

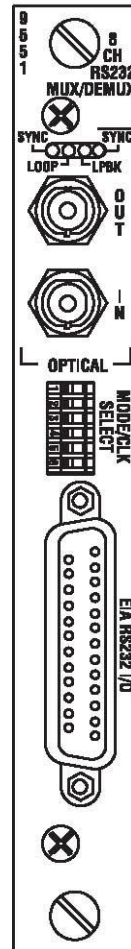


# Optelecom 9000 Series Installation and Operation Manual

## Model 9551

Eight Channel RS232 Fiber Optic Multiplexer/Demultiplexer

For bidirectional transmission of  
RS232 data over one optical fiber





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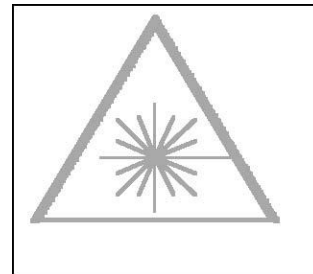
# Safety Instructions

**Note 1** This product contains a Class IIIb laser or LED fiber optic emitter. The following safety precautions apply.

**WARNING:** Do not disconnect the fiber optic connector while the unit is powered up. Exposure to Class I invisible optical radiation is possible when the internal fiber optic connector is disconnected while the unit is powered up.

All Laser versions have one of two **DANGER** labels, shown below, found on the front panel and/or on the edge of the circuit card containing the laser, near the fiber optic connector.

**DANGER**  
Invisible Laser Radiation  
When Open AVOID DIRECT  
EXPOSURE TO BEAM.



**CAUTION:** Using controls, making adjustments or performing operations other than those specified may result in hazardous radiation exposure. Exposure for only seconds may cause permanent eye damage as well as other injuries.



**Note 2** This assembly contains parts sensitive to damage by electro-static discharge (ESD). Use ESD precautionary procedures when touching, removing or inserting parts or assemblies.

# Functional Description

Two TKH Security USA Model 9551s work in tandem to transport eight channels of RS232 serial port data between two points via two optical fibers. In each unit, the data is converted to standard logic levels, multiplexed using TDM techniques, encoded and converted to light for transmission over an optical fiber. Received optical data is converted to logic levels, demultiplexed, and then converted back to RS232 compatible data.

The Model 9551 has two operating modes: Modem mode and Multiplexer mode.

- A) In the Modem mode, the unit is configured to emulate a wire modem (DCE) in the way the signals are routed (see Figure 3). Also, in modem mode, a full complement of clock source and rates may be selected for synchronous operation.
- B) In Multiplexer mode, the unit is configured as a straight through, transparent, full duplex RS232 data time division multiplexer. Also, in this mode a data re-clocking circuit may be enabled to resynchronize the received data on the primary channel with the transmit clock input to a channel reserved for that purpose. This feature allows the unit to function in a synchronous tail circuit without any concern for the link transmission delay (see Figure 2).

