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Draft Specification
of
Digital Clock with GPS Synchronization

SPECIFICATION NO. RDSO/SPN/TC/62/2008

Revision 3.0

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Abstract		
<p>This document specifies technical specification of Digital clock with GPS synchronization.</p>		

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I. SUMMARY:

This document covers the technical requirements of Digital Clocks with GPS Synchronization consisting of master clock and digital clocks suitable for platform area & office complexes of Indian Railways.

II. SOURCE:

Draft specification RDSO/ SPN/ TC/ 62/2008, Rev 3.0 has been prepared by RDSO, Lucknow as per Railway Board letter No. 2004/Tele/TCM/1 dated 27/12/2005.

III. FOREWORD:

RDSO/ SPN specification is issued as draft specification. This specification is circulated to customers/ Railways and field inspection units for comments.

In the absence of IRS specification, procurement may be made as per RDSO/ SPN specification.

This specification requires the reference to the following specifications:

IRS: S23	Electrical signaling and interlocking equipment
RDSO/SPN/144	The Safety and reliability requirement of electronic signaling equipment
IS:9000	Basic environmental testing procedures for electronic and electrical items

Wherever, reference to any specifications appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

For the purpose of this specification, the terminology given in IRS: S23 and RDSO/SPN/144 shall apply.

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

Draft Specification of Digital Clock with GPS Synchronization

Draft Specification No: RDSO/SPN/TC/62/2008 (Revision 3.0)

1. SCOPE:

The specification of Digital Clock covers technical requirement of GPS synchronized clock. These clocks are used for displaying correct times at various locations on platforms, in the control & other offices of Railways. It also covers the technical requirement of GPS receiver to be used for synchronization and master clock for synchronization of digital clocks when wired in network.

2. SYSTEM DESCRIPTION:

The digital clocks 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.

The digital clocks shall have a built-in GPS receiver and shall synchronize time as received from the GPS.

Master clock shall be used to synchronize digital clocks when wired in network. In such cases, digital clock will work as slave clock without any GPS receiver.

3. GENERAL SPECIFICATION:

- 3.1 It should be possible to suspend or mount digit clocks below shade/ roof of platforms, station buildings or on a wall or inside a concourse/ main entry of railway station/ buildings.
- 3.2 The digital clocks shall be dust proof, weather proof, waterproof and vibration proof as per IP 54.
- 3.3 Display on the digital clock shall be flicker free.
- 3.4 The display on a digital clock shall be immune from the effect of 25 KV traction line or electro-magnetic induction or any other electro-static induction.
- 3.5 Digital clock shall be covered with U.V. stabilized polycarbonate sheet with thickness of minimum 3mm in order to give good visibility and protection against dust. Single polycarbonate sheet without any joint should cover the clock.

- 3.6 LEDs with equal fringe and uniform intensity are to be used to ensure that the timing to be displayed is with excellent contrast so that no black patches are visible on the display screen of clock.
- 3.7 Digital clock shall be constructed using PCB module of LED matrix. The mechanical mounting of these modules shall be such that easy replacement of PCB module is possible in case of repair. Such replacement shall not call for removing any other PCBs.
- 3.8 The construction of the whole unit of digital clock should be modular, such that any module (i.e. PCB, connector, cable, power supply unit etc.) can be easily removed when defective and a fresh module is fixed to make the system functional again. Wiring between different modules should be done with the help of male/female type of connectors. There should not be any requirement of rewiring, re-soldering/ de-soldering or opening and reconnections of wiring etc. during the maintenance, unless there is damage to the wiring. Proper cable guides are to be provided inside the digital clock for drawing cables and wires neatly.
- 3.9 In digital clock, CPU card, driver modules & power supply modules should be easily accessible. LED modules should be accessible from front side.
- 3.10 The relevant ICs for the digital clock should preferably be of surface mounted device (SMD) to ensure high reliability.
- 3.11 Digital clock shall be capable of working in an ambient temperature range of -10°C to $+70^{\circ}\text{C}$ and relative humidity up to 95% at ambient temperature of 40°C without any degradation.
- 3.12 There should be in-built power supply to work directly on 230V AC with short circuit protection with properly rated fuse at its input.
- 3.13 Digital clocks when wired in network, shall communicate with master clock on a multidrop network.
- 3.14 The digital clock should not display any garbage. All the embedded boards with CPU should have watchdog circuit, which should reset the processor in case the processor goes haywire due to any external disturbance caused by high voltage traction etc.
- 3.15 Material used for the printed circuit board (PCB) shall be copper clad glass epoxy of grade FR-4 or equivalent. The thickness all PCBs shall be minimum 1.6 mm.
- 3.16 CONFORMAL COATINGS: Assembled and tested printed boards should be given a conformal coating to enable them for functioning under adverse environmental conditions. The coating material should be properly chosen to protect the assembly from the following hazards.
- a) Humidity
 - b) Dust and dirt

