# Technical Specification
# of
# Intelligent Remote I/O Module (RIOM)
# for
# Three Phase Electric Locomotives

## Specification No.CLW/C-D&D/ES/3/0555, Alt.0

***Issued in: February'2025***

***Total no. of sheets- 30***

**ISSUED BY:**
**Center for Design & Development**
**Chittaranjan Locomotive Works**
**PO: Chittaranjan, West Bengal**
**India – 713331**

| | |
|---|---|
| **Recommended by CDE/CLW** | |
| **Approved by PCEE/CLW** | |

# STATUS OF REVISION

| Sl.No. | Date of Revision | Clause No. | Page no. | Revision | Reasons for Revision |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |

# TABLE OF CONTENTS

# Chapter-1
# General

## 1. Scope &Objective:

This specification covers general guidelines for design, development, manufacturing, testing, supply, commissioning and field validating of Intelligent Remote I/O Module (RIOM).

Presently, Indian Railways manufactures WAG-9, WAG-9H, WAP-7 and WAP-5 type 3-phase electric locomotives equipped with Vehicle Control Unit (VCU) for control and data communication using MICAS-S2 and TCN (Train Communication Network) as per IEC-61375. The VCUs of locomotive are installed in vertically standing cubicles (SB cubicles) in the machine room of the locomotive. The VCU consist of processor cards, Admin card, MVB card, signal routing card, anlaog and digital I/O cards which controls the whole locomotive by making interface with traction converters, auxiliary converters, driver display units, cab equipments and auxiliary systems. For interfacing with analog and digital I/O cards, lots of control cables with different type of connectors have been used in the locomotive. In case of TCN based VCU with propulsion system, same wiring scheme is adopted for different propulsion system.

At present, the interfacing of drivers cab equipment with I/O channel of VCU is done through the following:

- Cables of drivers cab equipment is connected to F-panel.
- From F-panel these connections are continued further to SB panels through Loom no. 315 & 316 (CAB-1 to SB-1) and 354 & 355 (CAB-2 to SB-2). Both ends of these looms are circular type connectors.
- From circular connectors these drivers cab equipment connections are further connected to SB panel WAGO terminals (behind SB panels).
- From SB panel WAGO terminals, drivers cab equipment are finally connected to the I/O channels of the VCU.

The objective of this work is to design, development, manufacturing, testing, supply, commissioning and field validation of Intelligent Remote I/O Module (RIOM) for controlling & monitoring major functions of the locomotive by reducing hardware & cables.

## 2. Abbreviations & Keywords used throughout the document:

### 2.1. Abbreviations:

IR : Indian Railways
CLW : Chittaranjan Locomotive Works
RDSO : Research Designs & Standards Organisation
OEM : Original Equipment Manufacturer
IS : Indian Standard
IEC : International Electro-technical Commission
VCU : Vehicle Control Unit
MVB : Multifunction Vehicle Bus
RIOM : Remote I/O Module

### 2.2. Applicable Normative Standards:

This specification is based on the following Normative References and standards:

| | | |
|---|---|---|
| 1. | IEC 60068 | Environmental test procedure |
| 2. | IEC 62236 - 3-2 | EMI/EMC test procedure |
| 3. | IEC 61000-4-5 | Surges test procedure |
| 4. | IEC 61375 | Train Communication Network (TCN) |
| 5. | IEC 61131 | Railway application - Rolling Stock -Testing of rolling stock on completion of construction and before entry into service |
| 6. | IEC-801-1,2,3,4,5,6 | Electromagnetic compatibility for Industrial Process measurement & control equipment. |
| 7. | EN-50155 | Railway applications electronics equipment used on rolling stock |
| 8. | EN-50121-2 | EMC: Emissions to external environments |
| 9. | IEC-60077 | Rules for equipment for onboard rail vehicles |
| 10. | IEC-60571 Ed-3.0 2012-09 or latest | Rules for electronic equipment onboard rail vehicles |
| 11. | IEC-61373 | Electric Railway Equipment-Rolling Stock-Shock & Vibrations Requirements |
| 12. | IEC-60529 | Degrees of Protection provided by Enclosures (IP Code) |

## 3. Functionalities:

Following functionalities are required in the RIOMs :

**3.1.** Control of whole locomotive. It should meet the control and functionality requirement of VCU as described in RDSO spec no. RDSO/2007/EL/SPEC/0071 Rev.5 or latest for three phase drive propulsion system.

**3.2.** Control of all locomotive auxiliary systems.

**3.3.** Control of power supply.

**3.4.** Interface to drivers cab through driver display, meters, indicators, switches etc.

**3.5.** Interface to BUR-1, BUR-2 and BUR-3.

**3.6.** Interface to main converter controllers SR 1 and SR 2.

**3.7.** Interface of pneumatic block.

**3.8.** Administration of Multifunctional Vehicle Bus (MVB) traffic.

**3.9.** Interface to wired train bus for multiple operations.

**3.10.** RIOMs shall have spare MVB In/Out ports for interfacing third-party equipment if any like DPWCS and RMS etc.

**3.11.** RIOMs shall have spare analog and digital I/O for future provision.

## 4. Contractor's Responsibility:

The contractor's responsibility will extend to the following:

**4.1.** Supply of detailed instructions for proper installation of the equipment on the locomotives. For this purpose, the supplier shall depute his engineers/ supervisors to CLW/ Sheds/ Workshops for installation of the equipment on locomotive.

**4.2.** Commissioning of the equipment in service and depute his team of engineers/ supervisors for this purpose.

**4.3.** Supply the schematic drawings, user's manual for maintenance and trouble shooting.

**4.4.** Provide special tools and instruments separately which may be required for maintenance.

**4.5.** Provide required instrumentation and carry out detailed tests and field trials jointly with CLW/RDSO.

**4.6.** To give root cause analysis of all the failures and their corrective actions.

**4.7.** In case of any modification (hardware and software), necessary approval shall be obtained from CLW/RDSO. For the purpose of technical decisions on improvements/ modifications etc., of the equipment, the final authority from the purchaser's side will be CLW/RDSO.

