

Document No.	MP.0.3700.12	Revision No. 01	Date Issued: May 2021
Document Title: Technical Requirements of Microcontroller based Event Recorder used on HHP Locomotives			



भारत सरकार रेल मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

एच एच पी लोकोमोटिव के प्रयोग हेतु माइक्रोकंट्रोलर आधारित इवेंट अभिलेखीय यंत्र
की तकनीकी आवश्यकताएँ

**TECHNICAL REQUIREMENTS OF MICROCONTROLLER BASED
EVENT RECORDER USED ON HHP LOCOMOTIVES**

विशिष्ट संख्या एम.पी.0.3700.12 (संशो. 01)

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LIST OF AMENDMENTS

Sl. No.	Amendment date	Revision	Details
1.	January'2009	0	First Issue
2.	May, 2021	1	<p>GM Loco is replaced by HHP Loco and similar minor changes</p> <p>Type test plan is updated.</p> <p>Clauses of IEC 60571 referred in Para 12 has been updated as per latest revision.</p> <p>Clause No. 13 for Field trials has been reviewed and only guidelines of RDSO mentioned for trial period and trials quantity.</p> <p>Addition of new clause 21-Vendor Changes in approved status.</p> <p>Make In india policy has been incorporated at clause no. 22.</p> <p>Undertaking by equipment manufacturer has been incorporated at clause no. 23.</p> <p>Declaration of Confidentiality has been incorporated as Clause no. 24.</p> <p>Addition of new clause no.25.Title: References.</p> <p>The number of trial equipment, trial period is changed by the Qualifying period and Qualifying Quantity for field trials in clause no 13.1 and Field Trial Performance Format is incorporated at Clause no.13.1.</p> <p>At clause no. 12.9,High voltage test is renamed as supply over voltage test in line with Clause of referred IEC 60571 (Latest)</p> <p>At clause no. 12.0, Sr. No.8 Dielectric test is incorporated as Acceptance test.</p> <p>At clause no. 25, Reference at Sr. No. 1 is changed as IEC: 60571(latest revision)</p> <p>Test plan including pass/fail criteria has been incorporated as annexure VI.</p> <p>Minor changes have been done to streamline the contents.</p> <p>clause no 5.5,6.5 and 8.1(1) option for USB port has been added along with RS-232 communication port.</p> <p>In clause no.6.4 Pin No 10 and 11 has been labeled for RS 485 A and RS 485 B respectively and In annexure-V, Pin connection detail has been changed.</p>

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2. ANNEXURE- II,	Details of data in the packet including data and information
3. ANNEXURE- III,	Out line and Mounting detail
4. ANNEXURE- IV,	Data Recording format
5. ANNEXURE- V,	Connector and cable details
6. ANNEXURE- VI,	Test plan for Microcontroller based Event Recorder used on HHP Locomotives.

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1.0 INTRODUCTION

- 1.1** HHP class of diesel electric Locomotives (WDG4/WDG4D, WDP4, WDP4B,WDP4D) have been equipped with an Event Recorder. This is a vital of equipment generally located in HVC (High Voltage Cabinet) compartment on both Goods and Passenger variants of HHP locomotives. Event recorder keeps track of change of important parameters like locomotive speed, application of brakes through A-9 or SA-9, notch, status of power application, status of penalty application, status of horn application etc. on the locomotive.
- 1.2** HHP loco is controlled by computer commonly known as LCC (Loco Control Computer). This system is provided with software for giving data signal to the Event Recorder. Event Recorder is like a black box on an aircraft.
- 1.3** This specification covers the technical requirements for micro controller based Event Recorder for application on HHP locomotives. It is the responsibility of the manufacturer/supplier to develop circuit/detailed design as per this specification for processing the signal to the Event Recorder after accepting appropriate matching output signal from Loco Control Computer.

2.0 DEFINITIONS

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

- 2.1** “**RDSO**” means Research Designs and Standards Organization, Ministry of Railways, Manak Nagar, Lucknow-226 011.
- 2.2** “**BLW**” means Banaras Locomotive Works, Varanasi-221 004.
- 2.3** “**BG**” means 1676 mm gauge, referred to as Broad Gauge.
- 2.4** “**IEC**” means International Electro-technical Commission.
- 2.5** “**IS**” means Indian Standard.
- 2.6** “**AAR**” means Association of American Rail-roads.
- 2.7** “**UIC**” means Union International Des Chemins defer (International Union of Railways)
- 2.8** “**IRS**” means Indian Railway Standard.
- 2.9** “**IR**” means Indian Railways.
- 2.10** “**Purchaser**” means the President of the Republic of India.
- 2.11** “**Engineers**” mean the representatives of Research Designs & Standards Organisation, Ministry or Railways, Manak Nagar, Lucknow – 226011.
- 2.12** “**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.
- 2.13** “**Contractor**” means any person, firm or company with whom the order for the supply of the stores to be placed.
- 2.14** “**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.
- 2.15** “**LCC**” means Loco Control Computer.

3.0 SERVICE CONDITIONS

- 3.1** The equipment shall be suitable for traction application under the following environmental conditions, since these equipment will be used in diesel electric locomotives operating all over India :-

Maximum temperature (Atmospheric)	(i) 70 °C (under sun). (ii) 47 °C (in shade) (Temperature inside locomotive may reach 60 °C.)
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Minimum temperature (Atmospheric)	- 5 °C.
Humidity	90 % (Up to 100% during rainy season as per IEC 60721-3-5).
Altitude	Max. 1200 meter above mean sea level.
Reference site conditions	(i) Ambient temp. 47 °C (ii) Temp. inside engine compartment 55 °C
Annual rainfall	Between 1750 mm to 6250 mm. The locomotive shall be designed to permit it's running at 5 Km/h in a flood water level of 10.2 cm above the rail level.
Dust	Extremely dusty and desert terrain in certain areas. The dust content in air may reach as high a value as 1.6 mg / m ³ .
Atmospheric conditions in coastal areas in humidity salt laden and corrosive atmosphere	All the equipment shall be designed to work in coastal areas in humidity salt laden and corrosive atmosphere. (a) Maximum PH value: 8.5 (b) Sulphate: 7 mg / litre. (c) Max. concentration of chlorine: 6 mg / litre (d) Maximum conductivity: 130 micro siemens / Cm.

3.2 Equipment Voltage: The Event Recorder shall be powered from the locomotive's 74V power supply. The nominal voltages for locomotives are as follows:

HHP locomotives : 74 volts DC

The limits of variations of voltages in which the equipment shall operate satisfactorily are:-

HHP locomotives : 52 – 93 volts DC

3.3 Spikes & surges: Provision shall be made for suppression of transients (spikes and surges). The equipment shall withstand, without damage, the surge test mentioned in clause 12.10.

3.4 The system shall be interference free from the wireless communication system between the Guards–Driver-Control. The same shall be tested as per IEC 61000 for EMC compatibility.

