

Section 27 53 13
WIRELESS SYNCHRONIZED CLOCK SYSTEM
Design Standards

PART 1 GENERAL**1.1 SUMMARY**

- A. Section Includes: Wireless synchronized time system.
- B. Related Divisions and Sections
 - 1. Comply with the Related Sections paragraph of Section 270000.
 - 2. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.
 - 3. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

1.2 REFERENCES

- A. Comply with the References requirements of Section 270000.
- B. In addition to those codes, standards, etc., list in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Underwriters Laboratories
 - a. UL 863, "Time-Indicating and -Recording Appliances" applies to Primex XR digital clock series; confirm for other systems

1.3 DEFINITIONS

- A. Definitions as described in Section 270000 shall apply to this section.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:
 - 1. "DST": Daylight Saving Time
 - 2. "Elapsed Timer": a digital clock that counts up or down controlled by a switch controller (start, stop, reset, mode, etc)
 - 3. "FCC": Federal Communications Commission
 - 4. "GPS": Global Positioning System
 - 5. "LAN": Local Area Network
 - 6. "NIST": National Institute of Standards and Technology
 - 7. "NTP": Network Time Protocol
 - 8. "Time Device": a device that synchronizes time with the primary transmitter/synchronized time controller (e.g., clock, elapsed timer display, etc)
 - 9. "RF": Radio Frequency
 - 10. "SNTP": Simple Network Time Protocol
 - 11. "UTC": Universal Coordinated Time

1.4 SYSTEM DESCRIPTION

- A. The work of this section includes equipment, materials, accessories, fasteners, etc., and the labor and associated services necessary for a complete working wireless synchronized clock system, herein the System, and includes coordination through the General Contractor with other trades.
- B. Regulatory Requirements:
1. The System shall comply with Part 90 of FCC rules as follows:
 - a. Time devices shall not cause harmful interference.
 - b. Time devices must tolerate RF interference, yet continue (or recover to) normal operation.
 - c. Transmitter frequency shall be governed by FCC Part 90.35.
 - d. Transmitter output power shall be governed by FCC Part 90 257 (b).
 2. The System operates in the 72MHz transmitter band and thus requires a license granted by the FCC, known as a "Radio Station Authorization" (Form FCC 601 – LM), to ensure a safe and interference free operation for users. The work includes applying for and obtaining the required operators license. This license will be issued to and held by the Owner. This license grants the end user protected use for wireless transmission at the designated frequency. This license will designate a unique "call sign" for each end user.
- C. System includes the following components:
1. GPS antenna (as time signal receiver)
 2. Primary Transmitter / Time Synchronization Controller
 3. Repeater Transmitters
 4. Wireless clocks - analog clocks, digital clocks, timers, elapsed timers code blue elapsed timers
 5. Wire guards
- D. Time Source: The System shall have a single, continuous time source. The time source shall be GPS receiver. The time source shall synchronize to UTC.
- E. Accuracy Tolerance Requirements:
1. Clocks shall continuously indicate accurate time within 0.35 seconds (+/-) over a 24-hour period.
 2. Time Synchronization: The System shall synchronize time devices to within 10 milliseconds of the time source. Digital time devices shall synchronize no greater than 10 minute intervals and analog time devices no greater than 6 times per day.
- F. System Resiliency
1. The System shall have no single point of failure; i.e., the failure of any single component shall not cause failure of the System. Upon repair of failed component, the System shall automatically resume normal operation without the need to manually reset any component.
 2. The System shall have an internal time reference so that a failed connection to the time source shall not result in clocks failing to indicate the correct time.

3. The transmitters shall have an internal battery backup so that in the event of a power failure settings and correct time will be instantly recalled upon restoration of power.
 4. Clocks shall continue accurate time if the clocks stop receiving valid time signals. When a valid time signal is received, clocks shall resume normal operation.
- G. System Features and Operation:
1. The System transmitter shall be capable of variable power output levels (to provide variable coverage areas).
 2. DST Adjustment: The System, including clocks, shall automatically adjust for DST.
 3. Clocks:
 - a. Clocks shall be analog.
 - b. Clocks shall synchronize with the time source via the wireless transmission system.
- H. Time Source
1. GPS Time Source: The System shall include a GPS antenna/receiver obtain a time signal from GPS satellites in orbit to determine position and UTC time. The GPS receiver shall receive time data and synchronize this time to the primary transmitter/synchronized time controller.
- I. Work Covered Under Other Sections
1. Conduit, back boxes, and sleeves
 2. Power (e.g., 120VAC)
 3. Racks (for mounting transmitter/equipment)

