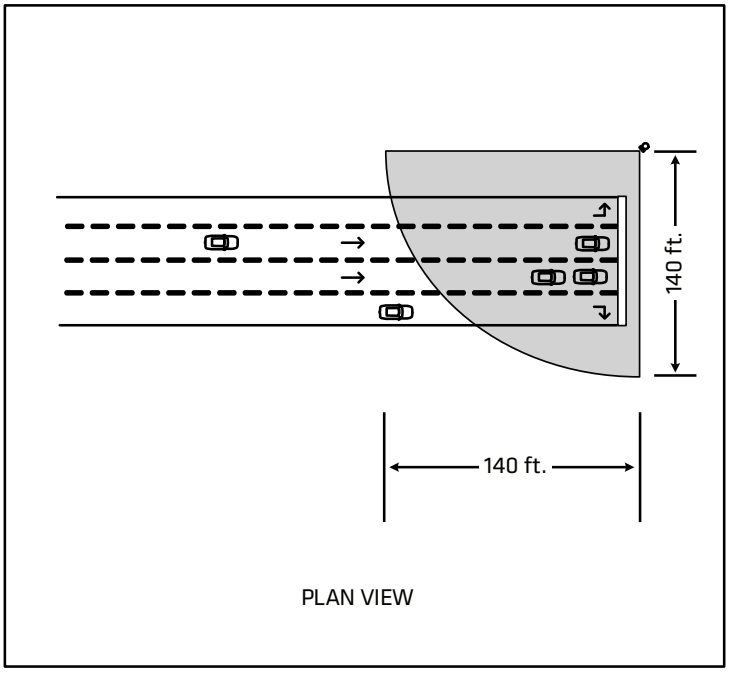
SmartSensor Matrix

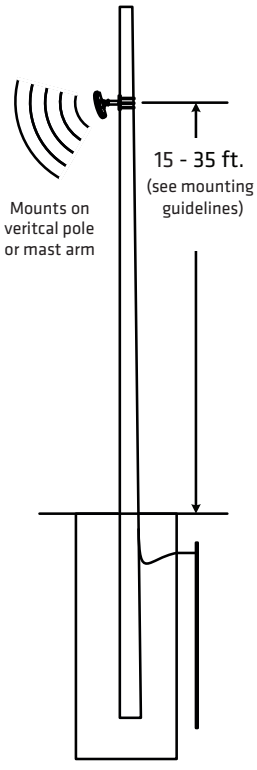
The SmartSensor™ Matrix is a first-of-its-kind stop bar presence detector designed for use at signalized intersections to detect vehicles with the reliability of radar and with all the advantages of non-intrusive detection.

Features

- Matrix of 16 radars for two-dimensional coverage
- Tracks vehicles through a 90 degree field of view that extends out 140 ft. (42.7 m)
- Includes Radar Vision™ technology to detect and track in two dimensions
- Reports real-time presence of both moving and stopped vehicles
- Standard detector-rack contact-closure interface
- Easy to install and operate
- Supports curved and angled lanes
- Includes preassembled cabinet back-plate, reducing the need to field wire
- Automated manufacturing process
- Patented auto-configuration process
- Patented Digital Wave Radar II™ technology
- Remote accessible for traffic monitoring and sensor management
- Flash upgradable
- Robust to changing temperature, light and weather conditions



PLAN VIEW



Technical Specifications

Sensor Outputs

- Real-time presence data in 10 lanes
- Maximum number of zones: 16
- Maximum number of channels: 16
- User-selectable zone to channel mapping
- AND logic triggers the channel when all the selected zones are active
- OR logic used to combine multiple zones to a channel output
- Channel output extend and delay functionality
- Algorithms mitigate detections from wrong way or cross traffic
- Fail-safe mode for contact closure outputs if communication is lost

Detectable Area

- Detection range: 6 to 140 ft. (1.8 to 42.7 m)
- Field of view: 90°
- Flexible lane configuration support including:
  - Up to 10 lanes
  - Curved lanes
  - Islands and medians

