SPECIAL SPECIFICATION
1983
Data Fiber Optic Transceiver

1. Description. This Item shall govern for the furnishing and installation of Data Fiber Optic Transceivers in designated equipment cabinets in the field and in the Control Center as shown on the plans and as detailed in the Special Specifications.

2. Submittal Components. As a minimum, the submittal for this Item shall completely address the following:

- optical wavelength
- data input/output compatibility
- optical input/output power and range
- data rate
- modulation method
- bit error rate
- transmitting device
- optical detector
- optical fiber compatibility
- power requirements
- connectors
- optical power
- data
- connectors
- optical
- unit physical size
- connectors
- power
- optical
- attenuation
- normal mode
- bypass mode
- system interconnection diagram
- transient suppression
- overcurrent protection
- environmental parameters

3. Material. All materials furnished, assembled, fabricated or installed under this Item shall be new, corrosion resistant and in strict accordance with the details shown on the plans and in the Specifications.

A. Functional Requirements. The Data Fiber Optic Transceiver shall be comprised of a transmitter and a receiver, and shall provide the interface between the D/I Muldem and the optical fiber network.

The transceiver may be an integral part of the D/I Muldem with the approval of the Engineer.

The transmitter section of the transceiver shall convert the T1 rate bit stream from the D/I Muldem to optical signals. The receiver section shall convert the optical signal to a T1 rate bit stream compatible with the D/I Muldem.

Two transceivers shall be used at each communications hub, except for the ones at the extremities of the fiber optic trunks, where only 1 transceiver is required. Where 2 transceivers are installed, 1 transceiver shall be connected for downstream signal flow and the second shall be connected for upstream signal flow.
B. Electrical/Optical Requirements.

1. **Optical Wavelength.** The operating wavelength shall be 1,300 nm.

   The wavelength and spectral line width selections shall be based on both the transmitter and the receiver designs.

2. **Data Input/Output.** The signal level and line codes shall operate with a standard pulse code modulation (PCM) T1 data stream (North American PCM DS-1 line per AT & T Technical Advisory 34) with the bit rate of 1.544 mb/s. The T1 shall be selectable between the Alternate Mark Inversion (AMI) D4 format and the B-8S format.

3. **Optical Input Output.** Optical output power to the glass fibers at the selected wavelength shall be adjustable and shall be sufficient to drive the upstream or downstream receiver at different spacings as indicated on the plans.

   Receiver input shall have the dynamic range to receive the signal from the upstream or downstream transmitter at different spacings.

   The transceiver shall be capable of transmitting and receiving at the D/I Muldem input/output rate of DS-1 over a fiber optic link with a 16 dB loss budget while meeting all performance requirements of this Specification.

4. **Data Rate.** The transceiver shall operate at the T1 data rate of the D/I Muldem described in the Special Specification, “Drop/Insert Multiplexor/ Demultiplexor”.

5. **Modulation.** Modulation method shall be selected by the Contractor subject to Engineer approval.

6. **Bit Error Rate.** The transceiver shall be capable of providing a bit error rate better than 10 to the minus 12th power at an operating loss budget of 16 dB.

7. **Transmitting Device.** The transmitting device shall be a light-emitting diode (LED) which shall have an MTBF better than 100,000 hours at 71°F.

8. **Optical Detector.** The optical detector of the receiver shall be an APD diode, a PIN or a device approved by the Engineer.

9. **Optical Fiber Compatibility.** The multimode transceiver shall be compatible with 50/125 micron multimode graded index glass fiber.

   The single mode transceiver shall be compatible with 8 to 10 micron single mode glass fiber.

10. **Power Requirements.** The transceiver shall operate from 115 volts ± 20 Volts AC and shall not draw more than 25 watts of power each.

   The equipment operation shall not be affected by 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, shall be included in the bid price of this Item.

11. **Power Service Transients.** The equipment shall meet the requirements of Section 2.1.6, “Transients, Power Service”, of NEMA Standard TS-1-1989 latest revision.

12. **Wiring.** All wiring shall meet the requirements of the National Electric Code. All wires shall be cut to proper length before assembly. No wire shall be doubled back to take up slack. Wires shall be neatly laced into cable with nylon lacing or plastic straps. Cables shall be secured with clamps. Cable slacks shall be provided to facilitate removal and replacement of assemblies, panels, and modules.

