805-T-192 RADIO INTERCONNECTION

(Revised 05-01-25)

Description

This work shall consist of furnishing and installing spread spectrum radio equipment for interconnecting traffic signal controllers at signalized intersections.

Materials

The Contractor shall select radio equipment materials from the QPL of Traffic Signal and ITS Devices. The Contractor shall furnish two copies of the instructions for hardware installation, programming, and system commissioning.

The spread spectrum radio modems shall provide all the needed features to communicate with NEMA TS2 Type 1 and Type 2 traffic signal controllers in a coordinated closed loop system. Radio modems shall be capable of both Ethernet and serial data transfer. The radio modems shall be software configurable to be either a master, repeater, repeater/slave, or slave radio.

The radio modem shall

1. require no user license from the FCC;
2. operate in the 900 MHz range and be of frequency hopping spread spectrum, FHSS, technology;
3. support data rates from 1.2 kbps to 115.2 kbps asynchronous;
4. have a receiver sensitivity of at least -110 dBm;
5. have a minimum RF output level of 1 watt;
6. have a minimum of 50 user-selectable hopping patterns and a minimum of 50 RF non-overlapping channels allowing multiple systems to operate in the same line-of-sight path;
7. operate as a transparent RS232, or RS422/RS485, or FSK 1200 baud types of links for use in a point-to-multipoint system;
8. provide an RJ-45 10/100BaseT Ethernet interface;
9. be IP addressable;
10. have an external SMA female type or N-female RP-TNC female antenna connector; and
11. be supplied with power supply for 120V AC operation.

The modems shall be rack or shelf mounted in standard NEMA TS2 Type 1 or Type 2 cabinets. The modems shall have an operation temperature of -40 to 176°F, have a maximum current draw of 500 mA for the transmission of 1 watt of RF output power, while operating on 12V DC. Lighting and

transient protection on all data lines and antenna connector, and AC/DC power distribution, shall be provided with the system.

The spread spectrum radio modems shall include a Windows based, configuration software package, which shall include a graphical user interface, GUI, allowing for ease of programming, through pre-written drivers for all Department approved traffic controllers and have the ability to automatically determine, and connect, at their radios baud, stop and parity settings. The configuration software shall allow for signal level, RSSI, data integrity, message polling, and spectral analysis testing. The software shall also allow all the radios within a system to be configured from a single location. All radio equipment and cables shall be delivered preconfigured and ready for field operation.

The manufacturer, or vendor, shall supply with each modem, the operational manual containing procedures for all features incorporated in the modem.

a. Transient Protection

Transient protection shall be installed between the radio modem and the field antenna. The transient protection shall be flange mounted in the cabinet and have a minimum transient current of 40kA for 8 x 20 µs pulse, an insertion loss or < 0.1 dB, have an operating frequency in the 900 MHz range, allow throughput energy to be < 220 µJ for 6kV/3kA @ 8/20 µs waveform, have throughput voltage ≤ 144 Vpk, and turn-on voltage shall be ± 600 volts. The unit impedance shall be 50 Ω.

b. Antennas

The antenna for the radio modem at the system master/local controllers shall be capable of providing a transmission range adequate for communication with all radio modems or repeaters in the system and shall be configured as a single omni, single-yagi, or dual-yagi, two single-yagi antennas on differing alignments, for each radio as described below.

(1) Omni Antennas

All omni antennas shall be capable of producing between 6 dBd and 10 dBd (8.15 dBi and 12.15 dBi) of gain while operating in, and covering the entire 902-930 MHz frequency range. The voltage standing wave ratio, VSWR, of the omni antenna shall be 1.5:1 or less when the antenna coax feed impedance is 50 Ω. Omni antennas shall be fabricated of fiberglass, brass, copper, and/or aluminum and shall be rated for wind velocities of at least 100 mph. The minimum length of the omni antenna shall be 60 in. and it shall be designed and fabricated with a fiberglass radome with a minimum diameter of 2 in. to prevent ice from collecting directly on the driven element. All omni antennas shall have a cableless N-female connector directly affixed and sealed to the antenna body. All hardware and fastenings devices shall be fabricated from stainless steel.

