MANUAL FOR MAINTENANCE & TROUBLESHOOTING OF

LOCO KAVACH V2.0

IN

WAP-4, WAP-5, WAP-7, WAG-7, WAG-9, WDM & WDG Locomotives

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CHANGE HISTORY

#	Name of the Document	Date	Reason for changes	Version No.
1	Loco Kavach V2.0 Maintenance & Troubleshooting Manual	26-04-2025	Initial Version	1.0

REFERENCES

#	Document Name	Document Number	Version Number/Year	Source
A	Safety and Reliability Requirements of Electronic Signaling Equipment	RDSO/SPN/ 144/2006	Rev 2	RDSO
B	RDSO Specification for Train Collision Avoidance System	RDSO/SPN/ 196/2020	4.0	RDSO
C.	Railway Applications - Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)	EN50126-1&2	1999 (with corrigendum 1-28 Feb 2007), Feb 2007	CENELEC

GLOSSARY OF TERMS

#	Abbreviation	Meaning
1	BC	Brake cylinder
2	BIU	Brake interface unit
3	BP	Brake pipe
4	COM	communication
5	DPS	Digital Power Supply
6	EMI/EMC	Electromagnetic interference/Electromagnetic compatibility
7	GPS	Global Positioning System
8	GSM	Global System for Mobile Communications
9	KMS	Key management system
10	LCD	Liquid Crystal Display
11	LED	Light-emitting diode
12	LP-OCIP	Loco pilot’s operation cum indication panel
13	MCB	Molded circuit breaker
14	Modem	Modulator- demodulator
15	PPC	Peripheral Processing Card
16	PWR	Power
17	RDSO	Research Designs and Standards Organization
18	RF	Radio Frequency
19	RFID	Radio Frequency Identification Number
20	RPS	Radio power supply
21	Rx	Receive
22	SD	Secure digital
23	SIM	Subscriber identification module
24	SOS	“Save our souls” a distress message
25	SPAD	Signal passing at danger
26	SPN	Specification
27	TB	Terminal block
28	TCAS	Train Collision Avoidance System
29	Tx	Transmit
30	VC	Vital Computer

Contents

1.0 Purpose:

1.1 This document provides guidelines for correct maintenance and troubleshooting of Loco Kavach system along with its peripheral components.

2.0 Specification

2.1 The TCAS System has been designed to meet the RDSO Specification No: RDSO/SPN/196/2020 V4.0 Amdt 3.

3.0 Components of Loco Kavach System:

3.1 Loco Kavach System consists of the following sub-systems.

- 3.1.1 Loco Kavach Unit
- 3.1.2 Loco Pilot Operation-cum-Indication Panel (LP-OCIP)
- 3.1.3 RFID Reader
- 3.1.4 RF Communication and GPS/GSM Antennae
- 3.1.5 Pulse Generators
- 3.1.6 Speedometer Interface Unit
- 3.1.7 Brake Interface System
- 3.1.8 Other equipment
  - 3.1.8.1 EMI Filter Box
  - 3.1.8.2 Cab Input Box
  - 3.1.8.3 RFID Reader Power Supply &
  - 3.1.8.4 Radio Unit
- 3.1.9 Inter-connection Cable Assembly

4.0 References:

Ref #	Document title	Document number
1	Personnel Safety Instruction Manual	5 16 76 0014
2	Loco Kavach Power Supply Connectivity Diagram	5 16 49 0426
3	Loco Kavach inter connectivity diagram for E-70	5 16 49 0608
4	Loco Kavach inter connectivity diagram for CCB	5 16 49 0618
5	Loco Kavach inter connectivity diagram for IRAB	5 16 49 0619
6	Block diagram of Loco KAVACH Vital Computer	5 16 49 0628
7	Block diagram of Radio Unit	5 16 49 0629
8	Block diagram of Interface Units	5 16 49 0630

Ref #	Document title	Document number
9	Inter-connection drawing from Cab Termination Unit and SB Panels E-70	5 16 49 0624
10	Inter-connection drawing from Cab Termination Unit and SB Panels CCB	5 16 49 0625
11	Inter-connection drawing from Cab Termination Unit and SB Panels IRAB	5 16 49 0626
12	Manual for Installation of Loco KAVACH V2.0 In WAP-4, WAP-5, WAP-7, WAG-7, WAG-9, WDM & WDG Locomotives	5 53 76 0014
13	Procedure for Commissioning Kavach in Locomotives	5 53 76 0013
14	Maintenance Activities for Onboard Kavach, issued by CoE	IRISET/CoE/Kavach/Misc dated 31-01-2024

5.0 Safety instructions

Maintenance of Loco TCAS and its associated sub-systems in a railway environment is prone to personnel safety risks. Instructions for personnel safety as indicated in document Personnel Safety Instruction Manual 5 16 76 0014 [Ref: 1] shall always be followed. Failure to follow these instructions will cause insurance claims to be invalid.

6.0 Technical description of Loco KAVACH

6.1 Loco Kavach inter connectivity diagram for E-70 [Ref: 3]
6.2 Loco Kavach inter connectivity diagram for CCB [Ref: 4]
6.3 Loco Kavach inter connectivity diagram for IRAB [Ref: 5]
6.4 Block diagram of Loco KAVACH Vital Computer [Ref: 6]
6.5 Block diagram of Radio Unit [Ref: 7]
6.6 Block diagram of Interface Unit [Ref: 8]

7.0 List of special tools:

7.1 Power Analyser app
7.2 Spare cable with 14shell Male & Female cable,20mtr -1No
7.3 Spare cable with 12shell Male & Female cable,20mtr -1No
7.4 Spare GSM cable, 20Mtr – 1No
7.5 Spare GPS cable, 20Mtr – 1No.
7.6 Allen key set - 1No
7.7 Screwdriver set- 1No
7.8 Digital multi meter-1No
7.9 Torque wrenches up to 60N-M – 1No

8.0 List of field replaceable spare parts:

#	Module Name	SAP Part number	Spare part description
1	Peripheral Processing Card (PPC)	6000041106	PPC MODULE ASSEMBLY LOCO
2	Vital Computer Card (VCC)	6000030472	VCC MODULE ASSEMBLY_51690003
3	Voter Card (VTR)	6000044351	VOTER_MODULE_ASSEMBLY_LOCO
4	Vital Gate Way card (VGW)	6000054725	VITAL_GATEWAY_MODULE_ASSEMBLY_LOCO
5	CAB INPUT	6000030476	CAB INPUT MODULE ASSEMBLY_51690007
6	Radio Power Supply (RPS)	6000032843	PPCB_RADIO_POWER_SUPPLY_LOCO
7	RADIO	1000024985	GUARDIAN RADIO MODEM_10W RF POWER_CALAMP
8	Digital Power Supply-1 (DPS-1)	6000033735	MODULE DIGITAL POWER SUPPLY DPS1-ELECT
9	Digital Power Supply-2 (DPS-2)	6000033736	MODULE DIGITAL POWER SUPPLY DPS2-ELECT
10	Driver Machine Interface (DMI) Unit	6000043167	OCIP_DMI_UNIT
11	Speedometer-1 (SPD-1)	6000052976	SPEEDO-METER_UNIT-1_ASSY_KAVACH_4.0
12	Speedometer-2 (SPD-2)	6000052977	SPEEDO-METER_UNIT-2_ASSY_KAVACH_4.0
13	CAB INPUT BOX	6000054464	CAB_INPUT_BOX_E70_ASSY_KAVACH_4.0
14	Electro Magnet Interference (EMI) FILTER card	6000032852	PPCB_EMI_LINE_FILTER_ELECT
15	Radio Frequency Identifier Power Supply Unit (RFID PSU)	6000033492	RFID_POWER_SUPPLY_MODULE
16	RFID READER UNIT	6000051262	RFID_READER_UNIT_HBL
17	GPS+GSM ANTENNA	6000050102	GPS_GSM_UNIT_ASSEMBLY

18	Relay Interface Box (RIB)	6000044546	RELAY INTERFACE BOX E70 ASSY KAVACH 4.0
19	LOCO ANTENNA	6000049391	LOCO KAVACH ANTENNA HBL UHF-OMNI-LOCO-03
20	Pulse Generator (PG)	6000052789	PULSE_GENERATOR_UNIT_KAVACH_4.0
21	GSM Antenna Cable (LMR200)	6000058270 6000058271	CABLE_ASY_LMR200_GSM A_15M_516490596 CABLE_ASY_LMR200_GSM B_23M_516490597
22	GPS Antenna Cable (LMR200)	6000058268 6000058269	CABLE_ASY_LMR200_GPS A_15M_516490594 CABLE_ASY_LMR200_GPS B_23M_516490595
23	RF Antenna Cable (LMR400)	6000058272 6000058273	CABLE_ASY_LMR400_RD-A RX_15M_516490598 CABLE_ASY_LMR400_RD-A TX_15M_516490600
24	BIU Signal Cable (MC5 to MC15)	6000058274 6000058275	CABLE_ASY_LMR400_RD-B RX_23M_516490601 CABLE_ASY_LMR400_RD-B TX_23M_516490602
25	DMI Interface Cable (MC1 to MC11) & MC3 to MC13)	6000032084 6000032086	CABLE ASY_OCIP/DMI-A SIG(10P)_516490011 CABLE ASY_OCIP/DMI-B SIG(10P)_516490013
26	RIFD PS to READER Interface Cable	6000057978 6000057979	CABLE ASY RFID A CN1_CN2_18M_516490575 CABLE ASY RFID B CN1_CN2_28M_516490576
27	TCAS to RFID PS Interface Cable (MC6 to MC19) & (MC7 to MC20)	6000032088 6000032089	CABLE ASY_RFID READER-A_516490015 CABLE ASY_RFID READER-B_516490016
28	Speedometer Interface Cable (MC8 to MC21) & MC22 to MC23)	6000032090 6000056486	CABLE ASY_SPEEDO METER_516490017 CABLE ASSY_SPEEDO METER B_516490537
29	CAB Input Interface cable	6000032091	CABLE ASY_CAB TERMINATION_516490018

