MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
RADAR VEHICLE PRESENCE STOP-BAR DETECTOR

SIG:EMS 1 of 6 APPR:HLO:NJB:04-24-23
FHWA:APPR:04-28-23

a. Description. This work consists of furnishing and installing, or removing, a radar vehicle presence stop-bar detector (RVPSD) system including up to four sensors, at an intersection as shown on the plans; furnishing and installing, or removing up to four vehicle sensors at an intersection; and storage or disposal of all removed materials.

b. Materials. Furnish RVPSD system and interface in accordance with this special provision. Furnish hardware wiring and other appurtenant materials in accordance with sections 918 and 921 of the Standard Specifications for Construction and this special provision.

1. Radar vehicle presence stop-bar detector (RVPSD).

A. Furnish an RVSPD from the following list.

(1) Wavetronix SmartSensor Matrix

(2) Approved equal (AE). Ensure the AE is evaluated, tested, and approved per the MDOT New Traffic Signal Device Product Review Guidelines. The review time is not justification to delay the project.

2. Ensure the cable between the sensor and cabinet meets all the following specifications:

A. A 6-conductor cable that attaches to an 8-pin connector.

B. Furnish power and dual recommended standard (RS)-485 communication through twisted pair. RS-485 conductor nominal capacitance, conductor to conductor: less than 40 picofarad per foot (pF/ft) at 1 kilohertz (kHz). RS-485 conductor nominal conductor DC resistance: less than 16.7 ohms/1000 feet (304.8 m) at 20 °C. Cable assembly shielded with aluminum/polyester shield and tinned copper drain wire. Ensure power wires are 20 AWG while communication wires are 22 AWG and Restriction of Hazardous Substances (RoHS) compliant.

C. Ensure the cable end connector meets *the MIL-C-26482* specification and is designed to interface with the appropriate *MIL-C-26482* connector. Ensure the connector back shell is an environmentally sealed jacket, and the outer diameter of this jacket is within the back shell's cable outer diameter (O.D.) range to ensure proper sealing. Ensure the back shell has a strain relief with enough strength to support the cable slack under extreme weather conditions.

D. Ensure the manufacturers' instructions are followed to ensure proper connection.

3. Ensure the RVPSD furnishes all the following functional capabilities:

A. Process vehicle detection signal from one, up to four radar sensors.

B. Detect vehicles by transmitting electromagnetic radar signals through the air. The signals bounce off vehicles in their paths and part of the signal is returned to the RVPSD. Multiple returned signals are then processed to determine true presence of stopped vehicles at the intersection.

C. Delineate lanes and detect true presence of up to 10 lanes of traffic per approach.

D. Detect the presence of vehicles in up to 16 detection zones per sensor with custom detection zones.

E. Mount and detect vehicles in lanes with boundaries as close as 6 feet from the first lane detected from the sensor.

F. Detect vehicles in real time as they travel across each detector zone.

G. Place new detector zones from an external computer through the serial port when editing existing lane configurations.

H. Prevent memory loss during power outages.

I. Continue to operate using the existing zone configurations when the operator is defining or modifying a zone pattern and not allow the new zone configuration to go into effect until the configuration is saved by the operator.

J. Be programmable by the user to save and upload any stored configurations.

K. Detect vehicles in lanes located with the far boundary at 140 feet from the position in which the sensor is mounted.

L. Allow any spacing of traffic lanes positioned from the minimum offset to the maximum range. Ensure unequally sized or spaced lanes are handled so that detections from the lanes meet all specifications. Ensure the minimum lane width is 4 feet with a maximum lane width of 36 feet.

M. Simultaneously detect vehicles from a lane located at the minimum offset and from a lane located at the maximum range.

N. Ensure the field of view of the sensor is at least 90 degrees. This enables the sensor to furnish simultaneous detection from a lane located at the minimum offset and a lane located at the maximum range as described by sensor Detection Coverage. The field of view of the sensor determines the area in which it can detect traffic. If the field of view is smaller, then the sensor will have to be positioned further away from the stop-bar which will diminish the number of lanes which can be delineated.

