TC8108

CHANNEL STACKER™
8 to 64 CHANNEL
STACKABLE
FIBER OPTIC MULTIPLEXER

User's Manual

MODEL:_____

S/N:_____

DATE:_____

Notice!

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TC COMMUNICATIONS
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- ❒ **Stackable Up to 64 Async Channels/32 Sync Channels (or combinations of both)**
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- ❒ **Field Interchangeable Interfaces: (Standard) RS-232, RS-422, Contact Closure**
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- ❒ **Built-In Channel Scan Signal Generator**
- ❒ **Built-In Optic Remote Loopback and Electrical Local Loopback Functions**
- ❒ **Rack-Mountable or Stand Alone**

Description

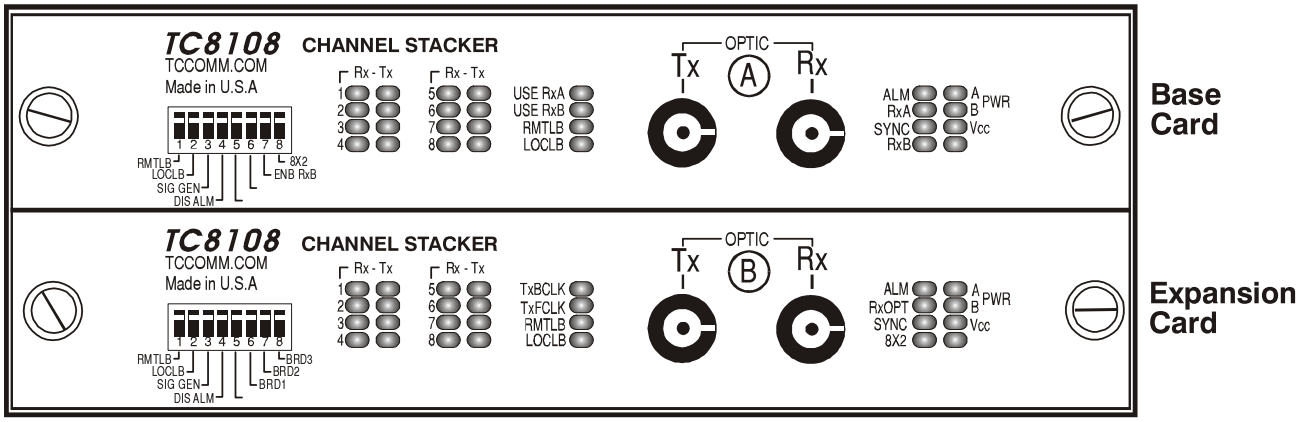
The **Channel Stacker™** Fiber Optic Multiplexer, Model TC8108, offers the most flexibility of any multiplexer of its type currently available in today's marketplace. This flexibility is evidenced by field interchangeable interfaces, modular expendability from 8 to 64 channels, built-in power redundancy and optional optical redundancy. The TC8108 is based on modern FPGA (field programmable gate array) technology. As a result, it benefits users by enabling optimum flexibility, low current consumption, high reliability and maximum MTBFs.

Each Channel Stacker™ unit consists of an 8-channel base card and optional 8-channel add-on expansion cards. Up to eight cards (64 async or 32 sync channels) can be "stacked" in a rack assembly. Each card can be configured for up to 8 async channels or 8 sync channels, or combinations of both. Configurations are set at the factory.

The TC8108 can provide up to 64 channels of asynchronous data at 19.2 Kbps; however, higher data rates will result in fewer available channels (see Chapter 6 - Specifications). Because the electrical interfaces are modular, they are interchangeable at any time (before or after installation). A user can mix two different interfaces, in four channel increments, on each 8-channel card. Standard interfaces include RS-232, RS-422 or Dry Contact Closure. Custom interfaces include RS-423, RS-485 & TTL.

Fiber optic connectors are ST (FC optional); electrical connectors are RJ-11 Female. Power is 9 to 12VDC or 115/230VAC with an external power cube.

