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**Draft Specification
of
Analog Clock System with GPS Synchronization**

SPECIFICATION NO. RDSO/SPN/TC/76/2008

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**TELECOM DIRECTORATE
RESEARCH DESIGNS & STANDARDS ORGANISATION
Manak Nagar,
LUCKNOW-226011**

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This document specifies technical specification of Analog clock system with GPS synchronization.		

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TABLE OF CONTENTS

Sr. No.	Item	Page No.
1.	Scope	5
2.	System Description	5
3.	General Specification	5
4.	Analog Clock	6
5.	Master Clock Equipment	8
6.	Quality Requirements	12
7.	Multipurpose Time Signal	12
8.	Time Synchronization with Serial ASCII II Time- Telegram	13
9.	External GPS Receiver for Analog Clocks	14
10.	Tests & Requirements	15
11.	Test Procedure	16
12.	Quality Assurance	21
13.	Marking & Packing	21
14.	Information to be supplied by the Manufacturer	21
15.	Information to be supplied by the Purchaser	22
16.	Training	22
17.	Diagrams	22
18.	Schematic Diagram of Analog Clocks for Indoor Application	23
19.	Schematic Diagram of Analog Clocks for Outdoor & Indoor Application	24

**RESEARCH DESIGNS & STANDARDS ORGANIZATION
MINISTRY OF RAILWAYS
MANAK NAGAR, LUCKNOW**

Draft Specification of Analog Clock System with GPS Synchronization

Draft Specification No: RDSO/SPN/TC/76/2008 (Revision 0.0)

1.0 SCOPE:

This specification covers technical requirement of Analog Clocks, GPS synchronized stand alone clocks and clocks systems consisting of GPS synchronized master clock with slave clocks.

These clocks are used for displaying the correct time at various locations of platforms of Railway Stations and in the control & other offices of Railways. It also covers the technical requirement of GPS receiver to be used for synchronisation.

2.0 SYSTEM DESCRIPTION:

- 2.1 The synchronized analog clock shall use Global Positioning System (GPS) receiver to receive correct time. The clocks shall have local battery backed Real Time Clock (RTC) which shall be synchronized to the time information received from the GPS. In case of failure of GPS system, the clock's local RTC time shall be displayed.
- 2.2 The synchronized analog clock shall have a built-in GPS receiver and shall synchronize time as received from the GPS.
- 2.3 Master clock shall be used to synchronize analog clocks when wired in network. In such cases, analog clock will work as slave clock and GPS receiver shall not be provided in slave clock.

3.0 GENERAL SPECIFICATION:

- 3.1 Analog clocks shall display time information by means of dial and hands and by providing intuitive reading of time information as well as excellent visibility for passengers.
- 3.2 These shall be mainly used in public areas such as platforms or station halls. In addition to that, analogue indoor clocks can be installed in office rooms.
- 3.3 While using multipurpose time signal to drive indoor and outdoor analog slave clocks, these devices shall not require additional 230 V AC or any other power supply.

- 3.4 Cabinet colour of outdoor analog clocks shall be carried out in specific colour as specified by Railways and dials of clock shall show IR logo.
- 3.5 Analog clocks shall be usually integrated in clock systems by functioning in slave clock mode. Outdoor analog clocks shall also operate in stand alone mode by having direct GPS synchronization.
- 3.6 Preferably 5 pair PVC insulated twin twisted screened color coded cable in which each core is of size 7/0.2 (7 strands, each of 0.2 mm diameter) with nominal insulation thickness of 0.6mm and sheath thickness of 0.9mm as per standard BIS: 5308 PART-1 should be provided for the data communication wherever required.
- 3.7 PVC insulated flexible 3 core power cables shall be used for power supply wiring wherever required conforming to specification no. IS:694:1990 reaffirmed 1995 or latest and shall have sufficient cross sectional area of 2.5 sq mm (minimum) copper conductor with insulation thickness 0.7mm, sheath thickness of 1.0 mm and overall diameter 9 mm to withstand power load.

4.0 ANALOG CLOCK:

4.1 Indoor Analog Clocks, 30 and 40 cm:

- 4.1.1 Round clocks with hour and minute hands shall be as per schematic shown in Clause 18.0.
- 4.1.2 The clock shall set itself completely automatic to the correct time after connecting it to the multipurpose time signal coming from a master clock type A, B or C.
- 4.1.3 The clock shall work on 2 wires.
- 4.1.4 The clocks shall be available in sizes, 30 and 40 cm diameter providing minimum viewing distances (daylight) of 40 and 50 m respectively.
- 4.1.5 Mounting kit shall be provided for the clocks to allow two clocks to be combined into a double-sided clock with a bracket for ceiling and wall mounting. (Optional)
- 4.1.6 The colour of the hands shall be black and the colour of the case shall be white.
- 4.1.7 The design of the dial, including logo, shall be as specified by Railways.

