SECTION 682

FIBER OPTIC TRANSCEIVER

DESCRIPTION

682.01.01 GENERAL: The contractor shall furnish a Fiber Optical Transceiver/Self Healing (OTR/SH) that interfaces the traffic controllers with the central control system using Single Mode Fiber Optic (SMFO) cable. This communications device shall contain a self-healing optical ring and perform remote control of master/slave functions. The OTR/SH provides an electrical signal interface for an Electronic Industry Association (EIA)-232/422/485 port and 4 SMFO interfaces (2 transmit and 2 receive) that support fault tolerant, optical counter rotating ring as well as add/drop/repeat capability allowing field controllers to be interconnected in a multi-dropped configuration. The device shall be an International Fiber Systems (IFS) Model #D19130SHR, or equivalent, as approved by the Freeway & Arterial System of Transportation (FAST) Manager or designee.

This specification is for equipment only, no installation, to be delivered to the FAST Traffic Management Center (TMC) for testing and approval prior to final acceptance. The agency Project Director shall be notified prior to the delivery to the TMC. No partial shipments will be accepted. All equipment supplied on this project will be delivered during a single delivery, and shall be labeled clearly with the project and location designation.

All equipment selection shall be approved prior to purchase by the FAST Manager or designee.

MATERIALS/EQUIPMENT

682.02.01 GENERAL: The OTR/SH shall require no user adjustments other than switch selection of the desired interface, anti-streaming time, and Master/Slave operation. When the OTR/SH is installed in a rack mounted card cage, the unit shall be hot-swappable with no adverse affects to itself or other units in the cage.

All equipment supplied shall have a full lifetime replacement/repair warranty.

682.02.02 MECHANICAL: The OTR/SH shall be a surface mount device (field), or rack mount (hub) configurations, when specified. The field mounted Video Optical Transceiver (VOTR) shall be enclosed in corrosion resistant housing that protects the internal circuitry from the environment. The housing shall be provided with suitable holes for mounting to a flat surface.

When it is specified, the rack mounted OTR/SH shall occupy no more than 4 Rack Units (RU) 7 inches of space and be of the same manufacturer and compatible with the 19 inch 48 centimeters rack-mountable card cage. The rack mounted OTR/SH shall be able to obtain all necessary power from the card cage assembly without the use of external power cables.

All OTR/SH shall have external, silk screened, labeling of the device type, model number, part number, serial number, Light Emitting Diode (LED) status indicators, connector functions, and manufacturer on the front panel and/or the housing. Internal labeling shall be provided to clearly identify all dipswitches and jumper positions.

The OTR/SH shall have LED status indicators for the following signals:

(a) A looped locked, Forward Direction.
(b) A loop locked, Reverse Direction.
(c) B looped locked, Forward Direction.
(d) B loop locked, Reverse Direction.
(e) Transmit Data A.
(f) Receive Data A.
(g) Transmit Data B.
(h) Receive Data B.
(i) Power (PWR).

682.02.03 OPTICAL:

(a) The OTR/SH shall have the following characteristics:
   1) Laser diodes operating at 1,310 millinometers.
   2) Link loss budget of 20 dB (minimum).
   3) Less than 2 μsec optical repeating delay.
   4) Straight Tip (ST) connectors 4.
   5) Minimum connection of 0.67 meters (2 feet) of cable with no optical attenuation.
   6) Anti-Streaming Function.

(b) The OTR/SH shall provide fault-tolerant self-healing data communication paths for the following scenarios:
   1) **Scenario 1:** A self-healing ring configuration is functioning, then a cable break occurs on the working ring between 2 OTR/SH's.
   2) **Scenario 2:** A self-healing ring configuration is functioning, then 2 cable breaks occur, 1 on the working ring and 1 on the protect ring between 2 OTR/SH's.
   3) **Scenario 3:** A self-healing ring configuration is functioning, then a single slave OTR/SH failure occurs.

682.02.04 ELECTRICAL SIGNAL INTERFACES:

(a) **Data:**
   1) Bi-directional data communication (simplex and full duplex operating modes).
   2) Switch selectable EIA-232, EIA-422, or EIA-485 multi-dropped interfaces.
   3) Data rates from DC to 100 kbps.
   4) Bit error rate of 10⁻¹¹.
   5) DB-25 connector with standard EIA 232 pinout.
   6) Switch selectable anti-streaming (4 - 64 seconds, or disabled).

(b) The OTR/SH shall be designed such that there is no command "echo" of the original command received by the host computer. The OTR/SH master shall be capable of communication with at least 32 slave units on the self-healing ring.
682.02.05 CONTROL: The OTR/SH shall operate in either the "Master" mode or "Slave" mode. The OTR/SH master shall transmit digital signals from a hub location to a number of field (slave) OTR/SH locations. Both master and slave units shall be identical. The determination of master or slave shall be accomplished by either a manual switch on the OTR/SH or by remote contact closure. A "closed" remote contact closure would put the OTR/SH in the Master mode.

682.02.06 POWER: The OTR/SH shall operate to specification when supplied with 120 ± 15 VAC, 60 ± 3 Hz single-phase power. The use of transformers to reduce the 120 VAC prime power input to a lower level used by the OTR/SH is acceptable.

