

Special Specification 6432

Advanced Warning End of Green System (AWEGS) Wireless



1. DESCRIPTION

Furnish and install Advanced Warning End of Green System (AWEGS) with wireless remote devices, as shown on the plans, or as directed by the Engineer.

The system will detect when each approach is transitioning yellow, or red (non-green) and trigger flashing beacons and static signs to alert the approaching drivers to be prepared to stop at the intersection they are approaching. The system will be AC or DC powered, as shown on the plans. The system will operate 24 hrs. per day, 7 days per week and will flash amber beacons on the highway at a specified time just before or right at non-green condition becomes present for each of the defined intersection approaches.

2. MATERIALS

Ensure the system is comprised of all items of hardware, software, interconnect cabling, radios, antennas, mountings, and cabinets and enclosures required to provide an operational system to detect and warn vehicles for each approach to the intersection, as shown on the plans or as directed. The interconnect between the Traffic Signal Controller Cabinet and the AWEGS deployed will be 900 MHz wireless communication. The equipment furnished and installed under this section must include the following:

- radio master transmitters and remote receivers, with matching antenna kits,
- advanced Software, required for monitoring data from the system,
- traffic Signal approach status detectors,
- LED beacons and static signs,
- Roadside Flashing Beacon Assemblies (or AC or Solar – per plans),
- controller enclosures and ancillary equipment,
- mounting hardware, and
- cabling as required.

Ensure that the materials and construction methods comply with the details shown on the plans or as directed, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 624, "Ground Boxes"
- Item 636, "Signs"
- Item 644, "Small Roadside Sign Assemblies"
- Item 680, "Highway Traffic Signals"
- Item 685, "Roadside Flashing Beacon Assemblies."

Provide prequalified flasher controller assemblies from the Department's MPL in accordance with [DMS-11160](#), "Flasher Controller Assembly."

When shown on the plans or as directed, provide prequalified solar powered flasher controller assemblies from the Department's MPL in accordance with [DMS-11150](#), "Solar Power Flasher Controller Assembly."

Materials referenced under this Specification are new, corrosion resistant, and in strict accordance with the details shown on the plans or as directed. Materials used in the assembly of this system must be pre-approved by the TxDOT Traffic Operations Division (<https://ftp.txdot.gov/pub/txdot-info/cmd/mpl/qtrfsgieqgp.pdf>)

3. EQUIPMENT

3.1. AWEGS. Wireless “End of Green” Master Assembly.

3.1.1. Traffic Signal Cabinet. “End of Green” Detection.

3.1.1.1. **Detector Performance.** Provide a complete system that will identify when a specified movement or phase is about to transition from permissive (green) to non-permissive (yellow and red). This detection of the color change of the approach must be concurrent with the flashing beacons on the AWEGS advanced beacon locations associated for each approach defined in the plans. The beacons must remain engaged until the next permissive (green) is presented on the approach detailed on the plans. Alignment of the phase detection must be directional such that only the approaching AWEGS beacons activate per design. If multiple AWEGS for each direction or approach at an intersection (per plans), the alignment and design function independent for each approach. Design must fail-safe to constant flash, should the communication to the advanced beacon be disrupted. Furnish units with a detection unit installed inside the Traffic Signal Cabinet, as approved by the Engineer.

3.1.2. Interconnect for Wireless AWEGS Communication to Advanced Beacons.

3.1.2.1. **Radio Master Units.** Furnish shelf-mountable units with power requirements of 6 to 30VDC (or Transformer for 120VAC to DC) with maximum overall size of 4.5 in. Width x 4.5 in. Length x 2.0 in. Height. The transponder radios will work in the 900 MHz band and will be able to transmit to a minimum of four (4) AWEGS system per cabinet. The unit includes an RJ-45 port for IP-configuration and must be configurable to be compatible with the Districts radio beacon network. The transponder units must be capable of receiving instructions from the traffic signal controller that an approach is about to transition and should transmit a contact-closure output to the appropriate AWEGS remote location for that approach. Unless otherwise approved, furnish units that are NEMA TS2 temperature rated and approved by the TXDOT TRF for use with 900 Mhz systems.