4.2 Specifications of Analog Clocks for Indoor Application:

Diameter (nominal)	30 cm	40 cm
Overall dimension (diameter)	310 - 325 mm	413-425 mm

Max. depth, single-sided	56 mm	59 mm
Max. depth, double-sided	121 mm	126 mm
Max. weight, single-sided	0.9 kg	1.2 kg
Max weight, double-side	2.1 kg	2.7 kg
Cover glass	convex, acrylic	convex, acrylic
Accuracy when synchronization missing	$\pm 5s/24hours$ $20\pm 5^{\circ}C$	@ $\pm 5s/24hours$ $20\pm 5^{\circ}C$

4.3 Indoor & Outdoor Analog Clocks, 50, 60 & 80 cm:

- 4.3.1 Round clocks for indoor and outdoor application shall be with hour and minute hands, illuminated with circular standard-sized fluorescent lamps as per schematic shown in Clause 19.0.
- 4.3.2 The clocks shall be available as single and as double-sided. Dials of clocks shall be available in 50, 60 and 80 cm diameter, providing minimum viewing distances (daylight) of 60, 70 and 90 m respectively.
- 4.3.3 The double-sided clocks shall have a rotatable supporting middle piece to enables fixing on wall, ceiling, socket or pole mounting. The fixing brackets shall be length-adjustable.
- 4.3.4 The clock shall set itself completely automatic to the correct time after connecting it to the multipurpose time signal coming from a master clock type A, B or C.
- 4.3.5 The clock shall require 2 wires for the multipurpose time signal and mains power supply of 160 to 270 Volts, 50 Hz AC for the illumination.
- 4.3.6 The clock shall need additional 230 V AC power supply when operated in RS 485 or GPS-mode,
- 4.3.7 The housing of the clock shall consist of light metal duly powder coated in specific colour as defined by Railways.
- 4.3.8 A convex acrylic glass shall be provided on front side to protect the clock.
- 4.3.9 The colour of the hands shall be black whereas the colour of dial & logo shall be as specified by Railways.
- 4.3.10 The single sided clock shall be easily mountable with its backside part. The double sided clocks shall be available for wall- and ceiling mounting. Three lengths of suspension- and wall-mounting rods shall be provided of length 500, 600 and 800 mm.

4.4 Specifications of Analog Clocks for Indoor and Outdoor Application:

Diameter (nominal)	50 cm	60 cm	80 cm
Overall dimension (diameter)	530-540 mm	630-640 mm	830-840 mm

Max. depth, single-sided	160 mm	160 mm	160 mm
Max. depth, double-sided	242 mm	242 mm	242 mm
Max. weight, single-sided	7 kg	8.5 kg	11.5 kg
Max weight, double-side	12.5 kg	14.5 kg	19 kg
Cover glass	convex, acrylic	convex, acrylic	convex, acrylic
Accuracy when synchronization missing	$\pm 5s/24hours @ 20\pm 5^{\circ}C$	$\pm 5s/24hours @ 20\pm 5^{\circ}C$	$\pm 5s/24hours @ 20\pm 5^{\circ}C$

4.5 Time Synchronization:

4.5.1 For time synchronization, indoor analog clocks shall have an input for multipurpose time signal. In addition to that, outdoor clocks shall be equipped to connect with a GPS time-code receiver as specified in Clause 9.0 to provide stand alone function without being integrated in a clock system.

4.5.2 The clock shall check the incoming time-telegram as follows:

4.5.2.1 Parity and Plausibility

4.5.2.2 Consistency: The time shall not be accepted before three consecutive, plausible messages with correctly incremented time information have been received.

4.5.3 Accuracy of the clock when synchronized shall be ± 50 ms to the incoming time-telegram.

5.0 MASTER CLOCK EQUIPMENT:

5.1 Types of Master Clocks and Their Applications:

5.1.1 Type A: For small train stations, standard sub-master clocks shall be provided having one RS 485 clock line and two clock lines for multipurpose time signal.

5.1.2 Type B: For large stations and for synchronization of 2-wire communication systems, standard sub-master clocks shall be provided having up to eight clock lines, either of type RS 485 or multipurpose time signal.

5.1.3 Type C: For centralized synchronization and communication via Fibre Optics Transmission System (FOTS), customized main master clock equipment shall be provided having high precision and reliability based on a modular approach.

5.1.4 Time Synchronization: All kind of master clock equipment shall be synchronized from various time-references as mentioned below:

5.1.4.1 GPS time-code receiver as specified in Clause 9.0.

- 5.1.4.2 Synchronization via Network Time Protocol over a LAN/WAN network.
- 5.1.4.3 Serial interfaces RS 232 / RS 422 for FOTS backbones as per Clause 8.0.

5.2 Technical Requirements of Master Clocks Type A (MC-A):

- 5.2.1 The master clock shall receive the correct time information from GPS or the main master clock and set itself to the correct time.
- 5.2.2 Outputs of the MC-A: Two separate multipurpose time signal outputs as defined in Clause 7.0 shall be provided to drive self-setting clocks, providing time, date and power supply for analog clocks on 2-wires. The two outputs can individually be configured as 24V, polarized minute-impulse-lines.
- 5.2.3 Serial ASCII-telegram on a RS 485 output shall be provided as defined in Clause 8.0.
- 5.2.4 Operation Control: The MC-A shall have numerical keyboard with the keys 0..9 and additional cursor keys for the navigation in the menu. The display shall be LCD-matrix-type, 4 lines with 20 characters each with backlight. The operation shall be user-friendly, menu driven and in English language.
- 5.2.5 To compensate its quartz-drift and quartz-aging, the MC-A shall be synchronized by the following time references:
 - 5.2.5.1 Accuracy of the MC-A with missing link to the Master Clock shall be +/- 0.1 second/ 24hours.
 - 5.2.5.2 The aging of the quartz shall be compensated by automatic calibration-software.
- 5.2.6 Potential free contact for local alarm signalisation shall be provided.
- 5.2.7 The MC-A shall work on mains power supply 160 to 270 Volts, 50 Hz AC and shall have battery backup of 24V, 2.3 Ah for atleast 10 hours active power reserve which will also depend upon the number of connected slave clocks.
- 5.2.8 Reliability: The Mean Time Between Failure (MTBF) of MC-A shall be at least 60,000 hours.
- 5.2.9 The MC-A shall have metal-sheet housing, mountable in 19" cabinet.

