

The Innovation Behind Broadband Wireless



ASWipLL / AS3010 Systems

Wireless IP-Based Local Loop System

Release 5.2

Hardware Installation Guide



Leading the World in Wireless DSL

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Revision Record: ASWipLL Hardware Installation Guide		
Pub. Rev.	Date	Update Description
-	Nov-00	First edition and printing. (Marconi)
-	Mar-01	ASWipLL Release 1.4 (Marconi)
-	Apr-01	ASWipLL Release 2.0 (Marconi)
-	Jul-01	ASWipLL Release 2.2 (Marconi)
-	Nov-01	ASWipLL Release 2.6 (Marconi)
-	Jun-02	ASWipLL Release 3.0A (Marconi)
01	Feb-03	ASWipLL Release 4.0. Author: MD. Updates: Airspan template and content (connector pinouts; cable crimping, and general)
02	May-03	ASWipLL Release 4.2F. Author: MD. Updates: graphics, deleted BSR with serial port.
03	Jul-03	ASWipLL Release 4.2A. Author: MD. Updates: Chapter 1 for Transparent Bridging; 5.8 GHz; 2.8 GHz.
04	Aug-03	ASWipLL Release 4.2A. Author: MD. Updates: formatting; graphics; BSDU LEDs
05	Oct-03	ASWipLL & AS3010 Rel. 4.2B. Auth: MD. Updates: RSSI Plug for SPR; IDR RSSI levels; SDA-4S/Vltag; safety guidelines; Append. D.
06	Feb-04	ASWipLL & AS3010 Rel. 4.4. Auth: MD. Updates: RSS LED plug photo
07	Aug-04	Rel. 4.6. Auth: MD. Updates: SDA-1/48V; SDA-1/DC; Link Quality; additional FCC safety guidelines; Site Planning; miscellaneous.
08	Feb-05	Rel. 4.8. Auth: MD. Updates: surge protector; ASWipLL 900 ext. ant; removed SDA-1/48V; added SDA-4S/DC and SDA-E1.
09	Mar-05	Rel. 4.8. Auth: MD.
10	Mar-05	Rel. 4.8. Auth: MD. Updates: removed specs.
11	Aug-05	Rel. 5.2. Auth: MD. Updates: PolyPhaser lightning protector; SDA-1 Type II
Publication No. 02030311-11		

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About this Guide

This section discusses the purpose, targeted audience, references, organization, conventions, and technical support.

Purpose

The purpose of this guide is to provide information required to install the ASWipLL system hardware devices. These devices include the Base Station Radio (BSR), Point to Point Radio (PPR), Base Station Distribution Unit (BSDU), Base Station Power Supply (BSPS), Global Positioning System antenna (GPS), Subscriber Premises Radio (SPR), Subscriber Data Adapter (SDA), and Indoor Data Radio (IDR).

Targeted Audience

This guide is intended for the certified person who is responsible for installing the ASWipLL system. This person should be a professional installer who is familiar with electronic circuitry, wiring, and wireless networking.

Referenced Documentation

For a system description and detailed information on software configuration, refer to the following documentation:

- *ASWipLL System Description*: provides an overview of the entire ASWipLL system.
- *WipConfig User's Guide*: Airspan recommends that you refer to this guide for performing serial initial configuration.

- *WipManage User's Guide*: Airspan recommends that you refer to this guide as a reference for using the WipManage program for configuring and managing the ASWipLL devices.
- *ASWipLL Commissioning Manual*: Airspan recommends that you refer to this guide for descriptions on configuring and managing the ASWipLL devices.

Organization of this Guide

This guide is organized into the following chapters and parts:

- Chapter 1, "**Overview**": provides a brief overview of the ASWipLL devices.
- Chapter 2, "**Safety Guidelines**": lists the safety guidelines for handling cables and electricity during the installation.
- Chapter 3, "**Package Contents**": lists items provided in standard ASWipLL kits.
- Chapter 4, "**Required Tools**": lists the tools required for installing the system.
- Chapter 5, "**Radio Site Planning**": describes radio issues for planning the site before installation.
- Part 1, "**Base Station Installation**": includes the following chapters concerned with installing ASWipLL equipment at the Base Station:
 - Chapter 6, "**Basic Design of Devices**"
 - Chapter 7, "**Mounting the Devices**"
 - Chapter 8, "**Network Cabling**"
 - Chapter 9, "**Serial Cabling**"
 - Chapter 10, "**Connecting Third-Party External Antennas**"
 - Chapter 11, "**Power Cabling**"

- Part 2, "**CPE Installation - SPR**": includes the following chapters concerned with installing an SPR (interfacing with subscriber's network through an SDA) at the subscriber's premises:
 - Chapter 12, "**Basic Design of Devices**"
 - Chapter 13, "**Mounting the Devices**"
 - Chapter 14, "**Network Cabling**"
 - Chapter 15, "**Serial Cabling**"
 - Chapter 16, "**Connecting Third-Party External Antennas**"
 - Chapter 17, "**Antenna Alignment using RSS LED Adapter**"
 - Chapter 18, "**Power Cabling**"
- Part 3, "**CPE Installation - IDR**": includes the following chapters concerned with installing an IDR at the subscriber's premises:
 - Chapter 19, "**Basic Design**"
 - Chapter 20, "**Mounting**"
 - Chapter 21, "**Network Cabling**"
 - Chapter 22, "**Serial Cabling**"
 - Chapter 23, "**Connecting Third-Party External Antenna**"
 - Chapter 24, "**Antenna Alignment using RSS LEDs**"
 - Chapter 25, "**Power Cabling**"
- Appendix A, "**Glossary**": glossary of terms used in this guide
- Appendix B, "**Installing the BSPS**": describes the procedures for installing an optional third-party Base Station Power System.
- Appendix C, "**Cable Crimping**": describes the crimping procedure for 15-Pin D-type, N-type, and GPS connectors.

- Appendix D, "**RSS Led Plug Cabling for SPR with DB9 Port**": describes connector pinouts for SPR-to-RSS LED Adapter cabling when the old SPR model that provides a 9-pin D-type port is used.
- Appendix E, "**RJ-45 to DB15 Adapter for IDU/ODU Connectivity**": describes the use of an optional RJ-45 to DB15 adapter for connecting the outdoor radio to the indoor hub/switch.
- Appendix F, "**Extending IDU/ODU Cable Length**": provides step-by-step procedure for extending the length of the CAT cable connecting the indoor unit to the outdoor radio.
- Appendix G, "**Evaluating Link Quality**": describes the procedures for evaluating quality of the BSR-SPR link.
- Appendix H, "**Installing SDA-E1 for TDMoP**": provides step-by-step instructions on installing ASWipLL SDA-E1 for TDM over packet applications.
- Appendix I, "**Installing Lightning Protector**": provides step-by-step instructions on installing third-party lightning protector.
- Appendix J, "**FCC Declaration of Conformity** ": provides a declaration of FCC conformity for the ASWipLL radios.

Conventions

This guide uses the following bulletin conventions:



Warning: Provides information that can prevent and avoid bodily or mechanical harm.



Note: Provides useful information.

Customer Service

For service and support for your ASWipLL system, contact your regional Airspan representative or Airspan's Technical Assistance Center (TAC) at:

- **Web site (Support Request Form):**
<http://www.airspan.com/Ultra/ContactForm/airspansupportform.asp>
- **Americas:** (+1) 561 893 8679
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Overview

Airspan's **ASWipLL** system provides a low-cost, high-performance point-to-multipoint frequency hopping- and IP-based broadband wireless access (BWA) solution. ASWipLL provides wireless local-loop (last-mile) connectivity designed to deliver high-speed data, Voice over IP (VoIP), and multimedia services to residential, SOHO, and small to medium enterprises. Delivering "always-on", high-speed Internet access and traditional voice services, ASWipLL offers service providers an integrated, scalable access solution providing quick-to-market deployment and low-market entry cost for broadband services.

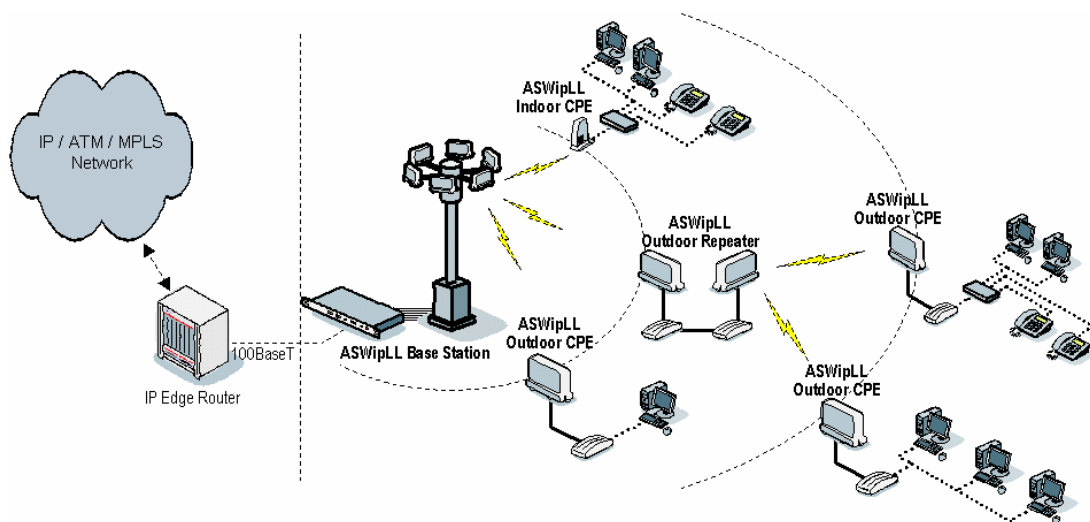


Figure 1-1: Typical ASWipLL applications

ASWipLL operates in both the licensed bands and unlicensed bands.

Each ASWipLL Base Station can support thousands of subscribers, providing each sector with high connectivity speeds of up to 4 Mbps. ASWipLL utilizes air protocol technology for wireless packet switching using Frequency Hopping technology. ASWipLL's in-house Preemptive Polling Multiple Access (PPMA) Air MAC

protocol technology, which recognizes transmission type and allocates bandwidth, is highly efficient—80% throughput (i.e. 80% of 4 Mbps produces 3.2 Mbps net capacity)—allowing multiple concurrent subscribers to utilize bandwidth over only a 1.33-MHz channel.

ASWipLL enables interconnection with the Public Switched Telephone Network (PSTN) by using an IP-to-PSTN gateway. ASWipLL supports VoIP by offering interoperability with a wide range of third-party products such as residential gateways (RGW), access gateways, gatekeepers, and softswitches.

ASWipLL introduces real-time adaptive modulation (2-, 4-, 8-level FSK) and auto retransmission request (ARQ); features offering high quality services whilst maximizing spectrum utilization.

ASWipLL provides bandwidth management by supporting both asymmetric and aggregated committed information rate (CIR) and maximum information rate (MIR), guaranteeing bandwidth levels to subscribers.

ASWipLL supports broadband services such as VLANs and VPNs based on IEEE 802.1Q/p. **ASWipLL** supports IP routing and PPPoE bridging, as well as transparent bridging.

ASWipLL provides embedded security features such as IP (packet) filtering based on addresses, protocols, and applications.

The **ASWipLL** system supports SNMP-based management, allowing remote fault, configuration, performance, and security management of the entire ASWipLL system. This includes remote simultaneous software upgrade of multiple ASWipLL devices.

1.1. System Architecture

The ASWipLL system offers modular Base Station architecture and high-performance subscriber equipment. The ASWipLL system architecture is composed of the following:

- **Base Station site:** consists of ASWipLL access units that interface between the provider's backbone and the ASWipLL subscriber sites.
- **Subscriber site:** consists of ASWipLL customer premises equipment (CPE) that interfaces between the Base Station and the subscriber's network.
- **Network operations center (NOC) tools:** Windows- and SNMP-based programs, providing fault, configuration, performance, and security management for the entire ASWipLL system.

1.2. Base Station Site

The ASWipLL Base Station interfaces between the subscriber sites and the service provider's backbone, delivering high-speed IP-based multimedia services to subscribers across the last mile.

The Base Station includes various ASWipLL devices (some optional), as listed below:

- Base Station Radio (BSR) / Point-to-Point Radio (PPR) -- outdoor radio
- Base Station Distribution Unit (BSDU) -- Ethernet switch
- GPS antenna for synchronization
- Base Station Power Supply (BSPS) -- provides -48 VDC power supply and power redundancy

The implementation of these devices depends on the desired network (e.g. point-to-point radio link), number of outdoor radios, and power source at the Base Station, and required synchronization method (e.g. by GPS).

1.2.1. Base Station Radio (BSR)

The BSR is an outdoor radio that is mounted outside on a pole or wall. The BSR provides a wireless link with subscribers and interfaces with the provider's backbone. Each BSR can serve up to 251 subscribers in a sector.

The BSR is available in various models. These models differ mainly by:

- Antenna design (providing integral flat-panel antennas, or N-type ports for attaching third-party external antennas)
- Antenna gain
- Frequency band in which they are configured to operate

The BSR connects to the indoor Ethernet hub/switch by a CAT 5 cable, which carries the Ethernet signal, frequency hopping synchronization signal, and DC power. For a Base Station consisting of multiple BSRs, the BSRs connect to the ASWipLL Base Station Distribution Unit (BSDU). For a Base Station consisting of a single BSR, the BSR typically connects to the ASWipLL Subscriber Data Adapter (SDA).

1.2.2. Point-to-Point Radio (PPR)

The PPR device is an outdoor radio similar to the BSR, but implemented in a point-to-point radio configuration, providing wireless communication with a single remote subscriber ASWipLL radio (i.e. SPR or IDR).

1.2.3. Base Station Distribution Unit (BSDU)

The BSDU is an Ethernet switch implemented at Base Stations consisting of multiple BSRs. The BSDU provides 100BaseT interface between the BSRs and the provider's backbone. The BSDU is also responsible for providing BSRs with -48 VDC power supply and for synchronizing BSDUs, BSRs, and Base Stations (when a GPS is implemented).

The BSDU is installed indoors in a standard 19-inch cabinet and connects to the BSRs by standard CAT 5 cables. Each BSDU can service up to six BSRs. In

addition, up to four BSDUs can be daisy-chained to support a maximum of 24 BSRs. Therefore, a Base Station at maximum configuration can serve up to 6,096 subscribers.



Note: At a Base Station consisting of a single BSR, the BSR typically interfaces with the provider's backbone through an SDA instead of a BSDU. (See Section 1.3.1, "Outdoor Radio with Indoor Switch/Hub").

1.2.4. Global Positioning System (GPS) - Optional

The GPS antenna is a rugged, self-contained GPS receiver and antenna that receives a universal GPS satellite clock signal. The GPS is an optional unit that connects to the BSDU. The GPS synchronizes (based on frequency hopping) multiple Base Stations, ensuring that the entire ASWipLL network operates with the same clock based on a universal satellite clock signal. This is crucial in eliminating radio frequency ghosting effects.

1.2.5. Base Station Power Supply (BSPS) - Optional

The BSPS is an optional third-party unit that is implemented at Base Stations to provide –48 VDC power supply and power redundancy. The BSPS is installed in a standard 19-inch cabinet. The BSPS connects to the BSDU(s).

The BSPS provides the BSDUs and BSRs with the following:

- Power supply of –48 VDC.
- Power redundancy in case of power failure. The BSPS charges a battery bank that provides power redundancy during mains failure. Thus, the BSPS acts as a DC-uninterruptible power supply (UPS) with a battery connected to it. The size of the battery determines the backup and charging time. Since the system is current limited, the maximum battery size is based on this limit.
- Remote power management and monitoring (by ASWipLL's WipManage program).

1.3. Subscriber Site

The ASWipLL customer premises equipment (CPE) are located at the subscriber's premises. The ASWipLL subscriber site consists of a radio transceiver that receives and transmits signals from and to the Base Station. The radio provides the subscriber with high-speed data access, Internet access, and VoIP at up to 4 Mbps.

The ASWipLL radios interface with the subscriber's Ethernet network either through a hub or switch, or directly, depending on the ASWipLL radio implemented.



Note: For VoIP support, Airspan can provide a third-party residential gateway (RGW). The RGW typically provides two POTS ports for telephony, a 10BaseT LAN port for subscriber PC/network, and a 10BaseT port for connecting to the SDA or IDR (depending on subscriber site configuration).

The ASWipLL system provides two different subscriber-site configurations:

- Outdoor radio with indoor Ethernet switch/hub
- Indoor radio only

1.3.1. Outdoor Radio with Indoor Switch/Hub

The outdoor radio with indoor Ethernet switch/hub configuration consists of the ASWipLL Subscriber Premises Radio (SPR) and the ASWipLL Subscriber Data Adapter (SDA), respectively.

1.3.1.1. Subscriber Premises Radio (SPR)

The SPR is an outdoor radio that provides a wireless link with the Base Station (i.e. BSR or PPR radio). The SPR interfaces with the subscriber's network through the SDA Ethernet hub/ switch. The SDA provides the SPR with DC power, lightning protection, and Ethernet (10BaseT and/or 100BaseT) interfaces with the subscriber's PCs/network (up to four PCs, depending on SDA model).

The SPR is mounted outdoors on a wall or pole. The SPR connects to the SDA by a standard CAT 5 cable.

The SPR is available in various models. These models differ mainly by:

- Antenna design (providing integral flat-panel antennas, or N-type ports for attaching third-party external antennas)
- Antenna gain
- Frequency band in which they are configured to operate

1.3.1.2. Subscriber Data Adapter (SDA)

The SDA is a switch or hub (depending on model), providing the SPR with -48 VDC power supply, lightning protection, and 10/100BaseT interface with the subscriber's PCs/network.

The SDA is installed indoors and can be mounted on a wall or simply placed on a desktop. The SDA connects to the SPR by a standard CAT 5 cable.

The SDA is available in the following models:

- **SDA-1:** hub providing one 10BaseT interface with the subscriber's computer (or LAN network if connected to another hub or a switch).
- **SDA-1/DC:** adapter that provides Ethernet (one 10BaseT) and regulated -48 VDC power to the SPR. This model can be powered from a power source of 10 to 52 VDC (e.g. from a solar panel or car lighter, which typically provide 12 VDC). This model is typically implemented in mobile wireless applications, e.g. in a car or truck.
- **SDA-1 Type II:** compact adapter that provides 10/100BaseT interface and -48 VDC power to the SPR. This model provides interchangeable plug prongs and can be plugged into a standard 110/240 VAC wall outlet or into a 10 to 52 VDC power supply (e.g. solar panel)
- **SDA-4H:** hub providing four 10BaseT interfaces with the subscriber's computers and/or networks. One of the 10BaseT ports provides crossover cabling for interfacing with another hub or LAN switch. Alternatively, it may be connected to another PC via a crossed Ethernet cable.

- **SDA-4S:** integrated LAN switch, providing four 10/100BaseT interfaces with the subscriber's PCs/network. The ports of the SDA-4S models support **Auto Negotiation**, allowing automatic configuration for the highest possible speed link: 10BaseT or 100BaseT, and Full Duplex or Half Duplex mode. In other words, the speed of the connected device (e.g. a PC) determines the speed at which packets are transmitted through the SDA-4S port. For example, if the device to which the port is connected is running at 100 Mbps, the port connection will transmit packets at 100 Mbps. If the device to which the port is connected is running at 10 Mbps, the port connection will transmit packets at 10 Mbps.

The SDA-4S ports also support automatic **MDI/MDI-X** crossover detection, allowing connection of straight-through or crossover CAT 5 cables to any port.

The SDA-4S is available in the following models:

- **SDA-4S (standard):** standard integrated LAN switch, providing four 10/100BaseT interfaces with the subscriber's computers. This model is ideal for SOHO implementation.
- **SDA-4S/DC:** integrated LAN switch, providing four 10/100BaseT interfaces and especially designed for implementation where available power supply is DC (10 to 52 VDC), e.g. from a **solar panel** or car lighter, which typically provide 12 VDC. This model provides regulated –48 VDC power to the SPR.
- **SDA-4S/VL:** provides VLANs between ports and the SPR, ensuring privacy between LAN users of the different ports. For example, all users connected to Port 1 do not "see" users connected to Port 2. This model is ideal for multi-tenant (VLAN security) implementation.
- **SDA-4S/VLtag:** ideal for multi-tenant applications where traffic engineering and privacy is required. SDA-4S/VLtag assigns a specific VLAN ID to traffic, based on the SDA-4S/VLtag port at which the traffic arrives. The VLAN IDs are fixed (since SDA-4S/VLtag is not user configurable). SPR converts the four VLAN IDs tagged by SDA-4S/VLtag to four VLAN IDs configured through ASWipLL's network management system (WipManage). The tag conversion is performed by SPR before sending the traffic to the air (i.e. to the BSR) and vice versa when coming from the air.

- **SDA-4S/1H3L:** provides a high-priority port (left-most port) for VoIP traffic.
- **SDA-4S/VL/1H3L:** combines the functionality of the SDA-4S/VL and SDA-4S/1H3L models (i.e. VLAN for each port and a high-priority port for VoIP).
- **SDA-E1:** integrated TDMoP fE1/Ethernet converter with standard SDA features.

The figure below displays a typical subscriber site setup implementing an SPR and SDA.