**4.8.** The Supplier shall be entirely responsible for the supply and commissioning of above system in accordance with the requirements of this specification.

**4.9.** The Supplier shall further be responsible for the sufficiency of the packing, marking etc. of all the parts of the work to ensure their delivery in good condition without any damage.

## 5. Railway's Responsibility:

Railways shall be responsible for the following:

**5.1.** Electrical energy for erection, testing & commissioning of RIOMs shall be provided by the IR free of cost.

**5.2.** The wages and allowances as well as the cost of the travel to and from the place of training for IR personnel at manufacturers premises.

**5.3.** The cabling in locomotive for interfacing RIOMs.

**5.4.** Any equipment re-layout on locomotive necessary for installation of RIOMs shall be done by the railways in association with the supplier.

## 6. Training:

The supplier shall arrange for training of Indian Railway personnel in various loco sheds and training schools regarding maintenance & trouble shooting of the system supplied. The supplier will provide detailed technical write-up to all the trainees. The frequency and man-hours of training shall be mutually decided by IR and Contractor.

## 7. Warranty:

**7.1.** The contactor shall warrant that everything to be furnished under the contract shall be free from defects and faults in design, material, workmanship and manufacture, and shall be of the highest grade and consistent with the established and generally accepted standards for stores of the type ordered and in-full conformity with the

contract and samples, if any, and shall, if operable, operate properly according to the contract.

**7.2.** The warranty for the stores to be supplied under this contract shall be 72 months from delivery or 60 months from date of satisfactory commissioning and acceptance test of the stores, whichever is earlier. The contractor shall immediately on receipt of notice of defect depute his engineer to start action for rectification of defects under warranty.

**7.3.** In the eventuality of major design modifications during the currency of the warranty period the warranty for such components shall be extended for such period as is mutually agreed.

**7.4.** The period of warranty will be extendable in case of recurring problems attributable to defective material or manufacturing.

**7.5.** The supplier shall be responsible for carrying out all the modifications at his own cost on any part of the equipment during the period of warranty provided such modifications/ improvements are decided (jointly between contractor and purchaser) to be necessary for meeting the requirements of reliability, performance and safety etc., of the equipment.

## 8. Approval for Design:

### 8.1. Design Aspect:

The design shall be developed based on the requirements given in this specification and sound engineering practices. The entire design of the system shall be supplied by the Contractor with required technical data and calculations to CLW/RDSO for approval before commencing the manufacturing. This includes hardware and control logic and detail operation with functional description of the system which will be implemented.

### 8.2. Documentation:

The Contractor shall submit the following information also for the design approval in printed form and digital format:

i. Schematic Circuit.
ii. Functional description in detail.
iii. System design concept including protection schemes (both electrical and mechanical).
iv. Detailed description of mounting, cables, connectors and connection diagrams of each system/ sub-system which are to be interfaced with locomotives.

v. Complete Bill of Material (BOM) including quantity, contractor details etc., of each component/ material.
vi. Modifications, if any, needed in the present existing locomotive to accommodate the offered system.
vii. Clause by clause compliance of this specification.
viii. Details of technical support and training offered.
ix. Detailed recommended list of spares with cost for 5 years' maintenance after warranty.
x. List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair of the system.
xi. Mechanical drawings of complete system as well as major sub-assemblies, details of dimensions, mounting arrangement and weight etc. Details of mounting accessories shall also be provided. Protection against dust and water ingress shall be explicitly shown.
xii. Details of infrastructure, manufacturing, testing and service engineering activities in line with guidelines issued.
xiii. ISO certification.

**8.3.** Approval of design means the approval of general design features. Notwithstanding the approval, the supplier will be wholly responsible for the performance and reliability of the complete system.

**8.4.** General Requirements

The equipment supplied against this specification shall meet the following general requirements:

- The equipment supplied shall be of good quality, rugged and reliable and capable to withstand environmental and use conditions. The individual components shall meet the lifecycle for that category of equipment.

- Wherever outsourced equipment is used, care shall be taken to ensure that the equipment is sourced from reputed manufacturers.

- The supplier of equipment supplied under this specification shall ensure proper interfacing and connectivity between equipment / software.

## 9. Field Trials:

After successful completion of prototype type test, the RIOMs shall be subjected to field service trials for a minimum period of 6 (six) months and minimum 50,000 Km of service. Venue of trial shall be mutually agreed between the purchaser and the supplier. Locomotives, provided for field trial, shall be preferably based at one loco shed for the ease of monitoring and after sales support.

## 10. Infringement of Patent Rights:

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

# Chapter-2

# Technical Details

## 2.1. GENERAL

**2.1.1.** For the electronic equipments to be supplied against this specification, the supplier shall make use of components and systems of high reliability, suitable for rolling stock applications. In this regard, the supplier is advised to refer to "Rules for Electronic Equipments used on Rail Vehicles IEC Publication 60571".

**2.1.2.** Adequate provisions should be made in the design for suppression of internal transients, spikes and to withstand external transients, spikes and surges as per limits laid down in IEC-60571 edition-3 or latest.

**2.1.3.** All electronic components and ICs used shall be selected after proper burn in and screening tests and shall be adequately rated to withstand the service requirements. A quality assurance scheme should be submitted by the supplier as per specification no. ELRS/SPEC/SI/0015 (latest revision) for approval of CLW/RDSO.

**2.1.4.** All the components on PCBs shall preferably be wave soldered. The surface mounted devices should be mounted using SMT workstation and complied with respective clause of RDSO specification no. ELRS/ SPEC/ SI/ 0015.

**2.1.5.** All the connecting wires, cables used on PCB in the sub units should be properly laid out with suitable connector. The cable used inside the sub unit should be properly supported with stiffeners. No soldering should be done on the PCB for inter connection.

