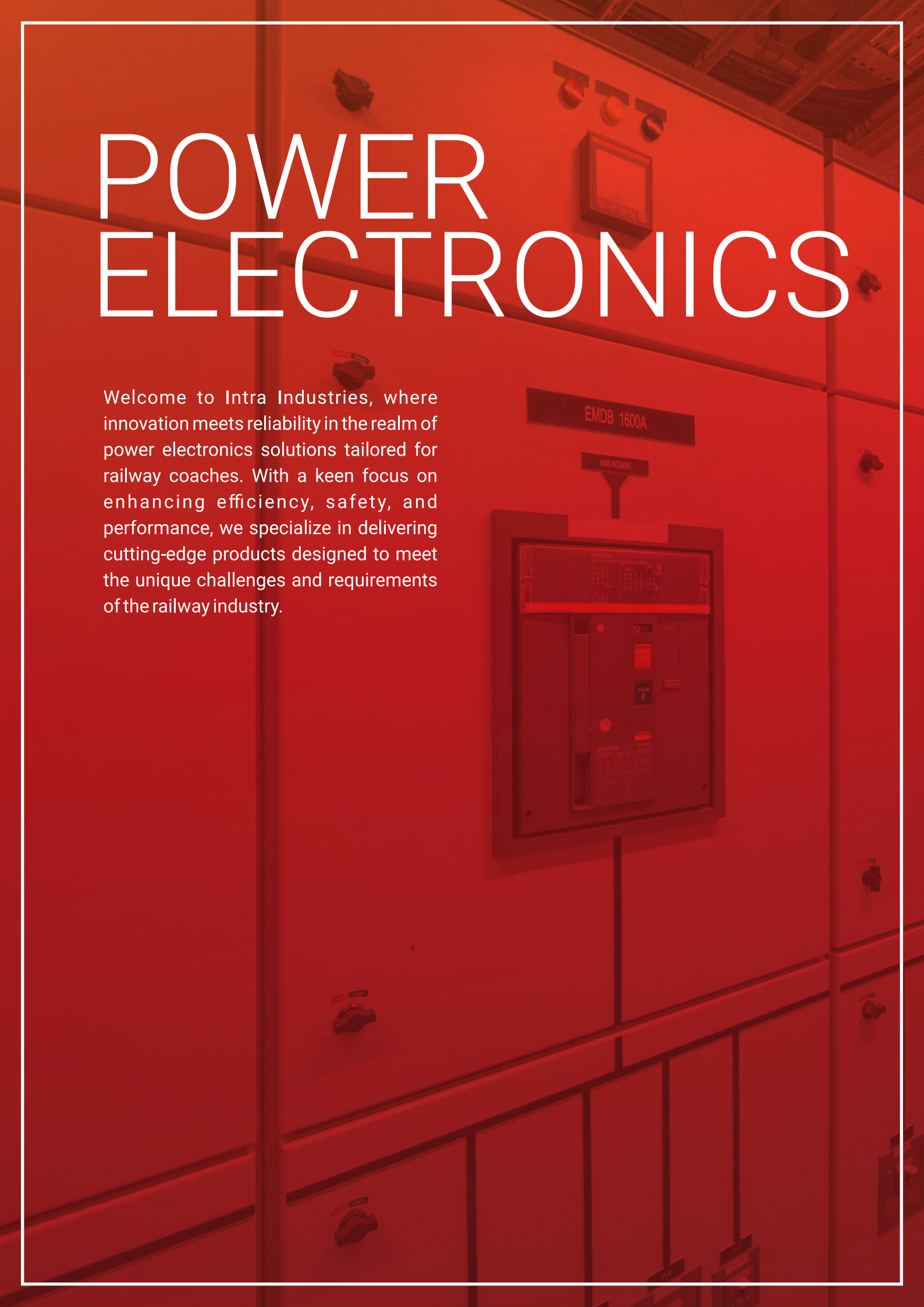
INTRA INDUSTRIES




EDIFY THE WORLD WITH INNOVATION

POWER ELECTRONICS

Welcome to Intra Industries, where innovation meets reliability in the realm of power electronics solutions tailored for railway coaches. With a keen focus on enhancing efficiency, safety, and performance, we specialize in delivering cutting-edge products designed to meet the unique challenges and requirements of the railway industry.



POWER ELECTRONICS SOLUTIONS

EMPOWERING RAILWAY COACHES WITH ADVANCED POWER SOLUTIONS

At Intra Industries, we understand the critical role that power electronics play in ensuring the seamless operation of railway coaches. Our comprehensive range of power electronics solutions is engineered to deliver consistent performance, durability, and energy efficiency, providing reliable power supply and control for various onboard systems.

OUR PRODUCT PORTFOLIO

4.5 KW Emergency Battery Chargers for Underslung Batteries

Designed to provide reliable backup power, our 4.5 KW emergency battery chargers are specifically engineered for underslung batteries used in railway coaches. With advanced charging algorithms and robust construction, these chargers ensure quick and efficient charging, ensuring continuous power supply during emergencies.

Pump Controllers for Water Handling in Coaches

Optimize water handling systems in railway coaches with our state-of-the-art pump controllers. Engineered for precision control and energy efficiency, our pump controllers ensure optimal water flow, pressure regulation, and system performance, enhancing passenger comfort and operational efficiency.

Power Distribution Panels for Supply Handling

Streamline power distribution and supply handling in railway coaches with our custom-designed power distribution panels. Featuring intelligent circuitry, robust components, and modular design, our power distribution panels provide efficient and reliable power distribution, accommodating various onboard systems and equipment.

