

RADIO REMOTE CONTROL SYSTEM

(Distributed Power Wireless Control System)

(RRCS/DPWCS)

USER MANUAL

RELEASE V-1.0
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1. INTRODUCTION

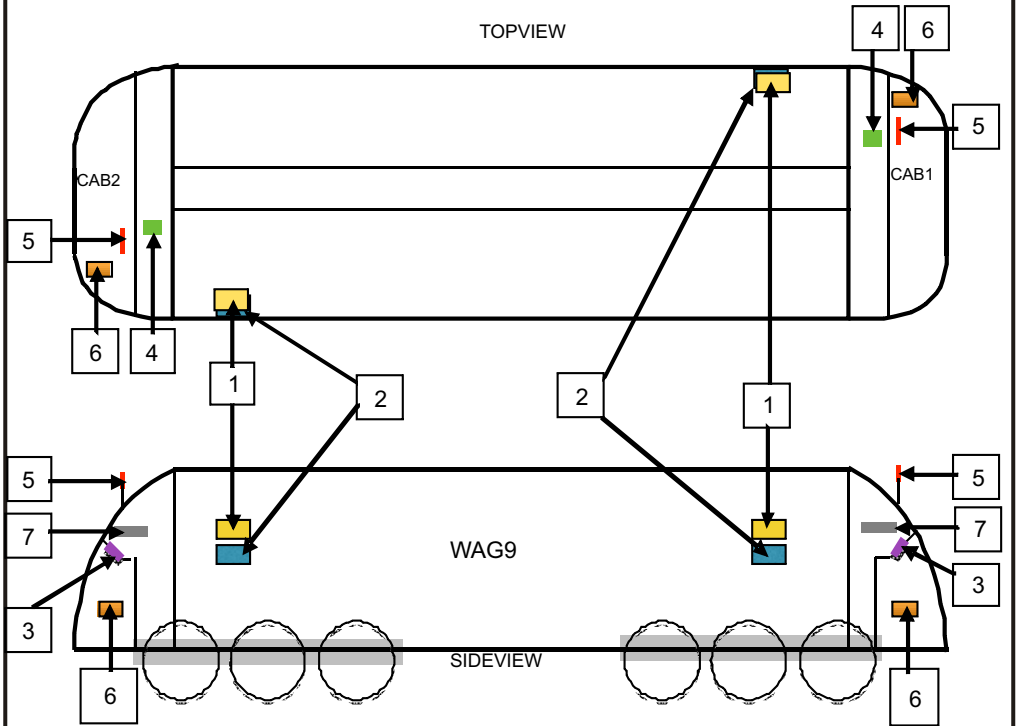
This document explains the special operating procedure needed for the working of Locomotives WAG9-31525 & WAG-31526 fitted with prototype Distributed Power Wireless Control System (DPWCS) developed by Indian Railways (IR) through Advanced Rail Controls Private Limited, Bangalore (ARC). Using DPWCS, Distributed Power (DP) operation is possible through wireless. In DP operation, two or more locomotives are attached in one train, but dispersed at different locations. The operation command of the train is achieved from the lead loco, known as the Master, using a single set of crew. Other locomotives are Slaves, which receives the command from the Master, and do not normally have crew. DP operation enables heavy haul and other benefits like increased throughput.

2. DPWCS Equipment Disposition

Following additional equipments are provided in DPWCS equipped locomotives and the functions are given against each.

| EQUIPMENT DISPOSITION | | | | |
|-----------------------|--|-------------------|--------------------|---|
| SL No | Name of Equipment | Quantity per Loco | Location | Function |
| 1 | Control & Communication Unit (CCU) | 2 | Machine Room | Implements DPWCS logic. Connected to Radio, VCU through MVB, DIU and BIU |
| 2 | Brake Interface Unit (BIU) | 2 | Machine Room | Provides Loco Brake and Auto Brake functions through E70 in the slave locomotives. Connected to CCU and Faiveley's E70 Brake system & Auto Brake controller in cab. |
| 3 | Driver's Interface Unit (DIU) | 2 | Cab | Implements Driver's Commands & Status Indication. Connected to MVB. |
| 4 | GPS Receiver | 2 | Roof | Provides the GPS coordinates of the current location of the locomotive. Connected to DIU. |
| 5 | Dipole Antenna | 2 | Roof | Transmission of telemetry & tele-command data from master to slaves and vice-versa. Connected to Radio through co-axial cable. |
| 6 | BIU bypass coupler | 2 | Cab | Total isolation of BIU, whenever needed. |
| 7 | Transducer Box (having 6 transducers) | 2 | Cab | Measures MR, BC1, BC2, BP, FP Pressures and AF, connected to BIU. |
| 8 | MVB Star Coupler PCB (inserted in Slot V of VCU1 & VCU2) | 2 | VCU1/VCU2 | Providing MVB connectivity to CCU and DIU |
| 9 | MCB | 2 | SB1 / SB2 cubicles | ON/OFF control of 110V DC power to the DPWCS |