## 2.2. Intelligent Remote I/O Module (RIOM):

**2.2.1.** The RIOM shall house its own power supply module, which will work from the locomotive battery. The nominal battery voltage is 110V DC, which is subjected to variation from 77V to 137.7V as per IEC-60571.

**2.2.2.** Digital I/O of RIOMs shall be suitable for 110V DC digital inputs and Potential free digital output. Analog I/O of RIOMs shall be suitable for +/- 20V DC analog signals.

**2.2.3.** MVB connection at the equipment side shall be provided through a 9 pin Sub-D connector with a coding frame. The equipment side receptacle shall use male contacts, while cable side plug shall use socket contacts. The connector pins shall

be of crimp type, gold plated. The system should access MVB variables by direct access through a laptop. Provision for downloading faults through a laptop computer.

**2.2.4.** The 110V DC power connector to the equipment shall be provided through a 3 pin miniature circular connector of MIL-C-26482 (Series-I) standard with bayonet locking. The receptacle on the equipment side shall have pin contacts and on the cable side, socket contacts. The contacts shall be of crimp type, gold plated. The supplier shall provide power supply cable of suitable length, duly provided with connector at one end and crimped to cable lug on the other side.

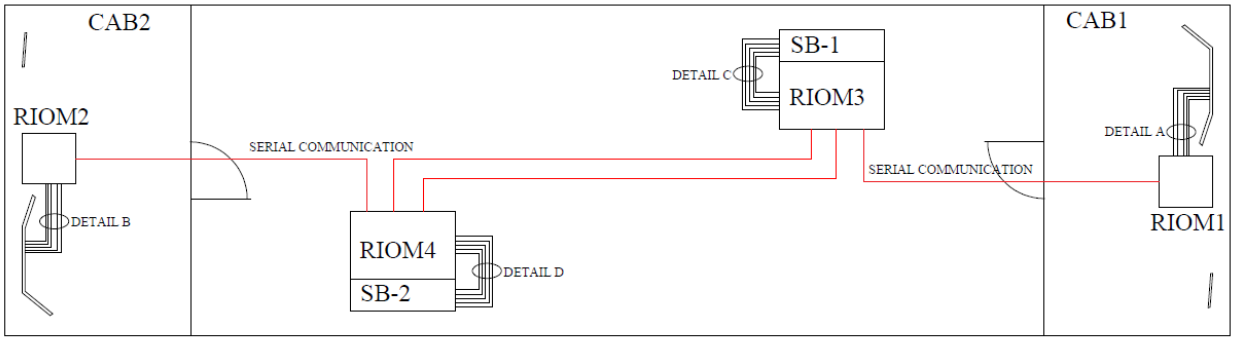
**2.2.5.** The RIOMs shall be installed in VCU-1, VCU-2 and underneath CAB-1 & CAB-2 driver desk. The general arrangement layout and signal list for VCU is attached as **Annexure-1** for guidance purpose. All the RIOMs i.e. VCU-1, VCU-2, CAB-1 & CAB-2 shall be connected through MVB/serial communication.

**2.2.6.** The RIOMs shall be mounted inside a mechanical enclosure. The mechanical enclosure shall be of MS with Zinc passivation.

**2.2.7.** The equipment shall have force cooling arrangement.

Annexure-1

TENTATIVE GENERAL ARRANGEMENT OF PROPOSED RIOMS ON THE LOCOMOTIVE




Detail A : Signals from Cab-1 A, C, D panel to RIOM-1
Detail B : Signals from Cab-2 A, C, D panel to RIOM-2
Detail C : Signals from SB-1 panel to RIOM-3
Detail D : Signals from SB-2 panel to RIOM-4

VCU-1 to CAB-1 Connection Detail-A

| Sl. No. | VCU Connector no/Pin | | Signal Name | Schematic no. | Cable no. |
|---|---|---|---|---|---|
| 1 | OA | 1 | 0101-LActKswD | 08A | 2500A |
| 2 | OA | 2 | 0101-LEmgStop | 06B | 3005A |
| 3 | OA | 3 | 0101-LMaxTELimit | 08E | 2540A |
| 4 | OA | 11 | 0101-LSwBankOp | 06F | 3069A |
| 5 | OA | 4 | 0101-LSwComprOff | 06E | 3034A |
| 6 | OA | 12 | 0101-LSwComprDir | 06E | 3035A |
| 7 | OD | 1 | 0101-LFootSwLoBk | 06D | 3033A |
| 8 | OD | 9 | 0101-LTrvDirFor | 08D | 2525A |
| 9 | OD | 2 | 0101-LTrvDirRev | 08D | 2527A |
| 10 | OD | 10 | 0101-LTEDemand | 08D | 2520A |
| 11 | OD | 3 | 0101-LBEDemand | 08D | 2521A |
| 12 | OD | 11 | 0101-LT/BDem>1/3 | 08D | 2522A |
| 13 | OD | 4 | 0101-LT/BDem>2/3 | 08D | 2523A |
| 14 | OD | 12 | 0101-LPBFaultAck | 17A | 5671A |
| 15 | OG | 7 | 0201-MLampFInd | 17A | 2099A |
| | | 19 | | | 5672A |
| 16 | OG | 7 | 0201-MLampFault | 17A | 2099A |
| | | 20 | | | 5673A |
| 17 | OG | 15 | 0201-BBuzzBlack | 11B | 2099A |
| | | 3 | | | 4237A |
| 18 | OG | 2 | 0201-BBuzzRed | 11B | 2099A |
| | | 14 | | | 4239A |
| 19 | QJ | 1 | 0202-BVCBDisable | 05B | 2313A |

