TC1910

Telephone to 10Base-T
Ethernet Extender
User's Manual

MODEL: _____

S/N: _____

DATE: _____

Table Of Contents

Features

❒ **2-Wire Analog Telephone Voice**

❒ **1 Two or Four Wire Analog 600 Ohm Channel**

❒ **Toll Voice Quality with Ringdown Capability**

❒ **Master or Slave switchable**

❒ **Dynamic Host Configuration Protocol (DHCP)**

❒ **Echo Cancellation**

❒ **ADPCM 32Kbit/16Kbit compression rate switchable**

❒ **RJ-45 Female Connector for the 10 BASE -T Signal**

❒ **LEDs Indicate telephone and network status**

❒ **FPGA Technology (Field Programmable Array) Consumes Low Power**

❒ **Various Power Voltages Available: 12VDC or Optional 24VDC, or 115/230VAC.**

❒ **Stand Alone or Rackmount**

Description

The TC1910 Ethernet Telephone Extender enables telephone service over a LAN via 10Base-T Ethernet connections. It has a built-in Codec that digitizes voice and converts to packets for transmission between local and remote TC1910s with designated IP addresses. It is compatible with PBX and Key Systems (POTS).

LAN connections can be made by most types of Ethernet devices, including switches, hubs, routers, bridges, transceivers, etc. A Web-based Configuration user interface (most browsers including Microsoft Windows Explorer, etc.) is provided to view network settings or change IP addresses from the factory default.

Phone connection is automatic upon power-up or when network interruption is restored. Depending on network traffic, multiple pairs of TC1910s can be used to set up individual point-to-point telephone links. An extreme temperature version (-20°C to +70°C), Model TC1910-T, is available for harsh environments.

The TC1910 provides Toll Quality sound within voice bandwidths from 300Hz to 3.4 Khz. Two types of voice applications are supported: one, connecting to a PBX for outside telephone service; two, setting up a "hot link" point-to-point connection, e.g. between two work stations, within a LAN. Two-wire FXS (foreign exchange subscriber) is provided on the telephone side with ring down capability and FXO (foreign exchange office) on the PBX side.

The TC1910 also supports one channel of two or four wire analog signal. The analog interface is for FSK (frequency shift key) applications. The analog interface has a 600 ohm isolation audio transformer. The analog voltage can be 0 to 3 Vpp.

Eighteen LEDs for network status, phone status, power and volume are provided to enhance status monitoring and diagnostics. Dry contacts for external alarm and ringer are standard. The TC1910 is available in standalone (TC1910S) or rackmount (TC1910R) versions. Power is standard 12VDC with optional 24VDC or 115/230VAC with an external power cube. Power redundancy is standard. 10Base-T connectors are RJ-45 Female and Phone connectors are RJ-11 Female

❹
OFHK (Off hook) indicator: "On" when the handset is offhook.
    If the TC1910 is configured for 600 Ohm analog:
    The OFHK LED will always be lit.
RING indicator: "On" when the phone is ringing.
    If the TC1910 is configured for 600 Ohm analog:
    The RING LED will always be lit.
HT-L (Hot Link) indicator: "on" when both TC1910's are
set to FXS. "Off" when one side is FXS and the other
side is FXO. It will flash when both units are set to FXO
and the ALARM will turn on.
CH-S (FXS channel status) indicator: "Flashing" when
the FXS module is not working properly. "Off" when normal.

❷
DHCP indicator: "On" when DHCP option is turned
on (Slave only)
ECHO CNCL (Echo cancellation): "On" when Echo
Cancellation option is turned on.
16K/32K CP-R (Compression Rate): Indicates the current
compression rate.

❸
FXS indicator: "On" when set to FXS.
FXO indicator: "On" when set to FXO.
    If the TC1910 is configured for 600 Ohm
    analog: The FXO LED will always be lit.
SLVE indicator: "On" when set to slave
MSTER indicator: "On" when set to slave

❶
ALARM indicator: (see next page).

❽
DIP Switches:
1. **FXO/FXS:** set the unit as FXO or FXS.
(If the unit is ordered as an FXO, the DIP
switch must be in the "down" position.
If the unit is ordered as an FXS, the DIP
switch must be in the "up" position.)
2. **MSTR/SLVE:** Set the unit as Master.
3. **DHCP:** Turn on the DHCP option.
4. **ECHO CNCL:** Turn on the echo cancellation.
5. **CP-R 16K/32K:** Select the compression rate.
6. **DIS ALM:** Disable the Alarm.
7. **RG TST:** Ring Test.
8. **DFLT:** Restore the default IP settings.

❼
Tx & Rx Volume
Indicators: indicate
the voice level.

❻
Power Input &
Operating Voltage Status:
PWR A: power supply from PWR A jack.
PWR B: power supply from PWR B jack.
VCC: +5 VDC operating voltage power supply.
SW CTR: It is on when the Saved Settings
        equal the Defaul Settings.
        Otherwise, it will be Off.