5.3 Technical Requirements of Master Clocks Type B (MC-B):

- 5.3.1 The master clock shall receive the correct time information from GPS or the main master clock and set itself to the correct time.
- 5.3.2 Outputs of the MC-B:

- 5.3.2.1 Up to eight separate multipurpose time signal outputs as defined in Clause 7.0 to drive self-setting clocks, providing time, date and power supply for analog clocks on 2-wires.
- 5.3.2.2 Up to eight separate 24V, polarized minute-impulse line outputs.
- 5.3.2.3 Up to eight separate, serial ASCII-telegram outputs on RS 232 or RS 422 / RS 485 (individually selectable) as defined in Clause 8.0.
- 5.3.2.4 The MC-B shall provide total eight clock outputs, either RS 485, or multipurpose time signal-signal.
- 5.3.3 Operation control: The MC-B shall have numerical keyboard with the keys 0..9 and additional cursor keys for the navigation in the menu. The display shall be LCD-matrix-type, 4 lines with 20 characters each with backlight. The operation shall be user-friendly menu-guided and in English language.
- 5.3.4 Accuracy of the MC-B with missing link to the Master Clock shall be +/- 0.1 second/ 24 hours.
- 5.3.5 The aging of the quartz shall be compensated by automatic calibration-software.
- 5.3.6 Potential free contact for local alarm signalisation shall be provided.
- 5.3.7 The MC-B shall work on mains power supply 160 to 270 Volts, 50 Hz AC and shall have battery backup of 24V, 2.3 Ah for atleast 12 hours active power reserve which will also depend upon the number of connected slave clocks.
- 5.3.8 Reliability: The Mean Time Between Failure (MTBF) shall be at least 60,000 hours.
- 5.3.9 The MC-B shall have metal-sheet housing and mountable in 19" cabinet. Battery back up module shall also be rack mountable.

5.4 Technical Requirements of Master Clocks Type C (MC-C):

- 5.4.1 General Features: The MC-C shall provide reliable, accurate time for slave clocks, sub- master clocks and subsystems. The MC-C shall preferably be synchronized to the time of GPS. When synchronized to GPS, the accuracy of the output of the Master Clock, measured at the output of the serial communication board, shall be better than +/- 10ms compared to the GPS-signal as reference. When the synchronization from GPS is lost, the deviation of the MC-C shall not be more than 0.1 seconds per day measured at a constant temperature.

5.4.2 The MC-C shall be designed as a modular time distribution system. It should be easily expanded with no practical limits by adding new modules and additional racks. The MC-C should be expanded with additional racks.

5.4.3 Each rack should represent a complete master clock system consisting of a master and a number of modules with specific functionalities.

5.4.4 Master: The master should monitor the modules, detect errors or faults and synchronize the modules to the correct time.

5.4.5 Modules: Each module should work independent from other modules. Each module should serve its outputs regardless of the status of any other module. All modules, including the master should be 'hot-pluggable'.

5.4.6 Module Specific Features:

5.4.6.1 Network Processing Module

- Available Network services:
 - NTP / SNTP Timeserver
 - Alarm reporting with SNMP Traps and Email
 - Remote control of the Master Clock over LAN / WAN
- RJ-45 10/100BASE-T with Auto-Negotiation.

5.4.6.2 Driver for Multipurpose Time Signal

- Four independent line outputs to control devices such as self-setting clocks, computer interfaces and remote switching relays.
- Measurement and supervision of line voltage line current and operating temperature.

5.4.6.3 Driver for Impulse Lines

- Four independent line outputs to control devices such as self-setting clocks, computer interfaces and remote switching relays.
- Measurement and supervision of line voltage line current and operating temperature.

5.4.6.4 Serial Communication

- Output of time and date information via four independent serial interfaces.
- Each output should be configured as RS232, RS422, RS485 individually.
- Automatic broadcasting of a configurable time telegram, asynchronous, ASCII or binary.

- The time variables of millisecond, hundredth of second, tenth of second, second, minute, hour, year, day of month, calendar week, day of the year, day of week, month, AM/PM, checksum, XOR checksum etc. should be transmitted in a freely configurable sequence:

5.4.7 The operator's terminal shall consist of a standard PC with Windows operating system.

5.4.8 The MC-C shall work on mains power supply 160 Volts to 270 Volts, 50 Hz AC.

5.4.9 Reliability: The Mean Time Between Failure (MTBF) for a single module shall be at least 1,00,000 hours and for complete system shall be at least 2,00,000 hours.

5.4.10 MC-C system consisting of Master, Charging Module and various modules shall be 19" rack mountable.

6.0 QUALITY REQUIREMENTS:

6.1 Performance Requirement: The system shall be so designed to have a very high reliability.

6.2 Applicable Standards: The clocks shall be designed to be operated in the environment of railways and to withstand rough electric and electromagnetic influences.

6.3 Casing of Indoor & Master Clocks shall be tested according to ingress protection class IP 31.

6.4 Casing of Outdoor Clocks shall be tested according to ingress protection class IP 54.

6.5 Electromagnetic Compatibility: Analog indoor/outdoor clocks and master clocks shall be tested according to the following norms for electromagnetic compatibility:

- EN 60950:2000 (7/2001) (or equivalent) for electric safety
- EN 61000-6-4 (or equivalent) for electromagnetic emission (industrial environment)
- EN 50121-4 (or equivalent) for electromagnetic Immunity

7.0 MULTIPURPOSE TIME SIGNAL (MTS):

7.1 MTS is a one-way two-wire data transmission system designed for secure data transmission with simultaneous supply of the end units connected to it.