- c) Airborne contaminants like smoke and chemical vapors
 - d) Conducting particles like metal clips and filings
 - e) Accidental short circuit by dropped tools, fasteners etc.
 - f) Abrasion damage
 - g) Vibration and shock (to a certain extent)
- 3.17 The solder masks (green/black) shall be applied on the solder side and component side of the card.
- 3.18 Following description shall be etched on the component side of the PCB:
- a) Component outline in the proximity of the component
 - b) Manufacturer's name
 - c) PCB name
 - d) Part number
- 3.19 Following description shall be engraved on the PCB:
- a) The manufacturing serial number
 - b) Month and year of manufacture
- 3.20 The display shall be preferably static driven. If multiplexing is used, it should be on digit-by-digit basis and refreshing time should not be more than 20 ms.
- 3.21 5 pair (10 core) color coded & twisted Data Communication Cable, each core made of Copper Conductor of 0.50mm diameter (7/0.20mm) ABC (Annealed Bare Copper) & Polyethylene Insulated having core outer diameter 1.3mm (wall thickness 0.25mm), such 2 core twisted in a pair and such 5 pair laid up & polyester taped, 0.6 mm ATC (Annealed Tinned Copper) Drain Wire, overlapped with Aluminum Foil for screening, polyester tape, grey color PVC outer sheath of wall thickness 1.3 mm should be provided for the data communication wherever required. Tolerance in dimensions should be within $\pm 10\%$.
- 3.22 All the data communication physical links shall be opto isolated along with Class-D surge protection.

4. SPECIFICATION OF LED:

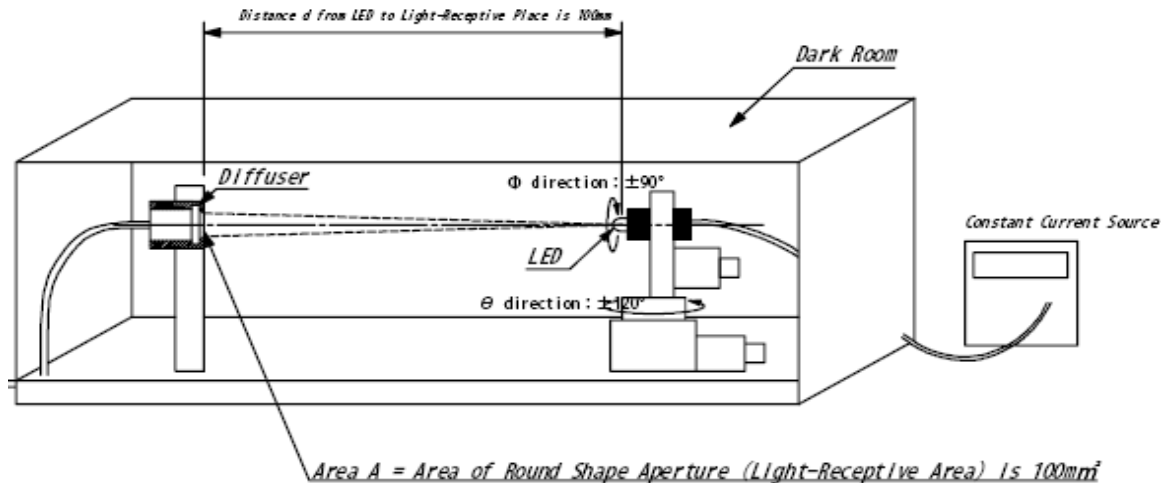
- 4.1 Super bright RED or ORANGE or GREEN or BLUE color LEDs of uniform intensity are to be used for longer visibility in digital clocks. Color of LED is to be specified by the railways/ purchaser. The intensity of the illumination should be such that it shall be possible to read the clock timings clearly from a distance of minimum 50 meters. This visibility is to be checked and ensured for that part/ spot of clock which has maximum intensity of ambient light.

4.2 LED Specification:

Diffused/ Colorless clear Red or Orange or Green or Blue color LEDs (Light Emitting Diodes) should meet following parameters.

