Louisiana

Department of Transportation

And

Development

Traffic Control Standard

Number 210

Wireless Magnetometer Vehicle Detection System (WMVDS)

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1. GENERAL

This special specification sets forth the minimum requirements for a wireless magnetometer vehicle detection system (WMVDS) that detects vehicles on a roadway via changes to the earth's magnetic field. When a change is detected the WMVDS provides contact closure to a traffic controller or similar device.

1.1 The WMVDS shall consist of the following components: In-pavement sensors, all wireless communication equipment needed to establish communication links to the controller cabinet, interface modules compatible with NEMA TS-2 V2.06b cabinet detector rack, surge protection for the WMVDS and system software for set-up and monitoring of the WMVDS.

1.2 Supplier or manufacturer must provide all system software and materials necessary for installation and maintenance of the WMVDS. Supplier must provide documentation for the use of software, installation instructions, and maintenance of the system.

1.3 Definitions

1.3.1 3-Axis Magnetometer: Instrument used for measuring the magnitude and direction of the earth's magnetic field. Device used to detect changes in the earths magnetic field within the vicinity of the instrument. The 3-axis magnetometer measures the height, width and length of the magnetic field around the instrument referenced as the X, Y, and Z axis.

1.3.2 Interface Module: Module used to plug into the detector rack of a NEMA TS-2 traffic controller cabinet or input file 170/2070 traffic controller cabinet. Provides contact closure to the assigned detector channel when vehicle detection is achieved by the in-pavement sensor.

1.3.3 Wireless Communications Link: Data communications channel connecting to nodes of a communications link using a radio frequency (RF) to connect the nodes. Wireless links to connect nodes such as: access point to the sensor and/ or access point to repeater.

1.3.4 Access Point: Wireless communications device used as the connecting node to establish a data communications link from the sensor to the interface module.

1.3.5 Repeater: Wireless node used to receive/transmit data with the access point.

Repeater is typically located near the sensor and may be used in tandem with another repeater for longer distances or to communicate around obstructions.

1.3.6 In-pavement Sensor: Device placed in the roadway and used to detect a change in the earth's magnetic field when a vehicle passes over its measured area of influence. In-pavement sensor houses the 3-axis magnetometer used to sense the change in the earth's magnetic field. Sensor acts as a data communications device to an access point to transmit contact closure when detection is achieved by the 3-axis magnetometer. In pavement sensors may also be referred to as a sensor in this

specification.

1.3.7 System software: Computer software used for set-up and monitoring of the WVMDS. Software allows the user to assign sensors to detector channels and to select sensitivity levels needed for the application.

1.3.8 Detection zone: Area of measured magnetic lines of flux by the in-pavement sensor.

1.3.9 Presence Detection: The ability of a vehicle detector to sense that a vehicle, whether moving or stopped, has appeared in its zone of detection.

1.3.10 Passage Detection: The ability of a vehicle detector to detect the passage of a vehicle moving through its zone of detection and to ignore the presence of a vehicle stopped within its zone of detection.

1.3.11 Detection Accuracy: The measure of the basic operation of a detection system (shows detection when a vehicle is in the detection zone and shows no detection when there is not a vehicle in the detection zone).

1.3.12 Delay Timing: When selected, applies delayed contact closure to the associated detector channel input. When a vehicle is detected by the WMVDS, the delay timing must time out before contact closure can occur to the detector channel.

1.3.13 Extension Timing: When selected, applies additional contact closure to the associated detector channel input. When a vehicle is no longer detected within a detection zone, extension timing must time out before contact closure is removed from the associated detector channel.

1.3.14 Hysteresis: The lagging of an effect behind its cause; especially the phenomenon in which the magnetic induction of a ferromagnetic material lags behind the changing magnetic field.

2.0 FUNCTIONAL CAPABILITIES

2.1 The WMVDS must be capable of detecting a variety of vehicle types including motorcycles, automobiles, large trucks and light rail trains. The system must allow the user to select sensitivity levels that adjust the amount of hysteresis to the magnetic field needed to achieve contact closure to the assigned detector channel. Magnetometer sensitivity level adjustments must allow for different levels of vehicle detection. Sensitivity level settings to the magnetometer must be accomplished using WMVDS software via wireless communication.

2.2 The WMVDS must be able to perform presence or passage detection as described in this specification.

2.3 The WMVDS must be able to perform delay and extension timing as described in this specification.

2.4 Equipment failure such as: the sensor, communications link, access point radio, repeater radio (if used) or interface module, shall result in constant vehicle call "fault state" on the affected detector channel to the traffic controller.

3.0 DETECTION PERFORMANCE

3.1 Detection accuracy must be comparable to properly operating inductive loops. Detection accuracy shall include the WMVDS ability to detect the presence of any vehicle within the sensors magnetic field and to communicate contact closure to the appropriate detector channel. If the WMVDS "false detects", (system applies contact closure when a vehicle is not present in the sensors magnetic field), this will count against the accuracy measured during performance testing. A minimum of 97% detection accuracy must be achieved by the WMVDS when measured in a 24 hour period.

3.2 The WMVDS shall provide real-time vehicle detection (within 150 milliseconds (ms) of vehicle arrival). Once detection is achieved by the sensor, the traffic controller must receive contact closure to the assigned detector channel within the 150 ms time frame.

4.0 IN-PAVEMENT SENSOR

4.1 The in-pavement sensor unit must be designed to operate reliably in adverse weather conditions and rated to operate from -40° F to +176° F.

4.2 In-pavement sensors must be capable of presence detection as defined in this specification. The in-pavement sensors as a minimum must create a 6 foot length x 6 foot width accurate area of detection when used for presence detection at an intersection.

