

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
WIRELESS VEHICLE DETECTION SYSTEM

SIG:EMS

1 of 6

APPR:HLO:NJB:05-05-20
FHWA:APPR:05-06-20

a. Description. This work consists of completing one or more of the following work types at locations shown on the plans:

1. Furnishing and installing a wireless vehicle detection system (VDS) including serial port protocol (SPP) radios, master interface access point contact closure (APCC) card, extension (EX) cards, and Isolator Module.
2. Furnishing and installing a repeater (RP).
3. Furnishing and installing a vehicle sensor node (VSN).
4. Removing and disposing of an existing wireless VDS.
5. Removing, storing and reinstalling an existing wireless VDS.
6. Removing and disposing of an existing RP.
7. Removing, storing, and reinstalling an existing RP.
8. Removing and disposing of an existing VSN.
9. Removing, storing, and reinstalling an existing VSN.

As applicable, this work includes removal or installation of mounting brackets, hardware, cable, connectors, grounding, sensors and orange epoxy and any other material required to ensure a complete removal or installation, as specified for a location.

b. Materials. Provide materials, as directed by the Engineer, necessary to provide a complete and operating job. Provide materials in accordance with sections 918 and 921 of the Standard Specifications for Constructions and this special provision.

1. Vehicle Detection System (VDS).
 - A. A complete VDS consists of:
 - (1) Master interface APCC card;
 - (2) EX card if required;
 - (3) Isolator Module;

(4) Mounting rack and hardware;

(5) The quantity of SPP radios as specified on the plans including *NEMA 4X* type enclosure with mounting bracket and hardware and Category 5e (CAT-5e) 600 volt (V) rated cable from the SSP to the Isolator Module;

(6) Any associated cable, connectors and hardware necessary to complete the work.

B. Provide a VDS that:

(1) Detects and counts vehicles using battery powered magnetometers utilizing wireless communications to transmit detection information;

(2) Provides vehicle counts per lane, lane occupancy, vehicle speed (when more than one VSN is installed per lane), and vehicle classification (when one or more VSN is installed per lane);

(3) Allows the time intervals for the above measurements to be user selectable from 30 seconds to 24 hours.

C. Provide an SPP radio that:

(1) Consists of a 2.4 gigahertz (Ghz) Master transceiver powered via CAT-5e cable;

(2) Includes 600V rated CAT-5e cable from the SPP to the Isolator Module;

(3) Includes an enclosure with mounting bracket, and associated hardware;

(4) Transmits detection information to a 170, 2070 or *NEMA* type controller in real-time;

(5) Operates on 48 volt direct current (VDC) at 3 watt power or via non-isolated external 10 to 15VDC at 2 watt power;

(6) Operates in an ambient temperature range of -37 degrees Fahrenheit (F) to +176 degrees F (-38 degrees Celsius [C] to +80 degrees C);

(7) Provides 1500V isolation and 5 kilovolt (kV) surge protection;

(8) Is housed in a plastic enclosure, no larger than 12 inches high, 8 inches wide, and 4 inches deep, meeting *NEMA 4X* and *International Protection Rating (IP67) standards*.

D. Provide a master interface APCC card that functions as the hub of the sensor network, communicating with up to 96 VSN's transmitting detection information to the APCC.

2. Vehicle Sensor Node (VSN).

A. A complete VSN consists of:

- (1) A magnetometer,
- (2) A microprocessor,
- (3) A wireless transceiver,
- (4) A battery, and
- (5) Orange epoxy for securing the node in the pavement.

B. Provide a VSN that:

- (1) Is 1.9 inches high, 2.9 inches square;
- (2) Is contained in a fully encapsulated housing to prevent moisture from degrading the components;
- (3) Operates in an ambient temperature range of -37 degrees F to +176 degrees F (-38 degrees C to +80 degrees C);
- (4) Operates on battery power for a minimum of 10 years under normal traffic conditions;
- (5) Detects a vehicle by measuring a change in the earth's magnetic field and transmits the detected information within 125 milliseconds (ms) of receiving the detected vehicle;
- (6) Can be programmed with a unique identifying code and transmits this code and detector information via a wireless radio communication method;
- (7) Automatically recalibrates in the event of a detector lock;
- (8) Responds within 100 seconds after the AP is powered up.

3. Wireless Repeater (RP).

A. A complete RP consists of:

- (1) A battery operated transceiver;
- (2) A battery with a minimum 8 year life; and
- (3) An enclosure with mounting bracket and associated hardware.

B. Provide an RP that:

- (1) Is housed in a plastic enclosure, no larger than 12 inches high, 8 inches wide, and 4 inches deep, meeting *NEMA 4X* and *International Protection Rating (IP67)*

standards;

(2) Extends the effective communication range of the VSN to the SPP up to 1000 feet; and

(3) Operates in an ambient temperature range of -37 degrees F to +176 degrees F (-38 degrees C to +80 degrees C).

4. Bus Interface Unit (BIU). Provide a BUI that meets the requirements of *Section 8 of the NEMA TS2-Specification*. Provide one 6 foot Port 1 communications cable to connect from the detector rack BIU to the controller unit.