8.1.1 ISA's Safety related application condition (SRAC) for Loco Kavach

Following ISA's SRAC shall be complied for Loco Kavach

SRAC_LOCO6: On failure of VC module, the loco shall be sent for maintenance at the first available instance, and the faulty VC module shall be replaced as per guidelines given in this manual

9.0 Corrective Maintenance:

10.1 Failure of any sub-system in Loco KAVACH is displayed in the Context Messages section of DMI, as shown in the following picture.

10.2 The following table lists all possible sub-system failures that appear on DMI. Troubleshooting chart in Annexure shall be referred for each failure condition and its associated troubleshooting guidelines and corrective actions.

#	DMI message	Section in Troubleshooting chart – Annexure-I
1	System Fault <GPS>	#1
2	System Fault <RFID>	#2
3	System Fault <RADIO>	#3
4	System Fault <SPD>	#4
5	System Fault <DMI>	#5
6	System Fault <BRAKE>	#6
7	System Fault <CIC>	#7
8	System Fault <MBT>	#8
9	System Fault <LCF>	#9
10	System Fault <TPF>	#10
11	System Fault <SPD-T>	#11
12	Waiting for communication	#12
13	BIU Isolated	#13

#	DMI message	Section in Troubleshooting chart – Annexure-I
14	EM Cock bypassed	#14
15	Waiting for MR	#15
16	Waiting for BP	#16
17	Waiting for BC	#17

10.3 Loco KAVACH functions may not perform as expected, under certain circumstances. Such functional problems are listed in the following table. Troubleshooting chart in Annexure shall be referred for each failure condition and its associated troubleshooting guidelines and corrective actions.

#	Functional problem	Section in Troubleshooting chart – Annexure-II
1	Loco KAVACH remains in SR mode, during start of mission	# 1
2	Loco KAVACH switches to SR mode from FS mode, during run	# 2
3	Loco KAVACH switches to LS mode from FS mode, during run	# 3
4	Loco KAVACH trips	# 4
5	Loco KAVACH applies undesirable brake	# 5
6	Loco KAVACH does not prevent SPAD	# 6
7	Loco KAVACH does not control speed on entry to loop-line	# 7
8	Loco KAVACH does not enforce PSR	# 8
9	Loco KAVACH does not generate SOS	SOS will be generated in block section and manual SOS
10	Loco KAVACH does not respond to SOS from Stationary KAVACH	If the Loco not in station boundary. >3Km
11	DMI screen goes blank	Cable issue
12	Signal aspect momentarily blank on DMI	RF Loss
13	Delayed update of MA	Application data issue

10.4 While attending to sub-system failures or functional problems, it is mandatory to check the health of all other peripheral systems in the Loco KAVACH, by checking the Health View on DMI.

10.4.1 This is done by pressing INFO, followed by CNFM buttons, and selecting Health options.

10.4.2 If any peripheral is found to be not working properly in the Health View, appropriate section in the Troubleshooting Chart shall be referred for identifying the problem and fixing it.

#	Health View problem	Section in Troubleshooting chart – Annexure-III
1	PPC	# 1
2	VCC	# 2
3	VTR	# 3

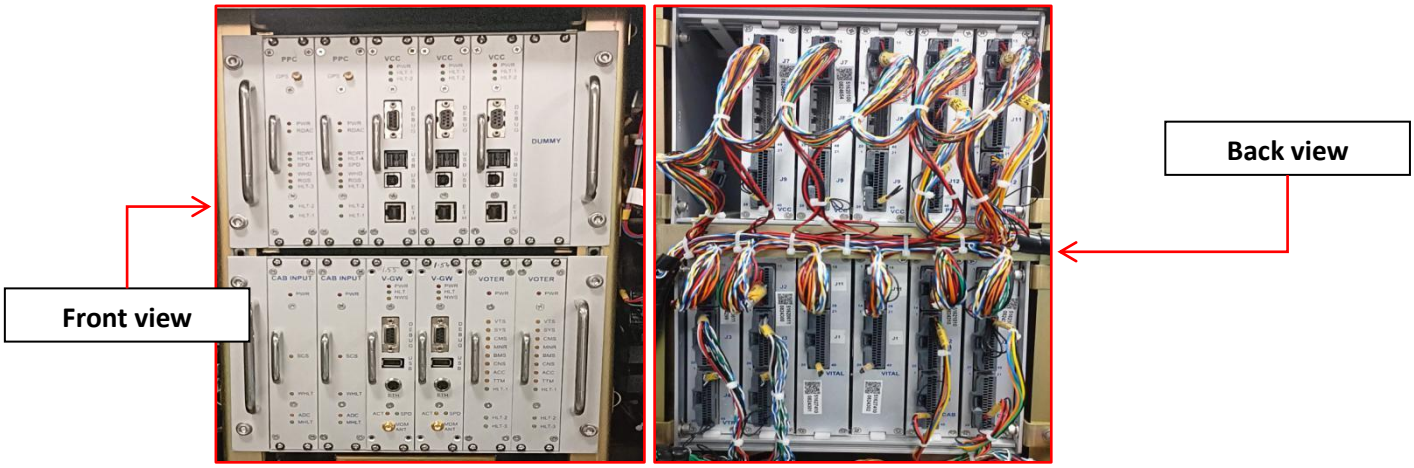
#	Health View problem	Section in Troubleshooting chart – Annexure-III
4	VGW	# 4
5	GSM	# 5
6	DPS	# 6
7	DMI	# 7
8	CIC	# 8
9	GPS	# 9
10	RADIO	# 10
11	RFID	# 11
12	SPD	# 12

10.5 Instructions for replacement of spare parts

10.5.1 PPCB module

PCB modules like PPC, VC, VOTER, V-GW, CIC can be replaced by using the given below procedure

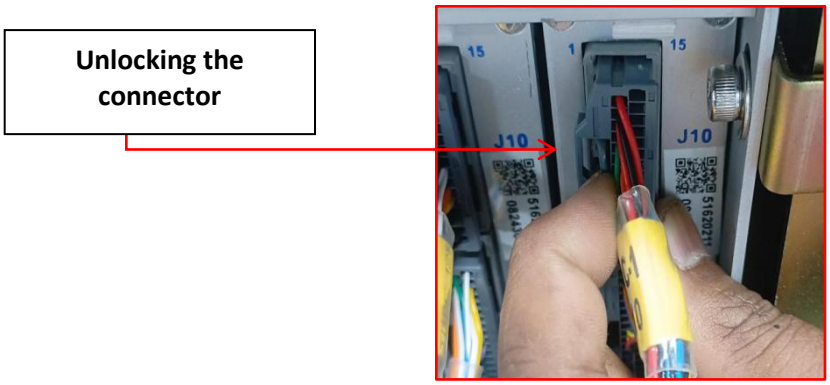
10.5.1.1 Unlock and remove the Front door & Back door of the Onboard Kavach Unit.



Front & Back view of Onboard Kavach

10.5.1.2 For faulty module, unlock the power connector and address connectors of the card.

#	Power Designator	Address Designator
PPC	J10	J11 & J12
VCC	J7	J8 & J9
Voter	J2	J3 & J4
V-GW	J11	J1
Cab input	J1	J2 & J3

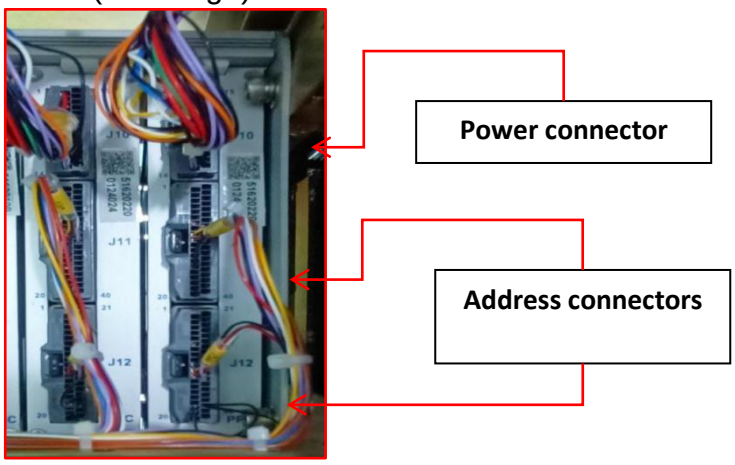


Note : 1. For PPCB, remove GPS cable carefully.