1.5 SUBMITTALS

- A. Comply with the Submittal requirements of Section 270000.
- B. Quantity: Furnish quantities of each submittal as noted in Section 270000.
- C. Substitutions: Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.
- D. Manufacturer Certification: Submit on manufacturer's letterhead evidence of certification to design, install, and commission the System of this section.
- E. Submittal Requirements at Start of Construction:
1. Product Data Submittal, describing finishes, sizes, and other pertinent aesthetic features as well as functional and operations features describing physical characteristics and method of installation. Submit brochure showing available colors, styles, sizes, and finishes of clocks
 2. Installation Instructions: Submit installation methods, set-up and maintenance instructions.
 3. Shop Drawings, approved by System manufacturer: Prior to installation and during final design, submit shop drawings including the following (at a minimum):
 4. Functional diagram, including equipment/component models
 5. Point-to-point wiring diagram, showing connections, wire types, connection types, etc

6. Floor plans, showing location of system transmitter(s) and locations of time devices including model/type, installation height, mounting method, etc, per device (this can also be in the form of a schedule with keyed tags)
 7. Operating License: Prior to installation, submit evidence of application for FCC Radio Station Authorization. Furnish the license or a copy of the application for the license, to the Owner prior to operating the equipment. Prior to close out, deliver the original license to the Owner.
 8. Test Plan: Prior to testing, submit step-by-step testing method, including metrics to be measured and expected results, and submit cut sheets of test equipment to be used during testing
 9. Installation and Testing Schedule
 10. Test Report: Prior to the punch walk, submit a test report that includes the measured metrics according to the test plan.
 11. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for Division 27.
- F. Submittal Requirements at Close Out:
1. As-Built Drawings, including floor plans showing clock locations and identifiers, timer device locations and identifiers, and other information necessary for the maintenance and troubleshooting of the completed System.
 2. Operations and Maintenance (O&M) Manual, including as-built drawings (17x11), product cut sheets, maintenance instructions, and contact information for warranty service, emergency service, and routine maintenance/service.
 3. Warranty Certificate, including System manufacturer's obligations, services, terms, and conditions.
 4. Spreadsheet containing identifiers. With each identifier, list its location (floor, room number, wall, side/position), description, manufacturer, model number, and (as applicable) date batteries were installed.
- 1.6 QUALITY ASSURANCE
- A. Comply with Quality Assurance requirements of Section 270000.
 - B. Manufacturer's Qualifications: System manufacturer shall have a five year record (minimum) of satisfactory manufacturing and support of systems comparable to basis of design system.
 - C. Electrical components, devices, and accessories shall be UL Listed and labeled per NFPA 70.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Comply with Delivery, Storage and Handling requirements of Section 270000.
- 1.8 WARRANTY
- A. Warrant System to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.
 - B. Manufacturer shall warrant system equipment (GPS receiver, primary transmitter, satellite transmitters, and wireless devices) for one year. Manufacturer offers extended warranties for transmitters and clocks, if desired.

PART 2 PRODUCTS

2.1 GPS RECEIVER

- A. General: The clock system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.
- B. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.
- C. External Antenna model: GPS roof mounted, with 16 foot cable (5m) attached.
- D. Internal Antenna model: GPS roof mounted, with 10 foot cable (3m) attached.
- E. Primex Wireless extension cable available: {50ft (15.25m)}, {100 ft (30.5m)}, {200ft (61m)}.
- F. The GPS Receiver cable must be plenum rated where required by local code.
- G. GPS Receiver: GPS roof mounted with 100 foot cable.
- H. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting.
- I. Provide mounting bracket for attachment to antenna mast structure.

2.2 TRANSMITTERS

- A. Input power requirements: 120 VAC 50/60 Hz
- B. Transmitter shall contain an internal clock such that a failed connection to the time source will not disable the operation of the clocks.
- C. Transmitter shall be capable of a GPS time source and an NTP time source. In GPS time source mode, the transmitter shall have an antenna port connected to a GPS antenna and shall provide power to the GPS antenna via this port. In NTP time source mode, the transmitter shall have an Ethernet port connected to the network to obtain NTP time source.
- D. Transmission:
 - 1. Frequency range: 72.020 to 72.980 MHz
 - 2. Frequency deviation: +/- 4 kHz
 - 3. Carrier frequency stability: +/- 20 ppm
 - 4. Output radio power: +26 to +30 dBm
 - 5. Radio technology: narrowband FM
 - 6. Channel bandwidth: 20 kHz maximum
 - 7. Transition mode: one-way communication
 - 8. Data rate: 2 kbps
- E. Primary Transmitter shall have 49 selectable channels to assure interference-free reception. Secondary Transmitter shall have 16 selectable channels.
- F. Transmitter shall have the following features:
 - 1. Time zone adjustment
 - 2. Daylight Saving Time bypass option

