

# **TC8000**

## **4 to 28 CHANNEL AUDIO/INTERCOM AND DATA FIBER OPTIC MULTIPLEXER User's Manual**

**MODEL:** \_\_\_\_\_

**S/N:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

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# Chapter 1 - Overview

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## Features

- ☐ **Muxes 4 to 28 Channels of Analog or Intercom Signals**
- ☐ **Covers Voice Band Width from 300Hz to 3.4Khz**
- ☐ **PCM Digitized Voice Technology-Extremely Low Noise**
- ☐ **Data Card can support 8 or 16 Channels of Data such as RS-232, RS-422, RS-485, TTL or Dry Contact Closure Detector**
- ☐ **Single Mode or Multimode**
- ☐ **Built-In Power Redundancy**
- ☐ **Optional Optical Redundancy**
- ☐ **Field Interchangeable Interface Modules**
- ☐ **LEDs for "Alarm", "Power A", "Power B", "Vcc", Channel Indicators**
- ☐ **Rack Mount or Standalone**

## Description

The TC8000 consists of AUDIO INTERFACE MODULES, a DIGITAL PROCESSING UNIT and OPTICAL Tx & Rx. Utilizing the latest technology and components available on the market, the audio interface modules contain CODEC chips to digitize analog audio signals and converts to PCM (pulse code modulation). The PCM signals are digital codes sampled by DIGITAL PROCESS UNIT and converted to series of logical "0" and "1". Then the series of code is transmitted through the optic transmitter. The receiving process is the same but reversed.

Three kinds of interfaces can be specified: analog, intercom and data.

The analog interface is for FSK (frequency shift key) applications. The analog interface has 600 ohm isolation audio transformer. The analog voltage can be 0 to 3 Vpp.

The intercom interface is for 4 or 2 wire voice communication. It connects to a handset with mouth and ear piece.

Since the analog and voice signals are digitized, the voice quality will not degrade as the distance is extended. For example, distances to 30 km are typical for a pair of TC8000's with 1300nm single mode fiber front end.

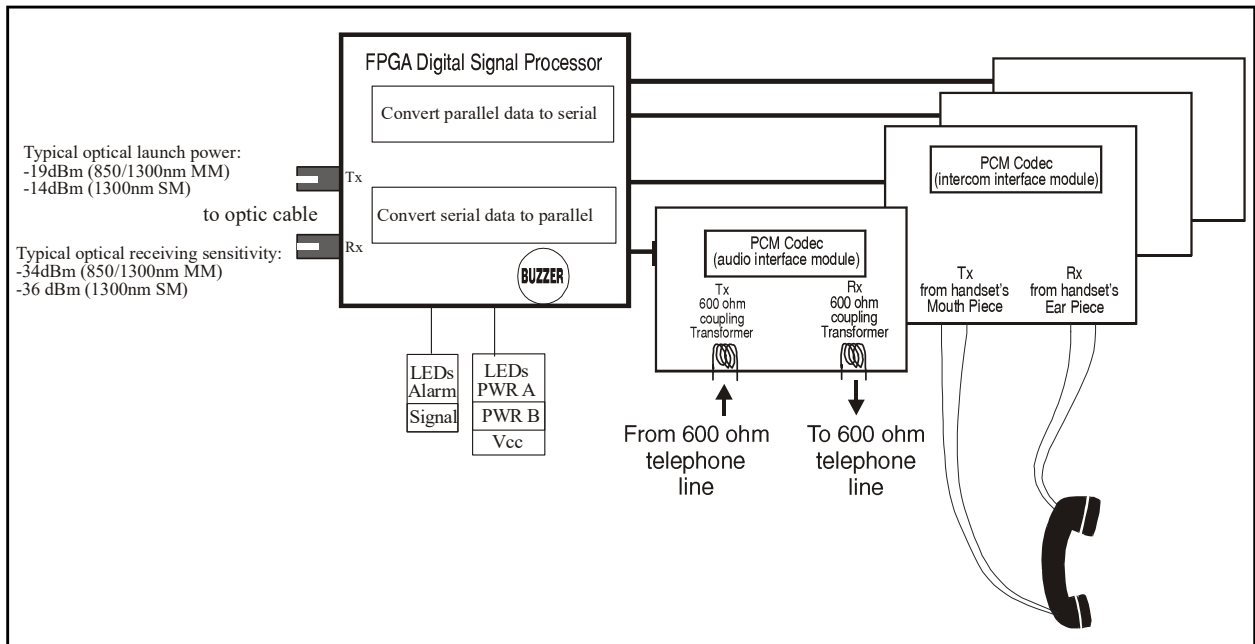
The TC8000 has four RJ-11 ports on the rear side to hook to either handsets or customer's audio devices.

The TC8000 Data Card offers several different interchangeable interfaces, such as RS-232, RS-422, RS-485, TTL and Dry Contact Relay. It can be upgraded or reconfigured to virtually any configuration; simply contact the factory should the need arise.

Built-in power redundancy is standard. Optical redundancy is available as an option. Fiber Optical connectors are ST (FC is optional); electrical connectors are RJ11. Power is 12VDC (24VDC or -48VDC, are optional).

The TC8000 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.

## TC8000 Functional Block Diagram



**Figure 1. Functional Block Diagram**

## Fiber Optics

### Connectors

Fiber optic connectors can be ST\*, or FC. (\*ST is a Trademark of AT&T). The optic connectors are located on the front panel: one for transmit and one for receive.

### Launch Power, Sensitivity & Loss Budget

Transmitter: Typical Launch Power:	-19dBm* (850/1310nm MM, @62.5/125 $\mu$ m)
	-14dBm* (1310nm SM, @9/125 $\mu$ m)
Receiver: Typical Sensitivity:	-34dBm* (850/1310nm MM, @62.5/125 $\mu$ m)
	-36dBm* (1310 SM, @9/125 $\mu$ m)
Loss Budget: 850nm Multimode, @62.5/125 $\mu$ m:	15dB
	1310nm Multimode, @62.5/125 $\mu$ m: 15dB
	1310nm Single Mode, @9/125 $\mu$ m: 22dB

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

### Transmission Distances (typical)

The TC8000 will work with all popular sizes and types of fiber. Transmission distances up to 4km\* are typical over multimode fiber at 850nm and 6km\* at 1300nm. Distances to 35km\* are typical over single mode fiber at 1300nm. Transmission distances may vary due to the characteristics of a given fiber optic cable.

### Fiber Optic Redundancy (optional)

With this option, the unit is equipped with two fiber optic pairs, Tx & Rx. In this case they are designated as TxA, RxA and TxB, RxB. Both TxA and TxB are transmitting optical signal at the same time, it depends on Receiving unit to decide either RxA or RxB is used.

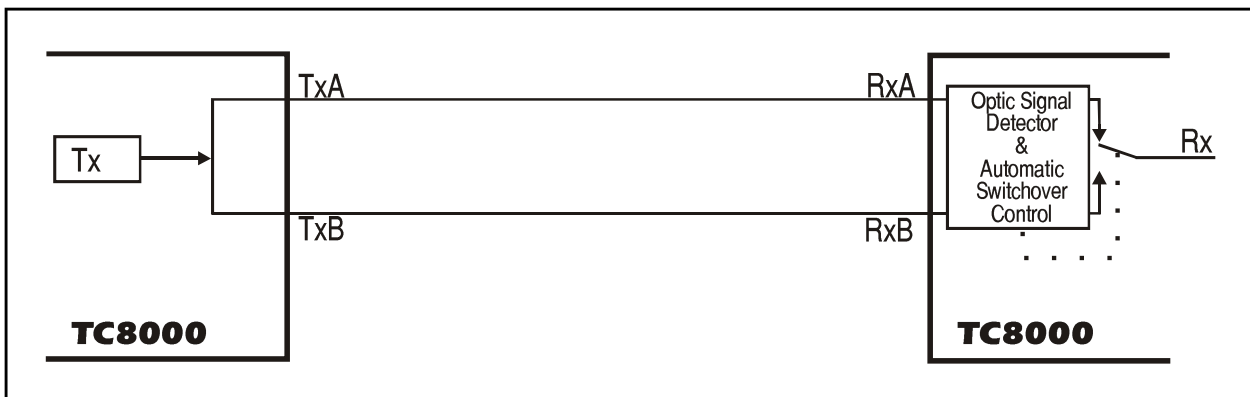


Figure 2. Fiber Optic Redundancy Diagram (Optional)

