MEI633

System Manual

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Approval Details

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Version History

Author	Date	Title or brief description of change	Version
Sridevi K	27-Oct-2009	Initial Version	Draft
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1 General Information

1.1 Manual Scope

This manual provides operational description, System-specific configurations and Application & technical specifications.

1.2 MEI633 System Manuals

- MEI633 Electronic Interlocking System Overview Manual Version 1.0
- MEI633 Electronic Interlocking Installation and Commissioning Manual Version 1.0
- MEI633 Electronic Interlocking System Start-up Manual Version 1.0
- MEI633 Electronic Interlocking System Maintenance and Troubleshooting Manual Version 1.0
- MEI633 Electronic Interlocking System Configuration and Programming Guide Version 1.0
- Interface Circuits document for the specific station
- Table of control for the specific station
- IO Truth table for the specific station
- Earthing and Lightning Protection Scheme for MEI633 Electronic Interlocking System Version 1.0
- RDSO/SPN/197/2008 for “Code of Practice for Earthing of Signalling Equipments”.

2 System Description

Interlocking is an arrangement of functions in a yard, interconnected in a manner that ensures safe passage of the train through the controlled area. An Electronic Interlocking System is used in the Railway stations and yards for ensuring the safe passage of trains. The train movement is allowed in accordance with the rules and regulations governing the movement of trains. The request to set a route or operate a signal or a point comes from the operator, who is a signalman, but the decision to allow the move is made by the interlocking system on the basis of the existing field conditions and the inbuilt safety logic. The final goal is to ensure safe passage of train through the controlled area. The System continuously monitors the field conditions, and if any condition is detected which violates the inbuilt safety logic, it drives the corresponding output to safe state.

The Electronic Interlocking System (EIS) offers a lot of advantages over the conventional relay based interlocking. An EIS occupies much less space, consumes less power, is easy to install and maintain and is cost-effective. The interlocking logic in the EIS is based on software and hence any modification is easy without the need for any wiring changes. This eliminates the need to block traffic for long intervals whenever there is need for system up-gradation or modification. The EIS are processor based systems which have extensive diagnostic tests built into them. This improves the reliability of the system and leads to minimal system down time even in case of failures. The faulty module can be located easily and replaced with a spare one.

The EI System operation involves the operation of functions, which directly affect the safety, and hence it is designed to be fail-safe i.e. any failure within the system does not cause the outputs to assume unsafe state. Fail- safe in railway parlance means the system shall put the signals to danger and will not move any switch in case of any failure.

MEI633 is a microprocessor based system with interface to the Points, Signals, Track Circuits, Axle Counters, Level Crossing Gates, Ground Frames, Block Instruments for Block working with adjacent stations, and crank handles for manual operation of Points. It has the provision to interface with an External Data Logger, CTC or ATP through Serial Link.

It is a self-contained independent system, which can be used standalone to control the train movement in the Yard. In case of big yards, where the System capacity is not sufficient to address the needs of interlocking, two systems can be cascaded using a Serial link to achieve the required functionality.

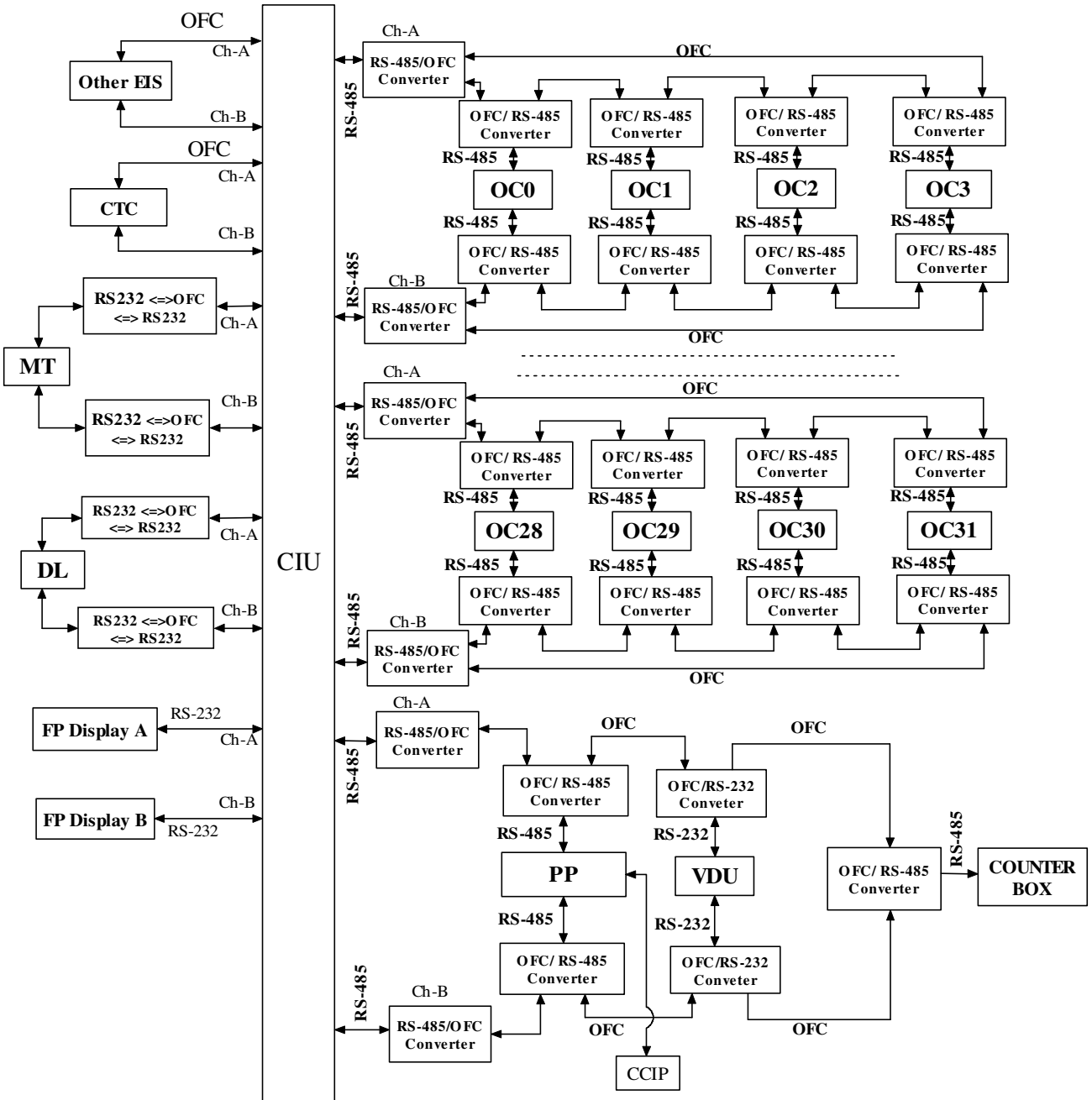
MEI633 System implements Two-out-of-Two Hardware architecture with identical Hardware and identical Software for Vital modules.

MEI633 System is implemented as multi-processor distributed system, with the System functionality being apportioned to various sub-systems. The division of the total System functionality into different subsystems provides modularity, expandability and cost-effectiveness.

MEI633 can be installed as a centralized system or a distributed system. When the Centralized installation is used, the Relays in the Relay room have to be repeated in the field for operating the respective functions. This requires extensive use of expensive Signaling cables. When used in distributed configuration, the field modules can be located in the Wayside Huts, in proximity to the functions being operated by them. For a group of Inputs and Outputs, a redundant pair of Optical fiber communication cable is used for carrying the commands from the Central Interlocking Unit to the field modules. Since the Signaling cables can be replaced with Optical fiber communication cable, substantial cost savings can be achieved.

MEI633 is modular system, which is scalable and configurable to suit the needs of a specific installation. The number of Object Controllers, the number of Input and Output WFMs in each OC, and the Input and Output modules required for the Panel Processor can be selected as per the Yard I/O requirement. The modular design of the MEI633 enables each customer to custom-configure a system that will meet the specific control and interface requirements for the intended application.

