Exhibit S

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P-COM

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January 1999

Tel-Link
Point-To-Multipoint

Sector Terminal Installation Manual

PRELIMINARY

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Tel-Link Point-to-Multipoint Sector Terminal Installation Manual

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1.0 General Information

Before installing and operating a Tel-Link Point to Multipoint (PMP) System, P-COM recommends that installation personnel read this section in its entirety, before installing. Once this is accomplished, the user can proceed directly to the section or subsection of interest.

This manual provides the installation procedures and guidelines for installing hardware associated with a Tel-Link Point to Multipoint (PMP) System. This manual is intended for personnel who are responsible for installing and testing the Tel-Link Point to Multipoint system. The user should keep this manual next to the system at all times.

P-Com highly recommends that the user utilize the P-COM PMP Installation Procedure Checklist located in Appendix A to ensure the correct procedures for installing P-COM PMP equipment are followed. For further assistance, contact P-COM the Technical Assistance Center at (407) 674-3699.

1.1 Manual Organization

This manual is part of a set of Tel-Link Point-to-Multipoint manuals that focus on specific aspects of the Point-to-Multipoint system. The set of manuals consist of the following:

- 68132 - Tel-Link Point-to-Multipoint Sector Terminal Installation Manual
- 68133 - Tel-Link Point-to-Multipoint Remote Terminal Installation Manual
- 68134 - Tel-Link Point-to-Multipoint Local Site Manager Manual
- 68135 - Tel-Link Point-to-Multipoint System Description Manual

The Manual is divided into 12 sections providing specific information needed to install and test the Tel-Link Point to Multipoint System. The sections are:

- **Section 1:** General Information – Contains discussions on the use of this manual, summary of the manual, special notations, and general safety reminders
- **Section 2:** Sector Terminal Overview
- **Section 3:** Tools and Test Equipment Required
- **Section 4:** Site Preparation
- **Section 5:** Equipment Unpacking and Inspection
- **Section 6:** Sector Terminal Outdoor Unit Installation
- **Section 7:** Sector Terminal Indoor Unit Equipment Physical Installation
- **Section 8:** Installation of Sector Terminal Wire and Cabling
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- **Section 11:** Initial Terminal Configuration and Testing
- **Section 12:** Technical Support

1.2 FCC Requirements Summary

Operators must be familiar with the requirements of the Federal Communications Commission (FCC) Parts 2 and 101 Regulations prior to operating any link using the equipment. For installations outside the United States, contact local authorities for applicable regulations.

1.3 Requesting Changes

We welcome your suggestions for improving this manual. A Reader Comments form is provided at the end of this manual on which you can record your comments and suggestions for improvements.

1.4 Special Notations

This manual uses four levels of special notation to alert you to important information concerning your safety, proper equipment handling, or useful tips for easier operation. These notations are shown below in descending order of importance

DANGER!

Indicates that personal injury can result if you do not comply with the given instruction. A DANGER! statement will describe the potential hazard, its possible consequences, and the steps you must take to avoid personal injury.

WARNING!

Indicates that serious damage to the equipment can result if you do not comply with the given instruction. A **WARNING!** statement will describe the potential hazard, its possible consequences, and the steps you must take to avoid serious equipment damage.

CAUTION!

Indicates that equipment damage and/or process failure can result if you do not comply with the given instruction. A **CAUTION!** statement will describe the potential hazard, its possible consequences, and the steps you must take to avoid equipment damage and/or process failure.

NOTE

Provides supplementary information to emphasize a point or procedure, or gives a tip for easier operation.

1.5 General Safety Reminders

To prevent possible personal injury or equipment damage, always observe the following rules:

- Installation and operations personnel should be familiar with the safety requirements before attempting installation or operation of the equipment covered by this manual. Failure to follow the requirements could result in death or injury to personnel and/or damage to the equipment.
- Always examine the general area for any potential hazards (such as wet floors or overhead powerlines) before beginning installation.
- Observe all DANGER! notations. Dangerously high voltages are present within this equipment, when in operation. Lethal line voltages may be present unless the main line power has been disconnected.
- Always remove any jewelry or other personal items that may conduct electricity before beginning installation.
- Keep away from live circuits. Whenever feasible in verifying circuits, check by continuity and resistance methods with all power off, rather than directly checking voltages.
- Observe grounding precautions. Verify that the unit under test or being installed and all measurement equipment are properly grounded.
- Do not test alone. Testing or adjusting the equipment should only be carried out in the presence of a person qualified to render aid.
- When lifting the equipment, use proper lifting techniques to prevent injury.
- It is the responsibility of the installer and the user to ensure that the public is not exposed to excessive RF levels. Such information must be posted near the antenna in the form of caution or warning notes and signs.

1.6 PMP Terminology

For the ease of the reader, a Glossary is provided at the end of the manual defining terminology used in P-COM Tel-Link Point-to-Multipoint manuals

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2.0 Sector Terminal Overview

The PMP network is designed around a series of Base Station sites strategically located within the desired coverage area, with each site supporting line-of-sight connections to many Remote Terminals. A Base Station provides 360° coverage through the use of segmented sectors, each providing 15°-90° coverage around the Base Station (refer to Figure 2-1). Each Base Station also interfaces to the Public Switched Network (PSN) through concentrated access links. A sectorized area of a Base Station Sector is supported by 1 to 5 Sector Terminals, depending on the number of Remote Terminals located in that sector. A Sector Terminal consists of an Indoor Unit (IDU) and an integrated RF/Antenna Outdoor Unit (ODU). The Sector IDU is a standard 19-inch rack-mount chassis with redundant power supplies, and space for plug-in cards. All cards are hot pluggable/swapable. Each sector antenna contains a transmit and receive horn, with azimuth beamwidths from 15° and 90°.

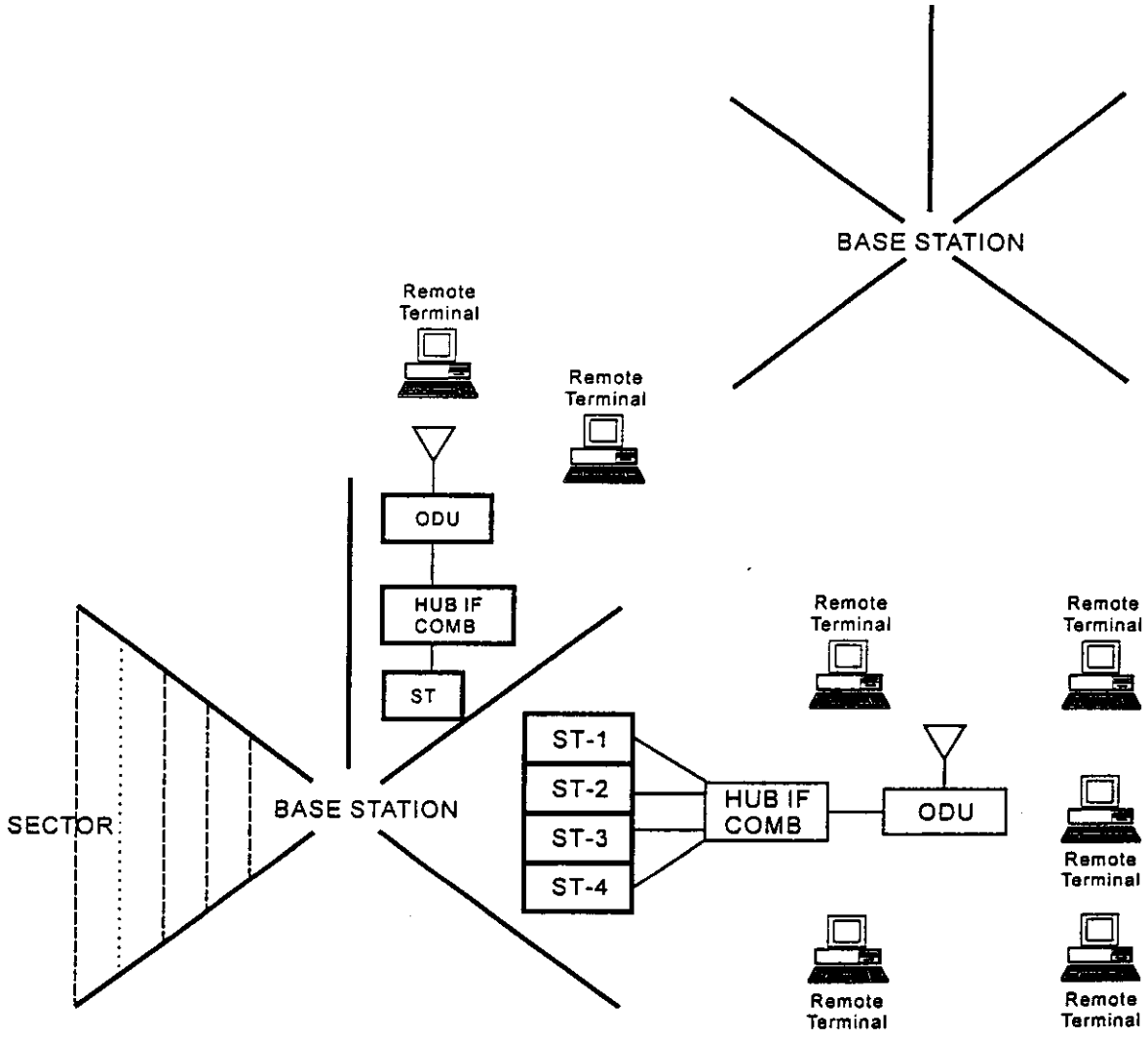

Figure 2-1 - Example of Simplified Base Station Site

The system utilizes a cell-multiplexed, continuous carrier to transmit data from a Sector Terminal to the Remote Terminals. A separate carrier is used by each Sector Terminal to deliver these cells to the Remote Terminals. These carriers are typically transmitted at slightly different frequencies to avoid interference. Frequency Division Multiple Access (FDMA) method is used by the Remote Terminals to transmit information to a Sector Terminal. The Remote Terminals each communicate on separate carriers with demodulators at the Sector Terminal.

The Sector Terminal consists of the following components:

- An IDU chassis to house modulator(s), demodulator(s), sector controller(s), power supply(ies) and Network Interface Modules (NICs)
- A Hub IF Combiner
- An outdoor unit (ODU) containing the RF electronics
- An Antenna and mounting hardware
- An IFL consisting of a single coaxial cable connecting the IDU to the ODU

2.1 Indoor Unit (IDU)

The Sector indoor unit (IDU) is located inside the customer's strategically located Base Station facility. Multiple Sector IDUs may be connected to a Hub IF Combiner to increase the capacity supported in a particular sector. The Hub IF Combiner is the interface between multiple Sector IDUs to an outdoor unit (ODU) via a single coaxial cable. The IDU is comprised of the following components:

- A software configurable QPSK, 16-QAM, or 64-QAM Modem consisting of a Modulator and Demodulator that provides the physical layer wireless communication link between the Sector Terminal IDU and the Remote Terminal IDU
- A Controller card that is responsible for controlling and monitoring local functions, and processing Network Management messages from the Network Operation Center.
- Network Interface Cards (NICs) which supports user interfaces, as well as signal monitoring and port statistics collection.

The Sector Indoor Unit (IDU) chassis consists of a modulator(s), demodulator(s), and controller(s) and can accommodate up to 5 T1 Network Interface Cards (NICs) (refer to Figure 2-2). Chassis configuration is performed from a Local Site Manager (LSM) laptop or desktop PC using the P-COM's WaveView Lite Windows application. Each card has specific variables, which need to be properly configured to establish a RF link to the PMP Remote Terminals and pass user data. Each card in the chassis has a physical and logical slot number and are individually addressed by logical slot number (refer to Figure 2-3).

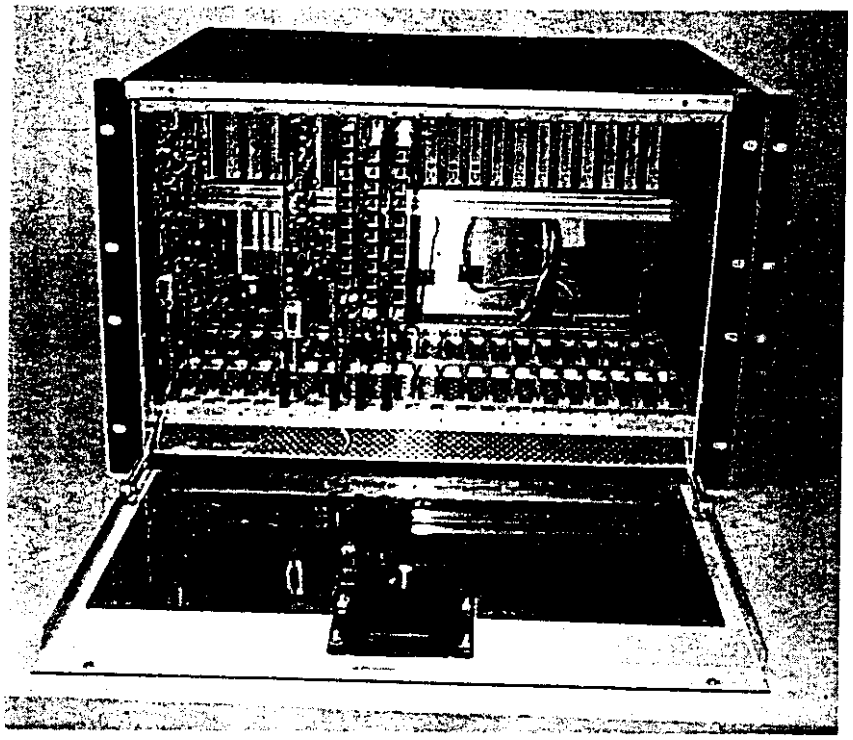

Figure 2.-2 – Sector Indoor Unit Chassis

Physical Slot Numbers

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
NIC 1	NIC 2	NIC 3	NIC 4	NIC 5	CLTR 1	CLTR 2	MOD 1	MOD 2	DEMOD 1	DEMOD 2	DEMOD 3	DEMOD 4	DEMOD 5	DEMOD 6	DEMOD 7	DEMOD 8	DEMOD 9	DEMOD 10

Figure 2-3 – Sector Station IDU Interior

Figure 2-4 shows a simplified block diagram of the IDU.