Electrical definition:

Voltage shape: sine-wave

Voltage tension: 1 $0 V_{eff} < u < 20 V_{eff}$

Frequency: $f = 50 \text{ Hz}$

Modulation: combined amplitude / frequency, $m = 2 \%$

Error-detection/correction: Hamming, Parity

7.2 Data and commands transmission to control clocks, interfaces and remote relay-switches:

- Time and Date
- Time Function
- Time-offset for 20 different time zones to control time clocks on a single MTS
- Switching functions: Command to time-scheduled switch on/off of remote relays on 64 independent addresses
- Operational mode of the slave clocks: Sweeping, stepwise (i.e. the clocks are moving every half minute, every minute or 'continuously'). Set the clock at 12'00 hours to halt for maintenance reasons to check the correct mounting of the hands.

8.0 TIME SYNCHRONIZATION WITH SERIAL ASCII II TIME – TELEGRAM:

8.1 Electrical interface: RS 485, RS 232, RS 422

8.2 Specification of the Time-Telegram:

Periodicity: Once per second

Timing: Terminating at the beginning of designated second in the telegram

Baud rate: 9600bps

Data bits: 7

Parity: Even

Stop bits: 1

Jitter: <50ms

8.3 Format of ASCII Telegram String:

Byte No	Meaning	Character	HEX code
1	Start of telegram	O	0x4F
2	Supervision	A	0x41
3	Season	W or S	0x57 or 0x53
4	Year tens	0...9	0x30...0x39
5	Year units	0...9	0x30...0x39
6	Month tens	0 or 1	0x30 or 0x31
7	Month units	0...9	0x30...0x39

8	Day of month tens	0...3	0x30...0x33
9	Day of month units	0...9	0x30...0x39
10	Day of week (Monday...Sunday)	1...7	0x31...0x37
11	Hour tens	0...2	0x30...0x32
12	Hour units	0...9	0x30...0x39
13	Minute tens	0...5	0x30...0x35
14	Minute units	0...9	0x30...0x39
15	Second tens	0...5	0x30...0x35
16	Second units	0...9	0x30...0x39

Note: W – standard time, S – seasonal time

9.0 EXTERNAL GPS RECEIVER FOR ANALOG CLOCKS:

9.1 GPS-receiver, together with antenna and generator for a serial time-telegram shall be integrated in a small-sized case for outdoor mounting. The connection between receiver-box and analog clock should be through a standard telephone-cable. The receiver-box should be directly powered from a master clock. A surge protection box should be provided.

9.2

Dimensions (without mounting bracket)	L 100 x W 100 x H 100 mm (Max.)
Ingress protection	IP 54
Satellites	L1 (1575.42MHz), 8 channel tracking, 3 satellites required
Serial time-telegram	DCF77 coded, UTC (current loop isolated)
Accuracy of leading edge (DCF77 code)	+/- 10 microseconds
Cold start	< 25 minutes
Power supply	10..40 VDC, < 0.5W
Connection Cable	4 wires x 0.25mm ² (AWG 23), up to 200m

9.3 Logical "0" = 100ms
Logical "1" = 200ms

A= early warning bit (for Daylight-Saving-Time - season change)

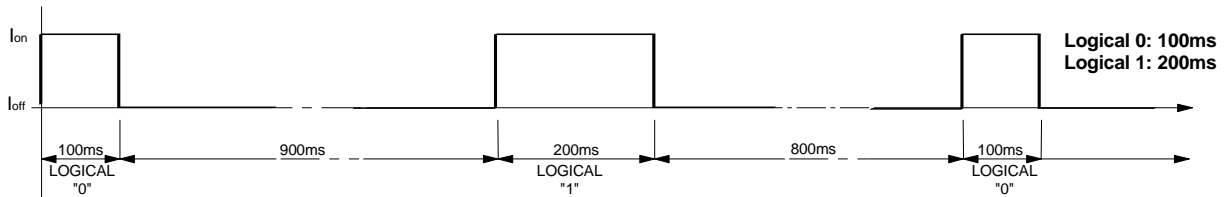
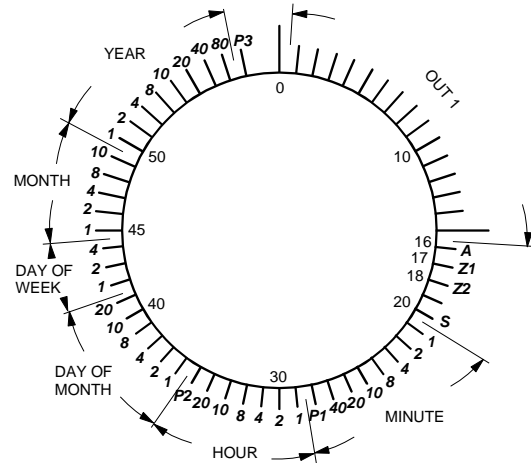
Z1 & Z2 = season bits

0 1 = winter

1 0 = summer

S= start bit

P1 = parity bit minute
 P2 = parity bit hour
 P3 = parity bit calendar



10.0 TESTS AND REQUIREMENTS:

10.1 Conditions of Tests:

- 10.1.1 Unless otherwise specified, all tests shall be carried out at ambient atmospheric conditions.
- 10.1.2 Inspection and testing shall be carried out to the effect that all requirements of this specification are complied with.
- 10.1.3 Inspection shall be carried out for analog clocks suitable for indoor & outdoor application in Railways and master clock. GPS Receiver shall be checked during inspection for their functional performance required for proper working of complete system as per specification.