TOPVIEW



DISCRETE ANALOG & DIGITAL 110V DC

ASYNCH OFC

MVB/ELEC

DISCRETE ANALOG & DIGITAL 110V DC

E70

VCU2

CCU2

BIU2

A9

GPS

RS 22

DIU1

ASYNCH OFC

MVB ELECTRICAL

MVB ELECTRICAL

ASYNCH OFC

ASYNCH OFC

MVB ELEC

MASTER

SLAVE

A9

BIU1

CCU1

VCU1

DIU2

RS4 22

GPS

DATA INTERCONNECTION BETWEEN PARTICIPANT MODULES

2. Driver Interface Unit (DIU)

The DIU is one of the key elements of DPWCS, as most of the operations can be carried out through DIU by the Driver. The DIU is designed in such a way that the same equipment can be used either in DPWCS fitted locomotives or in normal locomotives, by suitably selecting the mode of operation by the driver at the time of starting. The front view of the DIU is given below:



The DIU has four sets of menu buttons, positioned on left and right side of the panel. The buttons under 'DDU' and 'PXY' are used (and active) when the locomotive is not under DPWCS operation. When the locomotive is selected for DPWCS operation, the clusters 'RRC' on both left and right side becomes active. The DIU is made of 10.4" LCD panel with intensity variable LED backlight.

4. Step by Step procedure for Inauguration and Operation

The step by step procedure to be followed starting from Energization, Inauguration and Operation is given in the following section, which is primarily done through the DIU.

4.1 Slave

Step 1

- ☐ Switch OFF control Electronics.
- ☐ Switch ON RRC MCB from both SB1 and SB2 panel.
- ☐ Remove A9 handle.
- ☐ Release SA9 from both CAB 1 & 2.
- ☐ Make E70 same as leading LOCO.
- ☐ Put BL key in D position.

When the locomotive is powered ON, Screen-1 appears. This is the first screen in DIU of DPWCS. This screen provides an option to select two modes viz. RRC Mode and DDU Mode

- ☐ **After node 504 press RRC MODE and then press OK.**
- ☐ **After pressing RRC MODE, password screen will appear.**

