

# Special Specification 6416

## Wireless Wrong Way Driver System



### 1. DESCRIPTION

Furnish and Install Wireless Wrong Way Driver System (Wireless WWDS) at locations shown on plans or as directed.

### 2. EQUIPMENT

**General.** Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items, except for measurement and payment:

- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 622, "Duct Cable"
- Item 624, "Ground Boxes"
- Item 628, "Electrical Services"
- \*Item 636, "Signs"
- Item 644, "Small Roadside Sign Assemblies"
- Item 656, "Foundations for Traffic Control Devices"
- Item 687, "Pedestal Pole Assemblies"
- Item 6006, "Electronic Components"
- Item 6063, "Intelligent Transportation System (ITS) Solar Power System."

\* LED (Built-In) Wrong Way Warning Sign.

2.1. **Functional Requirements.** Furnish a Wireless Wrong Way Driver System (Wireless WWDS) that provides a highly visible, enhanced warning for the purpose of alerting the driver and proper authorities. Upon activation by thermal camera of a wrong way driver, the primary logic controller must activate and communicate wirelessly to other local alert signs on separate pedestal poles for the purpose of flashing synchronously and then cease operation after a programmable timeout. The Wireless WWDS equipment must also send alerts to a cloud-based web user interface as well as e-mail and Short Message Service (SMS) alerts for all configured users.

2.2. **Wireless WWDS System Components.** The Wireless WWDS system is composed of the principal items listed below and must all come from the same manufacturer. They are listed as follows:

- Light Emitting Diode (LED) Warning Alert Lights on Wrong Way signs to catch wrong way drivers' attention;
- primary enclosure mounted on detection pole and houses central communication and logic equipment;
- local wireless communications for communication between pedestal poles with LED Warning Alert Lights and the central pedestal pole containing the thermal detector, illuminator, and camera;
- thermal detector for detecting wrong way drivers at day or night who may be operating with or without the presence of headlights;
- white LED Illuminator for providing visibility during image capture at night;
- high-resolution camera to capture images and video of wrong-way vehicle after detection;
- cloud-based monitor system for wireless WWDS status configuration and wrong way driver alerts;
- external communications for system status configuration and wrong way driver alerts; and
- solar power system for powering lights and equipment.

Ensure all equipment and components listed are new and in operable condition without defect at time of delivery and installation.

- 2.3. **LED Warning Alert Lights.** Provide either “LED (Built-in) Wrong Way Warning Alert Signs” or “LED Rectangular Flashing Beacon Arrangements” as shown on the plans or as directed. All LEDs must be red and must be rated for 100,000-hr. life expectancy, have an operating temperature range of -40°F to 122°F, and be powered by a flash controller. Both options must:
- be capable of programming flash patterns, duration of activation, and LED intensity;
  - seamlessly Integrate with 900 MHz Frequency Hopping Spread Spectrum (FHSS) wireless transceiver to form a network of connected devices. Provide 2.4 GHz or 5.8 GHz wireless transceiver radio if interference is experienced;
  - have data logging capabilities;
  - be able to be programmed from a windows-based software using Ethernet or RS232 interface; and
  - use an Ingress Protection IP66 National Electrical Manufacturer Association (NEMA) 4X enclosure for the flash controller.
- 2.4. **LED (Built-In) Wrong Way Warning Sign.** Sign must be standard 0.080-in. grade aluminum with reflective sheeting and meet the Texas Manual on Uniform Traffic Control Devices (MUTCD). The sign must be composed of eight environmentally sealed, high powered LEDs along the perimeter of the sign, one in each corner and one spaced centered between each corner. High powered LEDs must be visible at more than 1,000 ft. during the daytime and more than 1 mi. during the nighttime. All LEDs must be red and must be rated for 100,000-hr. life expectancy, have an operating temperature range of minus 40°F to 165°F, and be powered by a flash controller. Ensure wiring on backside of sign is environmentally sealed for protection against weather and tampering. Ensure the sign’s LEDs are dimmable by a photocell sensor input or 6V solar panel to reduce night glare.
- 2.5. **LED Rectangular Flashing Beacon Arrangement (RFBA).** This arrangement must consist of two black powder-coated aluminum LED Beacon Enclosures, one enclosure centered and mounted above and one centered and mounted below a standard Wrong Way sign (R5-1a) of appropriated size that meets the Standard Highway Sign Designs for Texas (SHSD) and the Texas Manual on Uniform Traffic Control Devices (TMUTCD). Each LED Beacon Enclosure should be dimmable by a photocell sensor input. Each LED Beacon Enclosure holds two horizontally aligned rectangular flashing beacons (7 in. wide x 3 in. height), one red and one white, that must display one beacon to the left of the centered pole and one to the right of the centered pole. Each beacon is to be 7 in. apart and meet SAE J595 Class 1 certification.
- 2.6. **Primary Enclosure.** The primary enclosure must:
- be aluminum NEMA 3R type vented enclosure;
  - be able to be pole mounted;
  - be constructed of 0.125-in. aluminum;
  - be sufficiently vented;
  - designed with screening to prevent insects and other debris from entering; and
  - installed with Number 2 Corbin lock and tamper resistant hinges.
- 2.7. **Local Wireless Communications.** All Wireless WWDS pedestal poles must be equipped with a 900 MHz FHSS wireless transceiver. The wireless transceiver must:
- provide the ability to operate as a Gateway, Node, or Repeater;
  - provide a means to verify signal strength between network devices;
  - operate on the license Industrial, Scientific and Medical (ISM) band;
  - comply with Part 15 of Federal Communication Commission (FCC) rules; and
  - be housed in a NEMA 4X enclosure.
- 2.8. **Thermal Detector.** The thermal detector must be able of detecting and distinguishing a variety of moving targets including vehicles, motorcycles, and bicyclist without headlights in operation. The detector must:

- be able to visualize zones and fields of detection;
- detect moving objects within a speed range of 6 MPH to 110 MPH;
- be protected from reverse polarity power connections and power surges and comply with Part 15 Class A of FCC rules;
- have a IP68 housing weatherproof, ultraviolet resistant, and protected from water intrusion;
- detect up vehicles to 300 ft.;
- be long wave infrared (7 to 14 um);
- have a focal distance between 7.5 mm to 19 mm;
- have a horizontal field of view between 25° and 90°;
- have a vertical field of view between 19° and 69°;
- be able to program at least eight zones;
- be able to be programmed via an ethernet communication using a Windows-based software;
- be able to push visual confirmation of configured detection zones to user interface software; and
- meet NEMA TS2 shock and vibration.

2.9. **White LED Illuminator.** The LED Illuminator must:

- be able to determine ambient light levels and offers adjustable lenses to disperse light based on site-specific requirements;
- be triggered by WWDS logic controller under specific adjustable conditions; and
- use IP67 rated connectors for power and inputs.

2.10. **High-Resolution Camera.** The high-resolution camera must:

- be capable of storing recent images as a backup;
- adjustable settings for color, image compression, white balance, brightness, contrast, sharpness, exposure control, low light, and rotation;
- provide HDTV 1080P with WDR up to 60fps;
- have an enclosure that is IP66 NEMA 4X-rated;
- comply with FCC rules; and
- be programmable from Windows-based software.

2.11. **Cloud-Based Monitor System.** When a wrong-way driver is detected, the cloud-based monitor system must be capable of sending onscreen notifications to an online secure user interface using a standard browser. Notifications may also be sent to emails and SMS text. The notifications must come with color images identifying the vehicle by a direction and provide a time and date of detection. Event video and offline site streaming must be offered by the WWDS. System must also offer diagnostic alerts about the system status, such as temperature, battery voltage and network connectivity. The system must also maintain historical data for later analysis and reporting.

Communication Requirements must be as follows:

- Wrong Way Driver System must be capable of sending alert data to and receiving control commands from a cloud-based management software using cellular modem or local ITS fiber optic network;
- system must be capable of sending alert data to and receiving control commands from an external cloud-based management software using an agency's private communication network;
- system must be capable of sending alert data to and receiving control commands from an agency's Advanced Traffic Management Software using an agency's private communication network;
- cloud-based management software must be accessible by users from standard web browser with internet access;
- cloud-based management software must have an Application Programming Interface (API) with enough documentation to allow for integrating into third party software platforms;
- API must allow alert images and data received by cloud-based management software from WWDS to be sent to other software platforms using industry-standard communication methods; and

- API must allow software platforms to send control requests and responses, such as received alert classification, to cloud-based management software for manipulation of its stored alerts and direct communication with WWAS.

