. **Damping**

The Damping setting influences the response time of the regulator control loop. This setting is typically between 10% and 20%. A value outside of these bounds may result in instability of the output current.

5.5.5. **Contactor Delay**

The Contactor Delay setting should be set to match the turn on delay of the contactor. A very slow contactor could result in a no current fault if the DCMU does not see current flow fast enough. Adjusting this setting can accommodate for this condition. The applied delay will also affect open circuit and over current fault trip times as well. When possible, leave this setting as low as possible for quick reactions to faults.

5.5.6. **Soft Start**

The available soft-start feature ramps up the output current to the selected brightness step, instead of switching it on immediately to the full current of the selected step.

5.6. Monitoring Config Menu

The following table lists the features that can be selected under the Monitoring Config Menu.

Monitoring Config Menu		
Menu	**Description**	**Default Setting**
Lamp Outage	Monitors the number of lamps in the circuit which have failed.	N/A
Number of Lamps	Allows for input of the quantity of lamps in the circuit.	100
Lamp Out Warning	Allows for input of the quantity of lamps out in the circuit that will cause a warning.	5

Lamp Out Alarm	Allows for input of the quantity of lamps out in the circuit that will cause an alarm.	10
VA Changes	Monitors changes in VA on the CCR.	Disabled
VA Low Alarm	Allows for input of the percentage decrease in VA which will cause an alarm.	10%
VA High Alarm	Allows for input of the percentage increase in VA which will cause an alarm.	10%
Current Monitor	Monitors differences in output current from the CCR.	Enabled
Deviation Warning	Allows for input of the difference in output current which will cause a warning.	0.05A
Deviation Alarm	Allows for input of the difference in output current which will cause an alarm.	0.10A
Max Off Current	Allows for input of the high threshold of induced current that can be measured in the circuit while the regulator is set to OFF, above which an Off Current High Warning will trigger.	0.10A
Input Voltage	Monitors changes in input voltage to the regulator.	Enabled
Input Voltage Low Level	Allows for input of the Low Input Voltage threshold.	95%
Measure Now	Commands a megger reading to be taken in real-time.	N/A

Megger Resistor	Allows the value of the installed megger resistor to be input.	2000 Kohms
Reading Duration	Allows for input of the desired amount of time to energize the 500VDC megger power supply.	120 seconds
Auto Measure	Allows for the choosing of desired automatic settings.	Disabled
Warning Level	Allows for input of the megger reading threshold which will cause a warning.	500 Kohms
Alarm Level	Allows for input of the megger reading threshold which will cause an alarm.	100 Kohm
Output Voltage	Monitors whether the output voltage of the regulator is shorted.	Enabled
Fuse Monitor	Monitors for fuse failures. This is disabled for Ferroresonant CCRs by default as it is not used in them.	Disabled
Comms 24V	Not used.	N/A

5.7. System Commands Menu

The System Commands menu lists several options for saving and restoring Configuration and Calibration values. Take care when modifying items in the System Commands menu, as this will affect system performance.

System Commands Menu	
Menu	**Description**
Second Language	If the firmware is installed, a second language other than English can be selected. French and Spanish are available as second languages as of this publishing.

Factory – Restore Config	This command will reset the regulator to its factory default settings. This should only be performed if requested by Astronics DME. It is recommended to ensure configuration settings are saved before choosing to restore factory default settings, as the configuration will have to be re-input if a Known Good Configuration is not saved in memory.
Factory - Restore Calib.	This command will reset the regulator to its factory default calibration settings. This should only be performed if requested by Astronics DME. The calibration will have to be re-input if a Known Good Calibration is not saved in memory. A prompt will ask to Record Changes when exiting the Configuration menu (refer to Section 5.3). Press the Yes soft key button to make Factory Configuration or Calibration values permanent. Press the No soft key button to either cycle power to the DCMU or restore the previous settings with the Reset command.
Known Good Settings – Restore Config	This command will reset the regulator to a configuration of the most recent Known Good Settings if such a set of saved settings is in memory. The display will indicate "Known Good Config Not Found" if a configuration of saved settings is not in memory.
Known Good Settings – Save Config	This command will save the configuration data values to memory, and the display will indicate "Known Good Config Saved" when finished.
Known Good Settings - Restore Calib.	This command will reset the regulator to a calibration configuration of the most recent Known Good Settings if such a set of saved calibration settings is in memory. The display will indicate "Known Good Calib Not Found" if a configuration of saved calibration settings is not in memory.
Known Good Settings - Save Calib	This command will save the calibration configuration data values to memory, and the display will indicate "Known Good Calib Saved" when finished.
Clear Supp Warn	This command will clear any warnings which have been suppressed by depressing the WARNING button while the warnings were displayed.
Clear Counters	This command will clear the Operations and Elapsed timers for each brightness step.
Reset	This command should only be performed if requested by Astronics DME as it will reset the DCMU microprocessor.

Boot Block	This command should only be performed if requested by Astronics DME and should only be performed prior to loading a new program. When performed, it will terminate the control program. The processor will fail to execute the control program once this command is issued until power is removed from the DCMU for a few seconds.

6. CALIBRATION

WARNING

Allow only qualified personnel to perform the following tasks. Observe and follow the safety instructions in this document and all other related documentation.

6.1. Current and Voltage Calibrations

6.1.1. Zeros

The regulator control can be synchronized with the input voltage waveform by calibrating the Zeros. The 13 VAC supply on terminals 1 and 2 of TB2 on the DCMU detect and measure the input voltage waveform zero crossings.

6.1.1.1. Procedure

From the CCR menu, run the "zeroes" calibration routine (refer to Section 5 for accessing the CONFIG menu and navigation instructions): **-> CONFIG (enter password) -> CCR Config -> Calibrate -> Zeroes -> Execute**.

6.1.2. Cap Sync

The regulator control between the input supply and the output waveforms is synchronized by calibrating the Cap Sync. Since the input and capacitor voltages are out of phase with each other, this is a vital operation. The Cap Sync is supplied by the capacitor voltage sense winding connected to terminals 8 and 9 of the Firing Card.

6.1.2.1. Procedure

Turn the CCR output on to Step 1 and run the Cap Sync routine: -> **CONFIG (enter password) -> CCR Config -> Calibrate -> Cap Sync -> Execute**.

6.1.3. Input Voltage

The input voltage measurement can be calibrated from the CCR at any time, with the regulator output on or off.

6.1.3.1. Procedure

With a high accuracy DMM, measure voltage at power input terminals; adjust the Input Voltage in the CCR menu to match. This is found at -> **CONFIG (enter password) -> CCR Config -> Calibrate -> Input Voltage**.

The parameter is adjusted using the up and down navigational buttons and the changes can be Accepted using the appropriate Dot soft key button.

6.1.4. Input Current

When calibrating the input current measurement, the regulator should have the highest feasible load to achieve maximum accuracy. Calibration of the input current measurement must be performed with a true RMS meter and a high-accuracy current probe. Calibration can be performed by measuring the voltage across Firing Card terminals 4 and 5 if an appropriate measuring device is not readily available. Refer to Section 2.3.6, Table 2-3 for CT turns ratios necessary to calculate voltage/current.

6.1.4.1. Procedure

Measure input current with clamp-on current probe (or compute current from measured CT voltage); adjust the 'input current' in the CCR menu to match. This is found at -> **CONFIG (enter password) -> CCR Config -> Calibrate -> Input Current**. The parameter is adjusted using the up and down navigational buttons and the changes can be Accepted using the appropriate Dot soft key button.

6.1.5. Output Voltage

When calibrating the output voltage measurement, the regulator should have the highest feasible load to achieve maximum accuracy. A high-voltage probe is required due to the high output voltage exceeding the rating of a standard meter. Alternatively, the calibration can be performed by reading the output of the transformer feedback winding at Firing Card terminals 6 and 7. Refer to Section 2.3.4, Table 2-2 for feedback winding voltage ratios necessary to calculate voltage.

6.1.5.1. Procedure

With a DMM, measure output voltage across lightning arrestor terminals; adjust the 'Output Voltage' in the CCR menu to match. This is found at **-> CONFIG (enter password) -> CCR Config -> Calibrate -> Output Voltage**. The parameter is adjusted using the up and down navigational buttons and the changes can be Accepted using the appropriate Dot soft key button.

6.1.6. Output Current

Calibration of the output current measurement must be performed with a true RMS meter and a high-accuracy current probe. If a proper current probe is not available, the calibration can be done by measuring the voltage on Firing Card terminals 2 and 3. Refer to Section 2.3.6, Table 2-3 for further details on the voltage levels.

6.1.6.1. Procedure

Measure output current going to the field circuit with clamp-on current probe (or compute current from measured CT voltage); adjust the 'output current' in the CCR menu to match. This is found at -> **CONFIG (enter password) -> CCR Config -> Calibrate -> Output Current**. The parameter is adjusted using the up and down navigational buttons and the changes can be Accepted using the appropriate Dot soft key button.

6.1.7. Cap Voltage

Calibration of the capacitor voltage measurement is performed by taking a direct measurement across the capacitor bank. The capacitor voltage will be approximately the same as the supply voltage, but must be measured by way of the feedback winding on the Firing Card terminals 8 and 9. Refer to Section 2.3.4, Table 2-2 for further details on calculating the actual voltage using the feedback ratio.

6.1.7.1. Procedure

With a DMM, measure the voltage across the capacitor bank; adjust the 'Cap Voltage' in the CCR menu to match. This is found at **-> CONFIG (enter password) -> CCR Config -> Calibrate -> Cap Voltage**. The parameter is adjusted using the up and down navigational buttons and the changes can be Accepted using the appropriate Dot soft key button.

6.1.8. Output Voltage Span

Calibration of the output voltage span is required if the output voltage is not properly calibrated per Section 6.1.5. This prevents overvoltage tripping of the regulator. For proper operation, the output voltage should be calibrated.

6.1.8.1. Procedure

Adjust the 'Output Voltage Span' in the CCR menu to the calculated value or an estimated value. This is found at -> **CONFIG (enter password) -> CCR Config -> Calibrate -> Output Current**. The parameter is adjusted using the up and down navigational buttons and the changes can be Accepted using the appropriate Dot soft key button.

6.2. Lamp Outage & VA Calibration

Lamp Outage is a way to calculate the number of failed lamps in the airfield lighting circuit. When the secondary of an isolation transformer is closed, with either a shorting plug or a good lamp, the circuit is basically resistive. If the secondary is open because of a failed lamp, that portion of the circuit becomes inductive. This change in circuit inductance is measurable, and can be used to calculate how many lamps have failed. This function is of practical use only on airfield circuits where all lamps are the same.

6.2.1. Lamp Outage Calibration

Use these settings to enter into the monitor the number of lamps present on your circuit, the number of lamps out that will trigger an alarm, and the number of lamps out that will trigger a warning. These settings are found in -> **CONFIG (enter password) -> Monitor Config -> Lamp Outage.** Once the number of lamps, alarm threshold, and warning threshold are set, run the **Calibrate (LO & VA)** from the same menu. This executable calibration function will run through all of the current steps and store many data points within the DCMU including phase data

and inductance data. To verify that your lamps out measurement is calibrated disconnect an arbitrary number of lamps in your circuit, and observe what the monitor displays. If the displayed lamp outage number equals the actual number of failed lamps, calibration is complete. If the two numbers differ, use the **Adjust (LO)** function within the above mentioned menu and correct the lamps out number. This correction will complete the calibration. The more lamps used in this check, the greater the accuracy will be.

6.2.2. Phase Offset

When executed this routine will attempt to compensate for phase shifts that may be present in certain systems where there is a systemic phase shift between the output current and output voltage. This is a routine reserved for troubleshooting and should not be used in normal circumstances.

