CHAPTER

7 Implementation of KAVACH by One of the OEM

7.1 KAVACH System Consisting of:

(a) Station Kavach Unit

(b) Loco Kavach Unit

The loco Kavach system is located in the locomotive and takes the inputs from the locomotive and controls the locomotive brakes based on the movement authority received from the station Kavach unit.

Station Kavach unit is located in a station / IBS or near an LC gate. It takes the inputs like track status, point status etc from the yard and communicates the movement authority to the Loco Kavach units in its vicinity. It also communicates the gradient data, speed profile till the next approach station.

7.2 The Stationary KAVACH System consists of the following Subsystems

(a) Station Radio Interface unit

(b) Station Master Operation Cum Indication Panel

(c) GPS module

(d) Station Bottom Bins (Optional)

(e) Station Electronic Unit

(f) Remote/LC Gates Interface Unit (RIU)

2| iATP (Automatic Train Protection System) KAVACH

7.2.1 Stationary KAVACH Equipments

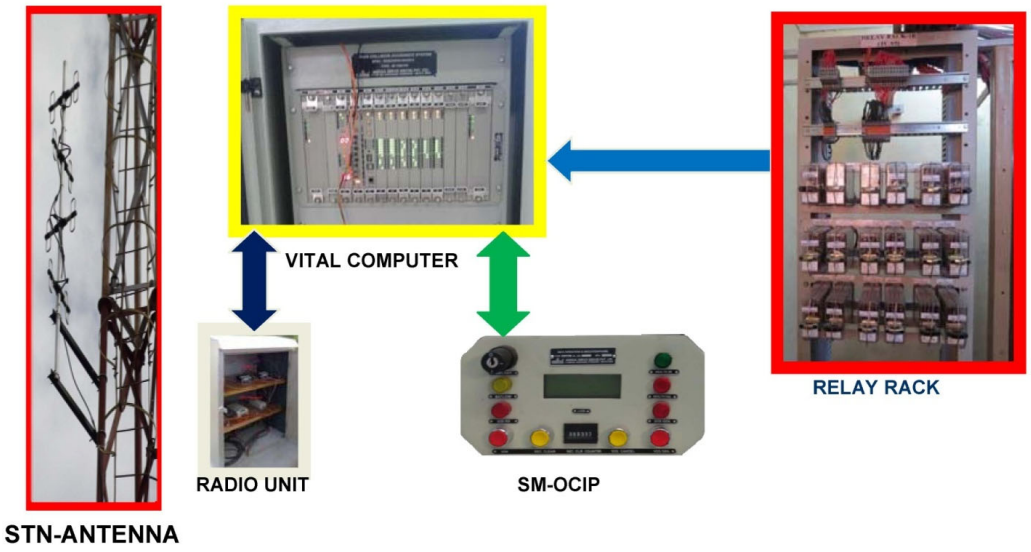

Fig. 7.1

7.2.2 Stationary KAVACH Architecture (MEDHA)

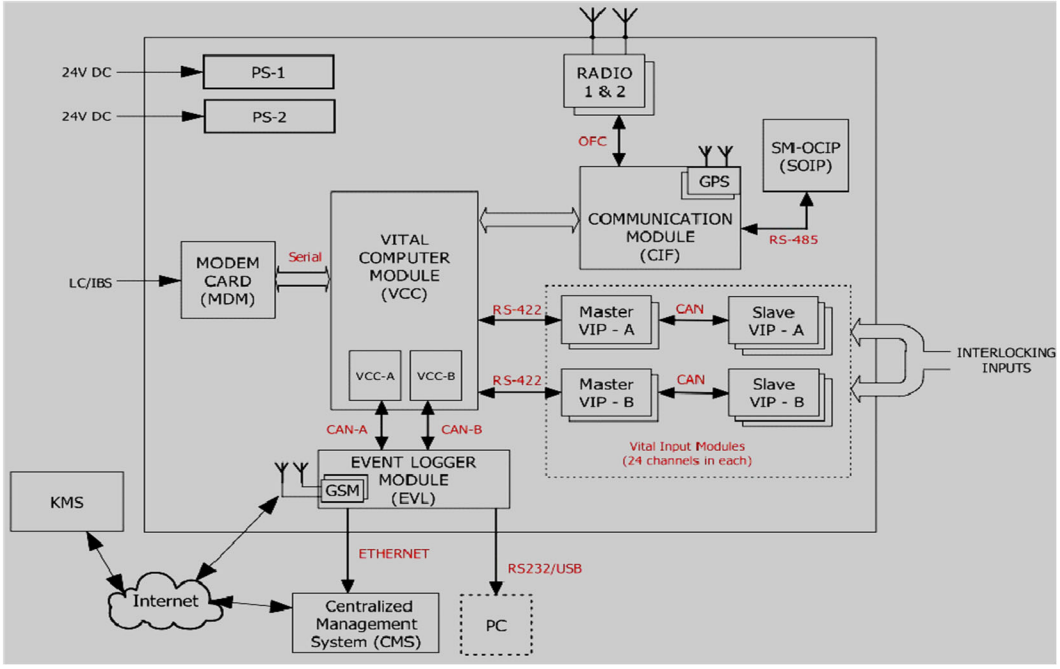

Fig. 7.2

7.2.3 MEDHA – Station Vital Computer

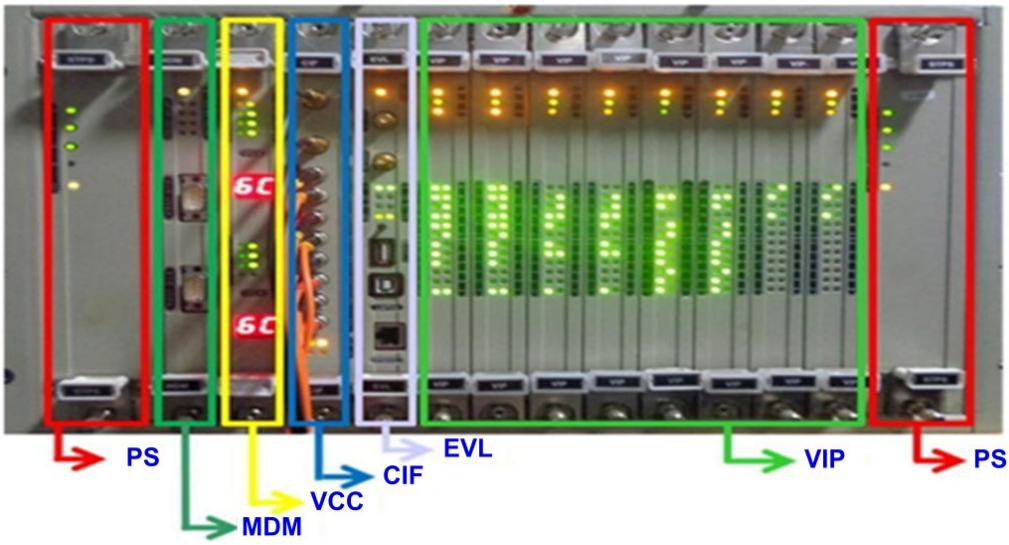

Fig 7.3

Station Kavach Electronic unit comprises of following modules

(a) Station Vital Computer (VCC)
(b) Vital Input Card (VIC)
(c) Communication Interface Module (CIF)
(d) Event Logger Module (EVL)
(e) Station Modem Card (SMDM)
(f) Operation & Indication Panel (SOIP)
(g) Power Supply Module (PS)

7.2.4 Stationary KAVACH Module Functions

Vital Computer module - Station Kavach Vital Computer module is designed as a Dual Electronic Structure based on composite fail-safety with fail-safe comparison. Vital Computer module consists of two vital processors (VP1 & VP2). Two independent computing channels with identical Hardware and common Software perform the safety checking and compare the outputs of two computing channels through inter-processor communication. The outputs are accepted as valid only if the two channels are in agreement.

