**STATE OF NEW JERSEY**
**DEPARTMENT OF TRANSPORTATION**
**TRENTON, NEW JERSEY 08625**

# METRIC SPECIFICATIONS FOR SINGLE MODE FIBER MODEMS
# (SINGLE MODE FIBER OPTIC CABLE)

N.J. Specification No. EBM-SMFOMODS Effective Date: July 1, 2001

New Jersey Department of Transportation Specifications for various data, video, and audio modems for use on single mode fiber optic cable.

The purpose of these specifications is to describe the minimum acceptable design and operating requirements for these modems.

## GENERAL - I

### 1-1 Components

The following types of modems are defined in this specification.

A. Full-Duplex RS232 Data Modem

B. Single Channel Video and Full-duplex RS232 Data Modem

C. Bi-directional Audio and Full-duplex RS232 Data Modem

D. Multi-Drop RS232 Data Modem

For each type, a modular version (integrated power supply) and a 483 millimeter Rack mounted plug-in version is required and subsequently specified in this document. In addition, a master (transmitter) and slave (receiver) matched set is required. Half the modems delivered for a specified quantity shall be masters and the remaining half shall be slaves. Master units are usually rack mountable while slave units are usually self-standing. However, the exact configuration for each unit will be specified by the Engineer.

In order to insure maximum similarity and compatibility, all components shall be a standard product line of the same manufacturer.

### 1-2 Single Mode Fiber and Optical Budgets

All modems shall operate on two or fewer dedicated single mode fibers. Each modem shall be equipped with two (2) single mode ST female connectors. The modems may operate at 1 300 and/or 1 550 nanometers wavelength(s). The modems must have an optical budget of at least 15 decibels. They must operate without signal quality loss for fiber lengths exceeding 8 kilometers, including fusion and patch-panel connections. The modems shall use laser diode emitters.

1-3 Environment

All fiber-optic modems, racks, and power supplies shall operate in the temperature range of -20 °C to +70 °C and over a relative humidity of 0 to 95 percent non-condensing. The modems must be designed to operate inside a NEMA 3R outdoor enclosure. The manufacturer must supply certification by an independent technical laboratory confirming that the equipment complies with these environmental specifications.

1-4 Testing

The equipment is subject to testing as described in Section VII of this specification.

1-5 Electrical Power

All modems and racks must operate on standard 120 volts AC electrical service. The equipment shall operate over a voltage range of 105 to 125 volts AC at 60 hertz. Modular units must be supplied with an internal or external power supply. The power supply must be equipped with a minimum of a 1.8 meter power cord terminating in a standard 2 or 3 prong line plug. Maximum power requirements must not exceed 100 watts for each modem.

1-6 RS232/RS422 Termination

For those modems requiring an RS232 port, the modem shall be equipped with a standard DB-25 connector configured for DCE operation. This may be accomplished with an adapter cable provided that all terminations are secure and lockable. However, the modem and/or adapter cable must support RTS/CTS, DTR/DSR, and CD (Carrier Detect) control functions via a "null modem" connection. Via this connection, the Carrier Detect (CD) and DSR signals must always be true to the DTE device. The DB-25 connector shall include standard screw lock hardware. The basic modem must be capable of RS422 operation via jumper and/or interface cable adjustments which can be accomplished by the end user. All components necessary for RS422 operation shall be supplied with each modem.

1-7 Bit Error Rate

The BER (Bit Error Rate) of all modems shall not exceed 10 to the -7 between any distance within the specified optical budget and operating temperature range.

## 483 MILLIMETER CHASSIS RACK - II

All types of modems defined in this specification must be capable of being rack mountable. The 483 millimeter chassis mount shall be capable of accepting a minimum of fourteen (14) slots. The RS232 data modem shall require no more than a single slot. The Video and Audio variants may require up to two slots.

2-1 Mechanical Dimensions

The modem rack shall not exceed 483 by 152 by 254 millimeters and must be supplied with all necessary hardware for installation in a standard 483 millimeter electronics rack.

2-2 Power Supply

The rack power supply shall meet the requirements of Section I-5. The rack power system and conditioning on each plug-in card must be configured so as to prevent a fault on one plug-in card from preventing the remaining cards from operating. Each plug-in card must contain its own fuse rated to protect the components contained on it. The power supply for the rack must be adequate to power the maximum complement of cards that may be supported. The unit must be supplied with a standard line cord of at least 1.8 meters in length.