10.2 Type Tests:

- 10.2.1 For type test, one complete system consisting of all type of clocks shall be subjected to following tests as applicable:
- Visual inspection (Clause 11.1)
 - Insulation Resistance Test (Clause 11.2)
 - Applied High Voltage Test (Clause 11.3)
 - Environmental/ Climate Tests (Clause 11.4)
 - Performance Test (Clause 11.5)
 - Endurance test (Clause 11.6.1)
 - Card-level functional tests on all the cards.
 - System level functional tests.

10.2.2 One single sided analog clock of 40 cm suitable for indoor application, one single sided analog clock of 80 cm suitable for outdoor application and all three types of master clocks shall be type tested for this purpose. All the system shall successfully pass all the type tests for proving conformity with this specification. If any one of the equipment fails in any of the type tests, the inspecting authority or his nominee at his discretion, may call for another equipment/ card(s) of the same type and subject it to all tests or the test(s) in which failure occurred. No failure shall be permitted in the repeat test(s). After successful completion type tests, these items are to be submitted to RDSO.

10.2.3 Any other tests shall be carried out as considered necessary by the inspecting authority.

10.3 Acceptance Tests:

10.3.1 The following shall constitute the acceptance tests which shall be carried out by the inspecting authority for the purpose of acceptance on 20% of the lots (minimum 2 each type of system) offered for inspection by the supplier:

- i) Visual inspection (Clause 11.1)
- ii) Insulation Resistance Test (Clause 11.2)
- iii) Performance Test (Clause 11.5)
- iv) System level functional tests.
- v) Endurance Test (Clause 11.6.2)

10.3.2 Any other tests shall be carried out as considered necessary by the inspecting authority.

10.4 Routine Tests:

10.4.1 The following shall comprise the routine tests and shall be conducted by manufacturer on every equipment and the test results will be submitted to the inspection authority before inspection.

- i) Visual inspection (Clause 11.1)
- ii) Insulation Resistance Tests (Clause 11.2)
- iii) Performance test (Clause 11.5)
- iv) Card-level functional tests on all the cards.
- v) System level functional tests.

10.4.2 Any other tests shall be carried out as considered necessary by the inspecting authority.

11.0 TEST PROCEDURE:

The test procedure shall be based on the system design. The methodologies to be adopted for various tests shall be decided taking into account the system design/configuration.

11.1 Visual Inspection: Each equipment of the system shall be visually inspected to ensure compliance with the requirement of clause 2 to 9 of this specification. The visual inspection shall broadly include:

11.1.1 System Level Checking:

- i) Constructional details.
- ii) Dimensional check.
- iii) General workmanship.
- iv) Configuration.
- v) Mechanical polarization of cards.

11.1.2 Card Level Checking:

- i) General track layout.
- ii) Quality of soldering and component mounting.
- iii) Conformal Coating.
- iv) Legend printing.
- v) Green or Black masking.

11.1.3 Module Level Checking:

- i) Indications and displays.
- ii) Mounting and clamping of connectors.
- iii) Proper housing of cards.

11.2 Insulation Resistance Test: This test shall be carried out –

- (a) Before the high voltage test
- (b) After the high voltage test
- (c) After completion of the climatic test

There shall be no appreciable change (value more than 10 Mega ohms and variation within 10%) in the values measured before and after high voltage test. After the completion of climatic test, the values shall not be less than 10 Mega ohms for the equipment at a temperature of 40⁰ C and relative humidity 60%. The measurement shall be made at a potential of 500V DC.

11.3 Applied High Voltage Test: The equipment shall withstand for one minute without puncture and arcing a test voltage of 2000 volts rms applied between:

- (a) AC line terminals and earth
- (b) DC line terminals and earth

The test voltage shall be alternating of approximately sinusoidal waveform of any frequency between 50 Hz. and 100 Hz. Printed circuit cards shall be removed.

11.4 Environmental/ Climate Tests:

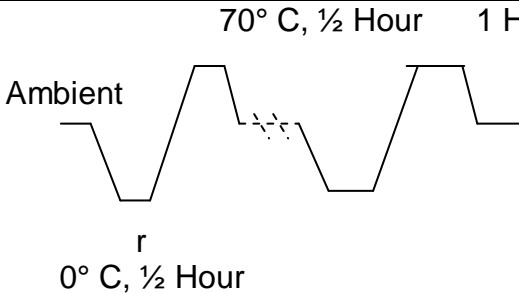
11.4.1 The analog & master clocks shall be capable of working in non-air conditioned environment in the field.

11.4.2 The analog & master clocks shall be suitable for installation on AC/ DC electrified and non-electrified sections. It shall be suitable in all areas including where locomotives having thyristor controlled single phase or 3-phase induction motors haul passenger or freight trains and where chopper controlled EMU stocks are operated.