5. Wireless Communication. Provide a VDS, RP, or VSN that operates in the unlicensed Industrial, Scientific and Medical (ISM) 2.4GHz band. Ensure the SPP and VSN operate in any one of the 16 channels available in the band. Provide two-way communication between the SPP and VSN to ensure integrity over the RP interface. Provide a VSN that uses a Time Division Multiple Access (TDMA) protocol wherein each sensor is assigned a time slot during which it transmits and receives one or more data packets. Ensure all system components are synchronized to the same time reference sourced by the APCC.

6. Software. Provide a VDS that is capable of accepting software and firmware upgrades. Provide software required to configure the VSN, SPP and RP units and to store and retrieve the detection data. Ensure the VSN and RP are reconfigurable by a user over the wireless communication interface.

7. Warranty. Provide materials with a manufacturer's warranty, transferable to the MDOT, that the supplied materials are free from all defects in materials and workmanship. Furnish the warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to acceptance.

c. Construction. Complete the work in accordance with sections 819 and 820 of the Standard Specifications for Construction, as shown on the plans, and as directed by the Engineer. Remove, store, and dispose of material in accordance with section 204 of the Standard Specifications for Construction.

1. Installation. When installing new equipment is specified, furnish and install the VDS, RP or VSN as shown on the plans. Installation includes master interface APCC card, EX card as required, Isolator Module, mounting brackets, hardware, cable, connectors, grounding, sensors and other appurtenances required for a complete system.

Install the VSN in a 4 inch by 2¼ inch hole, cored in the pavement in the traffic lane as indicated on the plans, or as directed by the Engineer. Encapsulate the VSN with orange epoxy.

Install the SPP and RP within range of the sensors and as indicated on the plans, or as directed by the Engineer.

2. Removal. When removal is specified, remove the existing VDS, VSN or RP units, associated enclosures, mounting brackets, hardware, and other appurtenances required for a complete removal. Dispose of removed materials.

3. Salvage. When salvage is specified, remove the existing VDS, VSN, or RP units,

associated enclosures, mounting brackets, hardware, and other appurtenances required for a complete removal, store salvaged materials in a protected and clean environment, and re-install the materials. Complete reinstallation in accordance with subsection c.1 of this special provision.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	Pay Unit
Wireless Vehicle Detection System	Each
Wireless Vehicle Sensor Node	Each
Wireless Repeater	Each
Wireless Vehicle Detection System, Rem.....	Each
Wireless Vehicle Sensor Node, Rem.....	Each
Wireless Repeater, Rem	Each
Wireless Vehicle Detection System, Salv	Each
Wireless Repeater, Salv	Each
Wireless Vehicle Sensor Node, Salv	Each

1. **Wireless Vehicle Detection System** includes installing a wireless vehicle detection system including the SPP radios, the master interface APCC card, BIU, the EX cards, and the Isolator Module. The work includes all mounting brackets, hardware, cable, connectors, grounding, and all appurtenant material required to complete the work.

2. **Wireless Vehicle Sensor Node** includes installing a wireless vehicle sensor node including the sensors, orange epoxy, and all appurtenant material required to complete the work.

3. **Wireless Repeater** includes installing a wireless repeater including the RP, mounting brackets, hardware, and all appurtenant material required to complete the work.

4. **Wireless Vehicle Detection System, Rem** includes removing a wireless vehicle detection system including the SPP radios, the master interface APCC card, the EX cards, and the Isolator Module. The work includes removing all mounting brackets, hardware, cable, connectors, grounding, and all appurtenant material required to complete the work. **Wireless Vehicle Detection System, Rem** also includes storage or disposal of removed material.

5. **Wireless Vehicle Sensor Node, Rem** includes:

A. Remove a wireless vehicle sensor node including the sensor, epoxy, and all appurtenant material required to complete the work;

B. Storage and or disposal of removed material;

C. Filling the old hole with black epoxy;

6. **Wireless Repeater, Rem** includes removing a wireless repeater including the RP, mounting brackets, hardware, and all appurtenant material required to complete the work. **Wireless Repeater, Rem** also includes storage or disposal of removed material.

7. **Wireless Vehicle Detection System, Salv** includes removing a wireless vehicle detection system including the SPP radios, the master interface APCC card, the EX cards, and the Isolator Module. The work includes removing all mounting brackets, hardware, cable, connectors, grounding, and all appurtenant material required to complete the work. **Wireless Vehicle Detection System, Salv** also includes storage and reinstallation on the project;

8. **Wireless Repeater, Salv** includes removing a wireless repeater including the RP, mounting brackets, hardware, and all appurtenant material required to complete the work. **Wireless Repeater, Salv** also includes storage and reinstallation on the project;

9. **Wireless Vehicle Sensor Node, Salv** includes:

A. Removing a wireless vehicle sensor node including the sensor, epoxy, and all appurtenant material required to complete the work;

B. Storage and reinstallation on the project;

C. Core drilling a new 4 inch by 2¼ inch hole, as indicated on the plans, or as directed by the Engineer, and encapsulating the VSN with orange epoxy; and

D. Filling the old hole with black epoxy.