NTPM99CA

Nortel Networks

WLAN Cable Access Point 6220
User Guide

Standard Release 1.0 Issue 1 Oct 2004

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Multi-Region Product Documentation

This document may describe features that are not available in your region due to local regulations.

Compliances

Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with instructions, may cause harmful and, if not installed and used in accordance with instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

.   • Reorient the receiving antenna
.   • Increase the separation between the equipment and receiver
.   • Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
.   • Consult the dealer or an experienced radio/TV technician for help

FCC Caution: To assure continued compliance, (example - use only shielded interface cables when connecting to computer or peripheral devices). Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired opera

Publication history

August 2004
Issue 1. Issued for WLAN Cable Access Point 6220 Release 1

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About this document

This document describes the system features used in the WLAN Cable Access Point 6220 Release 1.0 Product.

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Audience

The intended audience for this document includes:

Installers
Technicians
Network planners
Network & system engineers
Network administrators

List of Abbreviations

AP	Access Point
APU	Access Point Unit
ARP	Address Resolution Protocol
BPDU	Bridge Protocol Data Unit
BPSK	Binary Phase-Shift Keying
CATV	Community Antenna Television
CM	Cable Modem
CMTS	Cable Modem Termination System
CPE	Customer Premises Equipment
CSU	Corporate Service Unit
DBPSK	Differential Binary Phase-Shift Keying
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data Over Cable Service Interface Specifications
DQPSK	Differential Quadrature Phase Shift Keying
DVM	Digital Volt Ohm Meter
EAP	Extensible Authentication Protocol
EIRP	Equivalent Isotropic Radiated Power
EMI	Electromagnetic Interference
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FTP	File Transfer Protocol
HFC	Hybrid Fiber Coax
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial Scientific and Medical equipment
ISP	Internet Service Provider
ITU	International Telecommunication Union
LOS	Line of Sight
MAC	Media Access Control
MIB	Management Information Base
NAS	Network Access Server
NAT	Network Address Translation

NLOS	Non Line of Sight
NMS	Network Management System
NWID	Network ID
OLOS	Optical Line of Sight
ONU	Optical Network Unit
PCMCIA	Personal Computer Memory Card International Association
PI	Power Inserter
POE	Power over Ethernet
PSU	Power Supply Unit
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RADIUS	Remote Authentication Dial-In User Services
RF	Radio Frequency
RIP	Routing Information Protocol
SEC	Super Ethernet Converter
SMTP	Simple Mail Transfer Protocol
SNMP	Single Network Management Protocol
SNR	Signal to Noise Ratio
SSID	Service Set Identification
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TTL	Time to Live
UDP	User Datagram Protocol
UNII	Unlicensed National Information Infrastructure
UPS	Uninterruptible Power Supply
VLAN	Virtual Local Area Network
VSWR	Voltage Standing Wave Ratio
WEP	Wired Equivalent Privacy
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network

Technical Support and Information

If you purchased a service contract for your Nortel Networks product from a distributor or authorized reseller, contact the technical support for that distributor or reseller for assistance.

If you purchased a Nortel Networks service program, contact Nortel Networks Technical Support as indicated in the following table.

Internet	**http://www.nortelnetworks.com/cgi-bin/comments/comments.cgi**	• Click on Technical Support • Select Online Support • Open a Customer Service Request online
Telephone	**1-800-4NORTEL (1-800-466-7835)**	• Call 1-800-4NORTEL • Find the nearest Technical Solutions Center • Enter ERC (Express Routing Code) if it is available

FCC Conformance

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference. And (2) this device must accept any interference received, including interference that may cause understand operation.
This Class B digital apparatus complies with   Canadian ICES-003.

Safety guidelines

This chapter contains safety guidelines that you must follow for personal safety and for the correct handling and operation of equipment.

Warning and safety precautions

To prevent personal injury, equipment damage, or service interruption , follow all precautionary messages found in WLAN Cable Access Point 6220 documentation and the safety procedures established by your company.

The following precautionary messages appear in WLAN Cable Access Point 6220 documentation:

DANGER
Risk of personal injury
A precautionary message with this symbol indicates a risk of personal injury.

DANGER
Risk of electrical shock
A precautionary message with this symbol indicates a risk of personal injury caused by an electrical hazard.

CAUTION
Risk of interruption to service
A precautionary message with this symbol indicates a risk of service interruption or equipment damage.

The graphic symbol of an exclamation point within an equilateral triangle warns the user of the device that it is necessary to refer to the instruction manual and its warnings for proper operation of the unit.

Summary of Warning and Safety Precautions

MAKE SURE THAT POWER SUPPLIER IN HFC NETWORK IS TURNED OFF PRIOR TO CONNECTING THE COAXIAL CABLE TO THE CABLE ENTRY CONNECTOR ON APU ENCLOSURE.

DO NOT FASTEN OR UNFASTEN THE COAXIAL CABLE CONNECTOR ON THE APU WITH UNDER THE UNIT POWERED.

DO NOT CONNECT OR INJECT ANY AC POWER EXCEPT CATV UPS/POWER SUPPLY. SUCH A MISTAKE WILL CAUSE APU TO BE SERIOUSLY DEMAGED.

REFER SERVICING TO A QUALIFIED TECHNICIAN TO REDUCE THE RISK OF ELECTRIC SHOCK WHEN THE UNIT DOES NOT APPEAR TO OPERATE NORMALLY OR EXHIBITS A MARKED CHANGE IN PERFORMANCE.

WHEN INSTALLING THE UNIT, CHOOSE A LOCATION THAT PROVIDES A MINIMUM SEPARATION OF 20 cm FROM ALL PERSONS DURING NORMAL OPERATION.

THE APU AND CSU SHALL BE INSTALLED BY A PROFESIONAL FIELD TECHNICIAN

BOTH TYPES OF UNITS SHOULD BE INSTALLED BY ONLY A PROFESSIONAL FIELD TECHNICIAN TO REMOVE THE POSSIBILITY OF ABNORMAL INSTALLATION FOR APU AND CSU.

DO NOT EXPOSE THIS UNIT TO RAIN, MOISTURE OR DUST UNCOVERED.

BE SURE NOT TO BE SITUATED NEAR HIGH VOLTAGE POWER SOURCES.

MAKE SURE THAT ALL BOLTS ON THE ENCLOSURE ARE TIGHTENED FIRMLYY SO THAT WATER DOES NOT ENTER THE UNIT.

BE SURE THAT ALL CONNECTORS ARE CONNECTED TO THE UNIT AND THE RF CABLE HAS BEEN PROTECTED BY THE WATER-PROOF CAP.

BE SURE THAT THE POWER SUPPLY UNIT THAT PROVIDES AC POWER TO THE APU OPERATES WITHIN THE GUIDELINES IN THIS MANUAL.

IF YOU ARE NOT SURE OF THE TYPE OF POWER SUPPLIED TO YOUR UNIT, CONSULT YOUR LOCAL NORTEL NETWORKS REPRESENTATIVE OR NETWORK SERVICE COMPANY.

BE SURE THAT THE RADIO ANTENNA IS LOCATED AWAY FROM ALL POWER FACILITIES SUCH AS CABLE OR POWER SUPPLIERS.

NEVER PUSH OBJECTS OF ANY KIND INTO THE UNIT. IT MAY TOUCH DANGEROUS VOLTAGE POINTS OR SHORT-OUT PARTS THAT COULD CAUSE AN ELECTRIC SHOCK.

DO NOT ATTEMPT TO HANDLE THE UNIT YOURSELF. WITHOUT FULL KNOWLEDGE OF THE OPERATIONS AND CHARACTERISTICS OF THE APU PRODUCT AS OPENING OR REMOVING COVERS MAY EXPOSE YOU TO DANGEROUS VOLTAGE OR OTHER HAZARDS.

Overview

Introduction

This document describes the system features used in the WLAN Cable Access Point 6220 Release 1.0 Product.

The Wireless LAN Cable Access Point 6220 is an outdoor hardened, strand-mountable access point solution designed to extend the reach of the cable operators' hybrid fiber coax network utilizing wireless technologies from existing rights of ways. This solution from Nortel Networks provides cable operators a fast, low-cost alternative for delivering service to new customers by eliminating the time, permits, and construction costs associated with extending aerial or buried drops.

The WLAN Cable Access Point 6220 solution provides :

Flexible service platform

The WLAN Cable Access Point 6220 is a flexible service platform giving cable operators the ability to offer many different wireless services such as Public Hot Spots and Commercial High Speed Data services.

Standard Compliance and Interoperability

The WLAN Cable Access Point 6220 utilizes standard-compliant DOCSIS^{TM} cable modems, thus ensuring interoperability with the existing cable network. Wireless access is accomplished using industry-standard IEEE 802.11 radios approved by government regulatory agencies for use in "unlicensed" ISM frequencies.

Security

Security is of the highest importance when delivering wireless services. The WLAN Cable Access Point 6220 adheres to industry standards for 802.11 devices and augments those standards with additional security features designed to provide both the cable operator and the end-user maximum protection.

Performance optimization via multiple antenna options

Nortel Networks provides antenna options specifically engineered to enable the WLAN Cable Access Point 6220 to achieve peak link performance in Line of Sight (LOS) and Near LOS applications.

Ease of installation

Designed for simple, fast installation by professional technicians, the WLAN Cable Access Point 6220 is installed in a simple three-step procedure: lock down strand clamps, connect power via coax drop, and attach and align antenna for service optimization

Figure 1-1
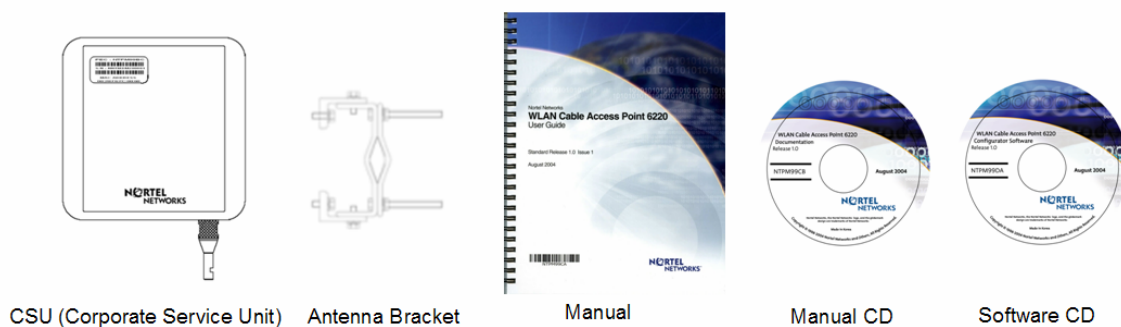**WLAN Cable Access Point 6220 Service Concept Diagram**
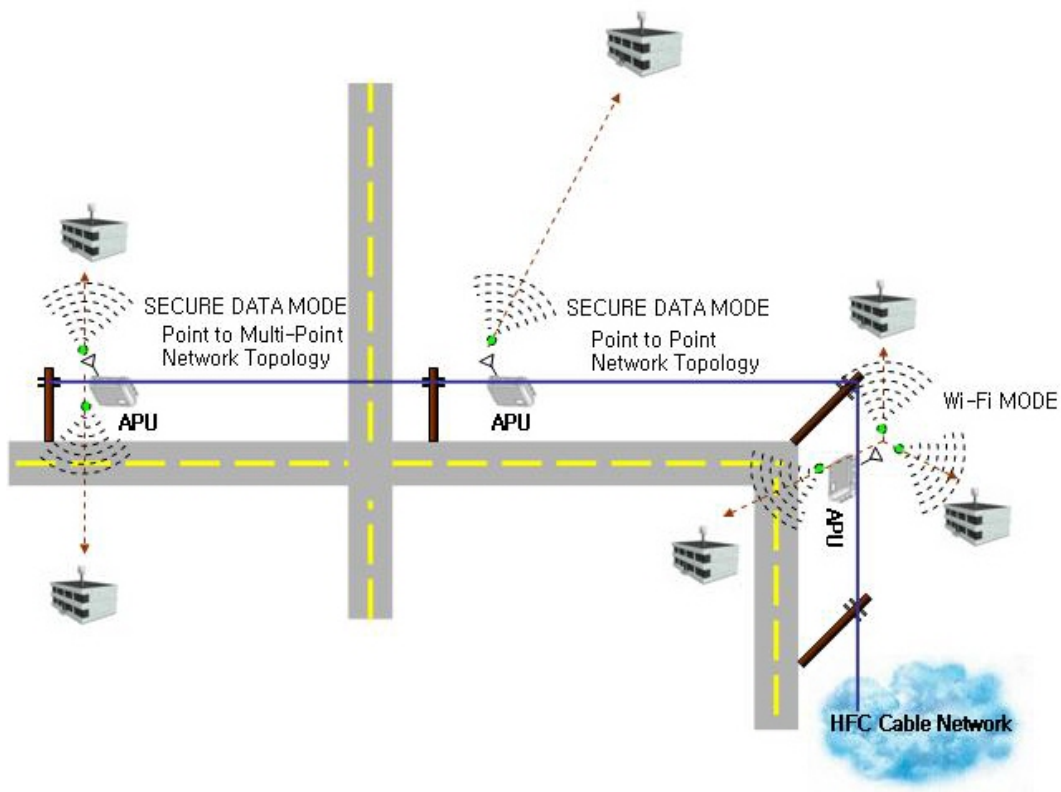
Product Description

Table 1-1
WLAN Cable Access Point 6220 Products

No.	PEC	Description
1	**NTPM99AC**	APU, 2.4G,B RADIO, CM
2	**NTPM99AE**	APU, 2.4G,FP ANTENNA, 14dB gain
3	**NTPM99AF**	APU, 2.4G,OMNI ANTENNA, 7dB gain
4	**NTPM99AP**	APU, 2.4G,BI-DIRECTIONAL ANTENNA, 9dB Peak
5	**NTPM99AE**	APU Antenna Mounting Kit / Tool
6	**NTPM99CB**	R1.0 WLAN6220 CAP DOC,CD
7	**NTPM99DA**	R1.0 WLAN6220 CAP SOFTWARE, CD
8	**NTPM99CA**	R1.0 WLAN6220 CAP DOC,PAPER
9	**NTPM99BC**	CSU, 2.4G,B RADIO, Flat Panel
10	**NTPM99EG**	CSU, Mounting Kit / Tool
11	**NTPM99BJ**	CSU, POE INJECTOR

Figure 1-2
WLAN Cable Access Point 6220 APU Package Components

APU (Access Point Unit)   Antenna Bracket   Manual   Manual CD   Software CD

Figure 1-3
WLAN Cable Access Point 6220 CSU Package Components

CSU (Corporate Service Unit)   Antenna Bracket   Manual   Manual CD   Software CD

APU(Access Point Unit)

The following is a list of WLAN Cable Access Point 6220 APU features:

Enclosure has three sorts of connector which support the connection to CATV Cable Network, Antenna and Monitoring Equipment.
Coaxial Port has the standard type of connector so that can be efficiently adapted to every connector regardless of the termination type of coaxial cable like "Trunk or Drop Cable"

Operation Power and Data Traffic are mixed at a signal amplifier as TBA(Trunk Bridge Amplifier), PI(Power Inserter) and supplied to the coaxial port on the APU through coaxial cable.

