Special Specification 6015
Fiber Optic RS-232 Data Modem

1. DESCRIPTION

Furnish and install Fiber Optic RS-232 Data Modem (FO-MODEM) in locations, as shown on the plans, and as detailed in the Special Specifications.

2. SUBMITTAL COMPONENTS

As a minimum, the submittal for this Item will completely address the following:

- Optical Wavelength,
- Unit physical size,
- Data input/output compatibility,
- Bit error rate,
- Optical input/output power and range,
- Modulation method,
- Transmitting device,
- Optical detector,
- Optical fiber compatibility,
- Transient suppression,
- Power requirements,
- Over current protection,
- Connectors: optical, data, power, gold plating,
- Environmental parameters
- Data rate

3. MATERIALS

3.1. **General Requirements.**Ensure all materials furnished, assembled, fabricated or installed under this Item are new, corrosion resistant, and in strict accordance with the details shown on the plans, and in the specifications.

3.2. **Functional Requirements.** Ensure the FO-MODEM will support the transmission of full duplex data at true RS-232 levels on both the input and output circuits and will operate over two single mode or two multimode optical fibers, between specified locations as shown on the plans, as detailed in the specifications, and as directed.

No adjustments to the FO-MODEM will be required, either in the field where the links are installed, nor periodically thereafter.

3.3. **Electrical/Optical Requirements.**

3.3.1. **Transmitting Device.** Provide a laser as the transmitting device for the single mode unit. A LED will be the transmitting device for the multimode unit.

3.3.2. **Transmitter Optical Output.** Output power to 8.5/125 single mode glass fiber at a wavelength of 1300 nm will be sufficient to accommodate a link loss budget of 15 dB or more. Output power to 50/125 multimode glass fiber at a wavelength of 1300 nm will be sufficient to accommodate a link loss budget of 13 dB or more.

3.3.3. **Optical Detector.** The optical detector of the receiver will be an APD diode or Pin diode.

3.3.4. **Receiver Optical Input.** Ensure the receiver input has a minimum sensitivity of 15 dB below the transmitter output level and operate within the parameters of this specification.

3.3.5. **Transmitting/Receiving Devices.** The transmitting/receiving devices will have a minimum mean time between failure (MTBF) of 100,000 hours at 122ºF (50ºC) ambient temperature.

Ensure the devices incorporate diagnostic power and data activity input LED's in both the transmitter and the receiver for quick visual indication of link operation.

3.3.6. **Modulation.** Modulation will be FM.

3.3.7. **Operating Mode.** Operating mode will be asynchronous, full duplex.

3.3.8. **Input/Output Impedance.** Impedance will be per RS-232.

3.3.9. **System Bandwidth.** Bandwidth will be DC to 19.2 Kbaud, minimum.

3.3.10. **Optical Fiber Compatibility.** Optical Fiber Compatibility will be 8.5/125 micron single mode glass fiber or 50/125 micro multimode glass fiber.

3.3.11. **Data Performance Requirements.** Ensure digital data transmitted and received by the FO-MODEM conforms to all the requirements of EIA Standard RS-232.

3.3.12. **Data Rate.** Ensure the FO-MODEM supports all required data transmission rates currently defined within an approved and published CCITT communication protocol standard.

3.3.13. **Bit Error Rate (BER).** The bit error rate of each data channel will not exceed 10 to the -9 power within optical budget.

3.3.14. **Power Requirements.** Ensure each FO-MODEM will operate at 12 to 24 volts DC from a separate power supply to be provided as part of this bid item and will not draw more than 5 watts of power each.

The separate power supply will operate from 115 volts AC plus or minus 10 percent, 60 Hz plus or minus 3 Hz.

Ensure that the equipment operation will not be affected by the transient voltages, surges and sags normally experienced on commercial power lines. It is the Contractor's responsibility to check the local power service to determine if any special design is needed for the equipment. The extra cost, if required, will be included in the bid of this Item.

3.3.15. **Power Service Transients.** Ensure the equipment meets the requirements of Section 2.1.6, "Transients, Power Service," of the NEMA Standard TS1-1989, or the latest revision.

3.3.16. **Wiring.** Ensure all wiring meets the requirements of the National Electrical Code. All wires will be cut to proper length. Sufficient cable slack will be provided to facilitate removal and replacement of assemblies, panels, and modules. No wire will be doubled back to take up slack. Lace wires neatly into cable with nylon lacing or plastic straps. Secure cables with clamps.