Screen 1

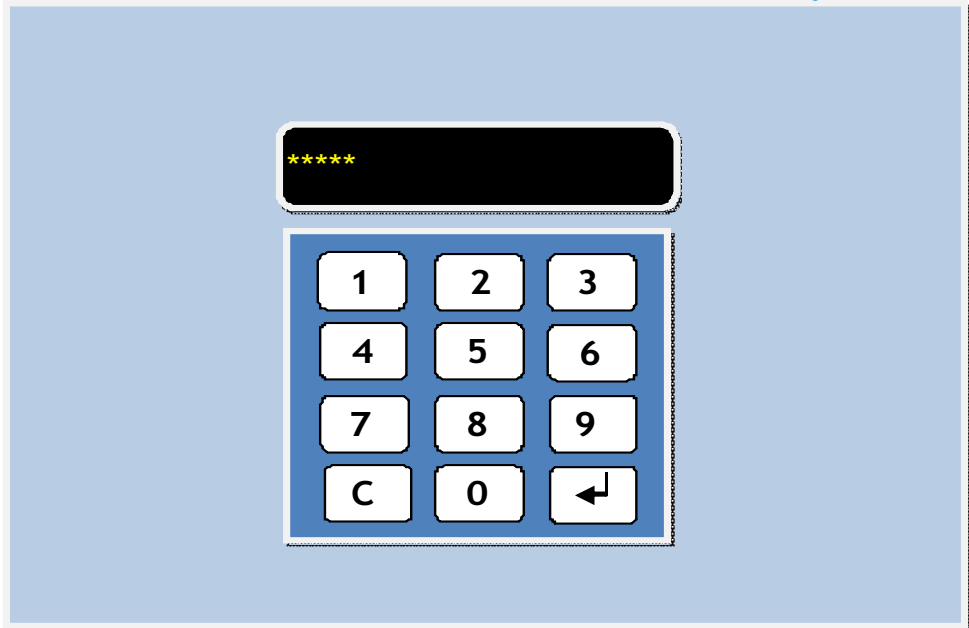
DRIVER INTERFACE UNIT

RRC
MODEDDU
MODE

OK

CANCEL

Select Mode**Advanced Rail Controls Pvt. Ltd. Bangalore**

Password Entry ScreenThe screen displays a password entry interface. At the top, there is a black rectangular box containing six yellow asterisks (*****). Below this box is a blue rectangular keypad. The keypad contains twelve white buttons arranged in a 4x3 grid. The buttons are labeled with the numbers 1 through 9, the letter 'C', the number '0', and a left-pointing arrow key.

➤ Press password 14488 and then press ↩ key.

In case, if entered password is wrong, Press “C” and re-enter.

Master Slave Selection Screen

RADIO REMOTE CONTROL

INAUGURATION PROCESS

The screen displays four buttons arranged in a 2x2 grid. The top row contains two blue buttons labeled 'MASTER' and 'SLAVE'. The bottom row contains two dark blue buttons labeled 'OK' and 'CANCEL'.

Select Loco in either Master/Slave Mode

➤ After entering password above screen will appear, press **SLAVE** and **OK**.

- After selecting **SLAVE**, inauguration progress screen will appear, as shown below.
- Put **BL** Key in **OFF** position and remove.

Inauguration Screen 2: Slave Logo

RADIO REMOTE CONTROL

SLAVE LOCO

Inauguration Progress

4.2 MASTER

Step 2

- Switch OFF control Electronics.
- Switch ON RRC MCB from both SB1 and SB2 panel.
- Put BL key in D position.

Screen 1

DRIVER INTERFACE UNIT

**RRC
MODE**

**DDU
MODE**

OK

CANCEL

Select Mode

Advanced Rail Controls Pvt. Ltd. Bangalore

When the locomotive is powered ON, Screen-1 appears. This is the first screen in DIU of DPWCS. This screen provides an option to select two modes viz. RRC Mode and DDU Mode.

- After node 504 press RRC MODE and then OK.
- After pressing RRC MODE, password screen will appear.

Password Entry Screen

- Press password 14488 and then press ↩ key.
- In case, if entered password is wrong, Press “C” and re-enter.

Master/Slave selection screen

RADIO REMOTE CONTROL INAUGURATION PROCESS

Select Loco in either Master/Slave Mode

- After entering password above screen will appear, press **MASTER** and **OK**.

➤ Master starts searching slave loco no.

Master Opening Screen

RADIO REMOTE CONTROL MASTER: 31525

Searching Slave Loco.....


SELECTED SLAVE

| | | | | |
|----------|------------------------------------|----------------------|----------------------|-------|
| SLAVE -1 | <input type="text" value="31526"/> | <input type="text"/> | <input type="text"/> | 31526 |
| SLAVE -2 | <input type="text" value="31282"/> | <input type="text"/> | <input type="text"/> | |
| SLAVE -3 | <input type="text"/> | <input type="text"/> | <input type="text"/> | |
| SLAVE -4 | <input type="text"/> | <input type="text"/> | <input type="text"/> | |

PRESS OK TO CONFIRM

CANCEL

OK

- Slave loco no is appeared on square box, Select slave loco no By pressing square box. Selected number will appear on right side of the screen as shown above. If selected loco no. is wrong in which case, before entering OK press CANCEL and re-select the loco number and press OK.
- After selecting slave loco number, wagon entry screen will appear.
- Select any one type of wagon attached in the train (eg. BOXN, BOB-Netc) and enter the no. of wagons of this type and press .
- If wagons are more than one type, follow above procedure again.
- Press **ENTER** after entering all data.
- Press **NO** if train has more slave.
- Press **OK** for confirmation, if entered wagon is wrong in which case, Press **CANCEL** and re-enter.
- All procedures are shown in below screen.