| | | | | | |
|---|---|---|---|---|---|
| | | 9 | | | 2316 |
| 20 | JA | 9 | 0101-LParkBrake | 06B | 3060A |
| 21 | JA | 2 | 0101-LPBFaultAck | 17A | 5671A |
| 22 | JA | 10 | 0101-LSwComprDir | 06E | 3035B |
| 23 | JA | 3 | 0101-LActKSwD | 08A | 2500A |
| 24 | JA | 11 | 0101-LActKSwC | 08A | 4242A |
| 25 | JA | 4 | 0101-LConstSpeed | 08E | 2541A |
| 26 | JD | 1 | 0101-LFootSwSand | 06C | 3117A |
| 27 | JD | 9 | 0101-LTrvDirFor | 08C | 2524A |
| 28 | JD | 2 | 0101-LTrvDirRev | 08C | 2526A |
| 29 | JD | 3 | 0101-LTEDemand | 08C | 2520A |
| 30 | JD | 11 | 0101-LBEDemand | 08C | 2521A |
| 31 | JD | 4 | 0101-LTE/BDem>1/3 | 08C | 2522A |
| 32 | JD | 12 | 0101-LTE/BDem>2/3 | 08C | 2523A |
| 33 | JG | 7 | 0201-MLampWSlip | 08E | 2099A |
| | | 19 | | | 2542A |
| 34 | JG | 7 | 0201-MLampCSpeed | 08E | 2099A |
| | | 20 | | | 2532A |
| 35 | JG | 6 | 0201-MLampParkBk | 06B | 2099A |
| | | 18 | | | 3071A |
| 36 | JJ | 6 | 0201-MLampFault | 17A | 2099A |
| | | 13 | | | 5673A |
| 37 | JG | 17 | 0201-MLampFind | 17A | 2099A |
| | | 4 | | | 5672A |
| 38 | JG | 10 | 0201-MLampHotel | 05D | 2099A |
| | | 23 | | | 2807A |
| 39 | JG | 22 | 0201-MLampTPart | 06F | 2099A |

| | | | | | |
|---|---|---|---|---|---|
| | | 9 | | | 3020A |
| 40 | LA | 9 | 0102-LSwBogOut1 | 17B | 4201 |
| 41 | LA | 2 | 0102-LSwBogOut2 | 17B | 2402 |
| 42 | LA | 10 | 0102-LSwConfig | 17B | 2404 |
| 43 | LA | 4 | 0102-LSwComprOff | 06E | 3034A |
| 44 | LA | 12 | 0102-LSwComprDir | 06E | 3035A |
| 45 | LG | 15 | 0202-MLampConfig | 17B | 2099A |
| | | 3 | | | 2407 |
| 46 | LG | 21 | 0202-BVCBDisable | 05B | 2316 |
| | | 9 | | | 2311 |

| | | | | | |
|---|---|---|---|---|---|
| 1 | AE | 3 | 0101-XAngTrans | 08C | 2528A |
| | | 5 | | | 2529A |
| | | 9 | | | 2530A |
| | | QE | | | 2531A |
| 2 | EG | 6 | 0201-XMeterT/B1 | 08E | 2533A |
| | | 1 | | | 2534A |
| | | QE | | | 2536A |
| 3 | EI | 6 | 0201-XMeterT/B2 | 08E | 2543A |
| | | 1 | | | 2544A |
| | | QE | | | 2546A |
| 4 | IC | | Driver Display Unit | 09F | |

VCU-2 to CAB-2 Connection Detail B

| Sl. No. | VCU Connector no/Pin | Signal Name | Schematic no. | Cable no. |
|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1 | OA | 9 | 0101-LActKSwD | 08A | 2500B |
| 2 | OA | 2 | 0101-LEmgStop | 06B | 3005B |
| 3 | OA | 3 | 0101-LMaxTELimit | 08F | 2540B |
| 4 | OA | 11 | 0101-LSwBankOp | 06G | 3069B |
| 5 | OA | 4 | 0101-LSwComprOff | 06E | 3034B |
| 6 | OA | 12 | 0101-LSwComprDir | 06E | 3035B |
| 7 | OD | 1 | 0101-LFootSwLoBk | 06D | 3033B |
| 8 | OD | 9 | 0101-LTrvDirFor | 08D | 2525B |
| 9 | OD | 2 | 0101-LTrvDirRev | 08D | 2527B |
| 10 | OD | 10 | 0101-LTEDemand | 08D | 2520B |
| 11 | OD | 3 | 0101-LBEDemand | 08D | 2521B |
| 12 | OD | 11 | 0101-LT/BDem>1/3 | 08D | 2522B |
| 13 | OD | 4 | 0101-LT/BDem>2/3 | 08D | 2523B |
| 14 | OD | 12 | 0101-LPBFaultAck | 17A | 5671B |
| 15 | OG | 7 | 0201-MLampFInd | 17A | 2099B |
| | | 19 | | | 5672B |
| 16 | OG | 7 | 0201-MLampFault | 17A | 2099B |
| | | 20 | | | 5673B |
| 17 | OG | 15 | 0201-BBuzzBlack | 11B | 2099B |
| | | 3 | | | 4237B |
| 18 | OG | 2 | 0201-BBuzzRed | 11B | 2099B |
| | | 14 | | | 4239B |
| 19 | QD | 9 | 0102-LPanUp | 05A | 2302 |
| 20 | JA | 1 | 0101-LTEDemand | 08D | 2520B |
| 21 | JA | 9 | 0101-LParkBrake | 06B | 3060B |
| 22 | JA | 2 | 0101-LBEDemand | 08D | 2521B |
| 23 | JA | 10 | AMSB_0101-LHotelOn | 05D | 2803B |