❺
LINK indicator: "on" when proper ethernet signal is detected at
at the RJ-45 port, "Flashing" when signal is not received.
ACT (Active) indicator: "on" when sending data across the
network. It is normal that the "ACT" LED will turn on occasionally.
SYNC indicator: will flash if signal is lost over 15 secs & will also
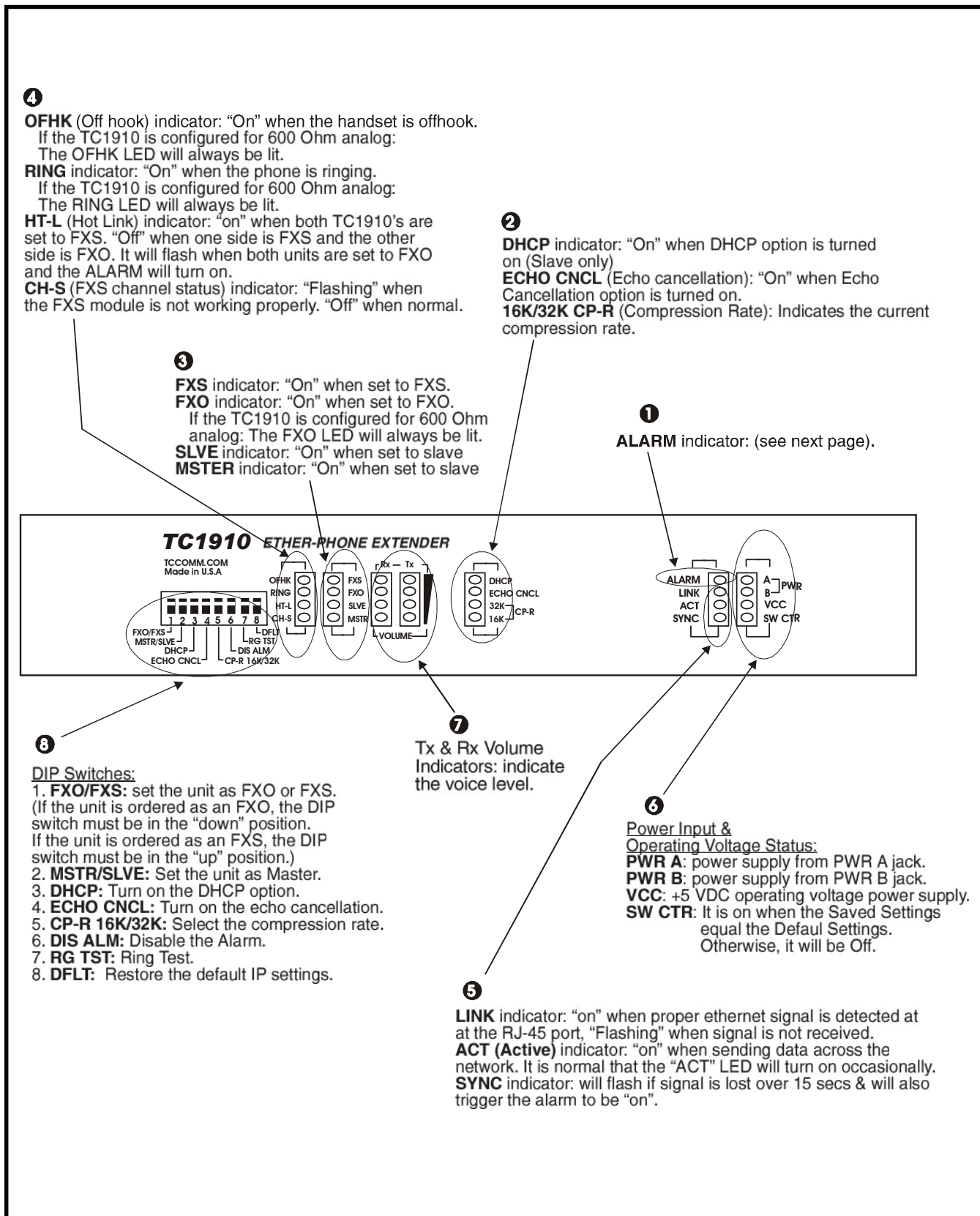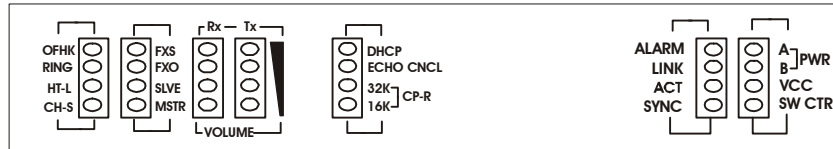trigger the alarm to be "on".

Figure 1.   TC1910's Front Panel

"PWR A/B" LED: It is on when power is present at PWR A/B connector on rear panel.

"VCC" LED: It is on when adequate power is being derived from the power source.

"SW CTR" LED: It is on when the Saved Settings equal the Default Settings. Otherwise, it will be Off.

"Alarm" LED: It will flash under the following conditions.
1. No Ethernet signal is detected. "LNK" LED will flash.
2. Communication link between Master and Slave is lost. "Sync" LED will flash.
3. FXS channel is not working properly. "CH-S" LED will flash.
4. Both Master and Slave are set to FXO. "HT-L" LED will flash.
5. "DFLT" switch is on. "MSTR" or "SLVE" LED will flash.

"Link" LED: It is on when proper Ethernet signal is detected and flashing when it is not.

"ACT" LED (Active):   It is on when data traffic is detected at the Ethernet port. It is normal that the LED will turn on occasionally.

"SYNC" LED: It is on when the communication link is established between the TC1910 pair (master and slave.) It will flash and the alarm will turn on if the communication link is lost for more than 15 secs. The TC1910 pair will automatically re-establish the link after any power or network disruption.

"DHCP" LED: The DHCP option is available for slave unit only. The LED will flash when the unit is getting the IP information from the DHCP server and it is on when the unit got the information. The LED is off for the master unit or when DHCP option is not set.

"ECHO CNCL" LED (Echo Cancellation): It is on when the Echo Cancellation option is turn on.

"32K/16K CP-R" LEDs (Compression Rate): It indicates the current ADPCM compression rate.

"TX / RX VOLUME" LEDs: The LEDs indicate the volume levels on both outgoing and incoming voice signals.

"FXS" LED: It is on when the unit is set to FXS.

"FXO" LED: It is on when the unit is set to FXO.
If the TC1910 is configured for 600 Ohm analog: The FXO LED will always be lit.

"SLVE" LED (slave):   It is on when the unit is set to slave. It will flash when "DFLT" is on.

"MSTR" LED (master):   It is on when the unit is set to master. It will flash when "DFLT" is on.

"OFHK" LED (off hook):   It will turn on when the user picks up the handset.
If the TC1910 is configured for 600 Ohm analog: The OFHK LED will always be lit.

"RING" LED: It will flash when the phone is ringing.
If the TC1910 is configured for 600 Ohm analog: The RING LED will always be lit.

"HT-L" LED (hot link):   It is on when both TC1910 is set to FXS. It is off when one side is FXS and the other side is FXO. It will flash when both unit is set to FXO and the alarm will turn on.

"CH-S" LED (FXS channel status): It will flash when the FXS module is not setting up properly. It is off normally.
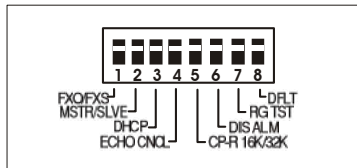
1. **FXO/FXS:**   Set the unit as FXO (down position) or FXS (up position).
(If the unit is ordered as an FXO, the DIP switch must be in the down position. If the unit is ordered as an FXS, then the switch must be in the up position.)
   NOTE: If the TC1910 units are configured for 600 Ohm analog: Both the Local and Remote TC1910 units must be set to FXO.

2. **MSTR/SLVE:**   Set the unit as Master (down position) or Slave (up position.)   The changes apply after the power is reset.

3. **DHCP:**   Turn on (down position) the DHCP option.   The changes apply after the power is reset. (Slave only.) Please refer to P.16 for more details.

4. **ECHO CNCL:**   Turn on (down position) the Echo Cancellation option.

5. **CP-R 16K/32K:**   Select the ADPCM compression rate for 16Kbit/s (down position) or 32Kbit/s (up position.) ADPCM 16Kbit/s and 32Kbit/s compression are corresponded to 57Kbit/s and 113Kbit/s on the Ethernet. The changes apply after the power is reset.

6. **DISALM:**   Disable (down position) the Alarm. "Alarm" LED will still flash during the "alarm on" condition. However, the buzzer will be off and the dry contact will be open.

7. **RG TST:**   Ring Test. Ring the phone when the unit is setup as FXS

8. **DFLT:**   Default. When set (down position,) the unit will restore the default IP address and Subnet after the power is reset. It is used during the initial setup or the IP address is lost.

