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Government of India
Ministry of Railways

SPECIFICATION FOR EVENT RECORDER FOR AC TAP CHANGER ELECTRIC LOCOMOTIVE

SPECIFICATION NO. ELRS/SPEC/ER/0033(REV.0) APRIL – 2005

अनुसंधान अभिकल्प एवं मानक संगठन

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CHAPTER 1

GENERAL

1.0 SCOPE & OBJECT:

1.01 These technical requirements cover Microprocessor based Event Recorder facility for application on A.C. Tap Changer Locomotives. The Event Recorder shall monitor and record the various events like Activation of Cab, Raising of Pantograph, Traction Motor's Current, and Status of Brakes etc. so that data are available for analysis to find out the cause of the accident.
The Event Recorder should be developed as a part of Microprocessor based Electronic Speed cum Energy Monitoring system and this specification should be read in conjunction with ESMON's Specification no. ELRS/SPEC/SPM/0002.

1.02 These technical requirements cover basic features of equipments. It is the responsibility of the manufacturer/supplier to develop circuit/detail design to meet the requirements of this specification.

1.03 Further revision shall be issued to include future requirement of Indian Railways, which may arise with experience in field or to facilitate its interface with other systems on conventional locomotives.

1.1 DEFINITIONS:

For the purpose of this specification, the following definitions shall apply:

1.1.1 TENDERER /SUPPLIER/ MANUFACTURER:

The Firm/Company who submit the offer for supply of Event Recorder.

1.1.2 PURCHASER:

- Indian Railways

1.1.3 RDSO

Research Designs and Standards Organization, Ministry of Railway, Manak Nagar, Lucknow – 226011

1.1.4 CLW:

Chittaranjan Locomotive Works

1.1.5 INSPECTING OFFICER:

A person nominated by the purchaser to inspect the equipment on his behalf or the representative of the Inspecting Officer so nominated.

1.1.6 CONTRACTOR:

Any Firm or Company with whom the order for supply of the equipment has been placed or intends to be placed.

1.1.7 EVENT RECORDER (ER)

Main Unit of the system, which shall receive the output from different sensors and MASTER of ESMON, record the complete data in Internal/External Memory provided within it.

1.1.8 ESMON

Electronic Speed cum Energy Monitoring System for Electric Locomotives.

1.1.9 MASTER

Recorder cum Indicator Unit of ESMON.

1.1.10 SLAVE

Indicator unit of ESMON.

1.2 CONTRACTOR'S RESPONSIBILITY:

The supplier's responsibility will extend to the following:

1.2.1 Supply of detailed instructions for installation of the equipment on the locomotive. For this purpose the supplier shall also depute his representative during installation of the first two equipments in the locomotive at each location (CLW / Shed / Workshop).

1.2.2 Commissioning, testing & field trials of the prototype equipment in service jointly with RDSO and will depute team of engineers to Railway field units for this purpose.

1.2.3 Quote for spares, which may be required for satisfactory maintenance of the equipments for a period of 3 years after completion of warranty period.

1.2.4 To enter into a maintenance contract with the user railway for repair of any electronic cards employed (if any) and to indicate repair charges for the cards in a similar manner as 1.2.3 above. The repaired card will have warranty of one year.

1.2.5 Supply suitable software "if applicable" for offline analysis of data downloaded from the locomotive.

1.2.6 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.

1.2.7 **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, which ever is earlier. The supplier shall replace all such equipment during the warranty period at his own cost. The replaced component shall further be under warranty for 12 months from the date of commissioning. The period of warranty will be extendable in case of recurring problems attributable to defective design, material or manufacturing. The supplier shall warrant that everything to be furnished hereunder shall be free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and consistent with established and accepted standards of material in full conformity with specification.

1.2.9 **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. Modification, if any required on the basis of the experience gained during the field trials of prototype equipment, shall be incorporated by the suppliers without any extra cost. Such modification shall be finalized in consultation with RDSO.

1.2.10 **TRAINING OF INDIAN RAILWAY'S PERSONNEL:**

The supplier shall arrange for training to Indian Railway personnel in operation, maintenance covering Installation, Commissioning, Maintenance and trouble shooting of the system including Data downloading & evaluation of Data through Evaluation Software. Three days training for five persons per location should be offered in the field of maintenance and troubleshooting. The syllabus and schedule of training programme shall be furnished by the supplier to RDSO as part of design proposal. Training will be arranged free of cost.

1.2.11 **INSTALLATION INSTRUCTIONS:**

Installation instruction shall be provided in acceptable form e.g. instruction card. These instructions shall include the method of inter connection, type of cable and grade of

cable, maximum resistance and whether the cable is screened. Details of any special precaution necessary shall also be stated.

1.2.12 **INSTRUCTION MANUAL:**

The manufacturer/ supplier shall supply sufficient copies of instruction manual. This shall include system description and operating, maintenance, calibration and Card Trouble shooting manual. List of spares with part no./ tech. specification shall also be included. Number of copies to be supplied shall be 10% of the number of equipment ordered, subject to a minimum of 2 copies per order.

1.3 RAILWAYS' RESPONSIBILITY:

Railways will be responsible for following:

1.3.1 The cabling required in loco.

1.3.2 Arrangement for providing location for mounting sensing equipments for different parameters to be recorded. However, details of the sensing arrangement will be finalised with the suppliers during design evaluation stage. Railway would modify/rework the locations where sensors would be mounted and mount the sensors.

1.3.3 Labour, consumables and electrical energy required for erection, testing & commissioning of the equipment will be provided by Indian Railways, free of cost.

1.3.4 The wages and allowances as well as the cost of the passage to and from the place of training for railway personnel only.

1.3.5 Provide potential free contacts according to the requirement of this specification.

1.4 INFRINGEMENT OF PATENT RIGHTES:

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

1.5 DOCUMENTATION:

1.5.1 The tenderer must submit the following information with the offer in printed form and neatly compiled in a booklet form. Offer with incomplete information may not be considered.

- Detailed specification of the offered Sensors.
- System/Functional description, System Design Concept, Block Circuit Diagram, details of major components/ equipments, circuit description, working principle and

salient features. The details of microprocessor / micro controller used, functional block description of PCBs used, control system hierarchy, protocol used and interfacing,

- Signal handshaking requirement or relay interface with the locomotive system, if any.
- Details of semiconductor devices used, their specification and data sheet.
- Mechanical drawings of complete cubicles as well as Major subassemblies / Rack with details of dimensions, mounting arrangement and weight, which are required to be taken out for maintenance. Details of mounting accessories should also be provided.
- Modification needed in present locomotive to accommodate the offered system.
- Clause-by-Clause compliance to RDSO Specifications.
- MOU (Memorandum of understanding) with the collaborator, wherever applicable.
- Details of Technical Support and Training Offered
- Salient features and advantage of offered system.
- Supply Experience
- Logistic proposed for Warranty Support.
- Recommended list of spares with cost for 3 year maintenance after warranty.
- List of special tools, jigs and fixtures needed for assembly, testing, commissioning, maintenance and repair.
- Details of protection provided and their effectiveness/ proposed set values and range and working principle. Details of implementation i.e. through software and hardware should be clearly spelt.
- QAM (Quality assurance manual)
- Test protocol with procedure of testing.
- ISO 9000 certification.
- Details of infrastructure, manufacturing and testing activities in line with guidelines issued vide RDSO spec no.- ELRS/SPEC/SI/0015 "Reliability of Electronics used in Rolling Stock Application."

