**REVISION OF SECTION 614**

**TRAFFIC SIGNAL EQUIPMENT**

**Section 614 of the Standard Specifications is hereby revised for this project as follows:**

**Subsection 614.08 shall be added as follows:**

*Traffic Signal Equipment*

**1**. *General.* This work shall consist of furnishing and installing a Digital Radio Communication System (DRCS) for a Type 170 controller consisting of a 2-way data radio, a programmable DRCS interface unit, antenna, lighting arrestor, mounting hardware, and operating software.

**2***. List of Equipment*. The Contractor shall furnish and install the following electrical signal equipment to meet the approval of the Engineer:

* Data radio modem (COMtrix Model 480)
* 12A 13.8 V DC power supply
* Cable to connect power supply to radio
* Lightning arrestor, Female/N connector breakout on both sides
* Motorola Maxtrac 800 MHz conventional radio
* Radio programming for the appropriate frequency assignment (Motorola)
* Mini UHF Male/N Male cable to connect radio and arrestor
* Two N Male crimp connectors to terminate cable run cabinet/span wire
* Required amount of RG-8U coax cable (cabinet to pole + 15 feet)
* 3db 3-element “yagi” antenna for 800-860 MHz operation
* Miscellaneous mounting hardware for antenna

Lead-time to acquire the radio modem equipment may take up to 150 days (5 months). It is the responsibility of the Contractor to plan accordingly in order to meet the project schedule for the required completion date of the signal installation.

**3**. *Digital Radio Communication System (DRCS).* The data radio shall employ FM 2-way (half duplex) transceivers and shall be capable of operation in an environment from –20 degrees C to 60 degrees C. The radio shall be approved by the Engineer prior to installation. The radio shall operate on frequencies in the 806 to 902 megahertz band. It is the responsibility of the Contractor to verify and set the operation radio frequency to a frequency that will allow the radio to transmit signals compatible with the radios installed at the adjacent signalized intersections.

**4**. *Radio Antenna.* The radio antenna shall be for exposed outdoor use on the same frequencies as the associated data radio. The antenna shall be “yagi” type unidirectional. The yagi antenna shall include a U-bolt mast clamp for attaching to the ~ 1-1/2” support tube. Antennas shall employ a standard UHF female connector for attaching to the PL 259 UHF male plug. Nominal impedance shall be 50 ohms.

# Radio Antenna Installation

1. The Contractor shall ensure that there is less than one volt AC between the cabinet frame ground and the traffic controller’s logic ground prior to installing the yagi antenna.

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**REVISION OF SECTION 614**

##### TRAFFIC SIGNAL EQUIPMENT

1. The Contractor shall ensure that there is less than one volt DC between the cabinet frame ground and the traffic controller’s logic ground prior to installing the yagi antenna.
2. In the event that spurious voltages are detected, the Contractor shall measure the amperage between the cabinet frame ground and the traffic controller’s logic ground. The Contractor shall be permitted to strap the DC ground on the 170 controller’s TB1 to the frame ground if the current is less than 20 mA. The Contractor shall consult a “master electrician” for approval before attempting this procedure.
3. When installing the yagi antenna, the Contractor shall use an elbow joint pipe. The pipe shall be oriented to point in the downward position, to prevent rainwater from entering the pipe.
4. The Contractor shall apply a silicon seal to the connector’s two cable collars where the RG8/RG-59 coax enters the metallic connector. The silicon seal shall also be applied to the connector threads before mating the male (radio) and female (antenna) components. In addition, the Contractor shall use an electrical tape approved by the Engineer to seal-out moisture at these locations.
5. The connector shall be placed inside the 1.5” pipe to prevent sun or wind exposure.
6. The Contractor shall place a jumper between the DC power supply’s ground and the DC ground on the 170 controller’s TB1 terminal strip to give the radio network’s electrical interface the same ground as the traffic controller.
7. The Contractor shall not use the GF1 receptacle for the AC line to feed the 7-12A DC power supply attached to the Maxtrac radio.
8. When attaching the coax N-type connectors to LAC-4N (or equivalent) lightning arrestors, the Contractor shall properly align the female N-type connector on the lightning arrestor with the mating male components.
9. To eliminate 60 Hz noise that may couple into the RF link when running the RJ-45 wire from the Radio Port on the COMtrix modem to the MaxTrac radio, the Contractor shall
10. not pass the RJ-45 wire through any cabinet areas with high voltage or current conductors.
11. The Contractor shall ensure that the interconnecting copper wire is attached to the appropriate over-voltage protection (i.e. lightning arrestor) for radio-drop installation with 4-wire audio links to other type 170 controllers, even if wires are underground.

