

SpecificationNo:	MP.0.0400.02 Part-2	Revision No: 4-d1	Date Issued: 07/12/2015
Specification Title: DPCS – Onboard Equipment on Locomotives with μ P-Controls/Analog Traction Control and IRAB			

REVISION HISTORY

Kindly see part 0 of the specification

FINAL DRAFT

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LIST OF REFERENCED DOCUMENTS

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0 Introduction

This document is a part of a set of documents specifying the requirements of distributed power control system for AC-DC diesel electric locomotives. Kindly see the list of referenced documents to locate other documents of the set. This part of the specification must be read in conjunction with part 0 of the specification.

1 Objectives and Scope of the specification

This document describes the requirements of onboard equipment for DPCS for locomotives equipped with the microprocessor based traction control system/Analog traction system and IRAB. This specification shall be applicable for the following class of locomotives:

S. No.	Loco Class	Traction Control	Brake Control
1	WDG ₃ , WDM ₃	AC-DC μ P based traction control system	IRAB
2	WDG ₃ , WDM ₃ , WDM ₂ WDP ₃ , WDP ₁	AC-DC Analog traction control system	IRAB

Table 1: List of locomotive class to which this specification applies

2 Terminology/Abbreviations / Definitions

Kindly refer common list in part 0 of the specification.

3 Referred standards

The following standards are referred by this specification. It is requested to kindly ensure operational understanding of all the referred standards.

- AAR S-5702
- AAR S-590
- AAR S-591
- IEC 60297
- IEC 60571
- IEC 60812
- IS 2500

4 Pre-requisites

4.1 Equipment manufacturers qualification

Manufacturer of the equipment shall be an RDSO approved supplier of the MBCS for diesel-electric locomotives.

In case of third party supply, the DPCS manufacturer shall have a formal MoU with:

- RDSO approved MBCS manufacturer and approval to supply DPCS modules must be provided by the concerned MBCS manufacturer, if the system is integrated with MBCS. In case the DPCS is stand alone for μ P based traction control system, such MOU may not require. Manufacturer should have experience in wireless technology and embedded control system
- For analog traction system, stand-alone DPCS system is required and manufacturer should have experience in wireless technology and embedded control system.

NOTE: In all cases responsibility of interfacing with locomotive systems shall be of the DPCS supplier.

4.2 Equipment requirements

The equipment specified in this document is expected to meet the following general requirements.

- i) The equipment shall be designed for installation on diesel electric locomotives equipped with MBCS or Analog traction control system. The equipment manufacturer shall get the equipment design approved by RDSO before fitment on locomotives.
- ii) The antennae for RF communication systems shall be fitted on the locomotive exterior and shall be located for best possible reception / transmission. These antennae shall be fitted in a manner that does not violate the MMD of Indian Railways.
- iii) The equipment, cabling and connectors shall be designed to handle the harsh environmental conditions of the locomotive.
- iv) The equipment shall be capable of working in all types of electrified as well as non-electrified territories.

5 Brief requirements overview

The locomotive on-board equipment (OBE) consists of hardware components and associated modification and integration of software for making the equipment functional and interfaced to the locomotive computer (if not stand alone). The following shall be considered as part of this equipment:

- Distributed Power Controller
- Interface for MBCS(requires upgradation of software / hardware and only when the DPCS is not stand alone)
- Interface to the Brake Interface Unit of IRAB System (The BIU is normally not the part of IRAB and is required to be fitted for implementing synchronized braking with DPCS. The BIU is governed by RDSO Specification no.MP.0.01.00.31).
- RF data communication system and associated hardware
- Human machine interfaces /DIALS (if available in micro Loco) for controlling the equipment
- Valves and sensors for the pneumatic brake system (as required to implement features)
- Connectors / cables and wiring accessories required for making the equipment functional
- Hardware and accessories for mounting equipment on the locomotive.
- Service support required for fitment, integration, software modification for making the features fully operational.
- Training for operations and maintenance of the equipment.

