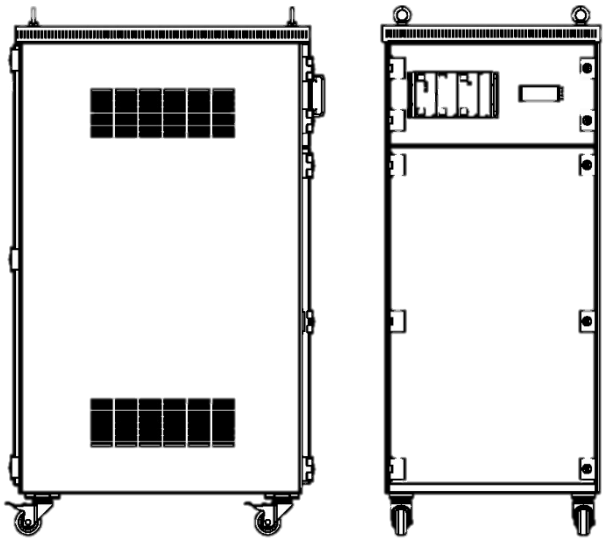

CCR CONSTANT CURRENT REGULATOR | MANUAL

Instruction Manual for Operation and Maintenance

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Contents

I. ABOUT THIS MANUAL

Rev.	Editor	Check	Date	Description	Pages
1.00	Y.M	A.M	11/11/2024		
2.00					
3.00					
4.00					

The manual shows the information necessary to:

- *Commission*
- *Operate*
- *Maintenance*
- *Troubleshooting*
- *Installation*
- *Transportation*

the VIS 2.5 to 30 kVA.

- *2.5 to 15 kVA: small cabinet*
- *20 to 30 kVA: big cabinet.*

How to work with this manual:

make sure to read the safety section before doing anything.

If you are starting up the device for the first time, read the Safety section, Technical specifications, Installation, and Commissioning.

Otherwise, based on your issue, find and read the relevant chapter.

II. SUMMARY

Abbreviation	Definition
CCR	Constant Current Regulator
DC	Direct Current
EFD	Earth Fault Detector
HV	High Voltage
LFD	Lamp Fault Detector
LV	Low Voltage
V	Volt
A	Ampere
AC	Alternating Current
VA	Volt-Ampere
CT	Current Transformer
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
HMI	Human Machine Interface
SCR	Silicon Controlled Rectifiers
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
AGS	Airfield Guidance Sign

1. SAFETY

Be careful when using this device, which is often used in circuits with dangerous voltages. Those who operate or maintain this device must be very careful and watchful.

A. Refer to the International Standard IEC 61820[1] –Electrical installation for lighting and beaconing of aerodromes - specifies the requirement safety of Constant current regulation for aerodromes ground lighting series circuits, and to the International Standard IEC 61821[2] - Electrical installations for lighting and beaconing of aerodromes - Maintenance of aeronautical ground lighting circuits for instructions on safety precautions.
B. Observe all safety regulations. To avoid injuries, always remove power prior to making any wire connections and touching any live part. Refer to the International Standards IEC 61820 and IEC 61821.
C. Read and become familiar with the general safety instructions provided in this chapter before you install, operate, maintain or repair the equipment.
D. Store this manual within easy reach of personnel installing, operating, maintaining or repairing the equipment.
E. Adhere strictly to the safety protocols mandated by your organization, conform to the established industry standards, and comply with all regulations set forth by relevant authoritative bodies.
F. General Safety Guidelines: This manual provides essential safety information for installing and using AVIASAFE equipment.
G. Equipment-Specific Warning: Remember that not all instructions apply directly to the specific equipment described here.
H. Refer to Sections: For detailed and specific warnings, check the relevant sections elsewhere in this manual.
I. Stay Informed: Prioritize safety during installation and usage.
J. Handle with Care: Follow guidelines to ensure safe operation.

1-1. Qualified Personnel

In this manual, “Qualified Personnel” refer to individuals who:

A. Qualified personnel must receive training under the supervision of AVIASAFE Company.
OR
B. They must have studied in the field of Electrical Engineering at an academic institution.
C. They must have fully read the user Manual.

[1] Electrical installation for lighting and beaconing of aerodromes

[2] Maintenance of aerodromes ground lighting CCR

1-2. Liability

AVIASAFE Company is not liable for injuring or damages arising from non-standard, unintended equipment use. Our equipment is designed solely for the purpose outlined in the manual. Any uses beyond the manual's description are considered unintended and may lead to severe personal harm, fatalities, or property damage.

Unintended uses include the following actions:

ATTENTION:

Please Note that the following cases will void the company's 2-year warranty.

A. Making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine AVIASAFE replacement parts or accessories.
B. Any cutting or chewing (by Animal or etc.) of the lead wires will not be covered by the company's warranty.
C. Any impact caused by transportation after the product's delivery or the product being removed from its form will not be covered by the warranty.
D. Any discrepancy in installation, operation, maintenance, as well as the information provided in the device specifications section, between to the information stated in the manual, will result in the product being excluded from the company's warranty.
E. 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.
F. Using materials or spare equipment that is inappropriate or incompatible with your AVIASAFE equipment.
G. Allowing unskilled personnel to perform any task on or with the equipment.

NOTE:

If necessary and with specific and coordinated arrangement with AVIASAFE Company, you can proceed with repairs and avail yourself of the company's after-sales services at the earliest opportunity.

1-3. Introduction to safety

Please adhere to the following guidelines when dealing with this equipment, as it may contain electrostatic devices, hazardous voltages, and components with sharp edges:

1. Before installation, carefully review the provided instructions.
2. Understand safety guidelines in this section before any equipment-related tasks.
3. Read and adhere to specific task instructions throughout the manual.
4. Ensure personnel can access this manual during installation, operation, and maintenance.
5. Follow local codes for electrical connections.
6. Adhere to company and industry safety protocols.

7. Use appropriately sized, insulated wires for rated current.
8. Safely route electrical wires to prevent damage.
9. Allow ample room for maintenance and front panel access.
10. Install specified safety devices to protect the equipment.
11. If safety devices are removed during installation, reinstall promptly and verify functionality before restoring power.

1-3. Installation

Read the installation section of all system component manuals before installing your equipment. A thorough understanding of system components and their requirements will help you install the equipment safely and efficiently.

A. Allow only skilled personnel to install CCR and spare equipment. Use only approved equipment. Using unapproved equipment in an approved system may void agency approvals and will void the warranty.
B. Make sure all equipment is rated and approved for the environment in which you are using it.
C. Follow all instructions for installing components and accessories.
D. Install all electrical connections to local mode provided they are not in contradiction with the general rules.
E. Use only electrical wire of sufficient gauge and insulation to handle the rated current and voltage demand.
F. Route electrical wiring along a protected path. Make sure they will not be damaged by moving equipment and animals (e.g., rodents).
G. Protect components from damage, wear, and harsh environment conditions.
H. Allow ample room for maintenance, panel accessibility (power products), and cover removal (power products).
I. Protect equipment with safety devices as specified by applicable safety regulations.
J. If safety devices must be removed for installation, install them immediately after the work is completed and check them for proper functioning.

1-4. Operation

Only skilled 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 the equipment. A thorough understanding of system components and their operation will help you operate the equipment safely and efficiently.

1. Only use this equipment as per the manufacturer's guidelines. Any other operation is strictly forbidden.
2. Entrust equipment operation to qualified individuals only.

3. Understand all system components thoroughly before starting operation.
4. Inspect protective devices. Ensure they function properly.
5. Never disable safety interlocks, electricals disconnect, or air valve.
6. If safety devices are removed during installation, reinstall them promptly and verify functionality.
7. Safely route electrical wiring to prevent damage.
8. Do not operate if aware of any malfunctions.
9. Refrain from servicing equipment near standing water.
10. Use the equipment only in its rated environments.
11. Exercise caution around live electrical connections.

1-5. Maintenance

This equipment may contain electrostatic devices, please follow the guidelines below:

A. Connect all disconnected equipment ground cables and wires after servicing equipment. Ground all conductive equipment.
B. Use only approved AVIASAFE replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals, impair specified performance and create safety hazards.
C. Do not operate a system if any of its components are malfunctioning. In such cases, promptly turn the system OFF.
D. Disconnect the electrical power supply and ensure it is securely locked out.
E. Only allow qualified personnel to perform repairs. Refer to the product's manual for instructions on repairing or replacing the malfunctioning components.
F. During maintenance operations that require the equipment to be powered on, ensure that it is set to the local state to prevent unintended activation of remote functions.
G. If it is necessary to power on the Constant Current Regulator (CCR) during loop maintenance, ensure that the Tower Communication cable is disconnected to avoid potential interference or unintended communication with external systems.

2. PRODUCT INTRODUCTION

2-1. Intro

The electrical power for most aerodrome ground lighting circuits is supplied by constant current regulators (CCRs). CCR technology ensures that the lighting systems in airport operate reliably and consistently, even in the presence of electrical fluctuations of changes in load conditions. It's worth noting that airport lighting systems are subject to specific regulatory standards established by aviation authorities, such as the International Civil Aviation Organization (ICAO) and the Federal Aviation Administration (FAA).

Some of the special features of CCR:

1. Fault Detection and Monitoring: CCRs in airport lighting system may include built-in fault detection and monitoring capabilities. These features allow the system to detect issues such as lamp failures or wiring faults and provide alarms or indicators to alert maintenance personnel.
2. Dimming Capabilities: CCRs with dimming capabilities can adjust the current output to provide different brightness levels, allowing for energy savings and flexibility in adapting to different lighting needs.
3. Environmental Protection: CCRs used in airport are often designed to withstand harsh environmental conditions. They may be built with rugged enclosures, corrosion-resistant materials, and protection against dust, moisture and extreme temperatures. These features ensure the longevity and reliability of the CCR in outdoor airport environments.

The CCR device, which is produced by AVIASAFE Company, used monocyclic square resonant network regulators.

Figure 1 CCR made by AVIASAFE Company

2-1-1. System Description

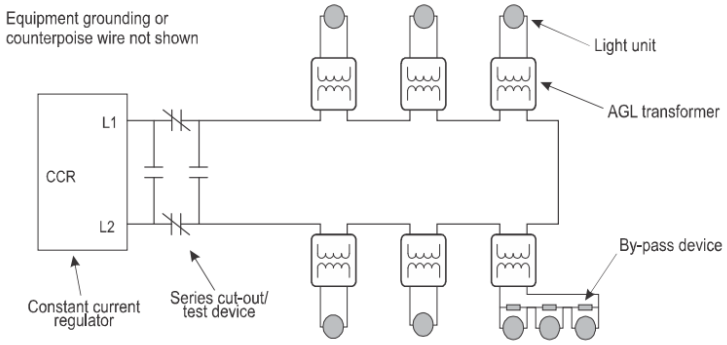


Figure 2 Series lighting circuit

2-2. STANDARD REQUIREMENTS

2-2-1. CCR Efficiency

Note: The sections that have been highlighted in the tables correspond to the product of this manual.

CCR size kilowatts (kW)	Minimum overall Efficiency (percent)
Less than 30	90
30	92
50	93
70	94

Table 1 CCR Efficiency

2-2-2. OUTPUT CURRENT

Note: The sections that have been highlighted in the tables correspond to the product of this manual.

6.6A				20A
1 Step	3 Step	5 Step	7 Step	5 Step
1:6.6A	3:6.6A	5:6.6A	7:6.6A	5:20A
	2:5.5A	4:5.2A	6:6.4A	4:15.8A
	1:4.8A	3:4.1A	5:5.2A	3:12.4A
		2:3.4A	4:4.1A	2:10.3A
		1:2.8A	3:3.4A	1:8.5A
			2:2.8A	
			1:2.2A	

Table 2 Output Current

2-2-3. REGULATION (CCR Output Current)

Note: The sections that have been highlighted in the tables correspond to the product of this manual.

Class	Style	Step	Nominal output Amperes (A) Root mean square (RMS)	Allowable range (A RMS)
1	1	3	6.6	6.50 – 6.70
		2	5.5	5.40 – 5.60
		1	4.8	4.70 – 4.90
1	2	5	6.6	6.50 – 6.70
		4	5.2	5.1 – 5.3
		3	4.1	4.0 – 4.20
		2	3.4	3.30 – 3.50
		1	2.8	2.70 – 2.90
2	2	5	20.0	19.70 – 20.30
		4	15.8	15.50 – 16.10
		3	12.4	12.10 – 12.70
		2	10.3	10.0 – 10.60
		1	8.5	8.20 – 8.80

Table 2 Regulation

2-3. Technical Specifications

2-3-1. Classification

A. Type: L-829 – Regulator with monitoring
B. Class: Class 1 - 6.6 A output current
C. Style: Style 2 – 5 brightness steps

2-3-2. CCR Efficiency & Power Factor

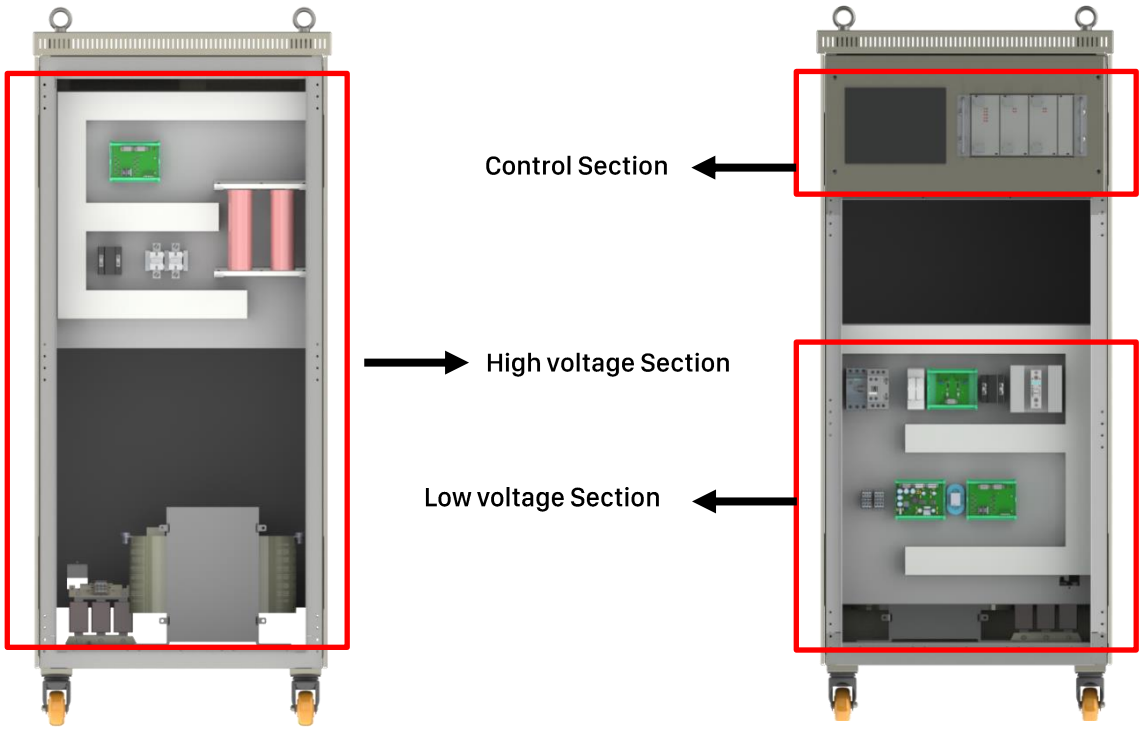
Power Factor	> 90% at nominal input and full load
CCR Efficiency	> 90% at nominal input and full load