Monitoring Port can provide the safe testing method for measuring CATV signal to an installation engineer by attenuating RF power and protect AC power signal.

Basically, Two kinds of mounting types are available for APU, such as a steel wire strand mounting and wall mounting, but in case of wall mounting, another optional bracket kit will be needed for installation. The available antennas are totally three types such as 'Directional Type', 'Bi-directional Type' and 'Omni-directional Type' , which can be mounted on the front or rear cover of APU with a Universal Bracket.

Cable Modem Module is compliant to DOCSIS 2.0(Cablelabs) as well as DOCSIS 1.1 and WLAN AP support the secure mode connection which mean that wireless traffic from APU and CSU is not scanned and detected by a conventional sniffing program like 'Netstumbler'.
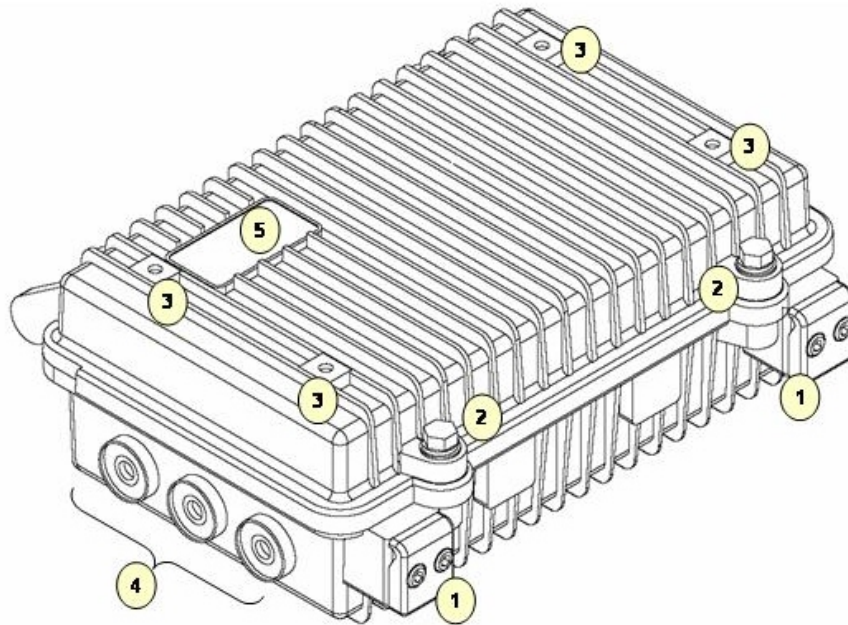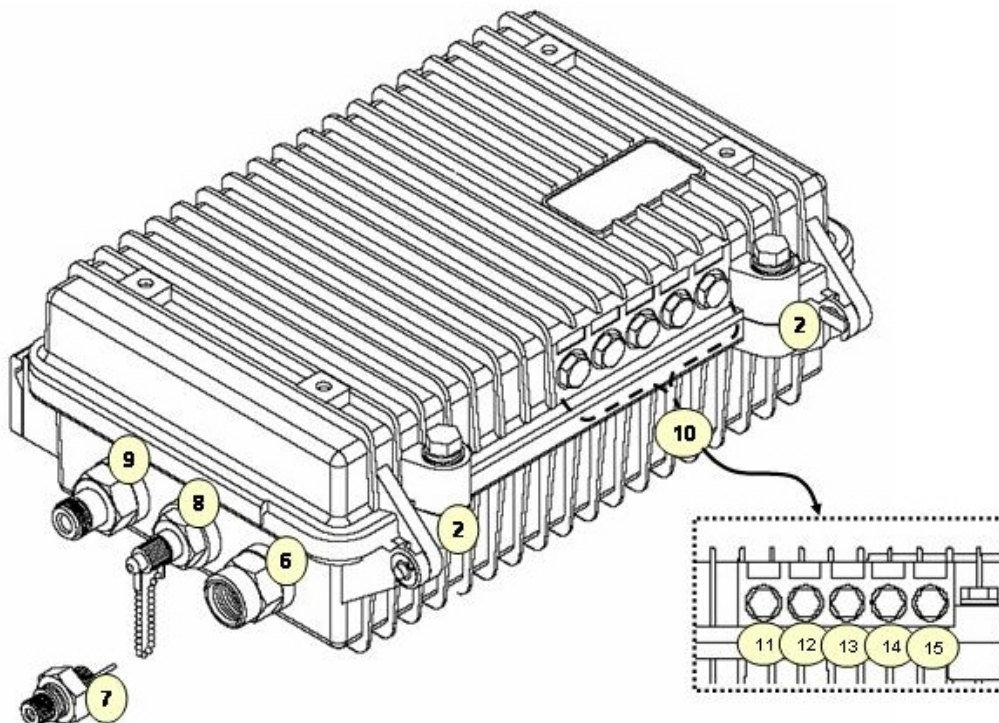
Figure 1-4
APU (Top head)

Figure 1-5
APU (Bottom)
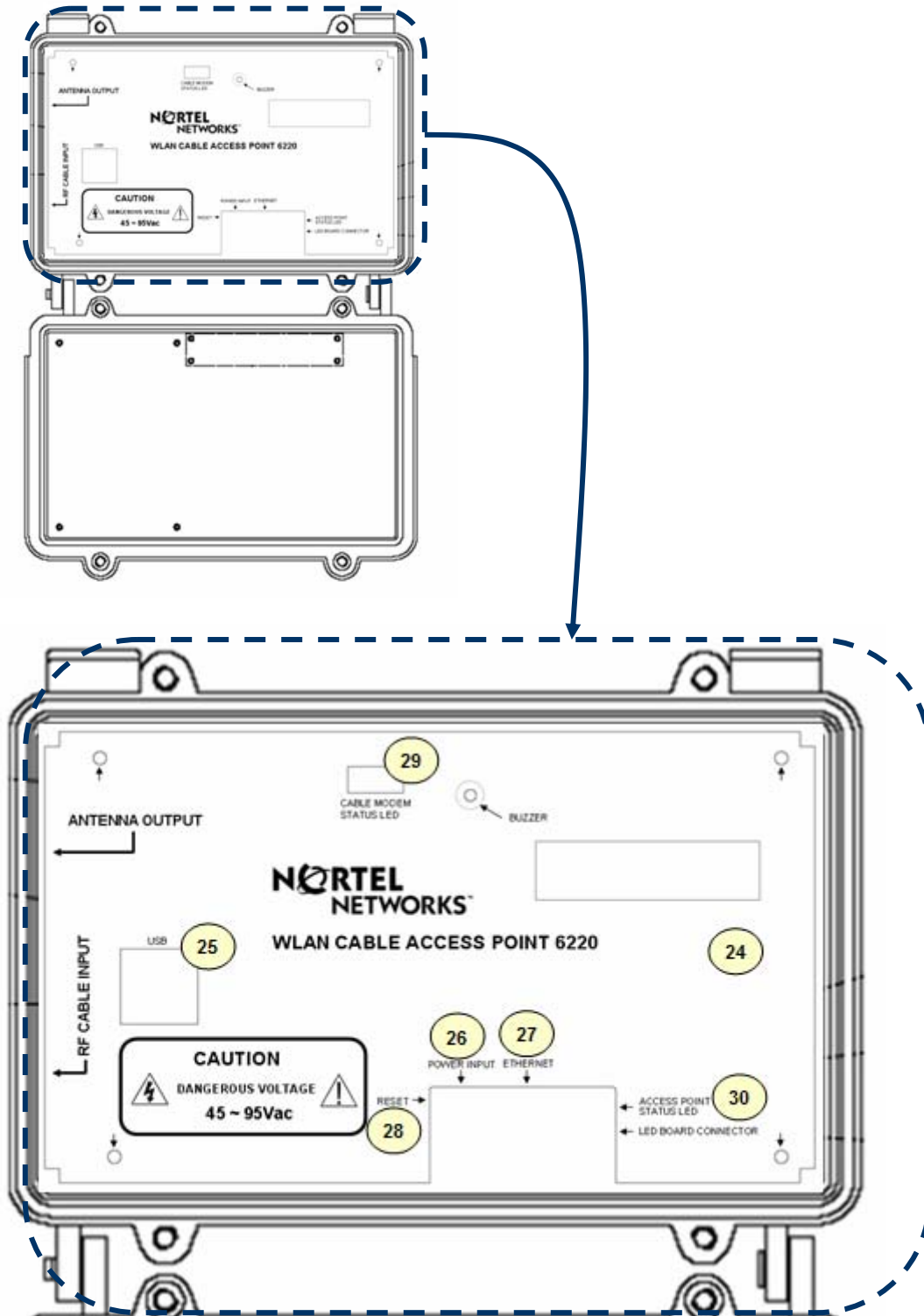
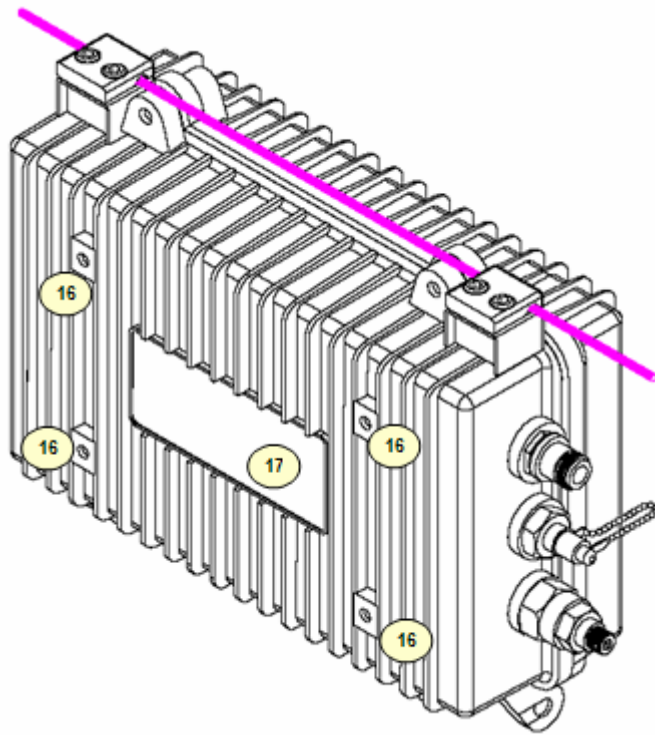**Figure 1-6**
Inner Panel (APU)

**Figure 1-7
APU (Back)**

**Figure 1-8
APU System Structure and Signal Flow**
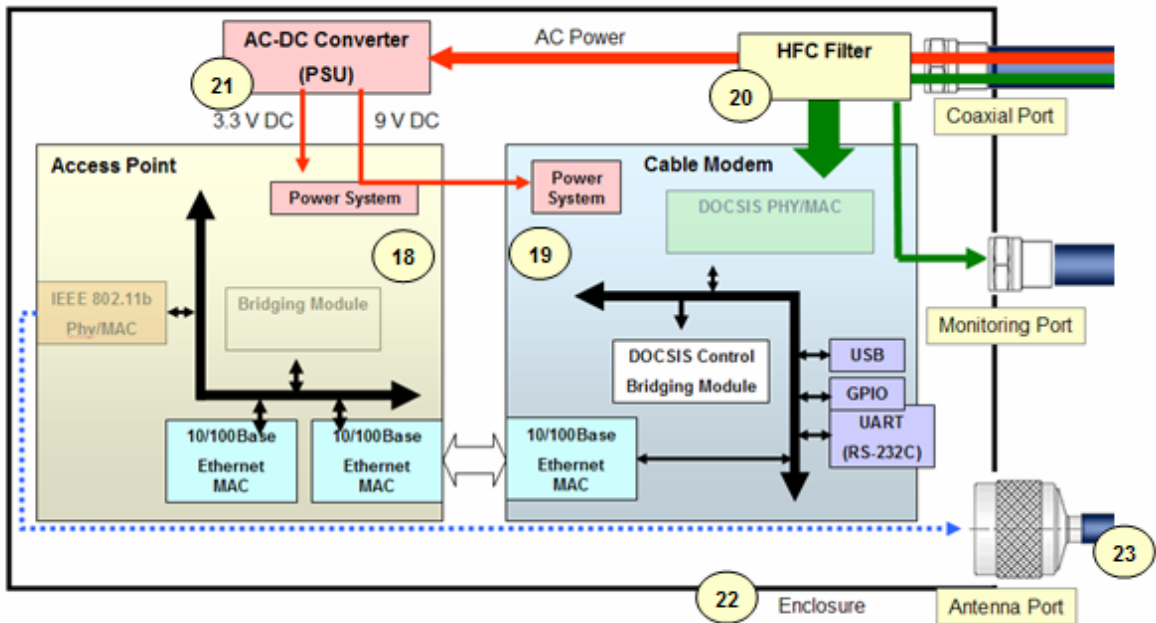
Table 1-2. Modules and Connectors (APU)

Item	Label	Description & Function	
1	Clamp Module	Provide strand mounting function to APU, Strand Clamp and Mount Bosses	
2	Lid Bolt	Lid Bolt for closing a case of APU enclosure	
3	Antenna Mount Hole	Screw Holes for mounting a APU antenna with a universal bracket	
4	Reserved Port	Reserved Location for a future upgrade and revision	
5	Logo Panel	Location for Nortel networks Logo	
6	Cable Entry Port	Port for coaxial cable connection. Trunk and Drop termination types are supported	
7	Cable Adaptor	Coaxial Adaptor Port to connect F-type Drop cable to APU Cable Entry Port	
8	Monitoring Port	Port reserved for safe testing of Cable RF signal. The signal on this port is attenuated by 20 dB	
9	Antenna Port	Port for antenna connection	
10	LED Panel	Provide the information for system operation status through LED Display	
11	LED1(Power)	Indicate Power is turned on	
12	LED2(Link #1)	ON	Indicate a valid cable modem operation
		Flash	Indicate that cable modem is linked up on the HFC network
13	LED3(Link #2)	ON	Indicates a Ethernet link between access point and cable modem
		Flash	Indicates that the access point is transmitting or receiving data
14	LED4(Radio #1)	ON	Indicates the 802.11b radio is enabled and operating
		Flash	Indicate that a frame is transmitted or received on the radio port
15	Reserved		Reserved location for a future upgrade
16	Antenna Mount Hole	Screw Holes for mounting a APU antenna with a universal bracket	
17	Label	Location for attaching a product label which include S/N,PEC,MAC address and so on	
18	Access Point	Mini-PCI type III Radio Card, System Board(Wi-Fi & Secure Data Mode [TM])	
19	Cable Modem	DOCSIS 2.0 compliant cable modem	
20	HFC Filter	Split a HFC Signal and AC power from the combined signal	
21	PSU	AC to DC Power converter	
22	Case	Housing case which can be mounted on strand and antenna mounting bracket	
23	Antenna	2.4GHz Radio Frequency Antenna (Flat Panel, Omni-directional and Bi-directional). APU antenna can be mounted on the front or rear cover of APU with universal bracket.	
24	Inner Panel	Cover Panel to secure the main system boards(WLAN AP, Cable Modem)	
25	USB Port	USB type port for testing the Cable Modem Module	
26	DC Connector	3-pin connector to supply DC power to system board from Power Converter	
27	Ethernet Port	Port to connect APU to laptop/PC for testing purpose	
28	Reset S/W	Switch to reset the system to default settings	
29	Cable Modem LED	Indicate the full status of Cable Modem	
30	Access Point LED	Indicate the full status of Access Point	

CSU(Corporate Service Unit)

The following is a list of WLAN Cable Access Point 6220 CSU features:

Enclosure has a POE connection interface and a DC Power Adapter Jack at the bottom of CSU.