4. Ensure the interface unit furnishes all the following functional capabilities:

A. Enable the user to plug an extension module into the appropriate slot without the need to rewire the interface unit.

B. Connect to the contact closure by furnished patch cable through RS-485 connectors.

C. Connect to the sensor through keyed color coded wire connectors to furnish connectivity, power, and surge protection.

D. Be available in both two and four channel configurations programmable from the contact closer and the user interface through a laptop.

E. When using the Software Development Life Cycle (SDLC) interface unit, directly connect the 16 channels of detection per sensor directly to the controller SDLC connector.

5. Ensure the detection zones configuration furnishes all the following functional capabilities:

A. Support up to 16 detection zones, per sensor, and each detection zone can be sized to suit the site and desired vehicle detection region.

B. Indicate vehicle presence in multiple detection zones on a single detector output channel by linking channels using “AND” or “OR” commands.

C. Allow detection zone outputs to be configurable to select normal, counting, pulse, extend, and delay outputs. Ensure timing parameters of pulse, extend, and delay outputs are user definable between 0.1 to 25.0 seconds.

D. Ensure the detection of stopped vehicles are within 5 percent of truth for a vehicle stopped in a designated zone. Ensure vehicle counts are within 5 percent of truth when placed as smaller zones past the stop-bar, within 10 percent of truth when placed before the stop bar or when loops no larger than 6 feet are used.

E. Feature directional detection zones to reduce false detections from objects traveling in other directions.

F. Allow detection zone setup without site-specific information such as latitude and longitude or temporal information such as date and time.

6. Ensure the sensor furnishes all the following operational capabilities:

A. Mount in a standard *NEMA TS 1, TS 2*, 2070 Advance Transportation Controller (ATC), 170 type detector rack. Interface unit to obtain power and furnish contact closure outputs or through the SDLC when connected to a SDLC interface unit.

B. Mount in a standard detector rack without the need for rack adapters or for rewiring the detector rack.

C. Operate satisfactorily in a temperature range from -30 °F to 165 °F (-35 °C to 74 °C) and a relative humidity range from 0 percent to 95 percent, non-condensing as set forth in *NEMA* specifications.

D. Power by 10 or 28 VDC.

E. Consume less than 10 Watts (W) power.

F. Include a RS-232 port for serial communications with a remote computer. Ensure the sensor RS-232 port is multi-drop compatible with a 9-pin “D” subminiature connector on the interface unit.

G. Use flash memory technology to enable loading modified or enhanced software through the RS-232 port without modifying the sensor hardware.

H. Include detector output pin-out that is compatible with industry standard detector racks.

I. Display detector outputs for each channel of detection, in real time when the system is operational, with visual cues such as LEDs on the front panel.

J. Furnish transient voltage suppression and isolation for the sensor inputs.

K. Bond and ground all equipment per the manufacture installation specifications.

L. Have two communication ports and ensure both ports can communicate independently and simultaneously.

7. Ensure the interface units provide all the following operational capabilities:

A. Maximum power of 75W at 80 °C.

B. Mount in a standard *NEMA TS 1, TS 2*, 2070 ATC, 170 cabinet.

C. Connect to as needed and mount in a standard detector rack without the need for rack adapters or for rewiring the detector rack.

D. Include detector output pin-out that is compatible with industry standard detector racks.

8. System Hardware. The RVPSD hardware consists of a radar detection sensor (RDS), a sensor back plate interface unit (SBPIU) or shelf mount interface unit (SMIU) or shelf mount SDLC interface unit; radar sensor contact closure cards as needed, mounted in a standard detector rack; a sensor mount; sensor cable and homerun cable as needed. Ensure installed RVPSD is compatible with existing solid state pre-timed or actuated traffic signal control equipment and cabinet environments. Ensure the interface units, contact closure(s) and the radar sensor(s) are from the same supplier to ensure compatibility.