Table 3 CCR Power Factor

2-3-3. COMPONENTS

COMPONENT		
CONTROL SECTION	HIGH VOLTAGE SECTION	LOW VOLTAGE SECTION
This section constitutes the control & monitoring system of the Constant Current Regulator using a micro-processor. All settings and controls are made through a key pad and actual value of the CCR is presented on a monitor and through LED indicators. Main Components: • Main Board • EFD Board • Communication Board • Input Sensor Board • Output Sensor Board • Driver Board	The high voltage section supplies current to the series circuit. Main Components: • Main Transformer • Current Transformer • Surge Arrester • Output Terminal • Input Choke	The low voltage section receives the input form the control through the thyristor. It supplies power to the output transformer. Main Components: • Circuit Breaker • Power Relay • Magnet Contact • Thyristor Module • Power Supply • Power Supply Board • Current Transformer • Surge Arrester • Input Terminal

Table 4 CCR Components



2-3-4. COMPLIANCES

A. ICAO Aerodrome Design Manual Part 5
B. FAA AC 150/5345-10, L-829
C. IEC 61822

2-3-5. FEATURE

The CCR (Constant Current Regulator) is a device that regulates the output current level. Its key features include:

A. Housing Divided into Three Areas: Electronic Control, Low Voltage & High Voltage
B. Nature Air Cooled
C. Local & remote control

2-3-6. SPECIFICATION

A.	Type	Thyristor Phase Control
B.	Input Voltage:	Single Phase 220V (50 / 60 Hz)
C.	Temperature Range	0 to +55°C
D.	Humidity:	10~95% operation rang
E.	Accuracy:	All step: within ±1%
F.	Remote Control:	Parallel: 24 VDC to 60 VDC / Serial: RS-485 Dual line

G. Protection:

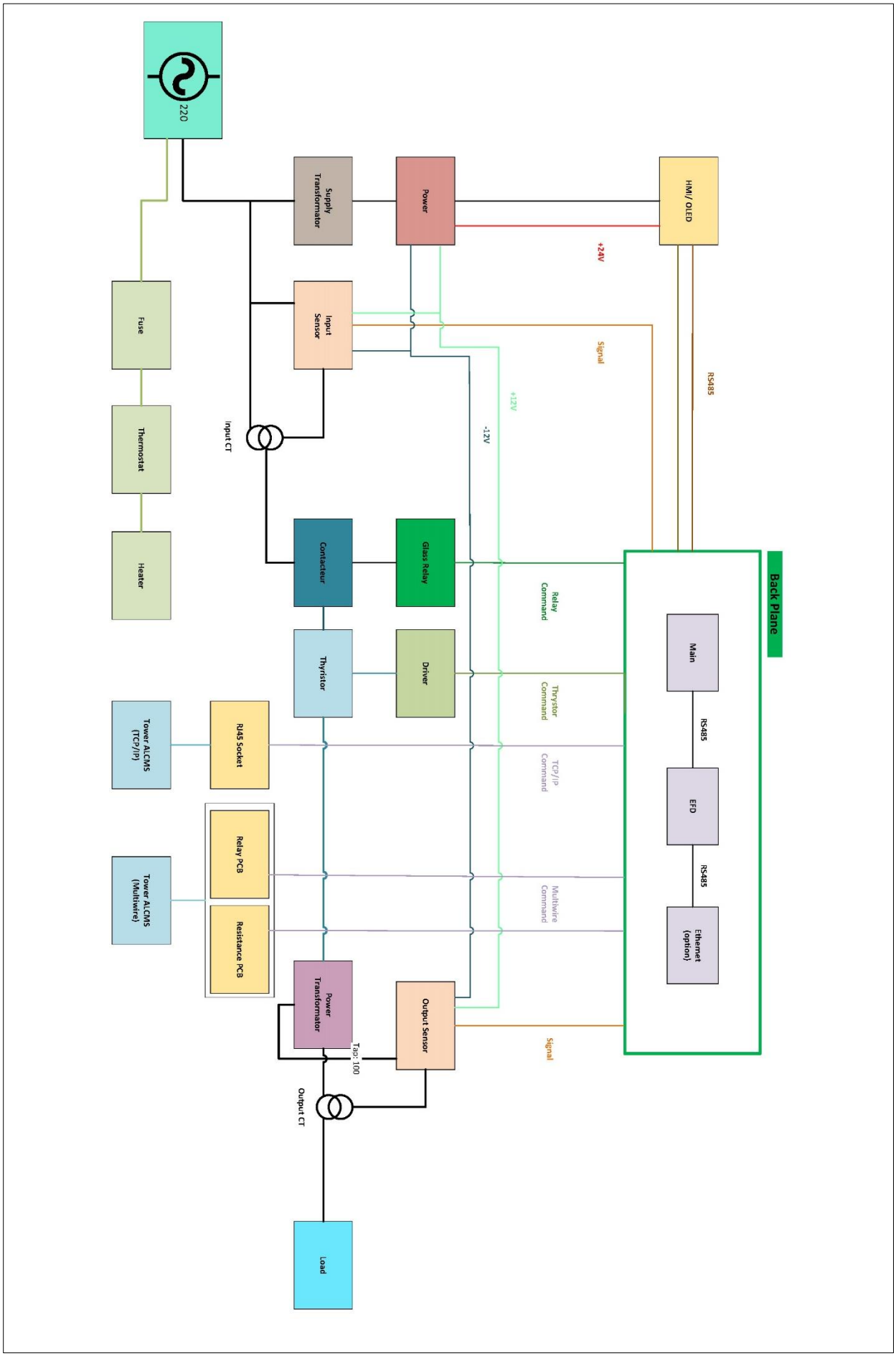
1- Over Current Protection:	2- Open circuit protection:
12= 6.85A < 4 sec / 12= 6.93A < 2 sec	I = 1.50A < 1 sec
12= 7.10A < 1 sec / 12= 8.30A < 0.3 sec	

H. Monitoring:

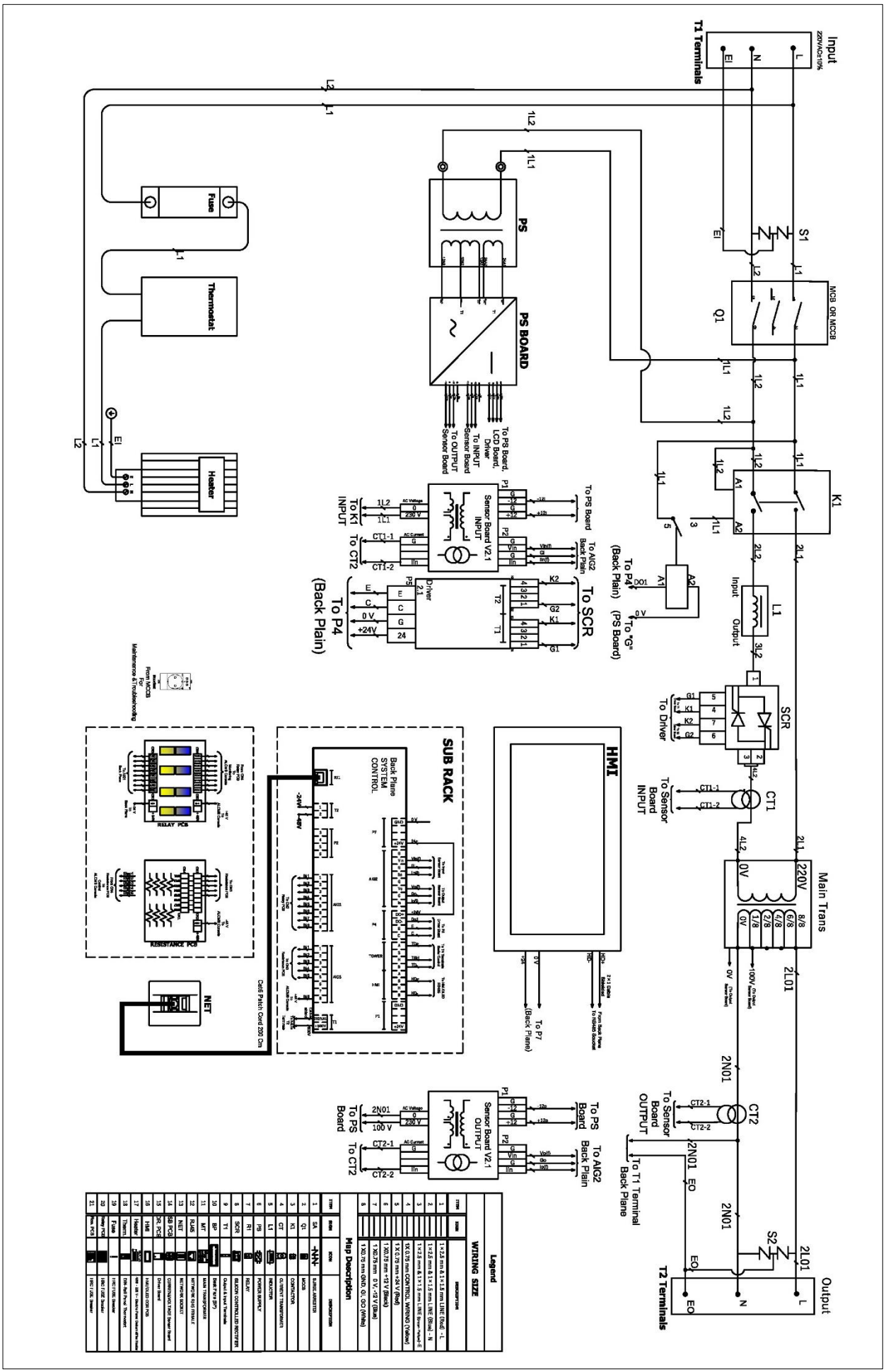
1. Over current monitoring
2. Open circuit monitoring
3. Fuse fault monitoring
4. Current regulation error monitoring
5. Input power loss monitoring
6. Output V-A Drop monitoring
7. Earth fault monitoring
8. V1, I1, V2, VA2 monitoring
9. Elapsed time monitoring

2-4. ELECTRICAL DESCRIPTION

2-4-1. BLOCK DIAGRAMS



2-4-2. GENERAL CIRCUIT DIAGRAM



2-5. MECHANICAL DESCRIPTION

2-5-1. EXPLODED DIAGRAMS

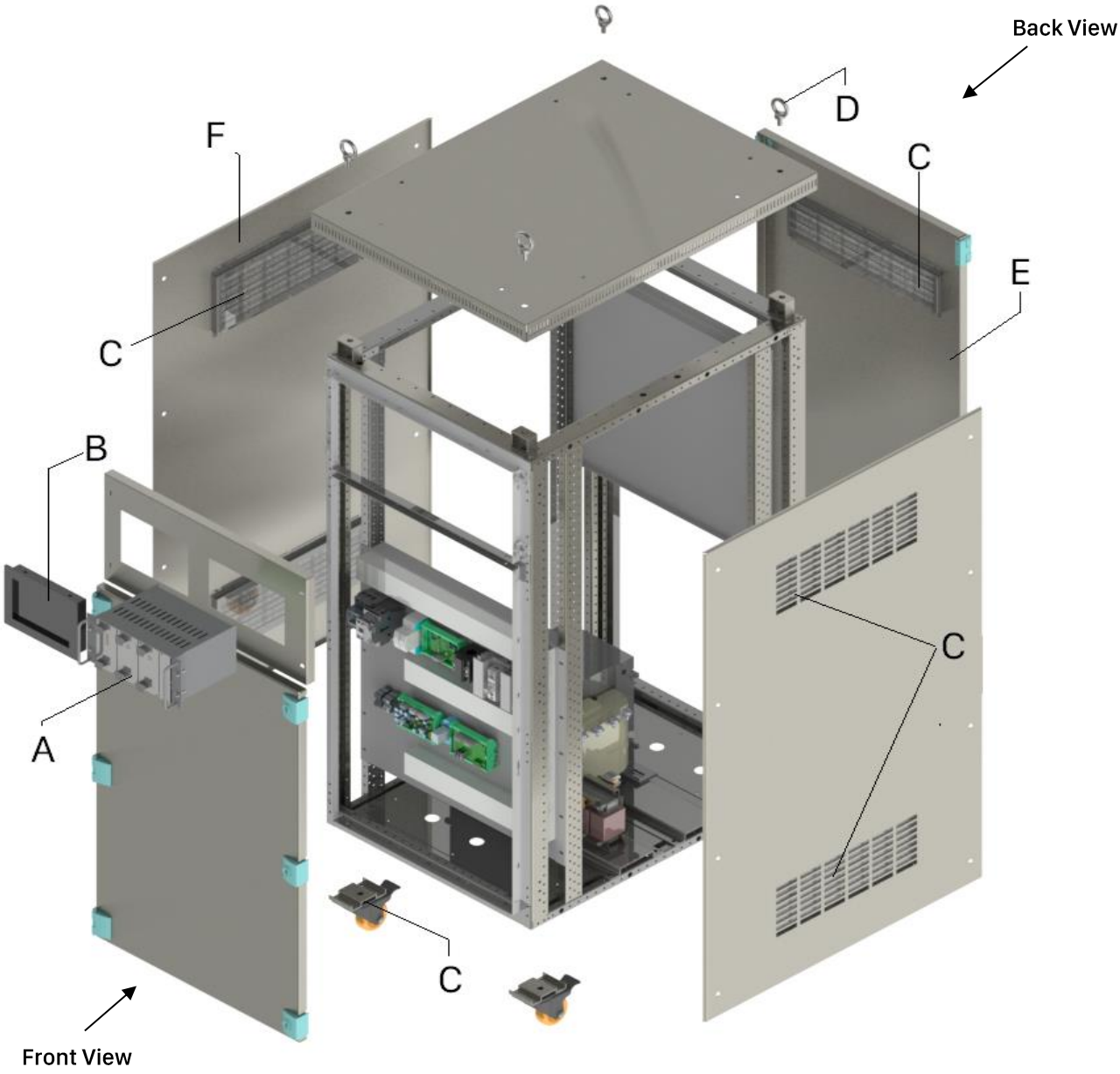


Figure 3 Exploded diagram

A. SUB RACK & CARTS CONTROL (*see 6-3-1*)

B. HMI

C. Ventilation grids

D. Transport clips

E. Back Page

F. Side Page

G. Wheels

2-5-2. Front & Back View

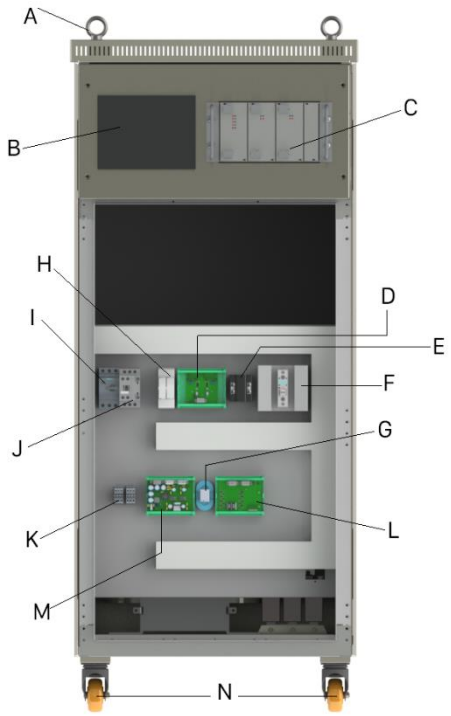


Figure 4 Front view

A. Transport clips
B. HMI
C. Sub Rack & Carts Control
D. Driver
E. Current Transformer
F. SCR
G. Relay
H. Surge Arrester
I. MCB / MCCB
J. Contactor
K. Terminals
L. Sensor Board Input
M. Power Supply
N. Wheels