13. **Transient Suppression.** All DC relays, solenoids, and holding coils shall have diodes across the coils for transient suppression.

14. **Power Service Protection.** The equipment shall contain readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection. Circuit breakers or fuses shall be provided and sized such that no wire, component, connector, PC board or assembly shall be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element or wiring.

15. **Fail Safe Provision.** The equipment shall be designed such that the failure of the equipment shall not cause the failure of any other unit of equipment.

A by-pass switch and sensing circuitry shall be provided to by-pass the D/I Muldem whenever the D/I Muldem loses power or malfunctions.

C. **Optical Bypass Switch.** The Contractor shall provide and install 2 optical bypass switches at each communications hub. In the event of a power failure, the optical switches shall cause the optical T1 data signals to bypass the Data Fiber Optic Transceivers and Drop/Insert Muldem at that particular hub. During normal power service, the optical switches shall pass the T1 data signals to the Data Fiber Optic Transceivers and Drop/Insert Muldem at that hub. The optical bypass switches shall be equipped with connectors compatible with the optical connectors of the transceiver. The attenuation of the bypass switches shall not exceed 5 dB in bypass mode or in normal mode. The Contractor shall furnish and implement all accessories necessary for complete and operating optical bypass switches.

D. **Mechanical Requirements.**

1. **Modular Design.** The equipment shall be modular in design such that major portions may be readily replaced in the field.

Modules of unlike functions shall be mechanically keyed to prevent insertion into the wrong socket or connector.

All modules and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.
2. **Connectors and Harness.** All external connections shall be made by means of connectors. The connectors shall be keyed to preclude improper hookups. All wires to and from the connectors shall be color coded and/or appropriately marked. Cable slack shall be provided to facilitate removal and replacement of assemblies, panels, and modules.

Data input and output connectors shall be fully compatible with the T1 connectors of the Drop/Insert Multiplexor.

Each and every conductive contact surface or pin shall be plated with a minimum of 50 microns of gold.

Optical input and output connectors for the multimode transceiver shall be the ST type with stainless steel housing and ceramic ferrule. Optical input and output connectors for the single mode transceivers shall be FC type.

Connecting harness of appropriate length and terminated with matching connectors shall be provided for interconnection with the D/I Muldem and the fiber optic network.

3. **Housing.** The housing of the transceiver shall be stainless steel, or aluminum protected with corrosion resistant paint.

The housing shall be suitable for rack mounting and shall be securely mounted in the communications cabinet.

E. **Environmental Design Requirements.** The equipment shall meet all its specified requirements during and after subjecting to any combination of the following requirements:

1. Ambient temperature range of minus 62°F to 140°F.
2. Relative humidity from 0% to 95%.

4. **Construction Methods.** The equipment design and construction shall utilize the latest available techniques with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

The equipment shall be designed for ease of maintenance. All component parts shall be readily accessible for inspection and maintenance. Test points shall be provided for checking essential voltages and waveforms.

A. **Electronic Components.** All electronic components shall comply with Special Specification, “Electronic Components”.

B. **Mechanical Components.** All external screws, nuts, and locking washers shall be stainless steel; no self-tapping screws shall be used unless specifically approved by the Engineer.

All parts shall be made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.
All materials used in construction shall be protected from fungus growth and moisture deterioration.

Dissimilar metals shall be separated by an inert dielectric material.


Documentation for the Data Fiber Optic Transceiver shall be in compliance with Article 4. of Special Specification, “Testing, Training, Documentation and Warranty”.

Warranty for the Data Fiber Optic Transceiver shall be in compliance with Article 5. of Special Specification, “Testing, Training, Documentation and Warranty”.

5. **Measurement.** This Item will be measured as each unit of the type shown on the plans furnished, installed, made fully operational and tested in accordance with this Special Specification.

6. **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 price bid for “Data Fiber Optic Transceiver (Multimode)” or “Data Fiber Optic Transceiver (Single Mode)”. This price shall be full compensation for all equipment described under this Item with all cables and connectors; documentation and testing and for furnishing all labor, materials, training and equipment necessary to complete the work.