1.5.2 Following documents shall be submitted by the successful tenderer after award of contract.

- Technical documentation explaining the complete scheme, characteristics, diagnostics, protection and control etc.
- Detailed drawings of each system/sub-system with interface details.
- Vendor list for subsystems
- Procedure for parameter alteration, software downloading, diagnostic uploading, analysis etc.
- Operation and Maintenance manual.
- Spare catalogue

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1.6 REFERENCE TO VARIOUS SPECIFICATIONS:

Assistance has been taken from the following international, British and Indian standard specification in formation of this specification.

Spec. no	Year & Month	Amendment No. & year –Month	
IS:3202	1965	1 (1990)	Code of practice for climate proofing for electrical equipment.
IS 2705(Part 2)	1964	2nd Rev. 1992	Current Transformer – Specification Part 2 : Measuring Current Transformer
IS 3156(Part 1)	1965	2nd Rev. 1992	Voltage Transformer – Specification Part 2 : Measuring Voltage Transformer
IEC:60571		--	Rules for electronic equipment used on rail vehicles
IEC:77	1968-01	--	Rules for electronic traction equipment.
ISO: 7816 -1	1987-07	--	Identification cards – integrated circuit(s) cards with contact – physical characteristics.
ISO: 7816 - 2	1988-12	--	Identification cards – integrated circuit(s) cards with contacts – Part II - dimensions and locations of the contacts
ISO/IEC – 7816 – 3	1989 - 09	2, (1994-12)	Information technology - identification cards – integrated circuit cards with contact. Part III electronic signals and transmission protocol.
ISO/IEC-7816-4	1995-09	--	Information technology - identification cards – integrated circuit cards with contact. Part IV inter industry commands for interchange
IEC-7816-5	1994	1 (1996)	Numbering system and registration procedure for application identifier.
IEC – 7816-6	1996	--	Identification cards – integrated circuit(s) cards with contacts - Part VI inter industry data elements.
IEC/TR3 61000-1-1	1992-05	--	Electro magnetic compatibility (EMC) Part I general section I application & interpretation of fundamental definition and terms
IEC-61000-4-6	1996-04	--	Testing and measurement techniques - Section VI, immunity to conduct disturbance, induced by radio frequency fields.
RDSO/ELRS/SPEC /SI/0015	Oct 2001	--	Reliability of Electronics used in Rolling Stock Application.

CHAPTER 2

TECHNICAL SPECIFICATION

2.1 BASIC DESIGN AND CONSTRUCTION:

The construction shall be mechanically robust so as to assure permanence in all mechanical, electrical, electronic or magnetic adjustments when used in accordance with manufacturer's recommendations.

The equipment being a safety item shall be designed for high degree of reliability.

2.2 The system shall be capable of recording in both (forward and reverse) direction of travel of the Locomotive.

2.3 In view of limited space available in the Locomotive, the equipment shall be designed as compact as possible.

2.4 INPUT/ OUTPUT TO EVENT RECORDER:

2.4.1 INPUT:

Supply voltage for the equipment shall be from a dc supply source normally consisting of accumulator battery or battery charger and output voltage of aux. winding of traction transformer. The nominal voltage and variation for electric locomotive are as follows:

S NO.	SIGNAL	LEVEL	REMARK
1	DC Power Supply	110 V (DC) (Variation from 70V to 136 V)	From Battery/Battery charger of locomotive.
2	Digital Inputs 24 Nos. (Minimum)	---	
3	Analog Inputs 15 Nos. (Minimum)	Given in next table	
4	Data Recorded by ESMON	---	

The effective range for above Analog inputs to be recorded is given in the table below:

S.No	ANALOG PARAMETERS		Nominal VALUE	EFFECTIVE RANGE	
				LOWER LIMIT	UPPER LIMIT
1.	SPEED			0 kmph	180 kmph
2.	TM Voltage		750 V	0	1000 V
3.	TM Current		900 A	0	1350 A
4.	Battery Voltage		110 V	0 V	150 V
5.	BC Pressure	Through A9	2.5 Kg/cm^2	0 Kg/cm^2	5.0 Kg/cm^2
		Through SA9	3.5 Kg/cm^2	0 Kg/cm^2	5.0 Kg/cm^2
6.	BP Pressure		5.0 Kg/cm^2	0 Kg/cm^2	6.0 Kg/cm^2
7.	Auxiliary Voltage		380 V	0 V	500 V

2.4.2OUTPUT:

S.no.	Signal	From	Remarks
1	CAN Bus Output	Event Recorder	MS Circular 9 Pin Connector

2.5 EQUIPMENT DESCRIPTION:

2.5.1 EVENT RECORDER:

Event Recorder shall be a Microprocessor based unit. It shall be capable of recording the parameters given in **Clause 2.8** on memory defined bellow. All Data shall be written in FAT16 format so that it can be directly copied to any IBM compatible PC using standard "COPY" Command or "Drag and Drop" feature of MSWINDOWS Explorer.

The equipment shall be designed in such a way so as to provide an intelligent based recording of Digital Parameters only (Time interval is decided by Recorder itself whenever there is a change in the respective parameter), however for the Analog Parameters the recording shall be done as specified in the following sub clauses.

It shall have following memory/sub memory in its data/event recording system:

a. INTERNAL MEMORY

An internal FLASH EEPROM memory of sufficient capacity to contain the following sub-memories.

i. **SHORT TERM MEMORY:**

To store the most recent data as per **Clause 2.8** for various events and data as recorded in the short term memory of ESMON for minimum last 30 minutes in loop form.

ii. **LONG TERM MEMORY:**

To store the most recent data of various events and parameters as per **Clause 2.8** for the last 60 days of halt and run or 50000 kms of distance travelled, in loop form, with resolution of 30 seconds.

iii. **FAULT AND CONFIGURATIONS MEMORIES:**

To record the equipment status and internal faults and contain customer specific configuration parameters to be used for processing the stored data.

The internal memory shall be accessible through RS 232C port interface.

b. **EXTERNAL MEMORY:**

Compact Flash Card shall be used as a External Memory Card. The memory card shall withstand temperature up to 70^0C and shall be accessible to only authorized person. The Flash Card shall be procured form company of repute. Supplier will ensure the availability of spare memory cards for a period of 10 years from the date of supply. The Compact Flash Card shall be interchangeable from one loco to another loco and also from one unit to another unit of any manufacturer.

The Compact Flash Card shall have sufficient capacity to contain the following sub memories.

i. **SHORT TERM MEMORY:**

A minimum 30 minutes SHORT-TERM memory to record all the parameters as per **Clause 2.8** with resolution of one second as in the Internal Memory.

ii. **LONG TERM MEMORY:**

To store the most recent data of various events and parameters as per **Clause 2.8** for the last 60 days of halt and run or 50000 kms of distance travelled, in loop form, with resolution of 30 seconds.

iii. **FAULT AND CONFIGURATION MEMORY:**

As in the Internal Memory.

2.5.2 CONNECTOR FOR COUPLING:

Event Recorder shall be connected to ESMON through RS 485 serial port using suitable connector as specified in Pin Allocation Details enclosed in **Annexure III**. This connection shall be made in such a way, in case of failure of Event Recorder the Event Recorder unit shall be isolated from the Master and Slave of ESMON and both Master and Slave of ESMON will work normally when connected together.