3.5 Electromagnetic Pollution – High degree of electromagnetic pollution is anticipated in areas, where the equipment will be mounted

4.0 SCOPE OF SUPPLY

4.1 The scope of supply will include the following-

. A ON BOARD EQUIPMENT:

.1 Event Recorder – This is the central control unit of the equipment with micro controllers and FLASH EEPROM memory, for calculating and recording the journey data with events. RS 485 communication has to be provided for communication with LCC.

.2 Connecting cables with MS type connectors as per Annexure IV.

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. B EVALUATION SOFTWARE

The software for data retrieval, analysis and printing, shall be developed and supplied by the manufacturer of the Event Recorder.

- 4.2** The system offered shall be of proven design. This is the responsibility of supplier of Event Recorder System to integrate with Loco Control Computer for data recording of the parameters mentioned at Para 8.2.
- 4.3** The design shall be developed as per requirement given in the specification. The detailed design shall be submitted to RDSO for scrutiny and approval of the design features before commencing of the manufacturing. The suppliers shall, however, be responsible for performance of complete system.

5.0 BASIC DESIGN AND CONSTRUCTION

- 5.1** The construction shall be mechanically sound so as to ensure ruggedness and durability in all mechanical, electrical, electronic or magnetic environments when used in accordance with manufacturer's recommendations.
- 5.2** The design shall conform to IEC-60571 or latest standard.
- 5.3** The equipment being a safety item shall be designed for high degree of reliability.
- 5.4** The system shall be capable of recording the events in both (forward and backward) directions of travel of the Locomotive.
- 5.5** The Event Recorder shall be capable of driving a RS-232/USB communication port. Necessary wiring shall be provided including a DB15 connector (receptacle) as a part of the cable form. DB15 connector for ER is mounted into a diagnostic panel along with other DB15 connectors for other microprocessor equipments.
- 5.6** The Event Recorder shall be contained in rugged and suitable metallic enclosure. The enclosure sheet used shall be of minimum 1.5 mm thickness to ensure adequate protection. The enclosure shall be tested as per IP-54 with the use of latest revision of IEC-60529.
- 5.7** The equipment shall be designed as compact as possible in view of limited space available in the HHP locomotive. The overall dimensions (WxHxD) of Event Recorder unit shall not exceed 160x215x90 mm. The mounting dimensions (WmxHm) for both the units shall be 190x190 mm. Outline and mounting details shall be as per Annexure-III. The equipment shall be designed so as to have interchangeability with other makes without any need for changing the cables.
- 5.8** Vendors are advised to study the space availability, location and other requirements, before submitting the offer, in their own interest.
- 5.9** Event Recorder should have a self-diagnostic feature. In case of any malfunction, the system must indicate the fault LED display.

6.0 COMMUNICATION METHODOLOGY AND PROTOCOL

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6.1 Communication methodology between LCC and Event Recorder

Two-way communication shall be used, so that the Event Recorder can send certain information back to the LCC (such as health signal and the software revision of the Event Recorder). The protocol shall broadly conform to the following requirements –

- a. The protocol for the event recorder communication shall conform to SAE J1708 and SAE J1587 specification.
- b. The MID 95 packet from the LCC to the Event Recorder is sent at every 200 m-second intervals.
- c. The MID 96 packet from the Event Recorder to the LCC is sent upon receipt of MID 95 packets.
- d. LCC continues to attempt to send packets to the event recorder at regular intervals of about 200 msecs. at all times. Incomplete or incorrect packets (wrong length or checksum) are discarded per the protocol.
- e. If the LCC does not receive a response from the Event Recorder, it shall keep track of inactivity, but continue to send new packets at every 200 m-second intervals. If ten seconds goes by without receiving the valid data, the LCC will register a fault condition.

6.2 Verification of communication protocol

The communication protocol shall be verified as per the following steps-

- a. Event Recorder shall be connected with LCC and power supply to the Event Recorder to be switched ON.
- b. Event Recorder should be set in receiving mode and shall wait for data from LCC.
- c. Once it receives the data from LCC, it will verify the data via message identification (MID) and check sum checking. In case of incorrect check sum, it shall remain in receiving mode. In case of correct check sum, Event Recorder shall come into transmitting mode and transmitting the data (MID 96) to LCC keeping the busy check number same that was received from LCC MID 95.
- d. Event Recorder shall also check from the busy check number to that it is previous number or incremented number. In case of incremented number, Event Recorder shall take as a new data. Like this communication shall set between LCC and Event recorder.

6.3 Control message packet

The control packet consists of a message identifier, up to 19 bytes of actual data, and a checksum. The signals details are explained in Annexure – I and the size including data & information from LCC is in Annexure-II.

- 6.4 The input signals for Event Recorder, transmitted from the LCC located inside the HVC compartment are available at pins No.10 & 11 in the signal distribution box (DB25 electrical connector). The signal distribution box is connected to COM 301 or equivalent communication module, which handles the serial link communication for the LCC control system. Pins No.10 (for RS 485 A) & 11 (for RS 485 B) are the dedicated serial link between Event Recorder and the LCC. There are no other applications, which share this communication channel.

- 6.5 The Event Recorder shall be capable of driving a RS-232 /USB communication port.

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Necessary wiring shall be provided including a DB15 connector (receptacle) as a part of the cable form. DB15 connector for Event Recorder is mounted into a diagnostic panel along with other DB15 connectors for other microprocessor equipments.

- 6.6** There shall be a provision to wait “20 bit time” before echoing a return packet from the Event Recorder to the LCC.

7.0 MOUNTING

<u>Components</u>	<u>Location</u>
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Event Recorder Unit	HVC (High Voltage Cabinet) compartment
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The equipment shall be suitable for mounting in any position viz. vertical, horizontal or in any inclined position between the horizontal and vertical plane.

8.0 TECHNICAL REQUIREMENTS

- 8.1** The Event Recorder Unit shall have: -

1. Communication port (Male) for communication (RS-232)/USB with LCC.
2. Communication port (Female) for serial link communication (RS-485) to LCC.
3. USB Data down loading port / Pen drive
4. Power supply port.
5. Memory fail indication of Event Recorder with blinking LED (RED colour).
6. Memory Freeze switch with LED indication (RED colour) under a sealed glass cover.
7. Power “ON” with LED indication (Amber colour).
8. A LED display screen for viewing the parameter and code mentioned in clause 8.3.
9. Push button for viewing the parameter mentioned in clause 8.3

- 8.2** The Event Recorder unit shall continuously record the following parameters in the memory. The time interval between the records can be as short as one second The interval is decided automatically by the recorder based on the frequency of change of parameter (e.g. in standstill condition, the recorder records only when one of the parameters changes and does not clog up memory with frequent readings): -

S.No.	Parameter
1.	Vehicle (Locomotive) Speed (in Km/h)
2.	Real time, in hours, minutes and seconds
3.	Distance, in meter.
4.	Tractive effort (in KN)
5.	Main Generator Power (in KW)
6.	Brake pipe pressure (in PSI)
7.	Brake Cylinder pressure (in PSI)
8.	Train Line 24 voltage (VDC)
9.	Throttle Handle position (Diesel locomotive- Idle, 1to 8)
10.	Reverser position (Forward / Reverse)
11.	Status of Horn (Horn Switch)