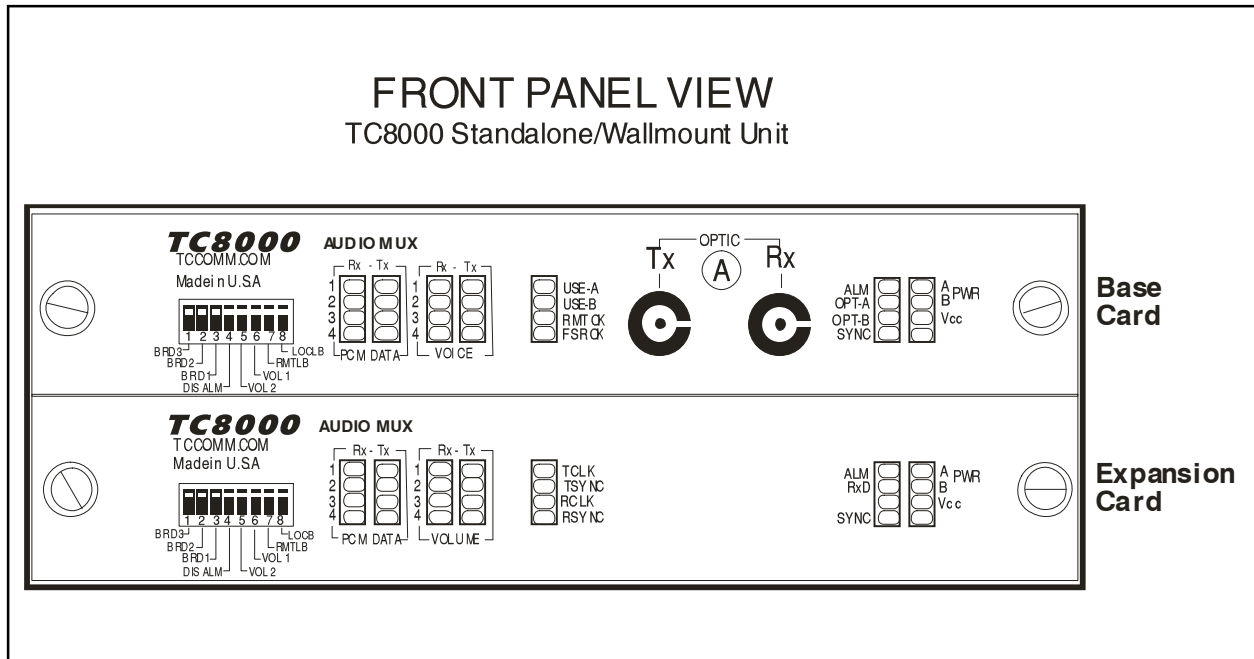


Figure 3. TC8000 Front Panel View

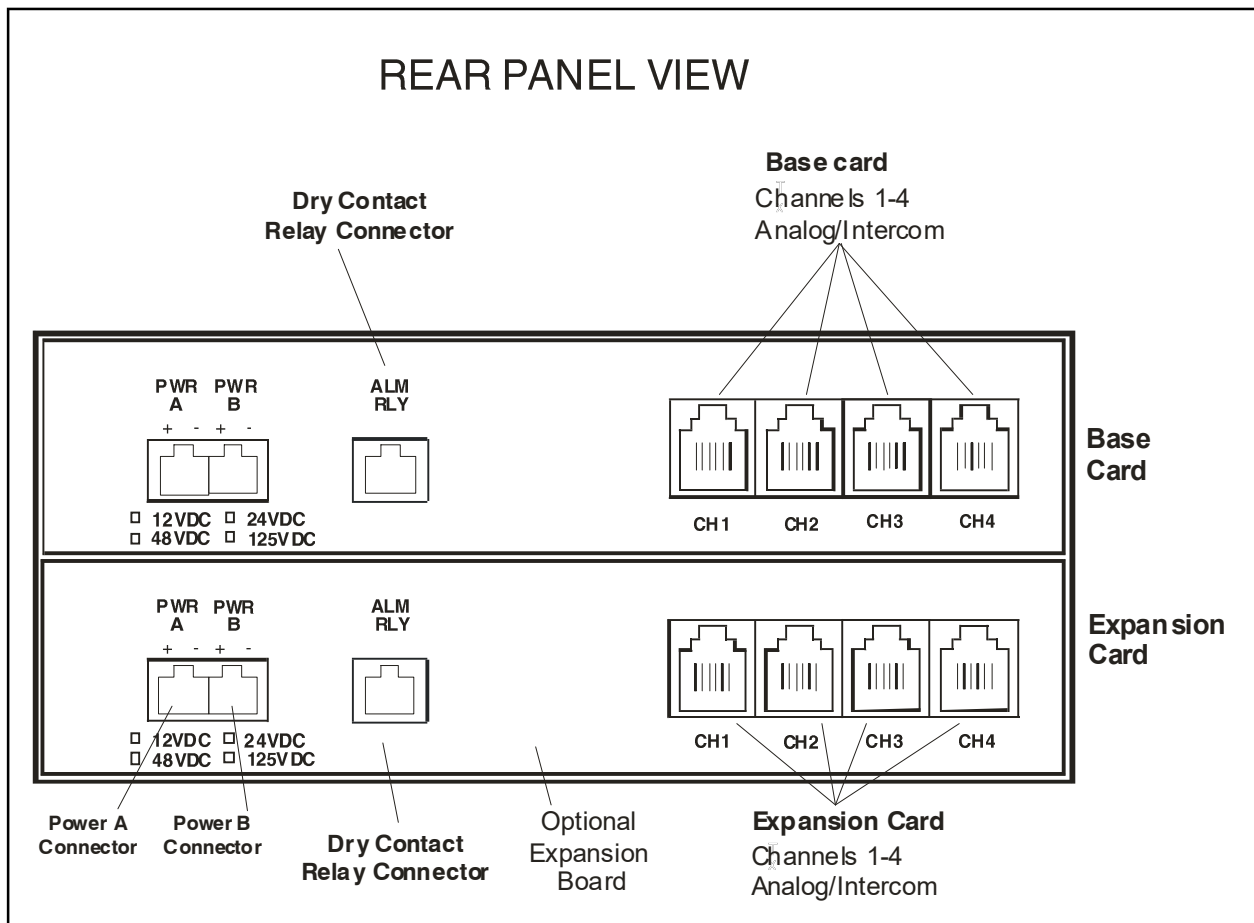
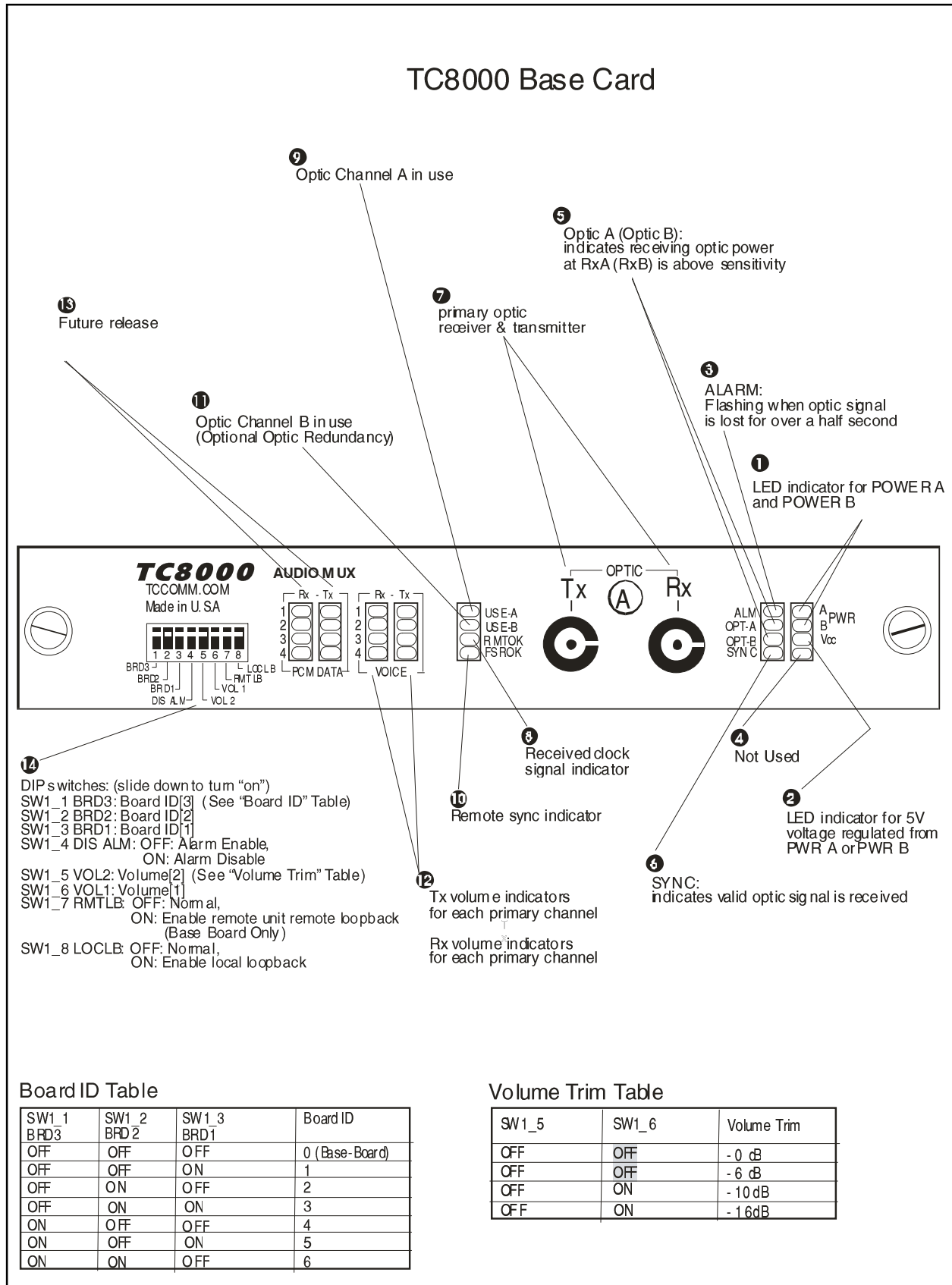