The MEI633 Block diagram is as follows:



2.1 MEI633 Functions and Capabilities

1. The System shall provide all the interlocking, control and indication functions as per approved interlocking plan, selection table and panel diagram of the station being controlled by the system.
2. Provision to expand the Interlocking and IO capacity by cascading two EI Systems.
3. Modular System Design, which is scalable to suit the needs of a specific installation. The number of Object Controllers, the number of Input and Output Modules in each OC, and the Input and Output modules required for the Panel Processor can be selected to suit the Yard Interlocking Requirement.
4. System can handle a maximum of 2048 field I/Os.
5. CIU can be connected to a maximum 32 Object Controllers, each capable of handling a maximum of 24 Vital Outputs and 40 Vital Inputs.
6. System can handle 3072 Panel I/Os for operator interface (672 Panel inputs and 2400 Panel outputs).
7. Time tested and safety-proven Relay based Boolean logic is used for interlocking.
8. Relay Based Boolean logic provides maximum flexibility to the User to design the Interlocking logic to meet any special Interlocking requirements for a specific installation.
9. In case of end cabin/ multi cabin working, system can interface with more than one CCIP or VDU control terminal or both.
10. System is based on Cyclic operation whereby all inputs are updated, outputs are computed and updated every cycle.
11. The system shall be suitable for working on sections on having 25 kV AC traction and where passenger/freight trains hauled by single-phase indication monitor controlled AC locomotives or chopper controlled EMU stock are operated.
12. MEI633 system has EMI/EMC and ESD Protection.
13. The system shall be capable of working in non air-conditioned environment and ambient temperature range between -10 Degree Celsius to 70 degree Celsius and Relative Humidity up to 95% at 40 Degree Celsius.
14. Unauthorized access is prevented by providing locking arrangement for the Equipment cabinet.
15. The occurrence of any error in any OC or hardware fault leading to unsafe condition causes the Vital Cut-off Relay to drop, immediately withdrawing all output commands and removing the source supply to outputs. Each OC is independent from other OC, Error in one OC does not affect the working of other OCs.

2.2 Basic Hardware and Software Features

1. The Electronic Interlocking System is designed to meet Safety Integrity Level 4 requirements as specified in the CENELEC Standard EN 50129.
2. All resistors used are rated for at least double the power, which is supposed to be dissipated in them. The voltage rating of the capacitor is at least 50% above peak value. The resistors and capacitors are of tolerances not more than 5% and 10% respectively.
3. ICs and other components used in the equipment are of industrial grade.
4. All fail-safe circuits works on continuous energisation principle such that open circuits in wiring, relay contacts, etc. or loss of power supply will not cause unsafe conditions.
5. To enhance the safety of the system, the design incorporates the detection of power supply variations beyond tolerable range at two levels.
6. Input Over-voltage and Under-voltage cut-off circuitry is provided on the Power supply boards and protection against output Over-voltage and Over-load is also provided.
7. The exclusive Voltage and Health Monitoring Card for the detection of Over-voltage and Under-voltage monitor the Power supply output voltage. In case of the Power supply voltage going beyond limits, it is shutdown by the VHM card.
8. Surge suppression and Reverse polarity protection provided for all the vital inputs add to the safety of the hardware.
9. Software is developed using using safe-subset ‘C’ language for safety critical system.
10. Software includes double stored variables for vital information. One is the actual information and the other contains the complement of the actual information.
11. Software includes self-check procedures to detect faults in the hardware.
    - Non-destructive RAM tests
    - Software timers test against vital reference clocks
    - Program/Application Data memory integrity tests using checksum verification
    - Address and Data bus tests
    - Relay contacts read back hardware test
    - Intermediate and final output read back test etc
12. Software of each module generates its health signature, which is verified by the other modules. A Dynamic Health Signature (DHS) is computed by each processor and sent to other processors along with the data being transmitted. This is to indicate the health of the processor. The data from the processor is considered valid only if the Health Signature indicates the proper cyclic operation of the respective module.
13. Software refreshes VHM modules in every cycle with a dynamic sequence to keep alive the system’s normal functionality. Failure to refresh with proper sequence or with in a period of 700 ms forces system to shutdown except in case of field module, where time out is 350 ms and forces system to safe state.

2.3 Overview of Operating Software and Software Handling

1. System Software reads the configuration data, IO Correspondence data, Indication and Interlocking Equations from Application Data Tables Pertaining to a specific Station Yard.
2. SW has two layers – the Executive SW which remains same for all the yards and Application SW which changes based on Yard configuration. The Application SW and Executive SW are stored in separate Flash EPROM's.
3. Executive software performs the following functions:
   - Reads the state of each of the field function.
   - Read the Signalling Operator commands.
   - Reads any other input available from CTC, or other interlocking system if connected.
   - Performs the various checks as per the rules governing the interlocking of the different train control functions and generates the outputs in the form of commands to the respective field functions. These output commands are used to control the output Relays, which controls different field functions.
   - Generates indication outputs for the Signalling Operator. These outputs are used to drive LEDs on the Operators Yard Display interface.
   - Stores any change in the input or output states as event log information.
   - Sends the event log information to the external data logger.
   - Provides the Maintainer Interface for the System maintainer to view event log information and the System operational and health Status.
4. Yard Data Compiler Tool Suite developed to generate application software depending on system application.
5. Data protection and validation is provided in software.

Refer MEI633 Electronic Interlocking System Configuration and Programming Guide Version 1.0 for programming of various cards used in MEI633.

3 MEI633 Subsystem

The MEI633 comprises of the following sub-systems:

3.1 Central Interlocking Unit (CIU)

Central Interlocking Unit consists of VIC, COMP, CIF and VHM cards, which are enclosed in a single box. Input data from PP/VDU Modules, OCMs is received by CIU. The received input data is processed for interlocking by CIU and output data is generated based on the input data. The respective output data is sent to PP/VDU Modules, Counter Box, MT and OCMs. CIU also has power supply modules to provide required voltages to all the cards in the CIU. VHM-A monitors the voltage and health of VIC-A, COMP-A.VHM-B monitors the voltage and health of VIC-B, COMP-B.

CIU has 12 serial communication ports, out of which 8 ports are used for 32 OCMs (on each port, a maximum of 4 OCMs can be connected), one port is used for PPs and VDUs (a maximum of 4 PPs and/or 4 VDUs can be connected), one port is reserved for other EIS, one port is reserved for CTC and the remaining port is reserved for future use, as shown in the block diagram. CIU is also connected to Counter Box, MT, Data Logger (DL) and Display units (identified as DISPLAY-A and DISPLAY-B).

3.2 Object Controllers (OC)

Object Controller Module consists of two IOCOMs namely IOCOM-A, IOCOM-B and a maximum of 8 WFMs. There can be a maximum of 32 OCMs in a system. WFMs are connected to IOCOM-A and IOCOM-B through RS485 interface. IOCOM-A and IOCOM-B are connected to COMP-A and COMP-B respectively, through OFC interface.

Input WFM gets the status of the wayside functions in the yard and sends the same to IOCOM-A and IOCOM-B. In turn IOCOM-A and IOCOM-B send the wayside function input data received from Input WFMs to respective COMPs. IOCOM-A and IOCOM-B receive the wayside function output data from respective COMPs and sends the same to Output WFMs. Output WFM receives the wayside function output data from IOCOMs and drives the wayside functions connected to it.

Each Input WFM can read at most eight wayside function inputs and each Output WFM can drive at most 8 wayside function outputs. A WFM consists of two WFPs – Master WFP and Slave WFP. Both the WFPs of each WFM are connected to IOCOM-A and IOCOM-B through RS485 interface. Master WFP and Slave WFP communicate through UART Interface. Output WFPs of an Output WFM verify each other's output relay data received from IOCOMs. Input WFPs of an Input WFM verify each other's input relay data.

OCM also consists of two VHMs namely OVH-A and OVH-B for monitoring the voltage and health of IOCOM-A and IOCOM-B respectively. OCM consists of power supply modules, which provides the required voltages to the cards in the OCM. All Output WFMs in OCM are monitored by Vital Cut-off (OVC) card. OVC card drives the VCOR, based on the voltage and health status of connected Output WFMs in the OCM.

3.3 Panel Processor Unit (PP)

Panel Processor module consists of two Panel Processors (PP A & PP B) and each is connected to a common set of Input and Output cards through parallel interface. On the other hand, each Panel Processor is connected to COMP through Optical Fiber Interface. Each Panel Processor scans the state of the inputs on CCIP through Input cards, and sends the same to VICs via the respective COMP. Each of them receives Indication Information from active VIC and drives the same to CCIP through output cards, providing visual indication to operator. Indication Information represents the current Yard status. The Panel Processor CPU cards and the Input/Output cards are housed in separate enclosures. The data transfer between the CPU cards in one enclosure and the Input/Output cards in the other enclosure is achieved by the use of PP Extender Driver card on the CPU enclosure and PP Extender Receiver card on the I/O Enclosure.

3.4 Power Supply Module

MEI633 uses three types of Power Supply modules viz, Type A, Type B and Type C Power supplies. These power supplies are designed specifically to meet the requirements of various cards in the CIU, OC and PP modules. All the three types take +24V as input. Power supply Type A (M633PSA-01) is used to power the Input and Output cards of the PP module and is rated at 4.5V@8A. Type B Power supplies (M633PSB-01) are used to provide power to the VIC, COMP, PP CPU and IOCOM CPU cards and are rated at 4.5V@3A. Type C Power supplies (M633PSC-01) are dual output type and are used to provide power to the Input and Output WFM CPU cards and are rated at 4.5V@6A, 5.8V@2A.

3.5 Control Cum Indication Panel (CCIP)

CCIP consists of Push Buttons/Knobs, Keys, LEDs and Buzzers. Push Buttons/Knobs are used to issue commands to System. Keys on CCIP can be in, Key In/Key Out position to enable/disable processing of the commands issued by operator to System. LEDs on CCIP indicate the yard status e.g. color signal on/off status, point position and track occupation status. Buzzers are used to indicate the stuck of any Push Button or yard status is not available to the system. CCIP is connected to PP Modules through Input and Output Cards. PP module's link status with CIU and its Health status are shown on CCIP.