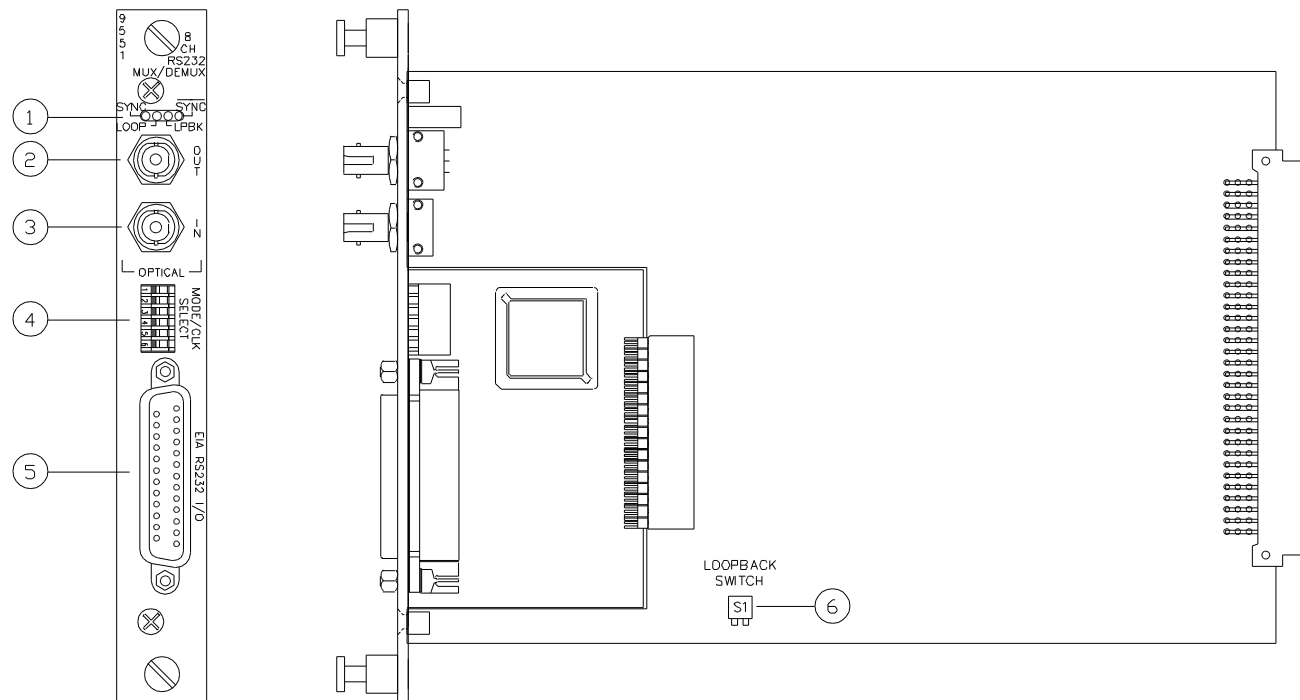
The 9551 is a single-width, rack-mountable card compatible with Series 9000 card chassis. It operates on 6VDC power from the chassis backplane. It is optically compatible with the Model 9555 standalone unit.

| TABLE 1 — LIST OF MODELS AND FEATURES |                           |                     |                               |                         |
|---------------------------------------|---------------------------|---------------------|-------------------------------|-------------------------|
| Fiber Type/Size                       | Model Number <sup>1</sup> | Optical Budget (dB) | Wavelength (nm) T to R/R to T | Range <sup>2</sup> (km) |
| Multimode (62/125µm)                  | 9551-S-ST                 | 19                  | 850                           | 5.3                     |
|                                       | 9551-L-ST                 | 18                  | 1310                          | 15                      |
| Singlemode (09/125µm)                 |                           | 25                  | 1310                          | 63                      |

<sup>1</sup> ST connectors standard; consult factory for availability of other connectors  
<sup>2</sup> Range based on losses of 3.0 dB/km @ 850 nm or 1.0 dB/km @ 1310 nm for 62.5/125 multimode fiber and 0.35 dB/km @ 1310 nm or 0.25 dB/km @ 1550 for 09/125 singlemode fiber, and includes a 3 dB safety factor.

# 9551 Indicator, Selector Switch, and Connector Location and Function

FIGURE 1



## 1. LED INDICATORS

- SYNC — When illuminated, this **green** LED indicates that the demux is synchronized with the incoming optical data signal.
- LOOP — When illuminated, this **green** LED indicates that the remote (far end) demux is synchronized with the incoming optical data signal. This means that two-way communication (LOOP) is established.
- LOOPBACK — When illuminated, this **yellow** LED indicates that the unit has been placed in LOOPBACK mode by setting the LOOPBACK *switch* ON.
- SYNC — When illuminated, this **red** LED indicates that the demux is not synchronized with the incoming optical data signal.

**2. OPTICAL INPUT/OUTPUT PORT:** Provides a connection for transmitting and receiving data over an optical fiber to a corresponding optical port at the far end unit.

**3. MODE/CLOCK SELECT SWITCH:** Selects Modem or Multiplexer mode, internal clock rate or external clock select, and enables synchronous data reclocking for synchronous tail circuit operation.

**4. RS232 ELECTRICAL DATA INPUT/OUTPUT CONNECTOR:** The RS232 signals are connected to the Model 9551 via a single 25-pin female D-shell connector.