2. For V-GW, remove GSM cable and Ethernet cable carefully.

10.5.1.3 Fasten PCB module to the rack using **M3X10mm** captive screws with torque wrench.

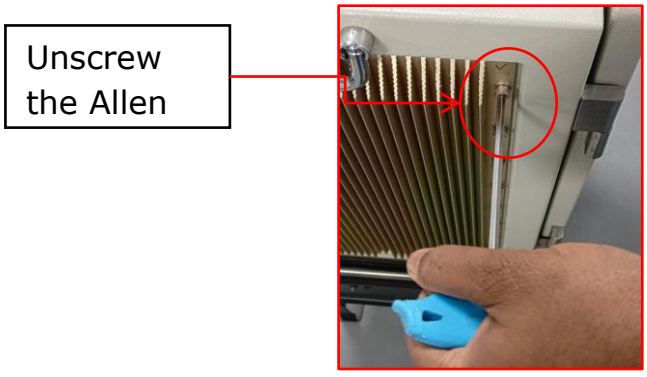
10.5.1.4 First insert the address connectors. Later insert the power connector.(Refer fig5)



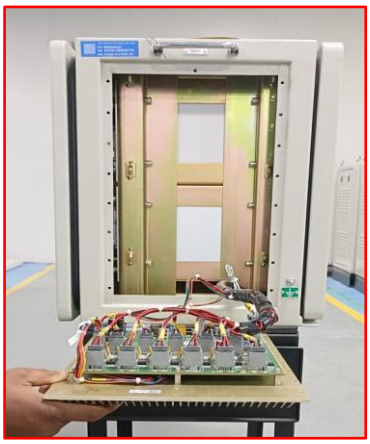
10.5.1.5 Now, connect the cables if necessary. (GPS,GSM & Ethernet)

10.5.2 DPS

10.5.2.1 Unscrew the faulty DPS Module fixed to On Board Kavach Unit using torque wrench/Allen key set with a torque of 6N-m



10.5.2.2 Remove the DPS module from the unit carefully.



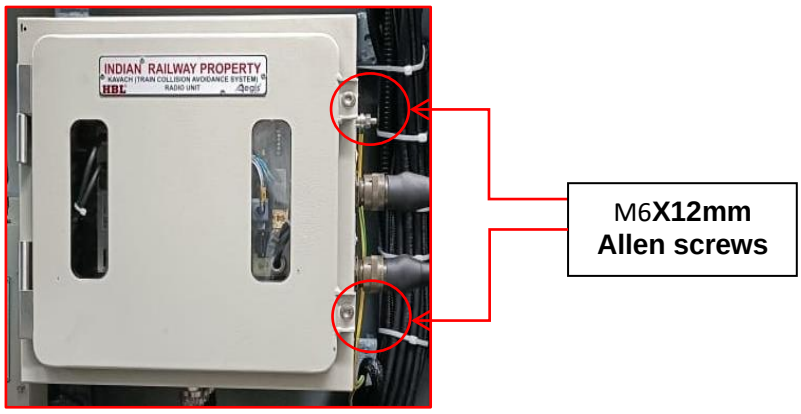
10.5.2.3 Now unlock all the connectors in DPS card carefully.

10.5.2.4 Take the new module and insert all the connectors in DPS card as per labeling on harness.

10.5.2.5 Fasten DPS Module to the enclosure using M5X20mm socket head screw, spring & plain washer by applying torque 6N-m with torque wrench/Allen key set.

10.5.3 Radio

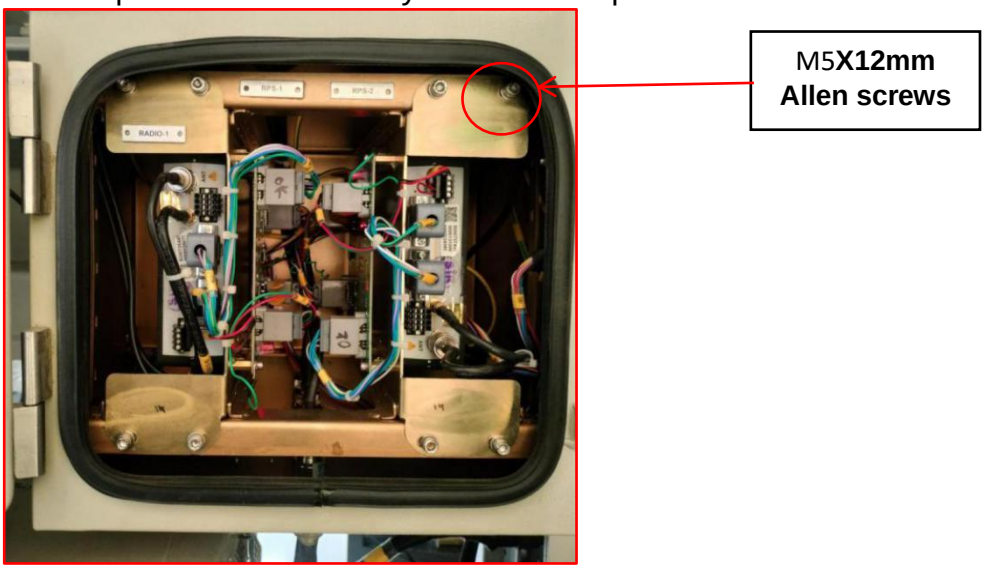
10.5.3.1 Unscrew the front door fixed to Radio unit using torque wrench/Allen key set with a torque of 10N-m.



Radio unit

10.5.3.2 Unlock all the connectors (RF, Power, DB9) in faulty Radio carefully.

10.5.3.3 Now unscrew the mounting plate fixed to enclosure using torque wrench /Allen key set with A toque of 6N-m.



10.5.3.4 Pull the mounting plate, later unscrew the Radio fixed to mounting plate using torque wrench /Allen key set with a torque of 6N-m.

10.5.3.5 Take the new Radio, fasten Radio to the mounting plate using M5X12mm socket head screw, spring & plain washer by applying torque 6N-m with torque wrench/Allen key set.

10.5.3.6 Insert the mounting plate in Radio unit at their respective place.

10.5.3.7 Insert all the connectors (RF,Power,DB9) in Radio unit as per labeling on harness.

10.5.3.8 Fasten mounting plate to the radio unit using socket head cap screws by applying torque 6N-m with torque wrench/Allen key set.

10.5.4 RPS

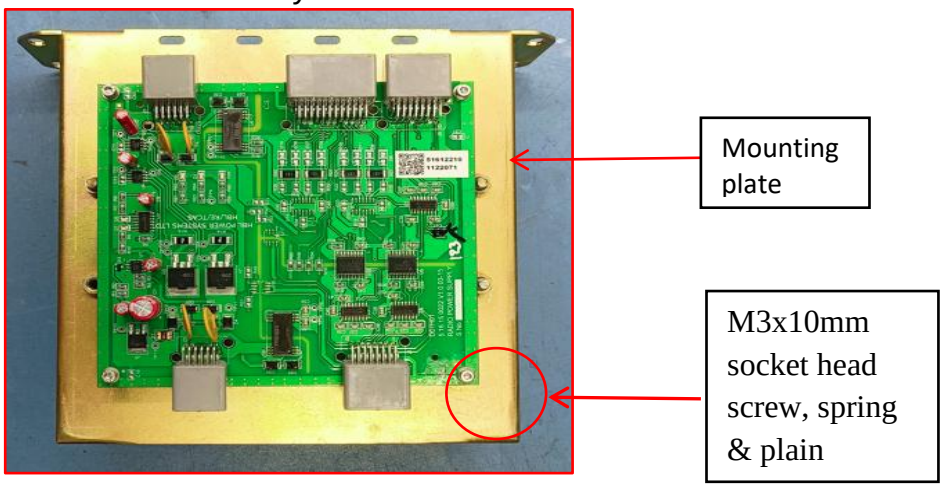
10.5.4.1 Unscrew the front door fixed to Radio unit using torque wrench/Allen key set with a torque of 10N-m.

10.5.4.2 Unscrew the mounting plate fixed to enclosure using torque wrench/Allen key set with a torque of 6N-m.

10.5.4.3 Pull the mounting plate, later unlock all the connectors in faulty RPS card carefully.

10.5.4.4 Unscrew the RPS card fixed to mounting plate using torque wrench /Allen key set with a torque of 1.3N-m.

10.5.4.5 Take the new RPS card, fasten RPS card to the mounting plate using M3X10mm socket head screw, spring & plain washer by applying torque 1.3N-m with torque wrench/Allen key set.



RPS card

10.5.4.6 Insert all the connectors in RPS card as per labeling on harness.

10.5.4.7 Insert the mounting plate in Radio unit at their respective place.

10.5.4.8 Fasten mounting plate to the radio unit using socket head cap screws by applying torque 6N-m with torque wrench/Allen key set.