9. System Software. Ensure the system software can detect vehicles in multiple lanes using only the radar image produced by 16 separate radar beams. Ensure software is capable of allowing the operator to program up to 16 detection zones per sensor by placing zones on user interface 90 degree image using only the user interface software. Programming sensor(s) detection zones will require the use of a laptop computer and will be connected through the interface unit via RS-232, RS-485, universal serial bus (USB) or Ethernet as

allowed by the interface unit.

10. Warranty. Furnish materials with a manufacturer's 2 year warranty, transferable to the Department or the Local Agency responsible for the project, 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.

During the warranty period, the manufacturer must furnish the following services at the manufacturer's pricing and terms of sale current at the time of the order:

A. Repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect, provided the product is returned to the manufacturer's factory or authorized repair site.

B. Be responsible for all costs associated with shipping products repaired or replaced under warranty.

C. Maintain an adequate inventory of parts to support maintenance and repair of RVPSD system during the warranty period.

D. Deliver parts within 45 days of placement of order.

E. Furnish technical support for the RVPSD system by manufacturer certified personnel. Ensure telephone technical support is provided within 8 hours of the time a call is made by a user. Ensure on-site technical support is also furnished as required for installation of repaired or replaced equipment.

F. Furnish sensor software updates to the Department or the Local Agency responsible for the project at no additional cost.

c. Construction. Furnish and install, or remove, RVPSD system as shown on the plans or as directed by the Engineer. Ensure that the RVPSD system is installed as documented by installation materials furnished by the manufacturer. Complete this work in accordance with sections 818 and 820 of the Standard Specifications for Construction, the applicable typical signal construction detail, and this special provision. Storage and/or disposal of the removed material are included.

When RVPSD system is called for, deliver all equipment internal to the controller cabinet to the MDOT Statewide Signal shop or to the inspecting agency for setup and installation in the controller cabinet.

Install sensor(s) not less than 18 feet above the roadway, or as shown on the plans, and install each sensor offset to the traveled way on which it will detect vehicles.

Do not turn on the radar sensor equipment until all other signal equipment has been installed and inspected. Obtain the Engineer's approval prior to beginning radar sensor installation. Correct radar sensor installation that was completed prior to the approval of the Engineer, and which is found to be non-optimal placement of the cameras at no additional cost to the contract. The Engineer will not authorize extra payment or time extensions for work required to reorient or move the sensor(s).

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
Radar Vehicle Presence Stop-Bar Detector System	Each
Radar Vehicle Presence Stop-Bar Detector System, Rem	Each
Radar Vehicle Presence Stop-Bar Detector System, Salv	Each
Radar Vehicle Presence Stop-Bar Detector Sensor	Each
Radar Vehicle Presence Stop-Bar Detector Sensor, Rem	Each
Radar Vehicle Presence Stop-Bar Detector Sensor, Salv	Each

1. **Radar Vehicle Presence Stop-Bar Detector System** includes furnishing and installing the radar system, interface unit, contact closure hardware, cable, connectors, and other appurtenant material required to complete the work.

2. **Radar Vehicle Presence Stop-Bar Detector System, Rem** includes removing any previous system processor, automatic control unit, monitors, amplifiers hardware, cable, connectors, and other appurtenant material. **Radar Vehicle Presence Stop-Bar Detector System, Rem** also includes storage, as directed by the Engineer, or proper disposal of all removed materials.

3. **Radar Vehicle Presence Stop-Bar Detector System, Salv** includes removing an existing radar vehicle presence detection system, storing the removed materials on site, and reinstalling at a location shown on the plans.

4. **Radar Vehicle Presence Stop-Bar Detector Sensor** includes furnishing and installing a radar detection sensor, enclosure, mounting bracket, hardware, cable, connectors, and other appurtenant material required to complete the work.

5. **Radar Vehicle Presence Stop-Bar Detector Sensor, Rem** includes removing all previous detection system, enclosure, mounting bracket, hardware, cable, connectors, and other appurtenant material, and includes storage, as directed by the Engineer, or proper disposal of all removed materials.

6. **Radar Vehicle Presence Stop-Bar Detector Sensor, Salv** includes removing an existing radar vehicle presence detection system, storing the removed materials on site, and reinstalling at a location shown on the plans.