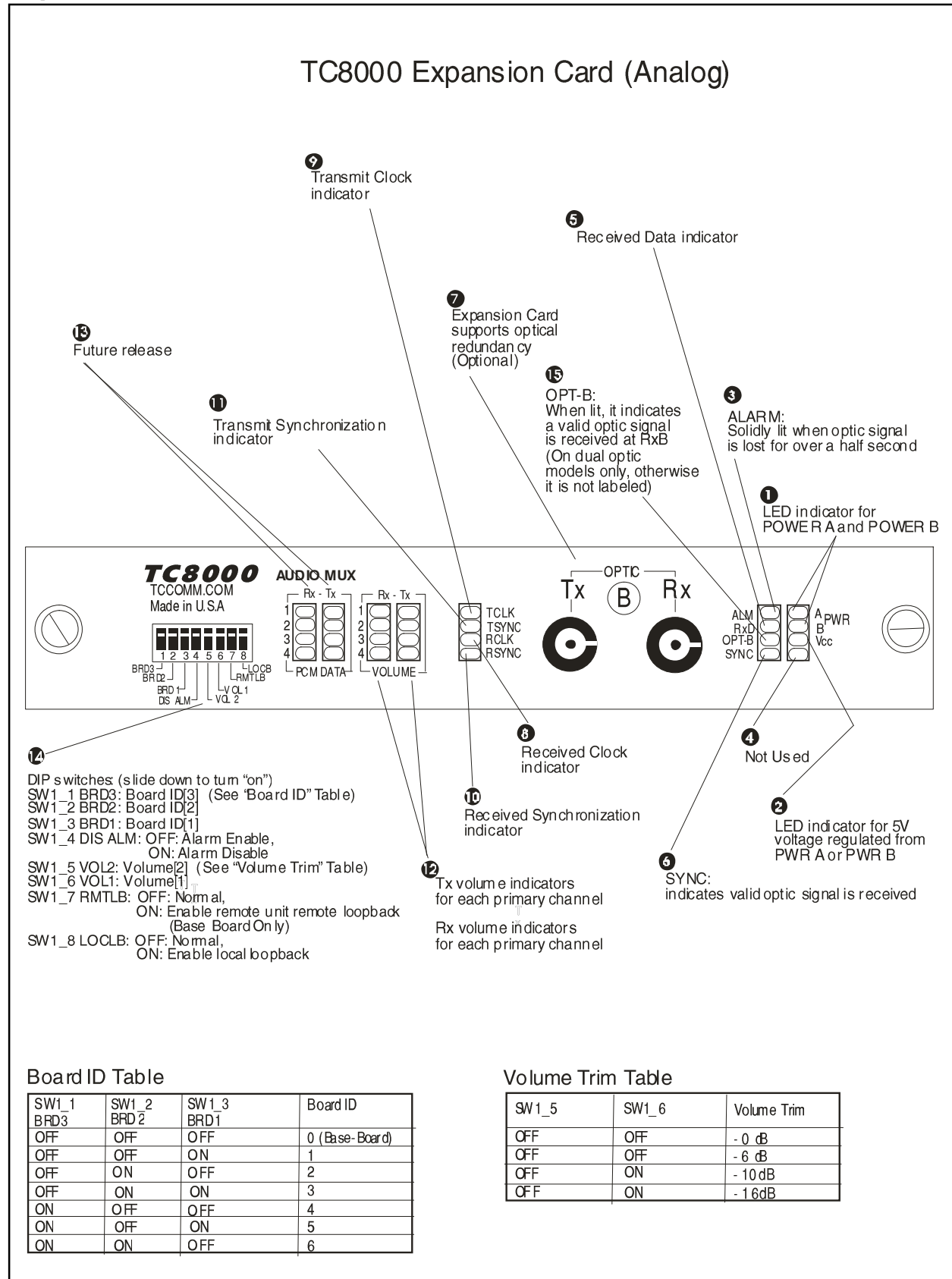
Figure 4. TC8000 Rear Panel View

## Base Card LEDs, DIP Switches



**Figure 5. TC8000 Base Card's Front Panel**

## Expansion Card LEDs, DIP Switches



**Figure 6. TC8000 Analog Expansion's Card Front Panel**



# Electrical Signal Interface Connection & Pin Assignments

The RJ-11 connectors are located at the rear panel of the TC8000.

