



Arcwave's ARCXtend HSD Enhanced 5.8 GHz Wireless Plant Extension Solution

Installation Guide

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Installation Guide

About this document

This guide is designed familiarize you with the ARCXtend HSD Enhanced 5.8 GHz WPE solution. The guide identifies the major components and describes their functions within the WPE solution. The installation and configuration processes are also discussed in fundamental terms.

Revision History

ISSUE #	AUTHOR	CHECK OUT	CHECK IN	COMMENTS
1.0	CM		MARCH 6, 2006	FOR BETA RELEASE
1.1	CM		MAY 23, 2006	ADDED ARCSMART 3.1 SUPPORT AND EXT BRACKET INFORMATION.

Related Documents

The following documents provide additional information about the ARCXtend HSD WPE solution:

- Arcwave's ARCSmart 3.1 User Interface Guide
- Arcwave Enterprise 3.1 MIB Specification

Feedback

We welcome your feedback on Arcwave documentation. This includes feedback on structure, content, accuracy, or completeness of our documents, and any other comments you may have. Please send your comments to marketing@arcwaveinc.com.

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U.S. Federal Communication Commission (FCC) and Industry Canada (IC) Notification

This device complies with part 15 of the U. S. FCC Rules and Regulations and with RSS-210 of Industry Canada. 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 operation. In Canada, users should be cautioned to take note that high power radars are allocated as primary users (meaning they have priority) of 5250 – 5350 MHz and 5650 – 5850 MHz and these radars could cause interference and/or damage to license-exempt local area networks (LELAN).

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the U.S. FCC Rules and with RSS-210 of Industry Canada. 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 these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

Increase the separation between the affected equipment and the unit;

Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;

Consult the dealer and/or experienced radio/TV technician for help.

Part 15, Section 15.21 Warning

Changes or modifications not expressly approved by Arcwave, Inc. could void the user's authority to operate the equipment. FCC IDs and Industry Canada Certification Numbers are listed below:

- FCC Identifier:
- FCC Identifier:
- IC Radio Cert. No.:

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- IC Radio Cert. No.:

RF Safety Warning

To ensure compliance with FCC recommended General Population/Uncontrolled exposure limits the ARCXtend Hub and CPE must be installed at a minimum of one foot from areas frequented by the general population.

To ensure compliance with FCC recommended Occupational/Controlled exposure limits, field engineers and technicians should maintain a minimum working distance of six inches, as measured from the front of the Hub or CPE to the front of their bodies. For working distance inside six inches, RF exposure should be limited to an average of 30 minutes at a time. All Arcwave equipment, however, has been designed to allow installation and maintenance at a range well within FCC RF exposure levels.

DOCSIS Network Considerations

Embedded Cable Modem Operation

The ARCXtend Hub contains an embedded cable modem for remote management of the hub via the DOCSIS network, obtaining the DOCSIS operating parameters needed to program the hub and monitoring input RF signal level and quality. The embedded cable modem is identical in operation to a customer cable modem and requires Internet Protocol (IP) connectivity.

Setup

Prior to deployment of the ARCXtend solution, the embedded cable mode configuration file and firmware must be loaded on the TFTP server. The configuration and firmware files are included on the documentation CD shipped with each hub and can be downloaded from the Support Extranet, <http://www.arcwaveinc.com/support.html>.

The configuration file provided by Arcwave contains the necessary modem specific information required to do firmware downloads.

Before an individual hub can be assigned an IP address its MAC address must be provisioned in the DHCP server. If the MAC address is not provisioned prior to deployment, most likely the embedded cable modem will receive a default configuration with Network Access set to “disable”. The Ethernet MAC address of the embedded cable modem is located on a label on the back of each hub.

Load Balancing Groups

Currently, the ARCXtend solution does not support upstream shared spectrum (aka load balancing) groups where the cable modem(s) can be moved from one upstream frequency

to another based on plant conditions. Both the customer cable modem and the cable modem located inside the hub must be explicitly excluded from this feature. This is usually accomplished by putting the MAC addresses of both in an exclusion list kept by the CMTS.

Downstream and Upstream Frequency (Channel) Configuration

The customer cable modem should never be configured to acquire a specific downstream frequency as there is not a one-to-one correlation between the cable network downstream frequency and the downstream frequency output by the ARCXtend CPE. The downstream frequency output by the ARCXtend CPE is purely a function of the downstream wireless channel selected.

When multiple downstream and/or upstream frequencies (channels) are used on the cable network, the “AutoFrequencySet” feature must be disabled and the “CATV EIA Input Channel” and the “Upstream Frequency” must be set manually. Alternatively, the correct downstream and upstream frequency can be included in the embedded cable modem configuration file in which case the “AutoFrequencySet” feature can be used.

TCP/IP Port Filtering

TCP/IP port filtering is the practice of selectively enabling or disabling Transmission Control Protocol (TCP) ports and User Datagram Protocol (UDP) ports on computers or network devices. The following ports must be open for SNMP, HTTP, and TFTP applications to be performed on the Hub:

- Port 161/162 for SNMP
- Port 80 for HTTP
- Port 69 for TFTP

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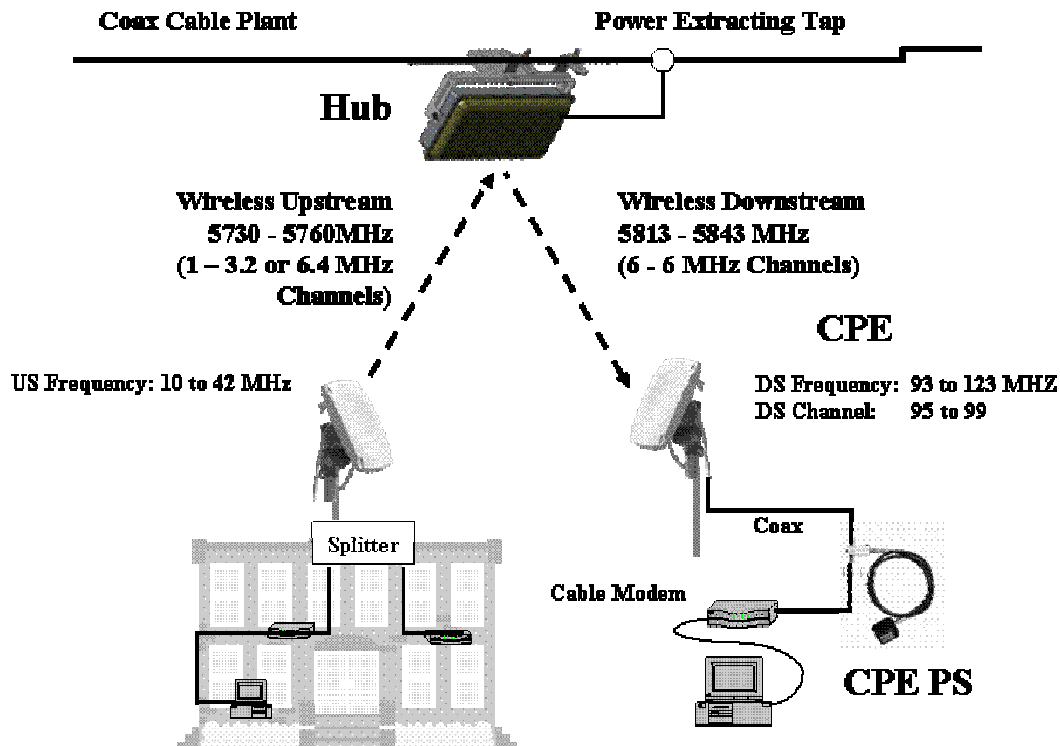
Introduction

The ARCXtend HSD Enhanced 5.8 GHz WPE solution is a physical layer wireless bridge device that provides wireless connectivity between a coaxial cable plant and one or more customer sites. The WPE solution operates in the 5,725 MHz to 5,850 MHz frequency band and supports the transparent delivery of one digitally modulated 6 MHz cable downstream EIA standard or HRC cable channels and one 3.2 MHz or 6.4 MHz maximum bandwidth upstream channel transporting the following services:

- DOCSIS 1.0/1.1/2.0 high speed data, IP Video or Voice over IP (VoIP) signals
- MPEG video streams
- Other digitally modulated services such as Ethernet or TDM over HFC.

The solution consists of these major components:

- Strand mount hub (Hub)
- Customer premise equipment devices (CPE)
- CPE power supply (PS)



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The hub connects directly to the coaxial portion of cable plant using a standard power extracting tap and is line powered over coax using 60 or 90 VAC. The CPE is installed at the customer site, connects to a standard cable modem, and is powered over the coax cable using a wall mounted AC adaptor and DC to coax power inserter.

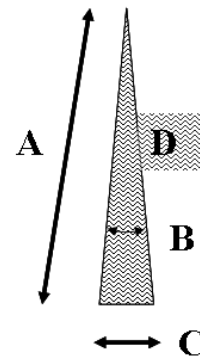
In the downstream direction the hub receives a digitally modulated EIA standard or Harmonically Related Carrier (HRC) Offset cable channels in the range between 88 and 860 MHz from the cable plant and up converts it to one of the six available wireless channels in the upper part of the 5.8 GHz frequency band. The CPE receives the wireless signal and down converts it to a channel in the range 93 to 123 MHz for reception by a cable modem.

In the upstream direction the CPE transmits the entire 10 to 42 MHz frequency range in the lower part of the 5.8 GHz frequency band. The hub receives the wireless channel, tunes to the frequency carrying the active upstream channel, and down converts it back to the original frequency in the 10 to 42 MHz range. With Arcwave's PureBurst upstream noise suppression technology the hub's upstream transmitter is only "opened" when a wirelessly attached cable modem is sending data. The digital signals are never demodulated/modulated ensuring transparent service and equipment support.

Coverage and Range

The ARCXtend Enhanced 5.8 GHz WPE solution hubs are factory configured for extended range or extended coverage applications. The range and coverage profile for both solutions are detailed in the following table and illustration.

Hub Type	DS Modulation	Range (A) (mi)	Arc (B) (deg)	Arc (C) (mi)	Area (D) (sq-mi)
AX1655-ER	64 QAM	2	20°	0.7	0.7
	256 QAM	$\frac{3}{4}$		0.3	0.1
AX1655-EC	64 QAM	2	60°	2.1	2.1
	256 QAM	$\frac{1}{2}$		0.5	0.1



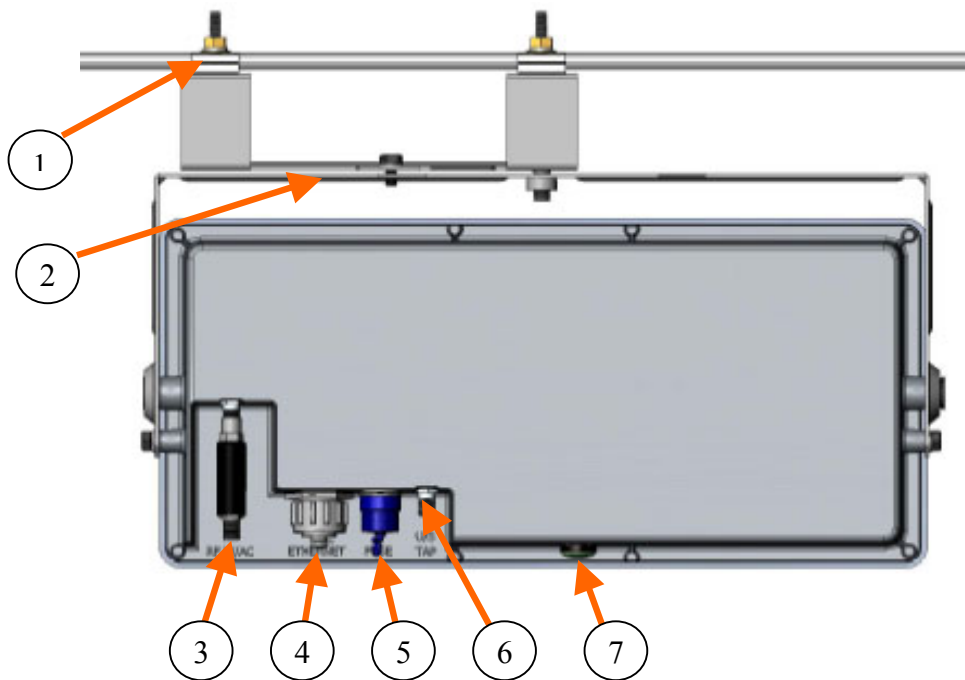
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The Hub

The Hub is a self-contained weather-protected, strand mountable unit providing a bi-directional wireless connection between a cable plant and a cable modem. The Hub includes an integrated transceiver, patch antenna, embedded cable modem, hub controller and Arcwave's ARCSmart intelligent management software.