4.3 In-pavement sensors must be capable of passage detection as defined in this specification. The in-pavement sensors as a minimum must create a 6 foot length x 4 foot width accurate area of detection when the sensors are set back from the intersection for passage detection on an arterial.

4.4 In-pavement sensors as a minimum must use a 3-axis magnetometer in the design and operation of the unit. The sensor must monitor the earth's magnetic field throughout the course of the day and establish a baseline reference value for the X, Y, and Z axis. As a minimum the refresh rate on the magnetometer's processor will be 64 HZ and reference the earth's magnetic field every 3 minutes updating the baseline value for vehicle detection. The sensor must be able to detect a change in the magnetic field as referenced to the sensitivity setting selected by the user and the size of the vehicle passing over its detection zone.

4.5 The in-pavement sensor must operate on batteries without the need for underground power or communication cable connections to the unit.

4.6 The average operating life span of the sensor under battery power must be a minimum of 10 years.

5.0 DETECTOR INTERFACE MODULE OR MAGNETOMETER (SENSOR) CONTROLLER UNIT

5.1 One or two access points must communicate to an interface module plugged into the detector rack or use shelf mounted sensor controller with a RS485 and 2.4 GHZ communication interface. The interface module or the sensor controller will provide detector contact closure date to the traffic controller. The sensor

controller will use a NEMA TS-2 SDLC connector addressable from the traffic controller.

5.2 The operating temperature range of the interface module or sensor controller, as a minimum must be -30° F to +165° F.

5.3 The interface module shall be designed to operate in a NEMA TS-2 detector rack or 170/2070 cabinet input file. The interface module must be capable of operating on 12V or 24V DC (detector racks may be wired for 12V or 24V DC).

5.4 The sensor controller must be designed to interface with the RS485 communications in a NEMA TS-2 cabinet and be addressable with the traffic controller using a SDLC connection point in the cabinet. The sensor controller must communicate contact closure to an assigned detector channel in the traffic controller when vehicle detection is achieved by a magnetometer. As a minimum the sensor controller must be able to collect and transmit contact closure data from 64 HZ in pavement sensors to assigned vehicle detector channels in the traffic controller.

5.5 The interface module must provide 2 or 4 detector channels. Sensors must be assignable to the available detector channels on the interface module using software provided with the WMVDS.

5.6 The front face of the module shall identify detector channel 1 and detector channel 2.

Each must use an LED to indicate contact closure on the channel. When vehicle detection is achieved, the LED will be on and contact closure applied to the detector channel. During periods of no vehicle detection the LEDs will be in an off state and no contact closure will be applied to the detector channel.

5.7 The interface module will use an LED indication to indicate a "fault state" with the WMVDS. When the fault state is active contact closure will be applied to the appropriate detector channel.

5.8 Sensor controllers must apply contact closure when communication to an in pavement sensor is lost for a period of 60-75 seconds. Contact closure must be applied on the detector channel until communication to the sensor is re-established with the unit.

5.9 A link light or the use of a software GUI will be used to indicate a valid communications link is established between the interface module and access point. If no link is established between the two devices, the interface module will apply contact closure to all detector channels.

6.0 COMMUNICATION REQUIREMENTS

6.1 Access points and repeaters must be rated for outdoor use and housed in an appropriate NEMA enclosure. The operating temperature range of these devices, as a minimum, must be from -30° F to +140° F.

6.2 As a minimum, access points must be capable of handling data communications for

up to 48 sensors. The access points must be able to communicate to sensors from a distance of 150 feet when mounted 20 feet above the road surface. Repeaters may be used to achieve distances above 150 feet out to 1,000 feet.

6.3 All communications equipment will operate in an unlicensed frequency range permitted by the FCC.

6.4 The communications system must have alternative frequency channels selectable by the user. Should interference occur on a frequency channel the user must be capable of switching to an alternative channel free of interference.

6.5 All communications equipment must meet all applicable IEEE standards and FCC standards as required for the frequency range used by the WMVDS.

6.6 Surge protection meeting Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment GR 1089 standards must be used for devices receiving power over Ethernet.

6.7 Access points must be able to operate from power over Ethernet (48V DC) or a 120V AC source.

7.0 SOFTWARE

7.1 Firmware for in-pavement sensors and access points must be upgradable via a wireless connection to the device.

7.2 The software must allow for sensitivity adjustments to the sensor detection algorithms used by the WMVDS. As a minimum the system will use 12 different sensitivity levels ranging from .12 to 25.6, change in milli-gauss of the measured magnetic field. The sensitivity adjustments must be selectable by the user. Contact closure will be transmitted to the interface module when a change to the magnetic field is equal to or greater than the selected sensitivity setting.

7.3 The software must allow the user to program delay time as defined in this specification. As a minimum, the software must allow for a range 0 to 25 seconds of delay time.

7.4 The software must allow the user to program extension time as defined in this specification. As a minimum, software must allow for a range 0 to 5 seconds of extension time.

7.5 The software will allow the user to assign selected sensors to specific detector channels. In-pavement sensors must be assignable to detector channels via system software.

7.6 The software must display each sensor, sensor vehicle detection activity and its communication status on a GUI display.

7.7 Software must show battery level and received signal strength indication (RSSI) for each in pavement sensor used at the intersection.

8.0 WARRANTY

8.1 A five (5) year warranty on all parts and components of the entire Wireless Magnetometer Vehicle Detection System (WMVDS) must be provided by the manufacturer. The warranty shall begin when the Wireless Magnetometer Vehicle Detection System (WMVDS) is installed.