**5. LOOPBACK SWITCH:** When S1 is turned ON (Position 1 in the down position) the unit is taken out of OPERATE mode and placed in LOCAL AND REMOTE LOOPBACK mode. When in LOOPBACK mode, all data inputs are looped back to their respective outputs and an incoming optical signal to the optical IN port is looped back and retransmitted from the optical OUT port, effecting a loopback of the data at the remote unit. While in LOOPBACK mode, both the SYNC and LOOP indicators should be illuminated.

# Connections and Configuration Guide

## SET-UP PROCEDURES

Although the MODE/CLK SELECT switches may be set at any time, it may be more convenient to set them prior to mounting the units. These switches allow the user to select:

- A) Modem or Multiplexer mode
- B) Synchronous reclocking enable (Multiplexer mode)
- C) Clock source/rate (Modem mode)

Switches 1 through 4 are for clock source/clock rate select. Refer to Table 2 for the applicable settings. The clock rates given are for DCE source outputs from pin 15 of the Model 9551. If EXTERNAL is selected, the clock signal from the local DTE is input on pin 24 of the Model 9551. If RECEIVE is selected, the clock signal recovered from the received optical signal is output on pin 17 and pin 15.

| TABLE 2 — SWITCH SETTINGS FOR INTERNAL CLOCK RATE OR CLOCK SOURCE |                            |       |       |       |
|---|----------------------------|-------|-------|-------|
| Clock Rate/Source   | Mode/Clock Select Switches |       |       |       |
|   | Pos 1                      | Pos 2 | Pos 3 | Pos 4 |
| 1.2 kHz   | up                         | dn    | dn    | up    |
| 1.8 kHz   | dn                         | dn    | dn    | up    |
| 2.4 kHz   | up                         | dn    | up    | dn    |
| 3.6 kHz   | dn                         | dn    | up    | dn    |
| 4.8 kHz   | up                         | dn    | up    | up    |
| 7.2 kHz   | dn                         | dn    | up    | up    |
| 9.6 kHz   | up                         | up    | dn    | dn    |
| 14.4 kHz  | dn                         | up    | dn    | dn    |
| 19.2 kHz  | up                         | up    | dn    | up    |
| 28.8 kHz  | dn                         | up    | dn    | up    |
| 38.4 kHz  | up                         | up    | up    | dn    |
| 57.6 kHz  | dn                         | up    | up    | dn    |
| 76.8 kHz  | up                         | up    | up    | up    |
| 115.2 kHz   | dn                         | up    | up    | up    |
| External  | dn                         | dn    | dn    | dn    |
| Receive   | up                         | dn    | dn    | dn    |

- Switch 5 enables the synchronous data reclocking when used in a synchronous tail circuit. This switch is usually not set until the system is in operation to determine if it should be down. If the Modem mode is selected, the switch must be off.
- Switch 6 should be up for Multiplexer mode and down for Modem mode. See Figures 2 and 3 for the signal routing in each of these modes.

### **ELECTRICAL CABLING**

The RS232 signals are connected to the Model 9551 via a single mating 25-pin male D-shell connector. Connect the signals to the connector per the following figures. For transmission of data and clock information use two RS232 channels.

In Modem mode, in most cases it is possible to make a 1-to-1 wire connection between the DTE and the 9551. Refer to Figures 2 and 3 for the signal routing.

In Multiplexer mode, if used as an asynchronous multiplexer or if clock and data are being transferred in a setup other than a synchronous tail circuit, simply connect your equipment outputs to the 9551 inputs and vice versa, per Figure 2.

If the 9551s are used in a synchronous tail circuit, wire the data and clock I/O per the synchronous tail circuit hookup as shown in Figure 4. Other channels may be hooked up as desired to carry control lines or other RS232 signals.