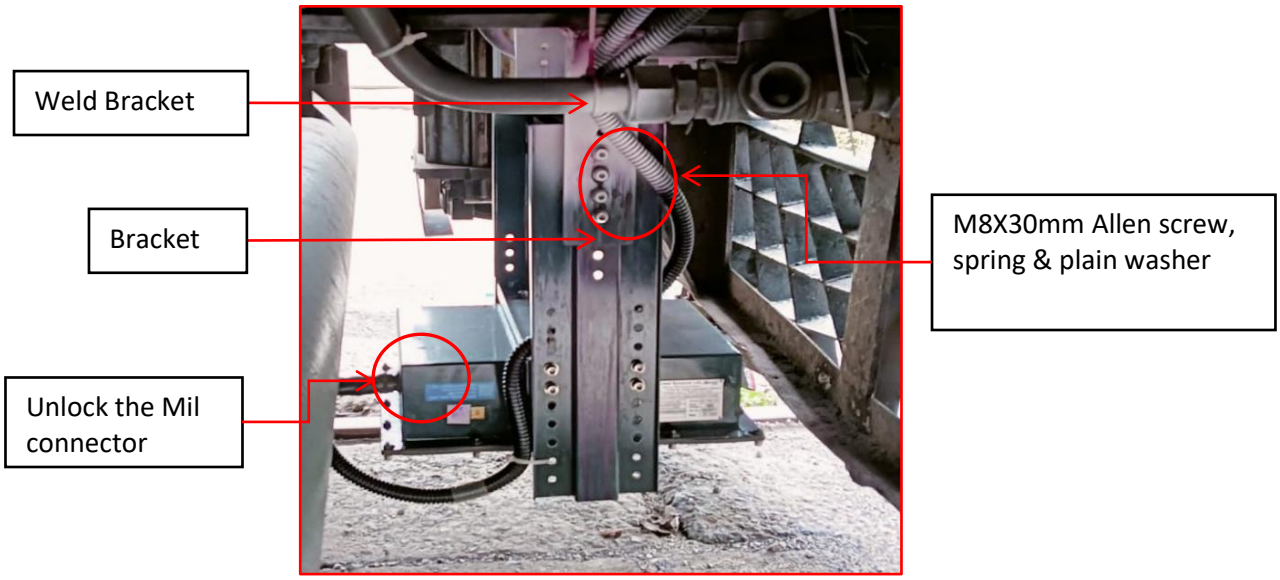
10.5.5 RFID Reader

10.5.5.1 Unlock the Mil-connector fixed to the RFID reader unit.

10.5.5.2 Unscrew the bracket fixed to weld bracket using torque wrench/Allen key set with a torque of 25N-m.

10.5.5.3 Take new RFID reader, fasten bracket to the weld bracket using M8X30mm Allen screw, spring & plain washer by applying torque 25N-m with torque wrench/Allen key set.

10.5.5.4 Insert the mil connector to the reader as per labeling on harness.



RFID Reader

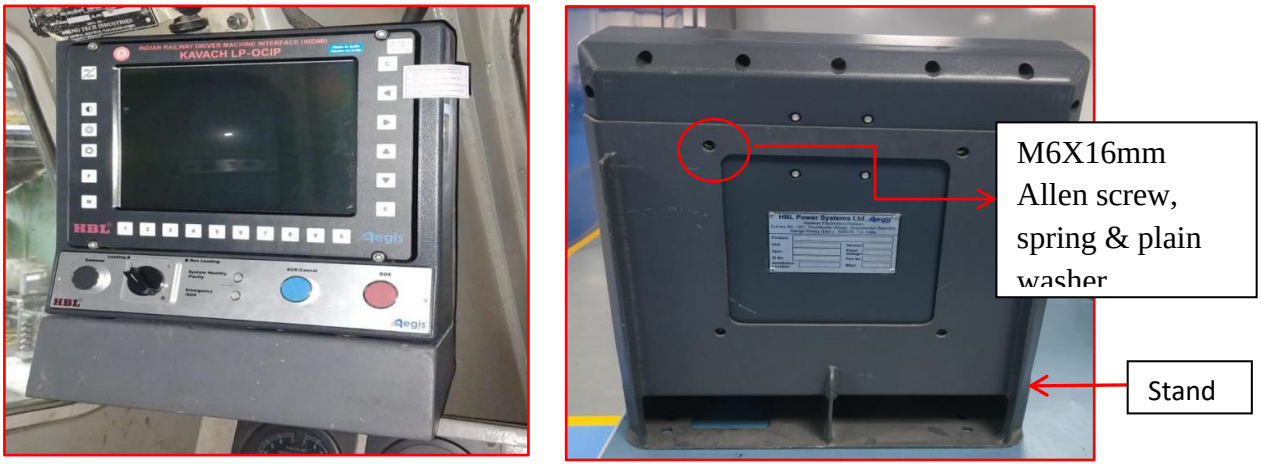
10.5.6 DMI

10.5.6.1 Unlock the Mil-connector fixed to the DMI unit.

10.5.6.2 Unscrew the DMI fixed to stand using torque wrench/Allen key set with a torque of 10N-m.

10.5.6.3 Take a new DMI unit. fasten DMI unit to the stand using M6X16mm Allen screw, spring & plain washer, by applying torque 10N-m with torque wrench/Allen key set.

10.5.6.4 Insert the mil connector to DMI unit as per labeling on harness.

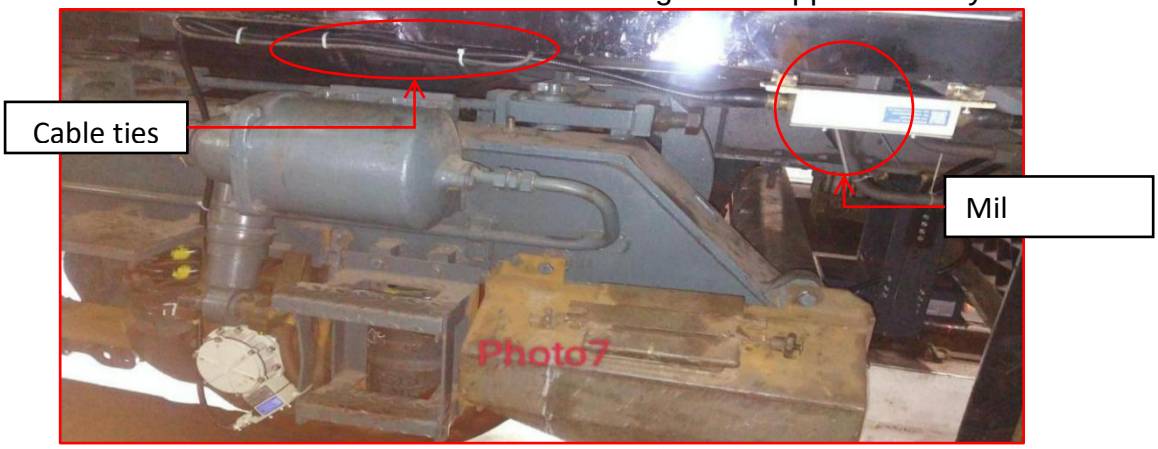


DMI

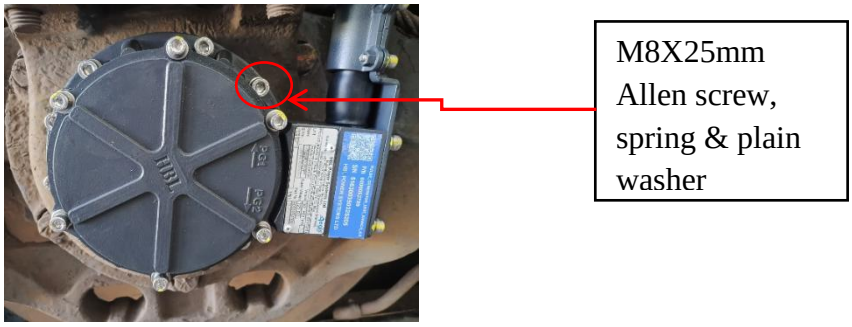
10.5.7 PG

10.5.7.1 Unlock mil connector of Pulse generator fixed to speedometer unit.

10.5.7.2 Remove the cable ties using wire stripper carefully.



10.5.7.3 Unscrew the Pulse generator fixed to lock plate using torque wrench/Allen key set with a torque of 25N-m.



Pulse Generator

10.5.7.4 Take new Pulse generator, fasten pulse generator to the lock plate using M8X25mm Allen screw, spring & plain washer, by applying torque 25N-m with torque wrench/Allen key set.

