



# वितरित शक्ति नियंत्रण प्रणाली: भाग-3

## DISTRIBUTED POWER CONTROL SYSTEM (DPCS) PART-3: ONBOARD EQUIPMENT FOR LOCOS WITH $\mu$ P TRACTION CONTROL & CCB



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### Brief Description

This set of four documents (numbered part 0 to 3) describe the requirements for equipment required for setting up distributed power control for running of trains with diesel electric locomotives. The full set of specifications detail these for requirements of various sub components like, locomotive onboard equipment, radio frequency communications and functional requirements of the equipment with special features for ensuring fail safe operations.

## **FOREWORD**

RDSO had initially issued two separate specifications for Remote Control System of diesel electric locomotives for distributed power applications. After initial field trials need for having interoperability between different makes of remote control systems was realized.

These set of specifications combine and bring together all previous specifications, experience gained through trials and additionally detail features necessarily required for creation of interoperable systems. As of date there are no global standards for interoperability of DPCS. Almost all implementations are of proprietary designs that do not interoperate. The requirements listed here create an initial platform for achieving interoperability. Therefore, interoperability as detailed in these documents is subject to trials. However when the systems described here is paired with identical systems, all features shall be available for distributed power applications.

This set of specifications are also planned to be extended to cover the requirements of Cab Display Unit for setting up End Of Train Telemetry (EOTT) which is under development separately. Sharing of a common radio modem for both DPCS and EOTT applications is the prime consideration. However this feature is planned to be incorporated in a subsequent revision of this specification.

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## LIST OF AMENDMENTS

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## LIST OF REFERENCED DOCUMENTS

Kindly see part 0 of the specification.

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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 diesel electric locomotives. Kindly see the list of referenced documents to locating other documents of the set.

## 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 and computer controlled brake. This specification shall be applicable to the following class of locomotives:

S. No.	Loco Class	Traction Control	Brake Control
1	WDG <sub>4</sub> , WDP <sub>4</sub>	3- $\Phi$ AC-AC traction control system	Knorr Bremse CCB system
2	WDG <sub>3</sub> , WDM <sub>3</sub>	AC-DC $\mu$ P based traction control system	Knorr Bremse CCB system

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

## 2 Terminology / Abbreviations

Kindly refer common list in part 0 of the specification.

## 3 Definitions (Optional)

Kindly refer common list in part 0 of the specification.

## 4 Brief description of the system/equipment/components

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. The following shall be considered as part of this equipment:

- Interface for locomotive computer.
- RF data modem and associated hardware
- 8-port Ethernet switch compliant to IEEE 802.3 10 BaseT and 100 BaseTx with M12, D-coding.
- Connectors / cables and wiring accessories required for making the equipment functional.
- Software for enabling all equipment features on the locomotive computer.
- Service support required for fitment, integration, software modification for making the features fully operational.
- Training for operations and maintenance of the equipment.

## 5 General requirements

### 5.1 Manufacturers qualification

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

Incase 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.
- CCB manufacturer, where required, for control brakes directly by the DPCS.

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

### 5.2 Equipment Requirements

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

- The equipment shall be designed for installation on diesel electric locomotives equipped with MBCS. The equipment manufacturer shall get the equipment design approved by RDSO before fitment on locomotives.

- ii) The computer interface cards of the equipment shall be interfaced with the locomotive computer, preferably be an integral part of the system and shall plug into the system bus.
- iii) 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.

Note: A diesel electric locomotive is expected to be equipped with GPS, GPRS and RF antennae. The use of tri-band antennae as specified in part 2 of this specification is suggested.

- iv) The equipment, cabling and connectors shall be designed to handle the harsh environmental conditions of the locomotive.
- v) The equipment shall be capable of working in all types of electrified as well as non electrified territories.

### 5.3 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.

## 6 Functional requirements

The functional requirements of the DPCS are detailed in Part 0 of this specification. These should be implemented.

The following additional technical requirements are specific to the class of locomotives and shall be complied by the DPCS.

### 6.1 Locomotive system interfaces

The DPCS equipment shall interface in a manner that it shall be possible to communicate and control the MBCS, CCB.

DPCS equipment shall also monitor train line signals of the MU coupler.

### 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 exclusive of the radio communications system described in part-2 of this specification.

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 Communication media for communicating with RF modems

RF modems shall be connected to the DPCS through Ethernet switch. The network shall implement TCP/IP. The locomotive DIALS units shall also be connected to this Ethernet switch.

The whole arrangement of connections shall enable the DIALS and MBCS equipment to share the RF modems.

## 7 Technical requirements

The DPCS shall comply with the following technical requirements for the equipment

- i) All cards and plug-in devices of DPCS interfacing with the vehicle computer shall comply with all requirements of the respective MBCS.
- ii) The criteria for testing of the DPCS equipment that interfaces with the MBCS shall be identical to that of the MBCS components.

## 8 Applicable drawings

There are no drawings forming a part of this specification.