System Hardware

- A SmartSensor Matrix corner radar for each approach
- A traffic cabinet preassembled backplate with:
  - AC/DC power conversion
  - Surge suppression
  - Terminal blocks for cable landing
  - Communication connection points
  - Cabinet side mount or rack mount
- Contact closure input file cards:
  - 2 or 4 channel
  - Compatible with industry standard detector racks

Maintenance

- No cleaning or adjustment necessary
- No battery replacement necessary
- Recalibration is not necessary
- Mean time between failures: 10 years (estimated based on manufacturing techniques)

Physical Properties

- Weight: 4.2 lbs. (1.9 kg)
- Physical dimensions: 13.2 in. × 10.6 in. × 3.3 in. (33.5 cm x 26.9 cm x 8.4 cm)
- Resistant to corrosion, fungus, moisture deterioration, and ultraviolet rays
- Enclosure: Lexan EXL polycarbonate

Ordering Information

SmartSensor Matrix
SS-225

ACCESSORIES

SS-KIT – Wavetronix install kit

SS-112/114 – Click 112/114 rack cards

SS-704-xxx/705 – SmartSensor 6-conductor cable

SS-611 – SmartSensor mount

SS-B01-0003/0005/0008 – Intersection preassembled backplate – AC

SS-B01-0004/0006 – Intersection preassembled backplate – DC

SS-B02-0002/0003 – Intersection preassembled 19-inch rack

SS-710 – Sensor cable junction box

Wavetronix
78 East 1700 South
Provo, UT 84606
801.734.7200
sales@wavetronix.com
www.wavetronix.com

- Outdoor weatherable: UL 746C
- Watertight by NEMA 250 standard
- NEMA 250 compliant for:
  - External icing (clause 5.6)
  - Hose down (clause 5.7)
  - 4X corrosion protection (clause 5.10)
  - Gasket (clause 5.14)
- Withstands 5-ft. (1.5-m) drop
- Connector: MIL-C-26482
- Rotational backplate for 360° of roll

Electrical

- Power consumption: 9 W
- Supply voltage: 10–28 VDC

- Onboard surge protection

Communication Ports

- Two half-duplex RS-485 com ports support:
  - Dedicated detection comms
  - Configuration, verification or traffic display without disrupting detection comms
- Firmware upgradability over any com port
- User configurable:
  - Response delay
  - Push port

Radar Design

- Operating frequency: 24.0–24.25 GHz (K-band)
- Matrix of 16 radars
- No manual tuning to circuitry
- Transmits modulated signals generated digitally
- No temperature-based compensation necessary
- Bandwidth stable within 1%
- Printed circuit board antennas
- Antenna vertical 6 dB beam width (two-way pattern): 65°
- Horizontal field of view: 90°
- Antenna two-way sidelobes: -40 dB
- Transmit bandwidth: 245 MHz
- Un-windowed resolution: 2 ft. (0.6 m)
- RF channels: 8
- Self-test for verifying hardware functionality
- Diagnostics mode for verifying system functionality

Configuration

- Automatic and manual configuration of lanes, stop bars and zones
- Lane positioning increment: 1 ft. (0.3 m)
- Four-sided zones of any shape and size
- Overlapping zones supported
- Sensor reconfiguration without detection disruption supported
- Graphical user interface with traffic pattern display
- Counting and Pulsed channels supported
- Windows Mobile®–compatible software
- Supported operating systems:
  - Windows Mobile v5.0 or greater (Socket Mobile 650-M)
  - Windows XP
  - Windows Vista
  - Windows 7
- Software-supported functionality:
  - TCP/IP connectivity
  - Sensor configuration back-up and restore
  - Backed-up sensor configurations can be viewed and edited
  - Real-time traffic visualization for performance verification and traffic display
  - Zone and channel actuation display
  - Virtual sensor connections for demonstration and training
  - Local or remote sensor firmware upgradability