10.5.7.5 Route the cable according to the harness drawing using cable ties.

10.5.7.6 Insert the mil connector to the speedometer unit as per labeling on harness.

10.5.7.7 Ensure the Mil connector is properly fixed to speedometer unit.

10.5.8 SPD

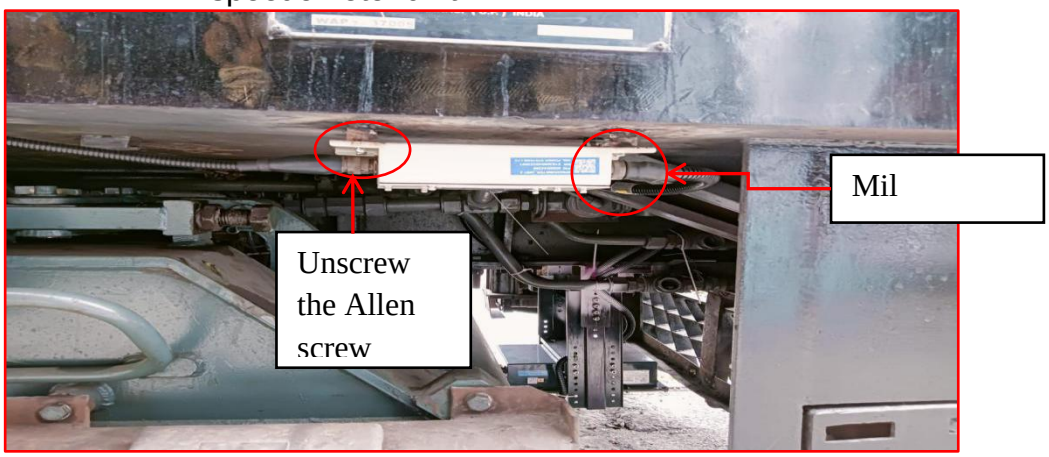
10.5.8.1 Unlock both the Mil connectors of the speedometer unit.

10.5.8.2 Unscrew the Speedometer unit fixed to loco enclosure using torque wrench/Allen key set with a torque of 10N-m.

10.5.8.3 Take new speedometer unit, fasten Speedometer unit to the loco enclosure M6X15mm using screw, spring & plain washer by applying torque 10N-m with torque wrench/Allen key set.

10.5.8.4 Insert all the connectors of speedometer unit, as per labeling on harness.

10.5.8.5 Ensure the Mil connectors are properly fixed to speedometer unit.



Speedometer unit

10.5.9 RF Antenna

10.5.9.1 Unlock both the RF cables (GPS&GSM) of the RF Antenna.

10.5.9.2 Unscrew RF antenna fixed to bracket using torque wrench/Allen key set with a torque of 25N-m.

10.5.9.3 Take the new RF Antenna, fasten RF Antenna to the stand using M8 nut, spring & plain washer by applying torque 25N-m using torque wrench/Allen key set.

10.5.9.4 Insert & fix both RF cables (GPS&GSM) to the RF Antenna.

10.5.9.5 Ensure LMR-400 cable should not sharp blend.

10.5.10 GPS/GSM antenna

10.5.10.1 Unlock the GPS & GSM connector (SMA) of the GPS/GSM Antenna.

10.5.10.2 Unscrew GPS/GSM antenna fixed to bracket using torque wrench/Allen key set with a torque of 10N-m.

10.5.10.3 Take new working GPS/GSM Antenna, fasten GPS/GSM Antenna to the stand using M6 Allen screw, spring & plain washer by applying torque 10N-m using torque wrench/Allen key set.

10.5.10.4 Insert the GPS/GSM Antenna connector (SMA) to the antenna, as per labeling on harness

10.5.10.5 Ensure LMR-200 cable should not sharp blend.

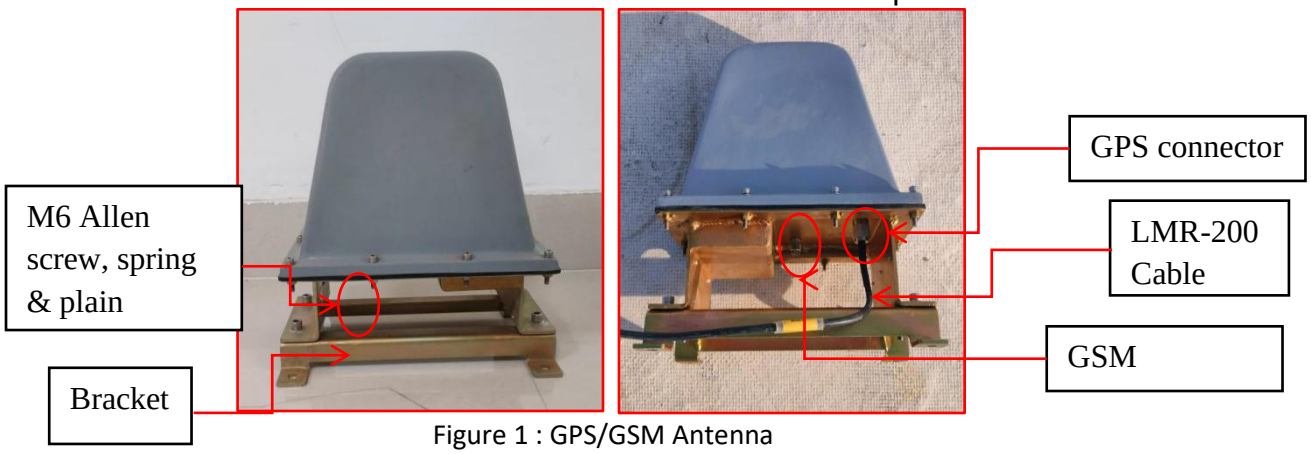


Figure 1 : GPS/GSM Antenna

10.5.11 External Cables

10.5.11.1 First identify faulty or damage cable in Loco unit.

10.5.11.2 Unlock the matting connectors of faulty cable on both sides connected to unit.

10.5.11.3 Remove the cable ties from the cable bunch using wire stripper carefully.

10.5.11.4 Take new respective cable. Route the cable as per drawing, using cable ties.

10.5.11.5 Fix the mating connectors of the new cable on both the sides connected to unit.

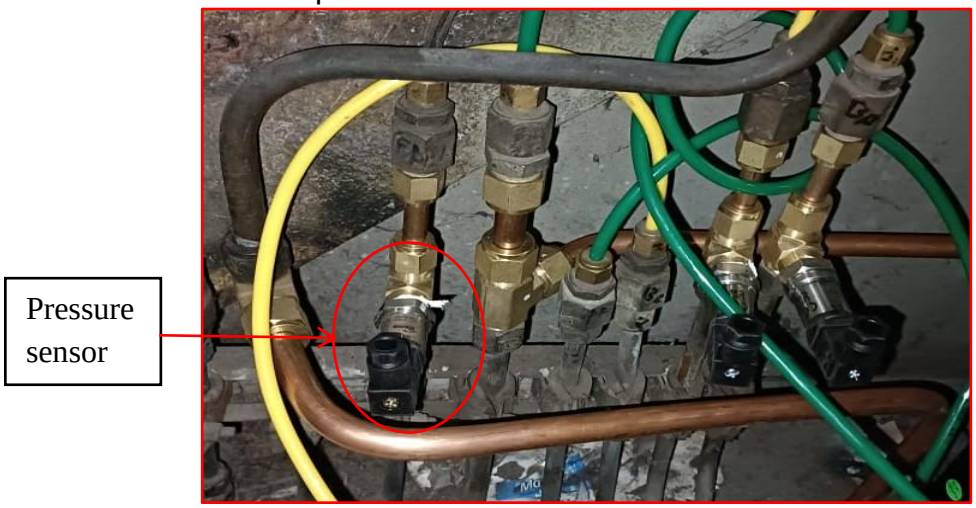
Note: The defective cables can be replaced only in the shed during overhaul.

10.5.12 Pressure sensors

10.5.12.1 Detach the pressure sensor connected to the pressure valve carefully, using 19mm spanner.

10.5.12.2 Take new Pressure sensor, install new pressure sensor to the pressure valve **using 19mm spanner**.

10.5.12.3 Use Teflon tape to avoid pressure leaks from the pressure valve threads.



10.5.13 Brake Interface Unit

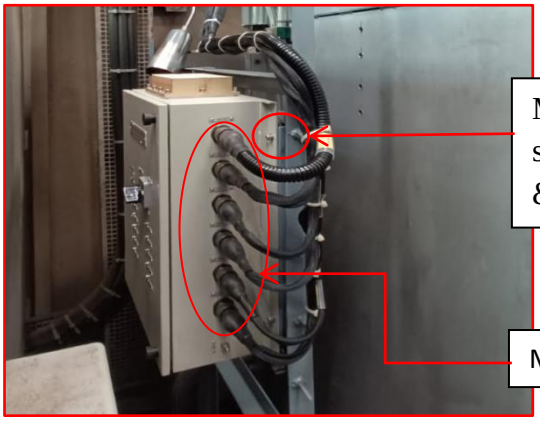
10.5.13.1 Unlock all the Mil connector of the Relay interface box.

10.5.13.2 Unscrew the Relay interface box fixed to loco enclosure using torque wrench/ Allen key set with a torque of 10N-m.

10.5.13.3 Take new Relay interface box, fasten Relay interface box to the loco enclosure using M6X20mm Allen screw, spring & plain washer by applying torque 10N-m with torque wrench/Allen key set.

