सत्यमेव जयते

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Government of India - Ministry of Railways
Research, Designs & Standards Organization,
LUCKNOW - 226011

No. EL/3.1.35/4 Dated: 18.06.2019

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MODIFICATION SHEET NO.RDSO/2019/EL/MS/0477 (REV. '0'), Dated 18.06.2019.

1.0 Title:

Operations of WAP-5/ WAP-7 in push pull

2.0 Object:

Indian Railway is planning to run the passenger trains with locomotives in push-pull formation which will lead to increased average speed of the train. This MS elucidates the modifications required to facilitate operation of WAP-5/ WAP-7 in push pull.

3.0 Present Scheme:

At present, the WAG9 locomotive is being operated in MU formation. In conventional MU 2'nos. WAG-9 locomotive are connected through UIC coupler to facilitate transfer of control

signals. The data transfer between the two locomotives is based on ABB, proprietary train network protocol or TCN compliant wired train BUS (WTB). In push pull operation two locomotives are operated in MU mode with the rake in between the front and rear locomotives. The communication between front and rear locomotives is established through wired media laid in the coaches.

3.1 Proposed Scheme

The operation of WAP-5/ WAP-7 in push pull shall be done by formation of MU of two WAP-5/ WAP-7 locomotives with rake between the locomotives. Scheme has been shown in Fig 1.0. Therefore, WAP-5/ WAP-7 shall be connected on each end of the train and control signals will be communicated by running control cable in the rake end-to-end.

To facilitate the MU operation in Push-Pull mode the control signal communication needs to be established between the two locomotives with train rake in-between. For this purpose 22 core cables throughout the rake would be required. Spare 22 core cables throughout the rake would be laid for redundancy purposed. It is advisable to have additional spare cores in each cable. At present only 18 cores are used. 4 cores are kept as spare for future extension.

The scheme for push pull operation with modified loco wiring is shown in Annexure-I.

The cable layout shall be as follows:

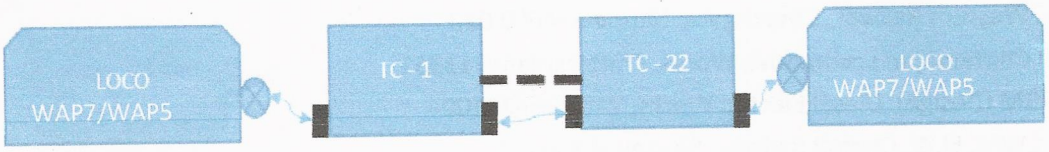


Fig. 1: Schematic Diagram for Push-Pull with WAP7/WAP5

22 Pin Circular UIC connector

Suitable connector

For 22 coach formation, the cable length from end to end shall be about 600 meters.

4.1 Modification Required in Loco Software

The main challenge shall be to negotiate the neutral section smoothly by both the locomotives, In MU formation the VCB open/close commands are immediately transferred from master to slave locomotive. As there is distance of about 500m between the two locomotives the opening of VCB in both the locomotives simultaneously will not result in proper neutral section negotiation as the slave locomotive will have its VCB opened and then closed before the neutral section comes. For this purpose a delay of time taken by the

locomotive to travel the rake length shall be introduced in the slave locomotive. The instance of opening of VCB of the master locomotive shall be transferred to the slave locomotive. The slave locomotive in turn will calculate the required time delay by having the information of train length and instantaneous speeds. An in built time delay logic required to be introduced in VCU software for operation of VCB of slave locomotive.

4.2 Modifications Required in the locomotives wiring

In order to form the MU in 3 phase locomotive the slave locomotive needs to be charged first and after it reaches node no. 503 the BL key is taken out and then master locomotive is charged. For this purpose, the BL key of slave locomotive shall be duplicated in the master locomotive which may be catered by extra 4+4 wires and addition seven wires shall be required for LED indication signal. Considering the above the total cores required shall be as below:

a. 3 Wires for MU
b. 8 Wires for BL key duplication
c. 7 Wires for LED indication signal & Fault Acknowledge

Thus, total 18 wires shall be required for MU formation. 4 additional core may be kept as spare for future extension.

