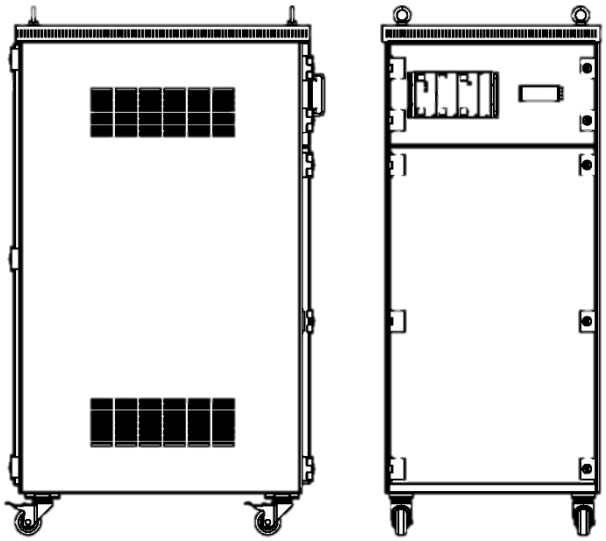

CCR CONSTANT CURRENT REGULATOR | MANUAL

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	02/11/2024		
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

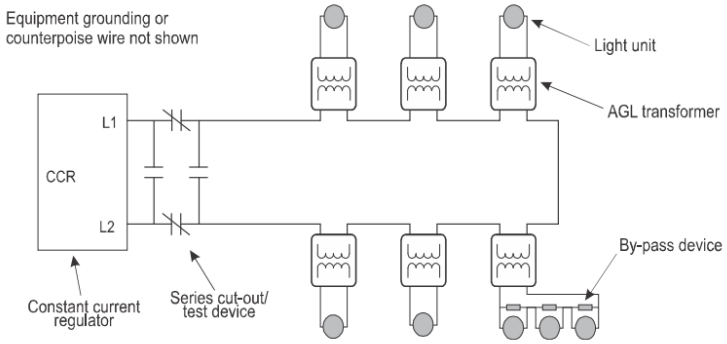


Figure 2 Series lighting circuit

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 — -40 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:

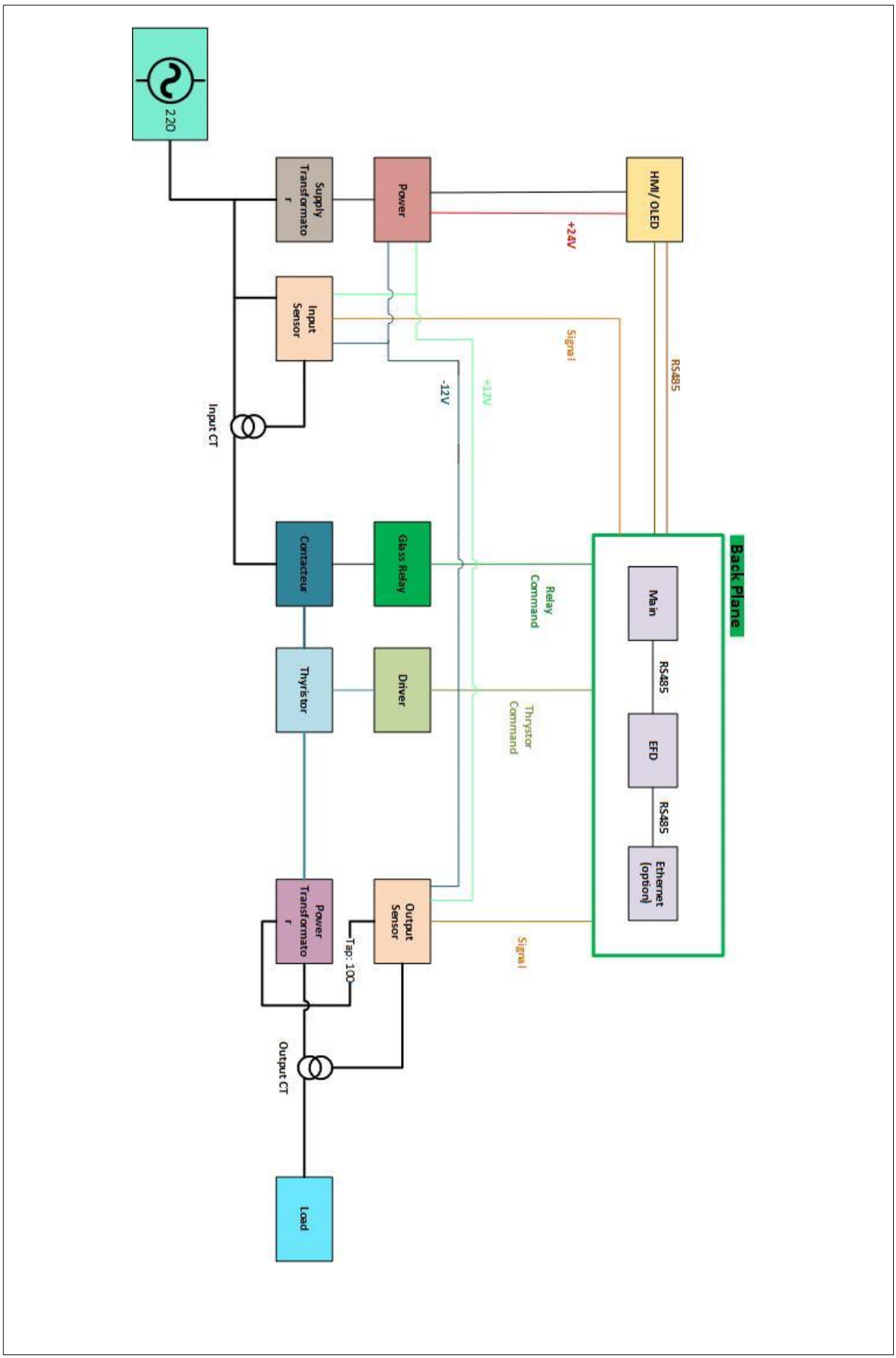
1- Over Current Protection:	2- Open circuit protection:
12= 6.85A < 4 sec / 12= 6.93A < 2 sec	I = 1.50A < 1 sec
12= 7.10A < 1 sec / 12= 8.30A < 0.3 sec	

H. Monitoring:

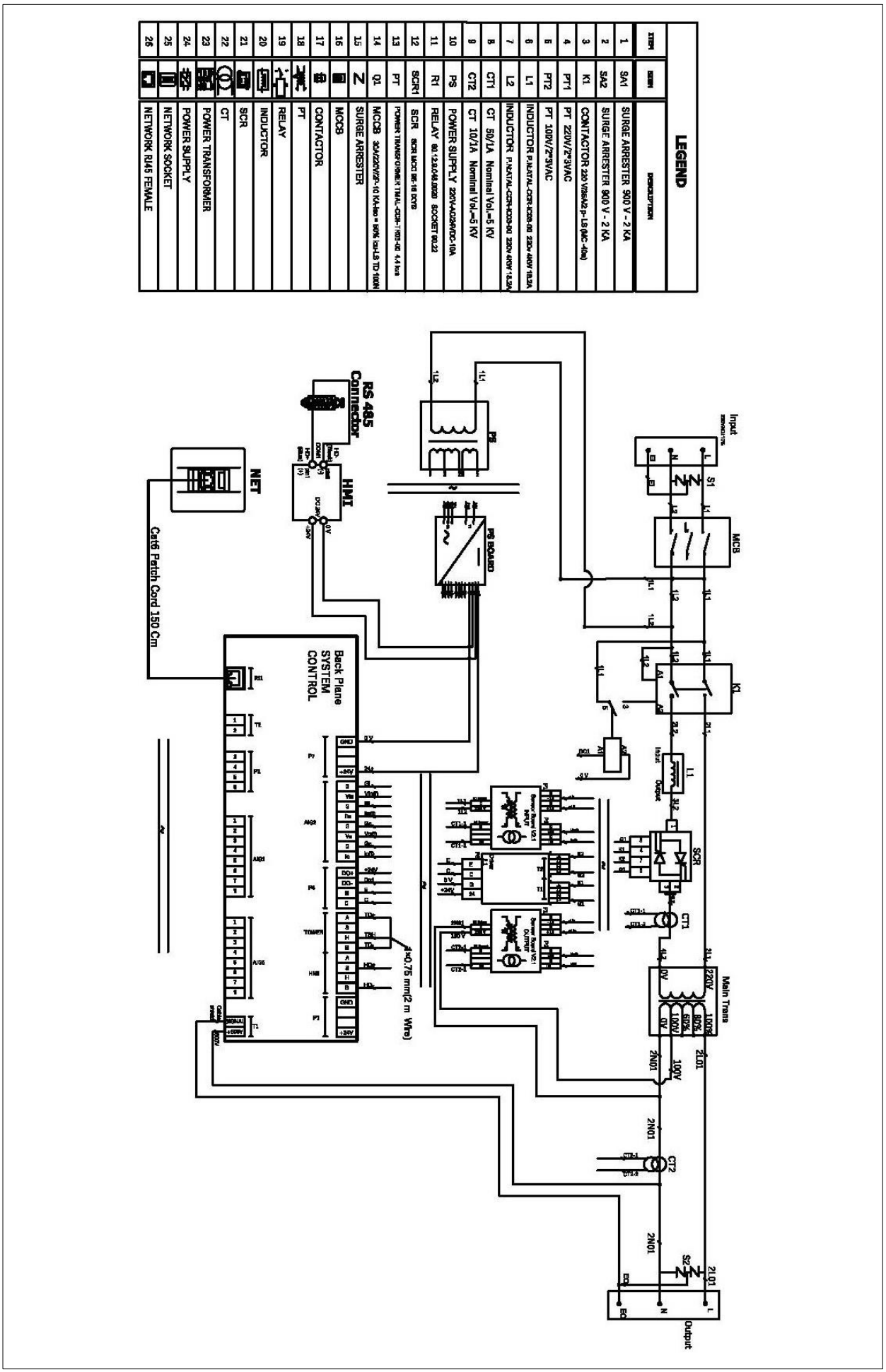
1. Over current monitoring
2. Open circuit monitoring
3. Fuse fault monitoring
4. Current regulation error monitoring
5. Input power loss monitoring
6. Output V-A Drop monitoring
7. Earth fault monitoring
8. V1, I1, V2, VA2 monitoring
9. Elapsed time monitoring

