सत्यमेव जयते

भारत सरकार

रेल मंत्रालय

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SPECIFICATION FOR

MICROPROCESSOR BASED ELECTRONIC SPEED CUM ENERGY MONITORING SYSTEM

FOR

ELECTRIC LOCOMOTIVES

SPECIFICATION NO. ELRS/SPEC/SPM/0002(REV.4)
Issued on 17.07.2018

Approved by	Signature
PEDSE	ओमप्रकाश 17.7.18

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SSE/System	SSE/System	EDSE/System 17/07/18

Status of Revision

S. N.	Date of Revision	Page No.	Revision	Reasons for Revision
1.	-	All	0	First Issue(May-1999)
2.	Sep-2002	All	1	Master & slave concept introduced. In addition to speed, Energy monitoring and recording introduced. Internal & External memory both provided in Master. Meant for conventional AC Tap Changer locos only. Etc.
3.	June-2004	All	2	To include requirement of equipment for three phase locomotives and to facilitate its interface with other systems on conventional locomotive. Internal memory transferred from Master to Slave. Provided Low Speed Relay output for VCD. D-type connectors were introduced in place of circular connectors.
4.	23.08.2017	All	3	Increase the font size of speed parameter on LCD display for better visibility, limiting the time drift in RTC, provided USB port both in Master & Slave and change the frequency range for determination of resonance frequency test. Etc.
5.	17.07.2018	16,18 & 19	4	To use Tailor made memory card.

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CHAPTER 1

GENERAL

1.0 SCOPE & OBJECT:

1.1 This specification covers requirements of **MICROPROCESSOR BASED ELECTRONIC SPEED RECORDING, INDICATING & ENERGY MONITORING SYSTEM** for application on Conventional A.C. Tap Changer Locomotives and SPEED RECORDING WITH INDICATING SYSTEM REQUIRED ON THREE PHASE LOCOMOTIVE (Energy Monitoring System already provided through Loco Microprocessor Control in Three Phase Locomotives).

1.2 The specification covers basic features of equipments. It is the responsibility of the manufacturer/supplier to develop circuit/detail design to meet the requirements of this specification.

1.3 DEFINITIONS:

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

1.3.1 Tenderer /Supplier/ Manufacturer

The Firm/Company who submits the offer for supply of Microprocessor based Electronic Speed Recording, Indicating and Energy Monitoring system.

1.3.2 Purchaser

Indian Railways

1.3.3 RDSO

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

1.3.4 Inspecting Officer

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

1.3.5 Contractor

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

1.3.6 Master

Recorder cum Indicator Unit, which will record the journey data.

1.3.7 Slave

Indicator unit, which shall follow the Master.

1.3.8 Signal Conditioning Unit (SCU)

Equipment to convert CT/PT output to low voltage signal that can be fed to microprocessor.

1.3.9 Speed Sensor

Pulse generating unit mounted on Locomotive axle to generate the pulses per revolution of Loco Wheel.

1.3.10 SENSCON

32 Shell 14 Pin circular connector that shall be used to connect Speed Sensor unit to MASTER Unit.

1.4 CONTRACTOR'S RESPONSIBILITY:

The contractor's responsibility will extend to the following:

1.4.1 Supply of detailed instruction 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).

1.4.2 Commissioning, testing & field trials of the prototype equipment in service. The supplier shall arrange to carry out detailed test & field trial jointly with RDSO.

1.4.3 The supplier shall supply suitable software for evaluation of data downloaded from the system.

1.4.4 The design shall be developed as per requirement given in this specification. The detailed design shall be submitted to RDSO for scrutiny and approval before commencing of the manufacturing. Here "approval" means the "approval of design features" only. The suppliers shall be responsible for performance of complete system.

1.4.5 MODIFICATIONS

The supplier shall be responsible for carrying out all the modifications at his own cost on any part of the equipment during the period of warranty required for satisfactory operation of the equipment as per technical specification. For

any technical matter the final authority is of 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.

1.4.6 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. The maximum safe transmitter speed shall be indicated. Details of any special precaution necessary shall also be stated.

1.4.7 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.

1.4.8 TRAINING OF INDIAN RAILWAYS PERSONNEL:

The supplier shall arrange for free of cost training to Indian Railway's personnel in operation, maintenance covering Installation, Commissioning, Maintenance and trouble shooting of the system including Data downloading & evaluation of Data through Evaluation Software.

1.5 PROVEN DESIGN AND TECHNICAL COLABORATION:

The system offered shall be of proven design. The supplier shall furnish documentary evidence of having manufactured similar system/sub-system successfully. In case of offers from foreign bidder they must indicate the plan for indigenisation in a phased manner and must enclose a copy of MOU with an Indian firm and Reserve Bank of India's clearance.

1.6 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 Microprocessor based Electronic Speed cum Energy Monitoring System and any other factors which may cause such dispute. The responsibility to settle any issue lies with the manufacturer.

1.7 DOCUMENTATION:

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.

a) Detailed specification of the offered Pulse Generator, major equipments like CT, PT, Master and SLAVE.

b) Details of semiconductor devices used, their specification and data sheet.

c) Mechanical drawings of complete system with details of dimensions, mounting arrangement and weight shall be provided.

d) System description, 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, PCBs used, control system hierarchy, protocol used for interfacing.

e) MOU (Memorandum of understanding) with the collaborator, wherever applicable.

f) QAM (Quality assurance manual)

g) Test protocol with procedure including schematic of test set up of testing.

h) Latest ISO 9001 certification.

i) 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."

1.8 RAILWAYS' RESPONSIBILITY:

Railway will be responsible for followings:

1.8.1 The cabling required in locomotive i. e. for connecting CT and PT in Tap Changer Locomotive and from SENSCON to MASTER for Three Phase Locomotive.

1.8.2 The cable for connecting potential free contacts to microprocessor based Electronic Speed Indicating & Recording Unit with Energy monitoring system.

1.8.3 Labour, consumables and electrical energy required for erection, testing & commissioning of System.

1.8.4 The wages and allowances as well as the cost of the travel to and from the place

of training for railway personnel.

1.9 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	Description
BS-3403	1990	--	Specification for indicating tachometer and speedometer systems for industrial, Railways and marine use.
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	--	Electromagnetic 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
BS-3190	1972	--	Specification for speedometer and odometer system for road vehicles
ELRS/SPEC/SI/0015	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 indicating and 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 SPEED CUM ENERGY MONITORING SYSTEM:

2.4.1 INPUT

SN	SIGNAL	TO	LEVEL	REMARK
1	DC Power Supply	Recorder/ Indicator unit	110 V(DC) (Variation from 70V to 125 V)	From Battery/Battery charger of locomotive.
2	AC Input for Energy Monitoring	SCU	415/380 V AC (variation 290 V to 500 V) through PT	From "a0" and "a1" terminal of Main Transformer
			OHE current through CT	Ring Type CT provided at A33 terminal of main Transformer
3	Digital Inputs - 3 Nos. (Minimum)	Recorder unit	1 No: for Dynamic Braking 1 No: for Coasting 1 No: spare.	From CTF1 and GR0 Terminals at SB in CAB1 of Locomotive.
4	Analog Inputs -2 Nos. (Minimum)	Recorder unit	1 No: for Voltage function 1 No: for Current function	From output of SCU.

2.4.2 OUTPUT:

SN	Signal	From	Remarks
1.	Relay Outputs – 5 nos. (Minimum)	Recorder	□ 1 No. for the Live sign of the speedometer. □ 2 Nos (Double Throw type) - one for the 105 % of the maximum speed and other for 110 % of the maximum speed. □ 1 No for vigilance control device cut out at low speed i.e. below 2 Kmph. □ 1 No spare.
2.	Speed Signal Output	Junction Box	Spare Ports for tapping Speed Signal for other Systems i.e. TCAS/TPWS

2.5 EQUIPMENT DESCRIPTION:

2.5.1 SPEED SENSOR:

Opto – Electronic Speed Sensor shall be used to generate pulses with numbers directly proportional to distance covered and frequency proportional to the speed of locomotive.

Two such sensors with hot redundancy will be provided for high reliability. The system shall be so designed that changeover from faulty speed sensor to good one shall be done automatically and an Error shall be logged in Error Log Memory to indicate failure of one sensor.

The Speed Sensor shall be designed so as to prevent the ingress of water, dust etc. and lubricant from axle box. It shall withstand Weather Proof Test and Water Tightness Test as per **Clause 6.5 and 6.6.**

The size of Pulse Generator used as speed sensor shall be as per CLW's Drg No. CLW/ES/SK-6/SPM.

2.5.2 RECORDER-CUM-INDICATOR:

The Speed cum Energy Recorder cum Indicator is the intelligent unit called MASTER. It is a composite unit consisting of Recorder and Indicator Unit mounted in the CAB of Locomotive. Recorder shall have central control of the

equipment consisting of microprocessor based CPU and a portable flash memory card & FLASH EEPROM based Internal Memory to record the data listed in **Clause 2.9** and power supply card.

It shall provide analog indication for speed with Digital Display for Indication of Energy and other parameter as listed in **Clause 2.7.1.10.**

2.5.3 INDICATOR:

An Indicator Unit (SLAVE), connected to MASTER for repeating its display shall be provided in the other CAB of Locomotive. It shall have analogue type Speed Indication having Digital Display for Indication of Energy and other parameter as listed in **Clause 2.7.1.10** and FLASH EEPROM based Internal Memory for recording the journey data listed in **Clause 2.9**.

2.5.4 VOLTAGE & CURRENT SENSORS:

For processing the energy related parameters, Voltage signal corresponding to 22.5 kV OHE voltage shall be taken from 415V/380V auxiliary winding of main transformer using dual voltage Potential Transformer (415/380: 110) and current signal can be taken using a ring type Current Transformer (300: 5) from primary of main transformer.

Rating of PT and CT shall be 10 VA with accuracy class 0.5 as per IS 3156(Part 2): 1992 and IS 2705(Part 2): 1992 respectively.

2.5.5 SIGNAL CONDITIONING UNIT (SCU):

This shall do the function of converting Voltage and Current signal taken from dual voltage Potential Transformer and ring type Current Transformer to low voltage signal that can be fed to Microprocessor of Recorder for Energy monitoring.

2.5.6 CONNECTOR FOR COUPLING:

Master Unit shall be connected to Speed Sensor (Pulse Generator) through circular connector provided at the end of Pulse Generator to ensure modularity and easy replacement of either pulse generator or Master itself. Connector provided at the end of Pulse Generator shall be 14 Pin 32 Shell female Sichem Connector **(SENSCON)** of Allied make only. The male counterpart of this connector shall be of Elbow type and Allied make only.

SENSCON (male Elbow type) shall be supplied loose along with cables.

A suitable support plate as per CLW's Drg No. CLW/ES/SK-5/SPM/0002(Rev2) shall be provided by the manufacturer to mount SENSCON below locomotive under frame.

2.5.7 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, where equipments may be mounted 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 block/schematic diagram of the system is shown in **Annexure XV.**

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

iv) All the cables used shall be Multi core copper cables having conductor cross section 0.5 mm^2, PTFE insulated, FRLS jacketed along with shielding. To ensure maximum noise immunity of the transmitted signal, only screened cable shall be used. The braid should have an optical coverage of > 80%.

v) Master and Slave Units will employ D – Type connector. 50 Pin (Male) connector provided for Master and Slave and 9 Pin (Female) connector provided for Master shall be of MIL Grade only and of either ITT Cannon/Allied/Tyco or Essen make. All connectors/contacts provided should be Solderable/Crimped.

On the back side of Master and Slave Cable Fixing Clamps shall be provided to hold cable for 50 Pin and 9 Pin connectors.

vi) Pin Allocation details for D type connectors to be used is enclosed in Annexure I.

2.5.8 JUNCTION BOX:

A Junction Box conforming to **CLW's drawing no. CLW/ES/SK-7/SPM/0002 (Rev. 2)** shall be provided in the Machine Room (behind TK-1 Panel where SCU is mounted) of Conventional Electric Locomotive and in CAB 2 of Three Phase Electric Locomotive to tap speed signal coming from SENSCON for sharing the same with TCAS/TPWS. Cable carrying speed signal from SENSCON coming to Master (RCI) unit shall be terminated into the Junction Box. From this junction box further cable connection to Master (RCI) unit and TCAS/TPWS will be taken. In order to avoid overloading of pulse generator due to TCAS/TPWS as well as to protect the PG in case of fault occurring in the TCAS/TPWS interface a fuse of suitable rating shall be provided inside Junction Box before tapping point of the speed signal to TCAS/TPWS to protect the pulse generator.

The mounting & clamping of fuse shall be rigid enough so that fuse does not get loose or falls due to vibration encountered in loco operation.

2.6 MOUNTING:

SN	Item	Symbolic Name	Place (Max. Space available in mm) (H X W X L)	
			Conventional Locomotive	Three Phase Locomotives
1.	Recorder-cum-Indicator	MASTER	**CAB-1** Driver's desk (285X175X215) Desk Mounted	**CAB- 2** Panel Mounted (285X175X215)
2.	Indicator	SLAVE	**CAB-2** Driver's desk (285X175X215) Desk Mounted	**CAB-1** Panel Mounted (285X175X215)
3.	Speed Sensor Unit	Pulse Generator (PG)	3rd axle on RH from CAB-1 (119X155 rounded)	3rd axle on RH from CAB-1 (119X155 rounded)
4.	Signal conditioning Unit	SCU	AC-1 Panel (190X220X75)	NIL
5.	Voltage Sensor	PT	a0 – a1 Terminals of the Main Transformer (155X245X150) Terminal strip is to be separate from the PT.	NIL
6.	Current Sensor	CT	A33 Terminal of the main transformer (120X190X320)	NIL
7.	32 Shell 14 Pin Circular Connector for Coupling Sensor	SENSCON	Under Frame/ Locomotive Frame	Under Frame/ Locomotive Frame
8.	Junction Box	JB	Behind TK-1 Panel in Machine Room	CAB 2 Side Wall in Machine Room

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

The mounting arrangement of Master and Slave shall be as per CLW's Drawing No. CLW/ES/SK-1-1 /SPM/0002 (Rev-2) to CLW/ES/SK-1-3 /SPM/0002 (Rev-2) (with box arrangement) for conventional and 3 phase

locomotive. In conventional locos mounting of these boxes will be done on mounting table with the help of 4 screws and in the case of 3 phase locomotive mounting shall be done by riveting these boxes on cable cover assembly at centre pillar of locomotive. The firms supplying smaller size of Master and Slave will provide adopter plate to match the Master and Slave box as per above drawings.

In existing AC Tap Changer Locomotives already in field, the mounting arrangement shall be provided as per CLW's Drg No. CLW/ES/SHED/SPM/0002 (Rev2) to ensure interchangeability.

For interchangeability of PT and CT the mounting dimensions and terminal position sequence should be same and it will be as per CLW's Drg no. CLW/ES/SK-2/SPM and CLW/ES/SK-3/SPM to suit M5 studs.

For Signal Conditioning Box mounting holes and terminal positions shall be as per CLW's Drg no. CLW/ES/SK-4/SPM.

Summary of accessories and their applicability in AC Tap Changer Locomotive and Three Phase Locomotive for Microprocessor based Electronic Speed cum Energy Monitoring System is given in **Annexure XVI.**

2.7 TECHNICAL DETAILS

2.7.1 INDICATING SYSTEM:

2.7.1.1 The Recorder cum Indicator (MASTER) and Indicator (SLAVE) shall continuously indicate:

i. Speed in Kmph, continuously in analog form with graduations of 2.0 Kmph.

ii. Real time, continuously in hrs, minutes and seconds on digital display.

iii. Cumulative Energy in KWH continuously on digital display.

Default LCD Display Screen on Master & SLAVE

In Tap Changer Locomotive

H	H	:	M	M	:	S	S								
X	X	X	X	X	X	X		K	W	H					

In Three Phase Locomotive (Character size 2.9mm X 8.0 mm (min))

H	H	:	M	M	:	S	S		X	X	X	K	M	P	H

OR

2.7.1.2 LED Indication shall be provided on both MASTER & SLAVE to indicate

i. Fault in system/memory full. This indication shall be along with a blinking display on LCD Screen to indicate reason for LED glowing. This display on LCD Screen shall be re settable by pressing Display Key on Keypad.

ii. Over Speed Indication.

2.7.1.3 DIAL:

Dial shall conform the following requirements both in MASTER and SLAVE:

i) Minimum visible diameter of the dial 120 mm.
ii) Ground of the dial white with black graduations, numerals and pointer.
iii)"Aviation Green" LED illuminated backlight for illumination of the dial.
iv) For Analog Indication minimum graduation of 2 kmph shall be provided.

2.7.1.4 DRIVE:

Stable and accurate stepper motor drive, with internal self-check on accuracy of MASTER and SLAVE shall be provided.

2.7.1.5 SCALE RANGE:

MASTER and SLAVE shall have Scale Range of 0 – 180 kmph spread over 240 degree (min) with speed least count of 2 kmph on Dial (Analog) and 1 kmph on LCD Display.

2.7.1.6 DIRECTION OF DEFLECTION:

The direction of deflection of the pointer shall be clockwise for increasing speed, when viewed from the front.

2.7.1.7 EFFECTIVE RANGE:

0 to 180 kmph.

2.7.1.8 BALANCING:

There shall be no variation in zero reading due to change in altitude and position of mounting i.e. vertical, horizontal or at angle.

2.7.1.9 REAL TIME CLOCK:

A Clock Chip shall be provided to maintain the time base in the system. The operating temperature of RTC chip shall be in the range of 0 ^{0}C to 70 ^{0}C with temperature compensation circuit. The maximum permissible drift in time setting shall be up to +/-2 min/year. **Alternatively**, a GPS receiver module may be provided to set the time automatically.

2.7.1.10 PARAMETERS TO BE DISPLAYED:

The equipment (MASTER & SLAVE) shall display following parameters on a 16X2 LCD Screen by pressing Display Key on Keypad except speed which shall be displayed with character size as 2.9mm X 8.0 mm(min.).

a. SPEED AND RELATED FUNCTIONS:

i) Speed in kmph.
ii) Over Speed Limit Setting
iii) Distance traveled in Km. (Odometer)
iv) Distance Traveled by Present Driver in Km.
v) Distance coasted by Present Driver in Km(up to two decimal points)
vi) Coasting Duration by Present Driver. (HH : MM : SS)
vii) Dynamic brakes Duration (HH : MM : SS)
viii) Wheel diameter setting
ix) Real time in HH:MM:SS in 24 hours scale
x) Date in DD: MM: YY
xi) Memory Status (used %)
xii) System Faults
xiii) Driver ID
xiv) Train No.
xv) Train load
xvi) Loco number.

b. ENERGY FUNCTIONS:

i) Energy consumed during run.
ii) Energy consumed during halt.
iii) Total Energy consumed.
iv) OHE voltage.
v) OHE current.
vi) Power Factor

2.7.2 RECORDING SYSTEM:

The recording system shall consist of:

2.7.2.1 INTERNAL MEMORY:

An Internal FLASH EEPROM memory of sufficient capacity to contain the following sub-memories. Internal memory shall be provided in both Master and Slave.

a. **SHORT TERM MEMORY:** To store the most recent data of the minimum last 3 hours of travel excluding loco halt time, in loop (circular) form, in respect of parameter mentioned in **Clause 2.9** with resolution of one second.

b. **FAULT AND CONFIGURATIONS MEMORIES**: To record the equipment status and internal faults in loop form and contain customer specific configuration parameters to be used for processing the stored data.

2.7.2.2 EXTERNAL MEMORY:

The memory card shall withstand temperature up to 70 ^{0}C and shall be accessible to only authorized person. The external memory card shall be procured from OEMs or authorized dealer of OEMs only. The firmware of system shall be able to read & write on Memory card of capacity upto 64GB. Supplier will ensure the availability of spare memory cards for a period of 10 years from the date of supply.

The Memory card shall have sufficient capacity to contain the following sub-memories:

a. **SHORT TERM MEMORY:** A minimum 3 hours SHORT-TERM memory with resolution of one second as in the Internal Memory.
b. **LONG TERM MEMORIES:** To store the most recent data of the last 90 days of halt and run or 62,000kms of distance travelled, in loop form, with resolution of 30 seconds in respect of parameters mentioned in **Clause 2.9.**
c. **FAULT AND CONFIGURATIONS MEMORIES:** As in the Internal Memory.

2.7.2.3 To avoid the problems of not recording of data, formatting of card etc. in case of changing the external memory cards from one system to another system, following features shall be provided.

i) When a card is taken out from an ESMON and provided back in the same ESMON or of the same make ESMON, the system shall not ask for any formatting etc. but shall continue to record the future data in loop form.

ii) If recorder sees new memory card, the system should prompt for using of memory card but should not format the card immediately. The system shall give enough time (60 seconds) to disable the formatting. Memory card shall be formatted only after lapse of specified time.

iii) Situations of 'card not available', 'Defective card' and 'data being not recording on card' shall be treated as faulty state and LED indication along with display on LCD shall be provided.