RADIO REMOTE CONTROL

MASTER LOCO

| Type of Wagon | Wagons Selected | No. Of Wagons |
|-------------------|-----------------|---------------|
| Master to Slave-1 | | |
| BOXN | BOBN | 50 |
| BOBN | BOXN | 5 |
| BOXNHI | | |
| TYPE-4 | | |
| TYPE-5 | | |

No. of Wagons : 55
Train Length : 610.5m

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |
| C | 0 | ← |

Cancel OK Enter

Press "Enter" after entering all the data....

RADIO REMOTE CONTROL

MASTER LOCO

| Type of Wagon | Wagons Selected | No. Of Wagons |
|-------------------|-----------------|---------------|
| Master to Slave-1 | | |
| BOXN | BOBN | 50 |
| BOBN | BOXN | 5 |
| BOXNHI | | |
| TYPE-4 | | |
| TYPE-5 | | |

No. of Wagons : 55
Train Length : 610.5m

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |
| C | 0 | ← |

Cancel OK Enter

TRAIN HAS ONE MORE SLAVE?

No Yes

- Below screen displays total no. of wagons and total length between master and slave and between each slave. If the entered data is wrong, Press **"BACK"** key to go to wagon entry screen and re-enter.
- Press **ENTER** for inauguration screen.

Wagon Entry Confirmation Screen

RADIO REMOTE CONTROL

MASTER LOCO

No. Of Wagons

| Master to Slave-1 | Slave-1 to Slave-2 | Slave-2 to Slave-3 | Slave-3 to Slave-4 |
|-------------------|--------------------|--------------------|--------------------|
| 55 | 57 | -- | -- |
| 650 | 620 | -- | -- |

No. of Wagons between each consist

Cross Verify the data you have entered. If correct press "ENTER" else press "BACK" to re-enter the data

Back
←

Enter
↵

- Once completed wagon entry, BP DROP checking screen appear, same as below screen.this will appear in both MASTER and SLAVE.
- After appearing below screen then press PANTO UP (Node 550)
- Then press VCB ON (Node 570)
- Wait for BP become 5Kg in both master and slave.
- After 5Kg ,BP continuity tested by dropping BP from slave automatically

RADIO REMOTE CONTROL

MASTER LOCO

COMMUNICATION ESTABLISHED

Initializing
'BP Drop CHECK'

Below screen shows the continuity status.

RADIO REMOTE CONTROL

MASTER LOCO

BP CONTINUITY CHECKING.....

| | | |
|-------------|-----|-----------------------------|
| Master BP | 3.5 | BP Continuity OK |
| Slave -1 BP | 3.4 | BP Continuity OK |
| Slave -2 BP | 3.4 | BP Continuity OK |
| Slave -3 BP | 3.5 | BP Continuity OK |
| Slave -4 BP | 3.4 | Dropping BP from Last Slave |

Monitor BP Status for Verification

➤ If BP continuity OK then below screen will be appear.

Inauguration Screen -6

RADIO REMOTE CONTROL MASTER LOCO

BP CONTINUITY CHECKED

INAUGURATION
SUCCESSFUL

LOCO "31525" is in "MASTER" Mode

➤ After inauguration, RRC home screen appears same as shown below.

Master Loco Home Screen

| SYN | Slave-1 | Slave-2 | Slave-3 | Slave-4 |
|-----------|---------|---------|---------|---------|
| Loco No | 31525 | 31526 | 31022 | |
| Node | 596 | 596 | 596 | |
| Panto | Up | Up | Up | |
| VCB | On | On | On | |
| TE/BE | 25 | 20 | 23 | |
| Speed | 5 | 5 | 5 | |
| MR/FP | 8.2/6 | 8.7/6 | 8.9/6 | |
| BP | 5.1 | 5.0 | 5.0 | |
| BC1/BC2 | 0.0/0.0 | 0.0/0.0 | 0.0/0.0 | |
| Parking B | 6.2 | 6.1 | 6.1 | |
| Airflow | 6.0 | 6.0 | 6.0 | |

MODES

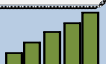
REBOOT

NEUTRAL SECTION

PANTO LOW

MENU

Enter



Status message / Fault message of slaves/ sanding valve status

Status/Fault

Main Menu:

- >1. Vehicle Diagnostics
- 2. Information Train Bus
- 3. Process Information

Loco No 31525

Hom

CLR

Enter

This is the Home screen for Master Loco as well as Slave Loco which displays the status of all the slave locos connected and also the status of master. Other than this it also displays the fault message of slave locos. Master Home screen has other options viz. MODES, REBOOT, NEUTRAL SECTION, PANTO LOW, MENU. And an enter key to confirm the selected option.