2-4. ELECTRICAL DESCRIPTION

2-4-1. BLOCK DIAGRAMS



2-4-3. GENERAL CIRCUIT DIAGRAM



2-5. MECHANICAL DESCRIPTION

2-5-1. EXPLODED DIAGRAMS

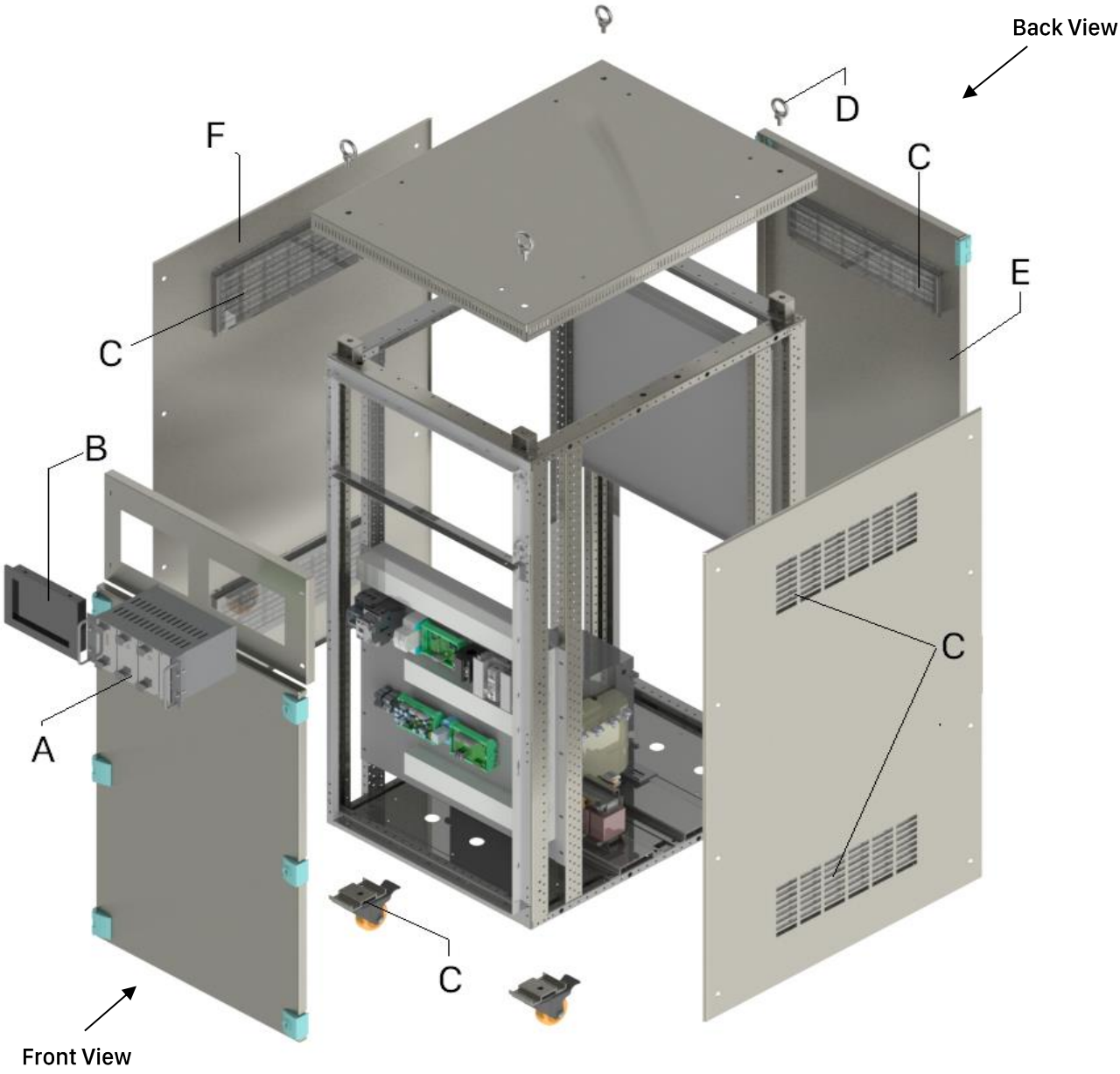


Figure 3 Exploded diagram

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

B. OLED

C. Ventilation grids

D. Transport clips

E. Back Page

F. Side Page

G. Wheels

2-5-2. Front & Back View

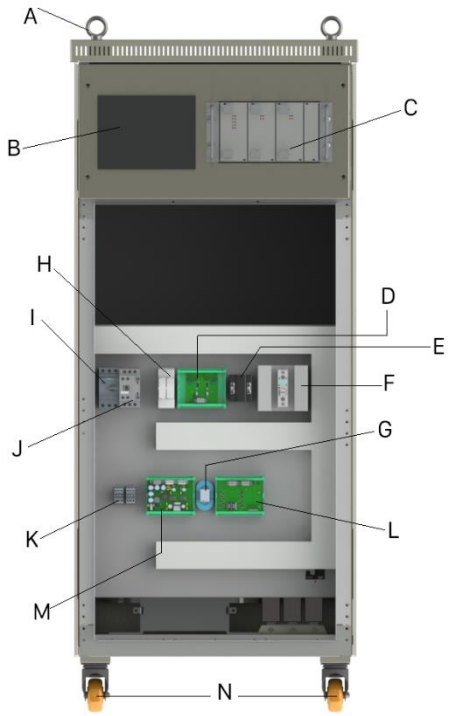


Figure 4 Front view

A. Transport clips
B. OLED
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

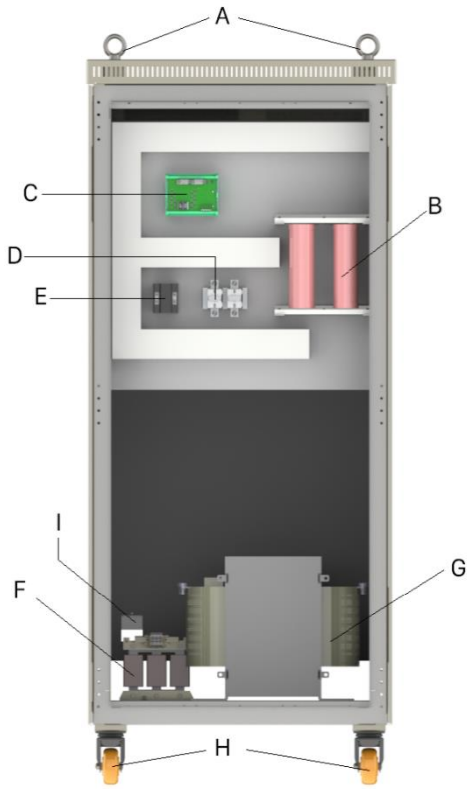
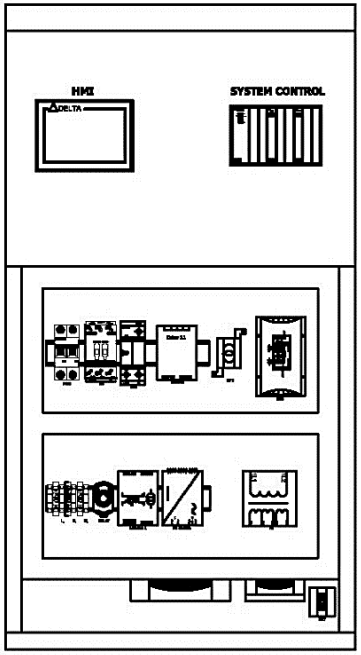
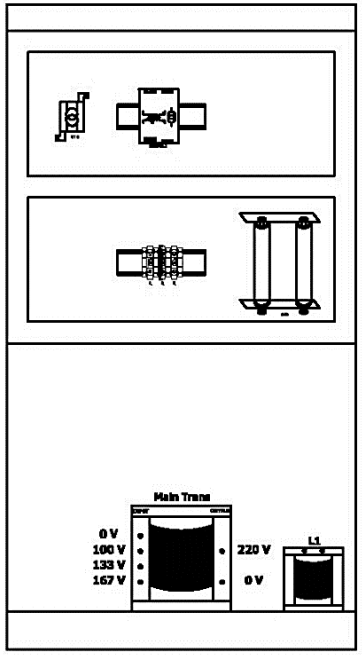


Figure 5 Back view

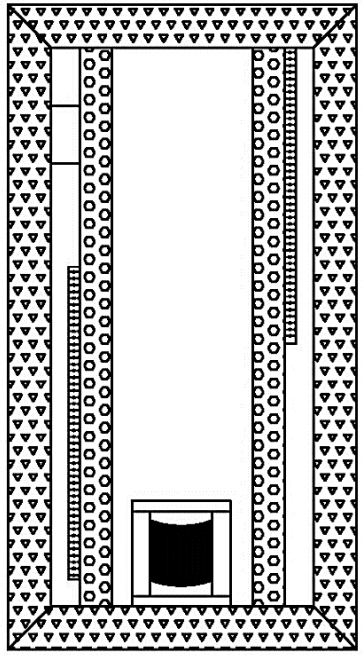
A. Transport clips
B. Surge Arrester
C. Sensor Board Output
D. Terminals
E. Current Transformer
F. Inductor
G. Main Trans
H. Wheels
I. NET



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.

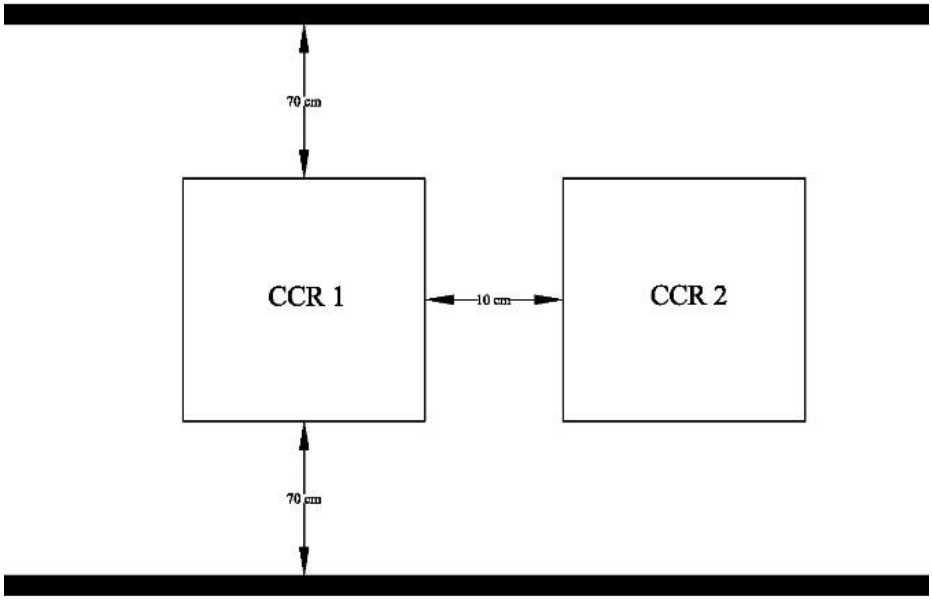


Figure 6 Right dimensions place for CCR

3-2. REQUIRED TOOLS

A. Cable and connectors
B. Cable cutter
C. Cutter
D. Wire stripper
E. Automatic wire stripper
F. Pliers
G. Voltage tester
H. Flat-head screwdriver
I. Phillips screwdriver
J. Clamp multimeter
K. Cable lug, size 6
L. Tubular cable lug and terminal
M. Socket wrench
N. Cat 6 SFTP network cable
O. RJ45 network socket
P. Network tool
Q. Multimeter probe

3-3. PROCEDURE

3-3-1. Key Point

A. Select the appropriate type of cable for power supply to the CCR based on the power range.
B. The upstream protection switch must be selected according to the list.
C. For safe connection, it is recommended to use wire lugs or tubular cable lugs for the input cables.
D. CCRs are all produced with single-phase voltage, except when a specific project requires the capability of two-phase or three-phase production.

3-4. INSTALLATION

3-4-1. Checking Installation

A. Single phase power supply

The device has electrical characteristics that are shown on the rating plate and factory test report. You need to make sure that this is compatible with the power supply.

The software on the motherboard records the rated mains voltage. This is needed for calculations.

You can see the configured rated voltage on the identification plate, on the front panel. You can also find it in the “Calibration” menu.

B. LV Protection

Each regulator in the sub-station switchboard must have its isolation device that can be locked and show the status of the regulator.

The LV protection for each CCR, which is connected to these devices, must be sized according to the CCR power, the rated voltage, and the existing protection type on the CCR.

The table below is for reference only and applies to cable lengths of less than 30m between fuse boxes and CCR.

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

Table 5 applies to cable lengths of less than 30m between fuse box

C. Lighting loop

Verify that the CCR power matches the installed power, test the loop continuity, and count the number of lamps that are not working.

D. Management by remote control

Confirm the mode of the remote control:

1. Serial network / external voltage

For external voltage mode, make sure that the CCR can handle the remote-control voltage according to its electrical specifications.

3-4-2. Connections

A. Power and Earth
B. Lighting Loop
C. Remote Control Connections
D. Loop Current
E. Circuit Selector

3-4-3. 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 6 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

2. Protection
   See § *2-3-6*.

   A. Earth fault level 1 = 1MΩ (if option present)
   B. Earth fault level 2 = 100KΩ (if option present)
   C. Restarts number = 1
   D. Over-current level 1 = 6.85 A (+ 4%)
   E. Disable time = 4s
   F. Over-current level 2 = 6.93 A (+ 5%)
   G. Disable time = 2s
   H. Over-current level 3 = 7.10A (+ 8%)
   I. Disable time = 1s
   J. Over-current level 4 = 8.30A (+ 25%)
   K. Disable time = 0.3s
   L. Open circuit current = 1.50A
   M. Disable time = 1s

3-4-4. Calculate resistance of series circuit

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

Where:

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

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

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

3-4-5. Complete the measurement

A. Make sure that the measured and the calculated values match and be proportional to each other.
B. Connect the series circuit cables to the equipment.
C. Install the cover or the box panel.

3-4-6. Measure the output current to the series circuit

A. Make sure that the series circuit is measured and approved.
B. Make sure that all power to the equipment is OFF.
C. Make sure that the series circuit is connected.
D. Connect an AC current clamp to the series circuit cable.

Measure:

A. Switch ON the equipment and set it to LOCAL mode.
B. Select the step 6.6A.
C. If the output current does not reach 6.6A, change the series circuit configuration before you proceed.
D. Compare the output current reading on the MONITOR with the reading on the True RMS Multimeter.
E. Examine if the output current reading is in accordance with local regulations.
F. If not, do not continue.

Check brilliance level:

A. Examine if all light fittings have the same brilliance level.
B. Examine all the brightness steps separately.

Finish:

A. Wait for approximately 30 minutes and make sure that the equipment works correctly.
B. Make sure that all power to the equipment is OFF.

3-5. TRANSPORTATION

3-5-1. General considerations

When it comes to the transport requirements for a constant current regulator (CCR), it is important to ensure its safe handling and protection to prevent any damage during transportation. Here are some general considerations:

1. Packaging: The CCR should be packaged securely to protect it from physical damage, vibration, and moisture. It is recommended to use appropriate packaging materials such as pallet, anti-static bags, foam padding, or bubble wrap to provide cushioning and insulation.
2. Handling: The CCR should be handled with care to avoid any mechanical stress or impact. It is advisable to hold the device by its edges or use proper handling tools to minimize the risk of damage to its components.

   In transportation, the CCR along with a pallet are delivered. The pallet is securely fastened underneath the crane using four screws. This setup allows for easy movement, as well as convenient wheel attachment, during the process of transportation.

