(For official use only)
(केवल सरकारी प्रयोग हेतु)

भारत सरकार

रेल मंत्रालय

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

PART-A: Specification of Locomotive Brake Interface Unit (BIU) for KAVACH (The Indian Railway ATP) and Distributed Power Control System for Diesel Locomotive and Distributed power Wireless control system (DPWCS) for Electric Locomotive fitted with IRAB class of brake system

Part-B: Schedule of Technical requirements for manufacturing and supply of Brake Interface Unit (BIU) for KAVACH (The Indian Railway ATP) and Distributed Power Control System for Diesel Locomotive and Distributed power Wireless control system (DPWCS) for Electric Locomotive fitted with IRAB class of brake system.

Specification No.MP.0.01.00.31, (Rev.05)
May 2024

Issued by

अनुसंधान अभिकल्प एवं मानक संगठन

मानक नगर, लखनऊ - 226011

RESEARCH DESIGNS AND STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW – 226011

LIST OF AMENDMENTS

Amendment Date	Version	Revised Para	Remarks
February, 2021	01	Para 6.7, 6.14, 6.18, 7.8, 11, 16.1 & 16.2	Revision of Para's to incorporate Equivalent Indian Standards
		Para 17.1	Field trial Quantity & field trial period are defined as per MP-M-8.1-1 (Latest) & Field trial performance feedback format added.
		Para 23	Addition of Para no. 23 as per ISO document no-QM-RF-7.1.3 Ver-2.0
		Para 24	Addition of Para no. 24 (Preference to Make In India) in compliance of directives issued by GOI for promotion of Make in India policy.
		Para 25	Addition of Para no. 25 (Vendor Changes in Approved Status)
		Para 26	Addition of Para no. 26 ,Type Test
		Para 27	Addition of Para no. 27, Routine Test
		Annexure-1, Para 4	Revision of Para 4 due to safety feature
March, 2021	02	Para 28	Addition of Para no. 28, date of enforcement
February 2022	03	Nomenclature of TCAS of whole Specification	Revised of nomenclature of TCAS of whole Specification as per Signal Dte. Note no. RDSO-SIG0TCAS(ME)/1/2020 date: 21.02.2022.
		Nomenclature of DPWCS of whole Specification	DPWCS added in whole Specification as per Electrical Dte. Note no. EL/3.1.3/DPWCS date: 11.02.2022.
		Para 27.2.6 and Para 27.2.7	Revision of Para 27.2.6 and Para 27.2.7 due to correct position of BP Cut-Off valve in REMOTE locomotive.
		Para 28	New Para 28 to incorporate schedule of technical requirements (Minimum requirements of infrastructure, manufacturing, testing & quality control for approval of manufacturer) added
		Existing Para 28	Para no. changed as Para 29 as new Para added.
		Annex-1,1 and 1.2	Revision of Para 1 due to change the type of Cable and Para 1.2 due to range limit of TSS2 and TSS3 Note ID.
		Annex- 4 & 5	Revision of Annex- 4 & 5 due to logic of BIU and correct position of BP Cut-Off valve in REMOTE locomotive and Reasoning need to be deleted due to this procedure are considered in routine inspection.
September 2022	04	Para 6.1 and 6.2	Revision of Para 6.1 and 6.2 as per RDSO QAM Note no. QAM/Vendor Policy dated 15.02.2022.
March 2024	05	Heading of Spec.	For compliance of Para no. 9.1& 9.2 of Rly. Bd. letter No. 2021/RS (G)/779/7 dated 18-01-2022.
		Para 4.8	Revision of Para 4.8, 6.18, 15.2, keeping in view
		Para 6.18	

		Para 15.2	of probable change in vendor approving agency.
		Para 16.3	The requirement is as per Para 4.3.5.1.1 of ISO document QO-D-8.1-10 (Latest) RDSO ISO procedure available on website.
		Para 17.1	1. RDSO Document for qualifying quantity and period is available in UVAM. 2. The requirement is as per Para 4.3.5.1.1 of ISO document QO-D-8.1-10 (Latest) RDSO ISO procedure available on website.
		Para 23	Revision of Para 23, keeping in view of probable change in vendor approving agency.
		Para 25	Revised as per ISO Document No. QO-D-8.1-11 and keeping in view of probable change in vendor approving agency.
		Para 26	Revision of Para 26, keeping in view of probable change in vendor approving agency.
		Para 28 Part-B	Para 28 is shifted in Part- B- in STR for compliance of Para no. 9.1& 9.2 of Rly. Bd. letter No. 2021/RS (G)/779/7 dated 18-01-2022.
		Annexure-2	Revision of Annexure-2, keeping in view of probable change in vendor approving agency.

Contents

SECTION-A (SPECIFICATION)

SECTION-B (STR)

PART-A

1. INTRODUCTION

1.1 Locomotive Brake Interface Unit (BIU), a sub-system unit in locomotive, is used to implement an interface across all types of locomotives fitted with IRAB class of brake system for implementation of braking instructions commanded by the KAVACH (The Indian Railway ATP) / Distributed Power Control System (DPCS) / Distributed power Wireless control system (DPWCS).

1.2 KAVACH is / are railway technical installation to ensure safe train operation in the event of human failure. Under unsafe train operation situations like collisions, SPAD etc., KAVACH gives audio-visual warning to driver and takes action to control the speed of the train / stop the train as per their respective system design.

1.3 DPCS / DPWCS allows multiple locomotives to be used at different locations over entire train consist. Such a system leverages the existing rolling stock and allows much longer trains to be run by minor up gradation of the locomotives.

2. OBJECTIVES AND SCOPE OF THE SPECIFICATION

2.1 This specification covers the system, technical, functional testing and other requirements of Brake Interface Unit (BIU) for Diesel and electric locomotives with IRAB brake system.

2.2 The BIU shall accept braking signal inputs from KAVACH / DPCS / DPWCS / Multiple Train Safety systems which will communicate with existing Brake system of locomotive for controlling the speeds. The scope includes Digital Standard Protocol to communicate with KAVACH / DPCS / DPWCS / Multiple Train Safety systems and transferring brake commands to existing IRAB system of locomotive.

3. TERMINOLOGY / ABBREVIATIONS

Abbreviations	Full form / Description
IEC	International Electro Technical Commission
RDSO	Research Designs & Standards Organization
TSS	Train Safety System
KAVACH	KAVACH (The Indian Railway ATP)
DPCS	Distributed Power Control System
DPWCS	Distributed Power Wireless Control System
BIU	Brake Interface Unit
AC	Alternate Current
DC	Direct Current
USB	Universal Serial Bus
IP	Ingress Protection
BP	Brake Pipe
BC	Brake Cylinder
SPAD	Signal Passed At Danger

UIC	International Union of Railways

4. DEFINITIONS

Throughout this specification and in any other specification here to annexed, the terms:

4.1 "Purchaser" means the President of the Republic of India;

4.2 "Tenderer" means Firm's / companies participating in the tender;

4.3 "Contractor" means any person, firm or company with whom the order for the supply of the stores to be placed;

4.4 "Sub-contractor" means any person, firm or company from whom the contractor may obtain any material or fittings to be used in the supply of or manufacture of stores;

4.5 "Supplier" means a party that supplies goods or services. A supplier may be distinguished from a contractor or subcontractor, who commonly adds specialized input to deliverables. Also called vendor;

4.6 "Manufacturer" means entity that makes a goods through a process involving raw materials, components, or assemblies, usually on a large scale with different operations divided among different workers. Commonly used interchangeably with producer.

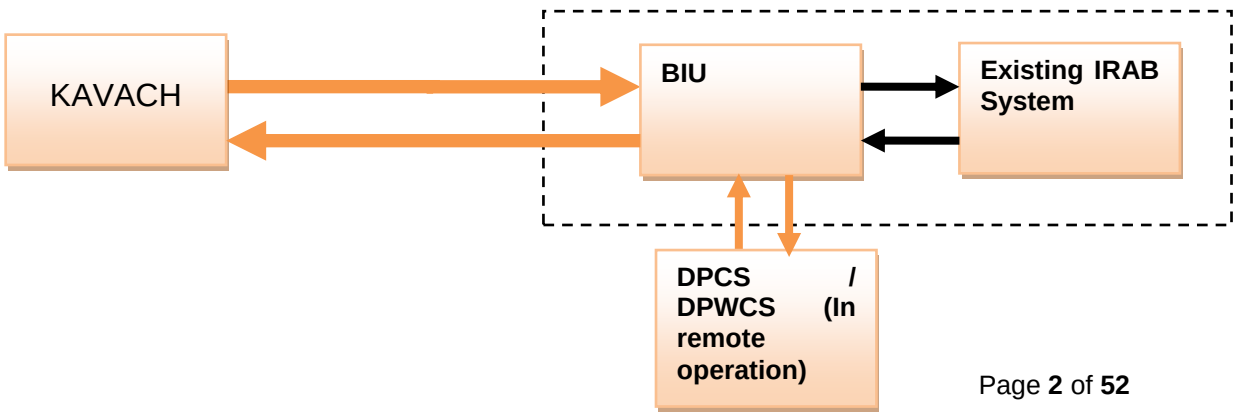
4.7 "Inspecting Officer" means the person(s), firms(s) or department(s) and his deputies nominated by the purchaser to inspect the stores on his behalf;

4.8 In case of tenderer needs any clarification in respect of any clause of this specification or regarding the drawings the tenderer shall obtain it from Motive Power Directorate, RDSO/ vendor approving agency.

5. BRIEF DESCRIPTION OF THE SYSTEM / EQUIPMENT / COMPONENTS

KAVACH / DPCS / DPWCS shall communicate braking related signal(s) to BIU. Further, BIU shall communicate these signals to existing brake system of locomotive for application of brake as well as for cutting off traction of locomotive and generate audio-visual indication to driver and give feedback to DPCS / DPWCS / KAVACH / Multiple Train Safety systems (TSSs) about execution of the same.

Schematic of Interface of KAVACH and DPCS / DPWCS to IRAB class of Brake System



6. General Requirements

6.1. The firm or its collaborator should have at least the following facilities:

a. Manufacturing facilities required for manufacturing of BIU.

b. Testing facilities to test performance of BIU.

6.2. In case the facilities of a collaborator are cited, a clear specific MOU / agreement of the firm with the said collaborator shall be furnished.

6.3. Being critical to safety, Firm shall use Pneumatic / Electro-pneumatic valves / sensors, etc. in BIU that are proven in Locomotive microprocessor controlled brake system in Indian Railways / Worldwide.

OR

Valves used in BIU application, from the firms having proven experience in supplying valves for Microprocessor control brake system/EP brake system of Locomotive/Coaching stock, can be permitted by MP Dte after rigorous field trials.

6.4. BIU under the scope of this specification shall be suitable for all types of diesel and electric locomotives of Indian Railways fitted with IRAB class brake system.

6.5. Fail-safe logic circuit (Hardware or Software or both, as required) shall be used for application of brake and to cut off traction. BIU shall self-check continuously its own functioning including transmission / reception of information. Any improper functioning shall be communicated to the KAVACH / DPCS / DPWCS for display to the driver. Provision shall be made to log such events. BIU failures shall be indicated timely and procedure shall be defined for train operation staff (loco crew and maintenance staff) for remedial action to be taken during such failure

6.6. BIU shall have provision to obtain feedback from IRAB system about execution of braking command given to it by DPCS / DPWCS / KAVACH / Multiple Train Safety systems (TSSs) and communicate it back to DPCS / DPWCS / KAVACH / Multiple Train Safety systems (TSSs).

6.7. BIU Electronic panel shall be protected as per IP 54 or Equivalent Indian Standards. All the remaining equipments/panel (mechanical, electrical, electro-pneumatic) of BIU shall be suitably protected, as per IP 50 or Equivalent Indian Standards. A certificate (original) from NABL accredited testing laboratory shall be considered satisfactory for this purpose.

6.8. Provision and installation of such equipment along with piping etc will also be in the scope of supply.

6.9. The BIU and its sub-assemblies / components shall be easily accessible for maintenance and inspection.

6.10. If any pneumatic valves are used in the device, functioning of the valves shall not be affected by moisture, dirt, temperature, fluctuation of pressure etc.

6.11. The electrical wires shall be suitably numbered and properly tagged in order to facilitate identification. The wires shall be laid properly in a conduit. Loose and dangling wires shall not be acceptable.

6.12. When the device is connected to the electric circuit in the locomotive, it shall be connected to the general wiring ensuring a rugged interface of the locomotive by plugs or any other suitable connections not requiring soldering and having locking arrangement.

6.13. BIU units shall be capable of working for their desired functioning in 25 KV 50 Hz AC and 1500 V DC i.e. electrified traction as well as non-electrified diesel traction areas.

6.14. The equipment shall work on DC supply source normally consisting of accumulator battery and / or an auxiliary generator. The nominal and limits of voltage in which the equipment shall operate satisfactorily are as under.

Type of Locomotive	Nominal Voltage	Limits of voltage
Diesel-electric	72 Volts DC	50 to 90 Volts DC
Electric	110 Volts DC	78 to 136 Volts DC

Voltage fluctuations lying between 0.6 to 1.4 times of Nominal voltage and not exceeding 0.1 second shall not cause any deviation in functioning of BIU unit (Clause 5.1.1.2 of IEC 60571) or Equivalent Indian Standards. Voltage fluctuations lying between 1.25 to 1.4 times of Nominal voltage and not exceeding 1 second shall not cause damage to the unit. The unit may not be fully functional during these fluctuations (Clause 5.1.1.2 of IEC 60571) or Equivalent Indian Standards.

6.15. The equipment shall operate satisfactorily in the MR pressure up to11 kg/cm^2.

6.16. The system shall have proper filters and signal conditioning at all the sensing ports to prevent any malfunctioning due to noise / distortion in DC control circuit of locomotive. For sensing the electrical signal from the loco circuit / KAVACH / DPCS / DPWCS, optical / galvanic isolation shall be preferred at both input and output.

6.17. BIU under the scope of this specification shall be approved by Motive Power Directorate.

6.18. Failure Mode Effects and Criticality Analysis of the equipment shall be done during the design process in conformance to IEC 60812 or Equivalent Indian Standards. The records of this analysis shall be provided to RDSO/ vendor approving agency upon requirement.

7. SYSTEM REQUIREMENTS / SYSTEM COMPOSITIONS

7.1. The BIU arrangement shall be such that the existing functionalities / features of IRAB brake system provided on locomotive remains un-affected in all the conditions of BIU i.e. working condition / failed / isolated.

7.2. The BIU shall be an integrated equipment to interface with the existing IRAB brake system of loco to provide full control of the Automatic (Train) brakes, the Independent (Loco) brakes and emergency brakes, in the event of brake application commanded by DPCS / DPWCS / KAVACH.

7.3. The requirements of DPCS / DPWCS, KAVACH are contained in their respective specifications as follows:

S.No.	System	Specification no.
1.	DPCS -Diesel Loco	MP.0.400.02(latest revision)
2.	KAVACH	RDSO/SPN/196/2012 (latest revision)
3	DPWCS- Electric loco	RDSO/2008/EL/SPEC/0074 (latest revision) and RDSO/2019/EL/SPEC/0142 (latest revision)

The system composition shall be to suit the above requirements, which may include hardware or software or both.

7.4. The communication between the BIU and the DPCS / DPWCS / KAVACH / Multiple Train Safety Systems (TSSs which may come in future) shall be on CAN. CAN communication ports should have galvanic / optical isolation. Details of CAN interface protocol is attached as **Annexure-1**.