2.5.3 SENSORS:

The following Sensors shall be used for sensing various parameters:

S No	PARAMETERS		TYPE OF SENSOR
1.	VOLTAGE	Battery Voltage	ABB make sensors VS250B or equivalent
		Traction Motor Voltage	ABB make sensors VS1000B or equivalent
2.	CURRENT	Traction Motor Current	ABB make sensors CS2000BR or equivalent
3.	PRESSURE	Brake Cylinder Pressure	Danfoss make MBS3200 ¼ - 18NPT, 4 – 20 mA 2 Wires sensor or equivalent
		Brake Pipe Pressure	
		Horn Pressure	FESTO make PEV – ¼ - B or equivalent

2.5.4 CONNECTING CABLES WITH CONNECTORS:

i. The connecting cables shall be provided with protective sheaths to withstand arduous service conditions and electrical noises and shall end with polarized connectors to eliminate chances of inadvertent wrong connections. Sufficient length of cable connecting various equipments shall be supplied. In case of electric locomotives the distance between two cabs is of the order of 20 meters (Approx)

ii. Supplier will submit a wiring diagram along with his offer. Cables, which are covered in scope of supply, shall be indicated with lugs. The tentative functional block diagram of the system is shown in **Annexure VI**.

iii. Terminals for Railway cables shall be of M5 standards.

iv. Multi core copper cables used shall be with 1.5 mm^2 PTFE insulated Copper conductor with FRLS jacket along with shielding.

v. Connectors shall be used as per Pin Allocation details enclosed in **Annexure III**.

2.6 MOUNTING:

S.No	Item	Symbolic Name	Place
1.	Event Recording Unit	ER	Behind AC-1 Panel
2.	Signal conditioning Unit	SCU	Behind AC-1 Panel
3.	Battery Voltage Sensor	BAS	To be seen during Installation
4.	TM Voltage Sensor	TMVS	To be seen during Installation
5.	TM Current Sensor	TMCS	BA Panel
6.	BC Pressure Sensor	BCPS	To be seen during Installation
7.	BP Pressure Sensor	BPPS	To be seen during Installation
8.	Horn Pressure Switch	HPS	To be seen during Installation
9.	Wiper Sensor	WS	To be seen during Installation

The equipment shall be suitable for mounting in any position viz. vertical, horizontal or in any inclined position between the horizontal and vertical planes.

However detailed drawings for above items shall be supplied by Chittaranjan Locomotive Works, Chittaranjan (WB).

2.7 TRANSFERRING THE DATA:

Normally, the data stored in the Compact Flash Card shall be transferred to the PC through Flash Card Reader Unit. The transfer of data from internal memory shall be only in exceptional cases when the portable memory has been damaged/ lost or cannot be salvaged. **Data Transfer Time in any case should not exceed from 05 minutes.**

The data from the Compact Flash Card shall be down loaded when its reserved capacity (85%) is used up, to prevent the recorded data being over written. To down load the data the Compact Flash Card shall be removed from **the locked cassette compartment of Event Recorder and inserted into the "Flash Card Reader Unit " interfaced** with PC equipped with evaluation software. After the data is down loaded, Compact Flash Card shall be erased for reuse. The **Flash Card Reader** shall be so designed that it does not require to be disconnected from the PC for normal use of the printer. It shall be possible to down load the data of only SHORT TERM MEMORY/LONG TERM MEMORY or both, with suitable commands.

The system should be equipped with RS232 serial port for direct downloading in the PC for Internal Memory.

2.8 PARAMETERS TO BE RECORDED:

The Event Recorder shall be capable of recording the following parameters on memory.

a. Complete Data as recorded in ESMON MASTER coming from ESMON MASTER through RS485 communication port.

b. Event Recording:

The equipment shall be designed in such a way so as to provide an intelligent based recording for Digital Parameters only (Time interval is decided by Recorder itself whenever there is a change in the respective parameter) of the parameters. Event Recorder shall record the following parameters:

i. Speed in Kmph
ii. OHE Voltage
iii. Transformer Primary Current
iv. Traction Motor Voltage
v. Traction Motor Current
vi. Notch Position of Tap Changer
vii. Battery Voltage
viii. Brake Pipe Pressure
ix. Brake Cylinder Pressure
x. Auxiliary Voltage
xi. CAB1/CAB2 Activated CAB
xii. Pantograph Up/ Down Position with respect to activated
xiii. Status of VCB/ DJ i.e. Open/Close
xiv. Mode of Operation i.e. Traction Mode/ Braking Mode
xv. Direction of Travel i.e. Forward/ Reverse with respect to activated CAB
xvi. Head Light Status ON/OFF
xvii. Flasher Light Status ON/OFF
xviii. Horn Status ON/OFF
xix. Status of Penalty Application
xx. Status of Emergency Brake by Assistant Driver
xxi. Tractive Effort/ Braking Effort (TE= Kw x 367/Speed in Kmph, BE= TE/0.95)
xxii. Wiper ON/OFF

2.9 REPORTING FORMAT:

Reporting format for Event Recorder Data shall be same as being used for printing ESMON Data as given in Anexure IV and Anexure V

2.10 LOCK:

The External Memory Card of Event Recorder unit shall be kept under suitable locking arrangement to prevent access by loco crew or any unauthorised personnel. The lock shall have the common key for all set of equipment.

2.11 CALIBRATION:

The supplier shall provide the procedure for calibration of the equipment and any kit required for calibration.

2.12 INTERFACING EQUIPMENT AND SOFTWARE:

2.12.1 INTERFACING WITH OTHER MICROPROCESSOR BASED EQUIPMENT IN LOCOMOTIVE:

As Event Recorder is used for monitoring the various Events during the travel of the locomotive and also recording these data on Static/Flash Memory, other Microprocessor based equipments like Fault Diagnostic System, Static Convertor and Vigilance control Device might also require to share the same data. A system based on Controller Area Network (CAN) Serial Communication Protocol shall be developed within the Event Recorder so that these data shall be available on a common BUS and can be fetched as required by other Microprocessor based Equipments inside the locomotive.
The standard CAN Protocol to be followed is CAN 2.0B. Data baud rate shall be 250 kbps and MS Circular 9 Pin connector and 2 Core double Shield Twisted Pair cable shall be used for CAN Physical Layer.

Following code in Hexadecimal form should be used for various commands

	COMMAND	CODE (In Hex)
	Request to send all data	C0
	Reply of all Data	C1
	Request for sending Date and Time	C3
	Reply for Date and Time	C4
	Firm Ware Version	F0 F1
	Vendor ID	F2 F3
	Equipment ID	F4 F5

DATA SEQUENCING

S. No.	Parameters	Identifier Code (In Hex)	
		Request	Reply
1.	Speed	C5	C6
2.	OHE Voltage	C7	C8
3.	OHE Current	C9	CA
4.	TM Voltage1	CB	CC
5.	TM Voltage4	CD	CE
6.	TM Current1	CF	D0
7.	TM Current4	D1	D2
8.	Notch Position	D3	D4
9.	Battery Voltage	D5	D6
10.	Brake Pipe Pressure	D7	D8
11.	Brake Cylinder Pressure1	D9	DA

12.	Brake Cylinder Pressure2	DB	DC
13.	Auxiliary Voltage "u"	DD	DE
14.	Auxiliary Voltage "v"	DF	E0
15.	Auxiliary Voltage "w"	E1	E2
16.	CAB1	E3	E4
17.	CAB2	E5	E6
18.	Panto UP	E7	E8
19.	Panto Down	E9	EA
20.	DJ/VCB Open	EB	EC
21.	DJ/VCB Close	ED	EE
22.	Traction Mode	EF	F0
23.	Braking Mode	F1	F2
24.	Forward Movement	F3	F4
25.	Reverse Movement	F5	F6
26.	Head Light1 ON	F7	F8
27.	Head Light1Dim	F9	FA
28.	Head Light1 OFF	FB	FC
29.	Head Light2 ON	FD	FE
30.	Head Light2Dim	FF	00
31.	Head Light2 OFF	01	02
32.	Flasher Light1 ON	03	04
33.	Flasher Light1 OFF	05	06
34.	Flasher Light2 ON	07	08
35.	Flasher Light2 OFF	09	0A
36.	Status of Horn CAB1	0B	0C
37.	Status of Horn CAB2	0D	0E
38.	Penalty Application	0F	10
39.	Emergency Brake by Assistant Driver	11	12
40.	Wiper1 ON	13	14
41.	Wiper1 OFF	15	16
42.	Wiper2 ON	17	18
43.	Wiper2 OFF	19	1A
44.	Wiper3 ON	1B	1C
45.	Wiper3 OFF	1D	1E
46.	Wiper4 ON	1F	20
47.	Wiper4 OFF	21	22

2.22.2 FLASH CARD READER UNIT:

To facilitate the transfer (downloading) of data from Compact Flash Card to IBM Compatible PC, the tenderer will quote separately an interface unit (Flash Card Reader Unit) compatible with different versions of Windows, IBM – PC. The purchaser shall decide the quantity to be supplied.