This module receive the status of signal aspects, position of points, berthing track circuit status and status of Block Instrument Line closed condition through vital input card. Based on the status of field functions, it finds out the current aspect of signals in

the yard and calculates the movement authority accordingly. This information will be conveyed to Loco Kavach unit(s) in the form of Signal information packet.

2oo2 Voting

Two-out-of-two voting (2oo2) also employs two devices. In this arrangement, of the two devices, both devices must "agree" to cause a shutdown before the shutdown will occur. I.e., both devices must vote to trip to cause a trip action. This is physically represented by two switches in parallel. De-energizing either the "A" switch or the "B" switch alone will not cause the entire circuit to de-energize. Only when both switches open is the circuit de-energized and the plant moved to a safe state. This arrangement does not have any tolerance to dangerous failures. A failure of the "A" device in the welded closed mode by itself will result in a dangerous failure of the overall system, and the same is true for the "B" device. While this arrangement does not have any tolerance to dangerous failures, it does have one degree of tolerance to safe failures. If the "A" device were to spuriously fail in the safe open-circuit mode, power will still be conducted through the "B" switch, preventing a spurious shutdown. The same is true for a spurious failure of the "B" switch.

As a result of being tolerance to one safe failure but no dangerous failures, this voting arrangement is commonly used to improve resistance to spurious failures at the cost of decreasing safety performance below what it would be if only a single device were used. As you can see in the table below, use of 2oo2 voting provides for a drastically reduced spurious trip rate, but that improvement in resistance to spurious trips comes with the cost of decreased safety. Specifically, the probability of failure on demand of a 2oo2 voting arrangement is twice as high as for a single device. As a result, this voting arrangement can only be used to reduce spurious trip rates for systems with low SIL requirements e.g., SIL 1.

Vital Input module - Vital Input modules are used for reading the outputs of interlocking system. As 2-out-of-2 architecture is adapted for the design of Stationary Kavach, each CPU in the 2-out-of-2 is connected to its own set of input cards for reading the field inputs. In each card 24 channels will be present, which can be used for reading NO contacts of field relays. Number of input cards for each system may vary from 1 to 32 cards.

The input contacts are isolated from the CPU data lines by using opto-isolators.

Each vital input card is capable of reading up to 24 inputs and Employed double cutting mechanism. Fail safe input read-back circuit, Inbuilt Surge Current protection, reverse Polarity protection are provided.

Communication Interface module - Communication module is used for performing communication between the Vital Computer module and other sub-systems.

Communication module has serial communication interface with Radio modems, GPS modules and SOIP communication

Event Logger module - The Event logger Card will be used as a Data recorder. This module communicates with Vital Computer module to get the system events. It will record system events and the fault information of all control modules in the Station Kavach unit. The Event logger Card will communicate with Centralized Management System through GSM and Ethernet interface.

Modem Card - Modem card provides Quad cable interface between the two Station Kavach units. Communication is a full-duplex with a single pair of quad cable.

Modem card provides Serial interface between the Station Kavach and IB/LC/Hut (RIU) units. Communication shall be a full duplex with a single pair of OFC fiber. Modem card shall receive serial data from Kavach Vital computer card, received data shall co- transmit it to VIPs placed at IB/LC/Hut (RIU) units. Data received from VIPs at IB/LC/Hut units shall send it to station Kavach Vital computer module.

Power Supply module for Top Bin - The Power Supply module will generate the voltages required for the operation of all the modules in the system from +24V DC Input Supply. This module will work with a voltage range of +24V DC (+30%, -20%).

Station KAVACH Top Back- plane - Backplane provides the necessary interface between all the cards in the system and connects the system to the other systems.

Power Supply module for Bottom Bin - The Power Supply module will generate the voltages required for the operation of all the modules in the system from +24V DC Input Supply. This module will work with a voltage range of +24V DC (+30%, -20%).

Station KAVACH Bottom Back-plane - Backplane provides the necessary interface between all the cards in the system and connects the system to the other systems.

Redundancy: Redundancy plays a key role in increasing the availability of a system, without compromising the safety aspects of the system.

Stationary KAVACH Radio Interface Units

The Stationary Kavach comprises of Radio Interface units, located near to the tower. Radio Interface units consisting of two Radio modems and two OFC to RS-232 converters. The Radio modems used have two ports- one for communication and the other for diagnostic port to detect the health status. The Vital processors have interfaces to these ports.