7.5. BIU shall have a provision of point to point communication with DPCS / DPWCS / KAVACH and TSS. In addition to this, BIU shall be expandable to interface with 2 more TSSs, which may come in future, on same TSS CAN port without any additional Hardware / software in BIU. CAN Protocol shall be remains same for the requirements mentioned in this specification for Additional 2 TSSs. BIU shall be responsible for successful interface with DPCS / DPWCS / KAVACH / TSS's. The CAN communication cables, connectors at BIU end shall be in the scope of BIU.

7.6. The BIU shall be interface with existing Brake Pipe circuit of locomotive. Connection location for BIU and other accessories are given in **Annexure-2**.

7.7. There shall be provision in BIU to cut off BP charging in remote locomotive automatically on receipt of command from DPCS / DPWCS. The arrangement shall be such that the BP charging is cut off on 100% basis and valve position feedback shall also be provided for alerting the Loco Pilot in case of any such malfunctioning. BIU should be able to measure air flow and communicate to DPCS / DPWCS for detection of train parting.

7.8. The envelope size of BIU should be as compact as possible, and must not exceed 500x520x500mm (Width x Height x Depth). The shape and size of the BIU and layout of the equipments shall be such that the BIU fits well in the locomotive with ample space for maintenance. In case of separate Electronic Panel, it shall not exceed 280x480x400mm (Width x Height x Depth). The system shall have provision to mount on wall or on floor as required in various locomotives. BIU shall be fitted in locomotive near to the locomotive brake system either panel mounted or rack / pipe mounted. Mounting arrangement shall be as per the relevant IEC / UIC or Equivalent Indian Standards applicable for brake equipments. The weight of BIU shall not be more than 100 kg.

7.9. There shall be provision for both manual and automatic isolation of the complete BIU. Automatic Isolation shall be achieved through suitable valve

electrically operated by the System and the manual isolation shall also be provided, in case of malfunction. Suitable Indication to DPCS / DPWCS / KAVACH system shall be made available in case of its isolation and event shall be recorded with date and time. Number of counts for such isolation shall also be available. After isolation, the normal brake characteristics of the locomotive brake system shall not be affected. The isolation mechanism shall be protected to avoid inadvertent isolation.

7.10. The equipment shall have Self-Test feature for detection of failed valves / sensors, by performing self-diagnosis in standby mode and give alerts to user through KAVACH / DPCS / DPWCS display.

7.11. Arrangement for data logging for the braking event shall be available with BIU. The status of following events shall be logged at 1 sec interval / change in events, with respect to date and time:

- KAVACH / DPCS / DPWCS / Multiple Train Safety systems (TSSs) brake command active
- Any change in BP / BC greater that 0.3 kg/cm2 to be logged
- Isolation of BIU
- BIU failure log
- Self check
- BIU Brake command override by Loco pilot brake command, vice versa

Facility for storage of data log shall be for 90 days. Suitable application running on PC shall be provided for downloading the Log and evaluating the same.

The BIU shall provide BIU isolation counter, all types of brake application counters and their duration, Override counter (BIU Brake command override by loco pilot brake command counters vice versa) in cumulative data.

The BIU should have arrangement to download events and fault data packs through common USB port in an external pen drive / LAPTOP.

7.12. The BIU should have provision to on board monitor and record the various brake parameters through a laptop.

7.13. An internal Battery backup shall be provided for maintaining real time clock in the event of failure of power supply. Event recording shall be done on real time clock basis.

7.14. BIU shall have provision of an emergency brake valve to apply emergency brake. It shall apply emergency brake on receipt of emergency brake command from KAVACH in lead locomotive on 100% basis. Provision of manual isolation of emergency valve should be made whenever required.

8. FUNCTIONAL REQUIREMENTS

8.1. Based on the input signal from the KAVACH / DPCS / DPWCS through BIU, the existing brake control system shall apply the corresponding brake.

8.2. There shall be provision to cutoff traction to the locomotive automatically whenever brake command signal is received on any of the inputs of BIU. This may be achieved through BIU.

8.3. On withdrawal of brake command from KAVACH / DPCS / DPWCS, the corresponding brake shall be released and restoration of traction cutoff control shall be enabled.

8.4. There shall be a facility to override the “KAVACH / DPCS / DPWCS initiated braking" by the “driver’s braking" (or vice-versa) to achieve higher braking intensity whenever required. Also, lower braking intensity of KAVACH shall be overridden by a higher braking intensity produced by other train safety system if any (in future). Arrangement for data logging for the above scenario shall be available.

8.5. BIU shall be capable of receiving braking command simultaneously from Loco pilot through Brake handle as well as from the DPCS / DPWCS, KAVACH, any other TSS at the same time. In case of multiple braking requests received simultaneously, the BIU should implement the command demanding for highest braking effort.

8.6. In case of light engine operation, KAVACH shall provide the amount of Brake Cylinder pressure equivalent to independent brake and BP drop accordingly.

8.7. The system must be able to provide braking application along with feedback over communication line to the Train Safety Systems.

8.8. The Brake pipe pressure generated shall not exceed 5.5 kg/cm^2.

8.9. The system should be designed modular in such manner that BIU supplied for DPCS / DPWCS and KAVACH may be upgraded to integrate additional TSS without any hardware or software change when they follow the Protocol and the Interface as stated in this specification.

9. TECHNICAL REQUIREMENTS

9.1. The system shall be of simple design, light in weight, robust in construction. The design shall be compact for ease of interfacing with existing brake control system of rolling stock.

9.2. The equipment shall be so constructed as to prevent unauthorized access to the system.

9.3. Mounting arrangement of BIU shall be secured against severe vibrations.

9.4. Manufacturer to submit the expected life of the BIU. List of recommended spares too shall be submitted by the manufacturer.

10. ENVIRONMENTAL / CLIMATIC REQUIREMENTS

The equipment shall be capable of working satisfactorily under the service conditions indicated below:

10.1. **Altitude** - Mean sea level to an altitude of 1200 meters.

10.2. **Relative Humidity** - Up to 100 %

10.3. Temperature (Ambient air) -

a) Maximum temperature

Stabled Locomotive under sun: 70 deg. C

On board Working lo co under sun: 55 deg. C

b) Minimum temperature: - 5 deg. C

c) Average temperature: 47 deg. C

10.4. **Ambient conditions** - The equipment shall be capable of operating efficiently in spite of dust, dirt, mist, torrential rain, heavy sand or snow storms, presence of oil vapors and radiant heat, coastal area etc. to which rolling stock is normally exposed in service.

10.5. The part of the BIU equipment, if exposed to solar radiation during normal usage, shall remain unaffected by it.

11. DETAILS OF STANDARDS FOLLOWED AND VALIDATION

- IEC-60571 or Equivalent Indian Standards General requirements and tests for electronic equipment used on Rail vehicles.
- IEC 60812 or Equivalent Indian Standards for Failure Mode Effects and Criticality Analysis (FMECA)
- IEC 61373 or Equivalent Indian Standards for Railway Applications- Rolling Stock Equipment - Shock and vibration tests.

12. MAINTENANCE AND DIAGNOSTIC AID

12.1 Supplier shall arrange to supply along with the equipment, maintenance manuals of the equipment one with each set. Manual shall contain information pertaining to detailed dimensional drawings indicating mounting arrangement layout, sub-assemblies, principle of operation, maintenance schedules, trouble shooting, details of special tools if required, parts catalogue and testing procedure of the equipment being supplied. Updated position of modifications shall also be incorporated.

12.2 Firm shall provide Operational Instructions handbooks to Loco pilots, trouble-shooting guidelines & Maintenance manuals to maintenance staff in both hard & soft copies. And also shall provide Instruction name plate with Help & trouble shooting guide lines in locomotive.

12.3 The supplier shall supply suitable software for downloading and offline analysis of downloaded diagnostic data.

12.4 Training of purchaser’s personnel for operation and maintenance shall be given by the contractor free-of-charge. Demonstration of the working of the device on locomotive shall be given by the contractor free-of-charge.

13. DOCUMENTS REQUIRED FROM SUPPLIER

Following details shall be furnished by the supplier along with the offer:

13.1 Assembly drawings of various components and schematic diagram with description of individual item and system as a whole.

13.2 Wiring schematic of BIU
13.3 Schematic diagrams with description for different scenarios like A9 application, SA9 application, BIU application, BIU Isolation, BIU power loss etc.
13.4 Test protocol with procedure of testing.
13.5 Operating and Troubleshooting instructions
13.6 Overhauling periodicity for different valves used in BIU
13.7 Overall dimensions and mounting arrangement.
13.8 Clause by clause compliance.

14. ACCESSORIES

The equipment provider shall provide the details of accessories and their functions. Final selection of accessories shall be made by the purchaser.

15. GUARANTEE / WARRANTY

15.1 The supplier shall be responsible for any failure or damage to equipment provided in the locomotive due to defective design, materials, and workmanship up to a period of 24 months after commissioning on the locomotive or 36 months from the date of supply, whichever is earlier. The supplier shall replace within reasonable time, such equipment during the warranty period at his cost. The period of warranty shall be extendable in case of recurring problems attributable to defective design, material or manufacturing. The supplier's liability in this respect of any complaints, defects and / or claim shall be limited to the furnishing and installation of replacement parts free of any charge.

15.2 The supplier shall be responsible for carrying out all the modifications at his cost on any part of the equipment during the period of warranty required for satisfactory operation of the equipment as per technical specification. For any technical decision the final authority from the purchaser's side is RDSO*/* vendor approving agency.

16. TESTS & VERIFICATION

BIU will be tested mechanically and electrically to prove its functional reliability as per details given below:

16.1 Electronic equipment used in the system shall be tested in accordance with IEC-60571 or Equivalent Indian Standards. The tests as per relevant clause of IEC-60571 or Equivalent Indian Standards shall be carried out on prototype only. A certificate (original) from NABL accredited testing laboratory shall be considered satisfactory for this purpose. Details of type tests is mentioned in **Para 26**.

16.2 The equipment shall be designed to withstand vibrations and shocks normally encountered in rail traction without damaging the equipment. Shock & Vibration test shall be done as per IEC 61373 (category 1, Class-B) or Equivalent Indian Standards. A certificate (original) from NABL accredited testing laboratory shall be considered satisfactory for this purpose.

16.3 The necessary tests shall be carried out as per the test scheme finalized in consultation with vendor approving agency. Test scheme shall be approved by

vendor approving agency.

17. FIELD TRIAL

17.1 After successful prototype development and testing, BIU shall be subjected to field trial. Quantity of BIU to be subjected to field trial and field trial period shall be as mentioned in UVAM. Supplier shall arrange commissioning, testing & field trials of the prototype equipment in service jointly with Rlys. / and shall depute team of engineers to Railway field units for this purpose. Assistance with regard to labour and other facilities which are available in the sheds / production units would, however, be provided to the supplier during prototype installation.

Field performance feedback format is as under:

Shed/ Rly.	Loco No.	Date of fitment	Date of failure, if any	Reason of failure	Remarks on performance

The acceptance criteria of field trial shall be the satisfactory field performance of equipment.

17.2 The manufacturer shall submit Makers test certificate for outsourced item, as applicable.

18. PAINTING, LABELING AND MARKING

The equipment shall be appropriately painted for aesthetics and protection. The parts, connector ports, mounting points etc shall be clearly marked in a manner that these are easily readable and remain legible over the lifetime of the equipment. ID plate Name of Component, Make, Sl. No, Date of Manufacture, Ratings shall be provided on all assemblies / subassemblies.

19. PACKAGING AND DELIVERY / SHIPMENT IF DIFFERENT FROM IRS

The equipment consists of sensitive and fragile electronic systems. These should be packed with precautions required to prevent damage in transit. All requirements of IRS conditions for packaging and delivery shall be applicable.

20. IPR DISCLAIMER PIN POINTING RESPONSIBILITY FOR VIOLATION IF ANY ON SUPPLIER

Indian Railway shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, components used in design, development and manufacturing of BIU and any other factor, which may cause such dispute. The responsibility to settle any issue lies with the manufacturer.

21. INFORMATION TO BE SUPPLIED BY SUPPLIER

The supplier shall furnish the details in support of requirements of Para 6.1 & 6.2 of this specification.

22. INFORMATION TO BE SUPPLIED BY PURCHASER

Nil.

23. QUALITY ASSURANCE PROGRAMME:

23.1 Supplier shall submit their internal quality assurance program in accordance with ISO Document of RDSO/ vendor approving agency.

23.2 Supplier shall, on demand by RDSO/ vendor approving agency/ Purchaser/ Inspecting authority nominated by RDSO/ vendor approving agency/ Purchaser, make the records of checks carried out during internal quality assurance available for scrutiny.

24. PREFERENCE TO MAKE IN INDIA:

The Government of India policy on "Make in India" shall apply.

25. VENDOR CHANGES IN APPROVED STATUS:

All the provisions contained RDSO's ISO procedures laid down in Document No. QO-D-8.1-11, dated (Latest) (Titled "Vendor- changes in approved status") and subsequent version/amendment thereof ***/*** respective ISO procedure of vendor approving agency , shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to maintain of products supplied to Railways.

26. TYPE TEST:

Type test shall be carried out on 01 unit of BIU. If RDSO/ vendor approving agency feels necessary to conduct type test on some more units, the samples will be picked up at random for further validations of design and drawings. This option shall be exercised by RDSO/ vendor approving agency based on the performance of the unit till design is validated. Once design is validated the final approval shall be given by the RDSO/ vendor approving agency. Following shall comprise type tests:

26.1 Visual inspection Test:

26.1.1 Brake Control Unit Visual Inspection

S.No.	Test	Acceptance Criteria	Observation
1.	Verify the locking arrangement of Control Unit/ Pneumatic Unit of door/ cover	Should be Lock/Unlock freely	
2.	Verify for the free insertion and removal of modules in Control Unit	Module movement should be free. Verification of Modules Polarization for preventing insertion at wrong location.	
3.	Verify the Modules fixed in the system	Ensure, location of cards marked on the control unit and	

		individual module names should be verified.	
4.	Dimensional check	Specified Dimension as per spec.	

26.1.2 List of assembly/ Sub- assemblies:

S.No.	Assembly / Sub-assemblies / Module	Qty.	Serial No.
1.			
2.			
3.			
4.			
5.			