If the Saved Settings equal the Default Settings, "SW CTR" LED will be on.

To properly restore the default IP settings, please follow the following steps.

   For Master:
   1. Power off the unit.
   2. Set the "DFLT" and "MASTER" switches to on (down) position.
   3. Power up the unit and wait for 2 seconds.
   4. Set the "DFLT" switch back to off (up) position.
   Master IP: 192.168.254.123 Subnet: 255.255.255.0

   For Slave:
   1. Power off the unit.
   2. Set the "DFLT" to on (down) position and "MASTER" to off (up) position.
   3. Power up the unit and wait for 2 seconds.
   4. Set the "DFLT" switch back to off (up) position.
   Slave IP: 192.168.254.124 Subnet: 255.255.255.0

RJ-11 Connector for "Phone/Line" or Analog Signal:

For FXO, use a regular phone wire to connect to the local phone network such as phone line from Telco or PBX phone line.

For FXS, use a regular phone wire to connect to conventional (2-wire) telephone.

Use this RJ-11 port to connect the two or four wire 600 Ohm analog signal.

RJ-45 Connector for "10 Base-T Ethernet":

Connect this port using a twisted pair Ethernet cable to the local network.

Dry Contact Relay Terminal Blocks:

The Dry Contact Relay is normally in "Open" position. It will force the relay to "Close" position under the following conditions:

1. Major Alarm is on (e.g. 10 Base-T signal lost). This function can be disabled by setting the front panel "DISALM" switch to on (down) position.
2. Ringing signal is received. This function can not be disabled by "DISALM" switch at the front panel.
3. The dry contact relay will close during power up.
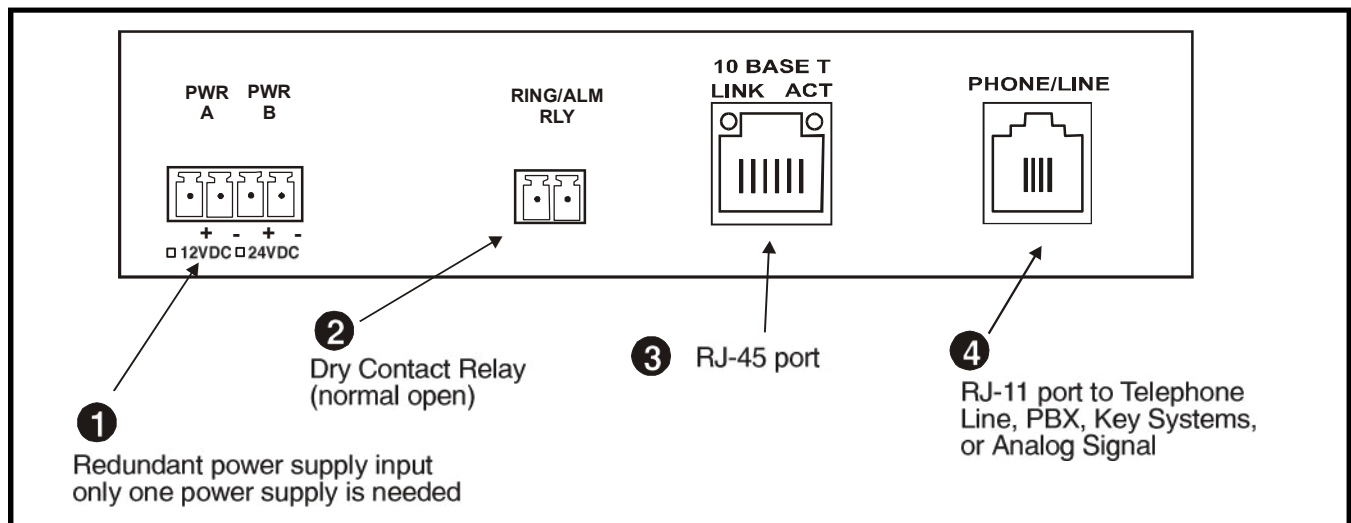
Figure 2. TC1910's Rear Panel

Chapter 2 - Application Diagrams

## Application Example 1: Hotlink Phone via Ethernet

The TC1910 is intended to provide flexible point-to-point telephone service via Ethernet Networks. It is often used by maintenance or service personnel in Campus, Traffic Control, or Utility Substation Networks. By connecting two TC1910's as shown below and using regular telephone sets, the users at both sides of the Ethernet link can have a hotlink phone line setup. When one user lifts up the handset, the remote side phone will start to ring. When remote side user picks up the handset, the phone will stop ringing and the conversation begins. When conversation is over, any user can terminate the phone link.
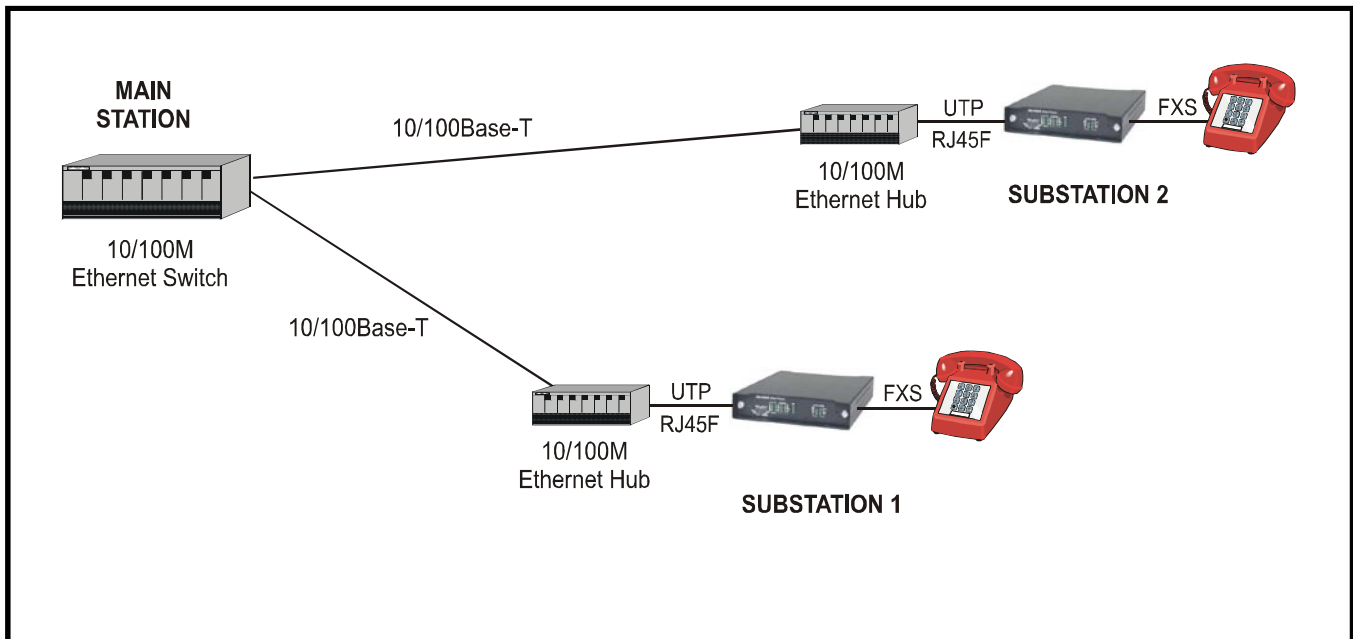
Figure 3. Typical Application Using TC1910 Ether-Phones to Provide Hotlink Phone Service in a Substation Environment.