11.4.3 The analog & master clocks shall meet the following climatic and environmental requirements:

SN	TEST		REFERENCE
1.	Change of temp test		IS 9000 Part XIV Sect. II
	Low temp	-10°C ± 3°C	
	High temp	+70°C ± 2°C	
	Rate of change in temperature	1°C / min	
	Duration	7hrs at each temp. -10°C & +70°C	
	Cycle	3	
	Condition	Fully functional during test	
2.	Dry heat test		IEC-571; IS:9000 Part-III Sect 3
	Temp	+70°C ± 2°C	
	Duration	16 hrs	
	Condition	Fully functional during test	
3.	Cold test		IS 9000 Part II Sect. III
	Temp	-10°C ± 3°C	
	Duration	2 hours	
	Condition	Fully functional during test.	
4.	Damp heat test (Cyclic)		IS 9000 Part V Sect. 2 Variant 1
	Upper temp	40°C ± 2°C	
	Humidity	95% (+1%, -5%)	
	Cycles	6	
	Condition	Fully functional during one hour period towards end of each cycle. Stabilization shall be done at 25° ± 3°C	
5.	Damp heat test (Steady state storage)		IS 9000 Part IV
	Temp	40° ± 2 °C	
	Humidity	93% (+2%, -3%)	
	Severity	4 days	

	Condition	Fully functional during test.		
6.	Salt mist test			IS 9000 Part XI procedure 3
	Mist + Damp heat	Procedure 3: 2 hours + 22 hours		
	Temp	35° ± 3° C		
	Humidity	93% (+2%, -3%)		
	Hours	22		
	Cycle	3		
	Condition	After this test, electrical parameters shall be monitored in addition to physical checks.		
7.	Dust test			IS 9000 Part XII
	Duration	1hour		
	Condition	After this test, electrical parameters shall be monitored in addition to physical checks.		
8.	Bump test			IS 9000 Part VII, Sec. 2
	PCBs/Modules/units in packed condition shall be subjected to bump test as under:			
	No of bumps	1000		
	Peak acceleration	400 m/s ²		
	Pulse duration	6 ms		
	No of axes	3		
	Condition	After this test, electrical parameters shall be monitored in addition to physical checks.		
9.	Vibration test			TEC (IPT 1001A-revised)
		Up to & including 75 Kgs. weight	Over 75 Kgs.	
	Freq. Range	05-350 Hz	5-150 Hz	
	Amplitude	± 6 mm constant displacement or 15m/ Sec. ² constant acceleration.	± 6 mm constant displacement or 15m/ Sec. ² constant acceleration.	
	No. of axes	3	3	
	No of sweep cycle	20	10	
	Total duration	105 min	105 min	
	If resonance is observed	10 min at each resonant freq.	10 min at each resonant freq.	

	Condition	After this test, electrical parameters shall be monitored in addition to physical checks.	
10.	Environmental Stress Screening tests (ESS) for Printed Circuit Boards (PCB) & sub systems: (The manufacturer shall carry out the following ESS tests on all modules on 100% basis during production / testing in the sequence as follows. Suitable records shall be maintained regarding the compliance of these tests.)		
10.1	Thermal cycling: The PCBs shall be subjected to thermal cycling as per the procedure given below. The assembled boards are to be subjected to rapid temperature cycling as mentioned below in the power off condition.		
	❖ This temperature cycling from 0° C to 70°C, ½ Hours at each temperature for 9 cycles and 1 hour at each temp. for the 10 th cycle. Dwell time of 1 hour is provided for the last cycle in order to oxidize defective solder joints exposed through thermal stress.		
	 <p style="text-align: center;">70° C, ½ Hour 1 Hour</p> <p>Ambient</p> <p style="text-align: center;">r</p> <p style="text-align: center;">0° C, ½ Hour</p>		
	❖ The rate of rise / fall of temp. shall be minimum 10° C per minute. ❖ In addition to physical checks, the electrical parameters are also to be monitored after this test.		
10.2	Power cycling: The power supply modules shall be subjected to 60 ON-OFF cycles for 1 hour. The ON-OFF switch usually provided in the modules may not be used for this purpose.		

11.5 Performance Test: The equipment shall comply with the requirements as specified in Clauses 2 to 9.

11.6 Endurance Test:

11.6.1 During type test, endurance test shall be conducted on system mentioned in Clause 10.2.2 for continuous operation which shall be 168 hours at 60°C burning without giving any deterioration in performance.

11.6.2 During acceptance test, endurance test shall be conducted on samples as per Clause 10.3.1 for continuous operation which shall be 48 hours at room temperature burning without giving any deterioration in performance.

12.0 QUALITY ASSURANCE:

12.1 All materials & workmanship shall be of good quality.

12.2 Since the quality of the equipment bears a direct relationship to the manufacturing process and the environment under which it is manufactured, the manufacturer shall ensure Quality Assurance Program of adequate standard.

12.3 Validation and system of monitoring of QA procedure shall form a part of type approval. The necessary plants, machineries and testing equipments required for production & quality assurance as per Scheduling of Technical Requirements (STR) shall be available with the manufacturer.

13.0 MARKING & PACKING:

13.1 The following information shall be clearly marked at a suitable place on each equipment:

- i) Name and Address of the manufacturer.
- ii) Month & Year of the manufacturing.
- iii) Serial number of Equipment.
- iv) Specification number.
- v) Schematic diagram of the equipment on the side of the cover.

13.2 The equipment and its sub assemblies shall be packed in thermocole boxes and the empty spaces shall be filled with suitable filling material. Before keeping in the thermocole box, the equipment shall be wrapped with bubble sheet. The equipment shall be finally packed in a wooden case of sufficient strength so that it can withstand bumps and jerks encountered in a road/rail journey.