3.1.2.2. **Atypical.** Installation of runs over 150 ft. will be provisioned by “LF” and paid as a separate item for conduit, electrical conductors, etc., as shown in the payment section and shown in the plans or as directed.

3.2. AWEGS. Wireless “End of Green” Remote Sign and Beacon Assemblies.

3.2.1. **Solar Radio Remoter Units.** Furnish radios and equipment for the remote locations from the same manufacturer of the master location. Provide back-panel-mounted units with solar power charger and power management to provide 6 to 30 VDC which fit within the cabinet provided for each AWEGS remote location. These remote units will provide control over the 120 VAC flashing beacons. Remote controllers will be capable of transmitting current condition of each output (LED Beacon 1 and LED Beacon 2) back to the Radio Master location. Remote units will be capable of unique identification such that the master can determine which AWEGS beacons to flash by which approach is transitioning.

3.2.2. **AC Radio Remote Units.** Furnish radios and equipment for the remote locations from the same manufacturer of the master location. Provide back-panel-mounted units with power requirements of 6 to 30 VDC (or Transformer for 120 VAC to DC) which fit within the cabinet provided for each AWEGS remote location. These remote units will provide control over the 120 VAC flashing beacons. Remote controllers will be capable of transmitting current condition of each output (LED Beacon 1 and LED Beacon 2) back to the Radio Master location. Remote units will be capable of unique identification such that the master can determine which AWEGS beacons to flash by which approach is transitioning.

- 3.2.3. **Radio Remote Units - Antenna.** The communications media and antenna must be provided by or approved by the radio manufacturer. Furnish and install a 10-db gain YAGI-directional antenna mounted at the highest location available on the AWEGS remote beacon installation controller cabinet is mounted. The Yagi and mounting equipment will be provided or approved by the radio manufacturer. Typically, these are going to be the highest point on the pole nearest the cabinet to establish best communication path with Master AWEGS location. The communications media between the antenna and the vertical back-mounted remote radio should be LMR 400 and will include a "polyphaser" surge protection device inside the AWEGS flasher cabinet along with a manufacturer provided whip to connect from the surge suppression device to the radio itself. The 50 ft. LMR run, terminated on each end for connection to the Yagi and to a polyphaser surge suppression device will be provided by the manufacturer, unless otherwise shown in the plans or as directed. Installation of the Yagi remote antenna will not be paid for separately from the installation of the AWEGS Wireless Remote item.
- 3.2.4. **Radio Remote GPS Locator Antenna.** Each remote-control radio will include a GPS antenna and 5 ft. whip, provided by radio manufacturer. Drill, silicone, and install GPS antenna atop the AWEGS flasher control cabinet. Each AWEGS remote flasher cabinet with a remote radio installed will have GPS to display location and synchronize radios per manufacturer. Installation of the GPS remote antenna will not be paid for separately from the installation of the AWEGS Wireless Remote item
- 3.2.5. **AWEGS Wireless Control Panels.** The system will have provisions for on, off, and auto to test AC or DC flashing beacon capabilities, as selected on the plans. All back panels will have on-board LED mounted displays indicating output status for both flasher outputs. All back panels will have a 12VDC output terminals available for auxiliary device connections.
- 3.2.6. **Solar Control Panels.** Provide TxDOT Approved MPL DMS-11150, "SOLAR POWERED FLASHER CONTROLLER ASSEMBLY" units. Solar control panel that will mount on back-panel inside a dual-battery cabinet. The solar charge controller will be fully automatic for maintaining the battery at the remote location. The remote radio controller will be capable of providing the charge from solar panel, batteries, and load currents (LED 1 and LED 2). A manual override switch will be provided to allow for override "On", for maintenance review purposes. When the override switch is in the "Off" position, the Master radio will be controlling the on/off function of the remote AWEGS beacons. Wire terminations to the solar charger (in), to the batteries (in/out), and to the LED 1 (out) and LED 2 (out), will all be incorporated into the remote radio controller back-panel.
- 3.2.7. **120V AC Control Panels.** Provide AC control panels containing the electronics (circuit breaker, surge arrester, flasher, and a 120VAC to 12VDC power supply) will be mounted in the cabinet using radio manufacturer's back panel. Wire terminations for the AC power (in) and to the LED 1 (out) and LED 2 (out), will all be incorporated into the remote radio controller back-panel.
- 3.2.8. **Typical Sign Types.** Furnish Minimum of 2 LED beacons and 2 warning signs for each pole. The warning sign will be on the selected approach, per plans. Flashing beacons will conform to Roadside Flashing Beacon Assembly, per plans, and small sign summary sheets.
- 3.2.9. **Typical Signs.** Provide signs 48 in. by 48 in. with the message W3-4 "BE PREPARED TO STOP" and 18 in. by 24 in. W16-3P "WHEN FLASHING" placard compliant with TMUTCD Standards per speed and approach. Each sign will be high intensity Retro-Reflective type-11 yellow sheeting. Vinyl signs are not allowed on TxDOT Projects. Sign sheeting must conform to the pre-approved 3M varieties listed in the MPL.
- 3.2.10. **Radio Operation.** Provide radio transceivers that will operate at 900 MHZ, an unlicensed frequency. The radio master will communicate to the remote sites and select frequencies using frequency hopping spread spectrum (FHSS) technology. The master transceiver will have the ability to bind all remote transceivers in the group, and isolate particular feedback from each unique AWEGS remote controller deployed in a single system, to maintain connectivity in the presence of permanent or temporary conflicts on similar channels.
- 3.2.11. **Warranty.** Furnish a warning system with a warranty for components to be free of defects in material and workmanship for a period of at least 36 mo. from the date of invoice. Guarantee that equipment furnished and installed for this project performs according to the manufacturer's published specifications. Assign, to the

