

**MANUAL FOR INSTALLATION OF  
STATIONARY KAVACH V2.0  
IN  
Way-side Locations**

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**CHANGE HISTORY**

#	Name of the Document	Date	Reason for changes	Version No.
1	Stationary Kavach V2.0 Installation Manual	25/04/2025	Initial Document	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/196/2017	3.2	RDSO
C.	Railway Applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)	EN50126-1&2	1999 (with corrigendum 1-28 Feb 2007), Feb 2007	CENELEC
D.	Railway applications - Communications, Signaling and processing systems - Software for railway control and protection systems.	EN50128	Jun-11	CENELEC
E.	Railway applications – Communication, Signaling and Processing systems –Safety related electronic systems for Signaling.	EN50129	2003 (With corrigendum of May 2010)	CENELEC
F.	Railway applications – Communication, Signaling and processing systems, Safety related communication in closed transmission systems	EN50159	Sep-10	CENELEC
G.	Railway application systems Electromagnetic Compatibility	EN50121-4	2006 with Corrigendum of May 2008	CENELEC
H.	Railway applications. Insulation coordination. Basic requirements. Clearances and Creepage distances for all electrical and electronic equipment	EN50124-1	Mar-01	CENELEC
I.	RDSO Specification for Earthing	RDSO/SPN/197/2008	1.0	RDSO
J.	RDSO Specification for Train Collision Avoidance System	RDSO/SPN/196/2020	4.0 d3	RDSO Specification for Train Collision Avoidance System

**GLOSSARY OF TERMS**

#	Abbreviation	Meaning
1	CENELEC	European Committee for Electro Technical Standardization
2	DC	Direct Current
3	DCN	Design change note
4	EI	Electronic Interlocking
5	ESD	Electrostatic Discharge
6	GPS	Global Positioning System
7	GSM	Global System for Mobile
8	IPS	Integrated Power System
9	KAVACH	Train Collision Avoidance System
10	LC	Level Crossing
11	OFC	Optical Fiber Cable
12	PCCL	Pre-Commissioning Check List
13	PCB	Printed Circuit Board
14	PDU	Power Distribution Unit
15	RDSO	Research Designs and Standards Organization
16	RF	Radio Frequency
17	RFID	Radio Frequency Identification
18	RIU	Remote Interface Unit
19	RSSI	Received Signal Strength Indicator
20	RTU	Radio Tower Unit.
21	SAT	Site Acceptance Test
22	SM-OCIP	Station master's operation cum indication panel.
23	SPD	Surge Protecting Device
24	TCAS	Train Collision Avoidance System

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## 1.0 Purpose

- 1.1 This document provides guidelines for correct installation of Stationary Kavach system along with its peripheral components. It also provides instructions for correct interconnection of all sub-systems for proper functioning of Kavach V2.0.

## 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 Stationary Kavach System:

- 3.1 Stationary Kavach System consists of the following sub-systems.
- 3.1.1 Stationary Kavach Unit
  - 3.1.2 RF Communication tower
  - 3.1.3 Radio Tower Unit
  - 3.1.4 RF Communication Antennae
  - 3.1.5 Station Master Operation-cum-Indication Panel (SM-OCIP)
  - 3.1.6 Station Termination Panel
  - 3.1.7 GPS & GSM Antennae
  - 3.1.8 OFC Communication rack
  - 3.1.9 Power supply arrangement
  - 3.1.10 Kavach – Inter-locking System Interface
  - 3.1.11 RFID Tags

## 4.0 List of documents required for installation and inter-connection:

#	Installation Activity / Reference Document title	Document number
1.0	<b>Station Kavach Installation</b>	
1.1	Station Kavach Relay Room Layout Diagram	EG-IC-FT-27
1.2	Station Kavach Installation Checklist	EG-IC-FT-48
1.3	Personnel Safety Instruction Manual	5 16 76 0014
2.0	<b>RF Communication Tower</b>	
2.1	RSSI Survey Report	STPI/YEAR/Zone/RSSI/Location <b>(Ex: STPI/23-24/NCR/RSSI/LC-555)</b>
2.2	RDSO Approved Drawing for Tower	RDSO/TC/TOWER/L/40/180/T/6.5
2.3	TCAS Tower Location Drawing	EG-IC-FT-21
2.4	TCAS Tower Location Lat Long survey report	EG-IC-FT-22
2.5	Stationary TCAS Tower (I&C)	5 16 76 0009
3	<b>Radio Tower Unit</b>	
3.1	KAVACH_RTU INSTALLATION DRAWING	5 16 76 0042