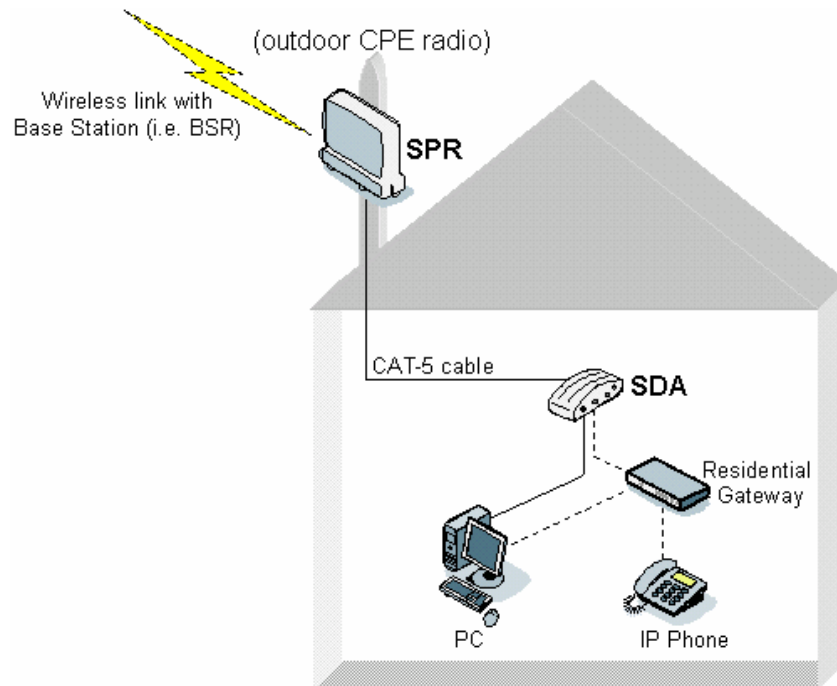


Figure 1-2: Subscriber site with SPR and SDA units (optional RGW)

1.3.2. Indoor Radio Only

The indoor radio unit configuration consists solely of the ASWipLL Indoor Data Radio (IDR). The IDR combines the functionality of the SPR and SDA, functioning both as a transceiver and a hub. The IDR provides one 10BaseT Ethernet interface with the subscriber's network. The IDR receives its power from a separate power supply adapter (AC/DC or DC/DC power adapter).

The IDR is available in various models. These models differ mainly by:

- Antenna design (providing integral flat-panel antennas, or TNC-type ports for attaching third-party external antennas)
- Antenna gain
- Frequency band in which they are configured to operate

The IDR model with an integral flat-panel antenna is typically mounted on an interior wall or on a desktop, ensuring line-of-sight with the Base Station. The IDR model with a third-party external antenna is also mounted indoors, but the external antenna is typically mounted outdoors to provide line-of-sight with the Base Station.

The IDR can be used for data and voice transmissions. In the case of voice, the IDR uses a third-party RGW to interface with the subscriber's IP phone. Figure 1-3 displays a typical setup for data and voice at a subscriber site implementing the IDR.

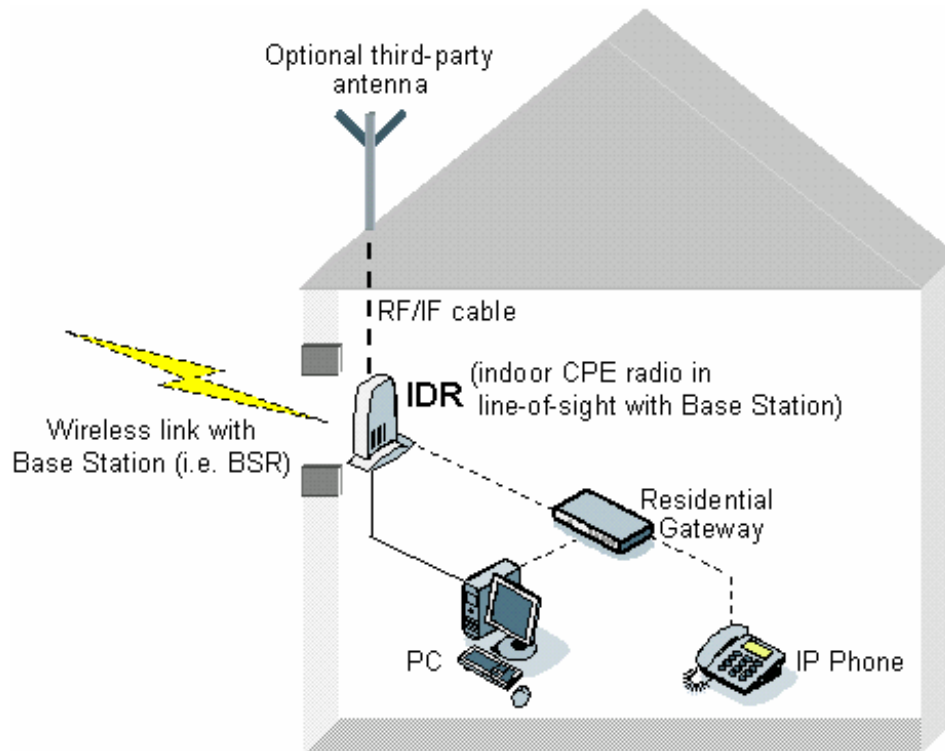


Figure 1-3: Subscriber site with IDR (optional third-party external antenna and RGW)

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Safety Guidelines

This chapter outlines safety guidelines that must be adhered to when installing the ASWipLL system.

2.1. General



Warning: The user and the installer should be aware that changes and modifications not expressly approved by Airspan Networks could void the user's authority to operate the equipment.



Warning: Never install equipment that is damaged.



Warning: Only qualified personnel should be allowed to install, replace, and service the ASWipLL equipment.

2.2. ASWipLL Radios and Third-Party External Antennas



Warning: Do not connect and disconnect antennas while the power is on. This can cause irreversible damage to the device.



Warning: The digital portion of the transceiver 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 the instructions, may cause harmful interference to radio communications. However, there is no guarantee that 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 on and off, the user is encouraged to try correct the interference by performing one or more of the following measures:

- Reorientate or relocate the receiving antenna
 - Increase separation between the equipment and receiver
 - Connect the equipment to 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
-
-



Warnings:

- 1) The device cannot be sold retail, to the general public or by mail order. It must be sold to dealers.
 - 2) Installation must be controlled.
 - 3) Installation must be performed by licensed professionals.
 - 4) Installation requires special training.
-
-



Warning: The ASWipLL radios and antennas should be installed ONLY by experienced installation professionals who are familiar with local building and safety codes and, wherever applicable, are licensed by the appropriate government regulatory authorities. Failure to do so may void Airspan's ASWipLL product warranty and may expose the end user or the service provider to legal and financial liabilities. Airspan and its resellers or distributors are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.



Warning: For **unlicensed** bands, it is the responsibility of the person installing the ASWipLL system to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), that only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance with FCC rules CFR47 part 15.204. The installer should configure the output power level of antennas according to country regulations and per antenna type.



Warning: For **unlicensed** bands, in accordance with FCC regulations, ensure that the external antennas provide an EIRP of less than or equal to **36 dBm** to prevent interference with other radios operating in the unlicensed band. The EIRP is defined by the following formula:

$$\text{Max. Power Output} + \text{Antenna Gain} - \text{Cable Loss} \leq 36 \text{ dBm (EIRP)}$$

Airspan does not supply cables for connecting external antennas. It is the responsibility of the installer to provide the cable and ensure the cable characteristics (i.e. cable loss) enables adherence to FCC's regulations concerning maximum EIRP. When calculating output power based on cable loss, **always assume** the ASWipLL radio is configured for maximum rate mode (i.e. 1.33/4 Mbps), which provides greater Tx power than low rate modes.

The table below lists **examples** of cable loss per cable (not supplied by Airspan) for maximum antenna gains, based on the formula above. Note that the EIRP is either equal to or less than 36 dBm.

Cable type	Cable length (ft)	Tx power (dBm)	Cable loss (dB)	Max. Antenna gain (dBi)	Max. EIRP (dBm)
BELDEN - 9913	10	21.1	0.6	15.5	36
	30	22	1.5	15.5	36
	100	23	4.4	15.5	34.1
BELDEN - 89907	10	22.4	1.9	15.5	36
	30	23	5.2	15.5	33.3
	100	23	16.3	15.5	22.2



Warning: The ASWipLL radios emit microwave radiation. Therefore, a minimum distance of 200 mm must be maintained from the front of the ASWipLL radios, except when operating in the following frequency bands:

- 700 MHz (i.e. ASWipLL 700) = 800 mm
- 2.5 GHz (i.e. ASWipLL 2.5) = 500 mm



Warning: To avoid RF interference between BSRs, ensure a minimum 1-meter horizontal separation between co-located BSRs.



Warning: To avoid RF interference between BSRs operating in the **700 MHz** where four BSRs are installed at a Base Station, in addition to 1-meter horizontal separation, a minimum 1-meter **vertical** separation must be provided between the two pairs of BSR antennas: one pair operating in the lower frequencies (i.e. 711.5 and 714.5 for 1 Msps mode; 712 and 714 for 1.33 Msps mode) and the other pair operating in the upper frequencies (i.e. 741.5 and 744.5 for 1 Msps mode; 742 and 744 for 1.33 Msps mode).



Warning: When using external antennas, the external antennas must not be co-located or operating in conjunction with any other antenna or transmitter.



Warning: Inherent risks exist in operating equipment in unlicensed bands (e.g. 900 MHz). Airspan recommends that you do not purchase or deploy any equipment that operates in unlicensed bands without first analyzing the interference environment at each of your proposed deployment locations. Please contact your Authorized Airspan System Integrator or Distributor if you have any questions or require assistance regarding interference analysis. Airspan Networks will not be held responsible for product performance issues related to interference.



Warning: In environments that produce disturbances such as paging systems, Airspan recommends using a narrow-band cavity filter and implementing the appropriate frequency bands (within the filter's capabilities), i.e. building an NVRAM frequency table using only these frequencies.



Warning: Mount outdoor radios so that their front panel ports face down to prevent water from settling on the ports. This avoids damage to the units such as corrosion and electrical short-circuiting.



Warning: Do not mount outdoor radios and external antennas in weather that may increase risk of electrocution such as rain or lightning.

2.3. Electrical Safety Guidelines



Warning: Connect power only after all network and antenna cable connections are performed. Powering the device before connecting, for example, the external antenna, can lead to irreversible device damage.



Warning: To prevent short-circuiting and electrical shocks, cables with exposed ends (i.e. not yet crimped) should be covered with protective polythene bags during external cable installation processes.

2.3.1. Handling Electrostatic Devices



Warning: To prevent ESD damage to ASWipLL devices, always wear an ESD wrist strap when handling these devices or coming into contact with internal components.

Electrostatic devices are those devices that may be damaged by the inadvertent discharge of static electricity from a charged body. The risk of damage, due to electrostatic discharge (ESD) to a device, may cause the device to fail suddenly, or it may induce a partial defect within the device, which will cause subsequent premature failure. Static electricity can result from operators walking on floors, moving around on chairs, from the movement of operator's clothing or even casual brushing against racks, benches or walls.

Airspan recommends the following guidelines to be adopted to minimize the risk of component failure due to electrostatic discharge to the device:

- ASWipLL devices are provided typically in see-through anti-static bags. Wherever possible, checking and inspection of a unit should occur without removing it from the bag.
- Where operators come into direct contact with any piece of electronic hardware, operators must wear an **ESD-preventive wrist strap**. All straps and cords should be tested using a Wrist Strap Tester prior to use. The wrist strap cords shall have a 2 Meg Ohm resistor fitted at either end. Wrist straps should be worn in direct contact with bare skin and not over clothing.

2.3.2. Grounding

Only certain ASWipLL devices require additional grounding. ASWipLL devices that do not require additional grounding provide grounding at the main electrical outlet. The following table lists the ASWipLL devices' grounding requirements.

Table 2-1: ASWipLL grounding requirements

Site	ASWipLL device	Grounding
Base Station	BSR/PPR	Through the mains (via BSDU), i.e. no additional grounding required
	BSDU	Additional grounding required (grounding lug at rear end of chassis)
	BSPS (third-party)	Additional grounding required (grounding lug at rear end of chassis)
CPE	SPR	Through the mains (via SDA), i.e. no additional grounding required
	IDR	Through the mains, i.e. no additional grounding required

2.3.3. Lightning Protection



Warning: Never install the equipment during stormy weather or lightning.

ASWipLL devices comply with the **Surge Immunity standard: EN 61000-4-5**. ASWipLL devices are protected from lightning surges as the outdoor devices (BSRs and SPRs) are encased in a plastic covering. Therefore, if lightning strikes the device, an electrical circuit cannot be completed, and hence, no electrical surge can occur.

In addition, ASWipLL outdoor and indoor (i.e. SDA) devices provide high-speed data line protection against direct and induced transient over-voltage surges on the cables. This capability is provided by the fact that all ASWipLL devices are designed with transient voltage suppressor (TVS) components that maintain potential differences.

However, in geographical areas that have above normal lightning activity, Airspan can supply an optional DC surge protector adapter (see Part II, Chapter 18, "Power Cabling").

2.4. Cabling



Warning: Cables with exposed ends (i.e. not yet crimped) should be covered with protective polythene bags during external cable installation processes.



Warning: Disturbance of cables on an In-Service exchange can cause loss of service. Extreme care must be taken when installing cables at any customer or subscriber premises.

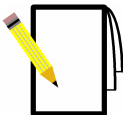


Warning: The standard maximum cable length between the outdoor radios and indoor switch/hubs (IDU/ODU) is 100 meters using the standard CAT 5 cable. However, you can extend this cable to up to 300 meters. See Appendix F, "Extending IDU/ODU Cable Length".

2.4.1. Considerations

The following issues should be considered during cabling at the ASWipLL Base Station and customer premises:

- Cable routes are to be defined in a site-specific documentation.



Note: A minimum separation of 200 mm should exist between power and data cables. However, it is permissible to allow these cables to cross each other at right angles.

- Observe recommended minimum bend radii when installing copper cables. Wherever a cable changes direction, ensure that it does so in a smooth curve with a radius of at least 50 mm to prevent damage.
- Plastic ties and wraps are to be used to secure cables at regular intervals to trays, guides, and mounting pole/bracket. Ensure all trimmed ends are disposed of safely and at regular intervals.

- Data cables of less than 20 pairs shall be mixed in bundles not exceeding 50 mm in diameter.
- Ensure cables are not trapped in cabinet doors, by slide-in equipment or support metalwork.
- Excessive stress on cable terminations caused by taught cables should be avoided. Connector strain relief, if not built into the connector used, shall be provided by means of a strategically located cable tie. A maintenance loop or a generous amount of cable slack shall be provided just before the cable reaches the ASWipLL device to allow for equipment removal without disturbance to adjacent cables.
- When installing network cables, ensure they are not damaged by friction or sharp edges.
- Data cables providing connection to the customer's network shall be run in protective conduits. Cable conduits should be secured to the wall in accordance with manufacturers instructions.
- External data cables are to be protected in metal conduits, which are to be secured to the building structure in accordance with manufacturer's recommendations.
- Wiring conduits must be placed in areas to prevent a trip hazard (e.g. don't install on roof walkways)
- Cables should be carefully fed through conduits and not pulled by means of any attached connector.
- Sufficient space should be provided in cable conduits, trunking or trays (where possible) to allow for future cabling growth.
- Data cables threaded into holes drilled in walls are to be covered by a waterproof sheath to prevent water penetration.
- Silicone sealant should be used to plug any holes on both internal and external wall surfaces once cables are in place.
- Cables not housed in conduits must be placed in a manner to avoid a trip hazard. (Avoid trailing wires across passageways.)

2.4.2. Labeling

The following labels are required to be fitted to ASWipLL equipment:

- Voltage Warning
- High Earth Leakage Current
- Signal Cable Designation

2.4.2.1. Voltage Warning



Warning: Voltages over 30 Volts AC and 50 Volts DC are categorized as hazardous. Hazard warning labels should be fitted where required. Certain countries require equipment warning and instruction labels to appear in the local language. When installing ASWipLL equipment ensure that local requirements regarding labels are given consideration.

- Where mains power is fed from separate phases, appropriate warning labels must be fitted to warn of the increased danger.
- The AC equipment used in the BSPS cabinet must carry a relevant voltage warning label specific to the country in which it is being installed. The label will be fitted to the cabinet doors displaying an electrical hazard symbol, the local operating voltage and the letters 'AC'.
- A power feed identification label (e.g. PWR 'A') shall be applied in the following locations:
 - On the rear of the main power rack adjacent to the terminal block
 - Attached to BSPS AC mains power plug or lead
 - Attached to the customer mains power socket or distribution rail
 - On the BSPS power circuit connection at the fuse board

2.4.2.2. High Earth Leakage Current

If equipment earth leakage current exceeds 3.5 mA, a warning label as shown in Figure 2-1 must be fitted to the rear of the main power rack alongside the AC inlet terminal block.

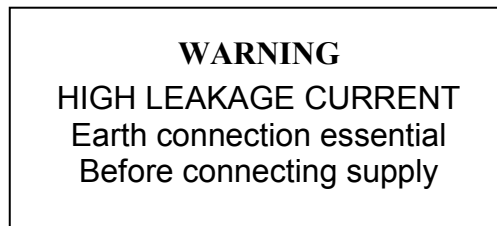


Figure 2-1: Warning label if earth leakage current exceeds 3.5 mA

2.4.2.3. Signal Cable Designation

All data cables should be labeled with both the source and destination at each end. A wrap around identification label is to be fitted to both ends of ASWipLL data cables. Care should be taken to ensure that the cable identification information is clearly visible. Fit the label 100 mm from the cable end. Wrap the label ensuring good adhesion to cable and itself.



Package Contents



Warning: Examine the ASWipLL shipping container. If you notice any damage, or missing items as listed in the Packing List, immediately notify the carrier that delivered the unit and contact an Airspan representative.

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Required Tools

The following tools are required for installing the ASWipLL system:

- Crimping tools (CAT-5 cables for 15-Pin D-type, N-type connectors, and for GPS connectors)
- Cable stripping tool
- Philips-head screwdriver
- Flat-blade screwdriver
- Torque wrench for N-type connectors
- 10-, 13-, and 17-mm A/F open ended spanner

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Radio Site Planning

Proper site selection and planning before installing your ASWipLL devices will ensure a successful deployment of your ASWipLL system. Site planning includes the following main considerations:

- **Minimum obstructions** (e.g. buildings) in the radio path between Base Station radio (i.e. BSR) and subscriber radios (i.e. SPR/IDR).
- Mount radios as high as possible to avoid obstructions in the wireless path.
- Check possibility of future obstructions such as plans to erect buildings and trees that may grow tall enough to obstruct the wireless path.
- Minimum incursions on Fresnel Zone (recommended minimum of 60% clearance of first Fresnel Zone).
- Align antennas for maximizing received signal strength (RSS)
- Consider nearby sources of interference that could degrade performance of radio. Mount radios as far from sources of interference as possible.
- Ensure Base Station radio and subscriber premise's radios are within maximum coverage **range of reception**.
- Maximum standard CAT-5 cable length connecting the outdoor radio to the indoor terminating equipment (i.e. switch/hub) is **100 meters** (this can be extended to up to 300 m).
- Ensure that you have sufficient **wiring conduit** and cable ties to channel and protect the CAT 5 cable connecting the outdoor radio to the indoor hub/switch.
- Ensure required **power mains outlet** is available at the site.

5.1. Minimal Radio Path Obstructions

ASWipLL radios communicate by propagation of waves. Thus, ensure minimum obstructions (from, e.g. buildings and trees) in the radio path between Base Station radio (i.e. BSR) and subscriber radios (i.e. SPR/IDR). It is essential that the ASWipLL radios or antennas be installed in such a way that their radio paths have a clear path with each other.

5.2. Fresnel Zone Clearance

There must be sufficient open space around the radio path to minimize interference with the radio beam. A minimum of **60% of the first Fresnel Zone** of the path should be clear of obstructions. Despite a clear line-of-sight, objects close enough to the transmission path may cause attenuation in signal strength and an increase in signal interference. Objects with reflective surfaces that seem relatively far away, but yet still encroaching on Fresnel Zone, may cause these interferences.

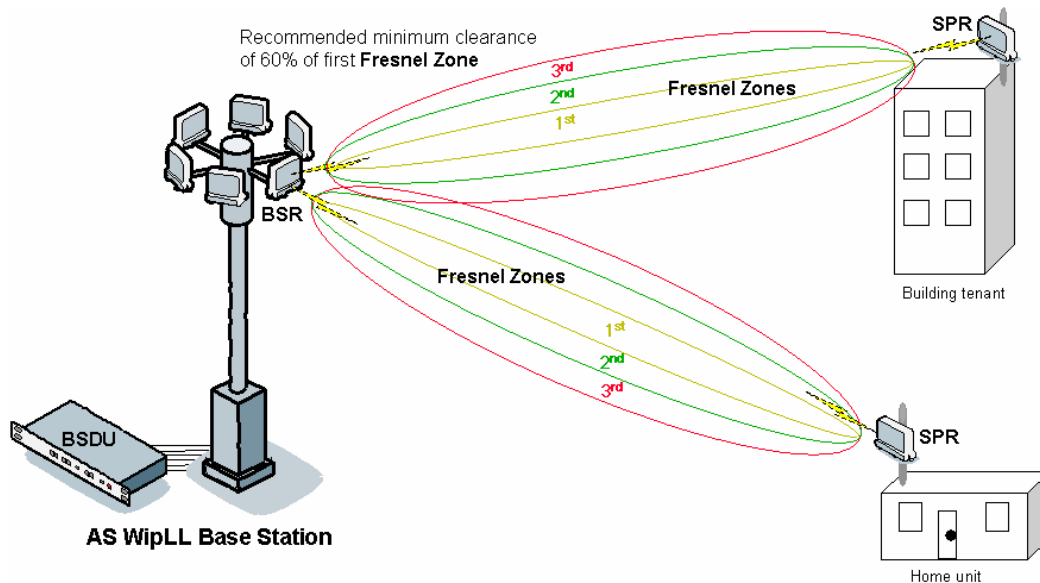


Figure 5-1: At least 60% of first Fresnel Zone should be clear

Fresnel Zones define the amount of clearance required from obstacles. These zones are composed of concentric ellipsoid areas surrounding the straight-line path between two antennas. Thus, the zone affects objects to the side of the path and those directly in the path. The first Fresnel Zone is the surface containing every point for which the distance from the transmitter to any reflection point on the surface point and then onto the receiver is one-half wavelength longer than the direct signal path.

One method for clearing the Fresnel Zone (to use the free space model to calculate link budget – see Section 5.6, "Calculating Link Budget") is by increasing the antenna height.

The first Fresnel Zone radius is calculated by the following equation:

$$r = \sqrt{\frac{75 \cdot d}{f}}$$

Where f is the frequency (in MHz) and d is the distance (in meters).

For example, using the formula above, a link of 4 km at 700 MHz produces a first Fresnel Zone radius clearance of about 20 meters. This implies that to ensure the ground does not enter into the first Fresnel Zone, both antennas (i.e. at Base Station and subscriber) must be mounted at least 20 meters above ground level (or clutter level). Typically, at least 60% clearance of the first Fresnel Zone is considered as LOS. Therefore, in the above example, a height of at least 12 meters (i.e. 60% of 20 meters) above ground level is sufficient for LOS.