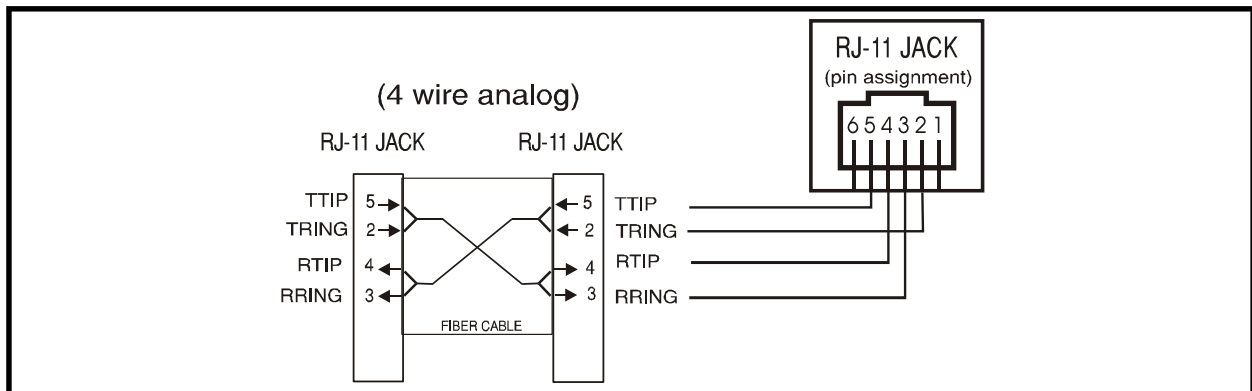
## Analog & Intercom Pin Assignments

RJ-11 x 8 gang connector at the rear panel.

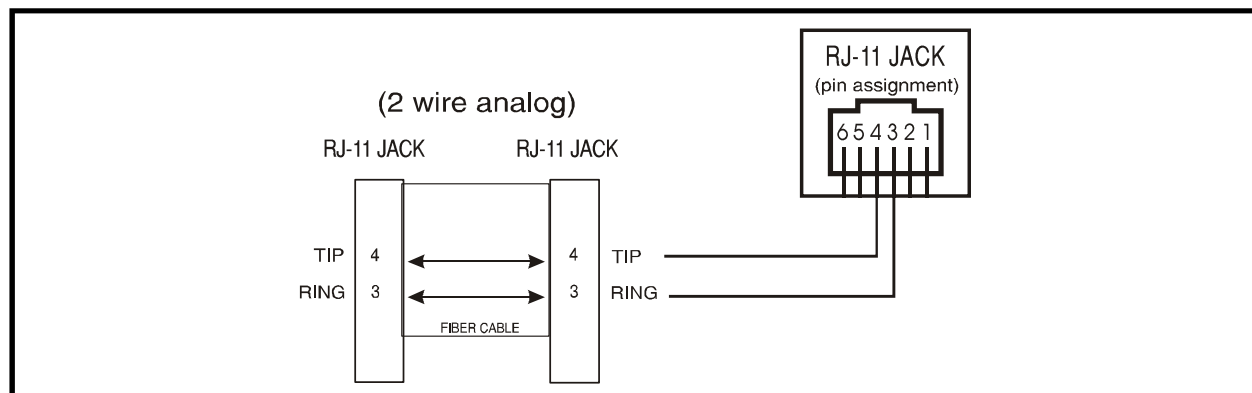
For analog audio signals:

pin 5 is transmit TIP & pin 2 is transmit RING.

pin 4 is receive TIP & pin 3 is receive RING.



**Figure 7. Four Wire Analog Pin Assignments & Connection Diagram**

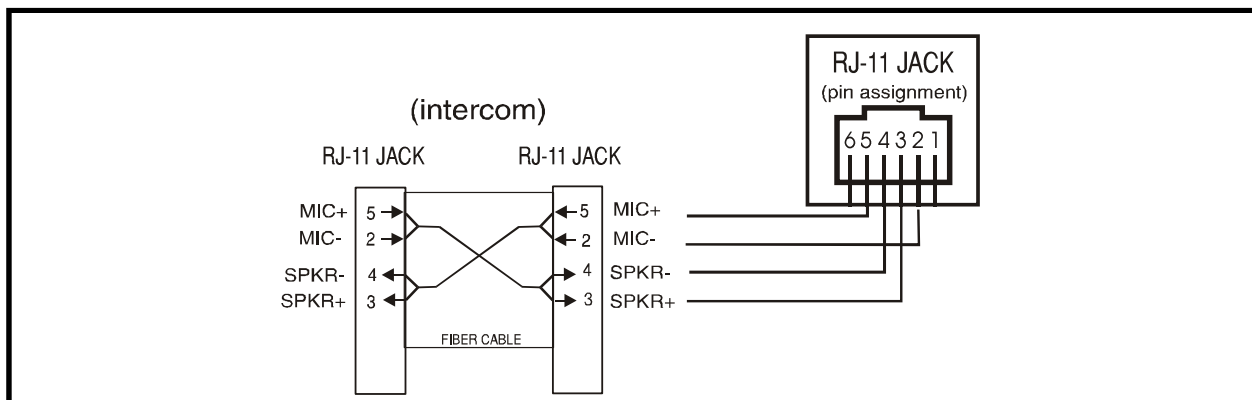


**Figure 8. Two Wire Analog Pin Assignments & Connection Diagram**

For intercom audio signals:

pin 5 is MIC+ & pin 2 is MIC-. (signal from handset's mouth piece)

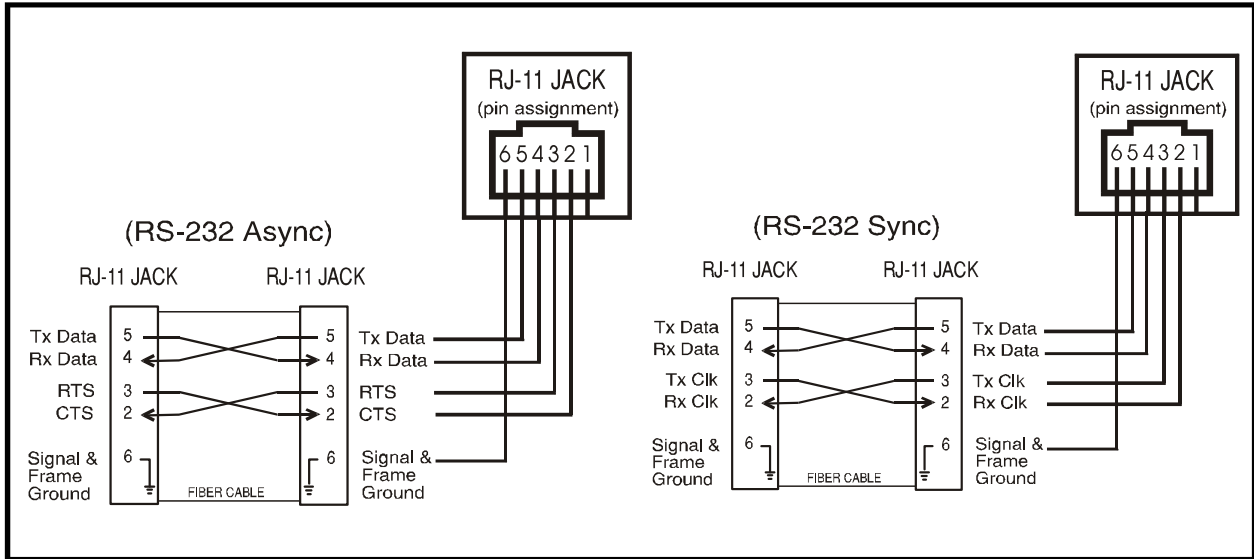
pin 4 is SPKR- & pin 3 is SPKR+. (signal goes to handset's ear piece)



**Figure 9. Intercom Pin Assignments & Connection Diagram**

## RS-232 (Async with Control & Sync)

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.