#	Installation Activity / Reference Document title	Document number
<b>4</b>	<b>RF Communication Antennae</b>	
4.1	Procedure for Antenna fixing & Cable Routing	5 16 90 0018
4.2	KAVACH_HIGH PROFILE ANTENNA INSTALLATION DRAWING	5 16 76 0041
<b>5</b>	<b>Station Master Operation-Cum-Indication Panel</b>	
5.1	KAVACH_SM OCIP INSTALLATION DRAWING	5 16 76 0040
5.2	KAVACH_SM OCIP TERMINATION PANEL INSTALLATION DRAWING	5 16 76 0046
<b>6</b>	<b>Arrangement of Station termination box</b>	5 16 49 0617
6.1	KAVACH_STATIONARY TERMINATION PANEL INSTALLATION DRAWING	5 16 76 0045
<b>7</b>	<b>GPS &amp; GSM Antennae</b>	
7.1	KAVACH_GPS GSM INSTALLATION DRAWING	5 16 76 0039
<b>8</b>	<b>OFC Communication Rack</b>	
8.1	KAVACH OFC COMMUNICATION RACK INSTALLATION DRAWING	5 16 76 0047
<b>9</b>	<b>Power Supply Arrangement</b>	
9.1	Power Supply Diagram and Load Calculation	5 16 49 0614
<b>10</b>	<b>Kavach - Interlocking System Interface</b>	
10.1	STCAS - Relay Interlocking Interface Procedure	5 16 76 0013
10.2	TCAS Relays Survey Report	EG-IC-FT-26
10.3	STCAS - Siemens EI Interface Drawing	5 16 49 0609
10.4	STCAS - Medha EI Interface Drawing	5 16 49 0610
10.5	STCAS - Kyosan EI Interface Drawing	5 16 49 0611
10.6	STCAS - Hitachi EI Interface Drawing	5 16 49 0612
10.7	TCAS Bell Test Report	EG-IC-FT-28
<b>11</b>	<b>RFID Tags</b>	
11.1	TCAS Aerial Videography	5 16 76 0012
11.2	Distance Mapping - RFID Tags Survey Report	EG-IC-FT-25
11.3	Installation procedure for RFID Tags	5 16 76 0031
11.4	RFID Tag Verification Report at site	EG-IC-FT-56
11.5	DCN Implementation Report at site	EG-IC-FT-52
<b>12</b>	<b>Inter-connection Drawings</b>	
12.1	Station Kavach Connectivity Diagram	5 16 49 0613
12.2	Cable Route Plan Tower to Station Kavach	EG-IC-FT-63

#	Installation Activity / Reference Document title	Document number
12.3	OFC Network Connectivity Drawing	Project specific drawings issued by Engineering
<b>13</b>	<b>Earthing</b>	
13.1	Station TCAS Tower Earth Drawing	5 16 76 0043
13.2	STCAS unit & TCAS Relay rack earth	5 16 76 0044
<b>14</b>	<b>Pre-Commissioning Check</b>	
14.1	PCCL for Stationary Kavach, issued by RDSO	
<b>15</b>	<b>Site Acceptance Testing (SAT)</b>	
15.1	SAT procedure, issued by RDSO	SIF:0593 (issued by RDSO)

## 5.0 Personnel safety instructions:



*Installation of STCAS 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 shall always be followed. Failure to follow these instructions will cause insurance claims to be invalid.*

## 6.0 Adherence to Railway administrative procedures:

- 6.1 Relevant procedures and guidelines of zonal railways shall always be followed for taking up work in railway premises and locomotives, with advance permissions taken from relevant officials.

## 7.0 Installation Procedure:

### 7.1 Stationary Kavach Unit

- 7.1.1 The Stationary Kavach Unit shall be installed in the location identified in the approved floor plan [Ref: 1.1], in the building identified for installation of Stationary Kavach system.
- 7.1.2 The Stationary Kavach Unit comes with a stand, which shall be grouted to the floor in the identified location.
- 7.1.3 The Stationary Kavach Unit shall be placed on the stand and secured with mounting bolts supplied in the Stationary Kavach Installation Kit.



### 7.2 RF Communication tower:

- 7.2.1 The location for installation of RF Communication tower shall be identified by conducting desktop RSSI survey, as part of Project Engineering work for the Kavach project. These location drawings shall be approved by User Railways.
- 7.2.2 The RF Tower shall be constructed, per the RDSO-approved drawing [Ref: 2.2], and following all instructions and guidelines given in the drawing and railways' engineering practices.