Operating Conditions

- Accurate performance in:
  - Rain up to 1 in. (2.5 cm) per hour
  - Freezing rain
  - Snow
  - Wind
  - Dust
  - Fog
  - Changing temperature
  - Changing lighting (even direct light on sensor at dawn and dusk)
- Ambient operating temperature: -40°F to 165°F (-40°C to 74°C)
- Humidity: Up to 95% RH (non-condensing)

Testing

- Tested under FCC CFR 47, part 15, section 15.249
- FCC certification on product label
- FCC regulation-compliant for life of the sensor
- Tested under IEC 61000-4-5 class 4
- Tested under NEMA TS 2-2003
  - Shock pulses of 10 g, 11 ms half sine wave
  - Vibration of 0.5 g up to 30 Hz
  - 300 V positive/negative pulses
  - Stored at -49°F (-45°C) for 24 hours
  - Stored at 185°F (85°C) for 24 hours
  - Operation at -29.2°F (-34°C) and 10.8 VDC
  - Operation at -29.2°F (-34°C) and 26.5 VDC
  - Operation at 165.2°F (74°C) and 26.5 VDC
  - Operation at 165.2°F (74°C) and 10.8 VDC

Manufacturing

- Manufactured in the USA
- Surface mount assembly
- IPC-A-610C Class 2–compliant
- Operational testing:
  - Sub-assembly test
  - 48-hour unit level burn-in
  - Final unit test
- Unit test results available

Support

- Training and tech support available from Wavetronix
- Wavetronix training includes:
  - Installation and configuration instruction to ensure accu-

rate performance
  - Classroom and in-field instruction
  - Knowledgeable trainers
  - Use of presentation materials
  - Virtual configuration using computer playback
  - Instruction in use of computer and handheld devices and other necessary equipment
- Wavetronix tech support includes:
  - Technical representatives available for installation and configuration
  - Ongoing troubleshooting and maintenance support

Documentation

- Instructional training guide
- Comprehensive user guide
- Installer quick-reference guide
- User quick-reference guide
- Documentation available upon request:
  - FCC certification
  - CE certification
  - IEC 61000-4-5 class 4 test report

Warranty

- Two-year warranty against material and workmanship defect Warranty (see SmartSensor Warranty datasheet for complete details)

The advertised detection accuracy of the company's sensors is based on both external and internal testing, as outlined in each product's specification document. Although our sensors are very accurate by industry standards, like all other sensor manufacturers we cannot guarantee perfection or assure that no errors will ever occur in any particular applications of our technology. Therefore, beyond the express Limited Warranty that accompanies each sensor sold by the company, we offer no additional representations, warranties, guarantees or remedies to our customers. It is recommended that purchasers and integrators evaluate the accuracy of each sensor to determine the acceptable margin of error for each application within their particular system(s).

SmartSensor Matrix Bid Specification

1.0 General. This item shall govern the purchase of aboveground radar presence detector (RPD) equivalent to the Wavetronix SmartSensor™ Matrix.

An RPD detects 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 RPD. The returned signals are then processed to determine traffic parameters.

RPDs are not affected by normal weather and environmental conditions such as rain, wind, snow, dust, etc. They also do not require cleaning and can maintain performance over a wide range of ambient temperatures.

RPDs provide a non-intrusive means of detecting traffic. This property not only makes them safer to install but also more cost effective than sensors that require roadway modifications or placement.

2.0 Sensor Outputs. The RPD shall present real-time presence data in 10 lanes.

The RPD shall support a minimum of 16 zones.

The RPD shall support a minimum of 16 channels.

The RPD shall support user-selectable zone to channel mapping.

The RPD shall use AND logic to trigger channels when all selected zones are active.

The RPD shall use OR logic to combine multiple zones to a channel output, and shall have channel output extend and delay functionality.