6 Detailed requirements

6.1 Component form, fit& function

The DPCS equipment shall be a set of components, software and services for installation, commission and training, which when executed shall enable distributed power control on the locomotives as described in part-0 of this specification.

The details of the individual components of the kit are described in the following paragraphs.

6.1.1 DPCS controller

The DPCS controller shall be robust intelligent controller that shall be fitted in the electrical controls cabinet of the locomotive.

The DPCS controller shall interface with other system components as indicated in the figure above for enabling the features detailed in part-0 of the specification.

6.1.1.1 Real-time clock

The system shall have a real-time clock with accuracy of better than +/- 5 seconds over 30 days. The RTC shall be capable of time synchronization through a software application which shall be synchronized

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to the MBCS clock. This application shall automatically synchronize the RTC to MBCS time once every 24 hours.

Note :In standalone DPCS, the synchronization with MBCS is dispensed with.

6.1.2 Radio module and antennae

As detailed at clause 5.4 of Part-0 of the specification.

6.1.3 Distributed Power HMI (DP-HMI)

The equipment shall provide an intuitive HMI for the locomotive operator which shall be fitted on the control desks in the locomotive cab.

The HMI shall be so located that it shall be within easy operating reach of the locomotive operator and shall not affect the visibility of the crew.

In case DIALS has been provided, the DPCS supplier has to interface with DIALS as unified HMI through Ethernet /RS485/CAN.

6.1.4 Train Line Interface Module (TLIM)

The TLIM shall be mounted in the electrical control panel and shall be capable of reading the status of the train lines and also driving these as required.

The equipment manufacturer may offer alternative location for mounting, if required.

6.1.5 Air Flow Sensor (AFS)

The air flow sensor shall be mounted on the under the locomotive cab at suitable location. The equipment manufacturer may offer alternative location for mounting, if required.

The sensor unit shall measure the air flow and provide feedback to the DPCS equipment for implementation of specified functional requirements.

Note: AFS may be available as a feature of the BIU system. The DPCS supplier shall ensure that the system architecture shall be sufficient for ensuring adequate safety during operations.

6.1.6 Electro-magnetic Brake Pipe Vent Valve (EMBPVV)

This valve is expected to be mounted on the brake pipe of the locomotive at a suitable location under the locomotive cab. The valve shall have port opening similar to the inner diameter of the brake pipe. This valve shall be controlled by the DPCS controller and is required for venting of brake pipe in case of emergency.

Note: The equipment manufacturer may omit a separate BP vent valve provided that the BIU has a vent valve that can be used to vent the BP as rapidly as a direct acting vent.

6.1.7 Brake Interface Unit (BIU)

To enable synchronized Braking in loco through DPCS having IRAB Brake system, Brake Interface Unit is required. The BIU is governed by separate RDSO Specification no.MP.0.01-00-31. The BIU is fitted with IRAB system and DPCS has to make interface as per open communication protocol detailed in relevant specification of BIU.

The DPCS equipment manufacturer shall ensure that the requisite interfacing is done with BIU for meeting the functional requirements.

6.1.8 Microprocessor based control system (MBCS)

In case the integration with MBCS system is required, the MBCS system needs software/hardware modification to enable DP control functions.

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The DPCS equipment manufacturer shall ensure that the requisite modifications are done on the MBCS for meeting the functional requirements.

Note : In standalone DPCS, the interfacing with MBCS may be dispensed with.

6.2 Equipment form and size

The equipment mounted in the cab shall follow IEC 60297.

The overall equipment size shall not exceed 6U height. Specific approval shall be taken for equipment not in conformance to IEC 60297.

The manufacturer shall provide detailed drawings for layout and mounting method for:

1. Cab mounted equipment
2. Cabling
3. Locomotive exterior mounted equipment

These shall be approved by RDSO prior to fitment on locomotives.

6.3 Function

The DPCS equipment shall meet the functional requirements specified in the part-0 of this document.

6.4 Interface

The DPCS equipment is an add-on to the locomotive control architecture. The equipment manufacturer shall ensure that all interfaces with the existing equipment is done in a robust and reliable manner such that the original functionality of the equipment is not degraded.