WHY CHOOSE INTRA INDUSTRIES POWER ELECTRONICS SOLUTIONS?

Quality and Reliability
Our power electronics solutions are built to the highest standards, using quality materials and components, ensuring durability, longevity, and consistent performance in railway applications.

Energy Efficiency
We prioritize energy-efficient designs and technologies, helping railway operators reduce energy consumption, lower operating costs, and contribute to sustainable and eco-friendly operations.

Customization
With our in-house design and manufacturing capabilities, we offer tailored power electronics solutions to meet the specific requirements and challenges of each railway project, ensuring seamless integration and optimal performance.

Expertise and Support
Backed by a team of skilled engineers and industry experts, we provide comprehensive support, from initial consultation and design to installation, commissioning, and after-sales service, ensuring smooth project execution and customer satisfaction.

EMPOWER YOUR RAILWAY COACHES WITH INTRA INDUSTRIES

Partner with Intra Industries for innovative, reliable, and high-performance power electronics solutions that empower your railway coaches with efficient and sustainable power management. Whether you are upgrading existing systems or planning new coach builds, we have the expertise, resources, and commitment to deliver solutions that meet your needs and exceed expectations.

Contact us today to explore how Intra Industries can enhance the power efficiency, reliability, and performance of your railway coach fleet with our advanced power electronics solutions.

Pump Conroller

☐ VFD

Model Name: IE-IR-PC

SPECIFICATIONS

Input	Phase, 4-Wire 415 Volts + 15%, 50Hz + 3% Eleetronics control using Digitol Signal Processor (DSP)
Output of regulated battery charger	Rated Capacity: 4.5KW, Constant voltage with current limiting O Output Current DC: 55A
Output Emergency Battery charger	Rated Capacity: 2 5KW Output Cument DC: 22A

FEATURES & BENEFITS

- Energy efficient solutions
- Modem and trendy Aesthetics
- Compact design which suits the urban architecture
- Sturdy performance
- Optimal Illumination
- Low maintenance cost
- Long Life
- High availed material for superior performance

Fire Detection

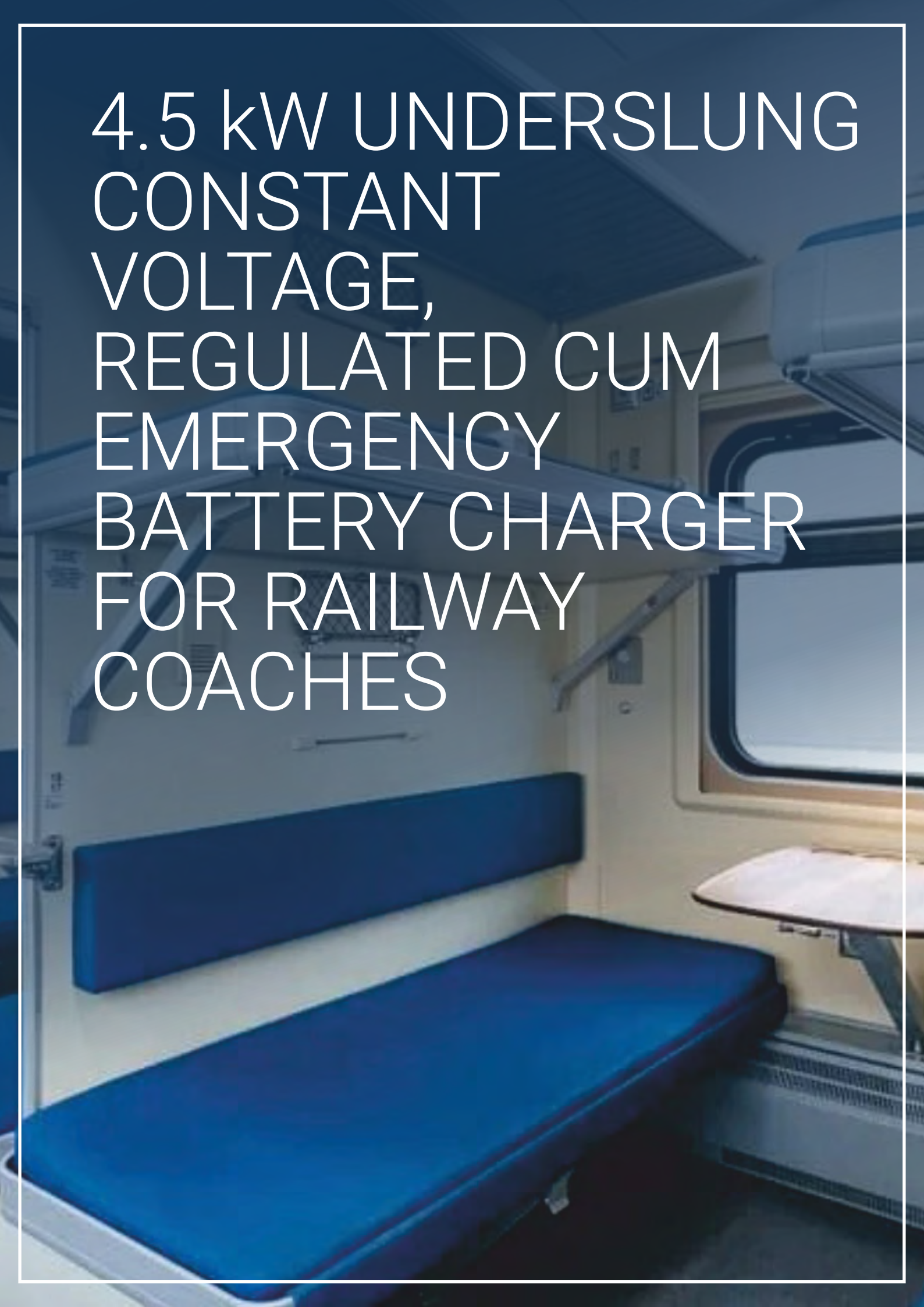
☐ Fire Detection System

Model Name:

SPECIFICATIONS

LED	White, Mid power LED, UL Certified
Colour Temperature	6000 - 7000K
LED Output efficiency	150 lm/W
LED Life	> 50,000 hours
CRI	>80
Operating Voltage	110 V DC (70 – 140 V)
Maximum Wattage	10W (Charging Power)
Body	MS CRC
Wiring	Low Beam/ High Beam, E-Beam cable with WAGO/ Phoenix connector
Weight	800 grams
Ingress Protection	IP – 54
Battery	Rechargeable 7Ah

4.5 kW UNDERSLUNG CONSTANT VOLTAGE, REGULATED CUM EMERGENCY BATTERY CHARGER FOR RAILWAY COACHES



The basic topology adopted for designing the 4.5KW under-slung Constant Voltage Regulated cum Emergency Battery Charger as per RDSO Specification No: RDSO/PE/SPEC/AC/0183 (REV '2') –2024, is of high frequency switch mode power supplyfor both the Regulated Battery Charger (RBC)part as well as the Emergency Battery Charger(EBC) section.
The Regulated Battery Charger is used for charging the lead acid 70/120Ah (both floodedand VRLA) batteries of LHB coaches and to supply power to all DC loads in the coach. This battery charger is fed power with three phase 415 volts AC 3 Phase, 4 wire at 50 Hz.

Input Data	Nominal Input Voltage Range for RBC - 415V AC, 3 Phase, 4 Wire
	Nominal Input Voltage Range for EBC- 240V AC
	Working Frequency- 50 Hz±3%
	Power Factor – Not Less than 0.98 at 100% Load for both RBC & EBC
Output Data for RBC	Power for RBC-4.5 kW
	Output Voltage- 110V -135V DC (Settable through keypad)
	Output current – 10A-20A for battery charging (Settable through user friendly keypad) and 15 A other Load
	Efficiency- 92% at Full load
	THD - ≤ 8% at full load for voltage and current
Output Data for EBC	Power for EBC- 2.6 kW
	Output Voltage-110V-122V Dc (Settable through Keypad)
	Output Current- 22 A
	Efficiency- 90% at full load
	THD - ≤ 8% at full load for voltage and current
Mechanical Data	Length X Width X Height- 900X535X650 mm
	Weight of Unit- 102 Kg
	Sheet Thickness- 2mm
	Cubicle is made of stainless steel sheet. The battery charger cubicle consists of current controlled regulated battery charger and emergency battery charger. The input & output connections are available on the front side of the cubicle.
Input/ Output Interface Section	It consist three phase input MCB for RBC, single pole MCB for EBC, output fuse, terminal blocks for input and output connections, this section is also provided control terminal block for charger.For Regulated Battery Charger, 3phase input AC terminals are marked as R, Y , B & output DC terminals are as DC +, DC- ,BC- & BC+. For Emergency Battery Charger input AC & Neutral terminal are marked. Spare terminal blocks are also provided.
Power/Control Section	1. Power section consists of Circuit breakers, Inductors, Rectifier, IGBT & Diode of both Regulated and Emergency Batter Chargers. The IGBT, Diodes are mounted on casted aluminium heat sinks.
	2. This section also contains DC link filter capacitor, protection module and other sub-assemblies and control cards of RBC & EBC. Section is provided with front LED card having LED indication for various features.
	3. The RBC is having MCB protection at input side and fuse at output apart from, the other various protections. Rear part of cubical consist of heavy component such as inductor & transformer used for both RBC & EBC & also has input sensing transformer, output choke.

WORKING OPERATIONS

1. The battery charger consist of three phases AC available at input is first rectified and then fed to the high frequency transformer through IGBT. An IGBT based bridge topology is used for this purpose .The smooth Dc link voltage converted into high frequency pulse width modulated AC voltage. The High frequency AC output is stepped down to the required level of the battery voltage by using transformer. The high frequency AC voltage from output transformer is rectified to DC voltage byusing Bridge diode rectifier. The diodes are fast recovery rectifier diodes.
2. The input voltage is rectified gradually with soft start to build the output voltage. The process of soft charging start is followed any time when the rectified circuit is turned ON.
3. The battery charger output available to the output choke (Buck Inductor) to control the ripple curren tand ripple voltage. The output to Battery terminal is provided through a contactor to protect the system from reverse polarity failures. The load current and the Battery charging current is sensed by Hall Effect based current sensors and the controller decides the CV/CC mode of operations based on the charging current and corresponding set parameters. The output connections are available on thefront side of the cubicle.
4. In case of overcurrent the IGBT pulses are blocked and the output voltage is zero. The DC link capacitors provided across the diodes. In case of over temperature of heat sink, output overvoltage, under voltage, short circuit, IGBT pulses are blocked and making output voltage zero.
5. In normal mode the RBC will give full output of 4.5kW and main circuit RBC will operate and 2.6kW EBC will be in standby mode. In the event of failure of normal mode i.e failure of RBC circuit, emergency mode will be automatically activated i.e EBC is in the operating mode.
6. The EBC is separate identical circuit operating at 240V AC (One of the phase (R, Y, B) and neutral) and output power is 2.6kW. The Emergency Mode activation LED indication provided on the frontpanel through Green LED.