Fig. 7.4 Radio Modem – Medha Make

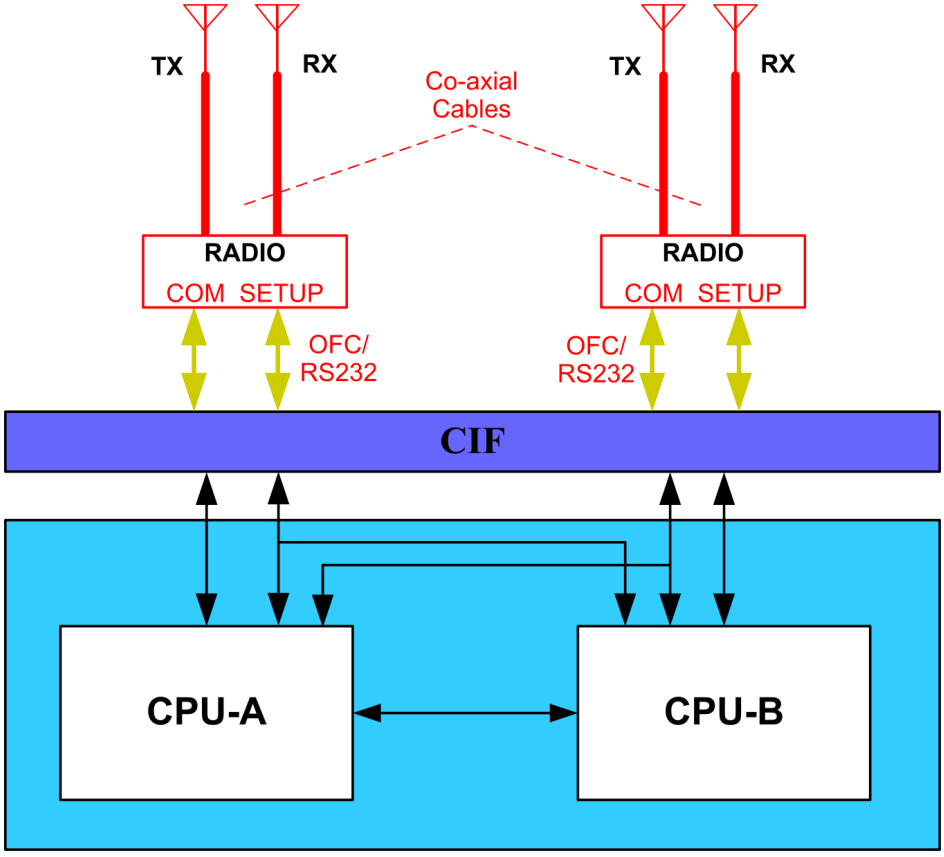

Fig .7.5 Radio modem Interface

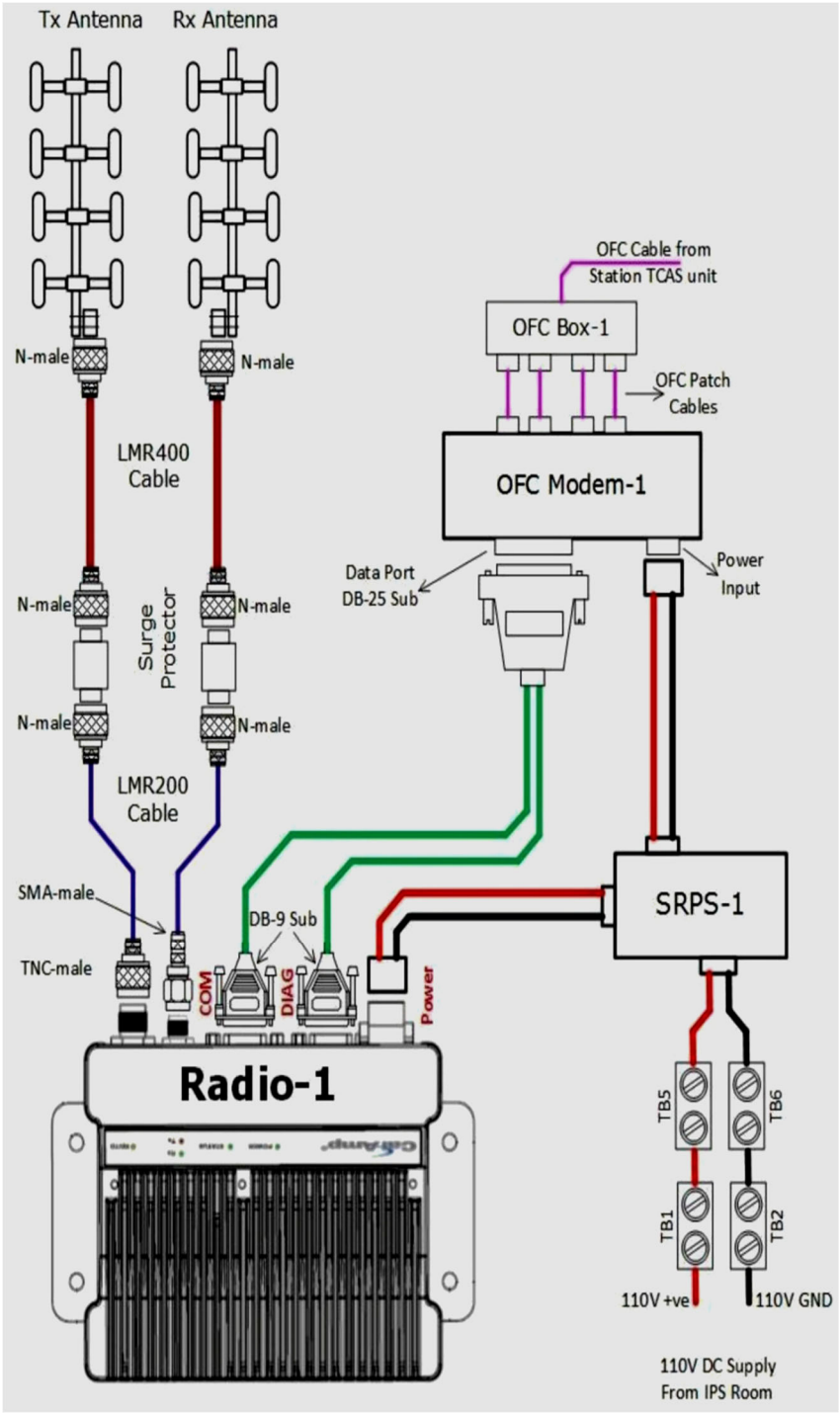

Fig. 7.6 Antenna wiring from Radio1 in Location Box

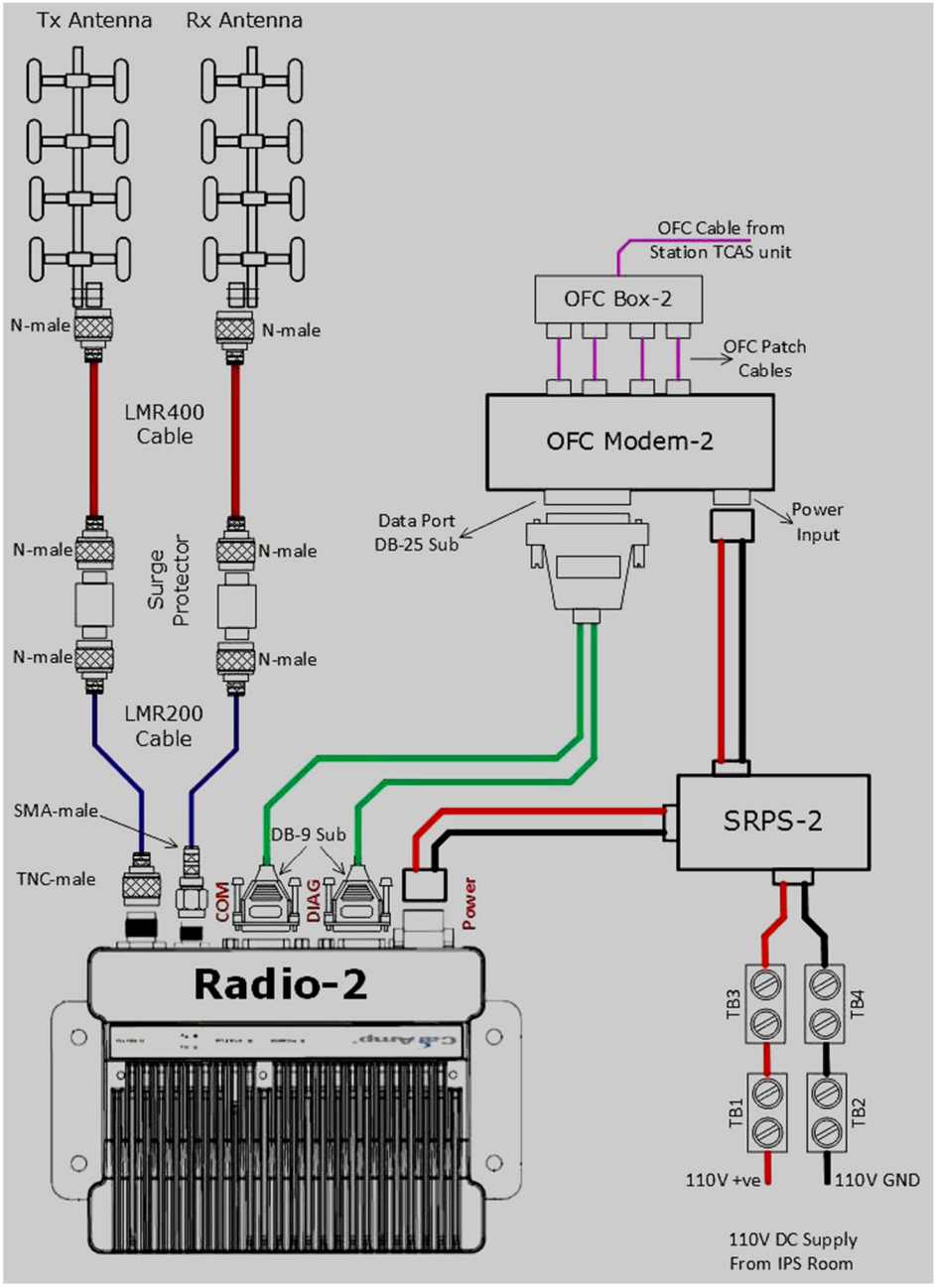

Fig. 7.7 Antenna wiring from Radio2 in Location Box

Station Radio Interface Unit - Station radio forms the important part of the Station Kavach unit. Station radio is used for communication between the Loco Kavach and Stationary Kavach units. Station Kavach unit is connected to the Radios by using the Communication Interface Module (CIF) and Station Radio Communication Interface Unit (SRCU) The radio interfaces with two dipole antennas – one for transmit and the other to receive the data. The two antennas are mounted on a tower which stands at a height of 30 meters to 40 meters. The Radio modems and SRCU modules are housed in a Tower box which is mounted on the antenna tower at a few feet height above the ground. The antenna cables coming from the Radio antenna and the OFC cables from the CIF module are terminated at the Tower box. The CIF module of the Stationary Kavach unit is placed in the relay room. The CIF interfaces with the SRCU by using four Multi Mode OFC cables – 2 for data, other 2 for diagnostics. The OFC cables are terminated at the location box and the optical signals are converted to electric signals by using the SRCU module. The SRCU has two sets of RS-232 interfaces (one for Loco communication data and the other for Radio diagnostics). The RS-232 signals are connected to the Communication port and set-up port of the Radio modem there is another similar setup for interface with the second radio modem, with the antenna tower and the CIF module being common for both the setups

Station Master Operation and Indication Panel (SM-OCIP)

The SMOCIP is an operator (Station Master) interface module placed within the reach of the Station Master. The interfaces that are provided are an LCD, a Key actuator, three Push buttons, six digit non-resettable counter and LED lamp indications.

Fig. 7.8 SM-OCIP Front View

The Push buttons of the SMOCIP module are powered only when the SM key is turned to IN position. The Station Master is authorized to give commands like SOS generation and SOS cancellation using these three push buttons labeled as SOS Gen, SOS cancel and SOS common. Commands are accepted by the Stationary Kavach only if the SOS common button is pressed in conjunction with SOS Gen /Cancellation button. This is to prevent form the accidental generation of SOS message.

The six digit non-resettable is used to register the count of SOS generation and cancellation operations. LED lamp indications are used to show the system health, battery health and SOS status are present in SMOCIP.

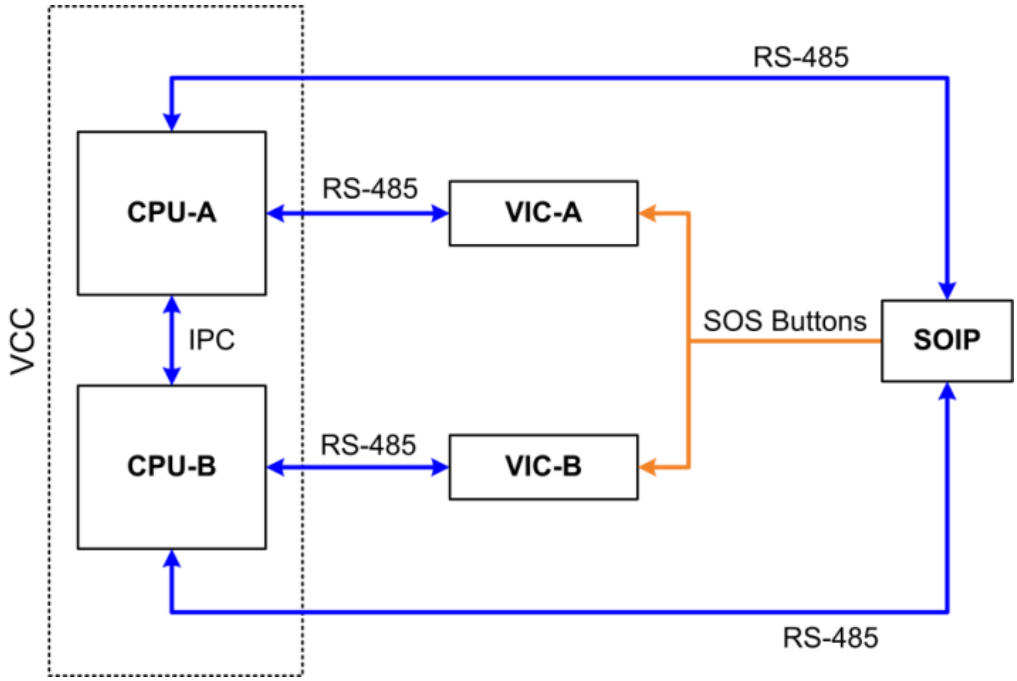

Fig. 7.9 SOIP Interface Diagram

7.2.5 SMOCIP module performs the following functions

1. Displays system information on LCD
2. Used by station master to generate and cancel the station general SOS using the push buttons
3. Displays the loco SOS information on LCD
4. Alerts the station master with a buzzer, when events like channel link fail, button stuck, critical faults, general SOS or loco SOS occurs