Operation Power & Data Traffic are mixed at POE Injector and supplied to the Ethernet Port on CSU through CAT5 Cable.
Basically, two kinds of mounting types are available for CSU, such as a pole mounting and wall mounting at house or tall building, but in case of wall mounting, another optional bracket kit will be needed for installation.

The antennas is basically Flat Panel type which is built-in CSU body and protected by a plastic material RADOM.
WLAN AP support the secure mode connection which mean that wireless traffic from APU and CSU is not scanned and detected by a conventional sniffing program like 'Netstumbler'.

**Figure 1-9
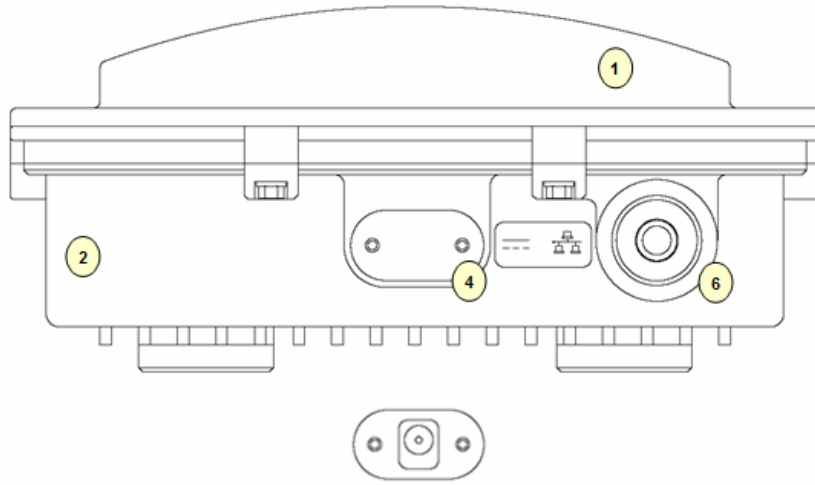WLAN Cable Access Point 6220 CSU (Bottom)**

**Figure 1-10
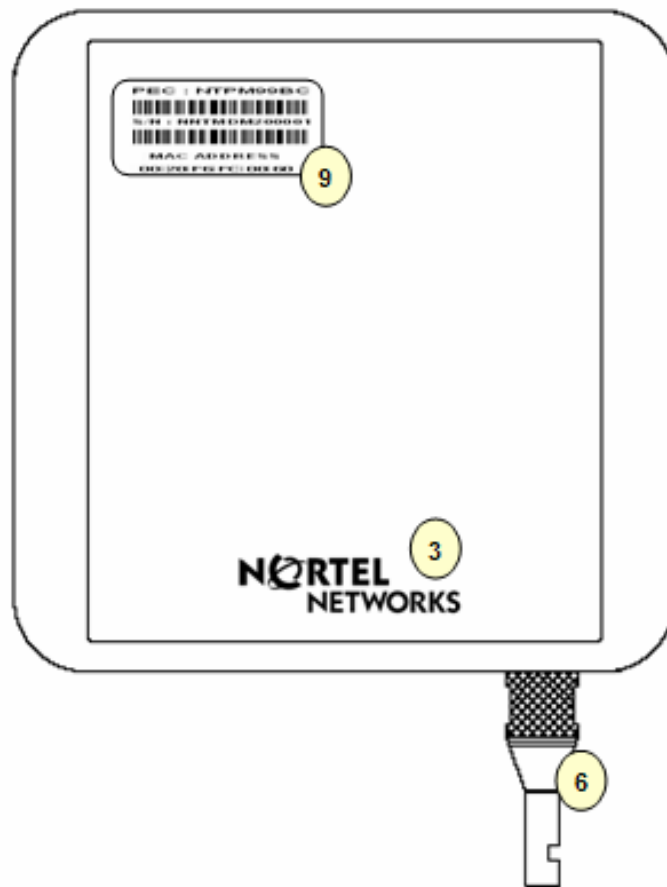WLAN Cable Access Point 6220 CSU (Front)**
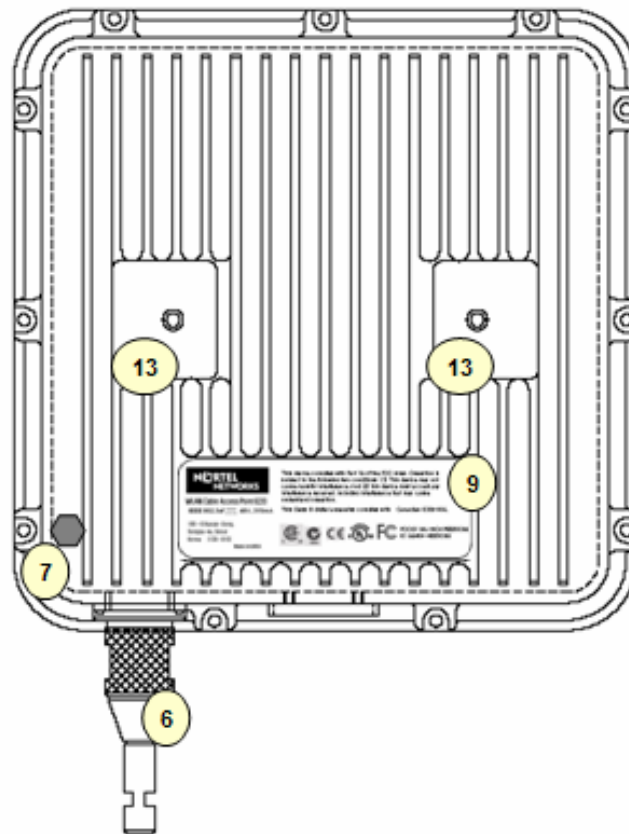
Figure 1-11
WLAN Cable Access Point 6220 CSU (Back)
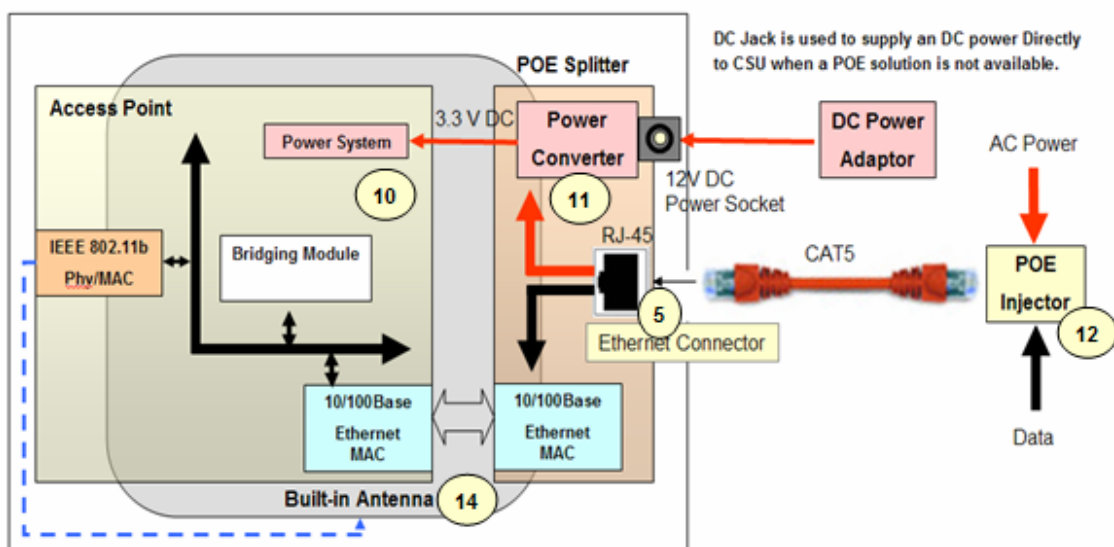

Figure 1-12
WLAN Cable Access Point 6220 CSU

Table 1-3. Modules and Connectors (CSU)

Item	Label	Description & Function
1	Antenna Radome	Protective Cover designed to contain a built-in antenna
2	Enclosure(Body)	Housing Integrated with an Antenna Case Assembly
3	Logo Panel	Location for Nortel networks Logo
4	DC Power Socket	Provide DC power(12V) from AC-DC Adaptor to CSU
5	Ethernet Port(POE)	Provide data connection between CSU and POE Injector or LAN Switch
6	EMI Cap	EMI Cap designed to prevent CSU from interfering to or from other devices Additionally, provide water proof feature accompanied by sealing tape.
7	Ground Point	Location for grounding the enclosure to earth for protecting the product from damage
8	Label(Front)	Location for attaching a product label which include S/N,PEC,MAC address and so on
9	Label(Back)	Location for attaching a product label which include S/N,PEC,MAC address and so on
10	Access Point	Mini-PCI type III Radio Card, System Board(Wi-Fi & Secure Mode ^{TM})
11	POE Splitter	Power Module to divide Ethernet Signal and DC power combined signal from POE Injector
12	POE Injector	Provide 802.3af based signal to CSU through Ethernet Port on CSU
13	Bracket Hole	Bolt Hole for assembly of mounting bracket
14	Built-in Antenna	2.4GHz Radio Frequency Antenna (Flat Panel).

Planning your WLAN Network

The wireless network is much different with a wired network. The Installation of a wireless network requires some additional planning. This planning includes RF Link Engineering like RF Path planning, site selection, and back-bone network preparation.

The radio links between all end sites are specified as three types of environmental connection listed as below:

LOS(Line Of Sight)
OLOS(Optical LOS)
NLOS(Non LOS)

Because High Frequency Radio travels in a straight forward line, a clear LOS(line-of-sight) between antennas is efficient and ideal. Frequently, locations of the desired links are fixed.

When you cannot achieve a clear line-of-sight, you must plan according to a basic consideration:

The Basic considerations for sites include:

▪ Installation Facility must be constructed (Electric Pole, Tower)
▪ Possibility of future obstructions
  - Trees that may obstruct the path
  - Buildings between the sites that may obstruct the path
▪ Lightening
▪ Distance between the sites and Network Structure.
▪ Strong RF interference

Site Survey & Planning

Definition

A site survey is a task-by-task process by which the surveyor discovers the RF behavior, coverage, interference, and determines proper hardware placement in a facility. The site survey's primary objective is to ensure that mobile workers and the wireless LAN's clients experience continuously strong RF signal as they move around the facility.

Items

- *Facilities Analysis*
- *Existing Networks*
- *Area Usage & Towers*
- *Purpose & Business Requirements*
- *Bandwidth & Roaming Requirements*
- *Available Resources*
- *Security Requirements*
- *Preparation Exercises*
- *Preparation Checklist*

Site Survey Equipment

- *Corporate service unit(CSU) with POE Injector*
- *Laptop and/or PDA*
- *Wireless PC card with driver & utility software*
- *Battery pack charger & DC-to AC converter*
- *Site survey utility software (loaded on laptop or PDA)*
- *Clipboard, pen, pencils, notebook paper, grid paper, & highlighter*
- *Blueprints & network diagrams*
- *Outdoor antennas(Omni-directional, Patch, Bi-directional)*
- *Cables & connectors*
- *Specialized software or hardware such as a spectrum analyzer*
- *Digital camera for taking pictures of particular locations within a facility*
- *Variable attenuator*

Wireless Network Planning

Procedure 1 (Location)

1. Select and identify enough location candidates to determine freely as the install point regardless of some design change to some extent.
2. The most crucial parameter is the range at which APU and CSU or other Wi-Fi Client are required to operate. The range can be determined by a conventional formula which consider a various kinds of environmental and radio equipments.
3. Another consideration in installing APU and CSU is the network connection like a CATV Coaxial Cable and CAT5 Ethernet Cable. Even though some location is the best location in terms of RF performance, the actual installed location is restricted by a limitation of cable reach.

Procedure 2 (Radio Link Path)

1. Choose the proper antenna type with a site survey result.
2. For best performance, mount the APU and CSU in a location where there is LOS(Line Of Sight) to each antenna.
3. Perform the field survey to summarize every obstacle like tree and earth bulge in consideration of OLOS(Optical LOS).
4. With the site survey result, adjust the tilt and angle of antenna so that there is maximum clearance within the FRESNEL ZONE of the direct path.
   Note: The best means of achieving FRESNEL ZONE clearance is to raise the height of APU or CSU mounting point as high as possible
5. In order to get the more exact information on RF radio link path, Calculate the Link Budget for Radio Link between APU and CSU which is referred in the end of this section.