3. Temperature and Environmental Conditions: Pay attention to the temperature and environmental conditions during transport. Extreme temperatures, humidity, or exposure to moisture can potentially affect the CCR's performance and reliability. Ensure that the transport environment remains within the specified temperature and humidity range provided by the manufacturer.
4. Documentation: Include any relevant documentation, such as user manuals include safety instructions, with the CCR during transport. This information will be beneficial to the recipient for installation, operation, and maintenance purposes.
5. Compliance: Verify that the CCR complies with any applicable regulatory standards of certifications required for transport. This may include safety certifications, electromagnetic compatibility (EMC) compliance, or other relevant regulations depending on the application and jurisdiction.
6. Shipping Method: Choose a reliable shipping method that provides appropriate handling and tracking for valuable electronic devices. Consider using a shipping service that offers insurance coverage for the package to protect against loss or damage.
   For transportation, the suggested means is a crane equipped with suitable cables. The cables are connected to four hooks located on the upper surface of the CCR. With this setup, the CCR can be easily moved and used for delivery purposes.

After delivering the device to the customer and placing it in a suitable location considering water, levelness, humidity, and electrical connections, you can use a pallet jack or a lift truck to lift the CCR off the ground. Then, you can loosen the pallet screws and connect the four wheels to the device using the appropriate tools. The wheels consist of two brake-equipped wheels at the front of the CCR and two regular wheels at the back. By doing this, the CCR can be easily moved to different locations as needed.

It is crucial to consult the specific guidelines and recommendations provided by the CCR manufacturer for the best practices regarding transport requirements. Following the manufacturer's instructions will help ensure the safe and intact arrival of the constant current regulator at its destinations.

3-9. Installation and setup Guidelines:

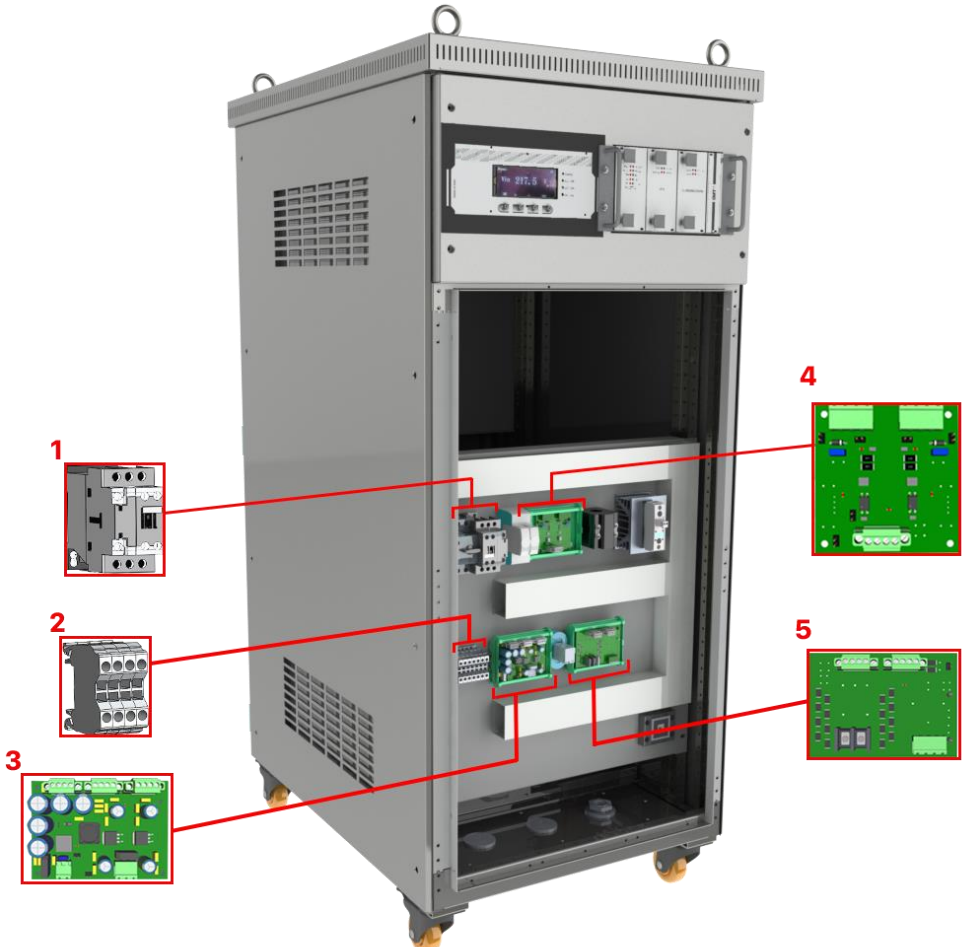


Figure 7 Installation and setup Guidelines

After placing the Constant Current Regulator (CCR) in the electrical panel, the following steps need to be performed in sequence:

A. After placing the CCRs properly, arrange the illumination band cables neatly on the cable tray from the cable gallery, and pull them behind the CCRs.
B. All input and output rings of the illumination band need to be labeled.
C. All CCRs should be powered from a separate input line, and the upper hand air key (MCCB) must have a current one step higher than the MPCB key within the CCR.
D. To start the CCR, set the transformer's output tap 1/8 initially.
E. Short the transformer's output.
F. Measure the output current of the CCR using clamp ammeter.
G. Check all connections once to ensure that the phoenix socket connections on the control systems boards are secure.
H. After verifying correct and complete connections, start the CCR in the first step, 2.8A.
I. Allow the output current to stabilize at this moment.
J. The value shown on the OLED board must match the current reading on the clamp ammeter.

K. Then select the second step and repeat the above steps, recording them in the CCR checklist.

L. Test the CCR in all 5 steps from 2.8 to 6.6 amperes and record the values exactly on the corresponding checklist for both OLED and clamp ammeter.

M. Turn off the CCR and place the MPCB switch in the off position.

N. Use an appropriate tap for the requested power from the CCR.

O. For a 20KW CCR, at 1/8 tap, it has power output pf 2.5 kilowatts.

P. Open the secondary connection of the CCR and connect the two band rings of the airport

Q. Measure the output current of the CCR using a clamp ammeter.

R. Place the MPCB switch in the on position.

S. Start the CCR in the first step, compare the output current on the OLED with the clamp ammeter reading, and record the startup of the CCR on the checklist.

T. Turn on the CCR in all steps from 2.8 to 6.6 amperes and record the output current on both the clamp ammeter and OLED in the respective checklist.

U. If the power exceeds the specified limit on the transformer's output tap, increase the tap setting.

V. Using maximum power to avoid excessive voltage drop is not recommended at all. This can lead to the imposition of reactive power on the network.

W. Connecting the secondary lighting band cable to the CCR output terminals must be done using a heat-shrink insulated cable rated at 10.

X. It is necessary to connect the shield of the secondary lighting Runway cable (input and output rings) to the grounding wire wing a branch terminal and then connect it to terminal Eo.

Y. The bonding of the CCR body, terminal Eb, and CCR input power supply ground terminal, which is related to the body ground, should be isolated from secondary cable ground and connected to the main grounding bar.

Figure 8 Installation and setup Guidelines

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

Table 7 Calculating cross-sectional area of copper and aluminum wires

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

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.

4. COMMISSIONING

NOTE:

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

4-1. Process

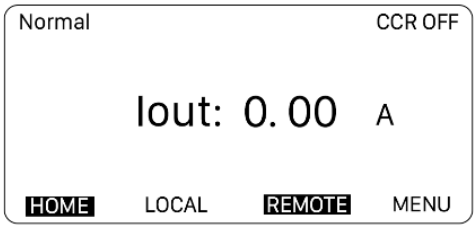
A. Turn off the master switches of the fuse box or the main circuit breaker.

B. Ensure that the cut-out plate jumpers are in a vertical position.

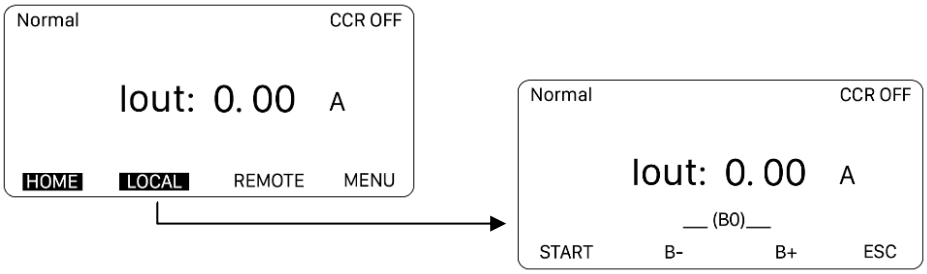
C. Close the CCR front panel

D. Connect to the power.

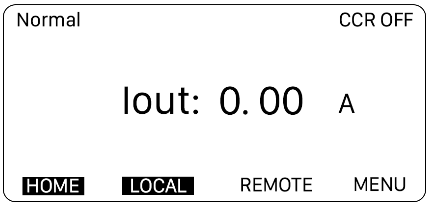
The display lights up:



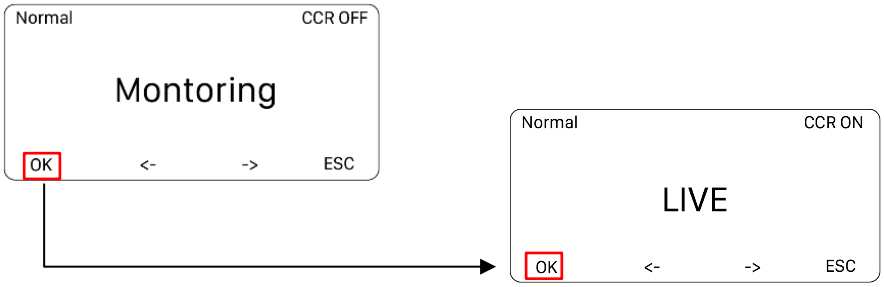
E. Press Local button, the display seems to:



F. Press the ESC button:

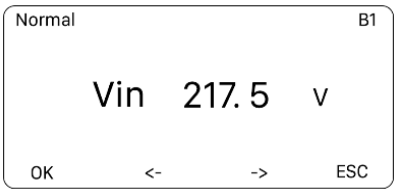


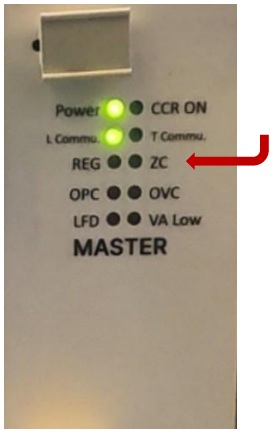
G. Press the MENU button:



H. Press the OK button and then press arrow keys to see Vin:

If the connections are correct, the Vin ≈ 220V.





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

J. Now CCR is ready to startup.

4-2. Tests

A. Switch off the CCR from the power.

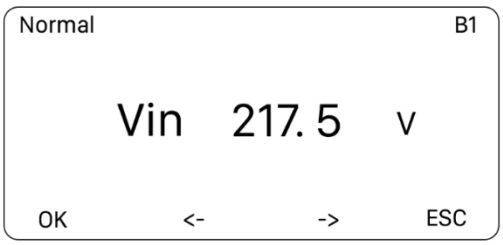
B. Completely disconnect the lighting loop.

C. Short circuit terminals “HV1” and “HV2” on the load plate, and install Ampere meter in series.

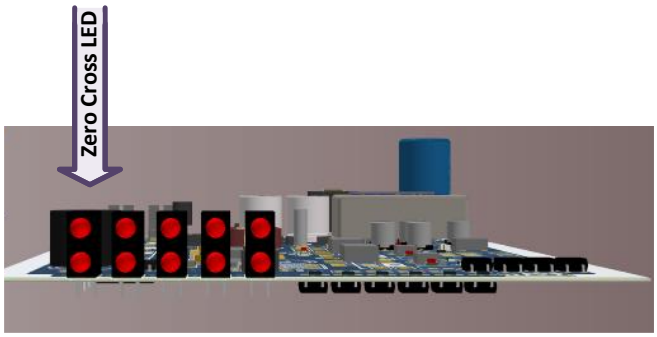
D. Connect the input power cable.

E. Connect the input key.

F. Verify the presence of a 220V voltage on the OLED.



G. Observed the blinking LED indicating the Zero Cross on the Main board.



H. If all the previous steps are observed, it means that the CCR device is in good condition and ready to be powered on.

I. Go to the local menu and start CCR in step A. Compare output current in display with the Ampere meter value. If the values are the same CCR is ok and ready to use. Check other steps as well.

J. Compare the measured output current by the clamp with the displayed output current on the Monitor.
K. If the measured current matches the displayed current on the OLED, the CCR device is in good condition and approved.
L. Use the selection buttons to gradually increase the brightness levels while verifying the current value displayed on the numeric screen. The maximum brightness is fixed at 6.6A.
M. Reduce the brightness levels again and then halt the CCR by pressing the stop button.
N. Verify the CCR's operation in remote control mode.
O. Progressively increase the brightness levels using the selection buttons while systematically checking the current value shown by the numeric display, maximum brightness being fixed at 6.6A.
P. Decrease the brightness levels again then stop the CCR.
Q. Disconnect from the power, connect the Lighting loop (or replace the jumpers of the Cut-out option), and eventually re-adjust the load tapping.