The RPD algorithms shall mitigate detections from wrong way or cross traffic.

The RPD system shall have fail-safe mode capabilities for contact closure outputs if communication is lost.

3.0 Detectable Area.

3.1 Detection Range. The RPD shall be able to detect and report presence in lanes with boundaries as close as 6 ft. (1.8 m) from the base of the pole on which the RPD is mounted.

The RPD shall be able to detect and report presence in lanes located within the 140 ft. (42.7 m) arc from the base of the pole on which the RPD is mounted.

3.2 Field of View. The RPD shall be able to detect and report presence for vehicles within a 90 degree field of view.

3.3 Lane Configuration. The RPD shall be able to detect and report presence in up to 10 lanes.

The RPD shall be able to detect and report presence in curved lanes and areas with islands and medians.

4.0 System Hardware. For each approach to be detected, one RPD corner radar shall be used.

4.1 Preassembled Backplate. Each RPD shall have a traffic cabinet preassembled backplate with the following:

- AC/DC power conversion
- Surge protection
- Terminal blocks for cable landing
- Communication connection points

The preassembled backplate for the RPD shall be a cabinet side mount or rack mount.

4.2 Contact Closure Input File Cards. The RPD shall use contact closure input file cards with 2 or 4 channel capabilities.

The contact closure input file cards for the RPD shall be compatible with industry standard detector racks.

5.0 Maintenance. The RPD shall not require cleaning or adjustment to maintain performance.

The RPD shall not rely on battery backup to store configuration information, thus eliminating any need for battery replacement.

Once the RPD is calibrated, it shall not require recalibration to maintain performance unless the roadway configuration changes.

The mean time between failures shall be 10 years, which is estimated based on manufacturing techniques.

6.0 Physical Properties. The RPD shall not exceed 4.2 lbs. (1.9 kg) in weight.

The RPD shall not exceed 13.2 in. by 10.6 in. by 3.3 in. (33.5 cm x 26.9 cm x 8.4 cm) in its physical dimensions.

All external parts of the RPD shall be ultraviolet-resistant, corrosion-resistant, and protected from fungus growth and moisture deterioration.

6.1 Enclosure. The RPD shall be enclosed in a Lexan EXL polycarbonate.

The enclosure shall be classified "f1" outdoor weatherability in accordance with UL 746C.

The RPD shall be classified as watertight according to the NEMA 250 standard.

The RPD enclosure shall conform to test criteria set forth in the NEMA 250 standard for type 4X enclosures. Test results shall be provided for each of the following type 4X criteria:

- External icing (NEMA 250 clause 5.6)
- Hose-down (NEMA 250 clause 5.7)
- 4X corrosion protection (NEMA 250 clause 5.10)
- Gasket (NEMA 250 clause 5.14)

The RPD shall be able to withstand a drop of up to 5 ft. (1.5 m) without compromising its functional and structural integrity.

The RPD enclosure shall include a connector that meets the MIL-C-26482 specification. The MIL-C-26482 connector shall provide contacts for all data and power connections.

7.0 Electrical. The RPD shall consume less than 10 W.

The RPD shall operate with a DC input between 10 VDC and 28 VDC.

The RPD shall have onboard surge protection.

8.0 Communication Ports. The RPD shall have two communication ports, and both ports shall communicate independently and simultaneously.

Two independent communication ports allow one port to be used for configuration, verification and traffic monitoring without interrupting communications on the dedicated data port.

The RPD shall support the upload of new firmware into the RPD's non-volatile memory over either communication port.

The RPD shall support the user configuration of the following:

- Response delay
- Push port

The communication ports shall support a 9600 bps baud rate.

9.0 Radar Design. The RPD shall be designed with a matrix of 16 radars.

The matrix of 16 radars enables the sensor to provide detection over a large area and to discriminate lanes.

9.1 Frequency Stability. The circuitry shall be void of any manual tuning elements that could lead to human error and degraded performance over time.