   Note: The link budget is a rough calculation of all known elements of the link to determine whether the signal will have the proper strength to the other end of the link.

Procedure 3 (RF Channel Selection)

1. Check all range of channels by RF measurement with Frequency Analyzer in order to see the interference effect with APU and CSU. Actually, RF interference is likely to arise from any other wireless system operating within the same frequency band as ISM/UNII Band Radio Products.

   Note: The final selection of operating channel should be done with the testing results of both APU and CSU.

Procedure 4 (Radio Performance Tuning)

Please refer to the Radio Link Test
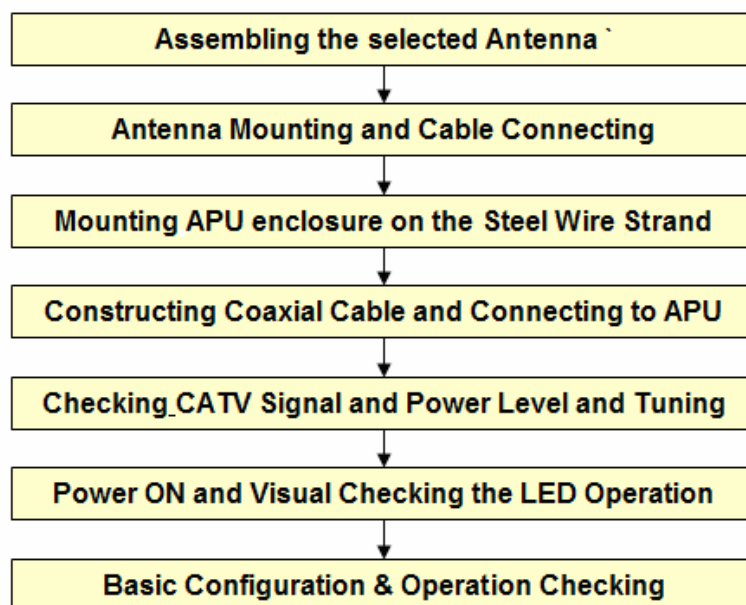
Installation

General

This section provides a complete set of procedures for the installation of WLAN 6220 equipment. It includes cable assembling information as well as required connection information for the WLAN 6220 units, mounting and powering instructions.

It is intended for use by trained installers familiar with CATV or Cable Modem and Wireless installations.

For technical assistance, contact your next level of support or Nortel Networks according to the information available in Technical Support and Information.

Installation Procedure Summary

APU(Access Point Unit)

Assembling the selected Antenna `

Antenna Mounting and Cable Connecting

Mounting APU enclosure on the Steel Wire Strand

Constructing Coaxial Cable and Connecting to APU

Checking CATV Signal and Power Level and Tuning

Power ON and Visual Checking the LED Operation

Basic Configuration & Operation Checking

CSU(Corporate Service Unit)

```
┌─────────────────────────────────────────────┐
│      Mounting CSU on the Installation Pole    │
└─────────────────────────────────────────────┘
                        │
                        ▼
┌─────────────────────────────────────────────┐
│      Assembling and Setting CSU with accessories │
└─────────────────────────────────────────────┘
                        │
                        ▼
┌─────────────────────────────────────────────┐
│      Basic Configuration & Operation Checking │
└─────────────────────────────────────────────┘
                        │
                        ▼
┌─────────────────────────────────────────────┐
│      Testing Connection between APU and CSU   │
└─────────────────────────────────────────────┘
```

Required Tools and Materials

Before you install the WLAN Cable Access Point 6220, ensure that the followings are prepared for installation work.

APU

WLAN Cable Access Point 6220 APU package does not contain an antenna and universal antenna bracket kit. For list of antennas and accessories, see the WLAN Cable AP 6220 manual or contact your local Nortel networks representative.

- One or more antenna cables (N-Male to the connector on the external antenna)
- External antennas selected by your self
- Flat blade screwdrivers
- Wire cutters
- Phillips screwdriver
- Torque wrench/driver
- Another proper tools for installation
- Heat gun with propane/Mapp torch
- Trunk & Distribution Cable Connector and Drop Cable F-connector port
- RF cable for connecting between the APU and Testing Unit (if needed)
- Portable CATV Spectrum Analyzer
- DVM(Digital Voltammeter)
- "Document CD" and "Software CD" that contains the APU Configurator, online help for the Configurator, and various documents.
- Advanced Tool: RF Testing Unit: CSU, Laptop computer with radio card

CSU

- IEEE 802.3af-2003-compliant Power over Ethernet (POE) injector or 12V DC Power Supply (When not using POE)
- Heat gun with propane/Mapp torch
- 1 CAT5 Ethernet Extender Coupler
- "Document CD" and "Software CD" that contains the APU Configurator, online help for the System Configuration, and various documents.
- PC or workstation with a Web browser for configuration

APU Installation & Configuration

Mounting and Installation Concept

Figure 3-1
APU Installation Concept on CATV Network Facility
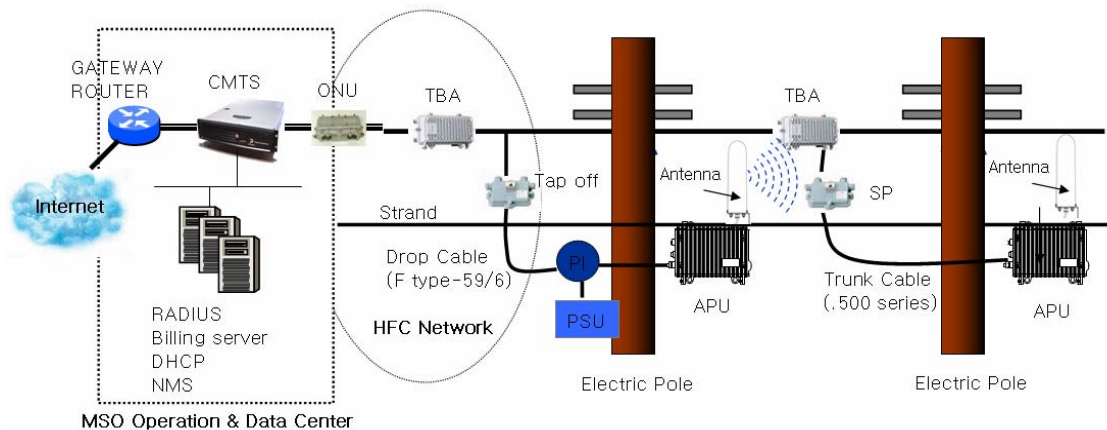
By default, APU is strand mountable. Each unit is shipped with a strand clamp module.

Both Drop and Trunk cable termination types are applicable to APU. The recommended method is Drop cable.

APU supports a variety of antenna types: omni-directional, flat panel and bi-directional. The antenna type should be selected according to the coverage needed and type of application - please refer to Appendix H for more detail information.

Procedure 1-1
Assembling and Mounting the selected Antenna

Common Procedure

1. Unpack an antenna box and check if it contains all parts listed in a manual in the box.
2. Prepare the recommended tools for assembly and installation of the antenna
3. Assemble the antenna and bracket kit following the assembly procedure for the selected antenna type.
4. Perform assembly of antenna and bracket as below.

Action

NTA 2407 (Flat Panel Antenna)

Step	Action

1. Make sure that each part number is the same with the actual parts in the box.
2. Attach the 2311 mounting bracket #1 to the antenna using the 1/4" flat washers, lock washers and hex nuts as shown in the mounting drawing.
3. Attach the 2311 mounting bracket #1 to mounting bracket #43 using the 1/4" flat washers, lock washers, hex nuts, and hex bolts as shown in the diagram. Ensure that the brackets are attached through the oblong hole in mounting bracket #43.
4. With the antenna connector oriented upward, fasten mounting bracket #43 to the radio using the M6 flat washers, lock washers, and hex bolts as shown in the mounting diagram.
5. To adjust the pan of the antenna, loosen the 1/4" hex bolts that attach the 2311 mounting bracket #1 with mounting bracket #43, adjust the pan, and re-tighten the bolts.

Lightning Protection
The antenna is at DC ground for lightning protection. If the antenna is mounted to a non-conductive structure it should in turn be grounded using practices supplied/approved by the customer.

Weatherproofing
All connections between the antenna connector and the transmission line must be weatherproofed according to standard industry practices.
Drainage

Since the RADOME is not pressurized, there is a drain hole in the connector base plate. The antenna must be installed so that the drain hole remains on the bottom. This drain hole must be kept open so that any moisture accumulating inside the RADOME will be able to drain properly.

Figure 3-2
NTA-2407 Antenna Assembly
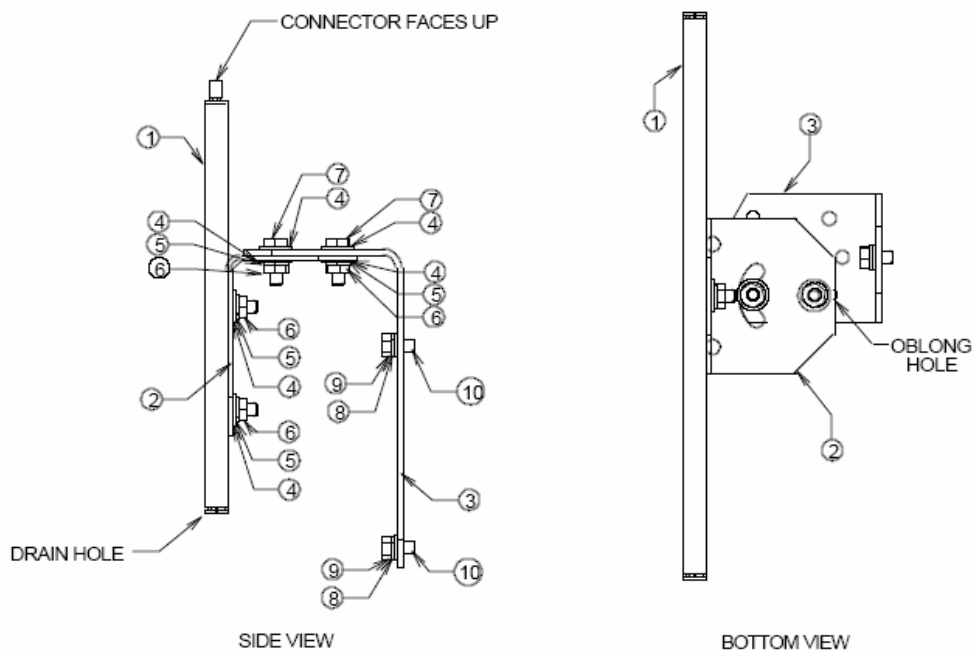
ITEM NO.	DESCRIPTION
1	Antenna
2	TA-2311-MBR-01
3	TA-MBR-43
4	1/4" Flat Washer S.S.
5	1/4" Split Lock Washer S.S.
6	1/4"-20 Hex Nut S.S.
7	1/4"-20 x 5/8" Hex Cap Bolt S.S.
8	M6 Flat Washer S.S.
9	M6 Split Lock Washer S.S.
10	M6 x 12 Hex Cap Bolt S.S.

NTA 2400 (Omni directional Antenna)

Step   Action

1. Make sure that each parts number is the same with the actual parts in the box.
2. Attach the mounting bracket to the antenna using the M6 flat washers, lock washers and hex cap bolts as shown in the mounting drawing.

3. With the antenna oriented upward, fasten the mounting bracket to the radio using the M6 flat washers, lock washers, and hex cap bolts as shown in the mounting diagram.
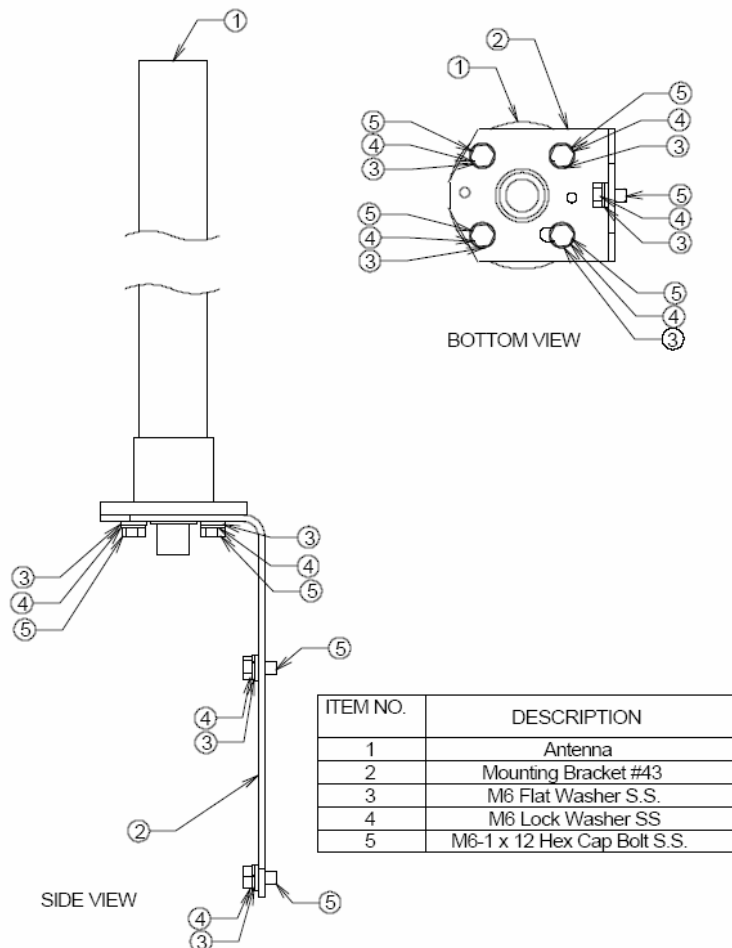
Lightning Protection
The antenna is at DC ground for lightning protection. If the antenna is mounted to a non-conductive structure (e.g. building wall, wooden pole etc.) it should in turn be grounded using practices supplied/approved by the customer.

Weatherproofing:
All connections between the antenna connector and the transmission line must be weatherproofed according to standard industry practices.

Figure 3-3
NTA-2400 Antenna Assembly

ITEM NO.	DESCRIPTION
1	Antenna
2	Mounting Bracket #43
3	M6 Flat Washer S.S.
4	M6 Lock Washer SS
5	M6-1 x 12 Hex Cap Bolt S.S.