5.3. Multipath Fading

Some of the transmitted signals may be reflected from a nearby building, by water under the signal path, or from any other reflectors. This reflected ("bounced") signal can then be received by the radio receiving the signal and superimposed on the main received signal, thereby degrading the signal strength.

To avoid multipath fading, for example, from nearby buildings, Airspan recommends installing the outdoor radios at the rear end of the buildings instead of at the front. In this installation setup, the front-end of the building blocks incoming signals from multipath reflections.

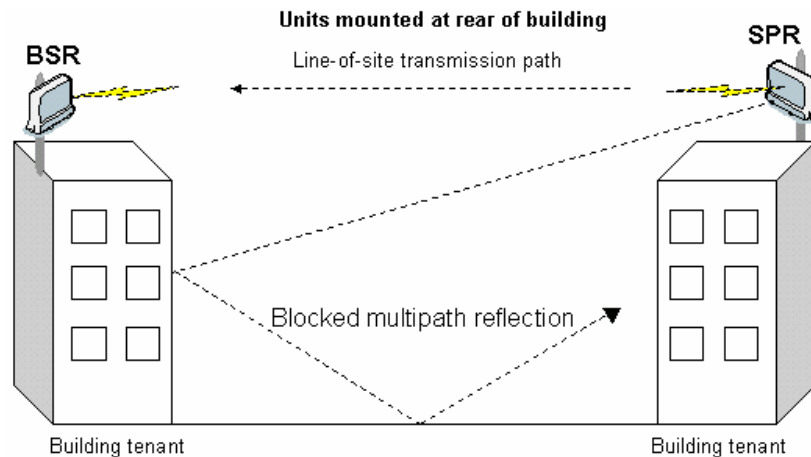


Figure 5-2: Radios mounted at rear, blocking multipath reflection

5.4. Spectrum Analysis for Locating Clear Frequencies

Before setting up your wireless link between Base Station and subscribers, Airspan recommends (especially in unlicensed bands), analyzing the RF spectrum at the Base Station to select only clear frequency channels (i.e. without interferences) for building a frequency table for wireless communication between Base Station and subscriber.

Prior to performing this test, you need to mount the radio/antenna in the desired installation spot. In general, you will be looking for frequencies with signal strengths of -85 dBm or greater.

For using Airspan's spectrum analyzer tool, refer to the *WipConfig User's Guide*. For evaluating link quality using the Spectrum Analyzer, see Appendix G, "Evaluating Link Quality".

5.5. Adjacent Base Station Radios

For installations involving co-location of BSRs, it is important to assign frequencies of maximum spacing. This is to reduce possible radio interference between adjacently installed BSRs. In addition, a 1-meter separation must exist between adjacent BSRs.

5.6. Calculating Link Budget

Link budget is the computation of the maximal achievable reception level for the communication link between the Base Station and the subscriber site. This level is the minimum required received signal level (RSS) at the antenna port for the radio to close the communication link at a given data rate and under the worst-case fading channel. The weakest signal a receiver can successfully pick up and demodulate at an acceptable bit-error rate is called receiver sensitivity. This level must be greater or equal to the radio's receiver sensitivity, which is the minimum RF signal power level required at the input of a receiver for certain performance (e.g. $>$ BER).

This takes into account the following parameters:

- **Transmit (dBm) EIRP:**

Tx transmitter power (dBm) - cable loss (dB) + Tx antenna gain (dBi)

- **Propagation (dB):**

Fade Margin + Free space loss (dB) = [fade margin] + $32.44 + 20\log d(\text{km}) + 20\log f(\text{MHz})$, where f is the frequency in MHz, and d is the distance between transmitting and receiving radios in km.

Note: Free space propagation loss is valid only when the first Fresnel Zone is clear.

■ **Receive (dBm):** Rx antenna gain (dBi) - cable loss (dB)

The formula to calculate receive signal strength:

$$\text{RSS} = \text{Tx EIRP} - \text{Path Loss} + \text{Receive (i.e. Tx gain - Tx cable loss)}$$

The RSS value must be greater than radio's receiver sensitivity for communication link to succeed.

Example:

- **Given:** frequency is 2.4 GHz; Tx power output is 27 dBm; Tx and Rx cable loss is 0 dB; Tx antenna gain is 11 dBi; Rx antenna gain is 15 dBi; distance between sites is 6 km; receiver sensitivity at 8-level FSK is -75 dBm.
- **Calculation:** $\text{RSS} = \text{Tx} + \text{Tx gain} - \text{cable loss} - \text{path loss (fade margin} + 32.44 + 20\log f + 20\log f) + \text{Rx gain} - \text{cable loss}$
Therefore, $\text{RSS} = 27 + 11 - 116 + 15 = -63$ dBi
- **Conclusion:** calculated link budget received signal strength (-63) is above the device's receive sensitivity threshold (-75); thus a communication link should succeed.



Notes:

- 1) ASWipLL radios can operate in 2-, 4-, and 8-level FSK with signal strengths (i.e. receiver sensitivity) greater than -90, -83, and -75 dBm, respectively.
 - 2) As the number of CPEs operating in low modulations (i.e. 2 and 4 FSK) increases, a decrease in cell bandwidth efficiency is expected. Therefore, to enable the highest bandwidth efficiency, it's recommended to ensure (e.g. by RF planning) that all CPEs operate in the highest modulation (i.e. 8 FSK).
 - 3) These link budget rules are theoretical. It represents the maximum achievable for a system. In reality we have interferences (other WLAN networks, bluetooth), industrial noise (microwave ovens), atmospheric losses (air moisture, scattering, refraction), badly pointed antenna, reflexions that will affect performances. Thus, It is necessary to take a sufficient security margin on large distances.
 - 4) Normally, a higher margin is desirable due to fluctuation in received power as a result of signal fading.
 - 5) The maximum transmit power output of ASWipLL radios (regardless of regulatory domain), depends on the operating frequency:
 - **31 dBm**: 700 MHz; 1.9 GHz (for BSR)
 - **30 dBm**: 900 MHz, 925 MHz, 1.5 GHz, 1.9 GHz (for SPR)
 - **27 dBm**: 2.3, 2.4, 2.5 (MMDS), 2.8, 3.x, and 5.8 GHz
- For maximum transmit power according to FCC standards, see Appendix I, "Declaration of FCC Conformity".
-

To Calculate Minimum Received Signal Strength		
Transmit	Transmit output power	dBm
	Cable loss (negative value)	dB
	Antenna gain	dBi
Propagation	Free space loss (negative value)	dB
	$32.44 + 20\log$ <input type="text"/> $(\text{km}) + 20\log$ <input type="text"/> (MHz)	
	Fade margin: <input type="text"/> dB	
Receive	Antenna gain	dBi
	Cable loss (negative value)	dB
Received Signal Strength		dBm

To Calculate Maximum Operating Range (Km)		
Received Signal Strength	Enter one of the following RSS values according to FSK levels: 8-level FSK = -75 dBm 4-level FSK = -83 dBm 2-level FSK = -90 dBm	dBi
Transmit	Transmit output power	dBm
	Cable loss (negative value)	dB
	Antenna gain	dBi
Frequency	Operating Frequency in MHz	MHz
Propagation	Fade Margin	dB
Receive	Antenna gain	dBi
	Cable loss (negative value)	dB
Operating range		km

Note: The maximum operating range depends on the antenna configuration and FSK level. The range can be increased to a maximum of 38 km by implementing a third-party external antenna.

5.7. Radio Antenna Alignment

Once the subscriber unit (i.e. SPR/IDR) is installed and aimed in the general direction of the BSR, it is recommended to measure the received signal strength (RSS) to determine the signal strength received from the BSR, and to precisely align the SPR/IDR for maximum signal strength.

You need to orientate (up/down, left/right) the SPR/IDR until the maximum RSSI levels are achieved, and then secure the SPR/IDR. For short links you can expect an RSSI of -60 dBm or better. For longer links, an RSSI of -75 dBm is acceptable. Any RSSI of less than -80 dBm may be too weak for the radios to reliably communicate.

Airspan offers various tools for measuring RSS (check with your Airspan representative regarding cost and supply):

- **SPR:**
 - RSS LED adapter (see Part II, Chapter 17, "Antenna Alignment using RSS LED Adapter")
 - WipConfig program (see Appendix G, "Evaluating Link Quality")
- **IDR:** built-in RSSI LEDs (see Part III, Chapter 24, "Antenna Alignment Using RSS LEDs")

5.8. Antenna Polarization Usage

The ASWipLL radios provide integral antennas or optional third-party external antennas. Depending on radio model, these antennas provide horizontal wave polarization (H-pol), vertical wave polarization (V-pol), or both. The usage of these polarization options depend on the environment in which the radio is operating. Horizontal polarized waves reflect better from horizontal surfaces (e.g. ground), while V-pol waves reflect better from vertical surfaces (e.g. building walls).

This explains why broadcast television uses H-pol waves while cellular technologies use V-pol waves. Therefore, it is expected that in rural areas H-pol will propagate better than V-pol, and vice versa in urban areas.

Furthermore, in an area saturated with interference generated from V-pol transmitters, the use of H-pol antenna may substantially improve the C/I (Carrier to Interference) ratio, thus improving system performance

5.9. Considerations when Using External Antennas



Notes:

- 1) To avoid unnecessary RF cable loss, use short-length cables and with low attenuation.
 - 2) Antennas should have a VSWR of less than 1:1.5.
 - 3) Ensure BSR and SPR/IDR use the same antenna polarity (i.e. vertical or horizontal).
 - 4) When using an omni-directional antenna, choose a type providing a wide vertical beam width (of at least 8°) to allow connection of closer CPEs.
 - 5) Antenna must be DC grounded.
-
-

5.9.1. Cable Loss

Airspan's ASWipLL radios provide transmit power compensation for power attenuation caused by cable loss (in cable connecting to external antenna). Cable loss is the loss of radio transmit (Tx) power as heat, and directly proportional to cable length and quality, and operating frequency.

To adhere to Effective Isotropic Radiated Power (EIRP) limitations in the regulatory domain (country) in which you are operating your ASWipLL system, when purchasing antenna cables, take into consideration cable loss per cable length. EIRP is calculated using cable loss:

$$\text{EIRP} = \text{max. transmitter power output} + \text{antenna gain} - \text{cable loss}$$

For example, FCC regulations state that when operating in unlicensed bands, the external antennas must provide an EIRP of less than or equal to 36 dBm to prevent interference with other radios. Thus, knowing this EIRP parameter, you can choose the cable that ensures adherence to this parameter value.

The table below lists examples of cable loss per cable length.

Table 5-1: Examples of cable loss per cable length

Cable type	Cable length (ft)	Tx power (dBm)	Cable loss (dB)	Max. Antenna gain (dBi)	Max. EIRP (dBm)
BELDEN - 9913	10	21.1	0.6	15.5	36
	30	22	1.5	15.5	36
	100	23	4.4	15.5	34.1
BELDEN - 89907	10	22.4	1.9	15.5	36
	30	23	5.2	15.5	33.3
	100	23	16.3	15.5	22.2



Note: Airspan does not supply external antenna cables. It is the responsibility of the installer to provide the cable and ensure the cable characteristics (e.g. length and cable loss) enables adherence to EIRP regulations (e.g. FCC) of the country or area in which the ASWipLL system is operating.

5.9.2. Omni-Directional Antennas

In some scenarios, where capacity demand is relatively low, external omni-directional antenna use at the Base Station may seem attractive. However, it is recommended to avoid using omni-directional antennas (if possible), due to the following disadvantages that these antennas pose compared to directional antennas:

- **Higher sensitivity to external interferences.**
- **Higher sensitivity to multipath**, resulting in the following:
 - The root mean square (RMS) delay spread at the Base Station is substantially higher.
 - Multipath interference at the CPE side (when using omni-directional antenna at the Base Station) is substantially higher. In fact, when using an omni-directional antenna, the existence of clear Fresnel zone between BSR and SPR/IDR is insufficient to eliminate multipath interference, since multipath, in this case, can be caused by reflections originating from obstacles outside the Fresnel zone.
- **Higher sensitivity to alignment.** Since the omni-directional antenna gain is achieved by narrowing the vertical beam width, a relatively low deviation in the antenna alignment will result in severe signal attenuation.

5.9.3. Operating in 900 MHz

The performance of ASWipLL 900 operating in the 900 MHz band may vary dramatically depending on the polarization of antennas, i.e. vertical or horizontal. Therefore, it is recommended that the operator, during installation, compare the performance between horizontal and vertical polarization of external antennas, and implement the polarization providing the best performance. Some third-party antennas that can be optionally supplied by Airspan for the 900 MHz band support both horizontal and vertical polarization.

5.9.4. Operating in Band-C for FCC Markets

Some operators (e.g. in the USA) have licenses for Band-C (710 to 716 MHz and 740 to 746 MHz). ASWipLL 700 provides an external antenna, allowing coverage in the entire 700 MHz band (698 to 746 MHz), including the licensed A and B bands used in USA.

A maximum of four BSRs operating in Band-C are allowed at a Base Station (in accordance with FCC regulations). This regulation ensures minimum RF interference with other radio devices that may be operating in nearby frequencies.

In the 1 Megasymbols per second (Mps) mode, the center frequencies are 711.5, 712.5, 713.5, 714.5, 741.5, 742.5, 743.5, and 744.5. Thus, the frequency allocation for four BSRs is **711.5, 741.5, 714.5, and 744.5**.

In the **1.33 Mps** mode, the center frequencies are 712, 713, 714, 742, 743, and 744. Thus, the frequency allocation for four BSRs is **712, 742, 714, and 744**.

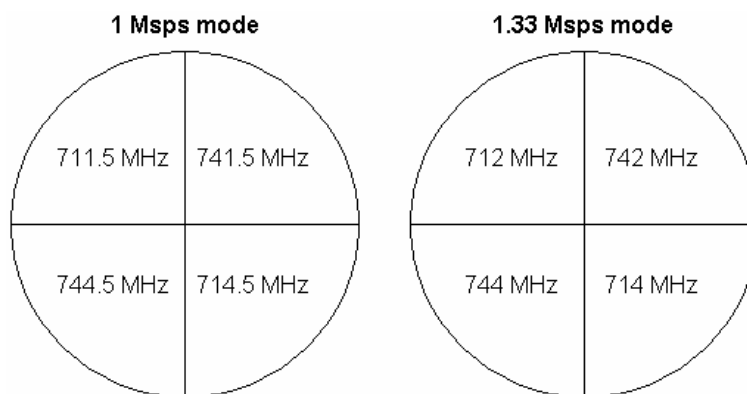


Figure 5-3: Frequency allocation in a four-sector Base Station

Radio interference may occur between the BSRs operating in the upper frequency range (i.e. 742 MHz and 744 MHz) and the lower frequency range (i.e. 712 MHz and 714 MHz). To overcome this interference, a **1-meter vertical separation** (in addition to the general 1-meter horizontal separation) is recommended between the BSRs operating in the upper frequency and the BSRs operating in the lower frequency.

5.9.5. Dual Antenna Receive Diversity

For specific BSR models (refer to the *ASWipLL System Description* book), two antennas (integrated or external) are provided for antenna receive diversity at the ASWipLL Base Station. This allows the BSR to select the antenna providing the best RF reception to receive the signal.

For BSR models without integrated antennas, dual diversity is provided by the existence of two N-type connectors for attaching two external antennas.



Notes:

- 1) The BSR with two antennas transmits using only one of the antennas (factory selected).
 - 2) Antennas must be orientated to cover the same area/cell (i.e. subscriber sites), from only a slightly different location.
-
-



Part I

Base Station Installation

Part I describes the procedures for installing the ASWipLL devices located at the Base Station, and includes the following chapters:

- Chapter 6, “Basic Design of Devices”
- Chapter 7, “Mounting the Devices”
- Chapter 8, “Network Cabling”
- Chapter 9, “Serial Cabling”
- Chapter 10, “Connecting Third-Party External Antennas”
- Chapter 11, “Power Cabling”

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Basic Design of Devices

This chapter describes the basic design of the ASWipLL devices that can be installed at a Base Station:

- BSR
- BSDU
- GPS
- BSPS

6.1. BSR

The BSR is an encased outdoor radio providing access to the BSR's communication ports on its front panel. The BSR's bottom panel provides holes for mounting.

6.1.1. Models

The BSR is available in the following basic physical designs:

- BSR with a built-in (integral), internal antenna
- BSR with an N-type port for connecting an optional third-party external antenna
- BSR with two N-type ports for connecting two optional third-party external antennas for dual antenna diversity

**Notes:**

- 1) BSR device with an N-type port(s) for attaching a third-party external antenna(s) do not provide a built-in antenna.
- 2) The BSR installation procedures described in this guide apply to all BSR models, except the procedures for attaching third-party external antennas (which apply only to BSR models providing N-type ports).

6.1.2. Physical Dimensions

The BSR's physical dimensions are described in the table below.

Table 6-1: BSR physical dimensions

Parameter	Value	Comment
Height	400 mm (15.74 inches)	The BSR's physical dimensions exclude the mounting kit
Width	317 mm (12.48 inches)	
Depth	65.5 mm (2.58 inches)	
Weight	4.7 kg	

6.1.3. Ports

The BSR provides ports on its front panel, as displayed below:

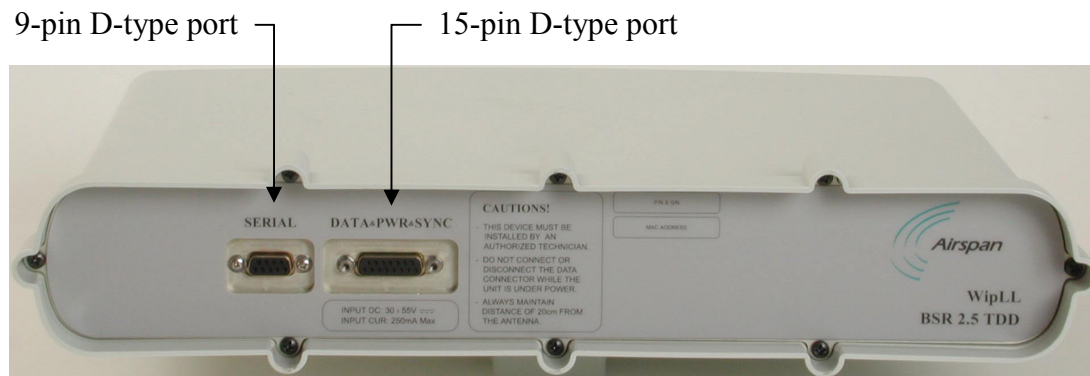


Figure 6-1: BSR front panel (built-in antenna model)



Note: BSR models that use third-party external antennas provide an N-type female receptacle for attaching an external antenna. In addition, specific BSR models (refer to the *ASWipLL System Description* book) provide two N-type receptacles for dual antenna receive diversity.

The table below describes the BSR ports.

Table 6-2: BSR ports

Port	Interface
15-pin D-type	<ul style="list-style-type: none"> Ethernet (10BaseT): with the BSDU (or SDA) Synchronization (controlled by BSDU) -48 VDC power: supplied by BSDU (or SDA)
9-pin D-type	Serial (RS-232): for local initial configuration (using WipConfig tool)
N-type	(Depends on model). For attaching third-party external antennas. Specific BSR models (refer to the <i>ASWipLL System Description</i> book) provide two N-type receptacles for dual antenna receive diversity. BSR models with built-in antennas do not provide N-type ports.

6.2. BSDU

The BSDU is an Ethernet switch encased in a chassis providing access to the BSDU's communication ports on the front and rear panels. The BSDU is installed in a standard 19-inch rack.

6.2.1. Physical Dimensions

The BSDU's physical dimensions are described in the table below.

Table 6-3: BSDU physical dimensions

Parameter	Value
Height	43.2 mm (1.7 inches)
Width	482.6 mm (19 inches)
Depth	228.6 mm (9 inches)
Weight	2.9 kg

6.2.2. Ports

The BSDU provides ports on the front and rear panels, as displayed below.

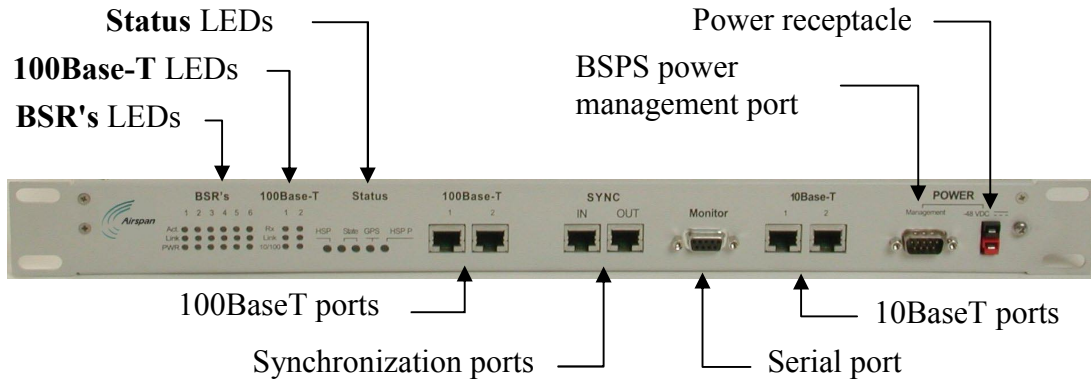


Figure 6-2: BSDU front panel

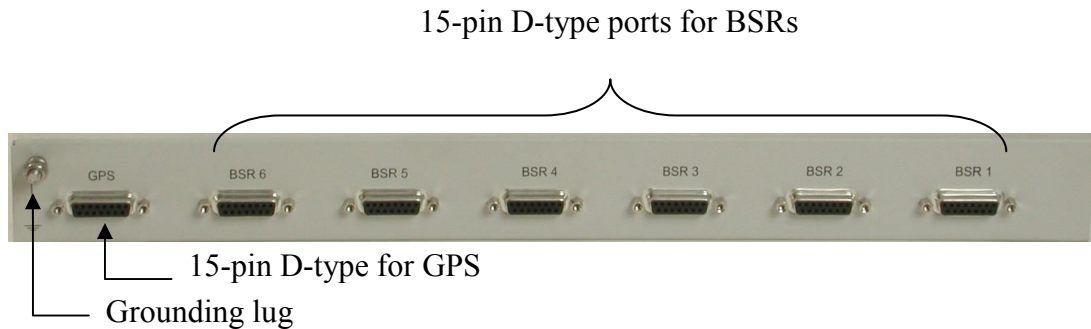


Figure 6-3: BSDU rear panel

The table below describes the BSDU's ports on the front and rear panels.