26.1.3 Pneumatic Panel Visual Inspection

S.No.	Test	Acceptance Criteria	Observation
1.	Dimensional check	Dimension as per Spec.	
2.	Operation instruction & Guard (if applicable)	Instruction Name plate to be available on the Guard	

26.2 Performance Test:

S.No.	Description	Details
1.	Functional Test Scheme of BIU as per Specification (Without BIU and BIU isolated mode)	As per **Annexure-3**
2.	Functional Test Scheme of BIU as per Specification with BIU	As per **Annexure-4**
3.	BIU Functional Test Procedure On Test Bench with 5 Control Systems	As per **Annexure-5**

26.3 Following Type Test shall be carried out as per IEC 60571 or Equivalent Indian Standards:

S.No.	**Test as per IEC 60571** or Equivalent Indian Standards	**Test Details**
1.	Cold Test	As per Para 12.2.4 of IEC 60571 or Equivalent

		Indian Standards
2.	Dry heat test	As per Para 12.2.5 of IEC 60571 or Equivalent Indian Standards
3.	Damp heat test	As per Para 12.2.6 of IEC 60571 or Equivalent Indian Standards
4.	Over voltage tests	As per Para 12.2.7 of IEC 60571 or Equivalent Indian Standards
5.	Surge	As per Para 12.2.8 of IEC 60571 or Equivalent Indian Standards
6.	Insulation resistance and voltage withstand test	As per Para 12.2.10 of IEC 60571 or Equivalent Indian Standards
7.	Salt Mist test	As per Para 12.2.11 of IEC 60571 or Equivalent Indian Standards
8.	Vibration and shock test	As per Para 12.2.12 of IEC 60571 or Equivalent Indian Standards
9.	IP54	As per IEC60529:2013-08 Ed.2.2 or Equivalent Indian Standards
10.	Immunity to Voltage dips, Short Interrupts and Voltage Variations on D.C input power port	As per IEC 60571 Clause 3.1.1.1 and 3.1.1.2 (61000-4-29 First edition, 2000- 08) or Equivalent Indian Standards
11.	Electrical fast transient/burst immunity	As per IEC 60571 Clause 10.2.7 Refers to IEC 62236-3-2, Tables 7 and 8 (IEC 61000-4-4, Ed 3.0) 2012 or Equivalent Indian Standards
12.	Conducted Emissions	As per IEC 60571 Clause 10.2.8.2 refers to IEC 62236- 3-2, Tables 4, 5 and 6 (CISPR 11 CE Edition 6.0 2015-06) or Equivalent Indian Standards
13.	Immunity to Conducted disturbances, Induced by RF fields	As per IEC 60571 Clause 10.2.8.1 refers to IEC 62236- 3-2, Tables 7 and 8 (IEC 61000-4-6, Ed.No.3.0,2008) or Equivalent Indian Standards
14.	Immunity to Electrostatic Discharge	As per IEC 60571 Clause 10.2.6 Refers to IEC 62236-3-2, Table 9. (IEC 61000-4-2, Ed.2) 2008 or Equivalent Indian Standards
15.	Radiated Susceptibility	As per IEC 60571 clause 10.2.8.1, refers to IEC 62236-3-2, Table 9. (IEC 61000-4-3 Edition 3.0 2007-11) or Equivalent Indian Standards
16.	Radiated emissions	As per IEC 60571 clause 10.2.8.2, refers to IEC 62236-3-2, Table 4,5 and 6. (IEC 61000-6-4) or Equivalent Indian Standards

27. ROUTINE TEST:

The routine test shall consist of visual check and functional test of BIU. The details of routine test are as under:

27.1 Following tests shall be done on 100% of offered lot :

27.1.1 Visual inspection Test:

27.1.1.1 Brake Control Unit Visual Inspection

S.No.	Test	Acceptance Criteria	Observation
1.	Verify the locking arrangement of Control Unit/ Pneumatic Unit of door/ cover	Should be Lock/Unlock freely	
2.	Verify for the free insertion and removal of modules in Control Unit	Module movement should be free. Verification of Modules Polarization for preventing insertion at wrong location.	
3.	Verify the Modules fixed in the system	Ensure, location of cards marked on the control unit and individual module names should be verified.	
4.	Dimensional Check	Specified Dimension as per spec.	

27.1.1.2 List of assembly/ Sub- assemblies

S.No.	Assembly / Sub- assemblies / Module	Qty.	Serial No.
1.			
2.			
3.			
4.			
5.			

27.1.1.3 Pneumatic Panel Visual Inspection

S.No.	Test	Acceptance Criteria	Observation
1.	Dimensional check	Dimension as per Spec.	
2.	Operation instruction & Guard (if applicable)	Instruction Name Plate to be available on the Guard.	

27.1.1.4 Functional Tests

Test clause #	Clause applicable as per RDSO Specification No. MP.0.01.00.31, (Latest)	Test description

27.1.1.4.1	7.9	BIU isolation checking in lead locomotive
27.1.1.4.2	8.1	Brake command tests through KAVACH (CAN-1)
27.1.1.4.3	8.3	Traction cut OFF checking in single locomotive
27.1.1.4.4	16.1	Insulation Resistance Test for Brake Control Unit
27.1.1.4.5	16.1	Dielectric test at 1.0 KV @ 50hz Test For Brake Control Unit (BCU)

Details are given below:

27.1.1.4.1 BIU Isolation checking in LEAD locomotive

S.No.	Test Description	Expected Result	Observed Results	Remarks
1.	Keep **ISOLATION** rotary switch in **ISOLATION** position and verify the status of counter on BIU	BIU counter should be incremented by one		
2.	Operate Normal Brake (NB) through KAVACH /TSS simulator	**BP:** 5 ± 0.1 Kg/cm^2 **BC:** 0 ± 0.1 Kg/ cm^2		
3.	Release Normal Brake (NB) through KAVACH /TSS simulator	**BP:** 5 ± 0.1 Kg/cm^2 **BC:** 0 ± 0.1 Kg/ cm^2		
4.	Now Place SA9 Control Handle in Full Service Position & A9 handle in the Emergency position.	**BP:** 0 ± 0.1 Kg/cm^2 **BC:** 3.5 ± 0.1 Kg/ cm^2		
5.	Now Place SA9 Control Handle in Release Position & A9 handle in the Release position.	**BP:** 5 ± 0.1 Kg/cm^2 **BC:** 0 ± 0.1 Kg/ cm^2		

27.1.1.4.2 Brake Command tests through KAVACH (CAN-1) Communication port

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.				
0.1 ***A9 Brake Command checking through*** **KAVACH*:***				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**

a)	Through KAVACH simulator Set the "***BP drop Command***" from KAVACH as **4.4 Kg/cm^2**	BP value should be **4.4 ± 0.1 Kg/cm^2**		
b)	Through KAVACH simulator Set the "***BP drop Command***" from KAVACH as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
c)	Through KAVACH simulator Set the "***BP drop Command***" from KAVACH as **3.5 Kg/cm^2**	BP value should be **3.5 ± 0.1 Kg/cm^2**		
d)	Through KAVACH simulator Set the "***BP drop Command***" from KAVACH as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
e)	Through KAVACH simulator Set the "***BP drop Command***" from KAVACH as **0 Kg/cm^2**	BP value should be **0.0 ± 0.1 Kg/cm^2**		
f)	Through KAVACH simulator Set the "***BP drop Command***" from KAVACH as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		

0.2 *SA9 Brake Command checking through* KAVACH*:*

S.No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through KAVACH simulator Set the "***BC raise Command***" from KAVACH as **1.0 Kg/cm^2**	BC value should be **1.0 ± 0.1 Kg/cm^2**		
b)	Through KAVACH simulator	BC value should be **0.0 ± 0.1 Kg/cm^2**		

	Set the "***BC raise Command***" from KAVACH as **0 Kg/cm^2**			
c)	Through KAVACH simulator Set the "***BC raise Command***" from KAVACH as **2.0 Kg/cm^2**	BC value should be **2.0 ± 0.1 Kg/cm^2**		
d)	Through KAVACH simulator Set the "***BC raise Command***" from KAVACH as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
e)	Through KAVACH simulator Set the "***BC raise Command***" from KAVACH as **3.5 Kg/cm^2**	BC value should be **3.5 ± 0.1 Kg/cm^2**		
f)	Through KAVACH simulator Set the "***BC raise Command***" from KAVACH as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.1.1.4.3 Traction Cut Off Checking in Single Locomotive

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.				
0.3 ***Traction Cut-Off checking during A9 Brake Command application:***				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	i) Through KAVACH /TSS simulators set the "***BP drop s Command***" from KAVACH /TSS as **4.4 Kg/cm^2.** ii) Through KAVACH /TSS simulators set the "***BP drop Command***" from KAVACH /TSS as **5.0 Kg/cm^2.**	i) Traction Cut Off relay should energize to cutoff the traction. BP value should be **4.4 ± 0.1 Kg/cm^2** ii) Traction Cut Off relay should de-energize. BP value should be **5.0 ± 0.1 Kg/cm^2**		

0.4 *Traction Cut-Off checking during SA9 Brake Command application:*				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	i) Through KAVACH /TSS simulators Set the "***BC raise Command***" from KAVACH /TSS as **2.0 Kg/cm^2.** ii) Through KAVACH /TSS simulators Set the "***BC raise Command***" from KAVACH /TSS as **0.0 Kg/cm^2.**	i) Traction Cut Off relay should energize to cutoff the traction BC value should be **2.0 ± 0.1 Kg/cm^2** ii) Traction Cut Off relay should de-energize. BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.1.1.4.4. Insulation Resistance Test for Brake Control Unit

S.No.	Test	Acceptance Criteria	Observation / Measured value
1.	Insulation measurement test will be carried out with 500V D.C Megger and then this test will be re-conducted after voltage withstand test. Megger the Electronics & Control circuits input and output pins of the unit / module are shorted together with respect to earth(All I/O pins shorted to body) and check the insulation level with 500V megger range and ensure that the insulation resistances are greater than 20M ohms. Record the actual values obtained.	> 20MΩ	

27.1.1.4.5 Dielectric test at 1.0 KV@50hz Test For Brake Control Unit (BCU)

S.No.	Test	Acceptance Criteria	Observation / Measured value
1.	The test voltage should be of sine wave, 1000V, 50HZ applied for one minute between the terminals of all I/O pins shorted and enclosure body.	No flash over to be observed	

27.2 Following functional test of the BIU shall be done as per Sample Size (The sampling plan shall be in accordance with IS2500):
Sample size for various tests is given below:

Lot size	**For tests as per Specification**	
	Sample size	**Number of rejection acceptable**
Up to 25	3	0
25-50	5	0
50-75	8	0
75-100	10	0
More than 100	10% of the lot	0

Samples should be picked up at random from the lot. If rejection number is more than the acceptable limit, inspection will be stopped and entire lot will be tested again by the firm. After checking the firm will re-offer the lot for re-inspection. Again, sample checking will be done by the inspecting authority. If second time also rejection is more than the acceptable limit, entire lot will be rejected.

The table below gives the list of tests to be carried out as per sampling plan mentioned in the above table Para 1.2:

Test clause #	**Clause applicable as per RDSO Specification No. MP.0.01.00.31, (Latest)**	**Test description**
27.2.1	8.1	Brake command checking through TSS1(CAN-3)
27.2.2	8.1	Brake command checking through TSS2(CAN-3)
27.2.3	8.1	Brake command checking through TSS3(CAN-3)
27.2.4	8.4	Higher brake intensity command checking in single locomotive
27.2.5	8.3	Traction cut OFF checking
27.2.6	7.3 specification for DPCS MP.0.400.02(latest revision)	Brake synchronization testing in Remote locomotive through DPWCS (CAN-2) communication port
27.2.7	7.9	BIU isolation check in remote locomotive
27.2.8	7.11	Event recorder verification

Details are given below:

27.2.1 Brake Command checking through TSS1 (CAN-3) Communication port in Single Locomotive:

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.				
0.5 ***A9 Brake Command checking through TSS1:***				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	Through TSS1 simulator Set the "***BP drop Command***" from TSS1 as **4.4 Kg/cm^2**	BP value should be **4.4 ± 0.1 Kg/ cm^2**		
b)	Through TSS1 simulator Set the "***BP drop Command***" from TSS1 as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/ cm^2**		
c)	Through TSS1 simulator Set the "***BP drop Command***" from TSS1 as **3.5 Kg/cm^2**	BP value should be **3.5 ± 0.1 Kg/cm^2**		
d)	Through TSS1 simulator Set the "***BP drop Command***" from TSS1 as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
e)	Through TSS1 simulator Set the "***BP drop Command***" from TSS1 as **0 Kg/cm^2**	BP value should be **0.0 ± 0.1 Kg/cm^2**		
f)	Through TSS1 simulator Set the "***BP drop Command***" from TSS1 as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
0.6 ***SA9 Brake Command checking through TSS1:***				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	Through TSS1 simulator Set the "***BC raise Command***" from TSS1 as **1.0 Kg/ cm^2**	BC value should be **1.0 ± 0.1 Kg/ cm^2**		
b)	Through TSS1 simulator	BC value should be		

	Set the "***BC raise Command***" from TSS1 as **0 Kg/cm^2**	**0.0 ± 0.1 Kg/cm^2**		
c)	Through TSS1 simulator Set the "***BC raise Command***" from TSS1 as **2.0 Kg/cm^2**	BC value should be **2.0 ± 0.1 Kg/cm^2**		
d)	Through TSS1 simulator Set the "***BC raise Command***" from TSS1 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
e)	Through TSS1 simulator Set the "***BC raise Command***" from TSS1 as **3.5 Kg/cm^2**	BC value should be **3.5 ± 0.1 Kg/cm^2**		
f)	Through TSS1 simulator Set the "***BC raise Command***" from TSS1 as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.2.2 Brake Command checking through TSS2 (CAN-3) Communication port in Single Locomotive:

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.				
0.7 ***A9 Brake Command checking through TSS2:***				
S.No	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	Through TSS2 simulator Set the "***BP drop Command***" from TSS2 as **4.4 Kg/cm^2**	BP value should be **4.4 ± 0.1 Kg/cm^2**		
b)	Through TSS2 simulator Set the "***BP drop Command***" from TSS2 as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
c)	Through TSS2 simulator Set the "***BP drop Command***" from TSS2 as **3.5 Kg/cm^2**	BP value should be **3.5 ± 0.1 Kg/cm^2**		
d)	Through TSS2 simulator Set the "***BP drop Command***" from TSS2	BP value should be **5.0 ± 0.1 Kg/cm^2**		

	as **5 Kg/cm^2**			
e)	Through TSS2 simulator Set the "***BP drop Command***" from TSS2 as **0 Kg/cm^2**	BP value should be **0.0 ± 0.1 Kg/cm^2**		
f)	Through TSS2 simulator Set the "***BP drop Command***" from TSS2 as **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
0.8	***SA9 Brake Command checking through TSS2:***			
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	Through TSS2 simulator Set the "***BC raise Command***" from TSS2 as **1.0 Kg/cm^2**	BC value should be **1.0 ± 0.1 Kg/cm^2**		
b)	Through TSS2 simulator Set the "***BC raise Command***" from TSS2 as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
c)	Through TSS2 simulator Set the "***BC raise Command***" from TSS2 as **2.0 Kg/cm^2**	BC value should be **2.0 ± 0.1 Kg/Cm^2**		
d)	Through TSS2 simulator Set the "***BC raise Command***" from TSS2 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
e)	Through TSS2 simulator Set the "***BC raise Command***" from TSS2 as **3.5 Kg/cm^2**	BC value should be **3.5 ± 0.1 Kg/cm^2**		
f)	Through TSS2 simulator Set the "***BC raise Command***" from TSS2 as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.2.3 Brake Command checking through TSS3 (CAN-3) Communication port in Single Locomotive:

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.