4.3 Modification to be carried out in the loco:

In order to form the MU in 3 phase locomotive the slave locomotive needs to be charged first and after it reaches node no. 503 the BL key is taken out and then master locomotive is charged. This activity is required to be completed within 10 mins. In case of Push-Pull mode, the locomotives shall be about 500 mtrs apart and completion of this activity within 10 mins on crowded platform may not possible. For this purpose, the BL key, BLDJ & BPFA of slave locomotive have been duplicated in the master locomotive. Thus, at least a total 18 wires shall be required for MU formation with extra functionalities.

(A) Modification in A-Panel Driver Desk: Details given in annexure-II

4.4 Modification in operation of computer.

In push pull operation, there is no MR equalization between master & slave loco and compressor governed by 172.3 pressure switch of main compressor (36), all the compressor of both loco(Master loco & slave loco) starts at the same time without taking care of individual loco MR pressure. Hence, the slave loco which is not participating in BP changing circuit, only maintain itself MR, MR safety valve blown continuously till master loco MR get maintained to 10 kg per square centimeter.

There is a provision in software of three phase loco, 172.2 pressure switch main compressor (35) is controlled each loco compressor individually. Therefore, during initial charging of MR

which is first controlled by 269.4 (Pressure switch low main reservoir, 37) the slave loco MR safety valve blown & thereafter the individual loco compressor controlled by 172.2 start.

4.5 Modification in the cooling scheme.

Following actions are required in each locomotive:

a. Additional BL key switch (125) socket, additional BPFA (163.1) and additional indication lamp LSDJ (137.3) to be fitted on both the CAB driver desks in both locomotives.
b. Existing BL connection 9 wire no 2067 to Add BL connection 9. Wire no. 2067 also available in Cab-1 WAGO connector XF13A:01 15 and Cab-2 WAGO connector XF86A:01 15. Wire loop will be connected from these WAGO to Add BL key connection 9 in respective Cab.
c. The following cable connection shall be done for duplication of BL Key, BLDJ & BPFA.

i. Cable Harness:

Sl. No.	Cable no.	A1 PANEL	F1 PANEL	Loom No.
1	2500AR	Add. BL Key Conn.2	XF13A:05-10	382
2	2503AR	Add. BL Key Conn.10	XF13A:05-11	382
3	2331AR	LSDJ-X1	XF13A:05-12	382
4	4242AR	Add. BL Key Conn.4	XF13A:05-13	382
5	2111AR	Add. BL Key Conn.1	XF13A:05-14	382
6	5671AR	Add. BPFA conn.14	XF13A:05-15	382
7	2111AR	Add. BL Key Conn.3	XF13A:05-14	382
8	2111AR	Add. BPFA conn.13	XF13A:05-14	382
9	5672A	Add. BPFA conn.X1	XF13A:04-07	382
10	2050	Add. BPFA conn.X2	XF13A:01-04	382
11	2050	LSDJ-X2	XF13A:01-04	382
12	2067	Addl. BL Key Conn.9	XF13A:01-15	382
Sl. No.	**Cable no.**	**F1 PANEL**	**SB1 PANEL**	**Loom No.**
1	2500AR	XF13A:05-10	XF22S:03-48	383
2	2503AR	XF13A:05-11	XF22S:03-49	383
3	2331AR	XF13A:05-12	XF22S:03-50	383
4	4242AR	XF13A:05-13	XF22S:03-51	383
5	2111AR	XF13A:05-14	XF22S:02-36	383
6	5671AR	XF13A:05-15	XF22S:02-57	383
7	5672AR	XF13A:05-16	XF22S:02-58	383
8	5671A	XF13A:04-6	XF22S:02-59	383
9	5672A	XF13A:04-07/04-09	XF22S:02-60	383
10	4242A	XF13A:04-5	XF22S:02-61	383
11	2111A	XF13A:02-1	XF22S:02-35	383
Sl. No.	**Cable No.**	**SB1 PANEL**	**SB2 PANEL**	**Loom No.**
1	2500AR	XF22S:03-48	XF77S:03-48	384