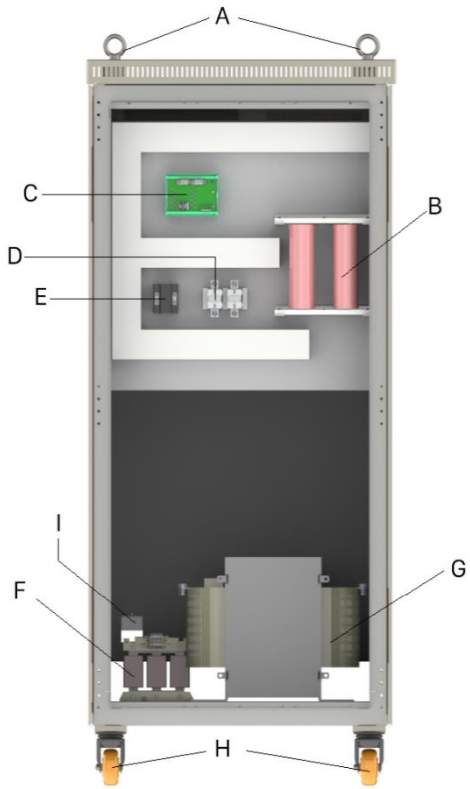
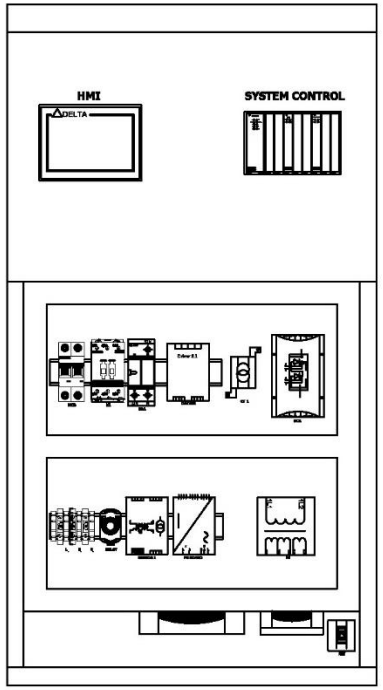


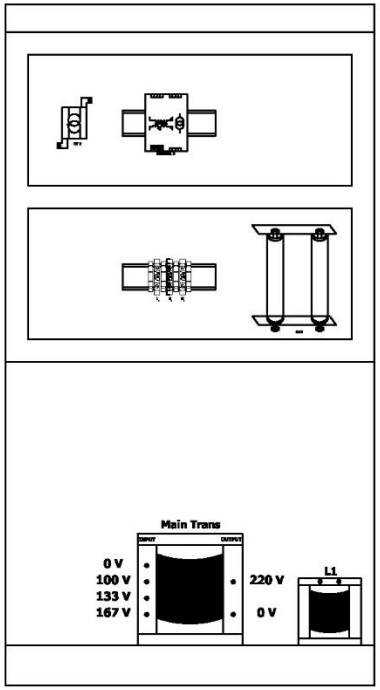
Figure 5 Back view

A. Transport clips
B. Surge Arrester
C. Sensor Board Output
D. Terminals
E. Current Transformer
F. Inductor
G. Main Trans
H. Wheels
I. NET

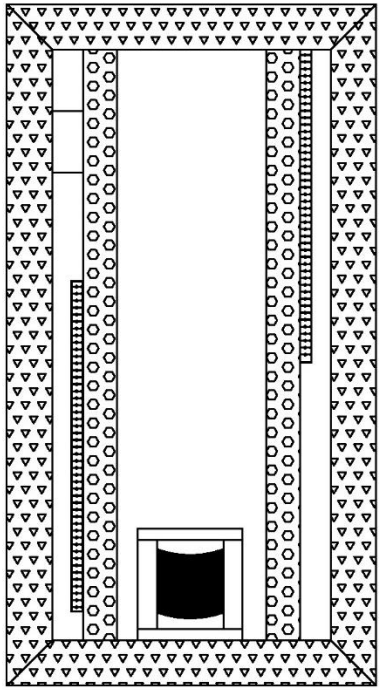
2-5-2. Drawing



FRONT VIEW CCR



BACK VIEW CCR



SIDE VIEW CCR

WIRING SIZE

ITEM	SIGN	DESCRIPTION
1	———	1×4 mm LINE (Black) - L
2	———	1×4 mm LINE (Blue) - N
3	———	1×4 mm LINE (Yellow) - E
4	———	CAT 6 LAN PATCH CORD (150 Cm)
5	———	1X 0.75 mm CONTROL WIRING (Yellow)
6	———	1 X 0.75 mm +24 V (Red)
7	———	1 X0.75 mm +12 V (Red)
8	———	1 X0.75 mm 0 V (Green)
9	———	1 X0.75 mm GND, GI, GO (Green)
10	———	2 X0.5 mm Cable (L=50 Cm)

3- INSTALLATION

⚠ WARNING

A. Only personnel qualified to work on high voltage systems should be permitted to install this regulator.
B. The high voltage involved with the unit and its environment makes them potentially dangerous.
C. If the regulator de-energizes suddenly, the output circuit could be interrupted by an over current, open circuit or under voltage condition.
D. Before inspecting the output circuit or the inner parts of the regulator, place the circuit breaker in OFF position (eventually, if possible, switch off the power).

- The following are delivered with the CCR:

A. The Instruction manual for the device
B. Special catalog for the device
C. Factory test reports for the device
D. Look for any mechanical problems or signs of impact in the frame and its parts when the device arrives.
E. In addition, confirm that the power transformer does not have any signs of being carried in wrong position and that its protective covering is undamaged

3-1. SUITABLE SPACE

The CCR is installed in a permanent location known as the CCR building or CCR vault. The exact location may vary depending on the airport's specific layout and requirements.

Its permanent location near the runway or taxiway ensures that the electrical systems are supplied with a constant and stable current, which is essential for the safe operation of airport lightings.

In deciding the permanent operation location for the device, the following points must be kept in mind:

A. An easy access must be kept to the front panel with no obstruction preventing the panel being opened.
B. CCRs can be placed side-by-side.
C. Leave a gap of at least 70cm at the back of the device to allow sufficient ventilation.
D. Environmental condition must be such that the temperature does not go outside the range -40°C to +55°C and that relative humidity does not exceed a maximum of 95%.
E. The location must be indoors.

The CCR has some holes on the top, front and back sides. These holes are for letting the air flow in and out of the CCR. The air helps to keep the CCR cool and prevent it from overheating. Overheating can cause serious damage to the CCR and its components. You should never cover or block these holes with anything. You should also leave enough space around the CCR for the air to circulate. The minimum space required is 70cm in front and behind the CCR, and 10cm between the CCR and other devices. The bottom of the CCR is also important. It is where

the air entire for the power transformer. You should not place the CCR on soft or uneven surface that could block the bottom air inlet.

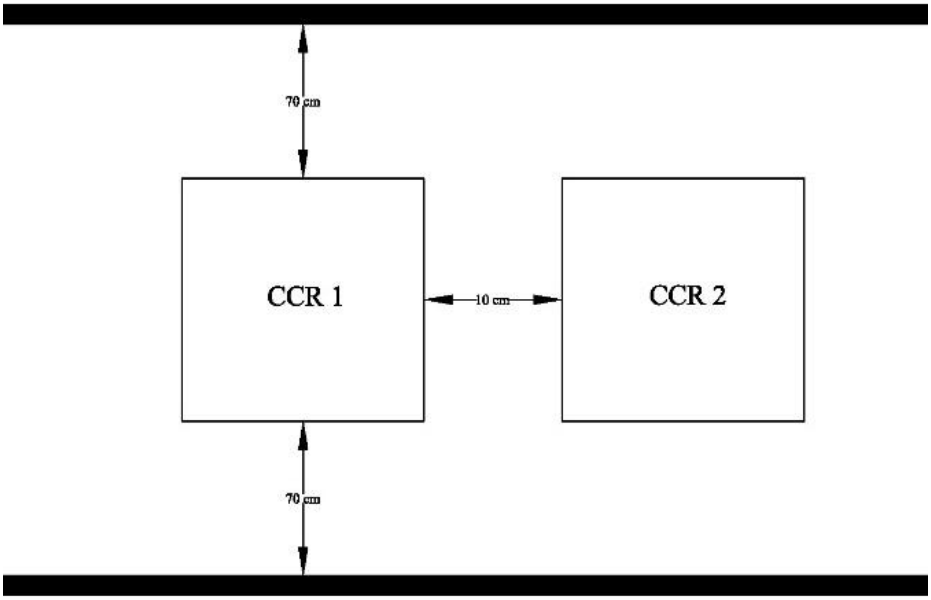


Figure 6 Right dimensions place for CCR

3-2. REQUIRED TOOLS

Using the table below, you can provide and have access to the tools required for installation, repair, and maintenance operations.

Wire stripper	
Cable cutter	
Pliers	
Flat-head screwdriver	
Phillips screwdriver	
Clamp multimeter	
Cable lug, size 6	
Socket wrench	
Cat 6 SFTP network cable	
RJ45 network Plug	
Multimeter	

3-4. Connections

A. Power and Earth
B. Lighting Loop
C. Multi-wire Connection
D. Circuit Selector

3-5. Select distribution switch (MCCB)

To select a distribution switch (MCCB) for a CCR, the MCCB key should be chosen, procured, and installed with an ampere rating higher than the downstream MCCB associated with the CCR. This key, installed at the designated location in the CCR substation, can consist of multiple MCCB keys, depending on the number of CCR units at the site. By switching each key on or off, the power voltage to the MCCB CCR input is connected or disconnected, allowing maintenance, troubleshooting, or installation tasks to be performed on the device.

3-6. Selection of the Appropriate Cable

In this section, the correct selection of the input cable cross-section is determined based on the distance, consumer power, and maximum current consumption.
Please ensure to review this section thoroughly before the installation process and select the appropriate cable to ensure safe and efficient operation.

Table 5 applies to cable lengths of less than 30m distribution switch

Single Phase Power Supply		
POWER	LV cable gauge	LV circuit breaker
2.5 kVA	6 mm²	25A
4 kVA	10 mm²	40A
5 kVA	10 mm²	50A
7.5 kVA	16 mm²	100A
10 kVA	25 mm²	125A
15 kVA	35 mm²	160A
20 kVA	50 mm²	200A
25 kVA	70 mm²	250A
30 kVA	95 mm²	300A

Here is the table for calculating cross-sectional area of copper and aluminum wires based on distance and allowable current:

Table 6 Calculating cross-sectional area of copper and aluminum wires

For example, a copper wire with a cross-sectional area of 10 mm^2 or an aluminum wire with a cross-sectional area of 16 mm^2, both at a distance of 100 meter, can withstand a current of up to 50 amperes.

Cu	Al																								
		1.5	2.5	4	6	10	16	25	35	50	70	95	120	150	185	240	300
		2.5	4	6	10	16	25	50	70	95	120	150	185	240	300	400	500
10		27	36	46	58	77	100	130	155	185	230	275	315	355	400	465	550
50		15	25	40	58	77	100	130	155	185	230	275	315	355	400	465	550
100		7	12	20	30	50	80	125	155	185	230	275	315	355	400	465	550
150		5	8	13	20	33	53	83	115	158	222	275	315	355	400	465	550
200		-	6	10	15	25	40	62	86	117	166	225	275	330	393	437	496
250		-	-	8	12	20	32	50	69	93	133	180	222	264	314	349	397
300		-	-	8	10	18	26	41	57	78	111	150	185	220	267	291	331
350		-	-	-	8	14	22	35	49	66	95	129	159	189	224	249	283
400		-	-	-	7	12	20	31	43	58	83	112	139	165	198	218	248
450		-	-	-	6.5	11	17	27	38	52	74	100	123	147	176	194	220
500		-	-	-	6	10	16	25	34	46	66	90	111	132	157	175	189
600		-	-	-	5	8	13	20	28	38	55	75	92	110	131	145	165
700		-	-	-	-	7	11	17	24	32	47	64	89	94	112	124	141
800		-	-	-	-	6	10	15	21	28	41	58	69	82	98	109	124
900		-	-	-	-	5	8	131	18	25	36	50	87	73	87	97	110
1000		-	-	-	-	5	8	12	17	23	33	45	55	66	78	87	99

3-7. Electrical Component of a CCR

For more detailed and comprehensive explanations of the various CCR components, please refer to *2-5-2*.