2.12.3EVALUATION SOFTWARE TO ANALYSE THE DATA:

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 MS Windows 98 compatible and shall not require knowledge of any programming language 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 user. The file management shall not require any knowledge of DOS.

2.12.4 IBM PC (PENTIUM OR ABOVE) WITH PRINTER:

This shall be installed by Indian Railways.

2.31 COLOUR SCHEME:

The colour of the equipments shall be as per IS – 5 Grey as follows:

Event Recorder	:	Shade Code 631
Housing of All type of Sensors*	:	Shade Code 632

* Only for Housings developed by Suppliers.

2.14 TIME SYNCHRONISATION:

The Clock of Event Recorder shall be synchronised with the Clock of ESMON periodically. The periodicity shall be 6 hour or whenever Driver takes charge of the locomotive and enters DriverID. The resolution of the Time synchronisation shall be up to 1 seconds.

2.15 COMPATIBILITY:

The Event Recorder shall be compatible with Microprocessor based Electronic Speed cum Energy Monitoring System in a following manner:

2.15.1 The Event Recorder shall be compatible with Microprocessor based Electronic Speed cum Energy Monitoring System to RDSO Specification ELRS/SPEC/SPM/0002 (Rev 0) May 99 and its further revisions.

2.15.2 The Event Recorder shall be compatible with Speedometers upgraded with the Microprocessor based Electronic Speed cum Energy Monitoring System to RDSO Specification ELRS/SPEC/SPM/0002 (Rev 1) May 99 and its further revisions.

2.15.3 The Event Recorder shall be capable of independently importing the data regarding Speed and Energy through RS485 Communication Port of Microprocessor based Electronic Speed cum Energy Monitoring System to RDSO Specification ELRS/SPEC/SPM/0002 (Rev 1) May 99 and its further revisions on **Cross Vendor Basis.**

CHAPTER 3

CLIMATIC & ENVIRONMENTAL CONDITION

3.1 TEMPERATURE:

The Event Recorder will be fitted inside the locomotive where the temperature will be

a)	Maximum temperature	} Stabled Locomotive under sun	: 70 deg. C
		} On board Working loco under sun.	: 55 deg. C
b)	Minimum temperature		: 0 deg. C
c)	Average temperature.		: 47 deg. C

3.2 RELATIVE HUMIDITY:

Upto 100% during rainy season.

3.3 ALTITUDE:

Upto 2500 m above mean sea level.

3.4 RAINFALL:

Very heavy in certain areas. The loco 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/cm^3.

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 some of the parameters shall be as follows:

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

3.7 VIBRATION:

The equipment shall be designed to withstand the vibrations and shock encountered in service satisfactorily as specified in IEC1287 (1995 -07) and 60571 (1998 - 02)

publication for the Electronic Equipments used on Rail Vehicle and relevant IECs as applicable to other equipment.

3.8 ELECTROMAGNETIC POLLUTION:

High degree of electromagnetic pollution is anticipated in locomotive machine room, where the equipment will be mounted. Necessary precaution should be taken in this regard.

The system shall be interference free from the communication system between the Guard-Driver-Control. The same should be tested as per IEC 61000 for EMC compatibility. Details given in **Clause 6.2.4**.

3.9 SPIKES & SURGES:

Provision shall be made for suppression of transients (spikes & surges). The equipment shall withstand, without damage, the surge test mentioned in **Clause 6.2.9**

CHAPTER 4

SCOPE OF SUPPLY

4.1 The scope of supply covers development, supply and commissioning (Only for First two sets) of complete set of Event Recorder for 25 kV AC Tap Changer Locomotive as per technical requirement laid down in this specification.

4.2 The supplier shall supply suitable Single user license for the software tool for Data Retrieval, Analysis and Configuration of unit.

4.3 Three days training for five persons per location is to be offered for IR personnel for training in the field of testing, maintenance and troubleshooting and repair.

4.4 Detailed operation and maintenance manual and Spare Catalogue.

4.5 Installation Drawings.

4.6 List of spares for 3 years maintenance.

4.7 Repair charges for the PCBs.

4.8 Testing jigs for troubleshooting at card level.

CHAPTER 5

INSPECTION

5.1 The whole of the material 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.

5.2 The inspecting officer shall have the power to:

5.2.1 Adopt any means he may consider necessary to satisfy himself that all the materials or fittings specified are actually used throughout the construction.

5.2.2 Visit at any reasonable time and without previous notice, either contractor's works or his sub-contractor's works to inspect the manufacturing and the quality of the work at any stage.

5.2.3 To 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 off in such manner as the Inspecting Officer may direct to avoid its inadvertent use in the product order as per this specification.

5.3 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. The contractor shall provide free of charge, such materials or fittings as may be required for testing whether at his own or his subcontractor's premises. The test for which facilities are not available may be carried out at RDSO or any other Government approved laboratory for which the testing charges shall be payable by the supplier.

5.4 The Inspecting Officer shall select all the equipments and the fittings required for test and the tests shall be carried out in his presence.

5.5 No material shall be packed or dispatched until the Inspecting Officer has passed it. The contractor's responsibility for its efficiency in every way shall remain the same as if it has been tested by him.

5.6 Should any part require alteration or any defect appears during the test or trial the contractor shall, without any extra charges, make such alteration or rectify the defects to the satisfaction of the Inspecting Officer.

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

CHAPTER 6

TESTS

6.1 CATEGORIES OF TEST

6.1.1 TYPE TEST:

Type test shall normally be carried out on one units of equipment of the approved design. 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.

The Type Test shall be repeated once in Three years by RDSO.

6.1.2 ROUTINE TEST:

Routine test shall be carried out on the pieces of equipment of each order.

6.1.3 ACCEPTENCE TEST:

Acceptance Test as given in the table 1 shall be carried on 10% of batch quantity subject to minimum of 5 nos.

6.2 TESTING DETAILS:

Test mentioned in Table 1 shall be carried out on the Event Recorder.

Table 1

S.No	Kind of Test	Clause		
		Type Tests	Routine Tests	Acceptance Test
1.	Visual inspection	Yes	Yes	Yes
2.	Performance test	Yes	Yes	Yes
3.	Reverse Polarity Test	Yes	Yes	Yes
4.	Effect of voltage variation	Yes	---	Yes
10.	EMI/EMC Compatibility Test	Yes	---	---
5.	Temperature variation	Yes	---	---
6.	Salt Mist Test	Yes	---	---
7.	Insulation Resistance Test	Yes	Yes	Yes
8.	Dielectric test	Yes	---	Yes
9.	Surge test	Yes	---	Yes
11.	Vibration and shock test	Yes	---	---
12.	Burn In Test	Yes	Yes	Yes

13.	**Functional Test (As per Test programme finalized during design approval stage)**	Yes	---	---

6.2.1 VISUAL INSPECTION:

Visual inspection shall be carried out to ensure that the equipment under test is of acceptable workmanship and in conformity with manufacturers design specification accepted by the purchaser. Make, rating of equipments, subassemblies will be checked with the details as per approved design. If a change is needed in make or rating of important equipments, sub-assemblies, it should be intimated and should have approval of RDSO. Equipment with modified subassemblies will be given separate revision number. All the important dimensions will be measured and should be in permissible tolerance. Following shall be checked:

i. Provisions for locking arrangement.

ii. Cable sockets and terminals.

iii. Pin Allocation Details

iv. Mounting arrangement.

v. Identification markings.