Table 6-4: Description of BSDU ports

Panel	Label	Port	Interface
Front	100Base-T	RJ-45 (two)	100BaseT interface with provider's backbone (WAN), and for BSDU and BSRs management interface (if 10Base-T ports are looped)
	SYNC	RJ-45 (two)	Synchronization between BSDUs
	Monitor	9-pin D-type female	BSDU serial interface
	10Base-T	RJ-45 (two)	BSDU management (port #2) and management

Panel	Label	Port	Interface
			to BSRs connected to BSDU (port #1)
	Management	9-pin D-type male	Base Station Power System (BSPS) remote management interface using WipManage
	48 VDC	Power receptacle	Connecting DC power supply from, e.g. BSPS
Rear	GPS	15-pin D-type	Global Positioning System (GPS)-based synchronization
	BSR	15-pin D-type (six)	DC power, Ethernet, and synchronization interfaces with BSRs

Note: A 5-mm diameter-grounding lug is present on the rear panel for grounding the BSDU.

6.2.3. LED Indicators

The BSDU provides various LED indicators located on the BSDU's front panel (see Figure 6-2). These LEDs are grouped under the following labels:

- **BSR's**
- **100Base-T**
- **Status**

6.2.3.1. BSR's LEDs

The **BSR's** LED indicators provide three LEDs for each of the six BSR ports. These LEDs are described in Table 6-5.

Table 6-5: BSR's LED description

LED	Color	Status	Meaning
Act	Yellow	On	Ethernet activity is detected on the BSR port
		Off	No Ethernet activity detected on the BSR port
Link	Yellow	On	Physical link exists between the BSDU and BSR
		Off	No physical link exists between the BSDU and BSR
PWR	Yellow	On	Power is supplied to the BSDU's BSR port
		Off	No power is available, or the BSDU's BSR port is disabled by software, or port failure has occurred

6.2.3.2. 100Base-T LEDs

The **100Base-T** LED indicators provide three LEDs for each of the two 100Base-T ports. These LEDs are described in Table 6-6.

Table 6-6: 100Base-T LED Description

LED	Color	Status	Meaning
Rx	Yellow	On	Data is received through the 100Base-T port
		Off	No data is received through the 100Base-T port
Link	Yellow	On	Viable physical link between the 100Base-T port and the external device to which this port connects
		Off	No physical link between the 100Base-T port and the external device to which this port connects
10/100	Yellow	On	Power is supplied to the 100Base-T port
		Off	No power at the 100Base-T port

6.2.3.3. Status LEDs

The **Status** LEDs indicate various synchronization and GPS functioning, as described in the table below.

Table 6-7: Status LED Description

LED	Color	Status	Meaning
HSP (Hop Synchronization Process)	Green	On	BSDU synchronization process is active
State (two LEDs)	Green	Only right LED is on	Synchronization process is starting
		Both LEDs are on	BSDU is the master unit
		Only left LED is on	BSDU is a slave unit
		Both LEDs are off	BSDU synchronization pulse lost (i.e. no synchronization)
GPS	Green	On	GPS antenna is connected to the BSDU
		Blinking	Receiving a satellite signal via GPS
HSP P (Hop Synchronization Process Pulse)	Green	On	Change state for the HSP pulse

6.3. GPS

The third-party GPS antenna is a rugged, self-contained GPS receiver and antenna. The GPS connects to the BSDU, providing satellite clock signals for synchronizing between multiple BSDUs and between multiple Base Stations that implement frequency hopping for wireless communication.

6.3.1. Physical Dimensions

The GPS physical dimensions are described in the following table.

Table 6-8: GPS physical dimensions

Parameter	Description
Diameter	4.5" (115 mm)
Height	3.6" (90 mm)
Weight	0.454 kg (2 lb)

6.3.2. Ports

The GPS provides a 12-pin male contacts for connecting a cable between it and the BSDU.



Figure 6-4: GPS antenna – side view

6.4. BSPS

For a detailed description of the BSPS, see Appendix B, "Installing the BSPS".



Mounting the Devices

This chapter describes the mounting procedures for the following devices:

- BSR
- BSDU
- BSPS

7.1. Pole Mounting BSR

The BSR is typically mounted outside on a pole, but it can also be mounted outside on a wall. Pole mounting allows the BSR to be easily adjusted in the horizontal (azimuth) and vertical (elevation) planes for antenna alignment.



Warning: The BSR device is an outdoor radio unit, and therefore, must only be mounted outside.



Note: In the standard BSR kit, Airspan does not supply wall-mounting brackets. To order wall-mounting brackets, contact your Airspan representative. BSR wall mounting is identical to SPR wall mounting (see Part II, Chapter 13, "Mounting the Devices").

The BSR is mounted using the mounting holes located on the BSR's bottom panel (see Figure 7-1) and the supplied pole-mounting brackets. The pole-mounting bracket is designed to support the BSR on a round pole of 45 mm in diameter.

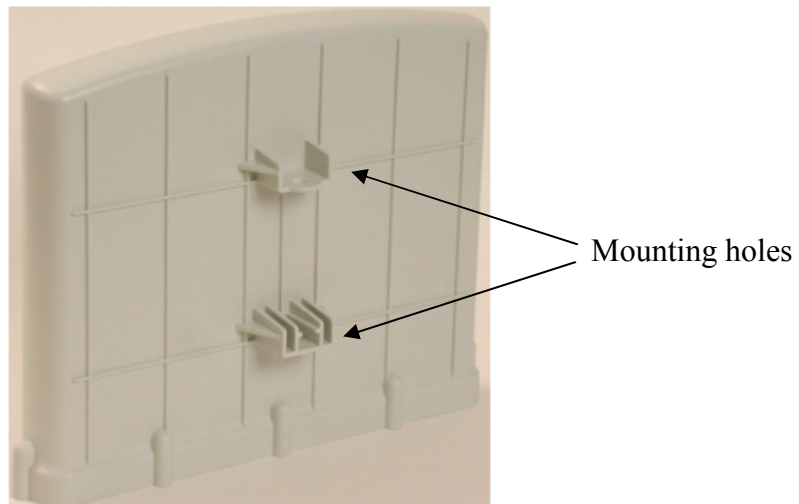


Figure 7-1: Mounting holes on BSR bottom panel

To prevent radio interference, each BSR requires a minimum of 1-metre horizontal separation between adjacent BSRs (see Figure 7-2).

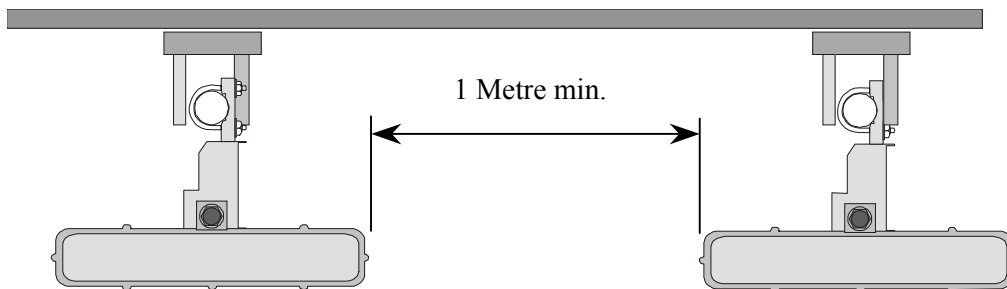


Figure 7-2: Minimum separation between mounted BSRs



Warning: To avoid RF interference between BSRs operating in the **700 MHz** where four BSRs are installed at a Base Station (and in addition to 1-meter horizontal separation), a minimum 1-meter **vertical** separation must be provided between the two pairs of BSR antennas: one pair operating in the lower frequencies (i.e. 711.5 and 714.5 for 1 Msps mode; 712 and 714 for 1.33 Msps mode) and the other pair operating in the upper frequencies (i.e. 741.5 and 744.5 for 1 Msps mode; 742 and 744 for 1.33 Msps mode).

A summary of the BSR pole-mounting procedure is displayed below.

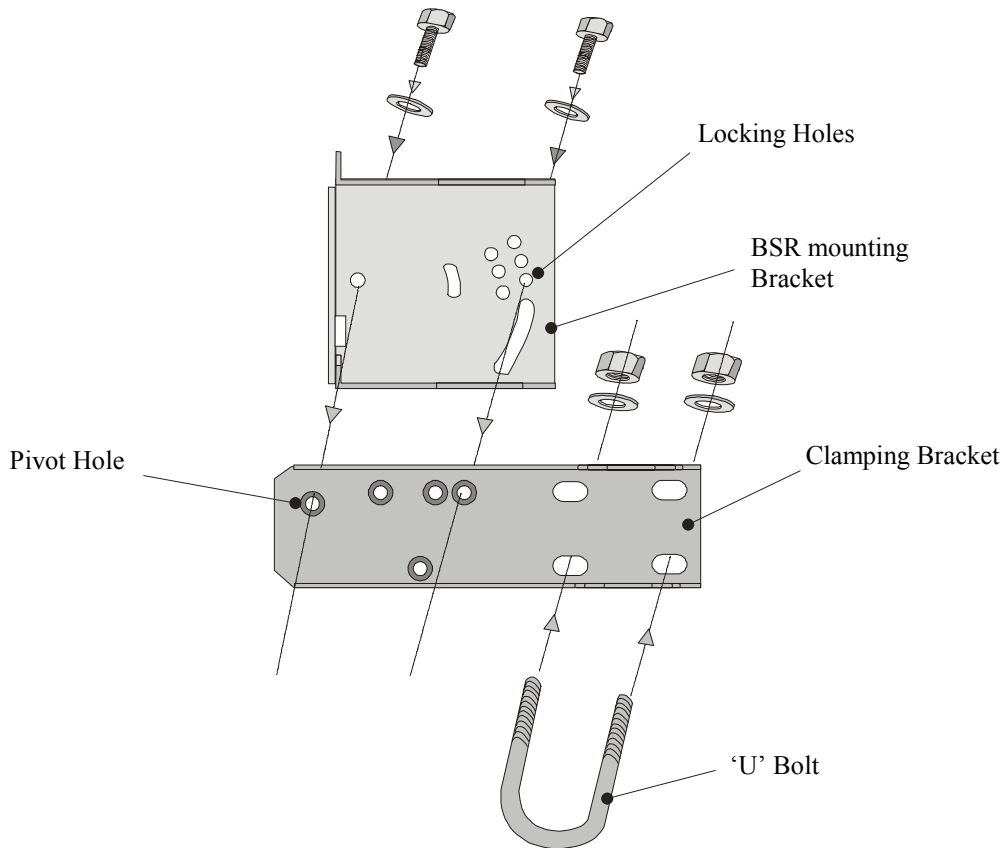


Figure 7-3: Attaching BSR pole-mounting brackets

To pole mount the BSR:

1. Attach the mounting bracket to the BSR:
 - a. Align the mounting bracket with the BSR's mounting holes so that the mounting bracket's side with the built-in nut is aligned with the BSR's mounting holes furthest from the BSR's front panel, as shown in the figure below.

- b. Slide an M10-flat washer and M10-spring lock washer onto an M10-hex head screw (ensure spring lock washer is closest to the bolt's head). From the external side, insert the M10-hex head screw through the mounting bracket and BSR's mounting holes. Fasten the M10-hex head screw (one is provided with a built-in nut while the other requires you to insert an M10-hex nut into the BSR's mounting hole).

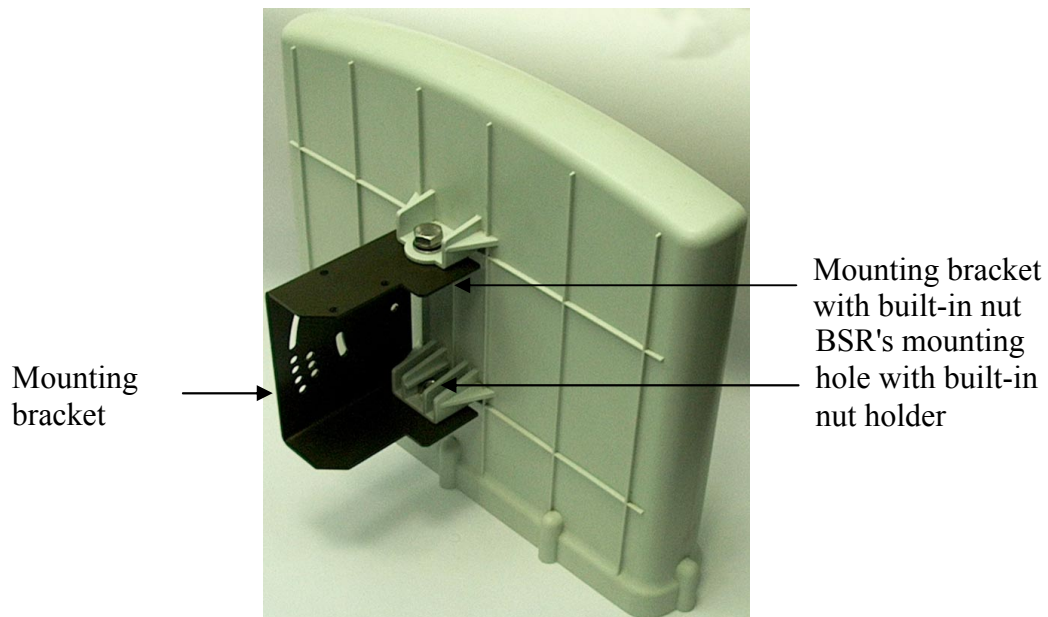


Figure 7-4: Mounting bracket connected to BSR

2. Attach the clamping bracket to the mounting bracket:
 - a. Slide an M6-spring lock washer onto an M6-hex head screw. Align the mounting bracket's and clamping bracket's pivot holes, such that the clamping bracket is aligned to the inside of the mounting bracket. From the external side of the mounting bracket, insert the M6-hex head screw into the pivot holes and then fasten, but not tightly. (The clamping bracket provides a built-in nut.)

- b. Choose an elevation hole on the mounting bracket and then align it with the corresponding hole on the clamping bracket. Slide an M6-spring lock washer onto an M6-hex head screw, and then from the external side of the mounting bracket, insert the M6-hex head screw through the elevation hole on the mounting bracket and into the clamping bracket's corresponding hole. Fasten but not tightly the M6-hex head screw (the clamping bracket provides built-in nut). The elevation hole can later be changed according to desired antenna orientation in the elevation plane.

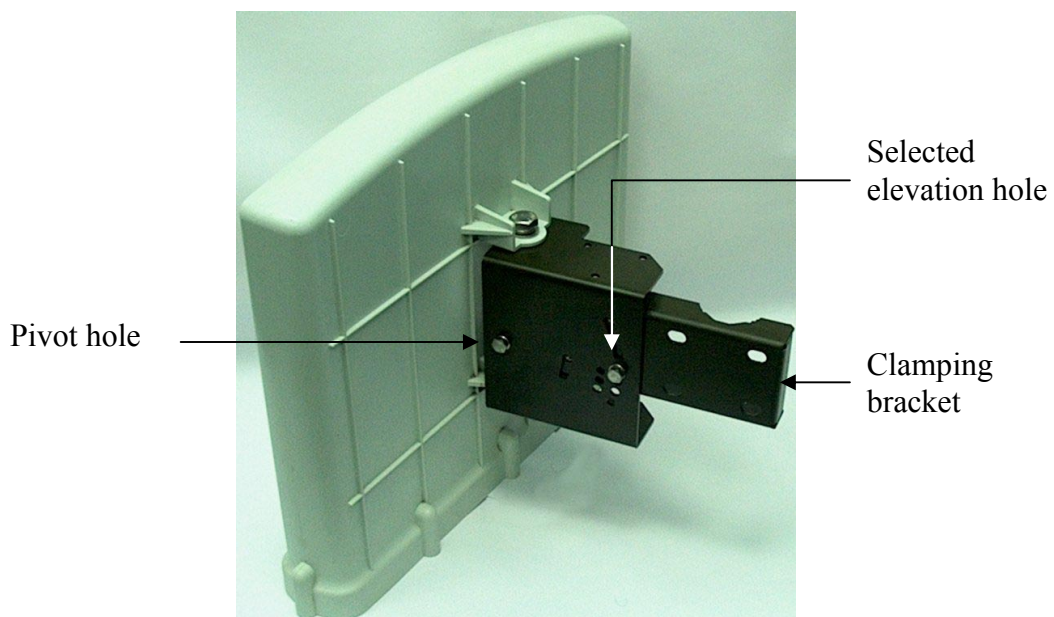


Figure 7-5: Clamping bracket attached to mounting bracket

3. Attach the U-bolt to the pole:
 - a. Place one U-bolt around the pole, and then insert the U-bolt screw side through the two corresponding holes (horizontally parallel) on the clamping bracket. Slide an M8-flat washer and M8-spring lock washer onto each U-bolt screw side (ensure that the flat washer is adjacent to the clamping bracket). Fasten each U-bolt side with the two M8-hex nuts.
 - b. Attach the second U-bolt as described above.

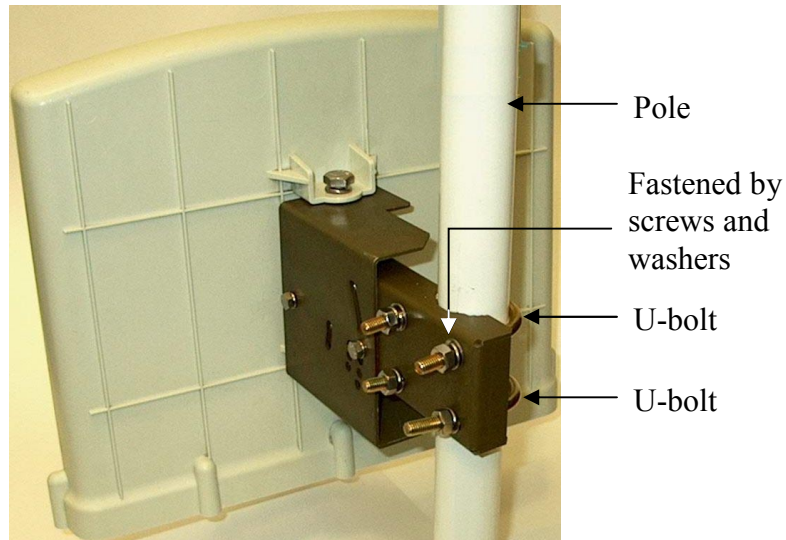


Figure 7-6: Attaching BSR to pole using U-bolts

4. Perform final BSR orientation:
 - a. Adjust the **vertical** position of the BSR by choosing a final elevation hole as described in Step 2. Lock the BSR at the desired position by inserting the locking bolt in the desired position and fastening it tightly. Fasten tightly the bolt in the pivot hole. See Figure 7-8 for a description of the angles (in degrees) of each elevation hole.
 - b. Adjust the **horizontal** position of the BSR by rotating the BSR about the pole, and then tightening the nuts of the U-bolts.

BSR positioning is obtained in two planes by adjustment of the mounting bracket assembly as shown in Figure 7-7.

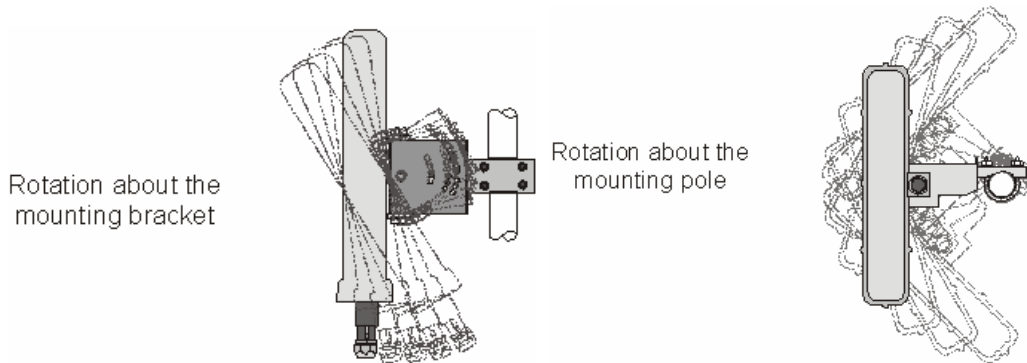


Figure 7-7: BSR orientation in vertical (top figure) and horizontal plane (lower figure)



Note: A thread-locking compound is to be used to prevent the bolts working loose.

The figure below displays the possible angles of elevation. As shown, the BSR pole-mounting bracket allows elevation between -18.5° and 26.3° .

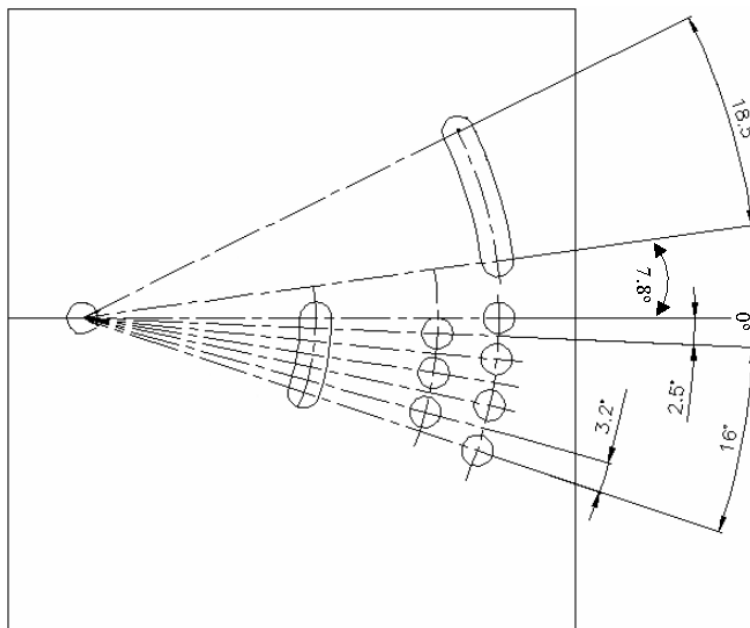


Figure 7-8: Orientating BSR in the elevation plane (side view of BSR)



Note: It is important to provide strain relief and drip loop for Cat-5 cables. Create a drip loop and strain relief using cable tie, to tie cable to pole, as displayed in the figure below.