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12.	Status of Headlight Switch 1& Switch 2
13.	Status of PCS
14.	Status of Penalty brake
15.	Memory Freeze
16.	Engine RPM (Optional)
17.	MR Pressure (Optional)
18.	Engine Temperature (Optional)

8.3 The following parameter shall be display on the LED display screen whenever a push button is pressed. LED display shall be made on front fascia of the unit each operation of the button should indicate the next parameter in sequence. The display should allow to go in sleep mode after one minute of button operation :-

Code	Parameter	
1	Vehicle (Locomotive) speed in	Km/h
2	Date in format	DD:MM:YY
3	Time in format	Hr:Min:Sec
4	Tractive effort in	KN
5	Main Generator power in	KW
6	B. P. pressure	Psi
7	Memory freeze	ON/OFF

9.0 RECORDING SYSTEM

9.1 All the data stored in electronic memory should be sufficient capacity to contain the following sub-memories-

(a) **SHORT -TERM Memory:** To store the most recent data of the last 72 hours of travel in loop (circular) form, in respect of parameters mentioned in clause 8.2 with resolution of one second or when ever there is any change in parameter (other then time and distance) which ever is earlier.

(b) **LONG -TERM Memory:** To store the data (speed, time, distance) of the last 90 days of halt and run or 60,000 kms of distance travel in loop form, shall be with resolution of 20 seconds.

The electronic memory shall be accessible through USB interface (locked under cover) to an IBM compatible PC / lap top computer /pen drive (Flash memory storage device).

9.2 TRANSFERRING THE JOURNEY DATA

9.2.1 The journey data (speed and events) shall be recorded in memory. The data stored in memory will be 90 days (run and halt) or 60,000 kms which ever is earlier. The recording of this data will be loop (circular) type i.e., the current data will overwrite the already

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recorded data if the memory is full. The data downloaded from the memory shall be transferred to a PC, laptop, palmtop or any futuristic hand held terminal (HHT) equipped with evaluation software. It should also be possible to plug a wireless device in the Event Recorder for wireless data transmission to other compatible receiver.

- 9.2.2** It shall be possible to sort out this data with suitable commands on the computer. Alternately, it shall be possible to download the data directly onto a PC / laptop /pen drive (Flash memory storage device) by connecting to the USB port on the 'Event Recorder'.

9.3 REPORTING FORMAT

- 9.3.1** Printing of data of event memory, long-term and short-term memories shall be in continuous printing format, instead of screen-by-screen printing, to cut down printing time. Normally, the display and printing of data of the long-term memory shall be selectable and shall print out events like status of horn, notch position, braking etc. or between specified times. The downloading of the memory data should not affect any other work like printing, processing of other work etc.

- 9.3.2** The printing/plotting of the data of short-term and event memory shall be in detail, in digital or graphical format, as desired.

- 9.3.3** The software shall also provide for printing of the data in the following selective Formats:

- a) Only the page desired to be viewed.
- b) Continuous print out of all pages.
- c) Between desired time/distance intervals.
- d) Data above/or below a specified parameter.
- e) Data for a particular section/speed.
- f) Data of a particular parameter as mentioned in clause 7.2.

- 9.3.4** The format for recording the parameter mentioned in clause 8.2 shall be as per Annexure- IV.

- 9.4** Necessary software for data retrieval, analysis and printing, in the above manner shall be developed and supplied by the manufacturer of the 'Event Recorder'. The software shall be menu-driven and shall not require knowledge of any programming and shall be suitable to be operated with minimum computer literacy. The software shall have file management system for retaining the data in the file name assigned by the operator. The file name of the downloaded file should carry the loco no. and date of downloading. The file management should allow conversion of downloaded file to document file format including MS Excel, MS word etc. also and the data saved should be displayed in tabular and graphical formats.

9.5 MEMORY FREEZE

A "Memory Freeze" facility shall be provided to allow the locomotive to be moved after an incident, without over writing the Event recorder data stored during last 24 hours of travel. The switch for freezing the data shall be under a sealed glass cover on "Event Recorder units". The glass shall be broken, when required, for operating the switch. A LED freeze indication shall also be provided.

9.6 MEMORY FAIL INDICATION

A warning display shall be provided on the Event Recorder module, which will indicate any failure in the memory recording. The warning display should be LED based.

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9.7 **OPTIONAL REQUIREMENT**

The supplier shall offer the equipment with their own sensor fitted at the appropriate place in the locomotive for recording the optional parameter as mentioned in the clause 8.2.

10.0 **INSPECTION**

10.1 The whole of the materials or fittings used in the construction of the equipment shall be subjected to inspection by the Inspecting Officer and shall be to his entire satisfaction.

10.2 The Inspecting Officer shall have the power to:-

.1 Adopt any means he may consider necessary, to satisfy himself that all the materials or fittings specified are actually used throughout the manufacturing are as per relevant standard.

.2 Visit at Contractor's Works or his Sub-contractor's works any time and without previous notice, to inspect the process and quality of the work at any stage.

.3 Reject any material or fittings that do not conform to the relevant standard specifications or have not been manufactured in accordance with approved practices. The rejected materials or fittings shall be marked in a distinguishable manner and shall be disposed off in such manner as the Inspecting Officer may direct to avoid its inadvertent use in the product ordered as per this specification.

10.3 Inspection of equipments and fittings shall, as far as possible, be carried out at the works of the manufacturer. Testing of subassemblies and components procured from sub-contractors may also be carried out at their premises, if so required. The supplier shall provide, free of charge, such materials or fittings as may be required for testing whether at his own or his sub-contractors premises. The tests for which facilities are not available may be carried out at RDSO or any other approved laboratory, for which the testing charges shall be payable by the supplier/manufacturer.

10.4 All equipments and fittings required for tests shall be selected by the Inspecting Officer and the tests shall be carried out in his presence.

10.5 No item shall be packed or dispatched until the Inspecting Officer has passed it.

10.6 If any part should require alteration, or any defect appear during the tests or trials, the supplier shall without any extra charge make such alterations or rectify the defect to the satisfaction of the Inspecting Officer.

10.7 Copies of Maker's test certificate, guaranteeing the performance of the equipment, shall be supplied in duplicate along with the delivery of each set of equipment.

11.0 **TESTS**

11.1 Type Tests: Type tests shall normally be carried out on one unit of equipment of the approved design. If there is any change in design or source of supply of any component/sub-component/assembly, units made to the changed design or from new source shall be treated as a separate batch for the purpose of conducting type tests.

The Test Plan for prototype is attached as Annexure-VI

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11.2 Routine Tests: Routine tests shall be carried out on all the pieces of equipment of each order.

12.0 TESTING DETAILS

Tests mentioned in the following table shall be carried out on the equipment.