NTA 2412 (Bi-directional Antenna)

Step   Action

1. Make sure that each parts number is the same with the actual parts in the box.
2. Attach the mounting bracket to the antenna using the 1/4" flat washers, lock washers and hex nuts as shown in the mounting drawing.
3. With the antenna oriented upward, fasten the mounting bracket to the radio using the M6 flat washers, lock washers, and hex bolts as shown in the mounting diagram.

Lightning Protection
The antenna is at DC ground for lightning protection. If the antenna is mounted to a non-conductive structure (e.g. building wall, wooden pole etc.) it should in turn be grounded using practices supplied/approved by the customer.
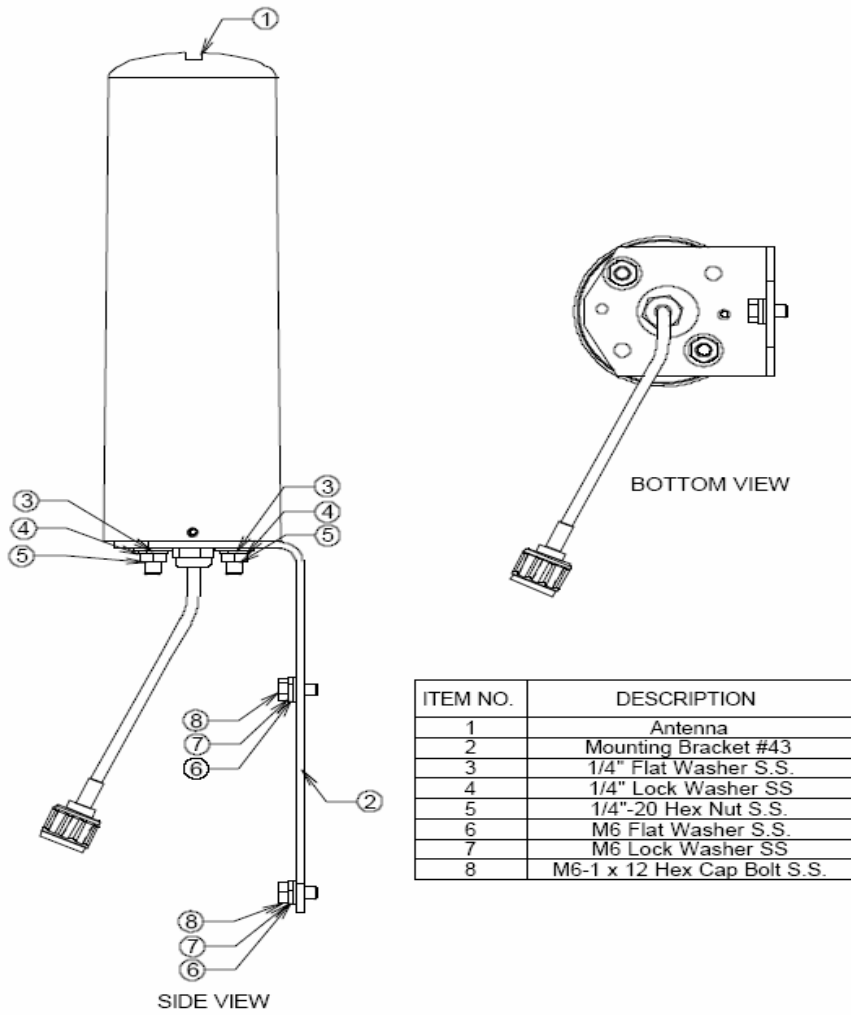
Weatherproofing
All connections between the antenna connector and the transmission line must be weatherproofed according to standard industry practices.

Drainage
Since the RADOME is not pressurized, there is a drain hole in the connector base plate. The antenna **must** be installed so that the drain hole remains on the bottom. This drain hole must be kept open so that any moisture accumulating inside the RADOME will be able to drain properly.

Figure 3-4
NTA-2412 Antenna Assembly

BOTTOM VIEW

SIDE VIEW

ITEM NO.	DESCRIPTION
1	Antenna
2	Mounting Bracket #43
3	1/4" Flat Washer S.S.
4	1/4" Lock Washer SS
5	1/4"-20 Hex Nut S.S.
6	M6 Flat Washer S.S.
7	M6 Lock Washer SS
8	M6-1 x 12 Hex Cap Bolt S.S.

Procedure 1-2
Antenna Mounting and Cable Connecting

Action

Step	Action
1.	Attach the bracket on the back surface of the APU and thread one flat washer onto each hex bolt. Screw each bolt with the washer into the two mounting holes.

Note: Even if APU enclosure has universal mounting holes on the front and rear cover, we recommend that you do not mount two kinds of antenna such as omni-directional and bi-directional type on the front cover. If inevitable, the left side of the front cover is the preferred location in consideration of antenna cable length.

2.	Tighten each bolt until the washer is pressed firmly into the APU Enclosure..

Figure 3-5
Antenna mounting with a bracket
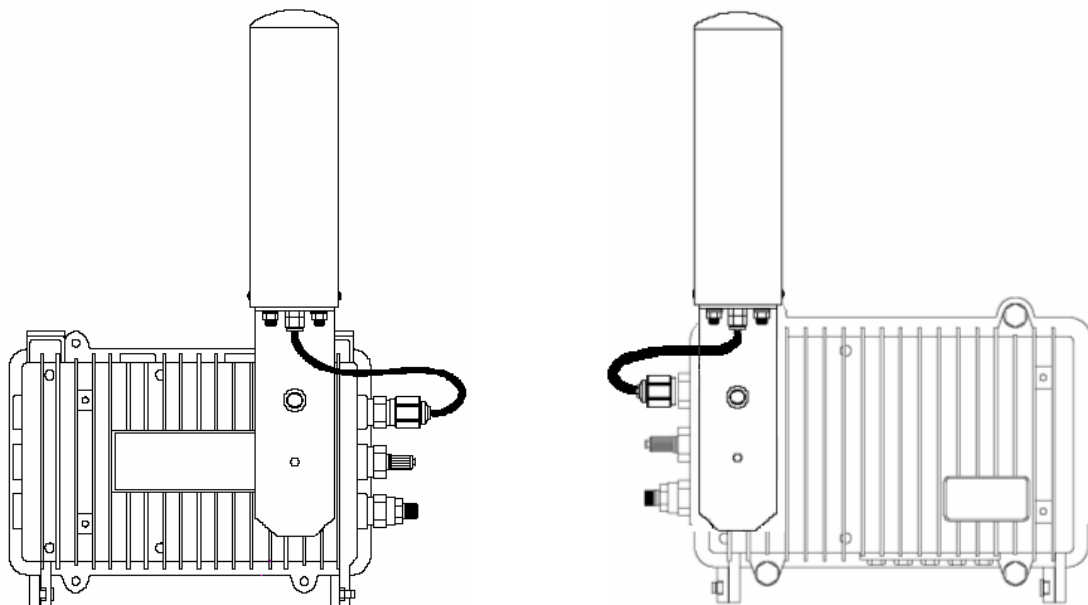
TYPE I   TYPE II

⚠	**BE SURE THAT THE RADIO ANTENNA IS LOCATED AWAY FROM ALL OTHER POWER FACILITIES LIKE CABLE OR POWER SUPPLIERS.**

Procedure 1-3
Mounting the APU on the Steel Wire Strand

Action

Step	Action

1. Prior to an installation, check if the strand has the strength to sustain the weight of the APU the weight of the APU or 10 lbs.

Note: During placing the cable, do not exceed the maximum rated pulling tension of the steel. After the cable has been placed, tension should be applied to the strand only. Refer to the table of guidelines found in the current NESC Rules 250-252.

Table 3-1
Strand Tension and limitation

Strand Diagram inches (mm)	Weight lbs/ft (kg/m)	Max rated Load lbs (kg)
0.109 (2.77)	0.032 (0.048)	1800 (816)
0.134 (3.40)	0.048 (0.075)	2680 (1216)
0.188 (4.77)	0.073 (0.109)	3990 (1810)
0.250 (6.35)	0.121 (0.180)	6650 (3016)

Figure 3-6
APU Installation scheme
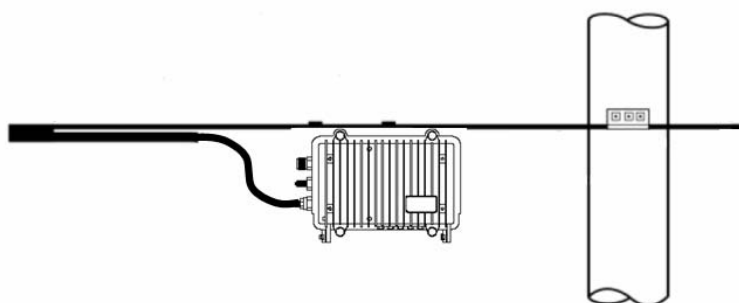
2. Attach the strand clamp assemblies to the top strand clamp bosses (mounting surfaces) with a long socket cap screw bolt (Diameter: 5 mm, Length: 15mm) and lock washers.
3. Slide the wire strand into the clamp module.
4. Tighten the bolts with power tool which have a hex head socket bit so that the enclosure cannot come off the strand, while the location can still be adjusted.
5. Torque the clamp bolts to between 35 and 60 in-lbs (3.9 and 6.8 N·m).

⚠ **MAKE SURE THAT ALL BOLTS IN THE ENCLOSURE ARE FIRMLY TIGHTENED.**

⚡ **WHEN INSTALLING THE UNIT, CHOOSE A LOCATION THAT PROVIDES A MINIMUM SEPARATION OF 20 cm FROM ALL PERSONS DURING NORMAL OPERATION.**

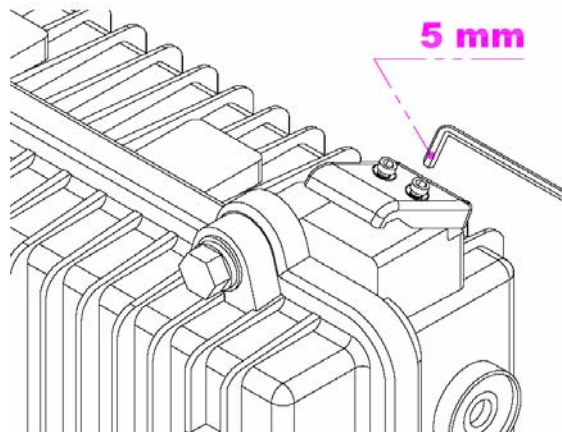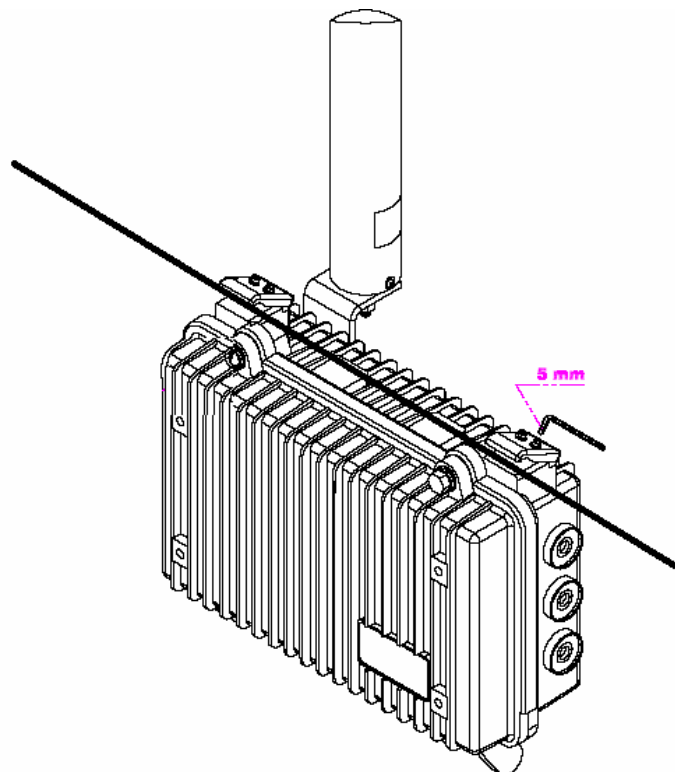**Figure 3-7**
Unfastening the Strand Mounting Clamps on the APU

Figure 3-8
Mounting APU on the Strand by tightening the socket cap screw bolt

Procedure 1-4
Constructing Coaxial Cable and Connecting to APU

Common Procedure

1. Prior to installation, choose a type coaxial cable to be connected to APU.
   - Trunk & Distribution Cable and Connectors : ".500 series"
   - Drop Cable and Connector : "F-type RG-59/6"
2. Perform installation of a coaxial cable as below.
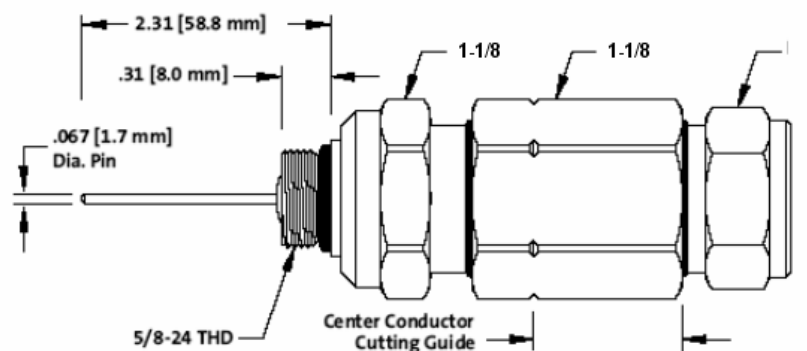
Action

Trunk Cable Connection

Step   Action

1. Prepare ".500 series Coaxial Cable", GRS Type connector and all required Tools for Terminator, Coring, Jacket stripper and Compression
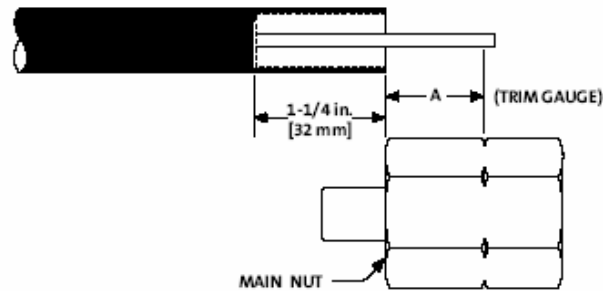
Figure 3-9
Trunk and Distribution Cable

Figure 3-10
Trunk Connector Design

2. Remove the outer jacket/armor to expose the inner jacket. And then, the removal of the outer jacket must be completed without scoring the inner jacket.