| | | | | | |
|---|---|---|---|---|---|
| 24 | JA | 3 | 0101-LActKSwD | 08A | 2500B |
| 25 | JA | 11 | 0101-LActKSwC | 08A | 4242B |
| 26 | JA | 4 | 0101-LConstSpeed | 08F | 2541B |
| 27 | JA | 12 | AMSB_0101-LHotelOff | 05D | 2804B |
| 28 | JD | 1 | 0101-LFootSwSand | 06C | 3117B |
| 29 | JD | 9 | 0101-LTrvDirFor | 08D | 2524B |
| 30 | JD | 2 | 0101-LTrvDirRev | 08D | 2526B |
| 31 | JD | 10 | 0101-LT/BEDem>1/3 | 08D | 2522B |
| 32 | JD | 4 | 0101-LT/BEDem>2/3 | 08D | 2523B |
| 33 | JG | 7 | 0201-MLampWSlip | 08F | 2099B |
| | | 19 | | | 2542B |
| 34 | JG | 7 | 0201-MLampCSpeed | 08F | 2099B |
| | | 20 | | | 2532B |
| 35 | JG | 6 | 0201-MLampParkBk | 06B | 2099B |
| | | 18 | | | 3071B |
| 36 | JG | 3 | 0201-MLampFault | 17A | 2099B |
| | | 15 | | | 5673B |
| 37 | JG | 4 | 0201-MLampFInd | 17A | 2099B |
| | | 17 | | | 5672B |
| 38 | JG | 10 | AMSB_0201-MLampHotel | 05D | 2099B |
| | | 23 | | | 2807B |
| 39 | JJ | 1 | 0201-BPanDisable | 05A | 2315 |
| | | 9 | | | 2301 |
| 40 | JG | 22 | 0201-MLampTPart | 06G | 2099B |
| | | 9 | | | 3020B |
| 41 | LD | 1 | 0102-LPanUp | 05A | 2302 |
| 42 | LD | 12 | 0102-MEmgBkVig | 11A | 3000 |

| | | | | | |
|---|---|---|---|---|---|
| 1 | AE | 3 | 0101-XAngTrans | 08D | 2528B |
| | | 5 | | | 2529B |
| | | 9 | | | 2530B |
| | | QE | | | 2531B |
| 2 | EG | 6 | 0201-XMeterT/B1 | 08F | 2533B |
| | | 1 | | | 2534B |
| | | QE | | | 2536B |
| 3 | EI | 6 | 0201-XMeterT/B2 | 08F | 2543B |
| | | 1 | | | 2544B |
| | | QE | | | 2546B |
| 4 | IC | | Driver Display Unit | 09F | |

VCU-1 to SB-1 Connection Detail-C

| Sl. No. | VCU Connector no/Pin | | Signal Name | Schematic no. | Cable no. |
|---|---|---|---|---|---|
| 1 | OA | 9 | **0101-LSwfailMode** | 17A | 5675 |
| 2 | OA | 10 | 0101-MMRBlowerOk | 05M | 2896 |
| 3 | OJ | 10 | 0201-BSelfMCE | 08B | 4202 |
| | | 3 | | | 2519 |
| 4 | OJ | 2 | 0201-BContCP1 | 06E | 4202 |
| | | 9 | | | 3115 |
| 5 | QA | 1 | 0102-MFuseAux | 05F | 2854 |
| 6 | QA | 9 | 0102-MMCBBloCT1 | 05G | 2855A |
| 7 | QA | 2 | 0102-MMCBBloMR1 | 05F | 2853A |
| 8 | QA | 10 | 0102-MMCBMScBlo1 | 05F | 2852A |

| | | | | | |
|---|---|---|---|---|---|
| 9 | QA | 3 | 0102-MMCBPumpC1 | 05G | 2857A |
| 10 | QA | 11 | 0102-MMCBPumpT1 | 05G | 2856A |
| 11 | QA | 4 | 0102-MMCBBloTM1 | 05F | 2850A |
| 12 | QA | 12 | 0102-MMCBTScBlo1 | 05F | 2851A |
| 13 | QD | 1 | 0102-MEFR415/110 | 05F | 2859 |
| 14 | QD | 9 | 0102-MEFRHotel | 05G | 2860 |
| 15 | QD | 2 | 0102-MAuxConVCB | 05C | 2330B |
| 16 | QD | 10 | 0102-LVCBOn | 05B | 2312 |
| 17 | QD | 3 | 0102-MEFRFilter | 05G | 2869 |
| 18 | QD | 11 | 0102-MEFRContrl | 05G | 2870 |
| 19 | QD | 4 | 0102-BDetCoCo | 17B | 4202 |
| 20 | QJ | 13 | 0202-BVCBOnPulse | 05B | 2320 |
| | | 6 | | | 2329 |
| 21 | QJ | 10 | 0202-BContSelfH | 08A | 4202 |
| | | 3 | | | 2509 |
| 22 | QJ | 4 | 0202-BVCBOn | 05B | 2325 |
| | | 12 | | | 2326 |
| 23 | JA | 1 | 0101-MMCBCompr1 | 05F | 2840A |
| 24 | JA | 12 | 0101-MPrSw8Bar | 06E | 3036 |
| 25 | JD | 10 | 0101-LVigOff | 11A | 3000 |
| 26 | JG | 12 | 0201-MWaterOpen | | |
| | | 24 | | | |
| 27 | JJ | 10 | 0201-BAirDryer | 06D | 4201 |
| | | 3 | | | 3042 |
| 28 | JJ | 4 | 0201-BEPAntSpin1 | 06B | 4201 |
| | | 12 | | | 3046A |
| 29 | JJ | 2 | 0201-BContHotel | 05D | 2801A |