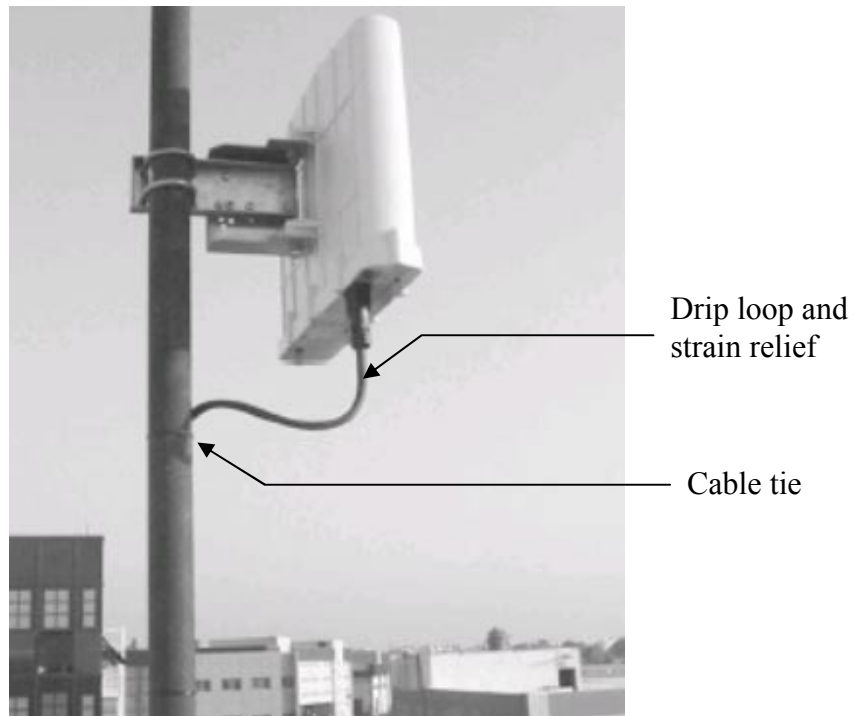


Figure 7-9: Pole-mounted BSR with cable drip loop and strain relief

7.2. Rack Mounting BSDU

The BSDU is designed for mounting in a standard 19-inch (48.3 cm) equipment rack or telco rack with 1-rack unit (1-U) of vertical rack space. The sides of the BSDU chassis provide integrated front-rail mounting brackets. Therefore, all that is required for mounting the BSDU is to attach the BSDU front-rail mounting brackets to the rack's mounting rails using the supplied four M5-mounting screws and plastic cup washers.

To rack-mount the BSDU:

1. Determine the rack rail holes (left and right side) that will be used for attaching the chassis.
2. Insert four nuts into the rack's rail holes you designated in Step 1. These nuts are housed in Tinnerman clips, which allow you to fasten them into the rail holes. To insert the Tinnerman clips, hold the clips, squeeze them, and then insert them into the rail hole.
3. Carefully insert the BSDU into the rack, aligning the BSDU's mounting bracket holes with the rack rail holes.
4. Insert the M5-mounting screws, with plastic washers, into the BSDU mounting bracket holes, on each side, as shown in Figure 7-10. In this way, the chassis is supported until you tighten the chassis screws.
5. Tighten the M5-mounting screws to fasten the chassis to the cabinet.

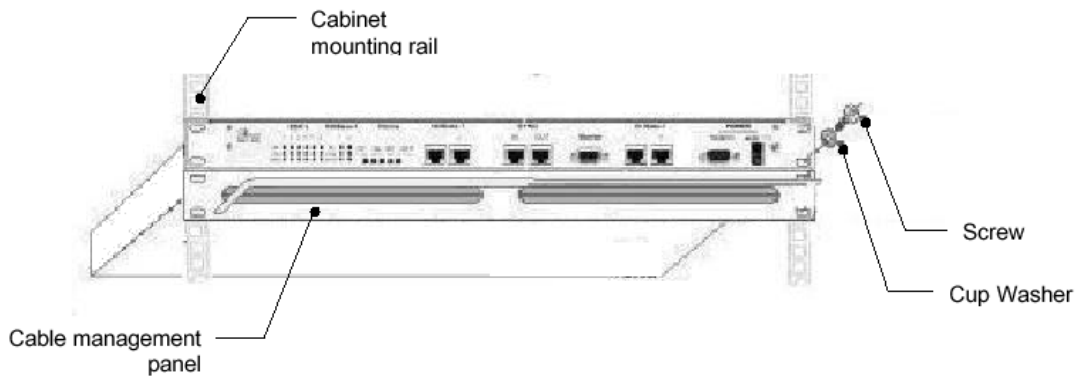


Figure 7-10: BSDU rack mounting



Note: When mounting multiple BSDUs in a cabinet, vertical spacing (above and below) is required for feeding cables to the rear.

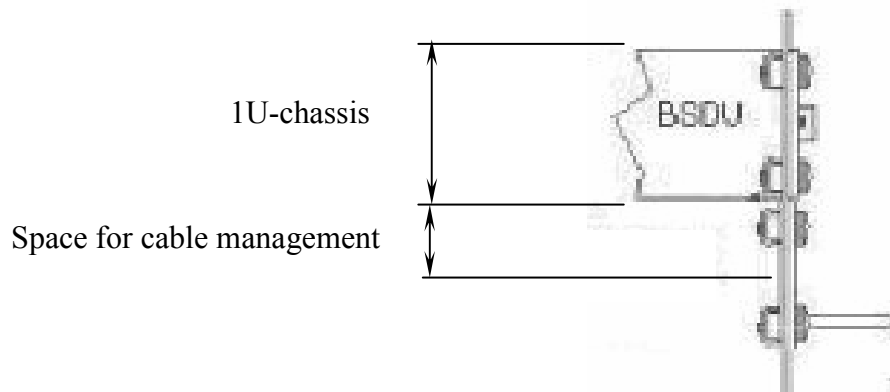


Figure 7-11: BSDU and vertical space for cables

7.3. Mounting BSPS (Optional)

The BSPS is supplied pre-mounted in a standard 19" x 11U rack, providing available space for additional equipment (i.e. BSDUs, which require 1U each). Thus, no mounting procedures are required.



Connecting Third-Party External Antennas

This chapter describes the procedures for connecting third-party external radio and Global Positioning System (GPS) antennas to the BSR and BSDU, respectively. The implementation of these antennas depends on the BSR model (with respect to radio antennas) and the need for synchronization of the ASWipLL system (with respect to GPS antennas).

10.1. Connecting Radio Antennas to BSR

The BSR model without an integrated antenna provides an N-type port(s) for connecting a third-party external antenna(s). Specific BSR models (refer to the *ASWipLL System Description*) provide two N-type connectors for connecting two third-party external antennas. Two antennas provide dual-antenna diversity, whereby data is transmitted using only the main antenna, while data is received by the antenna (main or secondary) with the best radio frequency (RF) reception.



Notes:

- 1) BSR models that provide N-type connectors for attaching a third-party external antenna do not contain an internal, built-in antenna.
 - 2) Refer to the *ASWipLL System Description* for a list of BSR models implementing third-party external antennas.
-
-

The following lists the BSR-to-third party external antenna cable setup:

- **Cable** (third party): RF coaxial
- **Connector** (third party): N-type male

The usage of N-type ports for BSR models with two N-type ports:

- If you are using only one antenna, connect the antenna to the N-type port labeled **Primary**.
- If you are using two antennas, connect the secondary antenna to the N-type port labeled **Secondary**.



Warnings:

- 1) Before connecting the external antenna, ensure that the BSR is **not** connected to the power source.
 - 2) Before powering on the BSR, ensure that some type of equipment such as an antenna or an RF attenuator is connected to the N-type port. This eliminates the risk of damaging the BSR device.
-



Warning: It is the responsibility of the person installing the ASWipLL system to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), that only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance with FCC rules CFR47 part 15.204. The installer should configure the output power level of antennas according to country regulations and per antenna type.



Warning: For ASWipLL 700 (i.e. 700 MHz band), where four BSRs are installed at a Base Station, a 1-meter separation must be provided between the antennas of the BSRs operating in the lower frequencies (i.e. 711.5 and 714.5 for 1 Msps mode; and 712 and 714 for 1.33 Msps mode) and the antennas of the BSRs operating in the upper frequencies (i.e. 741.5 and 744.5 for 1 Msps mode; and 742 and 744 for 1.33 Msps mode).



Warning: In accordance with FCC regulations, ensure that when operating in unlicensed bands, the external antennas provide a maximum EIRP of 36 dBm to prevent interference with other radios operating in the unlicensed band. The EIRP is defined as:**Max. Power Output + Antenna Gain + Cable Loss \leq 36 dBm (EIRP)**



Note: It is recommended that the same antenna polarization (i.e. horizontal/vertical) exists at both ends of the link (i.e. Base Station and subscriber site).

To connect the BSR to a third-party external antenna:

- Connect the third-party **N-type male** connector, at the end of the RF cable, to the N-type port located on the BSR's front panel, as displayed in Figure 10-1.

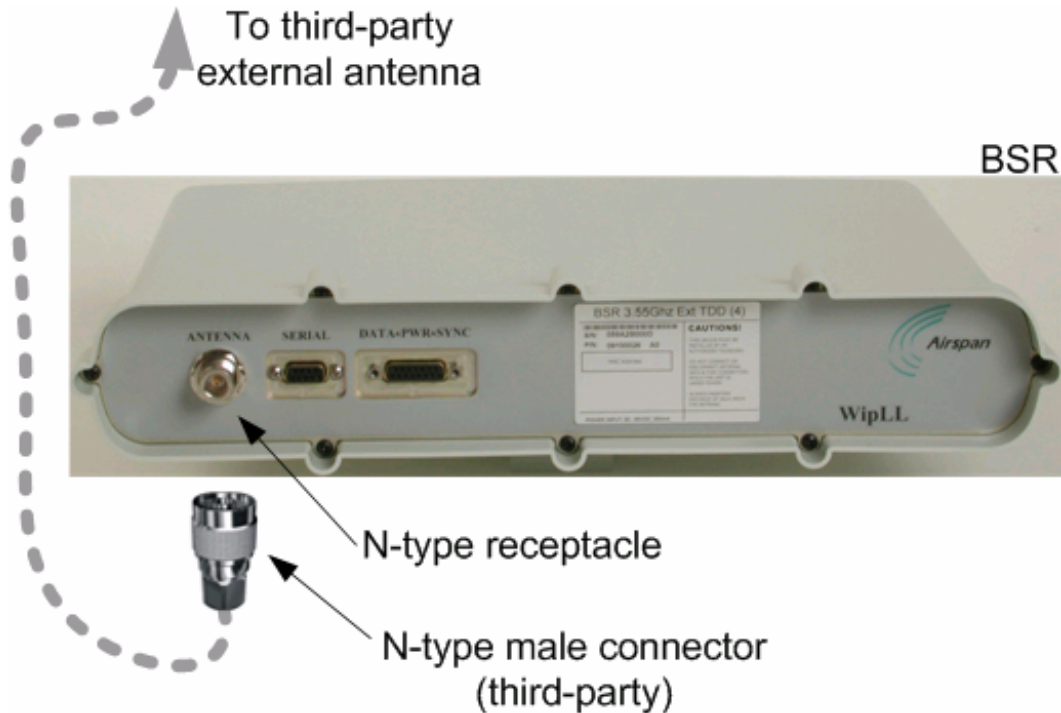
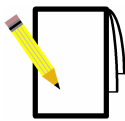


Figure 10-1: Attaching third-party external antenna

**Notes:**

- 1) For crimping RF coaxial cables to N-type connectors, see Appendix C, "Cable Crimping".
- 2) Ensure that the third-party antenna cable is of sufficient quality to reduce or eliminate loss when operating in the required frequency band. (Airspan does not supply cables for external antennas.)

10.2. Connecting GPS Antenna to BSDU

The following subsections describe connecting the GPS to a BSDU.



Note: A GPS is required for synchronizing between multiple Base Stations that implement frequency hopping for wireless communication.

10.2.1. Mounting the GPS

Depending on individual customer requirements and environmental influences there are several available options for mounting the GPS:

■ **Pole Mounting:**

The GPS may be mounted to a pole similar to that used to mount the BSR (See Chapter 7, "Mounting the Devices").

■ **Mounting Plate:**

The GPS may be mounted to a wall or roof top structure using a purpose-made mounting plate supplied with the unit.

■ **Direct Mounting:**

The unit may be mounted directly to a suitable structure that has been provided with holes suited to the GPS mounting details.

■ **Magnetic Mounting:**

An optional magnetic mounting device is available to allow GPS mounting to a suitable surface, e.g. vehicle roof or steel building structure. This device is attached by means of the threaded holes provided in the base of the GPS.



Note: When mounting the GPS on a metal pole that is in physical contact with the ground, the GPS will not synchronize. To enable synchronization, you need to isolate the GPS from the pole using isolation material.

10.2.2. Connecting the GPS

The GPS antenna connects to the BSDU's 15-pin D-type port, labeled **GPS**, located on the BSDU's rear panel, as shown below.



Figure 10-2: BSDU rear panel showing GPS port



Warning: To avoid electrical or fire hazard, ensure that the connection to the GPS is made prior to connecting the BSDU to the power supply.



Note: Airspan supplies unterminated cables for connecting the GPS to the BSDU. For an explanation on cable crimping, see Appendix C, "Cable Crimping".

The GPS-to-BSDU cable setup is as follows:

- **Cable:** multipair overall shielded (22 AWG)
- **Connectors:**
 - **GPS side:** 12-pin female (Deutsch MMP26C-2212S1)
 - **BSDU side:** 15-pin D-type male

- **Connector pinouts:** The GPS connector receptacle contains 12 male contacts, as displayed in Figure 10-3.

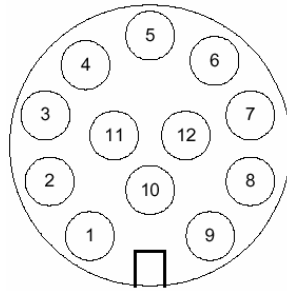


Figure 10-3: GPS connector pinouts

The connector pinouts for the GPS-to-BSDU cabling are described in the table below.

Table 10-1: Connector pinouts for BSDU-to-GPS cabling

Multipair overall shielded (22 AWG) cable				
GPS			BSDU	
12-pin female			15-pin D-type male	
Pin	Pin name	Cable color	Pin	Lead
1	POWER	Red	9	
2	RX_DATA_1-	Blue	5	TD+ (after R5)
3	RX_DATA_1+	Black	6	TD-
4	TX_DATA_1-	Yellow	4	RD-
5	TX_DATA_1+	Black	3	RD+ (after R3)
6	RX_DATA_2-	Brown	x	
7	RX_DATA_2+	Black	x	
9	GND	Black	10	
11	1PPS+	Green	8	1PPS-
12	1PPS-	Black	7	1PPS+ (After R7)

To connect the GPS antenna to the BSDU (see Figure 10-4):

1. Connect the **12-pin female** connector, at one end of the cable, to the 12-pin receptacle located on the underside of the GPS.
2. Connect the **15-pin D-type male** connector, at the other end of the cable, to the 15-pin D-type port labeled **GPS** located on the rear panel of the BSDU.

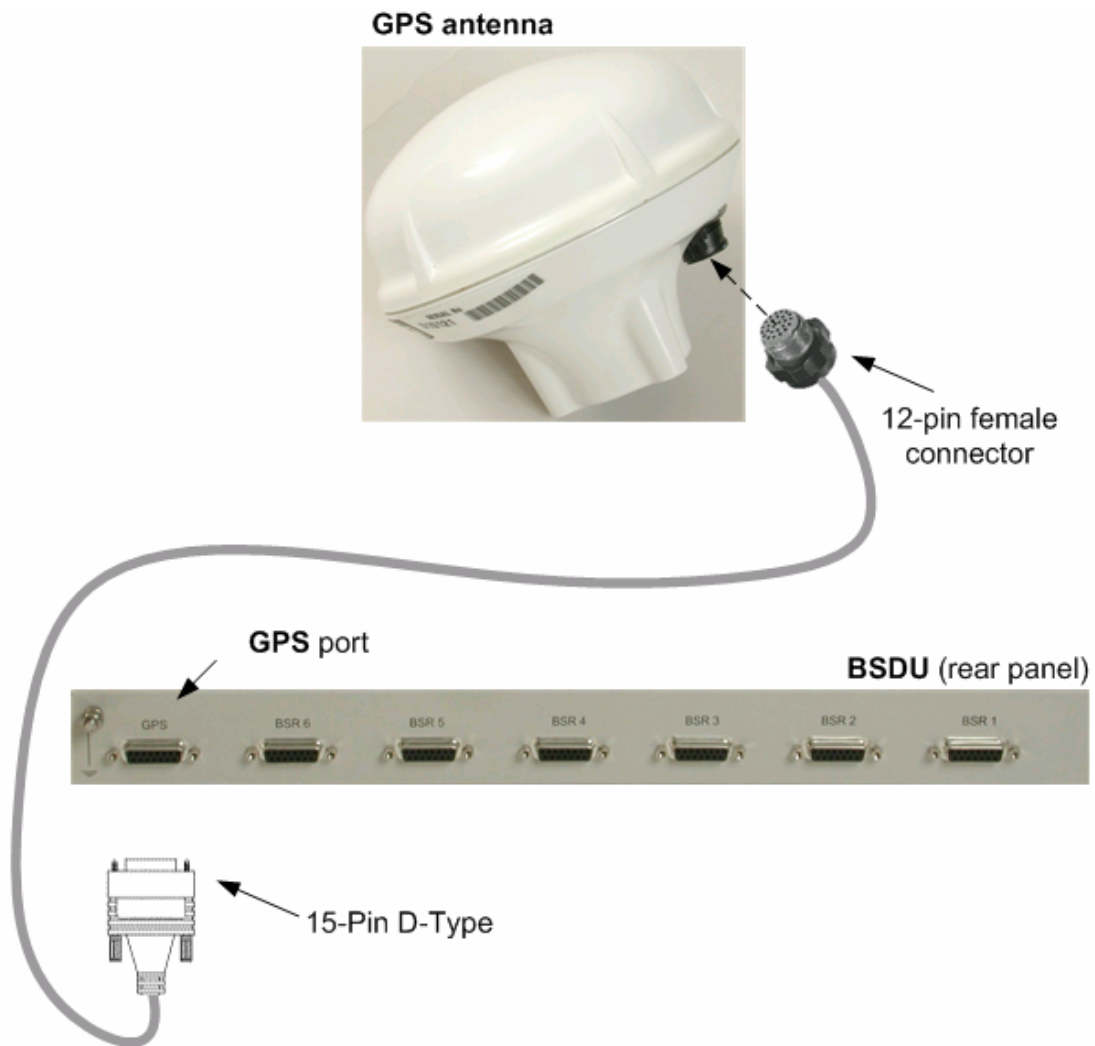


Figure 10-4: GPS-to-BSDU cable connections



Notes:

- 1) When installing the cable, secure the cable to the mounting pole or bracket with a cable tie to hold the weight of the cable (i.e. cable strain relief).
 - 2) A loop should be left in the dressed cable for maintenance purposes and to prevent the cable weight being taken directly on the connector itself.
 - 3) Ensure that the connector is waterproof.
-
-



Basic Design of Devices

This chapter describes the basic design of the ASWipLL devices installed at a subscriber site when an SPR is implemented:

- SPR
- SDA
- RSS LED Adapter

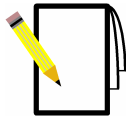
12.1. SPR

The SPR is an encased outdoor radio providing access to the SPR's communication ports on its front panel. The SPR's bottom panel provides holes for mounting.

12.1.1. Models

The SPR is available in the following basic physical designs:

- SPR with built-in antenna:
- SPR with an N-type port for attaching a third-party external antenna.



Notes:

- 1) SPR devices with N-type ports for attaching third-party external antennas do not provide built-in antennas.
 - 2) The SPR installation procedures described in this guide apply to all SPR models, except the procedures for attaching third-party external antennas (which apply only to SPR models providing an N-type port).
-
-

12.1.2. Physical Dimensions

The SPR's physical dimensions are described in the following table.

Table 12-1: SPR physical dimensions

Parameter	SPR model		Comment
	Standard-Gain / External Antenna	High Gain Antenna	
Height	311 mm (12.24 inches)	400 mm (15.74 inches)	The SPR's physical dimensions exclude the mounting kit.
Width	224 mm (8.82 inches)	317 mm (12.48 inches)	
Depth	65.5 mm (2.58 inches)	65.5 mm (2.58 inches)	
Weight	2.5 kg	4.7 kg	

12.1.3. Ports

The SPR provides a communication port (15-pin D-type) on the front panel (see figure below).



Figure 12-1: SPR (with built-in antenna)



Notes:

- 1) SPR models without built-in antennas provide an N-type port for connecting a third-party external antenna.
- 2) Previous SPR models provide a 9-pin D-type port for serial interface.

12.2. SDA

The SDA is an encased device that interfaces with the SPR.

12.2.1. Physical Dimensions

The SDA's physical dimensions are described in the table below.

Table 12-2: SDA physical dimensions

SDA	Dimension (H x W x D)	Weight
-----	-----------------------	--------

SDA-4S, SDA-4H, SDA-1, SDA-1/DC	200 mm (7.87 inches) x 150 mm (5.9 inches) x 40 mm (1.57 inches)	0.53 kg
SDA-1 Type II	72 x 42.5 x 26 mm (2.83 x 1.67 x 1.02 inches)	0.159 kg

12.2.2. Ports

The SDA provides access to communication ports on the front panel. The type and number of subscriber network ports depend on the SDA model, as described in the following table.