6.2.3. Calibration from the VA changes Menu

If lamp outage calculations are not required, the VA Calibration procedure can be run from the VA Changes menu. This is similar to the Lamp Outage calibration, but does not require the lamps-out measurements. It will simply measure output VA and trigger an alarm upon passing a low VA user set threshold, or a high VA user set threshold. These thresholds, as well as the executable nominal calibration function are located in -> **CONFIG (enter password) -> Monitor Config -> VA Changes.**

6.3. Automatic Megger Calibration

The Automatic Megger system consists of a 500 VDC/2 mA power supply and 2 MΩ precision resistor connected to one side of the regulator output and earth ground. The megger measures the insulation resistance to ground over a range of zero to 2 GΩ. The DC signal that is injected into the airfield lighting circuit does not affect the AC current that powers the lights. For this reason, the megger can be operated with the regulator on or off.

6.3.1. Calibrate Open

Enable the automatic megger and set the configuration parameters as outlined in Section 4.2.4. Verify the regulator is switched off. Disconnect the field circuit from the regulator output terminals, leaving the output of the regulator open. Defeat the door interlock. Place the CCR in Local mode using the REMOTE button on the keypad. Select "**Calibrate Open**" from the Auto Megger menu. This starts the calibration routine. The number shown while calibration is running is the raw value (approx. 31,000) from the megger board. If the "**Quit**" key is pressed, the display reading will change to "**Aborted**". A message will be displayed when calibration is complete.

6.3.2. **Calibrate Short**

Verify the regulator is switched off, interlock is defeated and system is in Local mode. Connect a jumper from the megger lead ring lug (attached to one of the regulator output terminals) to the cabinet ground stud. Select "**Calibrate Short**" from the Auto Megger menu. This starts the calibration routine. The number shown while calibration is running is the raw value (approx. 8,000) from the megger board. If the "**Quit**" key is pressed, the display reading will change to "**Aborted**". A message will be displayed when calibration is complete.

6.4. Calibration Values

Calibration values can be set as Known Good Calibration Settings from the System Commands menu. Refer to Section 5.7 for more details. If the regulator calibrations are accidentally changed, the Known Good Calibration Settings can easily be restored. To store your current configuration as a known good configuration select 'known good settings-save config' from the system configuration menu. To restore those values at a later date select 'known good settings – restore config'. The same can be done with calibration values, by selecting 'known good settings – save calib' and ' known good settings- restore calib'.

7. MAINTENANCE

WARNING

Allow only qualified personnel to perform the following tasks. Observe and follow the safety instructions in this document and all other related documentation.

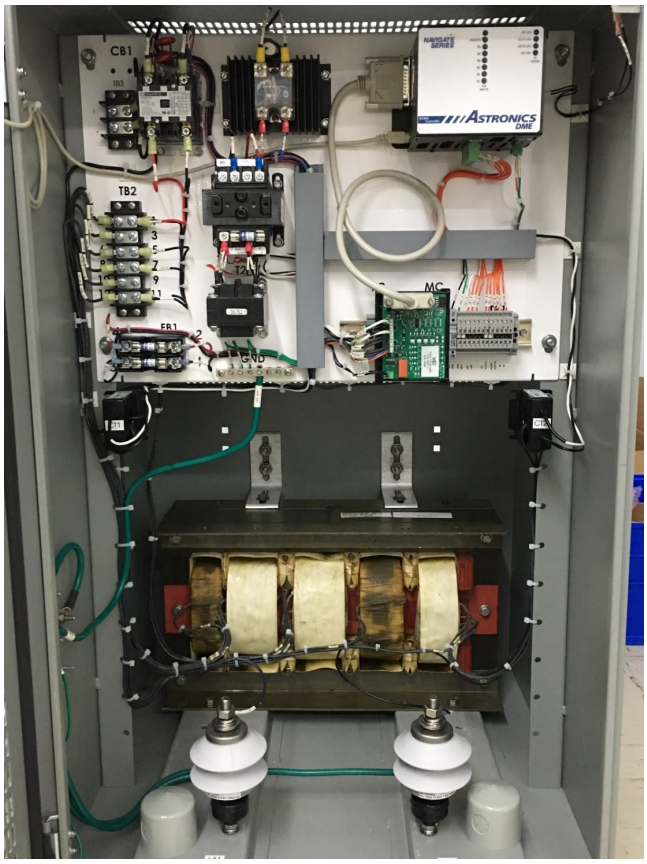


Figure 7-1 Regulator Cabinet

This regulator does not require any specialized maintenance. Perform preventative maintenance according to your airfield's standard maintenance schedule and according to AC 150/5340-26.

In addition to the recommended preventative maintenance inspection schedule for Constant Current Regulators defined in AC 150/5340-26, check that all power and control connections are secure, and re-tighten if necessary. Look for any burnt or discolored insulation. Visually inspect all components (including cabinet) for signs of mechanical damage. Verify that all components are clean and free of dust or dirt. Clean as necessary.

8. TROUBLESHOOTING GUIDE

This troubleshooting guide is intended for use by qualified personnel who are experienced with Constant Current Regulators. CCRs and airfield lighting circuits operate at voltages up to 5 kV, and should always be treated as high voltage circuits. Proper safety procedures should always be followed when working on this type of electrical equipment. The guide starts with the more basic and obvious faults and progresses to specific component tests. This guide attempts to be fairly comprehensive; however, it is difficult to detail every possible problem that might occur with the CCR and related system components. For several of these tests, a known good spare part may be needed.

Troubleshooting Guide		
Fault	**Reason**	**Check**
Regulator fails to power up and display is not operational. Display indicates **'No Input Voltage'**.	No Supply Voltage.	Ensure that regulator is connected to supply power and that supply power is switched to On. --- Ensure that main breaker in CCR is closed and showing no trip, if applicable.
	Blown Control Fuse.	--- Ensure that the DCMU is being supplied with power and that the display cable is properly connected. --- Ensure that any control fuses on the 13VAC connection to the DCMU have not blown if the DCMU has no power.
	Wiring connection to DCMU power supply card TB2 is faulty.	--- Measure terminals 1 and 2 on TB2 of the supply card to ensure 13VAC after removing the 3-pin plug.
	DCMU power supply card is faulty.	--- Connect terminals 3 (24 VDC) and 4 (COM) of TB7 if 24 VDC is present to bypass the power supply card and directly power the DCMU. If the DCMU powers up, this indicates a faulty power supply card. The regulator will not output current without the power supply card receiving 13VAC.
	DCMU is faulty.	
Regulator is operational, but display is not.	Connection between the display panel and the DCMU is poor.	Ensure that the PS2 connector from the display panel to the DCMU is firmly in place. Unplug and reinsert the connector if necessary.

Troubleshooting Guide		
Fault	**Reason**	**Check**
Display indicates 'Open Circuit'	Open circuit.	Ensure that the field circuit is intact. Short the regulator output and try again. If the regulator operates in short circuit, the problem is with the field circuit.
Display indicates 'Over Voltage'	Nearly open circuit	Ensure that the field circuit is intact. If the regulator is equipped with an S1 cutout, set the cutout to the shorting position and try again. If the regulator operates in short circuit, the problem is with the field circuit.
Display indicates 'No Cap Voltage'	Shorted Capacitor Bank.	Ensure each capacitor in the capacitor bank reads 50 µF with an appropriate meter. To do this, first shut off CCR and lock out power. This should only be done by qualified personnel. --- Remove the capacitor bank if it is shorted. Determine which capacitor is shorted using a continuity meter on each individual cap. This should only be done by qualified personnel. --- In an emergency situation, the CCR will still output a current below maximum if just one capacitor has shorted, no matter the load. Ensure that the connection between the sense coil and wires R1 and R2 on the firing card is not faulty if the capacitor bank is not shorted. Replace the firing card if a voltage is measured at the R1 and R2 terminals. --- Replace the DB25 cable from the Firing Card to DCMU if a firing card replacement does not resolve the fault.
	Faulty Capacitor Sense Coil input to Firing Card.	
	Faulty Firing Card.	
	Faulty DB25 cable from Firing Card to DCMU.	

Troubleshooting Guide		
Fault	**Reason**	**Check**
Output current will not go above 2.8A.	Solid state relay (SSR) failure.	Ensure that the contact of the SSR is open. To do this, one of the inductor wires (IndA or IndB) must be disconnected from the bottom of the SSR. Replace the SSR and Heat Sink assembly if inspection of the SSR contact reveals that it is closed.
Display indicates 'No Current'	Faulty Firing Card.	Replace the Firing Card if firing card relay is on and the K2 terminal is not getting 120VAC.
	Faulty contactor coil.	Ensure that the coil of the contactor is good.
	Faulty DMCU.	Replace the DCMU if a replacement is readily available.
	Shorted output CT.	Ensure output CT is working properly and replace if needed.
	Contactor Delay setting not high enough.	Ensure that the Contactor Delay setting is sufficient. The regulator may trip and indicate the No Current fault if it is turned on with too low of a setting value.
Display indicates 'Over Current'	Bad connection between Firing Card and SSR.	Ensure that the CCR Config is set as Ferro. Ensure the wiring integrity and connections of SSR1-A1 and SSR1-A2 between the firing card and SSR.
	Faulty SSR.	Remove and replace the SSR and Heat Sink assembly.
	Wrong Calibration values input.	With an appropriate meter, measure the output current. Output Current Calibration values should be restored or re-input if the output current is above normal.

Troubleshooting Guide		
Fault	**Reason**	**Check**
	Temporary Overcurrent Condition.	An obsolete Over Current fault may have been caused by a temporary overcurrent if the CCR is feeding circuit selector switches. To check if this is the case, ensure the regulator is operating properly (when connected to a load bank or short circuit if possible). Follow the previous steps if the fault persists.
	CCR Config is incorrect (SCR selected when using a Ferro).	
Below nominal current for active brightness step.	Calibration may be necessary.	Perform the Calibration procedures in Section 6 for Zeros and Output Current. Since the CCR transformer has a limit to the power it can output, the output current may be too little if the load on the regulator is too high. Check if the output current required is achievable when in short circuit. The output kW shown will match the connected load if the output current and voltage are calibrated correctly.
	Load on CCR is too high.	

Troubleshooting Guide		
Fault	**Reason**	**Check**
All LEDs on the DCMU flash concurrently.	Shorted power supply card.	This issue is caused by the 24 VDC output of the power supply card being higher than the circuit board protection device threshold. Ensure that the DCMU is receiving no power, then detach the 25 pin serial cable. Power up the DCMU, and check to see if the LEDs are still flashing. If the flashing stops, this indicates that an external connection is causing the issue (serial cable, monitor card, or Megger card).
	Capacitors of the power supply card have been discharged.	--- When a spare DCMU has been stored for a long enough time, this can also be the root problem. Detach the 24 VDC and 15 VAC connectors then connect the 15 VAC connector first if the power supply card experiences overcurrent.
Instability or no output current when regulator is turned on.	One or more critical CCR settings are incorrect and may have been modified.	Restore the Known Good Configuration Settings if they were previously saved to memory.

Troubleshooting Guide		
Fault	**Reason**	**Check**
Remote Control mode is being unresponsive or the active step does not match the step selected, does not work, or the wrong step is being selected.	If a communication card is used, there may be issues with the communication signals.	The DCMU will default to Failsafe mode if communications via a high speed data line are lost. Attempt to control the regulator in local mode if there is a lack of control when relay control is used. If relay control is being used, and there are complaints of a lack of control, try to operate the regulator in Local mode. --- The external system will require inspection if local mode works properly while remote relay control is used. If Local mode is fine, and remote relay control is being used, the external system will have to be checked. --- The LEDs on the DCMU will illuminate accordingly if a proper signal is being received on the DCMU remote input relay, the corresponding LEDs will be lit on the DCMU. If the LEDs are not lit, the problem may be with the input card.
	Problems with remote relay control.	
	Problem with input card to DCMU issues from remote relays.	

9. DCMU MENU NAVIGATION

The following charts are provided to assist with the menu via the CONFIG button. Some items may vary or not apply, depending on the Firmware and hardware that is installed in the regulator.

