

# Special Specification 6101

## Wireless Ethernet Radio (Local) Link



### 1. DESCRIPTION

Furnish and install Wireless Ethernet Radio (WER) (Local) Link in the 5.8 GHz frequency as shown on the plans, as detailed in the Special Specifications, and as directed by the Engineer. Provide all similar WER's from the same manufacturer.

Furnish, assemble, fabricate or install new, corrosion resistant materials in strict accordance with the details shown on the plans and in the specifications.

Provide an interference analysis for each WER link to identify potential sources of interference. Adjust antenna polarities and channel plans on equipment to minimize interference from other sources. If the interference analysis shows possibility for interference along any wireless link, conduct in-field monitoring to determine if actual interference exists.

Include licenses for all equipment, where required, for any software or hardware in the system.

Supply a medical statement as to the safety of the unit to the general public (example: Pacemakers, etc.)

### 2. FUNCTIONAL REQUIREMENTS

Provide the Wireless Ethernet Radio (Local) Link to be a point to point, license-free, dynamic modulating radio with an effective aggregate throughput of 105 Mbps. Ensure the WER uses Dynamic Frequency Selection technology and manual selection ability. The Dynamic Frequency Selection must continually adapt to avoid interference.

Ensure that the WER (Local) Link is capable of providing acceptable data throughput operation in "Line of Site," "Near Line of Site," and "Non Line of Site" installation locations.

Ensure the WER (Local) has an Ethernet port that can be used for configuration. Provide an auto-sensing Ethernet port for the connectivity.

Ensure the WER (Local) is integrated with a flat panel antenna in a rugged weatherproof housing that can be mounted with the antenna either vertical or horizontal.

Ensure the power and signal cables are UV Resistant Polyethylene jacketed coax cable.

Ensure the radio is software configurable via WER GUI or SNMP through the Ethernet port.

Ensure the WER (Local) Link, consists of both Outdoor and Indoor units, and is integrated with a flat panel antenna in a rugged weatherproof housing that can be mounted with the antenna either vertical or horizontal.

2.1. Ensure the WER (Local) meets the following requirements:

#### **Radio**

- |                       |                                      |
|-----------------------|--------------------------------------|
| ■ Output power        | -18 dBm to +27 dBm                   |
| ■ Frequency Range     | 5.725 GHz to 5.850 GHz               |
| ■ Receive Sensitivity | Adaptive between -94 dBm and -69 dBm |
| ■ Channel Size        | Configurable to 5, 10 or 15 MHz      |

- Wireless Data Rate (Mbps) Dynamically variable up to 105 Mbps (aggregate)
- Range Up to 155 miles (250 km)
- Duplex scheme Time Division Duplex (TDD)
- Modulation Dynamic; adapting between BPSK and 64 QAM
- Error Correction FEC (Forward Error Correction)
- Antenna Integrated with 23 dBi gain/8 degrees
- System Gain Up to 167 dB using integrated 23dBi antenna
- Security Proprietary or optional FIPS-197 compliant 128/256-bit AES Encryption
- Certification Federal Communications Commission (FCC)

### **Ethernet**

- Protocol IEEE 802.3
- Data throughput(aggregate) Up to 35 Mbps (5 MHz Channel)  
Up to 70 Mbps (10 MHz Channel)  
Up to 105 Mbps (15 MHz Channel)
- Latency <3 ms average each direction
- Interface 10/100 Base T (RJ-45) – auto MDI/MDIX
- Quality of Service 802.1p (2 levels)
- T1/E1 interface Single T1/E1 port; G703/G704,G823/G824

### **Management**

- System management Internet or SNMP v1/v2c/v3 MIBII and proprietary from manufacturer
- LED indicators Activity, Power status, and Ethernet link status

### **Installation**

- Link optimization Built-in GUI and voltage output information
- Connection distance From radio to primary network connection up to 330 ft.
- Lightning protection 2 required, one within outdoor radio and one at cable entrance point to the network

### **Physical**

- Weight no more than 11.8 lbs with bracket
- Dimensions not larger than 14.5" W x 14.5" H x 3.75" D
- Power supply part of indoor unit