S.No	Parameters	Red LED	Orange LED	Green LED	Blue LED
1	Size	5 mm Oval Radial	5 mm Oval Radial	5 mm Oval Radial	5 mm Oval Radial
2	LED Type	Diffused/ Colorless clear	Diffused/ Colorless Clear	Diffused/ Colorless Clear	Diffused/ Colorless Clear
3	Color	Red	Orange	Green	Blue
4	Wave Length	626+/-10nm	605+/- 10nm	525+/-10nm	470+/-10nm
5	Viewing Angle (50% I _v in mcd)	Horizontal: 60° (Minimum) Vertical: 25° (Minimum)	Horizontal: 60° (Minimum) Vertical: 25° (Minimum)	Horizontal: 60° (Minimum) Vertical: 25° (Minimum)	Horizontal: 60° (Minimum) Vertical: 25° (Minimum)
6	Luminous Intensity @ 20mA biased current	500 mcd	500 mcd	1400 mcd	600 mcd
7	Operating Temperature	- 30°C to +85°C	- 30°C to +85°C	- 30°C to +85°C	- 30°C to +85°C
8	Make	Avago/ Nichia/ OSRAM	Avago/ Nichia/ OSRAM	Avago/ Nichia/ OSRAM	Avago/ Nichia/ OSRAM

4.3 Viewing Angle of LED:



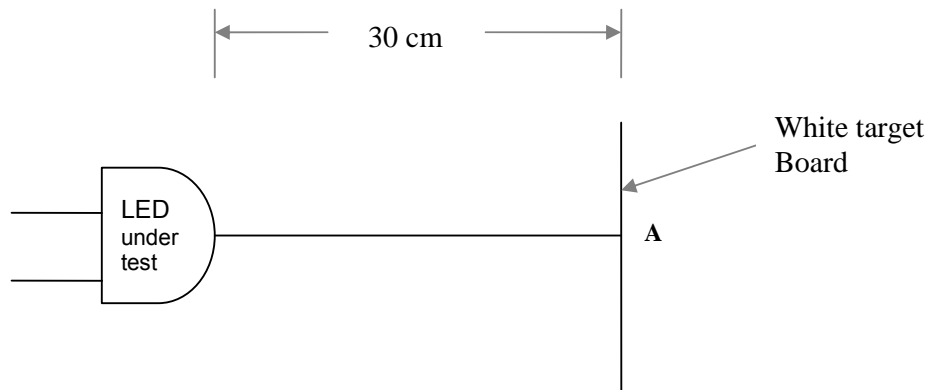
4.3.1 Connect the LED under test as shown in the above set up in a dark room.

- 4.3.2 Bias the LED such that the rated current flows in the LED under test.
- 4.3.3 Adjust the distance between the tip of the LED and Chromo meter or Spectrometer diffuser to 10 cm exactly.
- 4.3.4 Place the Chromo meter or Spectrometer to measure the intensity in Lux in the position indicated in the setup. Rotate the LED so that the chromo meter or Spectrometer records maximum Lux. Record this value and position of LED in degrees.
- 4.3.5 Rotate the LED in Horizontal (X-direction) to a point, at which the Lux reading is half of the value that was observed in the clause 4.3.4. Record the position of LED in degrees. Calculate the degrees the LED was rotated from the maximum intensity value to half intensity value. Record this value as θ_a (Theta). Similarly rotate the LED in opposite direction from the maximum intensity value and mark the point where the Lux value observed is half the value to the one observed in the center. Calculate the rotation in degrees from maximum Lux value and record this value as θ_b .

4.4 Calculation of dispersion Angle:

$$\text{Dispersion Angle} = \theta_a + \theta_b$$

4.5 Intensity of LED in mcd:



- 4.5.1 Connect the LED under test as shown in the above set up in a dark room.
- 4.5.2 Bias the LED such that the rated current flows in the LED under test.
- 4.5.3 Adjust the distance between the tip of the LED and white board to 30 cm exactly.
- 4.5.4 Use the Chromo meter or Spectrometer to measure the intensity in Lux at the center of the pattern formed on the white board due the illumination of the LED. The Value of the Lux observed at the center of the Pattern on the white board is the intensity of the LED in Lux.

Intensity of LED (mcd) = 92.9*Lux value observed at point - A in above setup.

4.6 **Pattern Observation on the White Board:**

The pattern observed on the white board should be uniformly illuminated and free from dark circles. The intensity should be maximum at center and should decrease uniformly from the center as we move radially outward.

4.7 **Biasing of the LED:**

In no case the average forward current shall exceed the limit as specified by the manufacturer for that part.

4.8 Manufacturer shall maintain proper account of LEDs being used. The record shall include various details like source of supply, procurement invoice number & date, quantity, incoming rejection, lot wise consumption etc. which may be verified by the inspecting officials.

4.9 LEDs used in display units of clocks shall be of high quality, procured from reputed manufacturers as mentioned in Clause 4.2. The maximum junction temperature of a LED shall not be less than 100⁰C and epoxy used in the LED shall have UV inhibitors.

4.10 Number of LEDs and their part number shall not be changed without prior approval of RDSO.

5. **SPECIFICATION OF DIGITAL CLOCK SUITABLE FOR PLATFORM AREA:**

5.1 Digital clock should be micro-processor/micro-controller based system. The micro-controller/micro-processor should be of reputed make.

