ITEM 680.05001005 - WIRELESS VEHICLE DETECTION SYSTEM REPEATER (LONG LIFE)
ITEM 680.05002005 - WIRELESS VEHICLE DETECTION SYSTEM FREEWAY SENSOR
ITEM 680.05003005 - WIRELESS VEHICLE DETECTION SYSTEM INTERSECTION SENSOR
ITEM 680.05004005 - WIRELESS VEHICLE DETECTION SYSTEM CONTACT CLOSURE INTERFACE (APCC)
ITEM 680.05005005 - WIRELESS VEHICLE DETECTION SYSTEM EXTENSION CONTACT CLOSURE CARD
ITEM 680.05006005 - WIRELESS VEHICLE DETECTION SYSTEM ISOLATOR MODULE (ISO)
ITEM 680.05007005 - WIRELESS VEHICLE DETECTION SYSTEM SERIAL PORT PROTOCOL DIGITAL RADIO (SPP)

DESCRIPTION

Under these items the contractor shall furnish and install a wireless, battery-powered magnetometer vehicle detection system as shown in the contract documents or where directed by the engineer.

The detection system shall provide accurate roadway information as needed to support traffic signal control. The wireless, battery powered magnetometer vehicle detection system shall consist of one or more of the following:

- Battery powered sensors installed in pavement in each traffic lane (paid under its respective item).
- Access Point Contact Closure (APCC) Card to interface between a standard 170/2070 or NEMA controller using contact closure signals.
- Serial Port Protocol Digital Radio (SPP) mounted on the side of the roadway, serving as the communications hub for the installation. Multiple SPPs may be employed per installation.
- Optional wireless repeaters mounted on the side of the roadway, serving to extend the radio range of an APCC.
- Contact Closure Extension cards to support the interface between an APCC and a standard 170/2070 or NEMA controller using contact closure signals (paid under its respective item).
- Isolation Module for each SPP.
- Category 5e cable between SSP and APCC.
- Software to control and configure the sensors, APCCs and repeaters.
- Software to store and retrieve detection data.
Communications between the sensors and the SPP or repeater and between the repeater and SPP shall be via radio. Detection data shall be relayed from each SPP to a local 170/2070 controller for real-time vehicle presence detection using contact closure signals over Category 5e cabling. As an option, data shall be capable of being relayed from each APCC to a central software system or central server over standard IP (Internet Protocol) networks.

**MATERIALS**

All sensor components shall be contained within a single housing. The sensor housing shall conform to NEMA Type 6P and IEC IP68 standards. All SPP components shall be contained within a single housing. The SPP housing shall conform to NEMA Type 4X and IEC IP67 standards. All repeater components shall be contained within a single housing. The repeater housing shall conform to NEMA Type 4X and IEC IP67 standards.

The sensor components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The sensor housing shall be capable of being installed in a 4” (100 mm) diameter hole approximately 2 ⅛” (57 mm) deep. An SPP shall be no larger than 12” (300 mm) H x 8” (200 mm) W x 4” (100 mm) D. A repeater shall be no larger than 5” (125 mm) H x 4” (100 mm) W x 4” (100 mm) D. An SPP and a repeater shall weigh no more than 4 pounds (1.8 kg) each. An SPP shall support at least 48 sensors. A repeater shall support at least 10 sensors.

The sensor, SPP/APCC, ISO and the repeater shall operate at temperatures from -37 F to +176 F (-38.3 C to +80 C). A sensor shall be battery-powered with an average lifetime of ten (10) years when the sensor is configured for and operating under normal traffic conditions. The long life repeater shall be battery-powered, have a life expectancy a minimum of 7 years and the battery
ITEM 680.05001005 - WIRELESS VEHICLE DETECTION SYSTEM REPEATER (LONG LIFE)
ITEM 680.05002005 - WIRELESS VEHICLE DETECTION SYSTEM FREeways SENSOR
ITEM 680.05003005 - WIRELESS VEHICLE DETECTION SYSTEM INTERSECTioN SENSOR
ITEM 680.05004005 - WIRELESS VEHICLE DETECTION SYSTEM CONTACT CLOSURE INTERFACE (APCC)
ITEM 680.05005005 - WIRELESS VEHICLE DETECTION SYSTEM EXTENSION CONTACT CLOSURE CARD
ITEM 680.05006005 - WIRELESS VEHICLE DETECTION SYSTEM ISOLATOR MODULE (ISO)
ITEM 680.05007005 - WIRELESS VEHICLE DETECTION SYSTEM SERIAL PORT PROTOCOL DIGITAL RADIO (SPP)

shall be field replaceable. An APCC shall be factory-configurable to support at least two (2) different power options:

- Power shall be supplied via an isolated nominal 48 VDC (36-58 VDC) input consuming a maximum of 3W and providing 1500 V isolation and 5 kV surge protection.
- Power shall be supplied via a non-isolated nominal 12 VDC (10-15 VDC) input, consuming a maximum of 2W

Each sensor shall detect a vehicle by magnetometer-type detection by measuring changes in the earth’s magnetic field near the sensor as caused by a stopped or passing vehicle. The sensor shall sample the earth’s magnetic field at a rate of 128 Hz and shall communicate time-stamped ON and OFF vehicle detection events. As an option, the sensor shall provide a mode where the complete X-Y-Z magnetic signatures of detected vehicles are transmitted as data. In the event of a detector lock, each sensor shall automatically recalibrate. Each sensor shall communicate by radio to a nearby SPP/APCC or repeater. Each sensor shall transmit its detection data within 150 ms of a detected event. Each sensor shall automatically re-transmit a detected event if no acknowledgement is received from the access point. Each sensor may stop retransmission after 8 attempts. After losing radio contact because of stopped vehicles over or near the sensor, each sensor shall be capable of re-establishing the radio link with its supporting access point or receiver in less than 2 seconds. Each sensor shall transmit a unique identifying code and shall respond within 100 seconds when the access point is powered on. When no APCC or repeater is present or powered on, the sensors shall not be required to detect vehicles.

The radio links between each sensor and SPP/APCC or repeater and between each repeater and SPP/APCC shall conform to the following requirements: The physical layer of the radio links between each sensor and SPP/APCC or repeater and between each repeater and SPP/APCC shall
conform to published standards. The center frequencies, bandwidths, and transmit power levels of the radio links shall allow operation in an unlicensed frequency band. Frequency channels shall be employed by the sensors, SPP/APCC, and repeaters to avoid interference with other devices operating in the unlicensed band. The frequency channels shall be user-configurable and at least 16 frequency channels shall be supported. The link budget (transmit power plus transmit antenna gain plus receive antenna gain minus receive sensitivity, where receive sensitivity shall assume a 1% packet error rate) for all radio links shall be 93 dB or greater.

Each sensor in an installation shall be capable of being individually configured with its own sensitivity level. A single sensor shall be capable of being configured with a sensitivity level that approximates the detection zone of a standard 6’ x 6’ (1.8 m x 1.8 m) inductive loop. Each sensor shall be capable of being configured with relatively higher or lower sensitivity levels as may be required to detect bicycles or motorcycles. Up to two sensors properly configured shall be capable of detecting motorcycles in a standard traffic lane and bicycles in a designated bicycle lane.

An SPP/APCC shall support the relay of sensor detection data through several interfaces as required by the application. Detection data shall be communicated to a standard roadside 170/2070 controller via APCC card capable of being installed in standard contact closure input shelves. As an option, detection data shall be communicated over TCP/IP via an integrated 10Base-T Ethernet interface. As an option, detection data shall be communicated as IP data over GSM-based cellular data services via an integrated GPRS cellular modem. As an option, detection data shall be communicated as IP data over CDMA-based cellular data services via an integrated 1xRTT cellular modem. The APCC shall be capable of simultaneously communicating detection data via the contact closure interface, optional Ethernet interface, and optional cellular data modem interface.
Category 5e Ethernet cable from the SSP to the APCC shall be furnished. Shielded (F/UTP) flexible patch/jumper cable of durable, flame retardant Category 5e Industrial Ethernet cords for transmitting 10Base-T or 100Base-T shall be provided. Jacket provides excellent mechanical, flex-life, oil resistance, low-temperature flexibility, UV, and aging characteristics. Cables shall be terminated with shielded encapsulated RJ-45 or cylindrical M12 connectors to achieve IP-67 rating. The cables shall be 4-pair, Stranded 26 AWG (7/34) tinned copper insulated with polyolefin and paired. Pairs cabled with overall clear polyester tape, aluminum polyester tape shield, and stranded tinned copper drain wire in. It shall be jacketed with pressured Polyurethane that may be over-molded. The cable shall have the following ratings:

- Cords meet TIA Cat 5e and ISO class D requirements.
- Temperature rating: 75 °C Max., -40 °C Min.
- Maximum plug-to-plug Cat 5e channel 80 meters.
- Nom. Impedance 1 - 100 MHz: 100 +/- 15 Ohms.
- RoHS compliant.
- Mutual Capacitance 13.5 pF/ft Nom. @ 1 MHz.