3. 12-hour or 24-hour display
 4. GPS or NTP time source, Local or LAN configuration
 5. UTC+ or UTC-
- G. Transmitter display:
1. Time readout
 2. AM and PM during 12-hour time mode
 3. Day and date readout
 4. Time zone indicator including Standard or Daylight Savings Time
 5. On-screen menu to verify diagnostics, errors, time updates, and switch settings, toggled by sequence of push buttons next to display
 6. Status LEDs
- H. Manufacturers:
1. Primex Wireless
965 Wells Street
 2. Lake Geneva, WI 53147
 3. Or approved equal

2.3 TRANSMITTER / SYNCHRONIZED TIME CONTROLLER

- A. Transmitter shall have the following features:
1. Time source input for GPS and/or NTP (via LAN).
 2. Daylight Saving Time automatic adjustment
 3. 12- and 24-hour, adjustable
 4. UTC+ or UTC-
 5. Internal calendar with leap years
- B. Transmitter shall be UL Listed.
- C. Manufacturers:
1. Primary Transmitter
 - a. Primex Wireless #XR05EM; 5-watt receiver/transmitter with external antenna
 2. Secondary Transmitter
 - a. Primex Wireless #XR01M; 1-watt receiver/transmitter with internal antenna
 - b. Primex Wireless #XR01EM; 1-watt receiver/transmitter with external antenna (100-foot cable)
 - c. Primex Wireless #XR01R; 1-watt repeater/satellite transmitter with internal antenna
 3. Or approved equal

2.4 ANALOG CLOCKS

- A. Analog clocks shall be wall mountable.

- B. Clocks' antennas shall be internal, not visible from its installed position.
- C. Face shall be white. Hour and minute hands shall be black.
- D. Input power: 120 VAC with an 18 inch (45.72cm) cord with two-prong plug
- E. Analog clocks shall keep the time during changing of batteries.
- F. Analog clocks shall automatically adjust for Daylight Saving Time.
- G. Analog clocks shall be assembled with tamper proof/theft resistant fasteners.
- H. Analog clocks shall automatically update time from the primary transmitter 6 times per day.
- I. Upon resumption of power after power loss, analog clocks shall self correct to the current time.
- J. If analog clocks stop receiving valid time signals from the primary transmitter, analog clocks shall continue to function as accurate quartz clocks until a valid time signal is decoded.
- K. Analog clock receivers:
 - 1. Receiver sensitivity: >-110 dBm
 - 2. Antenna gain: -7 dBd
- L. Manufacturers:
 - 1. Primex Wireless XR Traditional Series, 120VAC powered
 - a. #14155E; 12.5" (31.75cm), 120VAC, black
 - b. #14163E; 16" (40.64cm), 120VAC, black, if larger size is required for visibility
 - c. #14289: 12.5" Black, Dual Clock Kit, kit includes a bracket, mounting plate and hardware to easily assemble and install two each 12.5" traditional Series Clocks back to back
 - 2. Primex Wireless XR Traditional Series, Battery powered, if needed
 - a. #14155; 12.5" (31.75cm), black, Battery powered
 - b. #14163; 16" (40.64cm), black, Battery powered, if larger size is required for visibility
 - 3. Or approved equal

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and the system devices.
- B. Do not proceed until unsatisfactory conditions have been corrected.
- C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

- D. Verify that 120 volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.
- E. Elapsed Timer: Verify single gang electrical box for switch control is mounted and within 15 feet (4.5m) of elapsed timer. Verify pathway for connecting cable is available and compliant to local building codes
- F. AC-powered devices: Verify that electrical power outlet is near location of clock or timer and the outlet is operational and properly grounded.

3.3 INSTALLATION

A. General

1. Install system devices in accordance with applicable codes.
2. Install system devices in accordance with Manufacturer written instructions.
3. Provide all system equipment necessary for a complete and operable system.
4. Comply with requirements of Division 27 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling."
5. Cables: Install cables in raceways and cable trays except within consoles, cabinets, and desks [and except in accessible ceiling spaces and framed partitions where exposed wiring is allowed by Owner]. Install plenum cable where required. Conceal cable installation where possible.