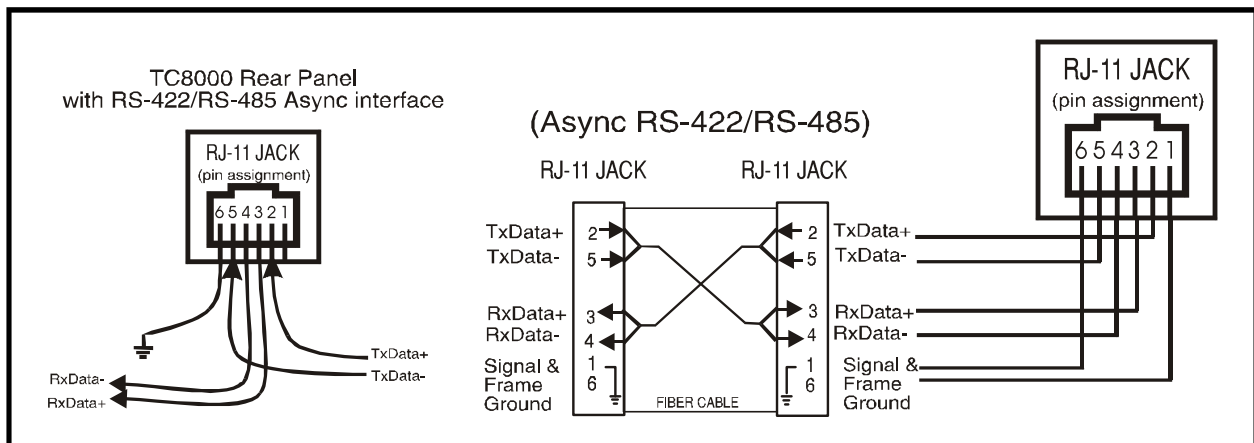
**Figure 10. RS-232 Async & Sync Pin Assignments & Virtual Connection Diagram**

## RS-422/RS-485 Asynchronous (Optional)

For RS-422 & RS-485 interfaces, pins 2 and 5 are balanced input pins. Pin 2 is the positive input (TxD+) while pin 5 is negative (TxD-).

Pins 3 and 4 are balanced output pins. Pin 3 is the positive output (RxD+) while pin 4 is negative (RxD-). Either pin 6 or pin 1 can be Signal Ground.

Only RS-422/RS-485 Async communications can be used with the TC8000 due to the limited number of pins on the RJ-11 connector.



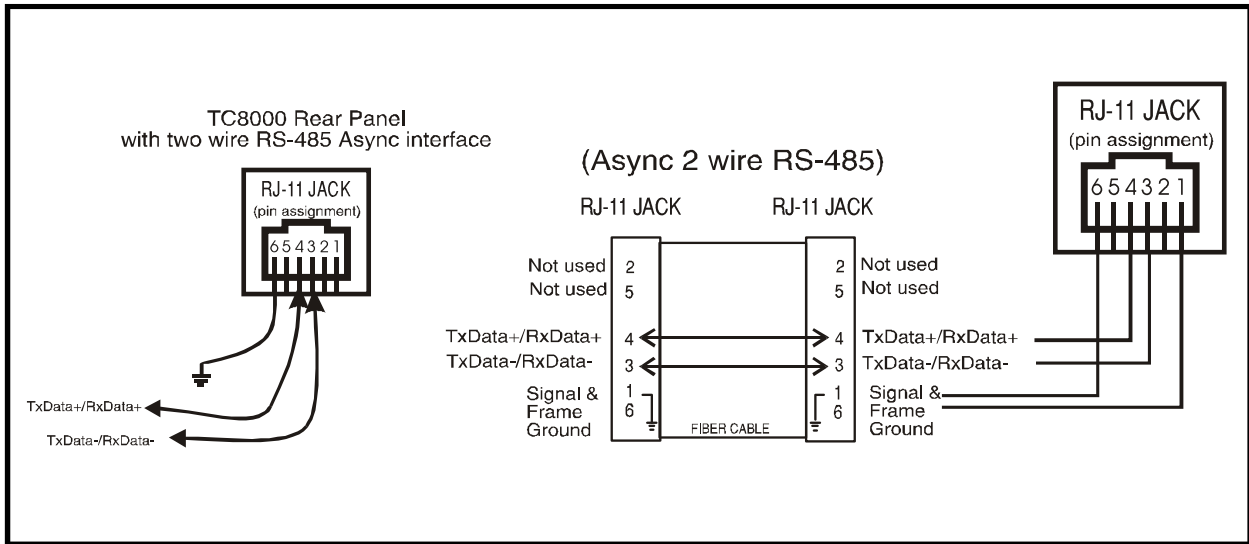
**Figure 11. RS-422/RS-485 Async Pin Assignments & Virtual Connection Diagrams**

## RS-485 (2 wire) Electrical Signal Interface Connection & Pin Assignments

### Two wire (Half Duplex) RS-485 Asynchronous (Optional)

For two wire RS-485, use pins 3 and 4.

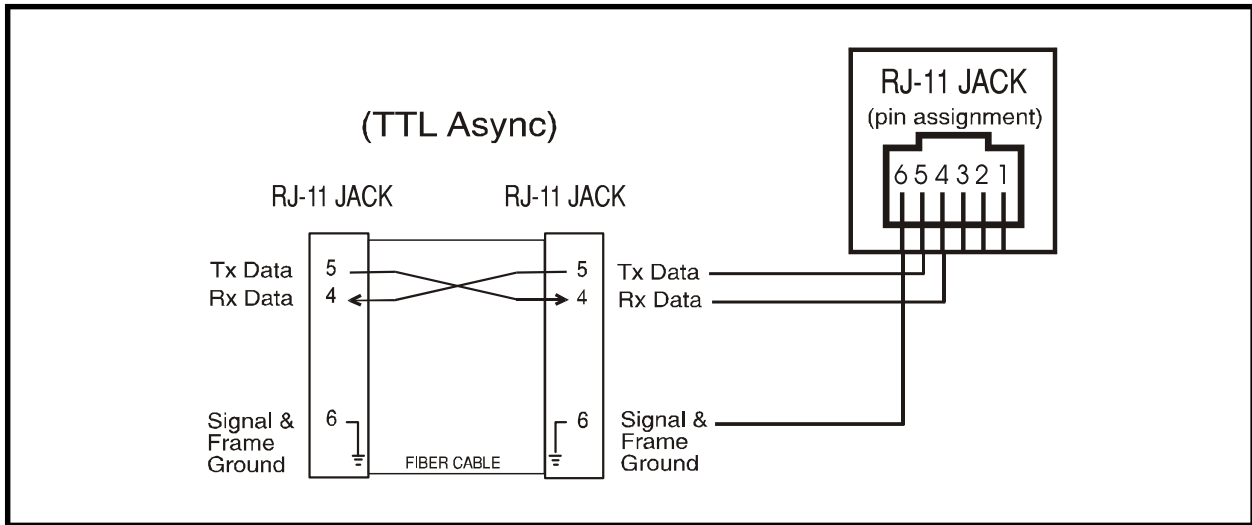
Either pin 6 or pin 1 can be Signal Ground.



**Figure 12. Two wire RS-485 Async Pin Assignments & Virtual Connection Diagrams**

## TTL Asynchronous

Similar to the RS-232 interface, the TTL interface utilizes pin 5 for the input (Tx) pin while pin 4 is the output (Rx) pin.