6.2.2 PERFORMANCE TEST:

Performance test is carried out to check and ensure that the performance of the equipment is in order and meets the specification requirements. This test shall be carried out at temperature 37±3 deg. c, relative humidity between 45% and 80% and magnetic field not significantly different from that of the earth. The operating voltage shall be nominal voltage specified in **Clause 2.4**.

6.2.2.1 GENERAL WORKING:

Run the complete system on a test bench give the Speed Signal through ESMON. Connect all the sensors. Length and type of connecting cable/terminals etc. shall be the same as to be supplied. Check for working of the system by simulating all Events.

After this period Event Recorder shall be connected to PC for down loading the data from internal & external memory to check that the recording are being

carried out as required. Both the Short Term & Long Term data shall be downloaded & checked.

6.2.2.2REVERSE POLARITY TEST:

Effectiveness of reverse polarity protection 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 performance test shall be carried out. Equipment should perform satisfactorily after the test.

6.2.3 EFFECT OF VOLTAGE VARIATION:

The complete system shall be operated and the operating voltage shall be varied between the limits specified in **Clause 2.4**. The variation in the voltage should not affect performance of the equipment.

6.2.4 EMC/EMI COMPATIBILITY TEST:

a. RFI RADIATED/ RADIATED SUSCEPTIBILITY:

This test shall be conducted as per IEC 1000 – 4 – 3. The complete system in simulated installed condition shall be put in to the Radiation Chamber & desired Radiation as defined bellow shall be applied:

Freq. Range	:	80 to 1000 MHz
Field Strength	:	10V/m
Amplitude Modulation:		80% at 1kHz Sinusoidal

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test.

b. INDUCED RF FIELD CONDUCTED/ CONDUCTED RF SUSCEPTIBILITY:

This test shall be conducted as per IEC 1000 – 4 – 6. The complete system in simulated installed condition shall be put for the test specified in IEC. The desired Radiation as defined below shall be applied on DC power in lines of Event Recorder & analog and digital input lines of Event Recorder:

Freq. Range	:	0.15 to 80 MHz
Amplitude	:	10V/m

Modulation : 80% Amplitude Modulation

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test.

c. **ELECTRICAL FAST TRANSIENTS/BURST:**

This test shall be conducted as per IEC 1000 – 4 – 4.The complete system in simulated installed condition shall be put for the test as specified in IEC. The recommended test severity level is level 4 with Direct Coupling for Power Lines & with Capacitive Coupling for Communication & Signal Lines. The EFT of defined severity shall be applied on Communication line, Analog and digital input lines of Event Recorder & DC power in lines of Event Recorder as follows:

Severity for Level 4 Pulse Shape : 5/50 n seconds		
	Power Lines	**Communication & signal Lines**
Pulse Repetition. Rate	2.5kHz	5 kHz
Coupling & Pulse Amplitude	4Kv Direct Coupling both positive & negative side for 60 seconds each sides	2 KV Capacitive Coupling both positive & negative side for 60 seconds each sides

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test.

d. **POWER FREQUENCY MAGNETIC FIELD:**

This test shall be conducted as per IEC 1000 – 4 – 8.The complete system in simulated installed condition shall be put for the test specified in IEC. The

recommended test severity level is level 5. The Power Frequency Magnetic Field of defined severity shall be applied on system in all X, Y, & Z planes.

Frequency: 50Hz

Amplitude: 100 A/m Continuous Level 5 for 60 seconds in each plane.

During test the equipment shall be watched for malfunctioning or any erratic behaviour. Data recorded in the memory of the system during test shall also be downloaded & evaluated through Evaluation Software for the performance of the system as well as Data Recording & Downloading system.

No degradation of the system & malfunctioning should be allowed during or after the test.

6.2.5 TEMPERATURE VARIATION TEST:

6.2.5.1COOLING TESTS:

Complete system 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 shall be kept for 2 hours, at the lowered temperature with a tolerance of $\pm$ 3 deg C (this period starting from the thermal enclosure is uniform throughout)

At the end of this period the performance test **(Clause 6.2.2)** shall be carried out keeping the equipment at low temperature.

6.2.5.2TEMPERATURE RISE TEST:

a. **DRY HEAT:**

The complete system or the individual sub assembly as the case may be normally energized shall be 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 (this period starting from the time when the temperature throughout the chamber is uniform).

At the end of this period, performance test (Clause 6.2.2) shall be carried out.

b. **DAMP HEAT:**

Place the equipment in the humidity test chamber. Raise the oven temp. to $40^0C \pm 2^0C$ and humidity of 100% over a period of 2 hrs.

Note the reading of time, humidity and temperature of oven after every hour. Stop the test after the chamber has attained steady state reading for last ten hours. Now lower the temperature to room temperature (25 ± 10^{0}C) over a

period of 3 hours, keeping the relative humidity between 80% and 100%. After this cycle carry out the performance test **(Clause 6.2.2)** and dielectric test as per **(Clause 6.2.8)** of this test procedure.

6.2.6 SALT MIST TEST:

The solution for producing the salt mist shall be prepared by dissolving 50±1 g of Sodium Chloride (NaCl) analytical reagent quality, in distilled or demineralised water to make 1± 0.02 l of final solution at 20°C, if the pH does not lie between 6.5 and 7.2, the solution shall be rejected.

During the test the temperature in the test chamber shall be maintained at 35±2°C.

The solution and the air used to produce the salt mist shall have a temperature equal to that of the test chamber.

The equipment should be tested in the manner in which is expected to be used and shall be arranged as nearly as possible, in the position it will occupy in actual use.

The test chamber shall be kept closed and spraying of the salt solution shall continue up to 16 hours without any interruption.

At the end of this test, the equipment shall be washed in running tap water for 5 min, rinsed in distilled or demineralised water, then dried to remove droplets of water and stored under the standard atmospheric conditions of the testing area not less than 1 hour and no more than 2 hour.

After that equipment is subjected to visual examination. No major damage shall occur to equipment during this period, then performance test shall be carried out.

6.2.7 INSULATION RESISTANCE TEST:

The insulation resistance test with 500 V megger shall be carried out and it should not be less than 100 MΩ at 70% RH for all the circuits.

6.2.8 DIELECTRIC TEST:

The aim of dielectric test is to prevent the mounting of components too close to the surrounding metal parts. The test shall be carried out with the circuit board connected in its place of operation at room temperature. The test voltage of a

nominal frequency of 50 Hz shall be applied for 1 min. between all the terminals of the circuit board short circuited & metal rack of the electronic assembly. For circuit board with a metallic supporting frame, the test voltage shall also be applied between all short-circuited connections of the plug connector and the

metallic supporting frame. The test voltage at frequency of 50 Hz or 60 Hz shall be approximately sinusoidal form, the r.m.s. Value of the test voltage shall be:

1000 V for rated supply voltages between 72 and 125 V.

The tests shall be considered as satisfactory if neither a disruptive discharge nor a flashover occurs.

6.2.0 **SURGE TEST:**

The surge voltage shall be applied at the point of connection between the external circuit and the electronic equipment likely to produce surges, in the form of wave shown diagrammatically in figure-I.

The duration D corresponds to the time value laid down for the surge voltages.

The energy of the surge will be defined by the impedance of the generator, which shall not exceed 500 Ω

If no other values are agreed between the user and the manufacturer, the values to be considered for the test are as follow

A = 1.5 KV, D = 45 µs Impedance = 500 Ω (fig II)

It is also possible to apply the waveform defined in fig II; the test may then be carried out in accordance with the diagram in figure IV.