2.12. **External Communications.** Cellular modem communication must use a 4G LTE cellular gateway to provide communication to the Cloud-Based Monitor System. The cellular gateway must:

- include an integrated 5 port 10/100 ethernet switch;
- comply with FCC rules;
- be capable of Over the Air (OTA) firmware updates and remote management;
- be programmable from Windows-based software; and
- include 5yr. of paid 4G internet service.

2.13. **Solar Power System.** Refer to plans or as directed to determine if 120 V AC / 60 Hz power or solar power is required. New electrical services will not be paid for under this Item, solar power systems must be purchased through wireless WWDS manufacturer and must:

- be sized to provide necessary power to charge batteries during the day;
- include batteries sized to maintain the system operation for three consecutive days with no sunlight;
- include voltage regulator;
- include power inverter if required by the system;
- include necessary battery ground box as shown on the Department's Electrical Detail sheets for battery storage if required;
- use tamper resistant fasteners for mounting;
- conform to the Ingress Protection rating of IP-67;
- use Pulse Width Modulation for battery charging;
- have the capability of using gel, sealed, or flooded batteries; and
- provide protection against high voltage, reverse current, reverse polarity, short circuits, and overloads.

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### 3. CONSTRUCTION

3.1. **Installation.** Before installation of any equipment, perform a site survey of the proposed locations to determine the optimal positioning of the signs and the detector unit to achieve proper operation based on the manufacturer's recommendations. Conduct BERT test on wireless links to assure 99% communication reliability between devices. Adjust locations as approved by the Engineer if necessary. If required, remove any existing Wrong Way signs from their mounts to allow the installation of the new signs. Mount Wrong Way sign that meets Section 2B.41 of the Wrong-Way Traffic Control at Interchange Ramps of the Texas Manual of Uniform Traffic Control Devices (TMUTCD), as shown on the plans, or as directed.

Install equipment in accordance with this Item and the lines, grades, details and dimensions as shown on the plans or as directed. Maintain safe construction practices. Ensure the mechanical execution of work complies with National Electrical Code (NEC).

Provide any additional mounting hardware and cabling necessary to install and make operational all equipment. Provide only new and corrosion resistant materials.

Adjustments or addition of sign attachment hardware, mounting components and hardware for detector-solar panels, support brackets and appurtenances, such as conduit, etc., may be necessary for compatibility with specified positioning recommended by the manufacturer, as shown on the plans, or as directed.

Replace any portion of the equipment that is damaged or lost during transportation or installation. Any unused or removed material deemed salvageable by the Department will remain on the property of the Department or be delivered to a designated site. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state and local regulations.

Contractor must complete vendor-provided training on the installation of all equipment before any work begins. Contractor must provide documentation that they have completed the required training from the equipment manufacturer before installation of the equipment. Contractor must have the manufacturer's representative on site to assist with the installation of all equipment before any work begins.

Contractor must coordinate with equipment manufacturer to ensure the Wrong Way Driver equipment is properly positioned and the Wrong Way Driver detection zones are accurate. Ensure that all equipment is functioning properly and communicating with manufacturer's equipment software. Testing should begin once proper system functionality is proven.

- 3.2. **Mechanical Components.** Ensure that all fasteners, including bolts, nuts, and washers not already included with equipment and with a diameter less than 5/8 in. are Type 316 or 304 stainless steel and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts not already included with the equipment and over 5/8 in. in diameter are galvanized and meet the requirements of ASTM A307. Separate dissimilar metals with an inert dielectric material.

- 3.3. **Wiring.** All wiring and electrical work supplying the equipment must meet the requirements of the most current version of the National Electrical Code (NEC). If additional cables are required, Contractor must furnish and install them at no additional cost to the Department. Provide conductors at least the minimum size indicated on the plans and insulated for 600 V.

Cables must be cut to proper length before assembly. Provide cable slack for ease of removal and replacement. All cable slack must be neatly laced with lacing or straps in the bottom of the cabinet. Ensure cables are secured with clamps and include service loops.

- 3.4. **Electrical Service.** (See Section 2.2.9., "Solar Power System.")