Each sensor, APCC, and repeater shall be capable of accepting software and firmware upgrades.

The wireless battery-powered magnetometer vehicle detection system shall provide software operating on conventional notebook/portable PCs to support configuration of a sensor, APCC, repeater and store & retrieve detection data.

Each Access Point Contact Closure Interface APCC card shall provide detector data as contact closure signals to the 170/2070 controller. An APCC card shall directly plug in to standard 170/2070 input files or NEMA detector racks. Additional Extension Contact Closure cards shall
ITEM 680.05001005 - WIRELESS VEHICLE DETECTION SYSTEM REPEATER
(LONG LIFE)
ITEM 680.05002005 - WIRELESS VEHICLE DETECTION SYSTEM FREEWAY SENSOR
ITEM 680.05003005 - WIRELESS VEHICLE DETECTION SYSTEM INTERSECTION SENSOR
ITEM 680.05004005 - WIRELESS VEHICLE DETECTION SYSTEM CONTACT CLOSURE INTERFACE (APCC)
ITEM 680.05005005 - WIRELESS VEHICLE DETECTION SYSTEM EXTENSION CONTACT CLOSURE CARD
ITEM 680.05006005 - WIRELESS VEHICLE DETECTION SYSTEM ISOLATOR MODULE (ISO)
ITEM 680.05007005 - WIRELESS VEHICLE DETECTION SYSTEM SERIAL PORT PROTOCOL DIGITAL RADIO (SPP)

provide up to 256 channels of detection data from a single APCC’s supported sensors, where each channel comprises an optically isolated contact closure relay and, if configured for TS2 operation, an additional contact closure relay to indicate the channel status. Each Extension Contact Closure card shall be configurable by providing contact closure signals in either presence or pulse mode with up to 31 seconds of delay timing and 7.5 seconds of extension (carryover) timing. The Extension Contact Closure card front panel shall provide status LEDs to monitor detection channel status, line quality and fault monitor. The Extension Contact Closure card front panel shall provide switches to select and configure presence or pulse mode, delay timing and extension timing. An Extension Contact Closure card shall be powered by the 170/2070 controller backplane via an 11-26 VDC input. An Extension Contact Closure card shall be surge protected to GR-1089 standards. An Extension Contact Closure card shall operate in temperatures from -37 F to +176 F (-38.3 C to +80 C). An Extension Contact Closure card shall operate in humidity up to 95% (non-condensing).

Silicone sealant used to secure and cover the sensor in the cored hole in the pavement shall conform to the provisions of §705-05, Silicone Joint Sealants for Pavements.

CONSTRUCTION DETAILS

Each sensor shall be installed in the roadway at the locations shown on the contract drawings or as ordered by the engineer. The roadway shall be core drilled to provide a 4” (100 mm) diameter hole, 2.25” (60 mm) deep. A small layer of silicone sealant shall be applied to cover the bottom of the hole. The sensor shall then be placed on top of this layer in the correct orientation as clearly marked on the sensor. The sensor shall be fully encapsulated with the silicone sealant to the lip of the cored hole.
The maximum distance between a sensor installed in the roadway and an SPP or a repeater with a clear line-of-sight between devices shall be at least 150’ (47.5 m) for an access point or repeater installed 24’ (7.3 m) above the roadway, at least 100’ (30.5 m) for an APCC or repeater installed 18’ (5.5 m) above the roadway and at least 75’ (22.9 m) for an APCC or repeater installed 12’ (3.7 m) above the roadway. The maximum distance between an APCC and a repeater shall be at least 750’ (228.6 m) when both units are installed 18’ (5.5 m) above the roadway with a clear line-of-sight between devices.

The SPP Digital Radio can be wired up to 2000’ (609.6 m) from the APCC. Up to 2 SPP’s can be wired to the APCC. Each SPP requires an ISO for proper operation. The Ethernet cable shall be provided in the appropriate length as indicated on the plans. There will be no separate payment for this cable.

Each installation of the wireless battery-powered magnetometer vehicle detection system shall consist of one or more sensors installed in each traffic lane where presence detection is required, avoiding sources of magnetic noise such as underground power cables, overhead high tension power cables, light rail or subway tracks, and power generation stations and sub-stations. The sensors shall be located as specified by the contract drawings, with each sensor’s supporting access point or receiver installed no farther than the maximum range indicated above.