0.9 *A9 Brake Command checking through TSS3:*

S.No.	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through TSS3 simulator Set the "***BP drop Command***" from TSS3 as **4.4 Kg/cm^2**	BP value should be **4.4 ± 0.1 Kg/cm^2**		
b)	Through TSS3 simulator Set the "***BP drop Command***" from TSS3 as **5 Kg/cm^2**	BP value should be **5 ± 0.1 Kg/cm^2**		
c)	Through TSS3 simulator Set the "***BP drop Command***" from TSS3 as **3.5 Kg/cm^2**	BP value should be **3.5 ± 0.1 Kg/cm^2**		
d)	Through TSS3 simulator Set the "***BP drop Command***" from TSS3 as **5 Kg/cm^2**	BP value should be **5 ± 0.1 Kg/cm^2**		
e)	Through TSS3 simulator Set the "***BP drop Command***" from TSS3 as **0 Kg/cm^2**	BP value should be **0 ± 0.1 Kg/cm^2**		
f)	Through TSS3 simulator Set the "***BP drop Command***" from TSS3 as **5 Kg/cm^2**	BP value should be **5 ± 0.1 Kg/cm^2**		

0.10 *SA9 Brake Command checking through TSS3:*

S.No.	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through TSS3 simulator Set the "***BC raise Command***" from TSS3 as **1.0 Kg/cm^2**	BC value should be **1.0 ± 0.1 Kg/cm^2**		
b)	Through TSS3 simulator Set the "***BC raise Command***" from TSS3 as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
c)	Through TSS3 simulator Set the "***BC raise***	BC value should be **2.0 ± 0.1 Kg/cm^2**		

	Command" from TSS3 as **2.0 Kg/cm^2**			
d)	Through TSS3 simulator Set the "***BC raise Command***" from TSS3 as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
e)	Through TSS3 simulator Set the "***BC raise Command***" from TSS3 as **3.5 Kg/cm^2**	BC value should be **3.5 ± 0.1 Kg/cm^2**		
f)	Through TSS3 simulator Set the "***BC raise Command***" from TSS3 as **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.2.4 Higher Brake Intensity Command Checking in Single Locomotive

0.11 ***A9 Higher Brake Intensity Command Checking:***				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	Through KAVACH /TSS simulators Set the "***BP drop Command***" as per below i. KAVACH as **5 Kg/cm^2** ii. TSS1 as **5 Kg/cm^2** iii. TSS2 as **5 Kg/cm^2** iv. TSS3 as **5 Kg/cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
b)	Through KAVACH /TSS simulators Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/cm^2** ii. TSS1 as **5 Kg/cm^2** iii. TSS2 as **5 Kg/cm^2** iv. TSS3 as **5 Kg/cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/cm^2**		
c)	Through KAVACH /TSS			

	simulators Set the "***BP drop Command***" as per below i KAVACH as **4.4 Kg/cm^2** ii. TSS1 as **3.5 Kg/cm^2** iii. TSS2 as **5 Kg/cm^2** iv. TSS3 as **5 Kg/cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/cm^2**		
d)	Through KAVACH /TSS simulators Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/cm^2** ii. TSS1 as **3.5 Kg/cm^2** iii. TSS2 as **2.5 Kg/cm^2** iv. TSS3 as **5 Kg/cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **2.5 ± 0.1 Kg/cm^2**		
e)	Through KAVACH /TSS simulators Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/cm^2** ii. TSS1 as **3.5 Kg/cm^2** iii. TSS2 as **2.5 Kg/cm^2** iv. TSS3 as **2.0 Kg/cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2.**	BP value should be **2.0 ± 0.1 Kg/cm^2**		
f)	Through KAVACH /TSS simulators Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/cm^2** ii. TSS1 as **3.5 Kg/cm^2** iii. TSS2 as **2.5 Kg/cm^2** iv. TSS3 as **2.0 Kg/cm^2** Place A9 handle position in LEAD locomotive to	BP value should be **0.0 ± 0.1 Kg/cm^2**		

	EB (**0 Kg/Cm^2**)			
g)	Through KAVACH /TSS simulators Set the "***BP drop Command***" as per below i. KAVACH as **5 Kg/cm^2** ii. TSS1 as **5 Kg/cm^2** iii. TSS2 as **5 Kg/cm^2** iv. TSS3 as **5 Kg/cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
0.12 *SA9 Higher Brake Intensity Command Checking:*				
S.No.	**Test Description**	**Expected Result**	**Observed Result in LEAD Locomotive**	**Remarks**
a)	Through KAVACH /TSS simulators Set the "***BC raise Command***" as per below i. KAVACH as **0 Kg/cm^2** ii. TSS1 as **0 Kg/cm^2** iii. TSS2 as **0 Kg/cm^2** iv. TSS3 as **0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
b)	Through KAVACH /TSS simulators Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/cm^2** ii. TSS1 as **0 Kg/cm^2** iii. TSS2 as **0 Kg/cm^2** iv. TSS3 as **0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/cm^2**	BC value should be **1.0 ± 0.1 Kg/cm^2**		
c)	Through KAVACH /TSS simulators Set the "***BC raise Command***" as per below	BC value should be **1.5 ± 0.1 Kg/cm^2**		

	i. KAVACH as **1 Kg/cm^2** ii. TSS1 as **1.5 Kg/cm^2** iii. TSS2 as **0 Kg/cm^2** iv. TSS3 as **0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**			
d)	Through KAVACH /TSS simulators Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/cm^2** ii. TSS1 as **1.5 Kg/cm^2** iii. TSS2 as **2.0 Kg/cm^2** iv. TSS3 as **0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**	BC value should be **2.0 ± 0.1 Kg/cm^2**		
e)	Through KAVACH /TSS simulators Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/cm^2** ii. TSS1 as **1.5 Kg/cm^2** iii. TSS2 as **2.0 Kg/cm^2** iv. TSS3 as **3.0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/cm^2**	BC value should be **3.0 ± 0.1 Kg/cm^2**		
f)	Through KAVACH /TSS simulators Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/cm^2** ii. TSS1 as **1.5 Kg/cm^2** iii. TSS2 as **2.0 Kg/cm^2** iv. TSS3 as **3.0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to full service value **3.5 Kg/cm^2**	BC value should be **3.5 ± 0.1 Kg/cm^2**		
g)	Through KAVACH /TSS			

	simulators Set the "***BC raise Command***" as per below i. KAVACH as **0 Kg/cm^2** ii. TSS1 as **0 Kg/cm^2** iii. TSS2 as **0 Kg/cm^2** iv. TSS3 as **0 Kg/cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.2.5 Traction Cut Off Checking

Place A9 & SA9 handles of REMOTE locomotive in RELEASE position.

0.13 *Traction CutOff checking during A9 Brake Command application:*

S.No.	Test Description	Expected Result	Observed Result in REMOTE Locomotive	Remarks
a)	i) Through DPCS/DPWCS simulator set the "***BP drop Command***" from DPCS/DPWCS as **4.4 Kg/cm^2.** ii) Through Through DPCS/DPWCS simulator Set the "***BP drop Command***" from DPCS/DPWCS as **5.0 Kg/cm^2.**	i) Traction Cut Off relay should energize to cutoff the traction. BP value should be **4.4 ± 0.1 Kg/cm^2** ii) Traction Cut Off relay should de-energize. BP value should be **5.0 ± 0.1 Kg/cm^2**		

0.14 *Traction CutOff checking during SA9 Brake Command application:*

S.No.	Test Description	Expected Result	Observed Result in REMOTE Locomotive	Remarks
a)	i) Through Through DPCS/DPWCS simulator set the "***BC raise Command***" from DPCS/DPWCS as **2.4 Kg/cm^2.** ii) Through Through DPCS/DPWCS simulator	i) Traction Cut Off relay should energize to cutoff the traction BC value should be 2**.4 ± 0.1 Kg/cm^2** ii) Traction Cut Off relay should de-		

	Set the "***BC raise Command***" from DPCS/DPWCS as **0.0 Kg/cm^2.**	energize. BC value should be **0.0 ± 0.1 Kg/cm^2**		

27.2.6 Brake Synchronization Testing in REMOTE Locomotive through DPCS/DPWCS (CAN-2) Communication port:

Select DPCS/DPWCS remote option in DPCS/DPWCS Simulator and give the commands to Brake Interface Unit through CAN communication port.

0.15 A9 Brake Synchronization checking in the REMOTE locomotive				
S.No.	**Test Description**	**Expected Result**	**Observed Result in REMOTE Locomotive**	**Remarks**
a)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **4.4 Kg/cm^2**	BP value should be **4.4 ± 0.1 Kg/cm^2**		
b)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
c)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **3.5 Kg/cm^2**	BP value should be **3.5 ± 0.1 Kg/cm^2**		
d)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
e)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote	BP value should be **2.5 ± 0.1 Kg/cm^2**		

	as **2.5 Kg/cm^2**			
f)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
g)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **0.0 Kg/cm^2**	BP value should be **0.0 ± 0.1 Kg/cm^2**		
h)	Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/cm^2**	BP value should be **5.0 ± 0.1 Kg/cm^2**		
0.16 ***SA9 Brake Synchronization checking in the REMOTE locomotive***				
a)	Through DPCS/DPWCS/simulator Set the "***BC raise Command***" from DPCS/DPWCS remote as **1.0 Kg/cm^2**	BC value should be **1.0 ± 0.1 Kg/cm^2**		
b)	Through DPCS/DPWCS/simulator Set the "***BC raise Command***" from DPCS/DPWCS remote as **0.0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
c)	Through DPCS/DPWCS/simulator Set the "***BC raise Command***" from DPCS/DPWCS remote as **2.0 Kg/cm^2**	BC value should be **2.0 ± 0.1 Kg/cm^2**		
d)	Through DPCS/DPWCS/simulator Set the "***BC raise Command***" from DPCS/DPWCS remote	BC value should be **0.0 ± 0.1 Kg/cm^2**		

	as **0.0 Kg/cm^2**			
e)	Through DPCS/DPWCS/simulator Set the "***BC raise Command***" from DPCS/DPWCS remote as **3.5 Kg/cm^2**	BC value should be **3.5 ± 0.1 Kg/cm^2**		
f)	Through DPCS/DPWCS/simulator Set the "***BC raise Command***" from DPCS/DPWCS remote as **0.0 Kg/cm^2**	BC value should be **0.0 ± 0.1 Kg/cm^2**		
0.17 ***BP-Cut OFF Valve Operation Checking in the REMOTE locomotive***				
a)	i) Create Communication fail between DPCS/DPWCS/simulator & BIU of the remote locomotive. ii) Through DPCS/DPWCS/simulator Set the "***BP drop Command***" from DPCS/DPWCS remote as 3.**5 Kg/cm^2** iii) Recover Communication failure between DPCS/DPWCS/simulator & BIU of remote locomotives.	i) BP Cut-OFF valve in REMOTE locomotive shall be blocked/closed not allowing charging or discharging from REMOTE locomotive brake system. ii) BP Cut-OFF valve in REMOTE locomotive shall be blocked/closed not allowing charging or discharging from REMOTE locomotive brake system. BP Cut-OFF valve in REMOTE locomotive shall be opened allowing charging/discharging from the REMOTE locomotive brake system. iii) Cut-OFF valve in REMOTE locomotive shall be opened allowing charging/discharging from the REMOTE locomotive brake		

	iv) Change A9 handle pressure in the LEADING locomotive to release value **5.0 ± 0.1 Kg/cm^2**	system. iv) BP charging in REMOTE locomotive should occur, BP value should be **5.0 ± 0.1 Kg/cm^2**.		

27.2.7 BIU Isolation checking in REMOTE locomotive

S.No.	Test Description	Expected Result	Observed Results	Remarks
1.	Keep **ISOLATION** rotary switch in **ISOLATION** position and verify the status of counter on BIU.	BIU counter should increment by one		
2.	Now in LEAD locomotive place SA9 Control Handle in Full Service Position & A9 handle in the Full Service position. Through Application software, Set the "***BP drop Command***" as **3.5 Kg/cm^2** and "**BC drop Command"** as **3.5 Kg/cm^2** from DPCS/DPWCS remote.	BP should not discharge and BC should not build from REMOTE locomotive. BP charge cut off valve in REMOTE locomotive shall be in blocked/closed not allowing charging or discharging from REMOTE locomotive brake system. **REMOTE BC:** 0 ± 0.1 Kg/ cm^2		
3.	Through Application software, Set the "***BP drop Command***" as **5.0 Kg/cm^2** and "**BC drop Command"** as **0.0 Kg/cm^2** from DPCS/DPWCS remote.	BP should not charge from REMOTE locomotive. BP charge cut off valve in REMOTE locomotive shall be in blocked/closed not allowing charging or discharging from REMOTE locomotive brake system. **REMOTE BC:** 0 ± 0.1 Kg/ cm^2		

27.2.8 Event Recorder Verification

S.No.	Test Description	Expected Result	Observed Results	Remarks
1.	Events recording at event change over	Events to be recorded whenever there is a change		
2.	Apply formation brake till there is a drop in BP by 0.3 kg/cm^2 value.	Event recording when conditions satisfy		
3.	Release formation brake till there is a raise in BP by 0.3 kg/cm^2 value.	Event recording when conditions satisfy		
4.	Apply Independent brake till there is a raise in BC by 0.3 kg/cm^2 value.	Event recording when conditions satisfy		
5.	Release Independent brake till there is a drop in BC by 0.3 kg/cm2 value.	Event recording when conditions satisfy		
6.	Valves Self Check	Event recording when conditions satisfy		
7.	Create Sensor faults & Valves Faults	Fault Data Pack Recording with all parameters		
8.	Apply NB through KAVACH /DPCS/DPWCS/TSS and now through A9 Handle apply FSB (BIU Brake command override by Loco pilot brake command)	Event recording when conditions satisfy		
9.	Apply NB through A9 Handle and now apply FSB through KAVACH /DPCS/DPWCS/TSS (Loco pilot brake command override by BIU Brake command)	Event recording when conditions satisfy		

10.	Download Cumulative Counters	Isolation counters & duration, Application duration, Brake application counters & duration,		
11	Connect Laptop and open Online Data Logging application	Log file should be downloaded into Pen drive/Laptop		

28. DATE OF ENFORCEMENT:

The date of enforcement of the specification is with immediate effect i.e. date of issue of Specification.

Annexure-1

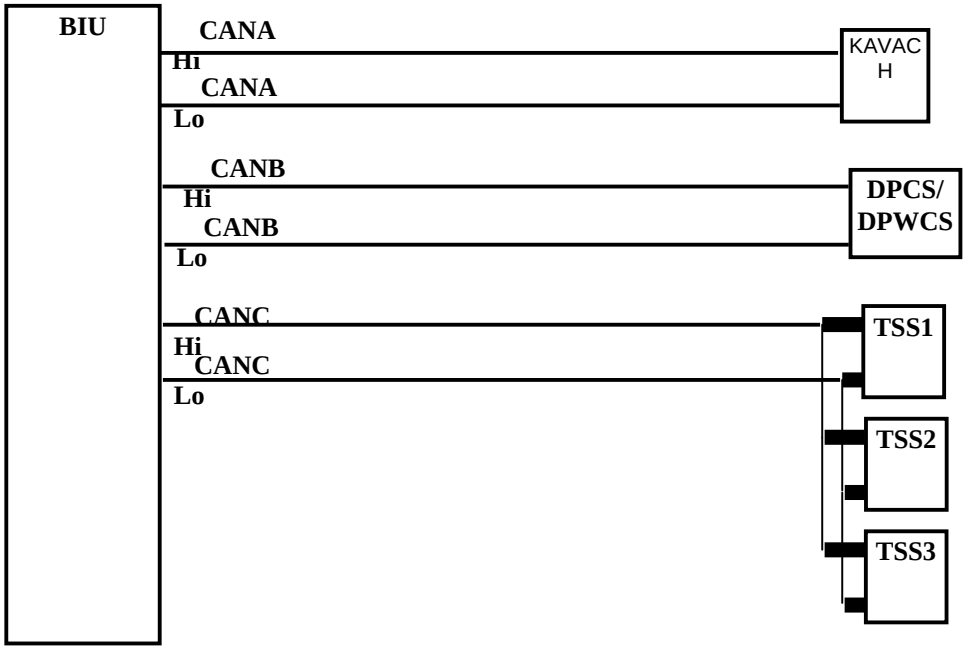
Brake Interface Unit

CAN Interface Protocol

for

KAVACH/DPCS/DPWCS/TSS1/TSS2/TSS3 Interface

1. BIU Interface Details



Cable and Wiring details							
S.No.	**Communication**	**Pin allocation**	**Connector onboard on BIU**	**Mating cable connector for BIU**	**Connector at Interface system end**	**Mating cable connector for Interface system**	**Cable Type**
1.	CANA	A: CAN_H B: CAN_L Body: Shield&GND	MG 02R-10SL-4P	MG 06F-10SL-4S	MG 02R-10SL-4P	MG 06F-10SL-4S	E-BEAM CABLE 1.5 Sqmm, 2CORE,Twisted Pair
2.	CANB	A: CAN_H B: CAN_L Body: Shield&GND	MG 02R-10SL-4S	MG 06F-10SL-4P	MG 02R-10SL-4S	MG 06F-10SL-4P	E-BEAM CABLE 1.5 Sqmm, 2CORE,Twisted Pair
3.	CANC	A: CAN_H B: CAN_L C: No Connection Body: Shield&GND	MG 02R-10SL-3S	MG 06F-10SL-3P			E-BEAM CABLE 1.5 Sqmm, 2CORE,Twisted Pair
Other end of CANC for multi node							
1.	TSS1	A: CAN_H B: CAN_L Body: Shield&GND			MG 02R-10SL-4S	MG 06F-10SL-4P	(The wiring for the other TSS should be from this connector)
2.	TSS2	A: CAN_H B: CAN_L Body: Shield&GND			MG 02R-10SL-4S	MG 06F-10SL-4P	(The wiring for the other TSS should be from this connector)
3.	TSS3	A: CAN_H B: CAN_L Body: Shield&GND			MG 02R-10SL-4S	MG 06F-10SL-4P	(The wiring for the other TSS should be from this connector)