2.8 TRANSFERRING THE JOURNEY DATA:

Normally, the data stored in the portable memory card shall be transferred to the PC through Memory 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.

The data from the portable memory 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 portable memory card shall be removed from the locked cassette compartment of Master unit and inserted into the "Memory Card Reader" interfaced with PC equipped with evaluation software. After the data is down loaded, the memory card shall be erased for reuse. The memory 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 download the data of SHORT TERM MEMORY/LONG TERM MEMORY with suitable commands.

The Master and Slave units shall be separately equipped with USB host port for direct downloading of data to USB Mass Storage Devices from External or Internal Memory as the case may be. This should be possible by executing certain commands from the Keypad and LCD display of Master and Slave units. User should be able to select either short term or long term data or both of external memory and short term data of internal memory as the case may be. The user interface protocol for Data Downloading is given in **Clause 2.16.3(d).**

The provision shall be made for retaining the data in the memory of System even after downloading to USB Mass Storage Device.

USB host port under lock & key arrangement shall be provided both in recorder and indicator.

2.9 PARAMETERS TO BE RECORDED:

The equipment; Recorder cum Indicator (Master) Unit shall continuously record the following parameters in the memory (both Internal and External):

a. SPEED AND RELATED PARAMETERS:

i) Speed in km/h.
ii) Over Speed with Time and Duration (Driver Wise/Train Wise)
iii) Distance traveled in Km. (Odometer)

iv) Distance coasted in Km. (up to two decimal points.)
v) Coasting Duration (HH : MM : SS)
vi) Real time in HH:MM:SS in 24 hours scale
vii) Date in DD: MM: YY.
viii) Dynamic brakes duration (HH : MM : SS)
ix) System Fault
x) Train load
xi) Driver ID
xii) Train No.
xiii) Loco number
xiv) Events like Memory Freeze, Power ON/OFF

b. ENERGY PARAMETERS:

i) Energy consumed during run in kWh.
ii) Energy consumed during halt in kwh(In Long Term Memory Only)
iii) Total Energy consumed
iv) Specific Energy Consumption (Driver Wise/Train Wise)
v) Average OHE voltage in kV. (Up to one decimal points.)
vi) Average OHE current in amp.
vii) Power Factor(In Long Term Memory Only)

2.10 REPORTING FORMAT:

2.10.1 Printing of data of 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 shall be selectable and shall print out events like violation of pre-determined speed, voltage, starts, stops and speed data between specified time or distance intervals. Selection mode may either be one or a combination of 2 or 3 conditions.

2.10.2 The printing/plotting of the data of short-term memory shall be in detail, with resolution of one second in digital or analog (graphical) format, as desired.

a: The analog (graphical) plotting of the data shall be possible in following configurations:

(i) Speed Vs time at constant time interval	Plotting of speed data at desired constant time intervals, the smallest intervals being same as sampling rate of recording i.e. 1 second for short term memory
(ii) Speed Vs Distance	Plotting of speed distance data, the smallest interval of distance will be as per sampling rate.
(iii) Energy Vs Time	Plotting of energy data at desired constant time intervals, the smallest intervals being 1 second.

(iv) Energy Vs Distance	Plotting of energy data at desired constant distance intervals, the smallest interval of distance will be as per sampling rate.

It shall also be possible to have above analog (graphical) print outs for desired time or distance intervals, on enlarged/amplified scale, for better clarity.

Parameters on "X" and "Y" axis shall be clearly marked on the Graphical Printouts with **Major gridlines** whatever the case be i.e. 1 second in case of Short Term Recording Printouts and 30 seconds in case of Long Term Recording Printouts.(For more details see formats enclosed)

b: The Tabular plotting of the data shall be possible in following configurations:

(i) Driver wise Specific Energy Consumption & Coasting/Dynamic Brake Data	
(ii) Specific Energy Consumption & Coasting /Dynamic Brake Data for desired Distance	
(iii) Specific Energy Consumption & Coasting/ Dynamic Brake Data for desired Time Period	

The software shall also provide for printing of the data in the following selective formats:

1. Only the page desired to be viewed.
2. Continuous print out of all pages.
3. Between desired time/distance intervals.
4. Data above/or below an specified speed threshold.
5. Data for a particular driver/train number.

For Reporting formats see Annexure enclosed. In case of Three Phase Locomotive Reporting Formats shall be same excluding Energy Parameters, Coasting and Dynamic Brake Data.

Note:

1. The information like File Name, Starting Date, and Ending Date etc. shall be printed on only first page.
2. The summary of data shall be printed on last page only.
3. In case print out is of one page, both "1" and "2" shall be printed on same page.

2.11 MEMORY FREEZE:

A memory freeze facility shall be provided to allow the locomotive to be moved

after an incident, without over writing the data stored during last 3 hours of travel. A Memory Freeze Switch shall normally be provided to freeze short term memory recording unaffecting the data recording over long term memory. The switch for freezing the data shall be under a sealed glass cover on the MASTER unit. The glass shall be broken, when required, for operating the switch. An LED indication with message in LCD display for memory freeze shall also be provided.

2.12 MEMORY FULL INDICATION:

A message on LCD display shall be provided on the MASTER to give advance warning for down loading the data from portable memory card when 85% of the memory capacity has been utilized. A memory full message shall also be recorded in Error Log Memory only once.

Under this condition display shall be as given below:-

S	P	E	E	D	X	X	X	K	M	P	H		M	F	L

OR

MFL

SPEED XXX KMPH

2.13 OVER SPEED ALARM:

Provision shall be made to give audio-visual warning at preset over speed setting. The over speed setting shall be done through Keyboard but the 105% and 110% of speed setting should be programmed as a percentage value of the over speed setting.

It should not be possible for the locomotive crew to interfere with this setting.

2.14 PERIOD OF MEASUREMENT:

The average speed of locomotive is the ratio of the distance travelled to the time required to cover that distance. Thus, determining the average speed involves measuring of a distance and a time period. The shorter the time period, the closer is the average speed to the instantaneous speed. With a view to have average speed indicated as well as recorded very close to instantaneous speed, measuring time period shall be of the order of 0.4 seconds or less.

2.15 WHEEL WEAR ADJUSTMENT:

Wheel wear adjustment between the new and fully worn wheel diameter in step of 1 mm shall be provided in the MASTER. This shall not be accessible to the locomotive crew.

The wheel diameters (mm) normally in use on the Indian Railways are:

NEW	FULLY WORN
1220	1144
1140	1064/1054
1092	1016/1006
1016	940
965	889
952	857
865	795
838	768
765	695
725	655
700	640

2.16 PARAMETER SETTING:

2.16.1 Provision shall be made in the Recorder cum Indicator (MASTER) unit, for manual input by a Membrane Keypad having 16 Keys. Function of Each Key shall be as described in parameter Setting & Viewing Protocol attached below.

2.16.2 Equipment shall have facility to set following parameters as per Parameter setting & viewing protocol in **clause 2.16.3:**

a. Setting by Authosied Person:

MASTER shall have facility to set following parameters by pressing a Push to ON switch provided under locked cassette compartment as described in parameters as per Parameter setting & viewing protocol.

i) Resetting of counters except Odometer.
ii) Over Speed Limit for alarm
iii) Real time in HH:MM:SS in 24 hours scale
iv) Date in DD: MM: YY.
v) Wheel diameter in mm
vi) Type of Locomotive
vii) Locomotive Number
viii) Name of Shed
ix) CT Factor
x) PT Factor
xi) Equipment Number
xii) Setting of Odometer

b. Setting by Locomotive Crew:

There shall be provision for entering the following parameters by the locomotive crew without opening the MASTER unit. Setting of these parameters shall be possible from both MASTER and SLAVE unit at halt condition as well as in running condition. There shall be provision of 16 digits alphanumeric entry for Driver ID and Train No.

i) Driver ID
ii) Train Number
iii) Train load.
iv) Dial Illumination

2.16.3 PARAMETER SETTING AND VIEWING PROTOCOL:

The Speed, Time Distance cum Energy Recorder and Indicator is provided with an analog illuminated dial pointer display to indicate speed in kmph. In addition a 16 character x 2 line backlit LCD is provided to view and set the parameters. The default display on LCD Display Screen on both MASTER and SLAVE shall be as per **Clause 2.7.1.1 (III)**.

In case analog display fails, a provision shall be made in such a way that above default display shall automatically change into Speed (Character size 2.9mm X 8.0 mm) display in Tap Changer Locomotives as given below:

H	H	:	M	M	:	S	S		X	X	X	K	M	P	H

OR

XXX	HH:MM:SS KMPH

The following is the protocol for viewing and setting the various parameters on the MASTER and SLAVE Units using Keypad. The data shall be viewed or set with a 16 key membrane Keypad having 10 Alphanumeric Keys containing Numeric digits 0 – 9 and Alphabetical Letters A to Z

Distribution of letters of Alphabet on numeric keys shall be as given below:

'0' Key shall have provision for "Space" — **0 Space**

'1' Key shall be as — **1**

'2' Key shall have letters A, B, C — **2 ABC**

'3' Key shall have letters D, E, F — **3 DEF**

'4' Key shall have letters G, H, I — **4 GHI**

'5' Key shall have letters J, K, L — **5 JKL**

'6' Key shall have letters M, N, O — **6 MNO**

'7' Key shall have letters P, Q, R, S — **7 PQRS**

'8' Key shall have letters T, U, V — **8 TUV**

'9' Key shall have letters W, X, Y, Z — **9 WXYZ**

- **CANCEL** — **CANCEL** — To cancel any selection or data entry
- **ENTER** — **ENTER** — To accept the data
- **TRAIN LOAD** — **TRAIN LOAD** — To feed the Train Load data
- **DISPLAY** — **DISPLAY** — To view or modify the parameters

- **DRIVER ID** — **DRIVER ID** — To feed the Driver ID

- **TRAIN NO.** — **TRAIN NO.** — To feed the Train Number

On pressing of Key '2' first time Numeric Digit 2 shall be entered. On pressing Key '2' 2nd time Letter 'A' shall be entered. On pressing Key '2' 3rd time Letter 'B' shall be entered. On pressing Key '2' 4th time Letter 'C' shall be entered and on pressing Key '2' 5th time Numeric digit 2 shall be entered again & above will repeat.

The same procedure for entering other letters shall be followed with other key as standard.

a. VIEWING OF THE PARAMETERS USING DISPLAY KEY:

It shall be Possible from both MASTER and SLAVE Unit to view parameters using display key when Locomotive is standstill as well as in running condition.

- The parameters as per the enclosed LCD Data Display format are displayed in succession with every press of the 'DISPLAY' key. At this mode current values set can only be seen. It shall not be possible to modify any value except the Dial Illumination Level.
- It shall be possible to return to default display by pressing 'CANCEL' key any time.
- Display shall return to default screen if no key is pressed for 10 seconds.
- If anyone wants to see any specific parameter continuously, a provision shall be made in such a way that pressing 'ENTER' Key in display mode when that parameter is displayed shall freeze the display to desired parameter on screen instead of default.
- Pressing 'ENTER' Key again shall return to default screen.

b. SETTING OF DIAL ILLUMINATION:

- There shall be provision of setting the Dial Illumination level at any time i.e. Loco moving or at Stand Still by pressing the Numeric Keys 1 to 9.
- A facility shall be provided when Key 1 is pressed, the Illumination Level shall be minimum.

- When Key 2 is pressed Illumination Level shall be greater than by around 10% when key 1 was pressed.
- When Key 3 is pressed Illumination Level shall be greater than by around 10% when key 2 was pressed.
- It shall keep on increasing like this up to key 9, where Dial Illumination shall be maximum 100%.
- When Key 1 is pressed again it should be again minimum.

c. SETTING OF THE PARAMETERS:

There are two kinds of parameters, which can be set by using keypad:

1. Parameters, which are to be entered by Locomotive Crew.
2. Parameter, which are to be set by Authorised person.

1. PARAMETERS TO BE ENTERED BY LOCOMOTIVE CREW:

A provision shall be made to set parameters given in Clause 2.16.2 b from both the MASTER & the SLAVE Unit in running as well as halt condition of Locomotive.

i. SETTING OF TRAIN LOAD:

- It shall be possible by pressing 'TRAIN LOAD' Key on the Keypad.
- After pressing 'TRAIN LOAD' Key existing Load data (stored in memory) shall be shown on Display.
- The new data for Train Load shall be entered using Keypad.
- Pressing 'ENTER' Key shall do acceptance of this entry. After pressing 'ENTER' Key the display shall return to default display mode after displaying "New Data Recorded" for 3 seconds.
- It should be possible by pressing 'CANCEL' Key to discard any new data entered and to retain the earlier stored data. After pressing 'CANCEL' Key, Display shall return to earlier stored data after displaying "Data Not Recorded" message for 3 seconds.

There shall also be provision for displaying "INVALID VALUE" message whenever any wrong entry is made.

ii. SETTING OF DRIVER ID:

- It shall be possible to enter the Alphanumeric diver ID by pressing 'DRIVER ID' Key on the Keypad.
- After pressing 'DRIVER ID' Key existing Driver ID (stored in memory) shall be shown on Display.
- The new Driver ID (Alphanumeric) shall be entered using Keypad.
- Pressing 'ENTER' Key shall do acceptance of this entry. After pressing 'ENTER' Key the display shall return to default display mode after displaying "New Data Recorded" for 3 seconds.
- It shall be possible to discard any new data entered by pressing 'CANCEL' Key and to retain the earlier stored data. After pressing 'CANCEL' Key, Display shall return to earlier stored data after displaying "Data Not Recorded" message for 3 seconds.

iii. SETTING OF TRAIN NUMBER:

- It shall be possible to enter the Alphanumeric Train Number by pressing 'TRAIN NO.' Key on the Keypad.
- After pressing 'TRAIN NO.' Key existing Train no. (stored in memory) shall be shown on Display.
- The new Train Number (Alphanumeric) shall be entered using keypad.
- Pressing 'ENTER' Key shall do acceptance of this entry. After pressing 'ENTER' Key the display shall return to default display mode after displaying "New Data Recorded" for 3 seconds.
- It shall be possible to discard any new data entered by pressing 'CANCEL' Key and to retain the earlier stored data. After pressing 'CANCEL' Key, Display shall return to earlier stored data after displaying "Data Not Recorded" message for 3 seconds.

2. PARAMETERS SETTING BY AUTHORISED PERSON (configuration mode):

(i) These parameters shall be entered from MASTER Unit only when Locomotive is standstill i.e. speed is 0 kmph and door of Locked Cassette Compartment is open. If Locomotive starts moving, the data entry, if in progress, shall be made to abort with a message "Loco Moving" on LCD Display for 3 seconds and then display shall return to default display.

(ii) Parameters those will be set in this mode are given in Clause 2.16.2a. However, some more parameters to be set can be added as agreed between Purchaser and Supplier.

(iii) SETTING OF PARAMETERS:

- **Provision shall be made to reset all counters except Odometer, which shall be reset separately, for which provision shall be made.**
- In order to go from display mode to Configuration Mode, a Push to ON Switch shall be provided inside the Locked Cassette compartment of MASTER.
- The provision shall be made in such a way that when this switch is pressed for 3 seconds the system should automatically changeover from Display Mode to Configuration Mode.
- At this moment a display "**CONFIGURATION MODE**" shall come on LCD Display to indicate readiness of system for configuration.
- Pressing 'DISPLAY' Key shall perform the function to display each parameter to be set consecutively.
- Pressing of 'DISPLAY' key shall show the parameter to be set.
- Enter the new value using Keypad.
- Pressing ENTER Key shall do acceptance of this entry. After pressing ENTER Key the display shall show the "NEW VALUE ENTERED" and value to confirm proper entry.
- Pressing 'DISPLAY' Key again shall display the next parameter to be set.
- All the parameters shall be entered in the same fashion as described above.
- If the parameter to be set has no change in the parameter value, pressing of 'DISPLAY' Key shall retain the current setting and display the next parameter.

SETTING OF TYPE OF LOCOMOTIVE:

There shall be provision for selection of Type of Locomotive (Tap Changer Loco/Three Phase Loco). When **Three Phase Loco** is selected the parameters related to Energy, Dynamic Brake and Coasting should not be displayed/recorded/printed.

- As LCD Display shows Type of Locomotive in first line and Earlier Loco type Setting (Tap Changer Loco/Three Phase Loco) in second line.
- To change the loco type press the "CANCEL", Key. At this time Type of Loco to be selected (Tap Changer Loco/Three Phase Loco) shall be displayed.
- Pressing "ENTER" key after this display shall change the setting to desired Loco Type.

(iv) When all parameters are set pressing 'ENTER' key after last parameter will return the system in display mode i.e. default display. Now close the Locked Cassette Compartment door.

(v) There shall also be provision for displaying "INVALID VALUE" message whenever any wrong entry is made.

In case authorized person forget to press "ENTER" key for exiting from Configuration Mode, a provision shall be made to return to default display mode from Configuration Mode automatically.

There shall be provision of discarding the new entered data by pressing cancel key.

d. Data downloading to USB Mass Storage Device:

There shall be provision of downloading the data of External and Internal Memory with the help of suitable command on LCD display through key pad as described below. This should be possible in Locomotive halt condition only:

In MASTR unit

i). When USB Mass Storage Device is inserted, a message "Press ENTER to proceed", prompting for acceptance of entering in to downloading mode shall be displayed on LCD Display of Master Unit of ESMON.

ii). Pressing "Enter" Key will start downloading mode.

iii).After entering in to downloading mode, system should prompt for downloading from External Memory and Internal Memory by displaying message "Press 1 for External & 2 for Internal Data and 3 for both".

iv). After pressing the appropriate Key on Key Pad, system should prompt for downloading the short term and long term or both by displaying message "Press 1 for short term & 2 for long term Data and 3 for both".

v). By pressing appropriate Key on Key Pad, corresponding data shall be downloaded in to USB mass storage device.

vi). In case there is no sufficient memory in USB Mass Storage Device, the system should indicate by displaying "No Enough Memory".

vii). After finishing download system should indicate completion of download by displaying "Download Complete".

In SALVE unit

i). When USB Mass Storage Device is inserted, a message "Press ENTER to proceed", prompting for acceptance of entering in to downloading mode shall be displayed on LCD Display of Slave Unit of ESMON.

ii). Pressing "Enter" Key will start downloading.

iii). In case there is no sufficient memory in USB Mass Storage Device, the system should indicate by displaying "No Enough Memory".

iv). After finishing download system should indicate completion of download by displaying "Download Complete".

2.16.4 LCD DATA DISPLAY FORMAT:

a. The details how the above parameters shall be displayed on LCD Display format is given below:

1. OHE Voltage

O	H	E		V	O	L	T	A	G	E				
X	X	.	X		K	V								

2. Speed

S	P	E	E	D		X	X	X		K	M	P	H		

OR

SPEED XXX KMPH

3. Speed limit for over speed alarm

O	V	E	R		S	P	E	E	D		L	I	M	I	T
X	X	X		K	M	P	H								

4. Current Date

D	A	T	E											
D	D	:	M	M	:	Y	Y							

5. Total Distance Travelled (Odometer)

K	M		T	R	A	V	E	L	L	E	D			
X	X	X	X	X	X	X		K	M					

6. Energy Consumed During Run

E	N	E	R	G	Y		A	T		R	U	N		
X	X	X	X	X	X	X		K	W	H				

7. Energy Consumed During Halt

E	N	E	R	G	Y		A	T		H	A	L	T		
X	X	X	X	X	X	X		K	W	H					

8. Energy Consumed by present driver

E	N	E	R	G	Y		C	O	N	S	U	M	E	D	
X	X	X	X	X	X	X		K	W	H					

9. Distance Traveled by present driver

K	M		B	Y		C	U	R		D	R	I	V	E	R
X	X	X	X	X	X	X		K	M						

10. Dynamic Braking Application Duration by present driver

D	B		A	P	P	L		D	U	R	A	T	I	O	N
H	H	:	M	M	:	S	S		H	O	U	R	S		

11. Distance Coasted by present driver

D	I	S	T	A	N	C	E		C	O	A	S	T	E	D
X	X	X	X	.	X	X		K	M						

12. Duration of Coasting by present driver

C	O	A	S	T	I	N	G		T	I	M	E			
H	H	:	M	M	:	S	S		H	O	U	R	S		

13. OHE Current

O	H	E		C	U	R	R	E	N	T					
X	X	X	X		A	M	P								

14. Memory Card capacity status

M	E	M		C	A	R	D		S	T	A	T	U	S	
X	X	X	%		F	U	L	L							

15. System fault Indication, if any occurred during operation

X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System 17/07/18

16. Wheel Diameter

WHEEL DIA													
XXXX MM													

17. Driver ID

DRIVER ID													
XXXXXXXXXXXXXX													

18. Train No.

TRAIN NO.													
XXXXXXXXXXXXXX													

19. Train Load

TRAIN LOAD													
XXXXXX TONS													

20 Loco No.

LOCO NO.													
XXXXX													

b. Parameters to be entered by Driver – At halt as well as in running condition:

1. Driver ID
(Alphanumeric Entry)

DRIVER ID													
XXXXXXXXXXXXXX													

2. Train No.

TRAIN NO.													
XXXXXXXXXXXXXX													

3. Train Load

TRAIN LOAD													
XXXXXX TONS													

c. Parameters to be set by authorised person (Shed Staff) – At halt only:

1. Reset Counters

RESET COUNTERS													

2. Max Speed for Over Speed Alarm

MAX SPEED													
XXX KMPH													

3. Current time Setting

TIME SETTING													
HH:MM:SS													

4. Current date setting

DATE SETTING													
DD:MM:YY													

5. Wheel Diameter Setting

WHEEL DIA SETTING													
XXXX MM													

6. Type of Locomotive

T	Y	P	E		O	F		L	O	C	O				
T	H	R	E	E		P	H	A	S	E		L	O	C	O

Second Display of 6.