10.5.13.4 Insert all the connectors of relay interface box, as per labeling on harness.

10.5.13.5 Ensure the Mil connectors are properly fixed to Relay interface box.



Brake Interface Unit

10.5.14 Cab Input Box

10.5.14.1 Unlock all the mil connector & glands of the cab input box.

10.5.14.2 Remove the Earth wire and their fixed bolt of the cab input box.

10.5.14.3 Unscrew the cab input box fixed to loco enclosure using torque wrench/Allen key set with a torque of 10N-m.

10.5.14.4 Take new cab input box, fasten cab input box to the loco enclosure using M6X20mm screw, spring & plain washer by applying torque 10N-m using torque wrench/Allen key set.

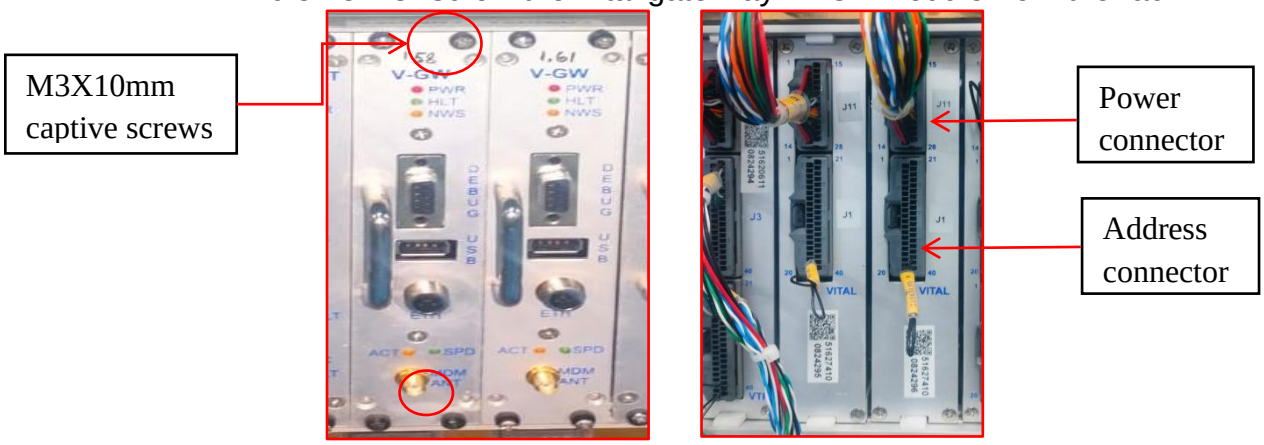
10.5.14.5 Insert all the Mil connectors to the cab input box, as per labeling.

CAB Input box

10.5.15 SIM card

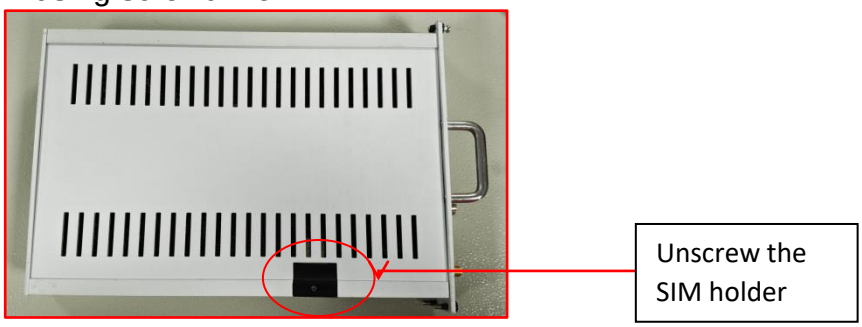
10.5.15.1 Unlock the Vital gate way PPCB Module address connector & power connectors.

10.5.15.2 Unscrew the Vital gate way PPCB module from the rack.



Vital gate way PPCB Module

10.5.15.3 Unscrew the SIM holder screw fixed to V-GW cassette using screwdriver.



Vital gate way PPCB module

10.5.15.4 Remove the inactive SIM card.

10.5.15.5 Take a new active SIM card and insert in the sim holder as per below image.

Insertion SIM card into the VGW PPCB

10.5.15.6 Fasten SIM holder to V-GW cassette using screwdriver.
10.5.15.7 Insert Vital gate way PPCB module in rack at its respective place, fasten Vital gate way PPCB module to the rack using M3X10mm captive screws.
10.5.15.8 First insert the Address connector later insert the power connector in Vital gate way PPCB module.

10.0 Preventive Maintenance:

10.6 Checklist for preventive maintenance

10.6.1 Ref [14] indicates the checklist issued by CoE for carrying our preventive maintenance checks on Loco KAVACH unit.
10.6.2 Periodicity of various checks to be performed is indicated in the checklist and shall be followed.

10.7 Instructions for special checks

10.7.1 Weld integrity of RFID Reader bracket shall be performed by dye penetrant test, as mentioned in Loco KAVACH Installation Manual [Ref: 12]
10.7.2 Each pulse generator shall be removed from the axle box and driving fork and drive pin shall be examined for any wear and tear evidence. If excessive wear and tear are noticed, the pulse generator shall be replaced with a new one of same type.
10.7.3 RF antenna performance shall be checked by connecting them to a VSWR meter and recording return loss. If return loss is more than 1.4 dBm, the antenna and/or cable shall be replaced.

11.0 Implementation of Field Change Notes:

11.1 Status of implementation of all applicable FCNs shall be verified from Configuration Management System, through WFMS.
11.2 If any FCN is not implemented, the same shall be implemented.

12.0 Functional testing after maintenance:

12.1 Procedure for Functional Testing, explained in Loco KAVACH Commissioning Procedure shall be executed, through Loco KAVACH Commissioning Wizard.
12.2 Functional Test report will be automatically uploaded to the respective Loco folder in WFMS.

13.0 Report preparation and database updating:

13.1 After all maintenance work is completed, relevant records shall be updated in FRACAS system.

14.0 Annexure - I: Troubleshooting Chart

#	Possible problem	Why	Why	Diagnostic procedure	Corrective action
1	GPS Fault	RGS Led found not glowing	Cable cut / Antenna fault	1) Check GPS cable connectivity at PPC 2) Check for GPS cable continuity. If there is no continuity, replace the cable. If the cable has continuity, change the antenna	Replace the cable / Antenna
		PPC cards restart	Speed from either of the PG showing zero on DMI	Check the speed of both PGs in log file. If PG1 shows “0” speed, PG1 is faulty. If PG2 shows “0” speed, PG2 is faulty.	Replace the faulty PG-1 unit / PG-2 unit.
2	RFID Reader Fault	DMI displays “System Fault” <RFID>	External cable cut.	Check continuity in both external cables. One between LOCO KAVACH to RFID PS and second cable from RFID PS to RFID Reader	Replace the faulty cable
			Non availability of I/P supply	Check the voltage level at J & L of external cable between Loco KAVACH and RFID PS. Check the DPS log for RFID channel voltage level. If voltage is not available, DPS card may be faulty	Replace DPS card
			RFID PS Card.	Disconnect external cable between RFID PS and RFID Reader Check the power consumption of RFID PS through power analyzer app. If the power consumption is not in the range of 70mA to 100mA, RFID PS may be faulty	Replace RFID PS
			RFID Reader Fault.	Check the power consumption of RFID PS through power analyzer app. If the power consumption is not in the range of 600mA to 800mA, RFID reader may be faulty	Replace the RFID reader
3	Radio Fault	DMI displays “System Fault” <RADIO>	Power Supply failure	Check continuity in external cable between LOCO KAVACH to Radio unit. Check the voltage level at J & L of external cable between Loco KAVACH and Radio unit Cn1 & CN2.	
			TX/RX not blinking	Check the cable connectivity at COM port on Radio Check the cable connectivity at CN1 / CN2 on LTCAS If connectivity at both COM port and CN1/CN2 found Ok, RPS card may be faulty	Fix the connectivity at COM port OR CN1/CN2 properly Replace RPS card
			Status remains RED	Radio Unit problem	Replace Radio
			RD/RT not blinking	Radio Unit problem	Replace Radio
4	SPD MTR Fault	DMI displays “System Fault” <SPD>	External cable cut.	Check continuity in external cable between LOCO KAVACH to SPD card	Replace the faulty cable
			SPD Card might be faulty	If the External cable continuity is OK, Check the power LEDs on speedometer card.	Replace speedometer card