1.1 Abbreviations

BIU	Brake Interface Unit
DPCS	Distributed Power Control System
DPWCS	Distributed Power Wireless Control System
KAVACH	KAVACH (The Indian Railway ATP)
TSS	Train Safety System
TSS1	Train Safety System 1 (Spare)
TSS2	Train Safety System 2 (Spare)
TSS3	Train Safety System 3 (Spare)
CAN	Control Area Network
BP	Brake Pipe
BC	Brake Cylinder
ID	Identifier
COB-ID	Communication Object Identifier
PDO	Process Data Object
RPDO	Receiver Process Data Object
TPDO	Transmit Process Data Object
NMT	Network Management
NC	Not Connected

1.2 Definitions

Brake Panel Test	For performing automatic functionality test of all Pneumatic valves and relays in the BIU panel.
BIU Node x	x = 1 => BIU KAVACH communication x = 2 => BIU -DPCS/DPWCS communication x = 3 => BIU -TSS1 communication x = 4 => BIU -TSS2 communication x = 5 => BIU -TSS3 communication

S.No.	Description	Value
1	Baud Rate	**500Kbps**
	KAVACH	
2	BIU Node 1 ID	**0x10**
3	KAVACH Node ID	**0x20**
	DPCS/DPWCS	
4	BIU Node 2 ID	**0x30**
5	DPCS/DPWCS Node ID	**0x40**
	TSS1	
6	BIU Node 3 ID	**0x50**
7	TSS1 Node ID	**0x60**
	TSS2	
8	BIU Node 4 ID	**0x70**
9	TSS2 Node ID	**0x7A**
	TSS3	
10	BIU Node 5 ID	**0x7B**

11	TSS3 Node ID	**0x7C**

Command Specifier	NMT Service
0x01	Start Remote Node
0x02	Stop Remote Node
0x80	Enter Pre-operational State
0x81	Reset Node
0x82	Reset Communication

State (Heartbeat)	Meaning
0x00	Boot-Up
0x04	Stopped
0x05	Operational
0x7F	Pre-Operational

2 BIU--KAVACH /DPCS/DPWCS/TSS1/TSS2 Communication Protocol Details

2.1 Network Management Functions

Byte No	Byte Information	Direction	Periodicity	COB-ID	Remarks
0	0 (Boot-up)	BIU -> KAVACH /DPCS/ DPWCS/TSS1/ TSS2/TSS3	After successful Initialisation during power ON	BIU Heart Beat (0x700 + BIU Node x ID)	This sequence shall be sent by BIU at the end of bootup stage.

Byte No	Byte Information	Direction	Periodicity	COB-ID	Remarks
0	0 (Boot-up)	KAVACH /DPCS/ DPWCS/ TSS1/TSS2/TSS 3 -> BIU	After successful Initialisation during power ON	Heart Beat (0x700 + KAVACH /DPCS/DPWCS /TSS1/TSS2/TSS3 Node ID)	This sequence shall be sent by KAVACH /DPCS/DPWCS/TSS1/TSS2/ TSS3 at the end of bootup stage. After bootup KAVACH /DPCS/DPWCS/TSS1/TSS2/ TSS3 shall enter to Pre-Operational

Byte No	Byte Information	Direction	Periodicity	COB-ID	Remarks
0	State	BIU -> KAVACH /DPCS/ DPWCS/ TSS1 / TSS2 / TSS3	500 ms	Heart Beat (0x700 + BIU Node x ID)	After BIU bootup

Byte No	Byte Information	Direction	Periodicity	COB-ID	Remarks
0	State	KAVACH /DPCS/ DPWCS/TSS1/ TSS2/TSS3 -> BIU	500 ms	Heart Beat (0x700 + KAVACH /DPCS/DPWCS/ TSS1 / TSS2 / TSS3 Node ID)	After KAVACH /DPCS/DPWCS/TSS1/TSS2/ TSS3 bootup

Byte No	Byte Information	Direction	Periodicity	COB-ID	Remarks
0	1	BIU -> KAVACH	-		BIU will send this command to

	(Start Remote Node)	/DPCS/ DPWCS/TSS1/ TSS2/TSS3		Network Management (0x00)	KAVACH /DPCS/DPWCS/TSS1/TSS2/ TSS3 for entering into operational state, until state is changed to operational, whenever required.
1	KAVACH /DPCS/ DPWCS/TSS1/TSS 2/TSS3 Node ID				

2.2 Data Management Functions

2.2.1 BIU -> KAVACH /DPCS/DPWCS/TSS1/TSS2/TSS3 Command Data

BIU -> KAVACH **/DPCS/DPWCS/TSS1/TSS2/TSS3 Status Data**					
Byte No	**Description**	**Byte Order**	**Resolution**	**Units**	**COB-ID**
0	Brake Pipe Pressure	Byte	0.05 Kg/Cm2 Per Bit	Kg/cm2	**0x200 +** KAVACH **/DPCS/DPWCS/TSS1/ TSS2/TSS3 Node ID**
1	Brake Cylinder Pressure	Byte			
2	Main Reservoir Pressure	Byte			
3	A9 Control Reference Pressure [$]	Byte			
4	SA9 Control Reference Pressure[#]	Byte			
5	Air Flow	Byte			
6	Feedpipe Pressure	Byte			
7	BIU Validity Byte	Byte	1	1	
0	BIU Isolation Counter	Lower Byte	1	1	**0x300 +** KAVACH **/DPCS/DPWCS/TSS1/ TSS2/TSS3 Node ID**
1		Higher Byte			
2	BIU Fault Code	Lower Byte	1	1	
3		Higher Byte			

4	BIU display only message code	Lower Byte	1	1	
5		Higher Byte			
6-7	Spare	-	-	-	
0	BIU Discrete Byte 1	Byte	1	1	**0x400 +** KAVACH **/DPCS/DPWCS/TSS1/ TSS2/TSS3 Node ID**
1	BIU Discrete Byte 2	Byte			
2	BIU Discrete Byte 3	Byte	1	-	
3 - 7	Spare	-			

Note: $:DPCS/DPWCS_Lead Locomotive→ If KAVACH /TSSx not equipped, then A9 Handle Pressure is considered as A9 Control Reference Pressure

→ If KAVACH /TSSx equipped, then Higher Braking effort among KAVACH /TSSx Brake command & A9 Handle Pressure is considered as A9 Control Reference Pressure

DPCS/DPWCS_Remote Locomotive → A9 Handle Pressure is considered as A9 Control Reference Pressure

Note: #: DPCS/DPWCS_Lead Locomotive → If KAVACH /TSSx not equipped then SA9 Handle Pressure is considered as SA9 Control Reference Pressure

→ If KAVACH /TSSx equipped then Higher Braking effort among KAVACH /TSSx Brake command & SA9 Handle Pressure is considered as SA9 Control Reference Pressure

DPCS/DPWCS_Remote Locomotive → SA9 Handle Pressure is considered as SA9 Control Reference Pressure

BIU Validity Byte :

Bit No	Information	Remarks
0	Brake Pipe Pressure Valid	Valid (1) = 0 to 6.0 Kg/Cm^2, Invalid (0) = > 6.0 Kg/Cm^2
1	Brake Cylinder Pressure Valid	Valid (1) = 0 to 4.0 Kg/Cm^2, Invalid (0) = > 4.0 Kg/Cm^2
2	Main Reservoir Pressure Valid	Valid (1) = 0 to 10.5 Kg/Cm^2, Invalid (0) = > 10.5 Kg/Cm^2
3	A9 Control Reference Pressure Valid	Valid (1) = 0 to 6.0 Kg/Cm^2, Invalid (0) = > 6.0 Kg/Cm^2
4	SA9 Control Reference Pressure Valid	Valid (1) = 0 to 4.0 Kg/Cm^2, Invalid (0) = > 4.0 Kg/Cm^2
5	Air Flow Valid	Valid (1) = 0 to 10.0 Kg/Cm^2, Invalid (0) = > 10.0 Kg/Cm^2
6	Feedpipe Pressure Valid	Valid (1) = 0 to 10.0 Kg/Cm^2, Invalid (0) = > 10.0 Kg/Cm^2
7	Spare	0

BIU Discrete Byte 1 :

Bit No	Information	Remarks
0	BIU Health	1= BIU healthy, 0= BIU fault,
1	BIU Brake Command override by Loco pilot	1= YES, 0=NO
2	Loco pilot Brake Request override by BIU	1= YES, 0=NO
3	BIU Manual Isolate	1= YES, 0=NO
4	BP Charging CUTOUT Feedback Status	1= CUTOUT, 0= CUTIN
5	Emergency Valve	1= CUTIN, 0=CUTOUT
6	Power Cut Off relay Feedback Status	1= ON, 0=OFF
7	Spare	0

BIU Discrete Byte 2 :

Bit No	Information	Remarks
0	BIU Brake Panel Test Success	1= YES, 0=NO
1	BIU Brake Panel Test Fail	1= YES, 0=NO
2	BIU Brake Panel Test Progress	1= YES, 0=NO
3 – 7	Spare	0

BIU Discrete Byte 3 :

Bit No	Information	Remarks
0	BP Charging Cutout Valve State	1=ON, 0=OFF
1	BP Control / Selection Valve State	1=ON, 0=OFF
2	BC Control / Selection Valve State	1=ON, 0=OFF
3	Emergency Valve State	1=ON, 0=OFF
4	BP Charging Cutout Valve health	1= Healthy, 0= Faulty
5	BP Control / Selection Valve health	1= Healthy, 0= Faulty
6	BC Control / Selection Valve health	1= Healthy, 0= Faulty
7	Emergency Valve health	1= Healthy, 0= Faulty

2.2.2 KAVACH /DPCS/DPWCS/TSS1/TSS2/TSS3 -> BIU Command Data

KAVACH **/DPCS/DPWCS/TSS1/TSS2/TSS3 -> BIU Status Data**					
Byte No	**Description**	**Byte Order**	**Resolution**	**Units**	**COB-ID**
0	Locomotive Speed	Lower Byte	0.01	Meter/sec	**(0x180 + BIU Node x ID)**
1		Higher Byte			
2	Discrete Byte1	-	1	-	
3	Discrete Byte2	-	1	-	
4	A9 Control Reference Pressure (BP drop Command)	Byte	0.05 Kg/Cm2 Per Bit	Kg/cm2	
5	SA9 Control Reference Pressure (BC raise Command)	Byte			
6 – 7	Spare	-		-	

Discrete Byte1 :

Bit No	Information	Remarks
0	BIU Brake Panel Test Request Command. (In case of remote, Master DPCS/DPWCS should send to remote DPCS/DPWCS when operator selects for remote BIU Brake panel test)	1=ON, 0=OFF
1	“KAVACH /DPCS/DPWCS /TSS1/TSS2/TSS3” Health Signal	1= Healthy, 0=Faulty
2	BP Charging CUTOUT Command (Also, this bit shall be set by DPCS/DPWCS, When Brake Panel Test is in progress at other locomotive in the consist)	1=ON, 0=OFF
3	BIU Isolate (This bit shall be given DPCS/DPWCS whenever BIU need to isolate)	1=ON, 0=OFF
4	Locomotive Speed Validity	1=Speed sensor healthy, 0 = Speed sensor faulty

5	Light Engine	1= Light Engine, 0= Train Formation
6	Remote Locomotive	1= Remote locomotive, 0= Lead locomotive
7	Locomotive working in Dynamic Braking	1= Dynamic Braking, 0= No Dynamic Braking

Discrete Byte2 :

Bit No	Information	Remarks
0	Fault Code Acknowledge	1=Fault Code ACK, 0= No Fault
1	Display Message Code Acknowledge	1=Display Message Code ACK, 0= No Message
2	A9 Control Reference Pressure Valid (BP drop Command)	Valid (1) = 0 to 6.0 Kg/Cm2, Invalid (0) = > 6.0 Kg/Cm2
3	SA9 Control Reference Pressure Valid (BC raise Command)	Valid (1) = 0 to 4.0 Kg/Cm2, Invalid (0) = > 4.0 Kg/Cm2
4 – 7	Spare	

3 Fault Code & Display Mechanism

- Whenever BIU detects a fault, then fault code will be sent to KAVACH /DPCS/DPWCS and “Fault Code Acknowledge bit” of Discrete Byte 2 to be set high by KAVACH /DPCS/DPWCS for one cycle after receiving the fault code. After receiving acknowledgment bit, BIU will send zero value or other fault code if present.
- Whenever BIU detects a “Display only Message”, then code will be sent to KAVACH /DPCS/DPWCS and “Display message Code Acknowledge bit” of Discrete Byte 2 to be set high by KAVACH /DPCS/DPWCS for one cycle after receiving the Display message code. After receiving acknowledgment bit, BIU will send zero value or other Display message code if present.

- KAVACH /DPCS/DPWCS shall show “Display only Message” on KAVACH /DPCS/DPWCS display whenever received from BIU on priority irrespective of Display screen status, because loco pilot attention is required for these messages for performing related actions.

4 Handling Mechanism

- BIU is network management initiator as it is common to KAVACH /DPCS/DPWCS/ TSS1/TSS2/TSS3.
- CAN Protocol with heart beat (Note: no node gaurding concept is allowed)
- BIU shall use time driven Message Frame triggering.
- BIU will send heartbeat for every 500milliseconds
- DPCS/DPWCS, KAVACH, TSS has to send heartbeat for every 500milliseconds.
- Periodicity for message frames: For 250 msec.
- If KAVACH /DPCS/DPWCS/TSS1/TSS2/TSS3 are not in operational state, The BIU will send "Network Management" COB-ID continuously, whenever required.
- If KAVACH /DPCS/DPWCS/TSS1/TSS2/TSS3 are in Pre-operational state then that particular node shall send only Heartbeat to BIU and message frames should not be communicated to BIU.
- The boot-up time of every system should be less than 20sec
- BIU shall have connectors for CAN-A, CAN-B and CAN-C with type MG 02R-10SL-4P, MG 02R-10SL-4S and MG 02R-10SL-3S respectively.
- For the parameters which have validity bit, should consider the value only when validity is high.
- BIU manufacturer has to ensure resolutions mentioned in Specification for Transducers interface.
- During CAN communication fail

  a. BIU shall not perform brake application of that respective interface.

  i. Brakes will be released and allow Loco Pilot operations. In addition to this, In Case of remote DPCS/DPWCS: BP Charging will cutout & acts as Bogie.

ii. If BIU receives Brake Command from other healthy channels then BIU will apply brakes accordingly.

b. Respective failed KAVACH /DPCS/DPWCS/TSS's node shall goto Pre-operational mode.