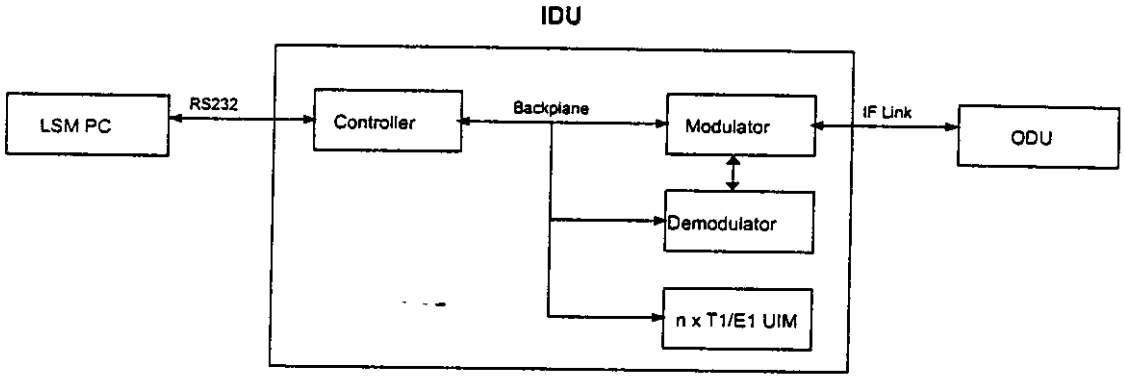

Figure 2-4 – IDU Block Diagram

A single, or dual for redundancy, power source (AC or DC) is required to provide power to the Sector Terminal. An optional external battery back-up unit can provide from 4 to 8 hours of operation in the presence of a primary power failure (refer to Figure 2-5).

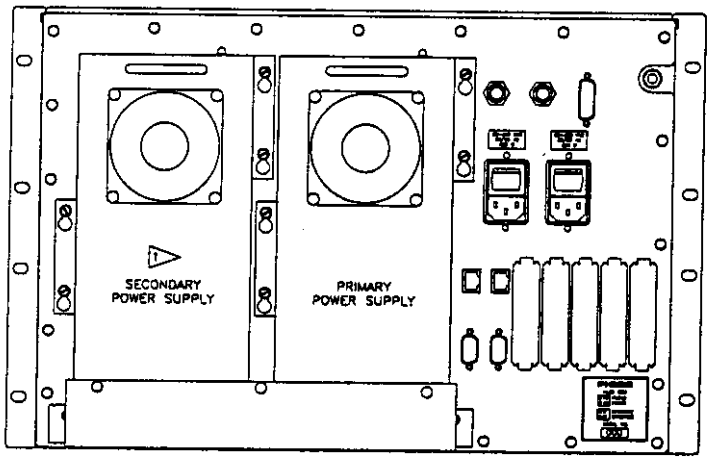

Figure 2-5 - AC Power Source

2.2 Hub IF Combiner

The Hub IF Combiner is used to combine multiple (up to four) Sector IDU signals and to route them to a single Outdoor Unit (ODU). These Sector IDU signals include Transmit IF and Receive IF signals and also carry telemetry information. After these signals enter the HUB IF Combiner they are coupled together with a high stability frequency oscillator and a +48 VDC signal. The high stability frequency oscillator operates as a system reference for the ODU and its control circuitry. The +48 VDC signal is the supply voltage for the ODU. The Sector IDU IF signals, the reference signals, the telemetry information and the +48 VDC signal are all distributed to the ODU by a single cable.

On the back panel of the Hub IF-Combiner is a switch that enables the user to select whether the unit is operating Link A or Link B. On the front panel a LED will be illuminated to identify which configuration has been selected.

The HUB IF Combiner is powered by 120 VAC (refer to Figure 2-6), or +48 VDC (refer to Figure 2-7) if the unit was ordered with the optional DC configuration.

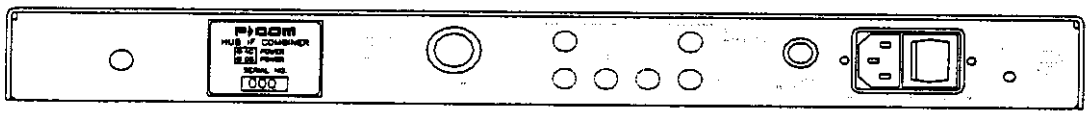

Figure 2-6 - IF Combiner 120VAC

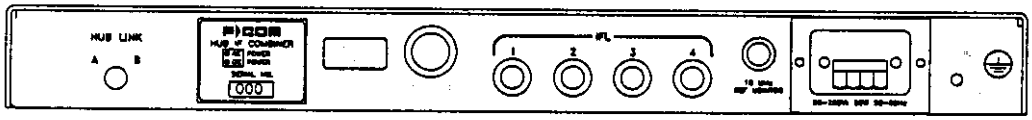

Figure 2-7 - IF Combiner 48 VDC

2.3 Outdoor Unit (ODU)

Figure 2-8 illustrates the RF/Antenna configuration for the Sector Terminal Outdoor Unit. The packaging includes the following components:

- ODU Enclosure
- RF Electronics
- ODU Controller Card responsible for controlling and monitoring ODU functions and for interfacing with the IDU

The ODU is frequency agile so that the same ODU can typically be used throughout the entire allocated frequency band. Subsequently, this reduces sparing levels.

The ODU meets all National Electrical Code requirements pertaining to lightning and power transients and meets or exceeds FCC and ETSI regulations pertaining to conducted and radiated Electromagnetic Emissions.

The ODU is sealed against the environment and is capable of functioning in ambient temperatures ranging from -40°C to +60°C, with up to 100% relative humidity. The ODU can survive steady state winds of 40 m/s with gusts to 55 m/s (89 mph/123 mph).

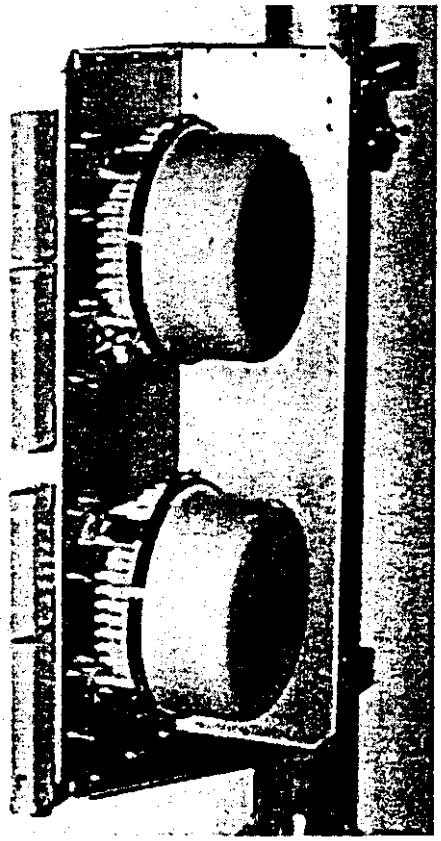

Figure 2-8 – Sector Terminal Outdoor Unit (Redundant Configuration)

Figure 2-9 illustrates the interior and interface baseplate of the Sector Terminal ODU.

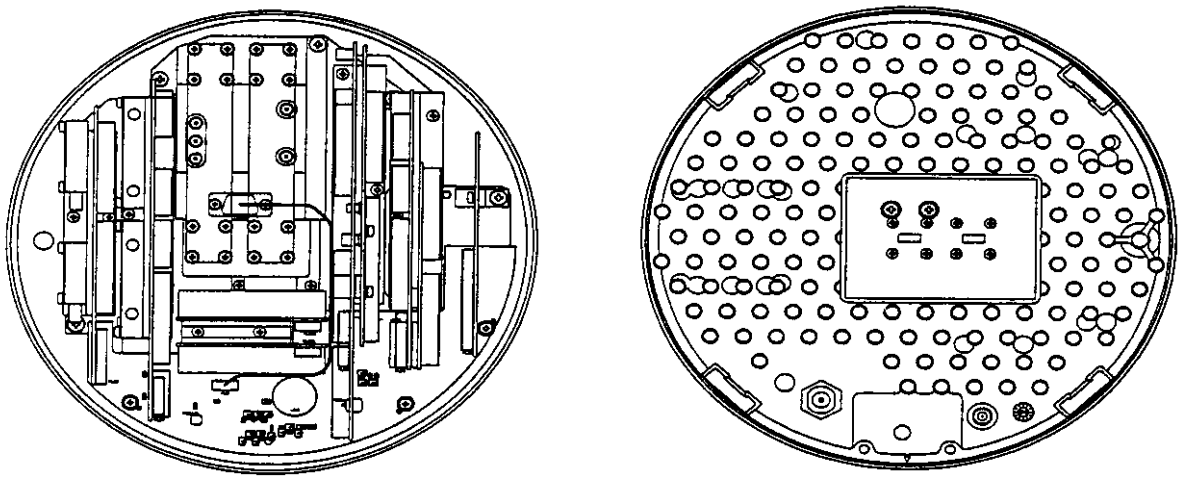

Figure 2-9 – Sector Terminal ODU & Baseplate

2.4 Antenna

The antenna is a lensed-horn antenna. For 24-26 GHz, two horns are used for transmit and receive functions. At 38 GHz, a single horn antenna is used. Specific antennae are used for horizontal or vertical polarizations and for azimuth beamwidths of 15°, 22.5°, 45° or 90°. The elevation beamwidth is typically 6°.

The antennae are mounted onto a rectangular mounting plate with mounting hinges used to install on a pole. One of the hinges allows for elevation adjustment.

- Feed
- Radome
- Mount

2.5 IF Cable Run

A single coaxial cable is used to connect the ODU to the IDU. The cable carries transmit IF signal, receive IF signal, telemetry 10 MHz reference signal and DC power. The IDU and ODU contain "N" type female connectors for interconnection of the coaxial cable. For increased EMC performance, P-COM recommends the use of Times-Microwave LMR-400 in Table 2-1, double screened, coaxial cable. Other coaxial cables with equivalent performance characteristics of the LMR-400, shown below, may be used. LMR-400 may be used in lengths up to 1000 feet. The maximum bend radius of LMR-400 is 6 inches (15 cm).

Table 2-1 - LMR-400 Performance Characteristics

Property	LMR-400
Dielectric	Cellular PE (low loss closed cell polyethylene foam) 0.285" nominal diameter
Shield	Aluminum laminated tape bonded to the dielectric with tinned/copper over braid. Diameter: 0.320" nominal
Jacket	Black PE Nominal jacket thickness: 0.045"
Capacitance	23.0 pf/ft
Impedance	50 Ω
Velocity of propagation	85%
DCR	Conductor 1.39 Ω/1000 ft.
Attenuation	30 MHz: 0.70 dB/100 ft
	220 MHz: 1.80 dB/100 ft
	450 MHz: 2.70 dB/100 ft
	900 MHz: 3.90 dB/100 ft

The signals that are carried between the IDU and the ODU on the coaxial IFL cable are provided in Table 2-2.

Table 2-2 - IFL Signals

IFL Signal	Frequency	Variation
IDU Transmit	205 MHz	±25 MHz
IDU Receive	490 MHz	±25 MHz
Telemetry	500-800 kHz	300 kHz
Reference Signal	10 MHz	1 ppm
IFL Power	**Voltage**	**Variation**
ODU Power	+48 Vdc	+40 to +57Vdc
IFL Connector	**Termination 1**	**Termination 2**
Type N male	IFL Combiner	ODU
Type BNC - N male	IFL Combiner	IDU

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3.0 Tools and Test Equipment Required

Tables 3-1, 3-2 and 3-3 are the recommended list of tools and test equipment necessary for the installation of a P-COM Point-to-Multipoint radio subsystem:

NOTE:

This is a Typical Installers tool Kit , on some installations additional tools may be necessary.

Table 3-1 – Required Tools and Equipment (Commissioning)

DESCRIPTION	QNTY	BRAND	PART NO
Antenna Alignment Tool	1	P-COM	
Binoculars	1		
Bit Error Rate Test Set, (with correct UIM interface module) FireBird Portable T1	1		
Circuit Tester	1	Ideal	6-035
Compass			
Computer, Laptop (with LSM Software)	1		
Flashlight	1	Mallory	ML901-F
Global Positioning System	1		
Printer, Color	1		
Multimeter, Handheld	1		
Radio, 2-Way or Cell Phone	2		
Safety Belt	1		
Screwdriver, Jewelers Set	1		
Static Material Kit	1	Charleswater	16430
Wood Stick	1	Desco	517F
Wrench, 8" Adjustable	1	Diamalloy	D78
Wrench, SAE ¼ - ¾ Set	1		
Wrench, Socket Set (Deep)	1		
Wrench, Torque (20 in lbs. – 55 ft lbs.)	1		

Table 3-2 – Required Tools and Equipment (Installation)

DESCRIPTION	QNTY	BRAND	PART NO
Binoculars	1		
Bit Error Rate Test Set, (with correct UIM interface module) FireBird Portable T1	1		
Cable Cutter	1	Klein	63050
Circuit Tester	1	Ideal	6-035
Compass			
Computer, Laptop (with LSM Software)	1		
Crimp Tool (Solderless Connectors)	1		
Crimp Tool, RJ-x Connectors (RJ-11, RJ-45)	1		
De-soldering Tool	1	Edsyn	AS196
Diagonal Cutters, Flush Cut	1	Diamalloy	S55KS
Flashlight	1	Mallory	ML901-F
Glasses, Safety	2	Eastern Safety	410
Global Positioning System	1		
Heat Gun	1		
Inclinometer	1		
Knife, Utility	1	Klein	44100
Knife/Scissors/Pouch	1	Klein	46037
Multimeter, Handheld	1		
N-Connector, w/Padded Jaws	1	Cresant	529-10
Pliers, Needle Nose 4" Insulated	1	Diamalloy	LN54
Pliers, Slip Joint 6" Insulated	1	Diamalloy	K16
Printer, Color	1		
Radio, 2-Way or Cell Phone	2		
Rope, Nylon 100 feet	1		
Rope, Nylon 50 feet	1		
Safety Belt	1		
Screwdriver, #0 Phillips	1	Xcelite	X100
Screwdriver, #1 Phillips	1	Xcelite	X101
Screwdriver, #2 Phillips	1	Xcelite	X102
Screwdriver, #2 Phillips Stubby	1	Xcelite	SX102
Screwdriver, #3 Phillips	1	Xcelite	
Screwdriver, ¼ x 1" Slotted	1	Xcelite	S141
Screwdriver, ¼ x 4" Slotted	1	Xcelite	R144
Screwdriver, 1/8 x 2" Slotted	1	Xcelite	R182
Screwdriver, 1/8 x 8" Slotted	1	Xcelite	R188
Screwdriver, 3/16 x 3" Slotted	1	Xcelite	R3163
Shrink-tube, 3/4" Epoxy Lined	1		
Shrink-tube, Variety Pack	1		
Soldering Iron, 25 watt	1	Kester	83-4000-000

