

FSK TRAIN BUS UNIT
Push-Pull Operation in WAP-5 Locomotive
OPERATING & MAINTENANCE MANUAL



TRANSFORMING RAILWAYS, TRANSFORMING INDIA

Advanced Rail Controls Pvt Ltd

Plot No114 (Aerospace Sector),
at Hitech, Defence & Aerospace Park, KIADB Industrial Area, Jala Hobli
Bangalore - 562 149

www.arc.net.in

mail@arc.net.in

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1.Scope

This Document describes the operating and maintenance manual of the FSK Train Bus Unit.

2.Introduction and working principle of FSK Train Bus (FSKTB)

FSK stands for **Frequency Shift Keying**. **FSK-based Wired Train Bus (WTB)** system enables seamless **push-pull operation** between WAP5 locomotives over long train formations, typically consisting of up to **24 coaches**. Since the locomotives are separated by over **600 meters**, reliable data transmission is achieved using **Frequency Shift Keying (FSK)** modulation, a robust technique suited for noisy and high-interference railway environments.

In this system, **MVB (Multifunction Vehicle Bus)** is used within each locomotive for internal subsystem communication, while the **FSKTB** extends communication between the two locomotives. The **FSK modem** encodes digital data for transmission:

- A logical '0' is transmitted by shifting the carrier to a **lower frequency (FL)**
- A logical '1' is represented by shifting the carrier to a **higher frequency (FH)**

As the data stream changes between 0s and 1s, the resulting signal is a **sine wave with frequency modulation at two distinct frequencies representing boolean '0' and '1'**, enabling **noise immunity and distortion resistant** transmission over the WTB cable.

1. FSK Train Bus Unit (Fig-1)



Fig-1

2.1 Do's and Don'ts

Do's:

- 1) The FSKTB MCB must be turned ON in both the master and slave locomotives during push-pull operation to ensure proper communication and system synchronization.
- 2) During single locomotive operation, the FSKTB MCB should be switched OFF to avoid unnecessary communication initialization.
- 3) Check the healthiness of the system by verifying the life sign LED on the FSK Train Bus Unit.

Don'ts:

1. Don't disturb the cables related to FSKTB.
2. Do not switch the FSKTB MCB ON/OFF during active communication, as this may disrupt the data exchange between locomotives and lead to system instability

2.2 Safety procedure and Warnings

Procedure to operate FSKTB:**OPERATING INSTRUCTIONS FOR FSK TRAIN BUS (FSKTB)**

1. Begin by turning ON both locomotive battery switches located in the SB2 panels, along with the FSK MCB inside the SB1 panel of each locomotive.
2. The Loco Pilot (LP) should then adjust the pneumatic handles as required and manually release the BC1/2 brakes in the slave locomotive using the TP16/18 valves.
3. Insert the BL key (REAR) located near the ALP into the 'D' position and wait for the slave locomotive to reach node 504. This is confirmed when the BPPA (REAR) indicator blinks once and turns off.
4. Once the slave reaches node 504, turn the BL key to the OFF position, allowing the slave locomotive to transition to node 612 (self-hold mode).
5. Remove the rear key and insert the BL key near the DDU on the LP side and turn it to the 'D' position.
6. Wait for the master locomotive to reach node 504. At this point, the slave should also return to node 504. During this phase, navigate to Train Bus > Information in the PIXY display to confirm that both locomotive numbers are visible — this indicates that communication between the two locomotives has been successfully established.
7. Additionally, confirm the slave node status using the DDU (displayed as "SLv") or in PIXY under Process Information > Commissioning Data > Node Information.
8. Once confirmed, raise the pantograph, at which point both nodes will transition to 550, and after VCB (main breaker) closure, both nodes will reach 570, indicating successful synchronization. Normal operating procedures can then continue.

2.3 Parts catalogue and replacements

Sl. No	PARTS	ARC Part No.
1	Power Supply Board	33101310CE
2	Analog Board	33101310BC
3	Administrator Board	3325108TFN
4	Back Panel Power_ST1	33101310CG
5	Back Panel Power_ST2	33101310CJ
6	Back Panel Signal_ST1	33101310CK
7	Back Panel Signal_ST2	33101310DC
8	Fan	1115123015
9	MCB	2222101001
10	MVB SIGNAL CONVERTER BOX	44101321CZ