T	Y	P	E		O	F		L	O	C	O				
T	A	P		C	H	A	N	G	E	R		L	O	C	O

7. Locomotive Number Setting

L	O	C	O		N	O	.								
X	X	X	X	X											

8. Shed Name

S	H	E	D		N	A	M	E							
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

9. CT Factor

C	T		R	A	T	I	O								
X	X	X	X												

10. PT Factor

P	T		R	A	T	I	O								
X	X	X	X												

11. Equipment Number

E	Q	U	I	P	M	E	N	T		N	O	.			
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

12. Set Odometer

S	E	T		O	D	O	M	E	T	E	R				

2.17 LOCK:

The MASTER unit shall be equipped with suitable locking arrangement to prevent tampering of the settings mentioned in **Clause 2.16.2a** by loco crew or any unauthorised personnel.

The lock shall have the common key for all set of equipment for one supplier.

2.18 CALIBRATION:

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

2.19 ACCURACY:

The accuracy of the Energy cum Speed Recording System when tested at a **temperature of 37±3^{0}C after** working for a period of not less than 30 minutes shall not be worse than ±1.5% of the maximum scale value. The additional error introduced by wheel diameter adjustment device shall not exceed ±0.5% of full scale deflection. The error of the odometer shall be within ±1% when tested with any wheel diameter.

2.20 INTERFACING EQUIPMENT AND SOFTWARE:

2.20.1 MEMORY CARD READER UNIT:

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

2.20.2 EVALUATION 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 Energy cum Speed Monitoring System. The software shall be menu-driven and MS Windows XX compatible and shall not require knowledge of any programming language and shall be suitable to be operated with minimum computer literacy. Software should be same for all versions of ESMON of same make and upward revision of software should retain backward compatibility.

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.

2.20.3 Personal Computer/Laptop with printer:

This shall be installed by Indian Railways.

2.21 COLOUR SCHEME:

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

Recorder cum Indicator (Master), Indicator (SLAVE) , Signal Conditioning Unit and Junction Box	:	Shade Code 631
Speed Sensor (Pulse Generator)	:	Shade Code 632

CHAPTER 3

SCOPE OF SUPPLY

PART OF THE SYSTEM	CONVENTIONAL TAP CHANGER LOCOMOTIVE	3 PHASE AC LOCOMOTIVE
Recorder cum Indicator (MASTER)	1	1
Indicator (SLAVE)	1	1
Speed Sensor Unit	1	1
Junction Box	1	1
Signal Conditioning Unit (SCU)	1	---
Voltage Sensor (PT)	1	---
Current Sensor (CT)	1	---
32 Shell 14 Pin Connector (SENSCON)	1	1
Support Plate for SENSCON	1	1
Cover Assembly	---	1
Cables	1 Set	1 Set
Memory Card Reader Unit	To be indicated by purchaser	
Evaluation Software	To be indicated by purchaser	

CHAPTER 4

CLIMATIC & ENVIRONMENTAL CONDITION

4.1 TEMPERATURE:

The Microprocessor based Electronic Speed Recording & Indicating System will be fitted in locomotive where the temperature will be

a)	Maximum temperature	} Stabled Locomotive under sun	: 70 °C
		} On board working loco under Shed	: 55 °C
b)	Ambient temperature	} Operating	: 0 °C + 70 °C
		} Storage:	: 0 °C + 55 °C

4.2 RELATIVE HUMIDITY:

Upto 100% during rainy season.

4.3 ALTITUDE:

Upto 2500 m above mean sea level.

4.4 RAINFALL:

Very heavy in certain areas. The equipment should be designed in such a way as to withstand its running in flood water level of 102 mm above Rail Level.

4.5 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.

4.6 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 concentration	: 7 mg /litre.
c)	Max. concentration of chlorine	: 6 mg /litre.
d)	Maximum conductivity	:130 micro siemens /cm

4.7 VIBRATION:

The System 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.

4.8 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 and Public Address System. The same should be tested as per IEC 61000 for Electro Magnetic Compatibility. Details given in **Clause 6.7.**

4.9 SPIKES & SURGES:

Provision shall be made for suppression of transients (spikes & surges). The equipment shall withstand, without damage, the surge test mentioned in **Clause 6.10.**

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 him 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 manufacture 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 standards/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.

5.2.4 Testing of equipment and fittings shall, as far as possible be carried out at the works of the manufacturer. Testing of bought out components may also be carried out at contractor/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 approved laboratory for which the testing charges shall be payable by the supplier.

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

5.2.6 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 the equipment had been manufactured and tested by him.

5.2.7 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.

5.2.8 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 be carried out on equipment of the approved design. Type test shall be again carried out if there is any change in design or source of supply of any components/sub-components/assembly /validity of type test has expired or purchaser so desires. These tests shall be witnessed by Representative of RDSO.

6.1.2 ROUTINE TEST:

Routine test shall be carried out on all the pieces of equipment of each order, which shall be witnessed by the consignee/nominated representative of the Consignee/Inspecting Officer as per Purchase 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 Microprocessor Based Electronic Speed Recording, Indicating & Energy Monitoring System.

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.	Reversal of polarity	Yes	Yes	Yes
4.	Effect of voltage variation	Yes	---	Yes
5.	Weather proof test*	Yes	---	---
6.	Water tightness test*	Yes	---	---
7.	EMI/EMC Compatibility Test	Yes	---	---
8.	Temperature variation	Yes	---	---
9.	Dielectric test	Yes	---	Yes
10.	Surge test	Yes	---	---
11.	Vibration and shock test	Yes	---	---
12.	Endurance test	Yes	---	---

Note: *For Speed Sensor Unit only.

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 Purchaser. The following parameters shall be checked during inspection:

- Fitment of 'Speed sensor' Unit on the axle box.
- Dial Illumination, Diameter of Dial, Scale Range and Dial Spread Over System.
- Provisions for locking of 'MASTER' & 'SLAVE' Unit.
- Provision of USB Port on Master and Slave unit.
- Cable sockets and terminals.
- Pin Allocation Details
- Indication for 'Memory Full', Over Speed Alarm, Equipment Fault.
- "Wheel Wear Adjustment" arrangement.
- Display arrangement for parameters to be displayed as per Clause 2.7.1.10
- Memory Freeze Switch.
- Mounting arrangement.
- Identification markings.

6.2.2 PERFORMANCE TEST:

These tests are carried out to check and ensure that the performance of the equipment is in order and meets the specification requirements. These tests 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.

6.2.2.1GENERAL WORKING:

Run the complete system on a test bench with a variable; constant speeds drive at mean wheel diameter and nominal operating voltage. Connect the speed sensor, via SENSCON, to the MASTER and SLAVE Unit. Input voltage and current signal corresponding to 415/380 volt auxiliary winding and current signal from secondary of current sensor unit shall be given to MASTER unit.

Length and type of connecting cable/terminals etc. shall be the same as to be supplied. Run the system for 30 minutes over the full scale range. Check for working of the system.

After this period MASTER unit 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 External & Internal Memory data shall be downloaded & checked.

6.2.2.2 ACCURACY TEST:

The accuracy of the system shall be measured for the mean wheel diameter at a temperature of 37±3 deg c after a warming period of not less than 30 minute. One of the following means shall be adopted for this test.

a. A 'Stroboscope' control by a master tuning fork or quartz crystal oscillator, monitoring the same shaft as that under test.

b. A digital frequency meter, operated in parallel to the sensor unit, by toothed wheel or other means of obtaining a succession of pulses as used for the sensor unit.

c. A standard system of known accuracy driven from the same shaft as that under test. The standard speedometer shall have an accuracy of ± 0.15%.

Ideally, accuracy shall be checked by setting the pointer of the speedometer system under test to the appropriate scale mark and reading the correct speed from the standard source. In case of method (a) above, the correct speed shall be set on the stroboscope and reading of the system under test shall be taken.

Each system shall be tested at a minimum of 5 approximately equidistant setting over the full scale range, both in ascending and descending order of the speed. A variable speed drive with constant angular velocity at any chosen setting shall be used for this purpose.

For checking the energy function, voltage and current signals shall be given in steps. The minimum step of voltage signal shall correspond to 19 KV OHE & minimum step in current signal shall be 10% of current sensor rating.

The accuracy of the system shall confirm to the requirements of Clause 2.19.

For checking the error introduced by wheel dia adjusting device, the shaft under test shall be rotated at different RPMs corresponding to varying wheel dia (covering new to worn out wheel dia in following 5 steps) but representing a fixed road speed. The reading of the speedometer under test shall then be taken by setting the wheel wear compensation device to various steps of wheel dia. Table below carries nominal readings for input speed of 100 kmph.

Input		**Indicator reading with wheel dia adjustment device set at**				
Wheel dia	**RPM**	**1016**	**1030**	**1054**	**1070**	**1092**
1016	522	100	101			
1030	515	99	100	102		
1054	503		98	100	101	
1070	496			98	100	102
1092	485				98	100

The difference between the speed observed for a particular setting of wheel diameter and input speed to sensor shall not exceed ±0.5% of the full scale deflection.

6.2.2.3BALANCE:

There shall be no variation in the reading at zero given by the indicating instrument vis a vis the calibration due to changes in altitude or its mounting position i.e. horizontal, vertical or at angle.

6.2.2.4 POINTER OSCILLATION:

When tested as follows the pointer oscillation, peak to peak, shall be within 1% of the maximum scale value.

The speedometer system shall be arranged so that it is driven at a steady speed, which can be varied over the effective range. The system shall be tested for oscillation at five approximately equidistant points, of which the lowest shall not be less than 10% of maximum scale value, over the effective range.

6.2.2.5 POINTER STABILITY:

When tested as follows the additional variation in indication of speedometer system shall not exceed 0.25% of the maximum scale value.

The speedometer system shall be arranged so that when first put into operation an indication of approximately 75% of the full scale reading is obtained. The system shall then be left running for 30 minutes. The difference between the indications shall be within the tolerance specified in the preceding paragraph.

6.2.2.6 DAMPING TEST:

The amount of over swing shall not exceed 5% of steady reading and the reading shall be to the limits of accuracy after reconnection when tested as follows:
The speed indicator shall be adjusted to zero. The speedometer system shall then be operated at 75% of the full scale reading. The indicator or input source shall then be mechanically or electrically disconnected and reconnected after the index has returned to zero. The amount of over swing on reconnection shall not exceed the figure stated in the preceding paragraph.

6.2.2.7 CHECK FOR OVER SPEED ALARM:

Run the system to the maximum speed to which the over speed alarm is set and check if the alarm is operating.

Relay output at 105% and 110% of Maximum Speed Setting shall also be checked.

6.2.2.8 RELAY OUTPUT TEST:

a. Live Sign Test:

Put on the supply and check for the Live sign Relay output. Live Sign Relay output should be available as long as the system is in working order with Power Supply ON.

b. 105% and 110% of Max Speed Relay Output Test:

Run the system and increase the speed to 105% of Max Speed Setting, the corresponding relay output should get closed. In the same way also test for 110% of Max Speed Setting Relay.

c. Low Speed Relay Output Test:

Put ON the supply of the system and check that Low Speed Relay Output is available. Start the system and gradually increase the speed as speed becomes 2 Kmph, the corresponding relay should get opened and output signal disappear/diminishes.

6.3 REVERSE POLARITY TEST:

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 2.19.**

6.4 VOLTAGE VARIATION TEST:

The complete system shall be operated for mean wheel diameter at three equally spaced speeds covering the full range. At each setting of the speed the operating voltage shall be varied between the limit specified in **Clause 2.4**. The variation in the voltage shall not affect the speed indication.

6.5 WEATHER PROOF TEST:

The weather proofed parts of the system (sub assembly which are outside the locomotives) shall be placed in a simulated installed position in 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 up 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.

6.6 WATER TIGHTNESS TEST:

The water proofed parts of the system (the speed sensor unit) shall be placed in a simulated installed position and immersed for one hour under water at a pressure of 0.13 bar (1.5 m head of water) at 37 $\pm$ 5 deg c, after which they shall be examined to see that there has been no penetration of water.

6.7 EMC/EMI COMPATIBILITY TEST:

6.7.1 RFI RADIATED TEST:

This test shall be conducted as per IEC 61000 – 4 – 3. The complete system in simulated installed condition shall be put in to the Radiation Chamber & desired Radiation as defined below shall be applied:

Freq. Range 80 MHz 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 behavior. Data recorded in the memory of the system during test shall also be

downloaded & evaluated through Evaluatio 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.

6.7.2 RFI CONDUCTED TEST:

This test shall be conducted as per IEC 61000 – 4 – 6. The complete system in simulated installed condition shall be put for the test. The desired Radiation as defined below shall be applied on DC power input lines of Recorder cum Indicator and analog & digital input lines of Recorder cum Indicator unit:

Freq. Range 0.15 MHz to 80 MHz

Amplitude 10V/m

Modulation 80% Amplitude Modulation

During test the equipment shall be watched for malfunctioning or any erratic behavior. 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.

6.7.3 ELECTRICAL FAST TRANSIENTS TEST:

This test shall be conducted as per IEC 61000 – 4 – 4.The complete system in simulated installed condition shall be put for the test. 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, Speed sensor signal lines of Recorder cum Indicator unit & DC power in lines of Recorder cum Indicator unit and indicator unit 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 behavior. 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.

6.7.4 POWER FREQUENCY MAGNETIC FIELD:

This test shall be conducted as per IEC 61000 – 4 – 8.The complete system in simulated installed condition shall be put for the test. 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 planes.

During test the equipment shall be watched for malfunctioning or any erratic behavior. 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.

6.8 TEMPERATURE VARIATION TEST:

6.8.1 COOLING 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 upto 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 accuracy test **(Clause 6.2.2.2)** shall be carried out keeping the equipment at low temperature.

6.8.2 TEMPERATURE RISE TEST:

6.8.2.1DRY HEAT TEST:

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, accuracy test **(Clause 6.2.2.2)** shall be carried out. The accuracy of this system under the above tests conditions shall be as under:

	Temperature range - deg C	Accuracy % of Maximum Scale Value
1.	0 – 34	±2.0
2.	34 - 40 (37±3)	±1.5
3.	40 –70	±2.0

6.8.2.2 DAMP HEAT TEST:

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 ± 10^0C) over a period of 3 hours, keeping the relative humidity between 80% and 100%. After this cycle carry out the Accuracy test as per **Clause 6.2.2.2** and dielectric test as per **Clause 6.9** of this test procedure.

6.9 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. 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 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.

The test shall be carried out at the normal temperature of the test site.

The test voltage at frequency of 50 Hz or 60 Hz shall be approximately sinusoidal form.

Tests on single pieces of apparatus:

For apparatus in circuits with rated voltages below 300 V DC or 100 V AC dielectric tests of apparatus and components part shall be made to earth at a voltage of 1000 V rms.

However, for apparatus in circuit of rated voltage less than 30 V, the test shall be carried out at 750 V.

6.10 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
800 V for a time D = 100 μs

Time D being that defined as above

6.11 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.

6.11.1 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 5 Hz – 50 Hz within a time not less than four minutes and the amplitude of

oscillation (a) expressed in millimeters should be varied as a function of frequency (f) according to the relation.

$a = 25/f$ for values of 'f' from 5 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 effects result on the operation of the apparatus.

6.11.2 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.

6.11.3 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 6.9).**

6.12 ENDURANCE TESTS:

The equipment shall be continuously worked for 100,000 kms at a scale reading of approximately 75% of full scale. These tests shall be carried out at the nominal operating voltage and for mean wheel diameter. The tests shall be acceptable if the equipment performs satisfactorily throughout the tests and also after the test.

6.13 FIELD TRIALS:

After successful completion of prototype tests, the equipments shall be subjected to field/ service trials for a minimum period of six months. The number of trial equipments and venue shall be as agreed between the purchaser and the supplier. The installation and commissioning of the equipments for field trials shall be carried out by the supplier at his own cost.

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 on 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. Speed scale range.

e. Name of the equipment e.g. 'Speed cum Energy Recorder/Indicator'.

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.

ORDERING INFORMATION

1.	RDSO Specification No.	
2.	Class of vehicle (Conventional Locomotives, Three Phase Locomotives) Tap Changer	
3.	Wheel diameter	New: mm Fully worn: mm
4.	Axle Box and axle box cover details (for mounting of speed sensor)	Drg. No (Enclose copy)
5.	System scale range	0 - 180 KMPH
6.	Mounting	Table mounted Panel Mounted
7.	Nos of memory reader required	_____Nos
8.	Copies of software required	_____Nos
9.	Nos of calibration kits required	_____Nos
10.	Nos of PT required	_____Nos
11.	Nos. of CT required	_____Nos

ANNEXURE I

Pin Allocation details
For speedometer and Energy meter measurement system

1.0 Following D Type Connectors shall be used in Microprocessor based Speed Recording System:

(i) 9 Pin D Type Female Straight PCB Solderable Connector:

This connector shall be used for feeding Speed Sensor Signals.

(ii) 50 Pin D Type Male Straight PCB Solderable Connector:

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

2.0 PIN ALLOCATION DETAILS:

Pin allocation for both is given below:-

Signal Type — Communication (RS485) MCC 01

From		To		Signal Name
MASTER		SLAVE		
Connector Type	Pin No.	Connector Type	Terminal No.	
50 Pin D – Type	17	50 Pin D – Type	17	RS 485B
	33		33	RS485GND
	50		50	RS485A

Signal Type — Speed Sensor MCC 02

From		To		Signal Name
MASTER		32 SHELL 14 PIN CONNECTOR (SENSCON)		
Connector Type	Terminal No.	Connector Type	Terminal No.	
9 Pin D – Type	3		1	SPEED 1 +VE
	4		2	+ V
	5		5	SPEED 2 +VE
	6 (is unused)		6	SHORTED WITH 2 OF SENSCON
	7		7	SPEED 2 -VE
	8		3	SPEED 1 –VE
	9		8	GND

Signal Type **Power Supply (110V DC DB I/P-GR 01/P) MCC 05**

From		To		Signal Name
MASTER IN CAB		Terminals in SB (CAB)		
Connector Type	Terminal No.	Connector Type	Terminal No.	
50 Pin D – Type	1	From terminals provided by I.Rlys in CAB-1		GND
	34		B -	B -VE
	35		B+	B +VE
	5		608	DB – 1
	6		609	DB – 2
	37		606	GR0 – 1
	21		607	GR0 – 2

Signal Type **Power Supply (110 VDC) MCC 06**

From		To		Signal Name
SLAVE		Terminal in CAB		
Connector Type	Terminal No.	Connector Type	Terminal No.	
50 Pin D – Type	1	From terminals provided by I.Rlys in CAB-2		GND
	35		1	B +VE
	34		2	B -VE

Signal Type **CT. PT MCC 04**

From		To		Signal Name
MASTER IN CAB		Signal Conditioning Unit in AC-1		
Connector Type	Terminal No.	Connector Type	Terminal No.	
50 PIN D – TYPE CONNECTOR	36	MS 3106 F 14S-2 4 Pin	A	CT/S1
	20		B	CT/S2
	4		C	PT/S1
	3		D	PT/S2

Signal Type **CT**

From		To		Signal Name
Signal Conditional unit		Terminals on Main CT in HT Compartment		
Connector Type	Terminal No.	Connector Type	Terminal No.	
Cable terminated with lugs to suit M5 studs	1	From terminals provided by Indian Rlys in AC-1 Panel	613	Aux CT/P1
	2		612	Aux CT/P2

Signal Type **PT Unit**

From		To		Signal Name
Auxiliary Winding of Main Transformer		PT Unit		
Connector Type	Terminal No.	Connector Type	Terminal No.	
Cable terminated with lugs.	965	Cable terminated with lugs.	1	Main PT/P1
	966		2	Main PT/P2

Signal Type **Aux PT**

From		To		Signal Name
Secondary Winding of Main PT		Signal Conditional unit		
Connector Type	Terminal No.	Connector Type	Terminal No.	
Cable terminated with lugs.	3	Cable terminated with lugs.	610	Aux CT/P1
	4		611	Aux CT/P2

DIGITAL AND ANALOG INPUT SIGNALS:

There shall be 3 Digital Input Signals and 2 Analog Input Signals; Pins allocated are as below:

Pin No.	Abbreviation	Name of the Signal	Position
6	DIG 1 +ve	Digital Input 1	Recorder
5	DIG 1 –ve		
21	DIG 2 +ve	Digital Input 2	Recorder
37	DIG 2 –ve		
8	DIG 3 +ve	Digital Input 3(Spare)	Recorder
7	DIG 3 –ve		
36	ANLG 1	Analog Input 1	Recorder
20	ANLG 1		
4	ANLG 2	Analog Input 2	Recorder
3	ANLG 2		

REALAY OUTPUT:

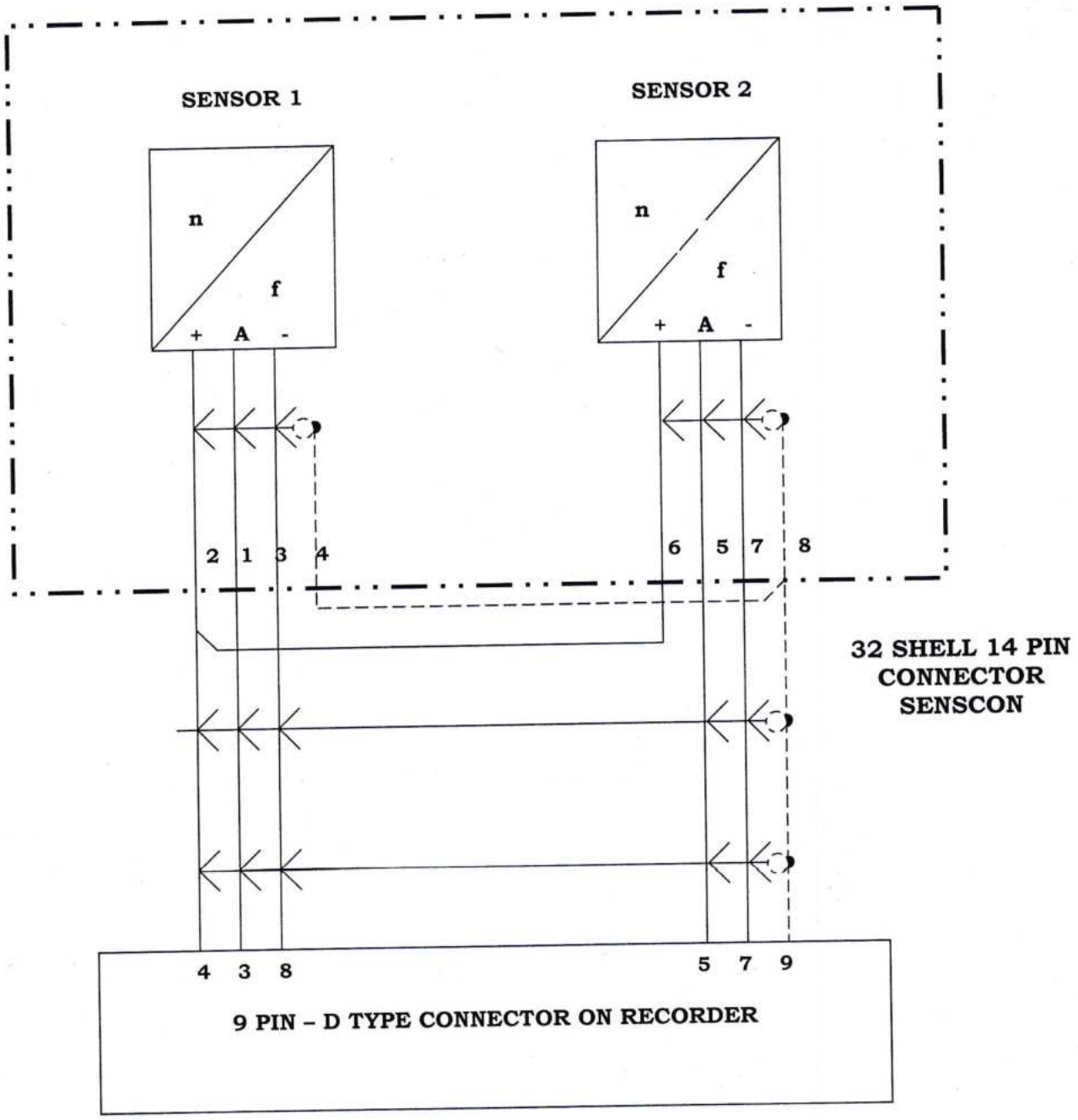
There shall be provision of minimum 5 Configurable Relay Outputs. Pins allocated are as follows:-

Pin No.	Name of the Signal	Position
9	Live Sign	Recorder
25		
41		
30	105% of max Speed	Recorder
45		
46		
13	110% of max Speed	Recorder
14		
29		
27	At Low Speed	Recorder
43		
11	Spare	Recorder
42		

ANNEXURE II

CONNECTION DIAGRAM FROM SPEED SENSOR TO MASTER UNIT

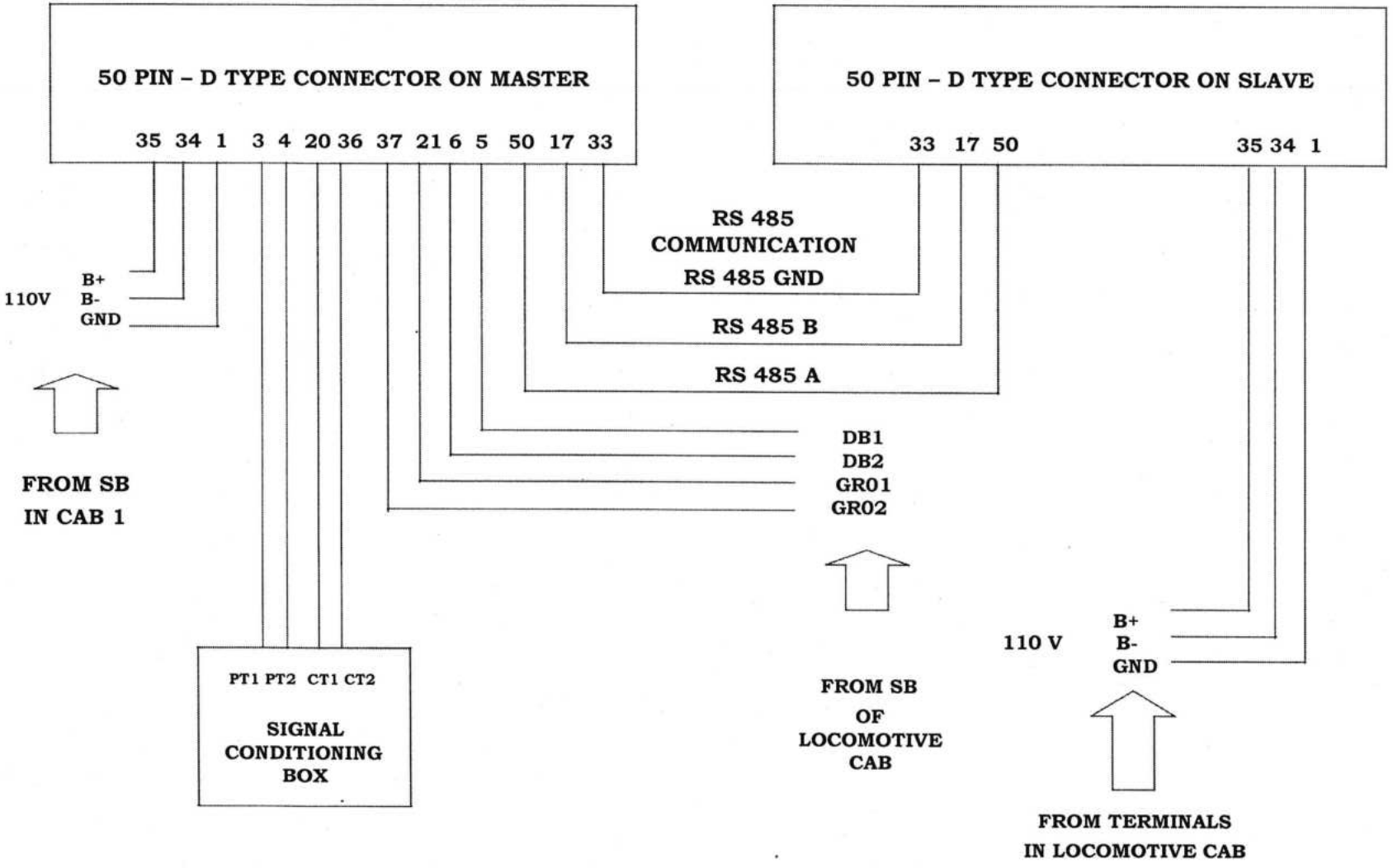
SPEED SENSOR



Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System 12/07/18

ANNEXURE III

CONNECTION DIAGRAM FOR 50 – D TYPE CONNECTOR ON RECORDER (MASTER) AND INDICATOR (SLAVE)



Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System

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
Train no.	Max Speed		Kmph PT Input		Volts
Driver ID	Wheel Diameter		mm PT Output		Volts
Equipment no.			CT Input		Amps
			CT Output		Amps

Date	Time	Inst. Distance	Inst. Speed	Coasting		DB App. Durations	OHE Voltage	OHE Current	Consumed Energy		Event
dd-mm-yy	hh:mm:ss	Km	Km/h	Distance Km	Time Sec	hh:mm:ss	KV	Amps	Run Kwh	Total kwh	

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

Prepared by	Checked by	Issued by
		17/07/18

ANNEXURE V

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

File Name
Shed
Loco No.
Equipment no.

Starting Date dd-mm-yy
Starting Time hh:mm:ss
Start Distance Km
Max Speed Kmph
Wheel Diameter mm

End Date dd-mm-yy
End Time hh:mm:ss
End Distance Km
PT Input Volts
PT Output Volts
CT Input Amps
CT Output Amps

Date	Time	Distance	Speed	Coasting		DB App. Durations	OHE Voltage	OHE Current	Consumed Energy			PF	Event
dd-mm-yy	hh:mm:ss	Km	Km/h	Distance Km	Time Sec	hh:mm:ss	Kv	Amps	Run Kwh	Halt kwh	Total kwh	%	

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

Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System

ANNEXURE VI

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
DRIVER WISE REPORT: DIGITAL REPORT

Driver ID		**Starting Date**	dd-mm-yy	**End Date**	dd-mm-yy
Loco No.		**Start Distance**	.....Km	**End Distance**.....Km	
Shed		**Starting Time**	hh:mm:ss	**End Time**	hh:mm:ss
Equipment no.		**Max Speed Limit**	.....Kmph		
Train No.					
Total Coasting Duration		**Time**		**Distance**	
	From hh:mm:ss	To hh:mm:ss		From .....Kms	To.....Kms
	From hh:mm:ss	To hh:mm:ss		From .....Kms	To.....Kms
	Total Duration in hh:mm:ss			Total Distance ..... Kms	
Total Dynamic Break duration		**Time**		**Distance**	
	From hh:mm:ss	To hh:mm:ss		From .....Kms	To.....Kms
	From hh:mm:ss	To hh:mm:ss		From .....Kms	To.....Kms
	Total Duration in hh:mm:ss			Total Distance..... Kms	
Over Speed		**Time**		**Violated Speed Value**	
	From hh:mm:ss	To hh:mm:ss		.....Kmph	
	From hh:mm:ss	To hh:mm:ss		.....Kmph	
Energy Consumption	Run	.....Kwh			
	Halt	.....Kwh			
	Total	.....Kwh			
Specific Energy Consumption	.....Kwh/1000GTKM				

Prepared by	Checked by	Issued by
		17/07/18
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ANNEXURE VII

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
ALL DRIVER WISE REPORT: DIGITAL REPORT

Starting Date	dd-mm-yy		End Date	dd-mm-yy	
Starting Time	hh:mm:ss		End Time	hh:mm:ss	
Start Distance		Km	End Distance		Km
Max Speed Setting		Kmph			

Driver ID	**Dynamic Brake duration**	**Coasting Distance**	**Over Speed**	**Energy Consumption**	**Specific Energy Consumption**
Driver ID 1	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Driver ID 2	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Driver ID ..	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Driver ID...	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Driver ID n *	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM

* "n " denotes nth Driver ID

ANNEXURE VIII

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
TRAIN WISE REPORT: DIGITAL REPORT

Train No. **Starting Date** dd-mm-yy **End Date** dd-mm-yy

Loco No. **Start Distance** .....Km **End Distance**.....Km

Shed **Starting Time** hh:mm:ss **End Time** hh:mm:ss

Equipment no. **Max Speed Limit** .....Kmph Volts

Driver ID ..... Volts

Total Coasting Duration

Time		Distance	
From hh:mm:ss	To hh:mm:ss	From .....Kms	To.....Kms
From hh:mm:ss	To hh:mm:ss	From .....Kms	To.....Kms

Total Duration in hh:mm:ss Total Distance ..... Kms

Total Dynamic Break duration

Time		Distance	
From hh:mm:ss	To hh:mm:ss	From .....Kms	To.....Kms
From hh:mm:ss	To hh:mm:ss	From .....Kms	To.....Kms

Total Duration in hh:mm:ss Total Distance..... Kms

Over Speed

Time		Violated Speed Value
From hh:mm:ss	To hh:mm:ss	.....Kmph
From hh:mm:ss	To hh:mm:ss	.....Kmph

Energy Consumption

Run .....Kwh
Halt .....Kwh
Total .....Kwh

Specific Energy Consumption Kwh/1000GTKM

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ANNEXURE IX

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
ALL TRAINS WISE REPORT: DIGITAL REPORT

Starting Date	dd-mm-yy	End Date	dd-mm-yy
Starting Time	hh:mm:ss	End Time	hh:mm:ss
Start Distance	Km	End Distance	Km
Max Speed Setting	Kmph		

Train No.	**Dynamic Break Duration**	**Coasting Distance**	**Over Speed**	**Energy Consumption**	**Specific Energy Consumption**
Train No. 1	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Train No. 2	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Train No. ..	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Train No....	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM
Train No. n	hh:mm:ss	.....Km	.....Kmph	.....Kwh	...Kwh/1000GTKM

* "n " denotes nth Train's No.

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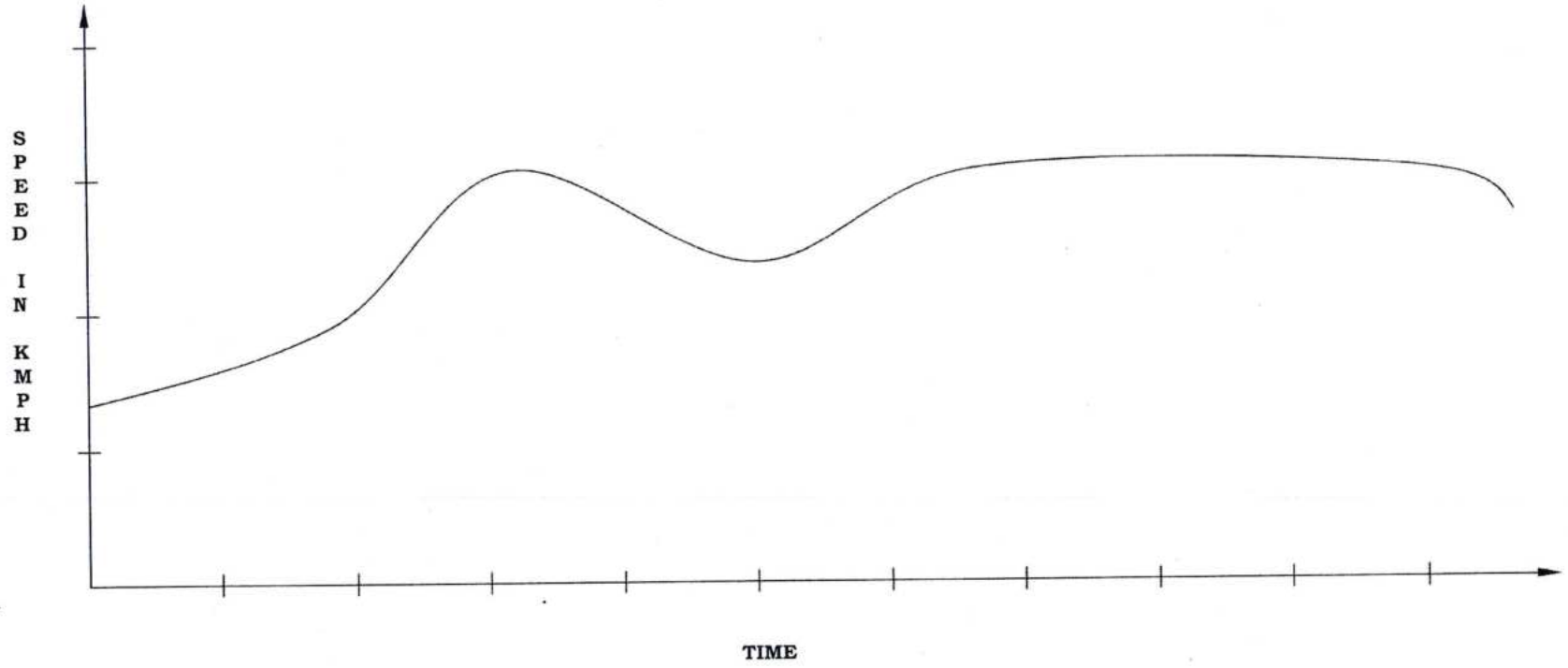
ANNEXURE X

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
GRAPHICAL REPORT (SPEED Vs TIME)

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
Train no.	Max Speed		Kmph PT Input		Volts
Driver ID	Wheel Diameter		mm PT Output		Volts
Equipment no.			CT Input		Amps
			CT Output		Amps



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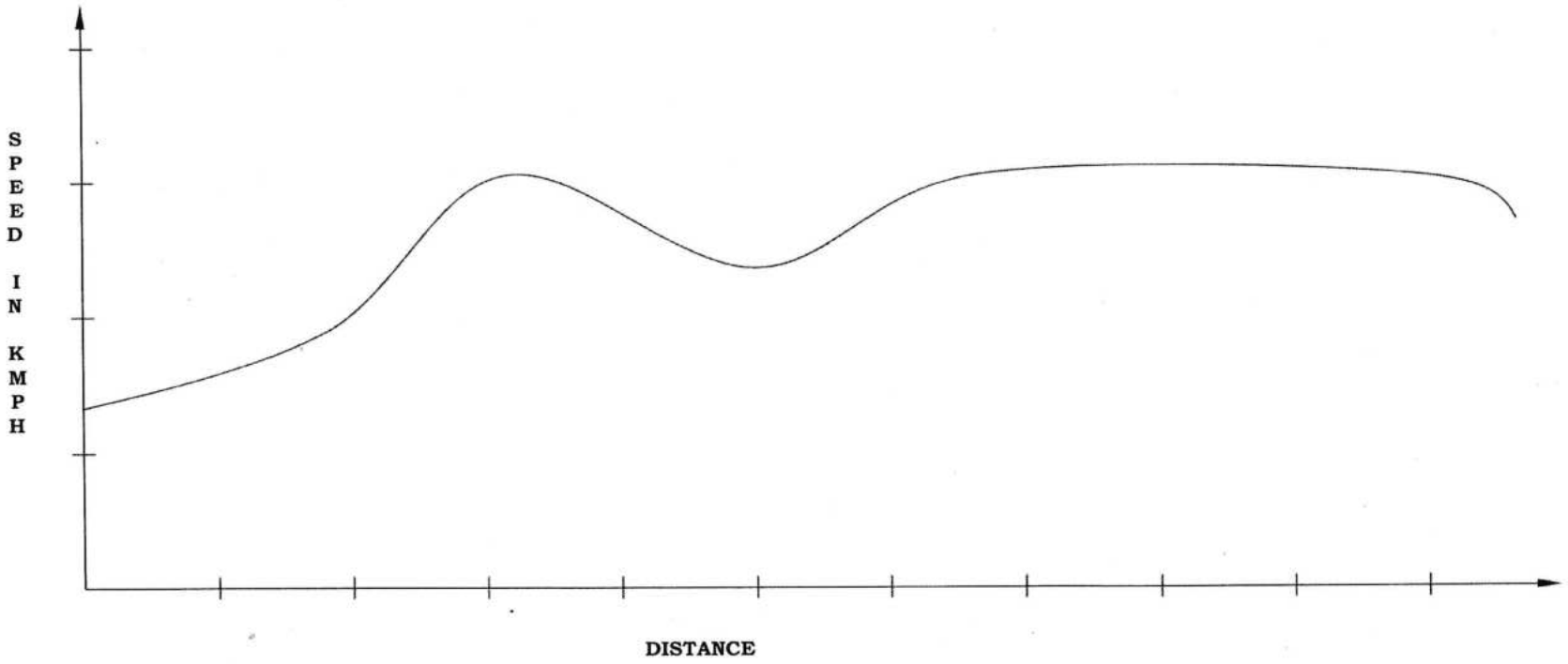
ANNEXURE XI

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
GRAPHICAL REPORT (SPEED Vs DISTANCE)

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
Train no.	Max Speed	Kmph	PT Input		Volts
Driver ID	Wheel Diameter	mm	PT Output		Volts
Equipment no.			CT Input		Amps
			CT Output		Amps