A number of PCBs have been employed in RBC-EBC unit.

1	SMPS Card	1 No
2	Main RBC/EBC Controller Card	1 No
3	IGBT Driver Card	4 No
4	Output Rectifier Card	1 No
5	IGBT Card	4 No
7	Current Sensor Card	1 No
8	Earth Fault Card	1 No
9	Soft Start Relay Card	1 No

CONTROL PCB

The main controller card consist of Microcontroller with digital gates and analog amplifiers to control the function of the battery charger. The microcontroller detect faults and abnormal operation of the battery charger. It monitors the status of various parameters, stored faults memory and display on LCD. The desired corrective and preventive actions are initiated through the respective controller in the event of battery charger in abnormal condition.

The functional descriptions are as follows:

1. Displays the parameters in the LCD.
2. RTC is used for real time stamping of fault-events
3. Decides the CV/CC Mode of operation.
4. Generates the IGBT Inverter-bridge gate pulses based on output voltage setting and actualoutput.
5. Check for the necessary protections based on faulty conditions and protects the output as well as system by switching off the output.
6. The fault conditions that are continuously monitored.

PROTECTIONS & INDICATIONS

PROTECTIONS FOR RBC -The RBC shall necessarily have the following protective features:

1. Protection against ingress of dust and water shall be IP-65 for complete unit.
2. Input supply over voltage set at 480±5 V.
3. Input supply under voltage set at 300±5V.
4. Output short circuit protection for both battery charging and load circuits preferably byblocking firing pulse.
5. Output overvoltage trip at 136±2 Volts.
6. Over load protection at 35 +20% Amp for 60 seconds.
7. Thermal over load of semiconductors.
8. Capacity to withstand input of 510V AC and 300V AC to RBC and EBC respectively for two minutes without any damage to any part of the RBC/EBC.
9. Reverse polarity protection in battery circuits.
10. Output current/ voltage limiting feature

PROTECTIONS FOR EBC

The EBC shall necessarily have the following protective features:

1. Input supply over voltage set at 240+15% V
2. Input supply under voltage set at 240-15% V
3. Output current limit @ 24 Amp.
4. Output short circuit
5. Reverse polarity

INDICATIONS:

Following indications glowing through 5 mm Green LED

1. Input AC ON– R, Y, B(3-Phase)
2. Battery charging Charger “ON”
3. Single phasing
4. Positive earth leakage (> 30 mA)
5. Negative earth leakage (> 30 mA)
6. Battery not healthy/Battery deep discharge
7. Emergency mode ON

Standards	Railway Applications	Remarks
IEC60571-2012	Electronic Equipment used on rolling stock	Dry Heat ,Damp Heat
IEC 60529 -2019	Degrees of protection provided by enclosures (IP Code)	IP 65 and IP 67
EN 45545-2 -2020	Standard on the safety of the railway sector	Performance, Fire Safety HL2 /Hl3
IEC 61000-3/EN 50155:2017, EN 50121-3-2:2017	Series Electromagnetic compatibility (EMC) - Part 3: Limit - ALL PARTS	Compliance in Class A
IEC 61373 -2010	Rolling stock equipment - Shock and vibration tests	Category 1, Class A

COMMUNICATION PORT FOR DOWN LOADING OF FAULTS:

The battery Charger shall be provided with self-checking watch dog feature and facility to down loaddata through USB port on commercially available USB pen drive. This data shall be directly open able in Microsoft office word OR Microsoft office excel worksheet and shall have date, time & stamp.

Key pad and USB port should be in front of the unit for easy accessibility. The RBC shall have following fault diagnostics features accessible through key pad/down loading.

1. Input under voltage < 300Volts
2. Input over voltage > 480Volts
3. Reverse polarity for battery circuit
4. Input single phasing
5. Output short circuit
6. Over Temperature
7. Output over voltage > 135V
8. Over current
9. Earth leakage for both lines

BATTERY HEALTH STATUS TEST

The RBC shall be switched off (zero output) for an hour 30 minutes and 20 A loads will be transferred on Battery attached. RBC will monitor battery voltage and the battery health status features.