B. GPS Unit (INTERNAL Antenna Transmitter Model only):

1. Install GPS unit on roof in location indicated, in clear view of the sky.
2. Install unit in location free from standing water and above accumulations of leaves or debris.
3. Seal cable connection to GPS with cable connection sealant.
4. Any added cable lengths must be protected from outside elements.

C. GPS Unit (EXTERNAL Antenna Transmitter Model only):

1. Locate transmitter in a penthouse, electrical closet or telecommunications room in a central location in the building.
2. Clearance around all side of the transmitter to comply with local building codes.
3. Attach GPS receiver to transmitter using cable.
4. Set GPS/LAN DIP switch to GPS.

D. Transmitter (EXTERNAL Antenna only)

1. Transmitter is connected to external antenna via a 50 ohm coaxial cable. Typical length – 100 feet (30.5m)
2. Cable routing should comply with ANSI EIA/TIA-569 and local building codes.
3. If cable is routed through conduit, the conduit should be a minimum of 2 inch (50.8mm) diameter.
4. Transmitter enclosure must be bonded to an earth ground per ANSI EIA/TIA 607, NEC Article 250, and local building codes.

5. Antenna should be mounted to a mast on the roof of the building connecting to the transmitter via a 50-ohm coaxial cable.
 6. Consult manufacturer instruction manual for specific clearances and mounting instructions.
 7. Antenna must be bonded to an earth ground per ANSI EIA/TIA 607, NEC Article 250, and local building codes.
- E. Transmitter (INTERNAL Antenna only)
1. Locate transmitter where indicated, a minimum of 2 to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.
 2. Transmitter(s) will be placed at locations indicated within specifications and drawings.
 3. Connect antenna to transmitter, using care not to strip threads.
 4. Connect power supply to the transmitter.
 5. Set the channel number on the display to correspond to the FCC license.
 6. Plug power supply into electrical outlet.
- F. Analog Clocks
1. Furnish all equipment necessary for a complete and operational system.
 2. Perform the following operations with each clock:
 3. Configure and set clock to correct time in accordance with manufacturer instructions.
 4. Observe clock until valid signals are received and clock adjusts itself to correct time.
 5. Install each clock per its model mounting specifications per manufacturer instructions and mounting instructions at the indicated location

3.4 LABELING

- A. Prior to installation, obtain written authorization from Owner for identifier assignment. In lieu of such direction, use the following system:
1. Clock
 - a. Prefix: "CLOCK"
 - b. First field: floor; for example: "2".
 - c. Second field: unique sequential 3-digit number; for example: "001".
 - d. Example; "CLOCK 2-001"
- B. Labels shall be permanent
- C. Time Device Requirements: Provide one label per time display. Permanently affix label to time display and position as shown on the Drawings; if not shown on the Drawings, center the label plate on the device's top side surface.

3.5 PRE-FUNCTIONAL TESTING

- A. General: Pre-functional testing shall verify that components are installed correctly, at the correct locations, are not damaged, and are ready for functional testing. Upon complete installation of the System, perform pre-functional testing.
- B. Antenna Unit and Related Wiring
 - 1. Verify the antenna unit is installed in a manner to satisfy the manufacturer's specifications.
 - 2. Verify the antenna unit is security fastened to a structural element, is free from standing water, and above accumulations of leaves or debris.
 - 3. Verify the antenna receiver unit retains a clear view of the sky.
 - 4. Verify weather protecting seals are present at roof or surface penetrations.
- C. Transmitter Units
 - 1. Verify the transmitter unit is installed per the manufacturer's specifications.
 - 2. Verify the transmitter unit is security installed and has no scratches, defects, dents, or other damage.
 - 3. Verify the transmitter's antenna is straight and vertical. Verify the antenna is not be touching any walls, cabling, racks, ceiling or obstructions that would case the antenna to bend or interfere with the performance of the antenna. Verify the antenna is not located around filing cabinets, lockers or metal framed walls.
 - 4. Verify power and signal connections to the primary transmitter / synchronized time controller to ensure no loose connections exist.
 - 5. Verify the transmitter unit is set to the transmission frequency in the registered FCC license for the unit. Verify the transmitter unit is set to the Owner's frequency management policy.
 - 6. Adjust transmitter (time accuracy, 12/24 hour operation, time zone, time-date option) to meet accuracy requirements.
- D. Time Devices / Clocks
 - 1. Visually inspect time devices/clocks. Verify the following:
 - a. Devices are mounted in the correct locations and heights. If the location was modified to suit signal coverage, note the location on the as-built drawing submittal.
 - b. Devices are installed plumb, level and tight against wall surface.
 - c. Devices have no scratches, defects, dents, or other damage
 - 2. For 120VAC powered devices, verify the existence of an adjacent power receptacle.
 - 3. Verify clear view to time devices (e.g., nothing blocks view to the time devices)
 - 4. Clean exposed surfaces of time devices/clocks using cleaning methods recommended by the manufacturer. Remove temporary labels from clock faces. Do not remove manufacturer labels from backs of time devices.
 - 5. Clean areas where drilling or coring has taken place. Ensure no dust, particles, waste materials, trash or otherwise installation produced trash is left behind.
 - 6. Protect finished installation through punch walk and final acceptance.
- E. Documentation

