WIRELESS MAGNETOMETER VEHICLE DETECTION SYSTEM

SECTION 16721
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1. Description. Install a Wireless Magnetometer Vehicle Detection System (WMVDS) as detailed in the plans that monitors vehicles on a roadway by measuring changes in the earth's magnetic field and provides detector outputs to a traffic controller and other devices. WMVDS will also provide traffic data described in this specification to other devices. This Item defines the requirements for a system that detects vehicles on a roadway using one or more battery powered wireless magnetometer vehicle detectors and system components to transmit detection information 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.

The system maybe composed of these principal items: One or more of the following items, two types of In-pavement sensors, presence sensors and passage sensors for each lane requiring presence, pulse and advanced detection, wireless Repeaters, hardwired Access Points and Serial Radios mounted on the side of the roadway, Base Module, Access Point Controller Cards, Serial Radio Isolators and Extension Interface Cards in cabinet. WMVDS shall include setup software, epoxy to install in-pavement sensor or sensors and mounting hardware for Repeaters, Access Points and Serial Radios.

A. Definitions.

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 earth's 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.

2. **Interface Module.** EX modules used to plug into the detector rack of a NEMA TS-1 or NEMA TS-2 traffic controller cabinet or input file 170 or 2070 traffic controller cabinet. Provides contact closure to the assigned detector channel when vehicle detection is achieved by the in-pavement sensor.

3. **Base Module.** Shelf or rack mounted processor to communicate with up to two Access Points wired and wirelessly, outputs detector calls using SDLC or directly to traffic signal controller or detection rack.

4. **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, Base Module, the sensor, access point to repeater or serial port protocol radio to sensor and repeater.
5. **Access Point.** Wireless communications device used as the connecting node to establish a data communications link from the sensor to Base Module.

6. **Access Point Controller Card.** A combination of access point and controller card that, supports two radios, and allows for additional communication, storage and processing of data from in-pavement sensors.

7. **Repeater.** Wireless battery powered node RP is used to receive and transmit in-pavement sensor data to 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.

8. **Serial Radio.** External radios that provide RS422 hard wired communications that can be up to 2000 feet in length, to and from access point controller card. They are used as the connecting nodes to establish wireless data communications link from in-pavement sensors or repeaters.

9. **Serial Radio isolator.** Hard wired electrical isolator that offers electrical isolation from Serial Radio to Access Point Controller Card. Serial Radio isolator extends the range of the RS422 communication between the Access Point Controller Card and the Serial Radio to up to 2000 feet. It is installed inside the cabinet and wired between Access Point Controller Card and the Serial Radio.

10. **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.

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

12. **Detection zone.** Area of measured magnetic lines of flux by the in-pavement sensor.

13. **Presence Detection.** The ability of a vehicle detector to sense that a vehicle, whether moving or stopped, has appeared in its zone of detection.
14. **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.

15. **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).

16. **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.

17. **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.

18. **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.

B. **Functional Capabilities.** Each WMVDS system shall consist of one or more Base Module, Access Point, Access Point Controller Card, Serial Radio, Serial Radio Isolator, Repeater, and Extension Interface Cards and in-pavement wireless battery powered magnetometers. Two types of wireless battery powered in-pavement sensors shall be used, one optimized for presence detection, presence sensor and one for advanced detection of moving vehicles, passage sensor. The Passage Sensor shall also be used for system detection, count, occupancy and in pairs speed calculation. Using supplied software Passage Sensor can be put in Presence Sensor mode but Presence Sensor cannot be put in Passage Sensor mode. Multiple in-pavement sensors placed in one lane shall be able to work as one detection zone using and or or logic. Each type of in-pavement sensor shall have ability to have independent extension and delay time configurable with supplied software.