Interfaces

The following illustration shows the rear of the Hub and identifies the interfaces.



1	Strand Mounting Clamps	5	Fuse
2	Alignment Brackets	6	U/S Tap
3	RF W/ AC	7	LED
4	Ethernet		

Strand Mounting Clamps

Cable industry standard clamps for mounting the hub to the strand cable.

Alignment Brackets

Mechanically adjustable horizontal and vertical hub alignment brackets for aligning the hub's integrated antenna to the desired coverage area. A 7/16" wrench is the only tool required for mounting and aligning the hub.

RF W/AC

An AC surge protected SCTE compliant female F-type connector for the RF and AC power connection to the cable network. The Hub requires an input RF power level at the port of between 0 dBmV and +30 dBmV with a minimum modulation error ratio (MER) of 35 dB for 256 QAM and 31 dB for 64 QAM. The input line power must be between 50 VAC and 110 VAC with a line frequency from 50 Hz through 60 Hz.

ETHERNET

A weather-proof RJ-45 connector for connecting a lap top PC for hub configuration and monitoring during installation or troubleshooting and for powering hub using 24 VDC power over Ethernet (PoE) per the table below:

Pin	Function	US T-568A Wiring Standard
1	Ethernet Tx+	green-white
2	Ethernet Tx-	green
3	Ethernet Rx+	orange-white
4	PoE - (+)	blue
5	PoE - (+)	blue -white
6	Ethernet Rx-	orange
7	PoE - (-)	brown-white
8	PoE - (-)	brown

FUSE

An SCTE compliant replaceable 1 ampere fuse providing over-current protection for the RF W/AC port.

U/S Tap

An SCTE compliant female F-type connector providing a -20 dB tap for monitoring the upstream channel.

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LED

Green/amber weather proof status LED indicating:

Amber Solid	Power ON
Amber Blinking	Embedded cable modem has Downstream Lock
Green Blinking	Embedded cable modem has Upstream Lock
Green Solid	Embedded cable modem is Operational

Ground Lug

The ground lug terminal is for bonding the hub chassis to the strand wire.

MAC address

Each hub model has a unique MAC address as indicated on the label located on the rear of the unit. This MAC address must be provisioned in the cable IP network DHCP server in order for the hub's internal cable modem to be assigned an IP address on power up.

Hub Configurations

The hub is available in extended coverage or extended range configurations as described below:

- The AX1655-EC extended coverage hub hangs from the cable strand and provides 60 degrees of coverage and has a maximum range of up to ½ mile.
- The AX1655-ER extended range hub hangs from the cable strand and provides 20 degrees of coverage and has a maximum range of ¾ mile.
- The AX1655-SMA pole mount adaptor kit allows the hub to be mounted on towers or buildings using off-the-shelf 1-1/2" to 4" O.D. mast mount hardware.
- The S3-SM-EXT-4 strand mount bracket with 4" cable clearance replaces the standard mounting bracket for applications where extra clearance as in the case of large cable bundles.

Integrated Antennas

The AX1655-ER extended range and AX1655-EC extended coverage Hub models include the following antennas:

	Style	-3 dB Horiz. Beamwidth	-3 dB Vert. Beamwidth	Transmit Gain	Receive Gain
AX1655-ER	Flat Panel	20°	18°	18 dBi	16 dBi
AX1655-EC	Flat Panel	60°	18°	14 dBi	14 dBi

The CPE

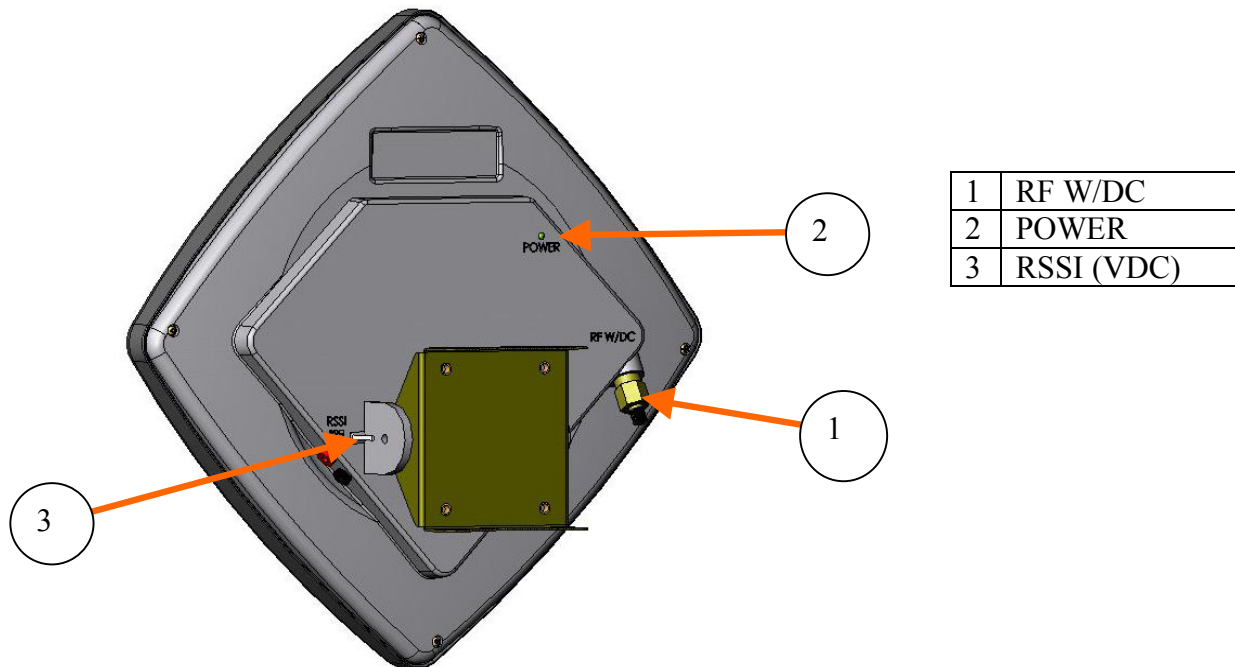
The CPE is a small footprint weatherproof radome that can be easily mounted on a rooftop or side of a building to provide connectivity to the wireless network. It contains an integrated transceiver and a narrow-beam antenna that can be easily aligned to receive the signal from a Network Hub. The CPE is roughly one foot square and supports low cost installation using the same hardware and skills as a small satellite dish.