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.

4-3. Procedure

1. Measure the input voltage
    A. Make sure that the manual switch is in the OFF position.
    B. Open the front door.
    C. Set the manual switch to the ON position.
    D. Put the CCR in Local mode.
    E. Push the OFF button. The equipment goes to the mode OFF.
    F. Measure the input voltage on the input terminals. Use a True RMS Multimeter.
    G. Examine if the voltage is in accordance with:
        i. The nameplate of the equipment.
        ii. Local regulations.
    H. Switch off the power supply.
    I. Close the front door.
2. Measure the output current in short circuit
    A. Make sure that all power to the equipment is OFF.
    B. Put the output in short-circuit.
    C. Measure the output current in short-circuit.
    D. Make sure that all power to the equipment is OFF.
3. Measure the resistance and the insulation resistance of the series circuit
    A. Prepare the series circuit.

B. Measure the resistance of the series circuit.
C. Measure the insulation resistance of the series circuit.
D. Calculate minimum insulation resistance of series circuit.
E. Calculate resistance of series circuit.
F. Complete the activities.

4. Measure the output current to the series circuit
   A. Make sure that the series circuit is measured and approved.
   B. Make sure that all power to the equipment is OFF.
   C. Make sure that the series circuit is connected.
   D. Connect an AC current clamp to the series circuit cable.
   E. Switch ON the equipment and set it to LOCAL mode.
   F. Select the step 6.6 A.
   G. If the output current does not reach 6.6 A, change the series circuit configuration before you proceed.
   H. Compare the output current reading on the OLED with the reading on the True RMS Multimeter.
   I. Examine if the output current readings are in accordance with local regulations.
   J. If not, do not continue.
   K. Examine if all light fittings have the same brilliancy level.
   L. Examine all the brightness steps separately.
   M. Wait for approximately 30 minutes and make sure that the equipment works correctly.
   N. Make sure that all power to the equipment is OFF.

4-4. Open-Circuit Test

To stop the CCR after about 0.3 seconds of running time with fault indication, you can physically disconnect the loop or remove the jumpers of the Cut-out option and then start the device.

4-5. Overload Tests

To perform this test with confidence, adjust the two brass straps of the load plate so that the maximum power of the CCR is significantly lower than the loop power. This will ensure that even in the event of a direct short-circuit of the thyristors, the current delivered by the equipment will always remain below 6.6A. This test can be conducted with certainty as part of a breakdown investigation, allowing a device that is already in service to be put back into operation without causing any damage to the lighting loop and without prior knowledge of its condition.

4-6. Calibrate Lamp Fault Detection

Do this procedure to make sure that the equipment indicates the correct number of broken lamps.

The equipment analyses the output current and the voltage pattern to calculate, on a linear load, the number of open circuited lamps, in compliance with IEC 61820. The accuracy is ± 1 lamp with a range from 1 to 15 broken lamps. The MONITOR shows the actual LFD value.

A. Make sure that the equipment is connected to the series circuit
B. Switch ON the equipment and set it to LOCAL mode

    Before you do any adjustments on the equipment, examine:

    I. the alarm and back-indication signals on the display and/or remote control
    II. if the power supply to the equipment is within the acceptance limits
    III. if the fused input switches and auxiliary fuses are operational
    IV. if the input fuses and auxiliary fuses work normally
    V. if all connectors are correctly in place
    VI. if no components show burned marks
    VII. if the input circuit breaker is in the 'open' position
    VIII. wires are not interrupted or damaged

C. Set the equipment to the highest brightness step
D. Examine if all light fittings light up. Go to the runway area to make a visual inspection
E. Push the OFF button on the UI
F. LFD calibration
G. Remove lamps
H. Examine the LFD measurement
I. Set alarm level

4-7. Adjust the number of available brightness steps

1. Use the configuration software tool
2. Examine all brightness steps one by one
    A. Make sure that the equipment is powered ON, in the ON state and in Local mode
    B. To select a brightness step, push the corresponding number on the keypad

5- 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.

5-1. Preliminary checks

Before any operation or adjustment check for

A. Local panel indications or back indication signals
B. Power supply voltage off
C. Cut off input fuses
D. Loose connections
E. Opens in wiring

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 MCB status
	Power supply fault	Check the power supply output
Indication "RE" and main Contactor are not energized	Power supply level too low (less than 80% nominal value) Current control module	Check the power supply. Correct eventually (if possible) The Voltage level. Replace or debug the module (volt age level monitoring)
Indication "RE" and main Contactor are energized	Shut Down by Inter connecting Terminal "COM" with "SHUT-DOWN" Current control module	Check if the signal is given and correct Replace or debug the module (thyristor turn-off circuit)
Protection of the power supply to the CCR Became operational	Too fast acting or too low-level Power supply wiring or CCR components	Eventually resize this Protection Check the wiring to the CCR Check the CCR (internal wiring, terminals, circuit breaker)
Circuit Breaker trips	Internal wiring or Components of the CCR Output circuit short circuit. Too sensitive circuit breaker	Check the CCR for short circuit or damaged insulations. Check the insulation of the output circuit. Check the circuit breaker.

No Communication LED Blinking in Display side	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 with ATC	The infrastructure fault	Check the Ethernet cable and the network privacy.
	Display Board Fault	Change display
The CCR has stopped The message: “ALARM: OPC.” is displayed	Lighting loop open	Measure the continuity of the loop (on the transformer primaries and secondaries)
	Contactor Fault	Check the Contactor status, change Contactor
	Glass relay fault	check it
	Output current < 1.0A for more than 500 ms	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 trigger-gates faulty	Measure the state of the thyristors
	Thyristors faulty in open circuit	Measure the state of the thyristors
	Output Sensor board	Change the Sensor board
The CCR has stopped The message: “ALARM: 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 and signal “RE” is given	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, send address correctly from PC
Data Not receiving, no Indication on CCR	Data Transmitting From PC	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: "ALARM: OVC." is displayed	Change the Lights when the circuit is on.	Change the lights when the circuit is off.
LV power protection fuses 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 circuit breaker 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.

5-2. 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

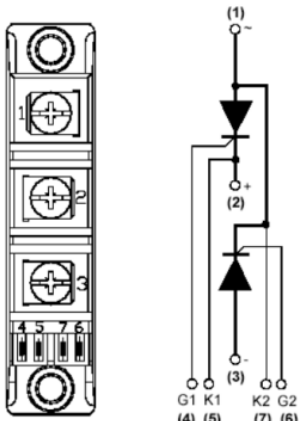


Figure 9 Thyristors

5-3. Locating Ground Faults in the Field

5-3-1. Grounded Circuit Analysis

Once it has been established that the circuit is shorted to ground, the troubleshooting procedures can be moved to the field. Keep in mind that if there is a section of lights out on the circuit, there will ALWAYS be at least two shorts or ground faults in the circuit.

A. At this time the circuit may be energized and a visual inspection can be made to try to locate the faults. If the circuit is a simple loop configuration, a visual inspection can sometimes be an effective means to find the problem.
B. It is best to have someone at the vault with a radio so that as soon as the good to bad transition areas in the circuit are located, word can be sent to the vault to shut off the regulator and lock it out so that repairs can be made.
C. Drive along the circuit looking for any section of lights that are out or appear to be extremely dim and mark this area by putting a surveyor's flag or a paint mark at the locations of the last light burning and the first light out. After the circuit has been de-energized and locked-out, check the lights at each end of these "transition areas" for burned transformers, connectors, etc.
D. Always remember that there will be at least two shorts in the circuit and both must be repaired. In some instances, especially in the case of direct-buried cables or when the circuit has been energized for a long period of time while ground faults are present, more than two shorts to ground may have occurred.

5-3-2. VOM Ground Fault Detection

The best method for finding ground faults after the initial visual inspection has been made is to locate them using the VOM.

A. Leave the ends of the circuit separated at the vault and suspend the ends of the cables in free air if disconnected from the cut-out or other connection.
B. Refer to as-built plans if available to locate the center of the circuit and break the circuit at that point by disconnecting the cable at one side of the transformer.
C. Take a reading to ground in both directions from this point and determine which way the fault is located. It is entirely possible that the meter may indicate a fault in both directions from this point or only in one direction as there may be two or more faults in the same section of cable.
D. Leaving this connection open (if possible), proceed to a point in the circuit approximately halfway between the midpoint and the vault in the direction of the fault and break the circuit again. As before, take a reading on the circuit in each direction to determine the location of the fault. Continue until each fault is located and corrected.

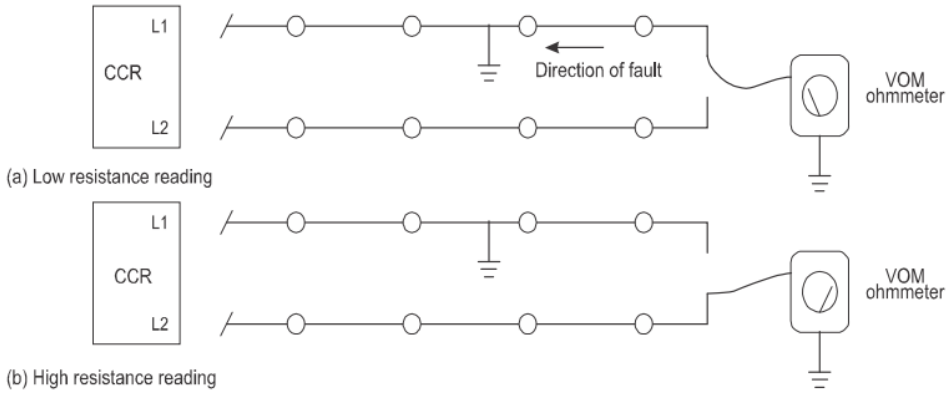


Figure 10 VOM Ground Fault Detection

During the course of troubleshooting, when you remove a transformer from the base or the ground if direct buried, you may find that the fault seems to disappear. When this happens, the fault is located at that transformer; normally you can visually see the burned transformer. However, in the case of an internal primary to secondary short in the transformer, there may not be anything readily apparent. Look at the fixture attached to the transformer and check to see if the socket or secondary plug is burned. This is usually a good sign of a primary to secondary short. A short of this nature can be confirmed by touching one lead of the VOM to one of the primary leads of the transformer and touching the other to one of the sockets on the secondary connector. If the transformer is shorted, continuity will be indicated on the meter. Sometimes checking between one of the primary connectors and the outside body of the transformer will indicate a transformer with a significant leak to ground. This can be performed with an insulation resistance tester for better results. If checking the insulation integrity of transformers, you can also submerge the transformer in a bucket of water and connect the positive lead of the resistance tester to one of the primary leads and the negative lead to a bare wire dropped into the bucket. If any leakage is shown, the transformer is suspect or bad depending on the reading. Reasonably new transformers should read over 1000 Mega Ohm, with readings decreasing with age.

5-4. Locating Open Circuit in the Field

5-4-1. Opened Circuit Analysis

Open circuits can be successfully located using similar tactics as those used for locating short circuits or ground faults. If the circuit appears to be grounded in conjunction with an open, the troubleshooting procedure used for finding ground faults may be used since the open and ground will likely be located at the same place. Many times, a cable will burn in two if left operating after a short to ground has developed. If the initial fault investigation has revealed an open in the field circuit and the circuit does not appear to be grounded, de-energize the regulator and lock out the regulator power supply and proceed to the field and locate the approximate center of the circuit.

For this type of troubleshooting where you are looking for continuity, it is helpful to have the ends of the circuit connected together at the vault via the cut-out or some other means as shown in Figure

16-5. That way, when the problem is corrected, it can be verified by being able to read a loop from any point in the circuit.

A. Proceed to the approximate midpoint of the circuit and disconnect the circuit at the transformer and ground the circuit in both directions. Check for continuity to ground at another point in the circuit by disconnecting the transformer.

B. If the circuit is connected together at the vault and you have only one open in the circuit, you should read continuity in one direction but not the other back to the grounded midpoint of the circuit.

C. When the grounded conductor is identified, have someone at the midpoint connection make and break the connection to ground in one direction and then the other until you have established which section of the circuit is open.

D. Then proceed to a point halfway between your present location and the grounded midpoint in the section of the cable that is open and take another reading. If this time you can read to ground in the direction of the midpoint of the circuit, then you know that the open is behind you or between you and the last point you tested. By moving the intentional ground point and looking for continuity in each section of the circuit, the open(s) can be quickly located.