2	2503AR	XF22S:03-49	XF77S:03-49	384
3	2331AR	XF22S:03-50	XF77S:03-50	384
4	4242AR	XF22S:03-51	XF77S:02-47	384
5	2111AR	XF22S:02-36	XF77S:02-48	384
6	5671AR	XF22S:02-57	XF77S:02-49	384
7	5671A	XF22S:02-59	XF77S:02-51	384
8	5672A	XF22S:02-60	XF77S:03-38	384
9	5672AR	XF22S:02-58	XF77S:02-50	384
Sl. No.	**Cable no.**	**SB2 PANEL**	**F2 PANEL**	**Loom No.**
1	2500AR	XF77S:03-48	XF86S:05-10	385
2	2503AR	XF77S:03-49	XF86S:05-11	385
3	2331AR	XF77S:03-50	XF86S:05-12	385
4	4242AR	XF77S:02-47	XF86S:05-13	385
5	2111AR	XF77S:02-48	XF86S:05-14	385
6	5671AR	XF77S:02-49	XF86S:05-15	385
7	5671A	XF77S:02-51	XF86S:05-16	385
8	5672A	XF77S:03-38	XF86S:05-17	385
9	5672AR	XF77S:02-50	XF86S:05-18	385
Sl. No.	**Cable no.**	**F2 PANEL**	**A2 PANEL**	**Loom No.**
1	2500AR	XF86S:05-10	Add BL Conn.2	386
2	2503AR	XF86S:05-11	Add BL Conn.10	386
3	2331AR	XF86S:05-12	LSDJ-X1	386
4	4242AR	XF86S:05-13	Add. BL Key Conn.4	386
5	2111AR	XF86S:05-14	Add. BL Key Conn.1	386
6	2111AR	XF86S:05-14	Add. BPFA Conn. 13	386
7	5671AR	XF86S:05-15	Add. BPFA Conn. 14	386
8	5672AR	XF86S:05-18	Add. BPFA Conn. X1	386
9	2111AR	XF86S:05-14	Add. BPFA Conn. 3	386
10	2050	XF86S:04-02	LSDJ-X2	386
11	2050	XF86S:04-02	Add. BPFA Conn. X2	386
12	2067	XF86S:01-15	Add.BL Key Conn.9	386

UIC CONNECTION 18 Pin LP side(Cab1)

Sl. No.	Cable No.	From	To (UIC Pin No.)	Loom No.
1	2500A	XF22S:02-27	1	
2	2503A	XF22S:02-28	2	
3	2331A	XF22S:02-29	3	
4	4242A	XF22S:02-30	4	
5	2500AR	XF22S:02-31	5	
6	2503AR	XF22S:02-32	6	
7	2331AR	XF22S:02-33	7	
8	4242AR	XF22S:02-34	8	
9	2111A	XF22S:02-35	9	
10	U10		10	
11	U11		11	

12	2111AR	XF22S:02-36	12	
13	U13		13	
14	2050	XF13A:01-07	14	387
15	5672A	XF13A:04-07/04-09	15	387
16	5672AR	XF13A:05-16	16	387
17	5671AR	XF13A:05-15	17	387
18	5671A	XF13A:04-06	18	387

UIC CONNECTION 18 Pin LP side(Cab2)

SN	Cable No.	From	To (UIC Pin No.)	Loom No.
1	2500A	XF22S:02-27	1	
2	2503A	XF22S:02-28	2	
3	2331A	XF22S:02-29	3	
4	4242A	XF22S:02-30	4	
5	2500AR	XF22S:02-31	5	
6	2503AR	XF22S:02-32	6	
7	2331AR	XF22S:02-33	7	
8	4242AR	XF22S:02-34	8	
9	2111A	XF22S:02-35	9	
10	U10		10	
11	U11		11	
12	2111AR	XF22S:02-36	12	
13	U13		13	
14	2050	XF86S:04-02	14	388
15	5672A	XF86S:05-17	15	388
16	5672AR	XF86S:05-18	16	388
17	5671AR	XF86S:05-15	17	388
18	5671A	XF86S:05-16	18	388

ii. SB1 Control Panel:

Sl. No.	Cable No.	Looping in SB1		
1	2500A	XF22S:02-17	XF22S:02-27	
2	2503A	XF22S:02-19	XF22S:02-28	
3	2331A	XF22S:02-14	XF22S:02-29	
4	4242A	XF22S:02-61	XF22S:02-30	
5	2500AR	XF22S:03-48	XF22S:02-31	
6	2503AR	XF22S:03-49	XF22S:02-32	
7	2331AR	XF22S:03-50	XF22S:02-33	
8	4242AR	XF22S:03-51	XF22S:02-34	

iii. F-Panel (Cab#2):

Sl. No.	Cable No.	Looping in F2 panel		
1	Looping	XF86S:04-07	XF86S:05-17	

d Revised construction details of the Jumper between Loco and the first/last coach/power car need to be as follows:

e Modification required in compressor control circuit

(i) Remove the loop between XF77S:01 23 and XF77S:01 24 provided as per RDSO Modification Sheet no. RDSO/2013/EL/MS/0427 (Rev. '0') dated 23.10.2013.

(ii) Remove the wire no. 3038 from Q2 terminal of 172.3 (pressure switch main compressor 36) and connect it to Q1 terminal of the 172.3 i.e. connect to the wire no. 3101.

(iii) Put the switch ECPSW in OFF position as provided by VCU redundancy modification suggested by CLW if provided.

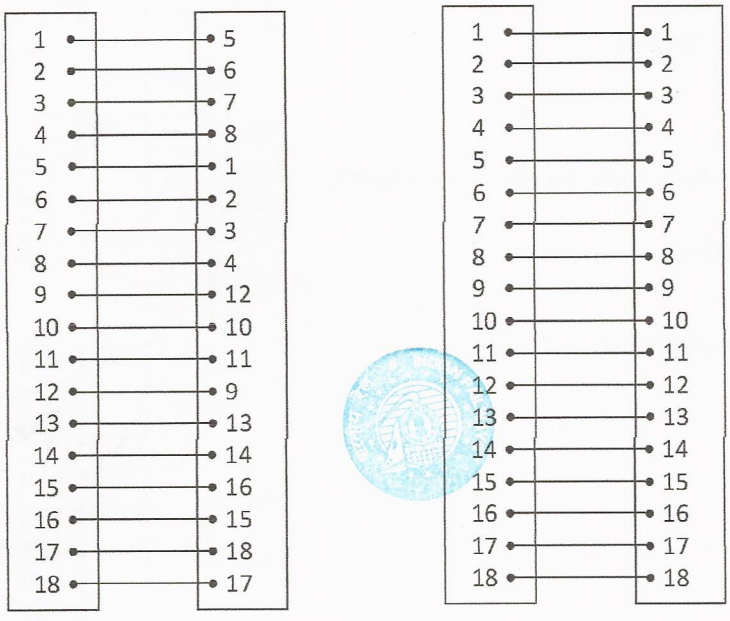


Fig. 2: Schematic of Jumper

f At present there are two variants of WAP7 locomotive:

a. Locos without hotel load converter. These locomotives are only one UIC connector at each end of the locomotive.

b. Locos with hotel load converter. These locomotives have two UIC connector at each end of the locomotive.

g For locomotives with f (a) arrangement, the scheme mentioned above can be directly implemented as considering the UIC LP side as single UIC.

h For locomotives with f (b) arrangement, the existing wirings of LP side UIC should be removed and above scheme can be directly implemented. Hotel load scheme has been implemented in ALP side UIC connector which should not be touched.

5.0 Application to Class of Locomotives:

The MS is applicable to WAP-5 class of locomotives.

6.0 Material required:

i. Control Cable, as per the modified cable index.
ii. 2 Nos BL Key (One for each cab)
iii. 2 Switch (BPFA) (One for each cab)
iv. 2 LED Lamp (One for each cab)
v. Modified loco software shall be provided by CLW.

7.0 Material Rendered Surplus:

NIL

8.0 Reference:

As per need by PU/ Workshops/ Electrical Loco sheds.

9.0 Modification Drawing:

NIL

10.0 Agency of Implementation:

CLW/DLW/ELS

19/6/19

(Suresh Kumar)
for Director General (Elect.)