3. Using the built-in trim gauge, verify the center conductor trim length(15/16 inch: 24mm) and remove the dielectric to a depth of 1 1/4 inch(32mm) from end of outer conductor

Figure 3-11
**Constructing Trunk and Distribution Coaxial Cable**

4. After all dielectric and pre-coat have been removed from the center conductor, re-check the center conductor length and trim accordingly.

**Figure 3-12**
Shading the tip of the center conductor
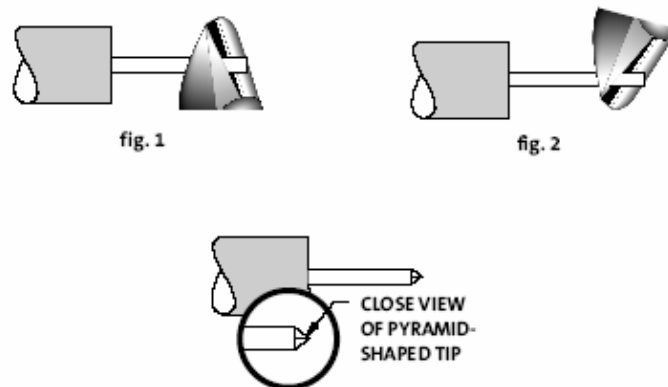
5. Make a cut halfway though and rotate the cutters 90° and complete the cut.
6. Slide the heat shrink tubing over cable
7. Remove the outer jacket to a length 1/2 in.(12.7mm)
8. Install the back nut into the cable.
9. Remove and clean flooding material
10. Install the main nut onto the cable, as a final check on both coring depth and center conductor length. The center conductor will protrude 1/16" to 1/8" past the end of the main nut.
11. Make sure that the cable is fully inserted into the connector so that the jacket butts up against the outer conductor seizing mechanism.

Figure 3-13
Combining Back Nut with Main Nut

BACK NUT   MAIN NUT
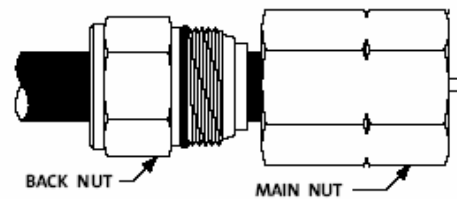
12. In order to prevent damage to the connector on APU enclosure, cut the pin of Body connector to the length of 0.59 inch(15mm) with a cutting tool

13. Install the Body connector to the enclosure and tighten strongly

Figure 3-14
Adjusting the length of the center conductor

15mm

BODY   Cutter

Antenna Connector

Monitoring Port

BODY

Body Connector

Coaxial Connector
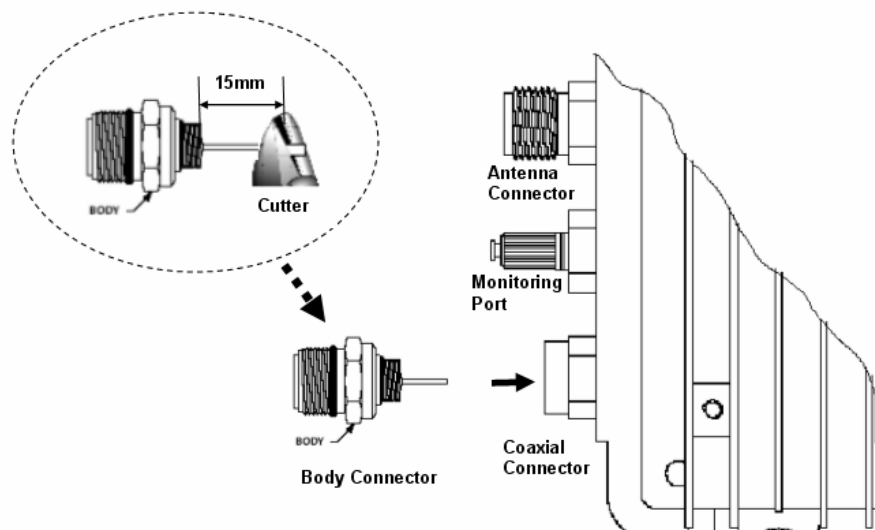
⚠️ **MAKE SURE THAT THE PIN LENGTH OF BODY CONNECTOR DOES NOT EXCEEDS 15mm(0.59055 inch) TO PREVENT DAMAGE TO THE JOINT PORTION OF THE HFC FILTER IN THE ENCLOSURE**

14. Bring the main nut and cable to the body connector, Hand-tighten many nut to body continually keeping pressure on cable towards the body so that the center conductor will be properly seized.

15. Using two wrenches, one wrench to hold the BODY from rotation, continue tightening the main nut to the body until a firm stop is reached.

16. Tighten the back nut by hand, then using two wrenches, one on the main nut, complete installation by tightening the back nut firmly to secure the cable (approximately 35 lbs, ft)

17. Secure the center conductor into equipment enclosure with the seizing screw

Figure 3-15
Connecting the main connector module to the connector port
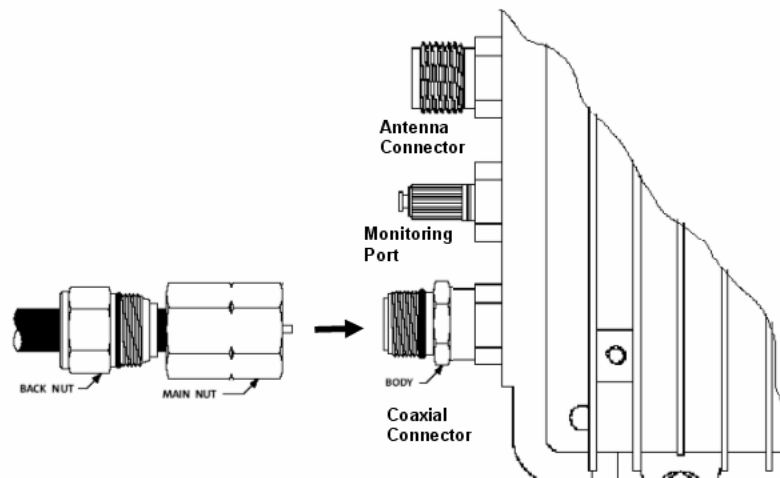
⚡	**MAKE SURE THAT THE POWER SOURCE IS TURNED OFF PRIOR TO CONNECTING COAXIAL CABLE(75 ohm) TO PROTECT A TECHNICIAN FROM ELECTRICAL SHOCK**

18. Slide the heat shrink tubing over the connector against the APU.
19. Shrink the tubing with a painting motion not concentrating on any one area using a propane torch with a broad "soft" frame.
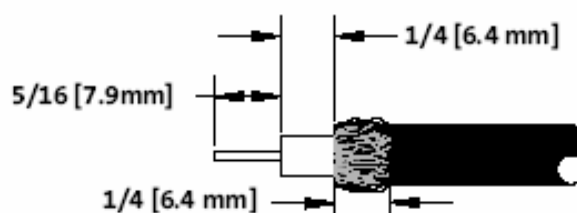
Figure 3-16
Shrink the tubing for a Water Proof
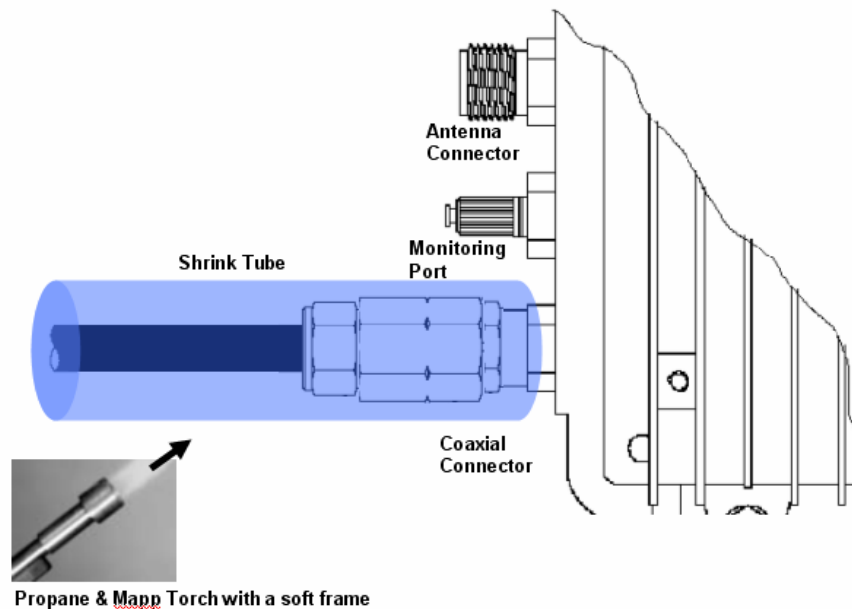
Drop Cable Connection

Step   Action

1. Prepare "F series Coaxial Cable", connector and all required Tools for Terminator, Coring, Jacket stripper and Compression
2. Remove the outer jacket/armor to expose the inner cable. Fold exposed braid back over jacket. Leave foil attached to dielectric.

**Figure 3-17
Drop Cable**

3. Push connector onto cable until the cable dielectric is flush with the connector post face. Approximately 1/4 inch (6.4mm) of center conductor will protrude beyond the end of the connector nut.
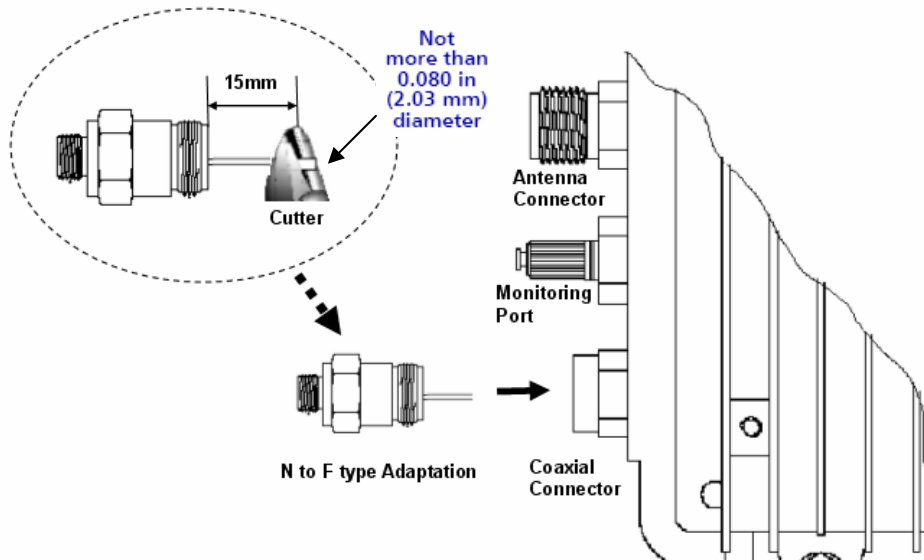
**Figure 3-18
Drop Connector Design**
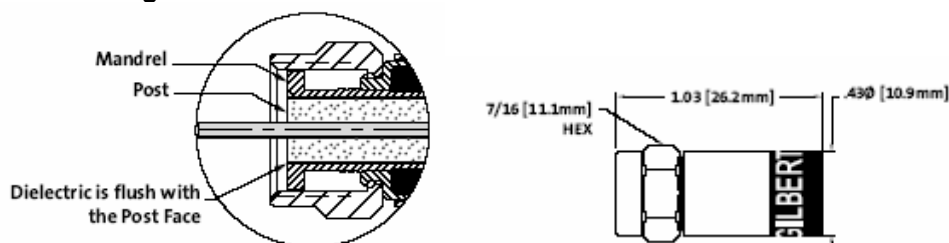
4. Slightly angle the connector/cable and insert into the compression tool area between the plunger tip and the cable gate allowing the center conductor to enter the center conductor guide. Push the cable into the cable gate. Compress the connector by squeezing the tool handles together until a positive stop is reached.

5. Remove the connector/cable from the tool by opening the cable gate to release the assembly from the tool.
    In order to prevent damage to the connector on APU enclosure, cut the pin of N to F type adapter to the length of 0.59inch (15mm) with a cutting tool
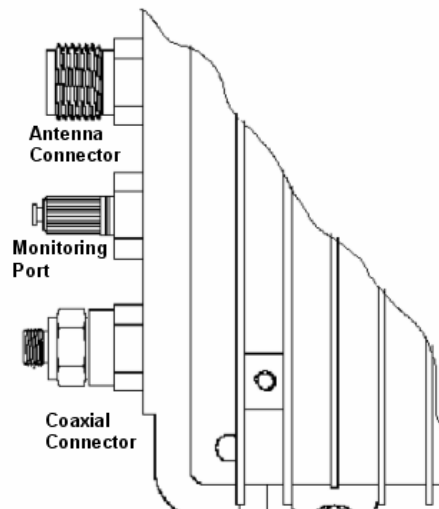
Figure 3-19
Adjusting the length of the center conductor


```
+-----------------------------------------------------+
|  /!\   MAKE SURE THAT THE PIN LENGTH OF ADAPTATION  |
|        CONNECTOR  NOT EXCEEDS 15mm(0.59055 inch) TO |
|        PREVENT DAMAGE TO THE HFC FILTER JOINT       |
|        PORTION IN THE UNIT.                          |
+-----------------------------------------------------+
```

MAKE SURE THAT THE PIN LENGTH OF ADAPTATION CONNECTOR NOT EXCEEDS 15mm(0.59055 inch) TO PREVENT DAMAGE TO THE HFC FILTER JOINT PORTION IN THE UNIT.
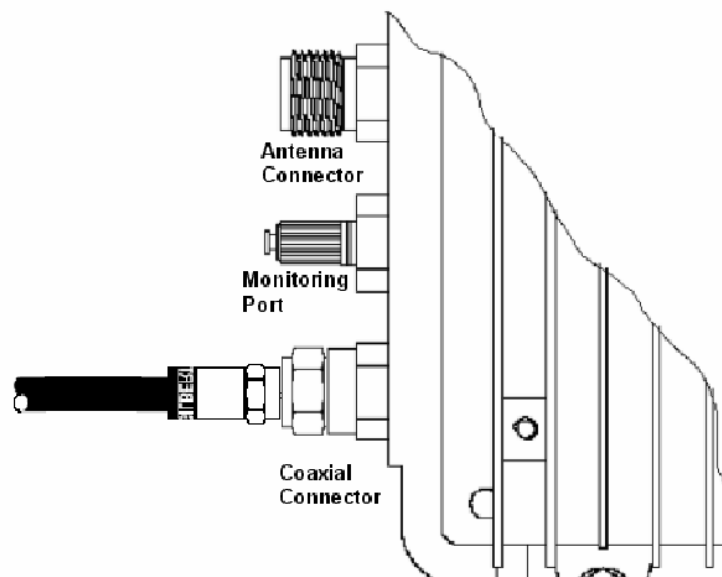
6. Install the N to F type Adapter to the enclosure and tighten strongly

Figure 3-20
Connecting the N to F type Adapter to the enclosure

7. Connect a coaxial cable to the F-connector port and fasten enough to prevent a water intrusion into the gap between connectors.

