

**CONNECTED VEHICLE ROAD SIDE UNIT.
(NEW 3-10-20)**

The following new Section is inserted after Section 680:

**SECTION 681
CONNECTED VEHICLE ROAD SIDE UNIT**

681-1 Description.

Furnish and install a Connected Vehicle (CV) Road Side Unit (RSU) in accordance with the Contract Documents. The CV RSU is a component of the CV equipment.

681-2 Materials.

The Connected Vehicle (CV) equipment must be compatible with United States Department of Transportation (USDOT) approved Security Credential Management System (SCMS) message security solution for vehicle-to-infrastructure (V2I) communications and meet the applicable industry standards listed in Table 681-2.1.

Table 681-2.1 CV Equipment Requirements and Standards	
Document Identifier	Description
FHWA-JPO-17-589 (April 28, 2017)	Dedicated Short-Range Communications Roadside Unit Specifications https://rosap.ntl.bts.gov/view/dot/3600
3GPP Release 14	https://www.3gpp.org/ftp/Specs/latest/Rel-14/
IEEE 802.11-2012 (or later)	Institute of Electrical and Electronics Engineers (IEEE) Standard for Information technology--Telecommunications and information exchange between systems local and metropolitan area networks-- Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
IEEE 1609.0-2013 (or later)	IEEE Guide for Wireless Access in Vehicular Environments (WAVE) - Architecture
IEEE 1609.2-2016 (or later)	IEEE Standard for WAVE -- Security Services for Applications and Management Messages
IEEE 1609.3-2016 (or later)	IEEE Standard for WAVE -- Networking Services
IEEE 1609.4-2016 (or later)	IEEE Standard for WAVE -- Multi-Channel Operation
IEEE 1609.12-2016 (or later)	IEEE Standard for WAVE -- Identifier Allocations
IEEE 802.3at-2009	Standard for Power over Ethernet

FCC Title 47, Parts 0, 1, 2, 15, and 90	Federal Communications Commission (FCC) Code of Federal Regulations (CFR)
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The CV equipment includes hardware, software, ancillary devices, and all material necessary to enable wireless V2I communications. Ensure that all assembly hardware, including nuts, bolts, external screws and locking washers less than 5/8 inch in diameter, are Type 304 or 316 passivated stainless steel. Use stainless steel bolts, screws and studs meeting the requirements of ASTM F593. Use nuts meeting the requirements of ASTM F594. Ensure all assembly hardware greater than or equal to 5/8 inch in diameter is galvanized. Use bolts, studs, and threaded rod meeting the requirements of ASTM A307. Use structural bolts meeting the requirements of ASTM F3125, Grade A325.

The CV equipment must be FCC certified. Ensure that the FCC identification number is displayed on an external label and that all devices operate within their FCC frequency allocation of 5.9 GHz Dedicated Short-Range Communication (DSRC) and Cellular V2X (C-V2X). Both the antennas and the base units must be FCC certified if they are approved separately.

CV equipment must be capable of remote firmware updates to include SCMS updates and other related firmware updates. Device manufacturers must make firmware updates available to the Department and maintaining agency at no cost.

DSRC and C-V2X capabilities are required. Concurrent DSRC and C-V2X operation is not required.

681-2.1 Roadside Unit (RSU): The RSU must be a commercially available production grade device that provides information and supports public safety operations in a V2I/V2X communication environment. Preconfigure RSUs to account for specific site to be ready for the installation and operation at the site shown on the plans. This includes MAP data. Identify site specific conditions in advance of the device installation.

Provide RSUs that are interoperable with all FDOT APL approved ATC traffic signal controllers.

Ensure that the RSU is permanently marked with manufacturer name or trademark as well as part number and serial number. Ensure that the markings are visible after installation.

681-2.1.1 Wired Interfaces: The RSU must include a wired Ethernet interface.

681-2.1.2 DSRC Interface: The RSU must include a commercial grade radio that transmits and receives DSRC messages within the 5.9GHz band. Supports Single Channel Continuous and dual Channel Alternating DSRC Channel Modes simultaneously.

681-2.1.3 Cellular Interface: Supports LTE V2X PC5 mode 4, defined by 3GPP Rel-14.

681-2.1.4 Antennas: Ensure that antennas are provided for all radio frequency (RF) connectors on the RSU. Only those antennas tested with the device to obtain the FCC Grant of Equipment Authorization (or similar antennas with equal or lesser gain) may be used and must not be co-located or operated with any other antenna or transmitter, except in accordance with the FCC multi-transmitter policy. Antennas must be removable to allow for the antennas to be installed at a distance from the RSU unit or replaced as needed.

681-2.2 Configuration and Management: RSU must be provided with all hardware, software, configuration tools and software licenses required for local and remote configuration, operation, and management including access to all user-programmable features as well as health and status monitoring, event logging, and diagnostic utilities. Configuration and management functions must be password protected. Access to all user-programmable features, alarm monitoring, configuration parameters, event logging and diagnostic utilities must be through a vendor provided Graphical User Interface (GUI). The RSU must be provided with an open application programming interface (API) and software development kit available to the Department at no additional cost. The RSU must automatically recover from a power failure once power is restored. Ensure that all programmable settings are restored to their previous configurations and that the system resumes proper operation.