| | | | | | |
|---|---|---|---|---|---|
| | | 9 | | | 2805 |
| 30 | LA | 1 | 0102-MReTempCEL | 08B | 2517 |
| 31 | LA | 3 | 0102-LSwFailMode | 17A | 5675 |
| 32 | LA | 11 | 0102-MRelMCEOn | 08A | 4243 |
| 33 | LD | 1 | 0102-LWaterOccupy | | |
| 34 | LD | 9 | 0102-LVCBOn | 05B | 2312 |
| 35 | LD | 2 | 0102-LSwKSim | 17A | 5671A |
| 36 | LD | 10 | 0102-MPrSw75Bar | 06E | 3038 |
| 37 | LD | 3 | 0102-MAuxConVCB | 05C | 2330A |
| 38 | LD | 11 | 0102-BDetCoCo | 17B | 4201 |
| 39 | LD | 4 | 0102-MIPrimHigh | 05C | 2088 |
| 40 | LD | 12 | 0102-MBrakElecOk | 06H | 3008 |
| 41 | LG | 19 | 0202-BRelMCEOff | 08A | 4201 |
| | | 7 | | | 2066 |
| 42 | LG | 6 | 0202-BSelfMCE | 08B | 4201 |
| | | 18 | | | 2518 |
| 43 | LG | 4 | 0202-BLampTest | 07E | 2099A |
| | | 17 | | | 3503A |
| 44 | LG | 10 | 0202-BVCBOn | 05B | 2325 |
| | | 23 | | | 2326 |
| 45 | LG | 12 | 0202-BVCBOnPulse | 05B | 2320 |
| | | 24 | | | 2329 |
| 46 | LJ | 9 | 0202-BContCompr1 | 06E | 4201 |
| | | 2 | | | 3114 |
| 47 | LG | 2 | 0202-BContSelfH | 08A | 4201 |
| | | 14 | | | 2506 |

VCU-2 to SB-2 Connection

Detail D

| Sl. No. | VCU Connector no/Pin | | Signal Name | Schematic no. | Cable no. |
|---|---|---|---|---|---|
| 1 | OA | 1 | 0101-MMCBCompr2 | 05F | 2840B |
| 2 | OA | 10 | 0101-MMRBlowerOk | 05M | 2897 |
| 3 | OJ | 14 | 0201-BEPAutBkOut | 06H | 3051 |
| | | 7 | | | 3016 |
| 4 | OJ | 6 | 0201-BResVigPeBk | 11A | 4204 |
| | | 13 | | | 4225 |
| 5 | OJ | 10 | 0201-BEPAntSpin2 | 06B | 3101 |
| | | 3 | | | 3046B |
| 6 | OJ | 4 | 0201-BVigReset | 11A | 4204 |
| | | 12 | | | 4226 |
| 7 | OJ | 2 | 0201-BVigControl | 11A | 3101 |
| | | 9 | | | 4224 |
| 8 | QA | 1 | 0102-MPrSwPan1 | 05A | 2307 |
| 9 | QA | 9 | 0102-MPrSwPan2 | 05A | 2308 |
| 10 | QA | 2 | 0102-MPrSwParkBk | 06B | 3070 |
| 11 | QA | 10 | 0102-MBrakElecOK | 06H | 3008 |
| 12 | QA | 3 | 0102-LCockBkCon | 06A | 3056 |
| 13 | QA | 11 | 0102-LEmgBkOut | 06A | 3055 |
| 14 | QA | 4 | 0102-MPrSwLocoBk | 06A | 3059 |
| 15 | QA | 12 | 0102-MPrSwEmgBk | 06A | 3051 |
| 16 | QD | 1 | 0102-MPrSwAFlow | 06A | 3050 |
| 17 | QD | 2 | 0102-MPrSw75bar | 06E | 3038 |
| 18 | QD | 10 | 0102-MFireAlarm | 11B | 4227 |

| | | | | | |
|---|---|---|---|---|---|
| 19 | QD | 3 | 0102-MPrSwBkCyl2 | 06A | 3053 |
| 20 | QD | 11 | 0102-MPrSwLowMR | 06E | 3044 |
| 21 | QD | 4 | 0102-MPrSw8bar | 06E | 3036 |
| 22 | QD | 12 | 0102-MPrSwBkFP | 06E | 3043 |
| 23 | QG | 6 | 0202-BEPRelPBk | 06B | 3101 |
| | | 18 | | | 3048 |
| 24 | QG | 15 | 0202-BEPCPUnload | 06D | 4204 |
| | | 3 | | | 3112 |
| 25 | QG | 4 | 0202-BEPSand13 | 06C | 3101 |
| | | 17 | | | 3028 |
| 26 | QG | 10 | 0202-BEPPan1 | 05A | 2064 |
| | | 23 | | | 2105B |
| 27 | QG | 24 | 0202-BEPSand24 | 06C | 3101 |
| | | 12 | | | 3029 |
| 28 | QJ | 10 | 0202-BContCompr2 | 06E | 4204 |
| | | 3 | | | 3116 |
| 29 | QJ | 1 | 0202-BPanDisable | 05A | 2309B |
| | | 9 | | | 2315 |
| 30 | QG | 9 | 0202-BEPApplyPBk | 06B | 3101 |
| | | 22 | | | 3047 |
| 31 | QG | 2 | 0202-BEPLBkOut | 06D | 4204 |
| | | 14 | | | 3111 |
| 32 | JD | 3 | AMSB_0101-MSpeed105% | 10A | 4208 |
| 33 | JD | 11 | AMSB_0101-MSpeed110% | 10A | 4244 |
| 34 | JD | 12 | AMSB_0101-MSpeedAlarm | 10A | 4207 |
| 35 | JJ | 6 | AMSB_0201-BLampTest | 07E | 2099B |
| | | 13 | | | 3503B |