CPE Configuration

The CPE comes in one configuration, model number AX3655-VM-10, which includes a 10° receive and 17° transmit beamwidth high gain antenna.

Interfaces

The following illustration shows the rear of the CPE and identifies its interfaces.



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RF W/DC

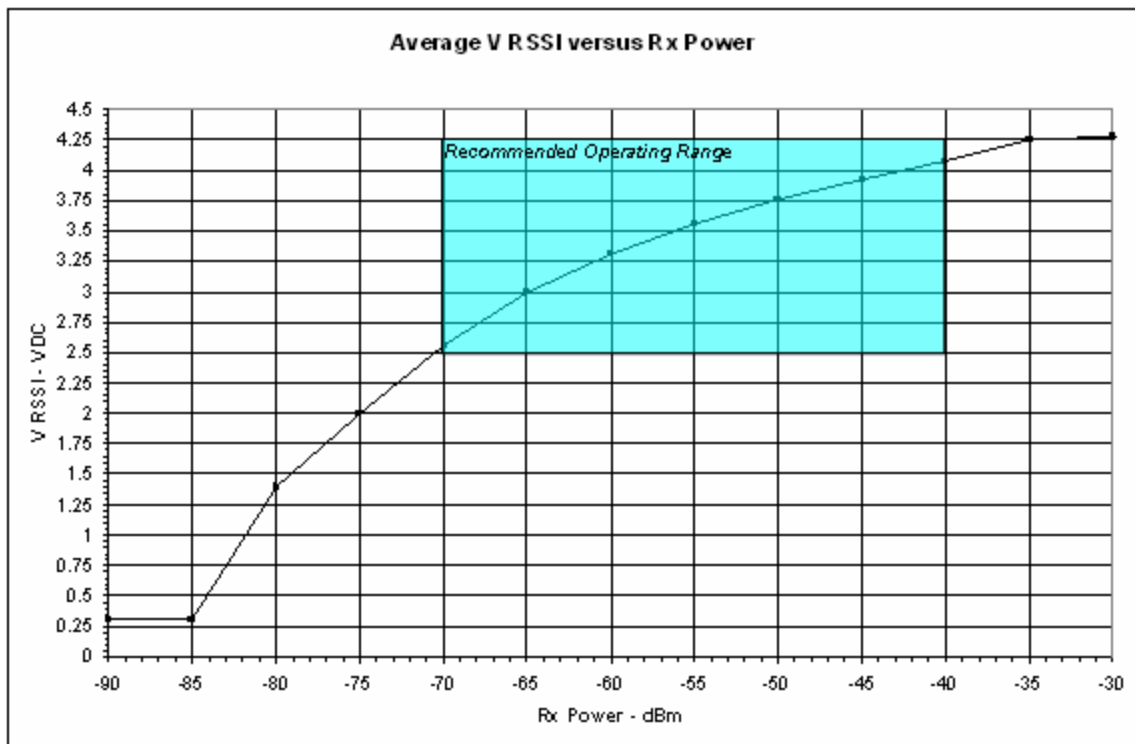
An SCTE compliant F-type connector provides the RF connection to the cable modem and for powering the CPE. The CPE operates on 18 Vdc nominal which is provided by the Arcwave supplied wall mounted 120 VAC CPE adaptor and DC power inserter, model number AX3655-PS-24. The DC inserter must be located within 300 feet of the CPE to ensure a minimum input voltage of 12 VDC at the RF W/DC port. The CPE can accept an input RF signal between 10 and +30 dBmV from the cable modem.

POWER

The **Power** Led indicates the CPE is power on.

RSSI (VDC)

The RSSI banana jacks produce a DC voltage proportional to the wireless received signal level. The recommended operating range is between 2.5 and 4.25 VDC which corresponds to a receive signal level of between -70 and -40 dBm as shown in the graph below.



Deploying the ARCXtend Equipment

Personnel installing the equipment must be familiar with basic cable drop, cable modem and ARCXtend WPE solution installation and troubleshooting techniques.

Equipment, materials and tools

The following equipment, materials and tools are required for installation:

Equipment	Source	Use
Digital Cable TV Installation Meter	Sunrise Telecom Hukk CM500 or equivalent	Hub installation & link commissioning
7/16" wrench	Multiple	Hub and CPE installation
Spotting Scope or Binoculars	Multiple	Hub site selection
Bucket Truck	Multiple	Hub Installation
Walkie Talkies or Cell phones	Multiple	Communicate between Hub and CPE sites
Laptop Computer w/ Serial & Ethernet Ports	Multiple	Hub monitoring and configuration

Material	Source	Use
Hub	Arcwave	Wirless interface to cable network on plant side
CPE	Arcwave	Wirless interface to cable network on customer side
DC Inserter and Adaptor	Arcwave	Powering CPE
Power Passing/Extracting Tap	Multiple	Provides RF signal and power for network hub
CPE Mounting Hardware	Telewire	Mounting CPE at the installation site
RG-6 coaxial cable and male "F" type connectors	Multiple	Connecting the network hub to the power passing tap Connecting the CPE to the cable modem
Ground device	Multiple	Grounding the CPE installation
Surge Protector	Array Solutions Model 310	Protects the cable modem and subscriber equipment from damage due to a lightning strike.