C. In case of KAVACH, BIU shall apply emergency brake.

5 Fault Code List:

Fault Code	Message
0x1001	A9 Handle Pressure Sensor Failure
0x1002	SA9 Handle Pressure Sensor Failure
0x1003	Main Reservior Pressure Sensor Failure
0x1004	Brake Pipe Pressure Sensor Failure
0x1005	Brake Cylindr Pressure Sensor Failure
0x1006	Air Flow Sensor Failure
0x1007	Feed Pipe Pressure Sensor Failure
0x1008 - 0x100F	Spare
0x1010	Brake Pipe Charging Cutout Valve Failure
0x1018	Formation Brake Control Failure
0x1020	Independent Brake Control Failure
0x1028	Emergency Brake Control Failure
0x1030	Traction Cutoff Control Failure
0x1038	Pneumatic Power Supply Failure
0x1040	BIU ISOLATED
0x1048 – 0x1FFF	Spare

Note: Further Fault codes can be defined as per requirement in future.

6 Display Code List:

Display Code	Message
0x2001	Operate BIU BP charging manual cock
0x2003	Operate Emergency Valve manual cock
0x2005	Operate BIU Isolate Switch
0x2006	Cannot apply A9 brakes in Remote loco & it act as bogie
0x2007	Keep Loco BP cutout cock (52 No) in cutout position in Remote locomotive
0x2008 – 0x2FFF	Spare

Note: Further Display messages can be defined as per requirement in future.

Annexure-2

CONNECTION LOCATION FOR BIU AND OTHER ACCESSORIES

Connection Equipment	Location
BP Transducer	To Brake Pipe line to Brake Pipe gauge on the control stand.
BC Transducer	To Brake Cylinder line to BC Gauge on the control stand.
MR Transducer	Pneumatic Pipe to MR Gauge on the control stand.
Air Flow Sensor	MR 2 on the control stand.
Any other Transducer required	Location will be decided in consultation with RDSO/ vendor approving agency.
BIU	In control line of automatic and independent brake between automatic and independent brake controllers and MU2B valve. A suitable tapping may also be taken across the BP charging COC (Item No. 52). In case, any other tapping location is required, the same shall be decided in consultation with RDSO/ vendor approving agency.

Ref: RDSO Drawing no.SKDP- 3100 (latest revision).

Annexure-3

Functional Test Scheme of Brake interface Unit (BIU) as per RDSO Specification MP.0.01.00.31, (Latest)

i) Without BIU: Test should be conducted without BIU i.e. all connections are disconnected.

ii) All tests should be repeated again with BIU isolated mode.

S.No	Test Parameters	Observations		
		BP	**BC**	**Remarks**
1.0	**Test Setup**			
1.1	Set the Air Brake Panel to LEAD-IN position by operating MU2B Valve.			
1.2	Main reservoir pressure of 8-10 Kg/Cm2 is required for the test procedure.			
1.3	Isolating Switch of BIU is in `Isolated` position.			
1.4	Check the BP leakage should not exceed 0.7 kg/cm2 in 5 minute			
2.0	**Initial setup**			
2.1	Place the SA9 handle & A9 handle in the **RELEASE** position.			
2.2	A9 handle in the **FULL SERVICE** position.	3.4 Kg/Cm^2.		
2.3	A9 handle in the **RELEASE** position.	5.0 Kg/Cm^2.		
2.4	Move the SA9 handle in full application.	5.0 Kg/Cm^2.		
2.5	Place the SA9 handle **RELEASE** position.	5.0 Kg/Cm^2.		
3.0	**A9 Control Operation**			
3.1	Isolating Switch of BIU is in `Application` position.			
3.2	Ensure Brake Interface Unit is in healthy condition.			
3.3	Place A9 Control Handle in Minimum reduction Position and record the following:			
	a) Brake pipe stabilizing pressure b) BC Pressure should be	4.5 to 4.7 kg/cm^2 0.6 to 1.1 kg/cm^2		
3.4	Place A9 Control Handle from Minimum reduction Position to release position and record the following:			
	a) Brake pipe stabilizing pressure b) BC Pressure should be	5 ± 0.1 kg/cm^2 0.0 kg/cm^2		
3.5	Place A9 Control Handle in Full Service Position and record the following:			
	Full service application by A-9 a) Brake pipe stabilizing pressure b) Time for Brake pipe pressure to stabilize c) Time for BC pressure to build up to 1.7 kg/cm2 For 'Passenger' position For 'Goods' position d) Maximum BC pressure	3.2 to 3.4 kg/cm^2 1.8 ± 0.1 kg/cm^2		

3.6	Release full service application by A-9 a) Time for Brake pipe to charge up to 5.0± 0.1kg/cm^2 b) Time for BC pressure to drop from maximum to 0.4 kg/cm^2 For 'Passenger' position For 'Goods' position		
3.7	Emergency Application by A-9 a) Time for Brake pipe pressure to drop to 0 kg/cm^2. b) Time for BC pressure to build up to 1.7kg/cm^2 For 'Passenger' position For 'Goods' position c) Maximum BC pressure	 1.8 ± 0.1 kg/cm^2	
3.8	**Release after emergency application:** a) Brake pipe charging time upto 5 kg/ cm^2 i) in 'Release' condition of magnet valve ii) in 'Run' condition of magnet valve b) Time for BC pressure to drop from maximum to 0.4 kg/cm^2 For 'Passenger' position For 'Goods' position		
4.0	**SA9 Control Operation**		
4.1	Place SA9 Control Handle in Release Position		
4.2	Place SA9 Control Handle in Full application Position a) Time for BC pressure to build up to 3.3 kg/cm^2 b) Maximum BC pressure	 3.5 ± 0.1 kg/cm^2	
4.3	Independent brake release Time for BC pressure to drop to 0.4 kg/cm^2		

5	**MU-2B Control Valve Operation**		
5.1	MU-2-B Lead position a) A-9 brake valve in any application zone Brake pipe pressure BC pressure a) A-9 brake valve in release position Brake pipe pressure BC pressure b) SA-9 brake valve in application position BC pressure c) SA-9 brake valve in release position BC pressure	 Start dropping Start raising 5.0± 0.1 kg/cm2. 0.0 kg/cm2. 3.5 ± 0.1 kg/cm2. 0.0 kg/cm2.	

5.2	MU-2-B Trail position a) Move A-9 brake valve from 'release' to 'emergency' application position and set MU-2B valve to 'trail' position. Then move A-9 brake valve to i) 'Release' position. Brake pipe pressure BC pressure ii) Full Service position Brake pipe pressure BC pressure b) Move SA-9 brake valve from 'release' to 'application' position BC pressure c) Charge the BP to 5 kg/sq cm. Keeping MU-2B valve in 'lead' position and then set MU-2B valve to 'trail' position. Then move A-9 brake valve to i) Full service: BP pressure BC pressure ii) Emergency: BP pressure will drop BC pressure will not rise	 0.0 kg/cm2. 1.8 ± 0.1 kg/cm2 0.0 kg/cm2. 1.8 ± 0.1 kg/cm2 1.8 kg/cm2. 5.0± 0.1 kg/cm2. 0.0 kg/cm2. Starts dropping 0.0 kg/cm2.	

Annexure-4

Functional Test Scheme of Brake interface Unit (BIU) as per RDSO Specification MP.0.01.00.31, (Latest)

(With BIU)

S.No	Test Parameters	Observations		
		BP	**BC**	**Remarks**
1.0	**Test Setup**			
1.1	Set the Air Brake Panel to LEAD –IN position by operating MU2B Valve.			
1.2	Main reservoir pressure of 8-10 Kg/cm2 is required for the test procedure.			
1.3	Isolating Switch of BIU is in `Isolated` position.			
1.4	Check the BP leakage should not exceed 0.7 kg/cm^2 in 5 minute			
2.0	**Initial setup**			
2.1	Place the SA9 handle & A9 handle in the **RELEASE** position.			
2.2	A9 handle in the **FULL SERVICE** position.	3.4 kg/cm^2.		
2.3	A9 handle in the **RELEASE** position.	5.0 kg/cm^2.		
2.4	Move the SA9 handle in full application.	5.0 kg/cm^2.		
2.5	Place the SA9 handle **RELEASE** position.	5.0 kg/cm^2.		
3.0	**A9 Control Operation**			
3.1	Isolating Switch of BIU is in `Application` position.			
3.2	Ensure Brake Interface Unit is in healthy condition.			
3.3	Place A9 Control Handle in Minimum reduction Position and record the following:			
	a) Brake pipe stabilizing pressure b) BC Pressure should be	4.5 to 4.7 kg/cm^2 0.6 to 1.1 kg/cm^2		
3.4	Place A9 Control Handle from Minimum reduction Position to release position and record the following:			
	a) Brake pipe stabilizing pressure b) BC Pressure should be	5 ± 0.1 kg/cm^2 0.0 kg/cm^2		
3.5	Place A9 Control Handle in Full Service Position and record the following:			
	Full service application by A-9 a) Brake pipe stabilizing pressure b) Time for Brake pipe pressure to stabilize c) Time for BC pressure to build up to 1.7 kg/cm^2 For 'Passenger' position For 'Goods' position d) Maximum BC pressure	3.2 to 3.4 kg/cm^2 1.8 ± 0.1 kg/cm^2		
3.6	Release full service application by A-9			

	a) Time for Brake pipe to charge up to 5.0± 0.1kg/cm^2 b) Time for BC pressure to drop from maximum to 0.4 kg/cm^2 For 'Passenger' position For 'Goods' position		
3.7	Emergency Application by A-9 a) Time for Brake pipe pressure to drop to 0 kg/cm^2. b) Time for BC pressure to build up to 1.7kg/cm^2 For 'Passenger' position For 'Goods' position c) Maximum BC pressure	 1.8 ± 0.1 kg/cm^2	
3.8	**Release after emergency application:** a) Brake pipe charging time upto 5 kg/ cm^2 i) in 'Release' condition of magnet valve ii) in 'Run' condition of magnet valve b) Time for BC pressure to drop from maximum to 0.4 kg/cm^2 For 'Passenger' position For 'Goods' position		
4.0	**SA9 Control Operation**		
4.1	Place SA9 Control Handle in Release Position		
4.2	Place SA9 Control Handle in Full application Position a) Time for BC pressure to build up to 3.3 kg/cm^2 b) Maximum BC pressure	 3.5 ± 0.1 kg/cm^2	
4.3	Independent brake release Time for BC pressure to drop to 0.4 kg/cm^2		

5	**MU-2B Control Valve Operation**		
5.1	MU-2-B Lead position a) A-9 brake valve in any application zone Brake pipe pressure BC pressure a) A-9 brake valve in release position Brake pipe pressure BC pressure b) SA-9 brake valve in application position BC pressure c) SA-9 brake valve in release position BC pressure	 Start dropping Start raising 5.0± 0.1 kg/cm2. 0.0 kg/cm2. 3.5 ± 0.1 kg/cm2. 0.0 kg/cm2.	

5.2	MU-2-B Trail position a) Move A-9 brake valve from 'release' to 'emergency' application position and set MU-2B valve to 'trail' position. Then move A-9 brake valve to i) 'Release' position. Brake pipe pressure BC pressure ii) Full Service position Brake pipe pressure BC pressure b) Move SA-9 brake valve from 'release' to 'application' position BC pressure c) Charge the BP to 5 kg/sq cm. Keeping MU-2B valve in 'lead' position and then set MU-2B valve to 'trail' position. Then move A-9 brake valve to i) Full service: BP pressure BC pressure ii) Emergency: BP pressure will drop BC pressure will not rise	 0.0 kg/cm^2. 1.8 ± 0.1 kg/cm^2 0.0 kg/cm2. 1.8 ± 0.1 kg/cm^2 1.8 kg/cm^2. 5.0± 0.1 kg/cm^2. 0.0 kg/cm^2. Starts dropping 0.0 kg/cm^2.		
6.0	**Control Operation by BIU** (Also record time of application and release w.r.t. BP & BC in FSB & EB)			
6.1	Operate normal brake (BP Pressure 0.6 drop) application by BIU			
6.2	Release normal brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			
6.3	Operate full service brake (BP Pressure 1.5 drop) by BIU			
6.4	Release full service brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			
6.5	Operate Emergency Brake (EB) by BIU.			
6.6	Release Emergency Brake (EB) by BIU.			
7.0	KAVACH **/LOCO-Pilot High Brake Command Checking for A9**			
7.1	Operate normal brake (BP Pressure 0.6 drop) by BIU			
7.2	Place A9 Control Handle in Full Service Position			
7.3	Place A9 Control Handle in Release position			
7.4	Place A9 Control Handle in Emergency Position			
7.5	Place A9 Control Handle in Release position			
7.6	Release normal brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			
7.7	Place A9 Control Handle in Minimum service Position			

7.8	Operate Full service brake (BP Pressure 1.5 drop) by BIU			
7.9	Place A9 Control Handle in Emergency Position			
7.10	Place A9 Control Handle in Release Position			
7.11	Release full service brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			
7.12	A9 Control Handle in Minimum Position			
7.13	Operate Emergency Brake by BIU			
7.14	Release Emergency Brake (EB) by BIU			
7.15	A9 Control Handle in Full Service Position			
7.16	Operate Emergency Brake by BIU			
7.17	Release Emergency Brake (EB) by BIU			
7.18	Place A9 Control Handle in Release Position			

8.0	Control Operation by BIU for Light Engine (Activate light engine logic in BIU)			
8.1	Operate Normal Brake (0.6 drop) application for BP and apply 1.2 Kg for BC by BIU.			
8.2	Release normal brake (BP Pressure build to 5+_0.1kg/cm2) application for BP and release brake for BC by BIU			
8.3	Operate Full service brake (BP Pressure 1.5 drop) by BIU			
8.4	Release full service brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			
8.5	Operate Emergency Brake (EB) by BIU.			
8.6	Release Emergency Brake (EB) by BIU.			
Control Operation by BIU for Light Engine (Activate light engine logic in BIU) (Also record time of application and release w.r.t. BP & BC) In case of FS & EB, maximum BC 3.5 Kg/cm2 & record time to build BC up to 3.3 kg/cm2.				
Passenger Mode				
8.7	Operate normal brake (BP pressure 0.6 drop) application by BIU			
8.8	Release normal brake (BP Pressure build to 5+_0.1kg/cm2) application by BIU			
8.9	Operate Full service brake (BP Pressure 1.5 drop) by BIU			
8.10	Release full service brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			

8.11	Operate Emergency Brake (EB) by BIU.			
8.12	Release Emergency Brake (EB) by BIU.			
	Goods Mode			
8.13	Operate normal brake (BP pressure 0.6 drop) application by BIU			
8.14	Release normal brake (BP Pressure build to 5+_0.1kg/cm2) application by BIU			
8.15	Operate Full service brake (BP Pressure 1.5 drop) by BIU			
8.16	Release full service brake (BP Pressure build to 5+_0.1kg/cm2) by BIU			
8.17	Operate Emergency Brake (EB) by BIU.			
8.18	Release Emergency Brake (EB) by BIU.			