Table 3-2 – Required Tools and Equipment (Installation) *(Continued)*

DESCRIPTION	QNTY	BRAND	PART NO
Soldering Iron, Solder	1	Weller	SP23
Speed Square	1		
Static Material Kit	1	Charleswater	16430
Tape Measure	1		
Tie Wraps	1		
Wire Brush, Stiff	1		
Wire Stripper, 10-18 AWG	1	Ideal	45-120
Wire Wrap Tool, 24 & 26 Gauge, Manual	1		
Wire Wrap Tool, 24 & 26 Gauge, Power	1		
Wrench, 8" Adjustable	1	Diamalloy	D78
Wrench, SAE ¼ - ¾ Set	1		
Wrench, Socket Set (Deep)	1		
Wrench, Torque (20 in lbs. – 55 ft lbs.)	1		

Table 3-3 – Required Tools and Equipment (Survey)

DESCRIPTION	QNTY	BRAND	PART NO
Flashlight	1	Mallory	ML901-F
Safety Belt	1		
Radio, 2-Way or Cell Phone	2		
Wood Stick	1	Desco	517F
Compass			
Computer, Laptop (with LSM Software)	1		
Flashlight	1	Mallory	ML901-F
Global Positioning System	1		
Printer, Color	1		
Multimeter, Handheld	1		
Camera, (Digital Preferred)	1		
Soldering Iron, 25 Watt	1	Weller	SP23

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4.0 Site Preparation

Prior to beginning physical installation of the Tel-Link Point to Multipoint (PMP) equipment, the Site preparation work should be complete. Site preparation includes but is not limited to the following:

- Completed Site Survey Checklist (P-COM highly recommends the use and completion of the Site Survey Checklist located in Appendix B)
- System Configuration Document Specification

The criteria below should be evaluated prior to designating Remote to Sector terminal RF paths with the use of Site Surveys and Link Budgets:

- An unobstructed line-of-sight
- Be within range (distance separation) with respect to the modulation type used
- Be within the antenna beamwidth

The IDU Equipment should be installed in a location that is:

- Dry and clean
- Well ventilated
- Easily accessible
- Within 1000 feet of subsequent T1 equipment
- Within 1000 feet of the ODU when using LMR-400 or equivalent Coaxial cable
- Complies with all environmental specifications

> **NOTE:**
>
> P-COM highly recommends that a blower or fan be used with an enclosed rack containing three or more IDU's.

The IDU is designed to be installed in a 19 inch equipment rack or enclosed cabinet. However, the IDU may be mounted on a tabletop if necessary.

4.1 ODU/Antenna Installation Preparation

Verify the location selected has the following characteristics:

- Space on pole is adequate for mounting the antenna and ODU.
- Verify pole that the ODU/Antenna assembly is to be mounted on has been installed in the designated location identified on the Site Survey Checklist.
- Verify pole has been securely installed and a 10-12 AWG copper wire connects the pole to earth ground.
- Perform a continuity test between the pole and earth ground. Continuity should measure ≤1 Ohm.

4.2 IDU Installation Preparation

Verify the location selected has the following characteristics:

- Each site should be identified if the Indoor Unit (IDU) is to be rack mounted or placed on a tabletop. This information should be annotated in a completed Site Survey Checklist.
- Verify the required rack or table is installed, secured to the floor, and ready to accept the IDU.
- Sufficient space is provided for the installation of the Hub IF Combiner.

4.3 Power Preparation

Verify the location selected has the following characteristics:

- Verify the correct power source has been provided within close proximity to the location where the IDU is to be installed.
- Verify the power source is controlled through an appropriately sized circuit breaker or fuse
- Verify power to the IDU is in the OFF position.

4.4 IFL Installation Preparation

P-COM recommends the IFL should be Times-Microwave LMR-400 coaxial cable.

- Verify the Inter Facility Link (IFL), between the ODU and IDU locations, is present.

NOTE:
Maximum cable length of 1000 Ft (300 meters) between the IDU and ODU

- Verify a sufficient length of IFL is present at both ends to provide a service loop prior to being terminated to the equipment.
- Verify each end of the IFL is terminated with a Type-N male connector.

5.0 Equipment Receiving, Unpacking and Inspection

5.1 Introduction

This procedure provides information for unpacking and inspecting the Tel-Link Point to Multipoint equipment prior to physical installation.

5.2 Receiving and Unpacking the Equipment

At a minimum, check for the following

Step 1 Check the outside of the shipping crates for visible signs of damage. Crushed corners or tears in cardboard may indicate rough handling which may result in hidden damage to equipment.

Step 2 Inventory shipping crates and other packages received in the shipment. Verify that all items listed on the Electronic Goods Descriptive Inventory or applicable shipping document were received. Identify all missing items on the inventory sheet.

Step 3 Record any noted damage to the outside of the packaging material on the carrier' Bill of Lading and have the transportation company initial the sheet. All notations should indicate location and condition.

Example: 1" x 2" scratch on left front (LF) metal panel; not LF panel scratched. Another example would be 4" x 6" dent in center panel; (not dent in panel).

WARNING!

The warranty will be violated if you do not take anti-static precautions when unpacking or assembling the PMP boards in the PMP shelf. Circuit modules can be damaged by electrostatic discharge. Ensure that an approved anti-static wrist strap is connected between the wrist of the person and an electrical ground before handling any of the circuit modules.

CAUTION!

Covering the floor with 1/8" pressed board, or equivalent, will prevent damage to the floor covering.

Step 4 Carefully open the equipment packaging.

5.3 Inspecting the Equipment

Step 1 For each of the PMP subsystems received, verify the equipment received matches the shipping list by Part Number and Serial Number. Report and discrepancies immediately using the field return procedure outlined in Section 13 of this manual.

The Tel-Link Point-to-Multipoint (PMP) system may be ordered in different configurations. Table 3-3 shows the Part Number for all system parts. In addition, the quantity of boards for redundant and non-redundant configurations is identified. The Equipment Parts List may contain more than the users specific requirements.

CAUTION!

Tampering with seals will void the warranty.

Table 5-1 – PMP Sector Terminal Equipment Parts List

SECTOR INDOOR UNIT (IDU)			
		Quantity (Per Configuration)	
Description	**Part Number**	**Redundant**	**Non-Redundant**
Sector IDU Chassis	48068	1	1
Sector Controller	28520	2	1
Modulator	28020	2	1
Demodulator	28023	1:N	0:N
Network Interface Module	28530	1	1
Power Supply		2	1
Filler Panels	58512	As Required	As Required
Hub IF Combiner Shelf		2	1
SECTOR OUTDOOR UNIT (ODU)			
		Quantity (Per Configuration)	
Description	**Part Number**	**Redundant**	**Non-Redundant**
Sector ODU Module	Frequency dependent	2	1
Waveguide Antenna (Tx/Rx)	Frequency dependent	2	1

Step 2 After unpacking the equipment, visually inspect the equipment for damage and ensure that:

- All components mounted on the individual boards are secure.
- The circuit boards are not cracked.
- There are no loose leads.
- The shelf unit has not been dented or damaged in any way.

Step 3 Dispose of as much packing material as possible. P-COM suggests that the user retain at least one of each box with all packing materials. In the unlikely event that it is necessary to return a unit, the user will possess the required packing material for safe shipment of the unit.

Step 4 Make claims for any damages incurred during shipment to the transportation company involved in accordance with company procedures.

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6.0 Sector Terminal Outdoor Unit Installation

6.1 Introduction

This procedure provides instruction for installing a P-COM Tel-Link Point to Multipoint Sector Terminal ODU/Antenna.

6.2 Tools Required

For a listing tools required to install an antenna/mounting assembly, refer to the vendors manuals.

6.3 Materials Required

- Antenna/mounting assembly. This assembly typically includes all hardware needed to install the antenna to the mount, and the mount to a pole.
- Outdoor Unit (ODU)

6.4 Sector Terminal ODU/Antenna Installation

WARNING!

Failure to follow installation procedures may result in damage to the ODU/Antenna and render the radio unusable. Read through the entire procedure before attempting installation. Contact P-COM Technical Assistance Center (TAC) with any questions.

Step 1 Refer to the appropriate antenna vendor's installation manual to assemble the mount.

Step 2 Install the horn antennas to the appropriate mounting plate locations. The transmit horn is to be installed in the upper antenna location, the receive antenna in the lower position. Verify that the appropriate polarization (refer to the Configuration Document) of the antenna is used.

Step 3 Install the ODU to the mounting plate.

Step 4 Install the flexible waveguide (one transmit and one receive) between the ODU and horn antennas. Refer to Figure 6-1 for identification of the transmit and receive ports.

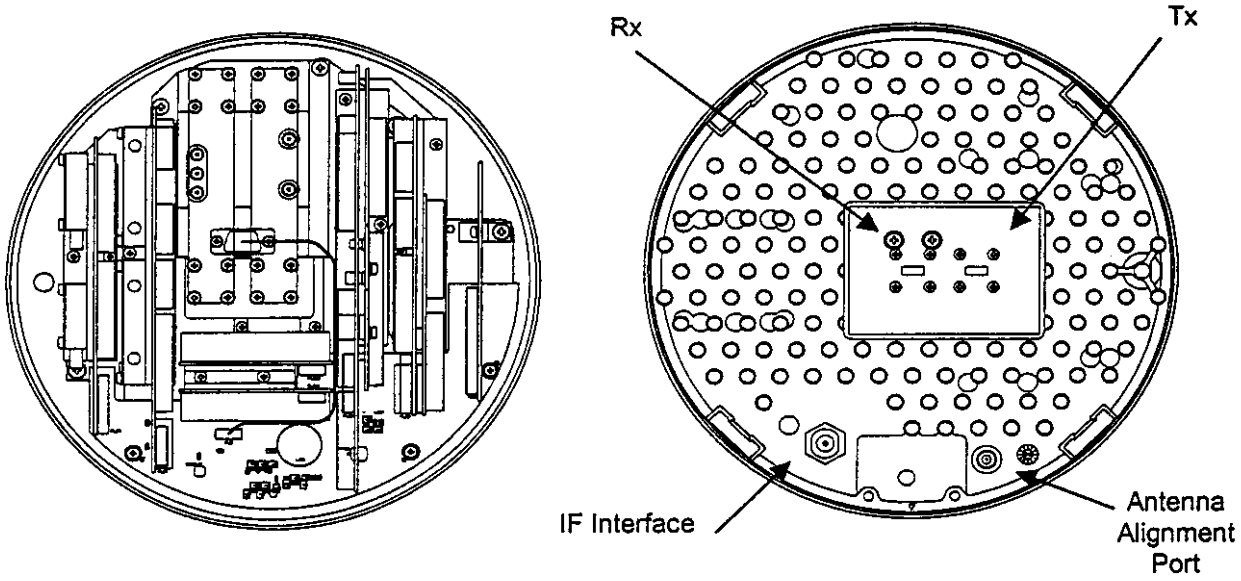

Figure 6-1 – Sector ODU & Baseplate

Step 5 Install the antenna assembly with the ODU to the pole or antenna mount. Tighten the nuts sufficiently to prevent the mount from sliding, but allows movement in the azimuth direction.

Step 6 Prior to securely tightening the bracket bolts, point the antenna to the desired azimuth angle as defined in the Configuration Document. A compass should be sufficient to aim the antenna in the desired direction. Take into consideration of magnetic deviation when comparing the angle read on the compass to the desired azimuth angle. Set the elevation angle of the antenna to zero degrees using a level.

Step 7 Tighten the mounting bracket bolts to secure the antenna assembly to the mount.

Step 8 The mounting system includes elevation fine adjustment. Refer to the antenna vendor's installation manuals for procedures of how to make these fine adjustments. Attach an inclinometer to the rear of the antenna bracket. Adjust the elevation adjustment to achieve the elevation angle as defined in the Configuration Document. Tighten the bolts associated with the elevation adjustment.

7.0 Sector Terminal IDU & Hub IF Combiner Installation

7.1 Introduction

This procedure provides instructions for installing the IDU and Hub IF Combiner chassis in a standard 19 inch common equipment rack or cabinet. A typical installation of Sector IDUs in a rack is shown in Figure 7-1.

Prior planning of the rack layout of IDU(s) should be considered, in particular where multiple Sector IDU's will be installed. In addition, one or two (redundant application) Hub IF Combiners will be required to be installed with the Sector IDU's. One rack unit (RU) space should be allocated for each IF Combiner chassis.