(2) Yagi/Dual-Yagi Antennas

All yagi antennas shall be capable of producing between 10 dBd and 13 dBd (12.15 dBi and 15.15 dBi) of gain while operating in, and covering the entire 902-930 MHz frequency range. The voltage standing wave ratio, VSWR, of the omni antenna shall be 1.5:1 or less when the antenna coax feed impedance is 50 Ω. The front to back ratio shall be at least 20 dB for each yagi antenna. Yagi-directional antennas shall be fabricated of either anodized or powder coated 6061/T6 aluminum rod and seamless drawn pipe and shall be rated for wind velocities of at least 100 mph. All yagi antennas shall have a cableless N-female connector directly affixed and

sealed to the antenna body. The yagi antenna shall be designed and fabricated so that polarization changes (vertical to horizontal) can be made on the antenna mount without adjusting the mast. Single yagis shall be connected by a low loss N-female "T" splitter/coupler and LMR-400 cable to form dual-yagi systems. All hardware and fastenings devices shall be fabricated from stainless steel.

c. Antennas Cable and Hardware

The coaxial cable used as the transient protection to antenna lead shall have no greater than 3.8 dB loss per 100 ft of length and shall be LMR-400.

All LMR-400 connections are to be stripped, deburred, and crimped using the ST-400-EZ LMR-400 stripping tool, DBT-01 LMR-400 deburring tool, and a 0.429 in. hex crimp die for solderless LMR-400 connections respectively. All connections shall be completely sealed by heat shrinking double walled, adhesive lined shrink tubing for weather proofing and strain relief.

Cables shall be included to interface the radio equipment to the transient protection. The antenna mounting hardware shall securely attach the antenna to the strain pole/cantilever arm. The coaxial cable fitting on the antenna shall not support the weight of the coaxial cable run to the base of the strain pole/cantilever arm.

d. Data Cables

Cables shall be included to interface the radio equipment to the system master, co-located secondary controller, remote secondary controllers and any communication interface panels as needed. Cables shall include strain relief back shells designed to mate and lock with the telemetry connector on the system master and local controllers. All radio equipment and cables shall be delivered preconfigured and ready for field operation.

All miscellaneous equipment necessary to complete the installation shall be as specified by the radio modem manufacturer.

Construction Requirements

To receive maximum signal strength, the radio antennas shall be positioned by adjusting the antenna direction while monitoring signal strength through the telemetry radio. The radio antenna mounts shall be securely fastened to the poles. Coaxial cable shall be installed inside metal poles and conduits. External cable on poles shall not exceed 3 ft unless approved by the Engineer. Approved external cable runs exceeding 3 ft shall be secured using manufacturer specified hangers at a maximum spacing of 3 ft. Cable terminations shall be in accordance with the manufacturer's recommendations. Connectors outside of cabinets shall be sealed in accordance with the manufacturer's recommendations. The Contractor shall deburr any holes made in metal poles and install grommets for protection. Drip loops shall be provided between the antenna connector and the metal pole entrance or first pole clamp. Cable bends shall be in accordance with the manufacturer's specified bending radius.

Testing

Test of the radio interconnection system shall be performed after the installation is complete. Notice of the testing shall be provided to the district traffic office at least two business days prior to the test. The Contractor shall adjust the radio antennas to optimize the communication signal for the system. The strength of the communication

signal shall be determined using computer software provided by the radio interconnection system manufacturer. The test shall be conducted with complete foliage on deciduous trees in the vicinity or on a date approved by the Engineer. The test results shall include the signal strength, site polling results using long message polling, and noise levels. The test results shall be above the minimum guidelines set by the radio interconnect system manufacturer.

Method of Measurement

Radio antenna, radio interconnect, radio splitter will be measured by the number of units installed.

Signal cable will be measured in accordance with 805.15.

Radio, interconnection system testing will not be measured for payment.

Basis of Payment

Radio, interconnection system testing will be paid for at the contract lump sum price.

Signal cable will be paid for in accordance with 805.16.

If specified as pay items, radio antenna, radio interconnect, radio splitter will be paid for at the contract unit price per each.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Radio Antenna	EACH
Radio Splitter	EACH
Radio, Interconnect	EACH
Radio, Interconnection System Testing	LS

The cost of the radio modem and all component parts, except an antenna or splitter, necessary to interconnect a traffic signal to one or more signalized intersections shall be included in the cost of Radio, Interconnect.