Encl: Nil

Copy to:

Secretary (Electrical),
Railway Board, Rail Bhawan,
New Delhi – 110 001

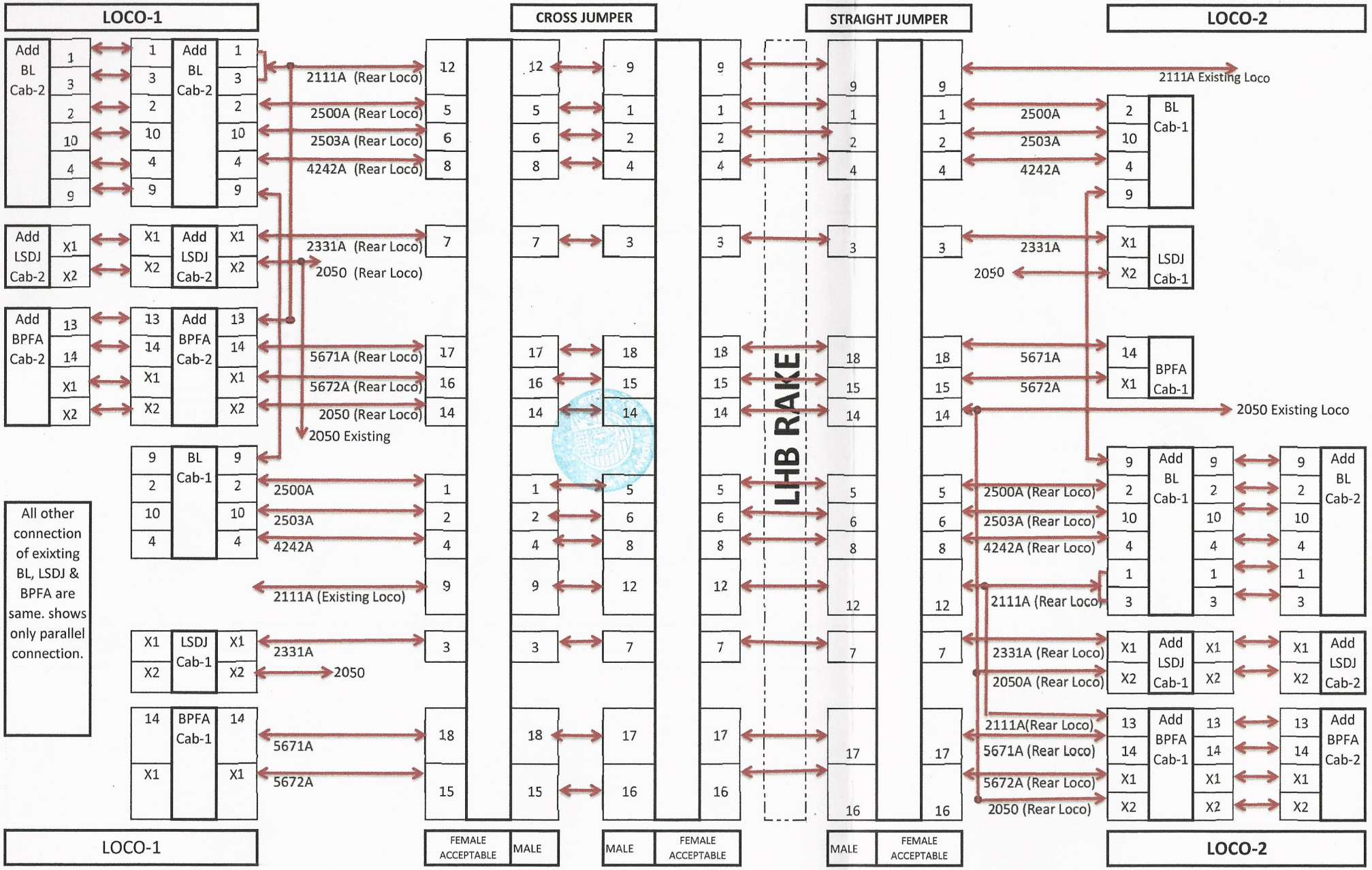
19/6/19

(Suresh Kumar)
for Director General (Elect.)

Encl: Nil

ANNEXURE-I

SCHEME FOR PUSH PULL OPERATION OF WAP-5/ WAP-7



MODIFICATION IN A-PANEL DRIVER DESK.

ANNEXURE-II