**FIGURE 2 — SIGNAL ROUTING, MULTIPLEXER MODE**

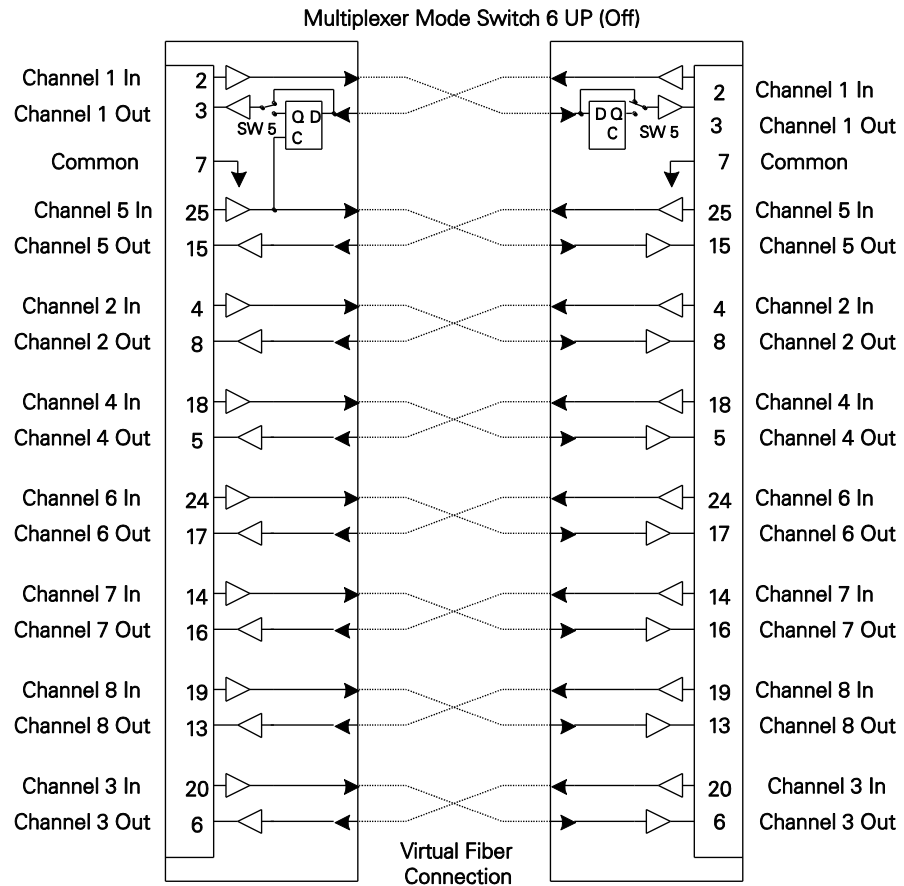


FIGURE 3 — SIGNAL ROUTING, MODEM MODE

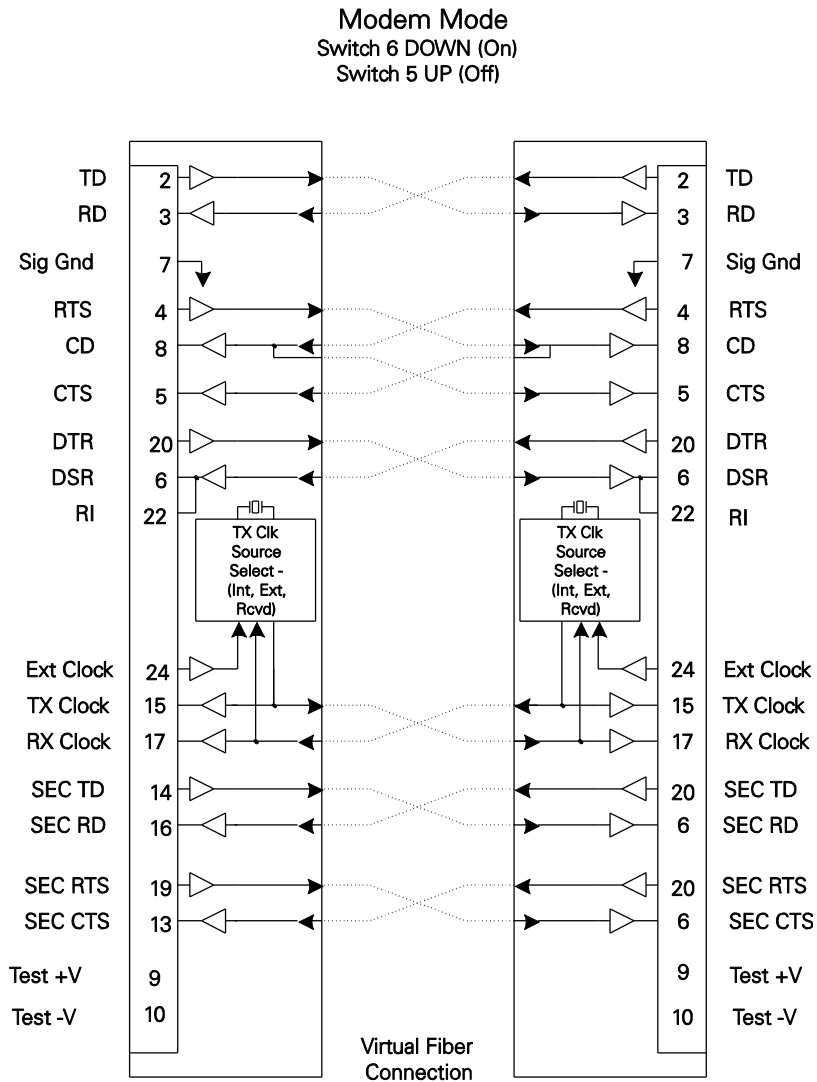
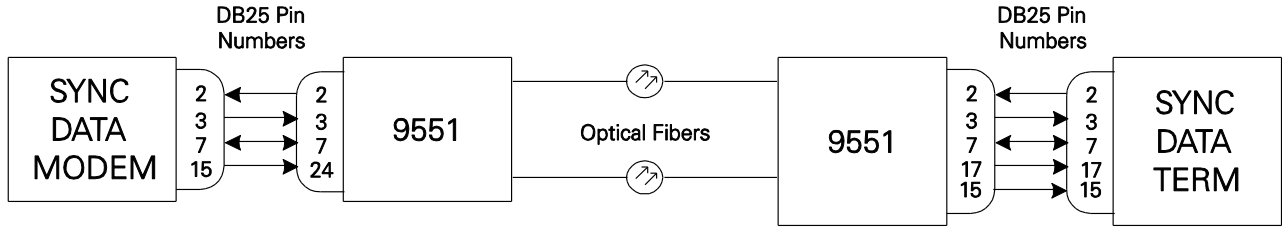


FIGURE 4 — SYNCHRONOUS TAIL CIRCUIT HOOKUP



**DIPSWITCH SETTINGS — SYNCHRONOUS RECLOCKING**

If the 9551 is in multiplexer mode and operating as a synchronous tail circuit, whereby the equipment outputs a clock and requires the data presented to it to be synchronous with that clock and to have the correct phase relationship to that clock, then the Synchronous Reclock switch (Switch #5) *may* have to be enabled, depending on the clock rate and the link distance. Figure 4 shows the typical hookup for a tail circuit of a modem to terminal equipment and Figure 5 gives examples of two different times of travel (from two different link lengths), one resulting in a situation where the reclocking can be disabled and one where it must be enabled. As a rule of thumb — leave the reclocking disabled and enable it only if it doesn't work in the disabled mode. If this approach does not result in success (an operational link), it will be necessary to observe the clock and data signals at the clock source end with a breakout box and an oscilloscope. **Only the switch at the clock source end mux should be enabled if required, not the switch at the data source end.**