All transmit modulated signals shall be generated by means of digital circuitry, such as a direct digital synthesizer, that is referenced to a frequency source that is at least 50 parts per million (ppm) stable over the specified temperature range, and ages less than 6 ppm per year. Any upconversion of a digitally generated modulated signal shall preserve the phase stability and frequency stability inherent in the digitally generated signal.

This specification ensures that, during operation, the RPD strictly conforms to FCC requirements and that the radar signal quality is maintained for precise algorithmic quality. Analog and microwave components within an RPD have characteristics that change with temperature variations and age. If the output transmit signal is not referenced to a stable frequency source, then the RPD is likely to experience unacceptable frequency variations which may cause it to transmit out of its FCC allocated band and thus will be non-compliant with FCC regulations.

The RPD shall not rely on temperature compensation circuitry to maintain transmit frequency stability.

Temperature-based compensation techniques have been shown to be insufficient to ensure transmit frequency stability. One reason this type of technique is not sufficient is that it does not compensate for frequency variations due to component aging.

The bandwidth of the transmit signal of the RPD shall not vary by more than 1% under all specified operating conditions and over the expected life of the RPD.

The bandwidth of an RPD directly affects the measured range of a vehicle. A change in bandwidth causes a direct error in the measured range, i.e., a 5% change in bandwidth would cause a range error of 10 ft. (3 m) for a vehicle at 200 ft. (61 m). If the bandwidth changes by more than 1% due to seasonal temperature variations and component aging, then the RPD will need to be frequently reconfigured to maintain the specified accuracy.

9.2 Antenna Design. The RPD antennas shall be designed on printed circuit boards.

Printed circuit board antennas eliminate the need for RF connectors and cabling that result in decreased reliability. Printed circuit antennas are less prone to physical damage due to their extremely low mass.

The vertical beam width of the RPD at the 6 dB points of the two-way pattern shall be 65 degrees or greater.

The antennas shall cover a 90 degree horizontal field of view.

The sidelobes in the RPD two-way antenna pattern shall be -40 dB or less.

Low sidelobes ensure that the performance from the antenna beam widths is fully achieved.

9.3 Resolution. The RPD shall transmit a signal with a bandwidth of at least 245 MHz.

The bandwidth of the transmit signal translates directly into radar resolution, which contributes directly to detection performance. For example, an RPD that transmits at a low bandwidth will have low radar resolution, which could cause it to count a single vehicle as two vehicles in adjacent lanes. As another example of the adverse effects of low radar resolution, the response from a sign or other radar target in the roadway may spill over into the lanes of travel and desensitize the radar. In order to achieve the specified detection accuracy in a variety of conditions, the unwindowed radar resolution cannot be larger than 2 ft. (0.6 m) at the half-power level, which requires a bandwidth of 240 MHz. The high radar resolution reduces the problem of vehicle responses getting drowned out by brighter vehicles in adjacent lanes and improves performance for moving and stopped vehicles near roadway targets.

9.4 RF Channels. The RPD shall provide at least 8 RF channels so that multiple units can be mounted in the same vicinity without causing interference between them.

9.5 Verification. The RPD shall have a self-test that is used to verify correct hardware functionality.

The RPD shall have a diagnostics mode to verify correct system functionality.

10.0 Configuration.

10.1 Auto-configuration. The RPD shall have a method for automatically defining traffic lanes, stop bars and zones without requiring user intervention. This auto-configuration process shall execute on a processor internal to the RPD and shall not require an external PC or other processor.

The auto-configuration process shall work under normal intersection operation and may require several cycles to complete.

10.2 Manual Configuration. The auto-configuration method shall not prohibit the ability of the user to manually adjust the RPD configuration.

The RPD shall support the configuring of lanes, stop bars and detection zones in 1-ft. (0.3-m) increments.

When lanes have variable widths or have variable spacing (e.g. gore between lanes), precise resolution is necessary.

