MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
WIRELESS INTERCONNECT FOR CLOSED LOOP TRAFFIC SIGNAL SYSTEM

a. Description. This work consists of one or more of the following work types, at locations shown on the plans:

1. Furnishing and installing a wireless interconnect, closed loop, master, repeater, or remote.

2. Removing and disposing of an existing wireless interconnect, closed loop system, including the master, repeater, and remote.

3. Removing, storing and reinstalling an existing wireless interconnect, closed loop system master, repeater, and remote.

As applicable, this work includes removal or installation of interface equipment, mounting assembly, brackets, hardware, fittings, connectors, wiring, cable to controller, grounding, risers, conduit, and any other material required to ensure a complete removal or installation, as specified for a location.

b. Materials. Provide materials, as directed by the Engineer, necessary to provide a complete and operating wireless interconnect, closed loop traffic signal system. Provide materials in accordance with sections 918 and 921 of the Standard Specifications for Constructions and this special provision.

Provide wireless interconnect, closed loop, master, repeater, or remote in accordance with this special provision. Provide wireless interconnect, closed loop package compatible with solid state pre-timed or actuated traffic signal control equipment and cabinet environments.

1. Wireless Interconnect, Closed Loop, Package. Provide equipment meeting the following requirements:

A. Operate in the license-free, Spread Spectrum band [902-928 megahertz (MHz)], utilizing Frequency Hopping technology.

B. Be compatible with the communications protocol of an on-street master type traffic signal system equipped with both Recommended Standard (RS)-232 and Frequency Shift Key (FSK) interfaces.

C. Utilize 139 user-selectable channels, with 62 available hopping sequences, (ensure two are non-overlapping).

D. Be completely configurable via included software for hop pattern, operation as

master-repeater or remote, baud rate, drivers to interface to units currently in the field, and compatible with the wireless systems.

E. Have software features to provide:

(1) Spectrum analysis at each radio.

(2) Remote programming and remote maintenance from the master location.

F. Have an RS-232 interface capable of 1200 bit per second (bps) to 115.2 Kilobits per second (Kbps) with an 8 or 9 bit format or 1200bps Bell 202 FSK (2 or 4-wire); RS-485 interface is optional.

G. Have a maximum 8 millisecond end-to-end latency.

H. Have light emitting diode (LED) indicators for power (PWR), transmit (TX) data, Receive (RX) data, and for the active data port.

I. Have DB9F connector for RS-232 port and registered jacks (RJ)-22 for FSK.

J. Have an operating temperature of -30 degrees Fahrenheit (F) to 165 degrees F (-35 degrees Celsius [C] to 74 degrees C).

K. Operate with voltages between 10.8 volts (V) direct current (DC) and 30V DC, with a maximum current draw of 265 milliamperes (mA).

L. Have a radio sleep mode with a maximum current draw of less than 1mA.

M. Be programmable for radio frequency (RF) output levels of 1 milliwatt (mW), 10mW, 100mW or 1 watt (W).

N. Provide 16-bit cyclic redundancy check (CRC) error checking with auto re-transmit.

O. Be available as shelf mounted, rack-mounted or *NEMA 4X* weatherproof versions.

P. Not require controller hardware or software modifications,

Q. Have built-in store-and-forward repeater.

2. Shelf mount unit option: Provide FSK type interface equipment meeting the following additional requirements:

A. Not exceed 9 inches long by 2 inches wide by 5 inches high.

B. Have threaded Neill-Concelman (TNC) female antenna connector.

C. Be supplied with 120V alternating current (AC) wall cube power supply.

D. Have received signal strength indicators (RSSI) signal strength LEDs.

3. Shelf mount unit option: Ensure RS-232 type interface equipment meets the following

additional requirements:

A. Not exceed 4.38 inches in depth by 3.56 inches in width by 1.69 inches in height (not including connectors or mounting bracket).

B. Have TNC female antenna connector.

C. Have power cable supplied with radio modem.

D. Have RSSI signal strength LEDs.

4. Ensure antennas, connectors, and cable meet the following requirements, as applicable:

A. Master Location. Provide from 2 to 4, 10 decibel (dB) Yagi Antennas for a back-to-back operation, specified for the frequency range of the radio, connected to a Pasternack PE 2047 or Encom Wireless EP Splitter type power divider, or approved equal.