FAULT FINDING

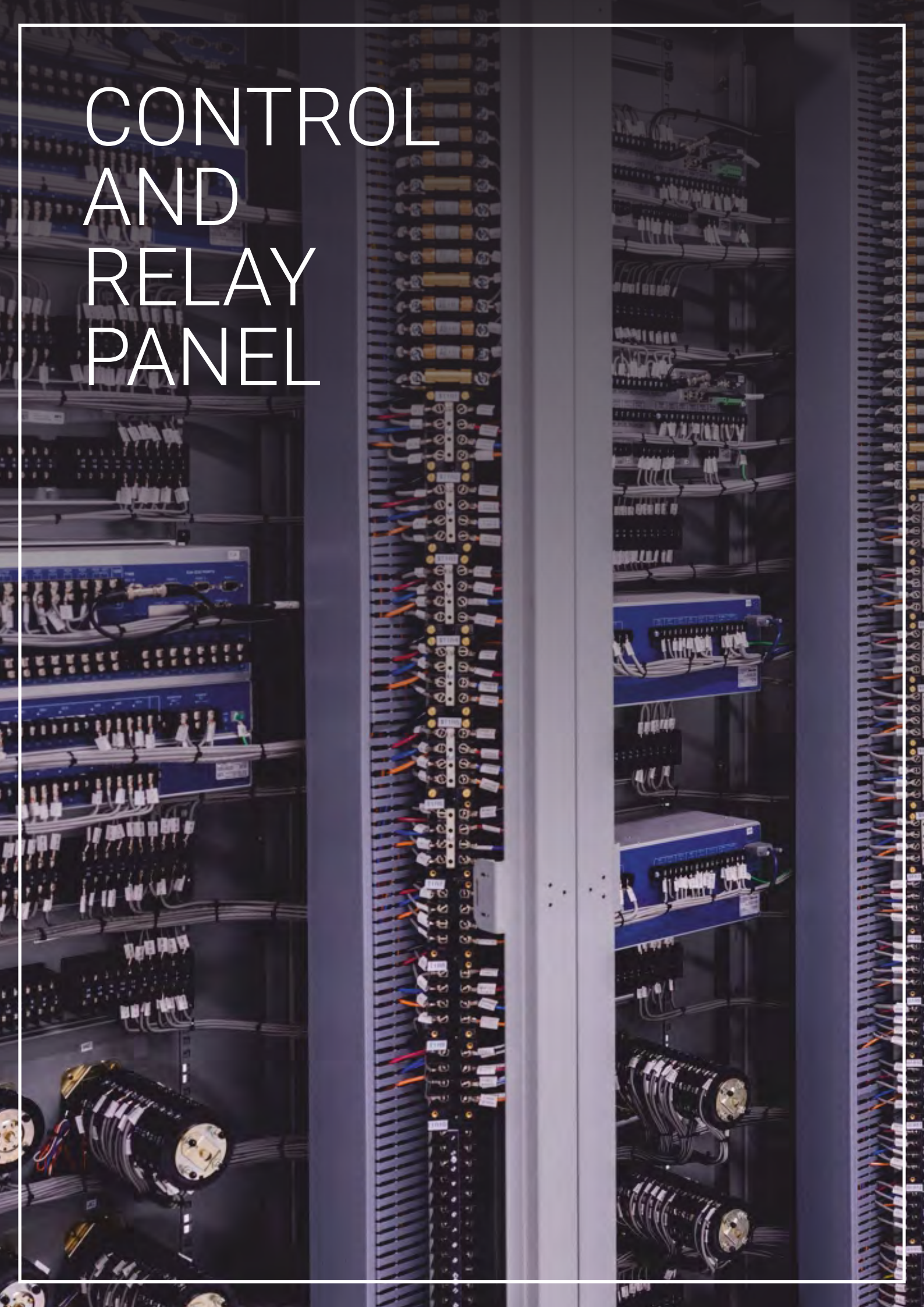
In the event of malfunction of the equipment is reported, the front cover of the RBC beopened and before replacing any component/assembly observation in the display unit is to beseen. Coach battery has to be remaining connected. RBC has some built in fault diagnosis features like IGBT over temperature, output short circuit, battery reverse polarity etc which are displayed in the display unit. Though the system will work without a display unit, the display unit is checked first for easy detection of fault.

SAFETY GUIDELINES FOR BATTERY CHARGER OPERATOR

The operator of the battery charger must ensure that all personal working on the charger and its associated equipment's are familiar with the safety regulation and they are correctly applied.

1. Check all connections for tightness during commissioning.
2. If RBC is fitted first time in coach, display shall be reset and clear old data. Connect BC+ terminal to battery positive.
3. Battery should be isolated from the output of the charger.
4. Wait until the circuit capacitor bank discharged before working on the charger.
5. The storage location of the battery charger must be clean and dry.
6. Do not ON the Battery Charger if any damage noticed.
7. Don't connect / short DC+ & BC+.
8. Do not attempt megger test during on condition.
9. Don't touch control IGBT with naked hands.
10. After attention or replacement check connection polarity
11. It is not necessary to open the under slung unit unless defect is observed.

CONTROL AND RELAY PANEL



A Control and Relay Panel (CRP) forms an essential part of electrical substations and industrial power systems. Its primary function is to monitor, control, and protect various electrical equipment such as transformers, generators, motors, and transmission lines.

These are essential for the safe and efficient operation of traction substations. These panels play a crucial role in monitoring, controlling, and protecting the electrical equipment within the substation.

It serves as a critical interface between electrical equipment and operators, ensuring safe, reliable, and efficient operation of power systems.

IMPORTANCE OF CONTROL AND RELAY PANEL

Safety and Control
Panels ensure safe and reliable operation by providing a centralized location for monitoring and controlling electrical systems.

Automation & Efficiency
These panels allow for automated processes, reducing human intervention and increasing productivity.

Data Acquisition & Analysis
Modern panels incorporate data logging and analysis capabilities for system optimization and troubleshooting.

Process Optimization
They enable monitoring and adjustment of critical parameters for enhanced performance and efficiency.

KEY COMPONENTS OF CONTROL AND RELAY PANEL

Control Components
Push buttons, selector switches, Indicators, and annunciation lights enable manual control and system status indication.

Relay Components
Numerical Relays are used for switching high-voltage circuits with low-voltage signals, providing isolation and protection.

Protective Devices
Circuit breakers, fuses, overcurrent relays, and thermal relays safeguard equipment from overloads, short circuits, and other hazards.