1. MCCB & Contactor
2. Input Terminal
3. Power Board
4. Driver Board
5. Input Sensor Board

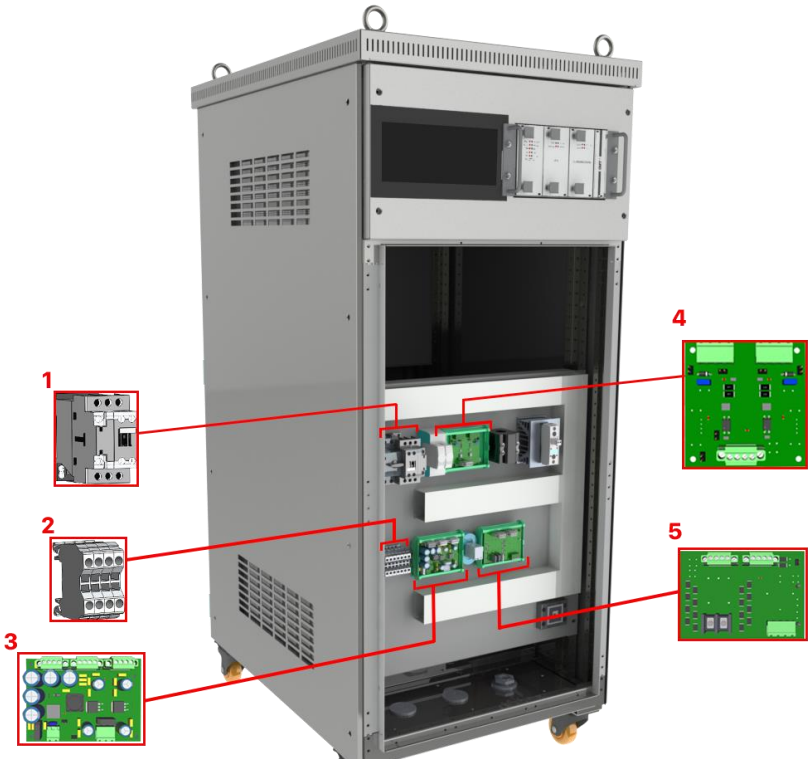


Figure 7 Electrical Component of a CCR – Front view

1. Output Sensor Board

Figure 8 Electrical Component of a CCR – back view

3-8. Measuring Input Voltage

To ensure the voltage supplied to the CCR is appropriate for the proper functioning of all its components and to prevent damage to the CCR and the equipment connected to its output, the input voltage of the CCR must be measured.

To check the input voltage reaching the MCCB of CCR switch. First ensure that the distribution switch (MCCB) is turned off. Then, using a multimeter or voltmeter, measure the voltage across the two terminals of the MCCB switch. If the measured voltage is 220V, the CCR is now ready for operation.

3-9. Physical Installation and Cable Connection

3-9-1. Preliminary Setup

a. Assume that all required cabling has been completed in the cable gallery, and the cables for each CCR are positioned on the cable ladder at a height of 1 meter form the ground, ready for connection.

3-9-2. Cable Entry

a. The prepared cables should be routed into the CCR through connections installed on the gland plate.
b. These connections can use silicone fittings or glands, depending on the setup.

3-9-3. Preparing CCR Output Cables

a. Strip the insulation from the ends of the Airfield primary cables (6mm^2 cross-section).
b. Use appropriate cable lugs and heat shrink tubing to ensure proper insulation.

3-9-4. Connecting to the CCR terminals

a. Attach the prepared cable ends to the CCR output terminals, also known as BUS BAR terminal, using bolts and nuts.
b. Secure the shield of the secondary cables with a 2.5mm^2 or 4mm^2 wire using heat shrink tubing for insulation.

3-9-5. Shielded Cable Connections

a. For each runway lighting ring, connect to two shielded Primary cables using a bi-colored wire (green and yellow) to the output terminal.

3-9-6. Labeling

a. Ensure that all secondary cables and runway lighting cables are appropriately labeled for Maintenance operations.

3-9-7. Input CCR connections

a. The CCR's primary input connections are single-phase and depend on the electrical specifications, CCR power, and distribution switch.
b. Connect the input cables to the CCR as follows:

- L1 (Phase)
- L2 (Neutral)
- E1 (Earth)

3-9-8. Grounding Considerations

a. The output earth connection must be isolated
b. Input earth is for the CCR chassis, control panel, and electrical substation.
c. Output earth is designated for runway lighting cables.

3-9-9. Communication

3-9-9-1. ModBus TCP/IP

If a network system has been installed at the airport using Modbus TCP/IP, proceed as follows:

a. The network cable embedded in the electrical panel CCRs should be connected to the network socket embedded on the CCR LV Section using an appropriate network cable.
b. For more information about this protocol, refer to Section *4-9*.

3-9-9-2. Multi-wire

If a network system has been installed at the airport using multi-wire, proceed as follows:

NOTE:

Please note that this type of connection is optional.

a. Two PCB – Relay PCB and Resistance PCB – embedded in the CCR LV Section can be used for the multi-wire system connection.
b. Simply connect the relevant control and monitoring wires (15 strands) to the corresponding PCBs.
c. In the Resistance PCB and connector CN4, the following connections should be made:
    - IN1 to IN5 connected to Step 1 to Step 5 in the Control multi-wire section of the ALCMS.
d. In the Relay PCB and connector CN4, the following connections should be made:
    - Out1 to Out8 connected to the following outputs in the PLC ALCMS:
        1. CCR ON/OFF
        2. STEP1
        3. STEP2
        4. STEP3
        5. STEP4
        6. STEP5
        7. Remote/Local
        8. Error/Fault
e. For more information about this protocol, refer to Section *4-10*.

3-9-10. Final Inspection

a. Double-check all connection, ensuring they are secure and compliant with the installation standards.

b. Verify the isolation of the output grounding system from the input grounding system.

4. COMMISSIONING

4-1. Main Menus

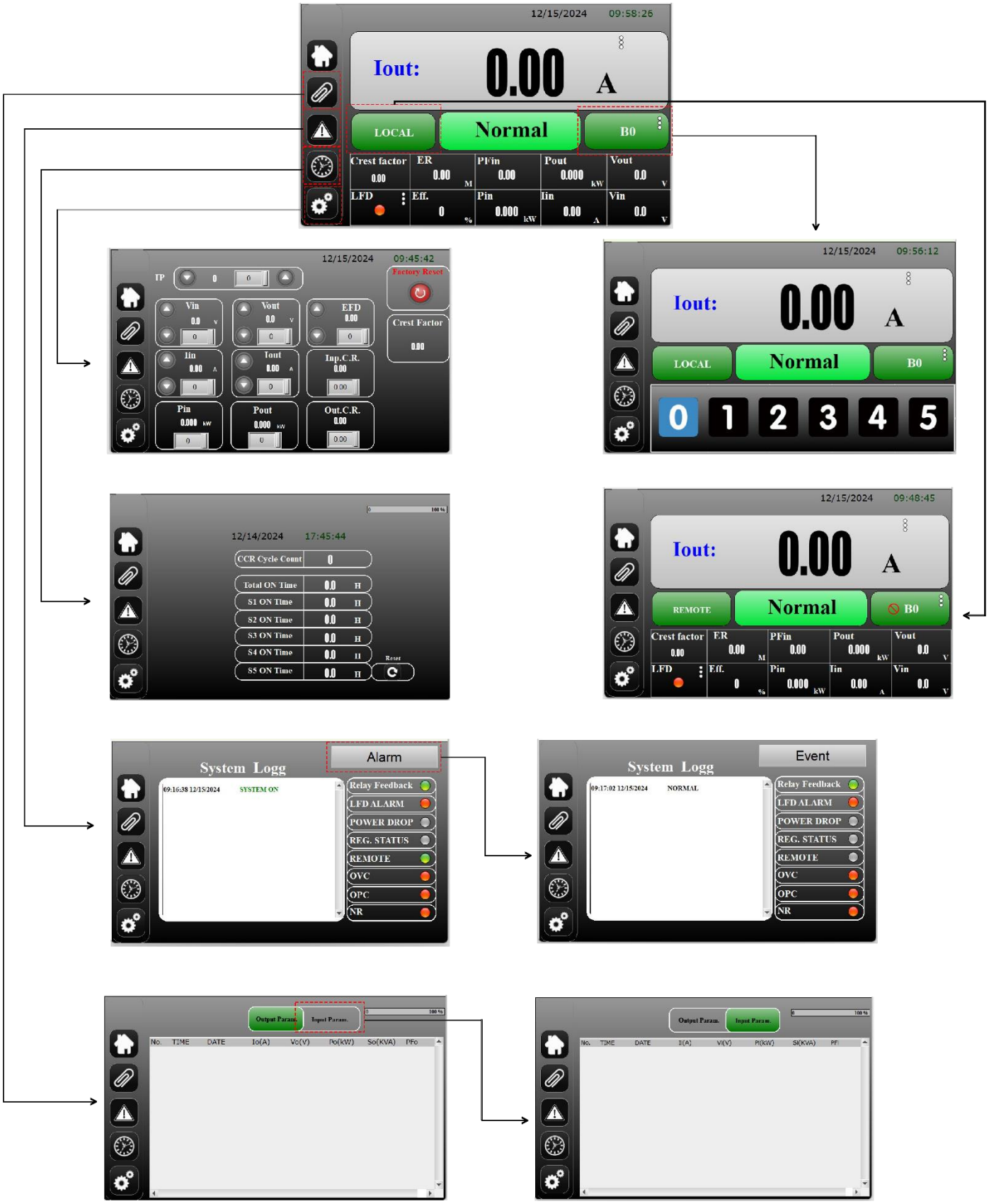


Figure 9 Menus Diagram

NOTE:

Once you have finished all the installation operations described in the previous section, you can continue.

4-2. Output Short-Circuit Procedure

After ensuring all connections are secure in the Installation Section and completing all necessary steps, you can proceed to power on the CCR and conduct the required tests:

a. Ensure the distribution switch for the CCR is turned off.
b. Short-circuit the CCR output terminal (BUS BAR) or connect it to a 10-ohm, 500W laboratory resistor for testing purposes.
c. Turn the MCCB or MPCB switch the CCR front panel to the ON position.
d. The CCR will be energized, and the HMI interface will be activated.
e. Use a clamp multimeter set to AC mode to measure the output current. Place the clamp on the output cable, which is either short-circuited or connected to the 10-ohm resistor.
f. Configure the CCR to operate in LOCAL mode. (Refer to Section *4-8* for instructions on selecting Local mode)
g. Adjust the CCR to Step B1.
h. If the contactor engages initially but disconnects after a few seconds, this indicates an OPC error. (Refer to Section *6-1* for troubleshooting.)
i. If no errors occur, current will flow through the transformer. Use the clamp multimeter to measure the output current at Step B1. The current should be 2.8A, within a tolerance of ± 0.1A as per FAA standards.
j. If there is a discrepancy between the current displayed on the HMI and the reading on the clamp multimeter, calibrate the CCR. Refer to Section *5-3-2-5* for calibration steps.
k. Perform the above checks for all subsequent steps (up to Step 5).

By following these steps, you can ensure the proper operation and accuracy of the CCR before putting it into service.

4-3. Open Circuit Test

When turning on the CCR, you may encounter errors such as OPC. This issue typically arises when the CCR wiring connections are not properly secured or have loosened during relocation. As a result, the current within the CCR circuit cannot flow properly, leading to an OPC error. When you press the B1 or Step Command, the current is momentarily connected and then immediately disconnected.
The OPC message appears in red on the HMI, replacing the Normal status.

4-3-1. Steps to Resolve the Issue

a. Power off the CCR: Begin by turning off the MCCB or MPCB switch to cut power from the CCR.
b. Check the Wiring Connections: Use a multimeter set to the resistance check mode (Ohm) and verify each connection one by one based on the CCR wiring diagram (see 2-4-2)
c. Rectify Any Detected Issues: Fix any loose or faulty connections.
d. Power On the CCR: After resolving potential problem, turn on the MCCB or MPCB switch.
e. Acknowledge the OPC Error: Press the OPC error on the HMI, followed by selecting Step to check the CCR's initial startup.

If the issue persists, refer to the Section 6 for further guidance.

4-4. Calculate resistance of series circuit

A series resistor can be used as a protective device to limit the current flowing through a component or circuit. For example, a series resistor can be used to limit the current flowing through an LED, which can help to prevent damage to the LED due to excessive current.

$$R_{prim} = \rho \times \frac{L}{A} + y \times 0.1212$$

Where:

A. $R_{prim} = resistance\ of\ the\ series\ circuit\ in\ Ohm$
B. $\rho = 18 \times 10^{-3}\ (Ohm \times mm^2)/m$
C. $L = length\ of\ the\ circuit\ in\ m$
D. $A = Section\ of\ the\ cable\ in\ mm^2$
E. $y = number\ of\ series\ transformers\ in\ the\ circuit$

Ex. Circuit length is 8000 m, cable section is $6\ mm^2$, number of series transformers is 122:

$$R_{prim} = 18 \times 10^{-3} \times \frac{8000}{6} + 122 \times 0.1212 = 36.7\Omega$$

After obtaining the resistance of the cable, we can calculate the power loss in the cable.
Then, we add the calculated value to the power of the lamp to estimate and determine the approximate power of the line.

4-5. Adjusting the CCR

A. Maximum output power available for each power settings:

The maximum power levels (in KVA, or KW on a resistive load) allowed for each power setting, according to the rated power of the CCR are as follows:

Rated power	Charge adaptation setting							
	1/8	2/8	3/8	4/8	5/8	6/8	7/8	8/8
2.5 kVA	< 0.32	< 0.63	< 0.94	< 1.25	< 1.57	< 1.88	< 2.19	< 2.50
5 kVA	< 0.63	< 1.25	< 1.88	< 2.50	< 3.13	< 3.75	< 4.38	< 5.00
7.5 kVA	< 0.94	< 1.87	< 2.81	< 3.75	< 4.69	< 5.63	< 6.56	< 7.50
10 kVA	< 1.25	< 2.50	< 3.75	< 5.00	< 6.25	< 7.50	< 8.75	< 10.0
15 kVA	< 1.88	< 3.75	< 5.63	< 7.50	< 9.38	< 11.3	< 13.2	< 15.0
20 kVA	< 2.50	< 5.00	< 7.50	< 10.0	< 12.5	< 15.0	< 17.5	< 20.0
25 kVA	< 3.13	< 6.25	< 9.38	< 12.5	< 15.7	< 18.8	< 21.9	< 25.0
30 kVA	< 3.75	< 7.50	< 11.3	< 15.0	< 18.8	< 22.5	< 26.3	< 30.0

Table 7 Maximum output power available for each power

B. Preferred configuration values:

The preferred configuration is as follows:

1. Setting

See § *2-2-2.*

I = 2.80 A

I = 3.40 A

I = 4.10 A

I = 5.20 A

I = 6.60 A

Brightness number = 5

Maxi Current = Setting value + 100mA

Mini Current = Setting value – 100mA

4-6. Connecting the CCR to the Line

a. Cable Entry:

To connect the CCR to the line, it is recommended that runway lighting cables are routed from the underground (via cable ducts or cable galleries) and brought into the CCR through the gland plate before positioning the CCR in its designated location.

b. Secure Connection:

For a secure connection, the runway lighting cables should be terminated with size 6 cable lugs (*See 3-3*) and insulated using heat shrink tubing. These cables must then be firmly connected to the BUS BAR terminals using size 10 bolts and nuts.

c. Ground (Shield) Connection:

To connect the cable shield (ground) to the output ground terminal, use heat shrink tubing and a size 4 wire. Connect the shield of both input and output cables to the output ground terminal, which is located next to the BUS BAR terminals.