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Installation Overview

The installation process involves major four steps:

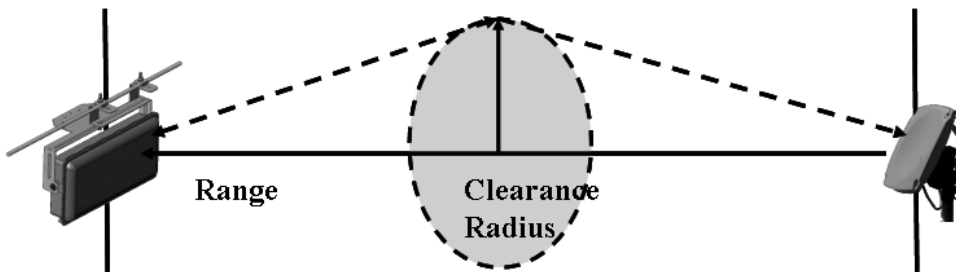
- Wireless link planning
- Installing the hub
- Installing and aligning the CPE(s)
- Installing the customer cable modem

Wireless link planning

Wireless link planning is essential to the success of WPE installation and is highly recommended before attempting to install the equipment. Refer to Arcwave's Wireless Plant Extension Application and Deployment Training presentation and Wireless Link Planning Tool located on Arcwave's support extranet or contact Arcwave customer support for guidance on how to complete this step.

An acceptable wireless link is one within the working range of Hub and with line of sight clearance to the customer sites.

Line of sight is defined as a path between the hub and CPE that is free of obstructions in the Fresnel zone. Obstructions can be trees, buildings, street signs, etc. An accepted rule of thumb is that LOS conditions exist when there are no physical obstructions within 60% of the Fresnel zone (obstruction free zone). The Fresnel Zone clearance is determined by the distance between the Hub and CPE as shown in the following illustration and table.



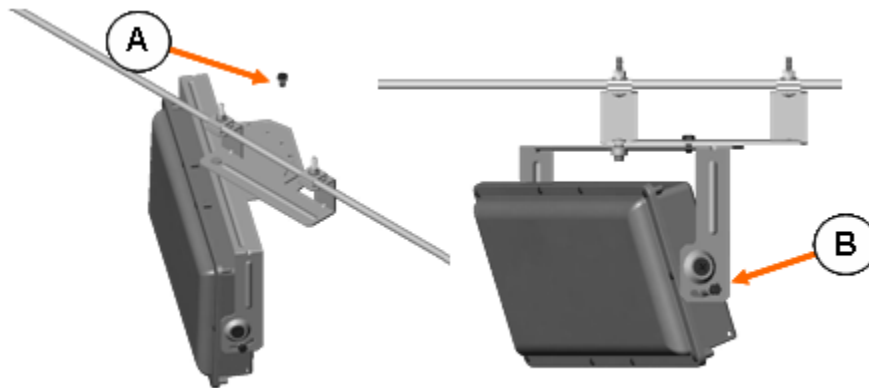
Range	500 ft	1000 ft	½ mile	1 mile	2 miles
Clearance Radius	3 ft	4 ft	6 ft	9 ft	12 ft

Installing the hub

This section provides instructions on how to install the hub on a cable strand with AC power provided over the coaxial cable. The hub can also be installed on a rooftop, mast or tower using the AX1655-SMA pole mount adaptor kit. It can be powered using power over Ethernet per the wiring diagram provided in the previous section.

Aligning the hub

Attach the bracket to the messenger strand with the two hanger bolts. Position the hub's antenna (located behind the radome) to the azimuth and elevation determined by the wireless link planning. The azimuth position is adjusted by placing bolt A in the appropriate location on the azimuth alignment bracket and the elevation is adjusted by loosening bolts B and rotating the hub face up or down and tightening bolts B at both ends.



Connecting the hub

- Install a CATV power passing/extracting tap suitable for your plant and the hub powering requirements. The hub draws 24 watts maximum and can accept 50 Vac and 110 Vac.
- Verify that the input downstream RF signal level is between 0 dBmV and +30 dBmV.
- Verify that the modulation error ratio (MER) of the downstream signal is a minimum MER of 35 dB for 256 QAM and 31 dB for 64 QAM operations.
- Connect the hub to the cable plant using a setup suitable for the cable plant and hub powering requirements.

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- Verify that the hub has power and the embedded cable modem has achieved operational status.

Configuring the Link

Link activation is accomplished using the ARCSmart HTTP web browser interface or the ARCNet element management system. The parameter names and assignments are the same for both interfaces. Detailed information is available for both tools in their respective user and installation guides located on the Arcwave Support Extranet, <http://www.arcwaveinc.com/support.html>. This section describes the ARCSmart GUI and shows how to perform a typical configuration.

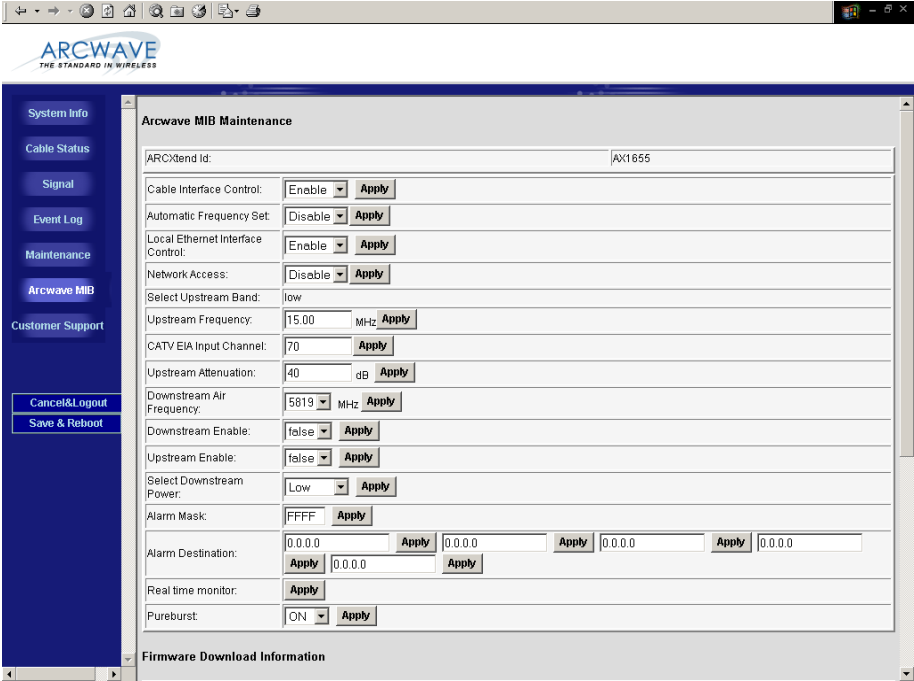
To launch ARCSmart:

- Connect a computer to the hub's RJ-45 Ethernet port.
- Open your Internet browser. You must use Microsoft Internet Explorer version 5.x or later.
- Enter the default IP address of the Hub (192.168.100.1) into the address bar of your browser and press the enter key on your keyboard. An Enter Network Password window appears.
- Enter the case sensitive username *admin* and press the **Tab** key to advance to the password field.
- Enter the case sensitive password *arcwave* and press **Enter**.