S. No.	Kind of test	Testing details		
		Clause No.	Type Tests	Routine Tests
1.	Visual Inspection	12.1	√	√
2.	Performance test	12.2	√	√
3.	Reversal of Polarity	12.3	√	√
4.	Effect of voltage variation	12.4	√	√
5.	Weather proof ness test	12.5	√	-
6.	Temperature variation .1 Cooling test .2 Temperature rise test	12.6	√	
7.	Insulation resistance test	12.7	√	√
8.	Di-electric test	12.8	√	√
9.	Supply Over Voltage Test	12.9	√	-
10.	Surge test	12.10	√	-
11.	Vibration & shock test	12.11	√	-
12.	Endurance test	12.12	√	-
13.	Validation test	12.13	√	-
14.	Transient burst susceptibility test	12.14	√	-
15.	Radio-frequency interference free test	12.15	√	-

Note: The Test given above is the minimum requirement and strictly governed by IEC 60571. The latest edition of IEC 60571 shall apply mutatis mutandis to this Test plan. The test other than above as specified may also be considered with mutual agreement between vendor and Vendor approving authority, if desired so.

12.1 VISUAL INSPECTION:

Visual inspection shall be carried out to ensure that the equipment under test is of acceptable workmanship and in conformity with manufacturer's design specification accepted by the purchaser. Checks shall be made for-

- .1 Cable sockets and terminals.
- .2 Communication & down loading port.
- .3 Mounting arrangement.
- .4 LED indications
- .5 Identification markings etc.

12.2 PERFORMANCE TEST

These tests are carried out to check and ensure that the performance of the equipment is in order and meet the specification requirements. The operating voltage shall be the nominal voltage specified in clause 3.2. The test shall be performed as under-

- .1 **General Working:** Run the complete system on a test bench with a simulator developed by the manufacturer, on a nominal operating voltage. Connect all the connections of the 'Event recorder' unit. Length and type of connecting cable /terminals etc. shall be the

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same as to be supplied. Serial communication shall be checked by one side sending a signal, and the other side indicating the signal and its value. This should be done for all signals, and for both direction of data travel. Run the system for the 30 minutes over input values of parameters mentioned in clause 8.2 and check the records by connecting it to computer.

- .2 The communication port shall be checked by connecting a laptop /computer to the remote DB15 port and verifying the communication takes place.
- .3 To test the short term memory, the Event Recorder unit shall be checked with the simulator for period of 30 minutes. Activity should include: Power, dynamic brake, each throttle position, moving, standstill, airbrake ON and OFF, horn blown, headlight ON and OFF, changing direction of travel, engine shutdown, engine starting etc. Data shall be verified with the manufacturer-supplied software to determine that all the events are recorded.

12.3 REVERSAL OF POLARITY

Where reversed polarity protection is provided, the effectiveness of this shall be tested over a period of not less than 1 minute within the specified voltage range. After this test the system shall be connected correctly and the accuracy shall comply with the requirements of clause 12.2.

12.4 EFFECT OF VOLTAGE VARIATION

The complete system shall be checked at the operating voltage varied between the limits specified in clause 3.2. The variation in the voltage shall not affect the system's performance.

12.5 WEATHER PROOFNESS TEST

The weather proofed parts ('Event recorder') of the system shall be placed in a simulated installed position in a chamber at a temperature of 55 \pm 5 deg. C for a period of 30 minutes, and then subjected to a fine air borne spray of ordinary tap water for 15 minutes. The temperature shall then be allowed to recover to 37 \pm 5 deg c after which the water shall be found not to have penetrated the system. The system shall operate correctly throughout this test.

12.6 TEMPERATURE VARIATION TESTS

.1 COOLING TEST

The 'Event recorder' unit shall be placed without any voltage applied, in a chamber where the temperature is progressively lowered from ambient to the lowest agreed temperature (at least up to 0 deg c) over a period of time not less than 30 minutes. The assembly is kept for 2 hours, at the lowered temperature with a tolerance of \pm 3 deg. c (this period starting from the time when the temperature inside the thermal enclosure is uniform throughout). At the end of this period the test shall comply (clause 12.2) and shall be carried out keeping the equipment at low temperature.

.2 TEMPERATURE RISE TEST

The 'Event recorder' unit normally energized, is placed in a chamber where the temperature is progressively raised from the ambient temperature to 70 deg. c or to highest agreed temperature with tolerance of \pm 2 deg. c over a period of time not less than 30 minutes. The assembly shall then be kept for 3 hours at this temperature with tolerance of \pm 2 deg. C (this period starting from the time when the temperature inside the chamber is uniform). At the end of this period the test shall comply (clause 12.2) and shall

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be carried.

12.7 INSULATION RESISTANCE

The insulation resistance shall be measured by applying 500 V DC for 15 sec. between all terminals coupled together and the body of the electrical/electronic equipment also between the windings. The insulation resistance shall be not less than 10 MΩ in both cases.

12.8 DIELECTRIC TEST

The dielectric test of the assembly which is to contain the equipped printed circuit boards, itself consisting only a rack and its wiring, shall be carried out in accordance with the rules of IEC Publication 60571 (Latest), clause 12.2.10.3.

12.9 SUPPLY OVER VOLTAGE TEST

The supply over voltage test shall be done as per clause 12.2.7 of IEC 60571 or latest.

12.10 SURGE TEST

Surges and electrostatic discharge shall be as per clause 5.4 of IEC 60571 or latest. The surge waveform shall be generated as per clause 12.2.8.1 of the IEC-60571 or latest. The test circuit given in figure 4 of IEC-60571 or latest shall be followed. The waveform A is mandatory.

12.11 VIBRATIONS AND SHOCKS

The complete assembly or a sub-assembly together with its auxiliaries and mounting arrangements (including shock absorbing devices, if used) shall be subjected to the following tests under the prevailing ambient conditions of the testing area in three mutually perpendicular planes. For these tests, the equipment shall be secured in a suitable position, to a machine producing vibrations of sinusoidal form with adjustable amplitude and frequency. The test shall be carried out in accordance with the rules of IEC Publication 60571, clause 12.2.12.

12.12 ENDURANCE TEST

The equipment ('Event Recorder') shall be continuously worked for 100 hours at the nominal operating voltage. The tests shall be acceptable if the equipment performs satisfactorily throughout the tests and also after the tests.

12.13 VALIDATION TEST

The Event Recorder unit shall be validated with the locomotive. The locomotive shall be operated on a short length of track for a period of 1 hour. Activity should include: Power, dynamic brake, each throttle position, moving ,standstill, airbrake ON and OFF, horn blown, headlight ON and OFF, changing direction of travel, engine shutdown, engine starting etc. Data shall be verified with the manufacturer-supplied software to determine that all the events are recorded.

12.14 TRANSIENT BURST SUSCEPTIBILITY TEST

The test shall be carried out in accordance with the rules of IEC Publication 60571, clause 12.2.8.3 or latest.

12.15 RADIO-FREQUENCY INTERFERENCE FREE TEST

The test shall be carried out in accordance with the rules of IEC Publication 60571, clause 12.2.9.1 or latest.