# Operation of the 9551

## VERIFICATION OF NORMAL OPERATION

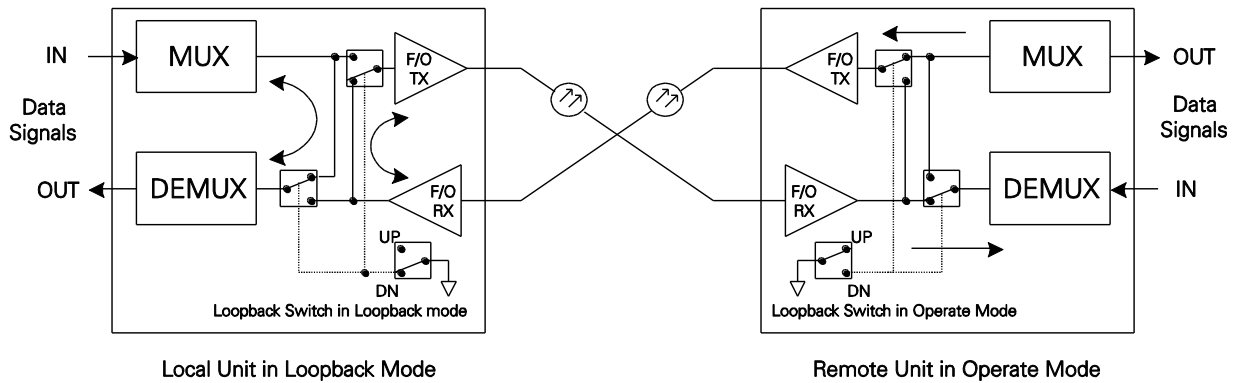
Under normal operation, the SYNC and LOOP indicators will be illuminated. If wire connections are not yet made and you wish to confirm the operation of any one or more channels, just make a temporary connection between the Test (+) output, pin 9, and the input you wish to test. The corresponding output per the signal routing diagram should measure greater than 4 volts when referenced to the common pin.

## TROUBLESHOOTING

| TABLE 3 — INDICATOR LED FUNCTION         |  |
|--|--|
| Symptom                                  | Possible Cause   |
| Both SYNC and SYNC not illuminated       | The card is not receiving power from the chassis; check chassis supply.  |
| SYNC not illuminated or SYNC illuminated | The optical connection at either end is bad, the optical fiber cable is defective, or the Model 9551 or 9555 is bad at either end. |
| LOOP not illuminated                     | The same causes as "SYNC not illuminated" but in the outgoing direction only.  |
| LPBK illuminated                         | The Loopback dipswitch is on, causing the unit to operate in Loopback mode. Refer to Loopback Mode section of manual.              |

## LOOPBACK TEST MODE

FIGURE 6 – SIGNAL ROUTING; OPERATE AND LOOPBACK



If trouble is encountered and the fault needs to be isolated or if proper data connections need to be verified in the absence of the optical cable, the LOOPBACK TEST mode may be helpful.

Refer to Figure 6 for the following discussion. When the loopback test mode is enabled by setting S1 (Loopback Switch) position 1 in the down position, the yellow LPBK indicator on the front panel will illuminate. See Figure 1 for the switch location on the printed wiring board. When in loopback test mode, the composite data output from the data multiplexer is disconnected from the optical transmitter and internally looped back to the demultiplexer. This effectively loops all data inputs back to the corresponding outputs. Good data loopback confirms good local data/audio interface circuitry and good local mux and demux operation.

Also, in LOOPBACK TEST mode, data output from the optical receiver is disconnected from the demux input and connected to the optical transmitter, retransmitting the received optical signal back to the remote units. This will cause the data inputs to the remote unit to be routed back to their respective outputs. Successful remote loopback of data confirms that the mux/demux sections of the remote unit as well as the entire bidirectional optical link are functioning properly. **NOTE:** Data jitter increases as the optical receiver sensitivity limit is reached. The jitter produced in each direction is additive when conducting this test. This test may not be successful if operating at the limit of sensitivity of one of the optical receivers.

# Operation with the 9911 Network Management Software

The 9551 permits alarm and diagnostic management via the 9911 Network Management Software. To do this requires the installation of a Model 9911 (RS232/RS485) Network Interface Card in the chassis with the 9551.

## DIGITAL STATUS BITS

The following table provides the information on the digital status bits available to the Network Management system.