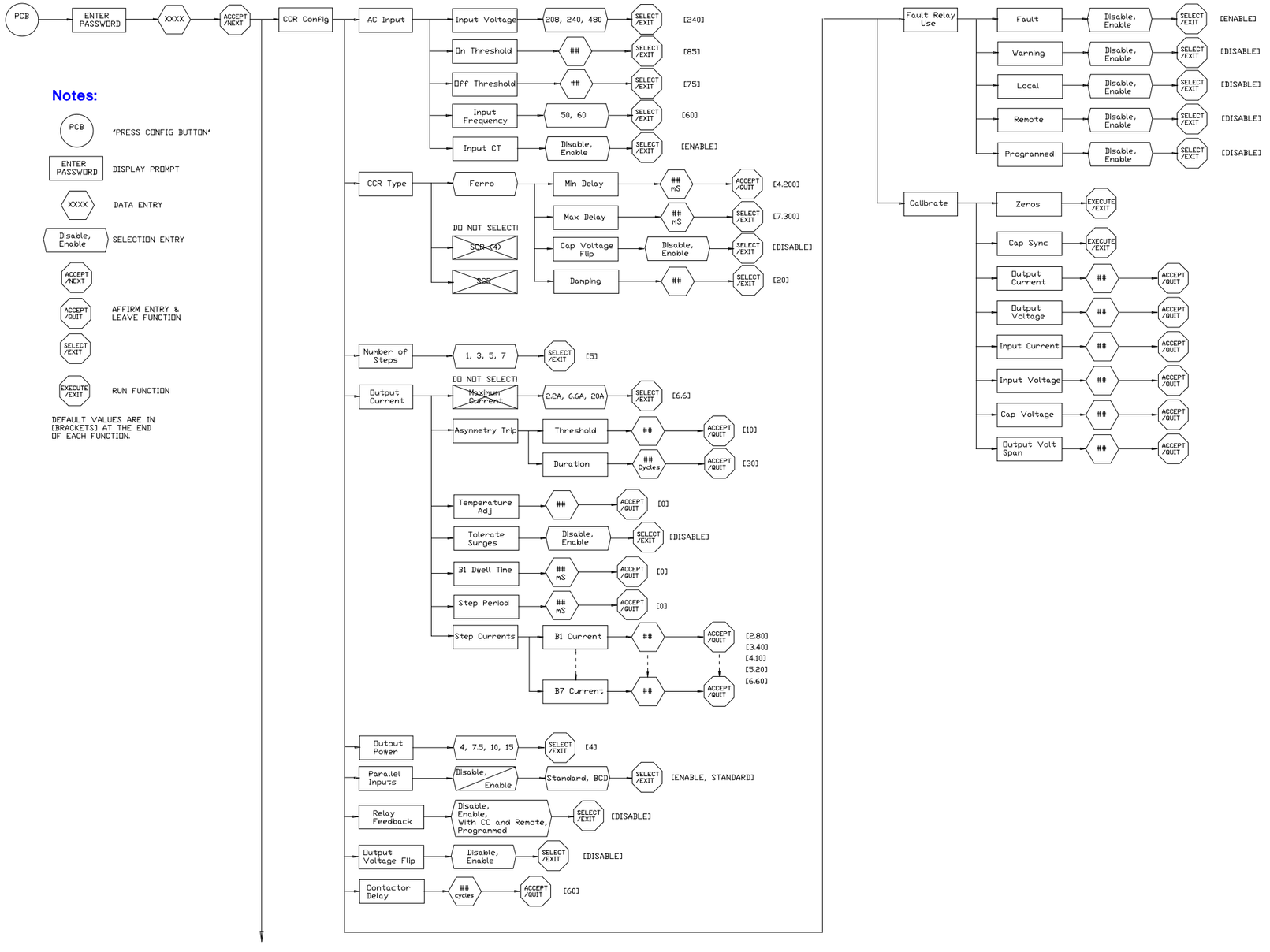


Figure 9-1 DCMU Navigation Map, CCR Configuration

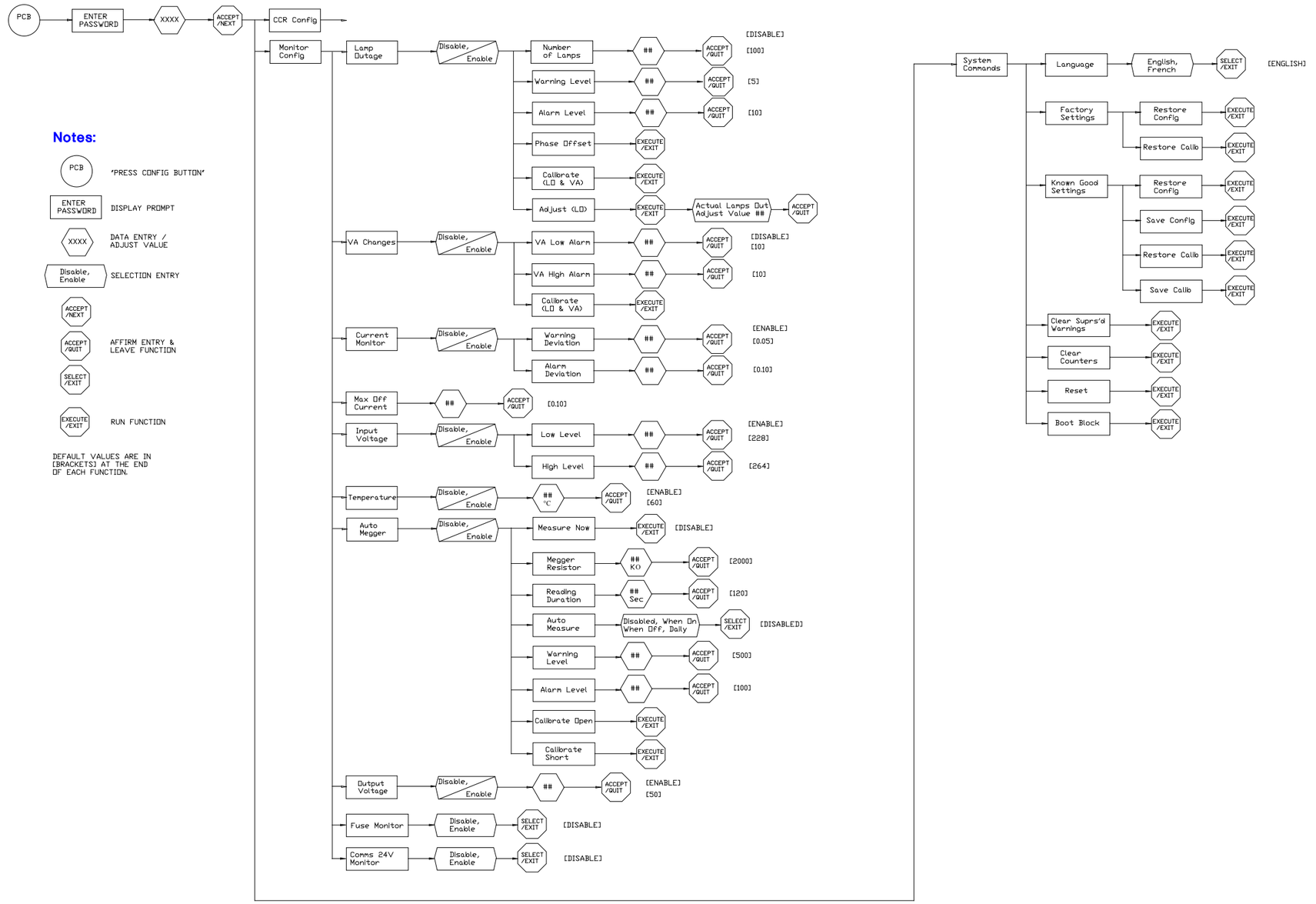


Figure 9-2 Map, Monitor Config and System Commands

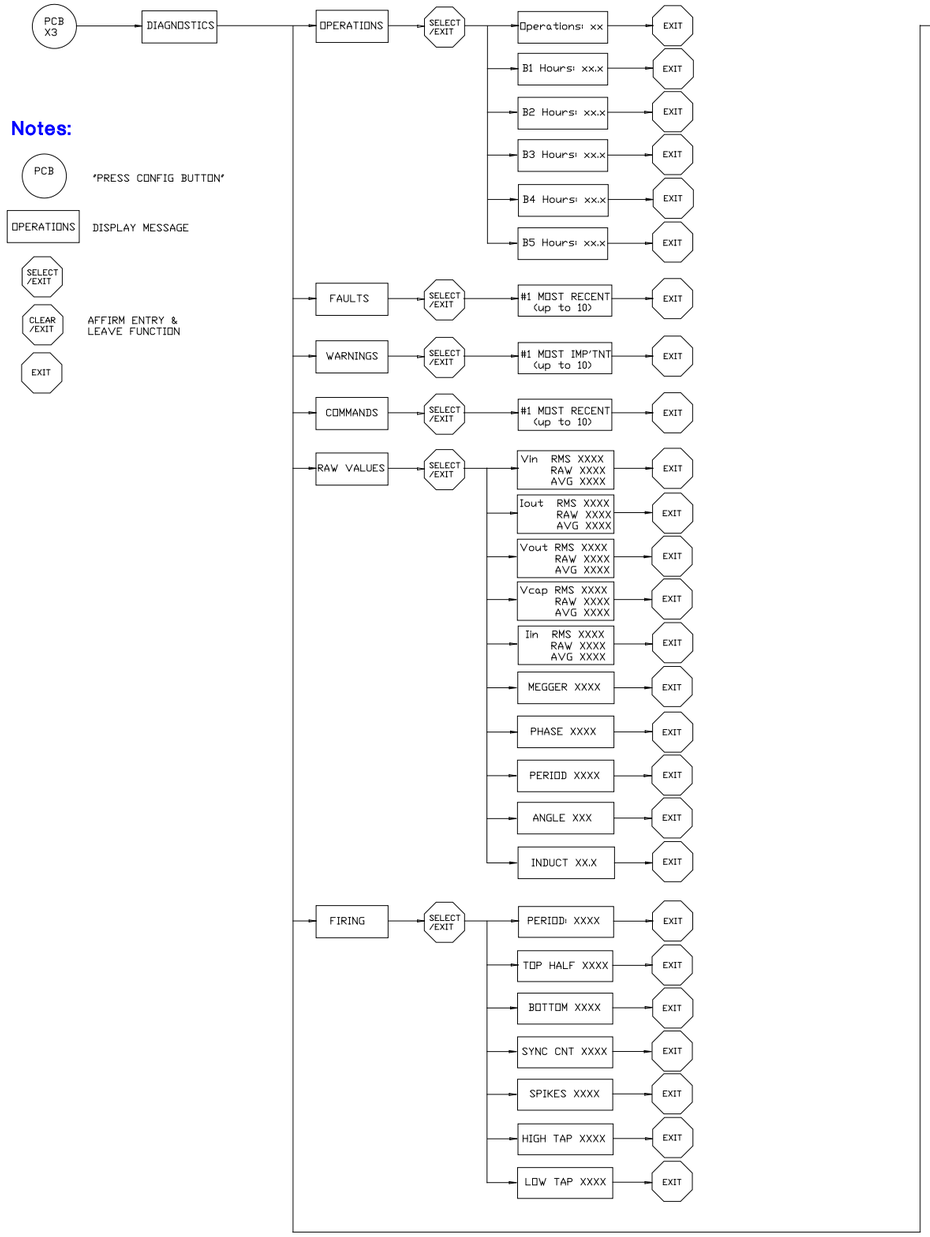


Figure 9-3 Map, Diagnostics

10. PARTS AND SPARES LISTS

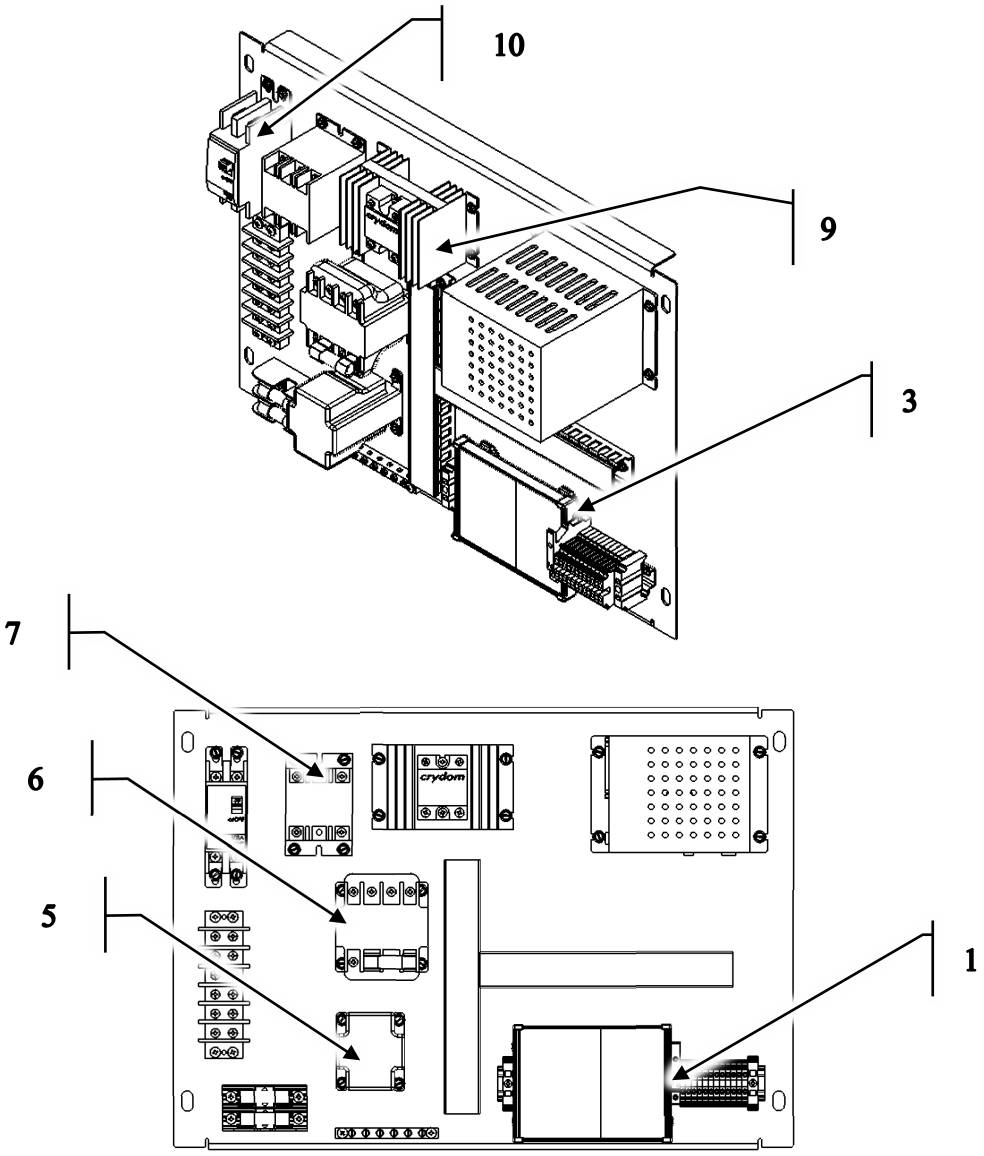


Figure 10-1

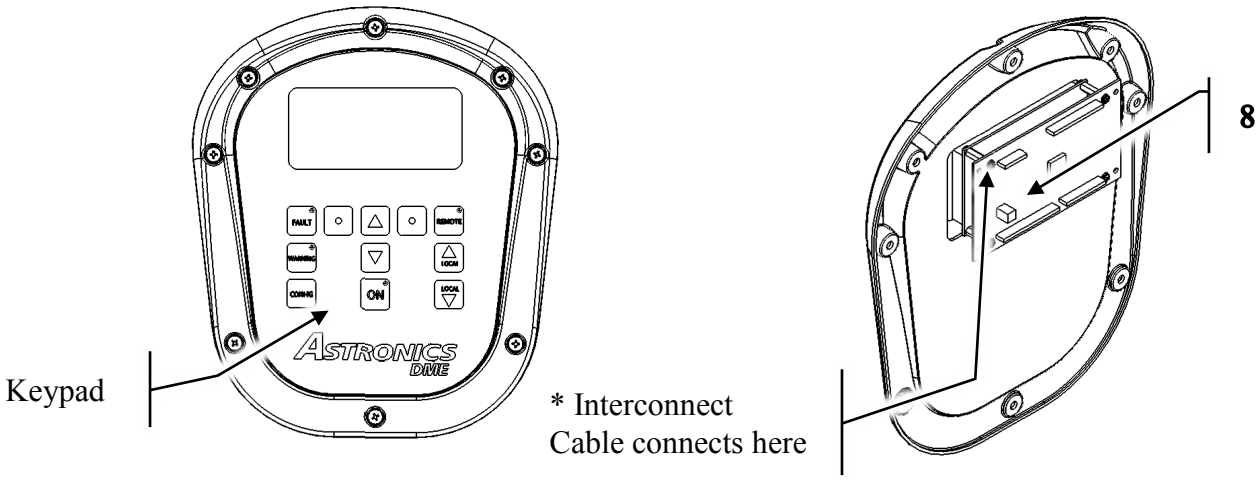


Figure 10-2

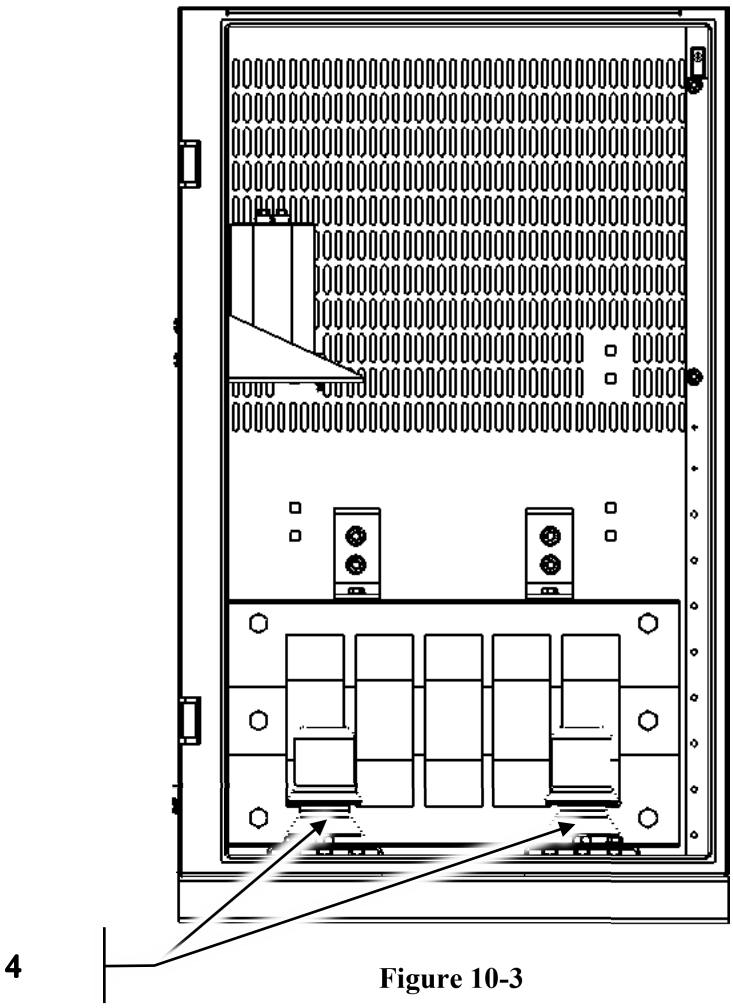


Figure 10-3

10.1. 4kW CCR

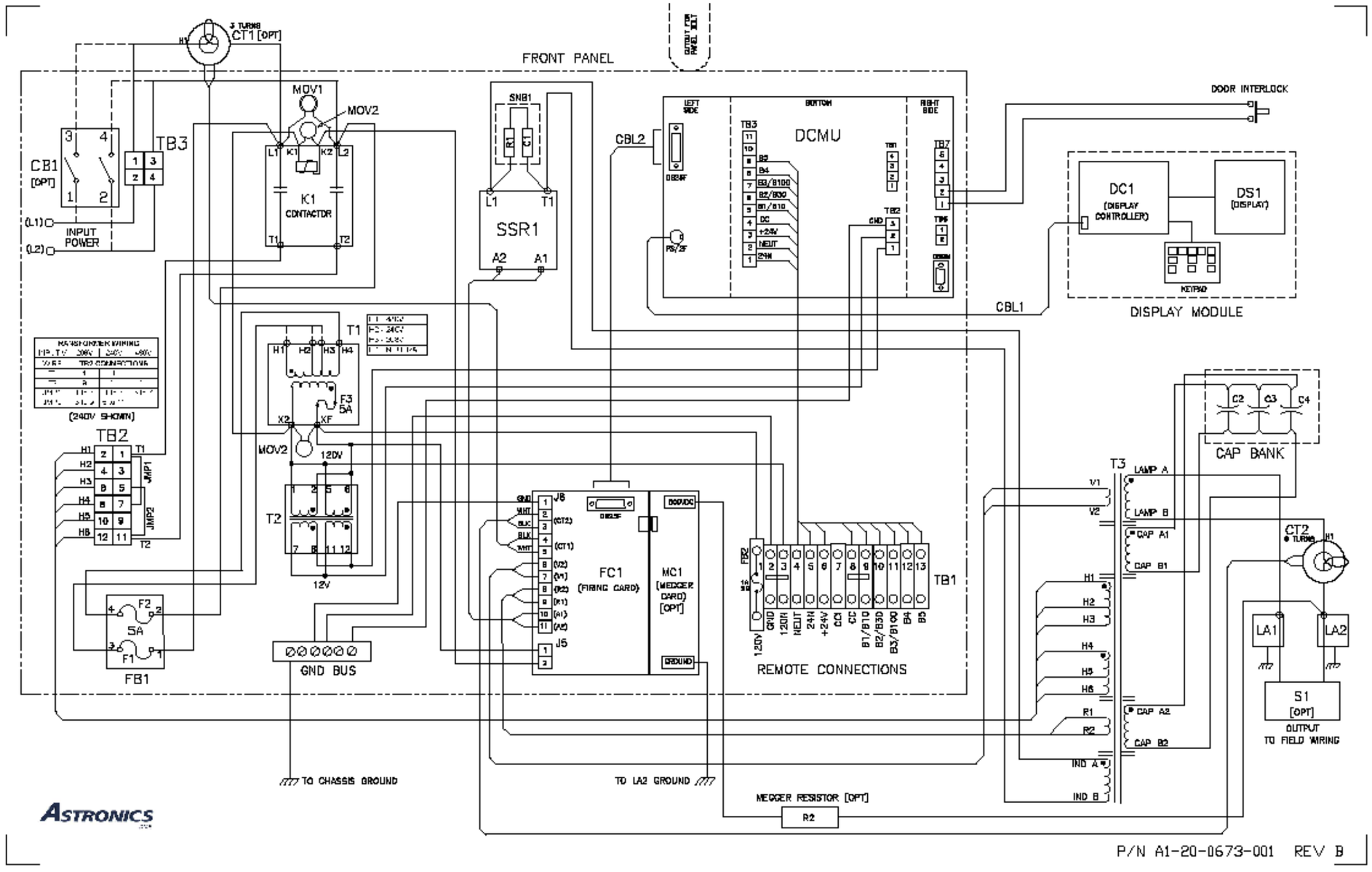
Table 10-1 4kW CCR Component Parts

Main	Part Name/Description	Ref Des	Part Number	QPA
*	ENCLOSURE, 4kW, 7.5kW, 10kW, L-829/L-828 CCR		A1-17-1145-001	1
	ASSY, 4kW FRONT PANEL, L-829/L-828 CCR	FP	A3-06-3172-001	1
	ASSY, CIRCUIT BREAKER, 15A, L-829/L-828 CCR		A3-06-3175-001	1
	ASSY, CIRCUIT BREAKER, 30A, L-829/L-828 CCR		A3-06-3175-003	1
	CONTACTOR, 25A, 600V	K1	A1-22-0013-001	1
	FUSEHOLDER, DUAL, PANEL MOUNT, 5AG	F1,F2	A1-21-0040-001	1
	CCR FIRING CARD	FC1	A3-06-1502-001	1
	CCR MEGGER OPTION CARD	MC1	A3-06-1504-001	1
	SSR, 125A, 660V, L-829/828 CCR	SSR	A1-11-0295-003	1
	HEAT SINK, SSR, CCR, 4kW/7.5kW/10kW/15kW/20kW		A1-17-1139-001	1
	ASSY, DCMU, 120/24V. L-829/828 CCR ASSY, DCMU, 120. L-829/828 CCR	DCMU	A3-06-3178-001 A3-06-3178-002	1
	TRANSFORMER,POWER, 208/240/480V-120V	T1	A1-09-0087-001	1
	TRANSFORMER,POWER, 120V-12/24V	T2	A1-09-0088-001	1
*	**TERMINAL BLOCK, REMOTE CONTROL**	TB1		1
	DIN RAIL, 9.5" LNG.		A1-03-0224-004	1
	TERMINAL BLOCK, UK3N		A1-03-0261-002	12
	TERMINAL BLOCK, D-UK 4/10,END COVER		A1-03-0261-008	1
	TERMINAL BLOCK, E/NS 35 N,END BRACKET		A1-03-0261-009	2
	FUSEHOLDER, DIN RAIL, 5x20mm	F3	A1-21-0041-001	1
	RAW, PLASTIC HOUSING, PCB		A1-18-2219-000	1
	TERMINAL BLOCK, 6 POS	TB2	A1-03-0302-001	1
	GROUNDING BLOCK, 6 POS	GND	A1-17-1138-001	1
	TRANSFORMER, FERRORESONANT, 4kW, MULTITAP	T3	A1-09-0089-002	1