Figure 10 BUS BAR terminal & Gland Plate

d. After correctly completing steps a to c, you can turn on the CCR.

Ensure the mentioned connections are secure, and then switch the MCCB/MPCB on the CCR front panel to the “ON” position.

If errors such as OPC, OVC, or NR are not on the HMI, it indicates that the CCR has successfully connected to the line.

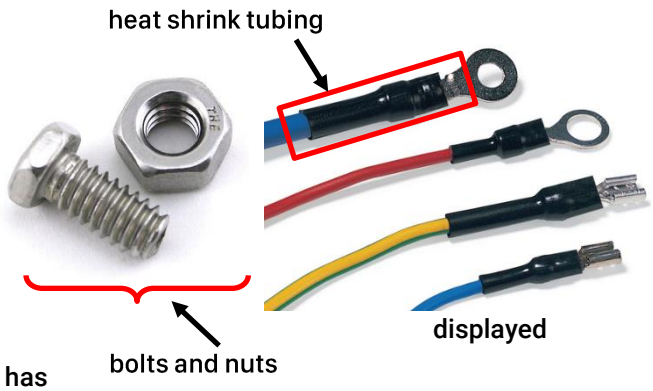


Figure 11 Bolts and nuts / Heat shrink tubing

4-7. Monitoring and Calibration via

The HMI on the CCR displays several parameters on the main screen, including input current, output current, input and output voltage, input and output power, crest factor, and efficiency.

After connecting the CCR to the main line and running it through various step, compare the HMI parameters to the actual system values.

If needed, calibrate these parameters see *5-2-2-5.*

4-7-1. Calibration Procedure

To do this, simply use a clamp power meter. First, ensure that the CCR is turned on and functioning correctly. Then, place the clamp of the power meter around the corresponding wire and read the voltage, current, and power values from the power meter. Compare these values with those displayed on the HMI. If there is any discrepancy, Refer to section *5-2-2-5* for detailed calibration instructions.

4-8. Preview

In this section, we will explore some of the menus and operations available on the HMI.

The display lights up:

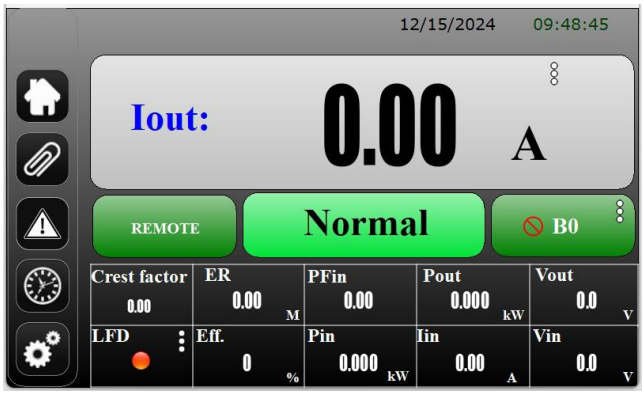


Figure 12 Menus – Main menu

a. When the CCR is powered on after the necessary checks, the HMI will activate, and the initial screen displayed will appear as follows.
b. Note that the CCR initially starts in REMOTE mode, and its STATUS will be set to NORMAL unless errors such as OPC, OVC, or NR are detected.
c. If HMI Connected the T Comm LED should be blinking.

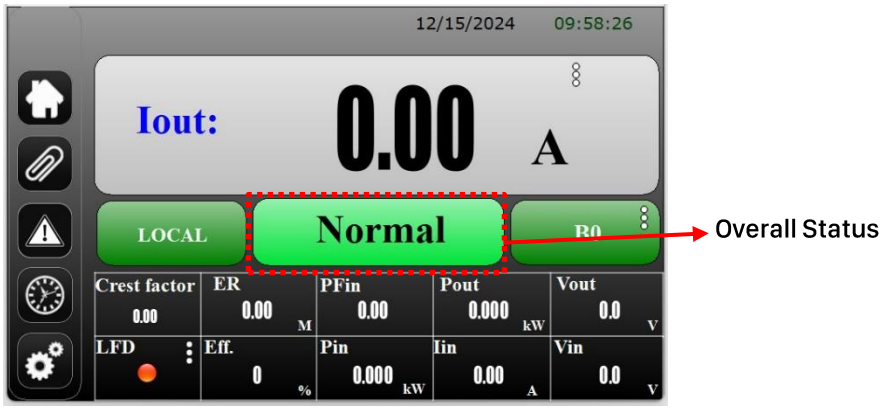


Figure 13 Menus – Overall Status

d. By tapping on the REMOTE section, the control mode of the CCR switches to LOCAL, allowing you to select the desired STEP and operate the CCR in LOCAL mode by tapping on B0.

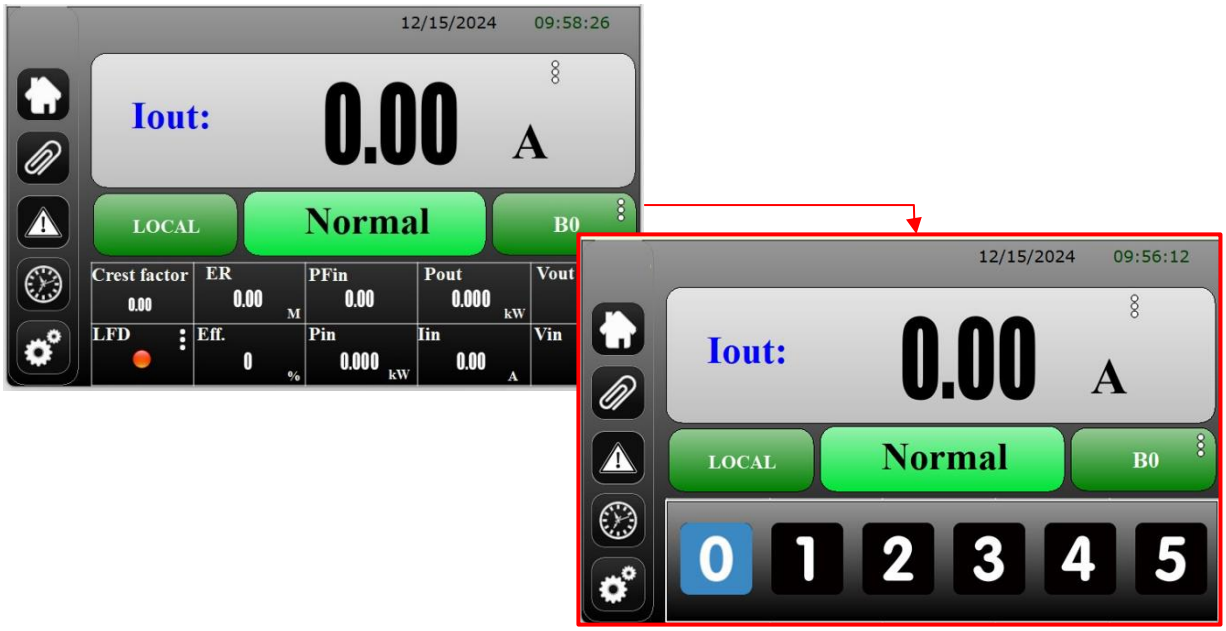


Figure 14 Menus - Steps

e. As explained in the previous section, the essential parameters required for the proper operation of the CCR HMI (Live Parameters). are displayed on the main screen of the HMI.

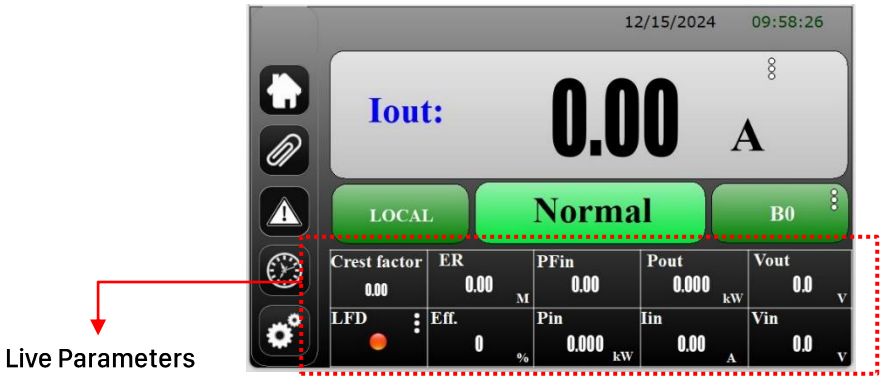
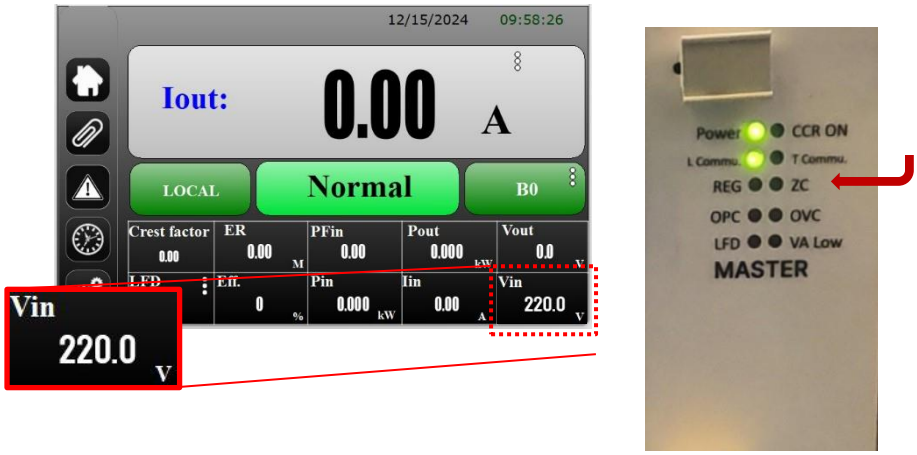


Figure 15 Menus - Live Parameters

NOTE:

You can calibrate all the parameters in the Setting Menu. (5-2-2-5)

f. if the CCR operates correctly, you can confirm its functionality by observing the illumination of the corresponding LEDs and verifying that Vin ≈ 220V.



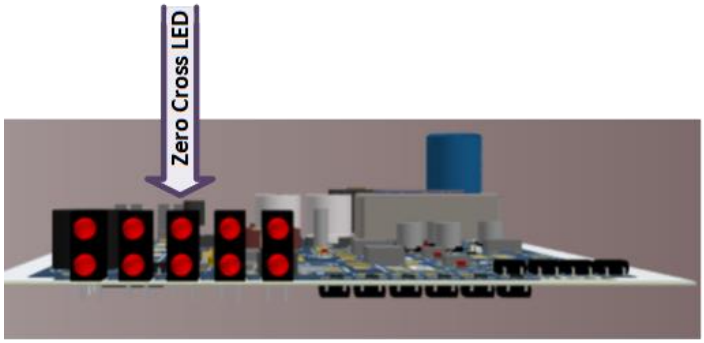


Figure 16 Menus - Verifying Vin

g. In next step ZC led on main board should be blinking

NOTE:
If there is any problem do not repeat the tests.
Check the connections again and check the state of the thyristors before starting up again.

4-9. Modbus TCP/IP

For airport where a network or fiber optic infrastructure is implemented, the easiest way to connect the CCR to the ALCMS console is through the TCP/IP protocol.

a. To establish this connection:
   - Use the network socket embedded in the CCR LV Section to connect the network cable to the switch located in the electrical panel.
   - Communication with the tower will be established via the network infrastructure at the airport using ALCMS.

b. CCRs in the settings section have the ability to configure the IP range from 192.168.1.100 to 192.168.1.200, allowing the IP-ALCMS program to be used for configuring the CCRs

c. This process must be carried out by a programmer on the tower controller.

4-10. Multi-wire

a. To establish the multi-wire protocol connection with the CCRs, the relay supply voltage must be limited by the operator (airport) within the voltage range 20 to 60 volts, as per previous information. However, it has been observed that the voltage is typically 48 volts.

b. This voltage is crucial in determining the correct line impedance.

c. For direct multi-wire communication, two boards – Relay PCB and Resistance PCB – embedded in the CCR LV Section can be utilized.

d. For the CCR control:
   - Use 5 wires for connections from B1 to B5

e. For monitoring control:

- Use 8 wires for monitoring.

f. For power supply:
   - Use 2 wires for ± 48V.

g. A total of 15 wires are required per CCR.

h. To connect with ALCMS:
   - Simply synchronize the control and monitoring wires through the PLC using the ALCMS program.

5. OPERATION

All the operations controlled and classification of different tasks performed by the microprocessor:

1. Monitoring the current and the alarm are engaged if it's in limit.
2. Updating indications of Remote , Local.
3. Displaying the True RMS value of output current, voltage and input current.
4. Displaying Power Output in KVA.
5. Displaying the Maximum step and the current step.
6. Displaying the Time counters of CCR-ON and individual step operation time.
7. Displaying the Lamp fault indication and the number of fail lamps.
8. Displaying the Earth fault value and shows the warning level and alarm level if an alarm set displaying the error message.

When a stop signal is detected by the microprocessor, it interrupts the optic signals to the thyristor and remains to wait until the next command is received.

5-1. Operation Modes & Controls

The operation modes and controls of the CCR include local modes for in-site control, as well as two remote modes: One utilizing multiwire communication for remote control and another utilizing TCP/IP for remote control.

1. Local Mode
2. Remote Mode

5-1-1. Local Mode

A. The CCR can be turned ON or OFF using the HMI. (*See 5-2-1*)
B. It has the ability to control brightness levels.
C. Remain in the current state.

5-1-2. Remote Mode

A. Remote mode control is exclusive to external devices and cannot be operated through the HMI. Functional keys such as Step change (CCR-ON/OFF) are locked in this mode.
B. The CCR operates on a standard DC voltage of 24V, with optional DC voltage options available at 20 to 60 VDC.
A. is configured with a single channel for communication.

5-1-3. CCR Indications

The front panel of the regulator provides local display of standard indications. The HMI in the front panel shows the input voltage, current, output current and voltage.