The sensors detect a vehicle by measuring a change in the earth's magnetic field near the sensor caused by the vehicle (i.e. magnetometer type detection). The WMVDS must be capable of detecting a variety of vehicle types including bicycles, 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 at least 12 different levels of vehicle detection. Sensitivity level settings to the magnetometer must be accomplished using WMVDS software via.
Each type of in-pavement sensor communicates time-stamped ON and OFF vehicle detection events. Both types of in-pavement sensor transmit detection information within 150ms of a detected event. Each type of in-pavement sensor automatically retransmits the detected event if no acknowledgement is received from the Access Point. Each type of in-pavement sensor may stop retransmission after eight attempts. Communications between the each type of in-pavement sensor, Repeater, Access Point and the Serial Radio is to be wireless. The RF link among the Access Point, Serial Radio, Repeater, and both types of in-pavement sensor must meet all applicable FCC standards as required for the frequency range used by the WMVDS. Communications is allowed only in an unlicensed band. The both types of in-pavement sensors and Repeater are reconfigurable by a user over the wireless interface to avoid interference from other users of the communications band. Spread spectrum, frequency hopping, or a minimum of 15 channels are provided for this purpose.

Serial Radio to sensor and Repeater to sensor RF line of sight range shall be at least 175 feet for an Access Point, Serial Radio or Repeater installed at 30 feet above the roadway, at least 150 feet at 20 feet above the roadway, and at least 75 feet at 12 feet above the roadway. The Repeater to Access Point or Serial Radio RF range shall be at least 1000 feet when both units have line of sight with no obstructions between them and are installed 18 feet above the roadway. Repeaters can be used in "tandem" operation with another Repeater to extend the RF Range another 400 feet. Each type sensor and Repeater shall transmit a unique identifying code, RF channel and current battery voltage. Each type of in-pavement sensor and Repeater must respond within 100 seconds when the Access Point or Access Point Controller Card is powered on. When any programmed in-pavement sensor or Repeater loses wireless communication with the Access Point or Access Point Controller Card for 30 7 0 seconds, or when no Access Point, Serial Radio or Access Point Controller Card is present or not powered on, the Access Point Controller Card, Extension Interface Cards defaults to fault mode and constant "on" output shall be transmitted to the controller. This fault shall not be able to clear itself or be cleared remotely. If the fault condition is repaired the detection may return to standard operation.

The Access Point to sensor RF line of sight range shall be 250 feet using Onmi antenna and 700 feet using directional antennas. Each Access Point shall communicate with at least 75 in pavement sensors.

2. Materials. All materials shall be able to operate at temperatures from -37°F to +176°F and up to 95% humidity (non-condensing).

A. In-Pavement Sensors Hardware. As required by the plans, in-pavement sensors and epoxy will be provided. Both in-pavement sensors shall consist of a magnetometer, a microprocessor, a wireless transmitter and receiver, and a
battery. Both in-pavement sensors components shall be contained within a single housing. Each unit shall have a unique serial number that is permanently and neatly displayed.

1. The in-pavement sensors housing will meet NEMA Type 6P and IEC IF68 standards. The in-pavement sensors components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The in-pavement sensors housing are installed in a 4 to 4.5 inch diameter cored hole that is 2.25 to 2.75 inches deep.

2. In-pavement presence 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 by 6 foot width accurate area of detection when used for presence detection at an intersection. Sensitivity settings change the detection area making it larger or smaller than 6 foot length by 6-foot width.

3. In-pavement passage 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 or used for passage vehicle monitoring.

4. Both In-pavement battery powered sensors shall as a minimum use a 3-axis magnetometer in the design and operation of the units. The sensors 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 128 Hz, providing a sampling rate of 8ms to the earth’s magnetic field. As a minimum, during periods of no detection the X, Y, and Z axis will refresh the baseline reference value every 8ms. The sensors 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.

5. The in-pavement sensors must operate on batteries without the need for underground power or communication cable connections to the unit. The average operating life span of the sensors under battery power must be a minimum of 10 years.

6. Each type of in-pavement sensors shall be capable of being individually configured with its own sensitivity level. Up to two sensors properly configured shall be capable of detecting motorcycles and bicycles in their designated lanes.

7. Each type of in-pavement sensor's firmware must be upgradable wirelessly through Access Point or Serial Radio and Access Point Controller Card.
B. Access Point Hardware. Provide as required by the plans, Access Point or Access Points. The Access Point is the communications hub of the sensor network. Each Access Point will communicate with at least 48 in-pavement sensors.

1. The Access Point shall be powered via 120 VAC, 48VDC, 3W, or via non-isolated external 10VDC to 15VDC, 2W power. Power may be shall be provided by the Contact Closure Card. The Access Point shall have at least one powering option that provides 1500V isolation and 5KV surge protection.