FRONT PANEL VIEW



REAR PANEL VIEW

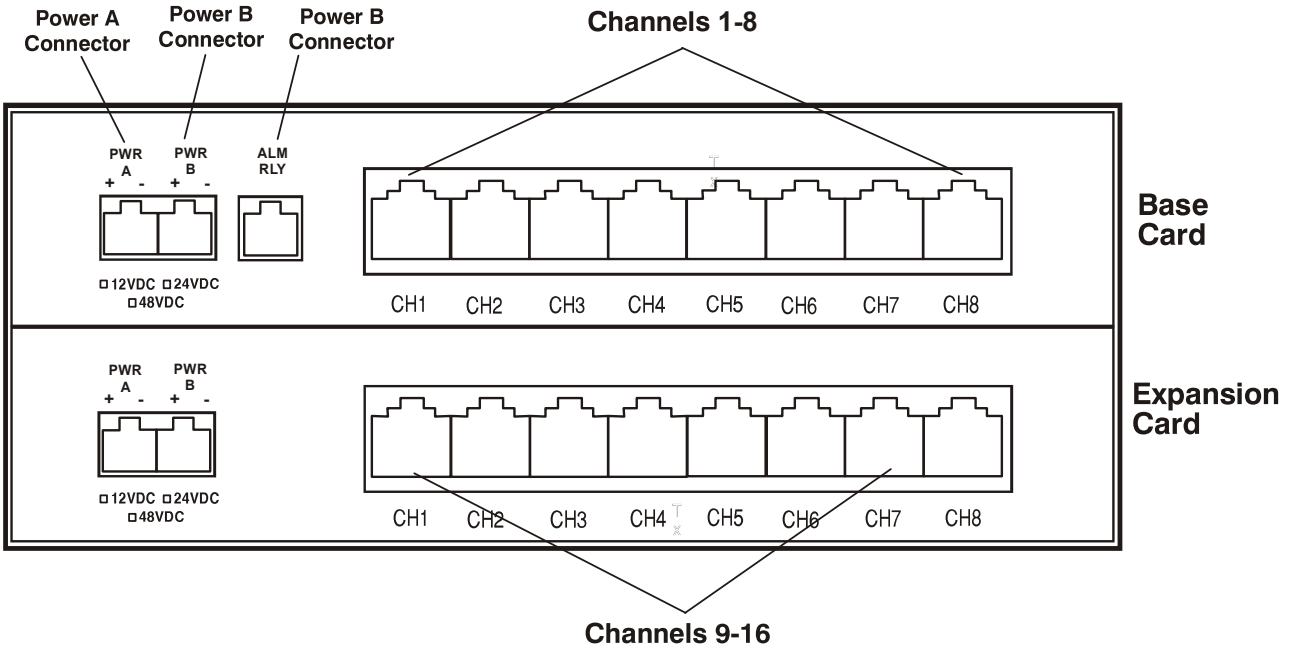


Figure 1. TC8108 Front and Rear Panels

Base Board LEDs, DIP Switches & Connectors

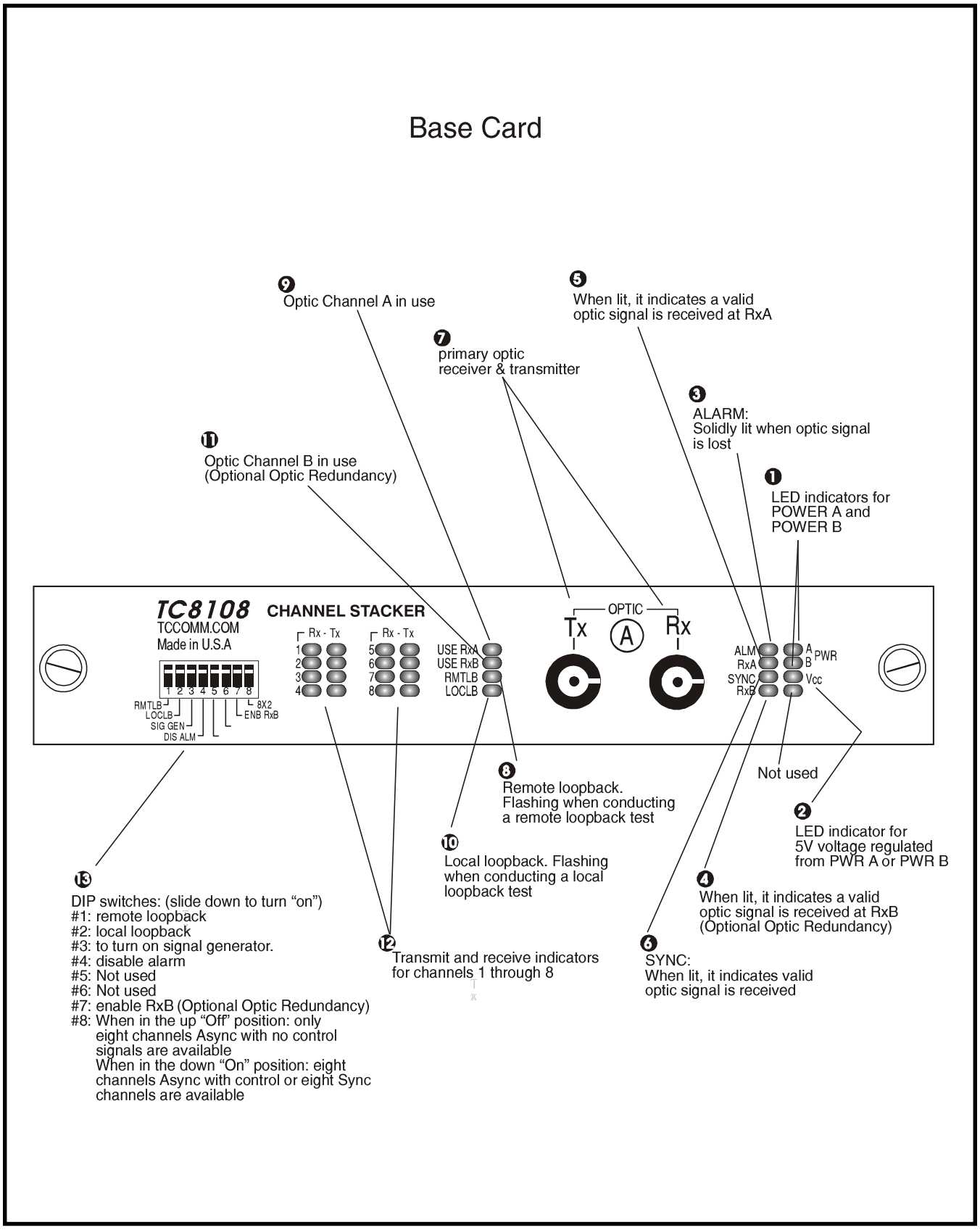


Figure 2. TC8108 Base Card's Front Panel

Expansion Board LEDs & DIP Switches

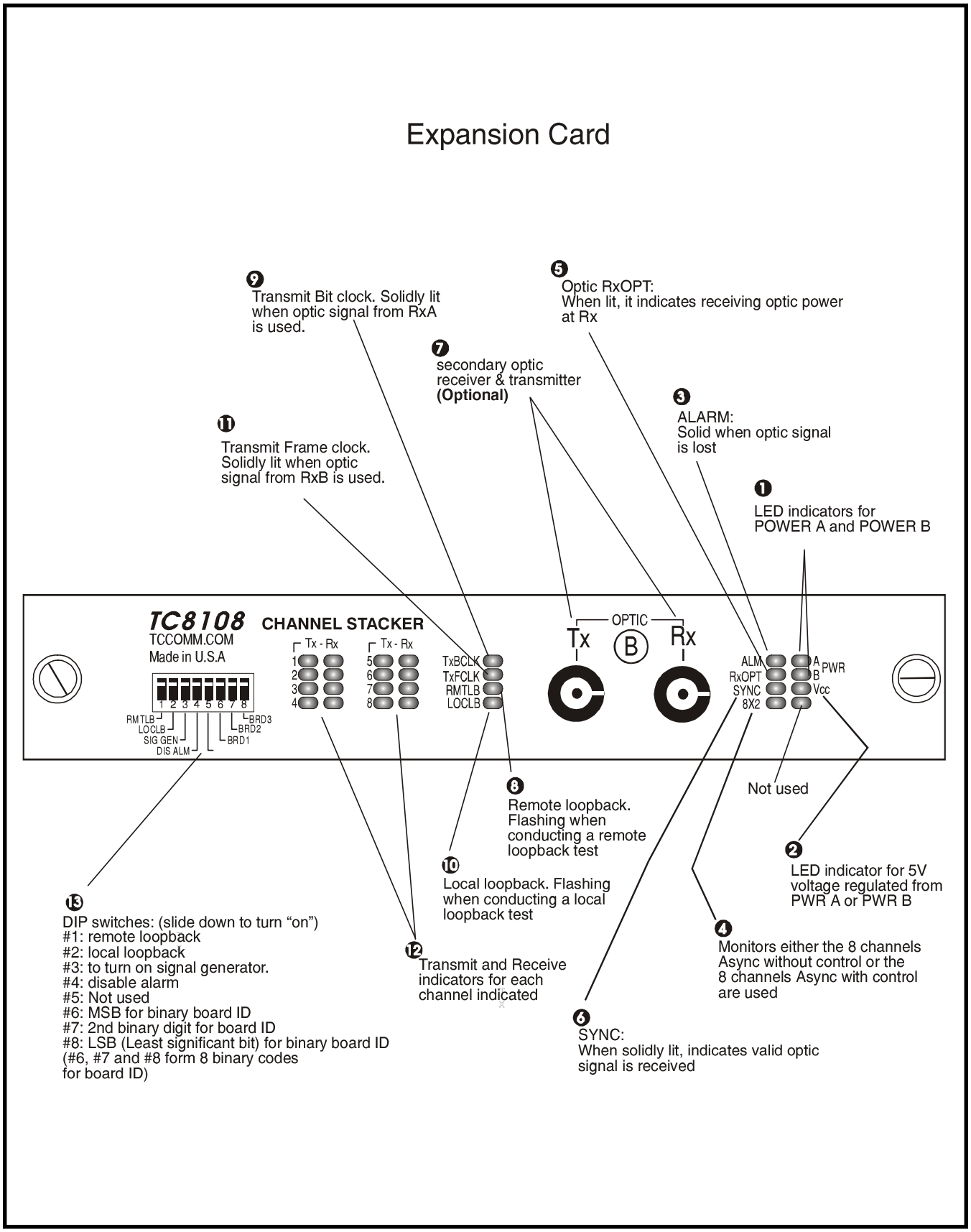


Figure 3. TC8108 Expansion Card's Front Panel

Transmission Distances (typical)

The TC8108 will work with all popular sizes and types of fiber. Transmission distances up to 3km* are typical over Multimode fiber at 850nm and 4km* at 1310nm. Distances to 35km* are typical over Single Mode fiber at 1310nm. Transmission distances may vary due to fiber optic cable's characteristics.

Launch Power & Sensitivity

Transmitter:	LED/ELED; typical Launch Power -	-16dBm* (850nm/1310nm MM, @62.5/125μm) -16dBm* (1310nm Single Mode, @9/125μm)
Receiver:	PIN Diode; typical Sensitivity -	-33dBm* (850nm/1310nm MM, @62.5/125μm) -36dBm* (1310nm Single Mode, @9/125μm)

**Launch power, sensitivity and distance are listed for reference only. These numbers may vary.*

Fiber Optic Redundancy (optional)

When this option is purchased, the unit is equipped with two pairs of fiber optic transmitters & receivers (designated as TxA, RxA, TxB, and RxB). Both "TxA" and "TxB" transmit the optical signal at the same time. The Receiving unit decides whether "RxA" or "RxB" is active. The default receiver is "RxA." The unit will automatically switch over to "RxB" when optic link "A" fails (either a cable breakage or optic transmitter/receiver fails).

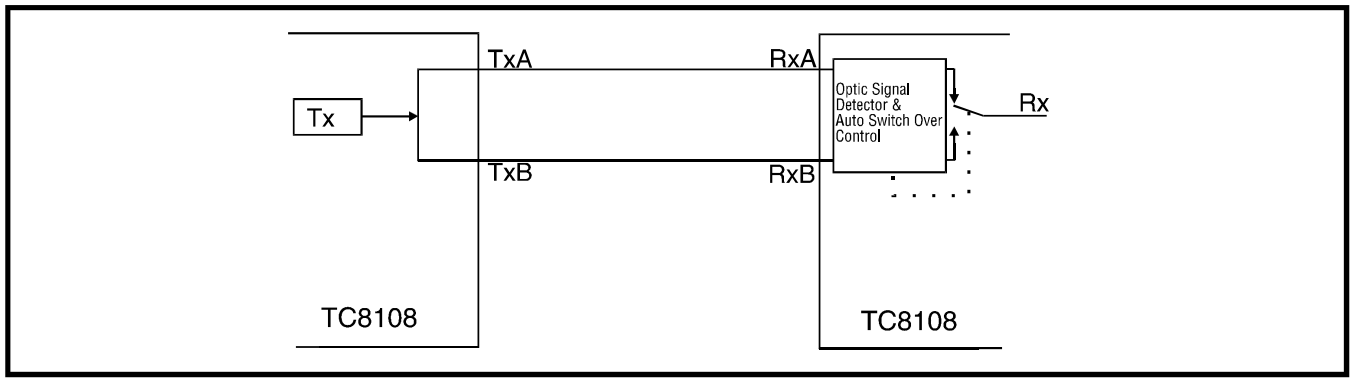


Figure 4. TC8108 (with Dual Optics) Logic Diagram

Dry Contact Alarm Relay

A terminal block connector on the rear panel of the base card (labeled "ALM RLY") provides for the Dry Contact Relay Alarm. Normally the dry contact relay is in the OPEN position. When there is an alarm condition, such as the loss of fiber optic signal or loss of power, the dry contact relay will be switched to CLOSED position.

Note: If SW4 (DISALM) on the front panel is in the down position, Alarm function will be deactivated. The on-board audio buzzer will not sound and the dry contact relay will not close under Alarm condition, such as loss of fiber optic signal.