5. Records the station general SOS operation using counter
6. Indicates system health and SOS active/ inactive status using LEDs.

LED's Indication

1. HEALTH OK LED Green colour indicates communication health status. If the communication is healthy between SMOCIP and SVCC, this LED turns ON, otherwise it remains OFF.
2. HEALTH FAIL LED Red colour indicates communication failure status. If there is communication failure between SMOCIP and SVCC, this LED turns ON, otherwise it remains OFF.
3. G-SOS LED Red colour indicates General SOS status. If General SOS is active, this LED turns ON, otherwise it remains OFF.
4. LOCO SOS LED Yellow colour indicates loco specific SOS status. If Loco specific SOS is active, this LED turns ON, otherwise it remains OFF.

Push Buttons

1. Three push buttons are operable only when SM key is inserted and is in 'IN' position.
2. G-SOS COM push button is used for general SOS generation and cancellation. It is also used as acknowledge button to acknowledge the events.
3. G-SOS CAN push button is used for general SOS cancellation.
4. G-SOS GEN push button is used for general SOS generation.

SMOCIP displays the following information on LCD screen, based on the detected event or information received from SVCC.

1. Checksum Display
2. Button Stuck Display
3. General SOS Display
4. Loco SOS Display
5. Critical Faults Display
6. Faults Display
7. Recovered Faults Display
8. Channel Link fail Display
9. System Link fail Display

7.2.6 Station Antenna

Base station stacked Dipole type Omni directional type antenna with Gain of 9.0 dB. Frequency band is 406-512 MHZ with input impedance 50 Ohms. Four antennae used and 1- TX and 1- RX antenna for each modem.

GPS & GSM Module - GPS is used for time reference of Station Kavach. It is housed in the Communication module, which communicates with the vital computer to give GPS related information. The GPS receiver outputs the data which is routed to the

Vital Computer Card after undergoing proper isolation in the CIF card. GSM is used to communicate with KMS server to get the Authentication keys. It is housed in the Event Logger module, which communicates with the KMS server.

GPS & GSM Antenna: The GPS chip set receives the GPS data with the help of GPS antenna which captures the information transmitted by the GPS satellites. The GPS antenna used is a patch antenna which is terminated with an SMA male connector. This GPS antenna is connected to the female SMA connector mounted on the CIF card whose other end is connected to the Pin 16 (Antenna Input RF IN) of the GPS chip set. To get the GPS information from maximum number of satellites, it has to be placed in a location where the GPS antenna has maximum possible sky view. The GPS & GSM antenna is enclosed in an Antenna Hood which is usually mounted on the top of the room containing Station Kavach cabinet.

GPS INTERFACE - GPS interface used for Time synchronization of Kavach Radio communication network .Two GPS Modems are used for Redundancy and both are active .Faulty one detected and isolated with in 3 cycles and auto recovery of faulty GPS .Real time events logging also possible.