7 Environmental/Climatic requirements

As detailed at Para 8 of Part-0 of the Specification.

8 Safety requirements

The equipment shall meet all statutory and regulatory criteria required for safety of users and maintainers.

The manufacturer shall highlight and indicate stored energy devices i.e. capacitors, spring pneumatic components etc. on the equipment for safe operation and maintenance.

Components carrying high voltage (which can result in electrical shock) should be carefully insulated and identified.

9 Life cycle management

As detailed at Para 10 of Part-0 of the Specification.

10 Accessories & spares

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

10.1 Diagnostic aids

The equipment manufacturer shall provide a list of diagnostic aid / software etc. required for trouble shooting and configuration to RDSO during type tests. The diagnostic aids to be provided to end users shall be jointly approved by RDSO and the manufacturer.

10.2 Special Maintenance tools

The equipment manufacturer shall provide all tools required for maintenance by the end user. The list of tools shall be jointly approved by RDSO and the equipment provider before supply.

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10.3 Spares

The equipment manufacturer shall provide all spares required for maintenance by the end user. The list of spares shall be jointly approved by RDSO and the equipment provider before supply.

11 Drawings

There are no drawings forming a part of this specification. However the equipment manufacturer is expected to be familiar with the locomotive layouts particularly of the roof, control equipment cubicle, the control desk and cab.

12 Documentation required

The manufacturer shall supply the following documents with the equipment. All documents shall be provided in both hardcopies and softcopies (PDF).

- Operating instructions and trouble shooting handbook.
- Sequence of operation where necessary
- Product catalogue and standard data sheet of offered system.
- Outline and general arrangement drawings
- Schedule of supply, listing all equipment with part numbers
- Block diagram and the flow charts of the DPCS operation and troubleshooting covering hardware and software
- Detailed specifications (technical catalogue and data sheet) for the equipment offered.
- Interfacing Circuit with descriptions for the equipment offered.
- Detailed trouble shooting directory.
- Maintenance manual with full description of maintenance and repair procedures.
- List of maintenance spares required for normal maintenance and emergency repairs.
- A copy of the detailed bill of materials for the DPCS shall be provided.
- The equipment provider shall provide all documents as specified in the specifications of the respective MBCS equipment.

13 Training

The equipment manufacturers shall arrange training. This shall be a part of the equipment supply. Personnel of Indian Railways shall be nominated to attend. The to and fro fare and living expenses shall be borne by Indian Railways

14 Tests & Verification

The equipment shall be tested for functional capability, ability to withstand environmental conditions and for reliable performance under field conditions.

The equipment shall be tested as per the details given in the following paragraphs.

14.1 Sampling plan

Unless otherwise specified, the sampling plan shall be in accordance with IS2500.

14.2 Types of tests

The equipment shall be tested as per the following scheme.

S. No.	Category of Test	Remarks
1	Type tests	These tests shall be done on prototypes to determine the functional compliance

	(Prototype)	and ability to handle the environmental conditions. Such tests are required only on initial approval, change of design and change of manufacturing processes. These tests shall be done as pre-requisite for design approval.
2	Field trials	These trials shall be conducted for establishing equipment reliability under field conditions. A minimum sample size shall be installed to work under field conditions and performance monitored for a specified time.
3	Acceptance tests	These tests shall be done as specified in the purchase order or by the inspection agency. These tests shall be done on all or sample of lot.
4	Routine tests	Tests are required to verify the functional working of the system. The manufacturer of the equipment is expected to plan a verifiable QAP which shall include such routine tests for ensuring that the product is conforming to the requirements. Results of the routine tests shall be maintained by the manufacturer in their internal tests and shall be made available on demand.

Table 2: Types of Tests

14.2.1 Type tests

RDSO shall evaluate the equipment for:

- Verification of suitability of design of the equipment and mounting arrangements
- Validation of compliance to the functional requirements specified
- Verification of compliance of environmental conditions by scrutiny of the certificates of testing.