14.0 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER:

14.1 The following documents in two sets should be supplied along with the system:

- i) Mechanical drawings of each sub system/ rack/ clock.
- ii) Installation and maintenance manual incorporating trouble shooting exercises, printed cards patterns, software etc.
- iii) Operating and trouble shooting manual.
- iv) Pre-commissioning check list.

15.0 INFORMATION TO BE SUPPLIED BY THE PURCHASER:

- 15.1 The purchaser should clearly indicate details of required items which shall mainly consist of following items as per requirement.

S.No	Description of the Item	Quantity
1.a	Double sided Indoor/ Outdoor Analog Clock of diameter - 50cm or 60cm or 80cm suitable for platform area (Either networking mode or stand alone mode)	As per site requirement
1.b	Single Sided Indoor/ Outdoor Analog Clock of diameter - 50cm or 60cm or 80cm suitable for platform area (Either networking mode or stand alone mode)	As per site requirement
2	Double sided Indoor Analog Clock of diameter - 30cm or 40cm suitable for platform area (Either networking mode or stand alone mode)	As per site requirement
3	Single Sided Indoor Analog Clock of diameter - 30cm or 40cm suitable for platform area (Either networking mode or stand alone mode)	As specified by the purchaser
4	Master Clock (MC-A or MC-B or MC-C type) for working of Analog clocks in networking mode	As specified by the purchaser
5	Five pair shielded communication cable	As per requirement
6	Power Cable and extension boards	As per requirement
7	Any other items or features required by the purchaser	As per requirement

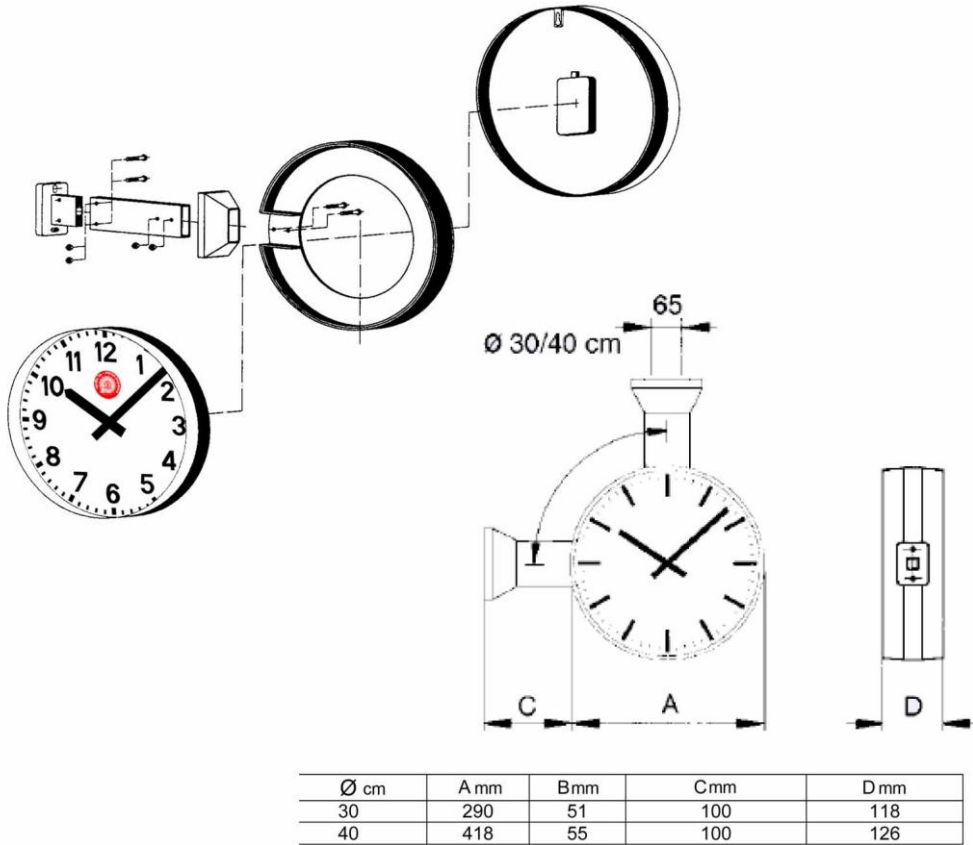
16.0 TRAINING:

- 16.1 On site training shall be provided to the Railway staff which shall include complete assembly of the system through the use of various modules, integration of hardware with software and complete operation of the system.

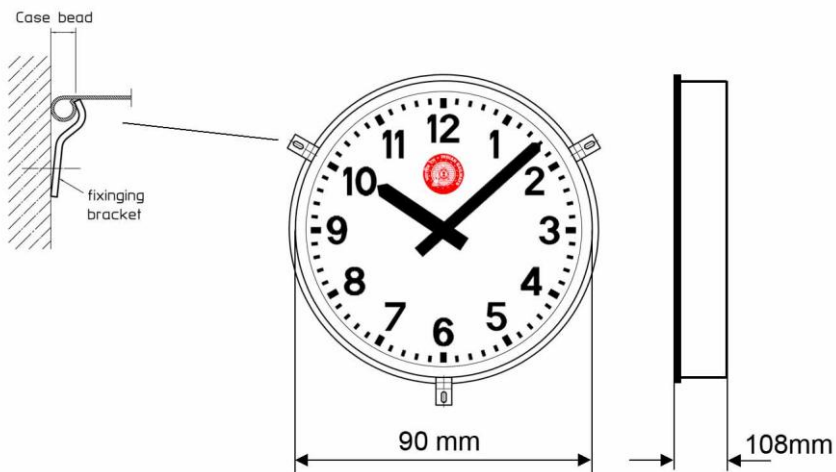
17.0 DIAGRAMS:

Detailed construction diagrams of Indoor & Outdoor Analog Clock suitable for platform area (single sided and double sided) and analog clock suitable for office complex are to be approved by RDSO before starting manufacturing.