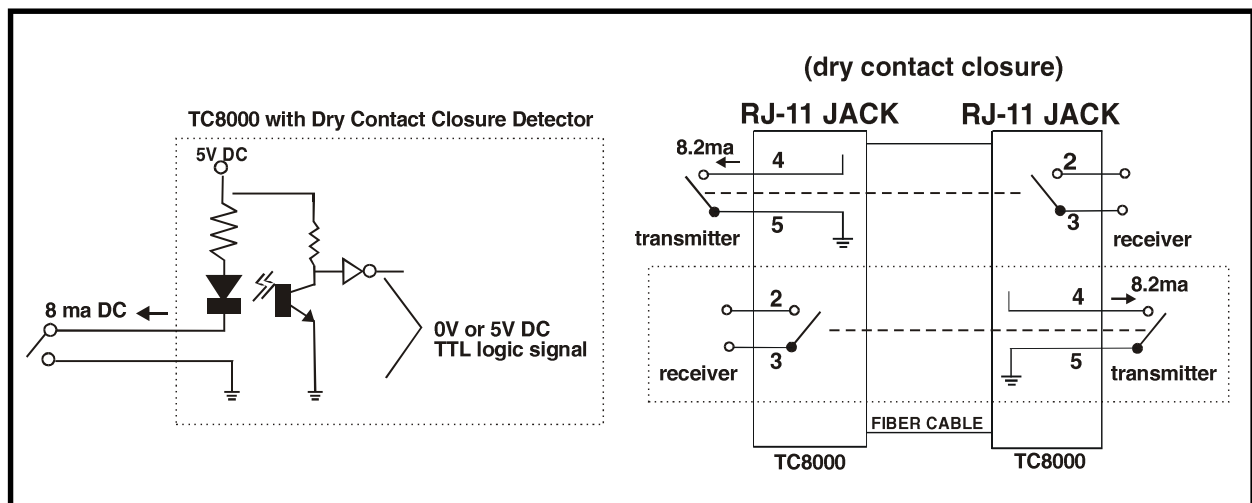
**Figure 13. RJ-11 TTL Async Pin Assignments & Connection Diagram**

## Dry Contact Closure Detector & Relay Switch (Optional)

For dry contact closure applications, the TC8000 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 TC8000. It reflects the remote detector's "on" and "off" status.

The diagram below, illustrates the virtual pin connections for using the TC8000 as either a 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.

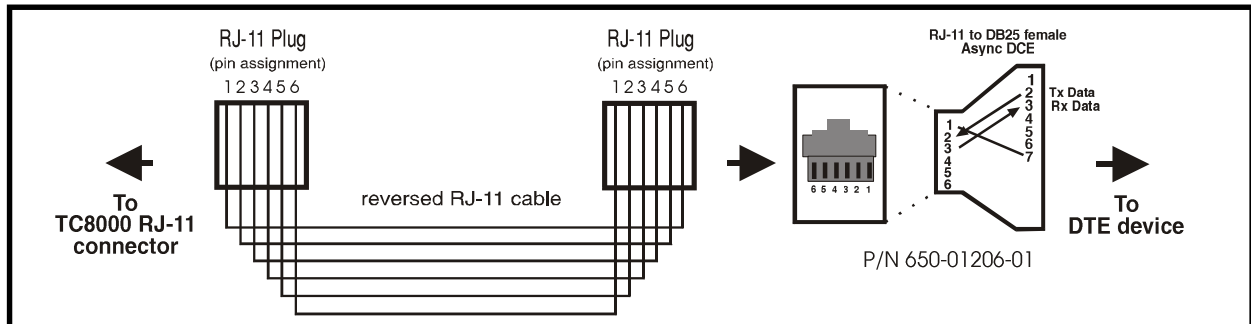
As an option, the relay switch on the receiver's side can be rated 1.8A DC switching current, and a load rating of 108VA.



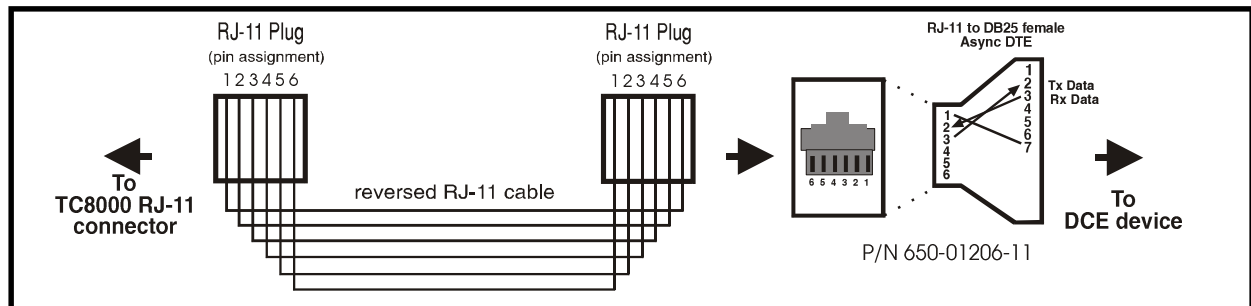
**Figure 14. Dry Contact Detector and Closure Logic Diagrams**

## RJ-11 to DB25 Female (Async & Sync) Connection Cables

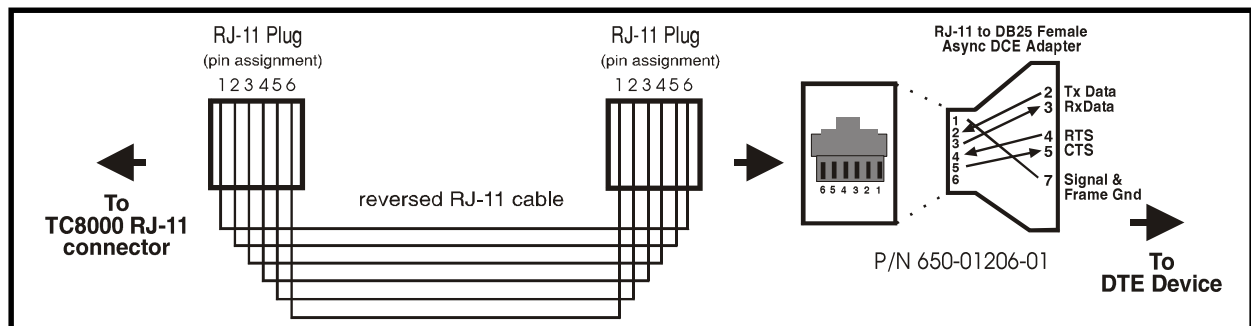
The user's device can be a DCE or DTE device (which may have a DB25 male connector). The following eight illustrations depict the RS-232/TTL, RS-232 Async with control, RS-232 Sync & RS-422/RS-485 wiring diagrams for constructing an RJ-11 to DB25 Female adapter cable.



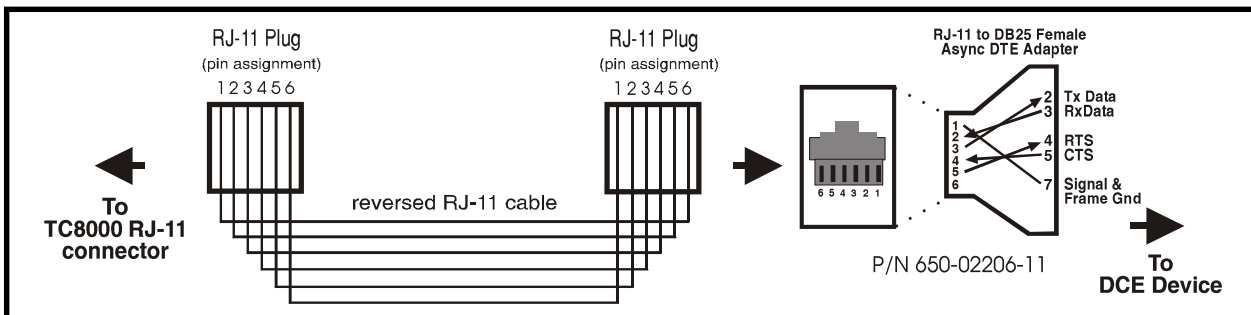
**Figure 15. RJ-11 (ASync DCE) RS-232/TTL Pin Assignments & Connection**



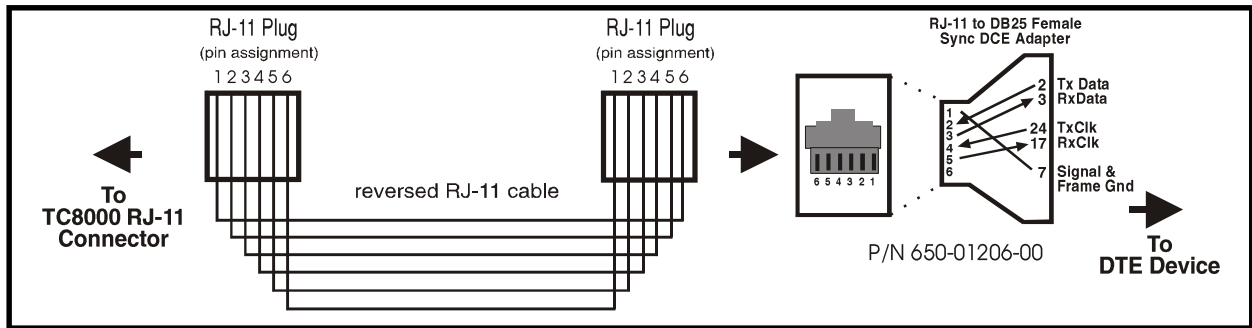
**Figure 16. RJ-11 (ASync DTE) RS-232/TTL Pin Assignments & Connection**