Application Example 2: Phone line Extension via Ethernet

This application is to extend a dial-up phone line via existing ethernet as shown in the following diagram. By connecting a TC1910 to a regular dial-up phone line, the users at the remote end can dial to the outside phone network just like regular telephone line extended.
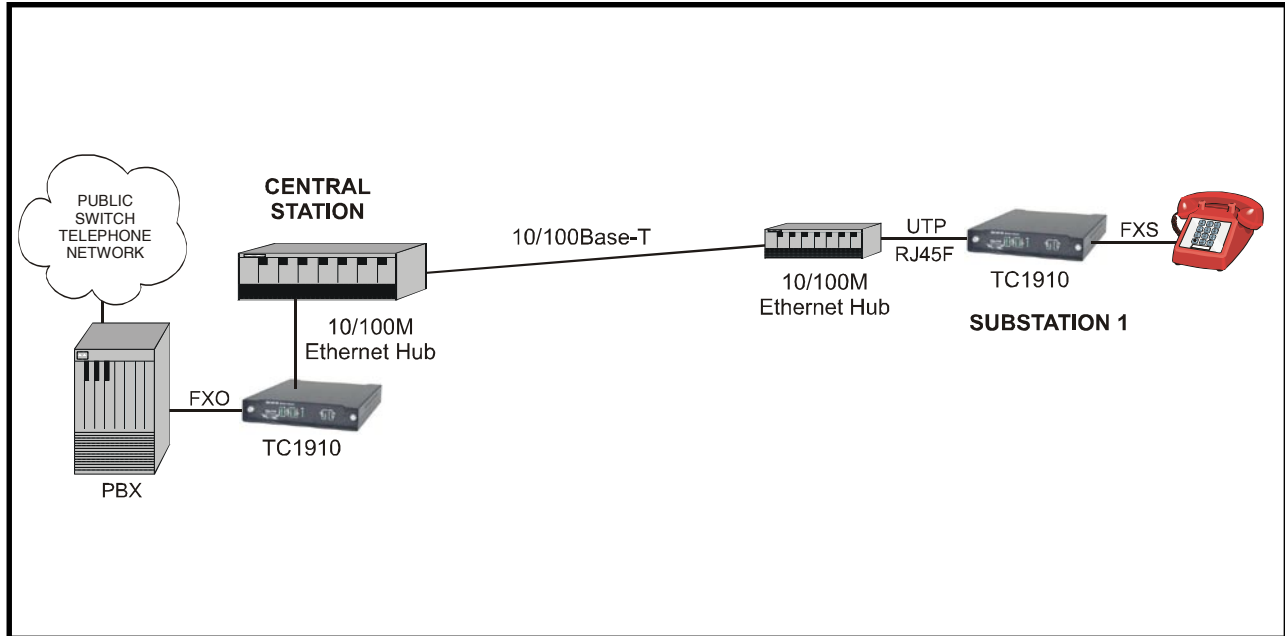
Figure 4. Typical application using TC1910 Ether-Phone Extender to extend a telephone line via an Ethernet LAN.

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 TC Communications' Customer Service Department.

Equipment Location

The TC1910 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.

Power Supply

Each TC1910 unit is powered via a rear panel's terminal block connector. There are two pairs of terminal block connectors ("PWR A" and "PWR B") for power redundancy, the power LEDs on the front panel will light according to which power jack(s) is/are connected. The power is 12 VDC @500mA, (24 VDC and AC 90 VAC to 240 VAC are optional).

Electrical Signal Connection

The RJ-45 & RJ-11 female connectors for the electrical signals are located on the rear panel.

TC1910 Configuration

TC1910's need to work in pairs in an Ethernet network. One unit needs to be set to Master "MSTR" and the other one needs to be set to Slave "SLVE" using the front panel DIP switch. If the TC1910 pair is separated by a firewall, the Master unit should be the one sitting outside of the firewall. (Please refer to P.7 "Dip-Switch Functions" for setting the unit to default setting.)

All units come with default Slave settings, please refer to the "Quick Start/Test" section on P.18 for simple setup examples.

*Note: The TC1910 **FXS** configured unit(s) will ring the phone channel during initialization, and the phone set connected on the FXS channel should ring 10 seconds after power up.*

For Slave:

Default IP: 192.168.254.124

Default Netmask: 255.255.255.0

For Master:

Default IP: 192.168.254.123

Default Netmask: 255.255.255.0

Web-based Interface Connection:

1. Connect the computer and TC1910 on the same Ethernet switch.
2. Power up the unit and the "LINK" LED should be on. (You can disable the alarm by setting the "DISALM" to down(on) position.)
3. Start your Web browser.
4. In the Address box, enter the IP address of the TC1910. For example, if the unit is set to default Slave, enter: http://192.168.254.124
   If the unit is set to default Master, enter: http://192.168.254.123
5. Once connected, you should see the following screen. (Please refer to "Testing & Trouble shooting" section, if not connected)
6. Click the links at the left of the page to navigate to the desired section.

Figure 5. TC1910 Home Page

If you are being asked for a username and password on any of the pages, use the following:
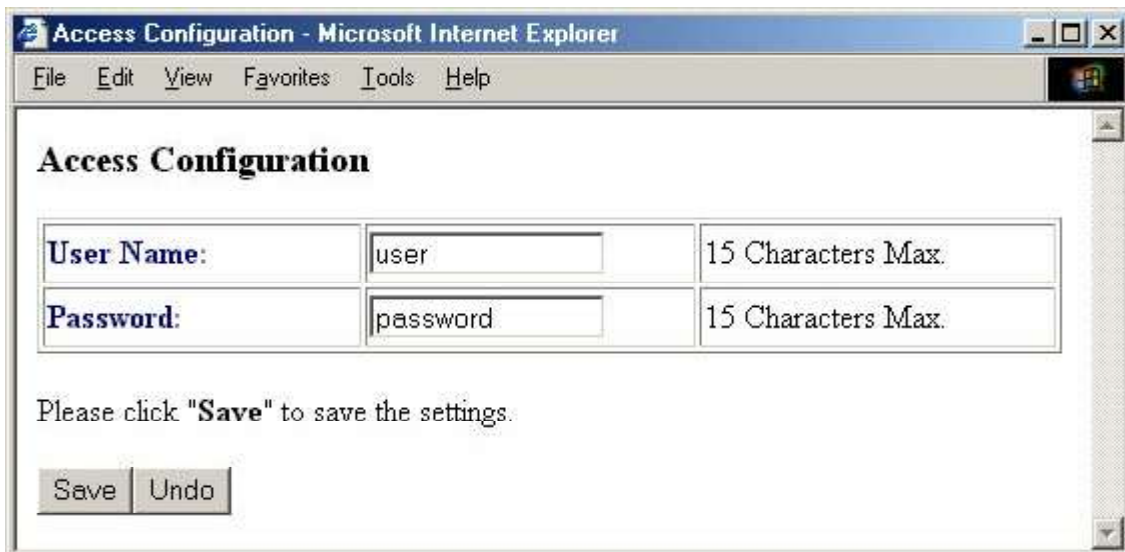
Default user name: **user**