3.6 Counter Box Module

Counter Box consists of CPU card and Driver card. Driver card is used to drive the counters and buzzers. CPU card is connected to Driver card and on the other hand it is connected to COMP-A and COMP-B, through Optical Fiber Interface. CPU card receives messages from both COMPs. Ultimately it takes data to drive counters and buzzers from the active COMP channel. Counter Box module also indicates VIC-A and VIC-B status (Active, Standby and Not Available) by the corresponding LEDs.

3.7 Data Logger (DL)

Data Logger (DL) is a device connected to CIU through RS232-OFC interface. DL is used to log the yard and system status in every cycle. Proprietary serial communication protocol is used for communication between CIU and Data Logger.

3.8 Video Display Unit (VDU)

Video Display Unit is a PC based application Software. VDU is connected to CIU through OFC interface. Operator can issue commands using the simulated buttons on the VDU screen. It sends the command and receives the yard status from COMP and displays the same on the VDU screen.

3.9 Front Panel Display (FPD)

LED Display is connected to CIU through RS232 interface. The system consists of two LED display units, namely Display-A and Display-B. LED Display is used to display the system faults/recovery messages.

3.10 Maintenance Terminal (MT)

Maintenance Terminal is a PC based application Software. MT is connected to CIU through RS232-OFC Interface. MT screen shows the status of the system, logs the events/faults received from CIU and generates alarm signal if any critical fault is received from the CIU. Proprietary serial communication protocol is used for communication between CIU and MT.

3.11 External and Internal Interfaces

CIU External Interfaces:

Subsystems	Interface	Description
CIU-PP/VDU	Serial Communication	Multidrop Optical Fiber Interface, CIU as Master and PPs/VDUs connected as Slave nodes. Max distance 1 km, Baud rate 115.2 kbps or more.
CIU-OC	Serial Communication	Ring fashion Optical Fiber Interface, CIU as Master and OCs connected as Slave nodes. Max distance 15 km, Baud rate 115.2 kbps or more.
CIU-MT	Serial Communication	RS232/OFC, Baud rate 115.2 kbps.
CIU – DL	Serial Communication	RS232/OFC, Baud rate 115.2 kbps.
CIU-FP Display	Serial Communication	RS232, Max distance 5m, Baud rate 115.2 kbps.

CIU Internal Interfaces:

Modules	Interface	Description
VIC Ch A-COMP Ch A	Shared Memory	8K x 16 DPRAM
VIC Ch A-COMP Ch B	Shared Memory	8K x 16 DPRAM
VIC Ch B-COMP Ch A	Shared Memory	8K x 16 DPRAM
VIC Ch B-COMP Ch B	Shared Memory	8K x 16 DPRAM

OC External Interfaces:

Subsystems	Interface	Description
CIU-OC	Serial Communication	Ring fashion Optical Fiber Interface, CIU as Master and OCs connected as Slave nodes. Max distance 15 km, baud rate 115.2 kbps or more.
Input/Output Relays	-	24V Supply to read the potential free input relay contacts or to drive the Output relay Coil

OC Internal Interfaces:

Interface	Interface	Description
IOCOM-WFMs	Serial Communication	RS485 Multidrop with IOCOM as Master and WFPs as Slave nodes, Baud rate 115.2 kbps

3.12 VCOR Relay

The Vital Cut-Off Relay (VCOR) is a fail-safe QN Signalling Relay that is driven by the Vital Cut-Off card. The front contacts of VCOR are used to provide power for driving the external output relays. The output relays can be driven only when the VCOR is in picked-up state. Each Object controller module is provided with one VCOR. The vital cut-off card is responsible for picking up the VCOR. The vital cut-off card monitors the voltages of all the output WFP CPU cards. It also monitors the health status of all the output WFP CPUs. The vital cut-off card energizes the VCOR only when the voltage inputs and health of all the output WFP CPUs are OK. For any failure detected in the status of voltage or health of the output CPUs, the VCOR is commanded to drop. Also, for any critical fault or any kind of wrong side failure that is detected by the output WFP CPU, the VCOR is dropped by which all the output relays connected to that particular Object controller are de-energized thereby ensuring the safety of the system.

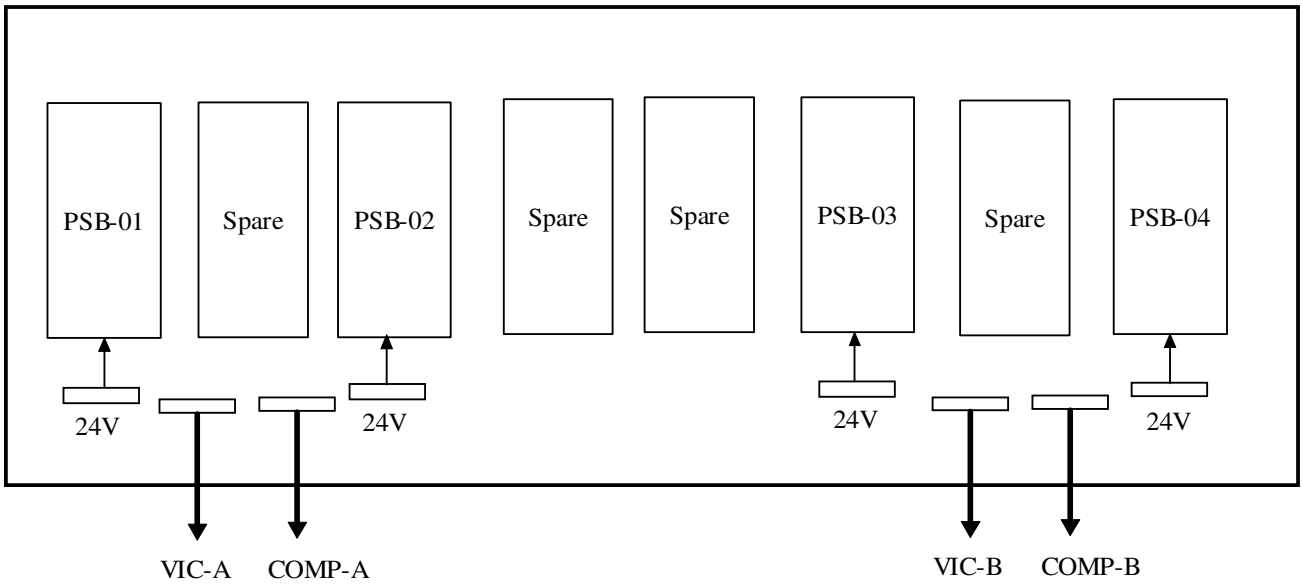
4 MEI633 Configuration

MEI633 consists of various sub-systems that can be housed in standard racks. Each sub-system / bin is designed to house individual PCBs pertaining to a logical sub-system of the MEI633. The following tables list the PCBs housed in the individual bins.

4.1 Central Interlocking Unit Rack – MCI (Top Bin)

PCB Name	MEI633 Part No.	Qty	Basic Function(s)
CIU Top Backplane	M633CTBP-01	1	Mother board for the Power supply cards
Power Supply Type B	M633PSB-01	4	To provide power to COMP CPU cards (2 no.s) and VIC cards (2 no.s)

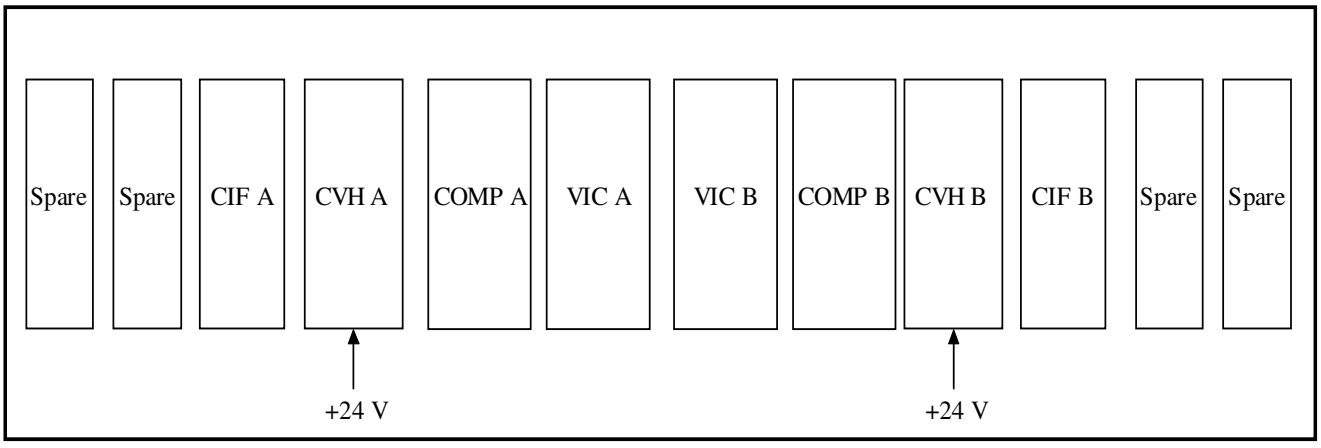
CIU TOP BACK PLANE



4.2 Central Interlocking Unit Rack – MCI (Bottom Bin)

PCB Name	MEI633 Part No.	Qty	Basic Function(s)
CIU Bottom Backplane	M633CBBP-01	1	Mother board for the CPU, CIF and VHM cards
Communication Processor card (COMP CPU card)	M633CCC-01	2	Bridges the field modules and PP with the Vital Interlocking computer through serial interface
Communication Interface card (CIF card)	M633CIF-01	2	CIF Card provides Isolated, Full Duplex RS485 Interface to the Communication Processor Card in the CIU module
Vital Interlocking Computer card (VIC card)	M633CVC-01	2	Performs the vital interlocking and indication logic computation
CIU Voltage and Health Monitoring card (CVH card)	M633CVH-01	2	Monitors the voltage and health of COMP and VIC cards