## 9 Safety requirements

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

## 10 Environmental/Climatic requirements

All requirement as specified in the specifications of the respective MBCS equipment shall be complied by the DPCS.

The antennae and its mounting equipment and wiring to the antennae are exposed to the atmospheric conditions. The climatic and environmental conditions prevailing in India are the following. The DPCS shall be designed to work satisfactorily in these conditions:

Atmospheric temperature	(i) Maximum temperature of metallic surface under the sun: 75 °C. (ii) Minimum temperature: -10°C (Also snow fall in certain areas during winter season.)
Humidity	100% saturation during rainy season
Reference site conditions	(i) Ambient temperature: 50 °C (ii) Humidity: 100% (iii) Altitude: 1776 m above mean sea level
Rainfall	Very heavy in certain areas
Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The dust content in air may reach a high value of 1.6 mg / m <sup>3</sup> . In many iron ore and coal mine areas, the dust concentration is very high affecting the filter & air ventilation system.
Coastal area	Humid & salt laden atmosphere with maximum pH value of 8.5, sulphate of 7 mg per liter, maximum concentration of chlorine 6 mg per liters and maximum conductivity of 130 micro siemens/cm
Vibration	The equipment, system and their mounting arrangement shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified in IEC 61373.
Wind speed	High wind speed in certain areas, with wind pressure reaching 150 kg/m <sup>2</sup>

**Table 2: Environmental Conditions**

## 11 Details of standards followed and validation

As specified in the specifications of the respective MBCS equipment.

## 12 Maintenance and diagnostic aid

As specified in the specifications of the respective MBCS equipment.

## 13 Documents required from supplier

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 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.

## 14 Accessories

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

### 14.1 Tools

The supplier 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.

### 14.2 Spares

The supplier 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.

## 15 Guarantee/Warranty

The equipment manufacturer shall provide warranty guarantee for performance as per the IRS conditions.

The subscription and the functioning of the GPRS / EDGE connectivity shall be ensured by the manufacturer for the duration of the warrantee and also during the period of extended warrantee.

## 16 Tests & Verification

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

### 16.1 Standards for testing

The equipment interfacing with the MBCS shall be tested in accordance to the requirements of the MBCS.

### 16.2 Sampling plan.

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

## 17 Types of tests

The equipment shall be tested as per the following scheme.

S. No.	Category of Test	Remarks
1	Type tests (Prototype)	These tests shall be done on a sampled lot of prototypes. Sampling shall be done as per guidelines contained in IS2500. 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 on all or sample of lot. Sampling shall be done as per IS2500. These may require simulated inputs for testing the operations under extreme conditions of inputs.
4	Routine tests	Tests are required to verify the functional working of the system. These may

	require simulated inputs for testing the operations under extreme conditions of inputs.
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**Table 3: Types of Tests**

## 17.1 Type Tests

The equipment cards interfacing to the MBCS shall be tested as per the requirements of the MBCS equipment.

The antennae and its accessories including cables and connectors shall be subjected tested in accordance to AAR S-5702 for meeting the environmental requirements over and above those specified for MBCS equipment.

Incase the equipment has been tested for compliance to requirements mentioned here, the details of tests conducted, testing agency and results of test shall be provided. RDSO shall decide on the available reports whether further specific testing is required.

## 17.2 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 10 locos for minimum three months. The following parameters shall be evaluated:

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

## 17.3 Acceptance test

Acceptance tests shall constitute the following:

- i) Verification of records of type tests
- ii) Verification of field testing reports.
- iii) Visual check of the system for:
  - a. General workmanship.
  - b. Quality of soldering and component mounting.
  - c. Legend printing.
  - d. Green masking.
  - e. Indications and displays.
  - f. Mounting and clamping of connectors.
  - g. Proper housing of cards.
- iv) Functional test of all features of the equipment if required by simulated inputs.

## 17.4 Routine test

The routine test shall consist of visual check and functional test as specified under acceptance test.

## 17.5 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) test certificates shall be provided.

## 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.

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ID plate Name of Component, Make, Sl. No, Date of Manufacture, Ratings shall be provided on all assemblies/subassemblies.

## 19 Packaging and delivery

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 Intellectual Property Rights

### 20.1 Undertaking by equipment manufacturer

All the specifications issued by RDSO shall include a requirement of undertaking to be signed by Vendors on “INFRINGEMENT OF PATENT RIGHTS”. The undertaking can be as under

Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/matters lies with the manufacturer/ supplier.

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### 20.2 Declaration of confidentiality of submitted documents by manufacturers

While submitting a new proposal/design, manufacturer must classify their documents confidentiality declaration, such as

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## 21 Information to be supplied by supplier

The equipment manufacturer must provide to RDSO, the complete details of algorithms, design and drawings required for the purpose of evaluation of the design and its functionality.

All documents as required by the specification of MBCS.

Operations and maintenance manuals, spare parts catalog shall be supplied to all users as required in both hard and soft (PDF) copies.

## 22 Information to be supplied by purchaser

Required design details and layouts of locomotives on which DPCS is required to be fitted.