3. Maintenance Schedule

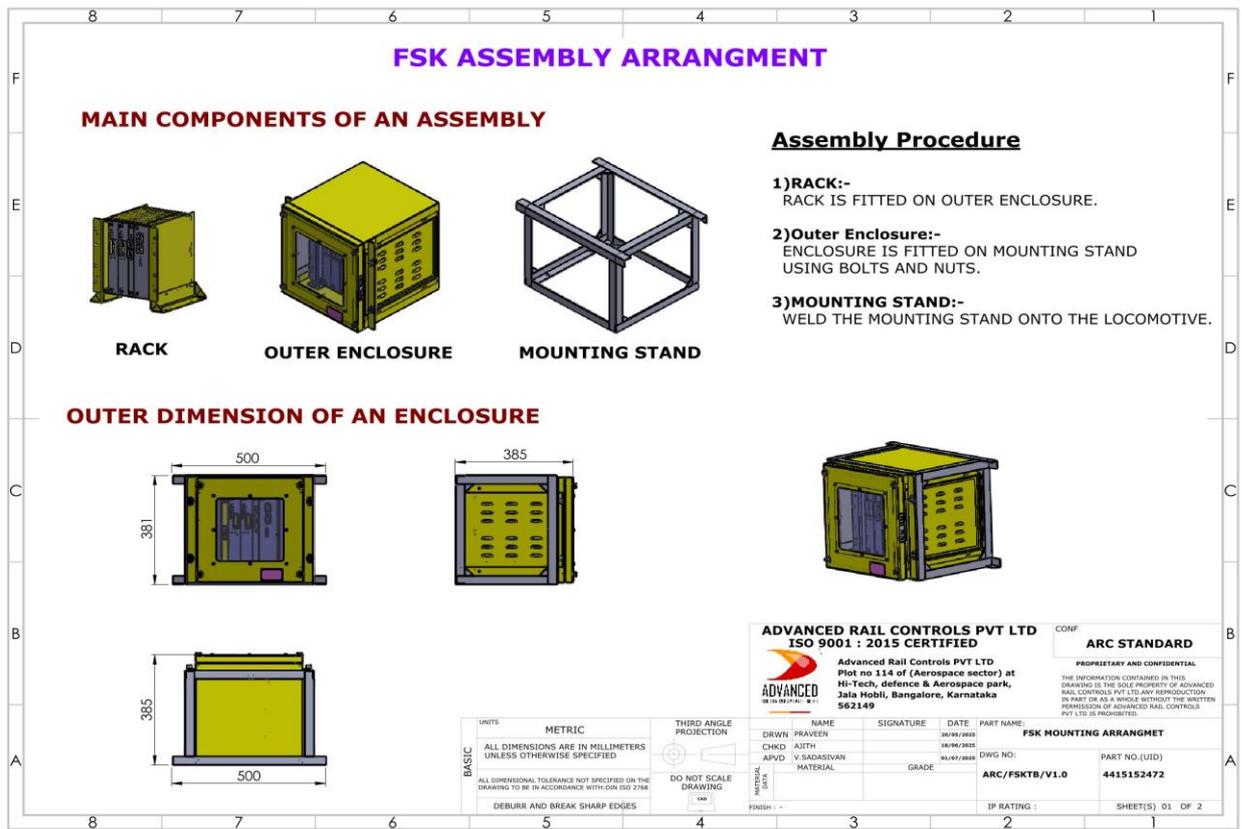
To be verified for every Loco schedule:

1. Ensure all mounting screws, bolts, and brackets are securely fastened.
2. Verify all cables connectors are tight, corrosion-free, and locked.

4. Cleaning, inspection and repairing

1. FSKTB Unit to be cleaned and inspected periodically
2. In case of PCB Boards are not working must be replaced or repaired with the authorised OEM Engineer.

5. Assembly



FSKTB mounting stand with mechanical dimensions is shown in the **FIG-1**

FSKTB mounting locations is shown in the **FIG-2**

NOTE: DEPENDS ON THE SPACE AVAILABLE IN LOCOMOTIVE.