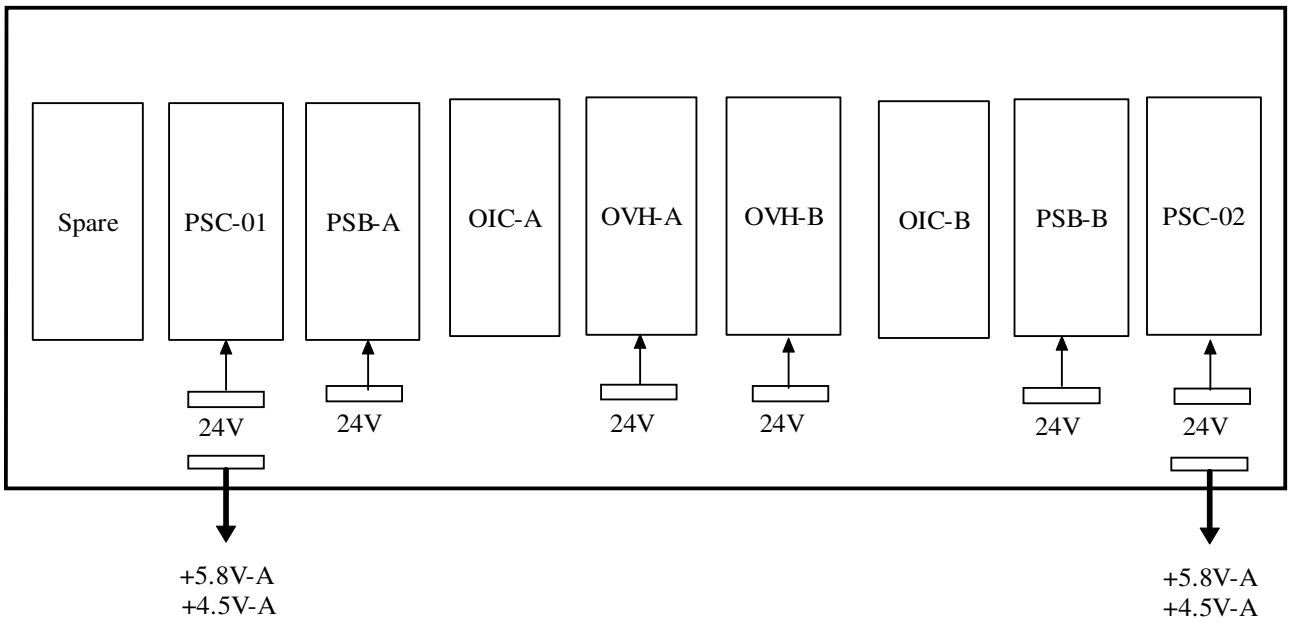
CIU BOTTOM BACK PLANE



4.3 Object Controller Rack – MOC (Top Bin)

PCB Name	MEI633 Part No.	Qty	Basic Function(s)
OC Top Backplane	M633OTBP-01	1	Mother board for the CPU, CIF and VHM cards
IO Communication Processor card (IOCOM CPU card)	M633OIC-01	2	Transfers information between COMP and WFMs
Power Supply Type B	M633PSB-01	2	To provide power to IOCOM CPU cards (2 no.s)
Power Supply Type C	M633PSC-01	2	To provide power to WFM CPU cards (2 no.s)
OC Voltage and Health Monitoring card (OVH card)	M633OVH-01	2	Monitors the voltage and Health of IOCOM CPU card

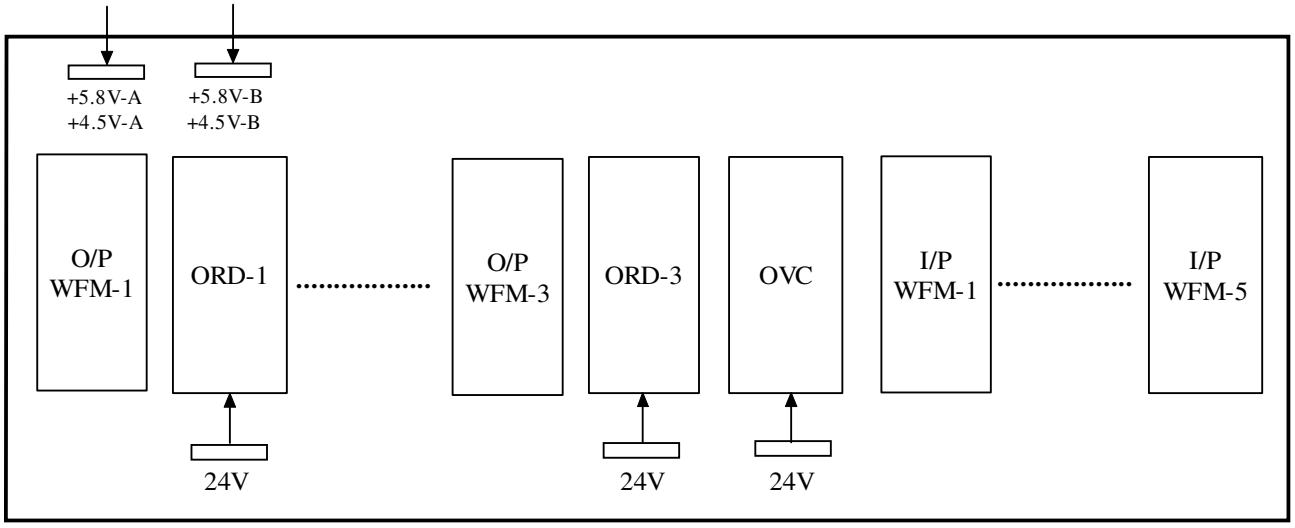
OC TOP BACK PLANE



4.4 Object Controller Rack – MOC (Bottom Bin)

PCB Name	MEI633 Part No.	Qty	Basic Function(s)
OC Bottom Backplane	M633OBBP-01	1	Mother board for the WFM cards
Input Wayside Function Module CPU Card (Input WFM CPU Card)	M6333OCI-01	5 (max)	Reads the status of input relays
Output Wayside Function Module Output Card (Output WFM CPU Card)	M6333OCO-01	3 (max)	Drives the field output relays through the Relay Driver card
WFM Relay Driver Card (ORD Card)	M633ORLD-01	3 (max)	Drives the field output relays in a fail-safe manner
Vital Cut-off Card (OVC Card)	M633OVC-01	1	Monitors the health of output WFM CPU cards

OC BOTTOM BACK PLANE

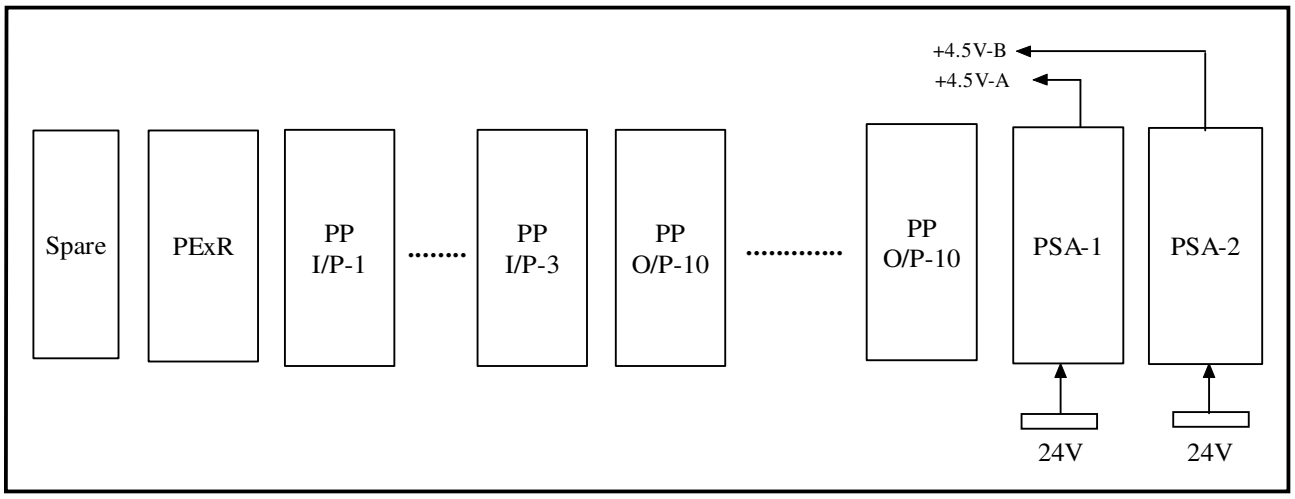


4.5 Panel Processor Rack – MPP (Top Bin)

PCB Name	MEI633 Part No.	Qty	Basic Function(s)
PP IO Backplane	M633PBP-01	1	Mother board for PExR, PP Input and Output cards
PP Extender Receiver Card	M633PExR-01	1	Interface between the CPU backplane and IO backplane
PP Input Card	M633PIP-01	3(max)	Interface card for scanning the CCIP buttons
PP Output Card	M633POP-01	10(max)	Interface card for driving the CCIP indication outputs
Power Supply Card -A	M633PSA-01	2	To provide power to PExR, PP Input and Output cards