### **Power**

- Supply Integrated with indoor unit
- Source 90-240 VAC, 50-60 Hz/36-60V DC
- Consumption 50 W maximum

### **Environmental**

- Operating temperature -40°F to + 140°F
- Humidity 0-95 % non-condensing
- Wind speed 202 mph

### **Regulatory**

- Safety UL60950-1; IEC60950-1;CSA-C22.2 No. 60950-1
- Radio 5.8 GHz; USA CFR 47 Part 15.247
- Electromagnetic Compatibility USA CFR 47 Part 15 Class B

- 2.2. **System Installation.** Provide and install all materials, including support, calibration and test equipment, to ensure an operating and functional wireless system link. This will include installation of WER equipment with power and data cables, and power and grounding system. Prior to beginning installation, inspect each site to verify suitability of installation and submit installation design and grounding and lightning protection design to the Engineer for approval prior to installation. This installation must include:
- 2.2.1. **System Power and Grounding.** Describe proposed grounding and lightning protection design. Connect equipment to the 115 Volt circuits provided at the sites. Bond all equipment racks in accordance with manufacturer's installation specification. Ground all equipment racks to the single-point ground for the site. Provide grounding and lightning protection for all cable runs on the support tower and at the equipment entry point.
- 2.2.2. **System Optimization.** Following installation of the completed system, optimize the equipment at each site in accordance with the specifications to provide a complete, operational system.
- 2.3. **Software.** Provide any and all programming and software required to support the WER system. Install the programming and software in the appropriate equipment at the time of acceptance testing, and will be used in the acceptance testing.
- Provide software updates free of charge during the warranty period.
- 2.4. **Power Requirements.** Provide equipment that is not affected by transient voltages, surges and sags normally experienced on commercial power lines. Check the local power service to determine if any special design is needed for the equipment. The extra cost, if required, must be included in the bid of this item.
- 2.4.1. **Wiring.** Provide wiring that meets the requirements of the National Electrical Code. Provide wires that are cut to proper length before assembly. Provide cable slacks to facilitate removal and replacement of assemblies, panels, and modules. Do not doubled-back wire to take up slack. Lace wires neatly into cable with nylon lacing or plastic straps. Secure cables with clamps. Provide service loops at connections.
- 2.4.2. **Transient Suppression.** Provide DC relays, solenoids and holding coils that have diodes or other protective devices across the coils for transient suppression.
- 2.4.3. **Power Service Protection.** Provide equipment that contains readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.
- Provide and size circuit breakers or fuses such that no wire, component, connector, PC board or assembly must be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element or wiring.
- 2.4.4. **Fail Safe Provision.** Provide equipment that is designed such that the failures of the equipment must not cause the failure of any other unit of equipment. Ensure automatic recovery from power failure must be within 5 sec. after resumption of power.
- 2.5. **Mechanical Requirements.** Provide printed circuit boards that are coated with a clear-coat moisture and fungus resistant material (conformal coating).
- 2.5.1. **Modular Design.** Provide equipment that is modular in design to allow major portions to be readily replaced in the field. Ensure modules of unlike functions are mechanically keyed to prevent insertion into the wrong socket or connector.
- Identify modules and assemblies clearly with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

- 2.5.2. **Connectors and Harnesses.** Provide external connections made by means of connectors. Provide connectors that are keyed to preclude improper hookups. Color code and/or appropriately mark wires to and from the connectors.

Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment.

Provide pins and mating connectors that are plated to improve conductivity and resist corrosion. Cover connectors utilizing solder type connections by a piece of heat shrink tubing securely shrunk to insure that it protects the connection.