3.3.17. **Transient Suppression.** All DC relays, solenoids, and holding coils will have diodes or other protective devices across the coils for transient suppression.

3.3.18. **Power Service Protection.** Ensure the equipment contains readily accessible, manually resettable or replaceable circuit protection devices, such as circuit breakers or fuses, for equipment and power source protection.

3.3.19. **Fail Safe Provision.** Design the equipment such that the failures of the equipment will not cause the failure of any other unit of equipment.

3.4. **Mechanical Requirements.**

3.4.1. **Modular Design.** Provide equipment that is modular in design to allow major portions to be readily replaced in the field.

Mechanically key modules of unlike functions to prevent insertion into the wrong socket or connector.

Clearly identify all modules and assemblies with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

3.4.2. **Connectors and Harnesses.** Make all external connections by means of connectors. Key the connectors to preclude improper hookups. Color code and/or appropriately mark all wires to and from the connectors.

Plate each conductive contact surface or pin with 20 microns of gold.

Optical input and output connectors will be the FC type for the single mode units and ST type for the multimode units.

Digital data inputs to and outputs from the FO-MODEM will be via DB 25 connectors configured in a format compatible with the interface requirements of the attached data communications equipment.

Provide connecting harness of appropriate length and terminated with matching connectors for interconnection with the terminal equipment, shown on the plans, or as directed.

3.5. **Environmental Design Requirements**

Ensure the equipment meets all its specified requirements during and after subjecting to any combination of the following requirements:

- Ambient temperature range of 0ºF to 140ºF, and
- Relative humidity from zero percent to 95 percent.

4. CONSTRUCTION METHODS

4.1. **General.** Ensure the equipment design and construction utilizes the latest available techniques with a minimum number of parts, subassemblies, circuits, cards and modules to maximize standardization and commonality.

Ensure the equipment is designed for ease of maintenance. All component parts will be readily accessible for inspection and maintenance. Provide test points for checking essential voltages and waveforms.

4.2. **Electronic Components.** Ensure all electronic components comply with Special Specification, “Electronic Components.”

4.3. **Mechanical Components.** Ensure all external screws, nuts, and locking washers are stainless steel. No self-tapping screws will be used unless approved.

Ensure all parts will be made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

Ensure all materials used in construction will be protected from fungus growth and moisture deterioration.

Separate dissimilar metals by an inert dielectric material.

5. DOCUMENTATION REQUIREMENTS

The documentation requirements will be in accordance with the Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty," Section 4.

6. TESTING

The testing will be in accordance with the Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty," Article 2 – 2(6). Testing will include the following:

6.1. **Data Performance Tests.** Digital data performance testing includes all tests necessary to ensure compliance with all of the requirements of EIA Standard 232. These tests will, as a minimum, demonstrate data communications between the transmitting equipment and the corresponding receiving equipment of each link. Using a loopback plug at each EIA-232 channel, terminating at a field location, a 24 hour bit error rate test (BERT), for each channel will be conducted, using a data communications test set. This BERT is used to determine the bit error rate (BER) through the system and terminating equipment at each end, and to certify that the EIA-232 channels can operate at a sustained rate of 19,200 bits/sec (bps) for a 24 hour period. The 511-bit CCITT standard pseudo-random pattern will be used for testing. The BER measured at 19,200 bps will not exceed the requirements of this specification, and the error free seconds (EFS) will be better than 99.98 percent. If this BER is exceeded on any channel, the problem will be corrected and the entire BERT will be completely restarted from the beginning, as if no previous BERT had been conducted. If a component has been modified as a result of the subsystem test failure, a report will be prepared and delivered to the Engineer prior to testing. All required test equipment will be supplied by the Contractor.

7. TRAINING

The training will be in accordance with Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty," Article 3.

8. WARRANTY

The warranty will be in accordance with the Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty," Article 6.

9. MEASUREMENT

This Item will be measured as each unit furnished, installed, made fully operational and tested in accordance with these Special Specifications or as directed.

10. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for "Fiber Optic RS-232 Data Modem (Single Mode)" or "Fiber Optic RS-232 Data Modem (Multimode)." This price will include all equipment described under this Item with all cables and connectors, all documentation and testing and will include the cost of furnishing all labor, materials, training, warranty, equipment, and incidentals.