Note the username and password can be changed using the Maintenance screen

- Click on **Arcwave MIB** in the left menu bar. This will launch the Hub configuration screen shown below.
- Enter the configuration settings determined in the wireless link planning process:

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PARAMETER	DESCRIPTION
Cable Interface Control	<p>Choose “Enable” to turn-on the RF interface of the ECM and “Disable” to turn it off. This parameter is useful when the Hub is used for a non-DOCSIS application, such as the wireless transport of a digital video or CBR (constant bit rate) voice signal, and there is no DOCSIS channel on the cable plant.</p> <p>Selecting “Disable” will prevent the ECM from continually scanning for a downstream channel, when none is present.</p> <p>When Cable Interface Control is set to “Disable”, Network Access is set to “Disable” and Upstream Attenuation can not be set to “99”, automatic mode. The default setting is “Enable”.</p>
Auto Frequency Set	<p>Choose “ENABLE” to have ARCSmart automatically program the Hub CATV EIA Input Channel and Upstream Frequency parameters with the same values used by the ECM. When set to “ENABLE” these values will change whenever the values are changed at the ECM. This setting is used for plug-n-play installation of the Hub. Choose “Disable” when these parameters will be set manually to values different than those used by the ECM. In this mode the values entered will persist regardless of the values used by the ECM and across a Hub power outage or reboot. This mode is useful when the Hub transmits a non-DOCSIS channel,</p>

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PARAMETER	DESCRIPTION
	<p>such as digital video or CBR voice.</p> <p>Note: “Cable Interface Control” must be set to “Enable” in order for this element to be set to “Enable”.</p> <p>The default setting is “Enable”.</p>
Local Ethernet Interface Control	<p>Choose “Enable” to allow local connection to the Hub via the RJ-45 connector. Choose “Disable” to disable the RJ-45 connection and prevent anyone from connecting locally to the Hub.</p> <p>When Local Ethernet Interface is set to “Disable”, Network Access is also set to “Disable”.</p> <p>The default setting is “Enable”</p>
Network Access	<p>Choose “Enable” to allow a locally connecting computer to obtain an IP address, via DHCP, from the head end server and to access the cable IP network.</p> <p>Choose “Disable” to prevent a locally connected computer from accessing the cable IP network. The locally connected computer will be assigned a default IP address in the 192.168.100.0/24 network.</p> <p>The default setting is “Disabled”</p>
Select Upstream Band	Not used on the AX1655.
Upstream Frequency	Displays the frequency of the output upstream channel.
CATV EIA Input Channel	<p>Displays the EIA standard or HRC cable channel number the input D/S channel.</p> <p>The embedded cable modem detects the cable plan being used and programs the hub accordingly.</p>
Upstream Attenuation	<p>Choose the amount of attenuation (in dB) in the upstream receive path of the Hub.</p> <p>If “99” is entered, ARCSmart will automatically set the attenuation based on the upstream channel transmit power out of the ECM. If a number in the valid range from 0 to 64 is entered, the attenuation is set to that value.</p> <p>This parameter is used to increase or decrease the upstream channel transmit power of a cable modem connected wirelessly to a Hub. Increasing the attenuation will cause the CMTS to increase the cable modem’s upstream channel transmit power. Decreasing the attenuation will cause the CMTS to decrease the cable modem’s upstream channel transmit power. The change in the attenuation and</p>

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PARAMETER	DESCRIPTION
Upstream Attenuation (Continued)	<p>the change in the upstream channel transmit power, while loosely related, is not one to one.</p> <p>Note: “Cable Interface Control” must be set to “Enable” in order for this element to be set to “99” .</p> <p>The default setting is “99”.</p>
Downstream Air Frequency	<p>Choose the downstream wireless carrier frequency.</p> <p>Valid settings for AX1655 model Hubs are: 5813, 5819, 5825, 5831, 5837, and 5843 (in MHz).</p> <p>The downstream channel frequency out of the CPE is the Downstream Air Frequency minus 5720 MHz.</p> <p>The default setting is 5825.</p>
Downstream Enable	<p>Choose “TRUE” to turn on the downstream wireless transmitter and “FALSE” to turn it off.</p> <p>The default setting is “TRUE”.</p>
Upstream Enable	<p>Choose “TRUE” to turn on the upstream wireless receiver and “FALSE” to turn it off.</p> <p>The default setting is “TRUE”.</p>
Select Downstream Power	<p>Choose the downstream wireless transmitter power setting: High, Medium or Low</p> <p>The default setting is Medium.</p>
Alarm Mask	<p>The alarm mask corresponds to the hex number, which when translated into a binary number gives an 8 digit number. The position of a digit ‘1’ in the field will enable the corresponding alarm and a digit ‘0’ would disable the corresponding alarm. All 0’s mask all alarms, all F’s passes all alarms. Individual alarms are represented as follows:</p> <p>Bit 0: 1 = System Lock Lost</p> <p>Bit 1: 1 = Hub Dead</p> <p>Bit 2: 1 = Input voltage outside of tolerance</p> <p>Bit 3: 1 = The Unit is operating near its maximum operating temperature.</p> <p>Bit 4: 1 = DCE Unlocked or Error</p> <p>Bit 5: 1 = Upstream (Receiver) Unlocked or Error</p> <p>Bit 6: 1 = Downstream (Transmitter) Unlocked or Error</p> <p>Bit 7: 1 = Local modification notification</p> <p>Example: If the user wanted alarms “System Lock Lost, Input voltage outside of tolerance, DCE Unlocked or Error and Local Parameter Modification Notification” turned on and the rest turned off, he would have to set the alarm mask to</p>