5-5. Check and measurements

5-5-1. Measure input voltage

A. Make sure that the main 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

5-5-2. Measure output current

A. Make sure that main switch 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

5-5-3. Check fuse breaker and voltage of switch board

A. Make sure that main switch is OFF

B. Check the nameplate of the equipment to make sure that the fuse breaker voltage and the current rating of the switchboard is compatible with the equipment. Allowed variance by standards:
    - IEC: ±10%
    - FAA: ±10%
C. Set the main switch to ON
D. Measure the voltage of the switchboard. (Use a calibrated True RMS multimeter)

5-5-4. Calculate minimum insulation resistance of series circuit

A. Calculate the minimum insulation resistance of the series circuit
B. Make sure that the calculate values are higher that the values measured during commissioning

5-5-5. Calculate resistance of series circuit

A. Calculate the resistance of the series circuit
B. Make sure that the calculated value is higher than the value measure during commissioning

5-5-6. Measure cable capacitance

Measure the cable capacitance toward the ground as follows:

A. Make sure that the main switch is OFF
B. Connect a multimeter to the regulator output cable. (Use a Multimeter that has an internal resistance of 10MΩ)
C. Disconnect the 500v DC power cable to the EFD module. (The multimeter now measures the discharge time of the cable capacitance from 400v DC to 147v DC)

5-6. LV power fault

A. Cause: CCR has stopped with message “Bad supply”

Solutions: Check the voltage level of the LV power supply / Check parameter settings in the “Configuration” menu

5-7. Open Circuit

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. Measuring board to mother board link faulty.

Solutions: Check state of the ribbon cable between measuring board and motherboard.

E. Thyristor trigger-gates faulty.

Solutions: Measure the state of the thyristors.

F. Protection detection level setting on motherboard.

Solutions: Check setting of the level in the menu “Alarms and warnings” then “Open circuit”.

G. Thyristors faulty in open circuit.

Solutions: Measure the state of the thyristors.

5-8. Overcurrent

A. Output current > programmed level.

Solutions: Large load decrease on the loop caused by circuit switching.

B. 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.

C. Faulty Thyristors in short-circuit.

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

D. SCR control cables disconnected or faulty.

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

E. Levels too low.

Solutions: Check levels in the menu “Alarms and Warnings” then “Overcurrent”.

5-9. Display remains off when CCR is connect to the power

A. CCR LV protection faulty.

Solutions: Check LV fuses.

B. Motherboard protection faulty.

Solutions: Check state of fuses F1 and F2 on the motherboard.

C. Motherboard faulty.

Solutions: Check motherboard with “Diagnostic” function of ALIZE software.

5-10. CCR does not work in remote control mode

A. Remote control protection fuses faulty.

Solutions: Check fuses.

B. Wrong configuration of remote-control type.

Solutions: Check configuration of remote-control type.

C. Insufficient remote-control voltage.

Solutions: Check remote control voltage (from 20 to 60Vdc or 120Vac).

5-11. LV power protection fuses trip during a brightness command

1. Thyristors faulty.

   Solutions: Check state of the thyristors.

2. Thyristors control boards faulty.

   Solutions: Replace the boards.

5-12. The switch does not close

1. Power supply fault.

   Solutions: Check state of fuse on the motherboard.

5-13. Burnt Lamps Detection

This option determines the number of burnt lamps in the output load. This is carried out by measuring the load Voltage versus Current phase shift. Internal parameters of the data collection system must be re-initialized each time the loop is modified (addition of transformers, replacement of transformers by more powerful ones, etc.) or if any settings have been changed (load adjustment, for example).

To increase the accuracy of the measurement, it is necessary to perform the calibration with 0 lamp burned (1st stage) and minimum 3% of lamps burned (2nd stage). Before perform the calibration, it is necessary to set the following parameter in the menu “Calibration”:

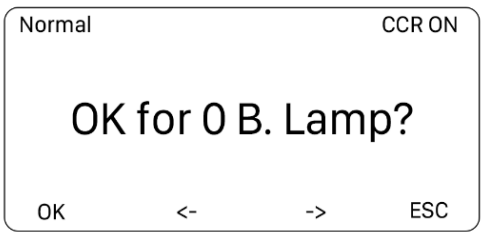
The X number must be set in function of the total number of lamps in the loop to realize the calibration (X can be set for 1 to 10 lamps).

Example: if the load loop is about 20 lamps, set the X parameter to 1 (1/20 = 5% > 3%).

Example: If the load loop is about 200 lamps, set the X parameter to 6 lamps. (6/200 = 3%).

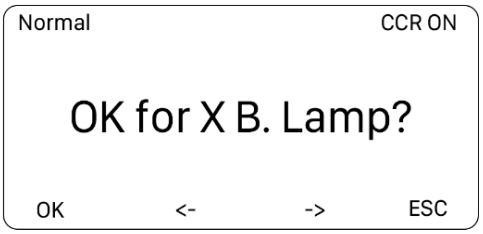
Initialization can be carried out in two stages:

A. The loop should be connected up to the CCR with no burnt lamp (all lamps are working). Go into the “Calibration” menu then:



Press OK to start initialization. The message “Wait please...” blinks, meaning that data collection is in progress. When the message stops flashing, data collection has been completed.

B. The loop should be connected up to the CCR with X lamp disconnected: Go into the “Calibration” menu then



Press OK to start initialization. The message “Wait please...” flashes meaning that data collection is in progress. When the message stops flashing, data collection has been completed.

The number of fault lamps can be seen in the “Monitoring” menu Two comparison levels (warnings level 1 & 2) are available. They are preferably fixed at 5 and 10.

6- 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.

6-1. 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

6-1-1. 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, fuse-holders or circuit breaker, contactor
B. Output terminals, brass straps on the load plate, and all screwed connections at the back of the load plate.

6-1-2. 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

6-1-3. 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

6-1-1. 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						×

6-2. Part Replacement

6-2-1. 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. Magnet rod for collecting loose items
   H. Angle socket wrench

6-3. Remove Panel

6-3-1. 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 rack and tighten the screws again.

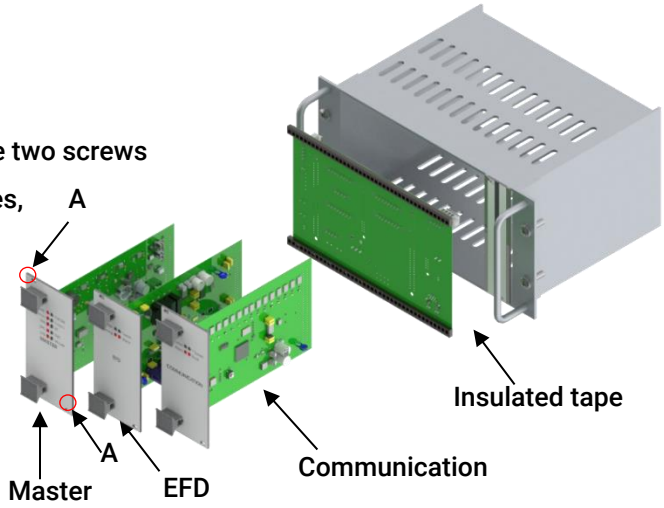


Figure 11 Sub Rack

7. 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 (Serial) , 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.

7-1. 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 serial communication for remote control.

1. Local Mode
2. Remote Mode (Serial Communication)

7-1-1. Local Mode

A. The CCR can be turned ON or OFF using the keypad by pressing the arrows buttons.
B. It has the ability to control brightness levels.
C. screens can be changed to monitor EFD, and Elapsed Time Modes when the CCR is in the OFF state.
D. Switches to communication mode.
E. Remain in the current state.

7-1-2. Remote Mode

A. Remote mode control is exclusive to external devices and cannot be operated through the keypad. Functional keys such as Step change and 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 12V, 48V, and 60V.
C. Only the mode can be changed to local while the CCR is in the OFF state. The LFD, and Elapsed Time can be checked regardless of the mode selected.

7-1-3. Serial Communication

A. Serial mode control is exclusively accessible through serial ports and cannot be operated using the keypad. All function keys, including step change and CCR-ON/OFF, are locked in this mode.
B. By default, the CCR is configured with a single channel for communication.
C. Optional dual from the PC is simultaneously transmitted through two ports. In case of cable failure on one port, the CCR seamlessly switches to the other port to ensure uninterrupted monitoring without any disruptions.

7-1-4. CCR Indications

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

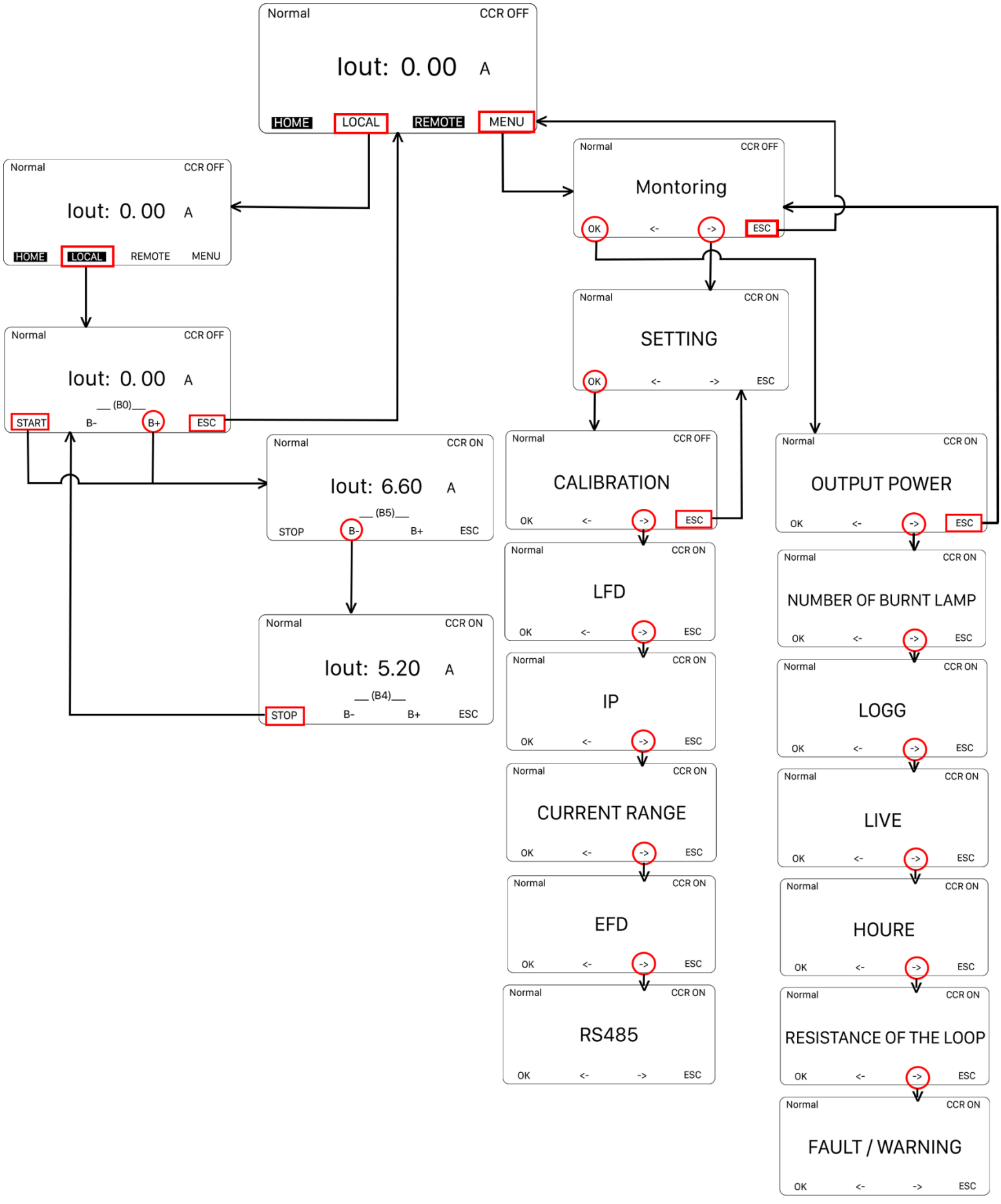
A. Display number of burnt lamps.
B. Display Earth leakage in kilo-ohm/Mega-ohm.
C. Display selected brightness level & constant step current.
D. Display of Elapsed Time of CCR-ON, step levels.
E. Alarm, indication of open circuit.
F. Alarm, indication of over current.
G. Alarm, Warning indication of burnt lamps.
H. Alarm, Warning indication of Earth Leakage.
I. Indication for input power loss.
J. Indication for current regulation error.
K. Indication for Output power (VA Low 10%).

7-1-5. Remote Indications

A. The OLED 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 keypad.

7-1-6. Serial Communication Indications

In the Communication mode, the status of the LCD is switched. Step levels are adjusted in response to commands issued by a PC. CCR-ON/OFF operation can be executed exclusively through communication with a PC and not through the keypad.