DESIGN FEATURES OF CONTROL AND RELAY PANEL

- The Control & Relay (C&R) panel shall be of the vertical self-supporting steel construction, low voltage, back-to-back duplex corridor type with central roofed-in access.
- The central access corridor shall be provided with lockable doors at either end.
- The control & relay panel as well as instrument and relay housings shall be dust and vermin-proof and shall be suitable for use in tropical humid climate.
- The instruments, control switches, push button, annunciation window, meters, mimic and indicating lamps shall preferably be mounted on front side of the control panels.
- Equipment like protection relays, auxiliary relays etc. shall be provided on rear panels.
- Bell / hooter, ICTs, terminal blocks, etc. may be mounted at suitable place inside the panel.
- The panel shall be fabricated from sheet steel of thickness not less than 3mm for front, rear, door paneland base panels, and not less than 2.0 mm for side, roof and doors

RELAYS USED IN CONTROL AND RELAY PANEL

- Instantaneous Overcurrent Relay
- IDMT Overcurrent Relay
- Instantaneous Earth Fault Relay
- IDMT Earth Fault Relay
- PT Fuse Failure Relay
- Transformer Differential Relay
- Inter Tripping Relay
- Distance Protection Relay
- Master Tripping Relay
- Thermal Overload Protection Relay
- Auto Reclosing Relay

Numeric Relays

CHALLENGES IN CONVENTIONAL CONTROL AND RELAY PANEL

Limited Accuracy and Adjustability

Electro mechanical relays rely on mechanical components and analog circuits, which can introduce inaccuracies and require manual adjustments for settings like pickup, time delays, and hysteresis. This makes precise coordination and calibration challenging.

Slow Response Time

Electromechanical relays have slower operating times compared to numerical relays, which can affect the speed and efficiency of protection schemes. This delay could lead to slower fault clearing times and potentially impact system stability.

Slow Response Time

Electromechanical relays often require more space due to their larger size and the need for clearances around moving parts.

Limited Diagnostic Capabilities

Unlike numerical relays, electromechanical relays do not typically offer built-in diagnostic features or remote monitoring capabilities. This makes troubleshooting and fault analysis more challenging and may prolong outage durations during maintenance.

Obsolete Technology

As power system technology advances, the availability of replacement parts and expertise for electromechanical relays may diminish. This could lead to difficulties in maintaining and supporting older relay installations.

WHY NUMERICAL RELAY?

Accuracy and Precision

Numerical relays use digital signal processing techniques, which provide high accuracy and precise measurements compared to analog relays.

Flexibility and Programmability

Numerical relays can be programmed and configured for a wide range of protection functions and settings. They are versatile and can adapt to different system requirements without needing physical adjustments or replacements

Communication Capabilities

Many numerical relays are equipped with communication interfaces (such as Ethernet, Modbus, IEC 61850, etc.) that allow them to communicate with other devices in the control system or with SCADA

Self-Diagnostics and Monitoring

Numerical relays often include self-diagnostic features that monitor their own health and performanceThey can detect faults or anomalies and provide alarms or notifications, which aids in proactive maintenance and reduces downtime.

Event Recording and Fault Analysis

Numerical relays can store detailed event records and fault data, including waveform capture capabilities.

Ease of Maintenance

Compared to electromechanical relays, which may require more frequent maintenance and calibration, numerical relays generally have longer maintenance intervals and are easier to troubleshoot due to their self-diagnostic capabilities and digital interfaces.

ELECTRICAL SAFETY AND PROTECTION MEASURES:

Grounding & Bonding

The panel is designed and installed according to relevant electrical standards and codes (e.g., NEC, IEC). This includes proper grounding, bonding, and clear labeling of all components.

Circuit Protection Devices

Appropriate circuit protection devices such as circuit breakers, fuses, and surge protectors are used to safeguard against overcurrents, short circuits, and voltage surges.

Overcurrent Protection

Implemented fuses, circuit breakers, and overcurrent relays to prevent overheating and potential fires.

Safety Interlocks

Utilize interlocks to prevent accidental access to hazardous areas or equipment during operation.

Safety Signage & Training

Provides clear warning signage and ensure that personnel are properly trained on safety procedures.

Enclosure and Access Control

Used enclosures that are properly rated for the environment to protect against dust, moisture, and physical damage.

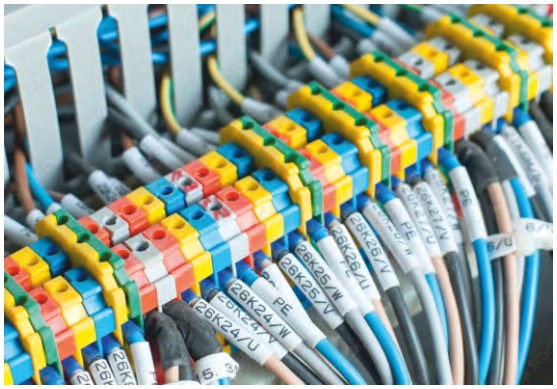
IMPORTANT FEATURES

- Suitable rating MCB's of reputed make as per latest IS/IEC 60898-1 or IEC 60947-2 MCBs for industrial applications, are provided in all potential circuits.
- The interior and central corridors of control panel are adequately illuminated by 240 V ac, 9-watt LEDs.
- All current free metallic bodies of equipment/relays etc. on the C & R panel are earthed properly.
- Multiple earthing of current/potenial transformer circuits shall be avoided.
- Identification labels of suitable size, indicating functions and numbering of respective equipment eg. Transformers, AT's, semaphore indications, relays, instruments and test blocks etc. shall be provided on the exterior of control and relay panels

TESTING AND COMMISSIONING PROCEDURES

Individual Component Tests

Each component, such as relays, circuit breakers, and control switches, is tested individually to ensure proper functionality.