The contractor shall not damage the sensors and other equipment during construction. The sensors shall be removed and installed during various phases and sub-phases in accordance with the contract drawings. Core holes left in the pavement upon removal of sensors shall be filled with asphalt cold patch by the contractor at no additional cost to the State. The contractor shall ensure that the wireless battery-powered magnetometer vehicle detection system operates.
ITEM 680.05001005 - WIRELESS VEHICLE DETECTION SYSTEM REPEATER (LONG LIFE)
ITEM 680.05002005 - WIRELESS VEHICLE DETECTION SYSTEM FREEWAY SENSOR
ITEM 680.05003005 - WIRELESS VEHICLE DETECTION SYSTEM INTERSECTION SENSOR
ITEM 680.05004005 - WIRELESS VEHICLE DETECTION SYSTEM CONTACT CLOSURE INTERFACE (APCC)
ITEM 680.05005005 - WIRELESS VEHICLE DETECTION SYSTEM EXTENSION CONTACT CLOSURE CARD
ITEM 680.05006005 - WIRELESS VEHICLE DETECTION SYSTEM ISOLATOR MODULE (ISO)
ITEM 680.05007005 - WIRELESS VEHICLE DETECTION SYSTEM SERIAL PORT PROTOCOL DIGITAL RADIO (SPP)

according to specification during all phases and sub-phases of construction. All equipment shall become the property of the signal system owner upon project completion.

METHOD OF MEASUREMENT

The wireless, battery powered magnetometer vehicle detection system will be measured as the number of units satisfactorily installed in accordance with the contract documents.

At a minimum, the wireless, battery powered magnetometer vehicle detection system requires:

- Access Point Contact Closure Interface Card (APCC); paid under its respective item.
- Serial Port Protocol Digital Radio (SPP) and Ethernet cable as required; paid under its respective item.
- Isolation Module (ISO); paid under its respective item.

Intersection sensors, Freeway sensors, Long Life Repeaters, Access Point Contact Closure Interface Card (APCC), Serial Port Protocol Digital Radio (SPP), Isolation Module (ISO), and Extension Contact Closure Cards will be specified on the plans and will be paid under their respective items. There will be no separate payment for the Ethernet cable provided in the appropriate length as indicated on the plans.

BASIS OF PAYMENT

The unit price bid shall include the cost of furnishing and installing each item shall include the cost of furnishing all labor, materials, equipment, tools and all necessary tests to satisfactorily complete the work in accordance with the contract documents.
ITEM 680.05001005 - WIRELESS VEHICLE DETECTION SYSTEM REPEATER (LONG LIFE)
ITEM 680.05002005 - WIRELESS VEHICLE DETECTION SYSTEM FREeways SENSOR
ITEM 680.05003005 - WIRELESS VEHICLE DETECTION SYSTEM INTERSECTION SENSOR
ITEM 680.05004005 - WIRELESS VEHICLE DETECTION SYSTEM CONTACT CLOSURE INTERFACE (APCC)
ITEM 680.05005005 - WIRELESS VEHICLE DETECTION SYSTEM EXTENSION CONTACT CLOSURE CARD
ITEM 680.05006005 - WIRELESS VEHICLE DETECTION SYSTEM ISOLATOR MODULE (ISO)
ITEM 680.05007005 - WIRELESS VEHICLE DETECTION SYSTEM SERIAL PORT PROTOCOL DIGITAL RADIO (SPP)

Payment will be made under:

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM DESCRIPTION</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>680.05001005</td>
<td>Wireless Vehicle Detection System Repeater (Long Life)</td>
<td>Each</td>
</tr>
<tr>
<td>680.05002005</td>
<td>Wireless Vehicle Detection System Freeway Sensor</td>
<td>Each</td>
</tr>
<tr>
<td>680.05003005</td>
<td>Wireless Vehicle Detection System Intersection Sensor</td>
<td>Each</td>
</tr>
<tr>
<td>680.05004005</td>
<td>Wireless Vehicle Detection System Contact Closure Interface (APCC)</td>
<td>Each</td>
</tr>
<tr>
<td>680.05005005</td>
<td>Wireless Vehicle Detection System Extension Contact Closure Card</td>
<td>Each</td>
</tr>
<tr>
<td>680.05006005</td>
<td>Wireless Vehicle Detection System Isolator Module (ISO)</td>
<td>Each</td>
</tr>
</tbody>
</table>