13.0 FIELD TRIALS:

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13.1 After successful completion of type tests, the full set of the equipments shall be subjected to field service trials for a specified period. The Qualifying period and Qualifying Quantity for field trials is governed by RDSO Doc.no.MP-M-8.1-1 (Latest). Supplier shall arrange commissioning & field trials of the prototype equipment jointly with RDSO. The period can be extended in case of failures attributable to design material or manufacturing of the system. Feedback shall be furnished by User Railways as per prescribed format as follows:

S.N	Loco No./Type	Event recorder make	Date of commissioning of event recorder	Date of failure (if failed)	Date of rectification (if failed)	Feedback/Remark incl. comments on issues related to Event recorder and its associated electronics if any.
1.						
2.						
3.						

Performance shall be closely monitored and evaluated by Vendor controlling authority for:

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

Notwithstanding anything that may be specified in this specification, the final responsibility for the suitability of the design shall lie with the vendor and shall carry out all modifications for satisfactory functioning during the period of field trials. Any safety related modifications issued by IR are to be carried out by the vendor.

13.2 Supplier shall also depute his representative for ensuring correct installation of first two equipments in the locomotive at each location (Shed/DLW). The venue shall be as agreed to between the purchaser and the supplier.

13.3 The supplier at his own cost shall carry out the installation and commissioning of the equipments for field trials.

14.0 MODIFICATIONS

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.

15.0 TEST CERTIFICATES AND MARKINGS

15.1 Test Certificates:- The manufacturer shall provide test certificate of the systems/parts procured from outside and used in the equipment supplied to the purchaser.

15.2 Identification Marking:- The following particulars shall be clearly and indelibly marked on the appropriate location of the equipment:-

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- .1 Manufacturer's/Supplier's identification or trade mark.
- .2 Manufacturer's/Supplier's designation (type, symbol or code etc.).
- .3 Manufacturer's serial No./Batch No. and year of manufacture.

15.3 Marking of terminals:- The correct operation of the equipment depends upon the specific connections of the terminals on speed indicators, event recorder unit and sensor units. As such terminals shall be marked appropriately.

16.0 WARRANTY

The supplier shall be responsible for any damage to equipment provided in the locomotive due to defective design, materials, workmanship up to a period of 18 months after commissioning on the locomotive or 24 months from the date of supply, whichever is earlier. The supplier shall replace within one month, such equipment during the warranty period at his cost. The period of warranty will 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. The warranty on whole system shall be applicable in case of upgrade.

17.0 ANNUAL MAINTENANCE CONTRACT

17.1 The event recorder unit is required to serve a life of 20 years. The supplier shall quote for spares, which may be required for satisfactory maintenance of the unit for a period of 3 years after completion of warranty period.

17.2 The supplier will be required to enter into a contract with the user railway, if required for repair of electronic cards employed (if any) and shall indicate repair charges for the cards. The repaired card will have warranty of one year.

18.0 TRAINING

The supplier shall arrange for training to IR personnel in maintenance and trouble shooting of the system supplied. One day training for three persons per location is to be arranged by the supplier in the field of maintenance and trouble shooting. The supplier shall furnish the syllabus and schedule of training programme to RDSO as part of design proposal. Training will be arranged free of cost. Suitable training material will be supplied to the participants.

19.0 INSTRUCTIONS MANUAL

Sufficient copies of Instructions Manual shall be supplied by the manufacturer or supplier. This shall include system description and operating, maintenance, calibration and installation instructions. List of spares with part Nos. or Tech. Specifications shall also be included.

20.0 DOCUMENTATION

Following documents shall be submitted by manufacturer along with the offer for evaluation :

1. Schematic circuit of the complete system.
2. Functional description of the complete system.

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3. System design details (hardware & software).
4. Communication protocols used and details of compatibility with the existing equipment.
5. Outline General Arrangement drawings of various equipment.
6. Supply of detailed instructions for installation of the equipment on the locomotive.
7. Clause by clause compliance and test results with the specification.
8. Salient features and advantages of the offered system.
9. Details of technical support and training offered.

21.0 VENDOR CHANGES IN APPROVED STATUS

All the provision contained in RDSO's ISO procedure laid down in document no. QO-D-8.1-11, dated 01.07.2020 (titled: "Vendor changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to maintain quality of products supplied to Railways.

22.0 PREFERENCE TO "MAKE IN INDIA"

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

23.0 UNDERTAKING BY EQUIPMENT MANUFACTURER

Vendor shall provide a signed copy of the undertaking on "INFRINGEMENT OF PATENT RIGHTS". The undertaking shall be as under :

India 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 dispute/matters lies with the manufacturer/supplier.

Details/design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of Railways for any such violations. Data, specifications and other IP as generated out of interaction with Railways shall not be unilaterally used without the consent of RDSO and right of Railways/RDSO on such IP is acceptable to them.

24.0 DECLARATION OF CONFIDENTIALITY OF SUBMITTED DOCUMENTS BY MANUFACTURERS

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

This document and its contents are the property of M/s XYZ (Name of the vendor) or its subsidiaries. This document contains confidential proprietary information. The reproduction, distribution, utilization or the communication of this document or any part thereof, without express authorization is strictly prohibited. Offenders will be held liable for the payment of damages. Indian Railways/RDSO is granted right to use, copy and distribute this document for the use of inspection, operation, maintenance and repair etc.

25.0 REFERENCES

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Assistance has been received from the following International and Indian Standard Specifications in the formation of this specification:-

1. IEC: 60571(latest revision)
Rules for Electronic equipment used on rail vehicles.
2. IEC: IEC-60529 (latest revision)
3. SAE J1708
4. SAE J1587
5. Document No. MP-M-8.1-1 Ver. 1.0 (Latest revision)
Master List of Qualifying Quantity for up-gradation to approved vendors and Qualifying Quantity & Qualifying Periods for Approval for RDSO vendor for developmental order of items controlled by MP Directorate.
6. QO-D-8.1-11, dated 01.07.2020 or latest
Document Title: Vendor - Changes in approved status.

ANNEXURE-I

SIGNAL LIST OF EVENTS

Serial out put to EVENT# 1							
Name	Signal Name	Addresses	Bit	Bit Size	Mux	Mux offset	Mux value
E1 Mid O1	EVENT MID OUT 1	0	0	8		0	0
E1 V Spd	EVENT Vehicle Speed	1	0	16		0	0
E1 Tr Eff	EVENT Tractive effort	3	0	16		0	0
E1 MGPwr	EVENT Main Generator power	5	0	16		0	0
E1 Br PPr	EVENT Brake pipe Pressure	7	0	8		0	0