7.2 Sector Terminal IDU Installation

7.2.1 Tools Required

- Screwdrivers, Flat and Phillips
- Wire Stripper
- Solderless Crimp Tool

7.2.2 Materials Required

- Eight (8) equipment mounting screws with washers. (Consult rack manufacturer's documentation for required size.)
- Eight (8) cage nuts. (May not be required, consult rack manufacturer's documentation.)
- 12 AWG Green Stranded Wire.
- 12 AWG Compression Ring Lug

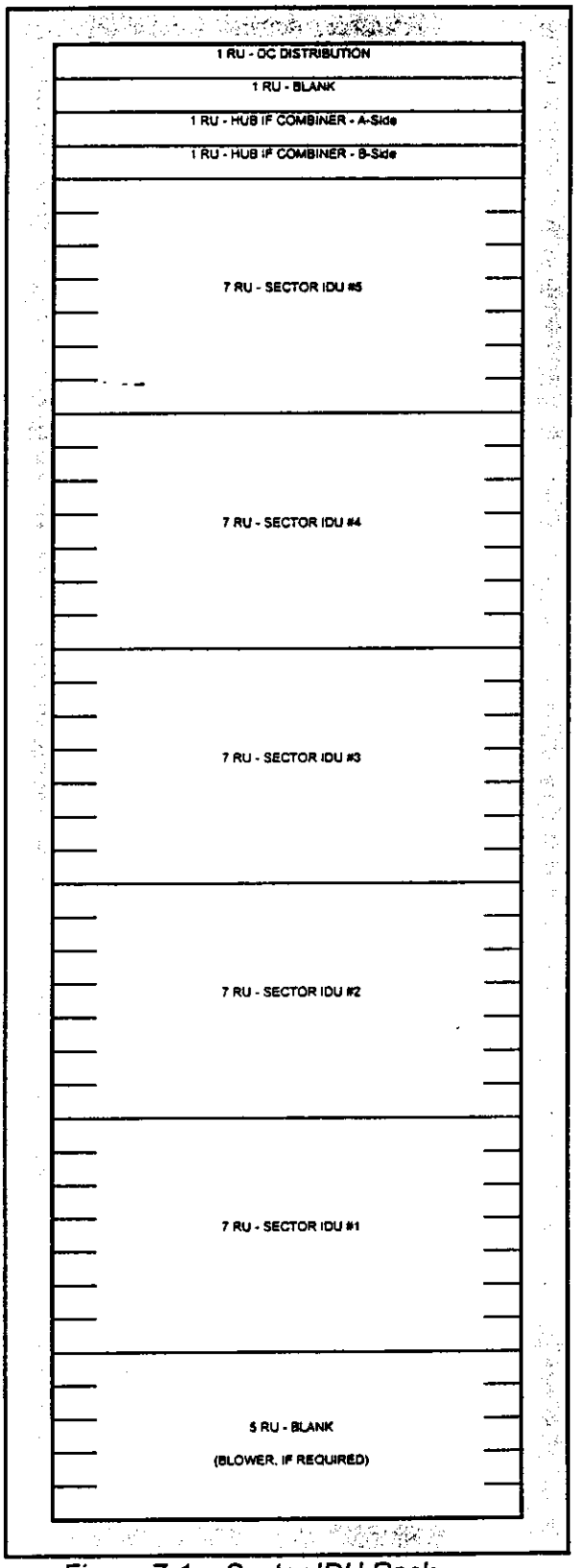

Figure 7-1 – Sector IDU Rack

7.2.3 Sector Terminal IDU Installation Procedure

> **NOTE:**
>
> P-COM highly recommends that a blower or fan be used with an enclosed rack containing three or more IDU's.

Step 1 Install the IDU using screws in the eight mounting holes.

> **NOTE:**
>
> Ground all chassis through the Earth Ground Lug located on the back of the chassis.

Step 2 Ground the IDU chassis by installing compression type lugs and connecting the lugs to the rack frame vertical channel by using 12 AWG (or larger) copper wire. Remove any paint or oxidation from the surface of the equipment rack and apply an anti-oxidant compound to assure electrical contact to the rack channel.

Step 3 Attach a Type-N (male) to BNC (female) adapter to the Type-N (female) connector on the rear of the IDU chassis.

7.3 Hub IF Combiner Chassis Installation

7.3.1 Tools Required

- Screwdrivers, Flat and Phillips
- Wire Stripper
- Solderless Crimp Tool

7.3.2 Materials Required

- Four (4) equipment mounting screws with washers per IDU. (Consult rack manufacturer's documentation for required size.)
- Four (4) cage nuts. (May not be required, consult rack manufacturer's documentation.)
- 12 AWG Green Stranded Wire.
- 12 AWG Compression Ring Lug

7.3.3 Hub IF Combiner Installation Procedure

Step 1 Install the IDU using screws in the eight mounting holes. The IF Combiner(s) are typically mounted at the top of the equipment rack.

Step 2 Ground the IDU chassis by installing compression type lugs and connecting the lugs to the rack frame vertical channel by using 12 AWG (or larger) copper wire. Remove any paint or oxidation from the surface of the equipment rack and apply an anti-oxidant compound to assure electrical contact to the rack channel.

Step 3 **Non-redundant Configurations:** P-COM recommends assigning the single Hub IF Combiner as "Side-A." On the left-hand side of the rear of the Hub IF Combiner, set the rece3ssed slide switch to "Side-A." Verify selection by viewing the LEDs on the front of the Hub IF Combiner chassis.

Step 4 **Redundant Configurations:** Assign one of the two Hub IF Combiners as "Side-A" and one as "Side-B." On the left hand side of the rear of the Hub IF Combiner, set the recessed slide switch to "Side-A" or "Side-B." Verify selection by viewing the LEDs on the front of the Hub IF Combiner chassis.

8.0 Sector Terminal Wiring and Cabling Installation

8.1 Inter Facility Link (IFL) Combiner Cabling and Wiring

The following shelf wiring is required for full system operations:

- Power Supply Cable
- IFL Coaxial Cable (IF Combiner to ODU)
- IFL Coaxial Cable (Sector IDU to Hub IF Combiner)

8.1.1 AC Power Supply

For AC operations, a standard computer AC power cable rated for 10 Amp capacity is supplied with each IDU chassis. The AC receptacle is found on the rear of the IDU chassis. Figures 8-1 and 8-2 show the AC power supply version rear view of the Sector IDU and AC Plug Close-up.

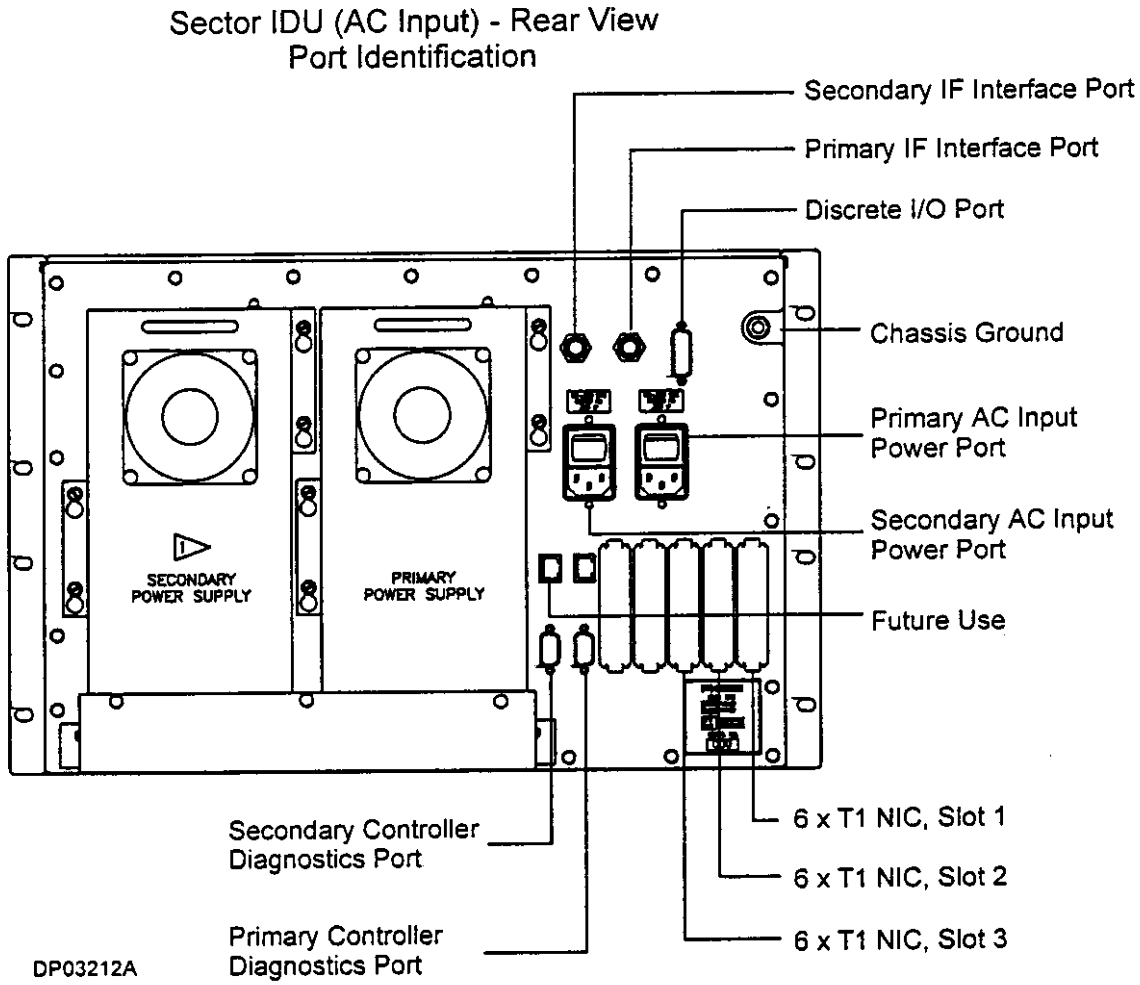

Figure 8-1 – Sector Terminal IDU (AC Input) Rear View

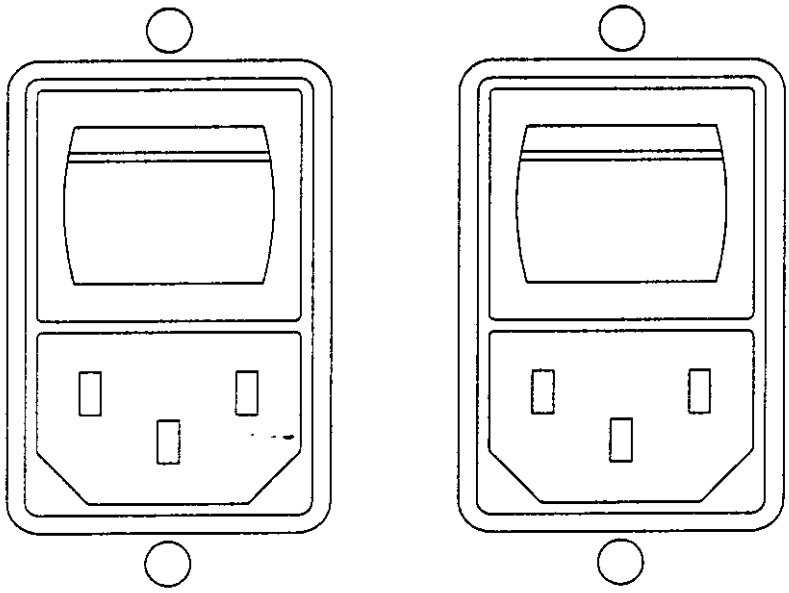

Figure 8-2 – AC Plug Close-up

The AC power to the Sector Terminal should be protected with a 3.0 Amp fuse or circuit breaker.

DANGER!

Before connecting the AC cord to the IDU, ensure that the power switch is turned off.

Two cables are supplied for the Hub/Sector IDU's configured for redundant operations. For redundant applications, the two cables should be routed to separate circuit breakers.

8.1.2 DC Power Supply

For DC operations, 12 AWG, 2-conductor cable is supplied. The cables for carrying DC power to the IDU's should be routed to a DC distribution panel preferably installed in the same rack. The DC distribution panel should provide individual fuse protection to each chassis and for each power lead in redundant applications. The DC receptacle is found on the rear of the IDU chassis. Figures 8-3 and 8-4 show the DC power supply version rear view of the Sector IDU and DC Plug Close-up.

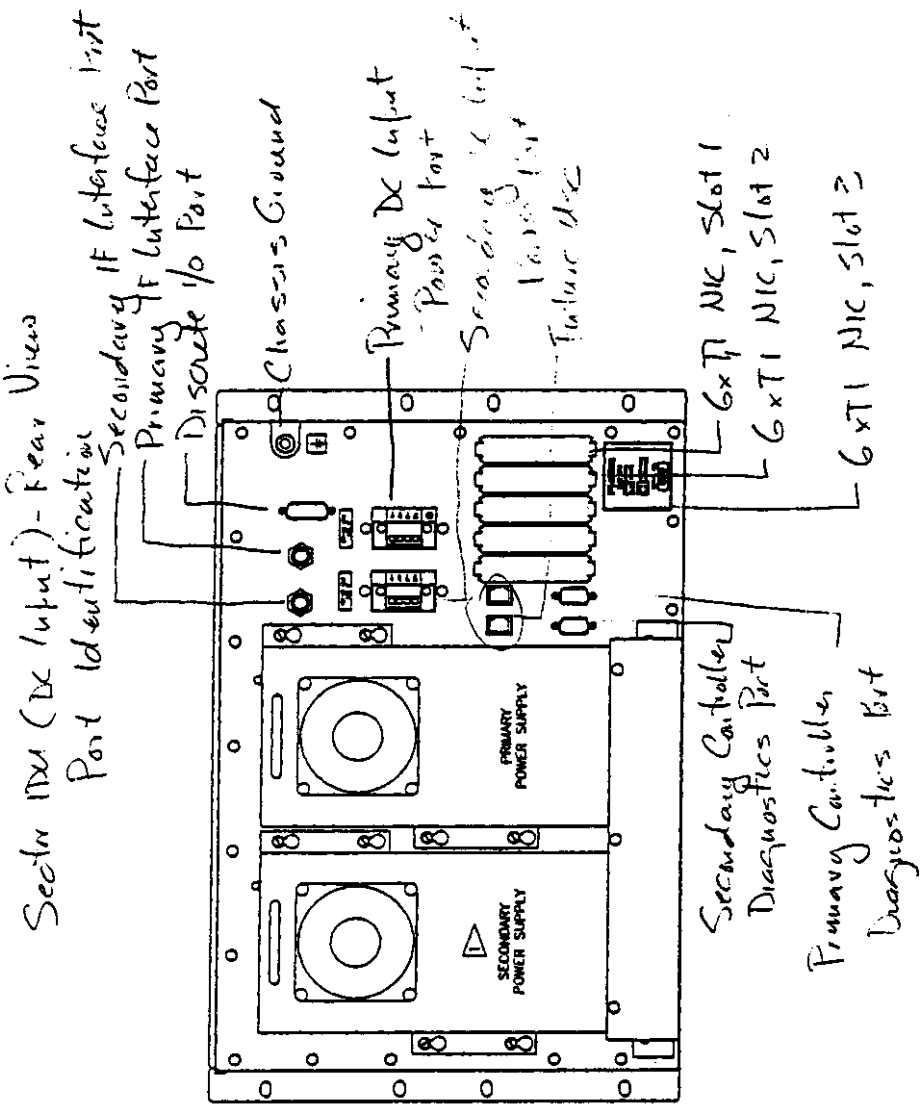

Figure 8-3 – Sector Terminal IDU (DC Input) Rear View

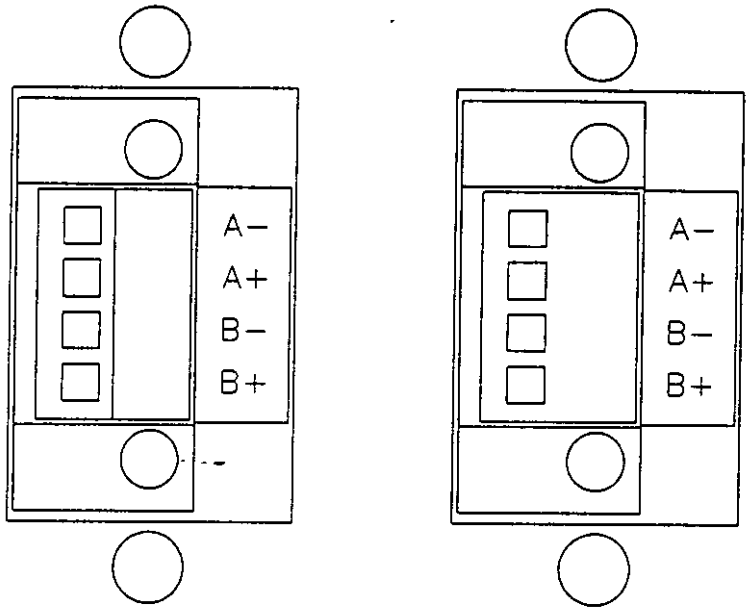

Figure 8-4 – DC Plug Close-up

The DC power to the Sector Terminal should be protected with a 5 Amp fuse.