5.2 Digital clock should have built-in GPS receiver in stand-alone mode with minimum specifications as specified in Clause 8.0 of this document. A Gold plated SMA connector shall be provided to connect GPS antenna.

5.3 The system should have a built-in RTC (Real Time Clock) using a self-contained module having following minimum specifications:

- a) It should be microprocessor bus oriented.
- b) Self contained sub system should include Lithium, Quartz & support circuitry.
- c) It should be non volatile with over 8 years of retention of data in absence of power.
- d) The accuracy should be in order of plus or minus ONE minute per month.

- 5.4 The system shall continuously display time maintained by the local RTC. This RTC shall be adjusted at least once in one minute to the time received from the GPS receiver or master clock. In case no GPS data is available, the clock shall display the local RTC time.
- 5.5 Communication status with GPS receiver shall be indicated with a blinking LED.
- 5.6 System should operate satisfactorily between operating temperature of -10°C to 70°C .
- 5.7 System should work satisfactory on 160 Volts – 270 Volts, 50 Hz, single phase power supply with under voltage and over voltage cut off protection. Short circuit protection should be provided for the power supply.
- 5.8 Complete system shall be housed inside powder coated enclosure made of galvanized MS sheet of minimum 16 SWG in black color or otherwise specified by purchaser.
- 5.9 Suitable arrangement shall be made for installing & hanging the digital clock as per site requirement and as specified by purchaser.
- 5.10 The system shall be made up of three distinct modules consisting of micro-processor/micro-controller module with GPS receiver when designed for stand alone mode, SMPS Power supply module and Display modules. The various modules shall be interconnected appropriately, such that replacement of any module shall not call for any de-soldering. Number of interconnecting wires shall be kept a minimum.
- 5.11 In data communication lines, Class “D” surge protection circuit and in power supply lines, Class “C” protection should be provided.
- 5.12 A test switch to check the display should be provided on one side of clock. When this switch is pressed the clock should display 88:88.
- 5.13 To protect the digital clock, a shade having angle of preferably 15° downward with respect to ground should be provided in such a way that it should not obstruct the view of clock.
- 5.14 Time shall be shown in Hours, Minutes separated by flashing colon indicating seconds. The time format shall be either 24 hour or 12 hour format with help of selection.
- 5.15 Digital clock suitable for platform area should either work in stand alone mode or in networking mode driven by master clock as specified by purchaser. In case of stand alone mode, each clock has to be provided with GPS receiver and in networking mode, only master clock is to be provided with GPS receiver.
- 5.16 Digital clock shall be as per schematic illustrated in diagram 1 and shall comply following specification:

Features	Description
Display type	Seven segment LED matrix
No. of sides	Single or Double sided (As specified by purchaser)
Size of LED display modules	As per details given in Diagram 1.
Specification of LED	As per Clause 4.2
Pitch of LED	10 mm \pm 1.0 mm
Number of Lines of LEDs in each segment of seven segment LED matrix	3 lines
Size of Seven Segment LED Matrix	320 mm (H) X 150 mm (W) \pm 1%
LED color	RED/GREEN/ORANGE/BLUE
Format	24 Hrs. or 12 Hrs. Format (88: 88)
Seconds display	Flashing colon with two dots of seven LEDs in a circular shape between HH and MM
Overall maximum housing dimensions	510 mm (H) X 1200 mm (L) X 250 mm (D) for single sided and 510 mm (H) X 1200 mm (L) X 300 mm (D) for double sided
Working Power Supply range	160V to 270V AC, 50 Hz.
Operating Temperature	-10 ⁰ to 70 ⁰ C
Humidity	0% - 95% - non condensing
Enclosure Material	Galvanized MS sheet metal structure of at least 16 SWG with display areas covered with UV stabilized Polycarbonate sheet of minimum 3mm thickness.

6. SPECIFICATION OF DIGITAL CLOCK SUITABLE FOR OFFICE COMPLEX:

- 6.1 Digital clocks suitable for office complex are to be provided mainly in control offices, station master offices, RRI cabin etc. or as specified by purchaser.
- 6.2 Digital clock suitable for office complex shall comply clauses 5.1 to 5.9.
- 6.3 The system can be made up of three modules as micro-processor/micro-controller module with GPS receiver when designed for stand alone mode, SMPS power supply module and display modules. The micro-processor/micro-controller module and display module can be combined as single module to optimize the clock size. The various modules shall be interconnected appropriately, such that replacement of any module shall not call for any de-soldering. Number of interconnecting wires shall be kept a minimum.
- 6.4 In data communication lines, Class "D" surge protection circuit should be provided.
- 6.5 Time shall be shown in Hours, Minutes and seconds separated by flashing colon. The time format shall be either 24 hour or 12 hour format with help of selection.