	CAP, 50uF, 600VAC METALLIZED POLYPROPYLENE	C2,C3,C4	A1-02-0176-002	3
	ASSY, TRANSFORMER,CURRENT SENSE, L-829/828 CCR	CT1,CT2	A3-06-3186-001	2
*	**DISPLAY MODULE**	DM1		1
	BEZEL, KEYPAD, L-829/828 CCR		A1-18-2221-001	1
	KEYPAD, MEMBRANE, L-829/828 CCR		A1-12-0127-001	1
	ASSY, OLED DISPLAY, L-829/828 CCR	DS1	A3-06-1503-002	1
	DISPLAY CONTROLLER, CCR	DC1	A3-06-1500-001	1
	PLATE, DISPLAY, L-829/828 CCR		A1-18-2222-001	1
	LIGHTNING ARRESTOR WITH CAP	LA1,LA2	A1-01-0167-001	2
	SWITCH, SNAP ACTION, 10A-125V	DS1	A1-12-0126-001	1
	RESISTOR, CCR MEGGER	R1	A1-01-0168-001	1
	ASSY, INTERNAL S1, L-829/L-828 CCR		A3-06-3177-001	1

Main	Part Name/Description	Ref Des	Part Number	QPA
	ASSEMBLY, EXTERNAL S1, CCR		A3-06-3167-001	1
	NAMEPLATE, L-829/828 CCR		A1-20-0675-001	1
	LAMINATE, 4kW, WIRING DIAGRAM		A1-20-0673-001	1
	FRONT PANEL, WIRING DIAGRAM, 4kW, L-829/828 CCR		A3-06-3168-001	1
	CHASSIS ASSEMBLY, WIRING DIAGRAM, 4kW, L-829/828 CCR		A3-06-3169-001	1
	ASSY, CASTERS, 4kW, 7.5kW, 10kW, L-829/828 CCR		A3-06-3176-001	2

See SPARE PARTS for a list of the available spare components for the 4kW CCR.

10.1.1. **4kW CCR WIRING DIAGRAM**



10.2. 7.5kW CCR

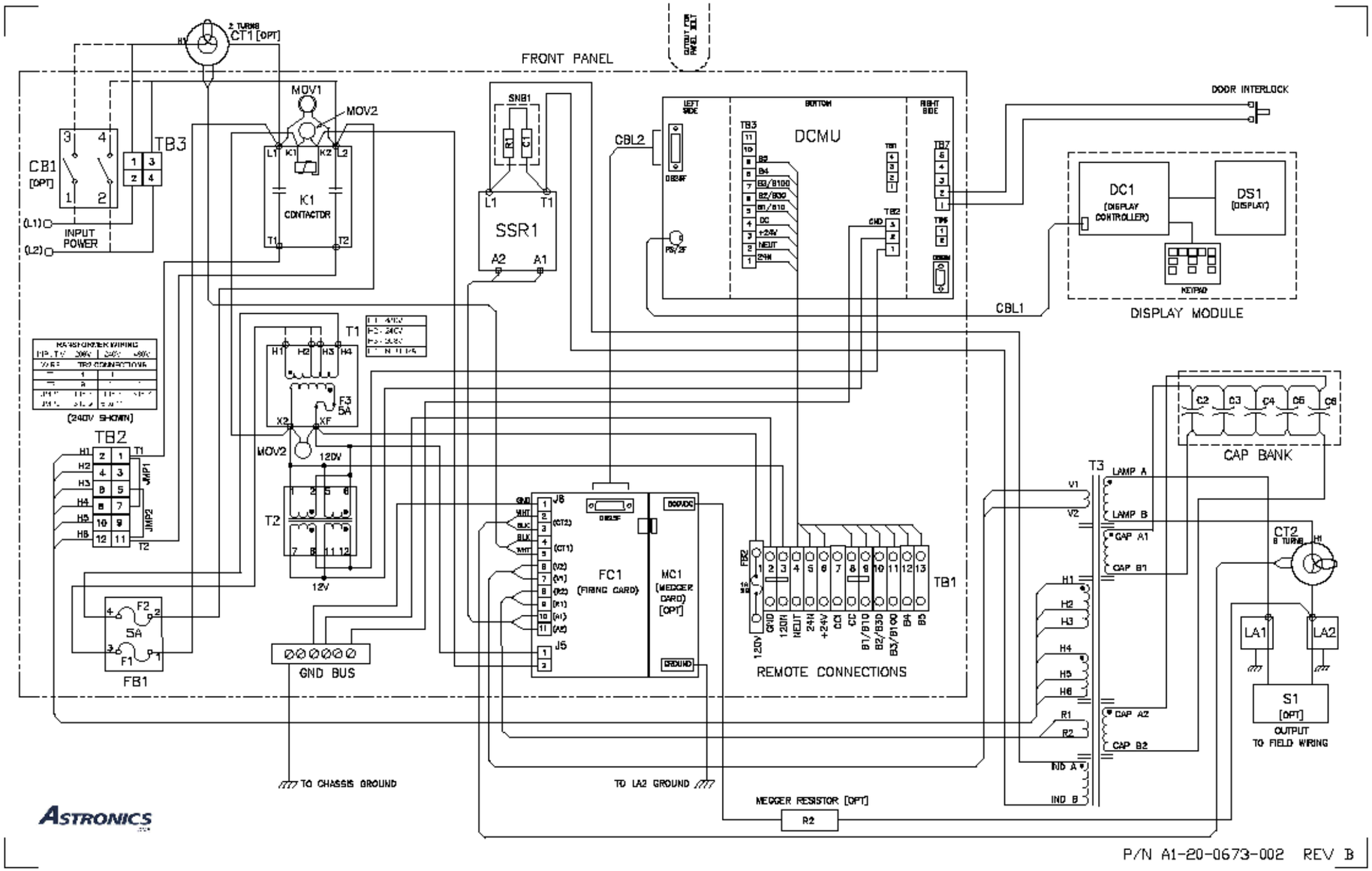
Table 10-2 7.5kW CCR Component Parts

Main	Part Name/Description	Ref Des	Part Number	QPA
*	ENCLOSURE, 4kW, 7.5kW, 10kW, L-829/L-828 CCR		A1-17-1145-001	1
	ASSY, 7.5kW FRONT PANEL, L-829/L-828 CCR	FP	A3-06-3172-002	1
	ASSY, CIRCUIT BREAKER, 25A, L-829/L-828 CCR		A3-06-3175-002	1
	ASSY, CIRCUIT BREAKER, 50A, L-829/L-828 CCR		A3-06-3175-004	1
	CONTACTOR, 40A, 600V	K1	A1-22-0013-002	1
	FUSEHOLDER, DUAL, PANEL MOUNT, 5AG	F1,F2	A1-21-0040-001	1
	CCR FIRING CARD	FC1	A3-06-1502-001	1
	CCR MEGGER OPTION CARD	MC1	A3-06-1504-001	1
	SSR, 125A, 660V, L-829/828 CCR	SSR	A1-11-0295-003	1
	HEAT SINK, SSR, CCR, 4kW/7.5kW/10kW/15kW/20kW		A1-17-1139-001	1