Default password: **password**

Figure 6. TC1910 Password Dialog

Access Setting

You can change the user name and password by clicking on the link "Setting" at the home page.
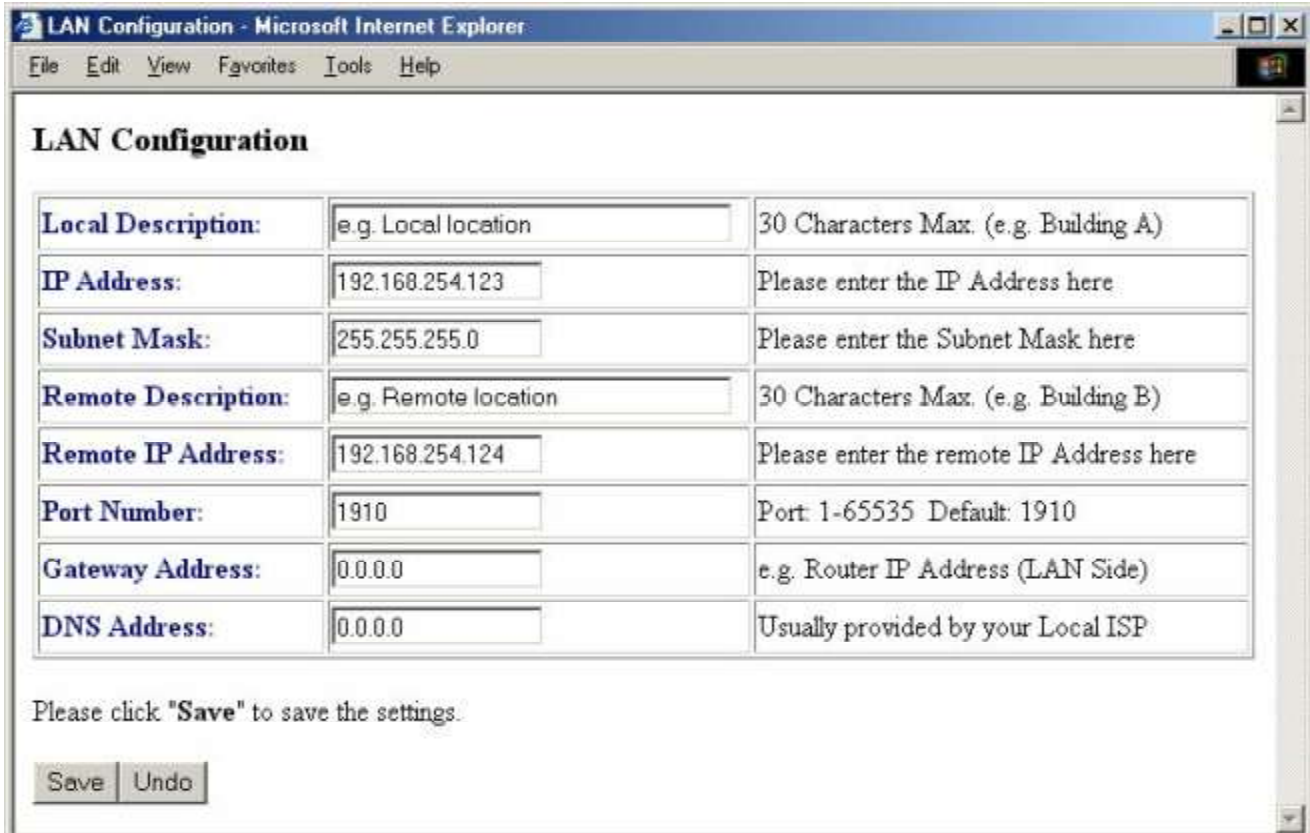

Figure 7. TC1910 Access Setting Page

Click the "Undo" button or browser's "Back" button to cancel all the changes.

Click the "Submit" button to save the changes.

Click the "Reset" button to apply the new access setting at the "Access Setting Summary" page.

LAN Setting

Click on the "LAN Configuration" Link at the home page and you should see the following screen.

Figure 8. TC1910 LAN Setting Page

(Note: Please contact your local network administrator for your network settings.)

Local Unit Description (not required): Enter the description for the local unit.

IP Address: Unit's IP Address. The default IP Address for master is 192.168.254.123, and the default IP Address for slave is 192.168.254.124.

If you change the IP Address, you must reconnect using the new IP Address. If you are using the DHCP option, this value will be set automatically.

Subnet Mask: This indicates the TCP/IP network class you are using.

The default Subnet Mask is 255.255.255.0. If you are using the DHCP option, this value will be set automatically.

Remote Unit Description (not require): Enter the description for the remote unit.

Remote IP Address: (not require for master unit.) For Slave unit, this is the IP Address of the remote Master. (It is recommended that user enter the remote Slave IP address here for the master unit for future refrence.)

The default remote IP Address for master is 192.168.254.124, and the default remote IP Address for slave is 192.168.254.123.

Port Number: This is the port which the TC1910 units will attempt connections.

Default value is 1910. (Range: 1-65535).

Note: (Some of the well known port numbers such as 1, 23, 80 , 546, and 547 cannot be used as communication ports because they are already used internally by the unit itself.)

Gateway IP Address: If your connection contain a router, enter the IP Address of the Router (LAN side.)

Default value is 0.0.0.0 If you are using the DHCP option, this value will be set automatically.

DNS IP Address: If you need to connect outside of your LAN, enter the DNS IP address here.

Default value is 0.0.0.0 If you are using the DHCP option, this value will be set automatically.