Table 12-3: Subscriber network ports per SDA model

SDA model	RJ-45 ports	Speed
SDA-4S models (SDA-4S; SDA-4S/DC; SDA-4S/VL; SDA-4S/Vltag; SDA-4S/1H3L; SDA-4S/VL/1H3L)	4	10/100BaseT (support Autonegotiation, and MDI/MDI-X automatic crossover, allowing connection of straight-through or crossover cables)
SDA-4H	4	10BaseT
SDA-1	1	10BaseT
SDA-1/DC	1	10BaseT
SDA-1 Type II	1	10/100BaseT

12.2.2.1. SDA-4S

The SDA-4S model and ports are shown in the figure below:

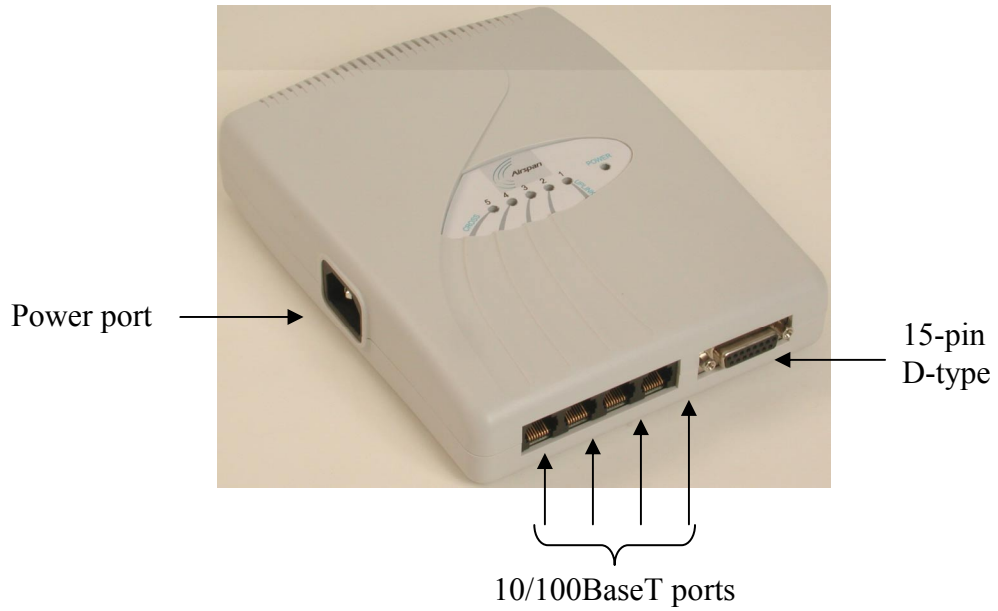


Figure 12-2: Ports of SDA-4S models

12.2.2.2. SDA-4H

The SDA-4H model and ports are shown in the figure below:

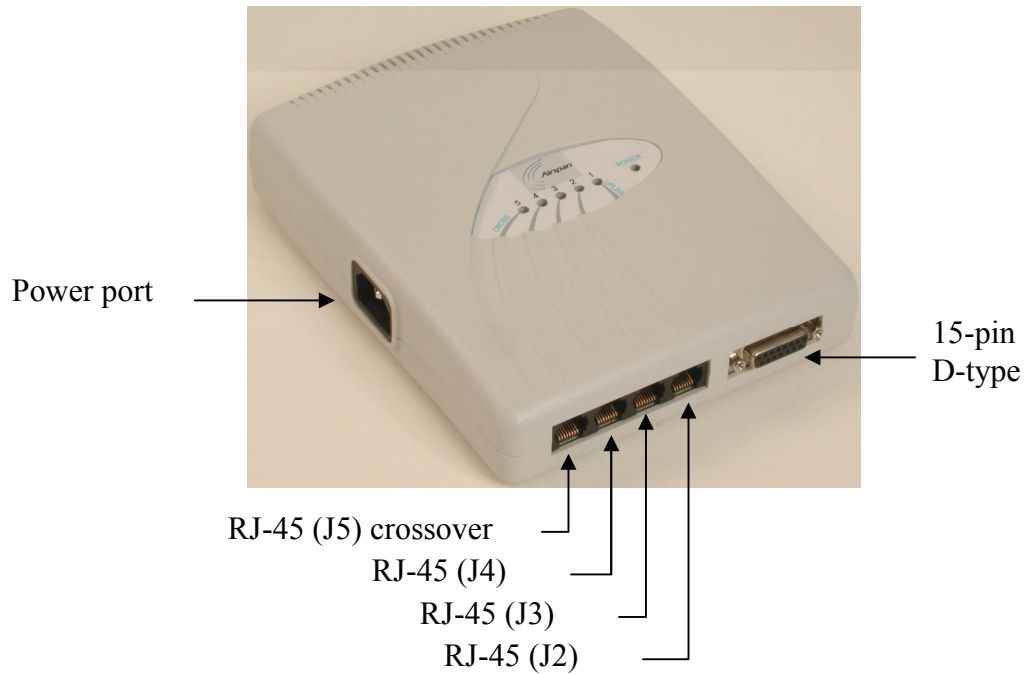


Figure 12-3: Ports of SDA-4H models

12.2.2.3. SDA-1

The SDA-1 model and ports are shown in the figure below:

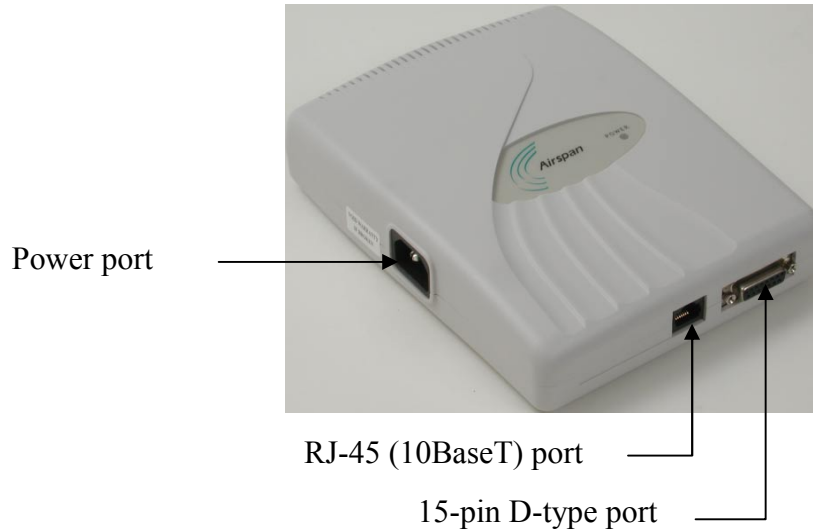


Figure 12-4: Ports of SDA-1 model

12.2.2.4. SDA-1/DC

The SDA-1/DC model and ports are shown in the figure below:

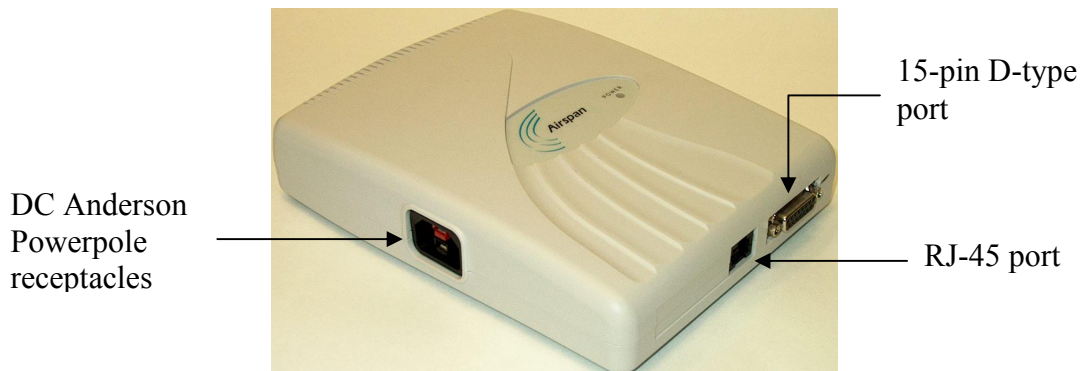


Figure 12-5: SDA-1/DC model

12.2.2.5. SDA-1 Type II

The SDA-1 Type II model and ports are shown in the figure below:

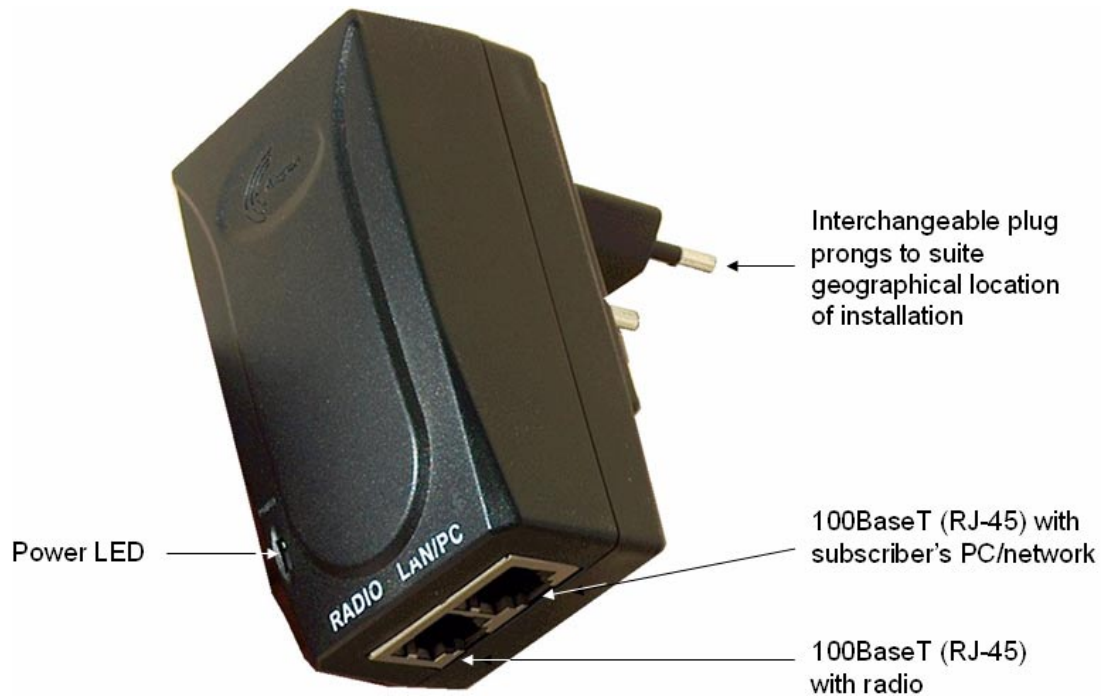


Figure 12-6: Ports and LED of SDA-1 Type II model

12.2.3. LED Indicators

The SDA models provide various LED indicators. These LEDs are located on the top panel of the SDA module.

12.2.3.1. SDA-4S

The figure below displays the location of the SDA-4S LED indicators.

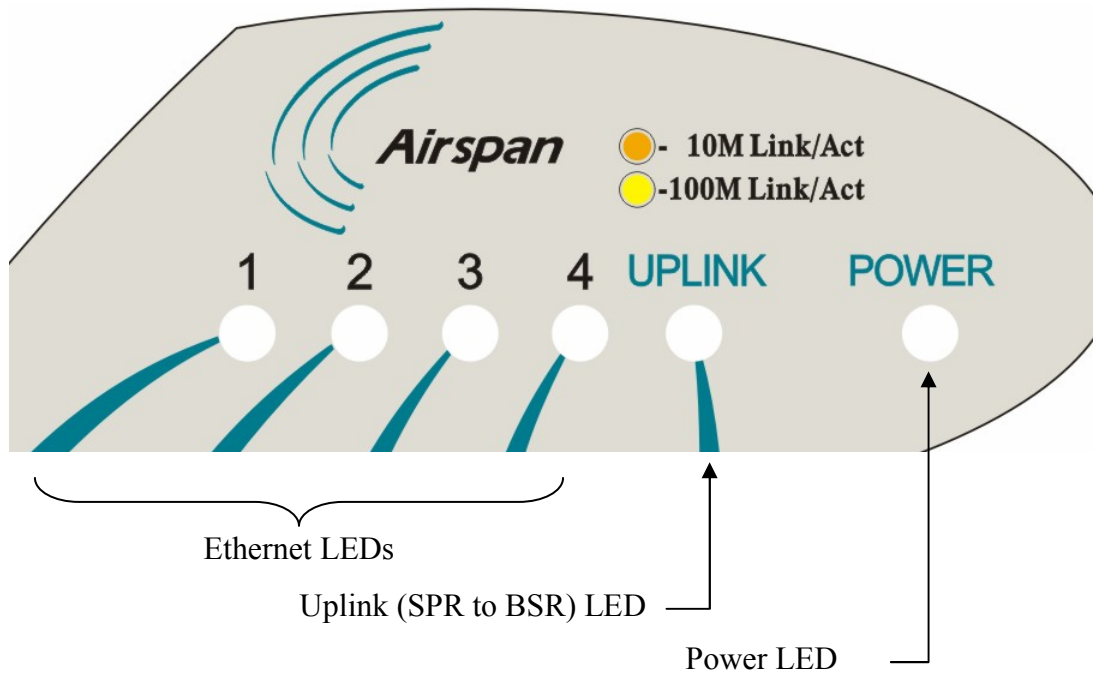


Figure 12-7: SDA-4S LED indicators

The table below describes the SDA-4S LED indicators.

Table 12-4: Description of the SDA-4S model's LED indicators

LED	Color	Status	Meaning
1	Orange	On	Physical link (10BaseT) between SDA-4S and SPR
		Blinking	Traffic flow between SDA-4S and SPR
		Off	No link between SDA-4S and SPR
2, 3, 4, and 5	Green	On	100BaseT physical link between SDA-4H and Ethernet network
		Blinking	100BaseT traffic flow between SDA-4H and Ethernet network
		Off	No traffic flow between SDA-4S and Ethernet network
	Orange	On	10BaseT physical link between SDA-4H and Ethernet network
		Blinking	10BaseT traffic flow between SDA-4H and Ethernet network
		Off	No traffic flow between SDA-4S and Ethernet network
POWER	Green	On	Power received by the SDA-4S model
		Off	No power received by SDA-4S model

12.2.3.2. SDA-4H

The figure below displays the location of the SDA-4H LED indicators.

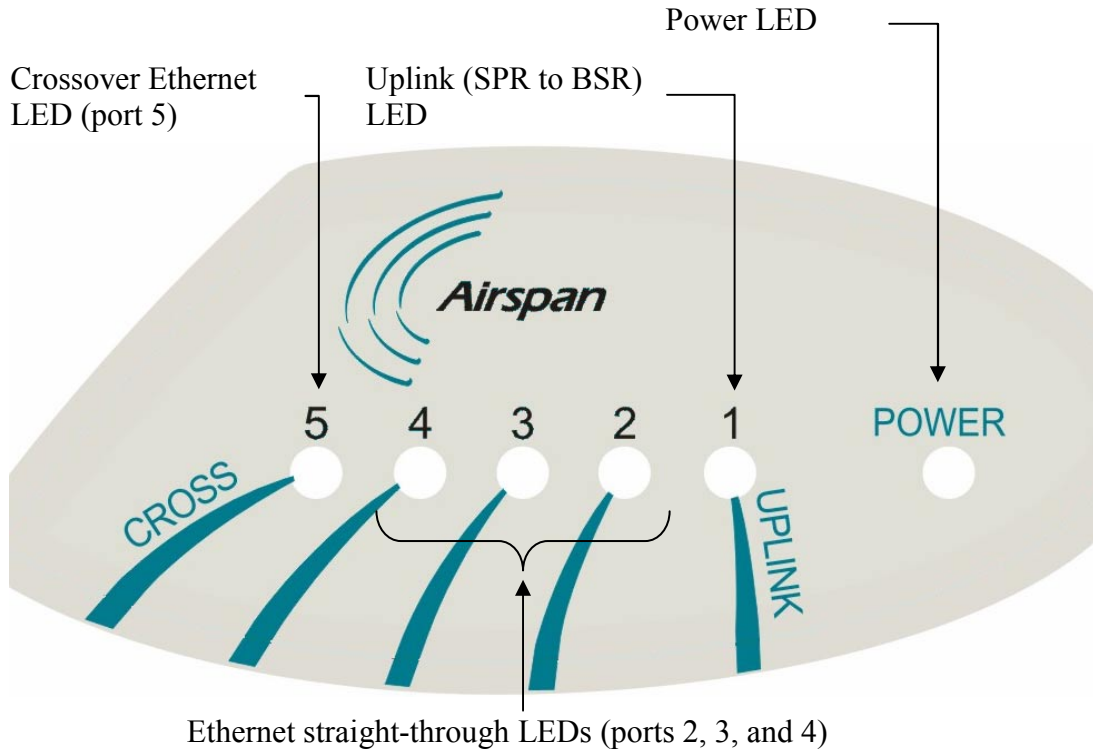


Figure 12-8: SDA-4H LED indicators

The table below describes the SDA-4H LED indicators.

Table 12-5: Description of the SDA-4H LED Indicators

LED	Color	Status	Meaning
1 (UPLINK)	Yellow	On	Physical link between SDA-4H and SPR
		Blinking	Traffic flow between SDA-4H and SPR
		Off	No link between SDA-4H and SPR
2, 3, and 4	Yellow	On	Physical link between SDA-4H and Ethernet network
		Blinking	Traffic flow between SDA-4H and Ethernet network
		Off	No link between SDA-4H and Ethernet network
5 (CROSS)	Yellow	On	Physical link between SDA-4H and crossover Ethernet port connection
		Blinking	Traffic flow between SDA-4H and crossover Ethernet port network
		Off	No link between SDA-4H and crossover Ethernet port connection
POWER	Green	On	Power received by the SDA-4H
		Off	No power received by SDA-4H

12.2.3.3. SDA-1, SDA-1/DC, SDA-1 Type II

The SDA-1, SDA-1/DC, and SDA-1 Type II models provide a single LED that indicates whether power is being received. The LED for the SDA-1 Type II also indicates correct port assignments for cabling.

Table 12-6: LED description for SDA-1, SDA-1/DC and SDA-1 Type II models

LED	Color	Status	Meaning
POWER	Green	On	Power received
		Off	No power received

12.3. RSS LED Adapter

The RSS LED adapter is an optional ASWipLL unit that measures received signal strength at the SPR.

12.3.1. Physical Dimensions

The following table lists the RSS LED Plug adapter dimensions:

Table 12-7: RSS LED adapter dimensions

Parameter	Dimensions
Height	123 mm (4.84 inches)
Width	68 mm (2.68 inches)
Depth	30 mm (1.18 inches)
Weight	85g

12.3.2. Ports

The RSS LED adapter provides two 15-pin D-type ports: male port for connecting to the SPR side; female port for connecting to the SDA side.

15-pin D-type male
(connects to SPR side)

15-pin D-type female
(connects to SDA side)



Figure 12-9: RSS LED adapter

12.3.3. LEDs

The table below describes the LEDs on the RSS LED adapter.

Table 12-8: LED description of the RSS LED adapter

LED	Color	Status	Description
Power	Red	On	SPR receives power from the SDA
		Off	No power supplied to the SPR by the SDA
		Blinking	Data transmission is occurring on the Ethernet LAN
RSS LEDs (where 1 is the lowest bar)	Green	All LEDs on	$RSS \geq -65$
		LEDs on: 1, 2, 3, 4, 5, 6, 7	$-69 \leq RSS \leq -66$
		LEDs on: 1, 2, 3, 4, 5, 6	$-73 \leq RSS \leq -70$
		LEDs on: 1, 2, 3, 4, 5	$-77 \leq RSS \leq -74$
		LEDs on: 1, 2, 3, 4	$-81 \leq RSS \leq -78$
		LEDs on: 1, 2, 3	$-85 \leq RSS \leq -82$
		LEDs on: 1, 2	$-89 \leq RSS \leq -86$
		LED on: 1	$-93 \leq RSS \leq -90$
		LED blinking: 1	$RSS \leq -94$



Note: A smaller RSS number indicates a stronger signal because the RSS level is given as a **negative** value (e.g. -66 is better than -70).

Mounting the Devices

This chapter describes the procedures for mounting the following devices:

- SPR
- SDA

13.1. Wall Mounting the SPR

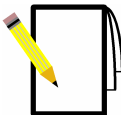
The SPR is mounted outside on an exterior wall. However, the SPR can also be pole-mounted.



Warning: The SPR device is an outdoor radio unit, and therefore, must only be mounted outside.



Warning: Mount outdoor radios so that their front panel ports face down to prevent water from settling on the ports. This avoids damage to the units such as corrosion and electrical short-circuiting.



Note: The standard SPR kit includes wall-mounting brackets. For ordering pole-mounting brackets (supply and costs), please contact your Airspan representative. SPR pole mounting procedure is identical to BSR pole mounting, thus, for a detailed description on pole mounting, see Part I, Chapter 7, "Mounting Devices".

The SPR is mounted using the mounting holes located on the SPR's bottom panel (see figure below), and the wall-mounting brackets (provided).

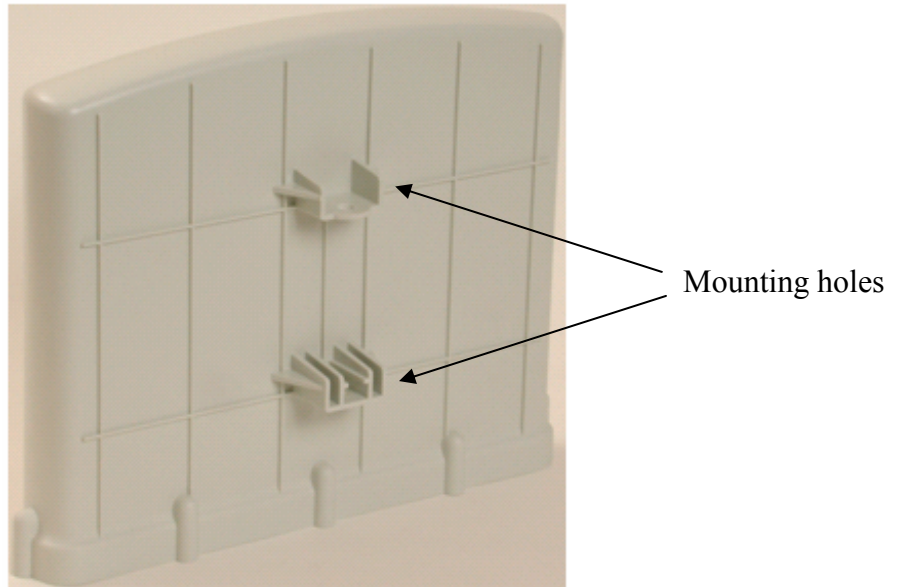


Figure 13-1: SPR bottom panel providing holes for mounting

A minimum of 3-meter separation is required between mounted SPRs and existing customer radio equipment when **not transmitting on the same sector** (see Figure 13-2).