2. The Access Point meets NEMA 4X and IP67 standards. The Access Point shall be no larger than 8 inches high by 8 inches wide by 8 inches deep and shall weigh no more than five pounds.

3. Access Point firmware may be upgradable using Windows PC running a Web Browser over Ethernet connection.

C. Access Point Controller Card Hardware. Provide as required by the plans Access Point Controller Card or Access Point Controller Cards. The Access Point Controller Card is the communications hub of the sensor network. Each Access Point Controller Card will communicate using one or two Serial Radios. Each Serial Radio will communicate with at most 48 in-pavement sensors.

1. The Access Point Controller Card cards provide detector outputs to the controller. They directly plug into standard NEMA TSI or TS2 and Type 170 or 2070 detector racks. Each card provides up to four channels of detection. Access Point Controller Card cards are powered by 11VDC to 26VDC: from cabinet detector rack.

2. The Access Point Controller Card, along with the Serial Radio or radios, maintains two-way wireless links to an installation's sensors and repeaters, establishes overall time synchronization, and transmits configuration commands and message acknowledgements. Each Access Point Controller Card will support up to two Serial Radios.

3. Access Point Controller Card firmware must be upgradable using Windows PC running supplied software over Ethernet connection.

D. Serial Radio Hardware. Provide Serial Radio or Serial Radios as required by the plans. The Serial Radio will communicate to the in-pavement sensors and Repeaters on one channel.

1. Serial Radio meets NEMA Type 4X and IEC IP67 standards.

2. Each Serial Radio must communicate with up to 48 sensors total they can be either in-pavement sensor. Each Serial Radio will have a maximum of 15 Repeaters configured. Up to 20 in-pavement sensors can be repeated.
using multiple repeaters and up to 12 in-pavement sensors can be repeated through multiple battery powered pole mounted repeaters.

3. The Serial Radio shall be no larger than 5 inches high by 4 inches wide by 3 inches deep and shall weigh no more than one pound.

4. The Serial Radio shall communicate and be powered through CAT5e communications cable. Cable length shall be less than 2000 feet.

5. Each Serial Radio to Access Point Controller Card connection will be through Serial Radio Isolator in cabinet.

6. Serial Radio Firmware must be upgradable through connected Access Point Controller Card.

E. **Base Module.** Provide rack or shelf mount Base Module as required by the plans. Shelf or rack mounted processor is the communications hub of the sensor network. Base Modules shall store diagnostic, count and occupancy data for a minimum of 30 days and be uploaded using Web browser. Each Base Module will communicate to one or two Access Points wired and/or wirelessly. Each Access Point will communicate with at least 75 in-pavement sensors.

1. Shelf mount Base Module outputs 64 detector calls using SDLC or 32 detector calls using wiring harness and standard NEMA TSI or TS2 and Type 170 or 2070 detector rack expansion cards to traffic signal controller.

2. Rack mount Base module plug directly into standard NEMA TSI or TS2 and Type 170 or 2070 detector racks. Each card provides up to four channels of detection and 28 more using expansion cards. Rack Mount Base Modules use 11VDC to 26VDC: from cabinet detector rack for power.

F. **Serial Radio Isolator Hardware.** Provide as required by the plans Serial Radio Isolator or Serial Radio Isolators. Serial Radio Isolators provide serial electrical isolation between Access Point Controller Card and each Serial Radio.

1. Serial Radio Isolator provides electrical isolation up to 1500V, surge protection up to 1500V, and AC power cross protection.

2. The Serial Radio Isolator must be properly electrically bonded to cabinet ground.

G. **Repeater Hardware.** Provide Repeater or Repeaters and poles as required by the plans. The Repeater will communicate to the in-pavement sensors on one RF channel and the Access Point or Serial Radio connected to Access Point Controller Card on a different RF channel.
1. Repeater meets NEMA Type 4X and IEC 1P67 standards.

2. Each Repeater must communicate with up to 10 in-pavement sensors total, each tandem Repeater will communicate with up to 6 in-pavement sensors.

3. Each Access Point or Serial Radio will have a maximum of 15 repeaters configured. Up to 20 of either type in-pavement sensor can be repeated using multiple Repeaters and up to 12 of either type in-pavement sensors can be repeated through multiple tandem repeaters.

4. The Repeater shall be no larger than 7 inches high by 7 inches wide by 4 inches deep and shall weigh no more than three pounds.