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#### REVISION OF SECTION 614

##### TRAFFIC SIGNAL EQUIPMENT

1. At a minimum, the Contractor shall use the standard telephone company lightning arrestors. They are available from the following distributors:
	* Graybar
	* Anixter
	* Reliable Electric

In addition, the Contractor shall only install “gas” arrestors. “Carbon” arrestors shall not be used.

1. When installing the yagi directional antenna, the Contractor shall point the antenna to the appropriate receiver on Double Header Mountain. The Contractor shall use a compass to determine where to point the yagi antenna (+/- 10 degrees) if the direction is not obvious.
2. Before inserting the COMtrix modem card, the Contractor shall verify that the intersection has a valid identification number for the controller and that this number is unique (ranging from 1 to 252) from all other traffic controllers that are participating on the radio network.

**5***. Lightning Arrestor*. The lightning arrestor shall protect the radio equipment from static electricity and lightning-induced surges of up to 5,000 amperes on the coaxial cable. The arrestor shall maintain a constant line impedance of 50 ohms, shall have a typical insertion loss of 0.25 dB or less at 500 megahertz, and shall be rated for a maximum power of 200 watts at 500 megahertz and 150 watts at 1,000 megahertz. Protection shall be accomplished by a replaceable gas-discharge tube that clamps surge voltages to less than 50 volts in ~ 100 nanoseconds. The arrestor shall have standard UHF female connectors for attaching to the PL 259 UHF male plugs, and shall have the following maximum dimensions: 4” long by 1.5” wide by 2.5” high.

**6***. Data Radio Modem and Packet Radio Controller*. The Contractor shall furnish and install a data radio modem that is compatible with the COMtrix model 480 packet radio controller for Type 170 controllers. The packet radio controller shall be capable of being integrated with the existing network of packet radio controllers that currently exists in the CDOT 800 MHz radio network.

Data radio modem shall meet the following requirements:

1. The modem shall connect with the radio using a 3-foot RJ-45 terminated cable. The cable shall be terminated at both ends with a RJ-45 male connector. There shall be no rearrangement apparatus or interface device between the modem and the radio. The cable wiring shall be symmetric such that a reversal (end-to-end swap) will not affect the operation of the modem.

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#### REVISION OF SECTION 614

##### TRAFFIC SIGNAL EQUIPMENT

1. The modem shall provide accessible apparatus for adjusting transmit deviation. It shall be possible for technicians to make adjustments to the transmit deviation while the unit is in service.
2. The modem shall be capable of operating in the standard CalTrans Type 400 modem slot that is available on all Type 170 controllers. The modem shall not be an external entity outside the Type 170 controller.
3. The modem shall allow the owner to attach other Type 170 controllers (up to 48) to any radio-hosted Type 170 controller using two wire pairs and standard type 400-modem technology and wire termination apparatus (terminal block TB1) provided on a Type 170 controller.
4. The modem shall allow the attaching of a laptop field computer to the modem without requiring removal of the modem from the traffic controller to utilize the C2S connector. The interface port shall allow the operation of the TrafficView program in the field without removing the modem from the Type 400 model slot.

Operating software shall operate under the Microsoft Windows operating environment. The operating software must be able to operate consistent with the TrafficView program.

**7**. *Signal Cable.* Signal cable shall consist of Type RG/8U coaxial cable with a nominal outside diameter of 0.405 inch and nominal attenuation of 3.0 db per 100 feet at 400 megahertz. Center conductor gauge and strand shall be No 9-1/2 AWG, solid, and the cable shall have a helical air core. Core insulation shall be semi-solid polyethylene, and the shield shall be aluminum polyester with tinned copper braid providing 95% coverage. Nominal impedance shall be 50 ohms.

Signal Cable Installation

* 1. All end terminations of the cable shall be by an AMP male plug, type N-male specifically designed for RG/8U cable. Any plug not immediately connected shall be left insulated by a plastic insulation cap or by electrical tape.
	2. Coaxial cable shall be installed as a continuous run from the antenna to the controller cabinet, with no splices allowed. Approximately three feet of coiled slack shall be provided in the span wire pole base, and approximately six feet of coiled slack shall be provided in the controller base for connecting the cable to the radio equipment.
	3. Following installation, both the cable shield and the conductor shall be tested for individual DC continuity, and for an open circuit between the shield and conductor. These tests shall be made between the extreme ends of the coaxial cable with the lighting arrestor inserted on the line.

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#### REVISION OF SECTION 614

**TRAFFIC SIGNAL EQUIPMENT**

**Subsection 614.14 shall include the following:**

**Pay Item** **Pay Unit**

Traffic Signal Equipment Each

Payment will be full compensation for all work necessary to complete this item.