9.0	KAVACH /Loco-pilot High brake command checking for SA9			
9.1	Operate normal brake (BC Pressure build to 1.2+_0.1kg/cm2,configurable) by BIU			
9.2	Place SA9 Control Handle in Middle Position.			
9.3	Place SA9 Control Handle in Release position.			
9.4	Place SA9 Control Handle in Full Service Position.			
9.5	Place SA9 Control Handle in Release position.			
9.6	Release normal brake (BC Pressure drop to 0+_0.1kg/cm2) by BIU			
9.7	Place SA9 Control Handle in Middle Position.			
9.8	Operate Full service brake (BC Pressure build to 2.4+_0.1kg/cm2) by BIU			
9.9	Place SA9 Control Handle in Full Service Position.			
9.10	Place SA9 Control Handle in Release Position.			
9.11	Release full service brake (BC Pressure drop to 0+_0.1kg/cm2) by BIU			
9.12	SA9 Control Handle in Middle Position			
9.13	Operate Emergency Brake (EB) by BIU			
9.14	Release Emergency Brake (EB) by BIU.			
9.15	Place SA9 Control Handle in Release Position			
9.16	Deactivate Light Engine circuit in BIU		-	

10.	Simulated Failures of BIU`s Valves (Check the behavior of BIU emergency and A9, SA9 functionality)	Observation (Record BP & BC pressure in each application)						
		NB (BIU)	FSB (BIU)	EB (BIU)	A9 FS	A9 EB	SA9 FS	Remarks (Whether BIU take any action on failure simulation automatically) -
		BP= BC=	BP= BC=	BP= BC=	BP= BC=	BP= BC=	BP= BC=	
10.1	Remove the power connector from MR solenoid valve/MR COC							Need to open the BIU and remove the wiring of internal solenoid valve to simulate the failures. During the production cycle, after completion of wiring will verify the insulation test as part of procedures. To simulate the failures need to open the unit and tamper the wiring causes to re-conduct the complete production cycle. This is not recommended for a production item for delivery. Also may causes the failure of these solenoid valves and VPC due to surges as trying to remove the connectors manually during power on and loaded Condition. As these failures are verified during prototype validation.
10.2	Connect the power connector to MR solenoid valve/MR COC							
10.3	Remove the power connector from BP-VPC/A9 Supply valve	BIU will be isolated after 10 Sec. of VPC Power disconnected.						
10.4	Connect the power connector to BP-VPC/A9 Supply valve							
10.5	Remove the power connector from BC-VPC/SA9 Supply valve							
10.6	Connect the power connector to BC-VPC/SA9 Supply valve							
10.7	Remove the power connector from BP solenoid valve/A9 Selection valve							
10.8	Connect the power to BP solenoid valve/A9 selection valve.							
10.9	Remove the power connector from BC solenoid valve/SA9 Selection valve							
10.10	Connect the power to BC solenoid valve/SA9 Selection valve							
10.11	Remove the power connector from Emergency Valve							
10.12	Connect the power connector from Emergency Valve							
10.13	Remove the power for BV out valve/BP Cutout valve							
10.14	Connect the power for BV out valve/BP Cutout valve							

10.15	Remove the BP Pressure Sensor connector.							
10.16	Remove the BPTP Pressure sensor connector /A9 Control handle Pressure sensor connector							
10.17	Remove the BC Pressure Sensor connector.							
10.18	Remove the BCTP pressure sensor connector /SA9 control handle pressure sensor connector							
10.19	Remove the MR Pressure Sensor connector.							

After NB application (BP 4.4 Kg/cm2 through KAVACH**)**

10.	Simulated Failures of BIU`s Valves (Check the behavior of BIU emergency and A9, SA9 functionality)	Observation (Record BP & BC pressure in each application)						
		NB (BIU)	**FSB (BIU)**	**EB (BIU)**	**A9 FS**	**A9 EB**	**SA9 FS**	**Remarks (Whether BIU take any action on failure simulation automatically) -**
		BP= BC=	**BP= BC=**	**BP= BC=**	**BP= BC=**	**BP= BC=**	**BP= BC=**	
10.1	Remove the power connector from MR solenoid valve/MR COC							Need to open the BIU and remove the wiring of internal solenoid valve to simulate the failures. During the production cycle, after completion of wiring will verify the insulation test as part of procedures. To simulate the failures need to open the unit and tamper the wiring causes to re-conduct the complete production cycle. This is not recommended for a production item for delivery. Also may causes the failure of these solenoid valves and VPC due to surges as trying to remove the connectors manually during power on and loaded Condition. As these failures are verified during prototype validation.
10.2	Connect the power connector to MR solenoid valve/MR COC							
10.3	Remove the power connector from BP-VPC/A9 Supply valve	BIU will be isolated after 10 Sec. of VPC Power disconnected.						
10.4	Connect the power connector to BP-VPC/A9 Supply valve							
10.5	Remove the power connector from BC-VPC/SA9 Supply valve							
10.6	Connect the power connector to BC-VPC/SA9 Supply valve							
10.7	Remove the power connector from BP solenoid valve/A9 Selection valve							
10.8	Connect the power to BP solenoid valve/A9 selection valve.							
10.9	Remove the power connector from BC solenoid valve/SA9 Selection valve							
10.10	Connect the power to BC solenoid valve/SA9 Selection valve							
10.11	Remove the power connector from Emergency Valve							
10.12	Connect the power connector from Emergency Valve							
10.13	Remove the power for BV out valve/BP Cutout valve							
10.14	Connect the power for BV out valve/BP Cutout valve							

10.15	Remove the BP Pressure Sensor connector.							
10.16	Remove the BPTP Pressure sensor connector /A9 Control handle Pressure sensor connector							
10.17	Remove the BC Pressure Sensor connector.							
10.18	Remove the BCTP pressure sensor connector /SA9 control handle pressure sensor connector							
10.19	Remove the MR Pressure Sensor connector.							

Note:

1. Tests mentioned in **Para 3, 4, 5 and 10** are to be repeated with **BIU OFF (Isolated)** condition.
2. Observation for **Para 3, 4 and 5** may also be recorded **without BIU** in circuit for comparison.
3. Reference: MP.TP.29/87 (Test Programme for Diesel Electric Locomotives Equipped With IBAB-1 Twin Pipe Pure Air Brake System)
4. Tests mentioned in Para 10 are to be repeated after applying NB by BIU.

Annexure-5

BIU Functional Test Procedure On Test Bench with 5 Control Systems

Table of Contents

1 Brake Interface Unit (BIU) Test Setup Overview

BIU test setup consists of 1 BIU Unit, 1 DPCS Simulator, 1 KAVACH Simulator, TSS1 Simulator, TSS2 Simulator and TSS3 Simulator.

DPCS, KAVACH simulator & TSS Simulators are for generating Brake commands.

2 Brake Command checking through KAVACH (CAN-1) Communication port in Single Locomotive:

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.

2.1 A9 Brake Command checking through *KAVACH*:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BP drop Command***" from KAVACH as **4.4 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BP drop Command***" from KAVACH as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BP drop Command***" from KAVACH as **3.5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BP drop Command***" from KAVACH as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BP drop Command***" from KAVACH as **0 Kg/Cm^2**	BP value should be **0.0 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BP drop Command***" from KAVACH as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		

2.2 SA9 Brake Command checking through *KAVACH*:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BC raise Command***" from KAVACH as **1.0 Kg/Cm^2**	BC value should be **1.0 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BC raise Command***" from KAVACH as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BC raise Command***" from KAVACH as **2.0 Kg/Cm^2**	BC value should be **2.0 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BC raise Command***" from KAVACH as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

e)	Through Application software Set the "***BC raise Command***" from KAVACH as **3.5 Kg/Cm^2**	BC value should be **3.5 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BC raise Command***" from KAVACH as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

3 Brake Command checking through TSS1 (CAN-3) Communication port in Single Locomotive:

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.

3.1 A9 Brake Command checking through TSS1:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BP drop Command***" from TSS1 as **4.4 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BP drop Command***" from TSS1 as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BP drop Command***" from TSS1 as **3.5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BP drop Command***" from TSS1 as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BP drop Command***" from TSS1 as **0 Kg/Cm^2**	BP value should be **0.0 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BP drop Command***" from TSS1 as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		

3.2 SA9 Brake Command checking through TSS1:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BC raise Command***" from TSS1 as **1.0 Kg/Cm^2**	BC value should be **1.0 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BC raise Command***" from TSS1 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BC raise Command***" from TSS1 as **2.0 Kg/Cm^2**	BC value should be **2.0 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BC raise Command***" from TSS1 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

e)	Through Application software Set the "***BC raise Command***" from TSS1 as **3.5 Kg/Cm^2**	BC value should be **3.5 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BC raise Command***" from TSS1 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

4 Brake Command checking through TSS2 (CAN-3) Communication port in Single Locomotive :

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.

4.1 A9 Brake Command checking through TSS2:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BP drop Command***" from TSS2 as **4.4 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BP drop Command***" from TSS2 as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BP drop Command***" from TSS2 as **3.5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BP drop Command***" from TSS2 as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BP drop Command***" from TSS2 as **0 Kg/Cm^2**	BP value should be **0.0 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BP drop Command***" from TSS2 as **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		

4.2 SA9 Brake Command checking through TSS2:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BC raise Command***" from TSS2 as **1.0 Kg/Cm^2**	BC value should be **1.0 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BC raise Command***" from TSS2 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BC raise Command***" from TSS2 as **2.0 Kg/Cm^2**	BC value should be **2.0 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BC raise Command***" from TSS2 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

e)	Through Application software Set the "***BC raise Command***" from TSS2 as **3.5 Kg/Cm^2**	BC value should be **3.5 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BC raise Command***" from TSS2 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

5 Brake Command checking through TSS3 (CAN-3) Communication port in Single Locomotive:

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.

5.1 A9 Brake Command checking through TSS3:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BP drop Command***" from TSS3 as **4.4 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BP drop Command***" from TSS3 as **5 Kg/Cm^2**	BP value should be **5 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BP drop Command***" from TSS3 as **3.5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BP drop Command***" from TSS3 as **5 Kg/Cm^2**	BP value should be **5 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BP drop Command***" from TSS3 as **0 Kg/Cm^2**	BP value should be **0 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BP drop Command***" from TSS3 as **5 Kg/Cm^2**	BP value should be **5 ± 0.1 Kg/Cm^2**		

5.2 SA9 Brake Command checking through TSS3:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BC raise Command***" from TSS3 as **1.0 Kg/Cm^2**	BC value should be **1.0 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BC raise Command***" from TSS3 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BC raise Command***" from TSS3 as **2.0 Kg/Cm^2**	BC value should be **2.0 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BC raise Command***" from TSS3 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
e)	Through Application software	BC value should be **3.5 ± 0.1**		

	Set the "***BC raise Command***" from TSS3 as **3.5 Kg/Cm^2**	**Kg/Cm^2**		
f)	Through Application software Set the "***BC raise Command***" from TSS3 as **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

6 Higher Brake Intensity Command Checking in Single Locomotive

6.1 A9 Higher Brake Intensity Command Checking:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BP drop Command***" as per below i. KAVACH as **5 Kg/Cm^2** ii. TSS1 as **5 Kg/Cm^2** iii. TSS2 as **5 Kg/Cm^2** iv. TSS3 as **5 Kg/Cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/Cm^2** ii. TSS1 as **5 Kg/Cm^2** iii. TSS2 as **5 Kg/Cm^2** iv. TSS3 as **5 Kg/Cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/Cm^2** ii. TSS1 as **3.5 Kg/Cm^2** iii. TSS2 as **5 Kg/Cm^2** iv. TSS3 as **5 Kg/Cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/Cm^2** ii. TSS1 as **3.5 Kg/Cm^2** iii. TSS2 as **2.5 Kg/Cm^2** iv. TSS3 as **5 Kg/Cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **2.5 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/Cm^2** ii. TSS1 as **3.5 Kg/Cm^2** iii. TSS2 as **2.5 Kg/Cm^2** iv. TSS3 as **2.0 Kg/Cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2.**	BP value should be **2.0 ± 0.1 Kg/Cm^2**		

f)	Through Application software Set the "***BP drop Command***" as per below i. KAVACH as **4.4 Kg/Cm^2** ii. TSS1 as **3.5 Kg/Cm^2** iii. TSS2 as **2.5 Kg/Cm^2** iv. TSS3 as **2.0 Kg/Cm^2** Place A9 handle position in LEAD locomotive to EB (**0 Kg/Cm^2**)	BP value should be **0.0 ± 0.1 Kg/Cm^2**		
g)	Through Application software Set the "***BP drop Command***" as per below i KAVACH as **5 Kg/Cm^2** ii. TSS1 as **5 Kg/Cm^2** iii. TSS2 as **5 Kg/Cm^2** iv. TSS3 as **5 Kg/Cm^2** Place A9 handle position in LEAD locomotive to release value **5 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		

6.2 SA9 Higher Brake Intensity Command Checking:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	Through Application software Set the "***BC raise Command***" as per below i. KAVACH as **0 Kg/Cm^2** ii. TSS1 as **0 Kg/Cm^2** iii. TSS2 as **0 Kg/Cm^2** iv. TSS3 as **0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/Cm^2** ii. TSS1 as **0 Kg/Cm^2** iii. TSS2 as **0 Kg/Cm^2** iv. TSS3 as **0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**	BC value should be **1.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/Cm^2** ii. TSS1 as **1.5 Kg/Cm^2** iii. TSS2 as **0 Kg/Cm^2** iv. TSS3 as **0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**	BC value should be **1.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BC raise Command***" as per below	BC value should be **2.0 ± 0.1 Kg/Cm^2**		

	i. KAVACH as **1 Kg/Cm^2** ii. TSS1 as **1.5 Kg/Cm^2** iii. TSS2 as **2.0 Kg/Cm^2** iv. TSS3 as **0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**			
e)	Through Application software Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/Cm^2** ii. TSS1 as **1.5 Kg/Cm^2** iii. TSS2 as **2.0 Kg/Cm^2** iv. TSS3 as **3.0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**	BC value should be **3.0 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BC raise Command***" as per below i. KAVACH as **1 Kg/Cm^2** ii. TSS1 as **1.5 Kg/Cm^2** iii. TSS2 as **2.0 Kg/Cm^2** iv. TSS3 as **3.0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to full service value **3.5 Kg/Cm^2**	BC value should be **3.5 ± 0.1 Kg/Cm^2**		
g)	Through Application software Set the "***BC raise Command***" as per below i. KAVACH as **0 Kg/Cm^2** ii. TSS1 as **0 Kg/Cm^2** iii. TSS2 as **0 Kg/Cm^2** iv. TSS3 as **0 Kg/Cm^2** Place SA9 handle position in LEAD locomotive to release value **0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

7 Traction CutOff Checking in Single Locomotive

Place A9 & SA9 handles of LEAD locomotive in RELEASE position.