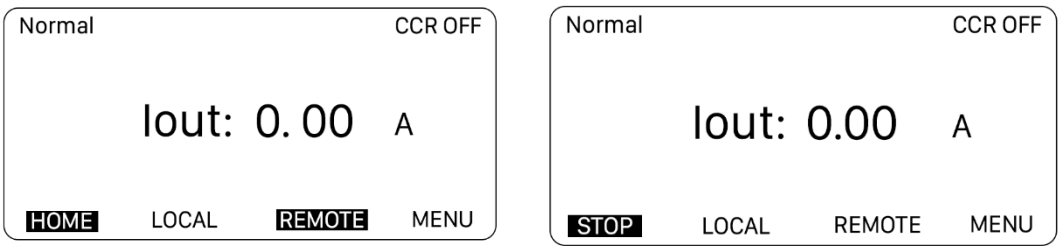

Normal
CCR OFF
Iout: 0. 00 A
HOME
LOCAL
REMOTE
MENU
Normal
CCR OFF
Iout: 0. 00 A
HOME
LOCAL
REMOTE
MENU
Normal
CCR OFF
Iout: 0. 00 A
__ (B0)__
START
B-
B+
ESC
Normal
CCR ON
Iout: 6.60 A
__ (B5)__
STOP
B-
B+
ESC
Normal
CCR ON
Iout: 5.20 A
__ (B4)__
STOP
B-
B+
ESC
Normal
CCR OFF
Montoring
OK
<-
->
ESC
Normal
CCR ON
SETTING
OK
<-
->
ESC
Normal
CCR OFF
CALIBRATION
OK
<-
->
ESC
Normal
CCR ON
LFD
OK
<-
->
ESC
Normal
CCR ON
IP
OK
<-
->
ESC
Normal
CCR ON
CURRENT RANGE
OK
<-
->
ESC
Normal
CCR ON
EFD
OK
<-
->
ESC
Normal
CCR ON
RS485
OK
<-
->
ESC
Normal
CCR ON
OUTPUT POWER
OK
<-
->
ESC
Normal
CCR ON
NUMBER OF BURNT LAMP
OK
<-
->
ESC
Normal
CCR ON
LOGG
OK
<-
->
ESC
Normal
CCR ON
LIVE
OK
<-
->
ESC
Normal
CCR ON
HOURE
OK
<-
->
ESC
Normal
CCR ON
RESISTANCE OF THE LOOP
OK
<-
->
ESC
Normal
CCR ON
FAULT / WARNING
OK
<-
->
ESC

7-3. User Interface

7-3-1. Operating mode

The device is controlled by mean of a 4 buttons keypad which allows to change the operating mode: “Stop” – Manual or “Local” mode – Remote or “Remote” control mode.

A. Stop mode:

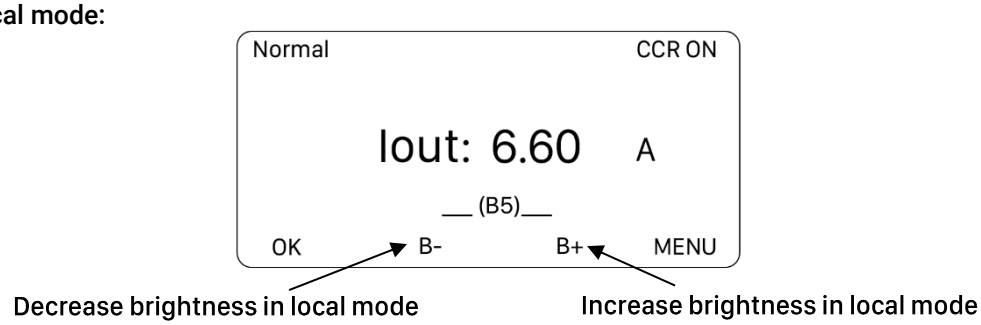


In that mode, “Stop” is highlighted. The CCR stops, whatever the current brightness orders (remote control or local selection). Menus can then be accessed.

Preferred information displayed: It can be changed by a long press on the “STOP” key, meanwhile the CCR is in Stop mode. The choice can be:

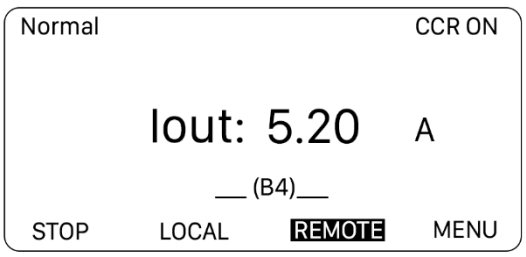
1. Output current Io – Brightness state Bx (as seen in examples below and above)
2. Output current Io – Output power
3. Output current Io – Output voltage

B. Local mode:



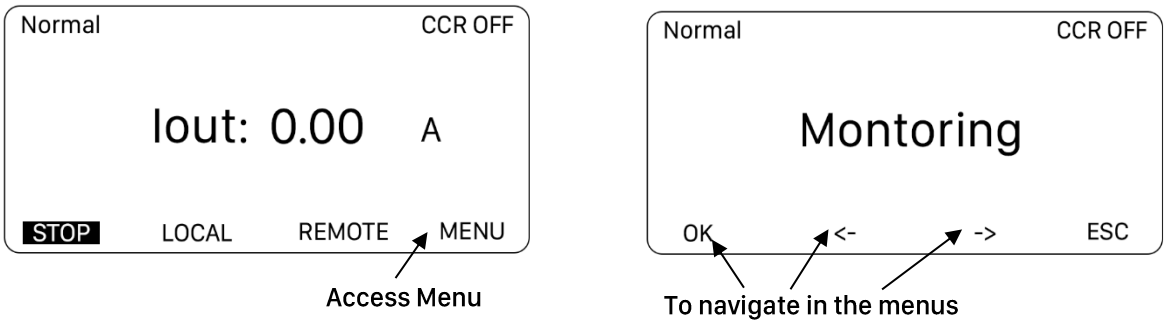
In that mode appears brightness controls: The brightness is chosen by pressing buttons B- and B+ (from B0 to B4 maximum, according to the number of brightness levels configured).

C. Remote control 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, or 120Vac), or the dry-contact type with internal power supply, and/or given by the mean of a serial network. (RS485, Ethernet)

D. Menus



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

- Monitoring
- Setting

By Pressing “Ok” you can use that menu, and by pressing “ESC” you can return to the previous menu.

7-3-2. Menu

7-3-2-1. Monitoring

A. Load Plate

(Menu → Monitoring → Load Plate)

The main function of the load adaptation plate is to adjust the power of the CCR to the installed power of the lighting loop.

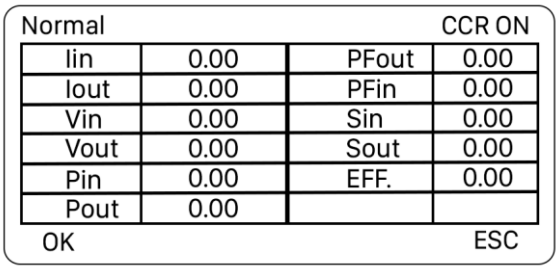
The load plate can be accessed from the back of the device. The value of the present tap of the load adaptation plate can be seen in the menu “Monitoring” then “Load tapping”:

B. Live

Alphanumeric display:

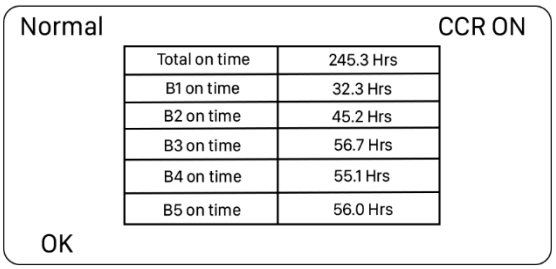
1. RMS input current
2. RMS output current
3. RMS output voltage
4. RMS input voltage
5. Input power supply
6. Output power supply
7. Output power factor
8. Input power factor

(Menu → Monitoring → Live)



C. Hour

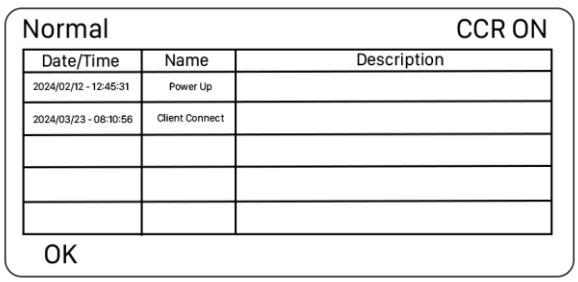
(Menu → Monitoring → Hour)



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

D. Logg

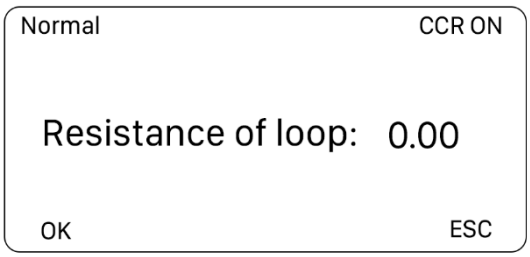
(Menu → Monitoring → Logg)



In the Logg menu, you can view all events such as power on, power off, errors, and related occurrences, read their descriptions, and take necessary actions if needed.

E. Resistance of loop

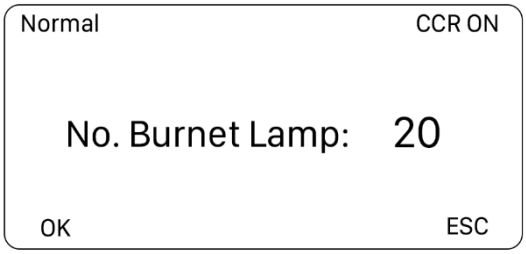
(Menu → Monitoring → Resistance of



The resistance ring parameter is one of the key points to consider when installing and setting up the CCR, which you can view in the specified menu.

F. Number of burnet lamp

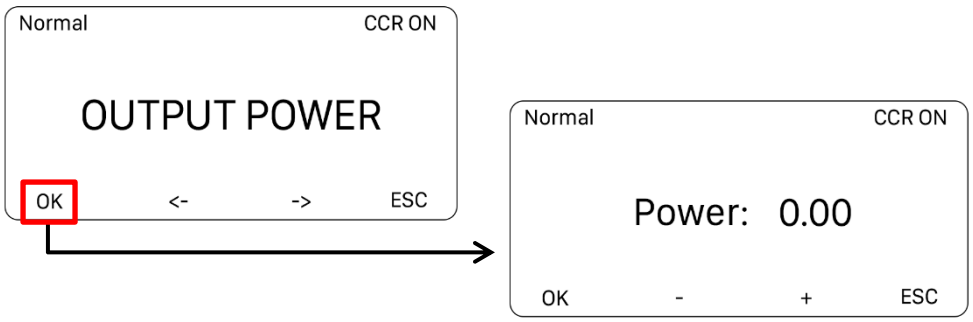
(Menu → Monitoring → Number of burnet



In this menu, you can view the number of burned lights in the Ring, and for its settings, you can access the specified menu.

G. Output Power

(Menu → Monitoring → Output Power)

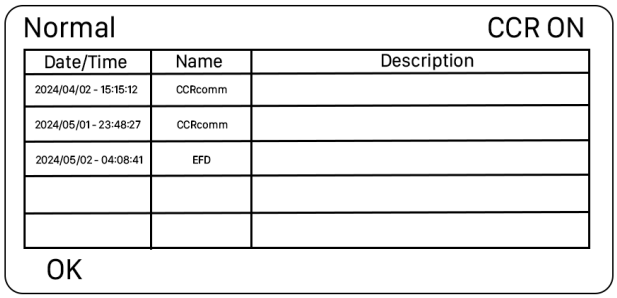


You can view Output power in this menu.

H. Fault/Warning

WARNING is an indicative message, which does not change regulation and supply function in connection with the load. (Except for mains warning). If any warnings have been detected, the following message(s) can be shown on the display

(Menu → Monitoring → Fault/Warning)



1. If option “EFD” exists:
   A. "No EFD" (interface EFD board not present or faulty).
   B. “No HV (500V) EFD” (no injection voltage: measurement of earth leakage cannot be done).
   C. “R Level EFD1” (A leakage has been detected, with a resistance value lower than the level 1).
   D. “R Level EFD2” (A leakage has been detected, with a resistance value lower than the level 2).
2. if option “Burnt lamps” exists:
   A. Level 1 Burnt lamps (The current number of burnt lamps is greater than level 1).
   B. Level 2 Burnt lamps (The current number of burnt lamps is greater than level 2).
   C. Power drop (if FAA selected: the load was cut more than 10%, in VA).
3. Mains power supply outside limits (Input voltage lower or greater than +/-10%).
4. Regulation outside limits (as “error regulation” programmed values).
5. "BAD Interface" message (control and monitoring board not present or faulty).

ALARM represents a major fault of the CCR or due to an external event, which have stopped the CCR (in order to protect itself or the lighting loop). In case of fault or damage, the display shows that the CCR stopped and one or more faults have been detected. The following message(s) are shown on the display:

1. Overcurrent
2. Open circuit (the CCR detected an output current lower and during a greater time than the programmed parameters)

In order to re-start (after having fixed the fault), cancel the ALARM pressing the RESET key.