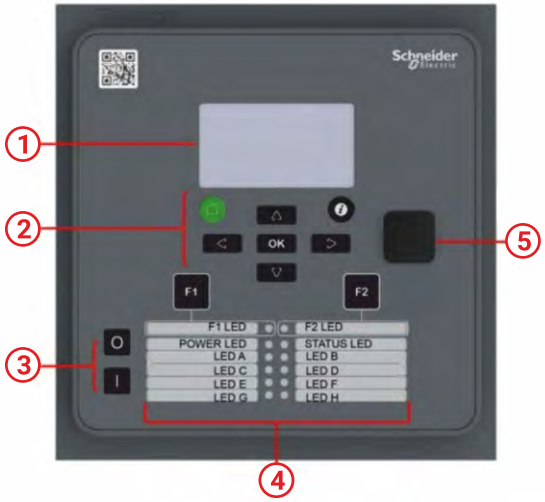
System Integration Test

After individual component testing, the entire system is integrated and tested to ensure proper communication and interaction between components.

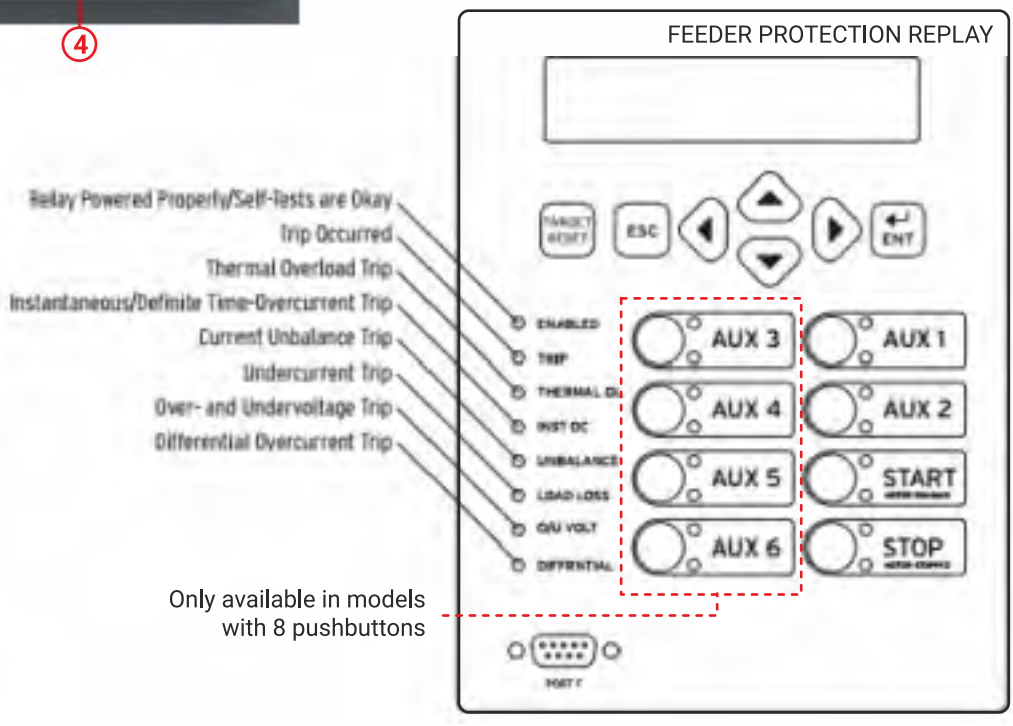
Functional Tests

These tests simulate real-world scenarios and verify that the panel operates as intended under various operating conditions.