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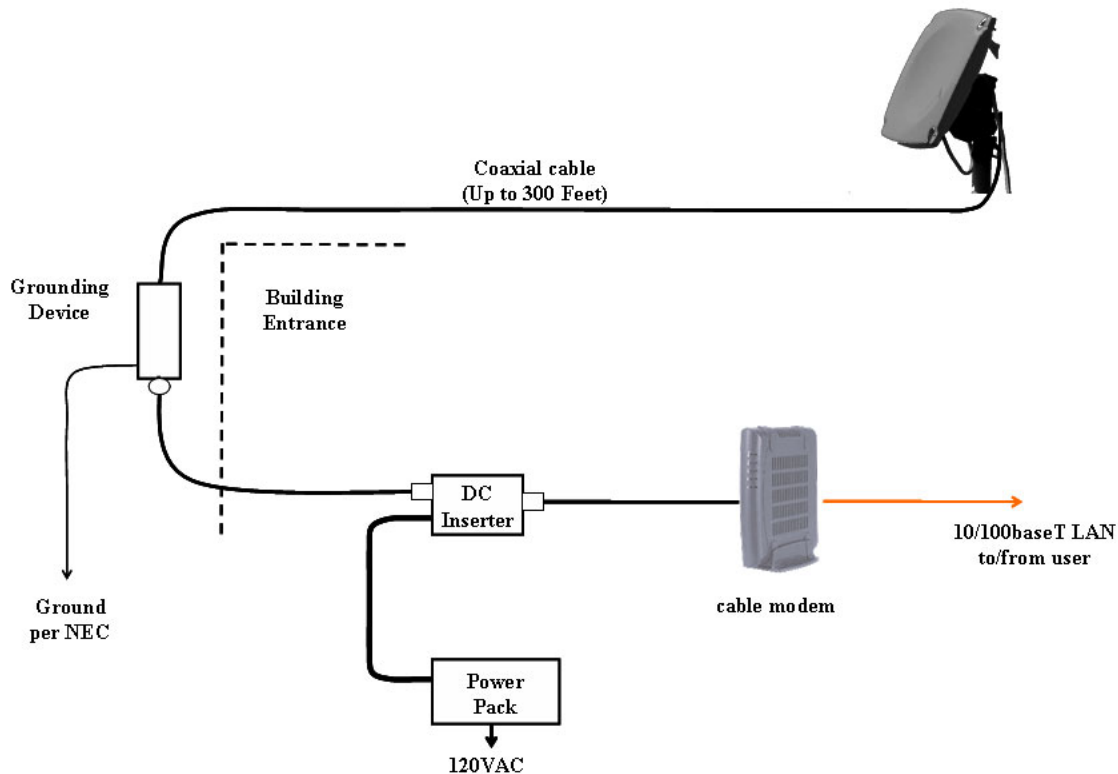
PARAMETER	DESCRIPTION
Alarm Mask (Continued)	0095 (Hex), which corresponds to 10010101 (Binary). The bits that correspond to the alarms we want turned on have been set to 1 and the rest have been set to 0. The default setting is all F's.
Alarm Destination	Enter up to (5) IP addresses where SNMP traps are to be routed to by the Hub. The default setting is all 0's.
Real time monitor	Click on the "Apply" button to refresh the Real Time Monitor display which captures all the values in the radio manager registers.
PureBurst	Choose "On" to enable PureBurst and "Off" to disable PureBurst. When no traffic is present on the upstream cable interface, PureBurst mutes the interface preventing the introduction of ingress noise into the cable network. The default setting is "On".

Installing the CPE

Install the mounting hardware (e.g. non-penetrating roof mount, eaves mount) and coaxial cable per the manufacturer's recommended procedures and in accordance with the National Electric Code and local ordinances.

- Loosen the (4) mounting bolts and slide the CPE on the mounting pipe.
- Visually align the CPE in the direction of the Hub and snug the mounting bolts to hold the CPE in place.
- Install the coaxial cable and ground connections as shown in the illustration below.
- Waterproof the coax connections using a suitable method such as taping with Coax-Seal or Scotch #88.

Install the power adaptor and DC inserter as shown in the illustration below.



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Please note the following during installation:

- The CPE accommodates a mounting pipe with of 1-1/4” to 2-3/8” in diameter and the CPE and mounting pipe require a minimum of 12 inches clearance on all sides for optimal performance.
- The CPE should be located as close to the edge of the building nearest the hub as possible. When the CPE is mounted towards the middle or back of the building, the incoming wireless signal may be reflected by the rooftop impairing the performance of the link. The CPE must be placed high enough on the rooftop to provide the required Fresnel zone clearance.
- When using RG-6 cable the power adaptor must be located within 300 feet of the CPE to ensure a minimum input voltage of 12 VDC at the CPE.
- The CPE should be mounted at least 2 feet below the highest point at the site to minimize the likelihood of lightning strikes.
- The CPE should be properly grounded for lightning protection to all applicable national (National Electric Code, sections 820-33 and 820-40) and local codes.
- An SCTE compliant surge protector should be placed between the CPE and customer cable modem.
- Be sure to leave sufficient slack for final CPE alignment and ensure that the cable runs directly downward from the connector to avoid water running down the cable and into the F connector.

Align the CPE

Point the CPE’s antenna (located behind the radome) at the Hub. The elevation is adjusted using the elevation alignment bolts and the azimuth is adjusted using the mounting bolts.

- Connect a voltmeter to the RSSI jacks on the back of the CPE.
- Pan the CPE from side to side (horizontally) and tilt it up and down (vertically) while observing the RSSI DC voltage on the meter. The goal is to obtain the maximum reading within the recommended operating range of between 2.5 and 4.25 volts which corresponds to a receive signal level of between -70 and -40 dBm.
- Tighten the elevation and mounting bolts.