- 3.5. **Grounding.** Ensure all WWDS devices, cabinets, and supports are grounded in accordance with the NEC, Electrical Details, and manufacturer recommendations.

- 3.6. **Training.** Provide manufacturer approved end user training to the Department and their representatives. Provide a minimum of two days of instruction in the operation and maintenance procedures. Train a maximum of 10 Department designated personnel. Training must cover at minimum, but is not limited to:

- hands-on operation of the sign;
- explanation of any system commands, their function and usage;
- required preventative maintenance procedures;
- equipment servicing procedures;
- sign troubleshooting and problem identification procedures; and
- use of diagnostic software.

Furnish a manufacturer approved training session agenda, a complete set of manufacturer-approved training materials. Provide one copy of the course material for each person. The training room will be provided by the Department.

- 3.7. **Warranty.** Ensure that the installed WWDS devices has a manufacturer's warranty covering:
- materials must be warranted for at least 3 yr. from accepted installation date;
  - the accepted installation date is defined as the date the Department determines the sign has passed installed testing requirements;
  - the warranty must cover all defects in material, design, and workmanship, and must cover 100% parts and labor for repair work, including diagnostics;
  - if the vendor standard warranty period exceeds 72 mo., with a minimum of 60 mo. from accepted installation date, then the standard warranty period must be in effect; and
  - the vendor must submit in writing the terms of warranty.

During the warranty period, the vendor must be responsible for labor, materials, shipping, traffic control and other costs as outlined below for required warranty repair. It is the intent of this warranty that the vendor performs warranty repair work. At the Department's option, the Department may perform minor warranty repairs at the vendor's expense without voiding the warranty. All diagnostics, testing, and replacements necessary to resolve any problems must be assumed by the vendor at no cost to the Department.

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#### 4. TESTING

To ensure proper installation, configuration, and functionality, the Wireless WWDS must be tested and certified under the direct on-site supervision of the manufacturer. Coordinate with the Department on scheduling a testing date at least 40 days before construction to allow manufacturer to provide a written test plan to the Department at least 30 days before the scheduled testing date.

Testing of the equipment must consist of the following procedures:

- once the equipment has been installed and activated, the exit ramp must be closed to traffic;
- a test vehicle must then be driven the wrong way down the ramp a minimum of ten times;
- if the system calls to be integrated to the TMC, then once a maximum of ten successful detections and notifications of the wrong way vehicle are received at the TMC, as well as successful activation of LED flashing signs or beacons, the equipment must be accepted as fully tested and ready for operation;
- to be accepted the last five successful tests must be consecutive;
- if the system does not call to be integrated to the TMC, then once a maximum of ten successful detections of the wrong way vehicle and successful activation of LED flashing signs or beacons, the equipment must be accepted as fully tested and ready for operation; and
- to be accepted the last five successful tests must be consecutive.

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 with laptop equipment. A final acceptance test must be conducted to demonstrate all control, monitor, and communication requirements for 60 days. The Engineer will furnish a letter acknowledging the final acceptance testing commencement date stating the first day of the final acceptance test.

The completion of the final acceptance test occurs when less than two false calls have occurred from 100 vehicles passing thru this detection zone, the system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects. Assume responsibility only for test failures directly related to the work in accordance with this Item. Upon completion of successful final acceptance testing, document the acceptance date and project identification information and provide two copies to the Engineer.

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#### 5. MEASUREMENT

This Item will be measured as each unit furnished, installed, made fully operational and tested in accordance with these Special Specifications.

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#### 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 "Wireless WWD System", "WWD LED Signs", "WWD RFBA", "WWD Cellular Modem", and "WWD Solar Power System" as specified on the plans.

This price is full compensation for furnishing and installing the complete installation of the Wireless WWD System as shown on the plans all labor, tools, equipment, mounting hardware, cables, any required equipment modifications for electrical service, documentation, warranty, and incidentals necessary to complete the work including traffic handling during testing. In addition, any conduit, ground boxes, batteries,

solar panels, cable to power source, Wrong Way R5-1a signs, Wrong Way R5-1a signs with LEDs, RFBA, Thermal Camera, LED illuminator, local wireless communication devices, primary logic controller, system integration, pedestal poles, and foundations used in the installation of the Wireless WWD System will be included in this bid price.