GSM - GSM used for Events & Faults loggings in NMS through GPS and to get security keys from KMS, to send SMS for emergency

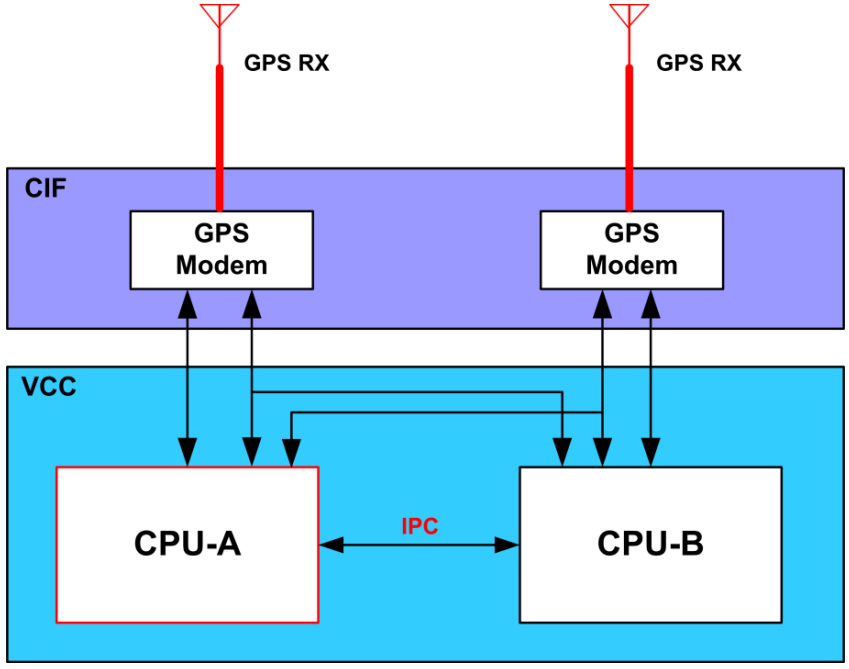

Fig. 7.10 GPS Interface

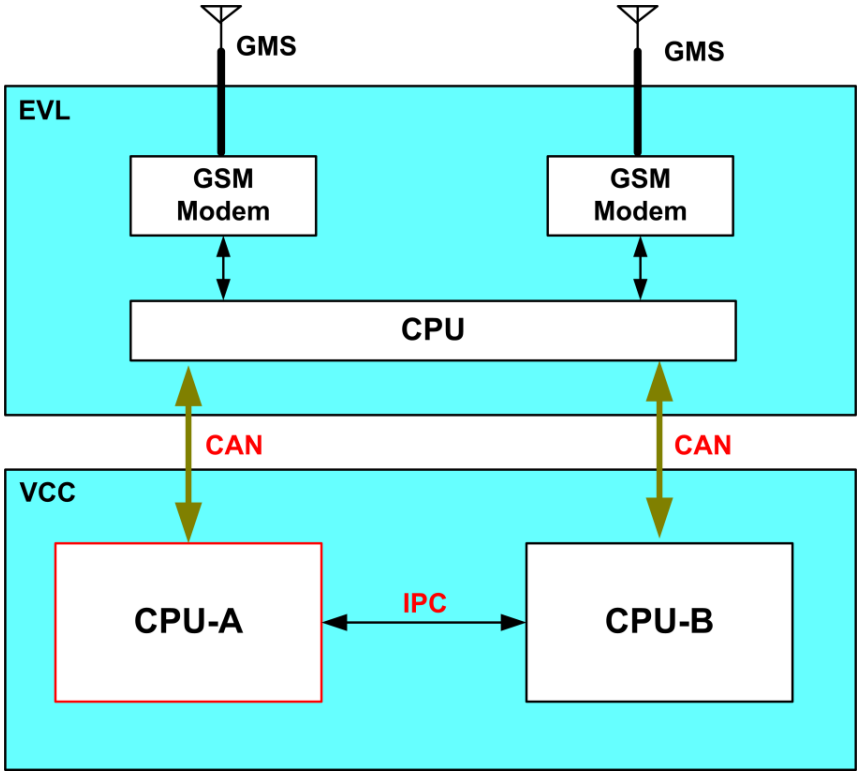

Fig. 7.11 GSM Interface

1. Two GSM modems are used for redundancy
2. Events and Faults logging in NMS through GSM
3. To get Security Keys from KMS
4. To send SMS for emergency/critical messages

Fig. 7.12 Placement of GPS & GSM Antennas

7.2.7 Remote Interface Unit (RIU)

- Remote Interface Unit (RIU) shall be used where remote signalling functions are required to be fetched to a nearby Stationary Kavach unit.
- RIU shall have provision for interfacing with signalling inputs in fail-safe manner.
- RIU shall use line modems for communicating with stationary Kavach unit. A single RIU shall be capable of handling at least 32 field inputs
- OFC or Quad cable, ring network shall be formed to increase availability of the network.
- A single RIU shall be capable of communicating with two adjacent RIU units so that the operations are not affected in case of communication link failure on one side only. It is 2oo2 architecture

7.2.8 Radio Communication arrangement

- Station Kavach and Loco Kavach communicates with each other through Radio modems.
- The Radio with a transmission power of 10W is capable of communicating with the other Kavach within the radius of 5 KM at- least.
- Antenna for station/ IBS/ mid-section interlocked Gate unit will be Combination of vertically polarized Omni-directional antennae.
- The tower for Radio communication will be of 30 meter/40 meter height
- Station Kavach and Loco Kavach units communicates with each other for every 2 seconds.
- Pair 1 : Station Tx - 456.8 MHz, Rx - 416.8 MHz
- Pair 2 : Station Tx - 466.8 MHz, Rx - 426.8 MHz
- Common Frequency, f0 - 441.8 MHz

7.2.9 Remot Interface Unit (RIU)

Fig. 7.13

Remote Interface Unit (RIU) comprises of the following sub systems

1. Equipment Rack
2. RS485OFBC Converter (M485OFBS)
3. Battery Charger
4. Battery Set

Each RIU consists of four Vital Input Modules (VIP) and each VIP module is reads maximum of 24 inputs. There- fore, station Kavach reads total 96 field inputs from each connected RIU subsystem. Remote signaling inputs are communicated to Station Kavach unit over an OFC media. If multiple RIUs are required to communicate with Station Kavach unit, they are to be connected in a ring network topology to increase the availability of the network. In ring network, each RIU is connected to two adjacent RIUs. In case, communication link fails with one adjacent RIU, inputs are communicated over the other communication link. The same set-up is used to interface LC gate inputs to stationary Kavach unit. Equipment rack is used to fetch the field inputs of relevant IB HUT/LC gate. All the modules are plug-in type and 6U high that plugs into a Back Plane (SBBP) in the rack.

RS485 to OFC Converter (M485OFBS)

RIU bins consist of full duplex RS485 communication interface to communicate with the Vital Computer Card of S Kavach. This module consists of two RS485 to OFC conversion sections - Primary and Secondary. This module facilitates the connection of RIUs in ring network topology. RIU consists of the following modules

S. No.	Module Name	Functions
01	Vital Input module (M110VIP)	Vital input module reads the outputs of interlocking system. Each card contains 24 channels, which reads NO contacts of field relays. The set of input modules consists of an interface to signal aspects, berthing track circuit, and LC gate status condition through potential free contacts. Each vital input module can read maximum of 24 input relays and indicates the status of all inputs. All the input contacts are isolated from the field input lines using opto-isolation of 2 kV. Vital input module scans and de-bounces the input relay status and form the input message to send the same to vital computer module of Station Kavach. Vital input module communicates the status of inputs in every cycle over ring network.
02	Power Supply module (M110SBPS)	The power supply module generates the voltages required for the operation of all the modules in the system from +24 V DC input supply. This card provides isolated output power of 4.5 V ± 5% to VIP cards in the system. This module works with an input voltage range of +24 V DC (+30%, -20%).
03	Bottom Back Plane (M110S BBP)	Backplane interfaces with all VIP cards in the system and connects the system to the other.
04	Field Interface Card (M110FIC)	FIC card interfaces with field inputs to VIP card through FRC cable. Each FIC card is capable of interfacing 48 inputs to RIU unit for CH-A and CH-B.