	ASSY, DCMU, 120/24V. L-829/828 CCR ASSY, DCMU, 120. L-829/828 CCR	DCMU	A3-06-3178-001 A3-06-3178-002	1
	TRANSFORMER,POWER, 208/240/480V-120V	T1	A1-09-0087-001	1
	TRANSFORMER,POWER, 120V-12/24V	T2	A1-09-0088-001	1
*	**TERMINAL BLOCK, REMOTE CONTROL**	TB1		1
	DIN RAIL, 9.5" LNG.		A1-03-0224-004	1
	TERMINAL BLOCK, UK3N		A1-03-0261-002	12
	TERMINAL BLOCK, D-UK 4/10,END COVER		A1-03-0261-008	1
	TERMINAL BLOCK, E/NS 35 N,END BRACKET		A1-03-0261-009	2
	FUSEHOLDER, DIN RAIL, 5x20mm	F3	A1-21-0041-001	1
	RAW, PLASTIC HOUSING, PCB		A1-18-2219-000	1
	TERMINAL BLOCK, 6 POS	TB2	A1-03-0302-001	1
	GROUNDING BLOCK, 6 POS	GND	A1-17-1138-001	1
	TRANSFORMER, FERRORESONANT, 7.5kW, MULTITAP	T3	A1-09-0089-003	1
	CAP, 50uF, 600VAC METALLIZED POLYPROPYLENE	C2-C6	A1-02-0176-002	5
	ASSY, TRANSFORMER,CURRENT SENSE, L-829/828 CCR	CT1,CT2	A3-06-3186-001	2
*	**DISPLAY MODULE**	DM1		1
	BEZEL, KEYPAD, L-829/828 CCR		A1-18-2221-001	1
	KEYPAD, MEMBRANE, L-829/828 CCR		A1-12-0127-001	1
	ASSY, OLED DISPLAY, L-829/828 CCR	DS1	A3-06-1503-002	1
	DISPLAY CONTROLLER, CCR	DC1	A3-06-1500-001	1
	PLATE, DISPLAY, L-829/828 CCR		A1-18-2222-001	1
	LIGHTNING ARRESTOR WITH CAP	LA1,LA2	A1-01-0167-001	2
	SWITCH, SNAP ACTION, 10A-125V	DS1	A1-12-0126-001	1
	RESISTOR, CCR MEGGER	R1	A1-01-0168-001	1
	ASSY, INTERNAL S1, L-829/L-828 CCR		A3-06-3177-001	1

Main	Part Name/Description	Ref Des	Part Number	QPA
	ASSEMBLY, EXTERNAL S1, CCR		A3-06-3167-001	1
	NAMEPLATE, L-829/828 CCR		A1-20-0675-001	1
	LAMINATE, 7.5kW, WIRING DIAGRAM		A1-20-0673-002	1
	FRONT PANEL, WIRING DIAGRAM, 7.5kW, L-829/828 CCR		A3-06-3168-002	1
	CHASSIS ASSEMBLY, WIRING DIAGRAM, 7.5kW, L-829/828 CCR		A3-06-3169-002	1
	ASSY, CASTERS, 4kW, 7.5kW, 10kW, L-829/828 CCR		A3-06-3176-001	2

See SPARE PARTS for a list of the available spare components for the 7.5kW CCR.