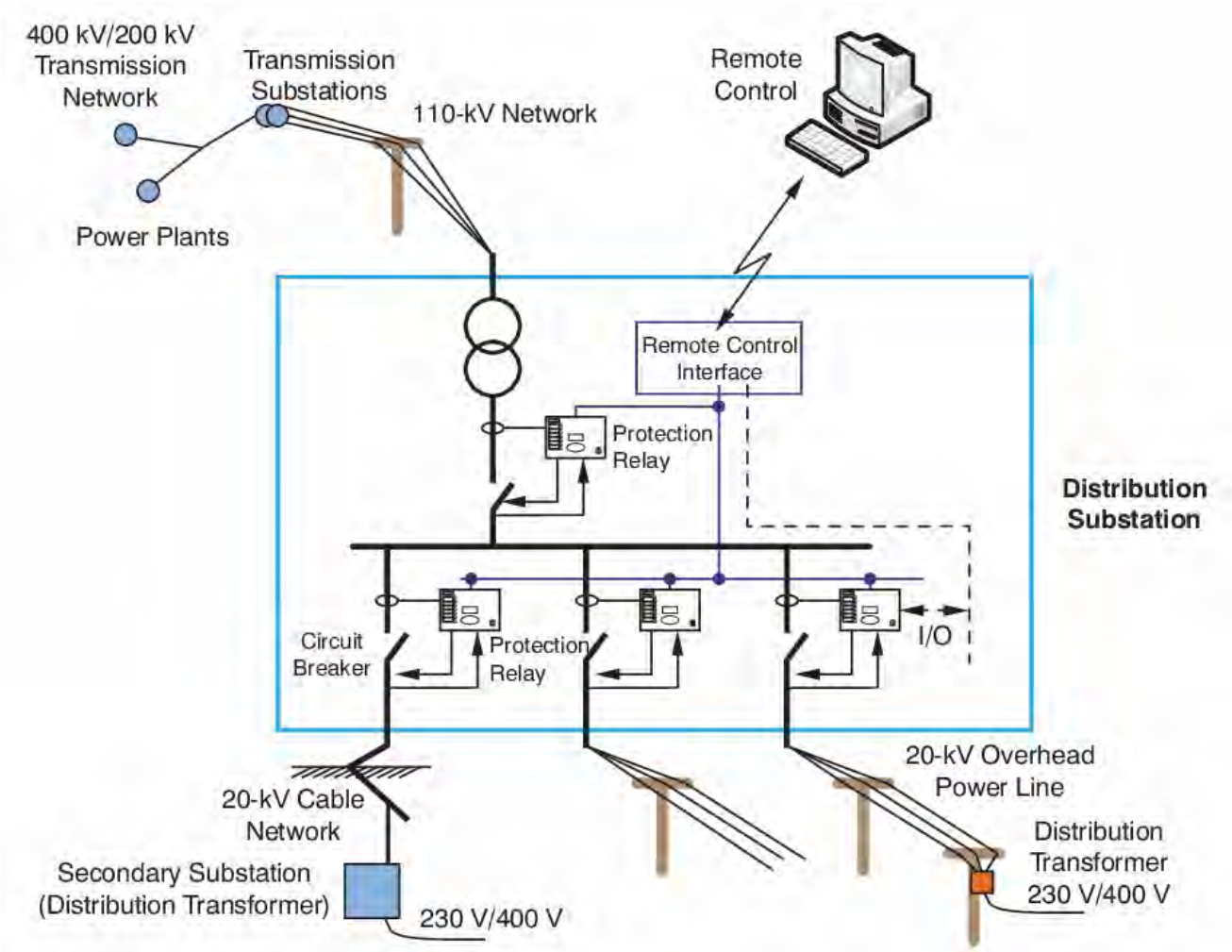
RELAY INTERFACE



1. 128 X 64 LCD
2. Navigation push-buttons
3. Object control buttons
4. LED indicators
5. Local port



WORKING



DESIGN SPECIFICATIONS

- Relays used are of the draw-out / with pluggable card type (Plugin), back- connected and suitable for semi-flush or flush mounting as per IEC 60529.
- Current Coils/input module are rated for 5A for relays on panels
- Voltage coil are rated for 110 V AC.
- The numerical relays used are capable of storing minimum 800 events serially with date and time stamp of 1ms accuracy.

Properties	Relay standards
Dielectric Withstand	2kv, 50 Hz for 1 min between circuit to earth/circuit to circuit (IEC 60255 -27)
Impulse voltage test	5 kV, 1.2/50 micro seconds (IEC 60255-27)
High frequency disturbance	Damped oscillatory wave test as per IEC 60255 -27 26Common mode: 2.5kV, 1 Mhz
Contact data	IEC 60255-1
Current carrying capacity	Continuously ≥ 5 Amps at 110 V DCShort time ≥30 Amps for 200 ms at 110 V DC
Making capacity at 110V DC	≥1 000 W at L/R = 40 ms
Breaking capacity at 110 V DC	≥30 W at L/R = 40 ms

SPECIFICATIONS

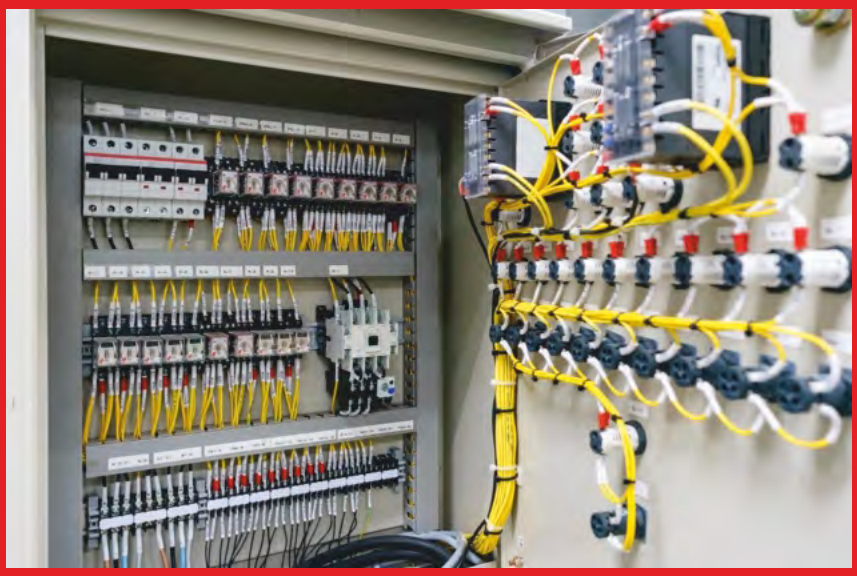
IEC61850	Communication networks and systems for power utility automation
IEC60255 Series	Electrical relays for power system protection
IS:8130	Conductors for insulated electrical cables and flexible cords
IS: 694	Control cable
IS: 9224	HRC cartridge fuse
IS: 6875	Control switch/ Push button
IS: 5578/11353	Panel wiring
IEC 60255-121	Electrical relays - Impedance measuring relays
IEC 60255-21-1	Vibration test on measuring relays and protection equipment
IEC 60255-26	Electromagnetic compatibility requirements

CONCLUSION

In conclusion,it has covered the key aspects of control and relay panel design, from the critical components to the important design considerations and safety features.

The electrical schematics and mechanical layout provide a detailed blueprint for implementation, while the thorough testing and validation process ensures the panel's reliability and performance.

With a focus on seamless installation, maintenance, and ongoing support, this control and relay panel design will deliver long-lasting value to our client.



Intra Industries Private Limited
Plant: Plot No. 7, 311/2, Kasar Amboli,
Adjacent to Cummins India, Pirangut, Pune – 412115

T: +91 9422040884 | Email ID: rishabh@intraelectronics.com

www.intraindustries.com