7.2.10 Interfacing Input relays

Inputs are read by RIU unit through field interface card. The cable 50 wire jacketed flat ribbon cable of length one metre connects FIC card to 50 pin shrouded header K19 on the station Kavach RIU unit back plane. The field inputs from relays are given to FIC card using CABLE SET 14 (bunch of cables) to the terminal blocks on the FIC card. If more number of inputs are to be connected, an arrangement similar to cable Set 14, cable 12 are used to connect the inputs to RIU back plane at connector K22.

7.2.11 Interlocking (IXL) System Inputs Interface

- Only Signal Aspects, Berthing Tracks, Point Machines
- Each vital input card is capable of reading upto 24 inputs
- Capable of reading 784 inputs (32 VIP Cards)
- Employed double cutting mechanism
- Two independent channels (2oo2 architecture)
- Fail safe input read-back circuit
- Inbuilt Surge Current protection, Reverse Polarity protection

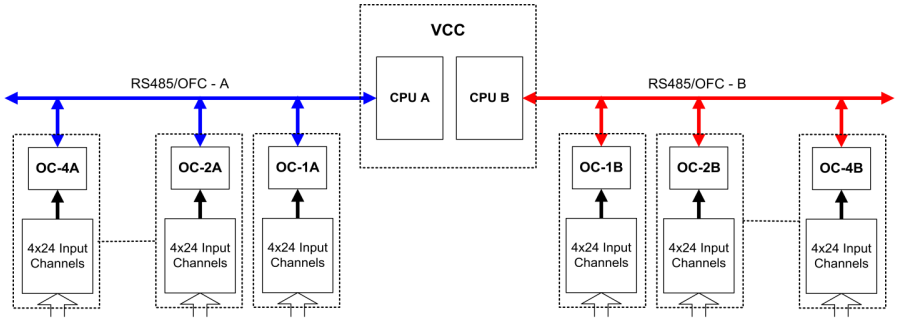

Fig. 7.14 Interlocking system inputs interface

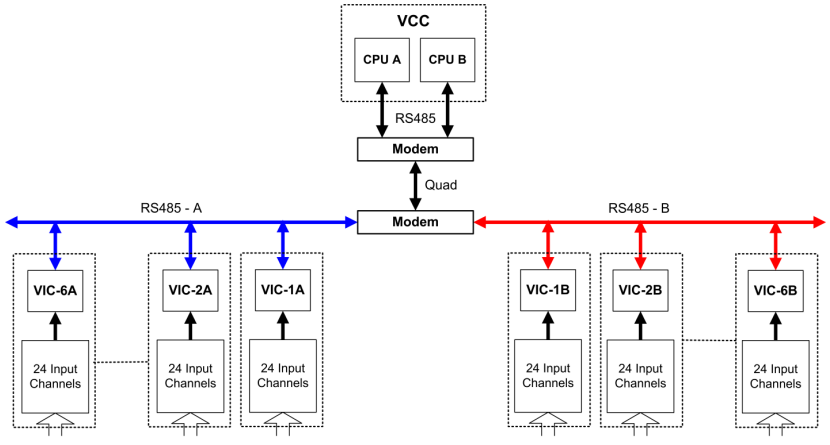

Fig. 7.15 LC Gate/ IB hut input interface

7.3 Loco KAVACH Unit

The loco Kavach system is located in the locomotive and takes the inputs from the locomotive and controls the locomotive brakes based on the movement authority received from the station Kavach unit.

The Loco Kavach unit comprises of the following sub modules.

1. Loco Kavach Electronic Unit
2. Loco Kavach Radio Interface Units
3. Speed Sensor
4. RFID Readers
5. Driver Machine Interface (DMI) Units
6. The Loco Kavach Electronic unit
7. The following table lists the modules housed in Loco Kavach Electronic Bins and their basic functionalities.

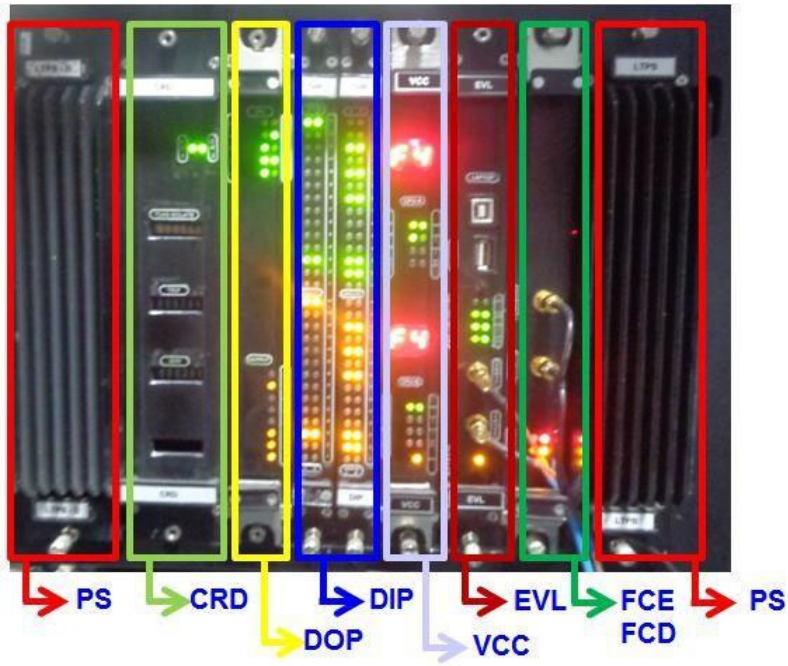

Fig. 7.16 Loco Kavach Control Unit (MEDHA)

S. No.	Module Name	Basic Function(s)
1	Vital Computer module (M110VCC)	Kavach consists of One Vital Computer module, with 2 Vital Processors running in 2-o-o-2 architecture with diverse hardware. System Inputs are read and processed independently from respective Input Channels of the Input Cards to give functional Outputs.

Contd…

S. No.	Module Name	Basic Function(s)
2	Digital Input module (M110DIP)	Kavach consists of two input cards. Each input card has 28 channels, with 14 channels corresponding to each vital processor. 14 channels in an input card are connected to the same input as the 14 other channels of the input card. The input contacts are isolated from the CPU data lines by using opto-isolators.
3	Digital Output module (M110DOP)	The Digital Output module is used to give different output of the system. The outputs are used to drive emergency relay, interface with the Brake Interface Unit (BIU) and perform non-vital operations like driving counters, buzzers, status indicating lamps. The Digital Output module receives the vial output drive data from the Vital Computer module.
4	Frequency Input and Communication Interface module (M110FCD for Diesel loco and M110FCE for Electric loco)	The FCD/FCE card is used to interface the VCC with external systems using, by converting the TTL level serial communication signals to RS485 signals, isolated from the VCC. This card consists of the GPS section, which the controller uses for time reference. This card consists of frequency input sections, which receive the frequency signals from the speed sensor and convert them to TTL level. This card also houses the power manager section which cuts off the supply to the controller in case of controller failure. Power manager also performs the important task of power sequencing.
5	Counter and Relay Driver module (M110CRD)	The Counter and Relay Driver module consists of the counters and emergency relay related to the system. Counters are used to maintain the count of different parameters of the system.
6	Event Logger module (M110EVL)	Event Logger module will be used to store the system events. This module is also used to communicate to the KMS and NMS using GSM. This module is interfaced to both the Vital processors through serial communication (CAN).
7	Loco Kavach Power Supply module (M110LTPS)	The system consists of two redundant Power Supply modules. The nominal input voltage to the card is +72V dc (Diesel Loco) and +110V dc (Electric Loco). These cards provide isolated power to all the cards in the system. Over voltage and Under voltage protections for the input and Over voltage and Overload protections for the output are provided.
8	Loco Kavach Back-plane (M110LCBP)	Backplane provides the necessary interface between all the cards in the system and connects the system to the other systems.