7.1 Traction CutOff checking during A9 Brake Command application:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	i) Through Application software Set the "***BP drop Command***" from KAVACH as **4.4 Kg/Cm^2.**	i) Power Cut Off relay should energize to cutoff the traction. BP value should be **4.4 ± 0.1 Kg/Cm^2**		
	ii) Through Application software Set the "***BP drop Command***" from KAVACH as **5.0 Kg/Cm^2.**	ii) Power Cut Off relay should de-energize. BP value should be **5.0 ± 0.1 Kg/Cm^2**		

7.2 Traction CutOff checking during SA9 Brake Command application:

S. No	Test Description	Expected Result	Observed Result in LEAD Locomotive	Remarks
a)	i) Through Application software Set the "***BC raise Command***" from KAVACH as **2.0 Kg/Cm^2.** iii) Through Application software Set the "***BC raise Command***" from KAVACH as **0.0 Kg/Cm^2.**	i)Power Cut Off relay should energize to cutoff the traction BC value should be **$_{2.0}$ ± 0.1 Kg/Cm^2** ii) Power Cut Off relay should de-energize. BC value should be **0.0 ± 0.1 Kg/Cm^2**		

8 BIU Isolation checking in LEAD locomotive

S.No	Test Description	Expected Result	Observed Results	Remarks
1	Keep **ISOLATION** rotary switch in **ISOLATION** position and verify the status of LED's on BIU	**BIU Mode** LED should switch off.		
2	Operate Normal Brake (NB)	**BP:** 5 ± 0.1 Kg/cm^2 **BC:** 0 ± 0.1 Kg/ cm^2		
3	Release Normal Brake (NB)	**BP:** 5 ± 0.1 Kg/cm^2 **BC:** 0 ± 0.1 Kg/ cm^2		
3	Now Place SA9 Control Handle in Full Service Position & A9 handle in the Emergency position.	**BP:** 0 ± 0.1 Kg/cm^2 **BC:** 3.5 ± 0.1 Kg/ cm^2		
4	Now Place SA9 Control Handle in Release Position & A9 handle in the Release position.	**BP:** 5 ± 0.1 Kg/cm^2 **BC:** 0 ± 0.1 Kg/ cm^2		

9 Brake Synchronization Testing in REMOTE locomotive Locomotive thorugh DPWCS (CAN-2) Communication port:

Select DPCS/DPWCS remote option in DPCS/DPWCS Simulator and give the commands to Brake Interface Unit through CAN communication port.

9.1 A9 Brake Synchronization checking in REMOTE locomotive

S. No	Test Description	Expected Result	Observed Result in REMOTE Locomotive	Remarks
a)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **4.4 Kg/Cm^2**	BP value should be **4.4 ± 0.1 Kg/Cm^2**		
b)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **3.5 Kg/Cm^2**	BP value should be **3.5 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **2.5 Kg/Cm^2**	BP value should be 2.5 **± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		
g)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **0.0 Kg/Cm^2**	BP value should be **0.0 ± 0.1 Kg/Cm^2**		
h)	Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as **5.0 Kg/Cm^2**	BP value should be **5.0 ± 0.1 Kg/Cm^2**		

9.2 SA9 Brake Synchronization checking in REMOTE locomotive

a)	Through Application software Set the "***BC raise Command***" from DPCS/DPWCS remote as **1.0 Kg/Cm^2**	BC value should be **1.0 ± 0.1 Kg/Cm^2**		

b)	Through Application software Set the "***BC raise Command***" from DPCS/DPWCS remote as **0.0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
c)	Through Application software Set the "***BC raise Command***" from DPCS/DPWCS remote as **2.0 Kg/Cm^2**	BC value should be **2.0 ± 0.1 Kg/Cm^2**		
d)	Through Application software Set the "***BC raise Command***" from DPCS/DPWCS remote as **0.0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		
e)	Through Application software Set the "***BC raise Command***" from DPCS/DPWCS remote as **3.5 Kg/Cm^2**	BC value should be **3.5 ± 0.1 Kg/Cm^2**		
f)	Through Application software Set the "***BC raise Command***" from DPCS/DPWCS remote as **0.0 Kg/Cm^2**	BC value should be **0.0 ± 0.1 Kg/Cm^2**		

9.3 BV Out Valve Operation Checking in REMOTE locomotive

a)	i) Create Communication fail between DPCS/DPWCS & BIU of remote locomotive. ii) Through Application software Set the "***BP drop Command***" from DPCS/DPWCS remote as 3.**5 Kg/Cm^2** iii) Recover Communication fail between DPCS/DPWCS & BIU of LEAD locomotives. iv) Change A9 handle pressure in LEAD locomotive to release value **5.0 ± 0.1 Kg/Cm^2**	i) BV Out valve in REMOTE locomotive shall be blocked/closed not allowing charging or discharging from REMOTE locomotive brake system. ii) BV Out valve in REMOTE locomotive shall be in blocked/closed not allowing charging or discharging from REMOTE locomotive brake system. iii) BP Cut-OFF valve in REMOTE locomotive shall be opened allowing charging/discharging from the REMOTE locomotive brake system BP value should be **3.5 ± 0.1 Kg/Cm^2.** iv) BP charging in REMOTE locomotive should occur, BP value should be **5.0 ± 0.1 Kg/Cm^2**.		

10 Traction CutOff Checking

Place A9 & SA9 handles of REMOTE locomotive in RELEASE position.

10.1 Traction CutOff checking during A9 Brake Command application:

S. No	Test Description	Expected Result	Observed Result in REMOTE	Remarks

			Locomotive	
a)	i) Through Application software Set the "***BP drop Command***" from KAVACH as **4.4 Kg/Cm^2.** ii) Through Application software Set the "***BP drop Command***" from KAVACH as **5.0 Kg/Cm^2.**	i) Power Cut Off relay should energize to cutoff the traction. BP value should be **4.4 ± 0.1 Kg/Cm^2** ii) Power Cut Off relay should de-energize. BP value should be **5.0 ± 0.1 Kg/Cm^2**		

10.2 Traction CutOff checking during SA9 Brake Command application:

S. No	Test Description	Expected Result	Observed Result in REMOTE Locomotive	Remarks
a)	i) Through Application software Set the "***BC raise Command***" from KAVACH as **2.4 Kg/Cm^2.** iii) Through Application software Set the "***BC raise Command***" from KAVACH as **0.0 Kg/Cm^2.**	i)Power Cut Off relay should energize to cutoff the traction BC value should be 2**.4 ± 0.1 Kg/Cm^2** ii) Power Cut Off relay should de-energize. BC value should be **0.0 ± 0.1 Kg/Cm^2**		

11 BIU Valves & Sensors Failures Simulation in REMOTE Locomotive

S.No	Test Condition	Observation(Record BP & BC pressure)			
		FSB	EB	SA9 FSB	Remarks
		BP= BC=	BP= BC=	BP= BC=	Need to open the BIU and remove the wiring of internal solenoid valve to simulate the failures. During the production cycle, after completion of wiring will verify the insulation test as part of procedures. To simulate the failures need to open the unit and tamper the wiring causes to re-conduct the complete production cycle. This is not recommended for a production item for delivery. Also may causes the failure of these solenoid valves and VPC due to surges as trying to remove the connectors manually during power on and loaded Condition.
1	Remove the power connector from MR Solenoid valve (Valve-1)				
2	Connect the power connector to MR Solenoid valve (Valve-1)				
3	Remove the power connector from BP-VPC	BIU will be isolated after 10 Sec. of VPC Power disconnected.			
4	Connect the power connector to BP-VPC				
5	Remove the power connector from BC-VPC				
6	Connect the power connector to BC-VPC				
7	Remove the power connector from BP Solenoid valve (Valve-2)				
8	Connect the power to BP Solenoid valve (Valve-2)				
9	Remove the power connector from BC Solenoid valve (Valve-3)				

10	Connect the power to Pilot BC Solenoid valve (Valve-3)				As these failures are verified during prototype validation.
11	Remove the power connector from Emergency Valve				
12	Connect the power connector from Emergency Valve				
13	Remove the power for BV out Valve.				
14	Connect the power connector BV out Valve.				
15	Remove the BP Pressure Sensor connector.				
16	Remove the BPTP Pressure Sensor connector. (A9 Control handle sensor)				
17	Remove the BC Pressure Sensor connector.				
18	Remove the BCTP Pressure Sensor connector.				
19	Remove the MR Pressure Sensor connector.				

12 BIU Isolation checking in REMOTE locomotive

S.No	Test Description	Expected Result	Observed Results	Remarks
1	Keep **ISOLATION** rotary switch in **ISOLATION** position and verify the status of LED's on BIU.	**BIU Mode** LED should switch off.		
2	Now in LEAD locomotive place SA9 Control Handle in Full Service Position & A9 handle in the Full Service position. Through Application software Set the "***BP drop Command***" as **3.5 Kg/cm^2** and "**BC drop Command"** as **3.5 Kg/cm^2** from DPCS/DPWCS remote.	i) BP should not discharge and BC should not build from REMOTE locomotive. BV Out valve in REMOTE locomotive shall be in de-energize state. **REMOTE BC:** 0 ± 0.1 Kg/ cm^2		
3	Through Application software Set the "***BP drop Command***" as **5.0 Kg/cm^2** and "**BC drop Command"** as **0.0 Kg/cm^2** from DPCS/DPWCS remote.	i) BP should not charge from REMOTE locomotive. BV Out valve in REMOTE locomotive shall be in energize state. **REMOTE BC:** 0 ± 0.1 Kg/ cm^2		

13 CAN Communication Interface Testing

13.1 CAN Communication Interface Testing with DPCS/DPWCS

S. No	Test Description	Expected Result	Observed Result in LEAD Unit	Remarks

1	BIU Heartbeat transmission checking.	Heart Beat should transfer for every 500 msec.		
2	DPCS/DPWCS Heartbeat transmission.	Heart Beat should transfer for every 500 msec.		
3	BIU to DPCS/DPWCS Command Data transmission checking	Command Data transmission shall occur for every 250 msec. Pressure values should update onDPCS/ DPWCS display		
4	DPCS/DPWCS to BIU Command Data transmission checking	Command Data transmission shall occur for every 250 msec.		
5	Fault Codes exchange checking	Remove BP sensor connector and observe the DPCS/DPWCS display		

13.2 CAN Communication Interface Testing with *KAVACH*, TSS1, TSS2, TSS3 in LEAD Unit

S. No	Test Description	Expected Result	Observed Result with KAVACH	Observed Result with TSS-1	Observed Result with TSS-2	Observed Result with TSS-3
1	BIU Heartbeat transmission checking.	Heart Beat should transfer for every 500 msec.				
2	TSS's Heartbeat transmission.	Heart Beat should transfer for every 500 msec.				
3	BIU to TSS's Command Data transmission checking	Command Data transmission shall occur for every 250 msec.				
4	TSS's to BIU Command Data transmission checking	Command Data transmission shall occur for every 250 msec.				

14 Event Recorder Verification

S.No	Test Description	Expected Result	Observed Results	Remarks
1	Events recording at event change over	Events to be recorded whenever there is a change		
2	Apply formation brake till there is a drop in BP by 0.3 kg/cm^2 value.	Event recording when condition satisfy		
3	Release formation brake till there is a raise in BP by 0.3 kg/cm^2 value.	Event recording when condition satisfy		
4	Apply Independent brake till there is a raise in BC by 0.3 kg/cm^2 value.	Event recording when condition satisfy		
5	Release Independent brake till there is a drop in BC by 0.3 kg/cm2 value.	Event recording when condition satisfy		
6	Valves Self Check	Event recording when condition satisfy		

7	Create Sensor faults & Valves Faults	Fault Data Pack Recording with all parameters		
8	Apply NB through KAVACH/DPCS /DPWCS/TSS and now through A9 Handle apply FSB (BIU Brake command override by Loco pilot brake command)	Event recording when condition satisfy		
9	Apply NB through A9 Handle and now apply FSB through KAVACH /DPCS/DPWCS /TSS (Loco pilot brake command override by BIU Brake command)	Event recording when condition satisfy		
10	Download Cumulative Counters	Isolation counters & duration, Application duration, Brake application counters & duration,		
11	Connect Laptop and open Online Data Logging application	Log file should be downloaded into Pen drive/Laptop		

PART-B

1. MINIMUM REQUIREMENTS OF INFRASTRUCTURE, MANUFACTURING, TESTING & QUALITY CONTROL FOR APPROVAL OF MANUFACTURER

1.1 The manufacturer should have acquired ISO: 9000 series certification for manufacturing of Brake Interface Unit (BIU) for **KAVACH (The Indian Railway ATP)** and Distributed Power Control System for Diesel Locomotive and Distributed power Wireless control system(DPWCS) for Electric Locomotive fitted with IRAB class of brake system.

1.2 The manufacturer shall have at least the following infrastructure and manufacturing facilities:

1.2.1 Adequate space and covered area with robust floor to accommodate the following:

a. Damp-free space for storage of raw materials
b. Manufacturing Activities
c. Finishing
d. Inspection and Testing
e. Storage and dispatch of finished products

1.2.2 **M&P requirement:** The following is the indicative list of Machineries and Plant to be available with the firm or its sub-vendor, as the case may be. The capacity of the machines shall be suitable for manufacturing the required job:

S.No.	Manufacturing Facilities
1.	Machine(s) having facilities of Bending, Cutting, Machining, Punching, shearing and bending facility
2.	Drill machine
3.	Cleaning and degreasing facilities like Aqueous cleaner
4.	Temperature controlled soldering & De-soldering station
5.	Welding Machine

3. List of Measuring and Testing Equipment

The firm shall have facilities and major equipment's needed for conducting test as follows:

A. **Measuring instruments**:

S.No.	Equipment/Facility
1.	Digital LCRQ meter
2.	Digital storage Oscilloscope
3.	Digital multimeter having the facility of diode & transistor testing.
4.	Fiber Optic Loss Insertion and Measurement Kit (where OFC is used)
5.	Function generator
6.	Hot & cold climate chambers for temperature cycling (Environmental

	Stress Screening (ESS) for PCB and subsystem).
7.	Humidity Chamber
8.	Hygrometer
9.	Insulation Resistance tester (Megger)
10.	Micrometer
11.	Oven
12.	Pressure Gauge
13.	Scale
14.	Torque wrench
15.	Variable DC power supply of suitable current capacity as required
16.	Vernier Caliper
17.	Weighing Machine

B. Test bench/ Equipment's

S.N.	Facility
1.	Well-equipped Test bench to check control operations. Brake command, Synchronization, cutoff and CAN communication and rest all functioning procedure are performed through the Test Bench as per Annexure in specification MP.0.01.00.31 (Latest)
2.	Specialized test stations for testing electronic sub-assemblies/PCBs
3.	Computer aided design system Workstation with Auto Cads facility

1.3 Quality Control Requirements

1. The manufacturer shall have a system of easy traceability of the product from raw material stage to finished product stage
2. The manufacturer shall submit Quality Assurance Plan (QAP) as per the standard format. QAP shall cover all aspects of process/ quality control requirement to obtain quality product
3. The manufacturer shall have a system to ensure that Equipment's are checked dimensionally and functionally prior to release for production and records of these checks are maintained.
4. The calibration of the Testing/Measuring Equipment's/Weighing machines should be done at least once in a year unless stated otherwise.
5. The manufacturer should have a Quality Manual indicating the extent of control over manufacturing and testing.
6. The manufacturer shall have a system of review of rejections detailing rejection rate, cause of rejection, corrective action taken etc. on regular basis and records thereof should be maintained.
7. The manufacturer shall have a system of documentation in respect of rejection at customer end, warranty replacement and failure of BIU in service.
8. The manufacturer should have a system of recording plant, machinery & control equipments remaining out of service, nature of repairs done etc.
9. Latest versions of relevant specifications and drawings shall be available with the manufacturer.

1.4. Qualification and Training:

1. Training needs for all personnel should be identified. Regular training should be organized covering personnel identified for a particular period.
2. The Inspection/Quality Control section should be headed by a graduate Engineer with at least 5 years' experience or a Diploma holder with at least 10 years' experience
3. Inspection staff conducting non-destructive testing should be adequately trained & qualified by recognized agency and should have adequate experience.
4. Laboratory and Shift Engineers shall have a minimum qualification either a Diploma or a Degree in Engineering (Mechanical or Electrical).