10.2.2. **7.5kW CCR WIRING DIAGRAM**



10.3. 10kW CCR

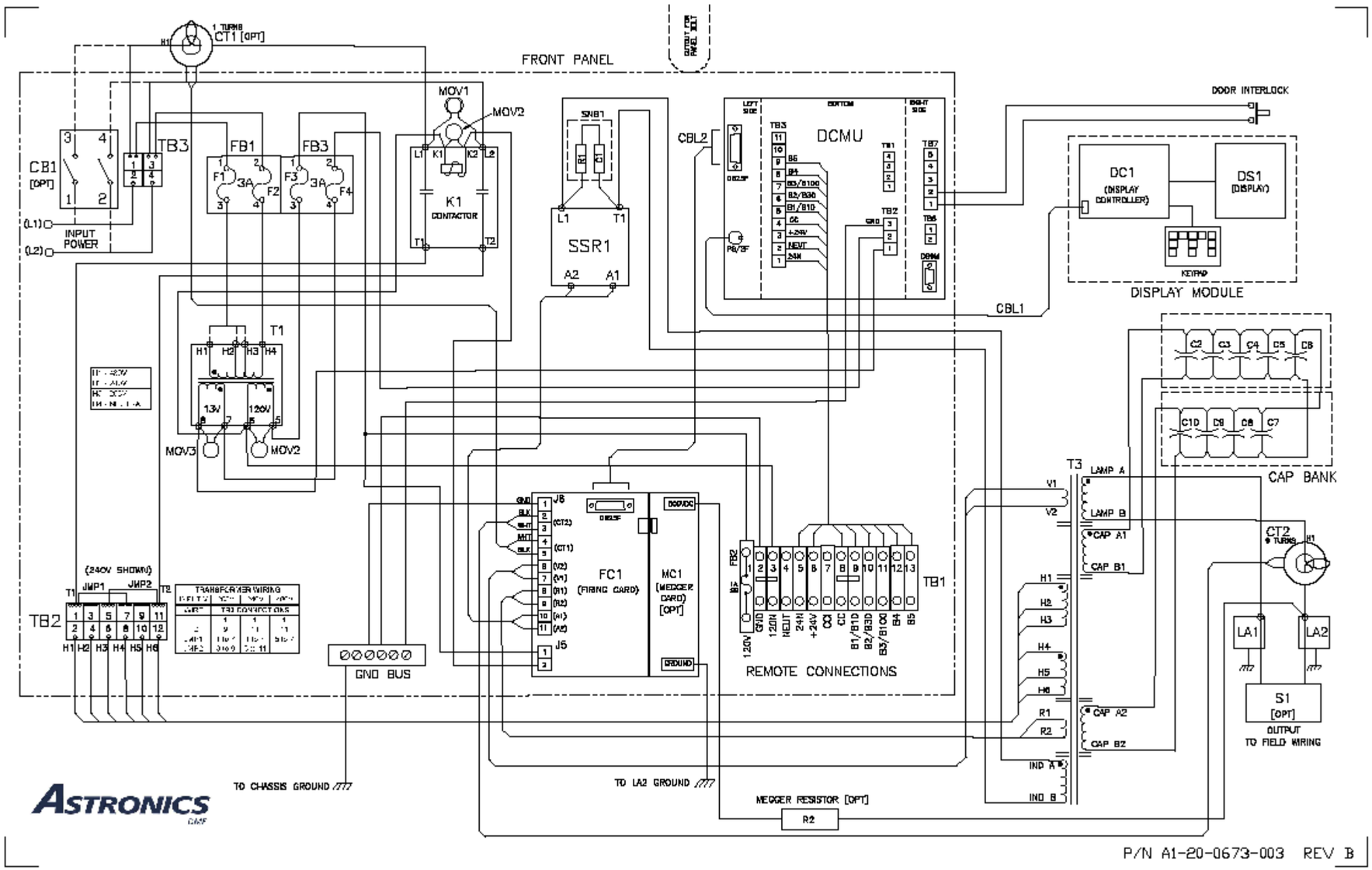
Table 10-3 10kW CCR Component Parts

Main	Part Name/Description	Ref Des	Part Number	QPA
*	ENCLOSURE, 4kW, 7.5kW, 10kW, L-829/L-828 CCR		A1-17-1145-001	1
	ASSY, 10kW FRONT PANEL, L-829/L-828 CCR	FP	A3-06-3172-003	1
	ASSY, CIRCUIT BREAKER, 30A, L-829/L-828 CCR		A3-06-3175-003	1
	ASSY, CIRCUIT BREAKER, 60A, L-829/L-828 CCR		A3-06-3175-005	1
	ASSY, CIRCUIT BREAKER, 70A, L-829/L-828 CCR		A3-06-3175-006	1
	CONTACTOR, 60A/75A, 600V	K1	A1-22-0013-003	1
	FUSEHOLDER, DUAL, PANEL MOUNT, 5AG	F1,F2	A1-21-0040-001	1
	CCR FIRING CARD	FC1	A3-06-1502-001	1
	CCR MEGGER OPTION CARD	MC1	A3-06-1504-001	1
	SSR, 125A, 660V, L-829/828 CCR	SSR	A1-11-0295-003	1
	HEAT SINK, SSR, CCR, 4kW/7.5kW/10kW/15kW/20kW		A1-17-1139-001	1
	ASSY, DCMU, 120/24V. L-829/828 CCR ASSY, DCMU, 120. L-829/828 CCR	DCMU	A3-06-3178-001 A3-06-3178-002	1
	TRANSFORMER,POWER, 208/240/480V-120V	T1	A1-09-0087-001	1
	TRANSFORMER,POWER, 120V-12/24V	T2	A1-09-0088-001	1
*	**TERMINAL BLOCK, REMOTE CONTROL**	TB1		1
	DIN RAIL, 9.5" LNG.		A1-03-0224-004	1
	TERMINAL BLOCK, UK3N		A1-03-0261-002	12
	TERMINAL BLOCK, D-UK 4/10,END COVER		A1-03-0261-008	1
	TERMINAL BLOCK, E/NS 35 N,END BRACKET		A1-03-0261-009	2
	FUSEHOLDER, DIN RAIL, 5x20mm	F3	A1-21-0041-001	1
	RAW, PLASTIC HOUSING, PCB		A1-18-2219-000	1
	TERMINAL BLOCK, 6 POS	TB2	A1-03-0302-001	1
	GROUNDING BLOCK, 6 POS	GND	A1-17-1138-001	1
	TRANSFORMER, FERRORESONANT, 10kW, MULTITAP	T3	A1-09-0089-004	1
	CAP, 50uF, 600VAC METALLIZED POLYPROPYLENE	C2-C7	A1-02-0176-002	6
	ASSY, TRANSFORMER,CURRENT SENSE, L-829/828 CCR	CT1,CT2	A3-06-3186-001	2
*	**DISPLAY MODULE**	DM1		1
	BEZEL, KEYPAD, L-829/828 CCR		A1-18-2221-001	1
	KEYPAD, MEMBRANE, L-829/828 CCR		A1-12-0127-001	1
	ASSY, OLED DISPLAY, L-829/828 CCR	DS1	A3-06-1503-002	1
	DISPLAY CONTROLLER, CCR	DC1	A3-06-1500-001	1
	PLATE, DISPLAY, L-829/828 CCR		A1-18-2222-001	1
	LIGHTNING ARRESTOR WITH CAP	LA1,LA2	A1-01-0167-001	2
	SWITCH, SNAP ACTION, 10A-125V	S1	A1-12-0126-001	1
	RESISTOR, CCR MEGGER	R1	A1-01-0168-001	1

Main	Part Name/Description	Ref Des	Part Number	QPA
	ASSY, INTERNAL S1, L-829/L-828 CCR		A3-06-3177-001	1
	ASSEMBLY, EXTERNAL S1, CCR		A3-06-3167-001	1
	NAMEPLATE, L-829/828 CCR		A1-20-0675-001	1
	LAMINATE, 10kW, WIRING DIAGRAM		A1-20-0673-003	1
	FRONT PANEL, WIRING DIAGRAM, 10kW, L-829/828 CCR		A3-06-3168-003	1
	CHASSIS ASSEMBLY, WIRING DIAGRAM, 10kW, L-829/828 CCR		A3-06-3169-003	1
	ASSY, CASTERS, 4kW, 7.5kW, 10kW, L-829/828 CCR		A3-06-3176-001	2

See SPARE PARTS for a list of the available spare components for the 10kW CCR.

10.3.3. **10kW CCR WIRING DIAGRAM**



10.4. 15kW CCR

Table 10-4 15kW CCR Component Parts

Main	Part Name/Description	Ref Des	Part Number	QPA
*	ENCLOSURE, 15kW, 20kW, 30kW, L-829/L-828 CCR		A1-17-1145-002	1
	ASSY, 15kW FRONT PANEL, L-829/L-828 CCR	FP	A3-06-3172-004	1
	ASSY, CIRCUIT BREAKER, 50A, L-829/L-828 CCR		A3-06-3175-004	1
	ASSY, CIRCUIT BREAKER, 90A, L-829/L-828 CCR		A3-06-3175-007	1
	ASSY, CIRCUIT BREAKER, 110A, L-829/L-828 CCR		A3-06-3175-008	1
	CONTACTOR, 90A, 600V	K1	A1-22-0013-004	1
	FUSEHOLDER, DUAL, PANEL MOUNT, 5AG	F1,F2	A1-21-0040-001	2
	CCR FIRING CARD	FC1	A3-06-1502-001	1
	CCR MEGGER OPTION CARD	MC1	A3-06-1504-001	1
	SSR, 125A, 660V, L-829/828 CCR	SSR	A1-11-0295-003	1
	HEAT SINK, SSR, CCR, 4kW/7.5kW/10kW/15kW/20kW		A1-17-1139-001	1
	ASSY, DCMU, 120/24V. L-829/828 CCR ASSY, DCMU, 120. L-829/828 CCR	DCMU	A3-06-3178-001 A3-06-3178-002	1
	TRANSFORMER,POWER, FRONT PANEL, L-829/828	T1	A1-09-0090-001	1
*	**TERMINAL BLOCK, REMOTE CONTROL**	TB1		1
	DIN RAIL, 9.5" LNG.		A1-03-0224-004	1
	TERMINAL BLOCK, UK3N		A1-03-0261-002	12
	TERMINAL BLOCK, D-UK 4/10, END COVER		A1-03-0261-008	1
	TERMINAL BLOCK, E/NS 35 N,END BRACKET		A1-03-0261-009	2
	FUSEHOLDER, DIN RAIL, 5x20mm	F3	A1-21-0041-001	1
	RAW, PLASTIC HOUSING, PCB		A1-18-2219-000	1
	TERMINAL BLOCK, DIST POWER, 125A, 600V TERMINAL BLOCK, DIST POWER, 310A, 600V	TB2	A1-03-0242-001 A1-03-0242-002	1
	GROUNDING BLOCK, 6 POS	GND	A1-17-1138-001	1
	TRANSFORMER, FERRORESONANT, 15kW, MULTITAP	T3	A1-09-0089-005	1
	CAP, 50uF, 600VAC METALLIZED POLYPROPYLENE STUD TERMINALS	C2-C10	A1-02-0176-002	9
	ASSY, TRANSFORMER,CURRENT SENSE, L-829/828 CCR	CT1,CT2	A3-06-3186-001	2
*	**DISPLAY MODULE**	DM1		1
	BEZEL, KEYPAD, L-829/828 CCR		A1-18-2221-001	1
	KEYPAD, MEMBRANE, L-829/828 CCR		A1-12-0127-001	1
	ASSY, OLED DISPLAY, L-829/828 CCR	DS1	A3-06-1503-002	1
	DISPLAY CONTROLLER, CCR	DC1	A3-06-1500-001	1
	PLATE, DISPLAY, L-829/828 CCR		A1-18-2222-001	1
	LIGHTNING ARRESTOR WITH CAP	LA1,LA2	A1-01-0167-001	2
	SWITCH, SNAP ACTION, 10A-125V	S1	A1-12-0126-001	1
	RESISTOR, CCR MEGGER	R1	A1-01-0168-001	1