7-3-2-2. Setting

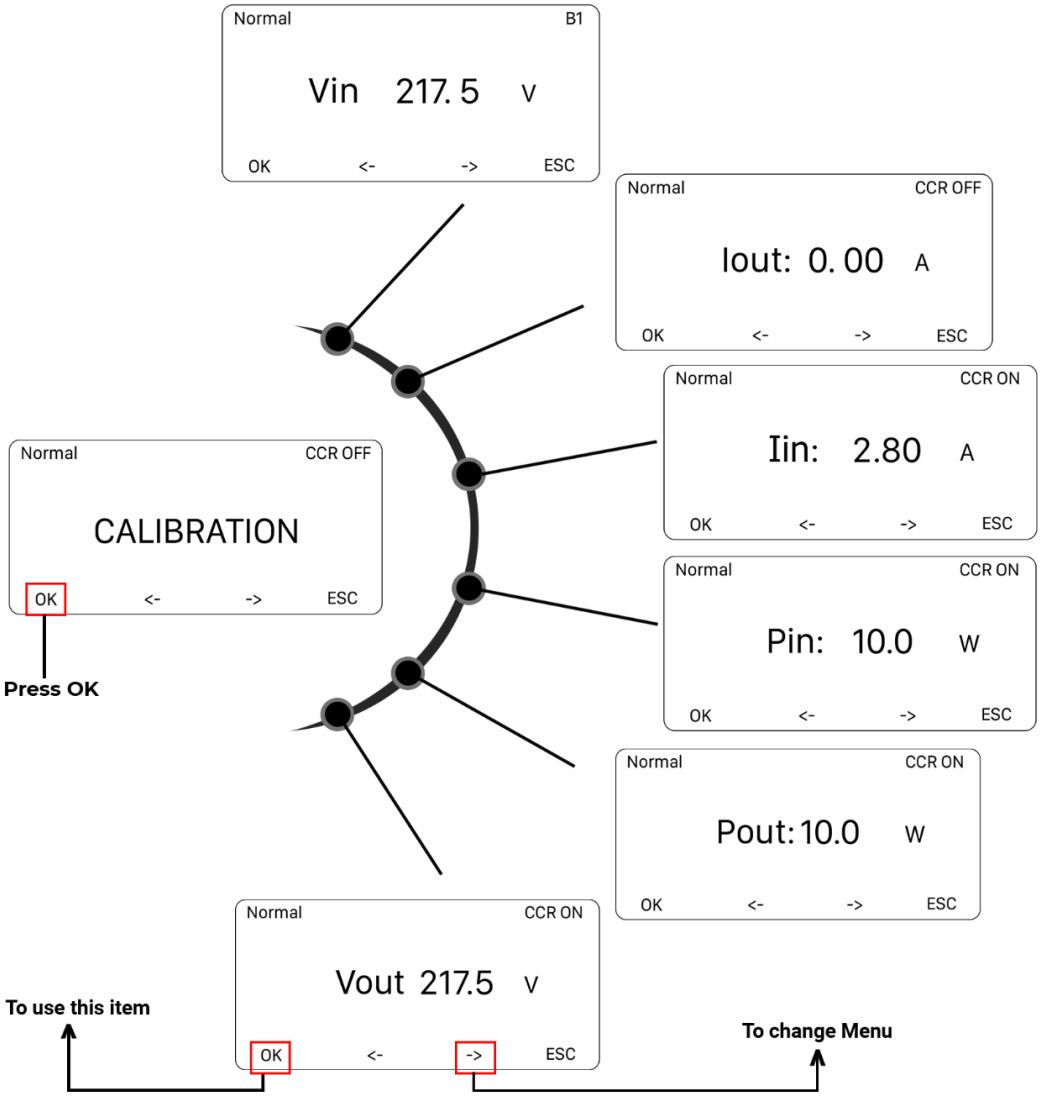
The “Setting” menu is used to assign values of current to brightness levels B0 to B4.

A. Minimum value = 2.8 A.

B. Maximum value = 6.6 A.

A. Calibration

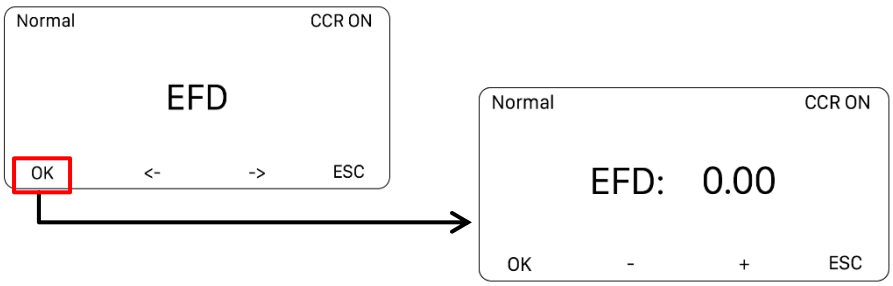
(Menu → Setting → CALIBRATION)



In the calibration menu, you can calibrate parameters such as input and output voltage, input and output current, input and output power.

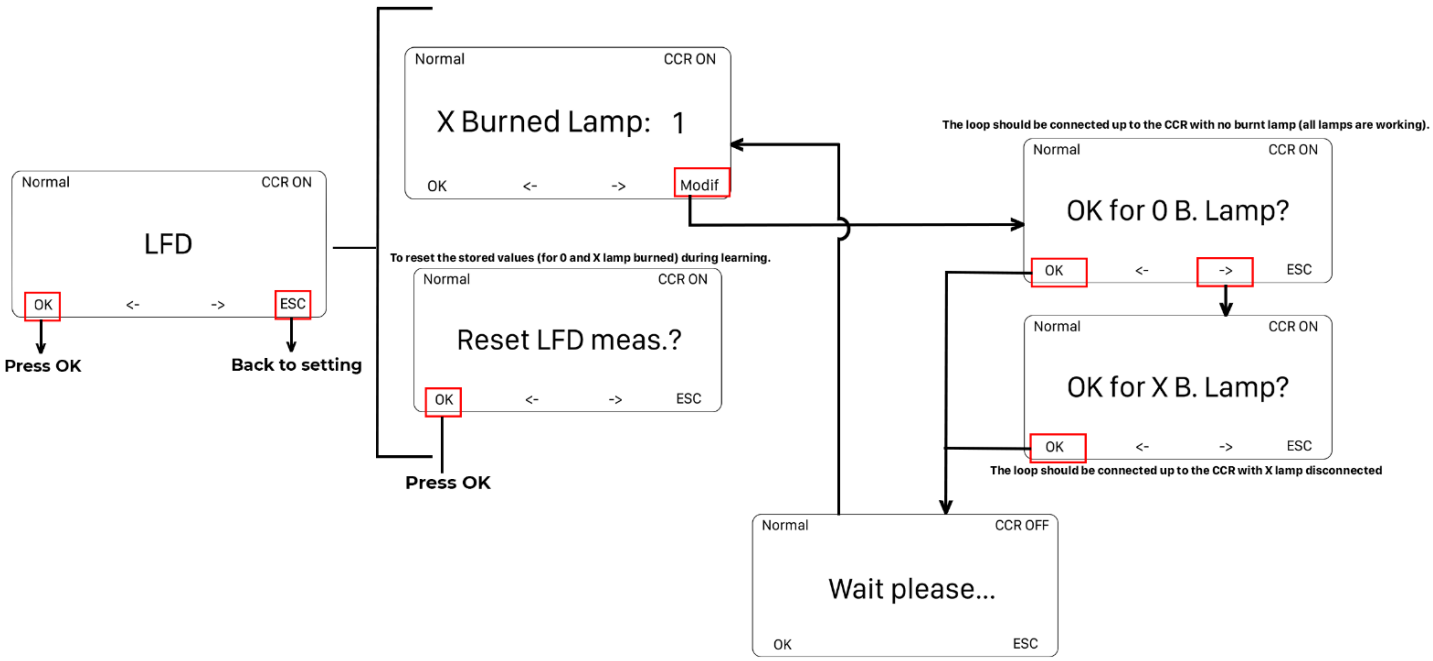
To do this, first navigate to the specified path to enter the calibration menu. Then, using the monitor keys, select you desired parameter (using the OK button) and perform the necessary actions to calibrate it.

B. EFD



C. LFD

(Menu → Setting → LFD)



Before perform the calibration, it is necessary to set the following parameter in the menu “LFD”:

The X number must be set in function of the total number of lamps in the loop to realize the calibration (X can be set for 1 to 10 lamps).

Example: if the load loop is about 20 lamps, set the X parameter to 1 (1/20 = 5% > 3%).

Example: If the load loop is about 200 lamps, set the X parameter to 6 lamps. (6/200 = 3%).

Initialization can be carried out in two stages:

1. The loop should be connected up to the CCR with no burnt lamp (all lamps are working). Go into the “LFD” menu then:

   Press OK to start initialization.

   The message “Wait please...” blinks, meaning that data collection is in progress. When the message stops flashing, data collection has been completed.

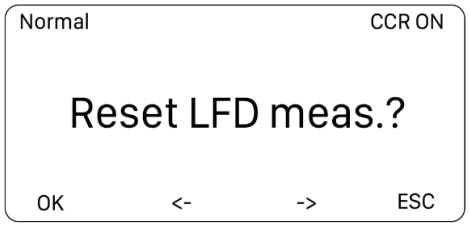
2. The loop should be connected up to the CCR with X lamp disconnected: Go into the “LFD” menu then

   Press OK to start initialization.

   The message “Wait please...” blinking meaning that data collection is in progress. When the message stops flashing, data collection has been completed.

The number of fault lamps can be seen in the “Monitoring” menu

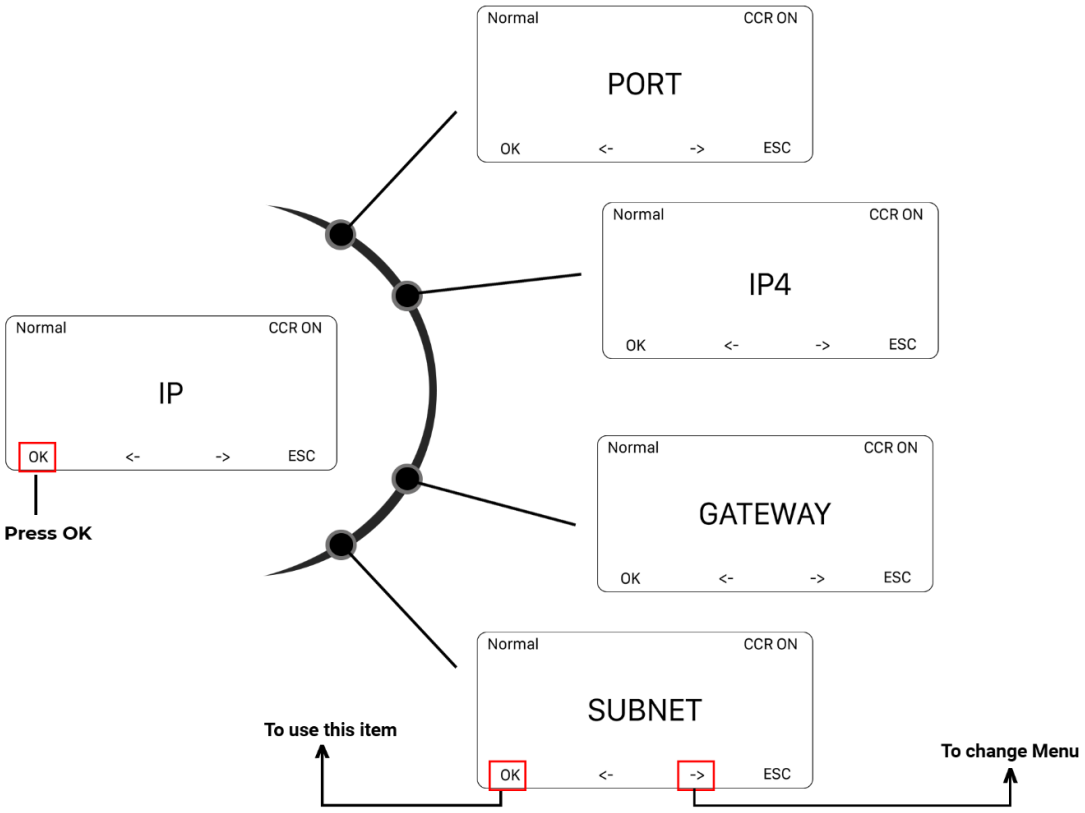
To reset the stored values (for 0 and X lamp burned) during learning. Go in the menu “LFD” then:



When press ‘OK’, learning is resetting and to determine the number of burnt lamps in the output load, it is necessary to realize a new learning calibration (for 0 and X lamp burned).