The values corresponding to the test with 1.5 KV are given in fig.II
The test shall be considered as satisfactory if it does not give rise to any deterioration or abnormal operation.
Permitted transient surges (non-repetitive i.e. with an interval greater from 5000 times the duration of the surge). Transient non-repetitive surges with respect to the zero potential of the supply, which are to be withstand by the electronic equipment, without disturbances at the connections between the later and external circuit, shall have the following maximum amplitudes:

7 KV for a time D = 0.1 µs
4 KV for a time D = 1 µs
3 KV for a time D = 5 µs
1.5 KV for a time D = 45 µs
600 V for a time D = 100 µs

Time D being that defined as above

6.2.10 THE VIBRATION 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.

a. **DETERMINATION OF RESONANCE FREQUENCY:**

In order to determine the possible existence of critical frequency producing resonance, the frequency shall be varied progressively over the range 1 Hz - 50 Hz within a time not less than four minutes and the amplitude of oscillation (a) expressed in millimetres should be varied as a function of frequency (f) according to the relation.

a = 25/f for values of 'f' from 1 Hz to 10 Hz.
a = 250/ f^2 for values of 'f' exceeding 10 Hz & up to 50 Hz.

If resonance is produced, the corresponding frequency shall be maintained for ten minutes in each case with the apparatus alive. A check shall be made that no ill affects results on the operation of the apparatus.

b. **TEST WITH SUSTAINED VIBRATIONS:**

The equipment in operation shall be then subjected to sustained vibration for a period of 2 hours either at the critical frequency, if any detected during the above test, or alternatively at a frequency of 25 Hz. The amplitude of the vibration shall be the value corresponding to the frequency concerned.

c. **TESTS TO SIMULATE THE EFFECT OF SHUNTING SHOCK:**

The equipment, in operation, shall be subjected for 2 minutes to 50 Hz vibration of such nature that the maximum acceleration is equal to 30-m/sq sec (amplitude a = 0.3 mm). At the end of the above tests, the assembly shall be subjected to performance tests (Clause 6.2.2) and di-electric test (Clause 6.2.8).

6.2.11 BURN IN TEST:

The cards used on the equipment will be subjected to burn- in as per the temperature cycle in Annexure-II. The cards will be kept energized during the test. Functional test of each card will be carried out after the burn in test. This will be part of internal test by manufacturer, whose results will be submitted during routine test.

CHAPTER 7

TEST CERTIFICATES AND MARKINGS

7.1 TEST CERTIFICATE:

The manufacturer shall provide test certificate of the system/parts procured from outside and used in the equipment supplied to the purchaser.

The Semiconductor devices, PCBs used do not come under scope of this clause. However the supplier shall ensure quality and performance report of above components by enclosing in internal Test Report of the System and submitting it to RDSO before Prototype Test.

7.2 IDENTIFICATION MARKING:

The following particulars shall be clearly and indelibly marked at the appropriate location of the equipment.

a. Manufacturer's/Supplier's identification or trademark.

b. Manufacturer's/supplier's designation (type, symbol or code etc).

c. Manufacturer's serial no/Batch no and year of manufacturer.

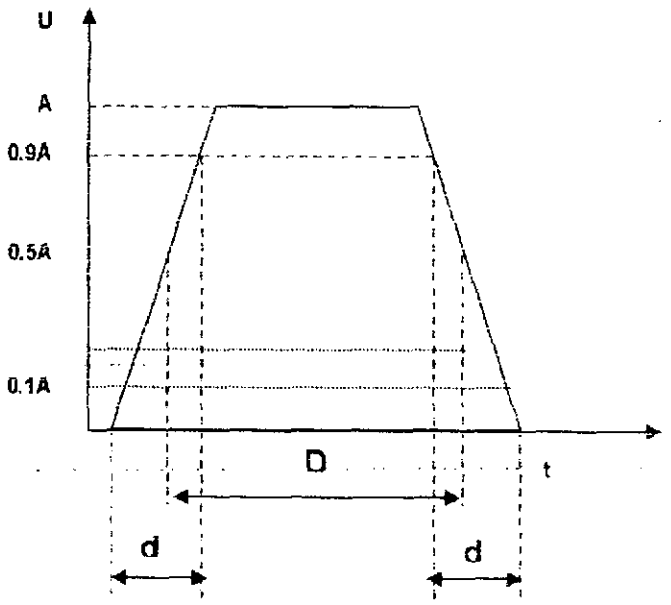
d. Name of the equipment e.g. 'Event Recorder'.

7.3 MARKING OF TERMINALS:

The correct operation of the equipment depends upon the specific connections of the terminals on system. As such terminals shall be marked appropriately.