7.3.1 Loco KAVACH Radio interface unit

The Loco Kavach comprises of two Radio Interface units with each unit consisting of one Radio modem, one RS-422 to RS-232 converter and the associated power supply. The Radio modems used have two ports- one for communication and the other for

diagnostic port to detect the health status. The Vital processors have interfaces to these ports. The Vital Processors can configure the Transmit and Receive frequencies, request and receive health information from the Radio modems.

7.3.2 RFID Readers

The Loco Kavach unit interfaces with the two RFID readers to read the Data programmed in the RFID tags which are mounted on the Tracks. The RFID tag is a passive device which is activated by the RFID reader. There are two RFID readers interfaced to the Loco Kavach. The Vital Processors configure the RFID reader to read two pages of width 64-bits each at one instance. The communication protocol between the Vital Processor and the RFID reader is as per the serial protocol defined in RFID Reader manual.

Fig. 7.17 RFID Reader

Fig. 7.18 LOCO – Radio Antenna

1. Gain 0 dB, Frequency band : 406 – 512 Mhz
2. Input Impedance: 50 Ohm
3. Polarization: Vertical

4. Radiation pattern: Omni directional
5. Wind rating: 200 km/hr
6. Weight (Kg): 3
7. 4 Antennae (1-TX and 1-RX antenna for each radio modem)

7.3.3 Speed Sensor interface

The Speed Sensor is mounted on the axle of the locomotives. Based on the wheel diameter (configurable) and number of rotations per second, the speed will be calculated. The speed sensor also has the ability to give the direction of the locomotive. The speed sensor has redundancy built into it.

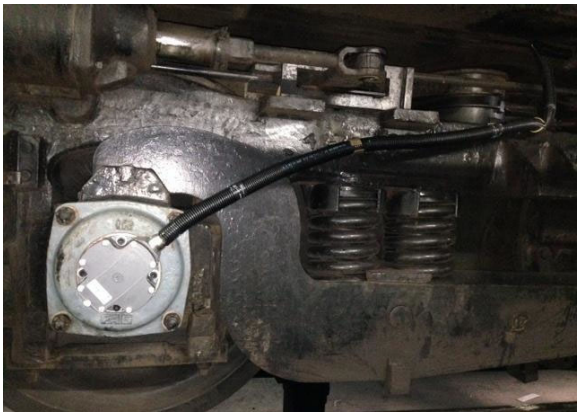

Fig. 7.19 Loco Speed sensor unit

7.3.4 Power supply module

Power Supply module converts 72/110V dc supply to the supplies required by the sub-systems of the Loco KAVACH unit. Nominal working voltage is 72V (for Diesel) & 110V (for Electric). Input working voltage range 20V to 100V (for Diesel) 60V to 160V (for Electric)

7.3.5 MEDHA-RFID

Fig. 7.20

Fig. 7.21

7.3.6 Loco to Station Radio Communication Requirement

Loco Kavach unit shall update its position to Station Kavach unit within station vicinity. Station vicinity is defined as 3.5km from Home Signal or Two Normal Tags before the Distant signal. Loco to Station communication is mandatory in this vicinity.

7.4 Station KAVACH System indications

Before set up and configuration of MCA110 system, we need to know front panel controls and indications associated with MCA110 system printed circuit boards. The front facia of all the cards are provided with LED indications. These indications assist the operator to know the status of the card at any point of time. The following tables provide detailed information about the indications and other components provided on the facia of station Kavach unit cards.

Station KAVACH vital computer card indications

Table 7.1 Vital input card indications

Indication/ Interface	Description
LED(POWER)	Indicates Power(3.3V) input to the card
LED(CYC)	Indicates Cyclic activity status, toggles in every cycle
LED(IPC)	Indicates Communication status with other CPU
LED(GPS-1)	Indicates Communication status with GPS-1
LED(GPS-2)	Indicates Communication status with GPS-2
LED(EVL)	Indicates Communication status with EVL
LED(VIP)	Indicates Communication status with VIP Cards
LED(OCIP)	Indicates Communication status with OCIP
LED(RAD)	Indicates Communication status with Radio
7 Segment Display	Displays Fault codes

Table 7.2 CIF Card controls and indications

Indication/Interface	Description
LED(POWER)	Indicates Power(3.3V) input to the card
LED(CYC)	Indicates Cyclic activity status, toggles in every cycle
LED(COM)	Indicates Communication status with vital computer card
LED(IP-1 to IP-24)	Indicates Input-1 to Input-24 status (Pick- up/Drop)

Table 7.3

Indication/Interface	Description
Connector (GPS-B)	Used to connect the Antenna for GPS Receiver – 2
Connector (GPS-A)	Used to connect the Antenna for GPS Receiver – 1
OFC Connector (VCB-2RX)	Used to connect the Radio-2 Diagnostic port receiver
OFC Connector (VCB-2TX)	Used to connect the Radio-2 Diagnostic port Transmitter
OFC Connector (VCB-1RX)	Used to connect the Radio-2 COMP port receiver
OFC Connector (VCB-1TX)	Used to connect the Radio-2 COMP port Transmitter
OFC Connector (VCA-2RX)	Used to connect the Radio-1 Diagnostic port receiver
OFC Connector (VCA-2TX)	Used to connect the Radio-1 Diagnostic port Transmitter
OFC Connector (VCA-1RX)	Used to connect the Radio-1 COMP port receiver
OFC Connector (VCA-1TX)	Used to connect the Radio-1 COMP port Transmitter
LED(VHMPWR)	Indicates Voltage Monitoring Circuit Power
LED (INTPWR)	Indicates Power (3.3V) input to the card
LED (V STS)	Indicates Vital Computer Card Voltage Monitoring Status
LED (V STS)	Indicates Vital Computer Health Status

EVL CARD Indications

Table 7.4

Indication/Interface	Description
LED(POWER)	Indicates Power (3.3V) input to the card
Connector (GSM-1)	Used to connect the GSM-1 Antenna
Connector (GSM-2)	Used to connect the GSM-2 Antenna
LED(CYC)	Indicates Cyclic activity status, toggles in every cycle
LED(ETH)	Indicates Communication status with E1 interface
LED(VCA COM)	Indicates Communication status with Vita computer-A
LED(VCB COMP)	Indicates Communication status with Vita computer-B
LED(GSM-1)	Indicates Communication status with GSM -1
LED(GSM-2)	Indicates Communication status with GSM -2
LED(PENDRV)	Indicates Pendirve connectivity status
LED(LAPTOP)	Indicates PC/Laptop connectivity status
USB Connector (PENDRIVE)	Used to connect Pendrive
USB Connector (LAPTOP)	Used to connect PC/Laptop
Ethernet Connector	Used to connect adjacent station Kavach through E1 interface

MDM Indications

Table 7.5

Indication/Interface	Description
LED (POWER)	Indicates Power(3.3V) input to the card
LED (STN-1 to STN-6)	Indicates Communication status with Adjacent Station/IBS/LC gate
Connector (DB-9)	Used to connect Quad-cable (2-wire)
Connector (DB-9)	Used to connect Quad-cable (2-wire)

Battery Charger card Indications

Table 7.6

Indication/Interface	Description
FAIL	Battery Charger output fail status
O/P	Battery Charger 24V output status
I/P	Battery Charger 110/230V AC Input status
LOAD	Battery Charging status
V.ADJ	Battery Charging Voltage Adjustment POT

7.5 System Start-up details

After configuring and installing MCA110, the next step in the start-up process i.e. applying power to the system, and then verify that the internal functions of the MCA110 system is working properly.