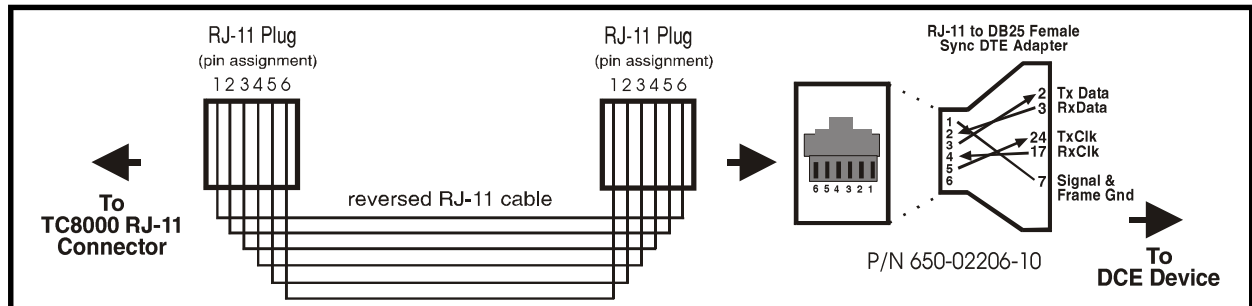
**Figure 17. RJ-11 (ASync DCE) RS-232 with Control Pin Assignments & Connection**



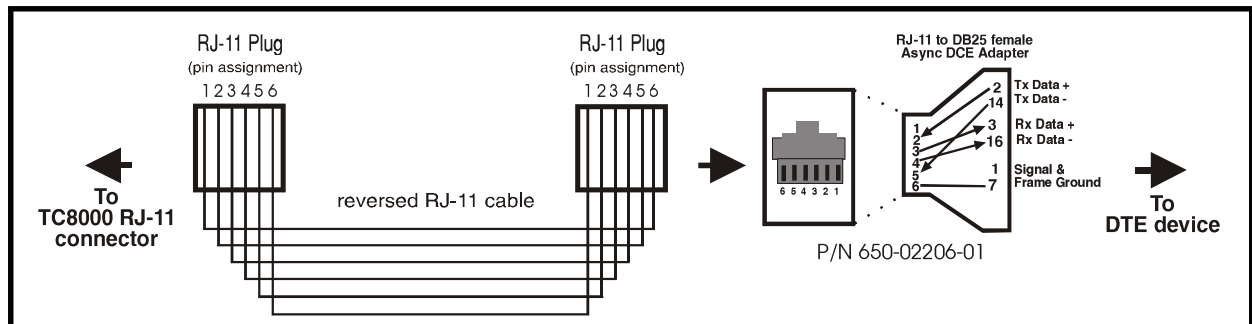
**Figure 18. RJ-11 (ASync DTE) RS-232 with Control Pin Assignments & Connection**



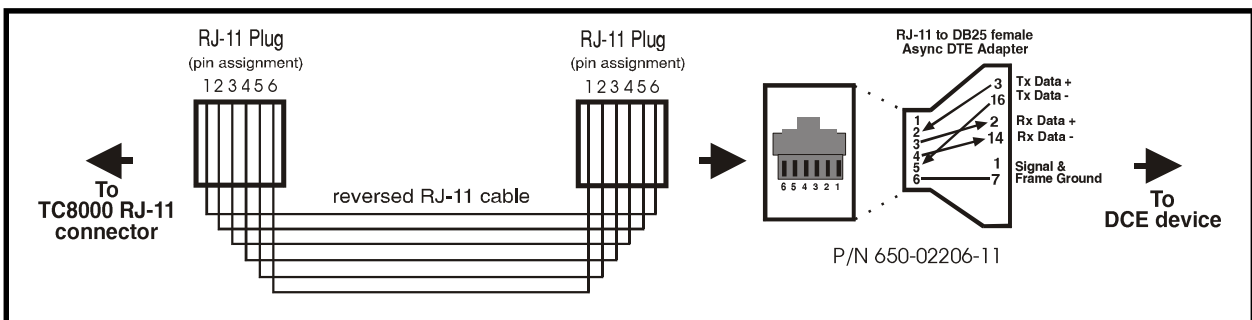
**Figure 19. RJ-11 (SYNC DCE) RS-232 Pin Assignments & Connection**



**Figure 20. RJ-11 (SYNC DTE) RS-232 Pin Assignments & Connection**



**Figure 21. RJ-11 (ASYNCH DCE) RS-422/RS-485 Pin Assignments & Connection**



**Figure 22. RJ-11 (ASYNCH DTE) RS-422/RS-485 Pin Assignments & Connection**

## 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 TC Communications Inc. Customer Service Department.

### Equipment Location

The TC8000 should be located in an area that provides adequate lighting and working space. Avoid locating it next to any equipment that may produce electrical interference or strong magnetic fields, such as elevator shafts, heavy duty power supplies, etc.

### System Configuration (see DIP switch settings on pages 7 and 8)

All the channels are factory configured as either ANALOG, INTERCOM or DATA. RJ11F Sockets are provided to connect the Analog, Intercom or data signals on the rear panel.

### Power Supplies

Each TC8000 card is powered by an external DC power adapter rated 12VDC @500mA(24VDC or -48VDC are optional). Observe the labeled polarities. Only one power source is needed to power the unit.

Either a power adapter or TC's power card can be utilized to supply the power.

The terminal block connector for power can be plugged into any power jack (either A or B) on the rear panel. Please refer to the rear panel page (page 6) for locations. Since each TC8000 is equipped with power redundancy capability, the power LEDs on the front panel will be "ON" to indicate related power input.

### Fiber 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 the connectors are frequently the source of communication problems. If problems are present, check the optic 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 of signal loss when installed should not suddenly test out as having a loss of 10dB. If this were the case, however, the fiber link or connector would probably be the source of the problem.

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

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

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

## System Start Up

After power is turned ON, the following status will be observed from the front panel:

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

All the LED status should match following table:

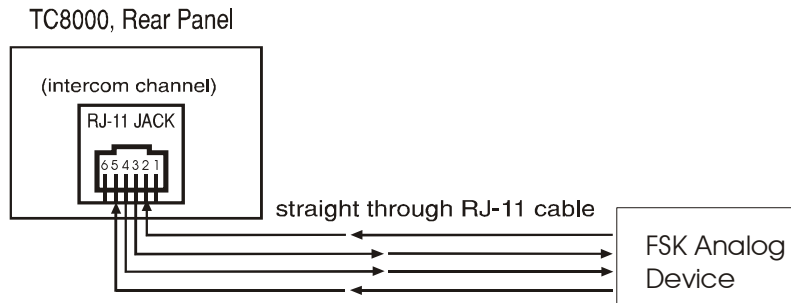
Power A	:	on, if power plug is inserted to power jack A (left jack)
Power B	:	on, if power plug is inserted to power jack B (right jack) (for power redundancy, insert two power plugs from different power supply)
Alarm	:	flashing, because no optic signal input
Vcc	:	on, to indicate good 5VDC derived from either power A or B

2. Apply a valid optic signal either from a remote peer TC8000 or loop back from its own optic Tx. Following LED changes should be observed:

Alarm LED is turned off.