B. Repeater Location. Provide 2, 10dB Yagi Antennas for a back-to-back operation, specified for the frequency range of the radio, connected to a Pasternack PE 2047 or Encom Wireless EP Splitter type power divider, or approved equal.

C. Remote Location. Provide 1, 10dB Yagi Antenna, specified for the frequency range of the radio.

D. Use Times Microwave Land Mobile Radio (LMR) or Andrew CNT 400dB cable, or approved equal, for connection between both the polyphaser and power divider and power divider and antenna for the master location. Use a LMR or CNT 400dB type cable between the polyphaser and the antenna for secondary locations.

E. Use Times Microwave TC-400-NMH or RF Industries RFN-1006-31 Type N male connectors, or approved equal, fastened at the ends of the LMR or CNT 400dB type cable for connection to polyphaser, power divider, and antenna.

F. Use one 2/C #16 PJ type traffic signal cable to connect the phone drop to the traffic signal controller at the master location, as shown on the plans, or as directed by the Engineer.

5. Surge Protection. Provide a broadband DC blocked polyphaser type surge protection device installed between the antenna/power divider and the radio equipment. Provide N Female type connectors for both the protected and surge sides of this device. Ensure the electrical and RF characteristics are as follows: Surge minimum 50 Kiloampere (kA), Turn on 600VDC (±20 percent), Frequency Range 1.25 Megahertz (MHz) to 1 Gigahertz (GHz), Insertion Loss less than 0.1dB over the frequency range.

6. Documentation. Provide manufacturer’s instructions for hardware installation, programming, and system commissioning to the Engineer at the time of installation.

7. Software. Ensure software meets the following requirements:

A. Be compatible with “Windows” type graphical user interface (GUI).

B. Supports remote diagnostics and radio link tests with no additional hardware.

C. Provides up to three message lengths to test various network configuration and link requirements.

D. Supports system wide remote configuration from master radio location.

E. Provides method for radio system optimization.

8. Warranty. Provide materials with a manufacturer warranty, transferable to the MDOT, that the supplied materials are free from all defects in materials and workmanship. Furnish the warranty and other applicable documents from the manufacturer, and a copy of the invoice showing the date of shipment, to the Engineer prior to acceptance.

c. Construction. Complete this work in accordance with sections 819 and 820 of the Standard Specifications for Construction, the typical signal construction detail(s), and this special provision.

1. Installation. When installing new equipment is specified, furnish and install the wireless interconnect closed loop master, repeater, or remote as shown on the plans. When installing salvaged equipment is specified, install wireless interconnection closed loop equipment, salvaged on the project, as shown on the plans.

Install the radio antennas after the rest of the signal equipment (signal heads, poles, case signs, span wire, etc.) has been installed. Obtain the Engineer's approval prior to beginning antenna installation. Correct radio antenna installation that was completed prior to the approval of the Engineer, and which is found to be non-optimal placement of the antennas at no additional cost to the contract. The Engineer will not authorize extra payment or time extensions for work required to reorient or move the radio antenna.

2. Removal. When removal is specified, remove the wireless interconnect, closed loop as shown on the plans. Removal includes the wireless closed loop interconnect package, shelf mounted unit, processor (with radio modem, when appropriate), power supply, surge protection, antennas, mounting brackets, hardware assembly, fittings, cable, connectors, grounding, and other appurtenances required for a complete removal.

3. Salvage and Disposal. Salvage and store, or dispose of, removed material as directed by the Engineer and section 204 of the Standard Specifications for Construction. Store salvaged equipment to be re-installed on the project in a protected and clean environment.

d. Measurement and Payment. The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	**Pay Unit**
Wireless Intercn, Closed Loop, Master	Each
Wireless Intercn, Closed Loop, Repeater	Each
Wireless Intercn, Closed Loop, Remote	Each
Wireless Intercn, Closed Loop, Rem	Each
Wireless Intercn, Closed Loop, Salv	Each

1. **Wireless Intercn, Closed Loop**, of the type specified, includes furnishing and installing a new master, repeater, or remote at the location(s) shown on the plans.

2. **Wireless Intercn, Closed Loop, Rem** includes removing and disposing of an existing wireless interconnect, closed loop package at the location(s) shown on the plans.

3. **Wireless Intercn, Closed Loop, Salv** includes removing an existing wireless interconnect, closed loop package, storing the removed materials on site, and reinstalling materials at the location(s) shown on the plans.