#	Possible problem	Why	Why	Diagnostic procedure	Corrective action
			SPD Card.	Disconnect external cable between SPD card and PG Check the power consumption of SPD through power analyzer app. If the power consumption is not in the range of 40mA to 60mA, SPD may be faulty	Replace SPD card
			PG Fault.	Check both Direction and Speed by rotating the PG. if either of DIR or SPEED is not delivered, the PG is faulty OR If the speed is not matching with speed of Odometer, PG is faulty	Replace PG
5	DMI Fault	"DMI fault" message displayed on DMI	External cable cut.	Check continuity in external cable between LOCO KAVACH(MC1/MC3)to active DMI(MC11/MC13) Unit.	Replace the faulty cable
			Non availability of I/P supply	Disconnect external cable & check the voltage level at J & L of external cable between Loco KAVACH and DMI unit . Check the DPS log for DMI channel voltage level. If voltage is not available, DPS card may be faulty.	Replace DPS card
			DMI Unit Problem	Check the power consumption of DMI through power analyzer app. If the power consumption is not in the range of 700mA to 800mA, DMI may be faulty.	Replace DMI Unit
			Voter Card Health fail	Check for Health LEDs on Voter Cards.If health LED's are not blinking.	Replace Voter card
6	During normal run, train stopped with application of Emergency Brake	DMI displays "System Failure <Brake Fault>	MC5 to MC15 cable problem	1) Check for loose connection at KAVACH to BIU external cable 2) Check for the cable continuity using multimeter from MC5 mill connector at TCAS side to MC15 cable at BIU side If there is a dry-solder/disconnection of cables at mil-connector it causes discontinuity of the cable.	Replace the external cable with new cable.
			BIC Card is problem	1) Check if the health LEDs on the BIC card are blinking. If the LEDs are not blinking, check for the 24V_ISO power supply to the BIC card at TP22 (+ve) with respect to TP21 (-ve). 2) Check for any loose connections at the J2 connector on the BIC card. 3) Check for any loose connections at the J4 connector on the BIC card. 4) If the 24V supply is not available on the BIC card, remove the J4 connector on the BIC card and check for the output voltage of the BIC PSU card at TP5 and TP6. 5) If voltage is available at the BIC PSU card but not on the BIC card, there may be a short on the BIC card. Check for any loose connections at the J2 connector of the BIC PSU card.	Replace the BIC card with new working card.

#	Possible problem	Why	Why	Diagnostic procedure	Corrective action
			QRV Relay is not ON	1) Check for loose connections, if any at BIC/J5 connector. 2) Check for loose connections at relay coil, terminals 1&2. Check for the 24V voltage availability across QRV relay coil.	Insert the J5 connector on BIC card properly, Tight the screw terminals of relay coil properly, Replace the QRV relay with new relay.
			NB, FSB, EB relay not ON, when KAVACH applies brake	1) Loose connections at relay coil terminals at A1 & A2. 2) Check for loose connection of J6 connector on BIC card. Check for the BIC fault codes on Loco log for which relay is not ON.	Tight the screw terminals at relay coil wiring, Insert BIC connectors properly, Based on the following fault codes, replace or connect the relay properly. **Fault code** / **Relay name**: 1 – NB Relay; 2 – FSB Relay; 3 – EB Relay
			Power supply failure to BIU unit	1) Check for MCB trip at Cabinput box 2) Check for the voltage availability at output of EMI filter card in Cabinput box 3) Check for the 110V availability, at BIC PSU card input at TP3 & TP4 using multimeter. 4) Check the cable continuity from MC18 Brake interface unit to CN1 on Cabinput card. Chek the continuity from MC18/J,L(+ve) to CN1/(A,B) and from MC18/K,M(-ve) to CN1/(C,D). Check for loose connections at J1 connector of BIC PSU	Power connections to the BIU unit should be connect proper. Replace the MC18 cable of BIU with new cable.
			Loose connections at Isolation switch	1) Check the loose connections at isolation switch at terminals 3, C1 or C2. Check the wire terminations at lugs are proper.	Tight the connection at isolation switch terminals by using screw driver.
7	During normal run, train stopped with application of Emergency Brake	System Fault <CIC> displayed on DMI	If two VC cards not in sync	If the VC cards are not in sync, system will go to failure mode with CIC.	Restart the VC cards or ON/OFF the system once.
			CAB input cards might be faulty	Check the health LED's and SCS leds on CIC cards are continuously blinking. If LED's are not blinking, restart the power supply of CIC cards once.	Replace the faulty CIC cards with working one.
8	Brake Test Fail	DMI displays "System Failure <MBT>	NB, FSB Relays not operated on BIU	1) Check for any loose connections at NB and FSB Relays coil terminals A1 & A2. Check for proper insertion of J6 connection on BIC card.	Tight the screw terminals of NB and FSB relay coils. Insert the J6 connector properly on BIC card.
			NB, FSB Relays not operated on IRU-1 or IRU-2	1) Check the cable continuity from BIU/MILB-1 to IRU-1 connector, if brake test fail from CAB-I. 2) Check the cable continuity from BIU/MIBL-2 to IRU-2 connector, if brake test fail from CAB-II.	Replace the MILB-1 cable with new cable. Replace the MILB-2 cable with new cable.
			Relays operated on both BIU & IRU but BP and BC pressures are not dropped as required.	1) Repeat the brake test, by doing loco re-configuration. 2) Check the valves operation on brake panel Check the working of control cards on brake panel with help of railway officials.	By informing the shed officials, replace the valves or Control cards on brake panel.

#	Possible problem	Why	Why	Diagnostic procedure	Corrective action
			Traction cut-off command fail	1) Check for the 110V available to Q-51(traction-cut off) relay at CAB Input terminals TB10(+ve) and TB12(-ve). 2) Check the wire continuity from BIU MC18/A to CAB input/TB3 and MC18/B to CAB input/TB4 3) Check the loose connections at isolation switch terminals, 1, A1 & A2. Check the wire continuity from Isolation switch to J7 (pin 3) connector on BIC card.	
9	**LCF fault showing on DMI**	LCF file may corrupted or may not loaded properly.	1. Loco ID shows **"0"** 2. LCF checksum showing invalid on DMI checksum view.	--	Reload the respective Loco LCF file as per the Loco configuration generation report.
10	**TPF fault showing on DMI**	TPF file may corrupted or may not loaded properly.	1. Train type selection shows blank/ invalid. 2. Unable to enter required no. Of passenger coaches. 3. Train type showing invalid on DMI	--	Reload the respective Loco(WAP7/WAP5/VB/EMU) TPF file as per the Loco configuration generation report.
11	<SPD-T>	System fault <SPD-T> displayed on DMI	Tag read in standstill more than two times.	--	Avoid tag reads in stand still more than two times.
12	**"Waiting for Communication message"** displayed on DMIs	1. DMI might be faulty 2. VC cards are not in sync	External cable between Loco KAVACH to DMI might be faulty.	1) Remove the external MC11/MC13 cable once and reconnect to DMI and check for the DMI communication is OK not OK. 2) Out of 3-VC cards, 2-VC cards are out of sync.	1. Reload the VC bin files once. 2. Replace the VC modules of faulty. 3. Replace the DMI unit, if the problem persist after replacement of VC
13	"BIU Isolated" message displayed on DMI in service mode	Power supply not available to BIU	Loose connections at Isolation switch	1. Check for Health LED's are blinking on BIC card. If not, check power the power supply availability to BIU. 2. Check the Loose connections if any, at Isolation switch.	1. If power supply not available BIU or Health LED's are not blinking. Then Restart the system once. 2. If found any loose connections at Isolation switch, tight the connections properly.
14	EM Cock bypassed	EM cock bypassed message displayed on DMI	Isolation Cock wires may cut. Isolation Cock Lever not opened fully	Check the cables cut at isolation cock at CAB-I or CAB-II Check the both cocks are opened fully or not.	Reconnect the cables to Isolation cock switch
15	Waiting for MR	MR pressure is not adequate	Wire cut/ wiring connection at sensors might be wrong/Sensor might be faulty	Wiring shall be connected to terminal 2 & 4 of MR pressure sensor.	Replace the faulty sensor with working one.
16	Waiting for BP	BP pressure is not adequate	BP Sensor wires cut/wiring connections at sensor might be wrong/sensor might be faulty	Wiring shall be connected to terminal 2 & 4 of BP pressure sensor.	Replace the faulty sensor with working one.
17	Waiting for BC	BC pressure is not adequate	BP Sensors wires cut/wiring connections at sensor might be wrong/Sensor might be faulty	Wiring shall be connected to terminal 2 & 4 of BC pressure sensors.	If the connection are wrong, reconnect the cable to terminal 2&4.