- 6.6 A test switch to check the display should be provided on one side of clock. When this switch is pressed the clock should display 88:88:88.
- 6.7 Digital clock display shall be LED type made of seven segment display matrix. Matrix should be made of six corner LEDs and seven segments in which each segment should be made of three LEDs in single line with 8.0 mm ± 1.0 mm pitch. All six corner LEDs and seven segments should be individually controlled. Each digit size shall be 70 mm ± 2.0 mm in height & 37 mm ± 2.0 mm in width.
- 6.8 Digital clock suitable for office complex should either work in stand alone mode or in networking mode driven by master clock as specified by purchaser. In case of stand alone mode, each clock has to be provided with GPS receiver and in networking mode, only master clock is to be provided with GPS receiver.
- 6.9 Digital clock shall be as per schematic illustrated in diagram 2 and shall comply following specification:

Features	Description
Display type	Seven segment Display Matrix
No. of sides	Single sided
Size of LED display modules	As per details given in Diagram 2.
Specification of LED	As per Clause 4.2
Pitch of LED	8 mm ± 1.0 mm
Size of Seven Segment LED Matrix	70 mm (H) X 37 mm (W) ± 2 mm
LED color	RED/GREEN/ORANGE/BLUE
Format	24 Hrs. or 12 Hrs. Format (88 : 88 : 88)
Seconds display	Flashing colon with dots between HH, MM and SS
Overall maximum housing dimensions	150 mm (H) X 420 mm (L) X 100 mm (D)
Working Power Supply range	160V to 270V AC, 50 Hz.
Operating Temperature	-10 ⁰ to 70 ⁰ C
Humidity	0% - 95% - non condensing
Enclosure Material	Galvanized MS sheet metal structure of at least 16 SWG with display areas covered with UV stabilized Polycarbonate sheet of minimum 3mm thickness.

7. SPECIFICATION OF MASTER CLOCK:

- 7.1 Master clock should be micro-processor/micro-controller based system. The micro-controller/micro-processor should be with minimum 8 bit CPU of reputed make.

- 7.2 Master clock should have built-in GPS receiver with minimum specifications as specified in Clause 8.0 of this document. A Gold plated SMA connector shall be provided to connect GPS antenna.

In case the master clock is physically situated where clear sky access is not possible and/or the RF cable length requirement exceeds standard length, the GPS receiver should be enclosed in a separate enclosure and placed near the Antenna. The GPS information shall be sent to Master Clock through proper serial interface. The GPS receiver should be powered from the Master Clock.

- 7.3 Master clock should have a built-in RTC (Real Time Clock) using a self contained module having following minimum specifications:
- a) It should be microprocessor bus oriented.
 - b) Self contained sub system should include Lithium, Quartz & support circuitry.
 - c) It should be non volatile with over 8 years of retention of data in absence of power.
 - d) The accuracy should be in order of plus or minus ONE minute per month.
- 7.4 Master clock shall continuously display time maintained by the local RTC. This RTC shall be adjusted at least once in one minute to the time received from the GPS receiver. In case no GPS data is available, the clock shall display the local RTC time.
- 7.5 Communication status with GPS receiver shall be indicated with a blinking LED.
- 7.6 Display format of master clock should of 7 segment display having 12 mm minimum digit height, red display color and 7 segment solid state display device.
- 7.7 Time should be in 24 Hours mode. There should also be provision for 12 Hours mode. Time is to be shown in Hours, Minute & second. There shall also be provision of time setting.
- 7.8 The master clock should be of multi port serial communication device to which digital clocks are to be interfaced. Master clock should be able to drive minimum 32 digital clocks. Depending upon requirement of additional digital clocks, ports of master clock are to be increased. The connectors for the data should be of type 9D.
- 7.9 The serial port connection to the digital clocks should be daisy chained and in case of a failure (like power down) of a particular digital clock, the extension of communication link should not be affected. Also in case of removal of any digital clock for repair, the input and output connectors should be mate-able to extend the communication link.