681-2.3 System Communication: The RSU must be assigned an IPv4 address provided by the Department. The RSU must be IPv6 compatible.

681-2.4 Electrical Specifications: Ensure the RSU is provided with a power over ethernet (PoE) injector as detailed in the plans. Powered ports on the PoE injector must meet the requirements set forth in IEEE 802.3at. Ensure the PoE injector operates using a nominal input voltage of 120V_{AC}. If the PoE injector requires nominal input voltage of less than 120V_{AC}, furnish the appropriate voltage converter.

681-2.5 Environmental Requirements: Ensure equipment performs all required functions during and after being subjected to the transients, temperature, voltage, humidity, vibration, and shock tests described in NEMA TS2, 2.2.7, 2.2.8, and 2.2.9.

681-2.6 Ports and Connectors: The RSU must include all necessary ports and connectors for a complete assembly. Type N weatherproof RF ports are required for the antennas. All ports must be legibly and permanently marked designating their intended use. All labels must be weather resistant.

681-2.7 FCC License: Compile all information required to register RSU devices and locations with the FCC and provide this information to the Engineer for review in accordance with Section 7-2. Support the permitting effort until complete.

681-3 Installation.

Install and configure all equipment in accordance with the Contract Documents, manufacturer's recommendations, and as directed by the Engineer. Furnish all equipment with the appropriate power and communication cables, mounting brackets, and mounting hardware according to the manufacturer's recommendations. Ensure that cables comply with NEC sizing requirements and meet all other applicable standards, specifications, and local code requirements.

Cut all wires to their proper length before assembly. Do not double back any wire to take up slack. Neatly lace wires into cables with nylon lacing or plastic straps. Secure cables with clamps and provide service loops at all connections. Ensure that all unshielded twisted pair/shielded twisted pair Ethernet network cables are compliant with the EIA/TIA-568-B standard and UL type CMX outdoor. Verify that all field wiring meets applicable National Electric Code (NEC) requirements.

681-3.1 RSU Installation: Install RSUs on existing poles or sign structures, or on new poles, as shown in the Plans. Ensure that status indicators remain unobstructed and visible.

Submit electronic configuration file backups to the Engineer following field testing. Backup files must include MAP files, communication settings, firmware, and all other files and settings required to program a new replacement RSU.

The RSU, mounting hardware, and any other related material that is exposed to the environment must be designed for 150 mph wind speeds and meet the requirements of the Department's Structures Manual.

681-3.2 Testing:

681-3.2.1 General: Subject all equipment to field acceptance tests.

Develop and submit a test plan for field acceptance tests to the Engineer for consideration and approval. The Engineer reserves the right to witness all field acceptance tests.

681-3.2.2 Field Testing: Once the CV equipment has been installed, conduct local field acceptance tests at each field site according to the submitted test plan. Perform the following:

1. Verify that physical construction has been completed as detailed on the Plans.
2. Inspect the quality and tightness of ground and surge protector connections.
3. Verify proper voltages for all power supplies and related power circuits.
4. Connect devices to the power sources. Verify that the LED on the RSU turns on.
5. Verify all wire and cable connections are correct and secure.
6. Verify the configuration of CV device network interfaces.
7. Connect to the CV equipment using Secure Shell from a remote computer.
8. Verify over the air RSU broadcasts using a multi-channel test tool (MCTT).
 - a. Ensure that the MCTT calibration certification is submitted to the Engineer.
 - b. Ensure that the data logging is active on all units under test and the data logs are sent to the required data repository.
 - c. Test DSRC with the security on and off. With mismatched security certificates, ensure that the message is logged but the payload is not decoded. With matching security certificates, ensure full payload is decoded.
 - d. Scan all DSRC channels and document that all sources of potential interference have been successfully mitigated.
 - e. Verify that the MCTT received TIMs, including SPaT and MAP data, where applicable.

681-4 Warranty.

Ensure that the manufacturer will furnish replacements for any part or equipment found to be defective during the warranty period at no cost to the Department or the maintaining agency within 10 calendar days of notification. Ensure that CV equipment has a manufacturer's warranty covering defects and remote troubleshooting for a minimum of two (2) years from the date of final acceptance by the Engineer in accordance with 5-11 and Section 608.

681-5 Method of Measurement.

The Contract unit price for each RSU furnished and installed, will include furnishing, placement, and testing of all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages and firmware, supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

681-6 Basis of Payment.

Price and payment will be full compensation for furnishing all materials and completing all work as specified in this section or shown in the Plans.

Payment will be made under:

Item No. 920-681- Connected Vehicle Road Side Unit – each.

Do Not Use Without
CO Specs Authorization