All the Green LEDs (for the appropriate # of channels) are on.

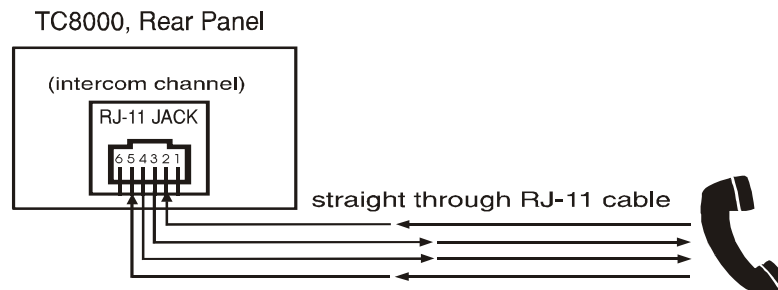
3. Analog Signal Connection:



4. Intercom Handset Connection:

An RJ-11 straight-through cable is provided to connect your handset. The handset that is compatible with the TC8000 is Walker Equipment's Model "W3-K-M".

Walker Equipment's phone number: (800)426-3738, (706)935-2600





## Chapter 3 - Troubleshooting

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### General

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The fiber optic link and/or the 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. One, it will verify that the total loss of the system is within the loss budget of the device. Two, it will provide a benchmark for future testing. For example, a system that has been tested as having 6dBm total loss when installed, and suddenly tests out as having a loss of 10dBm, obviously has a connector or link problem.

### Optic Loopback Test

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At anytime you may use a short cable to loopback from Optic Tx to Rx. The analog or intercom voice signal sent to RJ-11 pin 5 & 2 is looped back by fiber loop to pin 3 & 4.

For intercom channel, once loopback is setup, you can hear "echo" of you own voice from the ear piece.

## Chapter 4 - Specifications

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### Data Rates

Async and Sync(per channel) .....DC up to 19.2Kbps

### Audio Bandwidth

Analog, Intercom ..... 300 to 3.4 KHz

### Channel Capacity

Channels ..... 4 to 28

### Optical

Transmitter ..... LED/ELED/LASER

Receiver ..... PIN

Wavelength ..... 850nm/1300nm multimode

..... 1300nm singlemode

Fiber Optic connectors ..... \*ST (FC optional)

Loss Budget

..... 15dB multimode 850nm/1300nm @50 $\mu$ m

..... 15dB multimode 850nm/1300nm @62.5 $\mu$ m

..... 20dB singlemode 1300nm @9 $\mu$ m

\*ST is a Trademark of AT&T

### Electrical

Connector ..... RJ-11

Interface ..... RS-232, RS-422, RS-485, TTL, Dry Contact Relay, Analog or Intercom

TTL

Input Voltage Maximun Rating ..... -0.5 to 7V

Recommended TTL Input Voltage .....

Vin High ..... 2.0V to 5V

Vin Low ..... 0V to 0.8V

Maximum Analog Input ..... 3V p-p

### System

Bit error rate ..... 1 in 10<sup>9</sup> or better

Visual indicator .....

..... "POWER A", "POWER B", "Alarm", and Channel Indicators

### Power

Power source ..... 12VDC @500mA, 24VDC @250mA or

..... -48VDC @125mA

..... optional: 115 or 230VAC with external power cube

### Temperature

Operating ..... -10°C to 50°C

High Temperature (Optional) ..... -20°C to 70°C

Storage ..... -40°C to 90°C

Humidity ..... 95% non-condensing

## Physical

rack mountable card:

Height..... (19cm) 7.00"  
Width ..... (3.2cm) 1.25"  
Depth..... (22.8cm) 9.00"  
Weight..... (280gm) 10 oz

standalone box:

Height..... (19cm) 7.2"  
Width ..... (3.2cm) 2.6"  
Depth..... (22.8cm) 9.5"  
Weight..... (280gm) 3 lb

## Chapter 5 - 19" Rack & Power Card

### Features

- ☐ 4 U height (7")
- ☐ Dual Power Capability (Automatic Switchover in the Event of Failure)
- ☐ Universal Switching Power Supply Accepts  
90 to 263 VAC 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 90 to 264VAC 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.

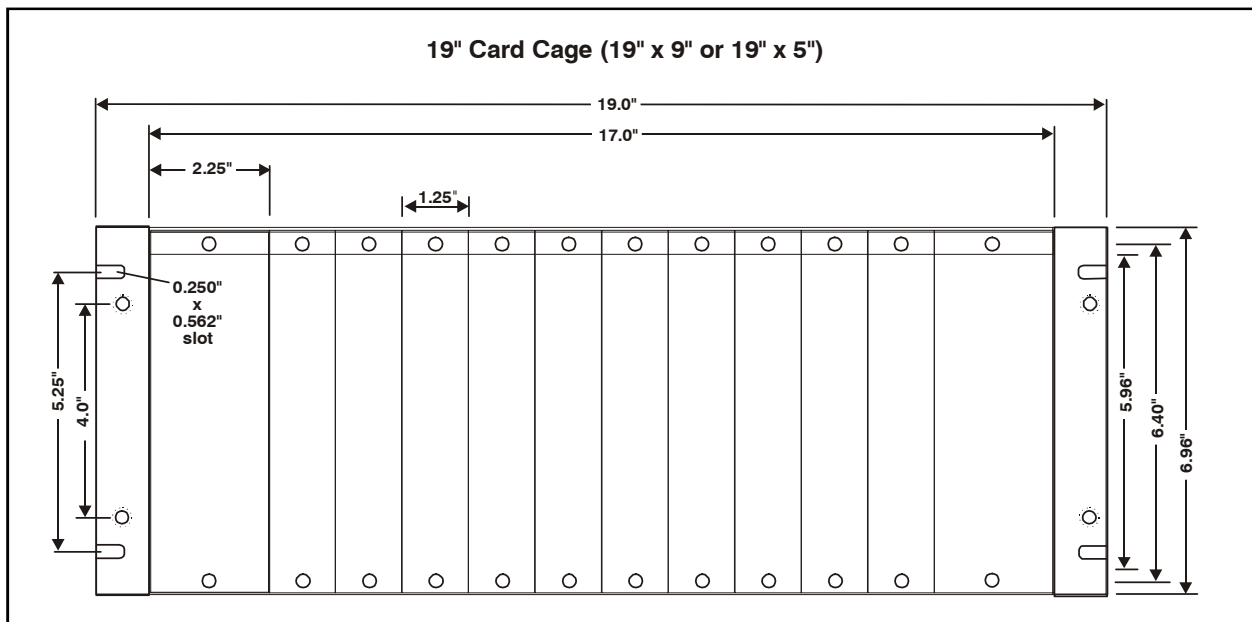


Figure 23. TCRM191/192 Rack Mount Card Cage

## Chapter 6 - Appendix

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### Return Policy

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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

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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).

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### Limitation of Liability

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In no event shall the total liability of TC Communications, Inc. to purchaser and/or end user for all damages including but not limited to compensatory, consequential and punitive damages, exceed the total amount paid to TC Communications, Inc. by purchaser for the goods from which the claim arose, in no event shall TC Communications, Inc. be responsible for indirect and consequential damages.

*Continue on next page.*

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## **Limitation of Liability (Cont.)**

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In no event shall liability attached to TC Communications, Inc. unless notice in writing is given to TC Communications, Inc. within ten days of the occurrence of the event giving rise to such claim.

TC Communications, Inc. shall not be responsible for delays or non-deliveries directly or indirectly resulting from or contributed to by foreign or domestic embargoes, seizure, fire, flood, explosion, strike, act of God, vandalism, insurrection, riot, war, or the adoption or enactment of any law, ordinances, regulation, or ruling or order or any other cause beyond the control of TC Communications, Inc.

TC Communications, Inc. shall not be responsible for loss or damage in transit and any claims for such loss or damage shall be filed by the purchaser with the carrier.