Click the "Undo" button or browser's "Back" button to cancel all the changes

Click the "Submit" button to save the changes, and you will see the following screen.
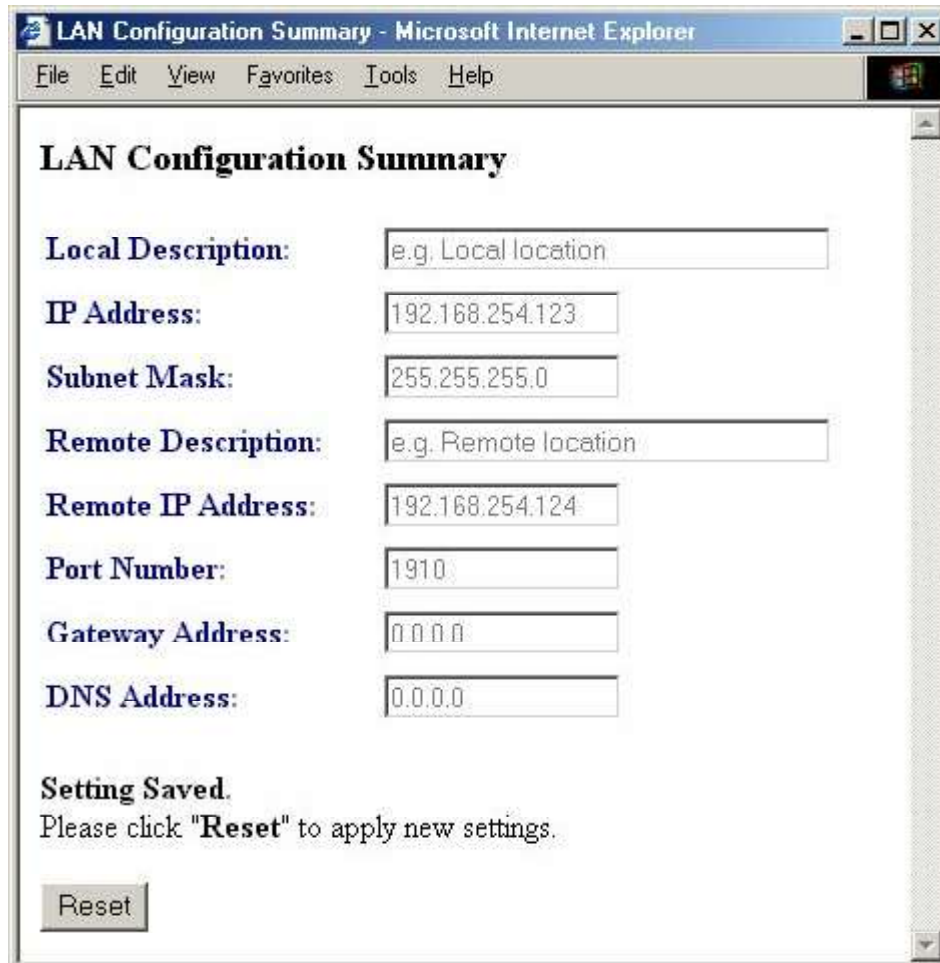
Figure 9. TC1910 LAN Configuration Summary Page

You need to Reset the unit to apply the new settings.

1. By clicking the "Reset" button at the bottom of the page. Or,

2. By resetting the power of the unit.

Static IP

Master unit's IP address must be Static. The IP address should be entered at the "IP address" field on the "LAN Setting" page.

Slave unit's IP address can be Static or Dynamic. For static IP setting, the IP address should be entered at the "IP address" field on the "LAN Setting" page.

(Please refer to "LAN setting" section for more detail.)

For Slave unit dynamic IP setting, please refer to the "DHCP" section below.

DHCP (Dynamic IP)

DHCP (Dynamic Host Configuration Protocol) option is for Slave unit only. It enables the Slave unit to get a temporary or permanent IP addresses (out of a pool) from a DHCP server.

In order to use the DHCP function, there should be a DHCP server residing at the user's local network. If DHCP server is not available, the Slave unit's IP address must be Static. Please refer to the "Static IP" section above for more information.

Before you turn on the DHCP option, you need to enter the Master's IP address at the "Remote IP address" field on the "LAN Setting" page for the Slave Unit.

Please do the following after the "Remote IP address" has been set on the Slave unit.

1. Power off the unit.

2. At the front panel, set "DHCP" DIP switch to on (down) position.

3. Power up the unit.

The "DHCP" LED will flash when the unit is obtaining an IP address from the DHCP server and the LED turns solid after the unit gets one.

Electrical Analog Signal Interface Connections & Pin Assignments for 2/4 Wire

The RJ-11 connector is located at the rear panel of the TC1910.

For four wire analog signals:

Pin 5 is transmit TIP & pin 2 is transmit RING.
Pin 4 is receive TIP & pin 3 is receive RING.
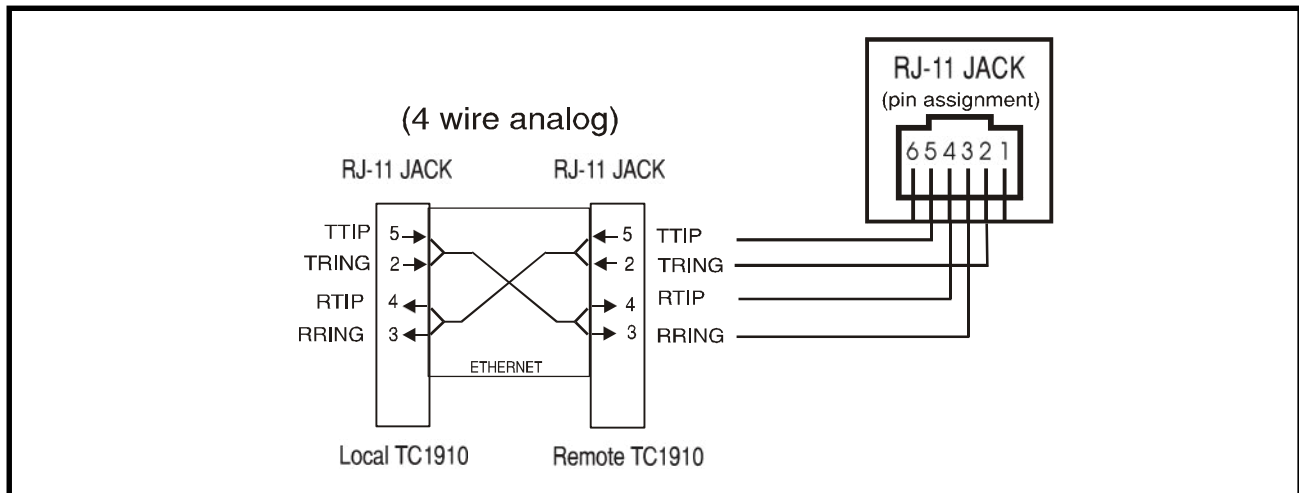
Figure 10. Four Wire Analog Pin Assignments & Connection Diagram.