Note: Above quantities refer to single PP top bin.

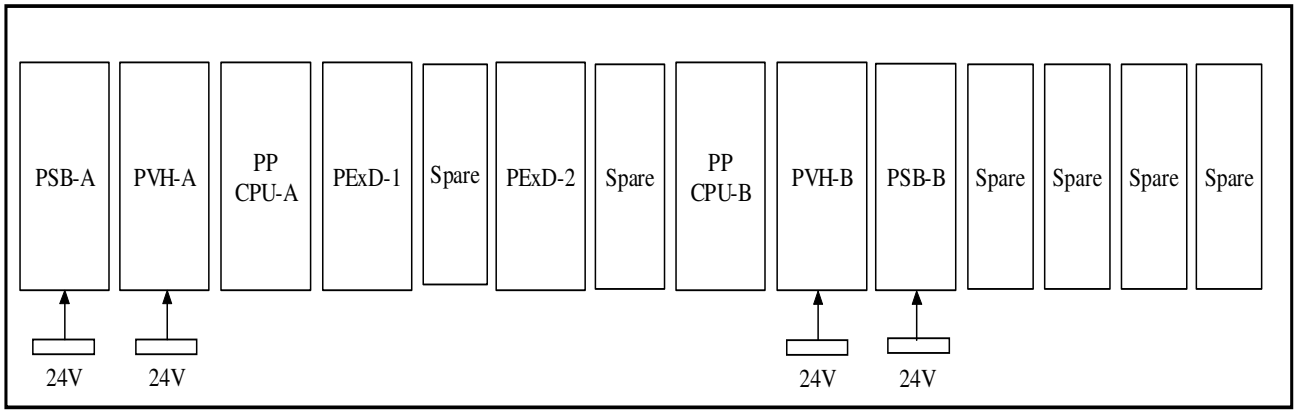
PP TOP BACK PLANE



4.6 Panel Processor Rack – MPP (Bottom Bin)

PCB Name	MEI633 Part No.	Qty	Basic Function(s)
PP CPU Backplane	M633PCBP-01	1	Mother board for the CPU, PVH, PSB and PExD cards
PP CPU card	M6333PCC-01	2	Scans the CCIP buttons and drives the indication
Power Supply Type B	M633PSB-01	2	To provide power to the PP CPU cards (2 no.s)
PP Extender Driver Card	M633PExD-01	2 (max)	Interface between the CPU backplane and IO backplane
PP Voltage and Health Monitoring card (PVH card)	M633PVH-01	2	Monitors the voltage and Health of PP CPU card

PP BOTTOM BACK PLANE



5 System Features

5.1 Power supply features

1. The Power supplies for the different sub-systems have been designed to have adequate safety factor for supplying power.
2. Power supply cards are provided with input under voltage and over voltage protection.
3. Power supply cards are provided with output overload and over voltage protection.

5.2 Printed Circuit Board features

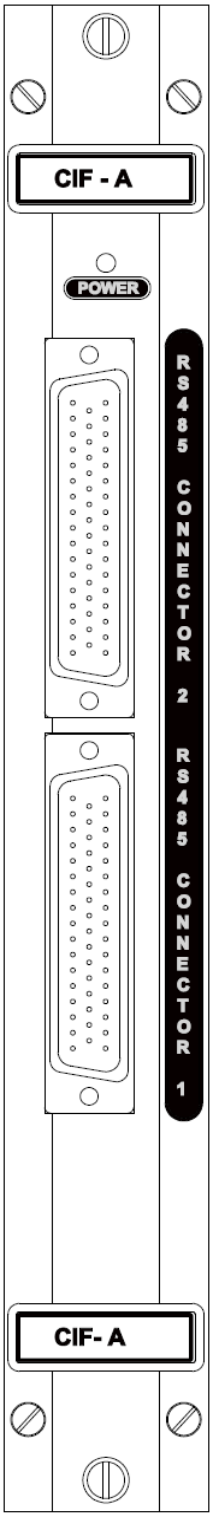
5.2.1 CIF Card

1. The CIF card facilitates conversion of TTL communication signals (Tx, Rx and RTS) to RS485 signals.
2. It provides an Isolated RS485 Full Duplex communication interface to the serial channels.
3. Each Card can support six or twelve channels depending upon the system configuration.
4. The Rx, Tx and the RTS signals of all the channels are provided with protection against over-voltage and surges.
5. It facilitates the COMP CPU card to check whether the CIF card is present and is powered or not.

CIF Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the card
Two 50 pin D type connectors	Provides full duplex RS485 interface with communication processor card

Nameplate: CIF-A and CIF-B



5.2.2 CVH Card

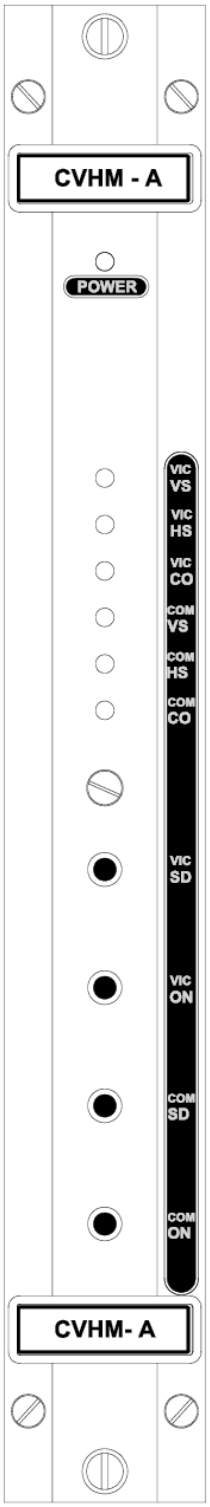
1. CVH Card generates Power Good signal if all the voltages are within predefined limits
2. It monitors the status of the COMP CPU and SVP CPU activities and indicates health of CPU.
3. In case of the voltages going beyond limits or the CPU activity being not correct it shuts down the power input to the corresponding CPU.
4. CPU Health monitoring is performed by pattern check, pattern struck, reset count, reset struck and shunt down command.
5. LED indications are provided for Power ON, VIC Voltage within limits, VIC Health Status, COMP Voltage within limits, COMP Health Status, VIC power cut-off and COMP power cut-off.

CVH Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the CVH card
LED (**VIC VS**)	**Glows Green:** VIC card voltages monitored by the Power Manager are within predefined limits **Glows Red:** Any of the VIC card voltages monitored by the Power Manager has gone beyond limits
LED (**VIC HS**)	**Glows Green and starts blinking:** VIC CPU Health OK **Glows Red:** VIC CPU Health Not OK
LED (**VIC CO**)	**Glows Green:** CPU is operating normally **Glows Red:** CPU Power is cut-off by the VHM card
LED (**COM VS**)	**Glows Green:** COMP voltages monitored by the Power Manager are within predefined limits

	Glows Red: Any of the COMP voltages monitored by the Power Manager has gone beyond limits
LED (**COM HS**)	**Glows Green and starts blinking:** COMP Health OK **Glows Red:** COMP Health Not OK
LED (**COM CO**)	**Glows Green:** CPU is operating normally **Glows Red:** CPU Power is cut-off by the VHM card
Push button (**VIC SD**)	When pressed power manager turns OFF the Power supply to VIC card
Push button (**VIC ON**)	When pressed power manager turns ON the Power supply to VIC and continues to function normally.
Push button (**COM SD**)	When pressed power manager turns OFF the Power supply to COMP
Push button (**COM ON**)	When pressed power manager turns ON the Power supply to COMP and continues to function normally