2-3 Extender Card

An extender card, which shall allow access to all components on any plug-in module, must be supplied for every five (5) racks supplied.

## FULL-DUPLEX RS232 DATA MODEM - III

This type of modem shall be required to transmit RS232 data at any baud rate in the range of 300 to 19 200 baud and must satisfy all of the Section I requirements.

3-1 Standalone Version

The standalone version shall be housed in a case not to exceed 127 by 102 by 51 millimeters. The unit must be properly fused.

3-2 Rack-Mounted Version

The rack-mounted version shall require no more than a single slot. A minimum of fourteen rack-mounted units shall be supported by each rack. The DB-25 connector shall be included on the face plate of the unit. As an alternative, a secondary convenience panel may be supplied on which the DB-25 connectors are installed. This convenience panel must be 483 millimeter rack mountable and have connectors which securely lock to either the front or back of the plug-in modem cards. If the convenience panel option is utilized, the DB-25 connectors must be permanently labeled to clearly indicate which modem is terminated on that position.

3-3 Transmit and Receive Indicators

Both types of modems must include Transmit and Receive Indicator lights which blink to indicate that data is actively being passed through the channel.

## SINGLE CHANNEL VIDEO AND FULL-DUPLEX RS232 DATA MODEM - IV

This modem shall be required to transmit NTSC compliant video from the slave to a master location. The video portion shall comply with the RS-250 specifications. A minimum of 60 decibel signal to noise ratio shall be provided. A full-duplex RS232 data channel shall also be provided. All functional requirements outlined in Section III must be satisfied for the data portion of this device.

4-1 Standalone Version

The standalone version shall be housed in a case not to exceed 178 by 127 by 102 millimeters. The unit must be properly fused.

4-2 Rack-Mounted Version

The rack-mounted version shall require no more than two slots. A minimum of seven rack-mounted plug-in units shall be supported by each rack. The connector requirements of Subsection 3-2 must be complied with.

4-3 Transmit and Receive Indicators

Both types of modems must include Transmit and Receive Indicator lights which blink to indicate that data is actively being passed through the RS232 channel.

4-4 Video Connectors

Standard BNC video connectors shall be provided on both the transmitter and receiver modules supporting a 1 volt pk-pk signal as defined by the NTSC specifications.

4-5 Video Transmission Technique

The video communications shall be via FM Analog or Digital technique. AM modulation techniques are unacceptable.

## BI-DIRECTIONAL AUDIO AND FULL-DUPLEX RS232 DATA MODEM - V

This modem shall be required to transmit audio in both directions simultaneously. A full-duplex RS232 data channel shall also be provided. All functional requirements outlined in Section III must be satisfied for the data portion of this device.

5-1 Standalone Version

The standalone version shall be housed in a case not to exceed 178 by 127 by 102 millimeters. The unit must be properly fused.

5-2 Rack-Mounted Version

The rack-mounted version shall require no more than two slots. A minimum of seven rack-mounted plug-in units shall be supported by each rack. The connector requirements of Subsection 3-2 must be complied with.

5-3 Transmit and Receive Indicators

Both types of modems must include Transmit and Receive Indicator lights which blink to indicate that data is actively being passed through the RS232 channel.

5-4 Audio Connectors and Performance

Audio connectors shall be via screw terminals (two per channel) or modular telephone jack. The input impedance must be 600 ohms. Frequency response shall be 0 to 10 kilohertz minimum. Performance shall meet or exceed 3002 standards in all other aspects.

## MULTI-DROP RS232 DATA MODEM - VI

This type of modem shall be required to transmit RS232 data at any baud rate in the range of 300 to 19 200 kilobaud and must satisfy all of the Section I requirements. From one master location, slave multi-drop units shall be able to be "daisy chained" on the same two fibers. All data transmitted from the master should be passed on to the RS232 transmit pin to the DTE device of all connected slaves. Data transmitted to any slave unit via its RS232 interface, must be received by the master unit. Addressing schemes shall be included in the application software which shall prevent more than one slave from transmitting data at the same time. In this regard, the slave fiber-optic modems do not need any special logic to prevent more than one remote from answering concurrently. This approach is designed to reduce fiber count for those types of remotes which can be supported in this fashion.