Note:

Dry Contact Alarm Relay (DCAR) can be ordered in Normal Closed configuration. Please contact the factory prior to purchasing.

When used in NC (Normal Close) configuration, the relay will OPEN if the unit loses power completely or the alarm is triggered by the loss of either fiber optic signal. If fiber optic signal is lost, the alarm "ALM" LED will be lit.

Electrical Signal Interface Connection & Pin Assignments

Eight RJ-11F sockets (on the rear panel) are provided to connect the user's electrical signals. When facing the rear panel, the card furthest to the right is the base card; Channel #1 is the top RJ-11F port.

TTL Asynchronous

Similar to the RS-232 interface, the TTL interface utilizes pin 5 for the input (TxD); pin 4 the output (RxD).

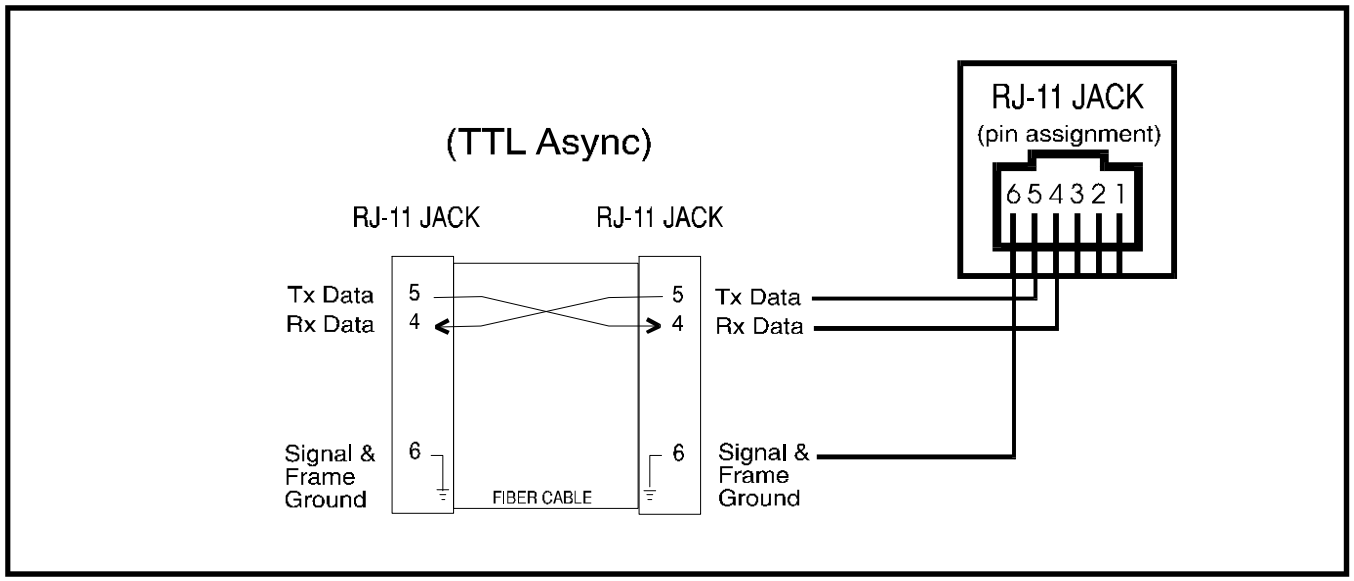


Figure 5. RJ-11 TTL Async Pin Assignments & Connection Diagram

RS-232 (Async & Async with Control)

For RS-232 interfaces, pin 5 is the input (TxD) pin while pin 4 is the output (RxD) pin. A separate channel on each RJ-11 port is available on pin 3 and pin 2 (for Async with Control or Sync interfaces). The second channel can be used as control (or handshake) signals or Tx Clock and Rx Clock signals for RS-232 synchronous applications.

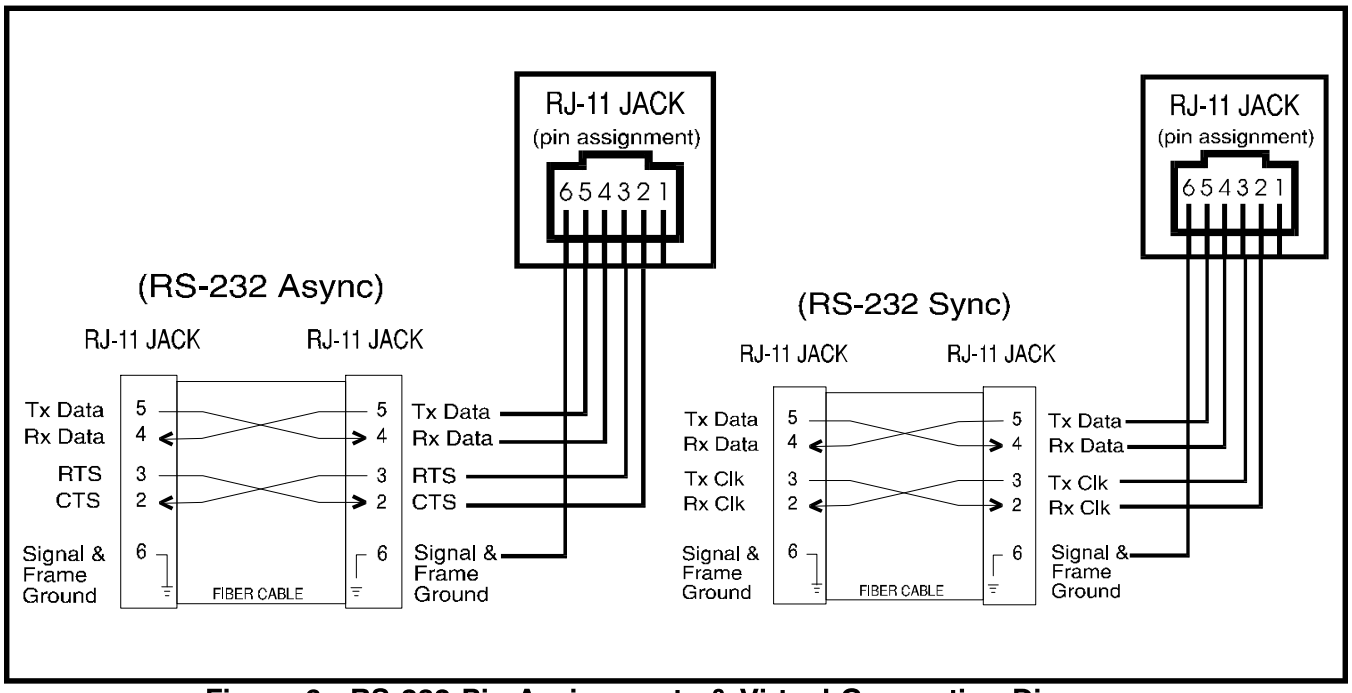


Figure 6. RS-232 Pin Assignments & Virtual Connection Diagrams

RS-422/RS-485 Asynchronous

For RS-422 interfaces, pins 2 and 5 are balanced inputs; pins 3 and 4 are balanced outputs. Pin 2 (TxD+) and pin 5 (TxD-) are input pins while pin 3 (RxD+) and pin 4 (RxD-) are outputs. Either pin 6 or pin 1 can be signal ground. Only RS-422 async communications can be used on the TC8108 due to the limited number of pins on the RJ-11 connector.

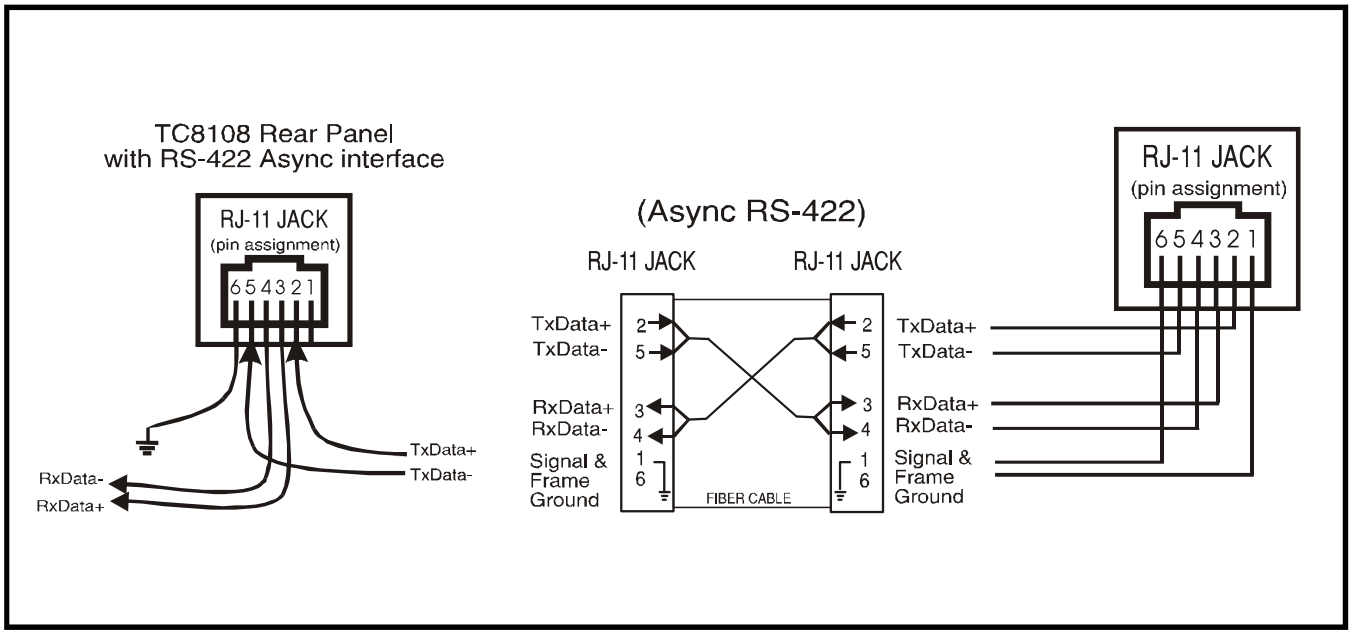


Figure 7. RS-422/RS-485 (ASYNC) Pin Assignments & Virtual Connection Diagrams

RJ-11 to DB25 Female DCE/DTE Connection

The user's device can be a DCE or DTE device (which may have a DB25 male connector). The following four illustrations depict the RJ-11 wiring diagrams for an RJ-11 to DB25 Female adapter cable.