Tests for compliance to environmental requirements shall be conducted as below **and as per Annexure-1**:

- The antennae and its accessories including cables and connectors shall be subjected to tests in accordance to AAR S-5702 for meeting the environmental requirements over and above those specified for MBCS equipment.
- These tests shall be arranged by the equipment manufacturer at reputed laboratories equipped with required facilities.

14.2.2 Field trials

The DPCS equipment shall be subjected to field trials as a part of initial acceptance. These trials shall be conducted after successful completion of all type tests and functional tests for all features.

Performance shall be closely monitored and evaluated by RDSO for 4(minimum)loco sets for minimum six months (extendable on requirement). The following parameters shall be evaluated:

- Reliability under actual operating conditions
- Advantages for locomotive operation and maintenance
- Maintainability of the system

14.2.3 Acceptance test

Acceptance tests shall constitute the following:

- Verification of records of type tests
- Verification of field testing reports.
- Verification of the internal tests reports of the manufacturer.
- Visual check of the system for:
 - General workmanship.
 - Quality of soldering and component mounting.
 - Legend printing.
 - Green masking.
 - Indications and displays.

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- f. Mounting and clamping of connectors.
- g. Proper housing of cards.
- v) Functional test of all features of the equipment if required by simulated inputs.
- vi) Reverse Polarity, Voltage Variation Test, Insulation test and Di-electric Test (if applicable).

14.2.4 Routine test

Routine tests are expected to be done on all products or samples of lots. The equipment manufacturer shall prepare a QAP for implementation of routine tests as required in the guiding standards specified in this document.

The records of the internal tests done shall be maintained by the manufacturer and the same shall be provided upon requirement.

14.2.4.1 Makers test certificate for outsourced item

All items that are outsourced by the equipment manufacturer shall be indicated so. The type and extent of control that has been exercised shall be provided with proper documentation.

The manufacturers (of the outsourced sub-assembly / component) test certificates shall be provided.

14.3 3rd Party test certificates and reduction of inspection requirements

If the equipment has been tested by 3rd parties for conformance to other similar requirements or has been used for similar purposes, the manufacturer may offer the following documents for reduction of requirement for inspections.

- Compliance to EN50155
- End user certificate stating satisfactory performance of the equipment.

These documents can be submitted during design approval to reduce the requirement of testing. However, RDSO reserves the authority to decide on tests to be conducted verification of conformance to requirements.

15 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.

16 Packaging and delivery/shipment

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.

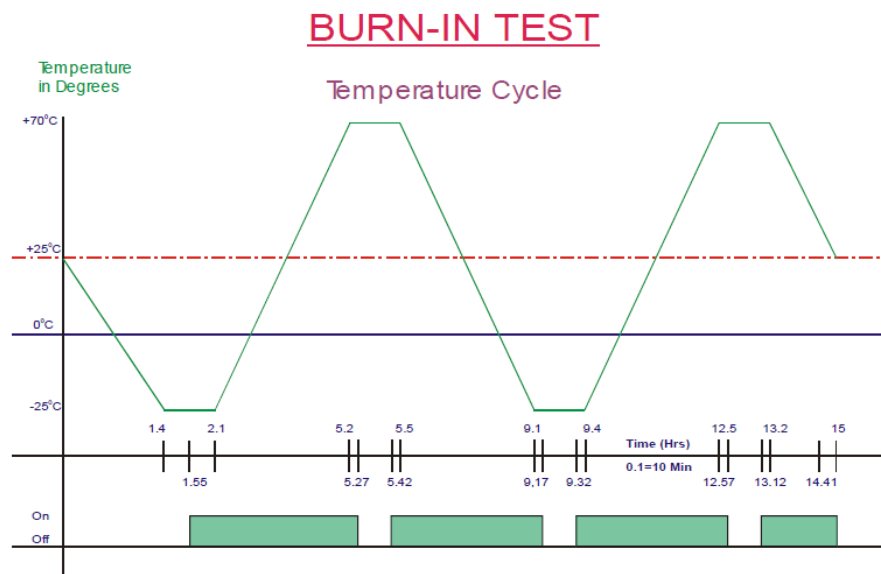
ANNEXURE 1: Prototype Test Methods for DPCS