- 7.2.3 Stage-wise inspection of tower manufacturing, erection, and commissioning [Ref: 2.5] shall be followed, per the railways' practices.
- 7.2.4 Earthing and other safety requirements mentioned in the approved tower drawing shall be complied with [Ref: 13.1].

**NOTE:** In some projects, construction of towers may not be in HBL's scope of work. In such cases, HBL is not responsible for compliance to the above requirements, other than the location of the tower.

### 7.3 Radio Tower Unit:

- 7.3.1 Each Stationary Kavach installation uses two Radio Tower Units (RTU).
- 7.3.2 RTUs shall be installed on a platform provided on the RF Tower [Ref: 3.1].
- 7.3.3 The hardware required for securing RTUs to the platform are included in the Stationary Kavach Installation Kit and shall be used to fix the RTUs properly on the platform.
- 7.3.4 Earthing and other safety requirements shall be complied with [Ref: 13.1].



### 7.4 RF Communication Antennae

- 7.4.1 Four RF Communication antennae shall be fixed on top of the RF Communication tower, per the orientation and heights indicated in the RF Antenna Installation drawing [Ref: 4.1] & [Ref:4.2].
- 7.4.2 Hardware for installation of the antennae are included in the Stationary Kavach Installation Kit and mentioned in the RF Antenna Installation drawing.
- 7.4.3 Care shall be exercised to ensure that the antennae are perfectly vertical with respect to the terrain or inclined towards the terrain by no more than 1°.
- 7.4.4 Care shall also be exercised to ensure that RF Antennae are not subject to compressive stress, when fixed on the tower. Antennae should not be bent or curved, due to these stresses.



*Antennae shall never be installed, inclined towards the sky!*

## 7.5 Station Master Operation-cum-Indication Panel (SM-OCIP)

- 7.5.1 SM-OCIP sub-system has two units – SM-OCIP and Termination Panel - SMOCIP.
- 7.5.2 Both units shall be installed in the approved location in the Station Master's Room.



- 7.5.3 SM-OCIP is typically installed on the interlocking system control panel desk. Termination Panel - SMOCIP is wall-mounted at a location close to the SM-OCIP. Instructions given in [Ref: 5.1] & [Ref:5.2] shall be followed for installation of these two units.

## 7.6 GPS & GSM Antenna

- 7.6.1 GPS & GSM antennae are integrated in one unit. This shall be installed on the roof-top of the building where Stationary Kavach is installed.
- 7.6.2 Each Stationary Kavach installation requires two GPS/GSM Antennae to be fixed. Both these antennae shall be installed at least 5 meters apart, following instructions in [Ref: 7.1].
- 7.6.3 Care shall be exercised to ensure that rainwater does not accumulate over the antenna.



- 7.6.4 Care shall also be exercised to ensure that GPS antenna is clear to the sky, with no obstructions from trees or other building structures.
- 7.6.5 GPS / GSM antenna cable, supplied from HBL factory, shall be laid through a suitable conduit, and routed to the Stationary Kavach Unit. Care shall be taken not to route the GPS / GSM antenna cable along other power lines, to prevent interference issues. The conduit shall be sealed adequately to prevent ingress of water.
- 7.6.6 Cables from both GPS/GSM Antennae shall be routed to Stationary Kavach Unit through diverse paths, to avoid common cause failure.

### 7.7 OFC Communication rack:

- 7.7.1 All stationary Kavach equipment in stations, IB Huts and LC Gates must be networked through OFC cable. Network design is made specific to the requirements of each project, and suitable drawings shall be released by Project Engineering team.
- 7.7.2 In each stationary Kavach location, an OFC rack shall be installed. This may be either wall-mounted or floor-standing, depending on the type of OFC network design in the project. The rack shall be installed [Ref: 8.1] in the approved location and grouted to the floor.
- 7.7.3 All networking equipment like modems, switches, routers shall be installed in this rack, along with suitable power supply and fiber termination arrangement.