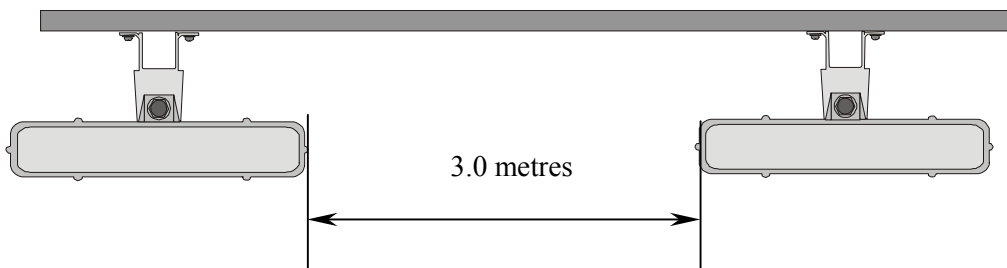


Figure 13-2: SPR separation when not transmitting on the same sector

A 1-meter separation is required between SPRs when on the **same sector** and transmitting to the same BSR without requiring shielding (see Figure 13-3).

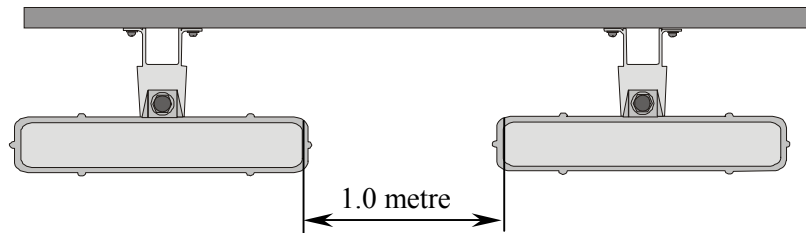


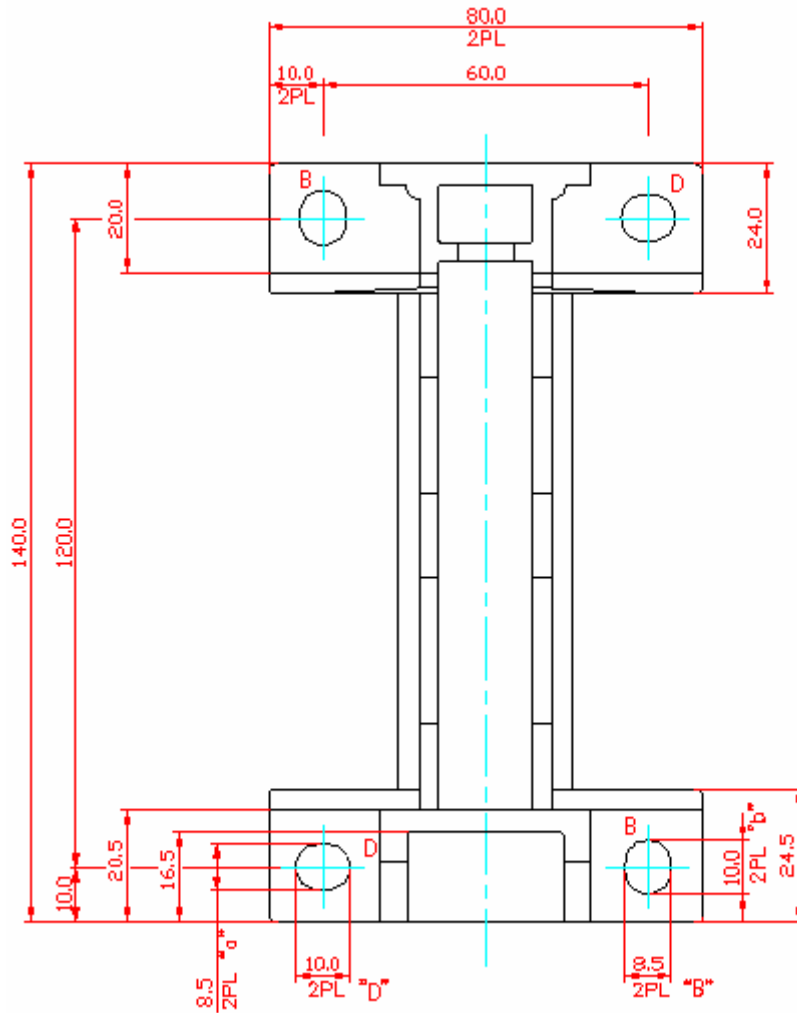
Figure 13-3: SPR separation when transmitting on the same sector to the same BSR

SPR wall mounting is performed in two stages:

- Attaching the mounting bracket to the SPR's mounting holes.
- Attaching the mounting bracket (attached to the SPR) to the wall.

To wall mount the SPR:

1. Position the mounting bracket on the mounting surface (e.g. wall), and then use a pencil to mark the position of the four mounting holes. Figure 13-4 displays the fixing dimensions. Ensure that the distance between the hole centers are 120 mm (height) and 60 mm (width).



All dimensions in millimeters (mm)

Figure 13-4: SPR mounting bracket dimensions for the four fixing holes

2. Drill holes for each hole that you marked in the step above.
3. Insert wall anchors (not supplied) into each of the drilled holes.
4. Align the mounting bracket's four holes with the wall anchors, and then insert a screw (not supplied) through the mounting bracket holes into each wall anchor, and tighten.



Note: Airspan does not provide screws for attaching the mounting bracket to the wall. The screw size depends on the structure of the building to which the bracket is to be attached. When selecting screw sizes, consideration must be given to the weight of the SPR and load that may be induced in windy conditions.

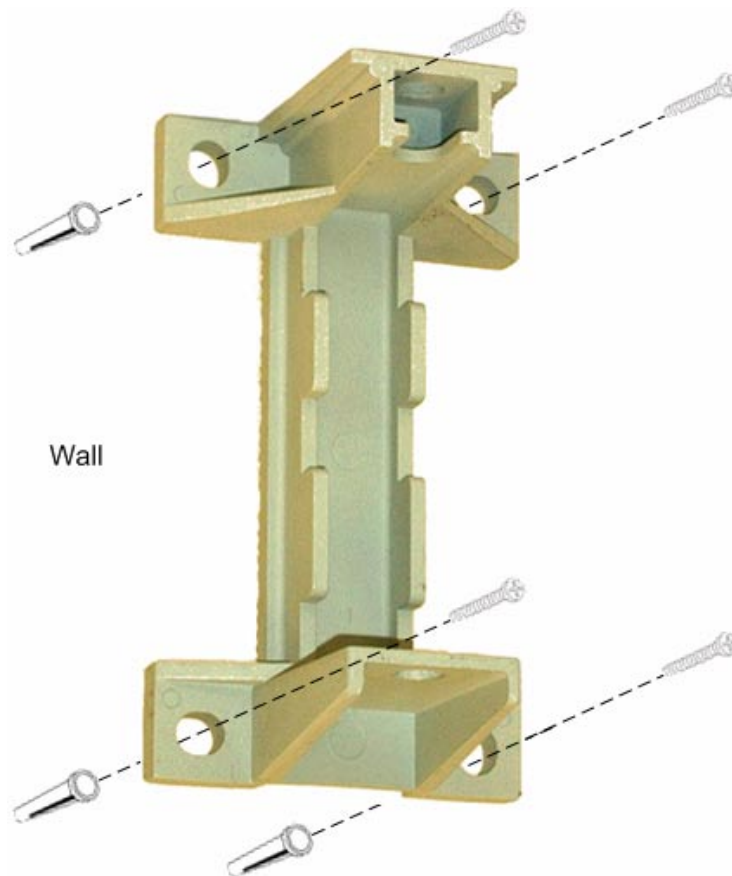


Figure 13-5: Attaching mounting bracket to wall

5. Attach the SPR to the mounting bracket by performing the following:
 - a. Slide an M10-spring lock washer and then an M10-plain washer onto each M10-hex head screw (ensure lock washer is nearest to head of screw bolt).

- b. Align the mounting bracket's holes with the SPR's mounting holes as displayed below. (The mounting bracket side that provides a groove for inserting a nut must be aligned with the SPR's mounting hole that is nearest to the SPR's rear panel.)
- c. From the external sides, insert the M10-hex head screws through the mounting bracket's holes and SPR's mounting holes. Loosely fasten with the M10-hex nuts.

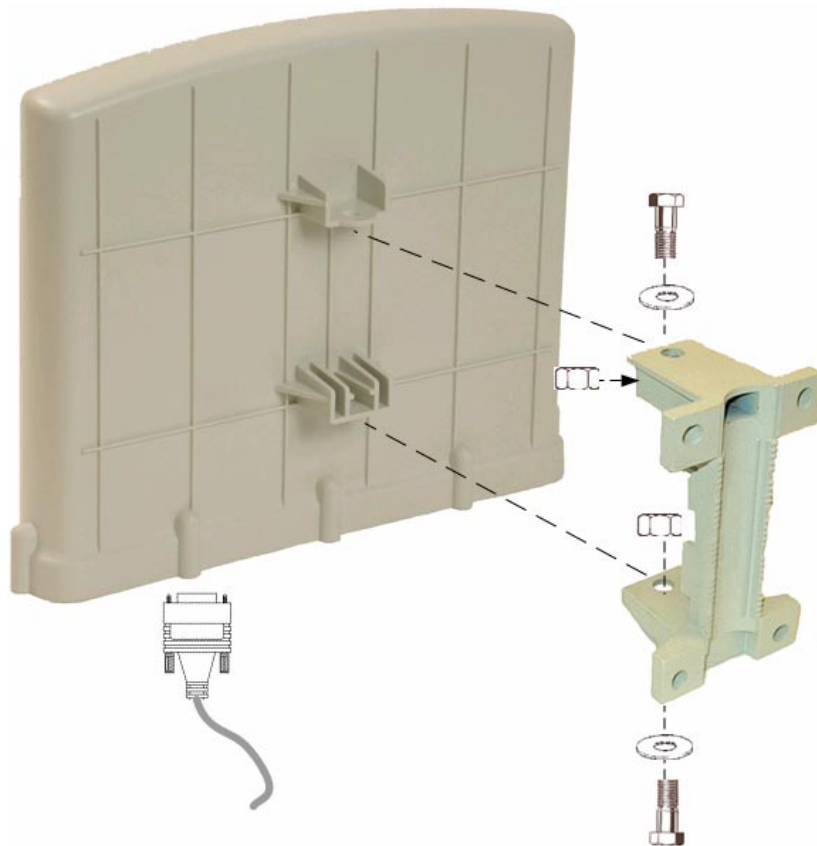


Figure 13-6: Attaching SPR to mounting bracket

6. Adjust the horizontal positioning of the SPR, and then tighten the two M10-hex head screws with the M10 hex nuts.

Rotation is restricted in the horizontal plane only. The permissible rotation is shown in Figure 13-7.

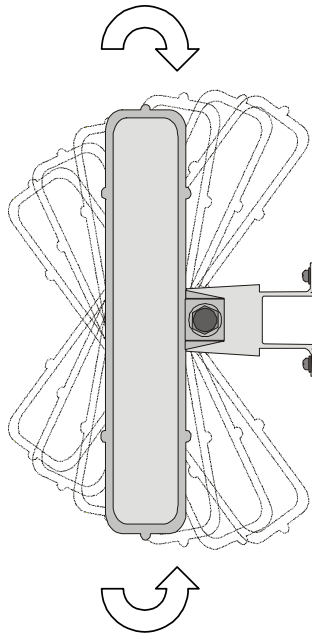


Figure 13-7: Horizontal rotation of the SPR (top view)

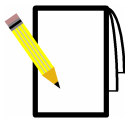


Note: A third-party thread-locking compound must be applied to the M10-hex head screws to prevent the bolts working loose.

13.2. Mounting the SDA

The SDA can be mounted in the following ways:

- Desktop mounted
- Wall mounted



Note: Mounting is the same for all SDA models.

13.2.1. Desktop Mounting

The SDA can simply be placed horizontally on a table. The SDA's bottom panel provides four rubber feet (pads) on each corner to provide cushioning and insulation from static electricity.



Figure 13-8: Rubber feet on rear panel for SDA desktop mounting



Warning: To prevent a fire hazard caused by overheating, do not place the SDA on a carpeted surface where airflow is restricted.

13.2.2. Wall Mounting

The SDA provides two mounting hooks molded into the SDA's bottom panel, as displayed below.

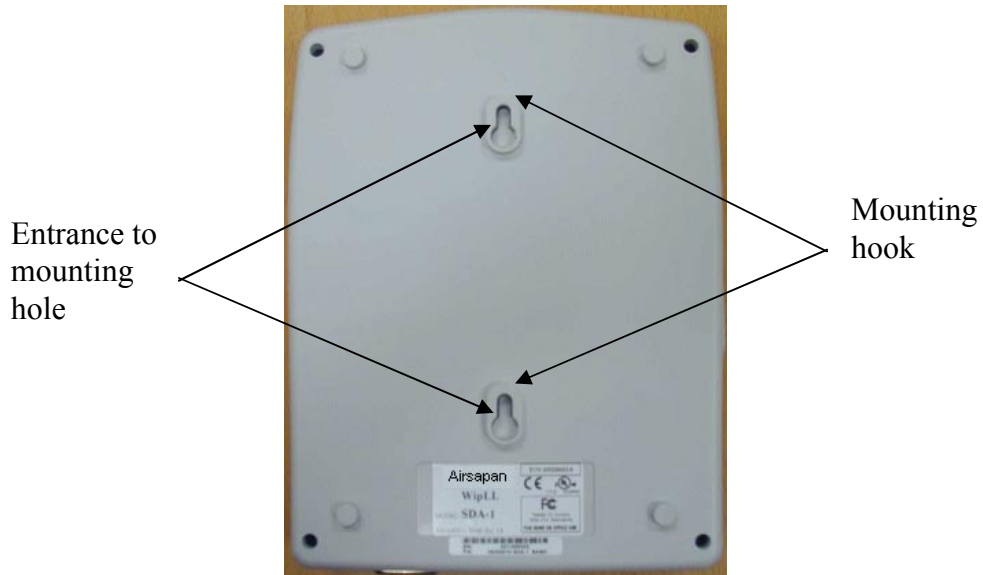
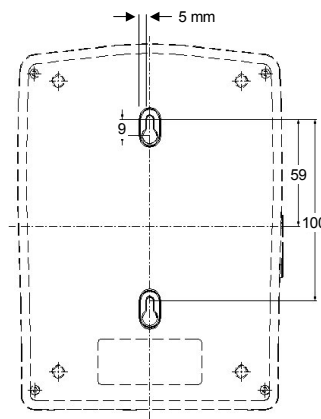


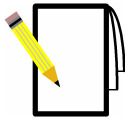
Figure 13-9: Mounting hooks on SDA rear panel

To wall mount the SDA:

1. On the wall, mark the position of the two SDA mounting hooks. The dimensions of the SDA's wall-mounting hooks are displayed in the template below.



2. Drill holes for each hole that you marked in the step above.
3. Insert wall anchors (supplied) into each of the drilled holes.
4. Insert the 9-inch screws (supplied) into the wall anchors. Ensure at least 2 mm of the screw is exposed to allow insertion into the SDA mounting holes.
5. Hold the SDA with both hands, and align the entrance to the two mounting hooks with the screws. Slide the screws into the mounting hooks, by lowering the SDA.

**Notes:**

- 1) For safety, both fixing points must be utilized when mounting the unit.
- 2) The SDA is supplied with a 1-metre AC power lead assembly. Therefore, ensure the unit is mounted within reachable distance to the customer's mains power outlet.
- 3) The cable must be dressed tidily and not be taught or pose a trip hazard when connected.
- 4) The maximum cable run between SDA and SPR is 100 meters. However, this can be extended to up to 300 meters (see Appendix F, "Extending IDU/ODU Cable Length").



Network Cabling

This chapter describes the procedures for network cabling at the subscriber site, and includes the following:

- Connecting SPR to SDA
- Connecting SDA to Subscriber's Ethernet Network
 - Connecting to a LAN/PC
 - Connecting to a Hub
 - Connecting to a Voice-over-IP (VoIP) Network (RGW)



Warning: To avoid electrical or fire hazard, ensure that the network connections described in this chapter are made prior to connecting power.

14.1. Connecting SPR to SDA

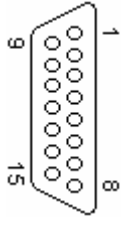
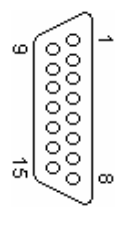
SPR interfaces with the subscriber's Ethernet network through the SDA. To connect the SPR to the SDA, you need to connect the SPR's 15-pin D-type port to the SDA's Ethernet radio port (15-pin D-type for all SDAs except SDA-1 Type II, which provides an RJ-45 port) using a standard CAT-5 cable.

The SPR-to-SDA cable setup is as follows:

- **Cable:** straight-through 10BaseT Ethernet UTP 4 Pair **CAT-5e** 24 AWG outdoor type (100 meters)
- **Connectors:**
 - **SPR side:** 15-pin D-type male (only 6 pins are used)
 - **SDA side:** 15-pin D-type male (only 6 pins are used) for all SDAs except SDA-1 Type II (RJ-45 port)

■ Connector pinouts:

Table 14-1: SPR-to-SDA connector pinouts

Straight-through cable							
15-pin D-type male	SPR		Wire color	Wire pair	SDA		15-pin D-type male /RJ-45
	Pin	Function			Pin	Function	
	1	+48 VDC	Blue / White	1	1	+48 VDC	
	2	48 RTN	Blue		2	2	
	3	Tx+	Orange / White	2	3	Rx+	
	4	Tx-	Orange		4	Rx-	
	5	Rx+	Green / White	3	5	Tx+	
	6	Rx-	Green		6	Tx-	

Notes:

- The connector pinouts are the same for all SDA models.
- Only pins 1 through 6 are used.
- The wire color-coding is ASWipLL's standard for wire color-coding (for a detailed description of ASWipLL's wire color-coding standard, see Appendix C, "Cable Crimping"). However, if you implement your company's wire color-coding scheme, ensure that the wires are paired and twisted according to the pin functions (e.g. Rx+ with Rx-) listed in the table above.

To connect the SPR to the SDA (see Figure 14-1):

1. Connect the **15-pin D-type male** connector, at one end of the CAT 5 cable, to the SPR's 15-pin D-type port labeled **DATA POWER SYNC**.
2. Connect the other end to the SDA:
 - For SDA except SDA-1 Type II: connect the **15-pin D-type male** connector to the SDA's **15-pin D-type** port (see Figure 14-1)
 - For SDA-1 Type II: connect the **RJ-45** connector to the SDA's **RJ-45** port labeled **RADIO** (see Figure 14-2)

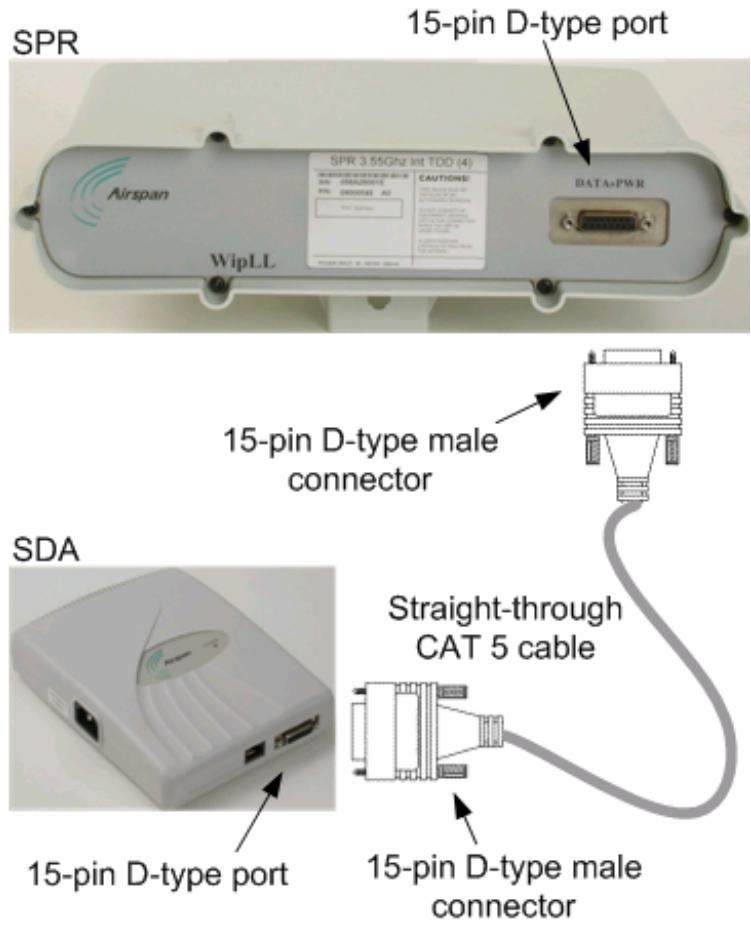


Figure 14-1: SPR-to-SDA (except SDA-1 Type II) cable connections

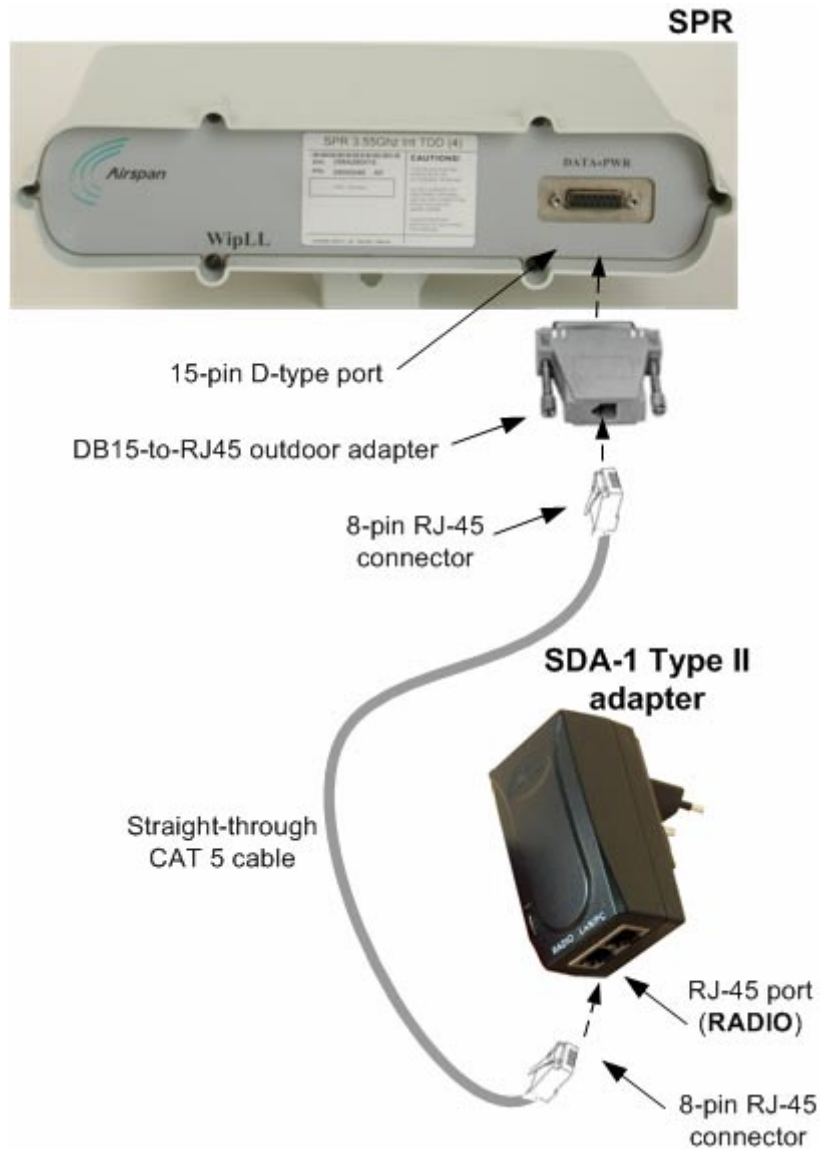


Figure 14-2: SPR to SDA-1 Type II cable connections



Warning: When the SDA-1 Type II is implemented at the Base Station (i.e. with the BSR), an RJ-45 adapter must be used (supplied) to connect the BSR to the SDA-1 Type II (see Chapter 8, Section 8.2, "BSR Connected to SDA").