Nameplate: CVHM-A and CVHM-B



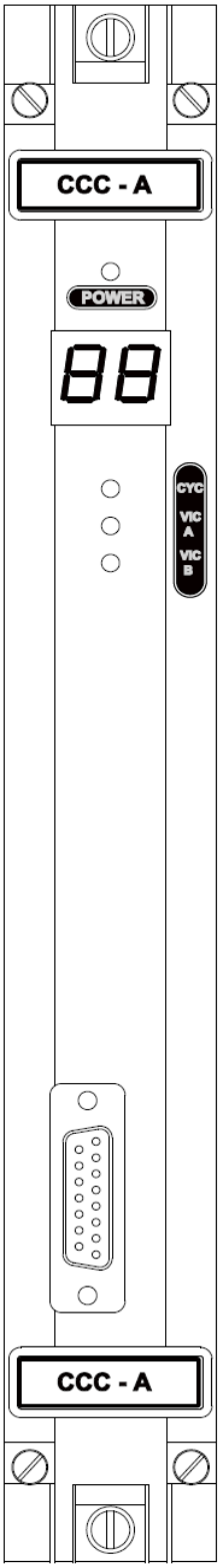
5.2.3 COMP CPU Card

1. COMP CPU card transmits and receives vital data.
2. It receives vital inputs from various IOCOMs, commands from Panel processor, slots from any other SSI (if connected) and commands from the CTC through various serial interfaces.
3. It receives the output messages through the DPRAMs and transmits these messages to the respective destinations.
4. Provision is provided in card for connecting to PC parallel port for Programming and debugging interface.

COMP CPU card Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the card
LED (**CYC**)	Cyclic activity status of COMP. Toggled every cycle
LEDs (**VIC A and VIC B**)	Active status of VIC A and VIC B respectively
9 pin Female connector (**RS 232**)	Used for Debug port & Application data download during offline mode

Nameplate: CCC-A and CCC-B



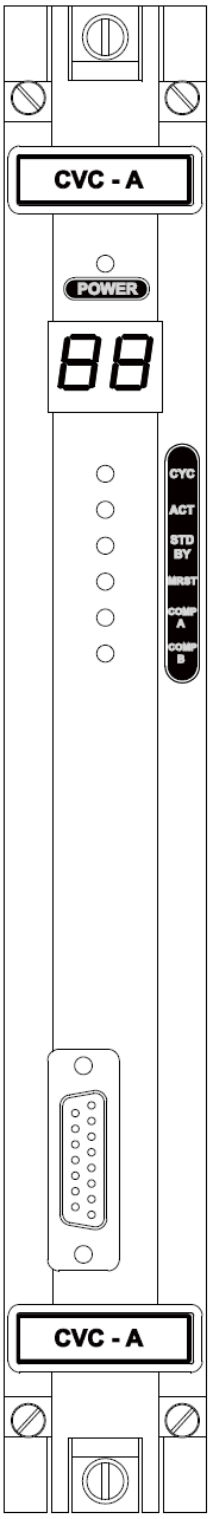
5.2.4 VIC Card

1. VIC card receives the inputs from OCMs, PP Modules, VDUs, OEIS, and CTC, and sends the output to the Communication Module.
2. It performs Vital Interlocking and Indication Logic Computation and Supervisory processor checks.
3. It has a Serial Communication Interface with MT for sending the Data Log and System Health information.
4. It is designed as a Dual Electronic Structure based on composite fail-safety with fail-safe comparison.

VIC Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the card
LED (**CYC**)	Cyclic activity status of SVP. Toggled every cycle
LED (**ACT**)	VIC is in active mode
LED (**STD BY**)	VIC is in standby mode
LED (**MRST**)	Provided for future use
LEDs (**COM A and COM B**)	Active status of COMP A and COMP B respectively
9 Pin D-Female Connector (**RS232**)	Used for Data Logger, Maintenance Terminal and Front Panel Display communication during normal operation and for Application Data download during offline mode.

Nameplate: CVC-A and CVC-B



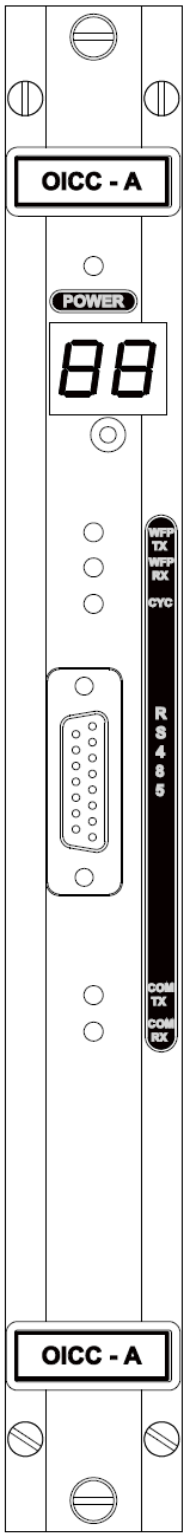
5.2.5 IOCOM CPU Card

1. IOCOM CPU card transfers data between the Communication Processor and the Wayside Function modules.
2. It receives the input messages from WFP and sends output messages to COMP.
3. It has provision for BDM/JTAG for connecting to PC parallel port for Programming and debugging interface.

IOCOM CPU Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the card
Dual digit 7 segment display	Visual indication of fault-codes
LEDs (**WFP TX** and **WFP RX**)	Transmission and reception of data from WFP's respectively
LED (**CYC**)	Status of cyclic activity of the CPU.
LEDs (**COM TX** and **COM RX**)	Transmission and reception of data from COMP card respectively
15 Pin Male Connector (**RS485**)	Provides serial communication between the OIC card and COMP card.

Nameplate: OICC-A and OICC-B



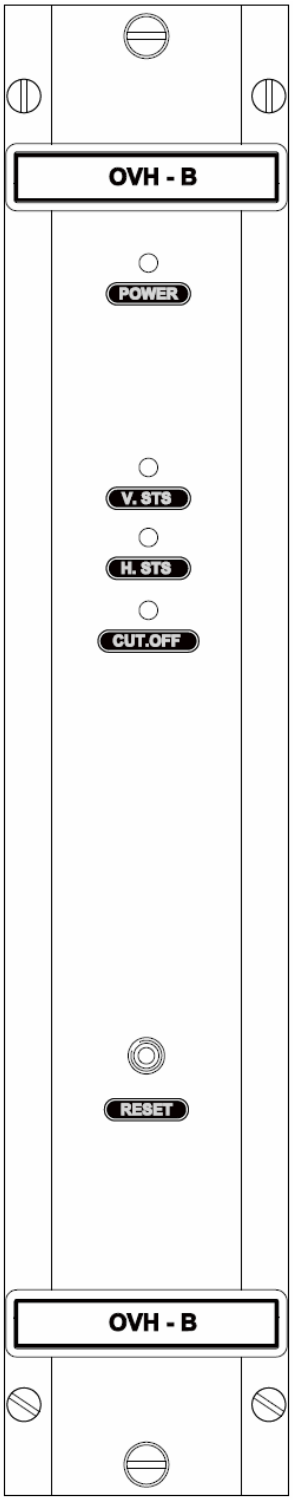
5.2.6 OVH Card

1. OVH card generates Power Good signal if all the monitoring voltages are within limits.
2. Shuts down the power input to CPU in case of the monitoring voltages going beyond limits or the CPU activity not being correct.
3. It monitors the status of the IOCOM CPU activity and indicates the status of CPU health.

OVH Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of power to the OVH card
LED (**V. STS**)	**Glows Green:** All the monitoring voltages are within predefined limits **Glows Red:** Any of the monitoring voltage has gone beyond limit
LED (**H. STS**)	**Glows Green:** IOCOM CPU Health OK **Glows Red:** IOCOM CPU Health Not OK
LED (**CUT. OFF**)	**Glows Green:** Card is operating normally **Glows Red:** IOCOM CPU power is cut off by OVH card
Push button (**RESET**)	When pressed, OVH card turns ON the Power to the OIC card when it is in OFF condition.

Nameplate: OVH-A and OVH-B



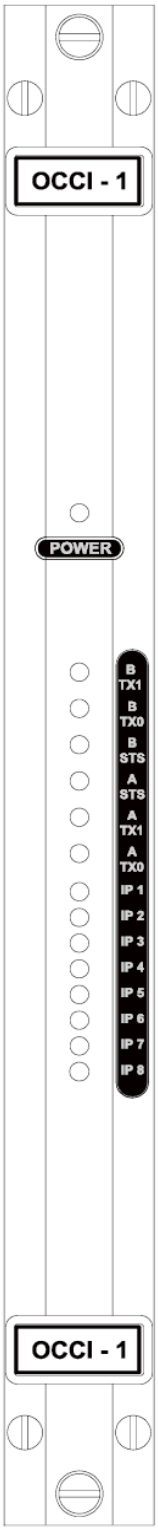
5.2.7 OCI Card

1. OCI Card scans the state of the input relays.
2. It frames the input data based on the state of the connected input relays. The framed input data is sent to IOCOM when they requested.
3. It indicates Input Relay connect status which is a Yard specific configuration setting.