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E1 Br Cy .Pr	EVENT Brake cylinder pressure	8	0	8		0	0
E1 TL24T	EVENT TL24	9	0	8		0	0
E1 Throt	EVENT Throttle position	10	0	4		0	0
E1 Rv Pos	EVENT Reverser position	10	4	2		0	0
E1 Gf Req	EVENT Generator field request	10	6	1		0	0
E1 Horn>	EVENT Horn switch	11	0	1		0	0
E1 HLgt1	EVENT Headlight switch 1	11	1	1		0	0
E1 HLgt2Br	EVENT Headlight switch 2	11	2	1		0	0
E1 PCSOp	EVENT PCS	11	3	1		0	0
E1 PBrk>	EVENT Penalty Brake	11	4	1		0	0
E1 Unit	EVENT Unit Info	11	5	3		0	0
E1 Spd OK	EVENT Vehicle Speed Valid	12	0	1		0	0
E1 TrEfV	EVENT Tractive effort Valid	12	1	1		0	0
E1 MGPwV	EVENT Main Generator power Valid	12	2	1		0	0
E1 Br PPV	EVENT Brake pipe Pressure Valid	12	3	1		0	0
E1 Cyl PV	EVENT Brake cylinder pressure Valid	12	4	1		0	0
E1 TL24V	EVENT TL24 Valid	12	5	1		0	0
E1 CTime	EVENT Current Time	13	0	32		0	0
E1 BusyA	EVENT Busy check	19	0	4		0	0

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ANNEXURE- II

Details of data in the packet including data and information

From LCC to Event Recorder - (sent every 0.200 second)

- 0 IR-ER MID OUT
Description: Message Identifier (MID) = 95
- 1-2 VEHICLE SPEED
Description: Locomotive speed signal
Data type: Word (Byte 1 is most significant byte)
Resolution: 0.010973 km/h/bit
Range: 0-710.1km/h
- 3-4 TRACTIVE EFFORT
Description: Locomotive Tractive effort feedback signal
Data type: Signed word
Resolution: 0.04 KN/bit
Range: 310KN to +1310KN (Negative value used for dynamic braking effort)
- 5-6 POWER
Description: Power output of the traction alternator
Data type: Word
Resolution: 0.1kw/bit
Range: 0 to 5553.5 KW
- 7 BRAKE PIPE PRESSURE
Description: Brake pipe Pressure feedback signal
Data type: Byte
Resolution: 1.0 PSI/bit (6894.8 Pa/bit)
Range: 0-255 PSI (0 to 1758183 Pa)
- 8 BRAKE CYLINDER PRESSURE
Description: Locomotive Brake cylinder pressure
Data type: Byte
Resolution: 1.0 PSI/bit (6894.8 Pa/bit)
Range: 0-255 PSI (0 to 1758183 Pa)
- 9 TRAIN LINE 24T VOLTAGE
Description: TL-24 T value
Data type: Byte
Resolution: 0.3 Volt/bit
Range: 0 to 76.5 VDC
- 10 CONTROLLER INFORMATION
Description: Throttle position
Data type: Discrete
Resolution: N/A
Range: Boolean
- Encoding: xxxx 0000 throttle handle in IDLE (No governor solenoid valves)

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- xxxx 0001 Throttle handle in TH1(No valve)
 xxxx 0010 Throttle handle in TH2(Governor A)
 xxxx 0011 Throttle handle in TH3(Governor C)
 xxxx 0100 Throttle handle in TH4(Governor A, C)
 xxxx 0101 Throttle handle in TH5(Governor B, C, D)
 xxxx 0110 Throttle handle in TH6(Governor A, B, C, D)
 xxxx 0111 Throttle handle in TH7(Governor B, C)
 xxxx 1000 Throttle handle in TH8 (Governor A, B, C)
 xxxx 1001 Dynamic Brake (Input DB 21T= TRUE) Governor A
 xxxx 1010 Trottle handle in STOP(if available) Governor D
 xx00 xxxx Reverser handle centered or removed
 xx01 xxxx Reverser handle in forward position
 xx10 xxxx Reverser handle in reverse position
 x0xx xxxx Generator Field Request FALSE
 x1xx xxxx Generator Field Request TRUE
- 11 HORN SWITCH
 Description: (any) Horn Switch
 Data type: Bit
 Resolution: N/A
 Range: Boolean
 Encoding: xxxx xxx0- HORN not energized
 xxxx xxx1 HORN energized
- 11 HEAD LIGHT SWITCH # 1
 Description: Headlight Switch # 1
 Data type: Bit
 Resolution: N/A
 Range: Boolean
 Encoding: xxxx xx0x- HDLT 1 not energized
 xxxx xx1x HDLT 1 energized
- 11 HEAD LIGHT SWITCH # 2
 Description: Headlight Switch # 2
 Data type: Bit
 Resolution: N/A
 Range: Boolean
 Encoding: xxxx x0xx- HDLT 2 not energized
 xxxx x1xx HDLT 2 energized
- 11 PCS
 Description: PCS
 Data type: Bit
 Resolution: N/A
 Range: Boolean
 Encoding: xxxx 0xxx- PCS not energized
 xxxx 1xxx PCS energized
- 11 PENALTY
 Description: Penalty Air Brake Feedback
 Data type: Bit
 Resolution: N/A
 Range: Boolean
 Encoding: xxx0 xxxx- Penalty air brake not applied

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xxx1 xxxx Penalty air brake applied

- 11 UNIT INFORMATION
Description: Discrete
Data type: Bit
Resolution: N/A
Range: Boolean
Encoding: 000x xxxx Unspecified
001x xxxx GT46MAC
010x xxxx GT46PAC
yyyx xxxx Reserved for future model identification
- 12 VEHICLE SPEED VALID
Description: Status of VEHICLE SPEED signal (provided above)
Data type: Bit
Resolution: N/A
Range: Boolean
Encoding: xxxx xx0x speed signal not valid
xxxx xxx1 speed signal valid
- 12 TRACTIVE EFFORT VALID
Description: Status of TRACTIVE EFFORT signal (provided above)
Data type: Bit
Resolution: N/A
Range: Boolean
Encoding: xxxx xx0x TE signal Not valid
xxxx xx1x TE signal valid
- 12 POWER VALID
Description: Status of POWER signal
Data type: Bit
Resolution: N/A
Range: Boolean
Encoding: xxxx x0xx TE signal Not valid
xxxx x1xx TE signal valid
- 12 BRAKE PIPE VALID
Description: Status of BRAKE PIPE PRESSURE signal (provided above)
Data type: Bit
Resolution: N/A
Range: Boolean
Encoding: xxxx 0xxx Brake Pipe pressure Not valid
xxx 1xxx Brake Pipe pressure valid
- 12 BRAKE CYLINDER VALID
Description: Status of BRAKE CYLINDER PRESSURE signal (provided above)
Data type: Bit
Resolution: N/A
Range: Boolean
Encoding: xxx0 xxxx- Brake Cylinder Pressure Not valid
xxx1 xxxx Brake Cylinder Pressure valid
- 12 TL_24T VALID

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	Description:	Status of TL_24T signal (provided above)
	Data type:	Bit
	Resolution:	N/A
	Range:	Boolean
	Encoding:	xx1x xxxx – TL_24T Not valid xx0x xxxx – TL_24T valid
13-16	REAL TIME CLOCK	
	Data type:	Long word (Byte 13 is most significant byte)
	Resolution:	N/A
	Range:	Binary
	Encoding:	An integer number representing the number of seconds, which have elapsed since (the beginning of day) January 1, 1970.
17-18	Spares	
19	IR-ER BUSY CHECK	
	Data type:	Discrete
	Resolution:	N/A
	Range:	Binary
	Encoding:	bits Description 0-3 Copy of the last busy check sent by the LCC 4-7 Unassigned (to be 0000 until assigned)
20	CHECKSUM	
	Description:	Used to verify the accuracy of the transmission. Receiving systems can use this information to determine whether or not the incoming data packet contains an error.
	Data type:	Word
	Resolution:	N/A
	Range:	Binary
	Encoding:	Its value represents the two's complement of sum of the preceding bytes.