5. The Repeater shall be battery powered and shall be designed to operate from its battery for a minimum of eight years of life under normal traffic conditions. The RP battery shall be field replaceable.

6. Repeater firmware must be upgradable wirelessly through Access Point or Serial Radio and Access Point Controller Card.

H. Extension Interface Card Hardware. Provide as required by the plans, Extension Interface Card or Cards. The Extension Interface Cards meet the requirements of NEMA TS-1 or NEMA TS-2 traffic controller cabinet or input file 170 or 2070 traffic controller cabinet. Where a difference occurs, these requirements shall govern.

1. The Extension Interface Cards provide detector outputs to the controller. They directly plug into standard NEMA TS1 or TS2 and Type 170 or 2070 detector racks. Each card provides up to four channels of detection. Each card provides pulse or presence detection outputs. Each card provides for up to 31 seconds of delay and 7.5 seconds of extension.

2. The front face of the module identifies detector channel 1 through 4. 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.

3. When the fault state is active contact closure will be applied to the appropriate detector channel.

4. The interface module must provide 2 or 4 detector channels. In-pavement sensor detection must be assignable to any available detector channels on the Extension Interface Cards using software provided with the WMVDS. Up to 15 sensors in-pavement sensors can be assigned to one
Extension Interface Card controller channel.

5. The Extension Interface Cards shall be powered by 111VDC to 26VDC. They are surge protected to NEMA TS2-2003 standards.

6. Cabinet electronics, either contact closure cards or Base Module, may communicate by wired or wireless means with the Access Point. If wired, means shall be provided for surge protection of the communication and/or power wires.

7. Upon restoration of electrical power after a power failure of any length, the Extension Interface Cards channel will automatically return to its normal state of operation within 30 seconds.

3. Equipment.

   A. Detection Performance. Detection accuracy must be comparable to properly operating inductive loops. Detection accuracy includes 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. The WMVDS 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 150ms time frame.

   B. Documentation. Provide the following documentation for each Wireless Magnetometer Vehicle Detection System: A user's manual with full operating instructions in electronic format and site drawing with all components ID numbers and RF channels. The contact name, address, and telephone number for the representative, manufacturer, or distributor for warranty repair. Warranty dates and forms required to submit for warranty repairs.

   C. Field Communication Link. The field communications link must be standard Ethernet communications connection from the Access Point or Access Point Controller Card to the equipment cabinet. The following requirements must govern for the various types of field communications link media described on the plans:

   1. CAT5e cable. In locations where the plans indicate CAT5e cable is required as the primary communications link for AP and SPP radios, this cable must be of the Direct burial Rated CAT5e Cable type with tough UV-resistant, waterproof polyethylene jacket, a gel-filled core, and 24 AWG, solid conductors or approved equivalent as directed.
2. Base Module and Access Point Controller cards will have the ability to configure desired IP address and communicate locally or remotely using supplied configuration software through standard TCP/IP over Ethernet networks. If called out in the plans cellular data modem interface will be available as optional equipment with extra cost, cellular service is not included in bid price.

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

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.

5. Surge protection meeting GR 1089 standards must be used for devices receiving power over Ethernet.

6. Access Point Controller Card shall be factory-configurable to support at least two (2) different power options Access Points must be able to operate from power over Ethernet 48VDC or under battery power 12VDC. AP Power shall be supplied via an isolated nominal 48 VDC input, consuming a maximum of 4 watts and providing 1500 V isolation and 5 kV surge protection. Access Point Controller Card power shall be supplied via a detector rack 12VDC to 24VDC input. All connection cables must be continuous from the equipment cabinet to the Access Point or Access Point Controller Card; no splices of any type will be permitted.

7. The Access Point Controller Card or Base Module shall be capable of simultaneously communicating and storing detection data via internal memory, Ethernet interface, SDLC or USB 2.0 ports. Optional data storage and communication available are SD memory.

D. Software. Provide GUI software that will allow the monitoring, setup, and programming of all detector unit functions, features, and timing entries.

1. The software must allow for sensitivity adjustments to the in-pavement sensors detection algorithms used by the WMVDS. As a minimum the system will use 12 different Presence Sensor sensitivity levels ranging from 12% to 25.6% of change in multi-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.