- 7.10 Master clock shall be made of distinct modules consisting of micro-processor/micro-controller module with GPS receiver, SMPS power supply module and display modules. The various modules shall be interconnected appropriately, such that replacement of any module shall not call for any de-soldering. Number of interconnecting wires shall also be kept a minimum.
- 7.11 System should operate satisfactorily between operating temperature of -10°C to 70°C .
- 7.12 System should work satisfactory on 160 Volts – 270 Volts, 50 Hz, single phase power supply with under voltage and over voltage cut off protection. Short circuit protection should be provided for the power supply.
- 7.13 In data communication lines, Class “D” surge protection circuit should be provided.
- 7.14 Complete system shall be housed inside powder coated enclosure made of galvanized MS sheet of minimum 16 SWG in black/grey color or Standard Euro rack or otherwise as specified by purchaser.
- 7.15 Master clock should be either rack mountable or wall mountable as specified by purchaser.
- 7.16 A test switch to check the display should be provided on master clock. When this switch is pressed the clock should display 88:88:88.
- 7.17 All digital clocks working as slave clocks and connected to the master clock should be synchronized with the time of the master clock.
- 7.18 In case of failure of any particular port of master clock, the spare port can be used immediately and the system should start functioning with minimum down time.
- 7.19 Each port of master clock should have LED indications for monitoring the communication health of that port and digital clocks connected on that port. The LED should glow red when link is failed and green when link is OK.
- 7.20 Proper communication protocols shall be provided to establish error free communication between the port and the corresponding system interfaced with that port.
- 7.21 Necessary diagnostic routines shall be provided with the help of which the faulty ports can be identified so that the necessary action can be taken to rectify the same.
- 7.22 The communication shall be in full duplex and master clock shall be able to recognize the connectivity with digital clocks working as slave clocks.
- 7.23 Diagnostic methods for testing different peripherals and communication ports shall be provided.

8. SPECIFICATION OF GPS RECEIVER:

8.1 GPS Receiver should have following minimum specification:

8.1.1 L1 frequency, C/A code, 8-channel (minimum) continuous tracking receiver.

8.1.2 1Hz update rate.

8.1.3 It should support NMEA protocols on serial port with configurable baud rate (TTL level)

8.1.4 Fully Compatible with SPS and accuracy should be better than 10 ms.

8.1.5 Reacquisition time better than 2 sec (90%).

8.1.6 Hot Start better than 15 sec (90%).

8.1.7 Warm Start better than 50 sec (90%).

8.1.8 Cold Start better than 180 sec (90%).

8.1.9 Antenna short circuit protection.

8.1.10 Operating temperature -40°C to +85°C

8.2 GPS Antenna: It shall be provided with either magnetic mounting or screw (fixed) mounting with micro-patch, active antenna powered from the receiver module itself as per site requirement.

9. POWER SUPPLY:

9.1 Power supply unit shall be operated from AC source ranging from 160 to 270 Volts 50 Hz AC, single phase with over voltage, under voltage and short circuit protection.

9.2 All the power supply units shall be operated at 50% load of maximum working capacity.

9.3 Power supply requirement for master clock and digital clocks shall be as low as possible.

9.4 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.

9.5 Suitable protection against transient coming in the power supply source or generated by some other source shall be provided. Suitable protection against voltage fluctuations of short durations shall also be provided.

9.6 Data Cable and Power Supply cable shall be taken through separate pipes/ conduits wherever required.

10. 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 For inspection of material, relevant clauses of IRS: S 23 and RDSO/SPN/144 shall apply.

10.1.3 Inspection and testing shall be carried out to the effect that all requirements of this specification are complied with.

10.1.4 Inspection shall be carried out for digital clocks suitable for platform area & office complex 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:

- (a) Visual inspection (Clause 11.1)
- (b) Insulation Resistance Test (Clause 11.2)
- (c) Applied High Voltage Test (Clause 11.3)
- (d) Environmental/ Climate Tests (Clause 11.4)
- (e) Performance Test (Clause 11.5)
- (f) Endurance test (Clause 11.6.1)
- (g) Card-level functional tests on all the cards.
- (h) System level functional tests.
- (i) LED parameter tests (Clause 11.7)

10.2.2 One double sided digital clock suitable for platform area, one digital clock suitable for office complex and one master clock 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 Separate enclosure of digital clock for platform area is to be fabricated suitable for keeping inside the environmental chamber for carrying out endurance and environmental/climatic tests. This clock shall be double sided with HOUR display modules along with flashing colon for SECOND on one side and MINUTE display modules on other side using same electronics of digital clock suitable for platform area. Display modules and electronics of this clock shall be placed in the double sided Platform Clock for carrying out other tests and to be submitted to RDSO.

10.2.4 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)
- vi) LED parameter test (Clause 11.7)

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.
- vi) Performance Test (Clause 11.5)
- vii) LED parameter test (Clause 11.7)

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

11. 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:

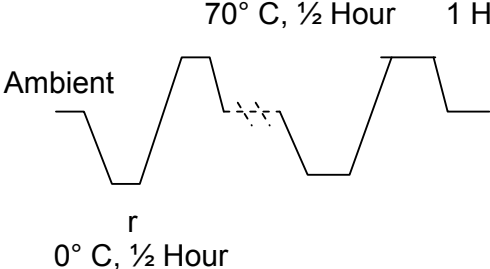
11.4.1 The digital & master clocks shall be capable of working in non-air conditioned environment in the field.