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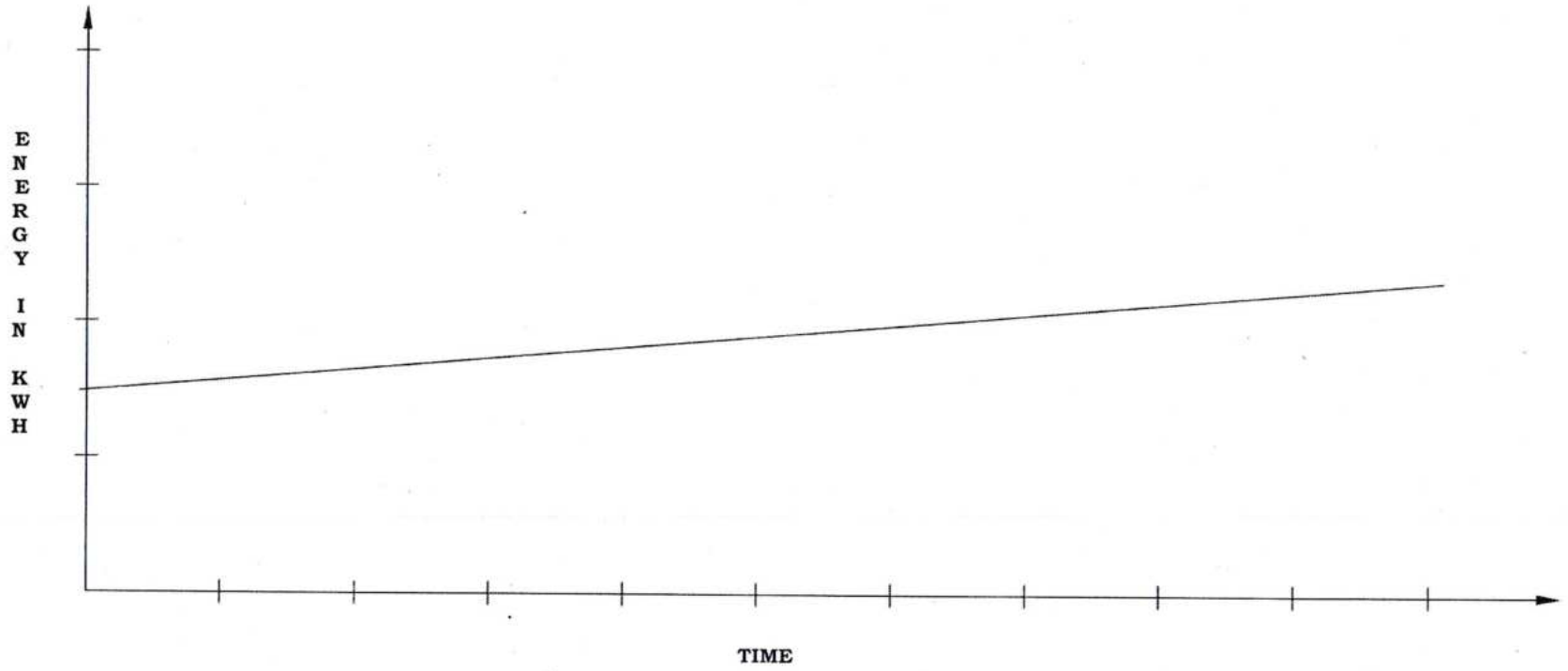
ANNEXURE XII

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
GRAPHICAL REPORT (ENERGY Vs TIME)

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
Train no.		Max Speed		Kmph	PT Input	Volts
Driver ID		Wheel Diameter		mm	PT Output	Volts
Equipment no.					CT Input	Amps
					CT Output	Amps



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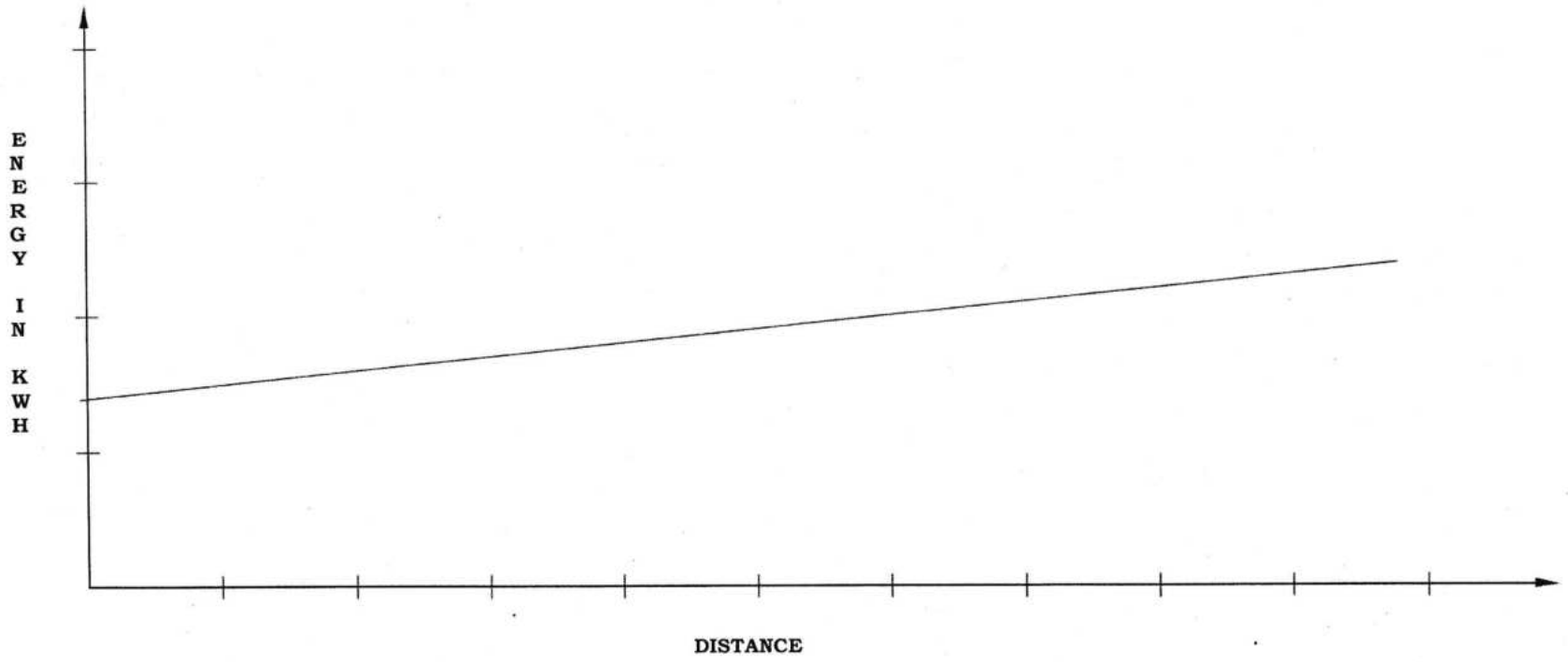
ANNEXURE XIII

NAME OF FIRM
SPEED CUM ENERGY MONITORING SYSTEM
GRAPHICAL REPORT (ENERGY Vs DISTANCE)

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
Train no.	Max Speed		Kmph	PT Input		Volts
Driver ID	Wheel Diameter		mm	PT Output		Volts
Equipment no.				CT Input		Amps
				CT Output		Amps



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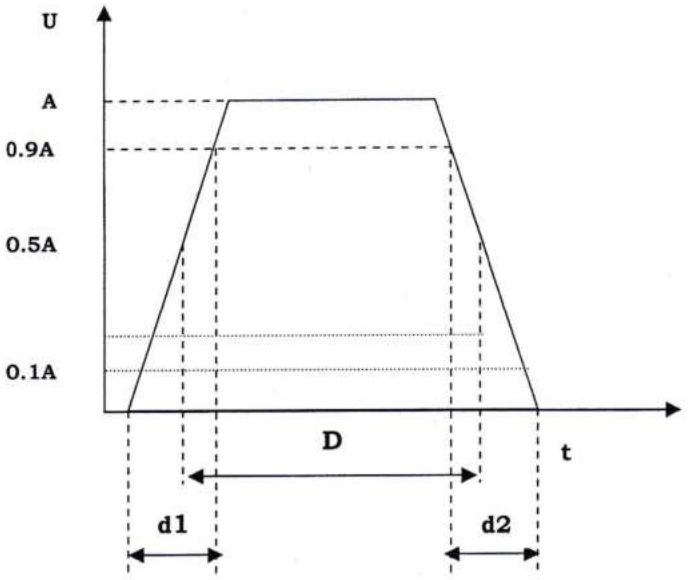
ANNEXURE XIV

SURGE TEST



d1 < 0.1D d2 < 0.1D

FIGURE I

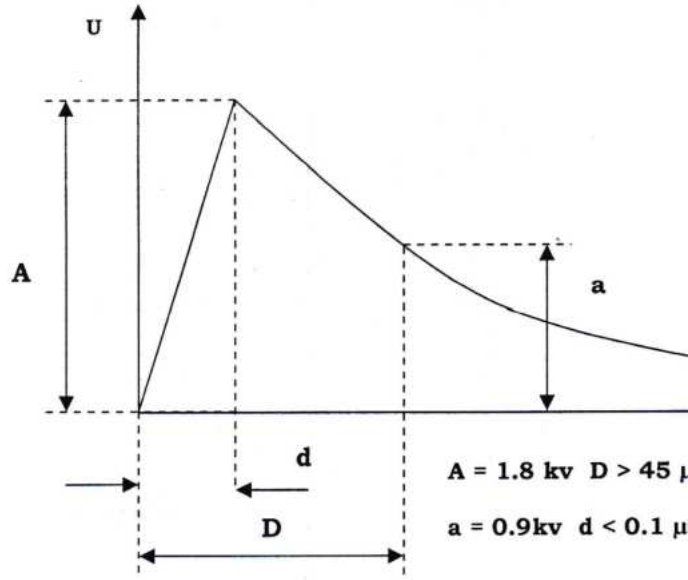


FIGURE II

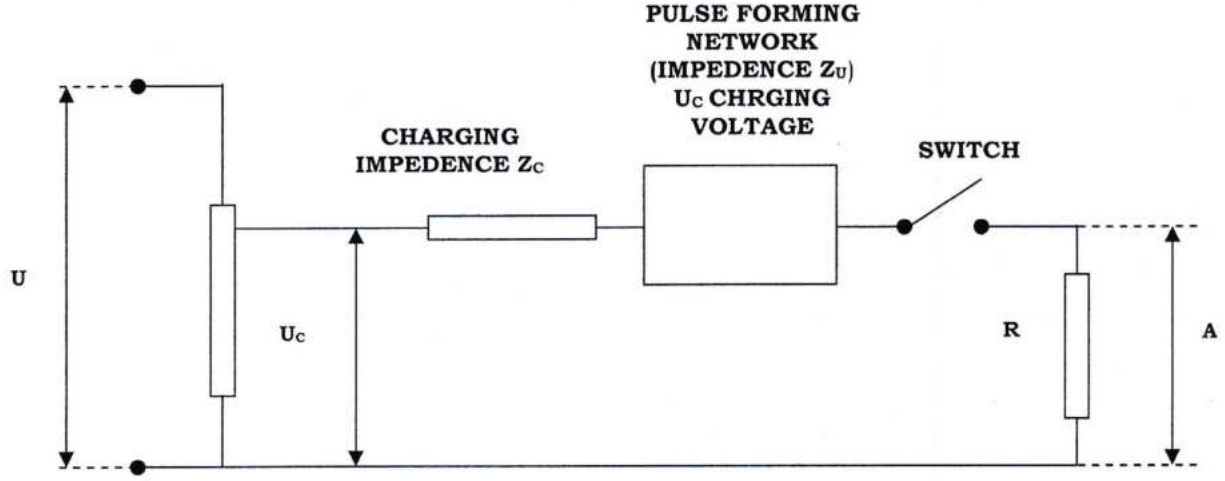


FIGURE III

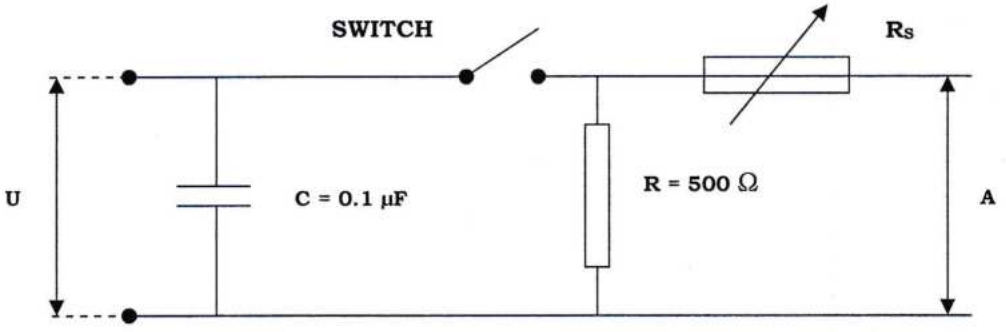
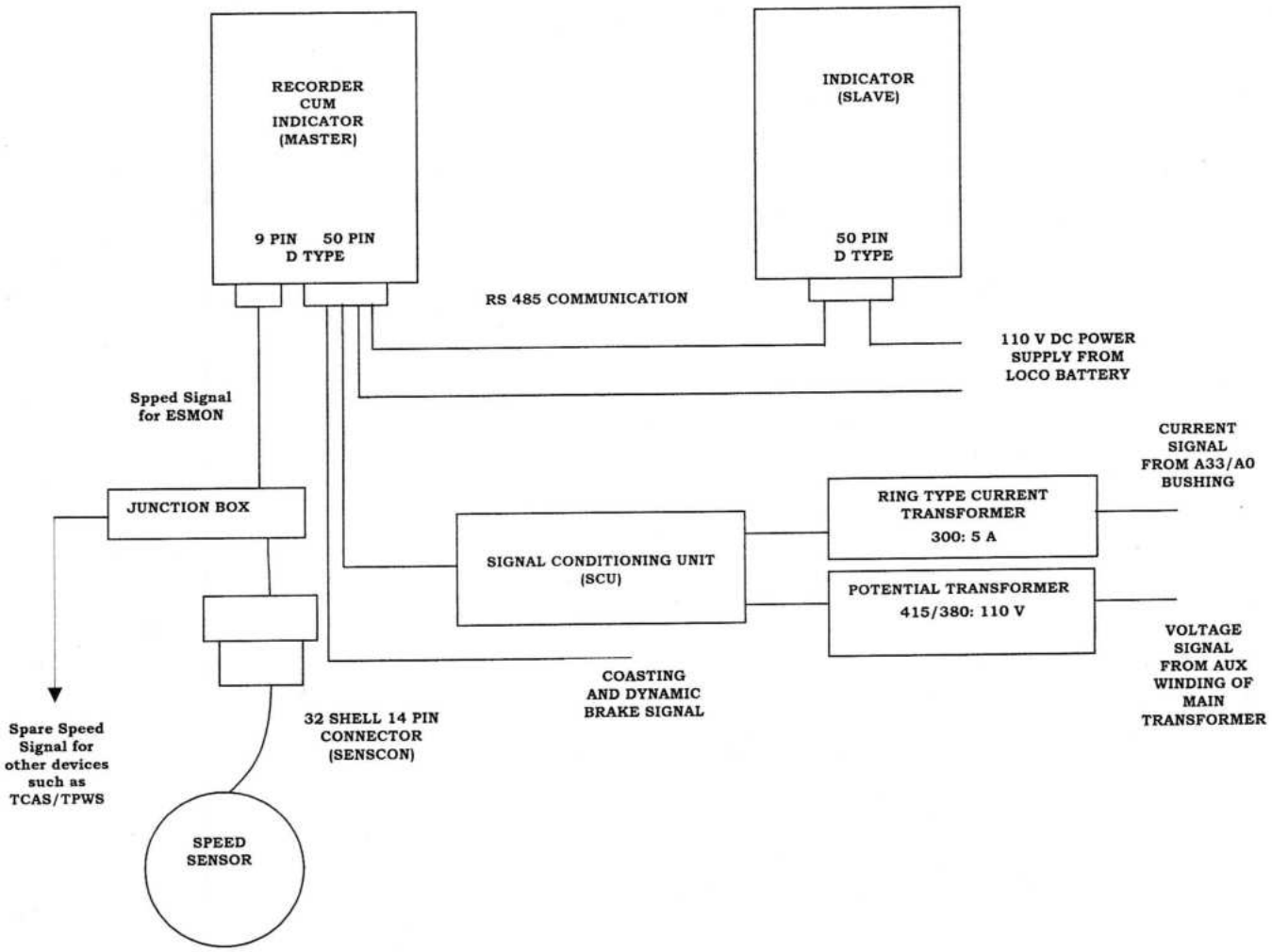


FIGURE IV

ANNEXURE XV

SCHEMATIC DIAGRAM FOR MICROPROCESSOR BASED ELECTRONIC SPEED RECORDING AND ENERGY MONITORING SYSTEM FOR ELECTRIC LOCOMOTIVES



ANNEXURE XVI

Summary of accessories and their applicability in AC Tap Changer Locomotive and Three Phase Locomotive for Microprocessor based Electronic Speed cum Energy Monitoring System.

SN	Description	Type & Make	Equipment Location		Remarks
			AC Tap Changer Locomotive	Three Phase Locomotives	
1.	Master		CAB-1	CAB- 2	Firm's Supply as per Drg No. CLW/ES/SK-1-1 to 3/SPM/0002 (Rev2)
2.	Slave		CAB-2	CAB-1	
3.	Pulse Generator (PG)		3rd axle (R.H.side)	4th axle (R.H.side)	Firm's Supply as per Drg No. CLW/ES/SK-6/SPM
4.	SENSCON (32 Shell 14 Pin Connector)	Allied make, Sichem Type, Female on PG side & male Elbow type for Master Cable	Below Under Frame	Below Under Frame	Firm's Supply
5.	Support Plate for SENSCON		Below Under frame	Below Under frame	Firm's Supply as per Drg No. CLW/ES/SK-5/SPM/0002 (Rev2)
6.	Potential Transformer (PT)		At aux winding of main Transformer	Nil	Firm's Supply as per Drg No. CLW/ES/SK-2/SPM
7.	Current Sensor (CT)		At 33 Terminal of the main transformer	Nil	Firm's Supply as per Drg No. CLW/ES/SK-3/SPM
8.	Signal conditioning Unit (SCU)		AC-1 Panel	Nil	Firm's Supply as per Drg No. CLW/ES/SK-4/SPM

9.	Cover Assembly		Nil	Centre Pillar in Both CAB	Firm's Supply as per Drg No. CLW/ES/SPM /0002/S-35A
10.	Junction Box	JB	Behind TK-1 Panel in Machine Room	CAB2 Side Wall in Machine Room	Firm's Supply as per Drg No. CLW/ES/SK-7/SPM/0002 (Rev 2)