682.02.07 ENVIRONMENTAL: The OTR/SH shall be designed to operate from -40° degrees Celsius (-40° degrees F.) to +74° degrees Celsius (165° degrees F.) with no cooling airflow, 0-95 percent relative humidity, non-condensing. The OTR/SH shall be compliant with National Electronics Manufacturers Association (NEMA) TS-1/TS-2 and Caltrans Traffic Signal Control Equipment Specifications for shock, vibration, and voltage transient protection.

682.02.08 19 INCH RACK MOUNTED CARD CAGE: When required at a hub location, the OTR/SH shall be able to be installed in a 19 inch rack mounted card cage. The cage height shall not exceed 4- RU. The cage shall contain a fault tolerant power converter compatible with OTR/SH module power requirements. The cage shall include provisions for interconnecting cabling and be designed to accommodate a minimum of 12 OTR/SH modules that shall be easily mountable and removable from the cage. When installed in the cage, the OTR/SH modules shall be securable. The module's maintenance indications shall not be distributed after being mounted in the drawer. A failure of one OTR/SH module shall not impact the operation of other OTR/SH modules installed within rack mounted cage.

682.02.09 FIBER OPTIC JUMPER CABLES: 4 fiber optic jumper cables shall be delivered with each transceiver supplied, and the fiber optic jumper cables shall meet the following requirements:

(a) 250 μm buffering of each fiber.
(b) 900 μm buffering of each fiber applied after the initial 250 μm buffering.
(c) Maximum factory measured insertion loss of 0.5 dB per EIA/Telcommunications Industry Association (TIA) 455-171.
(d) Less than 0.2 dB loss when subjected to EIA/TIA-455-1B, 300 cycles, 0.5 kg.
(e) Aramid yarn strength member.
(f) Rugged 3 millimeters (0.12 inch) (approximate) Polyvinyl Chloride (PVC) sheathing.
(g) Minimum bend radius of 320 millimeters (12 inches) following installation, 640 millimeters (25 inches) during installation.
(h) Minimum tensile strength of 444N (100 lbs).
(i) And ST connectors that are factory terminated with strain relief.
CONSTRUCTION

682.03.01 INSTALLATION OF EQUIPMENT: Though no physical construction is part of this deliverable, the Contractor shall furnish all mounting hardware (i.e., machine screws, nuts, locking washers) to install the OTR/SH securely in the cabinet. Mounting methods using tape, Velcro, and sticky back material will not be permitted. All necessary power adapters and cabling needed to obtain power from the power distribution assembly shall be provided.

As noted above, the Contractor shall also supply the 4 simplex fiber optic jumper cables needed to be installed from the field termination panel (field mounted) or from the fiber optic patch panel (rack mounted) to the 4 optical inputs of the OTR/SH. Contractor shall also supply the data cables for the DB-25 data connector. This consists of a 60 inch DB-25 M-M connector to plug into the OTR/SH on one end and the 2070N traffic signal controller on the other.

All OTR/SH shall be provided with protective covers on all optical connectors. The Contractor shall ensure that the protective covers remain on the optical connectors at all times when each connector is not being used.

METHOD OF MEASUREMENT

682.04.01 MEASUREMENT: The quantity of Shelf Mount Fiber Optic Transceivers with Cables will be measured per each complete and successfully tested.

The quantity of Rack Mount Fiber Optic Transceivers with Cables will be measured per each complete and successfully tested.

The quantity of 19 inch Rack Mounted Card Cage will be measured per each, complete and successfully tested.

Each card cage or OTR/SH will be measured as a unit for furnishing each OTR/SH, complete in delivery, in accordance to the quantities on the Bid Schedule.

Mounting hardware and power conversion hardware, if required, are incidental to the OTR/SH bid item and will not be measured or paid separately.

The equipment delivered will be tentatively accepted pending testing by the FAST Manager Director or designee. Only after a series of bench tests of the devices will the final acceptance be made and documented.

BASIS OF PAYMENT

682.05.01 PAYMENT: The accepted quantity of Shelf Mount Fiber Optic Transceivers with Cables will be paid for at the contract unit price bid per each, which shall be full compensation for the equipment, measured as provided under Measurement, complete including warranty, delivery to FAST, optical transceiver(s), SMFO cable, hardware, housing, 4 fiber optic jumper cables per optical transceiver, data connectors, optical connector covers, and testing of the equipment; as specified and as shown on the Drawings.

The accepted quantity of Rack Mount Fiber Optic Transceivers with Cables will be paid for at the contract unit price bid per each, which shall be full compensation for the equipment, measured as provided under Section 682.04.01, “Measurement,” complete including warranty, delivery to FAST, optical transceiver(s), SMFO cable, hardware, 4 fiber optic jumper cables per optical transceiver, data connectors, optical connector covers, and testing of the equipment; as specified and as shown on the Drawings.

The accepted quantity of 19 inch Rack Mounted Card Cage will be paid for at the contract unit price bid per each, which shall be full compensation for the equipment, measured as provided under Section 682.04.01, “Measurement,” complete including warranty, delivery to FAST, rack mounted card cage, hardware, and testing of the equipment; as specified and as shown on the Drawings.
Payment will be made under:

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<tr>
<th>PAY ITEM</th>
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<td>Shelf Mount Fiber Optic Transceivers (OTR/SH) with Cables</td>
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<tr>
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