10.3 Windows® Mobile-based Software. The RPD shall include graphical user interface software that displays all configured lanes and the current traffic pattern using a graphical traffic representation.

A visual representation of traffic patterns allows an installer to quickly associate specific detections with corresponding vehicles, and it facilitates verification of RPD performance.

The RPD shall include the ability to do counting and pulsed channels.

The graphical interface shall operate on Windows Mobile, Windows XP, Windows Vista and Windows 7 in the .NET framework.

The software shall support the following functionality:

- Operate over a TCP/IP connection
- Give the operator the ability to save/back up the RPD configuration to a file or load/restore the RPD configuration from a file
- Allow the backed-up sensor configurations to be viewed and edited
- Provide zone and channel actuation display
- Provide a virtual connection option so that the software can be used without connecting to an actual sensor
- Local or remote sensor firmware upgradability

11.0 Operating Conditions. The RPD shall maintain accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light, including direct light on sensor at dawn and dusk.

RPD operation shall continue in rain up to 1 in. (2.5 cm) per hour.

The RPD shall be capable of continuous operation over an ambient temperature range of -40˚F to 165.2˚F (-40˚C to 74˚C).

The RPD shall be capable of continuous operation over a relative humidity range of 5% to 95% (non-condensing).

12.0 Testing.

12.1 FCC. Each RPD shall be certified by the Federal Communications Commission (FCC) under CFR 47, part 15, sec-

tion 15.249 as an intentional radiator.

The FCC certification shall be displayed on an external label on each RPD according to the rules set forth by the FCC.

The RPD shall comply with FCC regulations under all specified operating conditions and over the expected life of the RPD.

12.2 NEMA TS 2-2003 Testing. The RPD shall comply with the applicable standards stated in the NEMA TS 2-2003 standard. Third party test results shall be made available for each of the following tests:

- Shock pulses of 10 g, 11 ms half sine wave
- Vibration of 0.5 g up to 30 Hz
- 300 V positive/negative pulses applied at one pulse per second at minimum and maximum DC supply voltage
- Cold temperature storage at -49°F (-45°C) for 24 hours
- High temperature storage at 185°F (85°C) for 24 hours
- Low temp, low DC supply voltage at -29.2°F (-34°C) and 10.8 VDC
- Low temp, high DC supply voltage at -29.2°F (-34°C) and 26.5 VDC
- High temp, high DC supply voltage at 165.2°F (74°C) and 26.5 VDC
- High temp, low DC supply voltage at 165.2°F (74°C) and 10.8 VDC

13.0 Manufacturing. The RPD shall be manufactured and assembled in the USA.

The internal electronics of the RPD shall utilize automation for surface mount assembly, and shall comply with the requirements set forth in IPC-A-610C Class 2, Acceptability of Electronic Assemblies.

The RPD shall undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Testing shall include the following:

- Functionality testing of all internal sub-assemblies
- Unit level burn-in testing of 48 hours' duration or greater
- Final unit functionality testing prior to shipment

Test results and all associated data for the above testing shall be provided for each purchased RPD by serial number, upon request.

14.0 Support. The RPD manufacturer shall provide both training and technical support services.

14.1 Training. The manufacturer-provided training shall be sufficient to fully train installers and operators in the installation, configuration, and use of the RPD to ensure accurate RPD performance.

The manufacturer-provided training shall consist of comprehensive classroom labs and hands-on, in-the-field, installation and configuration training.

Classroom lab training shall involve presentations outlining and defining the RPD, its functions, and the procedures for proper operation. These presentations shall be followed by hands-on labs in which trainees shall practice using the equipment to calibrate and configure a virtual RPD. To facilitate the classroom presentation and handson labs, the manufacturer-provided training shall include the following items:

- Knowledgeable trainer or trainers thoroughly familiar with the RPD and its processes
- Presentation materials, including visual aids, printed manuals and other handout materials for each student
- Computer files, including video and raw data, to facilitate the virtual configuration of the RPD
- Laptop computers or Windows CE handheld devices with the necessary software, and all necessary cables, connectors, etc.
- All other equipment necessary to facilitate the virtual configuration of the RPD

Field training shall provide each trainee with the hands-on opportunity to install and configure the RPD at roadside. Training shall be such that each trainee will mount and align the RPD correctly.