11. Multi Core Cable-Screened(shielded)

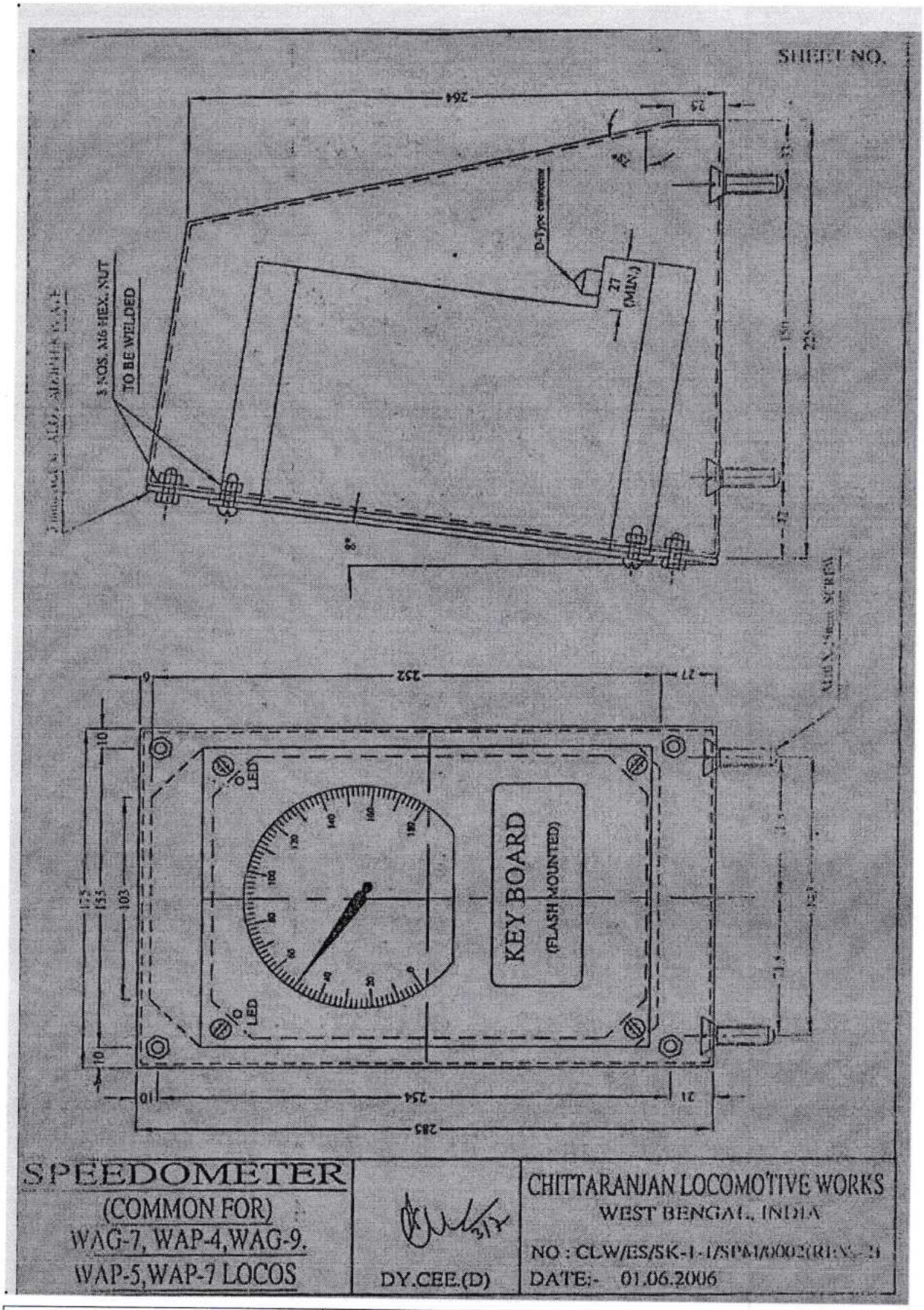
Description	**Type & Make**	**Cable Length & No. of Core**		**Remarks**
PG to SENSCON(Female)	14 Pin Allied Connector for SENSCON	2 Meters	2 Meters	Firm supply
SENSCON(Male) to JB		13 Meters (6Core)	13 Meters (6 Core)	Junction Box with fuse of suitable rating and Cable shall be supplied by ESMON manufacturer
JB to Master		9 Meters (6 Core)	9 Meters (6 Core)	JB to 9 Pin D-Type (Female) connector for Master
Master to Slave		27 Meters (3 Core)	27 Meters (3 Core)	50 Pin D-Type (Female) connector at both ends
Master to CAB(Battery, DBR,GR-0,CTF)		5 Meters (6 Core)	5 Meters (2 Core as DBR & Coasting not in use)	50 Pin D-Type(Female) connector to M5 socket for SB/CAB
Slave to CAB(For Battery)		5 Meters (2 Core)	5 Meters (2 Core)	50 Pin D-Type (Female) connector to M5 socket for SB/CAB

	Master to SCU		9 Meters (4 Core)	Nil	50 Pin D-Type(Female) connector to 4 Pin connector (Female) at SCU end
	SCU to PT		3 mm^2 Railway's standard cable (2 No.)	Nil	M5 Socket at both ends
	SCU to CT		3 mm^2 Railway's standard cable (2 No.)	Nil	M5 Socket at both ends
	Master to SB in Machine Room		Nil	Existing	50 Pin D-Type(Female) connector at Master to SB in Machine Room
	Slave to SB in Machine Room		Nil	Existing	50 Pin D-Type(Female) connector at Slave to SB in Machine Room
	JB to TCAS/TPWS	EMI/EMC shielded Cables from Junction Box to TCAS/TPWS interface shall be provided by TCAS/TPWS manufacturer.			

12. D-Type Connectors

Description	**Type & Make (Only MIL Grade)**	**Location**		**Remarks**
		AC Tap Changer Locomotive	**Three Phase Locomotives**	
50 Pin(Male)	ITT Cannon/Allied /Essen/Tyco make	Both for Master and Slave (2 No.)	Both for Master and Slave (2 No.)	Firm's Supply fitted both on Master and Slave Units
9 Pin(Female)	ITT Cannon/Allied /Essen/Tyco make	On Master Only for connection with PG	On Master Only for connection with PG	Firm's Supply fitted on Master Unit

	9 Pin(Male)	ITT Cannon/Allied /Essen/Tyco make	To be fitted on cable towards Master end for connection with PG	To be fitted on cable towards Master end for connection with PG	To be mfg. at CLW(Connectors/Pins/Sockets and Locking Screws to be supplied loose along with equipment)
	50 Pin(Female)	ITT Cannon/Allied /Essen/Tyco make	To be fitted on cable towards Master and Slave ends for connection of SB CAB (For Battery, GR,CTF and Energy (CT,PT) signals)	To be fitted on cable towards Master and Slave ends for connection of SB2 of Machine Room	



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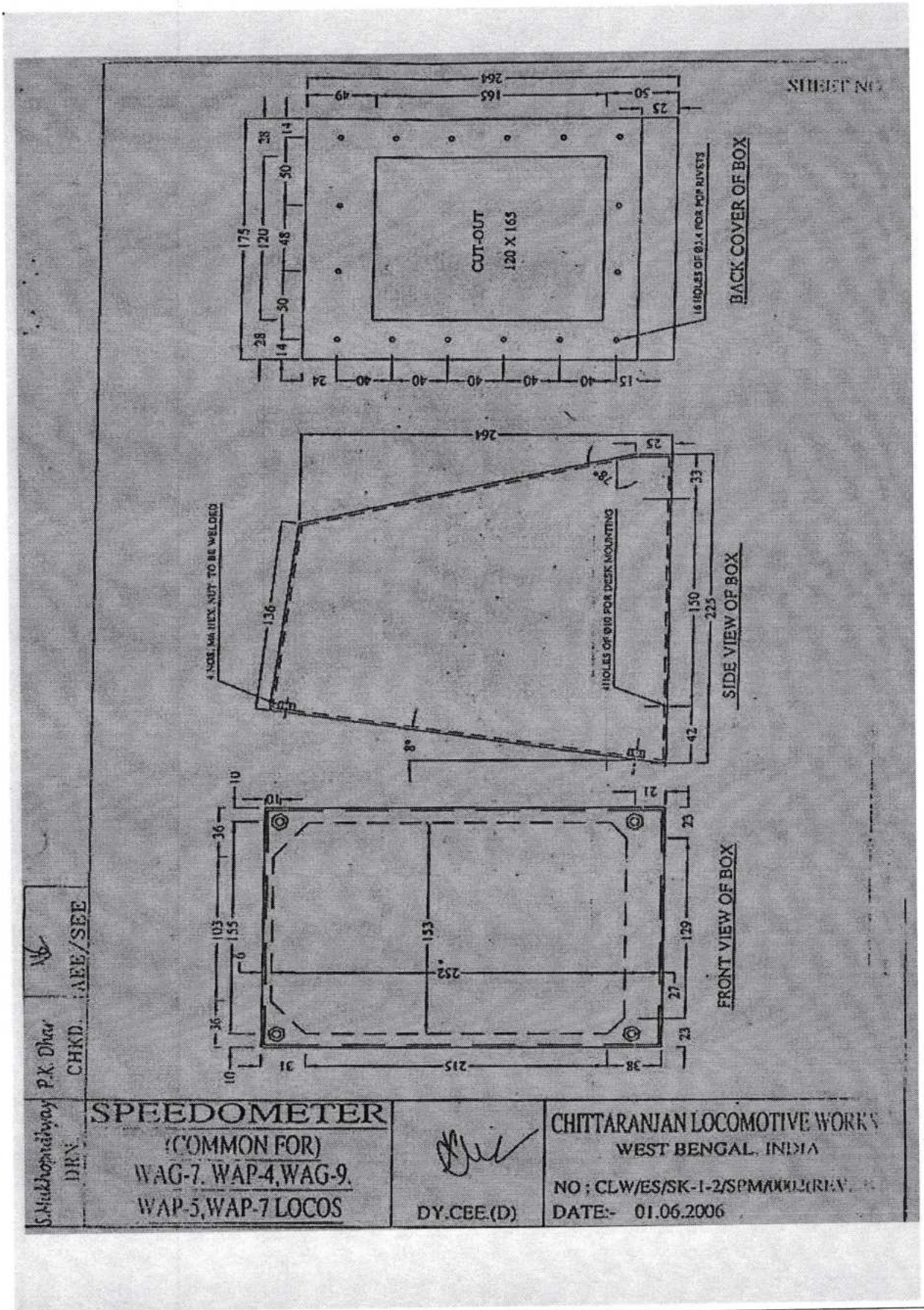
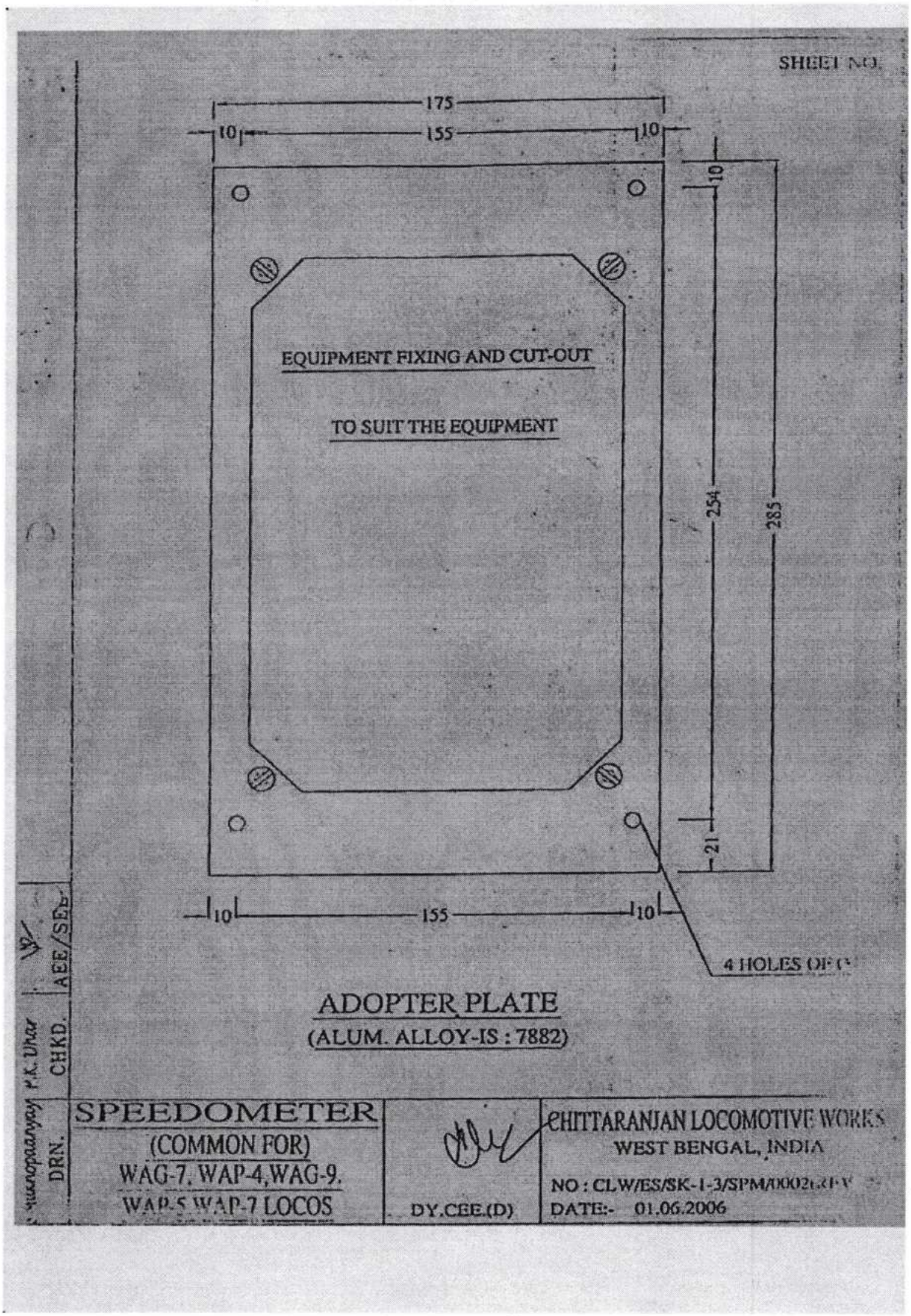

SHEET NO
BACK COVER OF BOX
CUT-OUT
120 X 163
SIDE VIEW OF BOX
FRONT VIEW OF BOX
S.Mukhopadhyay DRE
P.K. Dhar CHKD. ABE/SEE
SPEEDOMETER
(COMMON FOR)
WAG-7, WAP-4, WAG-9,
WAP-5, WAP-7 LOCOS
DY.CEE(D)
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
NO : CLW/ES/SK-1-2/SPM/0002(REV.
DATE:- 01.06.2006



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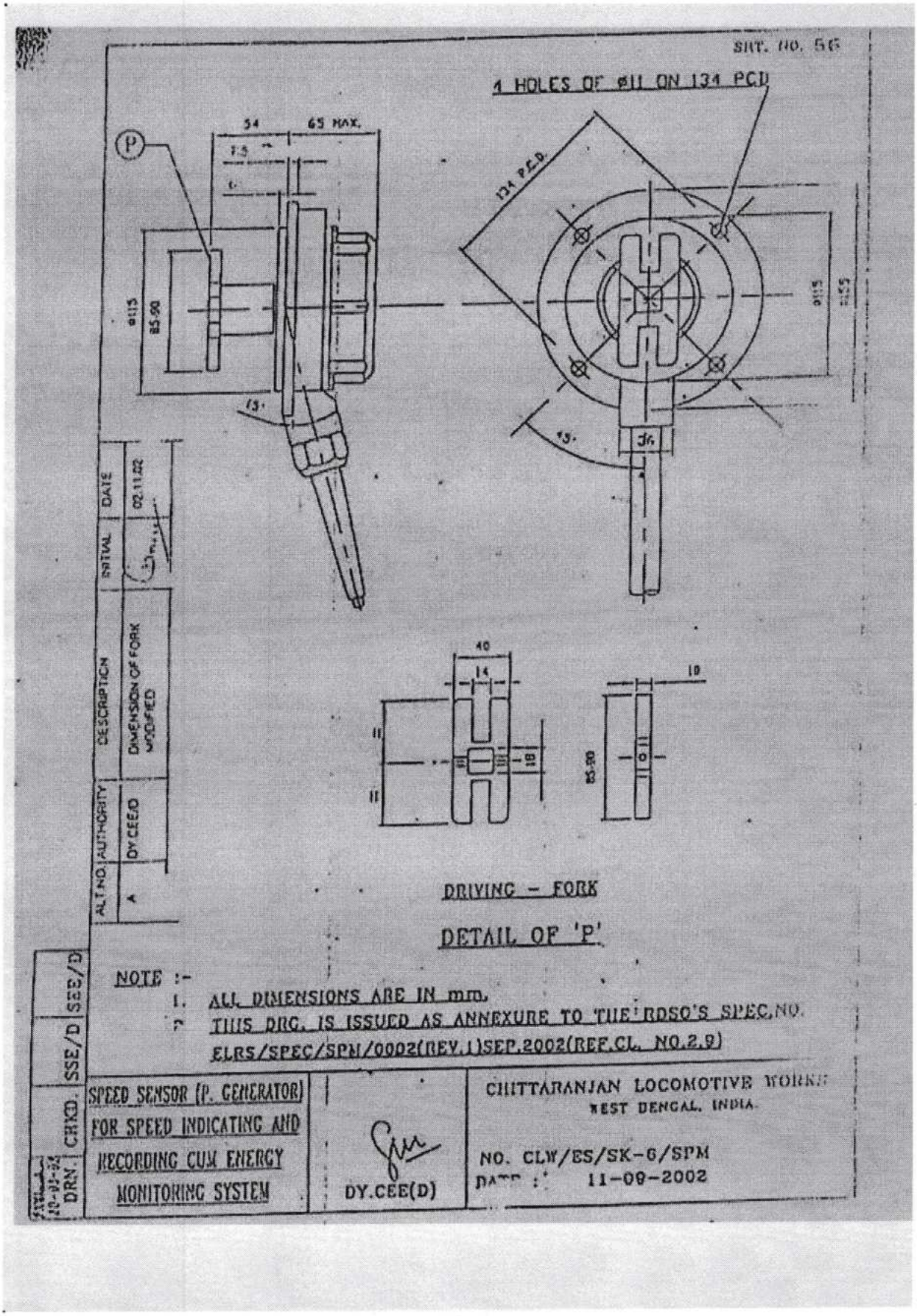
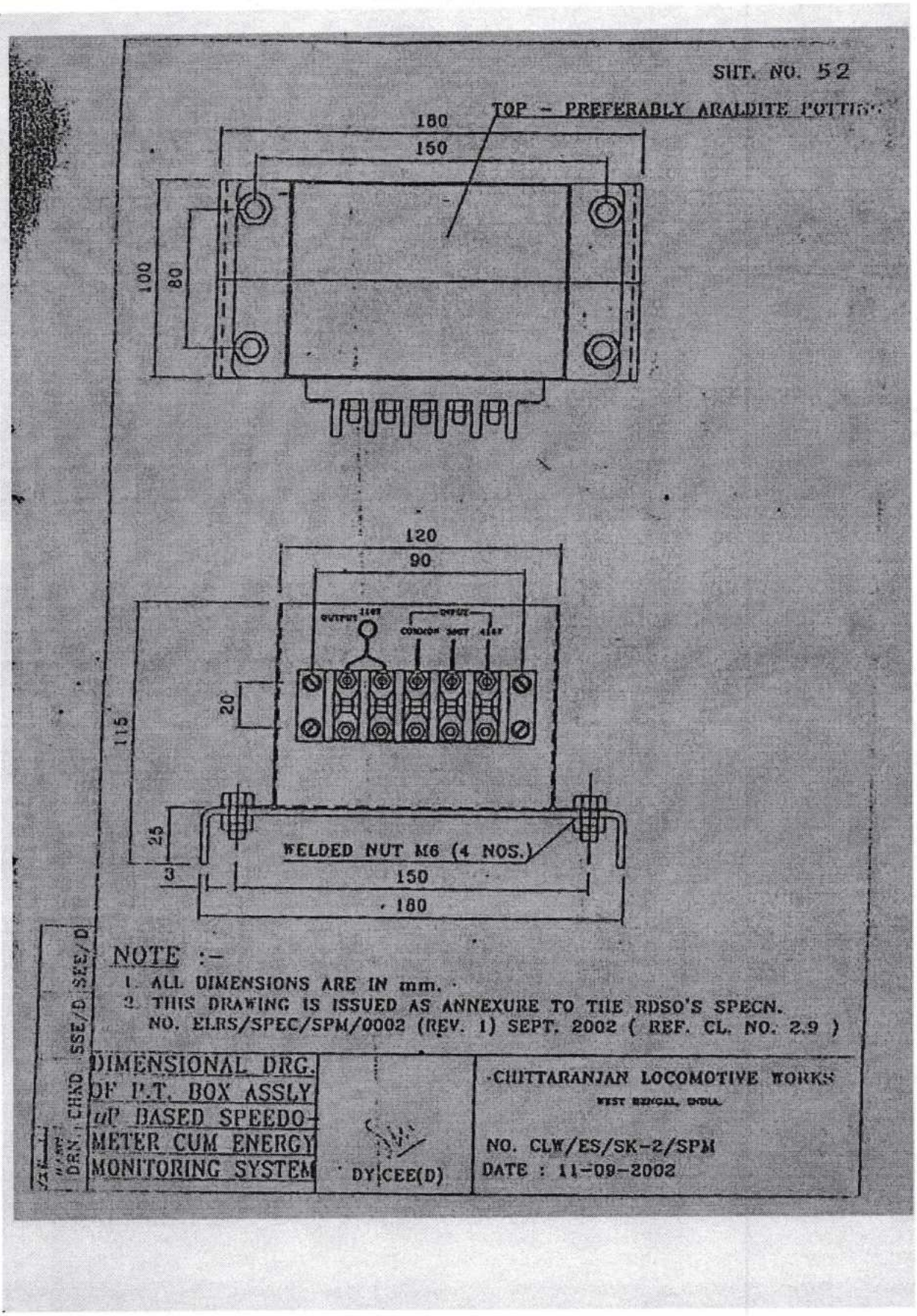
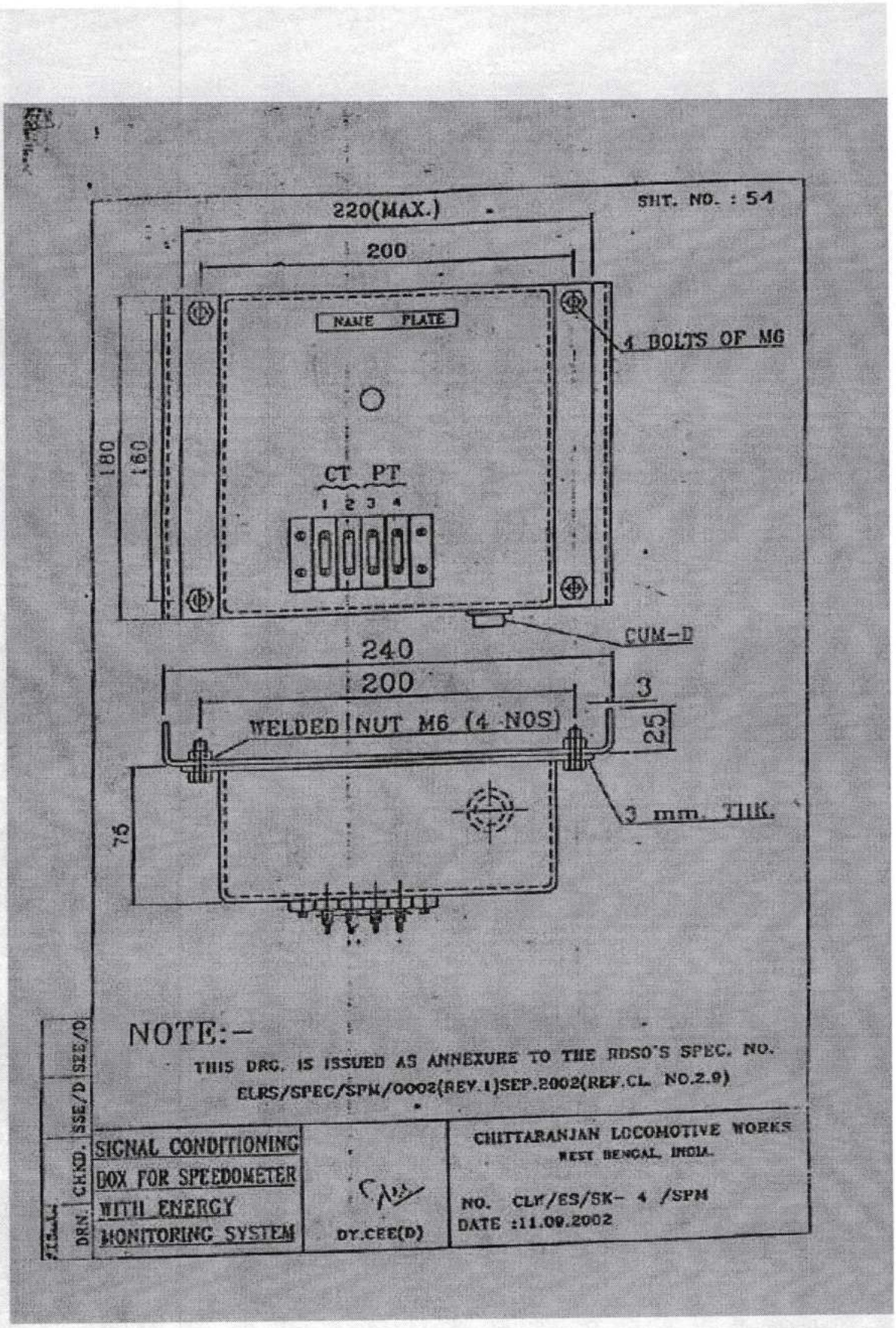
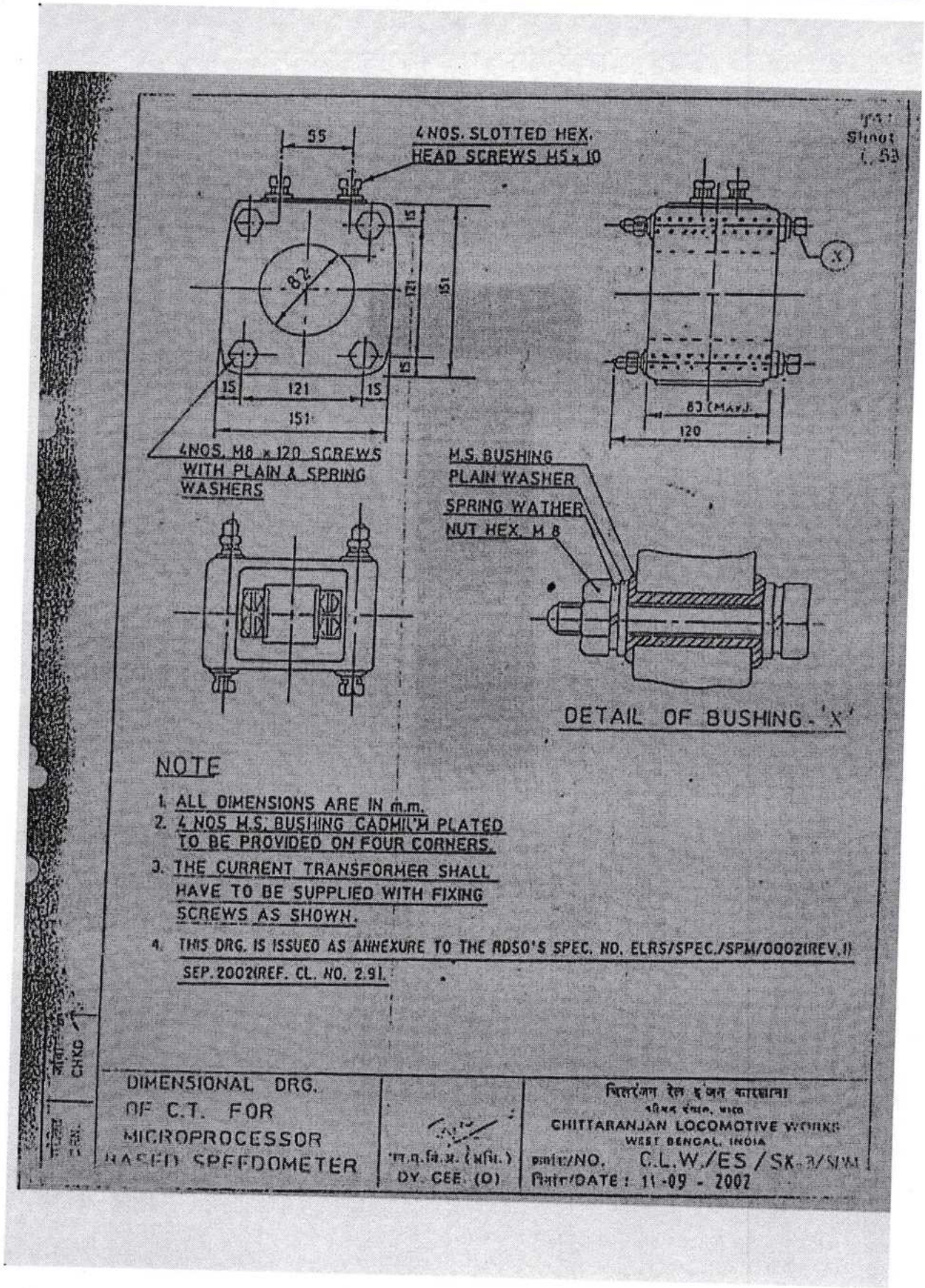


Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System

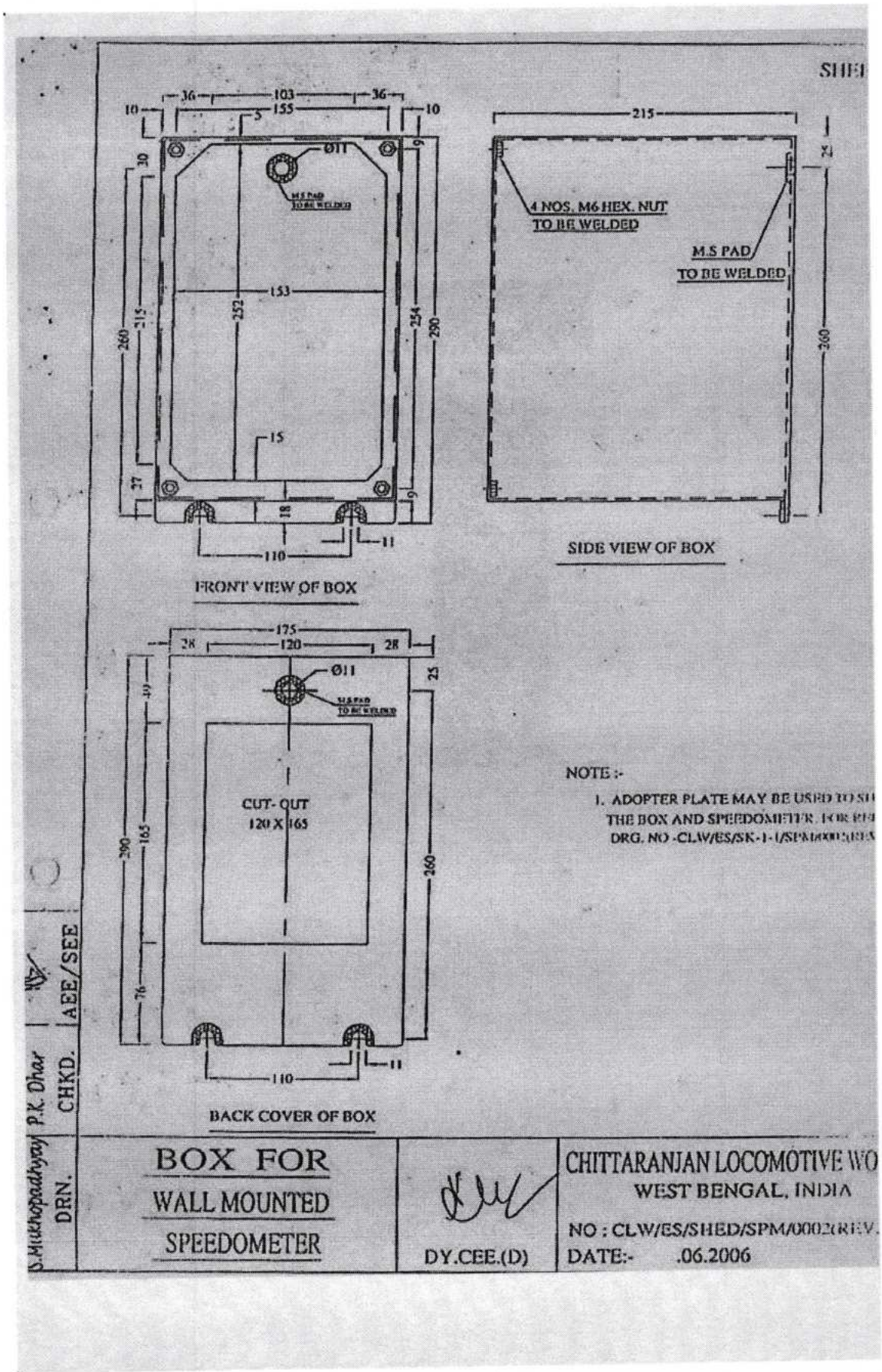


Prepared by	Checked by	Issued by
SSE/System	SSE/System	17/07/18 EDSE/System

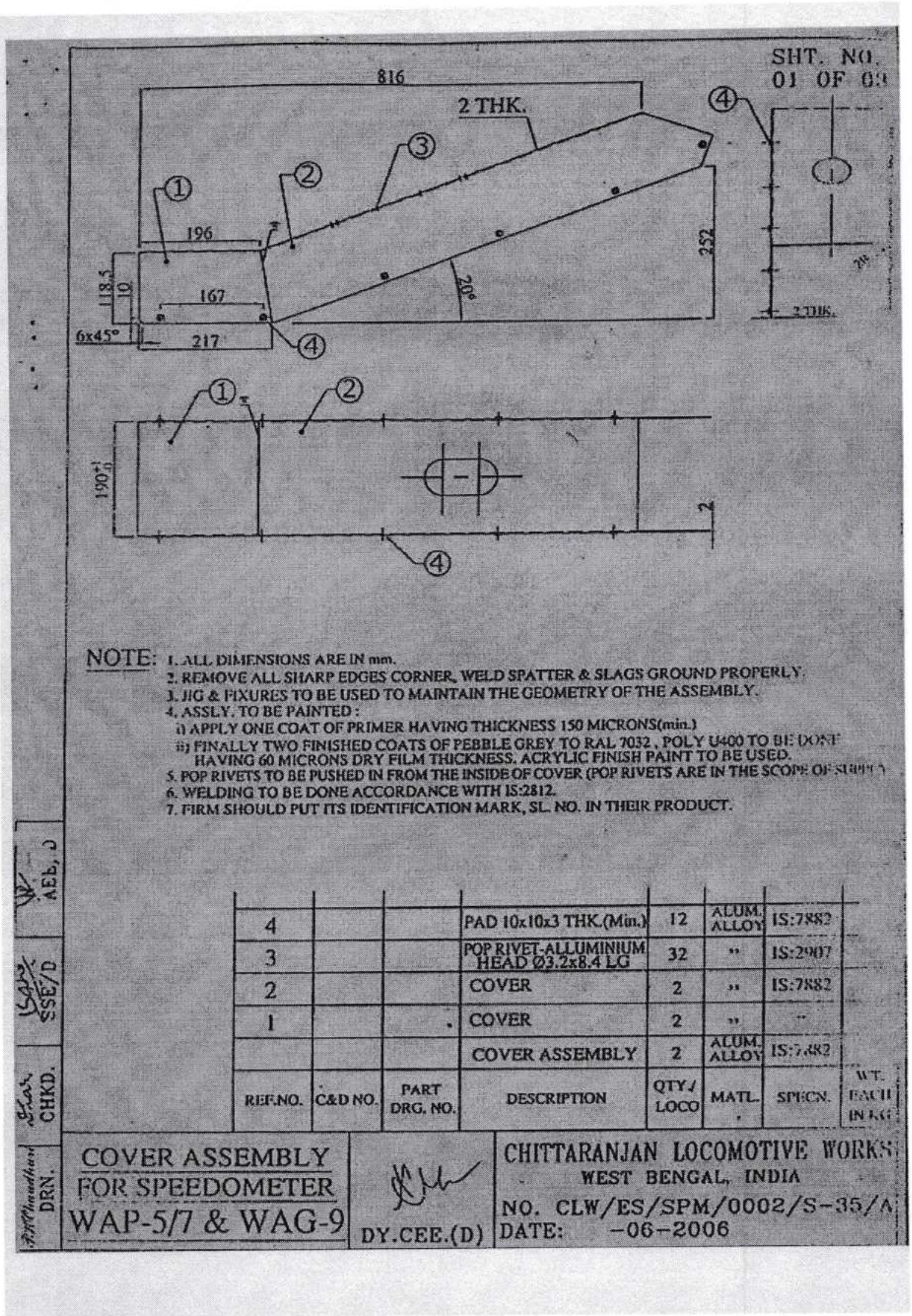

SHT. NO. : 54
220(MAX.)
200
NAME PLATE
4 BOLTS OF M6
180
160
CT PT
1 2 3 4
CUM-D
240
200
3
WELDED NUT M6 (4 NOS)
25
3 mm. THK.
75
NOTE:-
THIS DRG. IS ISSUED AS ANNEXURE TO THE RDSO'S SPEC. NO.
ELRS/SPEC/SPM/0002(REV.1)SEP.2002(REF.CL. NO.2.9)
SSE/D
SSE/D
CH.KD.
DRN.
SIGNAL CONDITIONING
BOX FOR SPEEDOMETER
WITH ENERGY
MONITORING SYSTEM
DY.CEE(D)
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA.
NO. CLW/ES/SK- 4 /SPM
DATE :11.09.2002



Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System



Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System



NOTE:
1. ALL DIMENSIONS ARE IN mm.
2. REMOVE ALL SHARP EDGES CORNER, WELD SPATTER & SLAGS GROUND PROPERLY.
3. JIG & FIXURES TO BE USED TO MAINTAIN THE GEOMETRY OF THE ASSEMBLY.
4. ASSLY. TO BE PAINTED :
   i) APPLY ONE COAT OF PRIMER HAVING THICKNESS 150 MICRONS(min.)
   ii) FINALLY TWO FINISHED COATS OF PEBBLE GREY TO RAL 7032 , POLY U400 TO BE USED HAVING 60 MICRONS DRY FILM THICKNESS. ACRYLIC FINISH PAINT TO BE USED.
5. POP RIVETS TO BE PUSHED IN FROM THE INSIDE OF COVER (POP RIVETS ARE IN THE SCOPE OF SUPPLY)
6. WELDING TO BE DONE ACCORDANCE WITH IS:2812.
7. FIRM SHOULD PUT ITS IDENTIFICATION MARK, SL. NO. IN THEIR PRODUCT.

REF.NO.	C&D NO.	PART DRG. NO.	DESCRIPTION	QTY/ LOCO	MATL.	SPECN.	WT. EACH IN KG
4			PAD 10x10x3 THK.(Min.)	12	ALUM. ALLOY	IS:7882	
3			POP RIVET-ALLUMINIUM HEAD Ø3.2x8.4 LG	32	"	IS:2907	
2			COVER	2	"	IS:7882	
1			COVER	2	"	"	
			COVER ASSEMBLY	2	ALUM. ALLOY	IS:7882	

AEE, J
SSE/D
CHKD.
DRN.

COVER ASSEMBLY FOR SPEEDOMETER WAP-5/7 & WAG-9

DY.CEE.(D)

CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
NO. CLW/ES/SPM/0002/S-35/A
DATE: -06-2006