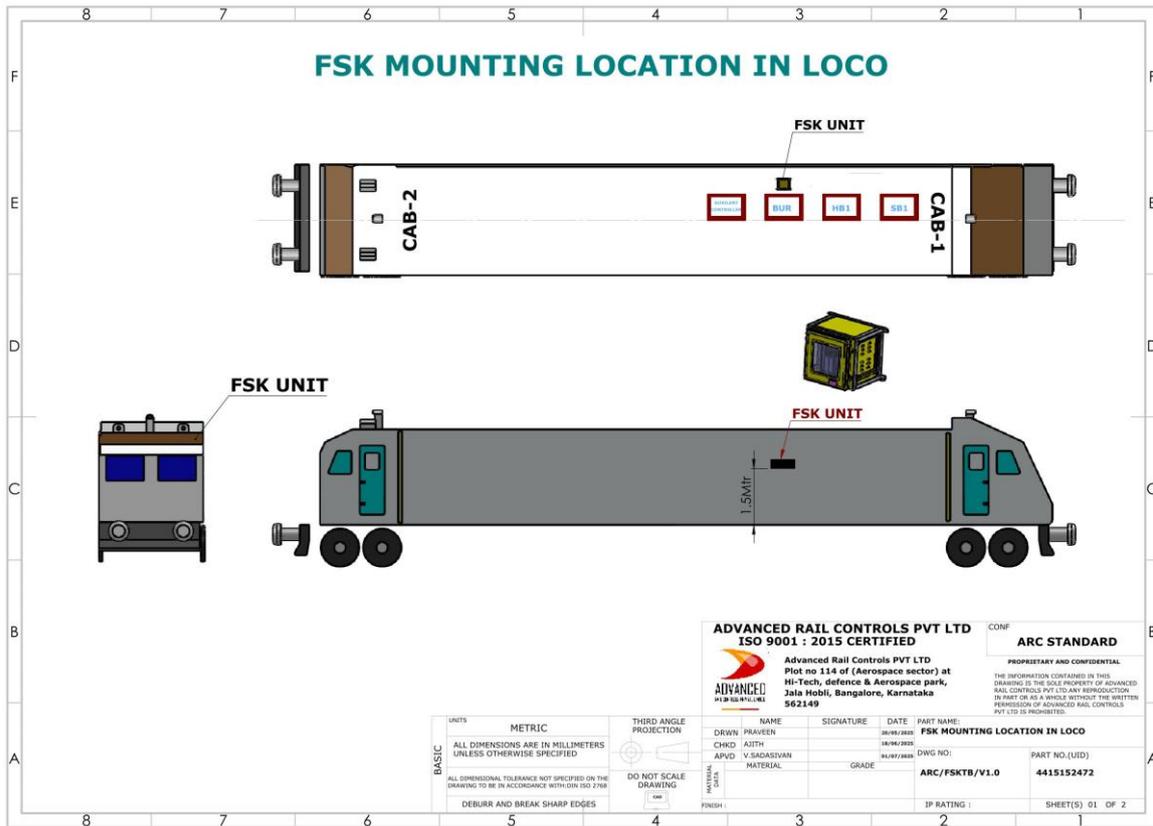


FIG-2 FSKTB MOUNTING IN LOCOMOTIVE

6. Performance Testing after reconditioning

Performance can be Tested as per the testing procedure document.

7. Troubleshooting guide

Troubleshooting instructions are given in Table below:

Sl No.	Symptom	Possible Cause	Corrective Action
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1	No slave loco node detected (e.g., not reaching 504)	<ul style="list-style-type: none"> - FSKTB MCB is OFF in one or both locomotives - BL key not in proper position - Communication cable disconnected 	<ul style="list-style-type: none"> - Ensure FSKTB MCB is ON in both locos - Verify BL key is in 'D' position (REAR then LP) - Check physical WTB cable and connectors
2	Slave node stuck at 612 or does not transition	<ul style="list-style-type: none"> - Incorrect sequence of key turning - Fault in rear BL key port - Slave loco not powered on correctly 	<ul style="list-style-type: none"> - Repeat the push-pull startup sequence - Inspect and clean rear BL key port - Confirm slave battery and FSK system is active
3	Master and slave showing different node numbers	<ul style="list-style-type: none"> - Communication lost mid-sequence - Node ID mismatch 	<ul style="list-style-type: none"> - Restart both systems and ensure sequence is followed - Check configuration for correct node IDs
4	Only one loco number visible in PIXY Train Bus Info	<ul style="list-style-type: none"> - Slave not responding - Node transition incomplete - Faulty unit 	<ul style="list-style-type: none"> - Restart FSK systems in both locos - Check node status in DDU and PIXY - Replace suspected FSK unit
5	Slave loco does not respond to master controls	<ul style="list-style-type: none"> - FSK modem malfunction - Configuration mismatch 	<ul style="list-style-type: none"> - Use PIXY: Process Info → Node Data - Replace or reprogram the Administrator Board
6	Train Bus errors in PIXY	<ul style="list-style-type: none"> - Ground loop issues - Firmware mismatch 	<ul style="list-style-type: none"> - Ensure proper grounding and shielding - Confirm same firmware version in both locos

8. Block Schema of FSKTB Rack for Electric locomotives