| <b>TABLE 4 — STATUS BITS</b> |  |
|------------------------------|--|
| <b>Signal Name</b>           | <b>Description</b>   |
| Local Sync                   | True if local demux is receiving a good optical signal and is "in sync"  |
| Remote Sync (LOOP)           | True if remote demux is receiving a good optical signal and is "in sync" |
| Rx Data Activity (ch 1)      | True if there is data activity on ch 1 output                            |
| Rx Data Activity (ch 2)      | True if there is data activity on ch 2 output                            |
| Rx Data Activity (ch 3)      | True if there is data activity on ch 3 output                            |
| Rx Data Activity (ch 4)      | True if there is data activity on ch 4 output                            |
| Rx Data Activity (ch 5)      | True if there is data activity on ch 5 output                            |
| Rx Data Activity (ch 6)      | True if there is data activity on ch 6 output                            |
| Rx Data Activity (ch 7)      | True if there is data activity on ch 7 output                            |
| Rx Data Activity (ch 8)      | True if there is data activity on ch 8 output                            |
| Loopback mode                | True if the unit is in Loopback mode                                     |

## **ANALOG STATUS SIGNALS**

The following is the information on the analog status signals available to the Network Management system.

| <b>TABLE 5 — ANALOG STATUS SIGNALS</b> |  |
|--|--|
| Optical power (Rx only)                | Indicates the received optical power level in microwatts |
| Laser current (Tx only)                | Indicates the laser drive current in milliamps           |

## **CONTROL BITS**

The unit may be placed in Loopback Mode remotely using the Network Management System.

# Specifications for the 9551

## OPTICAL

| Transmitter Version                                    |            | S   | L    | LD   |
|--|------------|-----|------|------|
| Wavelength (nm)  |            | 850 | 1310 | 1310 |
| Receiver Version                                       | Fiber Size | S   | L    | L    |
| Optical Output Power (dB) minimum                      | 50/125     | -20 | -20  | N/A  |
|  | 62.5/125   | -16 | -16  | N/A  |
|  | 09/125     | N/A | N/A  | -10  |
| Minimum Optical Input Power (dBm) for proper operation | 50/125     | -35 | -35  | N/A  |
|  | 62.5/125   | -35 | -35  | N/A  |
|  | 09/125     | N/A | N/A  | -35  |
| Link Budget  | 50/125     | 15  | 15   | N/A  |
|  | 62.5/125   | 19  | 19   | N/A  |
|  | 09/125     | N/A | 17   | 25   |
| Estimated Range in km <sup>1</sup>                     | 50/125     | 5   | 7    | N/A  |
|  | 62.5/125   | 16  | 16   | N/A  |
|  | 09/125     | N/A | N/A  | 63   |

<sup>1</sup> Range based on losses of 3.0 dB/km @ 850 nm or 1.0 dB/km @ 1310 nm for 62.5/125 multimode fiber and 0.35 dB/km @ 1310 nm or 0.25 dB/km @ 1550 nm for 09/125 singlemode fiber, and includes a 3 dB safety factor.

## DATA

|                               |   |
|-------------------------------|---|
| <b>Signal Interface</b>       | RS232   |
| <b>Channels</b>               | 8, synchronous or asynchronous  |
| <b>Sampling Rate</b>          | 920 kHz   |
| <b>Data Rate</b>              |   |
| Async                         | DC to 115 kbps  |
| Sync                          | 1.2, 1.8, 2.4, 3.6, 4.8, 7.2, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6, 76.8, 115.2 kbps |
| <b>Pulse Width Distortion</b> | 2% @ 19.2 kbps;<br>13% @ 115.2 kbps   |
| <b>Connector</b>              | DB25S   |

## POWER

|                     |                   |
|---------------------|-------------------|
| <b>Requirements</b> | 500 mA @ 6 VDC    |
| <b>Source</b>       | Chassis backplane |



**PHYSICAL**

**Dimensions (in inches)** 6.15 H x 0.8 W x 8.6 D  
**Weight (in pounds)** 0.5

**ENVIRONMENTAL**

**Operating Temperature** -40° C to 74° C  
**Storage Temperature** -55° C to 85° C  
**Relative Humidity** 0 to 95% noncondensing

**INDICATORS**

SYNC, NOT SYNC, LBPK (loopback), LOOP

**SOFTWARE MANAGEMENT SYSTEM SUPPORTED FUNCTIONS**

**Status Outputs** Laser/LED Drive, Received Optical Power, Demux Sync, Remote Demux Sync, Loopback Mode, RS232 RD Activity (8 ch.)  
**Control Inputs** Loopback Mode

**QUALITY**

**MTTF** Consult factory

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