| | | | | | |
|---|---|---|---|---|---|
| 36 | LA | 1 | AMSB_0102-MMCBBLoCT2 | 05G | 2855B |
| 37 | LA | 9 | AMSB_0102-MMCBBloMR2 | 05F | 2853B |
| 38 | LA | 2 | AMSB_0102-MMCBMScBlo2 | 05F | 2852B |
| 39 | LA | 10 | AMSB_0102-MMCBPumpC2 | 05G | 2857B |
| 40 | LA | 3 | AMSB_0102-MMCBPumpT2 | 05G | 2856B |
| 41 | LA | 11 | AMSB_0102-MMCBBLoTM2 | 05F | 2850B |
| 42 | LA | 4 | AMSB_0102-MMCBTScBlo2 | 05F | 2851B |
| 43 | LA | 12 | AMSB_0102-MEFRBUR | 05G | 2858 |
| 44 | LD | 9 | AMSB_0102-MprSwBkCyl1 | 06A | 3052 |
| 45 | LD | 2 | AMSB_0102-MSmogWarn | 11B | 4228 |
| 46 | LD | 10 | AMSB_0102-MFailFireEq | 11B | 4229 |
| 47 | LD | 3 | AMSB_0102-MprSwEmgBk | 06A | 3051 |
| 48 | LD | 11 | 0102-MPrSwParkBk | 06B | 3070 |
| 49 | LD | 4 | AMSB_0102-MVigWarn | 11A | 4220 |
| 50 | LJ | 10 | AMSB_0202-BEPLBkOut | 06D | 4203 |
| | | 3 | | | 3110 |
| 51 | LJ | 4 | AMSB_0202-BEPCPUnload | 06D | 4203 |
| | | 12 | | | 3113 |
| 52 | LJ | 2 | 0202-BEPPan2 | 05A | 2064 |
| | | 9 | | | 2105A |

# Chapter-3

## Environmental Conditions

The climatic and environmental conditions prevailing in India in the area of operations are the following:

**3.1** Temperature
Maximum temperature inside stabled Locomotive under sun : 75 deg. C
Maximum temperature inside working loco : 55 deg. C
(Temperature inside working locomotive may reach 60 deg. C)
Minimum temperature : -5 deg. C
The equipment shall be able to start up at the maximum specified temperature inside the locomotive without any pre-cooling requirement.

**3.2** Humidity: Upto 100% during rainy season.

**3.3** Altitude: Upto 1776 m above mean sea level.

**3.4** Rainfall: Very heavy in certain areas. The equipment shall be designed suitably.

**3.5** Atmosphere during hot weather: Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/cub. In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.

**3.6.** Coastal area: The equipment shall be designed to work in coastal area in humidity and salt laden and corrosive atmosphere. The maximum values of the condition shall be as follows:

a) Maximum pH value : 8.5
b) Sulphate : 7 mg per litre
c) Max. concentration of chlorine : 6 mg per litre
d) Maximum conductivity : 130 micro siemens /CM

**3.7** Vibration: The equipment shall be designed to withstand the vibrations and shock encountered in service satisfactorily as specified in IEC for the electronic equipment used on rolling stock.

**3.8** Electromagnetic Pollution – High degree of electromagnetic pollution is anticipated in locomotive machine room. Necessary precaution shall be taken in this regard.

# Chapter-4

## Scope of Supply & Deliverables

**1.** Scope of the specification is to Design, Development, Manufacture, Testing, Commissioning, Installation and field validation of Intelligent Remote I/O Module (RIOM) for three phase electric locomotive.

**2.** Following items shall be delivered per Locoset:

| SN | Item |
|---|---|
| 1 | VCU1 & VCU2 enclosure with RIOMs, fan assembly and heat exchanger. |
| 2 | RIOMs Enclosure at CAB1 & CAB2, fan assembly and heat exchanger. |
| 3 | Redundant MVB Interface Cables duly crimped with connectors at both end. |
| 4 | Power supply cables (110V DC) for RIOMs duly crimped with connector. |
| 5 | Suitable MCB for 110V supply tapping (to be provided for isolating the system). |
| 6 | Braided protective hose for protection of MVB and electrical cables. |

**3. Following documents shall be submitted by the Contractor:**

- Technical documentation explaining the complete scheme, characteristics protection and control.
- Procedure for parameter alteration.
- Operation manual containing detail functioning of RIOM.
- Trouble shooting manual explaining step-by-step fault finding procedure.

# Chapter-5

## Tests & Inspection

### 5. Tests:

**5.1.** The prototype equipment shall be subjected to type test according to IEC-60571(latest).

**5.2** Individual equipment and system/sub-systems as may be necessary shall be type and routine tested in accordance with the relevant standards/specification/ publications/details given elsewhere in this specification, which, if required, may be modified to suit local conditions.

**5.3** Type tests shall be carried out by the Supplier at his own responsibility and cost.

**5.4** Wherever the relevant standard test procedures do not adequately cover the requirements of arduous environmental conditions prevailing in India, CLW/RDSO might lay down special tests apart from those specified that shall be required to be conducted. These may include accelerated ageing test and endurance test.

**5.5** The Supplier shall formulate and submit a type test protocol/plan at design approval stage for approval of CLW/RDSO before undertaking manufacturing of the product. It shall, however, be open for CLW/RDSO to waive some of tests in case of equipment and sub-assemblies, where the manufacturer can establish it for the requirement of this specification that such test have already been carried out earlier on the same equipment and the equipment has been proved in prolonged service for traction applications.

**5.6** Modifications found necessary as a result of the tests/trials shall be incorporated in the locomotives by the Supplier at his own cost. Drawings incorporating those modifications, found necessary as a result of tests and trials, shall be submitted to CLW/RDSO for final approval.

**5.7** The manufacturer shall offer all the testing facilities free of charge to inspecting authority. Testing of equipment and fittings shall, as far as possible, be carried out at the works of the manufacturers. Testing of bought out components may also be carried out at sub-contractor's premises, if so required.

**5.8** The test for which facilities are not available may be carried out at any approved laboratory for which the testing charges shall be payable by the supplier.

**5.9** The contractor shall provide, free of charge, the materials or fittings which may be required for testing either at his own or at his sub-contractor's premises. All the equipments and fittings, required for testing, shall be selected by the inspecting officer and the tests shall be carried out in his presence.