DANGER!

Before connecting the DC cable to the IDU, ensure that the protection fuse is removed to prevent the application of power at this time.

Two sets of DC cables are required for redundant applications. These two cables should be routed to separate fuses.

8.1.3 Sector IDU Interfacility Coaxial Cabling Installation

The Sector IDU is connected to the Hub IF Combiner via a RG-58 (50 ohm) coaxial cable with BNC male connectors on each end. The length of the cable should be sufficient to allow a small service loop near each end. A Type-N (M) to BNC (F) adapter is installed on the IF ports of the Sector IDU to interface with this coaxial cable.

For non-redundant configurations, only one Hub IF Combiner will be used. The primary IF port of Sector IDU designated as "Sector IDU #1" should be connected to the port labeled "IFL 1" of the Hub IF Combiner. Sector IDU #2 should be connected to IFL 2 of the Hub IF Combiner.

For redundant configurations, two Hub IF Combiners will be used; one Hub IF Combiner designated at "Link A" and the other as "Link B". The primary IF port of Sector IDU #1 should be connected to the port labeled "IFL 1" of the "Link A" Hub IF Combiner. The secondary IF port of Sector IDU #1 should be connected to the port labeled "IFL 1" of the "Link B" Hub IF Combiner.

8.1.4 Network Interface Card (NIC) Interface Cable

The interface to the 6xT1 Network Interface Card (NIC) is a 50-pin Amp Champ, female, connector. Access to this port is from the rear of the Remote Terminal IDU chassis. Figure 8-1 identifies the slot number of the boards when installed.

The pin-outs of the connector on the 6xT1 NIC board are shown in Figure 8-5.

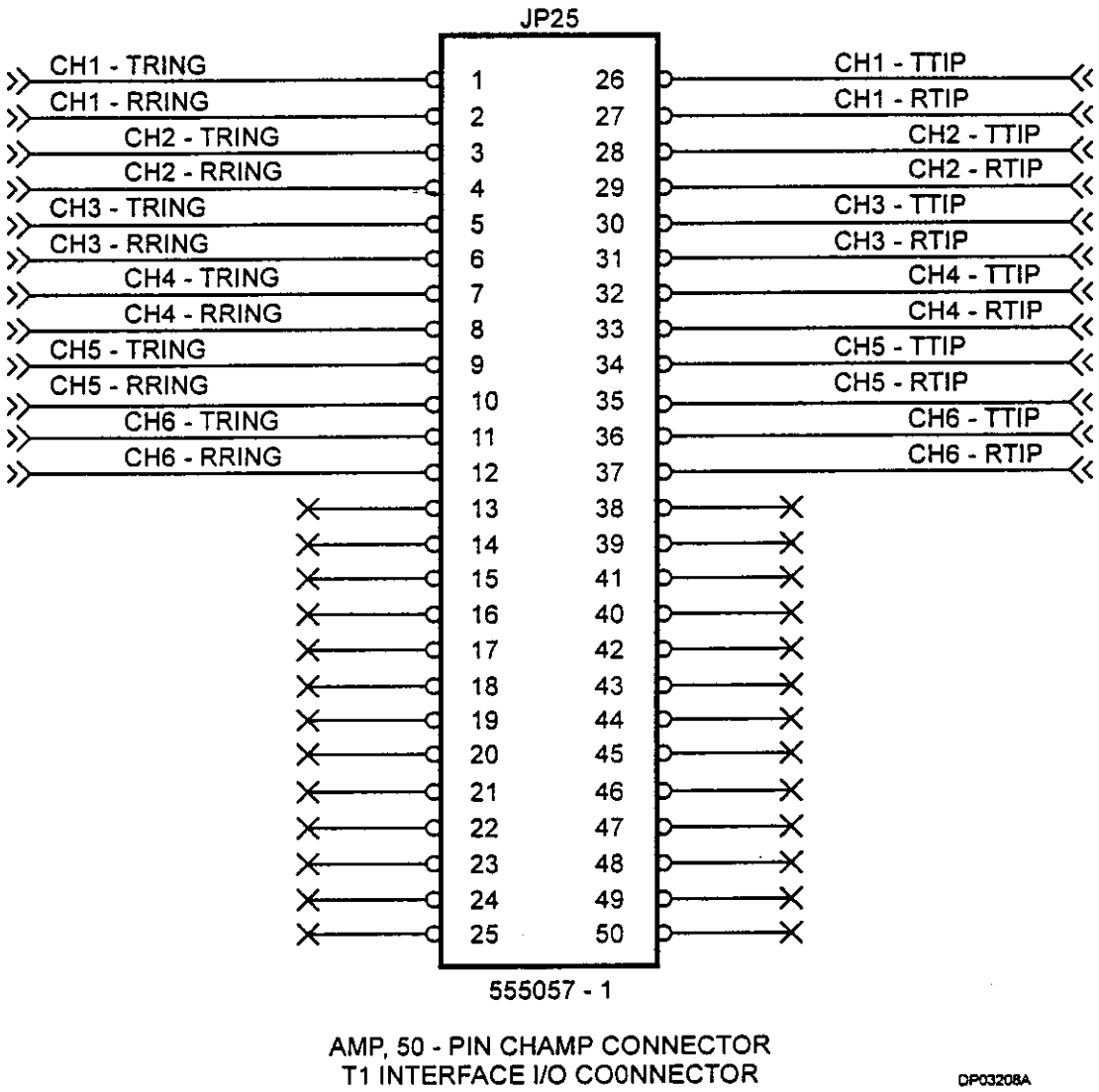

Figure 8-5 - NIC pinouts

It is preferable to use a 50-pin Amp Champ, male, connector, part number _____. Secure the connector to the UIM board with the two captive retaining screws on the male connector.

8.2 Hub IF Combiner Cabling and Wiring Installation

The following shelf wiring is required for full system operations:

- Power Supply Cabling
- Sector IDU IF Cables
- Inter Facility Coaxial Cable (IDU to Hub IF Combiner)

8.2.1 AC Power Supply

For AC operations, a standard computer AC power cable rated for 10 Amp capacity is supplied with each Hub IF Combiner chassis. The AC receptacle is found on the rear of the Hub IF Combiner chassis (refer to Figure 8-6).

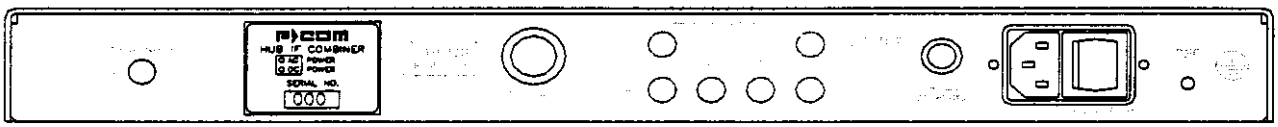

Figure 8-6 – Hub IF Combiner Rear View – AC Power Version

DANGER!

Before connecting the AC cord to the IDU, ensure that the power switch is turned off.

The AC power to the Hub IF Combiner should be protected with a 1.0 Amp fuse or circuit breaker.

8.2.2 DC Power Supply

For DC operations, 12 AWG, 2-conductor cable is supplied. The cables for carrying DC power to the IDU's should be routed to a DC distribution panel preferably installed in the same rack. The DC distribution panel should provide individual fuse protection to each chassis and for each power lead in redundant applications. The DC receptacle is found on the rear of the IDU chassis. Figure 8-7 shows the DC power supply version rear view of the Sector IDU.

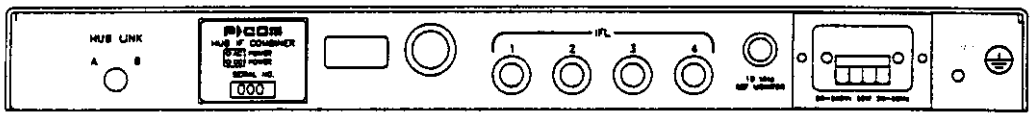

Figure 8-7 – Hub IF Combiner Rear View DC Plug Close-up

DANGER!

Before connecting the DC cable to the IDU, ensure that the protection fuse is removed to prevent the application of power at this time.

The DC power to the Sector Terminal should be protected with a 1.5 Amp fuse.

8.2.3 Sector IDU IF Coaxial Cable Installation

The RG-58 coaxial cables, with BNC male connectors, routed from the Sector IDUs are to be terminated into the IFL ports on the rear of the Hub IF Combiner (refer to Figure 8-8 for a rear view of the Hub IF Combiner). The Sector IDU designated at "Sector IDU #1" should be terminated into the port labeled "IFL 1". Sector IDU #2 should be terminated into IFL 2.

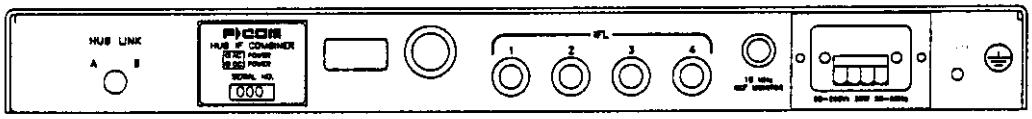

Figure 8-8 - Hub IF Combiner Rear View – DC Power Version

It is not necessary to terminate unused ports of the Hub IF Combiner.

8.2.4 IFL Coaxial Cable Installation Procedure

> **NOTE:**
>
> Typically, for redundant applications, the top ODU/Antenna assembly is routed to the Hub IF Combiner assigned as "Link A" and the bottom ODU/Antenna assembly is routed to the Hub IF Combiner assigned as "Link B."

Indoors

Step 1 Connect the IFL cable to the Type-N female port of the Hub IF Combiner.

Outdoors

Step 2 Connect a 90° Type-N adapter to the ODU Type-N female port.

Step 3 Connect the IFL cable to the 90° Type-N adapter

Step 4 Wrap the connector assembly with weather-proof tape to prevent moisture penetration.

9.0 Sector Terminal IDU Board Installation

Warning!

Precautions for anti-static protection should be taken whenever handling printed circuit boards. Circuit modules can be damaged by electrostatic discharge. Ensure that an approved anti-static wrist strap is connected between the wrist of the person and an electrical ground before handling any of the circuit modules.

The common equipment boards of a Sector IDU consist of the power supply, controller, Network Interface Card(s), modulator, and demodulator(s). For redundant configurations, two each of the following boards will be used: power supply, controller, and modulator. One additional demodulator board for all on-line demodulators will be installed for redundant operations. Up to five on-line NIC cards, plus an additional redundant card may be placed in a Sector IDU.

Placement of the common equipment boards within the IDU chassis is critical, and should follow the appropriate illustrations: Figure 9-1 for non-redundant configurations and 9-2 for redundant configurations. Insert the boards from left to right for each board type.

<< Insert interior view of a Sector IDU, non-redundant configuration >>

Figure 9-1 – Hub/Sector IDU – Non-Redundant

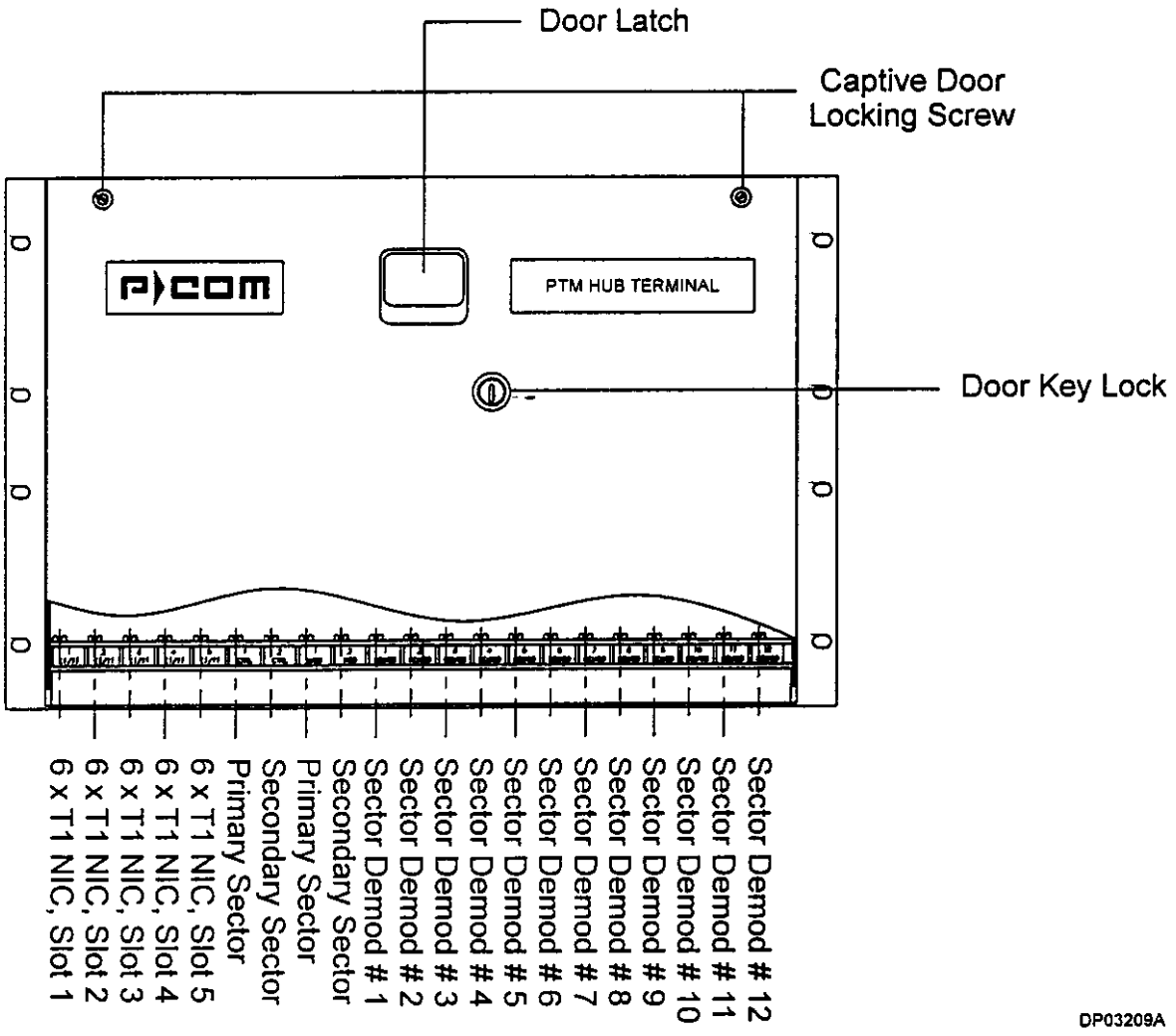

Figure 9-2 – Hub/Sector IDU Redundant

The printed circuit board has a high-density connector on one edge of the board and two black tabs on the opposite edge of the board. A diagram of the XXXX board is shown in Figure 9-3, identifying the high-density connector and the two black tabs. Within the chassis, a board slot consists of nylon guides located at the top and bottom of a board slot, and a high density mating connector located on the motherboard within the chassis.