Department, all manufacturer's normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project.

Repair or replace AWEGS equipment at the Contractor's expense prior to completion of the final acceptance in the event of a malfunction or failure. Furnish replacement parts for all equipment within 15 days of notification of failure by the Department.

4. CONSTRUCTION

- 4.1. **Installation.** Install AWEGS at the locations shown on the plans or as directed. Stake the assembly locations for verification by the Engineer unless otherwise shown on the plans. Contractor or Engineer may also request an AWEGS manufacturer has a field representative commission the location to check detection ranges and ensure the system will be working properly prior to commissioning the system.

Install LED signal beacons, sign, radio transmitters and receivers, traffic signal approach status detectors, controller enclosures and ancillary equipment, required mounting hardware, and cabling as required and shown on the plans, or as directed. Mounting hardware includes any extension arms as specified. Install the controller assembly as shown on the plans or as directed by the Engineer.

Use established industry and utility safety practices to erect assemblies near overhead or underground utilities. Consult with the appropriate utility company before beginning such work.

Install solar panels, batteries, and battery box (when required) as shown on the plans or as directed.

- 4.2. **Testing.** Testing of the installed equipment locations is for the purpose of relieving the Contractor of maintenance of the equipment. The Contractor will be relieved of the responsibility for maintenance of the equipment in accordance with Item 7, "Legal Relations and Responsibilities", after all testing is successfully completed.

Testing of the equipment will consist of the following procedure: once the equipment has been installed and activated, the signal will be observed for a minimum of 3 days. To be accepted, the AWEGS must flash at the correct time over a series of 6 observations during the 3 day observation period.

After each equipment location has been installed, the Department and the contractor will conduct approved continuity, stand alone, and system tests on the installed field equipment. The Engineer will furnish a letter acknowledging the final acceptance testing commencement date stating the first day of the final acceptance test.

5. MEASUREMENT

This Item will be measured by each system furnished, installed, made fully operational and tested in accordance with this specification and as directed. Items will include controller-to-master configuration, and master-to-remote configurations, made operational.

6. PAYMENT

The work performed, and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "AWEGS Wireless-Master", "AWEGS Wireless Remote-Solar", "AWEGS Wireless Remote-AC." This price will be full compensation for furnishing and installing all new system components including interconnects, radios, control panels, antennas, controller configuration, beacons, and warning signs; materials, internal electrical conductors, connectors and mounting hardware; communication network; integration with traffic signal, and for all labor, tools, equipment, testing, and incidentals necessary to complete the work.