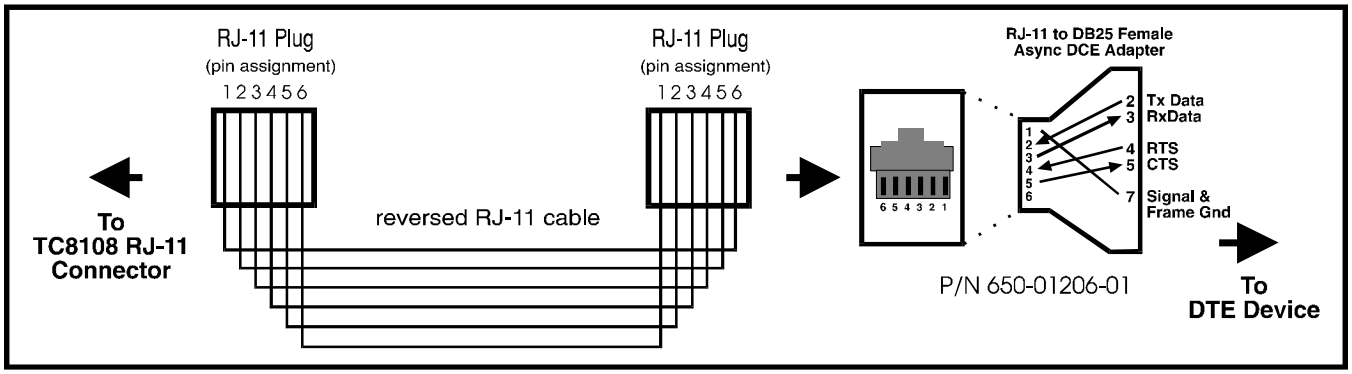


Figure 8. RS-232 (ASYNC DCE) Pin Assignments & Connection

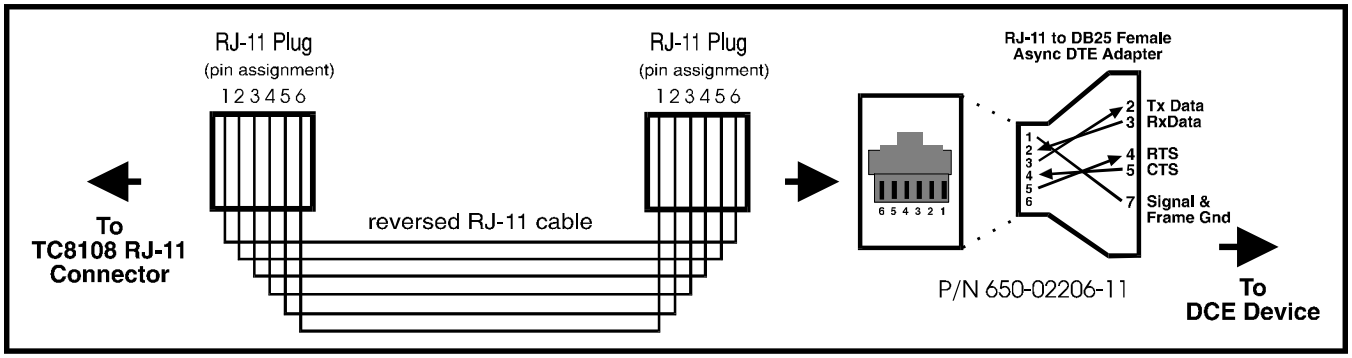


Figure 9. RS-232 (ASYNC DTE) Pin Assignments & Connection

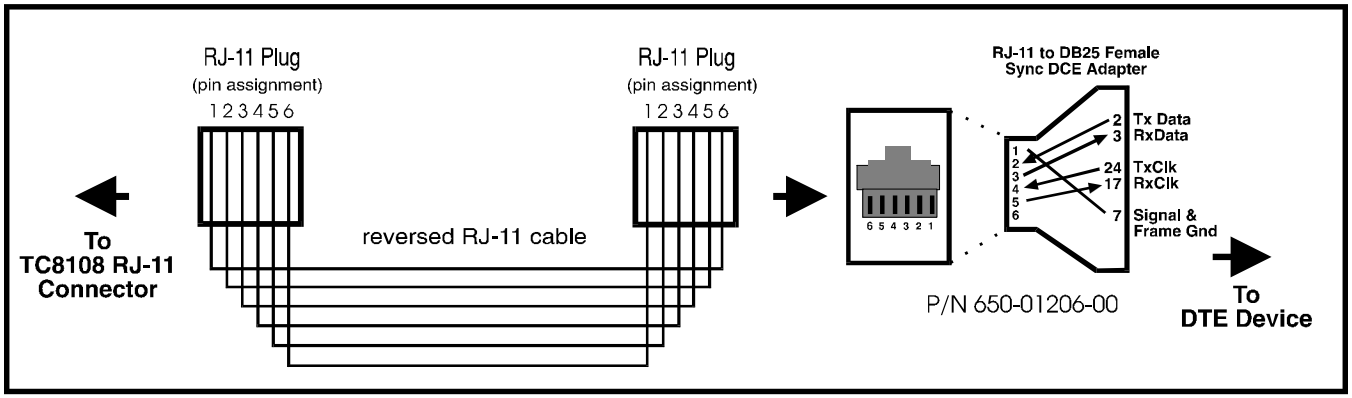


Figure 10. RS-232 (SYNC DCE) Pin Assignments & Connection

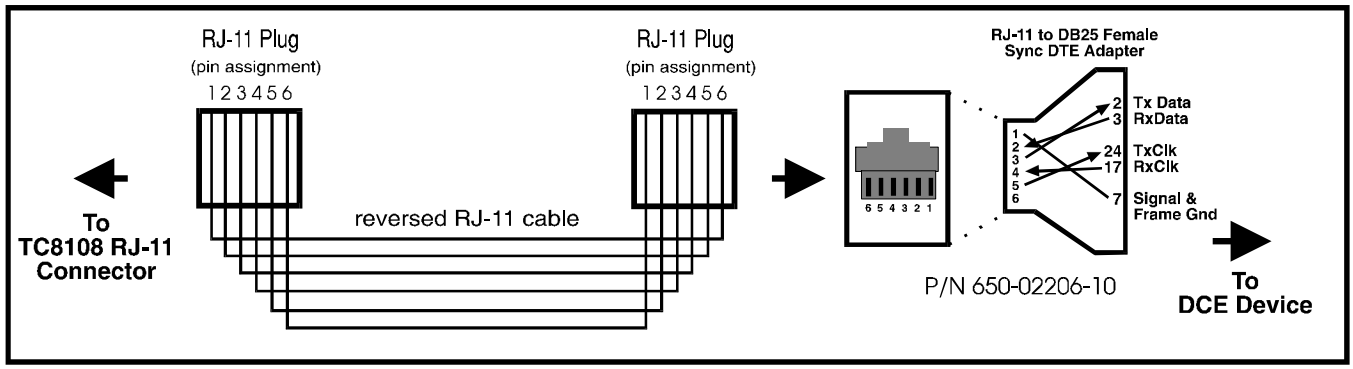


Figure 11. RS-232 (SYNC DTE) Pin Assignments & Connection

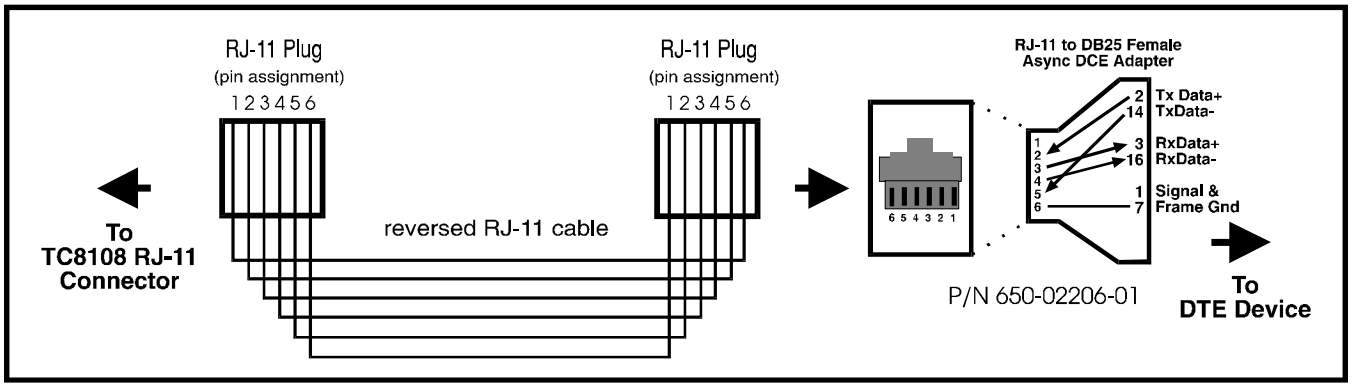


Figure 12. RS-422 (ASYNC DCE) Pin Assignments & Connection

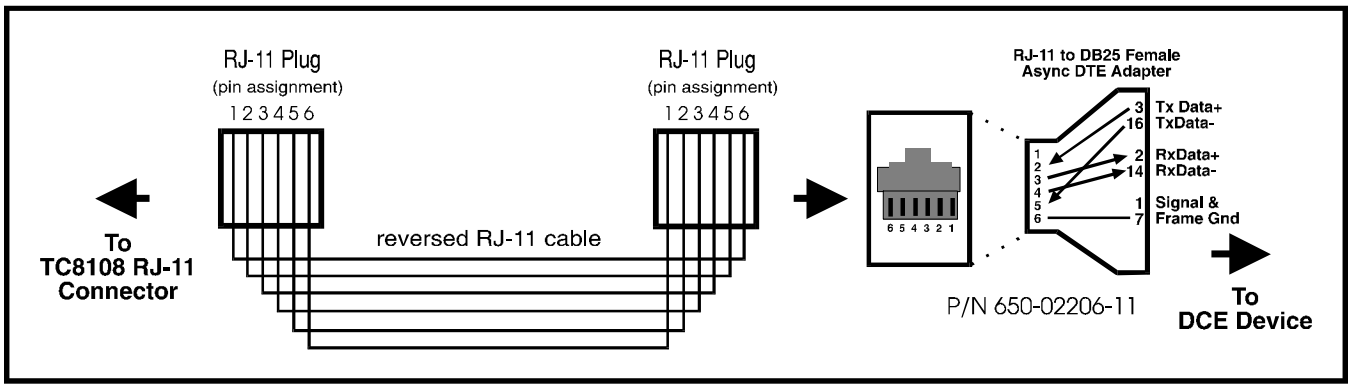


Figure 13. RS-422 (ASYNC DTE) Pin Assignments & Connection

Single Direction Dry Contact Closure Detector & Relay Switch (optional)

For single direction dry contact closure applications, only uni-direction transmission is allowed. The transmitter side has a dry-contact closure detector as illustrated in the diagram below.

The receiver side has a dry-contact closure relay switch. The "close" and "open" status is controlled by a relay switch inside the TC8108. It reflects the remote detector's "on" and "off" status.

As illustrated below, when the RJ-11's pin 4 and pin 5 are closed at the transmitter side, the status is reflected at the remote receiver's side. The relay switch on the receiver's side is rated 0.5A DC switching current, with a max load rating of 10VA.

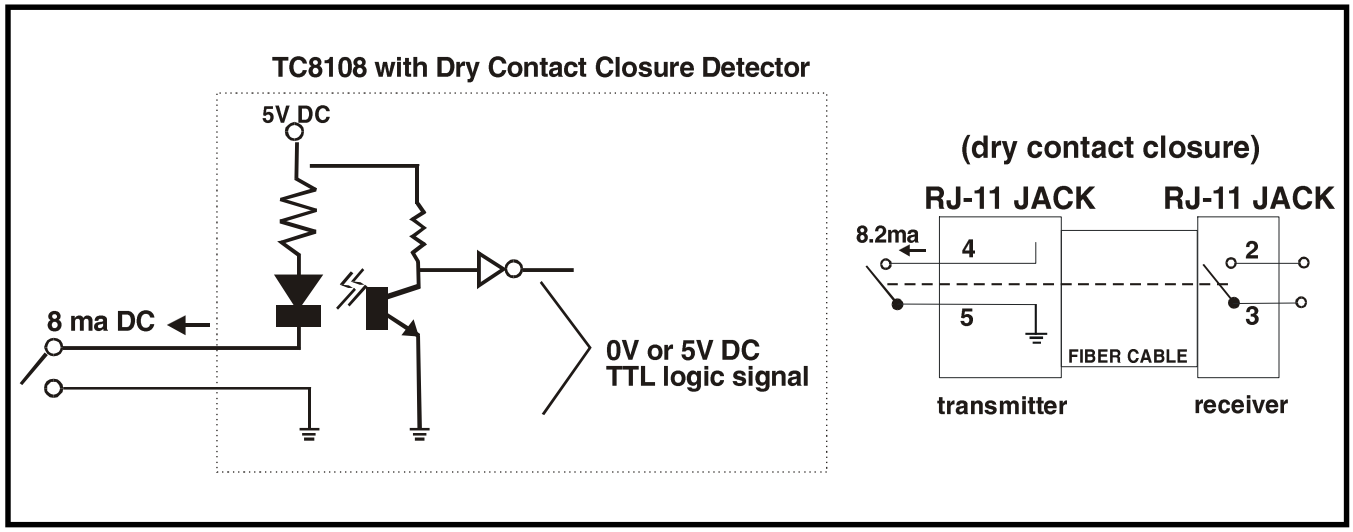


Figure 14. Single Direction Dry Contact Detector and Closure Logic Diagrams

Bi Directional Dry Contact Closure Detector & Relay Switch (optional)