OCI Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the card
LEDs (**B TX1** and **B TX0**)	Slave CPU status of communication with IOCOM-B CPU and IOCOM-A CPU respectively
LED (**B STS**)	Status of cyclic activity of the Slave CPU
LED (**A STS**)	Status of cyclic activity of the Master CPU
LEDs (**A TX1** and **A TX0**)	Master CPU status of communication with IOCOM-B CPU and IOCOM-A CPU respectively
LEDs (**IP1 to IP8**)	Input Relay State (Picked Up/Dropped)

Nameplate: OCCI-1, OCCI-2, OCCI-3, OCCI-4 and OCCI-5



5.2.8 OCO Card

1. OCO card receives Output relay drive data from IOCOMs and drives the relays.
2. It reads the Output Relay contact states to know whether the Output relays are in their commanded state.
3. It sends the read back data to IOCOMs.
4. It indicates Input Relay connect status which is a Yard specific configuration setting.
5. It performs self-test at power ON to detect any possible errors.

OCO Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the card
LEDs (**B TX1** and **B TX0**)	Slave CPU status of communication with IOCOM-B CPU and IOCOM-A CPU respectively
LED (**B STS**)	Status of cyclic activity of the Slave CPU
LED (**A STS**)	Status of cyclic activity of the Master CPU
LEDs (**A TX1** and **A TX0**)	Master CPU status of communication with IOCOM-B CPU and IOCOM-A CPU respectively.

Nameplate: OCCO-1, OCCO-2 and OCCO-3

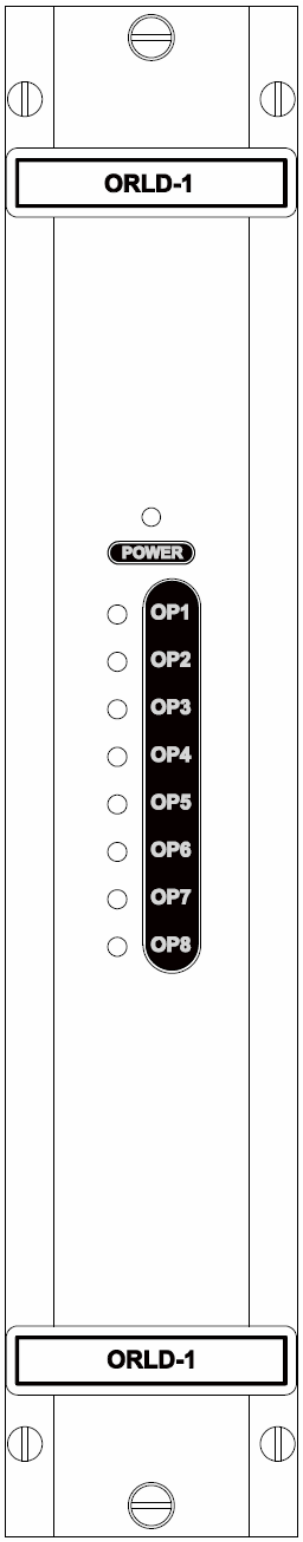
5.2.9 ORD Card

1. It can drive 8 External QN Type Fail-Safe Relays.
2. When the relay is to be driven it supplies 24V to the external relays.
3. It has reverse voltage, high voltage protection and against shorting of the drive signal.
4. Optical isolation is provided by Opto-couplers and Galvanic isolation by transformers.

ORD Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of vital power to the relays
LEDs (**OP1 - OP8**)	Drive status of the eight relays **Glows Orange:** Relay connected to that particular section is driven **Glows Red:** Drive signal is present but the relay is not driven as the fuse is blown due to over load condition **Glows Green:** External feed to the Relay during the fuse blown out condition

Nameplate: ORLD-1, ORLD-2 and ORLD-3



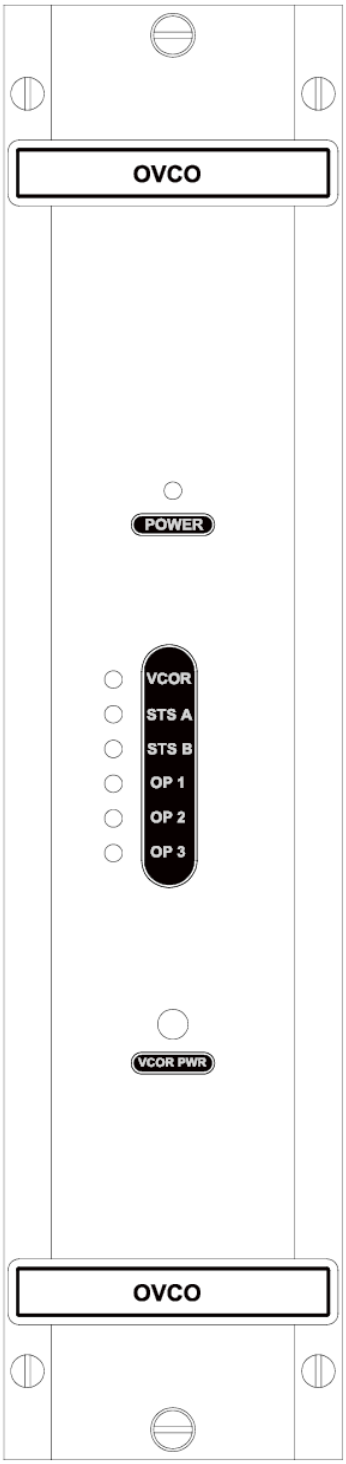
5.2.10 OVC Card

1. OVC card monitors the voltage outputs of the regulators on the WFP Output cards and indicates whether the voltages are within permissible limits.
2. It monitors the status of the Output WFP CPU activity and indicate the CPU health status.
3. It shuts down the power to the external relays in case of the voltages going beyond limits or the CPU activity not being correct.

OVC Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the Vital Cut-off card
LED (**VCOR**)	Vital Cut-off relay is being driven by the CPLDs
LED (**STS A**)	**Starts Blinking:** All the 'A' CPUs sends correct status pattern and the status of all the 'A' CPUs is OK
LED (**STS B**)	**Starts Blinking:** All the 'B' CPUs sends correct status pattern and the status of all the 'B' CPUs is OK
LEDs (**OP1** to **OP3**)	They are driven by CPLD B and represent the connect status of Output WFM card 1, 2 and 3
LED (**VCOR POWER**)	VCOR drive power is available to OVC card

Nameplate: OVCO



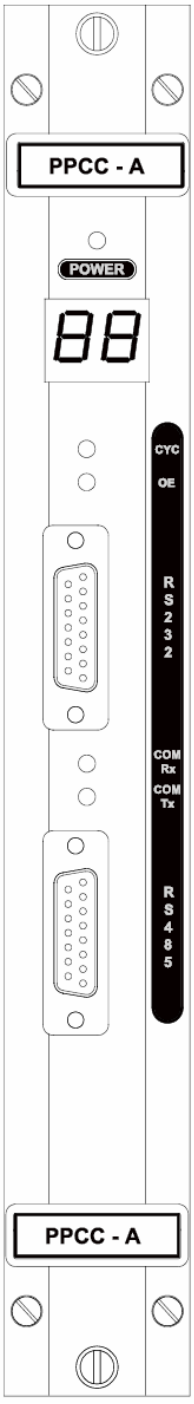
5.2.11 PCC card

1. PCC card scans the state of the buttons on CCIP and sends the same to COMP.
2. It receives the indication data from COMP and drives the indication LEDs on the Command cum Indication Panel.
3. Provision for BDM/JTAG is provided for connecting to PC parallel port for Programming and debugging interface.

PCC Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of the power to the card
Dual digit 7-segment display	Visual indication of fault codes
LED (**CYC**)	Status of cyclic activity of the CPU
LED (**OE**)	Reception of Password from the COMP for driving the output cards
LEDs (**COM Rx** and **COM Tx**)	Status of communication with COMP
15 pin Female connector (**RS232**)	Provides external communication interfaces for serial ports with RS232 levels
15 pin Male connector (**RS485**)	Provides RS485 communication interface with **RS485-OFC Bi-directional converter**

Nameplate: PPCC-A and PPCC-B



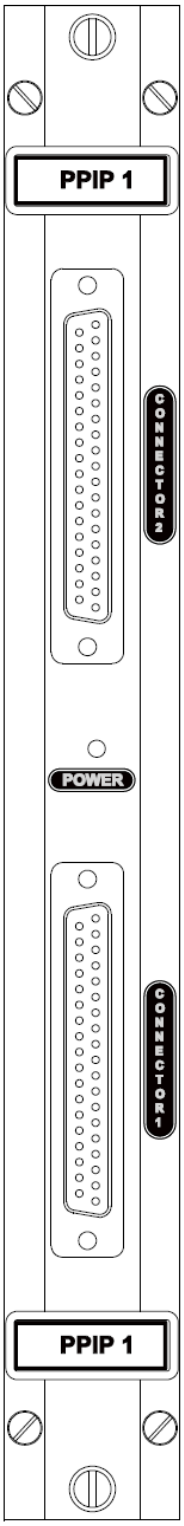
5.2.12 PIP card

1. PIP card facilitates the scanning of the buttons on the CCIP by the PP CPU card.
2. It has a provision to interface with two PP CPU cards at the same time.
3. Maximum of 64 PIP cards can be accommodated in a system.