### 3. CONSTRUCTION

- 3.1. **General.** Provide equipment that utilizes the latest available techniques for design and construction with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.
- Design the equipment for ease of maintenance. Provide component parts that are readily accessible for inspection and maintenance. Provide test points that are for checking essential voltages and waveforms.
- 3.2. **Electronic Components.** Provide electronic components in accordance with Special Specification 6006, "Electronic Components."
- 3.3. **Mechanical Components.** Provide external screws, nuts and locking washers that are stainless steel; no self-tapping screws will be used. Provide parts made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass. Protect materials from fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material.
- 3.4. **Documentation Requirements.** Provide documentation in accordance with Article 4, Special Specification 6005, "Testing, Training, Documentation, Final Acceptance, and Warranty."
- 3.5. **Testing.** Perform testing in accordance with Article 2, Special Specification 6005, "Testing, Training, Documentation, Final Acceptance, and Warranty." Test all WER to ensure compliance to all FCC and Department specifications.
- Additional testing requirement is as follows:
- 3.5.1. **System Testing.** Conduct System Testing at the manufacturer's facility as well as after installation at the designated TXDOT locations.
- Test each hop of the proposed system. This must include transmit power and frequency, receiver performance and frequency, proper operation of switch over, proper operation of alarms and switches and bit error rate (BER) testing for the configured hop. Prior to beginning the manufacturer's test, provide TXDOT with a copy of the test procedure as well as the proposed test date(s).
- Following completion of equipment installation and operational optimization, submit the Acceptance Test Plan to TXDOT for review and Approval. During the official Acceptance Testing, provide the technical staff to conduct the measurements and adjustments called for in the testing. TXDOT will participate in the testing as the Official Test Witness. Provide each page of the Acceptance Test Document for data recording of the test results, and the name of Contractor's representative conducting the test as well as a suitable field for the test date and signature of TXDOT Test Witness. Upon TXDOT Approval of the Test Plan and the Test Schedule, begin the Acceptance Test. This must include:
- 3.5.2. **System-level Testing of the System Paths.** Ensure testing of the installed system paths include:
- Measure and record the transmitter/receiver channel frequency and polarity.
  - Measure and record the transmitter power.

- Measure and record the receiver fade margin.
- Perform a one hour Bit Error Rate Test (BERT) on the primary equipment and record results.
- Verify the operation of all local alarm and control points using the alarm/monitoring equipment provided.

3.5.3. **System-level Test.** Following testing of the individual equipment, test each hop on an end-to-end basis and perform a BERT on the primary equipment.

Test and verify the operation of the alarm and monitor equipment in accordance with the Acceptance Test criteria.

3.6. **Experience Requirements.** The Contractor or designated subcontractors involved in the installation and testing of the WER must, as a minimum, meet the following requirements:

Two yrs. experience in the installation of WER System.

Two installed WER systems where Systems have been in continuously satisfactory operation for at least 1 year. The Contractor must submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the system.

One project (may be one of the two in the preceding paragraph) which the Contractor or subcontractor can arrange for demonstration to the Engineer.

Provide necessary documentation of subcontractor qualifications pursuant to contract award.

3.7. **Technical Assistance.** Ensure that a manufacturer's technical representative is available on site to assist the Contractor's technical personnel at each installation site and with WER system equipment installation and communication system configuration.

Do not execute the initial powering up of the WER equipment without the permission of the manufacturer's representative.

3.8. **Training.** Conduct a training class (minimum of 8 hours) for up to 10 representatives designated by TxDOT on procedures of installation, operations, testing, maintenance and repair of all equipment specified within these specifications. Submit to the Engineer for approval, 10 copies of the training material at least 30 days before the training begins. Conduct training within the local area unless otherwise authorized by the Engineer. Customize the training specifically for the TransGuide System.

3.9. **Warranty.** Provide a warranty in accordance with Article 6, Special Specification 6005, "Testing, Training, Documentation, Final Acceptance and Warranty."

## 4. MEASUREMENT

This Item will be measured as each Wireless Ethernet Radio (Local) Link furnished, installed, made fully operational with the TransGuide system and tested in accordance with these specifications or as directed by the Engineer.

Each Link is comprised of the radios, mounting brackets, wiring, power supplies, etc. needed at each end to establish a Link.

## 5. PAYMENT

The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for each "Wireless Ethernet Radio (Local) Link." This price includes all equipment described under this Item with all cables and connectors, mounting assemblies, all documentation and testing; and includes the cost of furnishing all labor, materials, training, warranty, equipment, and incidentals.