1. Document the pre-functional testing for each component and time device in the System – see documentation sample below (in Part 4 – Testing Forms).
2. After completing pre-functional testing forms, submit to the Owner's Representative and the commissioning agent. Forms not completely filled out will be rejected.
3. Functional testing cannot begin until pre-functional testing forms have been received and approved.

3.6 FUNCTIONAL TESTING

- A. General: Functional testing shall demonstrate beyond reasonable doubt that the System is correctly installed and configured, that the System has no errors, that all installed components meet or exceed performance requirements, and that the System is functioning properly. Should any test fail to show components are satisfactorily installed and properly functioning, make corrections and repeat functional testing.
- B. Test System under normal operating conditions with transmitters, antennas, time devices, and other system components set at their operational location to assure to assure reception of signal and proper operation according to the requirements of this section. Replace defective products.
- C. Transmitter Units
 1. Adjust time to within accuracy parameters of this specification.
 2. Manually remove the antenna connection while the device is powered, replace antenna connection and verify synchronization with master time signal.
 3. Disconnect and reconnect the power source from the unit to verify resynchronization of signal, and operating frequency of transmitter unit.
 4. Verify the unit is registering accurate time code as published with the Time and Frequency Division, NIST or Time and service department, USNO
- D. Time Devices/Clocks
 1. Verify time device has proper power – either battery or 120 VAC – and the power source is fully functioning.
 2. Verify time devices receive signals from the primary transmitter / synchronized time controller and properly processes this signal.
 3. Adjust time devices to meet Owner requirements (time zone, 12/24 hour operation, time-date option).
 4. For digital devices, adjust brightness level to satisfy Owner's requirements.
 5. Using plans showing the location of each time device, walk through the entire project and verify that each time device is fully operational and meets performance requirements. Record onto functional test form the operating condition of each time device, including each clock's identifier.
 6. Manually adjust time out of synchronization with master time transmitter prior to manually instigate resynchronization. Verify the clock device automatically adjusts itself to accurate time.
- E. Documentation
 1. Document the functional testing for each component and time device in the System – see documentation sample below (in Part 4 – Testing Forms).

2. After completing functional testing forms, submit to the Owner's Representative and the commissioning agent. Forms not completely filled out will be rejected.

3.7 PUNCH WALK AND DEMONSTRATION

- A. Set up punch walk with Owner and Engineer to demonstrate System operation.
- B. Punch the Work of this Section compliant to the requirements of Section 270000.
- C. Comply with system acceptance and certification requirements of Section 270000.

3.8 TRAINING

- A. Provide two hours of training to Owner's representatives. Training shall cover, at a minimum, calibrating GPS time receiver, setting and adjusting time devices, programming schedules and events, and routine maintenance.

Pre-Functional Testing Documentation
Section 275313 Wireless Clock System

Date _____

By _____

Room Number	Device ID	Device Description	Status †	Comments

Comments:

1.

2.

† – Status Legend:

“PASS” shall mean all pre-functional requirements have been satisfied (no corrections required)

“FAIL” shall mean corrections are required; “Comments” shall explain actions required to complete corrections

“N/A” shall mean not applicable

“S/N = See Notes in Comment

Functional Testing Documentation

Room Number Clock ID Pass/Fail

Legend:

Tester Initials = PASS Date of Tests

X = FAIL Tester Initials

N/A = Not Applicable Tester Name

SN = See Notes in Comments GCCC/CxA Approval

END OF SECTION