### 7.8 Power supply arrangement

- 7.8.1 All Kavach equipment require reliable and regulated power supply for efficient performance. The power supply requirements vary from one location to another, depending on availability of IPS power capacity, number of loads that require power supply etc.
- 7.8.2 For each location Power Supply Diagram and Load Calculation [Ref:9.1] is prepared and released by Project Engineering team. This drawing explains the equipment that shall be installed in each location, and the interconnection of these equipment to Kavach equipment.
- 7.8.3 Typically, power supply arrangement consists of the following equipment.
  - 7.8.3.1 IPS (either existing or new)
  - 7.8.3.2 DC-DC Converter
  - 7.8.3.3 Power Distribution Unit
  - 7.8.3.4 Surge Protection Device Unit and
  - 7.8.3.5 Earthing



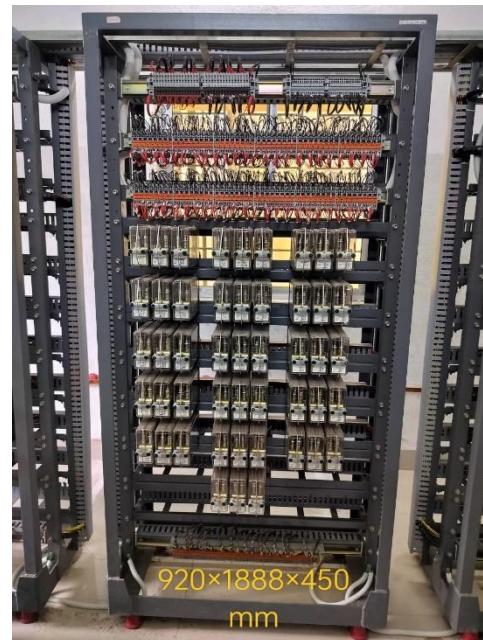


## 7.9 Kavach – Inter-locking System Interface:

Kavach can be interfaced with the inter-locking system either through a relay rack or through a digital interface unit to Electronic Interlocking System.

### 7.9.1 Interfacing through Relay Rack:

- 7.9.1.1 This activity shall be performed, using the STCAS - Relay Interlocking Interface Procedure [Ref: 10.1].
- 7.9.1.2 Project Engineering team prepares and releases a Relay Wiring Diagram for each station where Kavach has to be installed. This drawing provides details of all the inter-locking system relay contacts, which need to be wired to the Stationary Kavach Unit.
- 7.9.1.3 Pre-assembled and pre-wired relay racks are supplied from HBL factory, per the drawings released by Project Engineering team.



- 7.9.1.4 These relay racks shall be installed in the locations indicated in approved floor plan [Ref: 1.1] and fixed to the floor, through anti-vibration mounts.
- 7.9.1.5 All interlocking relay contacts indicated in the approved relay wiring diagram shall be connected to the Stationary Unit Kavach, using 16/0.2 mm wires, through fuses. Repeater relays shall be installed, in case there are no spare contacts in the inter-locking system relay rack.
- 7.9.1.6 If it is necessary to extend relay wiring from one room to another, in the same building or different buildings, 12-core or 24-core signaling cables shall be used.
- 7.9.1.7 40-core or 60-core indoor signaling cable shall be used to connect the Kavach Relay Rack to Stationary Kavach Termination cards.
- 7.9.1.8 All inter-connecting wiring / cabling between Kavach Relay Rack and Interlocking System shall be laid over the ladder through a trough.
- 7.9.1.9 All wires, terminals and terminal blocks shall be identified by wire markers and painted numbers, per the details given in the approved relay wiring diagram.
- 7.9.1.10 Bell test shall be conducted, along with representative from User Railways, after the inter-connection is done between Station Kavach Unit and the Kavach Relay rack, to confirm that all wires are correctly connected, per the approved relay wiring diagram. Bell test results shall be documented in TCAS Bell Test Report [Ref 10.7].

### 7.9.2 Interfacing to Electronic Interlocking System:

- 7.9.2.1 Wherever electronic interlocking systems are installed, it is possible to interface Stationary Kavach with Electronic Interlock through a direct digital interface.
- 7.9.2.2 Currently, this feature can be implemented for Siemens, Medha, Kyosan and Hitachi EIs.
- 7.9.2.3 The following Interface drawings shall be used for implementing the interface.
  - 7.9.2.3.1 [Ref: 10.3] for Siemens EI
  - 7.9.2.3.2 [Ref: 10.4] for Medha EI
  - 7.9.2.3.3 [Ref: 10.5] for Kyosan EI
  - 7.9.2.3.4 [Ref: 10.6] for Hitachi EI

- 7.9.2.4 All equipment required for interfacing Stationary Kavach with an electronic interlocking system shall be supplied from factory, and installed in the Relay Room, according to the layout shown in approved Station Kavach Relay Room Layout Diagram [Ref: 1.1].

#### 7.10 RFID Tags:

- 7.10.1 RFID Tags shall be installed on the sleepers, per the approved RFID Layout drawing, for the respective Station.
- 7.10.2 Procedure for installation of RFID Tags [Ref: 11.3] shall be followed for installation of RFID tags on sleepers.