15.0 Annexure - II: Troubleshooting Chart

#	Possible problem	Why	Why	Diagnostic procedure	Corrective action
1	Loco remains in SR mode, and does not switch to FS mode	KMS Keys are not Updated	SIM card is not working	Check the LTE Modem State in **InternetMonitorState** by TvgDiagnostics Application. If it is in “ModemPowerInitState” VGW card is faulty	Replace New VGW card.
				Check the Internet Status by TvgDiagnostics Application, if it is not ACTIVE, 1) Ensure latest Kms Apps are loaded & executed in VGW 2) Ensure GSM Antenna cable is fixed properly to VGW 3) Proper insertion of SIM card in VGW 4) Check SIM holder before inserting the SIM card	Replace New VGW card.
				1) Send a text message from HBL Loco KAVACH Test Tool to the SIM number installed in the Kavach unit. (SIM numbers can be obtained from WFMS) 2) Successful delivery of text messages can be checked on VGW app in HBL Loco KAVACH Test Tool. 3) If the text message is not successfully delivered, SIM card is either faulty or not re-charged.	Replace with new working SIM card, after getting it registered with KMS Server or re-charge existing SIM card.
			OTP not sent to server	1) Using HBL Loco KAVACH Test Tool, check status of OTP transmission. 2) If OTP acknowledgment is not received by Loco KAVACH, either KMS Server is down or Vital Gateway Card in Loco KAVACH is faulty.	1) Check with Railtel if KMS server is functional or not. 2) If KMS server is functional, replace Vital Gateway Card with a new one. SIM cards from the original VGW shall be installed in the new VGW.
			VCC card not synchronizing	3) Check all VCC cards store same Key index in KMS log file.	If not stored, erase the keys in all cards and re-generate the keys.
2	Loco KAVACH switches to SR mode from FS mode, during run	a) Foreign tag is read by Loco. b) Track profile information is not available with Loco. c) Three consecutive RFID tags are not read/missed by Loco. d) S2S communication failure e) Slip/Slide detected	--	1. Acknowledge the Loco by pressing ACK button on DMI and reconfigure the Loco again. 2. Check the RF communication with station KAVACH. 3. Tags might be not available in site/ misplacement of tags. 4. if the speed is locked more than 90s, slip/slide will be detected.	1. Check the tag placement and data base of respective station.
3	Loco KAVACH switches to LS mode from FS mode, during run	RF communication fail between stationary KAVACH and Loco KAVACH.	Station Radio doesn’t transmit packets to Loco.	1. If there is RF loss in communication mandatory zone Loco will switch to LS mode.	Check the Radio communication at station side.
4	Loco KAVACH trips	a) Loco crosses STOP signal b) Invalid status for Points/Tracks are received from station.	--	Select P_Trip followed by CNFM buttons on DMI and select OVRD followed by CNFM buttons on DMI.	
5	Loco KAVACH applies undesirable brake	If MA dropped suddenly, Loco will apply brakes	--	Signal aspect not processed by station correctly. Relay contact dropped suddenly.	
6	Loco KAVACH does not prevent SPAD	Odometer errors	Braking parameters are not accurate		

#	Possible problem	Why	Why	Diagnostic procedure	Corrective action
7	Loco KAVACH does not control speed on entry to loop-line	Odometer errors	Braking parameters are not accurate		
8	Loco KAVACH does not enforce PSR			Correct PSR information is not loaded in application data. PSR tag database not programmed correctly.	
9	Loco KAVACH does not generate SOS				
10	Loco KAVACH does not respond to SOS from Stationary KAVACH	If the Loco not in station boundary greater than 3Km			
11	DMI screen goes blank	Loose connectivity of the wire harness from Carrier Board to LCD display	LCD interface harness may damaged or came out from the mating connector due to higher vibrations.	1. Dismantle the Faulty LP-OCIP unit and check connectivity of **J5 to LCD cable** and ensure silicone sealant was applied at LCD cable mating part	1. Observe any abnormality in the LCD wire harness then replace the DMI unit with working DMI.
12	Signal aspect momentarily blank on DMI	RF communication loss between station and radio			
13	Delayed update of MA				
3	Data not Logging in VGW	100% usage of Disk space	Memory of SD card (32GB) is not sufficient.	Check the disk space through Putty application. If the Disk usage is found 100%, then clear the log data for 1st 30 days	Delete the log folder by month wise
		KMS Keys not logging	System Diagnostics Application not running	Check the availability of sysdiagnostic app using TvgRemoteUpdateApp.	Update sysdiagnostic app using TvgRemoteUpdateApp.
		Health Led is constant instead of blinking	VGW is hanging	Power recycle the card and try to ping	If not, replace new VGW
	Onboard Kavach Not powered ON	MCB trip	Cable Short / Open	Turn-Off MCBs in EMI filter box and turn ON main MCB at SB panel. If MCB trips, input cable is faulty. Check the voltage at input terminals of MCBs in EMI filter box, if there is no voltage, input cable is faulty	Replace input cable
			EMI Card failure	Remove MC10, check the voltage at input and output of EMI filter. If no output at EMI filter, the card is faulty	Replace EMI filter card
			DPS Card failure	Check the voltage at MC10 female connector, if voltage is available, DPS card1 /card2 are faulty. If voltages are not available at MC10, the cable is faulty	Replace faulty cable / DPS card
	Cab Signals not Available	Wiring at SB panels wrong	Cable	Ensure the MC9 Mil connector properly inserted in Cab Termination Unit or not Ensure the MC2 Mil connector properly inserted in Without radio unit enclosure or not Power Connector(J1) and 40 Pin Signals connectors(J2 & J3)properly inserted or not.	If found ok then verify them Mil connector(MC9) cable termination

16.0 Annexure – III Troubleshooting chart

#	Module Name	Why	Diagnostic procedure	Corrective action
1	Peripheral Processing Card (PPC)	1. Improper communication between Master and watchdog controllers. 2. Non-availability of 24V power supply	1. Check status of PWR LED, shall be glow 2. Check status of health LEDs, shall be blinking 3. Check the connector fitment of the JAE connectors	1. If PWR LED is not glowing, restart the module 2. If Health LEDs are not blinking, restart the module 3. Replace the module if module is not functioning after restart
2	Vital Computer (VCC)	1. Non-availability of 24V power supply 2. Improper locking of JAE connectors	1. Check status of PWR LED, shall be glow 2. Check status of health LEDs, shall be blinking 3. Check the connector fitment of the JAE connectors	1. If PWR LED is not glowing, restart the module 2. If Health LEDs are not blinking, restart the module 3. Replace the module if module is not functioning after restart
3	Voter Card	1. Non-availability of 24V power supply 2. Improper locking of JAE connectors	1. Check status of PWR LED, shall be glow 2. Check status of health LEDs, shall be blinking 3. Check the connector fitment of the JAE connectors	1. If PWR LED is not glowing, restart the module 2. If Health LEDs are not blinking, restart the module 3. Replace the module if module is not functioning after restart
4	Vital Gateway (V-GW)	1. Non-availability of 24V power supply 2. Improper locking of JAE connectors	1. Check status of PWR LED, shall be glow 2. Check status of health LED, shall be blinking 3. Check the connector fitment of the JAE connectors	1. If PWR LED is not glowing, restart the module 2. If Health LED is not blinking, restart the module 3. Replace the module if module is not functioning after restart
5	GSM			
6	DPS	1. Non-availability of input voltage 110V 2. Non-functionality of EMI-Filter card 3. Improper locking of MC10 & JAE connectors	1. Check status of input MCB 2. Check the output voltages of EMI Filter cards 3. Check status of Health LED on DPS card, shall be blinking 4. Check the voltages at connector MC10 5. Check the fitment of J2 on DPS1 and DPS2 are connected and locked properly	1. If MCB trip, turn MCB ON 2. If output voltage is not available on EMI filter card, replace EMI filter card 3. If Health LED is not blinking, replace the DPS module
7	DMI	1. Non-availability of 24V power supply 2. Improper cable connectivity	1. Check status of System Heath LED, shall be blinking 2. Remove the external MC11/MC13 cable once and reconnect to DMI and check for the DMI communication is OK / not OK.	1. If System Health LED is steady state with RED color, replace the module 2. Check the external cable connectivity at MC11/MC13, replace the cable if voltages are not available. 3. If voltages are available at MC11/MC13, replace the DMI
8	CIC	1. Non-availability of 24V power supply 2. Improper locking of JAE connectors	1. Check status of PWR LED, shall be glow 2. Check status of health LEDs, shall be blinking 3. Check the connector fitment of the JAE connectors	1. If PWR LED is not glowing, restart the module 2. If Health LEDs are not blinking, restart the module 3. Replace the module if module is not functioning after restart
9	GPS	1. Fault in antenna cable 2. Fault in GPS antenna 3. Fault in GPS module	1. Check the continuity of antenna cable 2. Check using another working antenna	1. Replace the cable, if no continuity 2. Replace antenna, if found faulty. 3. Replace the PPC card, if both cable & antenna are found OK.
10	Radio	1. Non-availability of input voltage 24V 2. Non-functionality of RPS card 3. Improper locking of connectors	1. Check status of PWR LED on Radio, shall be glow 2. Check status of STATUS LED on Radio, shall be blinking 3. Check the connector fitment of the MIL / JAE / D-sub connectors	1. If 24V voltage is available and PWR LED is OFF/RED, replace the Radio 2. If PWR LED is ON and no communication, replace RPS card 3. If the status LED remains in RED, replace Radio.
11	RFID	1. Non-availability of 24V power supply 2. Non-functionality of RFID PS 3. Improper cable connectivity	1. Check the input voltage 24V at RFID PS 2. Check the output voltage 12V at RFID PS 3. Check the input voltages 12V at RFID Reader	1. If 24V is not available, replace the cable 2. If 12V is not available at output of RFID PS, replace RFID PS 3. If 12V is not available at input of RFID reader, replace the cable. 4. Check the RFID reader with a working RFID PS, if reader is working replace the RFID PS else replace RFID Reader
12	SPD	1. Non-availability of 24V power supply 2. Non-functionality of SPD card 3. Improper cable connectivity	1. Check the input voltage 24V at SPD 2. Check the continuity of cables	1. If 24V is not available, replace the cable 2. If 24V is available and SPD is not functioning, replace SPD.