Main	Part Name/Description	Ref Des	Part Number	QPA
	ASSY, INTERNAL S1, L-829/L-828 CCR		A3-06-3177-001	1
	ASSEMBLY, EXTERNAL S1, CCR		A3-06-3167-001	1
	NAMEPLATE, L-829/828 CCR		A1-20-0675-001	1
	LAMINATE, 15kW, WIRING DIAGRAM		A1-20-0673-004	1
	FRONT PANEL, WIRING DIAGRAM, 15kW, L-829/828 CCR		A3-06-3168-004	1
	CHASSIS ASSEMBLY, WIRING DIAGRAM, 15kW, L-829/828 CCR		A3-06-3169-004	1
	ASSY, CASTERS, 15kW, 20kW, 30kW, L-829/828 CCR		A3-06-3176-002	2

See SPARE PARTS for a list of the available spare components for the 15kW CCR.
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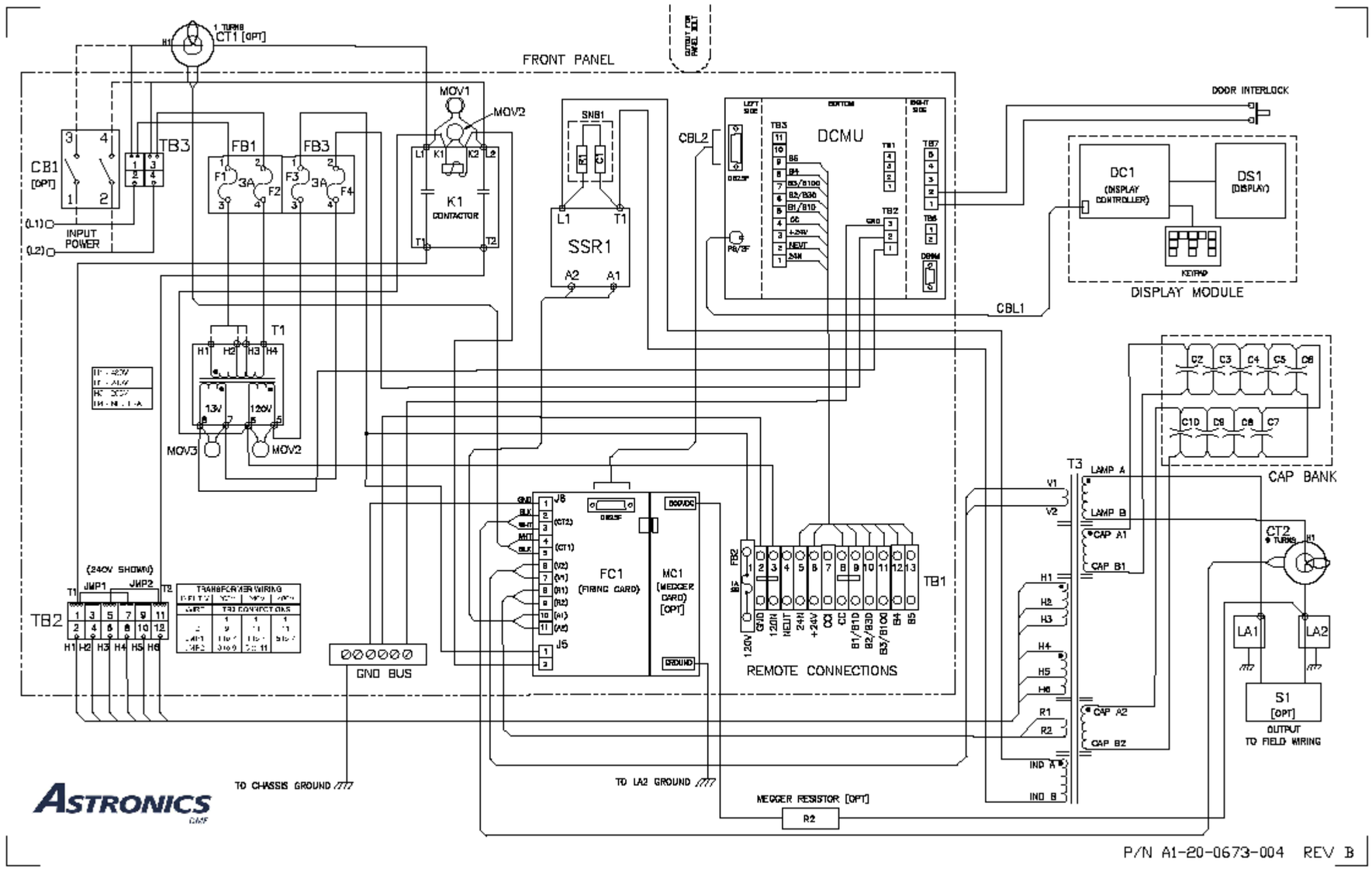
10.4.4. **15kW CCR WIRING DIAGRAM**



10.5. 20kW CCR

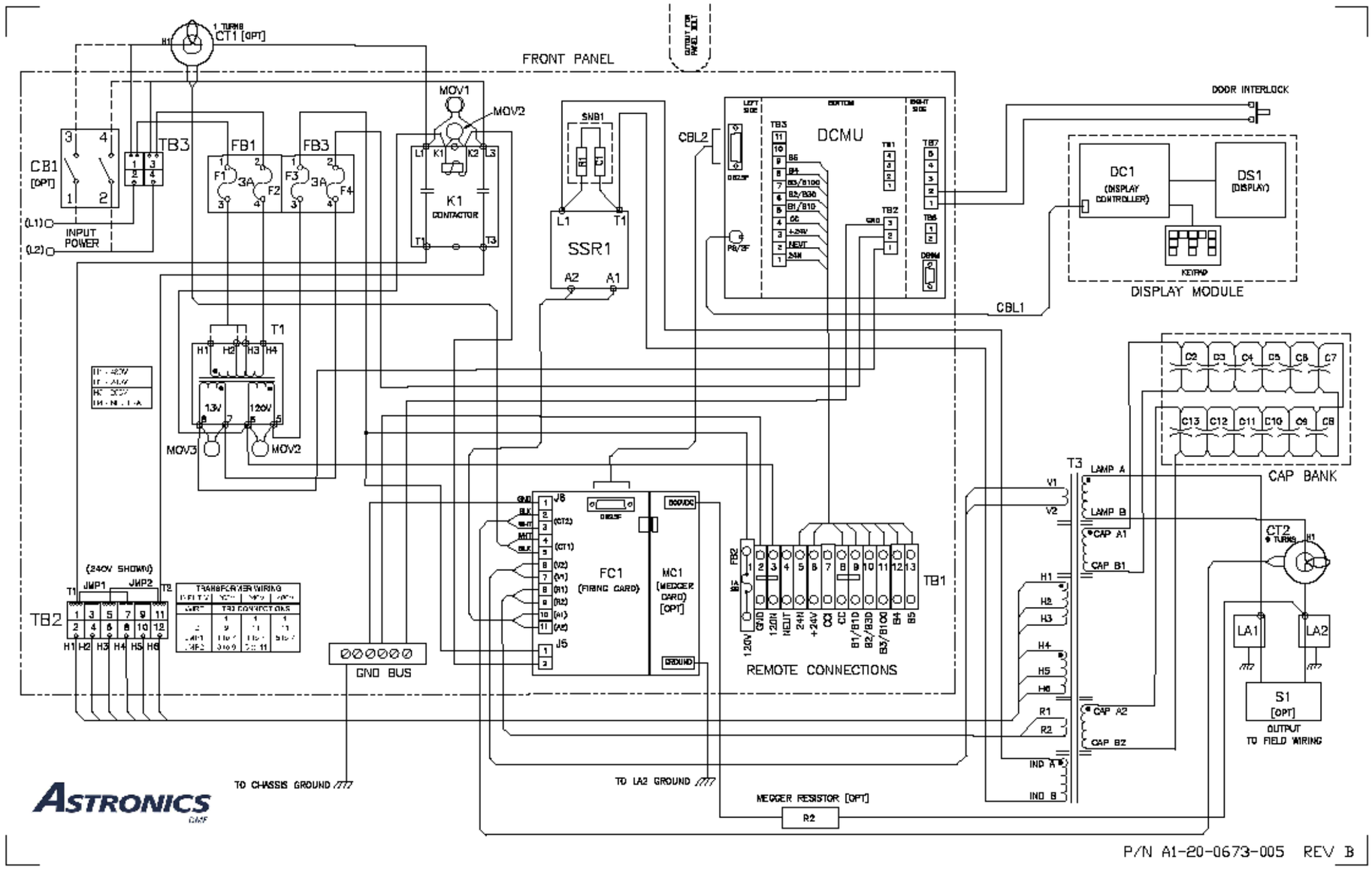
Table 10-5 20kW CCR Component Parts

Main	Part Name/Description	Ref Des	Part Number	QPA
*	ENCLOSURE, 15kW, 20kW, 30kW, L-829/L-828 CCR		A1-17-1145-002	1
	ASSY, 20kW FRONT PANEL, L-829/L-828 CCR	FP	A3-06-3172-005	1
	ASSY, CIRCUIT BREAKER, 60A, L-829/L-828 CCR		A3-06-3175-005	1
	ASSY, CIRCUIT BREAKER,110A, L-829/L-828 CCR		A3-06-3175-008	1
	ASSY, CIRCUIT BREAKER, 125A, L-829/L-828 CCR		A3-06-3175-009	1
	CONTACTOR, 185A, 600V	K1	A1-22-0013-005	1
	FUSEHOLDER, DUAL, PANEL MOUNT, 5AG	F1,F2	A1-21-0040-001	2
	CCR FIRING CARD	FC1	A3-06-1502-001	1
	CCR MEGGER OPTION CARD	MC1	A3-06-1504-001	1
	SSR, 125A, 660V, L-829/828 CCR	SSR	A1-11-0295-003	1
	HEAT SINK, SSR, CCR, 4kW/7.5kW/10kW/15kW/20kW		A1-17-1139-001	1
	ASSY, DCMU, 120/24V. L-829/828 CCR ASSY, DCMU, 120. L-829/828 CCR	DCMU	A3-06-3178-001 A3-06-3178-002	1
	TRANSFORMER,POWER, FRONT PANEL, L-829/828	T1	A1-09-0090-001	1
*	**TERMINAL BLOCK, REMOTE CONTROL**	TB1		1
	DIN RAIL, 9.5" LNG.		A1-03-0224-004	1
	TERMINAL BLOCK, UK3N		A1-03-0261-002	12
	TERMINAL BLOCK, D-UK 4/10, END COVER		A1-03-0261-008	1
	TERMINAL BLOCK, E/NS 35 N,END BRACKET		A1-03-0261-009	2
	FUSEHOLDER, DIN RAIL, 5x20mm	F3	A1-21-0041-001	1
	RAW, PLASTIC HOUSING, PCB		A1-18-2219-000	1
	TERMINAL BLOCK, DIST POWER, 125A, 600V TERMINAL BLOCK, DIST POWER, 310A, 600V	TB2	A1-03-0242-001 A1-03-0242-002	1
	GROUNDING BLOCK, 6 POS	GND	A1-17-1138-001	1
	TRANSFORMER, FERRORESONANT, 20kW, MULTITAP	T3	A1-09-0089-006	1
	CAP, 50uF, 600VAC METALLIZED POLYPROPYLENE STUD TERMINALS	C2-C13	A1-02-0176-002	12
	ASSY, TRANSFORMER,CURRENT SENSE, L-829/828 CCR	CT2	A3-06-3186-001	1
	ASSY, TRANSFORMER,CURRENT SENSE, 20kW, 30kW, L-829/828 CCR	CT1	A3-06-3186-002	1
*	**DISPLAY MODULE**	DM1		1
	BEZEL, KEYPAD, L-829/828 CCR		A1-18-2221-001	1
	KEYPAD, MEMBRANE, L-829/828 CCR		A1-12-0127-001	1
	ASSY, OLED DISPLAY, L-829/828 CCR	DS1	A3-06-1503-002	1
	DISPLAY CONTROLLER, CCR	DC1	A3-06-1500-001	1
	PLATE, DISPLAY, L-829/828 CCR		A1-18-2222-001	1
	LIGHTNING ARRESTOR WITH CAP	LA1,LA2	A1-01-0167-001	2

Main	Part Name/Description	Ref Des	Part Number	QPA
	SWITCH, SNAP ACTION, 10A-125V	S1	A1-12-0126-001	1
	RESISTOR, CCR MEGGER	R1	A1-01-0168-001	1
	ASSY, INTERNAL S1, L-829/L-828 CCR		A3-06-3177-001	1
	ASSEMBLY, EXTERNAL S1, CCR		A3-06-3167-001	1
	NAMEPLATE, L-829/828 CCR		A1-20-0675-001	1
	LAMINATE, 20kW, WIRING DIAGRAM		A1-20-0673-005	1
	FRONT PANEL, WIRING DIAGRAM, 20kW, L-829/828 CCR		A3-06-3168-005	1
	CHASSIS ASSEMBLY, WIRING DIAGRAM, 20kW, L-829/828 CCR		A3-06-3169-005	1
	ASSY, CASTERS, 15kW, 20kW, 30kW, L-829/828 CCR		A3-06-3176-002	2

See SPARE PARTS for a list of the available spare components for the 20kW CCR.