PIP Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of the power to the card
Two 37 pin D-Male Connectors	Provides external communication interfaces for 64 inputs coming from the CCIP

Nameplate: PPIP-1



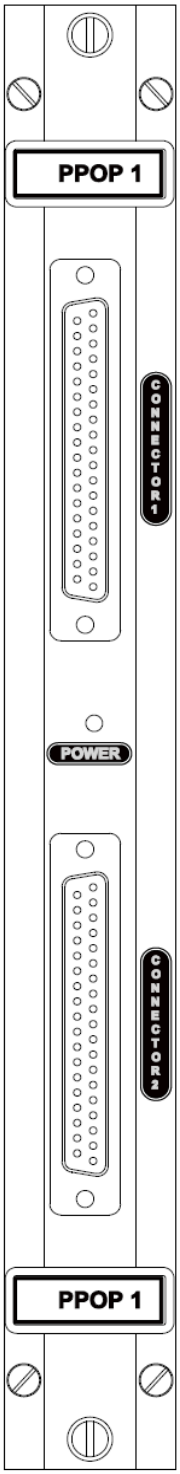
5.2.13 POP Card

1. POP card facilitates the driving of indication outputs on the CCIP by the PP CPU card.
2. It has a provision to interface with two PP CPU cards at the same time but drives the CCIP indications with the data sent by only one CPU card at any instant of time.
3. Maximum of 64 Output cards can be accommodated in a system.

POP Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of the power to the card
Two 37 pin D-Female Connectors	Provides external communication interfaces to drive 64 outputs on CCIP

Nameplate: PPOP-1



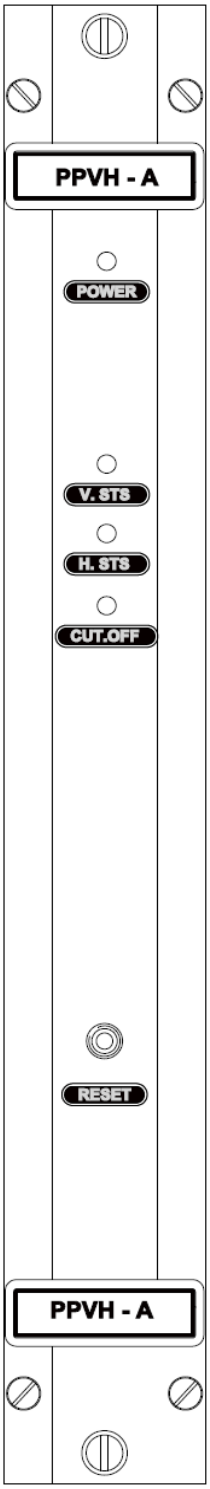
5.2.14 PVH Card

1. PVH card generates Power Good signal if all the monitoring voltages are within limits.
2. It monitors the status of the PP CPU activity and indicates the CPU health status.
3. It shuts down the power input to the CPU in case of the voltages going beyond limits or the CPU activity being not correct.

PVH Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of input power to the PVH card
LED (**V.STS**)	**Glows Green:** All the voltages monitored by the Power Manager are within limits **Glows Red:** Any of the voltage monitored by the Power Manager has gone beyond limit.
Third LED (**H.STS**)	**Glows Green:** PP CPU Health OK **Glows Red:** PP CPU Health Not OK
Fourth LED (**Cutt.Off**)	**Glows Green:** CPU is operating normally **Glows Red:** CPU Power is cut-off by the VHM card
Push-button switch (**RESET**)	When pressed, VHM card restarts the PP CPU card when it is in Power OFF condition

Nameplate: PPVH-A and PPVH-B



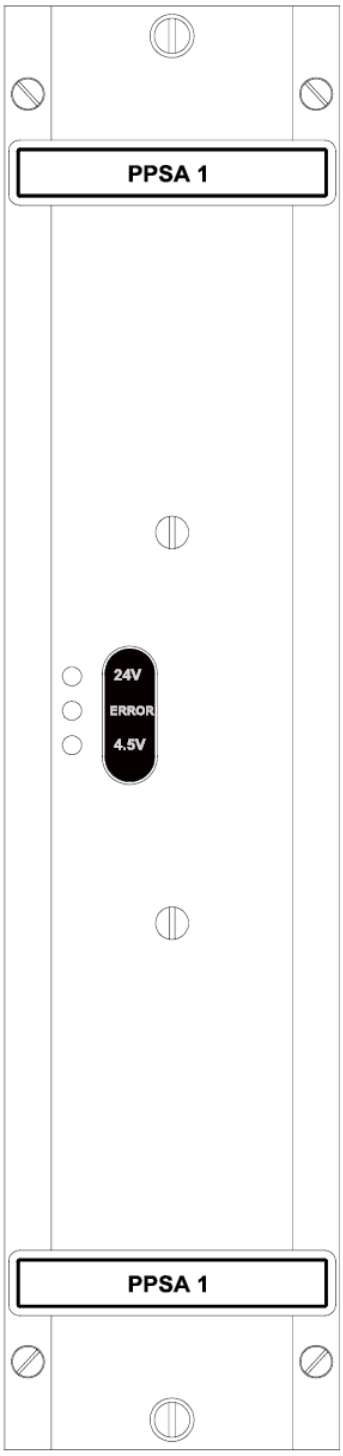
5.2.15 PSA Card

1. PSA card provides an output +4.5V with a capacity of delivering up to 8Amps of current.
2. The output voltage is used to operate Input and Output cards in Panel Processor Module.
3. The input of the card is provided with under voltage, over voltage and reverse polarity protections.
4. The output of the card is provided with under voltage, over voltage and over load protections.

PSA Facia Details

Indication/Interface	Description
LED (**24 V**)	Availability of power to the card
LED (**ERROR**)	Power supply Input out of limits
LED (**4.5V**)	4.5V Output voltage OK

Nameplate: PPSA1 and PPSA-2



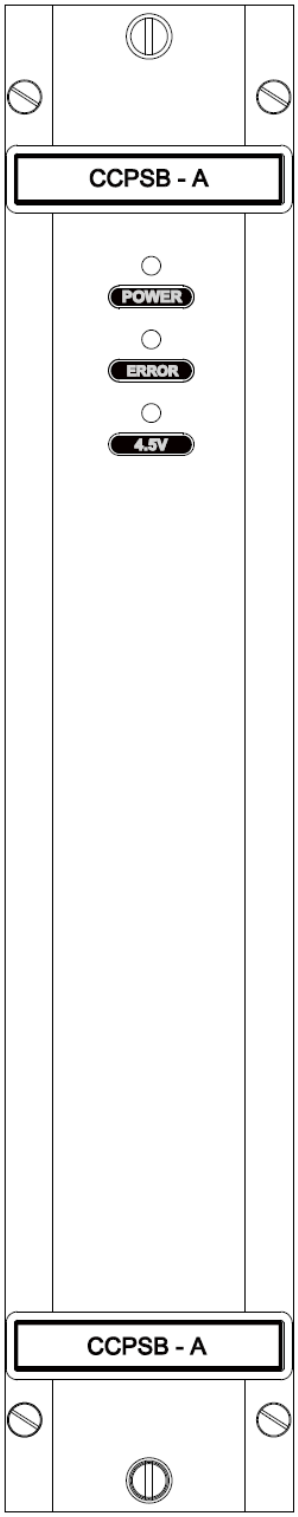
5.2.16 PSB Card

1. PSB card provides an output +4.5V with a capacity of delivering up to 3Amps of current.
2. The output voltage is used to operate CIU cards, IOCOM cards and PP cards.
3. The input of the card is provided with under voltage, over voltage and reverse polarity protections.
4. The output of the card is provided with over voltage and over load protections.

PSB Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of power to the card
LED (**ERROR**)	Power supply Input out of limits
LED (**4.5 V**)	4.5V Output voltage OK

Nameplate: CCPSB-A, CCPSB-B, CVPSB-A, CVPSB-B, OPSB-A, OPSB-B, PPSB-A and PPSB-B



5.2.17 PSC Card

1. PSC card provides an output voltage of +4.5V @ 6A and +5.8 @ 2A which are isolated form earth.
2. The output voltage is used for the operation of the CPU and Relay driver cards in the OC Module.
3. The input of the card is provided with under voltage, over voltage and Reverse polarity protections.
4. The output of the card is provided with over voltage and short circuit protections.

PSC Facia Details

Indication/Interface	Description
LED (**POWER**)	Availability of power to the card
LED (**ERROR**)	Power supply Input out of limits
LED (**5.8 V**)	5.8V Output OK
LED (**4.5 V**)	4.5V Output OK

Nameplate: OPSC1 and OPSC2