A. Display selected brightness level & constant step current.
B. Display of Elapsed Time of CCR-ON, step levels.

C. Alarm, indication of open circuit.

D. Alarm, indication of over current.

E. Indication for input power loss.

F. Indication for current regulation error.

5-1-4. Remote Indications

A. The HMI status can be switched to Remote mode.

B. Error indications should be checked according to the local process.

C. Step level changes are made based on input from another device.

D. CCR-ON/OFF can only performed using another device and not through the HMI.

5-2. User Interface

5-2-1. Operating mode

A. Stop mode:

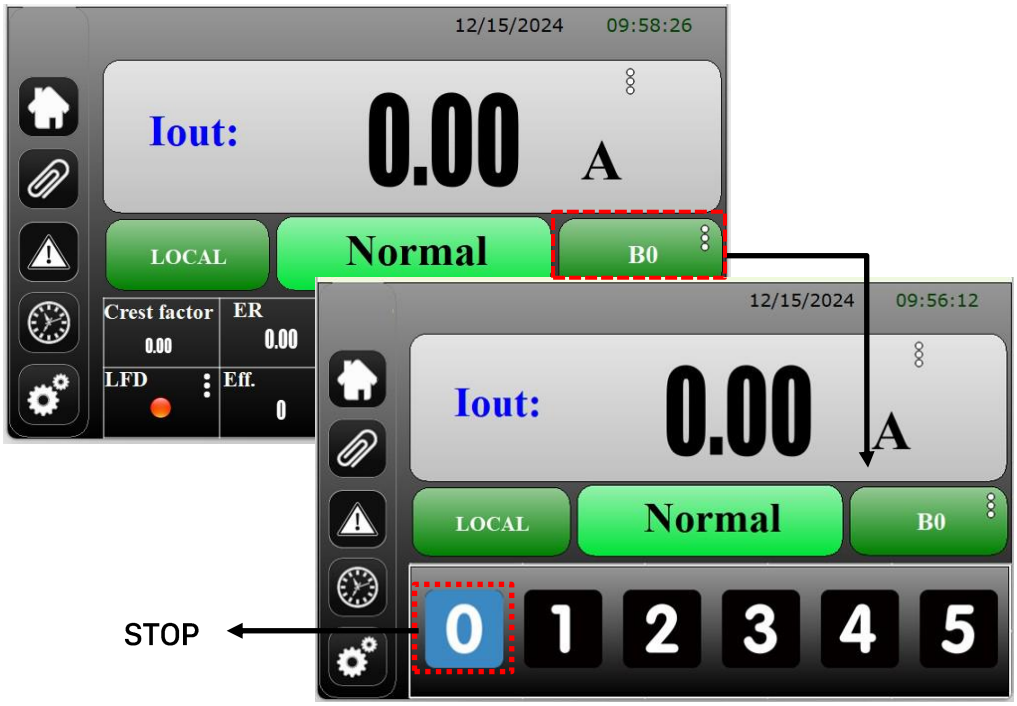


Figure 17 Menus - Stop Mode

In that mode, B0 is highlighted. The CCR stop, whatever the current brightness orders (local selection). Menus can then be accessed.

B. Local mode:

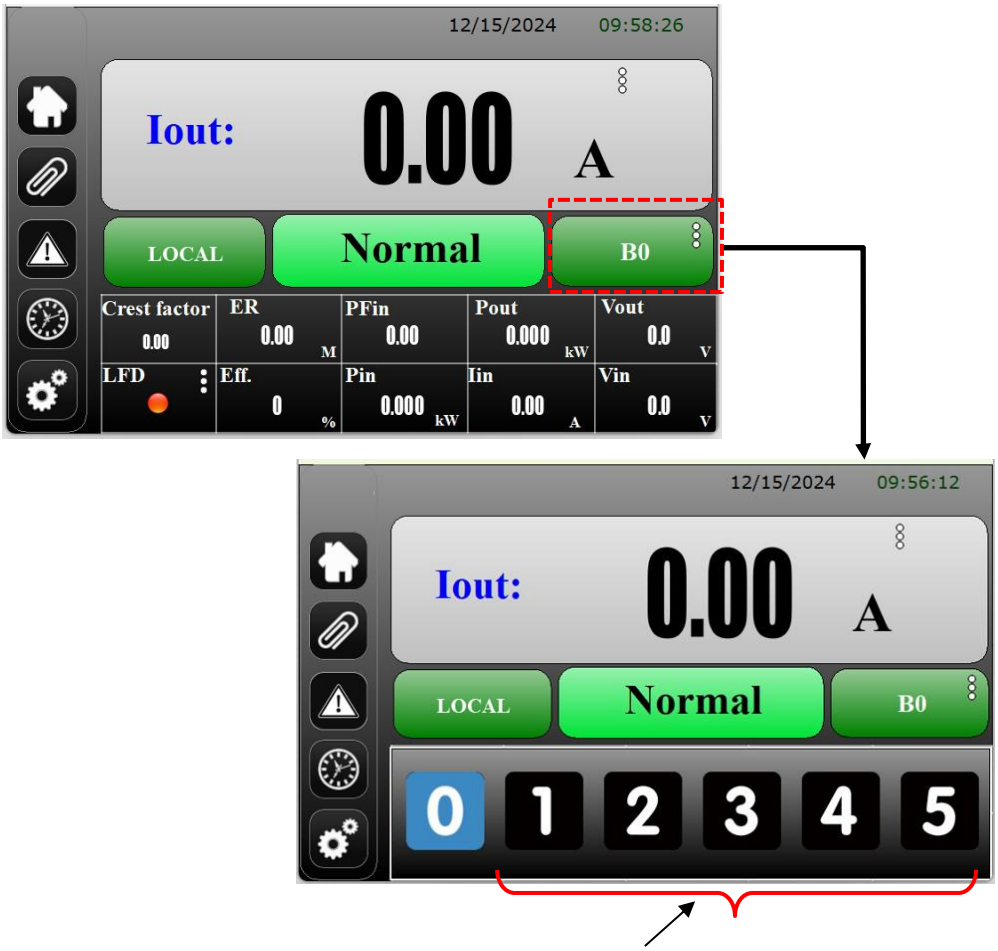


Figure 18 Menus - Local Mode

In that mode appears brightness controls: The brightness is chosen by pressing buttons from 1 to 5 maximum, according to the number of brightness levels configured.

C. Remote control mode:

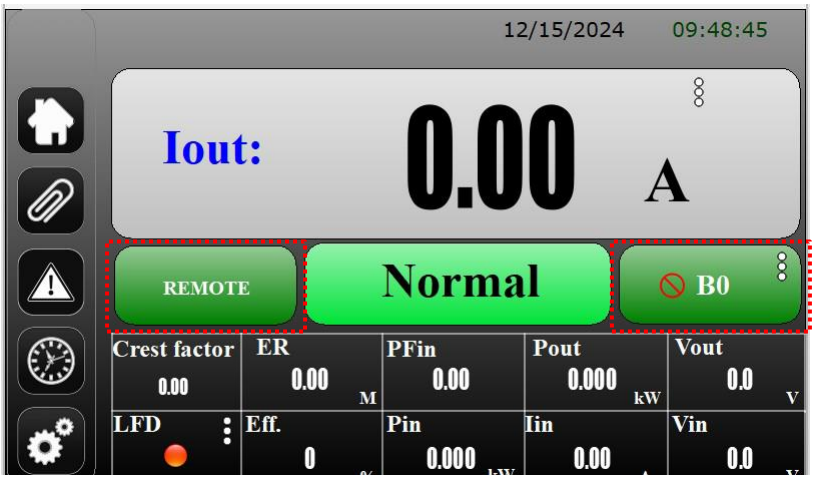


Figure 19 Menus - Remote Mode

In that mode, “Remote” is highlighted. Operation of the CCR is governed by remote control inputs on the CCR’s motherboard. If remote control commands overlap, priority is given to the first choice of brightness. The remote control is either of the multiwire type (20 to 60 DC positive or negative).

D. Menus

By using the on-screen direction, you can navigate between menus.
The menus available to you inside:

- Home
- Output/Input Parameters
- Alarm/Events
- Time
- Setting

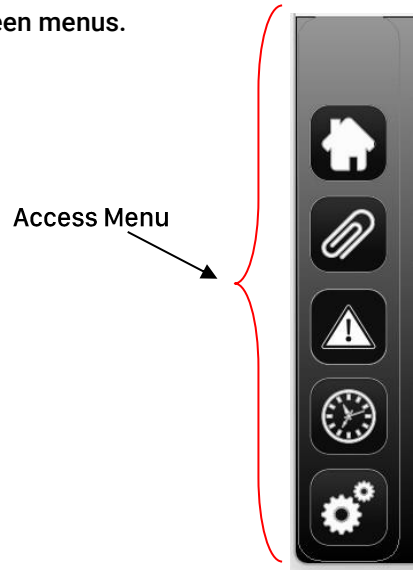


Figure 20 Menus - Access Menu

5-2-2. Menu

5-2-2-1. Home

A. Live

1. Crest factor
2. ER
3. Input power factor
4. Output power
5. RMS output voltage
6. LFD
7. Efficiency
8. Input power
9. RMS input current
10. RMS input voltage

Figure 21 Menus - Home

5-2-2-2. Time

Figure 22 Menus - TIME

In this menu, you can view the total time the CCR device has been on, as well as the time each of its workflow steps has been active in a clock format

5-2-2-3. Event

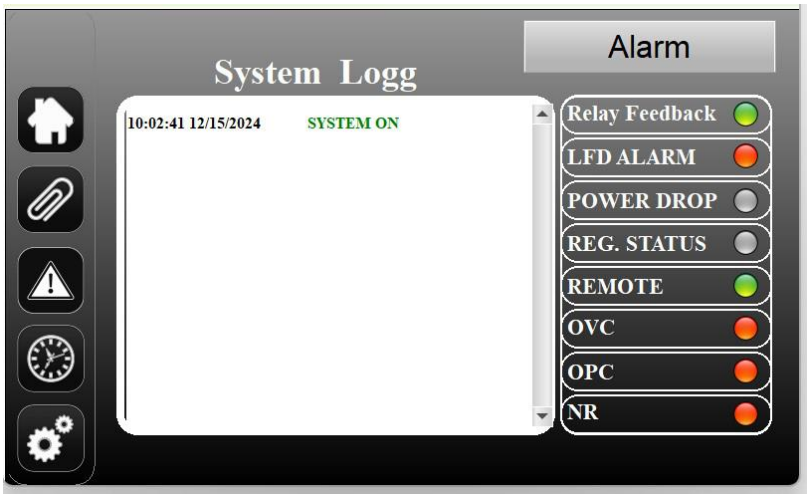


Figure 23 Menus - Event

In the Event menu, in addition to the display on the right side of the screen, you can track all the operational actions performed on the CCR.

Events recorded in this menu with precise date and time include actions such as turning the CCR on and off, powering the system on and off, changing the device's steps, and more.

This menu provides users and operators with a critical history of the CCR's operations, enabling them to identify and resolve past issues while enhancing the system's security and performance.

It is important to note that the Event menu and the Alarm menu are located within the same section, and you can switch between them by tapping the corresponding button.

5-2-2-4. Alarm

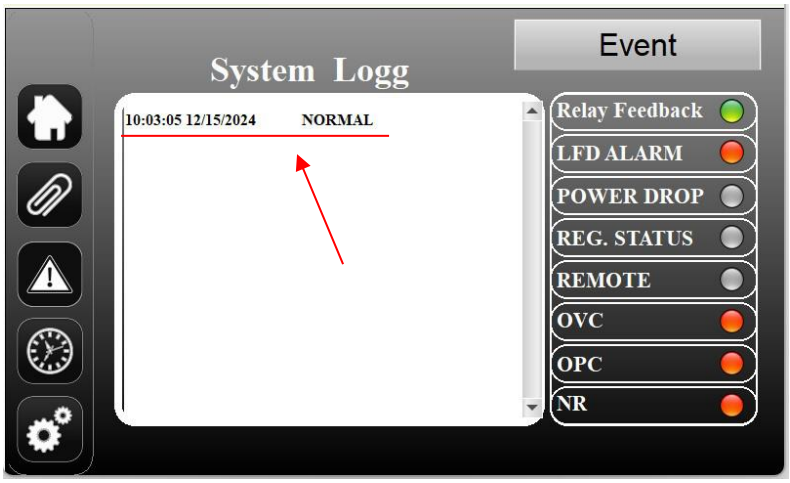


Figure 24 Menus - Alarm

In the Alarm menu, in addition to the display located on the right side of the screen, you can view all the errors and alarms that the CCR has encountered, along with their exact date and time.

5-2-2-5. Setting

a. The “Setting” menu is used to Calibration.

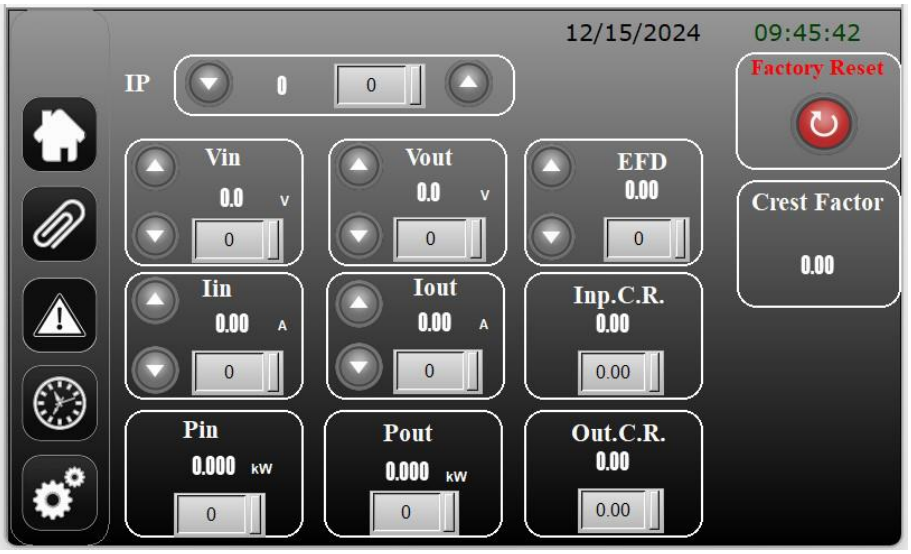


Figure 25 Menus - Setting

You may encounter an issue with the display of essential parameters such as voltage, current, etc. Rest assured, this is only a display issue, and it can be resolved by calibrating the device.

For example, if you measure the output current using a current clamp and notice a discrepancy between the measured value and the value displayed on the HMI, you can calibrate these values through the Settings menu.

To do so, enter the setting menu and select the parameter you want to calibrate. Then, either use the dropdown menu or the up and down buttons to adjust the calibration factor.

Adjust the factor until the value displayed on the screen closely matches the value measured by your electrical instrument (with minimal difference).

It is worth noting that increasing the factor will decrease the displayed value, while decreasing the factor will increase the displayed parameter.

By default, the factors are set to 1, and the device is calibrated with these values.

However, if for any reason calibration is needed, you can use the above method.