14.2 Technical Assistance. Manufacturer-provided technical support shall be available according to contractual agreements, and a technical representative shall be available to assist with the physical installation, alignment, and auto-configuration of each supplied RPD. Technical support shall be provided thereafter to assist with troubleshooting, maintenance, or replacement of RPDs should such services be required.

15.0 Documentation. RPD documentation shall include an instructional training guide and a comprehensive user guide as well as an installer quick-reference guide and a user quick-reference guide.

The RPD manufacturer shall supply the following documentation and test results at the time of the bid submittal:

- FCC CFR 47 certification (frequency compliance)
- CE certification
- IED 6100-4-5 class 4 test report (surge)

16.0 Warranty. The RPD shall be warranted free from material and workmanship defects for a period of two years from date of shipment.

The advertised detection accuracy of the company's sensors is based on both external and internal testing, as outlined in each product's specification document. Although our sensors are very accurate by industry standards, like all other sensor manufacturers we cannot guarantee perfection or assure that no errors will ever occur in any particular applications of our technology. Therefore, beyond the express Limited Warranty that accompanies each sensor sold by the company, we offer no additional representations, warranties, guarantees or remedies to our customers. It is recommended that purchasers and integrators evaluate the accuracy of each sensor to determine the acceptable margin of error for each application within their particular system(s).

SmartSensor Matrix Installation Specification

1.0 General. This item shall govern the installation of an aboveground radar presence detector (RPD) equivalent to the Wavetronix SmartSensor Matrix.

RPDs can provide accurate, consistent, and reliable presence detections provided they are installed properly. The requirements in this specification are intended to ensure proper RPD installation.

2.0 Mounting and Installation.

2.1 Mounting Assembly. The RPD shall be mounted directly onto a mounting assembly fastened to a mast arm, pole or other solid structure.

The RPD mounting assembly shall provide the necessary degrees of rotation to ensure proper installation.

The RPD mounting assembly shall be constructed of weather-resistant materials and shall be able to support a 20-lb. (9.1-kg) load.

2.2 Mounting Location. The RPD shall be mounted at a height that is within the manufacturer's recommended mounting heights.

The RPD shall be mounted at an offset from the first lane that is consistent with the RPD's minimum offset.

The RPD shall be mounted so that at least 20 feet along the farthest lane to be monitored is within the field view of the RPD.

The RPD shall be mounted with its cable connector down and shall be tilted so that the RPD is aimed at the center of the lanes to be monitored. Typically, the RPD is tilted off of vertical by 20–30 degrees.

The RPD shall be mounted on a vertical signal pole or on the horizontal mast arm.

The RPD shall be mounted so that its field of view is not occluded by poles, signs or other structures.

RPDs that are mounted within 20 ft. (6.1 m) of each other or that are monitoring the same intersection shall be configured to operate on different RF channels regardless of the pointing direction of the RPDs.

It is recommended that the manufacturer be consulted to verify final RPD placement if the RPD is to be mounted near large planar surfaces (sound barrier, building, parked vehicles, etc.) that run parallel to the monitored roadway.

2.3 Cabling. The cable end connector shall meet the MILC- 26482 specification and shall be designed to interface with the appropriate MIL-C-26482 connector. The connector backshell shall be an environmentally sealed shell that offers excellent immersion capability. All conductors that interface with the connector shall be encased in a single jacket, and the outer diameter of this jacket shall be within the backshell's cable O.D. range to ensure proper sealing. The backshell shall have a strain relief with enough strength to support the cable slack under extreme weather conditions. Recommended connectors are Cannon's KPT series, and recommended backshells are Glenair Series 37 cable sealing backshells.