**5.10** No material shall be packed or dispatched until it has been passed by the inspecting officer. Though the contractor's responsibility for its efficiency, in every way, shall remain the same as if the work had been manufactured and tested by himself.

**5.11** Should any part require alteration or any defect appear during the test or trial, the contractor shall make such alteration or rectify the defects to the satisfaction of the inspecting authority without any extra charges.

**5.12** Copy of characteristic properties and specification of each and every electronics & electrical items, used for manufacturing the system, shall be supplied to the inspecting authority as and when required to confirm about the quality of those items.

**5.13** If there is any change in design or source of supply of any components/sub-components/assembly, units made to the changed design or from new source shall be treated as new item for the purpose of conducting type tests.

**5.14** Type tests are to be repeated in case of any major change is made. In case of minor changes, i.e. change in type, rating of component etc., special test/tests as agreed by user and manufacturer are to be conducted to ensure their suitability and effectiveness of the modifications.

**5.15** The type tests shall be repeated once in three years by CLW/RDSO if required.

**5.16** On successful completion and passing of type tests, routine tests shall be done on the rest of the equipment.

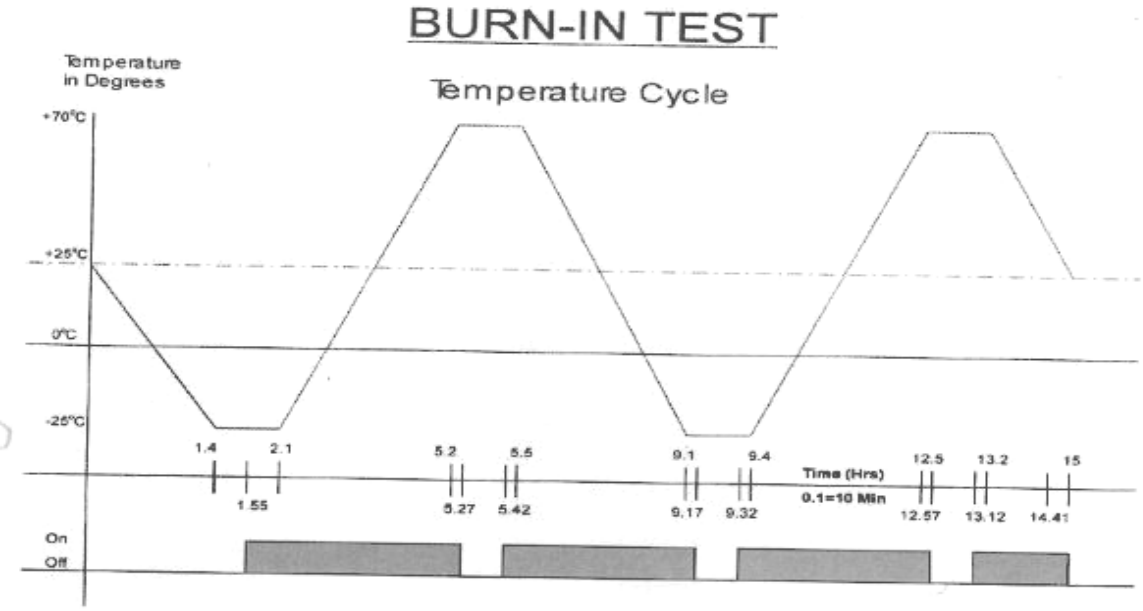
The type and routine tests to be carried out on complete unit are given in the following table with the clause number of IEC-60571 Edition-3.0 2012-09.

| Sl. No. | Name of Test | Clause No. of IEC-60571 | Type Test | Routine Test |
|---|---|---|---|---|
| 1 | Visual Inspection | 12.2.2 | ✓ | ✓ |
| 2 | Performance Test | 12.2.3 | ✓ | ✓ |
| 3 | Cooling Test | 12.2.4 | ✓ | × |
| 4 | Temperature Rise (Dry Heat) Test* | 12.2.5 | ✓ | × |
| 5 | Temperature Rise (Damp Heat Cyclic) Test | 12.2.6 | ✓ | × |
| 6 | Supply Overvoltage Test | 12.2.7 | ✓ | × |
| 7 | Surge Test | 12.2.8.1 | ✓ | × |

| | | | | |
|---|---|---|---|---|
| 8 | Electrostatic Discharge (ESD) Test | 12.2.8.2 | ✓ | × |
| 9 | Transient Burst Susceptibility Test | 12.2.8.3 | ✓ | × |
| 10 | Radio interference test | 12.2.9 | ✓ | × |
| 11 | Insulation test | 12.2.10.2 | ✓ | ✓ |
| 12 | Voltage Withstand (Dielectric) Test | 12.2.10.3 | ✓ | ✓ |
| 13 | Salt mist test | 12.2.11 | ✓ | × |
| 14 | Vibration and Shock Test | 12.2.12 | ✓ | × |
| 15 | Equipment stress screening test (Burn-in test) | 12.2.14 | ✓ | ✓ |

* Dry heat test – Dry heat test of the Electronics shall be carried out at 80°C.

**5.17** Burn in test – the cards used on the equipment shall be subjected to burn-in test for atleast 80 hours as per the temperature cycle. The cards shall be kept energized during the test. Functional test of each card shall be carried out after the burn in test. This shall be part of internal test by manufacturer, whose results shall be submitted during routine test.



## 6 Inspection:

**6.1** The type test & routine test shall be witnessed by the authorized representative of CDE/CLW.

**6.2** The inspecting authority may visit at any reasonable time and without previous notice, either contractor's works or his sub-contractor's works to inspect the manufacturers and the quality of the work at any stage.

**6.3** The inspecting authority can reject any materials or fittings that does not conform to the relevant standard/specifications or have not been manufactured in accordance with the approved practices. The rejected materials or fittings shall be marked in a distinguishable manner and shall be disposed on in such manner as the inspecting officer may direct to avoid its inadvertent use in the product order as per this specification.

**o----------X----------o**