SIGNAL STRENGTH



This indicates the **FULL** radio signal strength



This indicates the **MEDIUM** radio signal strength



This indicates the **LOW** radio signal strength

FAULT INDICATOR

Status/Fault

Slave loco fault and RRC system fault will appear on message status bar, by pressing BPFA slave fault will be acknowledged.

5. MODES

Various modes available are shown in this screen. Please note that SYNC & IND modes only are activated in Loco 31525 & 31526. Other modes are futuristic provisions. In SYNC mode, the slave follows all the commands of master and the loco state will be in synchronism with master. Whereas, in IND mode, the slave loco can be independently controlled through the DIU with respect to PANTO, VCB & Throttle.

Independent Mode

1. Select **MODES**
2. Select **IND**
3. Select **Slave 1** and press **Enter**

Now, four keys appear ie 'PANTO UP', 'PANTO DOWN', 'VCB ON', 'VCB OFF'. By pressing suitable key slave loco can be controlled independently.

For **SYN** mode selects **SYN** Key and Press Enter

6. NEUTRAL SECTION NEGOTIATION

1. Press `**NEUTRAL SEC OFF**` key on display (DIU).
 2. NEUTRAL SECTION OFF message will appear
 3. Switch off the **VCB**.
- After passing NEUTRAL SECTION
4. Press `**NEUTRAL SEC ON**` key on display.
 5. NEUTRAL SECTION ON message will appear
 6. Switch on the **VCB**.

7. PANTO LOWERING NEGOTIATION

1. Press `**PANTO DOWN**` key on display
 2. PANTO DOWN message will appear
 3. VCB OFF and Panto Down
- After passing Panto lowering section
4. Press `**PANTO UP**` key
 5. PANTO UP message will appear

Special Modes

There is a provision to re-start the slave locomotive/s and the RRC of the slave locomotive/s from the master locomotive itself as can be seen from the screen above. For this purpose, from the master screen, the REBOOT button can be pressed. Both the options will appear on the right side of the menu bar.

System Reboot

If the option System Reboot is selected from master loco, the RRC of the Slave locomotive will be restarted. Such situations may arise in case the desired handshaking does not happen between master and slave. There is no need for a re-inauguration, as the system remembers the previous configuration.

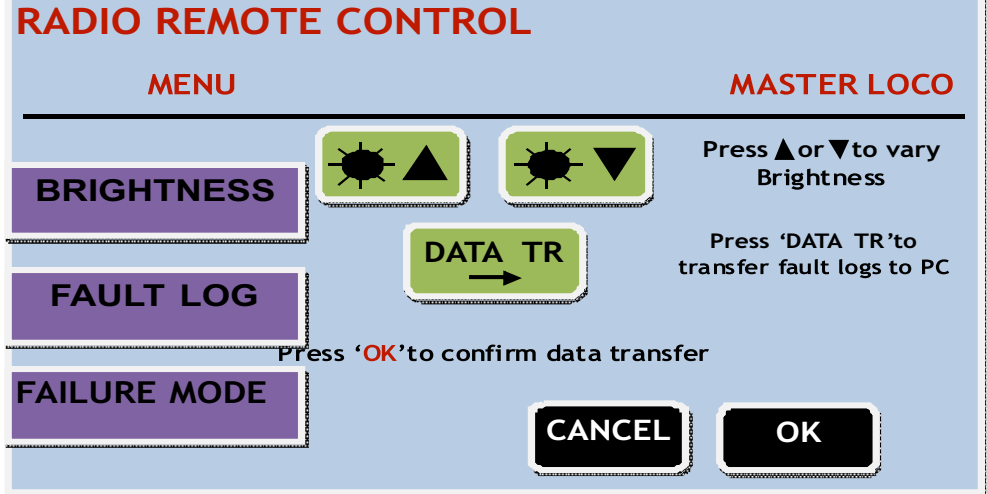
Loco Reboot

If the option Loco Reboot is selected from master loco, the slave loco will get restarted. Such a situation would arise for clearing any incipient faults in the slave loco.