2. The software or Web Browser GIU 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 31 seconds of delay time.
3. The software or Web Browser GIU must allow the user to program extension time as defined in this specification. As a minimum, software must allow for a range 0 to 7.5 seconds of extension time.

4. The software or Web Browser GIU will allow the user to assign selected channel and sensors to specific detector channels. In-pavement sensors must be assignable to detector channels via system software or Web Browser GIU.

5. Provide software on CD-ROM disks, or other approved media that is compatible with Microsoft Windows based 32bit and 64bit current XP, Vista and Windows 7 Operating systems for personal computers. The Department reserves the right to make copies of the software for its own use. Alternatively, GUI software may be integral to the main WMVDS module and accessed by standard web browser software.

E. Installation and Training. When required by plans or purchasing agency, the supplier or manufacturer of the WMVDS will supervise and assist in the installation and set-up of the equipment. A factory certified representative from the manufacturer will be on-site during installation of the WMVDS.

1. When required by plans or purchasing agency, up to two days of training shall be provided in the operation, setup and maintenance of the WMVDS. Instruction and materials shall be provided for a maximum of 10 persons and shall be conducted at a location selected by City of Houston or purchasing agency. City of Houston or purchasing agency shall be responsible for the cost of training.

2. Instruction personnel are required to be certified by the equipment manufacturer. The User's Guide is not an adequate substitute for practical, classroom training and formal certification by an approved agency.

3. Formal levels of factory authorized training are required for installers, contractors and system operators. All training must be certified by the manufacturer.

F. Warranty, Maintenance and Support. The WMVDS must be warranted to be free of defects in material and workmanship for a period of 5 years from date of shipment from the supplier's facility, with one exception the two year Repeater batteries. During the warranty period, the supplier shall repair with new or refurbished materials, or replace at no charge, any product containing a warranty defect provided the product is returned FOB to the supplier's factory or authorized repair site. Product repair or replaced under warranty by the supplier will be returned with transportation prepaid.

1. This warranty does not apply to products damaged by accident, improper operation, abused, serviced by unauthorized personnel or
unauthorized modification. During the warranty period, technical support shall be available from the supplier via telephone within 24 hours of the time a call is made by a user. This support shall be provided by factory-authorized personnel or factory-authorized installers.

2. Ongoing software and or firmware support by the supplier shall include updates of the WMVDS processor unit firmware and or software. These updates shall be provided free of charge during the warranty period. The update of the WMVDS software shall be tested and approved by the City of Houston before installation.

3. The supplier must maintain a program for technical support and software updates following expiration of the warranty period. This program shall be made available to the City of Houston in the form of a separate agreement for continuing support.

4. The supplier must maintain an adequate inventory of parts to support maintenance and repair of the WMVDS.

4. **Work Methods**, Install the in-pavement sensors in concrete or asphalt pavement. No in-pavement sensors will be installed before or during road paving.

Core finished pavement 4 to 4.5 inches in diameter and 2.25 to 2.75 inches deep. Place core in the center of the lane and at a distance from the stop bar shown in the plans. Place core to avoid 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.

Correctly orientate in-pavement sensors as clearly marked on the sensor. Apply sufficient epoxy to cover the bottom of the core hole, then place sensor in core hole and fully encapsulate with the epoxy to the lip of the cored hole.

Mount Access Point and antennas, or Serial Radio and Repeater to poles with provided hardware as shown on the plans. Orient Serial Radio and Repeater towards each other and associated in-pavement sensors with manufacture recommended line of sight distances between components to maintain proper communications. Run CAT5e direct burial rated cable and 16awg 3 conductor for 120 VAC from controller cabinet to Access Points, or Cat5 cable to Serial Radio and install RJ 45 connectors on each end using T-568A or T-568B straight through Ethernet cable color-code standards.

5. **Measurement and Payment**. This item will be measured by each intersection of all the required system components furnished, installed, made fully operational, and tested in accordance with this special specification or as directed.
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 Magnetometer Vehicle Detection System". This price shall be full compensation for furnishing, installing and testing the system, and for all labor, tools, equipment and incidentals necessary to complete the work.

The WMVDS power and communication cable from cabinet to Access Point must not be longer than 1000 feet. Cable from cabinet to Serial Radio must not be longer than 2000 feet.

END OF DOCUMENT