For two wire analog signals:

Pin 4 is the TIP & pin 3 is the RING.
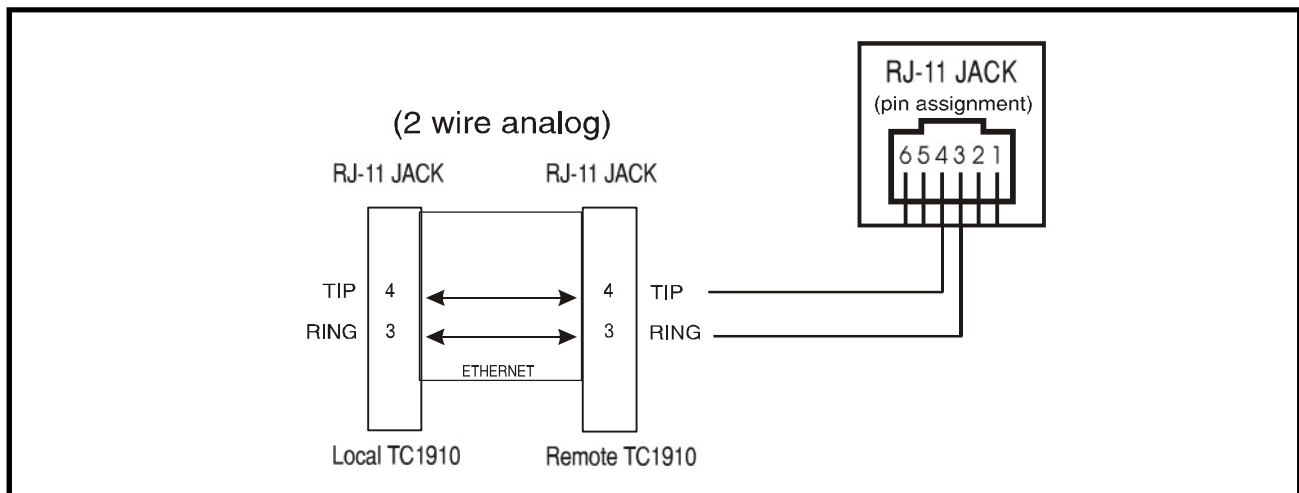
Figure 11. Two Wire Analog Pin Assignments & Connection Diagram.

PC Configuration:

In order to communicate with a TC1910 that is set to default, the user's PC IP address must be set within the range of 192.168.254.1 to 192.168.254.254, with a Network Mask of 255.255.255.0. To check your PC's IP Address and Network Mask. (Windows 98/ME)

1. Open "Control Panel"

2. Open "Network"

3. Click on the TCP/IP for the network card

4. Click "Properties"

If your PC has a compatible IP Address and Network Mask. Please go to the Web-based Interface section. (Attention: Please copy down the existing setting before making any changes. Contact your local network administrator if you are unsure about the settings. Improper settings may result in disruption of the current network.)
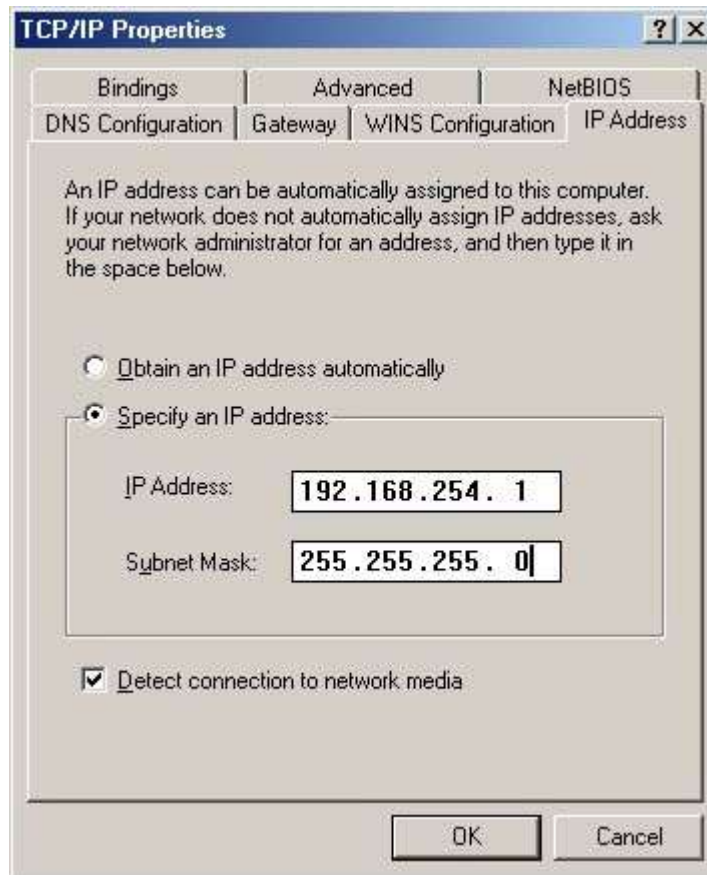
Figure 12. TCP/IP Properties

Under the TCP/IP Properties

Select the "Specify an IP address" option and type in the following

IP Address: 192.168.254.1 (Please make sure no other network device are using the same IP address.)

Subnet Mask: 255.255.255.0

Click OK and reboot the computer.

Testing & Troubleshooting continue

Quick Start/Test

Typically, most problems encountered with the TC1910 are related to network settings. To ensure the units are working properly, the following section will show you how to test the functionality of a TC1910 pair without any network settings.

Equipments:

1. One 10/100 Ethernet Switch/Hub or Use the supplied Cross Over Cable(for testing purpose only), see next page.

2. Two TC1910 units.

   For "Hotlink" tests, both of the units must be configured as FXS.

   For "Phone Line Extension" tests, one unit must be configured as an FXO and the other as FXS.

3. Two Regular Telephones.

4. Two telephone wires and two Ethernet cables.

Connect both TC1910 units to the Ethernet Switch and connect a phone to both units. Make sure the Ethernet switch is not connected to anything except the power and the TC1910s.
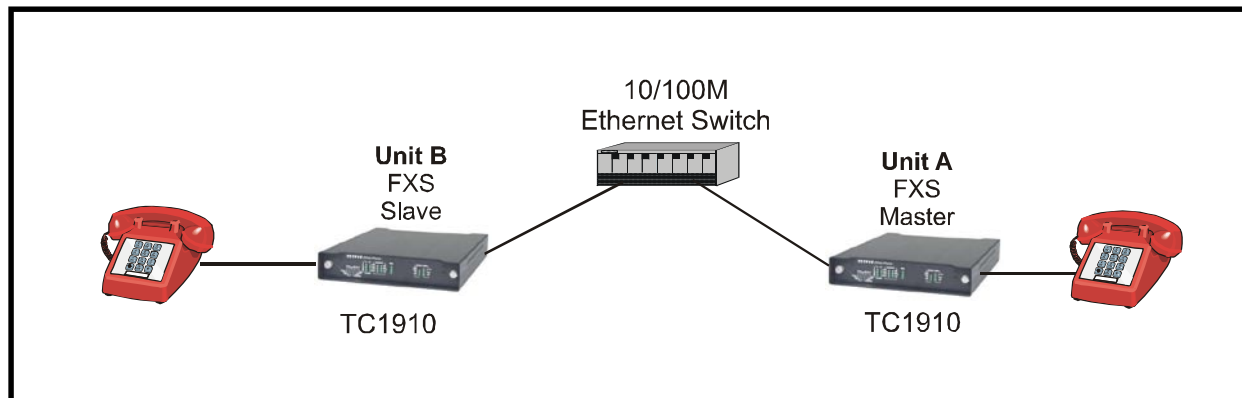
Figure 13. TC1910 Quick Test (Hot Link)

Unit A (Master)

Make sure the power of the unit is off. Set the "MASTER" and "DFLT" DIP switches at the front panel to on (down) position. (All other switches are set to off (up) position.)