Figure 3-21
Connecting the coaxial cable to the connector port

> **MAKE SURE THAT THE POWER SOURCE IS TURNED OFF PRIOR TO CONNECTING COAXIAL CABLE (75 ohm) TO PROTECT AN INSTALLER FROM ELECTRICAL SHOCK**

8. Slide the heat shrink tubing over the connector against the APU.
9. Shrink the tubing with a painting motion not concentrating on any one area using a propane/Mapp torch with a broad "soft" frame.

Figure 3-22
Shrink the tubing for a Water Proof

Shrink Tube
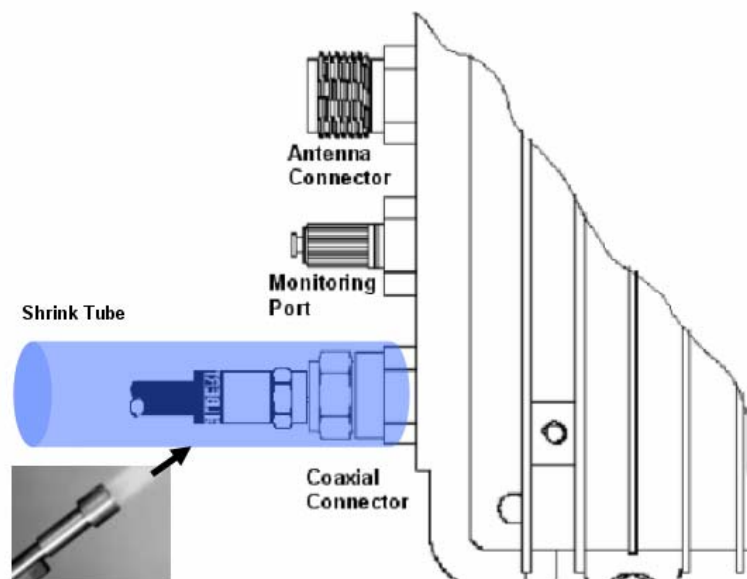
Coaxial Connector

Propane & Mapp Torch with a soft frame

Procedure 1-5
Checking CATV Signal and Power Level and Tuning

Action

Step	Action

1. Connect an actual coaxial cable to the coaxial port on the APU.
2. Connect a measurement coaxial cable to the monitoring port on APU.
3. Measure the Signal Power level at monitoring port

Note: In case of installation using a Trunk or Distribution Cable & Connector, it is crucially recommended to measure the RF Signal level directly at the termination of the coaxial cable from CATV AMP(TBA) or Splitter before connecting to APU in order to ensure a perfect operation of Cable Modem inside APU.

If the measured Signal level is outside from the allowed range referred in DOCSIS, you should adjust the AMP Power level or perform another proper tuning method to meet the requirement of RF signal level.
It is also recommended to measure AC voltage from CATV UPS Power Supply to ensure a perfect operation.

Note: In case of installation using a Drop Cable, it is recommended to measure the AC voltage from Local CATV Power Supply to ensure a perfect operation. But if you can confirm that a power supply facility is compliant to the power requirement of APU, this step can be skipped

4. Check if the acquired power level converted by adding 20dBmV to monitored value satisfy the range (-15dBmV ~ +15dBmV) referred in DOCSIS standard. But, some level margin should be added to the measured power level by 1 ~ 3 dB.

Figure 3-23
Measuring the Power Level at the Monitoring Port
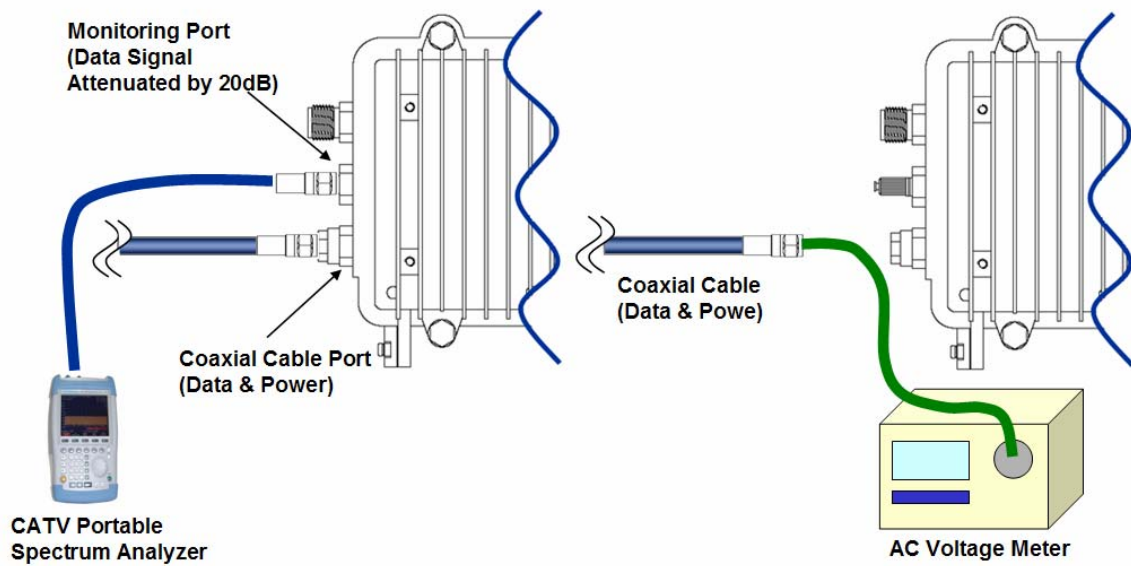
Acceptable Signal Levels

HFC Signal level (DOCSIS 1.1 ~ 2.0 Standard)
  + Standard Signal level (Actual Value): - 15dBmV ~ 15dBmV
  + Calculated Signal level at Monitoring Port (Downstream): - 35dBmV ~ -5dBmV
  + Effective Signal level at Monitoring Port (Downstream): - 37dBmV ~ -7dBmV
HFC AC Power level (Square wave): 45 VAC ~ 95VAC (Recommended level: 63Vac)

Procedure 1-6
Power ON and Visual Checking the LED Operation
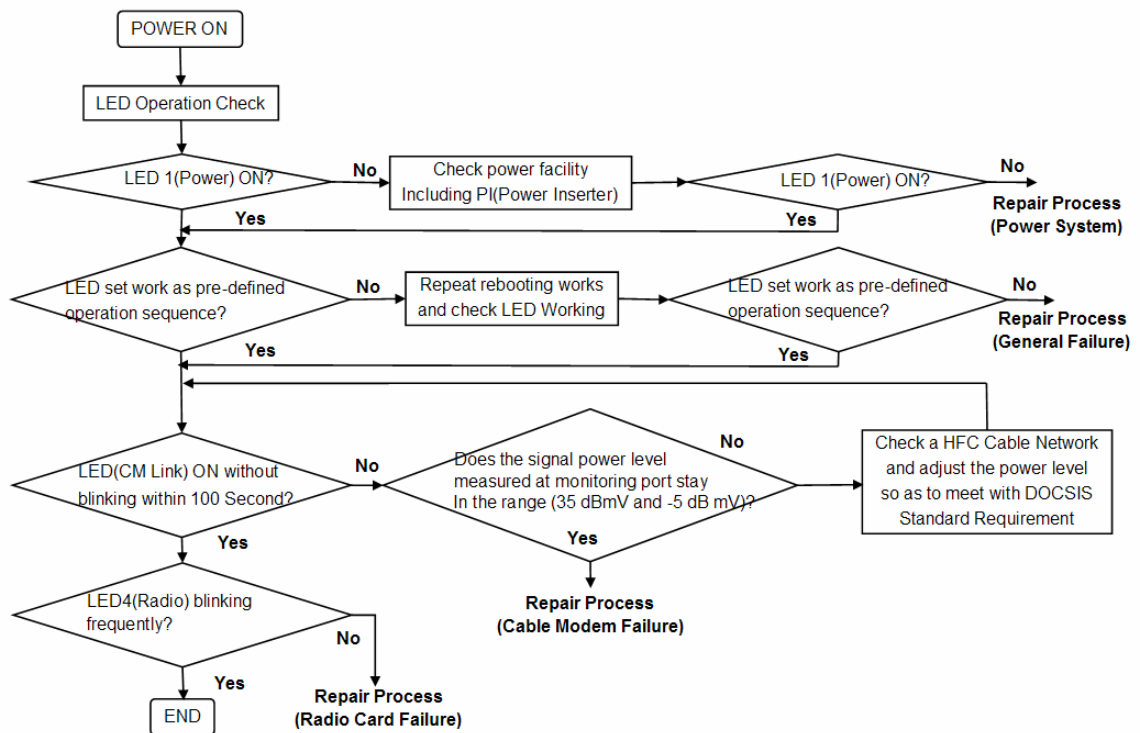
Action

Step	Action

1. Make sure that you know what each one of LED Lights means for the unit. Please refer to the LED indicators in Page
2. Turn ON the HFC Power Supply.
3. Check if the LED operation follows the pre-defined steps during and after booting.
4. Refer to the System Failure Analysis Procedure in the next page
5. Check if the LED 1(Power) is ON.

Note: If there is no LED light, check if the power supply which provides the CATV (HFC) network with AC power (45 ~ 95VAC) signal is working properly and that the CATV power is detected at the end of the coaxial cable. (If any problem has been found in the power system, the unit has to be entered into a Repair Process)

6. Check if LED 2(CM Link) flashes for over 100 seconds from when power is first supplied.
   If the LED flashes for more than 100 seconds, check if the data signal level at the monitoring port on the APU meets the recommended range of the signal level.

Figure 3-24
LED Visual Checking Procedure

```
                    ┌──────────────┐
                    │  POWER ON    │
                    └──────┬───────┘
                           ▼
                    ┌──────────────────┐
                    │ LED Operation Check │
                    └──────┬───────────┘
                           ▼
         ◇ LED 1(Power) ON? ◇──No──▶ Check power facility ──▶ ◇ LED 1(Power) ON? ◇──No──▶ Repair Process
                │ Yes              Including PI(Power Inserter)          │ Yes                    (Power System)
                ▼
    ◇ LED set work as pre-defined ◇──No──▶ Repeat rebooting works ──▶ ◇ LED set work as pre-defined ◇──No──▶ Repair Process
       operation sequence?                 and check LED Working           operation sequence?               (General Failure)
                │ Yes                                                              │ Yes
                ▼
    ◇ LED(CM Link) ON without ◇──No──▶ ◇ Does the signal power level ◇──No──▶ Check a HFC Cable Network
       blinking within 100 Second?          measured at monitoring port stay          and adjust the power level
                │ Yes                        In the range (35 dBmV and -5 dB mV)?      so as to meet with DOCSIS
                ▼                                      │ Yes                           Standard Requirement
    ◇ LED4(Radio) blinking ◇                 Repair Process
       frequently?         ──No──▶          (Cable Modem Failure)
                │ Yes
                ▼
          ┌─────────┐        Repair Process
          │   END   │        (Radio Card Failure)
          └─────────┘
```

CSU Installation & Configuration

Mounting and Installation Concept

Figure 3-25
CSU Installation Concept on User's facility
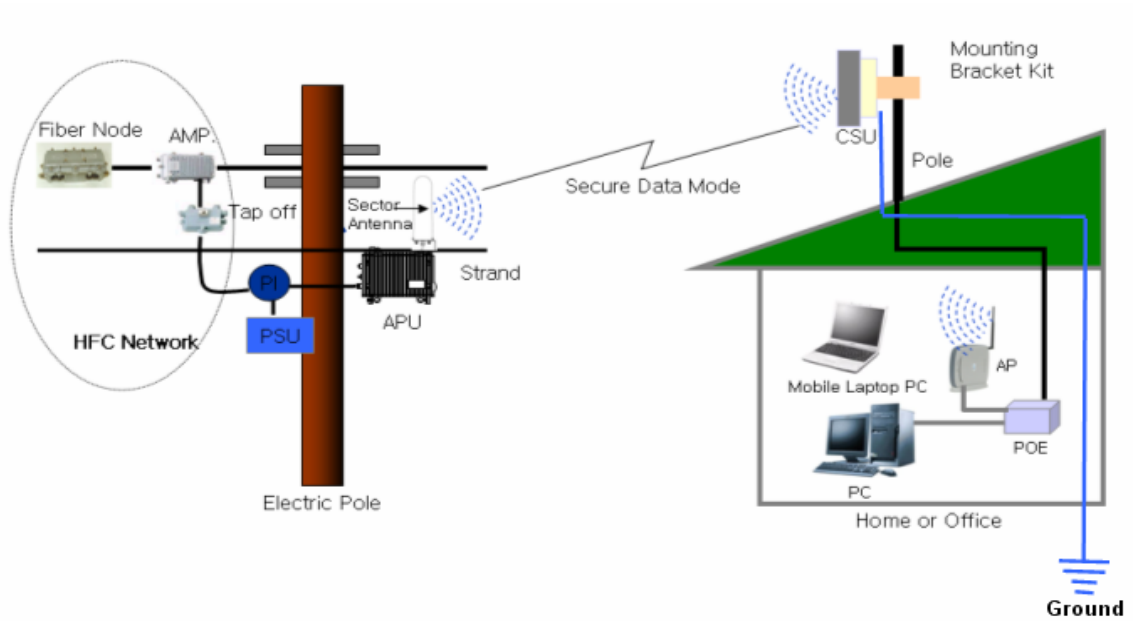
By default, CSU is pole mounted. Each unit is shipped with a pole mounting module.