11.4.2 The 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 digital & 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.	
	<div style="text-align: center;">  <p style="text-align: center;">70° C, ½ Hour 1 Hour</p> <p style="text-align: center;">Ambient</p> <p style="text-align: center;">r</p> <p style="text-align: center;">0° C, ½ Hour</p> </div> ❖ 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 for LED without giving any deterioration in light output.

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 for LED without giving any deterioration in light output

11.7 LED Parameter Test:

11.7.1 The parameters of LED are to be tested as specified in Clause 4.2 for all the tests as mentioned below.

- i) For type test, one LED from each LED module of Hours & Minutes from each side of Digital Clock suitable for platform area and two LEDs from Digital Clock suitable for office complex shall be tested.
- ii) For acceptance test, one LED from each side of digital clock suitable for platform area and one LED from 5 nos. of digital clocks suitable for office complex shall be tested as per sampling plan mentioned in Clause 10.3.1.
- iii) For routine test, one LED from a batch of 1000 LEDs shall be tested. If it fails, then total batch of LEDs shall be tested, of which if more than 1% of LEDs fails, then entire batch of LEDs shall be rejected.

12. 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. 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. 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.
- 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. 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 Digital Clock suitable for platform area (Either networking mode or stand alone mode)	As per site requirement
1.b	Single Sided Digital Clock suitable for platform area (Either networking mode or stand alone mode)	As per site requirement
2	Digital Clock suitable for Office Complex (Either networking mode or stand alone mode)	As per site requirement
3	Color of LEDs: Red or Orange or Green or Blue.	As specified by the purchaser
4	Master Clock for working of digital 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

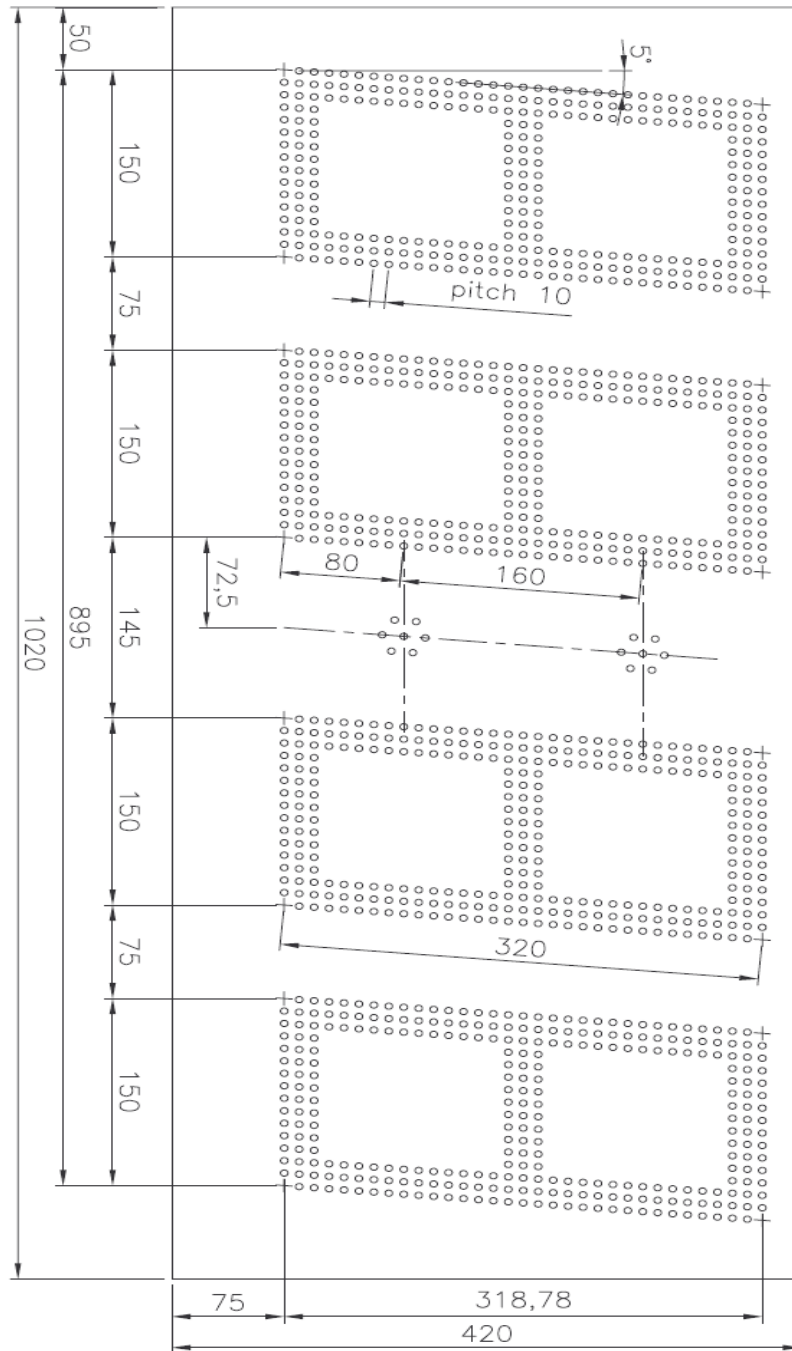
16. TRAINING:

- 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. DIAGRAMS:

Detailed construction diagrams of Digital Clock suitable for platform area (single sided and double sided) and Digital Clock suitable for office complex are to be approved by RDSO before starting manufacturing.