<< Insert diagram of a printed circuit board identifying the motherboard connector and insertion tabs >>

Figure 9-3 – Printed Circuit Board

To insert a printed circuit board, vertically align the printed circuit board with the board slot of the chassis. The majority of the components on the printed circuit board should be facing towards the right of the chassis. The high-density connector located on the printed circuit board is inserted into the chassis first, orientated to allow mating with the corresponding high-density receptacle on the motherboard within the chassis (refer to Figure 9-4).

<< Insert diagram showing the printed circuit board being inserted into the chassis showing the tabs extended >>

Figure 9-4 – Printed Circuit Board Insertion

The two black tabs on the front edge of the board are to be held in an extended orientation. Slide the board into the chassis, along the guides, until the two high-density connectors are close to mating. Use the grips of the black tabs to attach to the chassis frame, pressing the tabs towards the printed circuit board edge, making a secure connection with the two high-density connectors (refer to Figure 9-5).

<< Insert diagram showing close-up of tabs attaching to chassis frame during insertion >>

Figure 9-5 – Printed Circuit Board Insertion

WARNING!

The NIC Interface cable on the rear of the NIC card must be removed prior to extracting the NIC card

To remove a printed circuit board, grab the two black tabs on the edge of the printed circuit board. Extending these tabs will separate the printed circuit board high-density connector from its mate within the chassis. Slide the printed circuit board out of the chassis to complete the removal.

10.0 Sector Terminal Initial Power Application

10.1 DC Power Application

Step 1 Remove the DC connector from the Sector IDU.

Step 2 Insert the appropriately sized fuse in the fuse holder assigned to the chassis. Two fuses may be used for redundant configuration.

Step 3 Plug in the DC connector into the DC Power Port of the Sector IDU.

Step 4 Verify power is applied to the chassis by viewing the LEDs on the boards within the IDU chassis.

Step 5 If the LEDs on the boards do not illuminate, remove the DC connector from the IDU and verify wiring and voltage polarity.

10.2 AC Power Application

Step 1 Plug the AC cord for the Sector IDU into the AC source.

Step 2 Referring to the AC source in Step 1, insert the appropriately sized fuse, or switch the circuit breaker to the ON position. Two fuses or circuit breakers may be used for redundant configurations.

Step 2 Place the AC power switch on the Remote Terminal in the ON position.

Step 3 Verify power is applied to the chassis by viewing the LEDs on the boards within the IDU chassis.

Step 4 If the LEDs on the boards do not illuminate, remove the AC connector from the IDU and verify wiring and voltage polarity.

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11.0 Initial Terminal Configuration and Testing

Proper functioning of this command and response exchange verifies that the IDU's Local Site Manager (LSM) agent and other critical software components are present and operational. From the PC, the installer can use the **Get** and **Set** commands to communicate with the LSM agent in the IDU to set and interrogate the IDU configuration. Completion of the test will ensure configuration items are properly loaded.

11.1 Terminal Configuration

Step 1 After applying power to the IDU(s) and Hub IF Combiner, allow the units to warm up for five minutes.

Step 2 Verify that each card has completed its self-test process and the LEDs on the front of each card are in an operational state. (Refer to Table 11-1).

Table 11-1 – Board LED Indications

BOARD	LED COLOR	INDICATION	DESCRIPTION
Modulator	Green	On	OK
		Off	Fault
	Red	On	Fault
		Off	OK
Demodulator	Green	On	OK
		Off	Fault
	Red	Fast Blink	Demodulator configured, not locked
		Slow Blink	Demodulator not configured
		On	Fault
		Off	Demodulator configured, locked
Hub/Sector Controller	Green	Blinks	OK
		Off or Solid On	Backplane or Cell I/F has Fault
	Red	On	Fault
		Off	OK
T1	Green	Blinks	Operational
		Off	Fault
	Red	Blinks	Fault

Step 3 Connect the Local Site Manager (LSM) (laptop computer) to the LSM port on Controller #1 of the IDU. Connection is via a 10' cable with DB-9 connectors on each end. The LSM should be running the P-COM WaveView Lite software (Refer to Figure 11-1).

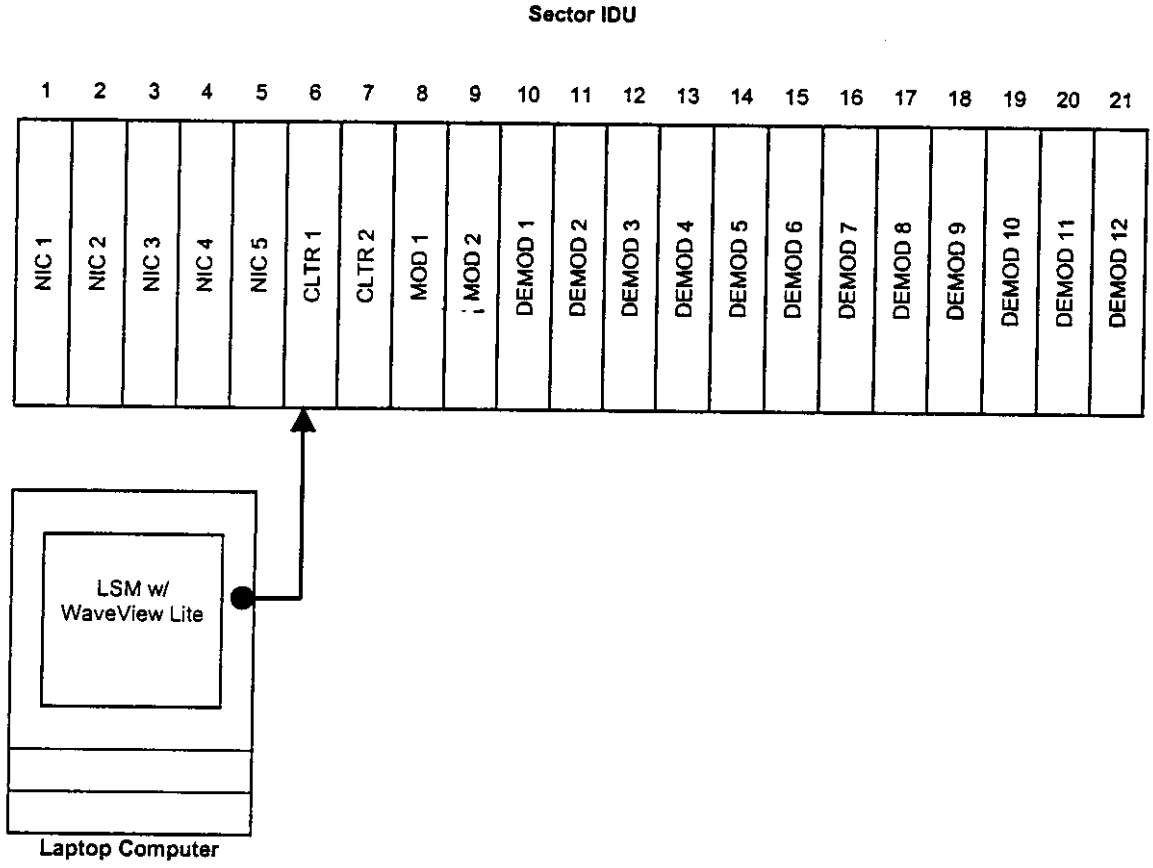


Figure 11-1 –LSM Attached To NMS Controller #1 of Sector IDU

Step 4 Load appropriate software in the Controller and each NIC or UIM card.

Step 5 Verify that the transmitter is disabled.

- Sector Terminal Set the **sc_Commissioning_Complete** register to "No"
- Remote Terminal Set the **sc_Commissioning_Complete** register to "No"

Step 6 Load (SET) appropriate registers in the IDU. Refer to the System Configuariont Document for appropriate frequencies, data rates, modulations, T1 mapping, etc. The icon to the left of each of the configuration item's name should have a green plus symbol to indicate successful loading of each configuration parameter.

11.2 Terminal (Local) Testing

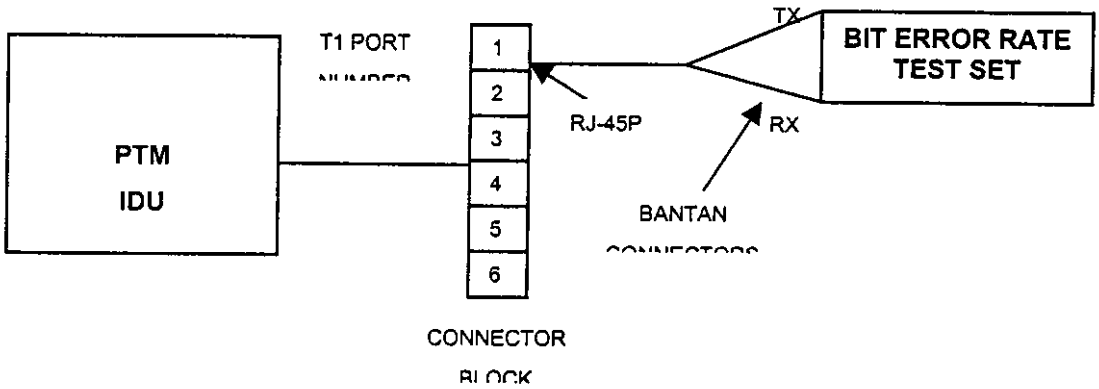
11.2.1 T1 Loopback Test

Perform a "Remote Loopback" BER test on each T1 port.

> **NOTE:**
>
> For this test, a Bit Error Rate test set is substituted for the actual CPE. P-COM recommends the TTC Fireberd test set, model 4000 or 6000, with the DS1/T1/D4ESF/SLC-96 data interface module. A self-loop test should be conducted on the test set prior to performing this procedure. A test is to be conducted for each of the T1 ports the IDU is configured with.

Step 1 Using the LSM, SET the **Remote_Loopback** register of the T1 port under test to **Enable**.

Step 2 Connect the Bit Error Rate (BER) test set to the T1 port under test with the BER test cable. (Refer to Figure 11-2).



PINOUTS		
RJ45P	**CIRCUIT DESC**	**BANTAM PLUG**
1	Chn Rx Ring	Tx Ring
2	Chn Rx Tip	Tx Tip
3	NC	
4	Chn Tx Ring	Rx Ring
5	Chn Tx Tip	Rx Tip
6	NC	
7	NC	
8	NC	

Figure 11-2 - Bit Error Rate Test Configuration

Step 3 Allow the test to run for 20 minutes. Record results of each T1 port.

Step 4 Upon completion of each test SET the **Remote_Loopback** register to **Disabled**.

11.2.2 Antenna Alignment

Step 1 **Enable the transmitter**

- Sector Terminal Set the **sc_Commissioning_Complete** register to "Yes"
- Remote Terminal Set the **sc_Commissioning_Complete** register to "Yes"

Step 2 Verify proper transmit level. SET the following registers:

- **TxLevCtrlDBM** 20
- **TX_Enable** Enabled
- **Antenna_Align** Enable

Step 3 Attach the P-COM Antenna Alignment Meter to the Test (BNC) port of the ODU.

Step 4 Loosen the appropriate bolts to allow the fine adjustment tuning of the antenna.

Step 5 Adjust the antenna in elevation and azimuth (elevation only for the Sector Antenna) to achieve maximum signal level.

Step 6 Securely fasten all bolts.

11.3 Terminal Commissioning

The Commissioning Test Procedure, outlines the steps to commission a Remote Terminal into a new or existing Sector Network. Follow the steps in this document to bring a new Remote Terminal on line.

12.0 Technical Support

12.1 Warranty

P-COM warrants Point-To-Multipoint products to be free from defects in materials and workmanship for a period of twelve (12) months from the date of shipment from the factory. Extended warranty options are available.

12.2 Return Process

The boards of the PMP product requiring service may be sent to P-COM Florida at any time whether the unit is under warranty or not. There is a charge for repairs after the twelve-month warranty period.

A product requiring service should be returned with a detailed description of the problem and proof of purchase date if the twelve-month warranty has not expired. The product should be returned in its original shipping carton to ensure that in-transit damage does not occur.

The following process should be used whenever returning equipment to P-COM:

Step 1 Contact P-COM at the telephone number below to obtain a Return Material Authorization (RMA) number and return shipping address:

P-COM Technical Assistance Center

Phone Number: 1-877-674-3600

FAX Number: 1-877-674-3700

Hours of Operation

8:00 AM to 5:00 PM EST

NOTE:

All equipment received without an RMA will be returned to the sender.