For bi directional dry contact closure applications, the TC8108 can be used as either the Closure or Detector depending on which pins are used. The transmitter side has a dry-contact closure detector as shown in the diagram below. The receiver side has a dry-contact closure relay switch. The "close" and "open" status is controlled by a relay switch inside the TC8108. It reflects the remote detector's "on" and "off" status.

The diagram below, illustrates the virtual pin connections for using the TC8108 as either a dry contact Detector (Transmitter) or a dry contact Closure (Receiver). The RJ-11's pins 4 and 5 are closed at the transmitter side, the status is reflected at the remote receiver's side RJ-11's pins 2 and 3. The relay switch on the receiver's side is rated 0.4A DC switching current, with a max load rating of 24VA.

As an option, the relay switch on the receiver's side can be rated 1.8A DC switching current, and a load rating of 108VA.

(**Note:** All units will be factory configured for the 0.4A DC current rating, unless otherwise specified and ordered.)

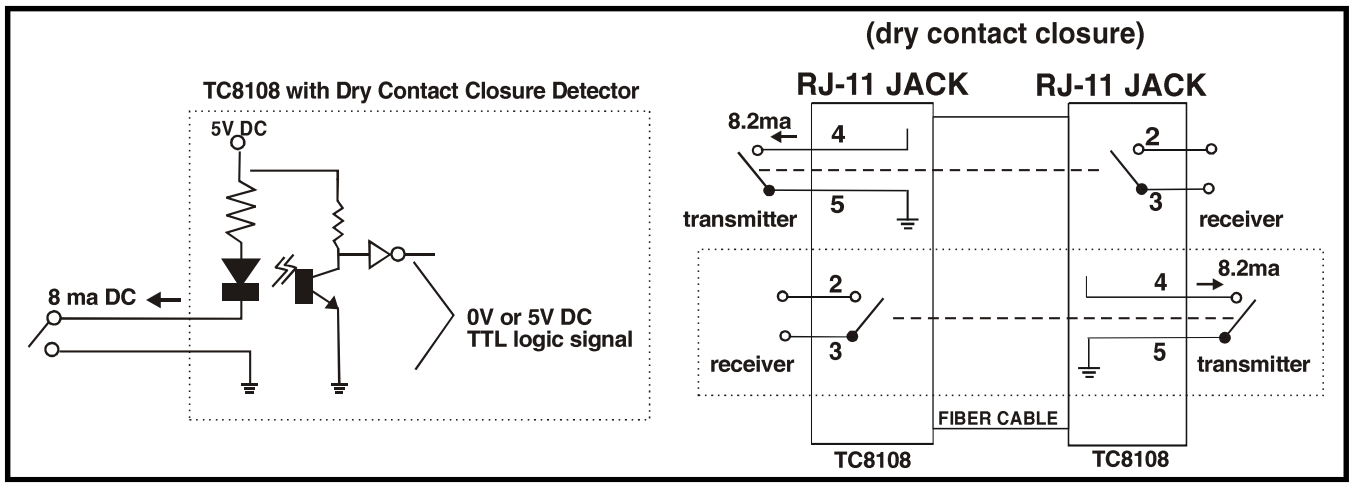


Figure 15. Bi Directional Dry Contact Detector and Closure Logic Diagrams

Chapter 2 - Installation

Unpacking the Unit

Before unpacking any equipment, inspect all shipping containers for evidence of external damage caused during transportation. The equipment should also be inspected for damage after it is removed from the container(s). Claims concerning shipping damage should be made directly to the pertinent shipping agencies. Any discrepancies should be reported immediately to the Customer Service Department at TC Communications, Inc.