Ensure that the input and output CT values remain unchanged, as they have been correctly and specifically configured at the factory.

This method is applicable for both input and output parameters.

- Output current calibration:

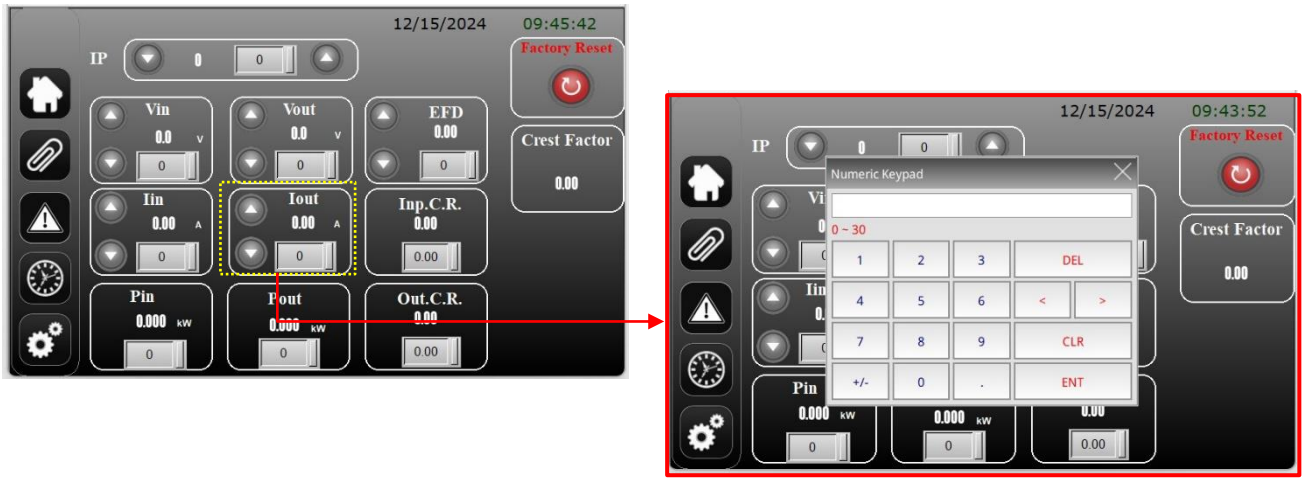


Figure 26 Menus - Output Current Calibration

- Output Voltage calibration:

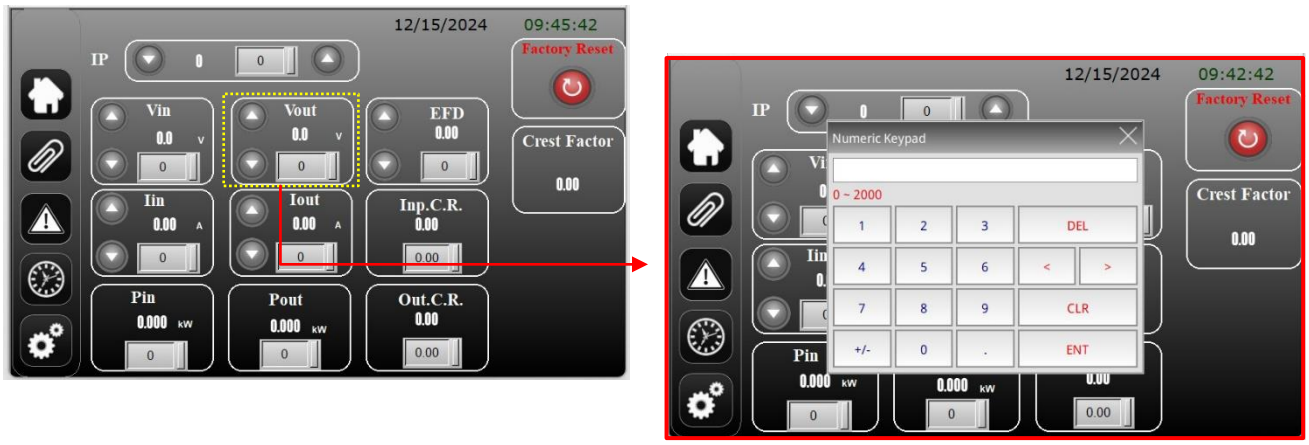


Figure 27 Menus - Output Voltage Calibration

b. IP

In the Setting menu and IP section, you can manually enter number between 100 to 200 by tapping the designated area, then press the ENT button to establish a connection with the tower. For example, if you enter the number 120 and press ENT, your selected IP will be 192.168.1.120

As soon as you tap the ENT button on the screen, the Ethernet lights (two red and two green) will turn on and then off, indicating that the connection has been successfully registered and established.

It is important to note that the number you enter in this section corresponds to the last three digits of the IP address.

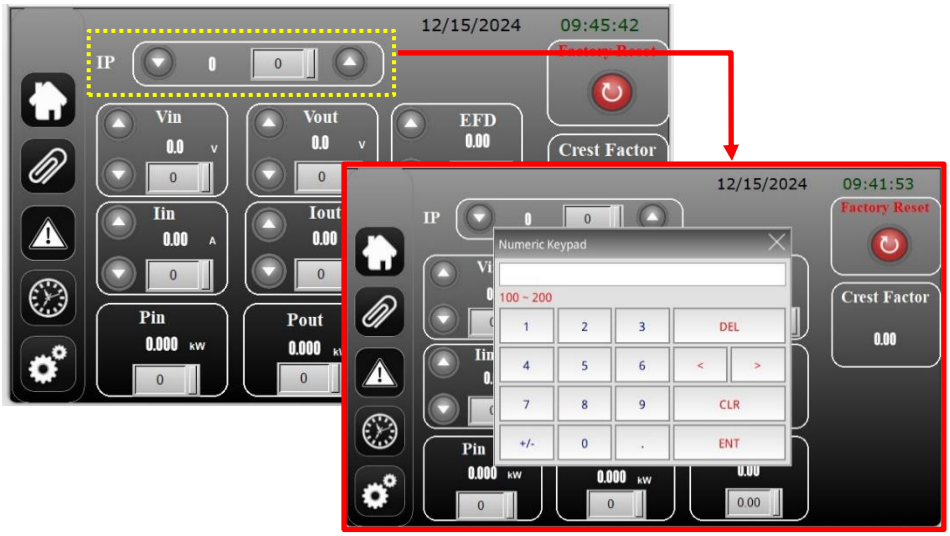


Figure 28 Menus - IP

5-2-6. Alarm and Warning

In the Alarm and Events menu, located on the right side of the screen, you can check for errors and ensure system stability.

In this section, you will encounter three colors: gray, green, and red, each representing a specific status (respectively: inactive, stable and active, and error detected).

The parameters displayed in this section include Relay Feedback, LFD alarm, Power Drop, Reg status, Remote, OVC, OPC, and NR.

For example, if you activate the Remote mode in the CCR and visit this menu, the Remote parameter will be shown in green, indicating that the remote mode is active.

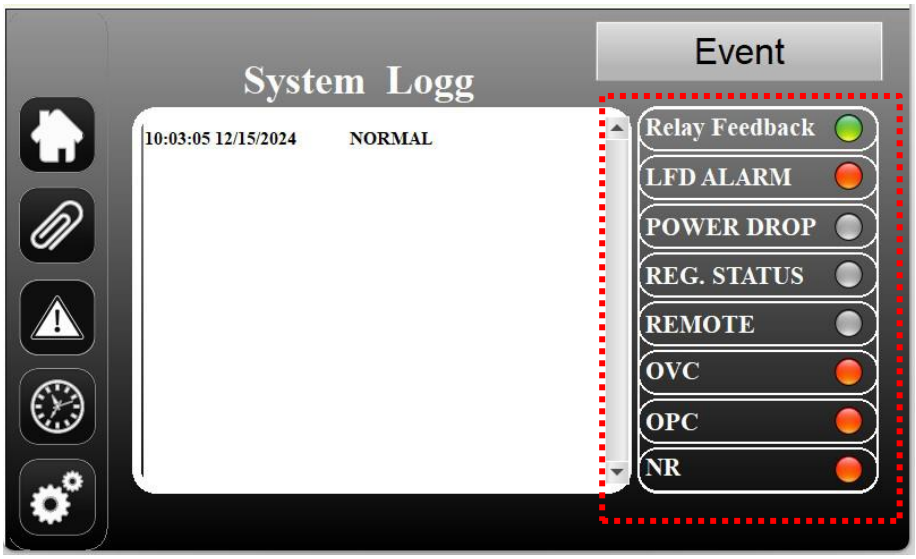


Figure 29 Menus - Alarm & Warning

It is important to note that the Power Drop and Reg status parameters are currently inactive and are displayed in gray.

Additionally, errors such as OPC and OVC, when triggered (shown in red), will also be displayed on the main menu.

5-2-7. Parameters

In the menu, there are two sections: input parameters and output parameters.

The parameters displayed to the user in each section include: time, date, output current, input current, input voltage, output voltage, output power, input power, input power factor, and output power factor.

In this menu, all the mentioned parameters are recorded approximately every 10 seconds and can be used as a section for monitoring the parameters.

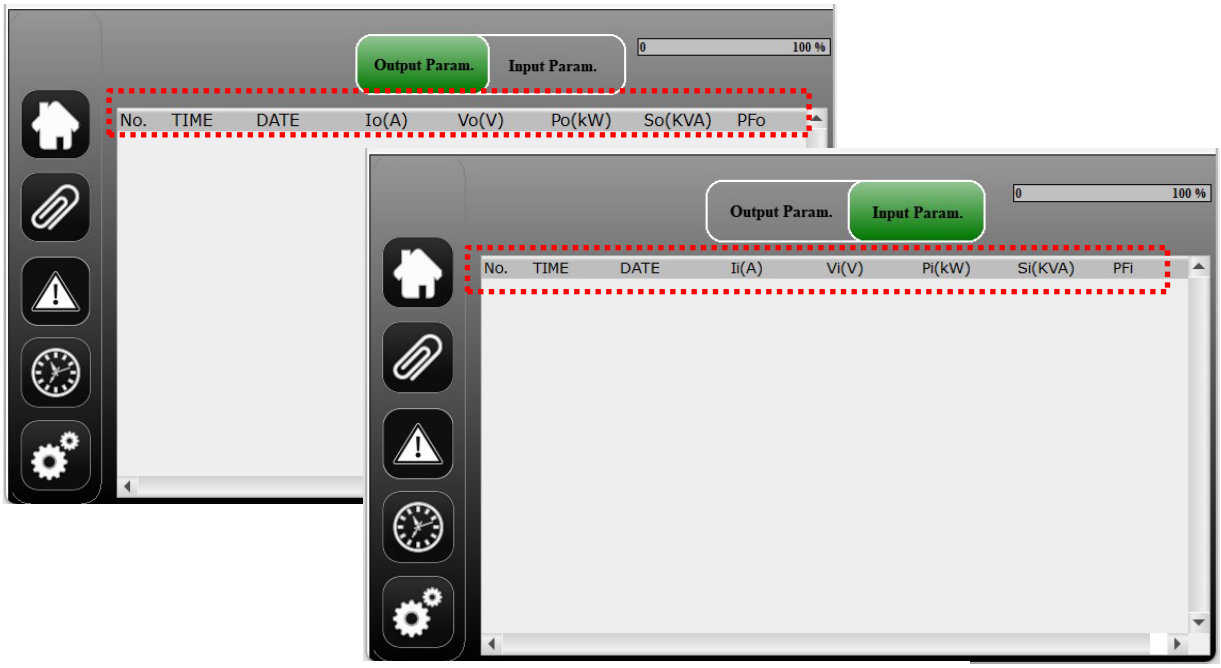


Figure 30 Menus - Parameters

6- TROUBLESHOOTING

WARNING

Do not troubleshoot unless you have read and understood all the information in the Safety Chapter and you are qualified to work in high-voltage systems.

1. **Set the equipment to Local mode**
2. **Set the equipment to the brightness step OFF before you examine the series- circuit**
3. **Switch OFF the main switch of the equipment**

If you do not obey the steps above, an increase in the power input can start cycling and restart the equipment. This results in a possible lethal output Voltage.

6-1. Preliminary checks

Before any operation or adjustment check for

A. Local panel indications or back indication signals
B. Power supply voltage off
C. Distribution switch is turned off
D. Loose connections

Table 8 Troubleshooting

Issue	Possible reason	Recommended action
CCR doesn't turn on (HMI is turn Off)	LV power fault	Check the voltage level of the LV power supply
	MCB fault	Check the MCCB/MPCB status
	Power supply fault	Check the power supply PCB output
MCCB/MPCB trips	Internal wiring or Components of the CCR Output circuit short circuit. Too sensitive MCCB	Check the CCR for short circuit or damaged insulations. Check the insulation of the output circuit. Check the MCCB/MPCB.
No T-Comm LED Blinking in SUB-RACK	RS485 communication fault between Main and display.	1. Check Cable 2. Change Main board 3. Change display
Vin Value in monitoring is not 220 Volt	Do not start CCR in this Condition	1. check or change sensor board 2. check or change power board 3. check or change Main Board
The CCR has TCP/IP communication Error.	The infrastructure fault	Check the Ethernet cable and the network privacy.
	Communication PCB fault	Wrong IP

The CCR has stopped The message: “OPC” is displayed	Lighting loop open	Measure the continuity of the loop
	Contactor Fault	Check the Contactor status, change Contactor
	Output current < 1.0A for more than 500ms	Measure the output current value
		Large load increase on the loop caused by circuit switching
	SCR control cables disconnected or faulty	Check the state of the cable’s connection between the Driver board and the thyristor
	Thyristor fault	Measure the state of the thyristors
	Output Sensor board	Change the Sensor board
The CCR has stopped The message: “NR” is displayed	Overload	Check the CCR Main transformer TAP
	Large number of ITs open	Check the number of ITs open due to missing or fault lamps
	CCR power insufficient	Check that the installed power is not greater than the power of the CCR
Only the minimum Brightness step is selected	Failure of the remote-control line Failure of the current control module	if the module operates Correctly in local than check the remote-control line Check the current control module
The output current is not reached	The CCR is overloaded	Check the output transformer tap. Check the power supply voltage Check the load
Receiving Data not transmitting	Only RX indication	Check the CCR address
Data Not receiving, no Indication on CCR	Data Transmitting	Check the CCR port, which is connected. If dual Communication is not present Only Need to connect on Com1 of CCR
Only the maximum output current and one other are correct	Brightness step id always selected	Check the remote-control Signals (one Selection is always present) Check the optional relay board. Check the current control module
The CCR has stopped The message: “OVC” is displayed	Change the Lights when the circuit is on.	Change the lights when the circuit is off.