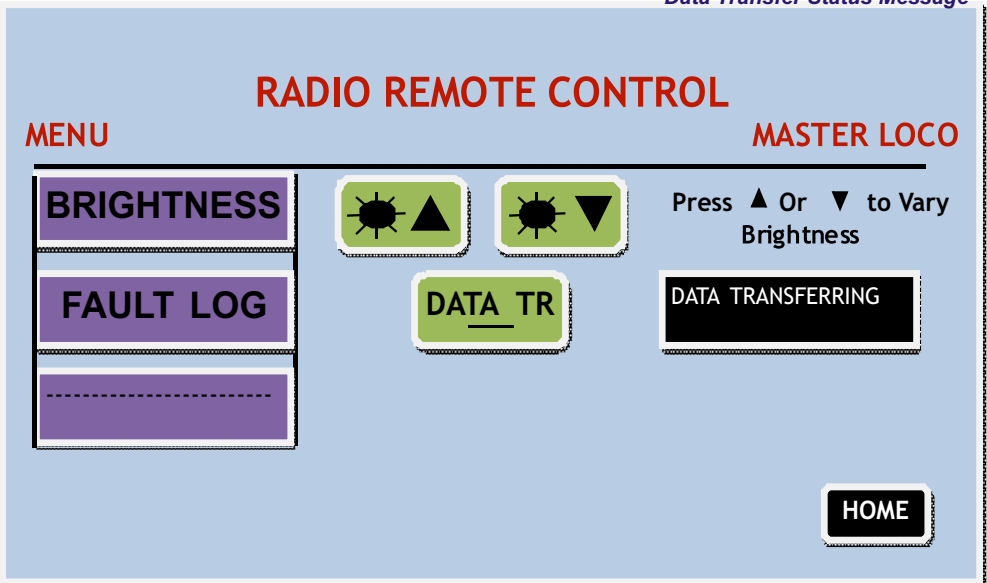
8. MENU OPTIONS

In MENU, brightness variation and fault log transfer options are given. Once the data transfer option is selected the status of data transfer is shown as a status message.

Brightness Control & Data Transfer Menu Screen



Data Transfer Status Message



RADIO REMOTE CONTROL

MENU

BRIGHTNESS

FAULT LOG

MASTER LOCO



Press ▲ or ▼ to vary
Brightness

DATA TR
→DATA TRANSFERING
COMPLETED

HOME

Once the key 'DATA TR' is pressed the status of the data transfer can be seen with the status message "DATA TRANSFERING". By pressing 'HOME' key you can go to the HOME screen of the DIU and if there is no action on the screen for 10 secs automatically HOME screen will appear. Once the data transfer is completed it will show the status message '**DATA TRANSFER COMPLETED**'

Cab Failure Mode:

When the CAB Computer fails(in VCU), RRC mode can be operated using the DIU by invoking CAB FAILURE MODE as shown below.

RADIO REMOTE CONTROL

MASTER LOCO

CAB FAILURE MODE

FORWARD

REVERSER

REVERSE



TE

40%

THROTTLE



BE

HOME

9. Troubleshooting Directory:

| S.L.No. | Expected Problem | Suggested Action | Remark |
|---------|--|--|--|
| 1 | Radio Loss while stopping at signal on gradient(Single Loco unable to start). | Manual Intervention by SLAVE Loco staff over walkie talkie communication(Release of BC1/BC2, advancing throttle etc.). | |
| 2 | Radio loss while on run. | No action expected by driver. | System will bring the throttle to ZERO and close the BP Valve. Train brake controlled by master only |
| 3 | BP Continuity Check taking more time. | Check leakage in Train pipe. | |
| 4 | DIU Touchscreen not responding while negotiating neutral section. | Use Hotel Load switch/Keypad for operation. | |
| 5 | Parking brake status of Slave (Applied/Released) in conflict with Master. | Check manually the solenoid valve on Slave. | |
| 6 | Problem in Slave Loco like Bogie Isolate, Harmonic Filter Isolate, Auxiliary Converter Isolate etc., | <ul style="list-style-type: none"> Do not Isolate RRC. Restart the Slave Loco using RRC. The Loco's will again pair in RRC mode. | |
| 7 | Need to restart the Loco after Inauguration . | <ul style="list-style-type: none"> Do not re-inaugurate. Restart the required Loco using RRC. | |
| 8 | Rear Loco Harmonic Filter current too high message in Master with Slave node jumping to 715. | <ul style="list-style-type: none"> Acknowledge the fault from master. Slave node will then jump to 550. Lower the Panto in Slave in independent mode. Raise the Panto in Slave in independent mode. Close the VCB. There is no need to isolate the RRC mode. | |

CONTACT DETAILS

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