Equipment Location

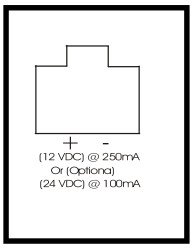
The TC8108 Channel Stacker™ should be located in an area that provides adequate light, work space and ventilation. Avoid locating it next to any equipment that may produce electrical interference or strong magnetic fields, such as elevator shafts or heavy duty power supplies. As with any electronic equipment, keep the unit from excessive moisture, heat, vibration and freezing temperatures.

System Configuration

The TC8108 has been pre-tested and switches have been set per factory specifications. The channels can be field configured (in groups of four) for RS-232 or RS-422 (contact factory for custom interfaces). The Card ID (or address) can be user-configured with three DIP switches on the front panel (see Figure 17 on next page).

Power Supply

Each TC8108 card is powered by an external DC power adapter rated 9 to 12 VDC @250mA. The connector is a terminal block connector, observe polarities . If your system has five TC8108 cards, the power supply requirement is 5 x 250mA = 1.25A. Either a power adapter or TC's power card can be utilized to supply power to the units.



The power connector can be plugged into any of the power jacks at the back panel. Since each TC8108 card is equipped with a power redundancy capability, the power LEDs on the front panel will light according to which power jack (A or B) is connected. Both LEDs will light when power redundancy is utilized.

Power-Up Test

Apply the power by plugging the power connector into a power jack. The power source can be from a power adapter or from a power card (installed on either the left or right side of the rack). After power is applied and all diagnostic DIP switches are in the up (Off) position, the following LED status should be observed from the front panel:

1. The Power "A" and/or "B" LED should be lit (depending on which power jack(s) is/are connected. The "Vcc" LED should also be lit. If the unit is a 16+ channel unit with a Base Board with Expansion Board(s), the "FCLK" LED should be lit on the expansion card(s).
2. The "RxA" LED on the Base Board and "OPTIC Rx" on the expansion card(s) should be flashing (they will light once a valid optic signal is received). If using the optical redundancy option, the "RxB" LED on the Base Board should Off until DIP switch #7 (on the base board) is enabled (down position). When Switch #7 is enabled, the "RxB" LED will be flashing. It will light once a valid optic signal is received.
3. The channel "Tx" and "Rx" LEDs on the front panel should be Off (they will light once a valid electrical signal is received).
4. The "Alarm" LED should be lit to indicate a "lost optic" condition (it will reset when the unit receives a valid optic signal at "RxA").

TC8108 Card ID Configuration

The Card ID (or address) must be set properly before using the TC8108. Set the Card ID for each card according to the example below. The Card ID at the Local unit should match the Card ID at the Remote unit for each card (in the same sequence). The Dry Contact Closure interface is the only exception to this. Because one side of the Dry Contact switch works as a Detector and the other works as a Closure (Relay), each Card ID will have a matching Card ID at the remote end, but in a different sequence. In this example, the 1st cards are the Detectors and the 2nd cards are the Closures, therefore the Local unit's 1st Card ID should match the Remote units 2nd Card ID (and vice-versa).

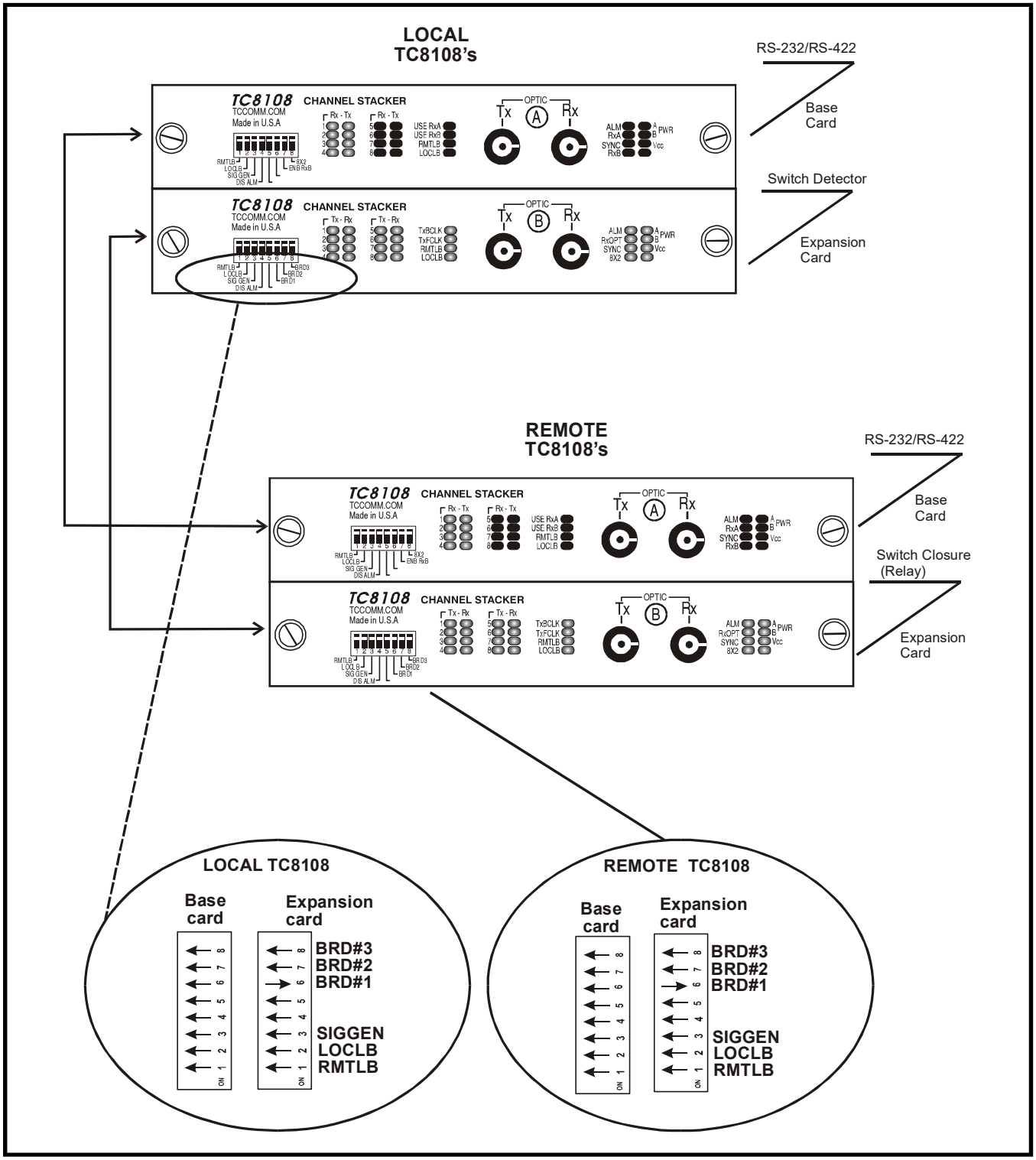


Figure 16. 2 Card TC8108 Installation Example (with Dry Contact Option on Cards 1 & 2)

Installation Procedure Summary

1. Apply the power by plugging the power plug to power jack. The power source can be from a power adaptor or from a power card (installed on either the left or right side of the rack).

2. Verify that the local unit's Card IDs are configured differently on each card and that each Card ID matches the remote unit's Card ID for the corresponding receiving card (they should be in the same sequence). For example:
   a. **1st card:** Base card default ID is zero.
   b. **2nd card:** set BRD#1 down and BRD#2 and BRD#3 to the up "Off" position.
   d. Set up the remote unit's Card IDs to match the local unit's Card IDs (in the same sequence). The only exception to this is when utilizing the Dry Contact Closure interface (see Figure 17). If the optional Dry Contact Closure interface was ordered with the units, verify that the local unit's "Detector" Card ID matches the remote unit's "Closure" Card ID.

3. Each card's "alarm" LED on the front panel will be lit. Once a valid optic signal is received they will turn Off. The "OPTIC Rx" LED (solidly lit) indicates a valid composite signal is being received.

4. Attach optic cables between units. The local unit's optic "TxA" connects to the remote unit's optic "RxA." If the unit is a Dual Optic model, connect the local unit's "TxB" to the remote unit's "RxB."

5. Conduct a Signal Generator test to verify optical connections (each card has its own built-in channel-scanning optic Signal Generator).
   a. On the Base Board, turn on the Signal Generator by flipping SW3 (SIGGEN) down "On" position. The "Rx" channel LEDs on the local unit should light sequentially from CH1 to CH8. Likewise, the "Tx" channel LEDs on the remote unit's Base Board should light sequentially, indicating receipt of the local unit's transmission.
   b. Repeat this step for each card on the unit. The Signal Generator's pattern should be transmitted to the remote unit's card with the same Card ID. Verify each card independently. When testing is complete, return SW3 (SIGGEN) to the up position on each card.