Unit B (Slave)

Make sure the power of the unit is off. Set the "DFLT" DIP switch at the front panel to on (down) position. (All other switches are set to off (up) position.)

Power up and set the "DFLT" DIP switch back to off (up) position on both units.

The communication link between the master and slave should establish automatically within 15 secs, and no LEDs should be flashing (it is normal for the "ACT" LED to turn on occasionally.)

When one side pick up the handset, the other side should ring. When both of the handsets are offhook, the voice should go through in both directions and can be heard on either end of the handsets.

Testing & Troubleshooting continue

If an Ethernet Switch is not available, you can replace the Switch with the supplied cross over cable as shown below. Follow the same procedures as shown on page 20, Quick Start/Test for Unit A (Master) and Unit B (Slave).

Hot Link Test
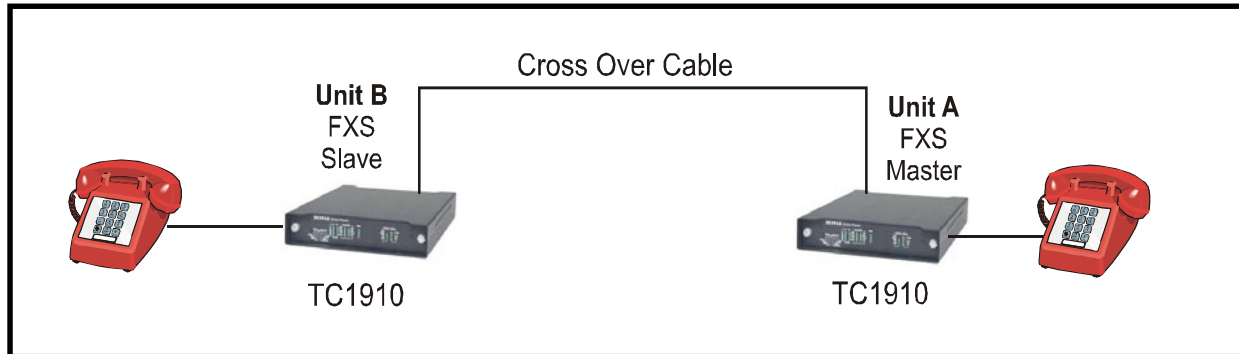
Figure 14. TC1910 Quick Test (Hot Link)

Testing & Troubleshooting continue

To test the Phone line Extension function, Simply do the following: (Power off is not needed)

Unit A: (Assuming FXO unit is odered).

Set the "FXO" DIP Switch to on (down) position.

Connect a phone line between the TC1910 and the wall jack.

Unit B:

No Change
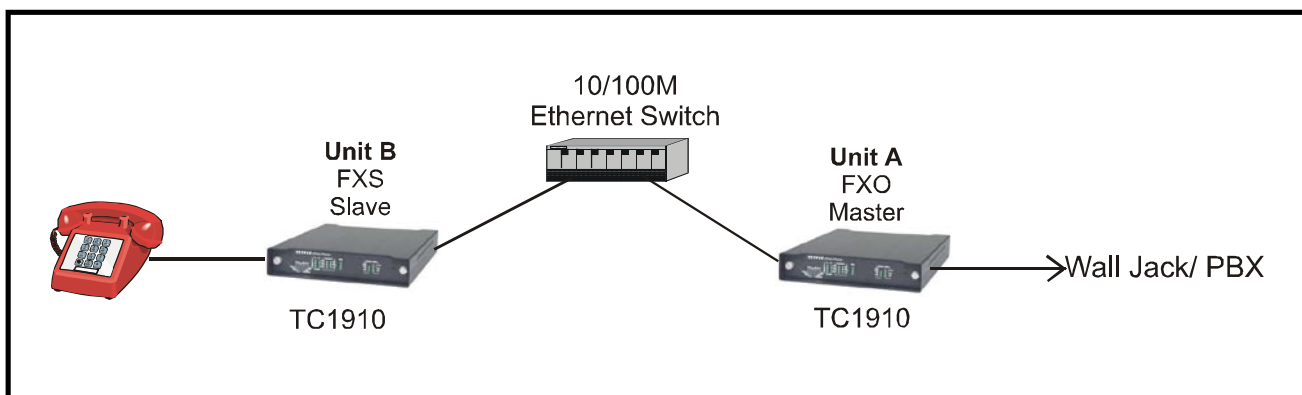
Figure 15. TC1910 Quick Test (Phone line Extension)

When handset at Unit B is picked up, the user should hear the dial tone and be able to dial to the outside phone network just like regular telephone line extended.

Audio Bandwidth

Telephone and Analog ....300Hz to 3.4Khz

Ethernet Bandwidth

With ADPCM 32Kbit/s compression.. 113K bps
With ADPCM 16Kbit/s compression.. 57K bps

Electrical

Phone Connector .... RJ-11 Female (2-wire)
Ring voltage ....80Vrms at 20Hz
FXO Input Impedance ....600 Ohm
FXS output Impedance ....600 Ohm
Ethernet (10Base-T) .... RJ-45 Female
Baud Rate 10Mbps

Alarm/Ring

Dry Contact.. Normal OPEN

Indicators

System status... ALARM, PWR A, PWR B, VccA, VccB
Telephone Signal Status Tx and Rx Volume, Off-hook, FXO, FXS, Ring, Hot Link
Ethernet Signal Status .... Sync, Link Status, Activity, DHCP, Master/Slave

Power Source

Standard .... 12VDC @500mA
Optional ....24VDC, or 115/230VAC with an external power cube

Temperature

Operating ....0°C to 50°C
Hi-Temp Version (optional) .... -20°C to 70°C
Storage .... -40°C to 90°C
Humidity .... 95% non-condensing

Physical (Standalone/Wallmount unit)

Height .... (3.53 cm) 1.4"
Width.. (18.14 cm) 7.1"
Depth .... (24.89 cm) 9.8"
Weight .... (835 gm) 1.85 Lbs

Appendix A

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).

Limitation of Liability

In no event shall the total liablility 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.

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Limitation of Liability (Cont.)

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.