LV power protection trip during a brightness command	Thyristors faulty	Check state of the thyristors
	Trigger boards faulty	Replace the board
Always Maximum Output current	Maximum brightness step is always selected. Failure of the optional relay board. Failure of the current regulator.	Disconnect the remote-control line for the minimum brightness Step Accentually check the Remote-control signals. (Check the relay contacts)

NOTE:

if the MCCB/MPCB trips without any obvious reason the current control module should be replaced, this module must be capable of handle any occurring over current so that damage to the load is excluded.

6-2. Check Thyristors

The state of the thyristors can be checked as follows using an ohmmeter:

1. Between pin1 & pin2, and between pin3 & pin1: Several mΩ, otherwise the Thyristors are in short-circuit
2. Between pin4 and pin5, between pin6 and pin7: A few Ω, otherwise the trigger gates are cut

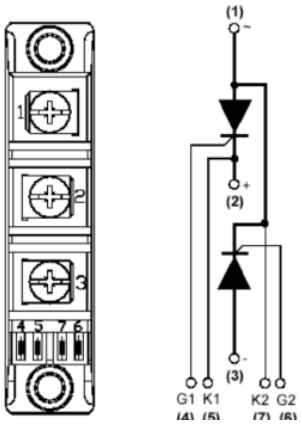


Figure 31 Thyristors

6-3. Check and measurements

6-3-1. Measure input voltage

A. Make sure that the MCCB/MPCB switch is off
B. Make sure that the input supply cables that come from the mains distribution panel are only connected to the equipment you want to measure
C. Switch on the main distribution to feed the equipment you want to measure
D. Make sure that all connectors are securely tightened
E. Measure the input voltage to the equipment. (Use a true RMS Multimeter)
F. Check the nameplate of the equipment and make sure that the input voltage is compatible with the equipment

6-3-2. Measure output current

A. Make sure that MCCB/MPCB is OFF
B. Install a calibrated True RMS multimeter with a current clamp in the output circuit
C. Switch on the equipment and set it to 2.8 to 6.6 brightness step

D. Read the output current from the true RMS multimeter

E. Make sure that the measurement is accurate. Calibrate the output current again if necessary

6-3-3. Calculate resistance of series circuit

A. Calculate the resistance of the series circuit (See *4-4*)

A. Make sure that the calculated value is higher than the value measure during commissioning

6-4. Open Circuit (OPC)

A. Lighting loop open.

Solutions: Measure the continuity of the loop.

B. Output current < 1.0A for more than 500ms.

Solutions: Measure the output current value / Large load increase on the loop caused by circuit switching.

C. SCR control cables disconnected or faulty.

Solutions: Check the state of the cable's connection between the regulation board and the thyristor control boards.

D. Thyristor trigger-gates faulty.

Solutions: Measure the state of the thyristors.

6-5. OVC

A. Overload combined with load decrease by switching.

Solutions: Check the adaptation of the load plate to the loop power / Check the number of ITs open due to missing or fault lamps.

B. Faulty Thyristors in short-circuit.

Solutions: Measure the state of the thyristors / Test in overload.

C. SCR control cables disconnected or faulty.

Solutions: Check the state of the cable's connection between the regulation board and the thyristor control boards.

7- MAINTENANCE

WARNING

Maintenance tasks of the regulator should only be carried out by personnel authorized to work on high-voltage equipment. When performing these maintenance tasks, it is important to operate the regulator under local control. This precautionary measure helps prevent the accidental activation of the regulator, which could result in severe injury or even loss of life.

7-1. Preventive schedule

Table 9 Preventive schedule maintenance

Interval	Maintenance Task	Action
Daily	Check All the Control Equipment for proper operation	Check Remote Control for all Brightness
Monthly	Check Input Voltage & record output Current all brightness	If regulator is not within the ±10% of design voltage notify company to correct voltage
Annually	Check contactor circuit breaker wiring and insulation inspect housing for rust and damages	Replace contact excessively burned or pitted. Operate the Control switch to check for proper

7-1-1. MONTHS

During the initial month of usage, it is crucial to conduct a comprehensive inspection of the terminals and connections, particularly those associated with high-voltage (HV) or low-voltage (LV) power circuits. This examination is aimed at ensuring optimal electrical conductivity and reducing the likelihood of electrical malfunctions or safety hazards. Here's a breakdown of the components that require attention:

A. Input terminals, contactor
B. Output terminals, brass straps on the load plate, and all screwed connections at the back of the load plate.

7-1-2. ANNUAL

A. Ensure the underside of the casing is free from dust to prevent buildup that may impede proper cooling
B. Verify that the power connections are securely tightened
C. Clear away dust from electronic circuit boards and LV rack components
D. Evaluate the operational functions of the equipment both locally and through remote control

7-1-3. THREE YEARS

The frequency at which these tasks are conducted should be determined based on the utilization of the CCR (Constant current regulator)

A. Initiate the process with a comprehensive visual inspection
B. Verify the integrity of the internal connections

C. Ensure proper correspondence among the current setting, displayed value, measured value using an insulated true RMS ammeter, and accuracy of the clamp.

If any inconsistencies are detected, consider calibrating the CCR to rectify the discrepancy

7-1-4. Preventive Maintenance Inspection Schedule

Table 10 Preventive maintenance inspection schedule

Maintenance Requirement	DAILY	WKLY	MTHLY	SMANLY	ANNLY	UNSCH
Check control circuits on all brightness steps	×					
Check condition and operation of regulator		×				
Check input voltage and current			×			
Check output current on each brightness step			×			
Check output load on regulator if needed				×		
Check relays, wiring and insulation				×		
Perform a short-circuit test					×	
Perform an open-circuit test					×	
Clean rust spots and repaint as necessary						×

7-2. Part Replacement

7-2-1. Required Tools

1. Measurement Tools:
   a. True RMS multimeter
   b. Multimeter
   c. Insulation tester 500V or 1000V
   d. Clamp or A-meter true RMS scale 10 and 30A

2. Tools:
   a. Standard electrical and mechanical tool kit
   b. Screwdrivers with protection up to 1000V
   c. Spanner set
   d. Allen keys 4 and 6mm
   e. Torque screwdrivers (2-10 Nm and adaptors)
   f. Short, slotted screwdriver
   g. Angle socket wrench

7-3. Remove Panel

7-3-1. Sub Rack

To replace the sub rack boards, first open the two screws that are marked with A, then using the handles, remove the board and replace it with a new one. Then place the new board back into the sub

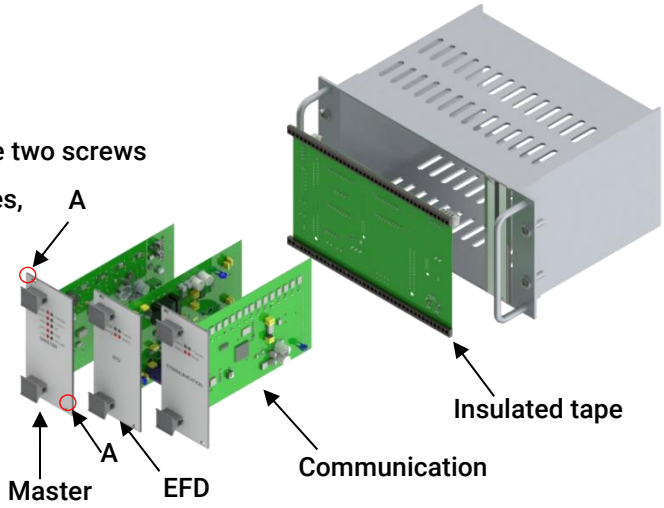
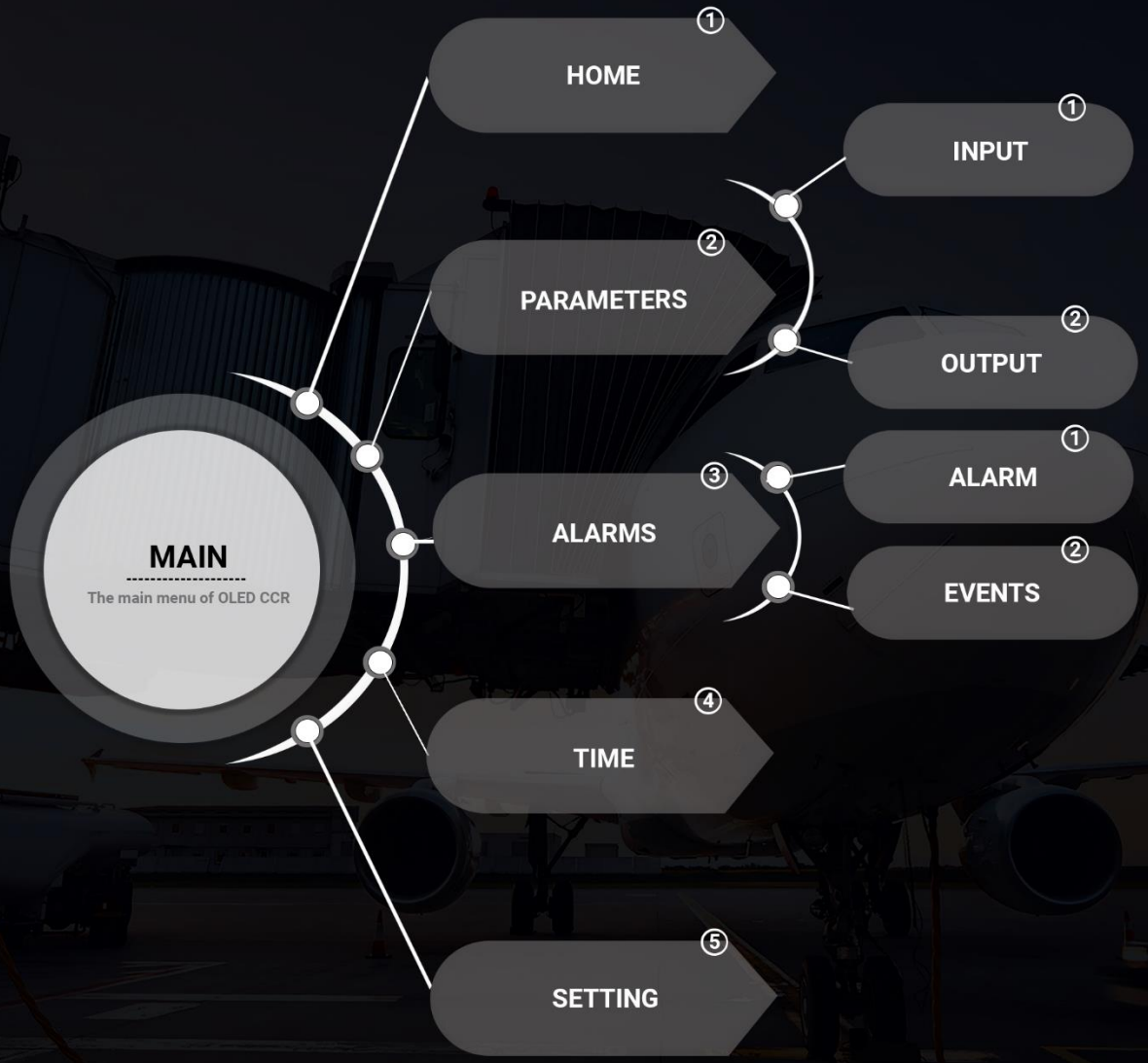


Figure 32 Sub Rack

TREE DIAGRAM OF CCR MENUS



I. APPENDIX A: PART NUMBER IDENTIFICATION

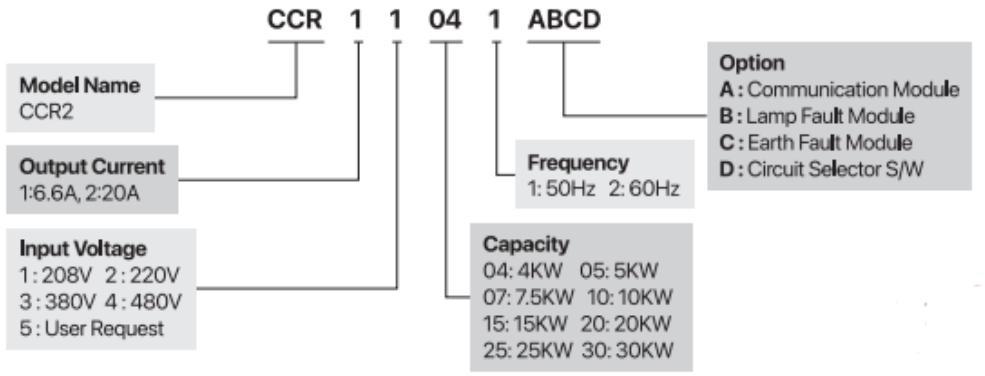


Figure 33 Part Number Identification

The CCR is identified by a serial ordering number which indicates its type, option and particularities. For Example, CCR12041ABCD = constant current regulator, 5steps, 220V, 30kW, 50Hz frequency, and output current is 6.6A, with Earth Fault detector, Lamp Fault detector.

II. APPENDIX B: PART LIST

Table 11 Part List

Type	Description	Power (KW)											
		1	2.5	4	5	7.5	10	12.5	15	17.5	20	25	30
Contactor	220V/3P (1 per Unit)	121-01-101	121-01-102	121-01-103	121-01-104	121-01-105	121-01-106	121-01-107	121-01-108	121-01-108	121-01-109	121-01-110	121-01-111
MCCB/MCB		121-04-101	121-04-102	121-04-103	121-04-104	121-04-105	121-04-106	121-04-107	121-04-108	121-04-108	121-04-109	121-04-110	121-04-111
Input Arrester		121-08-101											
Output Arrester		121-09-101								121-09-102			
SCR Switch		121-10-101	121-10-101	121-10-101	121-10-101	121-10-102	121-10-102	121-10-103	121-10-103	121-10-104	121-10-104	121-10-105	121-10-105
Main Transformer		121-13-101	121-13-102	121-13-103	121-13-104	121-13-105	121-13-106	121-13-107	121-13-108	121-13-109	121-13-110	121-13-111	121-13-112
Power Supply Transformer		121-14-101											
Input CT		121-15-101	121-15-102	121-15-102	121-15-102	121-15-102	121-15-102	121-15-103	121-15-103	121-15-103	121-15-103	121-15-104	121-15-104
Output CT		121-16-101											
PCB	Master PCB	121-17-101											
	Communication PCB	121-17-102											
	EFD PCB	121-17-103											
	Back plain PCB	121-17-104											
	Input Sensor Board PCB	121-17-105											
	Output Sensor Board PCB	121-17-105											
	Driver PCB	121-17-106											
	PS PCB	121-17-107											
	OLED PCB	121-17-108											

HMI		121-18-101
Gland	power Input & Output	121-21-101
	Input control	121-21-102
Socket	Ethernet	121-22-101