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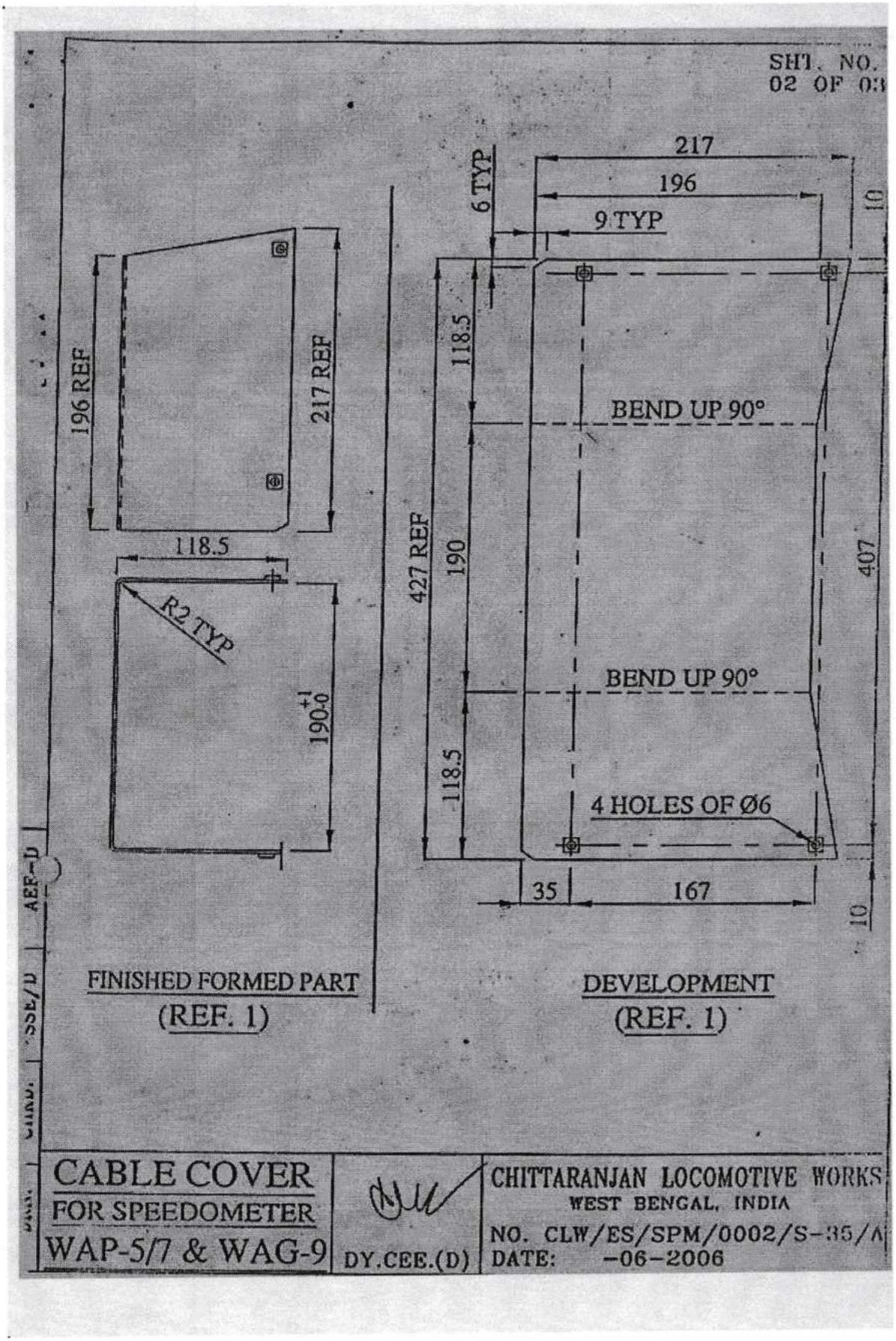
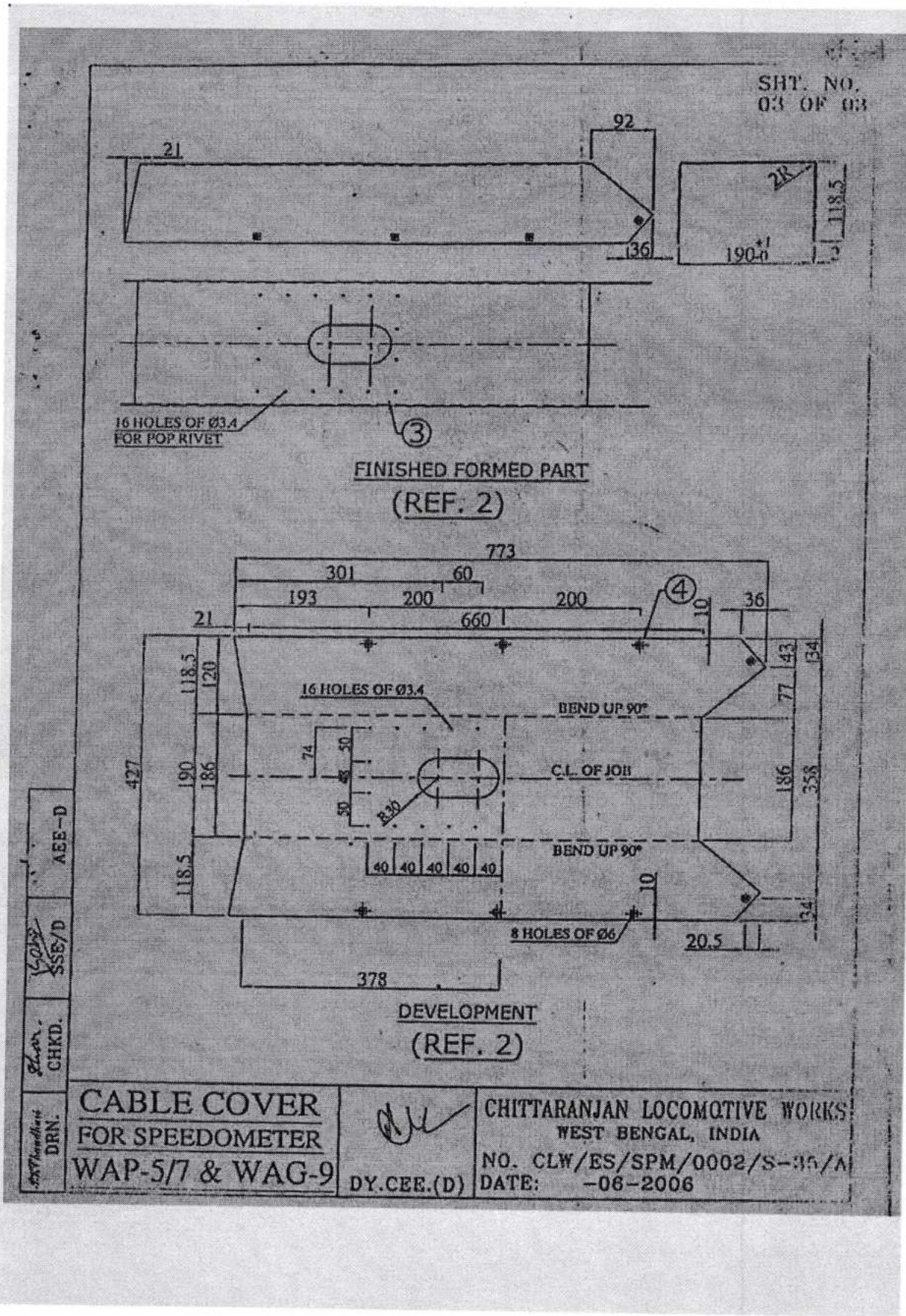
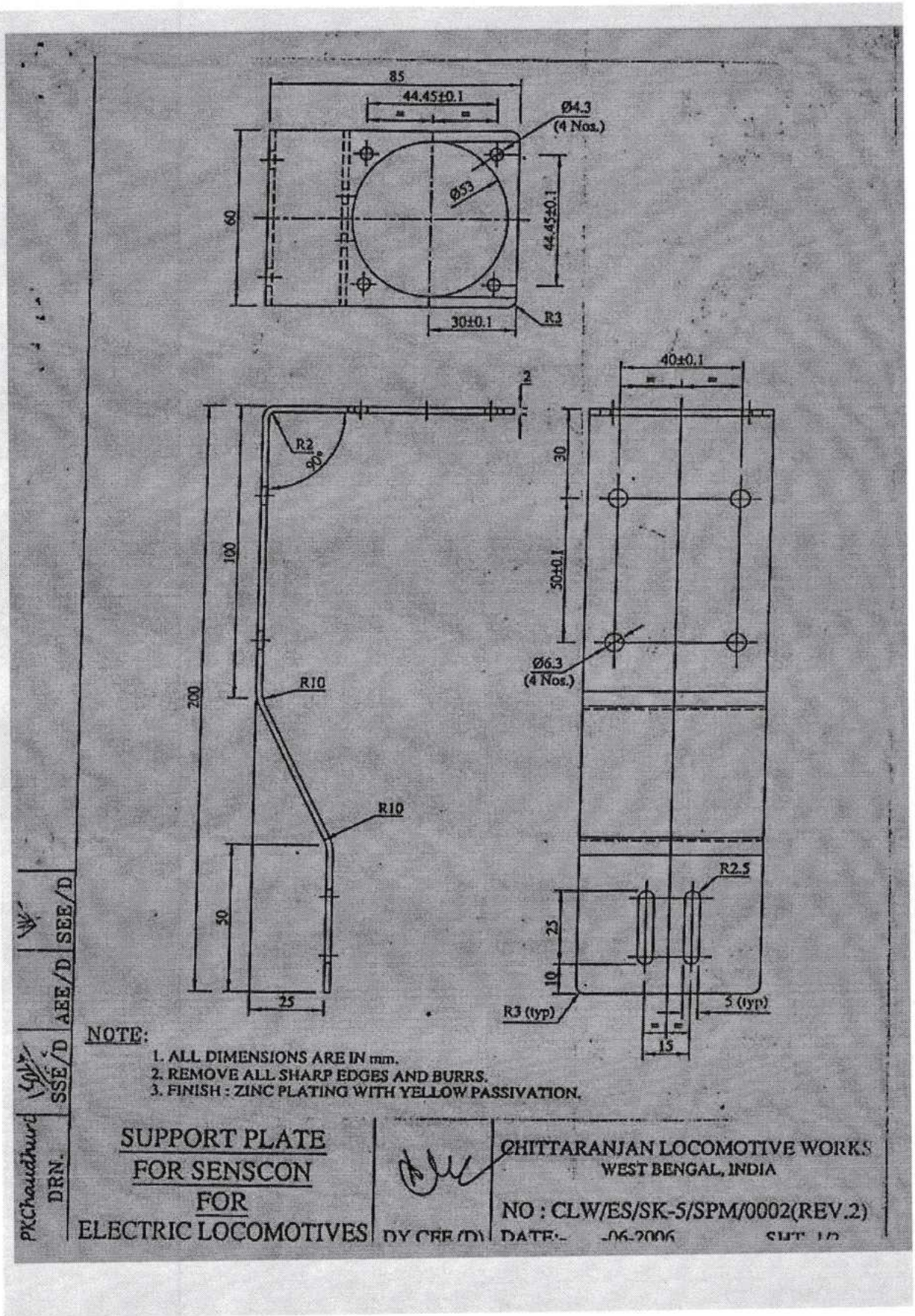
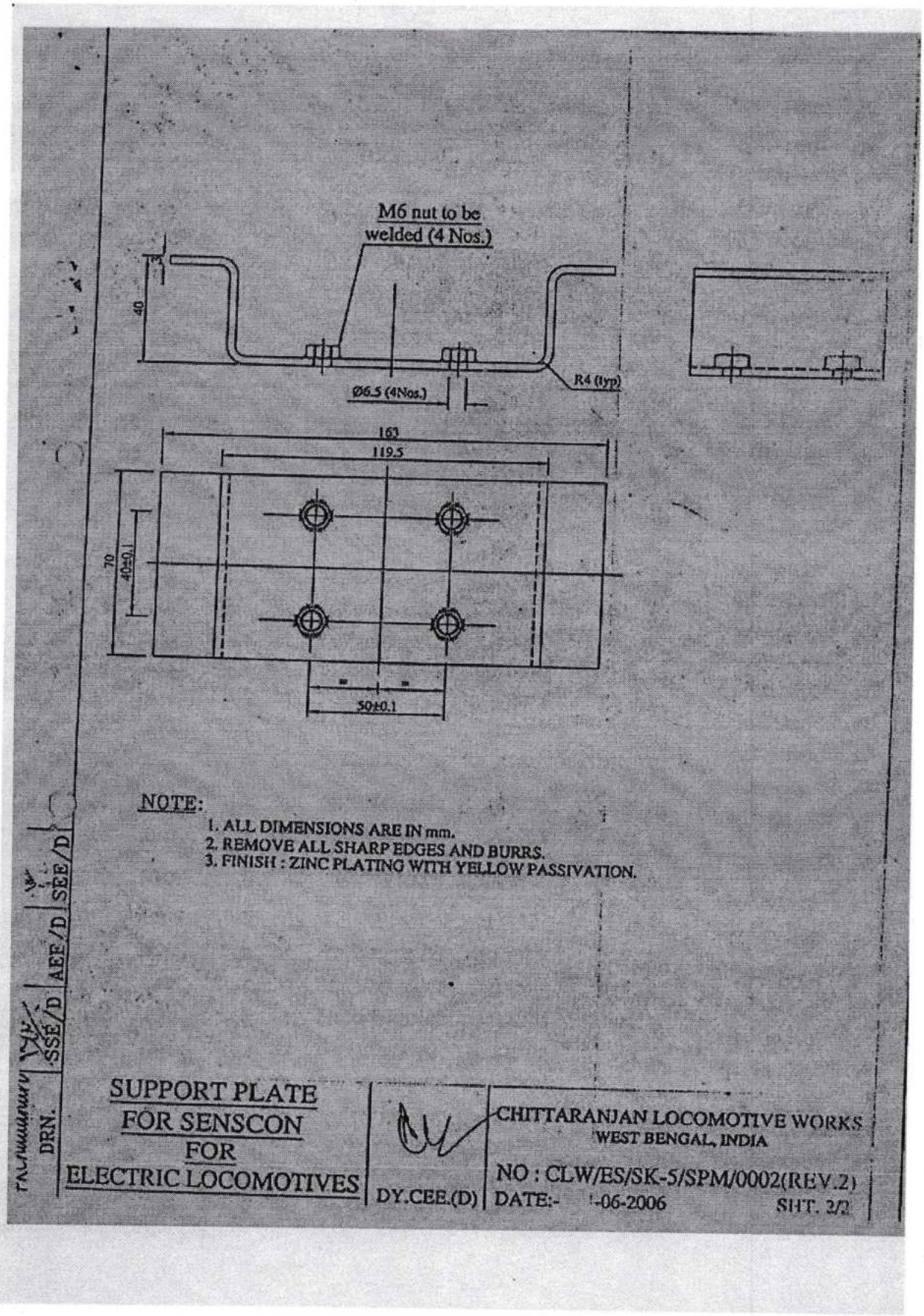

SHT. NO.
02 OF 03
217
196
9 TYP
6 TYP
10
196 REF
217 REF
118.5
R2 TYP
190 +1 -0
427 REF
190
118.5
BEND UP 90°
BEND UP 90°
407
4 HOLES OF Ø6
35
167
10
FINISHED FORMED PART
(REF. 1)
DEVELOPMENT
(REF. 1)
CABLE COVER
FOR SPEEDOMETER
WAP-5/7 & WAG-9
DY.CEE.(D)
CHITTARANJAN LOCOMOTIVE WORKS
WEST BENGAL, INDIA
NO. CLW/ES/SPM/0002/S-35/A
DATE: -06-2006



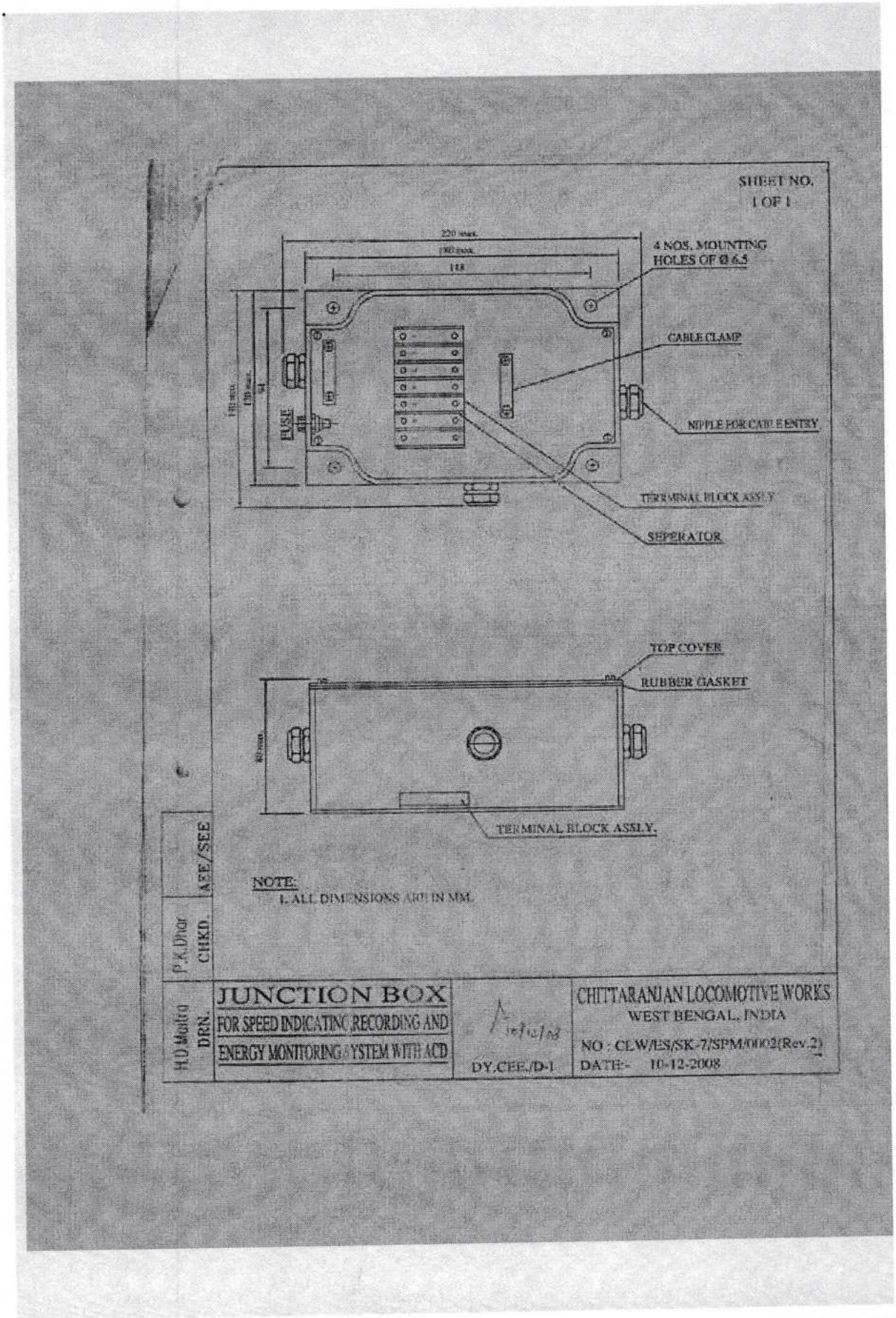
Prepared by	Checked by	Issued by
SSE/System	SSE/System	17/07/18 EDSE/System



Prepared by	Checked by	Issued by
SSE/System	SSE/System	EDSE/System



Prepared by	Checked by	Issued by
SSE/System	SSE/System	17/07/18 EDSE/System



Prepared by	Checked by	Issued by
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4140793/2025/O/o PED/TRACTION/RDSO

सत्यमेव जयते

भारत सरकार–रेल मंत्रालय
अनुसंधान अभिकल्प और मानक संगठन
लखनऊ - 226011
Tele/Fax : 2465739 & 42229 (Rly)
e-mail: sysconvloco.rdso@gmail.com

Government of India - Ministry of Railways
Research, Designs & Standards Organization,
LUCKNOW – 226011

स. EL/2.2.9/10 **दिनांक**: As signed

Principal Chief Electrical Engineer,

1. Central Railway, Mumbai CST-400 001
2. North Western Railway, Jaipur-302 006
3. East Central Railway, Hazipur-844 101
4. South Central Railway, Rail Nilayam, Secunderabad-500 071
5. East Coast Railway, Chandrashekharpur, Bhubaneswar-751 016
6. South East Central Railway, Bilaspur- 495 004
7. Eastern Railway, Fairlie Place, Kolkata-700 001
8. South Eastern Railway, Garden Reach, Kolkata-700 043
9. North Central Railway, Subedarganj, Prayagraj-211 033
10. Southern Railway, Park Town, Chennai-600 003
11. Northern Railway, Baroda House, New Delhi-110 001
12. South Western Railway, Hubli-580 024
13. North Eastern Railway, Gorakhpur-273001
14. West Central Railway, Jabalpur-482 001
15. North East Frontier Railway, Maligaon, Guwahati-781 011
16. Western Railway, Churchgate, Mumbai- 400 020
17. Banaras Locomotive Works, Varanasi - 221 004
18. Chittaranjan Locomotive Works, Chittaranjan-713 331
19. Patiala Locomotives Works, Patiala - 147 003

विषय: Amendment no. 01 to Specification no. ELRS/SPEC/SPM/0002, (Rev.4) titled as 'Microprocessor based Electronic Speed cum Energy Monitoring System for Electric Locomotives'.

संदर्भ: Railway Board letter no. 2003/Elect.(TRS)/113/safety(Misc.) dated 30.10.2023.

With reference to the above, following amendment is issued in the Specification no. ELRS/SPEC/SPM/0002, (Rev.4);

Clause No.	Existing	Modified as
2.7.1.9	**REAL TIME CLOCK** A Clock Chip shall be provided to maintain the time base in the system. The operating temperature of RTC chip shall be in the range of 0^0C to 70^0C with temperature compensation circuit. The maximum permissible drift in time setting shall be up to +/-2 min/year. Alternatively, a GPS receiver module may be provided to set the time	**REAL TIME CLOCK** A Clock Chip shall be provided to maintain the time base in the system. The operating temperature of RTC chip shall be in the range of 0 ^{0}C to 70 ^{0}C with temperature compensation circuit. The maximum permissible drift in time setting shall be up to +/-2 min/year. An inbuilt GPS receiver module shall be provided to update date & time

	automatically.	automatically.

This is for information and necessary action please.

Nikhil Singh
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(निखिल सिंह)
(Nikhil Singh)
संयुक्त निदेशक मानक विद्युत/सिस्टम
Jt. Director Std. Electrical/System

संलग्नकः: कुछ नहीं

प्रति प्रेषितः A.Secretary (Electrical), Railway Board, Rail Bhavan, New Delhi-110001 - for kind information please.

B.
i. M/s Autometers Alliance limited, C-63, Sector-57, Noida-201 307
ii. M/s Medha Servo Drives Pvt Ltd, P-4/5B, IDA Nacharam, Hyderabad - 500 076.
iii. M/s Laxven Systems, Plot No. 188/A, Lane –I,Phase –II, Sector – III, IDA Cherapally, Hyderabad-500 051.
iv. M/s Modern Railtech Equipment Manufactures Pvt. Ltd. B1-92/A, New B.B.T Road P.O.Daulatpur, P.S.- Maheshtala, Kolkata - 700141
v. M/s Hind Rectifier Ltd. (Equipment Division), Lake Road, Bhandup(W), Mumbai-400 078
vi. M/s IC Electrical Company (P) Limited, E-94, Bahadrabad Industrial Estate, Haridwar-249 402
vii. M/s VTL Electronics, Ecospace, Premises No.11F/12, Campus 2B, 2nd Floor, New Town, Rajarhat, Kolkata - 700 156
viii. M/s Thinkcircuit Railtech Pvt. Ltd. OJ Plex, No. 1218 – 2 & 3rd floor 80 Feet Road, Chandra Layout Bangalore - 560040
ix. M/s Urban Engineering Association Pvt .Ltd., Shilpangan-II, Model no.-2502, LB-I, Sector-III, Salt Lake City Kolkata - 700098
x. M/s Lotus Wireless Technologies India Pvt. Ltd. B-7, EEIE Industrial Park, B Block, Autonagar, Visakhapatnam - 530012
xi. M/s Theta Controls Pvt. Ltd. Plot No. 1, Electronic Co-Op Estate, Satara Plot No. 1, Electronic Co-Op Estate, Satara Road, Pune, Pune - 411009

For information and necessary action please.

Nikhil Singh
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(निखिल सिंह)
(Nikhil Singh)
संयुक्त निदेशक मानक विद्युत/सिस्टम
Jt. Director Std. Electrical/System

संलग्नकः: कुछ नहीं