Annexure I

SURGE TEST



d1 <

d2 <

FIGURE I

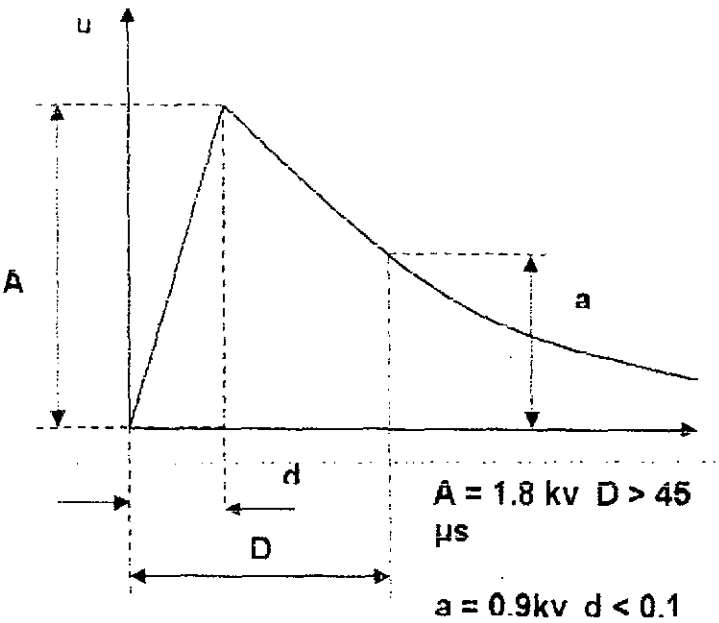


FIGURE II

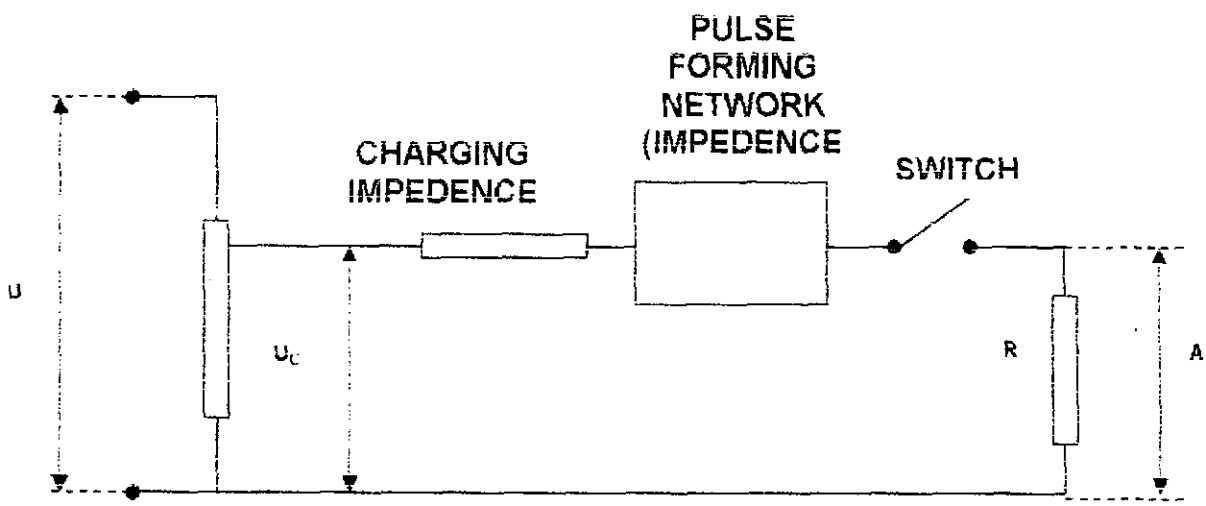


FIGURE III

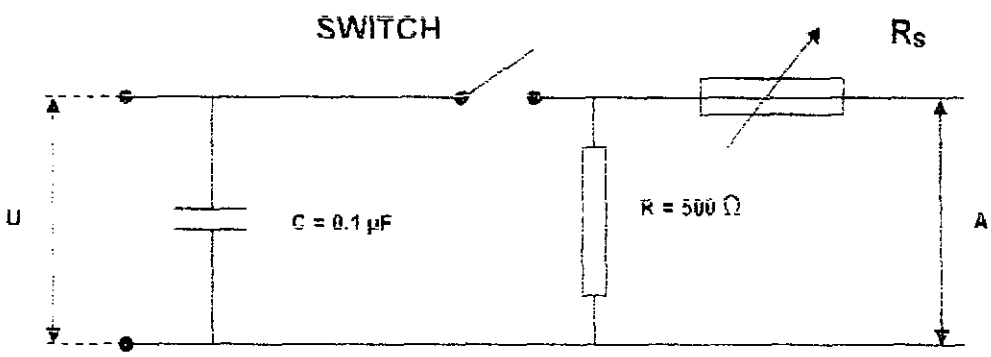
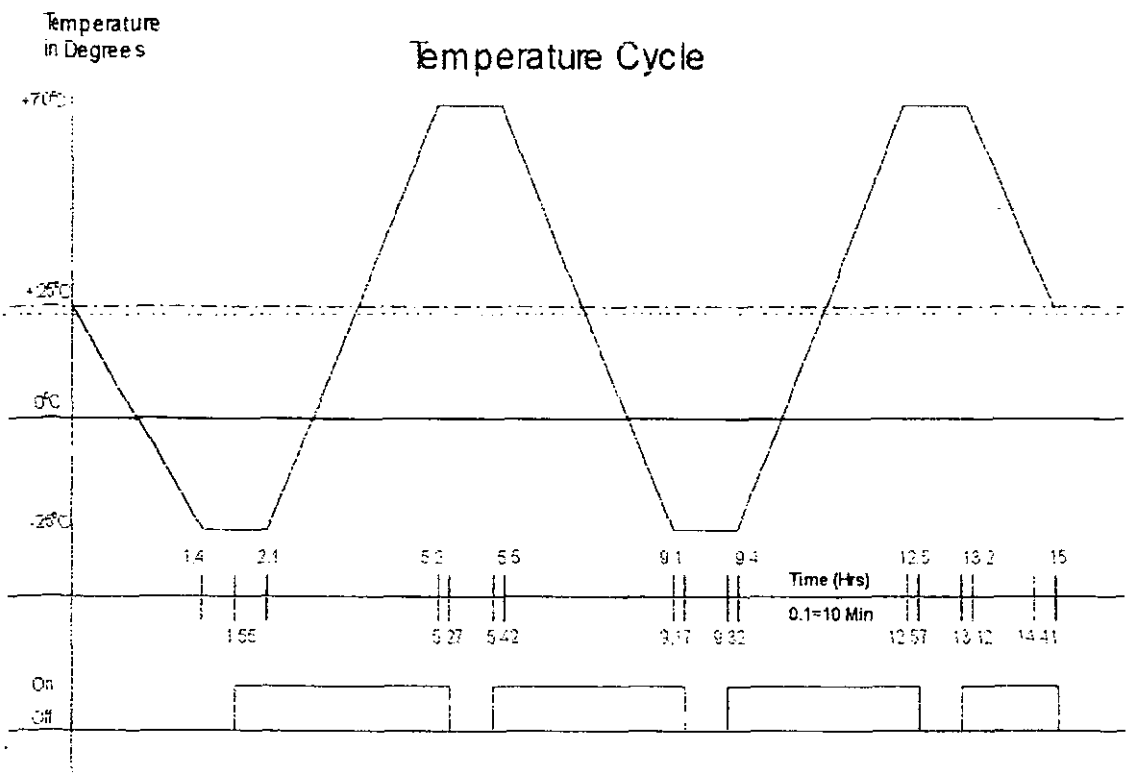


FIGURE IV

Annexure-II

BURN-IN TEST



Annexure III

Pin Allocation details for Event Recorder

Following Connectors shall be used in Event Recorder:

1.0 15 Pin D Type Connector:

This connector shall be used for feeding Signals from ESMON.

2.0 MS Circular Connector:

This connector shall be used for making connections with the outside peripherals.

3.0 PIN ALLOCATION DETAILS:

Pin allocation for both is given below

Signal Type		Communication (RS485)		
From		To		Signal Name
MASTER of ESMON		EVENT RECORDER		
Connector Type	Pin No.	Connector Type	Terminal No.	
50 Pin D – Type	17	15 Pin D – Type (Male)	5	RS485B
	33		7	RS485GND
	50		9	RS485A

Signal Type		Communication (RS485)		
From		To		Signal Name
EVENT RECORDER		SLAVE of ESMON		
Connector Type	Pin No.	Connector Type	Terminal No.	
15 Pin D – Type (Female)	5	50 Pin D – Type	17	RS485B
	7		33	RS485GND
	9		50	RS485A

Signal Type		DIGITAL INPUT			
From			To		Signal Name
			EVENT RECORDER		
Signal Name		Terminal No.	Connector Type	Terminal No.	
Activation of CAB	CAB1	BL Key	MS3102R22-14PW (19 Pin)	A	CAB1
	CAB2	BL Key		B	CAB2
Status of Pantograph	Panto1	ZPT1		C	PANTO1_UP/ DN
	Panto2	ZPT2		D	PANTO2_UP/ DN

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Status of DJ/VCB	DJFB	Aux. N/O Interlock of DJ/VCB		E	DJ/VCB OPEN/CLOSE
Emergency Brake		Through RS		F	EMER_BR
Status of Penalty Application		VCD		G	PENAULTY
Notch Position	'0'	GR 0		H	GR 0
	UP	SMGRVE UP		J	GR_UP
	Down	SMGRVE Down		K	GR_DN
	ON	SMGR ON		L	GR ON
	BETWEEN	SMGR BTN		M	GR BTN
Mode of Operation	Traction	Aux N/O Interlock of CTF		N	TRAC
	Braking	Aux N/O Interlock of CTF		P	BRAK
Dtrection of Travel	Forward	Aux N/O Interlock of Reversor "J"		R	FORW
	Reverse	Aux N/O Interlock of Reversor "J"		S	REV
		Battery Negative		U	B -ve
Status of Head Light 1	ON	From Head Light Switch	MS3102R22-14PX (19 Pin)	A	HL1 ON
	Dim	From Head Light Switch		B	HL1 DIM
	OFF	From Head Light Switch		C	HL1 OFF