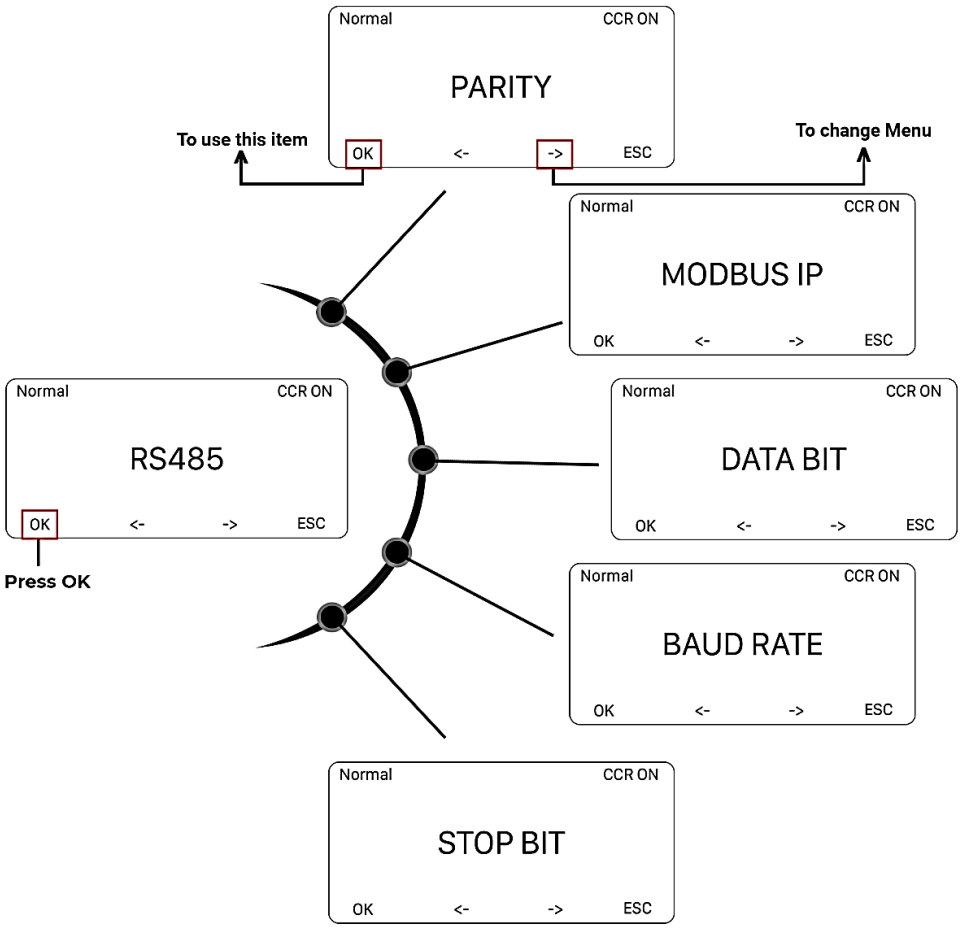
D. IP

(Menu → Setting → IP)

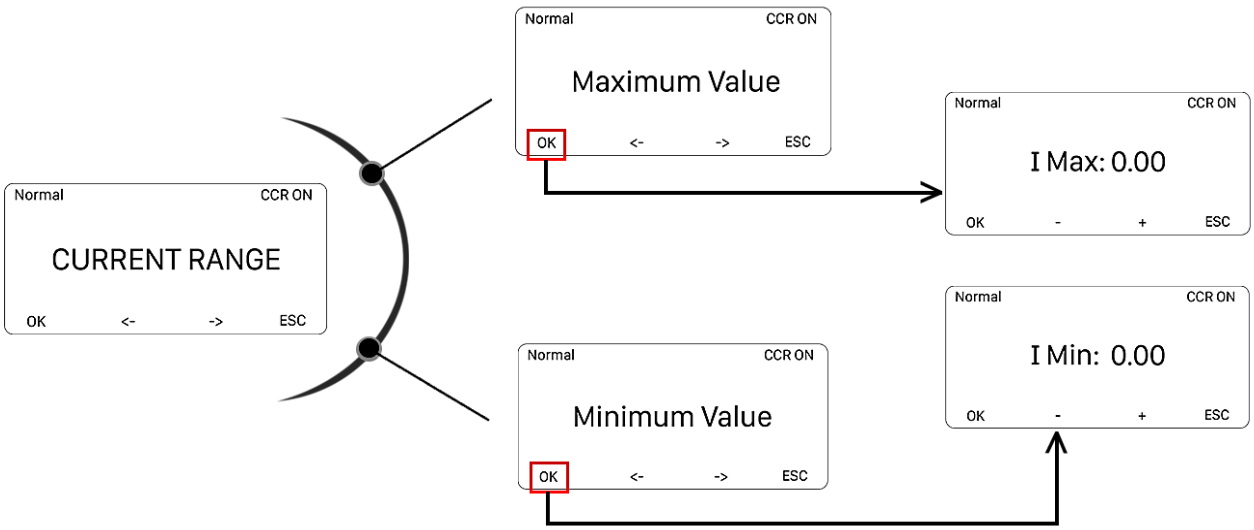


E. RS485

(Menu → Setting → RS485)



(Menu → Setting → Current Range)



The “Regulation Error” warning is triggered if the measured current is outside the ranges defined for each setting B0 to B4.

Each range is automatically calculated when a setting is changed (as described below) in the following way:

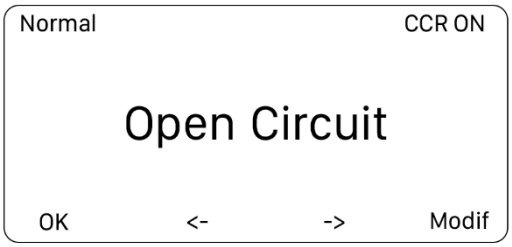
- Minimum value = Setting – 100mA
- Maximum value = Setting +100mA

Nevertheless, it is possible to set two limits of the current range manually using the "Current range" menu.

7-3-3. Alarm and Warning

A. Open Circuit

Open Circuit Protection is activated if the output current goes below a defined value (I level OC) for a defined period (Duration OC). The CCR stops instantly, and the display shows the message "Open Circuit".



B. Overcurrent

Overcurrent protection is activated if the output current goes above a defined value for a defined period. There are three adjustable Overcurrent levels:

Setting current levels, I>> Level 1, I>> Level 2, I>> Level 3, Duration IL1, Duration IL 2, Duration IL 3:

Go into the menu "Alarms and Warnings" then "Overcurrent"

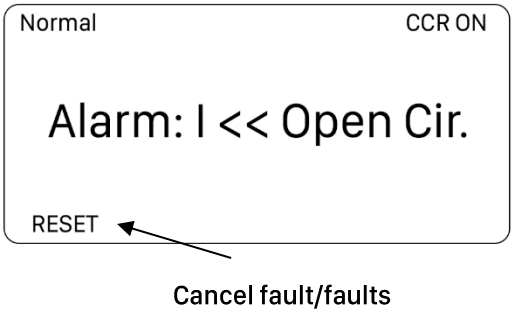
There is a fourth level, which is not adjustable: The fault "Peak Overcurrent!" occurs if the output current goes instantly above twice the nominal peak current (see IEC definition).

An Overcurrent fault can be Automatically cancelled according to the value of the "Restarts number" parameter.

As each fault occurs, the number of faults is incremented. If the number of faults is greater than or equal to "Restarts number" in a period of less than 10s the fault is activated. The number of faults is reset to 0 after 10s without fault.

If the programmed number of restarts is reached without control of the current, the CCR stops instantly, and the display shows which level has been reached.

Alarm (the CCR failed to supply the load); for example, the CCR is stopped by a loop open circuit:



Cancel fault/faults

C. Earth Fault

This option is used to measure the insulation of the load with respect to earth.

The insulation controller, or “earth fault detector” continually checks the electrical resistance between the loop and earth. It uses the principle of continuous current injection at 500V and its range of measurement is between 1 kΩ and 50 MΩ.

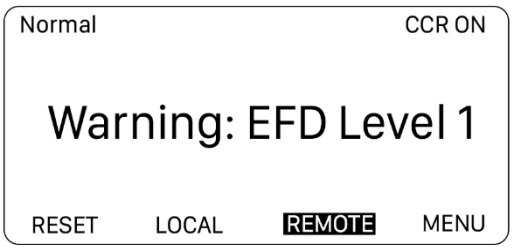
The insulation resistance value can be seen in the “*Monitoring*” menu Two comparison levels (warning and alarm) are available. They are preferably set at 1MΩ and 100kΩ.

You can Setting the Level EFD1 and Level EFD2 parameters.

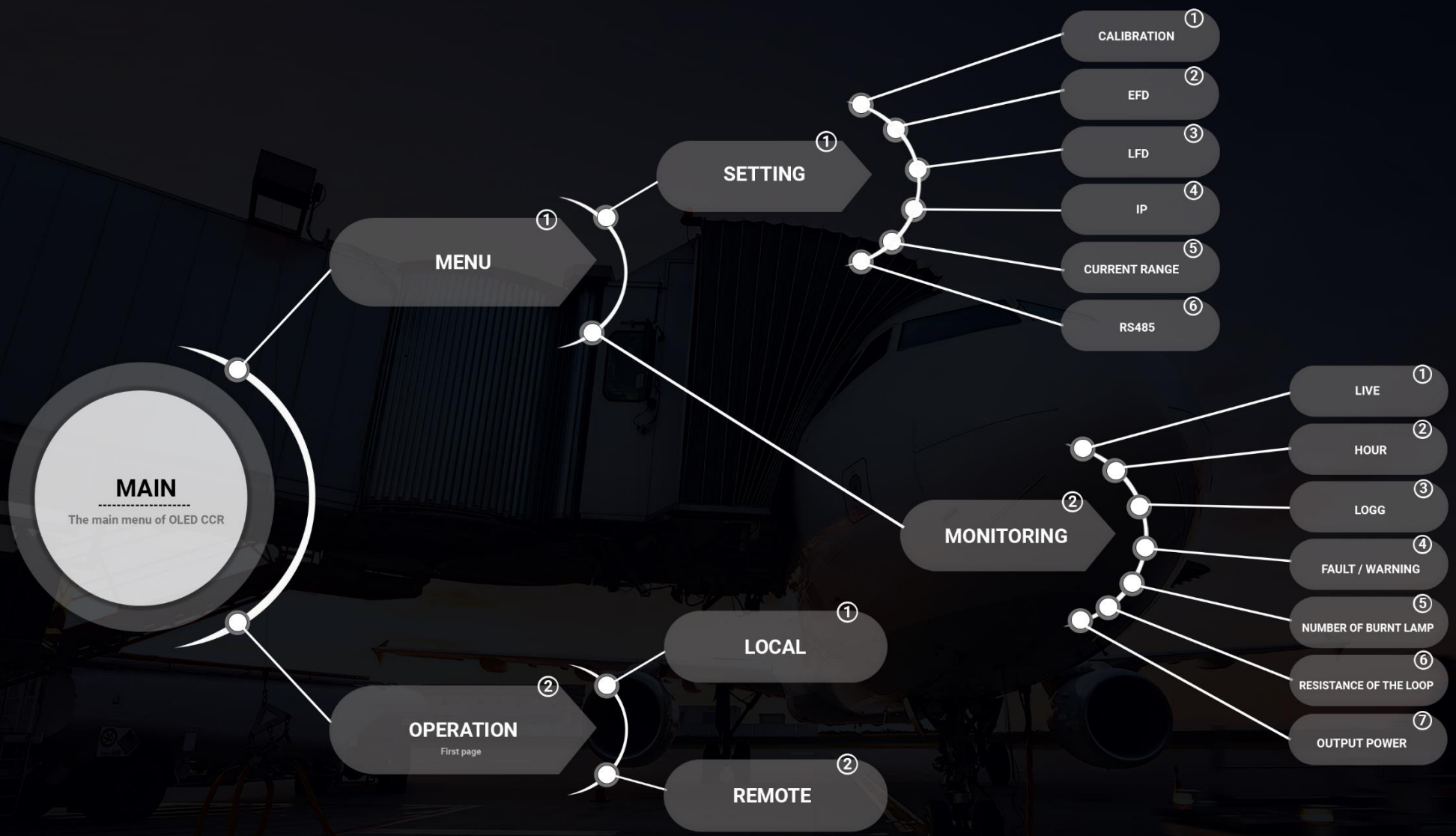
Remote indication:

1. Each level passed is indicated by a contact relay
2. The insulation resistance value, levels and warnings are transferred to the Modbus table.

Warning (the CCR doesn’t stop; warning is only indicative); for example, the earth insulation fault level 1 is detected:



TREE DIAGRAM OF CCR MENUS



Ⅰ. APPENDIX A: PART NUMBER IDENTIFICATION

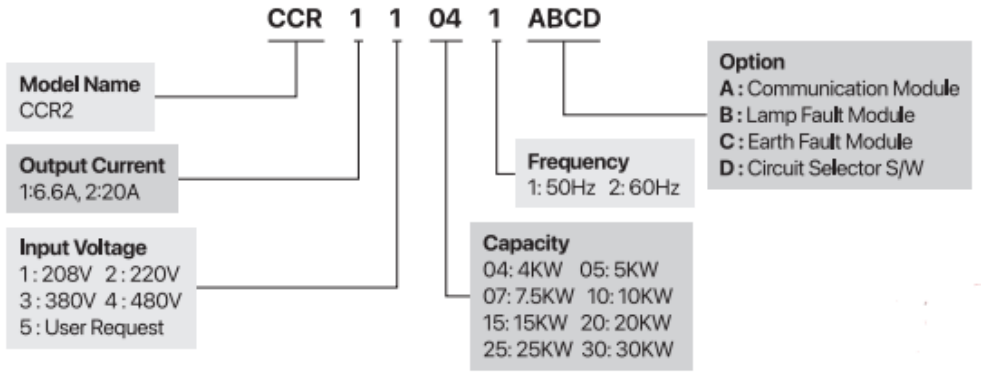


Figure 12 Part Number Identification

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	121-15-103	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