6. Repeat Step 5 at the remote unit (to verify optical connections in the reverse direction).

7. At the rear panel, apply the RS-232 or RS-422 electrical signal by plugging in an RJ-11 plug from the local device to the Base Board's "CH1" Port. The corresponding "Tx" Channel LED should light on the local unit to indicate a valid signal input. If the LED does not light, it usually indicates an incorrect or poor connection at the input. If this is the case, verify the connections and confirm them with the connection diagrams on page 9 (Electrical Signal Interface section).

   The corresponding "Rx" Channel LED on the remote unit should also light, indicating receipt of the local devices' signal. Connect another device to the remote unit's "CH1" Port. Verify that the electrical signal is being properly received between the two devices.

8. Apply additional RJ-11 inputs at local & remote units, verifying each channel's LED status and signal reception as connections are made.

Chapter 3 - Troubleshooting

General

Alarm conditions occur whenever an optical problem or "fault" condition is detected by the TC8108. Under normal operation, all LEDs should be Off.

All LEDs are Off

If no LEDs are lit on the unit, check the DC power supply, connector plug, and/or the power source. If the problem persists, contact the Technical Support Department at TC Communications, Inc.

Alarm LED

The "alarm" LED will be lit when an optic fault condition exists (such as a cable breakage or a poor optic connection).

Optic Cable Types

Conventionally, fiber optic cable with yellow-colored insulation is used for Single Mode applications; gray or orange-colored insulated cable is for Multimode use. If Multimode cable is used in a Single Mode application, the test results could be erroneous and confusing.

Calculating the Loss on the Fiber

The fiber optic link and/or connectors are frequently the source of various problems. Check out the connectors and the integrity of the link first. Ideally, the link should be calibrated for total loss after the installation has been completed. This will accomplish two things: (1) it will verify that the total loss of the link is within the loss budget of the device and (2) it will provide a benchmark for future testing. For example, a system that has been tested as having 6dB total loss when installed and suddenly tests out as having a loss of 10dB probably has a connector or link problem.

These are the reference values we use to calculate the loss on the fiber:

Multimode 850nm	**:**	**3 dB loss per km on 62.5/125μm cable***
Multimode 1310nm	**:**	**2 dB loss per km on 62.5/125μm cable***
Single Mode 1310nm	**:**	**0.5 dB loss per km on 9/125μm cable***
Single Mode 1550nm	**:**	**0.25 dB loss per km on 9/125μm cable***

**These numbers are listed for reference only. We recommend an OTDR reading be used to determine actual link loss.*

Chapter 4 - Bench Tests

Local Electrical Loopback Test

By sliding SW3 (LOCLB) down "On" position, the Local Loopback function will be initiated. Once activated, the unit makes an internal loop to "echo" the incoming RS-232/RS-422 electrical signal back to the user's device. This test allows the user to verify the electrical interface's connection, driver, and receiver's integrated circuitry on the TC8108. When done with the test, reset SW2 to the up position.

Local Optic Loopback Test

A short fiber optic jumper may be used to connect the TC8108's optic "Tx" to the optic "Rx" (on the same unit) at any time. By sliding SW3 (SIGGEN) down "On" position, the built-in channel-scanning Signal Generator can be used to verify the unit's optic transmit & receive capabilities. The "Tx" & "Rx" channel LEDs will light in sequence as the unit cycles through all channels. To test the "B" optics (on Dual Optic models), simply disconnect the "A" fiber connections while leaving the "B" fiber intact. When done with the test, reset SW3 to the up position.

Remote Optic Loopback Test

With the local unit's DIP Switch SW3 (SIGGEN) to the down "On" position and optic cables connected between two units, slide SW1 (RMTLB) on any card at the remote unit to down "On" position to loopback the incoming optical signal at the remote unit's optic "Rx" to it's optic "Tx." This allows the user to verify optic cable and connections between the two units. The remote unit's "Tx" & "Rx" LEDs should light in the same sequence as the local unit's "Tx" & "Rx" LEDs, indicating the status of the looped signal.

Remote Electrical Loopback Test

This test loops the composite optical & electrical signal (at the remote unit) back to the local unit in order to verify the integrity of the link. To perform this test, create an RJ-11 loopback cable with the Tx (pin 5 on an RS-232 Async interface) shorted to Rx (pin 4 on an RS-232 Async interface) at the RJ-11 connector plug.

With the local & remote unit's diagnostic DIP switches in the up (Off) position, insert an RJ-11 cable from your device into the local TC8108's RJ-11 port at the channel to be tested (channels should be tested individually). Connect your RJ-11 loopback cable at the remote TC8108's RJ-11 port on the same channel. Connect optical cables between the units. The local & remote unit's "Tx" & "Rx" LEDs should light on the corresponding channel tested. This test can also be performed utilizing the built-in Signal Generator instead of the local user's device.

Chapter 5 - Component Placement

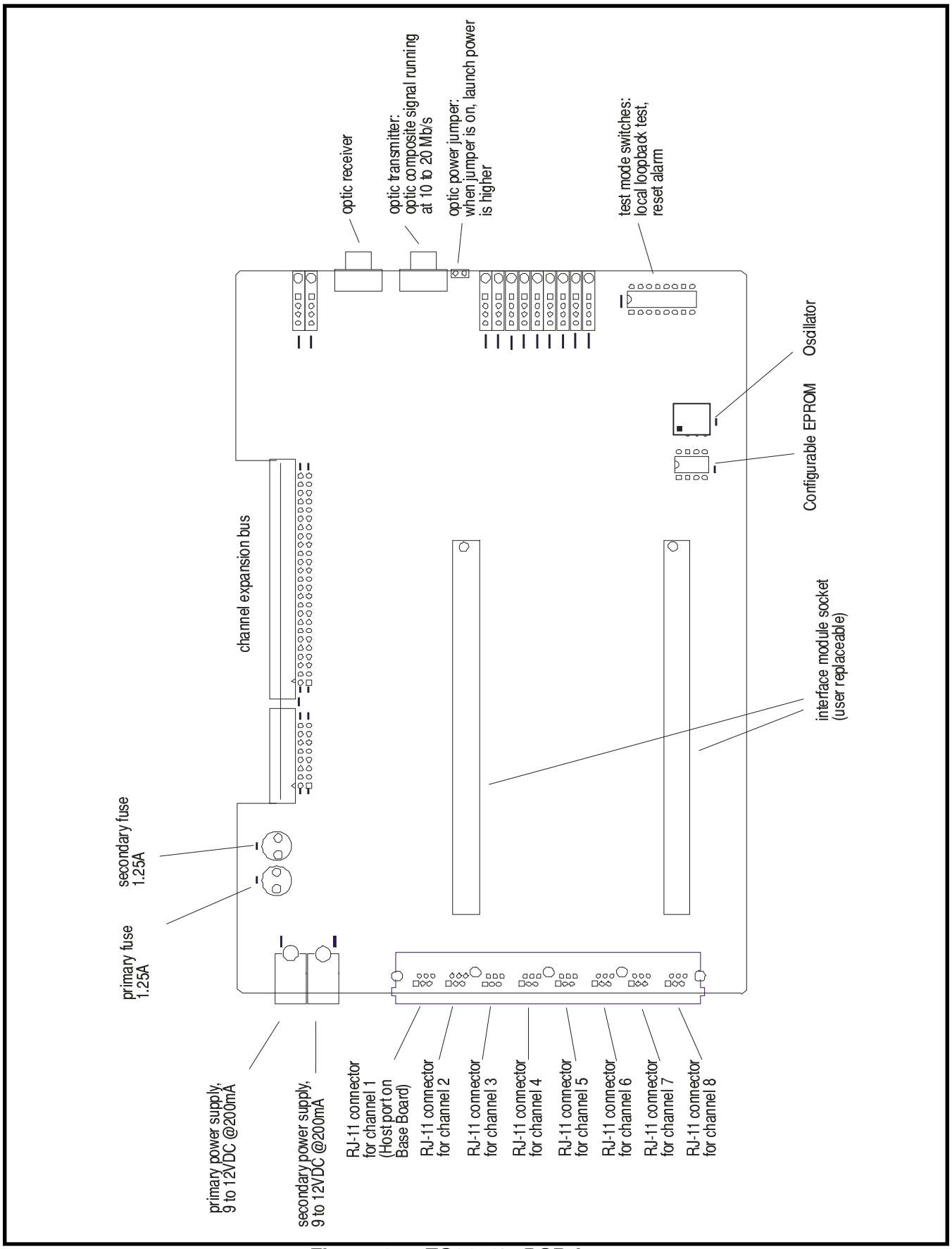


Figure 17. TC8108's PCB Layout

Chapter 6 - Specifications

Data Rates

Async (8/16/24/32 channels) ..... up to 38.4 Kbps*
Async (40/48/56/64 channels) ..... up to 19.2 Kbps*
Async (128 channels) ..... up to 16 Kbps*
Sync (up to 16 channels with ext. clk.) ..... up to 38.4 Kbps*
Sync (32 channel version with ext. clk.) ..... up to 19.2 Kbps*