From Event Recorder to LCC- (sent every 0.200 second)

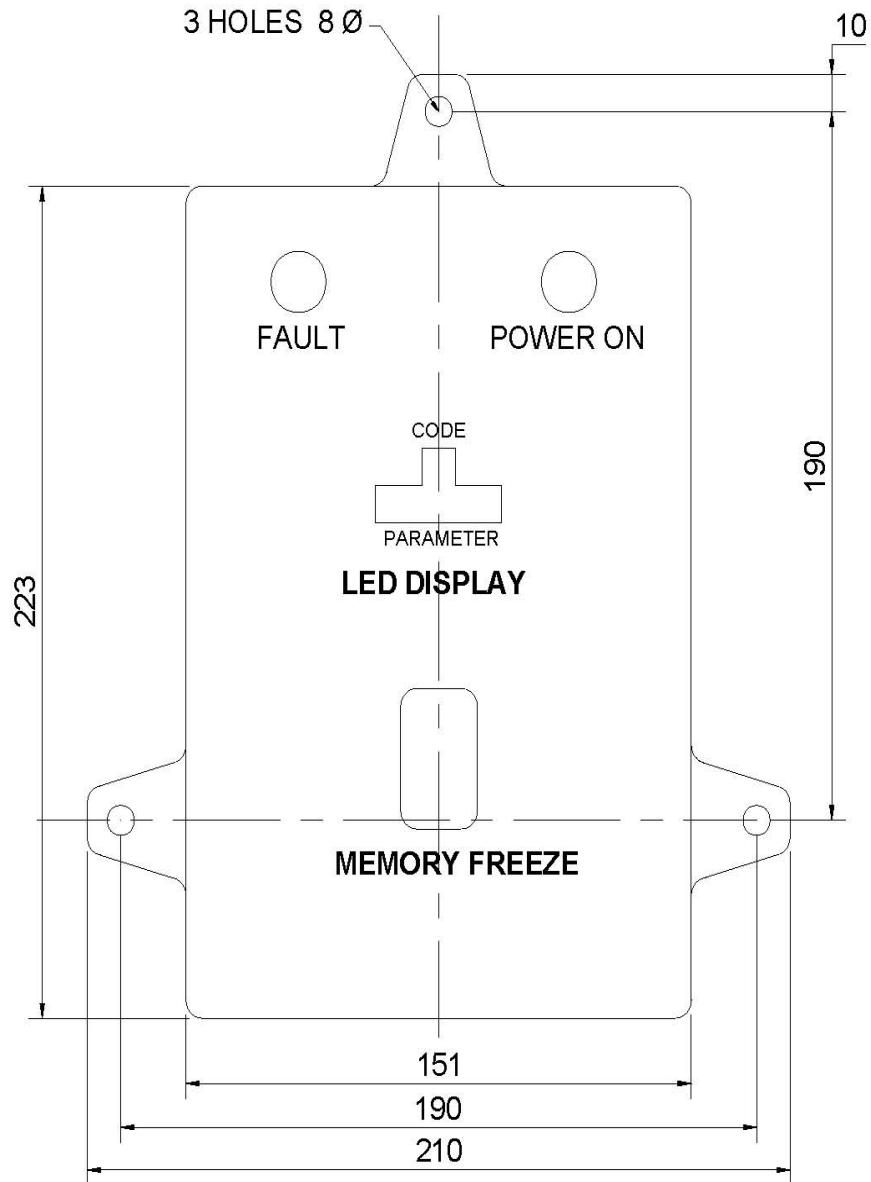
0	IR-ER MID IN	
	Description:	Message Identifier (MID) = 96
1-2	IR-ER SW MAJOR REV	
	Description:	Software major revision
	Encoding	Binary format
	Range:	0-255
3-4	IR-ER SW MINOR REV	
	Description:	Software minor revision
	Encoding	Binary format
	Range:	0-255
13-18	Spares	
19	IR-ER BUSY CHECK	
	Data type:	Discrete

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	Resolution:	N/A	
	Range:	Binary	
	Encoding:	bits	Description
		0-3	Copy of the last busy check sent by the LCC
		4-7	Unassigned (to be 0000 until assigned)
20	CHECKSUM		
	Description:	Used to verify the accuracy of the transmission. Receiving systems can use this information to determine whether or not the incoming data packet contains an error.	
	Data type:	Word	
	Resolution:	N/A	
	Range:	Binary	
	Encoding:	Its value represents the two's complement of sum of the preceding bytes.	

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ANNEXURE - III



OUTLINE AND MOUNTING DETAILS OF EVENT RECORDER FOR HHP LOCOMOTIVE

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ANNEXURE-IV

INDIAN RAILWAY																								
EQUIPMENT MAKE AND TYPE OF EVENT RECORDER																								
LOCO NO.																								
LONG TERM / SHORT TERM MEMORY																								
START DATE			END DATE			UNIT INFORMATION																		
START TIME			END TIME			PRINT DATE / TIME																		
DATE	TIME	SPEED	DISTANCE	TRACTIVE EFFORT	GENERATOR POWER	BRAKE PIPE PRESSURE	BRAKE CYLINDER PRESURE	TL24	GENERATOR FIELD REQUIEST	THROTTLE POSITION	REVERSAR POSITION	HORN	HEAD LIGHT (1)	HEAD LIGHT (2)	PCS	PENALTY BRAKE	VEHICLE SPEED VALID	TRACTIVE EFFORT VALID	POWER VALID	BRAKE PIPE VALID	BRAKE CYLINDER VALID	TL24T VALID	MEMORY FREEZE	

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ANNEXURE-V

DETAILS OF CABLE CONNECTOR & CONFIGURATION

S. No.	Signal Name	No. of pins	MS connector type on unit	MS connector type on cable	Pin connection details and Cable colour
1.	Power supply	3	MS 3102 R-10SL-3P	MS 3106F-10SL-3S	Pin A=Battery (-ve) (Black) Pin B=Battery (+ve) (Red) Pin C is open
2.	Communication for RS485	2	MS 3102 R -10SL-3S	MS 3106 F-10SL-3P	Pin A and Pin 10= RS 485 A (white) Pin B and Pin 11= RS 485 B (Blue)

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ANNEXURE-VI

Test Plan for Microcontroller based Event Recorder used on HHP Locomotives:

(A) Type Test Plan for Microcontroller based Event Recorder used on HHP Locomotives.