Procedure 2-1
Mounting the CSU on the Steel Wire Strand

Action

Step	Action

1. Prior to an installation, check if the Pole has the strength and stability to sustain the weight of the CSU at a strong wind
2. Please find a mounting tool for installing CSU illustrated in Figure 3-26
3. Place the CSU face (RADOME side) down on a flat surface.
4. Using the mounting tool, attach the Mounting Tilt Brackets to the back of the CSU and insert the two stainless steel M6 hex head screws and M6 split lock washers into the hole.

Figure 3-26
Assembling the mounting bracket on the CSU
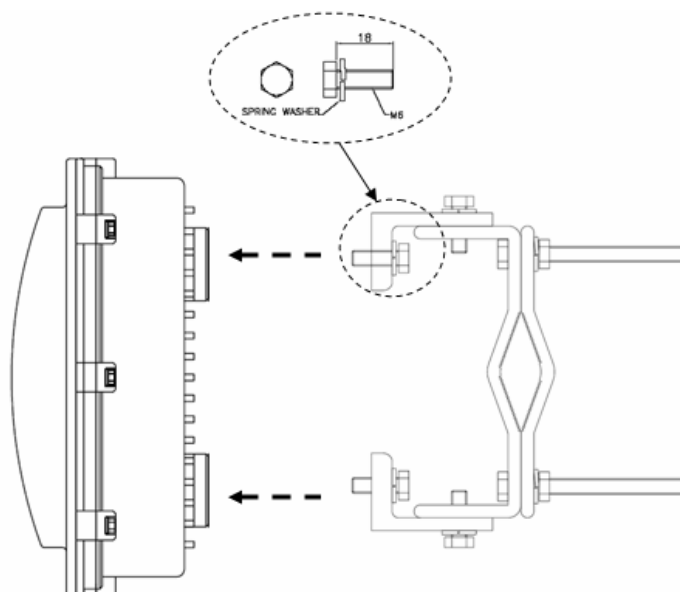
5. Lift the CSU to the selected installation point on the pole and then attach the clamp to the original location while lashing the CSU to the pole or using a hoisting rope to keep the unit in place during mounting work.
6. Slide two mounting nuts through a washer to each bracket hole as illustrated in Figure 3-27

54

7. Adjust the direction of CSU Antenna RADOME toward APU and fasten sufficiently to secure the CSU on the pole.

Figure 3-27
Assembling the mounting bracket with a installation tool
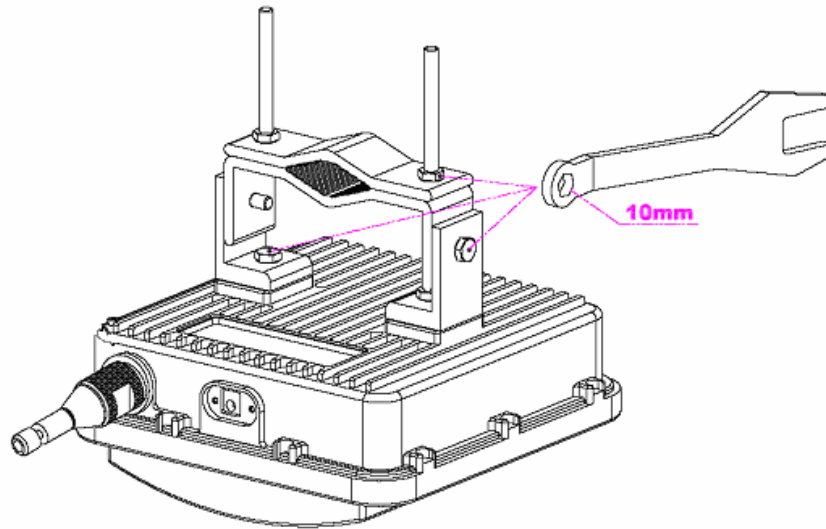
8. Adjust the up/down tilt (- 50 ° to 50 °) and move the top or bottom of the CSU until the unit is roughly positioned at the correct angle and height.

Figure 3-28
CSU Pole Mounting and Antenna Tilting
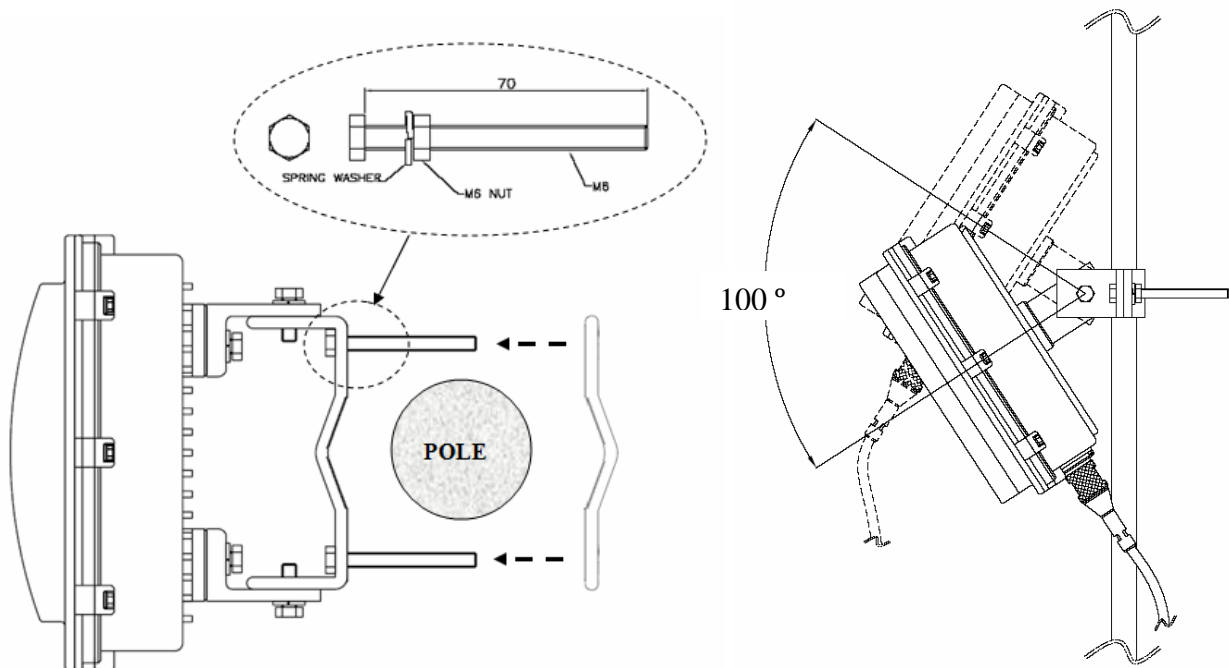
Procedure 2-2
Mounting the CSU on the Steel Wire Strand

Action

Step	Action

1. Loosen the EMI cap and slide the CAT5 or 6 cable without RJ45 connector into the hole of the EMI cap shaped like hood.
2. Follow the conventional procedure of creating a CAT5 or 6 Ethernet cable

Note: It is recommended to use a shielded cable like S-FTP(Foiled Twisted Pair) or STP (Shielded Twisted Pair) in which wire pairs are covered with overall shield material to prevent EMI effects to or from the near electronic devices or facilities.

Note: The cable from CSU to POE Injector and from POE Injector to CPE (PC) should be a straight-through cable.

3. Connect a cable to the CSU's POE port through the hole of EMI cap and tighten it firmly

Figure 3-29
**Connecting Ethernet Cable to CSU and Securing the Port Cap.**
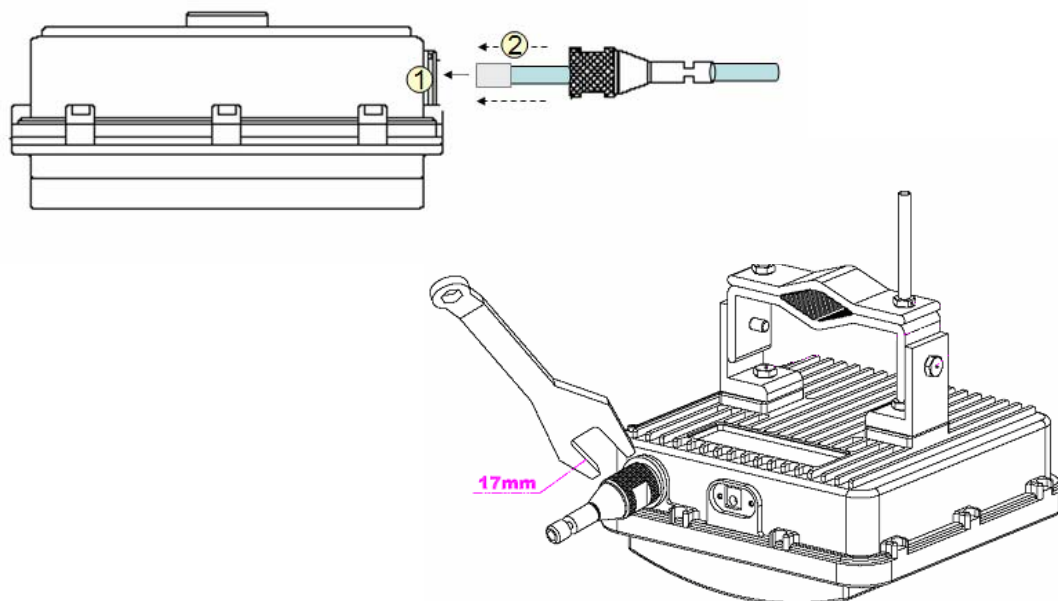
4. Secure the cable in the EMI cap by tightening it with a cable tie. Over-wrap the connectors with black self amalgamating tape or shrink the tubing with sliding over the cable to ensure a waterproof sealing. This is the most crucial step of the installation. If this procedure is not completed, a long-term and complex problems could occur.
5. Tighten the EMI cap securely with the special tool including the product package.

> ⚡ **WHEN INSTALLING THE UNIT, CHOOSE A LOCATION THAT PROVIDES A MINIMUM SEPARATION OF 20 cm FROM ALL PERSONS DURING NORMAL OPERATION.**

Figure 3-30
**Over-wrapping the EMI Cap and Shielded Cable with a Tape or shrink tube**
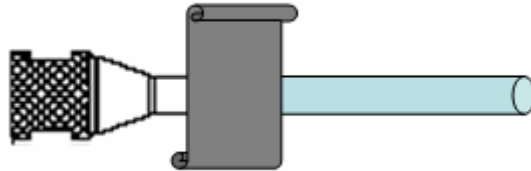
6. Connect the ground wire to the ground point at the lower right end of CSU back panel.

Figure 3-31
Connecting the ground wire to the ground point

Ground Point
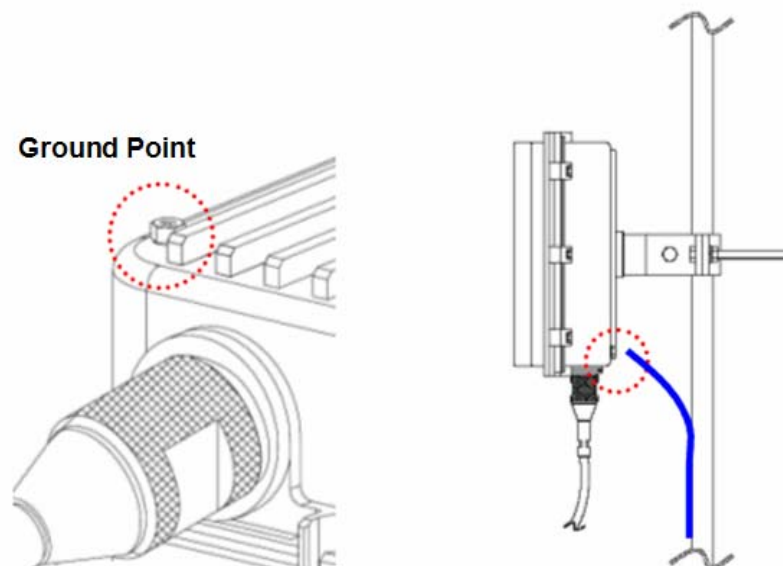
7. Connect the other end of the data cable to the POE Injector indoor.
8. Plug the power cord of the POE Injector into an electrical outlet

Figure 3-32
Connecting CSU and User PC by an Ethernet Cable though POE Injector

—— Direct Ethernet cable
···· Cross over Ethernet cable
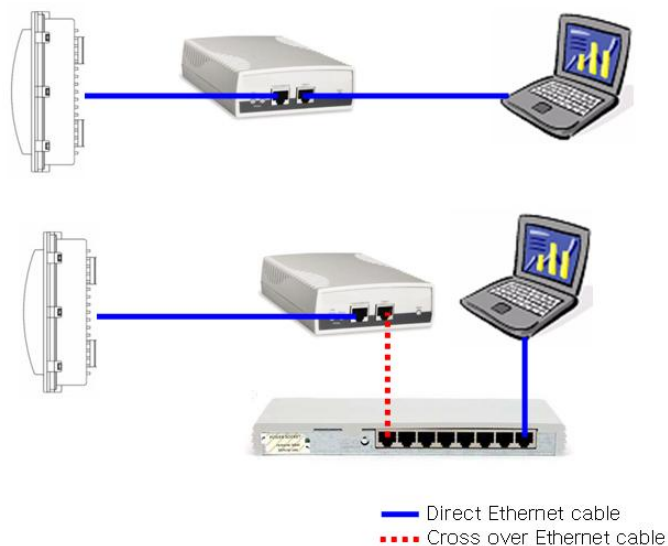
Mounting Tips

- Verify the Line-of-Sight -- Before installing the CSU, make sure a clear line-of-sight exists. Line of sight (LOS) can be defined as each antenna clearly seeing the other antenna, and seeing the remote locations when viewing from the central base location. Be sure to look level with the center of origin of the transmission (i.e., the middle of the antenna). Repeat this procedure from the remote location. Any disruption of the signal path due to trees, buildings, or any other obstructions may cause the link to function incorrectly. If you see any obstructions between two antennas, move one or both antennas to another location.

- Use mounting hardware provided to secure the unit to the pole.

- Leave the unit mounting loose enough to allow for movement when performing the alignment/testing procedure. The unit should be tightened only after the alignment/testing procedure is completed.

- Install the unit away from microwave ovens and 2.4 GHz cordless phones. Microwave ovens and some cordless phones operate on the same frequency as the unit and can cause signal interference.

- Begin at the lowest point, so the tape overlaps from bottom to top creating a shingled effect. This creates an effective barrier against water runoff. Apply this "shingle effect" to each layer of the sealing process. Apply two layers of electrical tape to the connector, and leave approximately 3 inches of cable exposed on either side of the connector.