Initial Checks

The following checks should be made before switching ON the system:

(a) No loose wires are hanging from any of the PCBs.
(b) Indications on the facias of all the PCBs are in OFF condition
(c) No PCB is projecting outside. The fixing screws for all the PCBs are fixed properly
(d) Field power cable is connected to PS Card and required Relay contacts.
(e) Relays are inserted in their respective slot.
(f) User Interface unit is to be connected properly.
(g) Communication and Power cables are properly terminated.

7.6 System Maintenance

This chapter provides instructions for performing a scheduled maintenance routine that is designed to detect early symptoms of equipment degradation.

Maintenance personnel must be familiar with the recommended methods for operating, testing, and repairing the MCA110 system equipment.

7.6.1 Tools

Following Tool kit shall be purchased separately.

Table 7.7

S. No.	Tool	Quantity
1	Digital multi-meter	1 No.
2	Ring spanner	1 No.
3	Open end spanner	1 No.
4	Socket spanner with handle	1 No.
5	Screw Driver No. 902	1 No.
6	Screw Driver No. 935	1 No.

7.7 Periodic maintenance

- Service Engineer shall download Events and Faults log and store in a PC with date and time.
- Wiring shall be verified to avoid loose contacts.
- Nuts and bolts shall be verified for tightness at cabin.

- Input Supply shall be monitored on the Terminal board and it shall be with in specified limits.

7.7.1 Electrostatic Protection

- Always stand on an approved conductive floor mat when touching or handling printed circuit boards.
- Always wear a wrist strap-grounding device. The wrist strap should have a 1.0MΩ current limiting resistor. Connect the wrist strap grounding connector to suitable ground connection.
- Periodically check each wrist strap for continuity using an approved tester. Continuity readings must be between 500kΩ and 10MΩ. Discard any wrist strap that does not meet this criterion.
- Always handle printed circuit boards by the edges. Do not touch board components.
- Once removed from the bin, immediately place printed circuit boards into a conductive-shielded bag. Wrap the bag in conductive foam to protect the circuit board during transport and shipment.

7.8 System Trouble Shooting

Troubleshooting the MCA110 system involves careful analysis of observable fault codes displayed on Station SM's OCIP LCD, and the ability to perform standard electrical and electronic troubleshooting operations.

System event log information associated with different modules are captured in Application terminal tool program contain information regarding the performance of MCA110. These event logs are useful while troubleshooting. The information placed in the event logs contain Fault Codes, which contain both Critical and Non Critical Faults.

The Critical Faults are the Faults, which may cause Restart or Shutdown of the Faulty module, or they indicate a serious error, which needs immediate attention.

The Maintainer is alerted about the Critical Fault by a Fault Buzzer in the OCIP Non Critical Faults are the faults, which do not cause the System to restart, or Shut-down, but the System may continue to operate in a de-graded mode of operation.

Trouble shooting each module

This section provides the troubleshooting actions to be taken for the fault codes observed on each Module.

Trouble shooting Vital Computer Card (M110VCC-01) faults

Table 7.8

Fault code on LCD/ 7 Segment display of MCC	Fault Code description	Trouble shooting action
X: FC_PBIST(0x01) Where X can be CPU A/B Note: Fault string displays in LCD and Hex code displays on 7 segment display of VCCs	Power on built in self test fail	Replace the VCC card
X:FC_DIP_SW_FLT(0x02)	Dip switch fail fault	
X: FC_CAN1_LPBK (0x03)	CAN1 loop back test fail	
X: FC_CAN2_LPBK(0x04)	CAN2 loop back test fail	
X:FC_DMA_MODULE (0x06)	DMA module test fail	
X: FC_WDT (0x07)	Watchdog test fail	
X: FC_CYC_TIMER(0x08)	Cycle timer test fail	
X: FC_POST_TIMER(0x09)	Post timer test fail	Replace the GPS Antenna
X: FC_CRC_MODULE(0x0A)	CRC module fail	Replace the VCC card persists replace the CIF card. Still problem persists replace the VCC Card
X: FC_FPGA_PWRUP(0x0B)	FPGA power up fail	
X: FC_SLF_TST_TMOUT(0x28)	Self test timeout	Replace the VCC card

Trouble shooting Vital Input Card (M110VIP-01) faults

Table 7.9

Fault code on LCD	Fault code description	Trouble shooting action
FC_DIP_SW_FLT Note: Fault string displays in LCD	Dip switch configuration fail	Replace the VIP card
FC_CAN1_LPBK	CAN1 loop back test fail	
FC_INT_FLASH	Internal flash test fail	
FC_INT_RAM	Internal RAM test fail	
FC_WDT	Watchdog timer test fail	
FC_CYC_TIMER	Cycle timer test fail	
FC_POST_TIMER	Post timer test fail	
FC_CRC_MODULE	CRC module test fail	
FC_SCI_LIN_LPBK	SCI LIN loop back test fail	
FC_SLF_TST_TMOUT	Self test timeout	

Trouble shooting Power Supply Card (M110STPS-01) indications

Front facia LEDs	Trouble shooting action
LED(POWER)	If Power LED is blank Press faulty PS card tightly. If problem persists, check Filter output voltage for 24V, if there is no output voltage, change the faulty filter.
LED(ERR)	If this LED is glowing Red Press faulty PS card tightly. If problem persists, check Filter output voltage for 24V, if it is not correct, change the faulty filter else change the faulty Power supply card.
LED(4.5V)	If 4.5V LED is OFF Press faulty PS card tightly. If problem persists, check Power supply card 4.5V output voltage, if it is not correct, change the faulty Power supply card(PS)
LED(6.2V)	If 6.2V LED is OFF Press faulty PS card tightly. If problem persists, check Power supply card 6.2V output voltage, if it is not correct, change the faulty Power supply card(PS)
LED(ISO 5V)	If 5V LED is OFF Press faulty PS card tightly. If problem persists, check Power supply card 5V output voltage, if it is not correct, change the faulty Power supply card(PS)

Note: please refer trouble shooting manual for further details

Do's and Don'ts

S. No.	Do's
1	Always refer correct documentation.
2	Always use recommended tools.
3	Log sheet shall be regularly updated and kept as future reference.
4	The steady battery voltage at 24 V should be maintained for Station Kavach
5	Ensure that all cards mounting screws are tightened properly
6	Under regular maintenance Download the events from EVL for every one month
7	Use the ESD footwear in case of Cards replacement or repair

S. No.	Don'ts
1	Don’t remove the modules from Station Kavach System is under Power ON condition. Remove the modules if necessary after switching OFF the power to system.
2	Repair of cards is a highly technical job and is not possible at site. Hence Railways should not carry it out. The card should be sent to MEDHA for repair.
3	Never practice any self made guideline not recommended in manual.