Channel Capacity

Async ..... 8 Channels; Stackable to 64 Channels
Sync ..... 8 Channels; Stackable to 32 Channels

Optical

Transmitter ..... LED/ELED
Receiver ..... PIN Diode
Wavelength ..... 850nm/1310nm Multimode
..... 1310nm Single Mode
Fiber Optic connectors ..... ST** (FC optional)
Loss Budget
..... 15dB Multimode 850nm/1310nm @62.5/125μm
..... 20dB Single Mode 1310nm @9/125μm

Electrical

Connector ..... RJ-11 Female
Interface (Standard) ..... RS-232, RS-422, Dry Contact Closure, or a combination*
Optional (Custom) ..... RS-423*, RS-485* or TTL*, or a combination*

System

Bit Error Rate ..... 1 in 10^9 or better
Channel Indicators (each channel) ..... Tx, Rx
System Indicators ..... Power A, Power B, alarm, Vcc, RxA, RxB, OPTIC Rx, FCLK
Diagnostic Functions ..... Remote Loopback, Local Loopback, Signal Generator

Power Source

Standard ..... 12V DC @600mA
Optional ..... 115 or 230V AC with external power cube

Temperature

Operating ..... -10°C to 50°C
Storage ..... -40°C to 90°C
Humidity ..... 95% non-condensing

Physical Characteristics (each Rackmount Card)

Height ..... (17.7cm) 7.00"
Width ..... (3.2cm) 1.25"
Depth ..... (23.0cm) 9.00"
Weight ..... (280gm) 8oz

**Consult factory for higher data rate and/or custom interface requirements*
***ST is a trademark of AT&T Corporation*

Appendix A - 19" Rack & Power Card (optional)

Features

- ❒ **4 U height (7")**
- ❒ **Dual Power Capability (Automatic Switchover in the Event of Failure)**
- ❒ **Universal Switching Power Supply Accepts 90V to 264V AC and 47 to 63 Hz AC**
- ❒ **Optional -48VDC Power Supply Available**
- ❒ **Over Load & Short Circuit Protection**

Description

The TCRM191 and TCRM192 Universal Rack Mount Card Cages hold up to 10 single multiplexer or modem type cards, or up to 5 double-mux or double-modem type cards. In general, the Model TCRM191 is used for multiplexers and the Model TCRM192 for modems.

Both can operate with one power supply or dual load-sharing power supplies. The AC power supply automatically adjusts for 90V to 264V AC input and 47 to 63 Hz operation. The DC power supply accepts -48VDC input. The AC and DC power supplies can be mixed in the same unit.

The dual power supplies feature automatic switchover in the event of a power failure. The Power switch and its LED are located on the front panel.

Both rack assemblies are 19" wide by 7" high. The TCRM191 is 9" deep and TCRM192 is 5.25" deep.

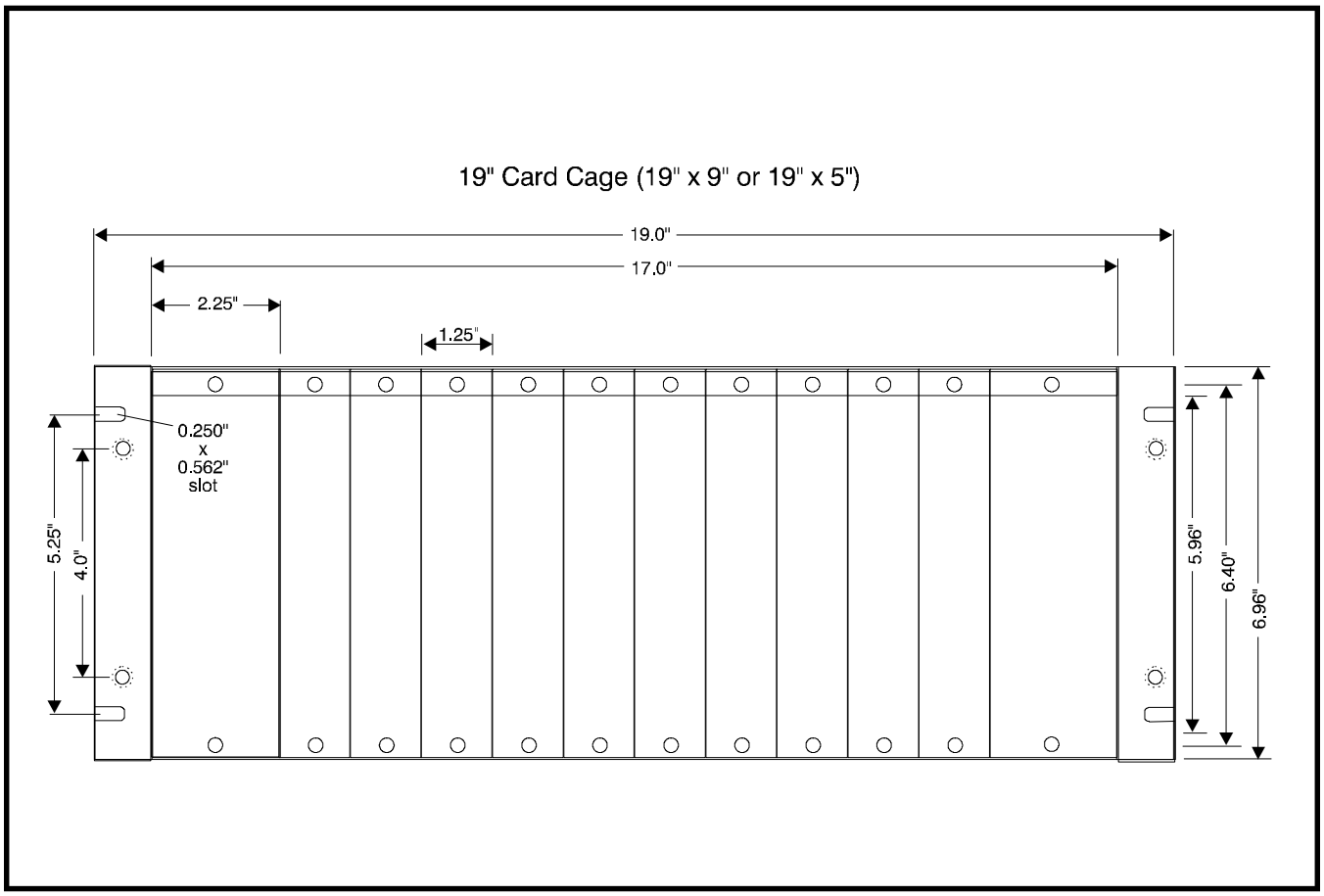


Figure 18. TCRM191/192 Rack Mount Card Cage

Appendix B

Return Policy

To return a product, you must first obtain a Return Material Authorization number from the Customer Service Department. If the product's warranty has expired, you will need to provide a purchase order to authorize the repair. When returning a product for a suspected failure, please provide a description of the problem and any results of diagnostic tests that have been conducted.

Warranty

Damages by lightning or power surges are not covered under this warranty.

All products manufactured by TC Communications, Inc. come with a five year (beginning 1-1-02) warranty. TC Communications, Inc. warrants to the Buyer that all goods sold will perform in accordance with the applicable data sheets, drawings or written specifications. It also warrants that, at the time of sale, the goods will be free from defects in material or workmanship. This warranty shall apply for a period of five years from the date of shipment, unless goods have been subject to misuse, neglect, altered or destroyed serial number labels, accidents (damages caused in whole or in part to accident, lightning, power surge, floods, fires, earthquakes, natural disasters, or Acts of God.), improper installation or maintenance, or alteration or repair by anyone other than Seller or its authorized representative.

Buyer should notify TC Communications, Inc. promptly in writing of any claim based upon warranty, and TC Communications, Inc., at its option, may first inspect such goods at the premises of the Buyer, or may give written authorization to Buyer to return the goods to TC Communications, Inc., transportation charges prepaid, for examination by TC Communications, Inc. Buyer shall bear the risk of loss until all goods authorized to be returned are delivered to TC Communications, Inc. TC Communications, Inc. shall not be liable for any inspection, packing or labor costs in connection with the return of goods.

In the event that TC Communications, Inc. breaches its obligation of warranty, the sole and exclusive remedy of the Buyer is limited to replacement, repair or credit of the purchase price, at TC Communications, Inc.'s option.

To return a product, you must first obtain a Return Material Authorization (RMA) number and RMA form from the Customer Service Department. If the product's warranty has expired, you will need to provide a purchase order to authorize the repair. When returning a product for a suspected failure, please fill out RMA form provided with a description of the problem(s) and any results of diagnostic tests that have been conducted. The shipping expense to TC Communications should be prepaid. The product should be properly packaged and insured. After the product is repaired, TC Communications will ship the product back to the shipper at TC's cost to U.S. domestic destinations. (Foreign customers are responsible for all shipping costs, duties and taxes [both ways]. We will reject any packages with airway bill indicating TC communications is responsible for Duties and Taxes. To avoid Customs Duties and Taxes, please include proper documents indicating the product(s) are returned for repair/retest).