6-1 Standalone Version (Slave)

The standalone version shall be housed in a case not to exceed 178 by 127 by 51 millimeters. The unit must be properly fused. In addition to the ST connectors required in Section I-2, a second set of ST connectors must be provided to repeat the signal. Data received on one port must be re-transmitted on the second port so as to insure that all "daisy chained" units will receive all data transmitted by the master.

6-2 Rack-Mounted Version (Master)

The rack-mounted version shall require no more than a single slot. A minimum of fourteen rack-mounted units shall be supported by each rack. The DB-25 connector shall be included on the face plate of the unit. As an alternative, a secondary convenience panel may be supplied on which the DB-25 connectors are installed. This convenience panel must be 483 millimeters rack mountable and have connectors which securely lock to either the front or back of the plug-in modem cards. If the convenience panel option is utilized, the DB-25 connectors must be permanently labeled to clearly

indicate which modem is terminated on that position. The master transmitter does not require a second set of ST connectors in that it does not have to re-transmit any received signal.

6-3 Transmit and Receive Indicators

Both types of modems must include Transmit and Receive Indicator lights which blink to indicate that data is actively being passed through the channel.

## TESTING - VII

All equipment defined in this specification shall be subject to factory testing as subsequently described. The factory test shall demonstrate or provide confirmation that all of the equipment operates over the specified environmental range for each component. In addition, the test shall verify that each type of modem is capable of operating at or beyond the specified optical budget within the BER specified. The communication throughput test shall be conducted at both temperature extremes.

The Supplier shall be responsible for submitting a test plan which has been designed to exercise and monitor the equipment for the purpose of determining compliance with the specifications. The Supplier shall also provide documentation to verify the modem has a mean time between failure rate of 100 000 hours at 70 °C.

## TRAINING - VIII

Prior to the acceptance of the first unit of each type, training shall be provided for the Department's engineering, maintenance and operations staff, at a facility provided by the Department. The training shall include all material and manuals required for each participant. The training shall be as follows:

8-1 Maintenance Training

The training shall be provided for a minimum of 16 hours for at least five (5) personnel with an electronics background. The training shall include operation instructions, theory of operation, circuit description, field adjustments, preventive maintenance procedures, troubleshooting and repair of all components.

8-2 Engineering Training

The training shall be provided for a minimum of 8 hours for at least twenty (20) engineering and operations personnel. The training shall include a complete demonstration of the operation and capabilities of the equipment. This session should include a complete review of any field adjustments or calibration of the modems which may be necessary for optimum performance and should stress day-to-day operation and isolation of problems down to the unit level. For example, procedures should be discussed of identifying a faulty modem in the field, as opposed to component level repair covered in Subsection 8-1.

## INSTRUCTIONS AND GUARANTEES - IX

9-1 One set of complete schematics and operations/maintenance manuals of each modem, power supply, and rack assembly shall be supplied with each ten assemblies furnished. Maintenance manuals shall include complete sub-component parts listing.

9-2 No changes or substitutions in these requirements will be acceptable unless authorized in writing. Inquiries regarding this specification shall be addressed to the Manager, Office of ITS Engineering, New Jersey Department of Transportation, P.O. Box 613, 1035 Parkway Avenue, Trenton, New Jersey 08625.

9-3 All components shall carry a two-year guarantee from the date of acceptance against any imperfections in workmanship or materials.

9-4 The manufacturer agrees upon the request of the Manager, Office of ITS Engineering to deliver to the Office, a sample of each assembly to be supplied in compliance with these specifications for inspection and test before acceptance. After completion of the test, the sample shall be returned.

9-5 The supplier shall furnish any and all equipment which they deem necessary for safe and reliable field operation of the modems as part of the quoted price for the specified equipment.

9-6 All components furnished under this specification must be current production equipment and of recent manufacturer, identical models of which are in field operation in not less than 100 locations in the United States or Canada. Untried or prototype units shall not be considered for acceptance.

9-7 All major components shall be identified with a metal plate containing the serial number with a bar code identification.

9-8 Any repairs made by a manufacturer or representative shall be documented and returned with units when warranty repaired. This documentation shall include an explanation of the exact repairs made and identification of parts replaced by part number and circuit number. All warranty repairs must be completed within thirty days of delivery of the equipment to the designated repair depot.