Status of Head Light 2	ON	Head Light Switch		D	HL2 ON
	Dim	Head Light Switch		E	HL2 DIM
	OFF	Head Light Switch		F	HL2 OFF
Status of Flasher Light1	ON	Output of Control Unit of Flasher		G	FL1 ON
	OFF	Output of Control Unit of Flasher		H	FL1 OFF
Status of Flasher Light2	ON	Output of Control Unit of Flasher		J	FL2 ON
	OFF	Output of Control Unit of Flasher		K	FL2 OFF
Status of Horn	CAB1	Pressure Switch		L	H1
	CAB2	Pressure Switch		M	H2
Status of Wiper1	ON			N	
Status of Wiper2	ON			P	
Status of Wiper3	ON			R	
Status of Wiper4	ON			S	
		Battery Negative		U	B -ve

Signal Type DIGITAL SIGNAL

From	To	Signal Name
	EVENT RECORDER	
SPARE	MS3102R22-14PY (19 Pin)	DIGITAL INPUT
SPARE	MS3102R22-14PZ (19 Pin)	DIGITAL OUTPUT

Signal Type — ANALOG INPUT

From SENSORS			To SIGNAL CONDITIONING UNIT		
Signal Name		Terminal No.	Connector Type	Terminal No.	Signal Name
Traction Motor Voltage1	From Voltage Sensor	MS3102 R16-9P (4 Pin)	MS3102R16-9SW (4 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Traction Motor Voltage4	From Voltage Sensor	MS3102 R16-9P (4 Pin)	MS3102R16-9SX (4 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Traction Motor Current1	From Current Sensor	MS3102 R16-9P (4 Pin)	MS3102R16-9SY (4 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Traction Motor Current4	From Current Sensor	MS3102 R16-9P (4 Pin)	MS3102R16-9SZ (4 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Brake Pipe Pressure1	Pressure Sensor (INPUT A9)	MS3102 R16-9P (4 Pin)	MS3102R16-8SW (5 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Brake Pipe Pressure2	Pressure Sensor (INPUT SA9)	MS3102 R16-9P (4 Pin)	MS3102R16-8SX (5 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Brake Cylinder Pressure1	Pressure Sensor (Bogie 1)	MS3102 R16-9P (4 Pin)	MS3102R16-8SY (5 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Brake Cylinder Pressure2	Pressure Sensor (Bogie 2)	MS3102 R16-9P (4 Pin)	MS3102R16-8SZ (5 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Battery Voltage	From Voltage Sensor (INPUT ZBA/UBA)	MS3102 R16-9P (4 Pin)	MS3102R16-8S (4 Pin)	A	+V
				B	GND
				C	–V
				D	OUTPUT
Auxiliary Voltage "u"	Voltage Sensor	PT u	MS3102R16-1P (7 Pin)	A	u 1
				B	u 2
Auxiliary Voltage "v"	Voltage Sensor	PT v		C	v 1
				D	v 2

Auxiliary Voltage "w"	Voltage Sensor	PT w		E	w 1
				F	w 2
SPARE		MS3102 R16-9P (4 Pin)	MS3102R18-4S (4 Pin)	INPUT	
SPARE		MS3102 R16-9P (4 Pin)	MS3102R18-4SW (4 Pin)	INPUT	
SPARE		MS3102 R16-9P (4 Pin)	MS3102R18-4SX (4 Pin)	INPUT	
SPARE		MS3102 R16-9P (4 Pin)	MS3102R18-4SY (4 Pin)	INPUT	

Signal Type **Analog**

From		To		Signal Name
SIGNAL CONDITIONING UNIT		EVENT RECORDER		
Connector Type	Terminal No.	Connector Type	Terminal No.	
MS3102R 20L-48SX (19 Pins)		MS3102R 20L-48PX (19 Pins)		
MS3102R 20L-48SY (19 Pins)		MS3102R 20L-48PY (19 Pins)		

Signal Type
CAN Out Put

From		To Other Microprocessor Based Equipment in Locomotive	
EVENT RECORDER			
Connector Type	Terminal No.	Signal Name	Terminal No.
MS3102R14SA-61P (7 Pin)	A	CAN_L	CAN_L Bus Line(Dominant Low)
	B	CAN_GND	CAN Ground
	C	--	Spare
	D	CAN_SHLD	Optional CAN Shield
	E	GND	Optional CAN Ground
	F	CAN_H	CAN_H Bus Line(Dominant High)
	G	CAN_V+	Optional CAN external positive supply

Signal Type **Power Supply** (110 VDC)

From		To		Signal Name
Terminal in CAB		Event Recorder		
Connector Type	Terminal No.	Connector Type	Terminal No.	
From terminals provided by I.Rlys in Loco CAB		MS3102R10SL-3P (3 Pins)	A	B -VE
			B	Spare
			C	B +VE

Signal Type **Power Supply** (110 VDC)

From		To		Signal Name
Terminal in CAB		Signal Conditioning Unit		
Connector Type	Terminal No.	Connector Type	Terminal No.	
From terminals provided by I.Rlys in Loco CAB		MS3102R10SL-3P (3 Pins)	A	B –VE
			B	Spare
			C	B +VE

Signal Type **PC/ Laptop Interface**

From	To	Signal Name
Event Recorder	PC/ LAPTOP	
Connector Type	Connector Type	
9 Pin D Type	RS232C Serial Port	RS232C *

Note: The connector type numbers given are for the connectors mounted on the respective units. For interconnecting cables a corresponding mating part to be selected

* Data Transfer Time in any case should not exceed from 05 minutes.

Annexure IV

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
SHORT TERM MEMORY: DIGITAL REPORT

File Name		Starting Date	dd-mm-yy	End Date	dd-mm-yy
Shed		Starting Time	hh:mm:ss	End Time	hh:mm:ss
Loco No.		Start Distance	Km	End Distance	Km
Equipment no		Max Speed	Kmph		

Date	Time	Inst. Distance	Inst. Speed	OHE Voltage	OHE Current	TM Voltage		TM Current		Bat Voltage	BP Pressure	BC Pressure		Aux Voltage			Consumed Energy			Event *
						TM1	TM4	TM1	TM4			BC1	BC2	u	v	w	Run Kwh	Halt Kwh	Total kwh	
dd-mm-yy	hh:mm:ss	Km	Km/h	Kv	Amps	Volts				Volts	Kg/cm^2	Kg/cm^2		Volts						

Total Dynamic Break		Total Coasting		Total		
Duration	Distance	Duration	Distance	Duration	Distance Traveled	Energy Consumed
HH:MM:SS	Km	HH:MM:SS	Km	HH:MM:SS	Km	Kwh

*** All Digital Parameters shall be taken as Events and shall be clearly indicated in the Event column whenever take place.**

163296

Annexure V

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
LONG TERM MEMORY: DIGITAL REPORT

File Name		Starting Date	dd-mm-yy	End Date	dd-mm-yy
Shed		Starting Time	hh:mm:ss	End Time	hh:mm:ss
Loco No.		Start Distance	Km	End Distance	Km
Equipment no.		Max Speed	Kmph		

Date	Time	Inst. Distance	Inst. Speed	OHE Voltage	OHE Current	TM Voltage		TM Current		Bat Voltage	BP Pressure	BC Pressure		Aux Voltage			Consumed Energy			Event *
						TM1	TM4	TM1	TM4			BC1	BC2	u	v	w	Run Kwh	Halt Kwh	Total kwh	
dd-mm-yy	hh:mm:ss	Km	Km/h	Kv	Amps	Volts				Volts	Kg/cm^2	Kg/cm^2		Volts						

Total Dynamic Break		Total Coasting		Total				
						Energy Consumed		
Duration	Distance	Duration	Distance	Duration	Distance Traveled	Run	Halt	Total
HH:MM:SS	Km	HH:MM:SS	Km	HH:MM:SS	Km	Kwh	Kwh	Kwh

*** All Digital Parameters shall be taken as Events and shall be clearly indicated in the Event column whenever take place.**

Annexure VI

FUNCTIONAL BLOCK DIAGRAM OF EVENT RECORDER