18. Schematic Diagram of Digital Clock suitable for Platform Area:



(Tolerance in Dimensions ± 5 mm)

Diagram – 1 (All dimensions in mm)

19. Schematic Diagram of Digital Clock suitable for Office Complex:

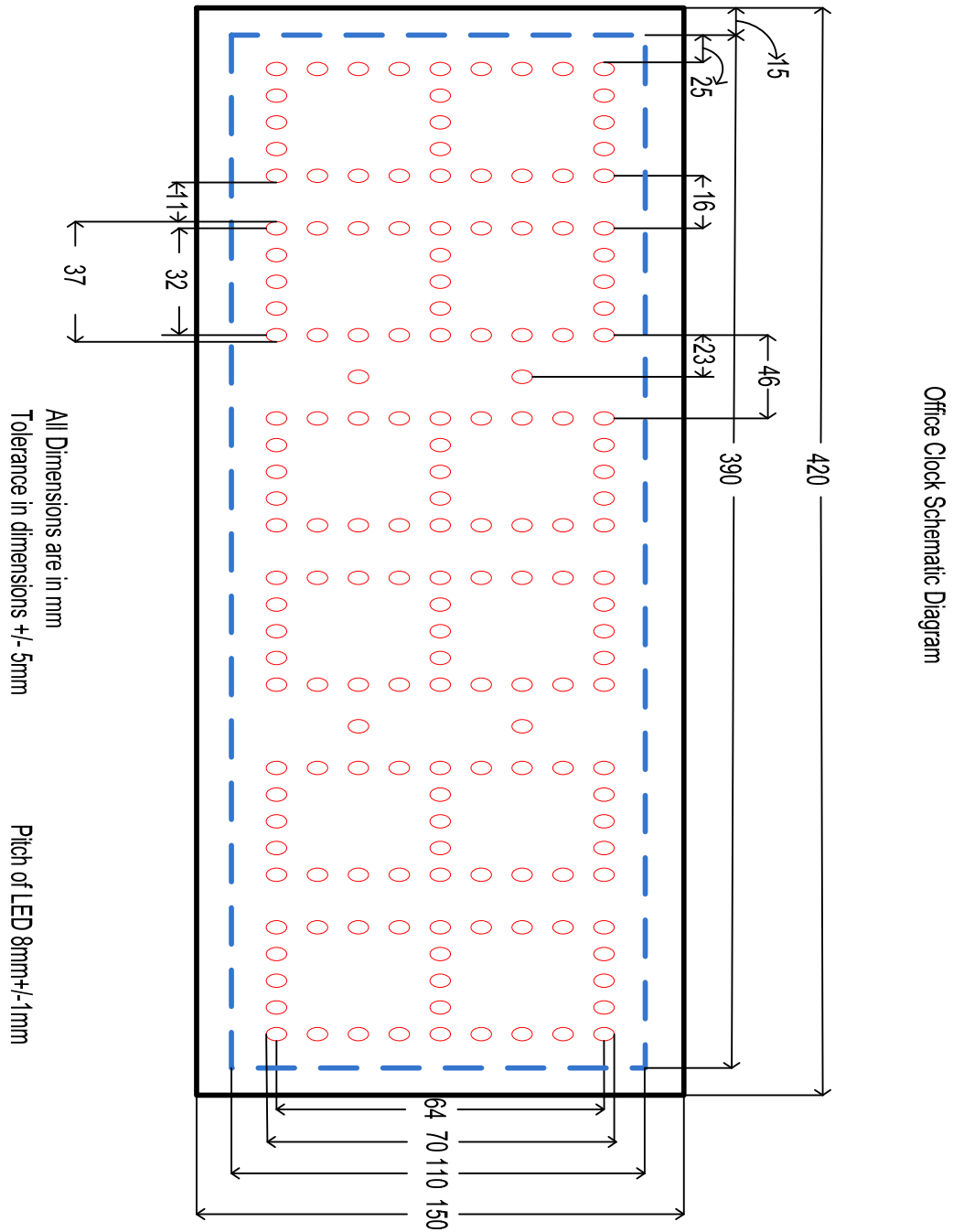


Diagram – 2 (All dimensions in mm)

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