Step 2 Pack the equipment in the original shipping containers, if possible. If original shipping containers have been discarded, pack the failed unit so as to protect it from shipping damage.

Step 3 Obtain insurance from the shipper that will cover the entire value of the equipment being returned.

Step 4 Send the equipment (pre-paid shipping) to the address received from the Technical Assistance Center.

Step 5 P-COM will notify the sender, upon receipt of the equipment, of an estimated time to repair and for return shipping instructions. An estimate of the repair cost will be given for all non-warranty repairs

All repairs covered under warranty will be completed at no cost and the return shipping (surface) will be paid for by P-COM. Repairs not covered by the warranty will be performed at current P-COM labor rates and material costs and billed to the customer. In addition, shipping will be billed for non-warranty repairs.

12.3 Spares Ordering Information

Spare parts may be ordered at any time. Please submit requests consisting of part description, part number and quantity to the following address:

P-COM Florida

Spares Ordering Department

1801 Penn Street

Melbourne, Florida 32901

Spare parts pricing may be obtained by calling or faxing P-COM's Spares Ordering Department at:

Phone Number: (407) 674-3699

FAX Number: (407) 674-3799

12.4 Recommended Spare Parts

The following table is a list of recommend spare parts:

Table 12-1 – Recommended Spare Parts

DESCRIPTION	PART NUMBER	QUANTITY
Hub/Sector IDU		
Sector Controller	28520	1
Modulator	28020	1
Demodulator	28023	1
Network Interface Modulator	28530	1
Power Supply	XXXXX	1
Hub/Sector ODU		
Hub/Sector ODU Module	XXXXX	1
Hub IF Combiner		
Hub IF Combiner Module	XXXXX	1
Remote IDU		
Remote Controller	28070	1
Modulator	28020	1
Demodulator	28023	1
User Interface Module	As Required	1
Power Supply #1 (+48 Vdc)	XXXXX	1
Power Supply #2 (+5, ±15 Vdc)	XXXXX	1
Remote ODU		
Remote ODU Module	XXXXX	1

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January 1999

APPENDIX A: PMP Installation Procedure Checklist

PMP INSTALLATION PROCEDURE CHECKLIST

(To Be Completed For Each Site)

Technicians Name:		Date:	

INTRODUCTION

This Installation Procedure Checklist is provided to ensure the correct procedures for installing P-COM PMP equipment are followed. The Checklist is to be completed for each site installed and the installer is to check-off each box upon completion of each step. Upon installation completion, the installer will sign and date the Checklist.

Site Name:	
Site Designation:	

Sector Terminal ☐ Remote Terminal ☐

FORMS:

- ☐ Verify possession of completed Site Survey form for the designated site
- ☐ Verify possession of System Configuration Document for designated site
- ☐ Verify possession of Commissioning Test Form for testing of a terminal

TOOLS:

- ☐ Verify all required tools listed in P-COM PMP Installation and Operation Manual are in good working order

INVENTORY: The shipping list should contain all equipment ordered by the customer for the total number of Sector and Remote Terminals

- ☐ Verify equipment received matches the shipping list by Part Number and Serial Number
- ☐ Verify equipment has arrived without any visible damage

NOTE:

Any visible damage should be reported immediately to the customer and to the P-COM TAC at: (407) 674-3699 or 1-877-674-3600.

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

OUTDOOR UNIT (ODU) INSTALLATION SEQUENCE

ODU/ANTENNA INSTALLATION PREPARATION

- ☐ Verify pole the ODU/Antenna assembly is to be mounted on has been installed in the designated location identified in the Site Survey Form
- ☐ Verify the pole has been securely mounted and that a 10-12 AWG copper wire connects the pole to earth ground
- ☐ Perform a continuity test between the pole and earth ground. Continuity should measure ≤1 Ohm

ODU/ANTENNA INSTALLATION:

- ☐ Properly install the ODU/Antenna assembly in accordance with the P-COM Installation and Operation Manual
- ☐ Sector ODU/Antenna: Align the antenna in the direction for operations as specified in the P-COM System Configuration Document
- ☐ Remote ODU/Antenna: Align the antenna in the general direction of the designated Sector Terminal. Fine-tuning will be performed during the "Initial Power-up and test Sequence."

ODU INTERCONNECT:

- ☐ Remote Terminal: Connect the IFL cable to the ODU RF Port (Type-N Connector)
- ☐ Sector Terminal: Connect the IFL cable between the appropriate ODU and Hub IF Combiner chassis. ODU #1 should be connected to Hub IF Combiner #1. ODU #2 should be connected to Hub IF Combiner #2

INTERFACILITY LINK (IFL) INSTALLATION SEQUENCE

IFL INSTALLATION PREPARATION: The IFL should be Times-Microwave LMR-400 coaxial cable, or equivalent, unless otherwise stated in the P-COM Site Survey Form

- ☐ Verify presence of an appropriate Interfacility Link (IFL) between ODU and IDU locations
- ☐ Verify sufficient length of IFL exists at both ends to provide a service loop prior to being terminated to the equipment
- ☐ Terminate each end of the IFL with Type-N male connector

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

INDOOR UNIT (IDU) INSTALLATION SEQUENCE

IDU INSTALLATION PREPARATION: Each site should be identified if the Indoor Unit (IDU) should be rack mounted or placed on a tabletop. This information is found in the P-COM Site Survey Form.

- ☐ Verify possession of IDU chassis and all appropriate cards intended to populate the IDU
- ☐ Verify presence of customer's interface demarcation
- ☐ Verify required rack/table is installed, secured to the floor, and ready to accept the IDU
- ☐ Verify correct power source has been provided within close proximity to the location where the IDU is to be installed
- ☐ Verify power source is controlled through an appropriately sized circuit breaker or fuse
- ☐ Verify power to the IDU is in the **OFF** position

IDU INSTALLATION:

- ☐ Properly install the IDU in accordance with the P-COM Installation and Operation Manual

IDU INTERCONNECT: There are four cables to be connected to the rear of the IDU

- ☐ Remote Terminal: Connect the IFL cable to the RF Port of the IDU
- ☐ Sector Terminal: For a Sector with one or more IDU's, connect Sector #1-Port #1 to Hub IF Combiner #1-Port #1. Connect IDU #1-IF Port #2 to Hub IF Combiner #2-Port #1. This same sequence should be followed if multiple IDUs are used in a Sector. A BNC (F) to Type-N (M) adapter may be required on each IF port on the IDU
- ☐ Sector and Remote Terminals: Connect the power leads/cord to the IDU Input Power port. Terminate the power leads/cord to the appropriate AC or DC power source. Two power leads/cables are to be terminated for a Sector Terminal
- ☐ Sector and Remote Terminals: Connect a ground wire from the chassis to a local earthgrounds

CUSTOMER PREMISE EQUIPMENT PREPARATION:

- ☐ Verify Customer Premise Equipment (CPE) has been installed within close proximity to the IDU equipment
- ☐ Verify sufficient length of CPE cable is present to provide a service loop prior to being terminated to the equipment
- ☐ Sector and Remote Terminals: After completion of the Commissioning Test Plan connect the CPE cable to the appropriate port on the User Interface Module (UIM) or Network Interface Card (NIC)

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

HUB IF COMBINER INSTALLATION: The Hub IF Combiner should be installed at least 1 rack unit above each Sector bank of IDUs to prevent air flow restriction

- ☐ Properly install the Hub IF Combiner in accordance with the P-COM Installation and Operation Manual

HUB IF COMBINER INTERCONNECT:

- ☐ For a Sector with one or more IDUs, connect IDU #1-IF Port #1 to Hub IF Combiner #1-Port #1. Connector IDU #1-IF Port #2 to Hub IF Combiner #2-Port #1. This same sequence should be followed if multiple IDUs are used in a Sector.
- ☐ Connect the power cord/leads to the Input Power port. Terminate the power cord/leads to the appropriate AC or DC power source
- ☐ Connect a ground wire from the chassis to a local earth ground

Initial Power-on and Test Sequence

- ☐ When prepared to apply power to the IDU, turn the circuit breaker assigned to the IDU to the ON position

SECTOR TERMINAL:

- ☐ Apply power to the Sector IDU Terminal. Allow the terminal to warm up for five minutes
- ☐ Verify each card has completed its self-test process and the LEDs on the front of each card are in an operational Green condition. Interpretation of LED conditions may be found in Table 4-1, Board LED Indications of the P-COM Installation and Operations Manual.
- ☐ Connect the LSM to the Controller
- ☐ Load appropriate software in the IDU
- ☐ Load (Set/Get) appropriate registers in the IDU
- ☐ Verify configuration loaded successfully
- ☐ Verify transmitter is disabled. The sc_Commissioning_Complete register should indicate "uncommissioned."
- ☐ Perform the "Remote Loopback" BER tests on all T1 ports in accordance with P-COM PMP Installation and Operation Manual
- ☐ Place T1 looping plugs in all T1 ports
- ☐ Enable the transmitter. Set the sc_Commissioning_Complete register to "commissioned."
- ☐ Verify proper transmit level

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

REMOTE TERMINAL:

- ☐ Apply power to the Remote IDU Terminal. Allow the terminal to warm up for five minutes
- ☐ Verify each card has completed its self-test process and the LEDs on the front of each care are in an operational Green condition. Interpretation of LED conditions may be found in Table 4-1, Board LED Indications of the P-COM Installation and Operations Manual.
- ☐ Connect the LSM to the Controller
- ☐ Load appropriate software in the IDU
- ☐ Load (Set/Get) appropriate registers in the IDU
- ☐ Verify configuration loaded successfully
- ☐ Verify transmitter is disabled. The sc_Commissioning_Complete register should indicate "uncommissioned."
- ☐ Perform the "Remote Loopback" BER tests on all T1 ports in accordance with P-COM PMP Installation and Operation Manual
- ☐ Align the Remote Terminal antenna. Connect a DVM to the test port of the ODU. Adjust the antenna in elevation, then in azimuth to obtain a peak voltage measurement. Typical measurements should indicated _____Vdc. Tighten down all mounting bolts
- ☐ Verify proper receive level is registered at the IDU
- ☐ Enable the transmitter. Set the rc_Commissioning_Complete register to "commissioned."
- ☐ Perform BER tests with the Sector Terminal for each T1 port for at least 30 minutes. Record performance on the data sheets provided for commissioning each terminal

Installation Completed

This concludes the P-COM PMP equipment installation sequence. Sign and date in the spaces provided below and proceed to the P-COM PMP Commissioning Test Plan.

Signature:		Date:	

PMP INSTALLATION PROCEDURE CHECKLIST

(To Be Completed For Each Site)

Technicians Name:		Date:	

INTRODUCTION

This Installation Procedure Checklist is provided to ensure the correct procedures for installing P-COM PMP equipment are followed. The Checklist is to be completed for each site installed and the installer is to check-off each box upon completion of each step. Upon installation completion, the installer will sign and date the Checklist.

Site Name:	
Site Designation:	

Sector Terminal ☐ Remote Terminal ☐

FORMS:

- ☐ Verify possession of completed Site Survey form for the designated site
- ☐ Verify possession of System Configuration Document for designated site
- ☐ Verify possession of Commissioning Test Form for testing of a terminal

TOOLS:

- ☐ Verify all required tools listed in P-COM PMP Installation and Operation Manual are in good working order

INVENTORY: The shipping list should contain all equipment ordered by the customer for the total number of Sector and Remote Terminals

- ☐ Verify equipment received matches the shipping list by Part Number and Serial Number
- ☐ Verify equipment has arrived without any visible damage

NOTE:

Any visible damage should be reported immediately to the customer and to the P-COM TAC at: (407) 674-3699.

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

OUTDOOR UNIT (ODU) INSTALLATION SEQUENCE

ODU/ANTENNA INSTALLATION PREPARATION

- ☐ Verify pole the ODU/Antenna assembly is to be mounted on has been installed in the designated location identified in the Site Survey Form
- ☐ Verify the pole has been securely mounted and that a 10-12 AWG copper wire connects the pole to earth ground
- ☐ Perform a continuity test between the pole and earth ground. Continuity should measure ≤1 Ohm

ODU/ANTENNA INSTALLATION:

- ☐ Properly install the ODU/Antenna assembly in accordance with the P-COM Installation and Operation Manual
- ☐ Sector ODU/Antenna: Align the antenna in the direction for operations as specified in the P-COM System Configuration Document
- ☐ Remote ODU/Antenna: Align the antenna in the general direction of the designated Sector Terminal. Fine-tuning will be performed during the "Initial Power-up and test Sequence."

ODU INTERCONNECT:

- ☐ Remote Terminal: Connect the IFL cable to the ODU RF Port (Type-N Connector)
- ☐ Sector Terminal: Connect the IFL cable between the appropriate ODU and Hub IF Combiner chassis. ODU #1 should be connected to Hub IF Combiner #1. ODU #2 should be connected to Hub IF Combiner #2

INTERFACILITY LINK (IFL) INSTALLATION SEQUENCE

IFL INSTALLATION PREPARATION: The IFL should be Times-Microwave LMR-400 coaxial cable, or equivalent, unless otherwise stated in the P-COM Site Survey Form

- ☐ Verify presence of an appropriate Interfacility Link (IFL) between ODU and IDU locations
- ☐ Verify sufficient length of IFL exists at both ends to provide a service loop prior to being terminated to the equipment
- ☐ Terminate each end of the IFL with Type-N male connector

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

INDOOR UNIT (IDU) INSTALLATION SEQUENCE

IDU INSTALLATION PREPARATION: Each site should be identified if the Indoor Unit (IDU) should be rack mounted or placed on a tabletop. This information is found in the P-COM Site Survey Form.