10.5.5. **20kW CCR WIRING DIAGRAM**



10.6. 30kW CCR

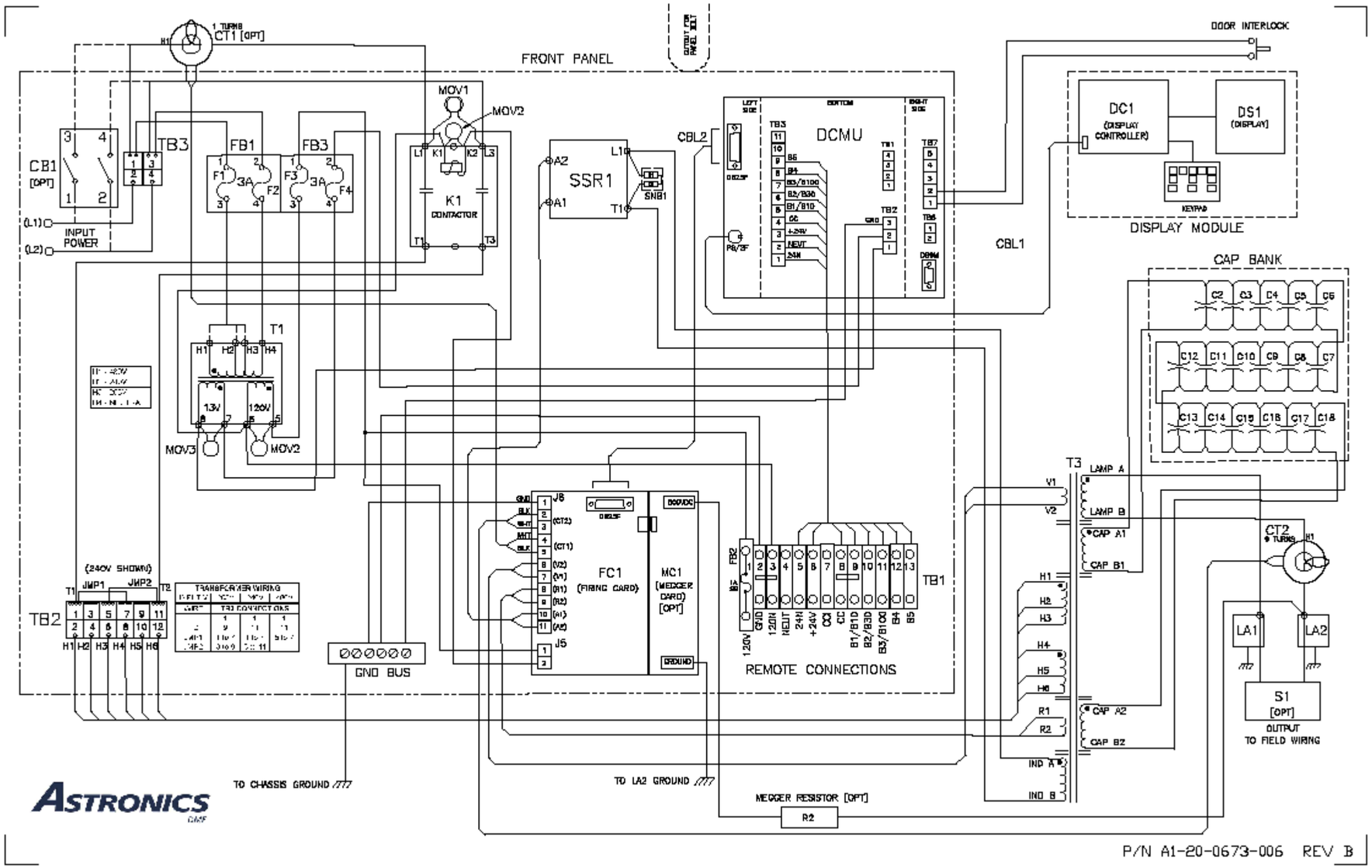
Table 10-6 30kW CCR Component Parts

Main	Part Name/Description	Ref Des	Part Number	QPA
*	ENCLOSURE, 15kW, 20kW, 30kW, L-829/L-828 CCR		A1-17-1145-002	1
	ASSY, 30kW FRONT PANEL, L-829/L-828 CCR	FP	A3-06-3172-006	1
	ASSY, CIRCUIT BREAKER, 90A, L-829/L-828 CCR		A3-06-3175-007	1
	ASSY, CIRCUIT BREAKER,160A, L-829/L-828 CCR		A3-06-3175-012	1
	ASSY, CIRCUIT BREAKER, 185A, L-829/L-828 CCR		A3-06-3175-011	1
	CONTACTOR, 225A, 600V	K1	A1-22-0013-006	1
	FUSEHOLDER, DUAL, PANEL MOUNT, 5AG	F1,F2	A1-21-0040-001	2
	CCR FIRING CARD	FC1	A3-06-1502-001	1
	CCR MEGGER OPTION CARD	MC1	A3-06-1504-001	1
	SSR, 125A, 660V, L-829/828 CCR	SSR	A1-11-0295-003	1
	HEAT SINK, SSR, CCR, 4kW/7.5kW/10kW/15kW/20kW		A1-17-1139-001	1
	ASSY, DCMU, 120/24V. L-829/828 CCR ASSY, DCMU, 120. L-829/828 CCR	DCMU	A3-06-3178-001 A3-06-3178-002	1
	TRANSFORMER,POWER, FRONT PANEL, L-829/828	T1	A1-09-0090-001	1
*	**TERMINAL BLOCK, REMOTE CONTROL**	TB1		1
	DIN RAIL, 9.5" LNG.		A1-03-0224-004	1
	TERMINAL BLOCK, UK3N		A1-03-0261-002	12
	TERMINAL BLOCK, D-UK 4/10, END COVER		A1-03-0261-008	1
	TERMINAL BLOCK, E/NS 35 N,END BRACKET		A1-03-0261-009	2
	FUSEHOLDER, DIN RAIL, 5x20mm	F3	A1-21-0041-001	1
	RAW, PLASTIC HOUSING, PCB		A1-18-2219-000	1
	TERMINAL BLOCK, DIST POWER, 125A, 600V TERMINAL BLOCK, DIST POWER, 310A, 600V	TB2	A1-03-0242-001 A1-03-0242-002	1
	GROUNDING BLOCK, 6 POS	GND	A1-17-1138-001	1
	TRANSFORMER, FERRORESONANT, 30kW, MULTITAP	T3	A1-09-0089-007	1
	CAP, 50uF, 600VAC METALLIZED POLYPROPYLENE STUD TERMINALS	C2-C18	A1-02-0176-002	17
	ASSY, TRANSFORMER,CURRENT SENSE, L-829/828 CCR	CT2	A3-06-3186-002	1
	ASSY, TRANSFORMER,CURRENT SENSE, 20kW, 30kW, L-829/828 CCR	CT1	A3-06-3186-002	1
*	**DISPLAY MODULE**	DM1		1
	BEZEL, KEYPAD, L-829/828 CCR		A1-18-2221-001	1
	KEYPAD, MEMBRANE, L-829/828 CCR		A1-12-0127-001	1
	ASSY, OLED DISPLAY, L-829/828 CCR	DS1	A3-06-1503-002	1
	DISPLAY CONTROLLER, CCR	DC1	A3-06-1500-001	1
	PLATE, DISPLAY, L-829/828 CCR		A1-18-2222-001	1
	LIGHTNING ARRESTOR WITH CAP	LA1,LA2	A1-01-0167-001	2

Main	Part Name/Description	Ref Des	Part Number	QPA
	SWITCH, SNAP ACTION, 10A-125V	S1	A1-12-0126-001	1
	RESISTOR, CCR MEGGER	R1	A1-01-0168-001	1
	ASSY, INTERNAL S1, L-829/L-828 CCR		A3-06-3177-001	1
	ASSEMBLY, EXTERNAL S1, CCR		A3-06-3167-001	1
	NAMEPLATE, L-829/828 CCR		A1-20-0675-001	1
	LAMINATE, 30kW, WIRING DIAGRAM		A1-20-0673-006	1
	FRONT PANEL, WIRING DIAGRAM, 30kW, L-829/828 CCR		A3-06-3168-006	1
	CHASSIS ASSEMBLY, WIRING DIAGRAM, 30kW, L-829/828 CCR		A3-06-3169-006	1
	ASSY, CASTERS, 15kW, 20kW, 30kW, L-829/828 CCR		A3-06-3176-002	2

See SPARE PARTS for a list of the available spare components for the 30kW CCR.

10.6.6. **30kW CCR WIRING DIAGRAM**



10.7. SPARE PARTS

Table 10-7 CCR Spare Components

Item	Figure #	Part Name/Description	Part Number
1	10-1	KIT, MEGGER CARD, L-829/828 CCR	K1-02-0033-001
2	****	KIT, MEGGER RESISTOR ASSY, L-829/828 CCR	K1-02-0033-002
3	10-1	KIT, 5.25" PLASTIC HOUSING PCB, L-829/828 CCR	K1-02-0033-003
4	10-3	KIT, LIGHTNING ARRESTORS, 2.55KV, 10KA, L-829/L-828 CCR	K1-02-0034-001
4	10-3	KIT, LIGHTNING ARRESTORS, 5.1KV, 10KA, L-828-829 CCR	K1-02-0034-002
5	10-1	KIT, 480V-120VAC TRANSFORMER, L-829/L-828 CCR	K1-02-0038-001
6	10-1	KIT, 120V-12VAC TRANSFORMER, L-829/L-828 CCR	K1-02-0038-002
6	10-1	KIT, POWER TRANSFORMER, L-829/L-828 CCR	K1-02-0038-003
7	10-1	KIT, CONTACTOR, 25A,600V	K1-02-0039-001
7	10-1	KIT, CONTACTOR, 40A,600V	K1-02-0039-002
7	10-1	KIT, CONTACTOR, 60/75A,600V	K1-02-0039-003
7	10-1	KIT, CONTACTOR, 90A,600V	K1-02-0039-004
7	10-1	KIT, CONTACTOR, 185A,600V	K1-02-0039-005
7	10-1	KIT, CONTACTOR, 225A,600V	K1-02-0039-006
8	10-2	KIT, DISPLAY, L-829/828 CCR	K1-02-0040-001
9	10-1	KIT, SSR, L-829/L-828 CCR	K1-02-0044-001
10	10-1	KIT, 15A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-001
10	10-1	KIT, 25A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-002
10	10-1	KIT, 30A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-003
10	10-1	KIT, 50A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-004
10	10-1	KIT, 60A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-005
10	10-1	KIT, 70A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-006
10	10-1	KIT, 90A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-007
10	10-1	KIT, 110A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-008
10	10-1	KIT, 125A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-009
10	10-1	KIT, 160A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-010
10	10-1	KIT, 185A CIRCUIT BREAKER, 600V, L-829/L-828 CCR	K1-02-0046-011

* This is a main assembly.
** These kits can appear in multiple locations, and are used as required.
**** This kit is not shown.

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