*Personnel safety guidelines [Ref: 1.3] shall be strictly observed, while working on the railway tracks for installation of RFID Tags.*

- 7.10.3 After installation, RFID tags shall be verified for collect installation location and programmed data, using the RFID Tag Verification Report At Site [Ref: 11.4].
- 7.10.4 During the course of execution of Kavach project, some changes in RFID tag layouts and data may be done by the Project Engineering team. Design Change Notes are issued by Project Engineering team for each such change. These design changes shall be implemented at site and results shall be reported in DCN Implementation Report At Site [Ref: 11.5] for each DCN.

#### 8.0 Inter-connection procedure:

- 8.1 After all equipment are installed and cables are laid, inter-connections shall be made between the various equipment, using the Station Kavach Connectivity Diagram [Ref: 12.1].
- 8.2 All OFC networking connections shall be made, using the project-specific OFC Network Connectivity Drawing [Ref: 12.3].

#### 9.0 Safety Related Application Conditions:

- 9.1 The following Safety Related Application Conditions shall be complied with, during installation of Stationary Kavach systems.

SRAC #	Requirement	Compliance process
SRAC_STN1	Earthing of equipment. The earthing resistance value as measured at each site (Station TCAS and RIU sites) shall be less than 2 ohms.	Earthing shall be done in accordance with following drawings. Station TCAS Tower Earth Drawing [Ref: 13.1] STCAS unit & TCAS Relay rack earth [Ref: 13.2] Earth resistance values shall be recorded in PCCL [Ref: 14.1]
SRAC_STN6	Correctness and completeness of following stationary TCAS	Compliance for RFID Tag installation shall be a per procedure for installation of RFID

SRAC #	Requirement	Compliance process
	<p>application specific data for RF Tag PAGE1 &amp; PAGE 2 data for all Tags. The purpose is for verifying that tags at site are programmed correctly. Duplicated with identical information related to operations except for Unique ID and ABS location. The RFID tags shall be fitted on sleepers between the rails as per guidelines given for Indian Railways.</p> <p>RFID tags shall be fitted on tracks in station section, point zones, near Signals &amp; in block section for giving Track-side information to Loco TCAS unit. RFID tags at all the places shall be</p>	<p>Tags [Ref: 11.3]. which shall be followed strictly followed</p>

## 10.0 Installation Checklist:

- 10.1 After the Stationary Kavach system and its associated peripheral units have been installed and inter-connected, the installation integrity shall be verified and documented, using the Station Kavach Installation Checklist [Ref: 1.2].
- 10.2 The installation is considered complete, when all activities listed in the Checklist are satisfactorily completed and documented.

## 11.0 Commissioning:

- 11.1 After the installation work is completed, two activities shall be carried out to commission Kavach in the site. One is Pre-commissioning Check List (PCCL) sign-off and another is Site Acceptance Testing (SAT).
- 11.2 PCCL [Ref: 14.1] shall be filled up with all the site-specific information and signed by HBL and railway officials.
- 11.3 SAT shall be conducted in accordance with RDSO-approved SAT procedure [Ref: 15.1]. All relevant tests shall be carried out and test records maintained in project documentation.
- 11.4 Kavach is considered ready for operational use when SAT is completed.

## 12.0 DOs and DON'Ts

### 12.1 DOs

1	Keep the TCAS system and location dust free
2	Maintain 77V-132V DC at the output of TCAS MCB
3	Check the system for blown fuse and proper fuse contact at regular intervals
4	SMOCIP LCD display is functioning properly
5	Ensure Proper connection of TCAS to CMS
6	Ensure that the system is firmly connected to Earth
7	Clean the TCAS system with soft cloth / Brush to get rid of dust
8	Use the ESD footwear in case of Cards replacement or repair
9	Ensure that all cards mounting screws are tightened properly

Table 1: DOs list

### 12.2 DON'Ts

1	Trouble shoot without proper system training.
3	Switch OFF any of the IPS / DC-DC converter modules when system is functioning.
4	Remove system modules / Fuse or connectors when TCAS is in operation.
5	Forcibly pickup or Remove relays related to TCAS.
6	Touch components on the PCBs or repair them.
7	Change configuration of the system using jumpers / Application data without approval.
8	Disturb OFC cable / connector.
9	Use removable media (Pen drive, etc.,) in Event logger Module without approval.
10	Repair of cards is a highly technical job and is not possible at site.
11	Never practice any self-made guideline which is not recommended in manual.

Table 2: DON'Ts list

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