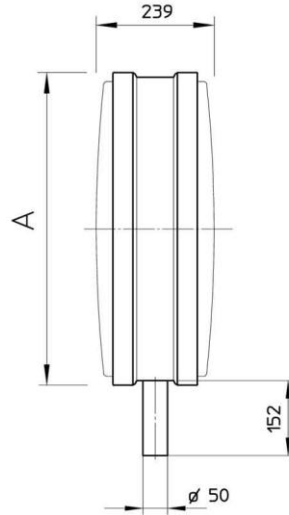
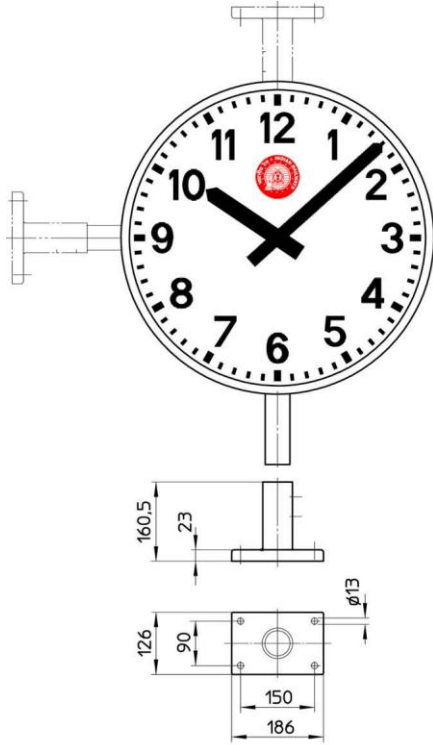
18.0 Schematic Diagram of Analog Clocks for Indoor Application:



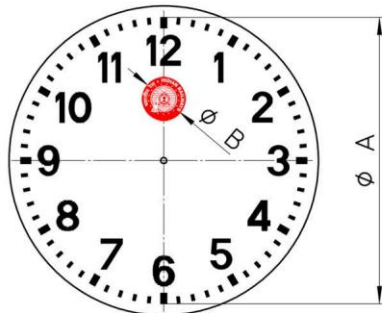
Clock with 80cm diameter (nominal) and optional fixing brackets



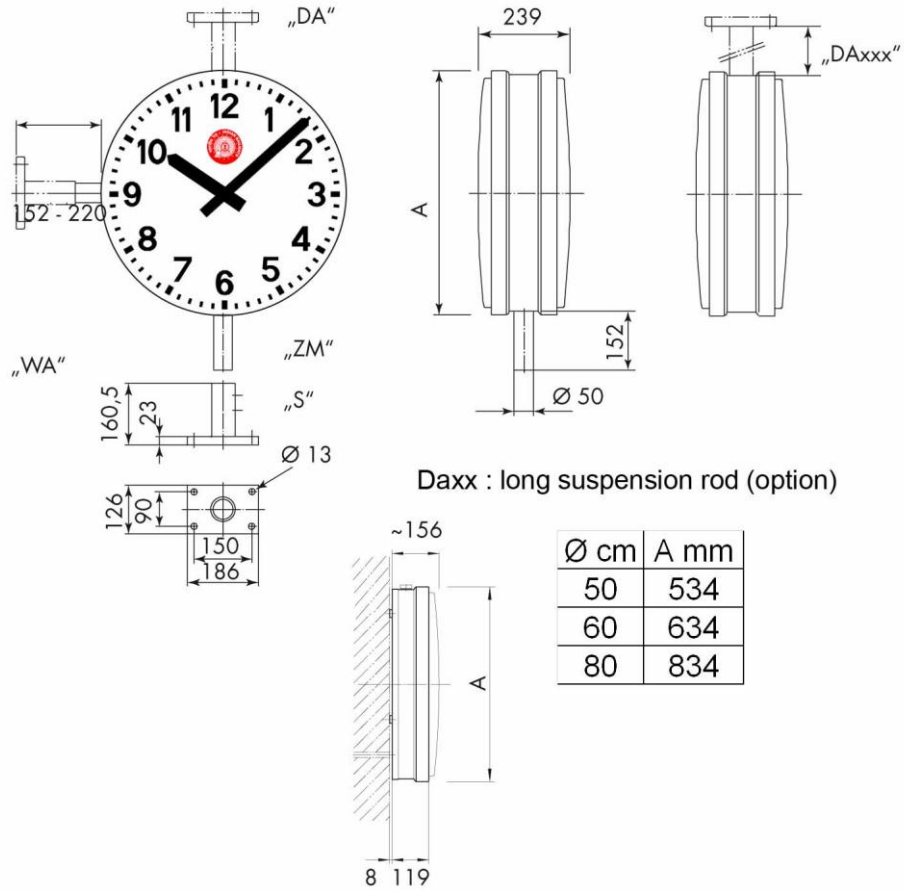
19.0 Schematic Diagram of Analog Clocks for Outdoor and Indoor Application:



\varnothing cm	A mm
50	534
60	634
80	834



\varnothing cm	\varnothing A mm	\varnothing B mm
50	470	70
60	582	82
80	760	110



Clock diameter in cm	Maximum viewing distance in m
50	60
60	70
80	90