- ☐ Verify possession of IDU chassis and all appropriate cards intended to populate the IDU
- ☐ Verify presence of customer's interface demarcation
- ☐ Verify required rack/table is installed, secured to the floor, and ready to accept the IDU
- ☐ Verify correct power source has been provided within close proximity to the location where the IDU is to be installed
- ☐ Verify power source is controlled through an appropriately sized circuit breaker or fuse
- ☐ Verify power to the IDU is in the **OFF** position

IDU INSTALLATION:

- ☐ Properly install the IDU in accordance with the P-COM Installation and Operation Manual

IDU INTERCONNECT: There are four cables to be connected to the rear of the IDU

- ☐ Remote Terminal: Connect the IFL cable to the RF Port of the IDU
- ☐ Sector Terminal: For a Sector with one or more IDU's, connect Sector #1-Port #1 to Hub IF Combiner #1-Port #1. Connect IDU #1-IF Port #2 to Hub IF Combiner #2-Port #1. This same sequence should be followed if multiple IDUs are used in a Sector. A BNC (F) to Type-N (M) adapter may be required on each IF port on the IDU
- ☐ Sector and Remote Terminals: Connect the power leads/cord to the IDU Input Power port. Terminate the power leads/cord to the appropriate AC or DC power source. Two power leads/cables are to be terminated for a Sector Terminal
- ☐ Sector and Remote Terminals: Connect a ground wire from the chassis to a local earthgrounds

CUSTOMER PREMISE EQUIPMENT PREPARATION:

- ☐ Verify Customer Premise Equipment (CPE) has been installed within close proximity to the IDU equipment
- ☐ Verify sufficient length of CPE cable is present to provide a service loop prior to being terminated to the equipment
- ☐ Sector and Remote Terminals: After completion of the Commissioning Test Plan connect the CPE cable to the appropriate port on the User Interface Module (UIM) or Network Interface Card (NIC)

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

HUB IF COMBINER INSTALLATION: The Hub IF Combiner should be installed at least 1 rack unit above each Sector bank of IDUs to prevent air flow restriction

- ☐ Properly install the Hub IF Combiner in accordance with the P-COM Installation and Operation Manual

HUB IF COMBINER INTERCONNECT:

- ☐ For a Sector with one or more IDUs, connect IDU #1-IF Port #1 to Hub IF Combiner #1-Port #1. Connector IDU #1-IF Port #2 to Hub IF Combiner #2-Port #1. This same sequence should be followed if multiple IDUs are used in a Sector.
- ☐ Connect the power cord/leads to the Input Power port. Terminate the power cord/leads to the appropriate AC or DC power source
- ☐ Connect a ground wire from the chassis to a local earth ground

Initial Power-on and Test Sequence

- ☐ When prepared to apply power to the IDU, turn the circuit breaker assigned to the IDU to the **ON** position

SECTOR TERMINAL:

- ☐ Apply power to the Sector IDU Terminal. Allow the terminal to warm up for five minutes
- ☐ Verify each card has completed its self-test process and the LEDs on the front of each card are in an operational Green condition. Interpretation of LED conditions may be found in Table 4-1, Board LED Indications of the P-COM Installation and Operations Manual.
- ☐ Connect the LSM to the Controller
- ☐ Load appropriate software in the IDU
- ☐ Load (Set/Get) appropriate registers in the IDU
- ☐ Verify configuration loaded successfully
- ☐ Verify transmitter is disabled. The sc_Commissioning_Complete register should indicate "uncommissioned."
- ☐ Perform the "Remote Loopback" BER tests on all T1 ports in accordance with P-COM PMP Installation and Operation Manual
- ☐ Place T1 looping plugs in all T1 ports
- ☐ Enable the transmitter. Set the sc_Commissioning_Complete register to "commissioned."
- ☐ Verify proper transmit level

PMP INSTALLATION PROCEDURE CHECKLIST

Site Name:		Date:	

REMOTE TERMINAL:

- ☐ Apply power to the Remote IDU Terminal. Allow the terminal to warm up for five minutes
- ☐ Verify each card has completed its self-test process and the LEDs on the front of each care are in an operational Green condition. Interpretation of LED conditions may be found in Table 4-1, Board LED Indications of the P-COM Installation and Operations Manual.
- ☐ Connect the LSM to the Controller
- ☐ Load appropriate software in the IDU
- ☐ Load (Set/Get) appropriate registers in the IDU
- ☐ Verify configuration loaded successfully
- ☐ Verify transmitter is disabled. The sc_Commissioning_Complete register should indicate "uncommissioned."
- ☐ Perform the "Remote Loopback" BER tests on all T1 ports in accordance with P-COM PMP Installation and Operation Manual
- ☐ Align the Remote Terminal antenna. Connect a DVM to the test port of the ODU. Adjust the antenna in elevation, then in azimuth to obtain a peak voltage measurement. Typical measurements should indicated _____Vdc. Tighten down all mounting bolts
- ☐ Verify proper receive level is registered at the IDU
- ☐ Enable the transmitter. Set the rc_Commissioning_Complete register to "commissioned."
- ☐ Perform BER tests with the Sector Terminal for each T1 port for at least 30 minutes. Record performance on the data sheets provided for commissioning each terminal

Installation Completed

This concludes the P-COM PMP equipment installation sequence. Sign and date in the spaces provided below and proceed to the P-COM PMP Commissioning Test Plan.

Signature:		Date:	

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APPENDIX B: Site Survey Checklist

SITE SURVEY CHECKLIST

(To Be Completed For Each Site)

ENGINEER:		DATE:	
CUSTOMER:		ADDRESS:	
CONTACT NAMES(S):			
TELEPHONE NUMBERS:			

SITE CHARACTERISTICS

NOTE:

Prior to site installation planning visit, complete line-of-sight, transmission engineering and preliminary frequency coordination work to establish viability of path selected.

Site Name:					
Site Designation:					
		Sector Terminal		Remote Terminal	
Coordinates:	GPS EPE:		Degrees	Minutes	Seconds
Latitude					
Longitude					
Ground Elevation AMSL (Above Mean Sea Level):					
Distance Between Hub And Remote Terminals					
Kilometers:					
Azimuth (True) From Sector:					
Hub/Sector Terminal:		Remote Terminal:			
Transmit Frequency (High/Low Band; Polarization)					
Transmit:		Receive:			
Available Conduit:					

SITE SURVEY CHECKLIST

CUSTOMER:		DATE:	
SITE NAME:			

OUTDOOR EQUIPMENT

Roof Access (Describe):	

Site Access

	Yes	No		Yes	No
Roof Access Door			Ladder Required		
Permit Required			Access Keys Required		
Roof Penetration			Wall Penetration		
Special Tools Required			On-site Escort Required		

If Yes, What Special Tools:	If Yes, Who Is Needed As The Escort:

Sketch/Photos Of Equipment And Site (on pages 5 and 6) – Include Site Layout (Topographical Map And Building Blueprints If Available), Location Of Antenna/ODU, And Briefly Explain How The Antenna/ODU Will Be Installed Below.

Tripod:	
Wall Mount:	
Parapet:	
Tower:	
Other:	
Pole Diameter:	

Show details in sketch of proposed mounting and hardware (pole) location. Show relationship to coaxial cable access and building ground. Show lightning rod ground connect point if applicable

Terrain Considerations:	

Obstructions:	

Other Considerations:	

SITE SURVEY CHECKLIST

CUSTOMER:		DATE:	
SITE NAME:			

INTERFACILITY POWER AVAILABLITY

Available Power (Voltage and Current)

NOTE:

Do not mount radio equipment in the proximity of machinery that can either generate large electromagnetic fields or large voltage spikes as they cycle on/off (i.e., air conditioners, elevator motors, etc.).

	Yes	No		Yes	No
AC Power On Roof			AC Power At Rack		
Identify Location/Distance to Available AC Power:					

Distance Between ODU and IDU:	

NOTE:

Maximum distance of LMR-400 Cable is 1000 Feet

	Yes	No
Has Cable Been Ordered?		

IFL Cable Supplied By P-COM ☐ Customer ☐

Distance Between IDU and Customer Premise:	

NOTE:

Maximum distance for T1 is 1000 Feet

Sketch/Photos Of Equipment – Cable Run From ODU To IDU

Show Access Points (i.e., Floors) (Sketch) (Space available on Pages 5 and 6)

	Yes	No
IFL Exists In-place		
Is Plenum Rated Cable Required?		

Length:		Type #	

	Yes	No
Is Pull Rope Installed In Conduit		
Is New Pull Rope Required		

SITE SURVEY CHECKLIST

CUSTOMER:		DATE:	
SITE NAME:			

INDOOR EQUIPMENT

What Type of Terminating Equipment Will Be Used (Customer Premise Equipment)

Check Site For:

	Yes	No		Yes	No
Phone Jack Available			AC/DC Power Provided		
Fuse Panel Available			Battery Back-up Required		
Is Equipment Redundancy A Requirement?					

Number of IDU's Required:				
IDU Mounting:	Rack Mounted		Tabletop Mounted	
Rack/Table Supplied By:	P-COM		Customer	

	Yes	No
Rack or Table Ordered?		

Limitations on Rack or Table Floor Space:

	Yes	No
Temperature/Humidity Controlled Room		
Air Flow Restrictions		
Fans Needed		

Other Rack Installation considerations:

Sketch/Photos Of Equipment Including (on pages 5 and 6) – Site layout (Include extracts from topographical map and building blueprints if available) and location of radio equipment

TOOLS REQUIRED

	Yes	No		Yes	No
Binoculars			Camera		
Cellular Phone (2 each)			Compass		
Flashlight/Strobe			GPS Receiver		
Tape Measure			Other		

SITE SURVEY CHECKLIST

CUSTOMER:		DATE:	
SITE NAME:			

SKETCH OF EQUIPMENT AND SITE

SITE SURVEY CHECKLIST

CUSTOMER:		DATE:	
SITE NAME:			

SKETCH OF EQUIPMENT AND SITE

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Glossary

AAU	Antenna Alignment Unit
AGC	Automatic Gain Control
AIS	Alarm Indicator Status
AMI	Alternate Mark Inversion
AMSL	Above Mean Sea Level
ASIC	Application Specific Integrated Circuit
B8ZS	Bipolar with Eight Zero Substitution
Base Station	The center of a cell where Sector Terminal(s) are installed.
BER	Bit Error Rate
BNC	Bayonet Nut Connector
BPV	Bipolar Violation
CAS	Channel Associated Signaling
CCS	Common Associated Signaling
CHAMP	Connector
CLAV	Cell Available
CPE	Customer Premise Equipment - Customer provided equipment that connects to the interface port(s) of the IDU.
CRC	Cyclic Redundancy Check
CSA	
DBPSK	Differential Bi-Phase Shift Keyed
DFM	Drive Fault Monitor
DLL	Dynamic Link Library
Down Link	The RF communications path from a Base Station to the Remote Terminal
DQPSK	Differential Quandrature-Phase Shift Keyed
DSP	Digital Signal Processor
EIA	Electronics Industry Association
EIRP	Effective Isotropic Radiated Power
EMC	
EPLD	Electronically Programmable Logic Device
ESF	Extended Super Frame Format
ETSI	
FCC	Federal Communications Commission

FDMA	Frequency Decision Multiple Access
FEC	Forward Error Correction
FPGA	Field Programmable Gate Array
FSK	Field Shift Keyed
FWA	Fixed Wireless Access
HDB3	High Density Bipolar Order 3
IDU	Indoor Unit
IF	Intermediate Frequency
IFL	Interfacility Link
ISDN	
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LIU	Line Interface unit
LMCS	Local Multi-Point Communications Services
LMDS	Local Multi-Point Distribution Services
LNA	Low Noise Amplifier
LOS	Loss of Signal
LSM	Local Site Manager -Laptop or desktop PC using the P-COM's WaveView Lite Windows application
MC	Modem Controller
MCF	Motorola Cold-Fire Processor
MIB	Management Information Base
NCO	Numerical Control Oscillator
NIC	Network Interface Card - Supports user interfaces, as well as signal monitoring and port statistics collection.
NMA	Network Management Agent
NMS	Network Management System
ODU	Outdoor Unit
OTA	Over the Air
PA	Power Amplifier
PA	Power Amplifier
PCB	Printed Circuit Board
PD	Pattern Detect
PMP	Point-to-Multipoint
POST	Power Up Self Test

POTS	
PSN	Public Switched Network
PSN	Public Switched Network
PTN	Public Telephone Network
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keyed
RAM	Random Access Memory
RCS	Redundancy Control Switch
Remote IDU	Remote Terminal Indoor Unit chassis located at the remote location
Remote ODU	Remote Terminal Outdoor Unit located at the remote location, connected to a directional antenna pointed towards the Sector Terminal.
Remote Terminal	Consists of a Remote IDU, Remote ODU and Interfacility Link
RF	Radio Frequency
RMA	Return Material Authorization
ROC	
ROM	Read Only Memory
RSSI	Receive Signal Strength Indicator
RU	Rack Unit
RX	Receive Signal
SAW	Surface Acoustic Wave
SCC	Serial Communication Controller
Sector	A geographic area radiating out from a Base Station. Typically referred to as the area covered by a Sector Antenna
Sector IDU	Sector Terminal Indoor Unit chassis located at the Base Station
Sector ODU	Sector Terminal Outdoor Unit chassis located at the Base Station location, connected to an antenna providing coverage over a sector.
Sector Terminal	Consists of one or more Sector IDUs connected to a common, or redundant, set of Hub IF Combiners and Sector ODU/Antenna assemblies
SF	Super Frame Format
SNMP	Simple Network Management Protocol
SPI	
TAC	Technical Assistance Center
TDMA	Time Division Multiple Access
Tel-Link	Brand Name for P-COM Point to Multipoint equipment
TX	Transmit Signal

UIM	User Interface Module
UL	
Uplink	The RF Communications path from the Remote Terminals to the Base Station
VOM	Volt-Ohm-Meter
WLL	Wireless Local Loop

January 1999

Reader Comment Form

We welcome your comments and suggestions for improving our manuals. Please record your suggestions below and FAX the completed form with your comments to (407) 728-9896.

NOTE

This form is for documentation comments only. Problems with hardware or software should be reported separately to the Technical Assistance Center at 1-877-674-3600.

1. Did you find any omissions or inaccuracies in the manual? If so, please specify the page and the problem. (It may help to include a marked up copy of the page along with this form.)

2. Did you find this manual understandable, usable, and well organized? Please make suggestions for improvement.

3. Is there sufficient documentation on the associated hardware or software required for your use of the Tel-Link Point to Multipoint System, as described in this manual? If not, specify the type of information you feel is missing.

4. Please indicate the type of user/reader that you most nearly represent:

_____**System programmer/System Manager**

_____**Process Engineer**

_____**Maintenance Technician**

_____**Other**_____

5. Please indicate the way(s) in which you use this manual:

_____**Instructional Tool**

_____**Reference Tool**

_____**Other**_____

Name _____

Company_____

Address_____

Telephone_____

Date_____

Title _____

Division_____

City _____

State, Zip/Country _____

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