The cable shall be the Orion Wire Combo-2204-2002-PVCGY or an equivalent cable that conforms to the following specifications:

- The RS-485 conductors shall be a twisted pair.
- The RS-485 conductors shall have nominal capacitance conductor to conductor of less than 40 pF/ft at 1 kHz.
- The RS-485 conductors shall have nominal conductor DC resistance of less than 16.7 ohms/1000 ft. (304.8 m) at 68°F (20°C).
- The power conductors shall be one twisted pair with nominal conductor DC resistance of less than 11.5 ohms/1000 ft.

(304.8 m) at 68˚F (20˚C).
- Each wire bundle or the entire cable shall be shielded with an aluminum/mylar shield with a drain wire.

The cable shall be terminated only on the two farthest ends of the cable.

The cable length shall not exceed 2000 ft (609.6 m) for the operational baud rate of RS-485 communications (9.6 Kbps).

If 12 VDC is being supplied for the RPD then the cable length shall not exceed 110 ft. (33.5 m).

If 24 VDC is being supplied for the RPD then the cable length shall not exceed 600 ft. (182.9 m).

Both communication and power conductors can be bundled together in the same cable as long as the abovementioned conditions are met.

2.4 In Cabinet Interface Equipment. The RPD shall be installed using the SmartSensor Matrix Preassembled Traffic Cabinet Backplate or an equivalent that provides input power surge suppression, sensor cable surge suppression, AC to DC power conversion (if necessary), and terminal blocks. The surge protection devices shall meet or exceed the EN 61000-4-5 Class 4 specifications.

2.5 Power Supply. If needed, the RPD shall be installed using the Click™ 202, Click 204 or an equivalent AC to DC power converter that meets the following specifications:

The power converter shall be power rated at 48 W for temperatures less than 140˚F (60˚C) with a 5% power decrease for each degree increase up to 158˚F (70˚C).

The power converter shall operate in the temperature range of to -29.2˚F to 165.2˚F (–34˚C to 74˚C).

The power converter shall operate in the humidity range of 5% to 95% at 77˚F (25˚C) non-condensing.

The power converter shall accept an input voltage of 85 to 264 VAC or 120 to 370 VDC.

The power converter shall operate at an input frequency of 47 Hz to 63 Hz.

The power converter shall produce an output voltage of 24 VDC ±4%.

The power converter shall withstand a voltage across its input and output of 3 kV. The power converter shall withstand a voltage across its input and ground of 1.5 kV.

The power converter shall conform to safety standards UL 60950-1 and EN 60950-1 and be certified and tested to meet the limited power source requirement according to clause 2.5. Its output current shall be limited to a maximum current of 4A both under normal and single fault condition; with double/reinforced insulation between its input and output circuits.

The power converter shall conform to EMC standards EN 55022 Class B and EN 61000-3-2, 3.

In brown-out conditions (i.e. < 85 VAC input), the output voltage of the power converter shall be less than 1 VDC.

The terminal blocks shall be color-coded insulation displacement terminal blocks.

The terminal blocks shall be prewired to the other in-cabinet equipment so that no wiring other than cable terminations, connecting input power and connecting input file cards shall be required during installation.

2.6 Input File Cards. The Click 114, Click 112 or an equivalent that meets the following specifications shall be used.

The input file cards shall be compatible with 170, 2070, NEMA TS 1, and NEMA TS 2 style input racks.

The input file card shall translate data packets from the RPD into contact closure outputs.

The input file card shall support presence detection.

The input file card shall receive data packets over an RS-485 bus at a baud rate of 9600 bps.

The input file card shall autobaud and auto-detect an RPD over wired and wireless communication channels that have a maximum latency of 500 ms.

The input file card shall comply with the NEMA TS 2-1998 Traffic Controller Assemblies with NTCIP Requirements (Section 2.8 specification).