Verify CPE output signal at input to cable modem

Using a spectrum analyzer or digital signal level meter, verify that the downstream channel power level is within the desired range for the cable modem. If it is not, correct per the following table:

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Power level is too high	Power level is too low	Signal is not present
<p>Install one or more 10 dB (AX3155-ECF-10) or 20 dB (Ax3155-ECF-20) low pass attenuators between the power inserter and the cable modem.</p> <p>If more than 30 dB of attenuation is required, reduce the hub's downstream power setting.</p>	<p>Verify the CPE alignment.</p> <p>Verify the hub's downstream power setting.</p> <p>Reduce/remove the low pass attenuation.</p> <p>Reduce the cable and RF hardware loss between CPE and cable modem or add bi-directional amplification.</p> <p>Verify that the range and Fresnel Zone clearance are within specifications.</p>	<p>Verify that the CPE Adaptor and DC inserter are installed properly</p> <p>Verify the DC power level at the input to CPE is between 15 and 24 VDC.</p> <p>Verify the coaxial cable connections.</p> <p>Verify that the range and Fresnel Zone clearance are within specifications.</p>

Verify cable modem output signal at CPE

Using a spectrum analyzer or digital signal level meter, verify that the channel power into the CPE is between +5 and +20dBmV for optimal performance and at a minimum between 0 and +25 dBmV. If it is too high or too low, adjust the **Upstream Attenuation** setting on the Arcwave MIB screen a proportionate amount.

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Cable Modem Installation

Connect the cable modem to the TV port of the DC inserter as shown in the prior illustration.

Set the upstream signal level

Using the cable modem's diagnostic interface, check that the upstream signal (US) level is within the desired operating range, typically +40 to +50 dBmV with a minimum value of +30 dBmV and a maximum value of +55 dBmV. If it is not, correct per the following table:

Power level is too high	Power level is too low
<p>Decrease the "Upstream Attenuation" setting in the Arcwave MIB Maintenance page of the user interface by an amount equal to the desired decrease in the upstream power level. i.e. if the US transmit power is 50 dBmV and it should be 45 dBmV then reduced the Upstream Attenuation setting by 50 dBmV minus 45 dBmV, or 5 dBmV.</p> <p>Reduce the cable and RF hardware loss between CPE and cable modem or add amplification.</p> <p>Redo the CPE alignment process</p> <p>Verify the wireless range and LOS path between Hub and CPE are within specified limits.</p>	<p>Increase the "Upstream Attenuation" in the Arcwave MIB Maintenance page of the user interface setting by an amount equal to the desired increase in the upstream power level. i.e. if the US transmit power is 40 dBmV and it should be 45 dBmV then increase the Upstream Attenuation setting by 50 dBmV minus 45 dBmV, or 5 dBmV.</p>

If the cable modem doesn't register with the network

If the cable modem does not register with the network, troubleshoot as follows:

Problem	Solution
<p>Does not detect and lock on to the DS channel</p>	<p>Verify that the MER of the downstream RF channel at the output of the CPE is within specified limits:</p> <p>MER should equal to or greater than 28 dB for 64 QAM, and equal to or greater than 31 dB for 256 QAM. If it is not, perform</p>

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Problem	Solution
	<p>the following checks:</p> <ul style="list-style-type: none">• Verify that the “Select Downstream Power” setting is correct for the downstream modulation and wireless range.• Change “Downstream Air Frequency” to a different channel to rule out interference.• Verify that the range and Fresnel Zone clearance are within specifications.
Does not detect and lock on to the US channel	<p>Using the customer cable modem’s diagnostic interface, verify that the cable modem is sending on the correct upstream RF channel:</p> <p>If it is sending on the correct RF channel but can’t lock on, reduce the Upstream Attenuation setting at the Hub.</p> <p>If it does not send on the correct channel, and Cable Interface Control and Automatic Frequency Set are enabled, verify that the Hub ECM and the subscriber cable modem are assigned to the same upstream frequency and that both are excluded from an upstream load balancing group.</p> <p>If it does not send on the correct channel, go to the Hub and verify the following:</p> <p>Using the U/S Tap port on the Hub, verify the Hub is receiving a wireless signal from the CPE.</p> <ul style="list-style-type: none">• If there is a signal present, adjust the “Upstream Attenuation” setting at Hub until the cable modem locks on to the US channel.• If there is not a signal, verify the there is RF output from the

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Problem	Solution
	customer cable modem. If there is no RF output replace the cable modem. If there is an RF output replace the CPE.
Cable Modem does not receive an IP address	Perform normal cable modem installation troubleshooting procedures.
Cable modem does not receive time of day (ToD)	Perform normal cable modem installation troubleshooting.
Cable modem does not receive the configuration file	Perform normal cable modem installation troubleshooting.
Cable modem initializes, receives the configuration file, and then reboots	Verify that the configuration file being downloaded to the cable modem does not contain downstream channel information. The downstream RF channel frequency being delivered by the CPE to the Cable Modem is different than what is received at the Hub.

Link Verification

Verify the ARCXtend wireless link

- Downstream path measurements

DS Modulation	Expected Performance	Troubleshooting
64 QAM	28 dB MER 10 ⁻⁸ BER, post-error correction	Inspect the constellation to determine the type of impairment affecting the signal and troubleshoot accordingly. Verify the plant MER is greater than required for the downstream modulation
256 QAM	31 dB MER 10 ⁻⁸ BER, post-error correction	

- Upstream path measurements

Parameter	Expected Performance	Troubleshooting
CM output Power	+40-50 dBmV typical +55 dBmV max +30 dBmV min	If the cable modem output power is too high, reduce the amount of loss in the drop to allow for margin or reduce the “Upstream Attenuation” setting. If cable modem output power is too low, increase the hub’s “Upstream Attenuation” setting.
BER	10-8 BER, post-error correction for QPSK and 16 QAM To test BER on the return path, the analyzer can ping the CMTS with a packet of known data. The ping command will return the packet to the analyzer from the CMTS on the downstream path.	Verify the return or upstream path of the wireless link at the U/S Tap on the hub with PureBurst disabled and with a spectrum analyzer set to maximum hold. If interference is present in the 10 to 42 MHz band, change to a different upstream RF channel or move the CPE to a different location.

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