Following table summarizes the type test of the equipment/system as per IEC 60571(Latest) or its equivalent to BIS:

S. No.	Standard	Test Name	Test Location	Test Result/Remarks
1.	RDSO Specification clause No. 12.1	Visual Inspection	At firm's premises/NABL Labs	Pass/Fail
2.	RDSO Specification clause No. 12.2	Performance test	At firm's premises/NABL Labs	Pass/Fail
3.	RDSO Specification clause No. 12.3	Reversal of Polarity	At firm's premises/NABL Labs	Pass/Fail
4.	RDSO Specification clause No. 12.4	Effect of voltage variation	At firm's premises/NABL Labs	Pass/Fail
5.	RDSO Specification clause No. 12.5	Weather proof ness test	At firm's premises/NABL Labs	Pass/Fail
6.	RDSO Specification clause No. 12.6	Temperature variation .1 Cooling test .2 Temperature rise test	At firm's premises/NABL Labs	Pass/Fail
7.	RDSO Specification clause No. 12.7	Insulation resistance test	At firm's premises/NABL Labs	Pass/Fail
8.	IEC 60571 -12.2.10.3 or its equivalent to BIS	Di-electric test	At firm's premises/NABL Labs	Pass/Fail
9.	IEC 60571 -12.2.7 or its equivalent to BIS	Supply Over Voltage Test	At firm's premises/NABL Labs	Pass/Fail
10.	IEC 60571-5.4 or its equivalent to BIS	Surge test	At firm's premises/NABL Labs	Pass/Fail
11.	IEC 60571- 12.2.12 or its equivalent to BIS	Vibration & shock test	At firm's premises/NABL Labs	Pass/Fail
12.	RDSO Specification clause No. 12.12	Endurance test	At firm's premises/NABL Labs	Pass/Fail
13.	RDSO Specification clause No. 12.13	Validation test	At firm's premises/NABL Labs	Pass/Fail
14.	IEC 60571- 12.2.8.3 or its equivalent to BIS	Transient burst susceptibility test	At firm's premises/NABL Labs	Pass/Fail
15.	IEC 60571- 12.2.9.1 or its equivalent to BIS	Radio-frequency interference free test	At firm's premises/NABL Labs	Pass/Fail

Test procedure:

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1. Visual Inspection test as per RDSO Specification clause No. 12.1

2. Performance test as per RDSO Specification clause No. 12.2

3. Reversal of Polarity test as per RDSO Specification clause No. 12.3

4. Effect of voltage variation test as per RDSO Specification clause No. 12.4

5. Weather proofness test as per RDSO Specification clause No. 12.5

6. Temperature variation test as per RDSO Specification clause No. 12.6

7. Insulation resistance test as per RDSO Specification clause No. 12.7

8 (a) Di-Electric Test as per clause 12.2.10.3 of IEC 60571 or latest.

Test procedure:

1. All input and output signal wires of the event recorder are shorted.
2. A voltage of 1000 volts, 50 Hz AC is applied between the metal Rack/enclosure and the short circuited points of the connectors of the unit for 1 minute.

Test Result:

1. No disruptive discharge or flash was observed.
2. After above test, the performance of unit tested and found satisfactory.

8 (b) IR Test after Dielectric Test :

Repeat the "Insulation Resistance Test" after the Dielectric test once again and record the Insulation Resistance Values. Values of insulation resistance should not deteriorate much.

9. Supply Over Voltage Test as per Clause no. 12.2.7 of IEC 60571 or latest

Procedure :

- This test shall be carried out as per clause 12.2.7 of IEC 60571
- Supply voltage shall be raised to 105 V DC (1.4x74) for 1 minute.
- During the test the equipment shall be monitored to detect any failure or malfunction.
- Repeat the test for 5 times.
- After completion of test, check the unit functionality by applying 74V DC input to equipment.

Acceptance Criteria

- No failure shall occur.
- Where non-linear surge absorbers are employed for surge suppression, checks shall be made at the end of the test sequence to verify that no degradation has occurred.

10. Surge Voltage test as per clause 5.4 of IEC 60571 or latest.

The surge waveform shall be generated as per clause 12.2.8.1 of the IEC-60571 or latest . The test circuit given in figure 4 of IEC-60571 or latest shall be followed. The waveform A is mandatory.

Test procedure :

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1. The surge waveform is to be generated and tested using the generator and waveform as specified in IEC 62236-3-2:2008 or latest 62236-3-2:2008 standard would be followed for surge test.
2. Surge Voltage is to be applied at BP and BN pins of working equipment.
3. Status LEDs are to be verified after the test.

Test Result :

1. There should not be any damage to the equipment.
2. No damage should occur to the equipment because of Surge Voltage Test.
3. The equipment should work satisfactorily after the test.

11. Vibration & shock test as per clause 12.2.12 of IEC 60571 or latest.

Test procedure:

1. The complete cubicle with its mounting arrangements is to be subjected to the tests indicated in IEC-61373 or latest.

Test Result :

1. There should not be any damages to the equipment after the test.
2. No damage should occur to the equipment because of test.
3. The equipment should work satisfactorily after the test.

12. Endurance test as per RDSO Specification clause No. 12.12.

13. Validation test as per RDSO Specification clause No. 12.13.

14. Transient Burst Susceptibility test as per 12.2.8.3 of IEC 60571 or latest.

Test procedure:

1. Test voltage of 2KV, 5/50 nS, 5KHz as per IEC 62236-3-2:2008 is to be used for testing.
2. The test is to be carried out in working condition of equipment as per procedure of IEC 61000-4-4 or latest.

Test Result :

1. No damage should occur to the equipment because of test.
2. The equipment should work satisfactorily after the test.

15. Radio Frequency Interference Immunity test as per 12.2.9.1 of IEC 60571 or latest.

Test procedure:

1. Radiated Radio Frequency Interference test is to be performed with 10V/m (r.m.s) severity as per IEC 61000-4-6 or latest.

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2. The equipments is to be kept energized during the test.
3. For conducted disturbances induced by radio frequencies fields, refer to IEC 62236-3-2:2008 (Table 7 and Table 8) or latest.
4. For radiated disturbances induced by radio frequencies fields, refer to IEC 62236-3-2:2008 (Table 9) or latest.

(B) Acceptance Test Plan:

This test is to be conducted for the system other than prototype for purchase inspection. This is the subset of type test mentioned above. Following test is required to be conducted for Acceptance test plan. The sampling plan as per IS: 2500,Pt.I, General Inspection Level-II should be adopted for selecting the samples against the lot and determining the acceptance/rejection of lot based on test result.

S. No	Standard	Test Name	Test Location	Test Result/Remarks
1	RDSO Specification clause No. 12.1	Visual Inspection	At firm's premises/NABL Labs	Pass/Fail
2	RDSO Specification clause No. 12.2	Performance test	At firm's premises/NABL Labs	Pass/Fail
3	RDSO Specification clause No. 12.3	Reversal of Polarity	At firm's premises/NABL Labs	Pass/Fail
4	RDSO Specification clause No. 12.4	Effect of voltage variation	At firm's premises/NABL Labs	Pass/Fail
5	RDSO Specification clause No. 12.7	Insulation resistance test	At firm's premises/NABL Labs	Pass/Fail
6	IEC 60571 -12.2.10.3 or its equivalent to BIS	Di-Electric test	At firm's premises/NABL Labs	Pass/Fail