1. DPCS Controller

S. No.	Test as per IEC 60571	Sub clause
1	Visual inspection	12.2.2
2	Performance test and Reverse Polarity	12.2.3
3	Cold start test	12.2.4
4	Dry heat test	12.2.5
5	Damp heat test, cyclic	12.2.6
6	Supply over voltages	12.2.7
7	Surges, electrostatic discharge and transient burst susceptibility tests	12.2.8
8	Radio frequency test	12.2.9
8.1	Radio frequency immunity test	12.2.9.1
8.2	Radio frequency emission test	12.2.9.2
9	Insulation test and Die-electric test	12.2.10
10	Salt mist test	12.2.11
11	Vibration, shock and bump test	12.2.12
12	Water tightness test	12.2.13
13	Equipment stress screening (Burn in Test as given below)	12.2.14
14	Low temperature storage test **	12.2.15

Burn In Test :

After mounting of components, the populated PCB cards kept in proper chassis in energized condition shall be burnt in for minimum 45 hrs at +75 deg. C and - 25 deg C as per the cycle. The PCBs will be tested for functionality to the extent possible during the burn-in test.



2. Antenna assembly unit

S.No	Test as per AAR S-5702	Clause no.
1.	Tunnel temperature test	3.2.2.3
2.	Temperature Extreme test	3.2.2.3.1
3.	Temperature Cycling test	3.2.2.3.2
4.	Sinusoidal Vibration Test	3.2.4.1
5.	Random Vibration Test	3.2.4.2
6.	Mechanical Shock test	3.2.4.3.2
7.	Salt Fog Test	3.2.5
8.	Steady state humidity test	3.2.3.2
9.	Blowing rain and dust test	3.2.6 and 3.2.7.2
10.	Blowing sand test	3.2.7.1

3. Radio Modem:

Test Compliance to EN 50155, EN 300 113-1, conformance to Type Approval of Radio Modem by WPC, Govt. of India.

4. HMI (if provided):

	Test Name	Standard	Sub Clause
1.	Visual Inspection	IEC 60571	12.2.2
2.	Performance Test, Reverse polarity test	IEC 60571	12.2.3
3.	Voltage variation Test	AAR S-5702	5.2
4.	Voltage Hold up Test	AAR S-5702	5.10
5.	Humidity Test	AAR S-5702	3.2.3
6.	Supply Over Voltages test.	IEC 60571	12.2.7
7.	Surge Voltage Test	IEC 60571	12.2.8.1
8.	ESD Test	IEC 60571	12.2.8.2
9.	Transient Burst Susceptibility Test	IEC 60571	12.2.8.3
10.	Radio Interference Test	IEC 60571	12.2.9
11.	Insulation Test	IEC 60571	12.2.10
12.	Dust Blow Test	AAR S-5702	3.2.7.2
13.	Sinusoidal Vibration Test	AAR S-5702	3.2.4.1
14.	Random Vibration Test	AAR S-5702	3.2.4.2
15.	Mechanical Shock test* (Alternative to Sinusoidal Vibration Test and Random Vibration Test)	AAR S-5702	3.2.4.3.2
16.	Temperature Extreme test	AAR S-5702	3.2.2.3.1
17.	Temperature Cycling test	AAR S-5702	3.2.2.3.2

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5. Validation Test at Loco:

The DPCS shall be validated at loco to ensure the functioning of fully integrated DPCS in Loco. The DPCS Manufacturer shall submit the detailed validation test protocol covering all the functionality of DPCS as per RDSO Specification for static and running functional trials for approval by RDSO to carry out validation Test.

Note:

1. The relevant sub clause is as per IEC 60571. Ed.3. Latest IEC 60571 standard should be referred for the tests.
2. Latest AAR 5702 standard should be referred for the tests.

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