**Notes:**

- 1) The standard CAT cable length is up to 100 meters. However, you can extend the cable length to up to 300 meters using ASWipLL IDU/ODU Extender (see Appendix F, "Extending IDU/ODU Cable Length").
- 2) Airspan supplies unterminated CAT cables. For a detailed description on crimping cables, see Appendix C, "Cable Crimping".
- 3) Airspan offers an optional RJ45-to-DB15 adapter for attaching to the SDA's 15-pin D-type port. This allows you to crimp an RJ45 connector to one end of the CAT cable. For a detailed description, see Appendix E, "RJ-45 to DB15 Adapter for IDU/ODU Connectivity".
- 4) For IDU/ODU connectivity of 40 meters and more, an outdoor lightning and surge protector must be implemented (see Appendix I, "Installing Lightning Protector".)

14.2. Connecting SDA to Subscriber's Ethernet Network

The SDA provides an RJ-45 port(s) for Ethernet connectivity to the subscriber's PC/network. The number of Ethernet ports and the speed of the Ethernet connection depend on the SDA model. For a description of the ports of the various SDA models, see Chapter 12, "Basic Design of Devices".



Note: Only subscriber terminal equipment (e.g. computer modem port) that is designed for full compliance with TNV-1 telecommunication network connectivity can be connected to the SDA-1. Warranty of Airspan's equipment shall be made void if the SDA is connected to a computer that is not compliant with TNV-1.

14.2.1. Connecting to LAN/PC

The SDA connects to the subscriber's PC(s)/LAN through the SDA's RJ-45 Ethernet port(s). The number of Ethernet ports depends on the SDA model.

The SDA-to-subscriber PC cable configurations are as follows:

- **Connector:** 8-pin RJ-45
- **Cable:** straight-through Ethernet cable



Note: The SDA-4S RJ-45 ports support MDI/MDI-X automatic crossover, i.e. straight-through or crossover CAT-5 cables can be connected to these ports.

- **Connector Pinouts:**

- SDA-4S, SDA-4H (ports J2, J3, J4), SDA-1, SDA-1/DC, and SDA-1 Type II models:

8-pin RJ-45 straight-through cable	
Pin	Function
1	+Rx
2	-Rx
3	+Tx
6	-Tx

Note: Pins not mentioned are not used.

- SDA-4H model (port J5) :

8-pin RJ-45 crossover cable	
Pin	Function
1	+Tx
2	-Tx
3	+Rx
6	-Rx

Note: Pins not mentioned are not used.

To connect the SDA to the subscriber's PC(s)/network (see Figure 14-3):

1. Connect the **8-pin RJ-45 male** connector, at the one end of the Ethernet cable, to the SDA's RJ-45 Ethernet port.
2. Connect the **8-pin RJ-45 male** connector, at the other end of the Ethernet cable, to the subscriber's PC (or device).

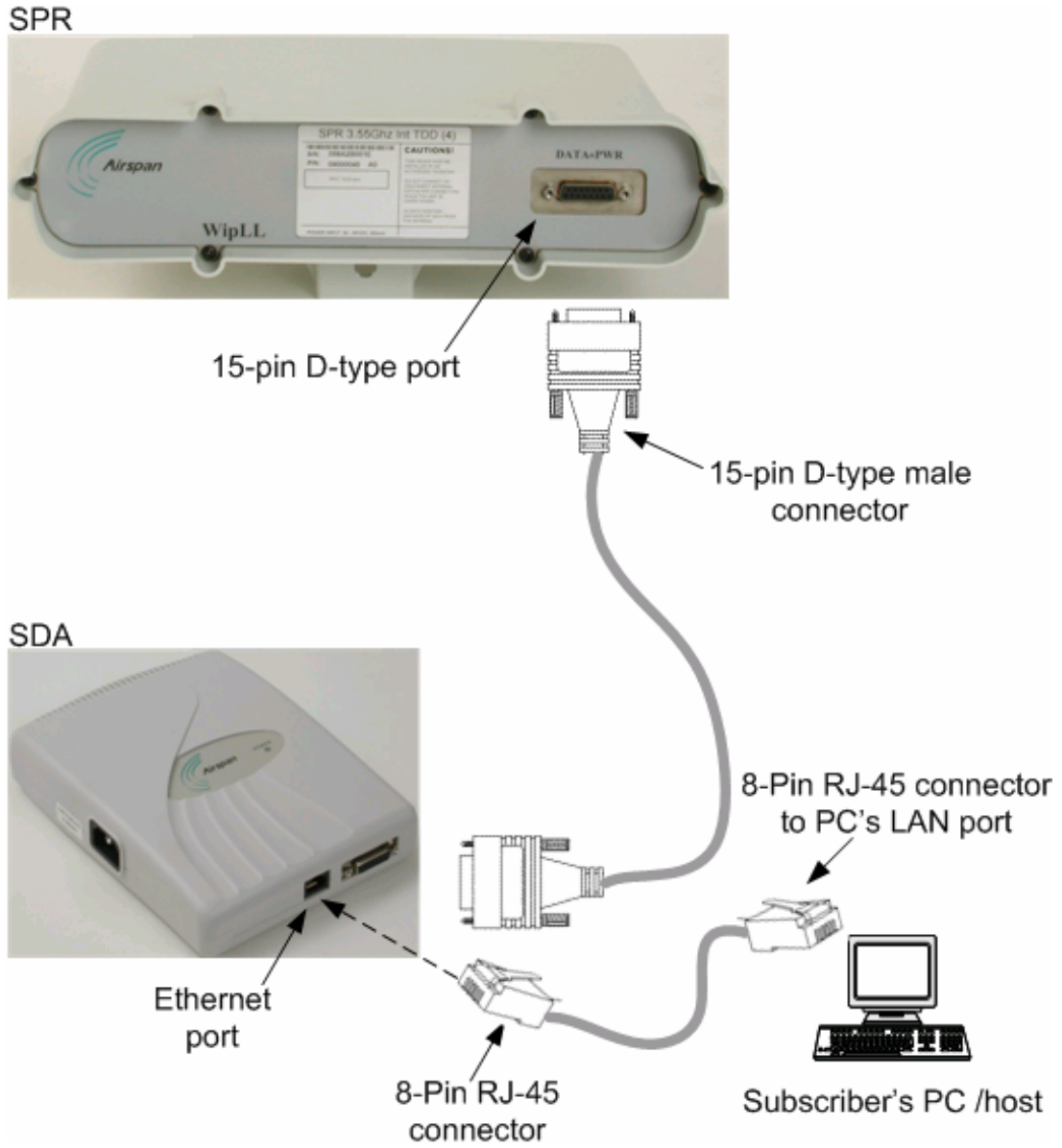


Figure 14-3: SDA-to-PC/network cable connections (e.g. SDA-1 model)

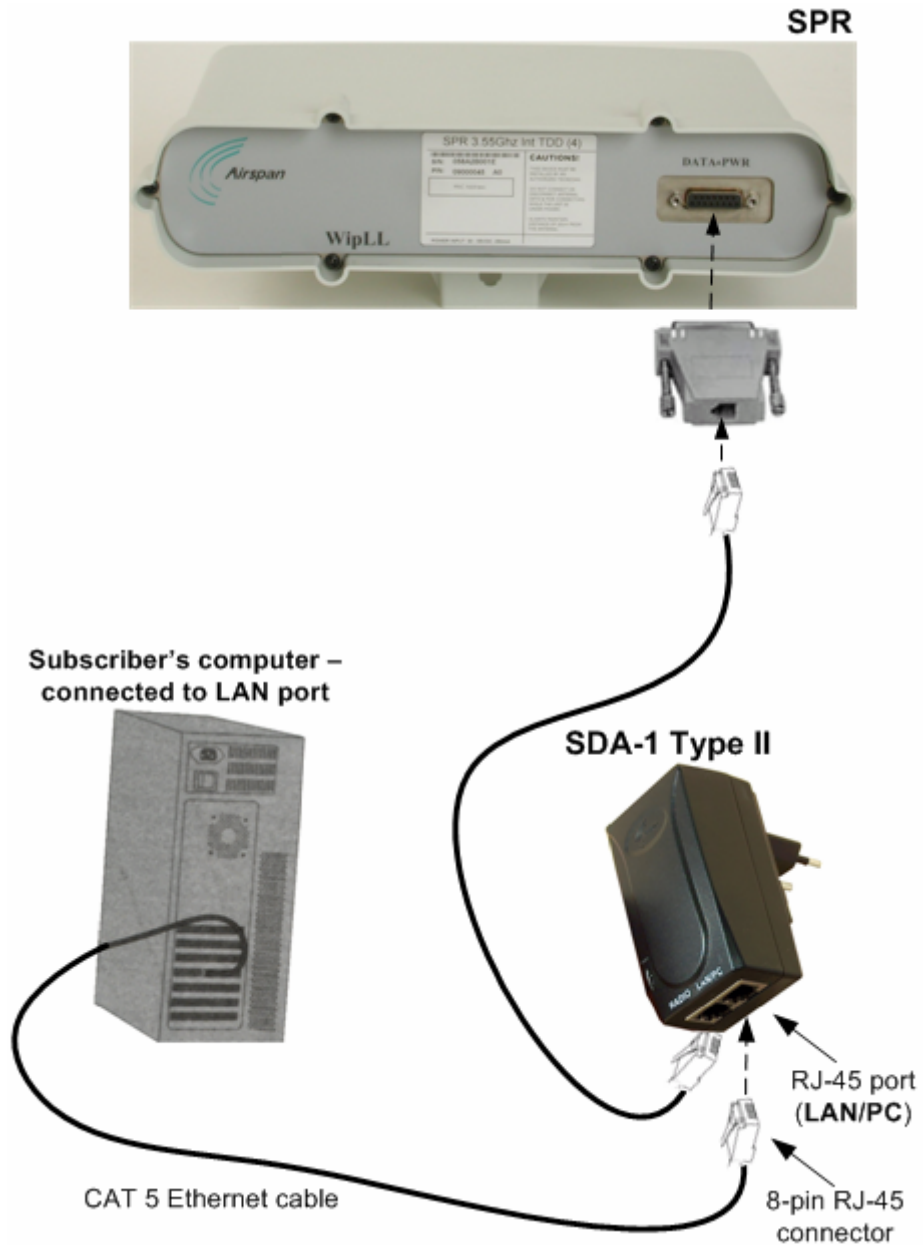


Figure 14-4: SDA-1 Type II to PC/network cable connections

14.2.2. Connecting to Hub

The SDA-4S and SDA-4H models can be connected to a hub (e.g. for daisy chaining). Generally, connecting hubs/switches to other hubs/switches requires crossover cabling. The ports of the SDA-4S support MDI/MDI-X automatic crossover, allowing connection of straight-through or crossover cables to any of the ports. However, for SDA-4H, only the left-most RJ-45 port (port J5) is a crossover port and can be connected to a hub.

The SDA-4S and SDA-4H cable configurations are as follows:

- **Connector:** 8-Pin RJ-45
- **Cable:**
 - **SDA-4H:** crossover-cable
 - **SDA-4S models:** straight-through or crossover cables
- **Connector pinouts:**

SDA-4H 8-pin RJ-45 (J5)	
Pin	Function
1	+Tx
2	-Tx
3	+Rx
6	-Rx

Note: Pins not mentioned are not used.

To connect SDA-4S or SDA-4H to a hub:

1. Connect the **RJ-45 male**, at one end of the cable, to any one of the SDA-4S's RJ-45 ports (see Figure 14-5), or to the SDA-4H's left-most **RJ-45 port - J5** (see Figure 14-6).
2. Connect the **RJ-45 male**, at the other end of the cable, to a hub.

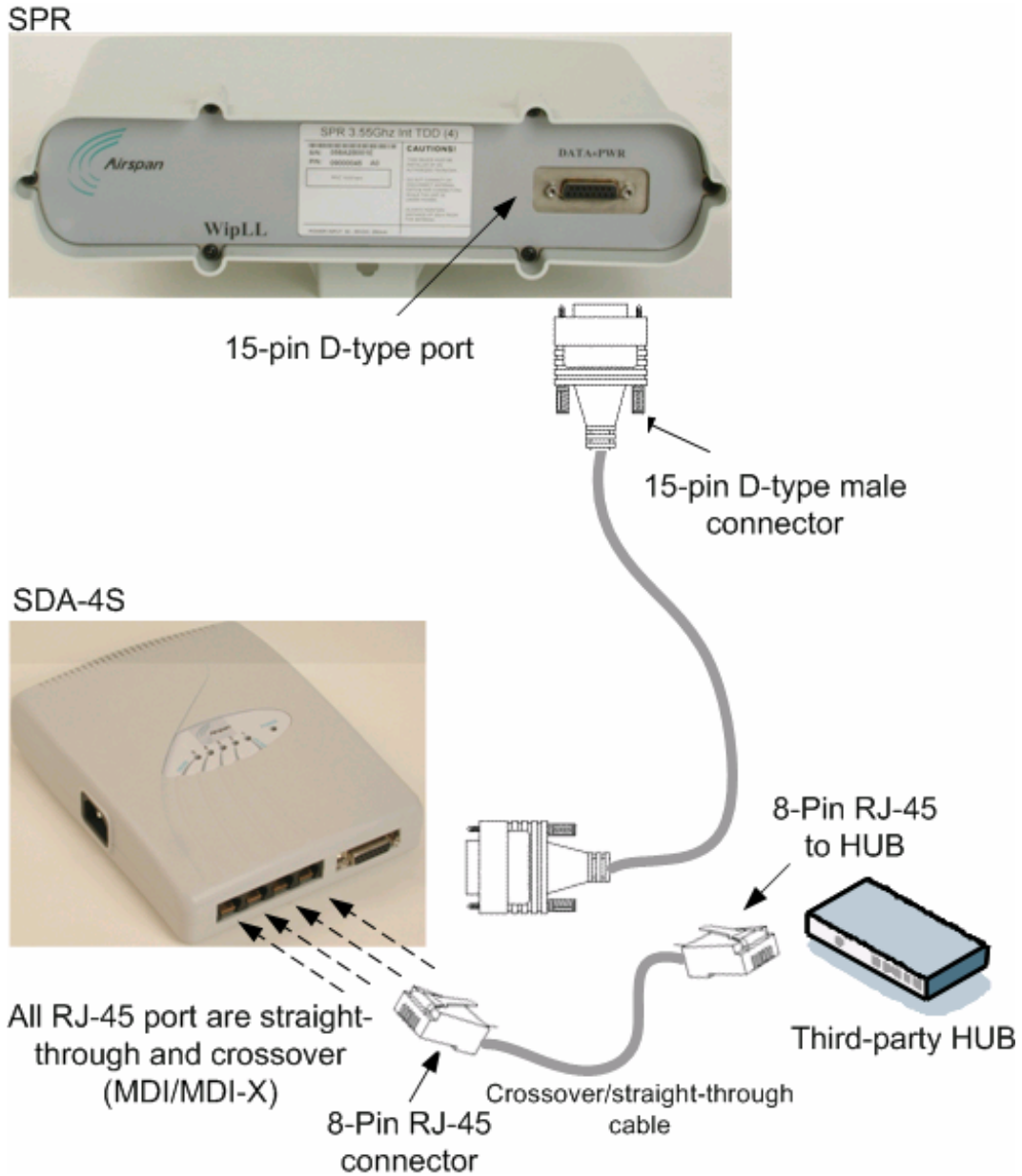


Figure 14-5: SDA-4S crossover/straight-through cable connections to hub

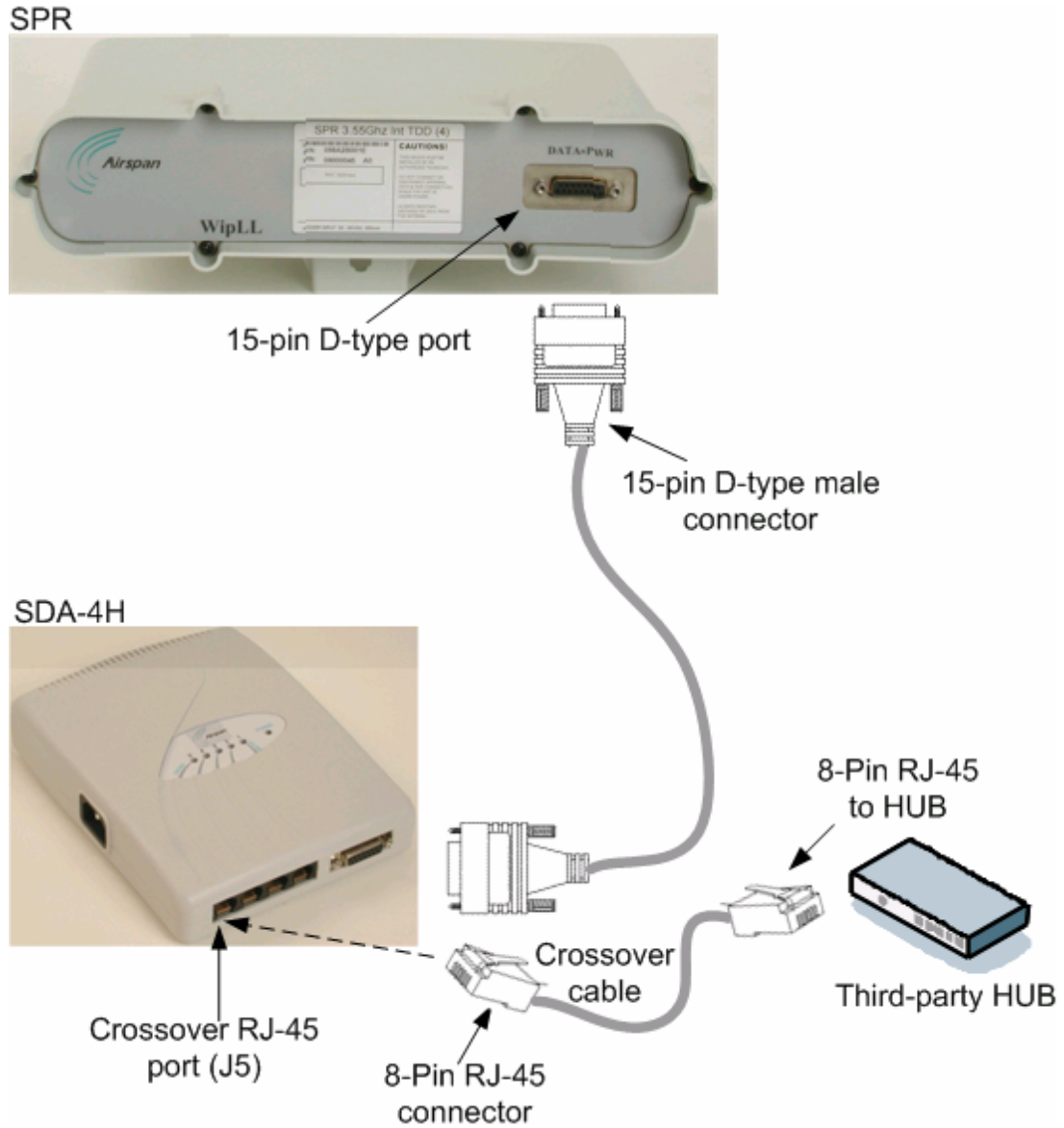


Figure 14-6: SDA-4H crossover cable connections to hub

14.2.3. Connecting to VoIP Network

The **SDA-4S/1H3L** and **SDA-4S/VL/1H3L** models' left-most RJ-45 Ethernet ports are used to interface with the subscriber's VoIP network. This port assigns highest priority level (compared to the other RJ-45 ports) to VoIP traffic.

The cable connections for connecting the **SDA-4S/1H3L** and **SDA-4S/VL/1H3L** models to the subscriber's VoIP network are as follows:

- **Connector:** 8-pin RJ-45 male
- **Cable:** straight-through or crossover
- **Connector pinouts:**

8-pin RJ-45 (left-most port)	
Pin	Function
1	+Rx
2	-Rx
3	+Tx
6	-Tx

Note: Pins not mentioned are not used.

To connect to the VoIP network (see Figure 14-7):

1. Connect the **RJ-45 male** connector, at one end of the Ethernet cable, to the **left-most RJ-45** port on the front panel of the **SDA-4S/1H3L** and **SDA-4S/VL/1H3L**.
2. Connect the **RJ-45 male** connector, at the other end of the cable, to the VoIP network, for example, to a Residential Gateway.

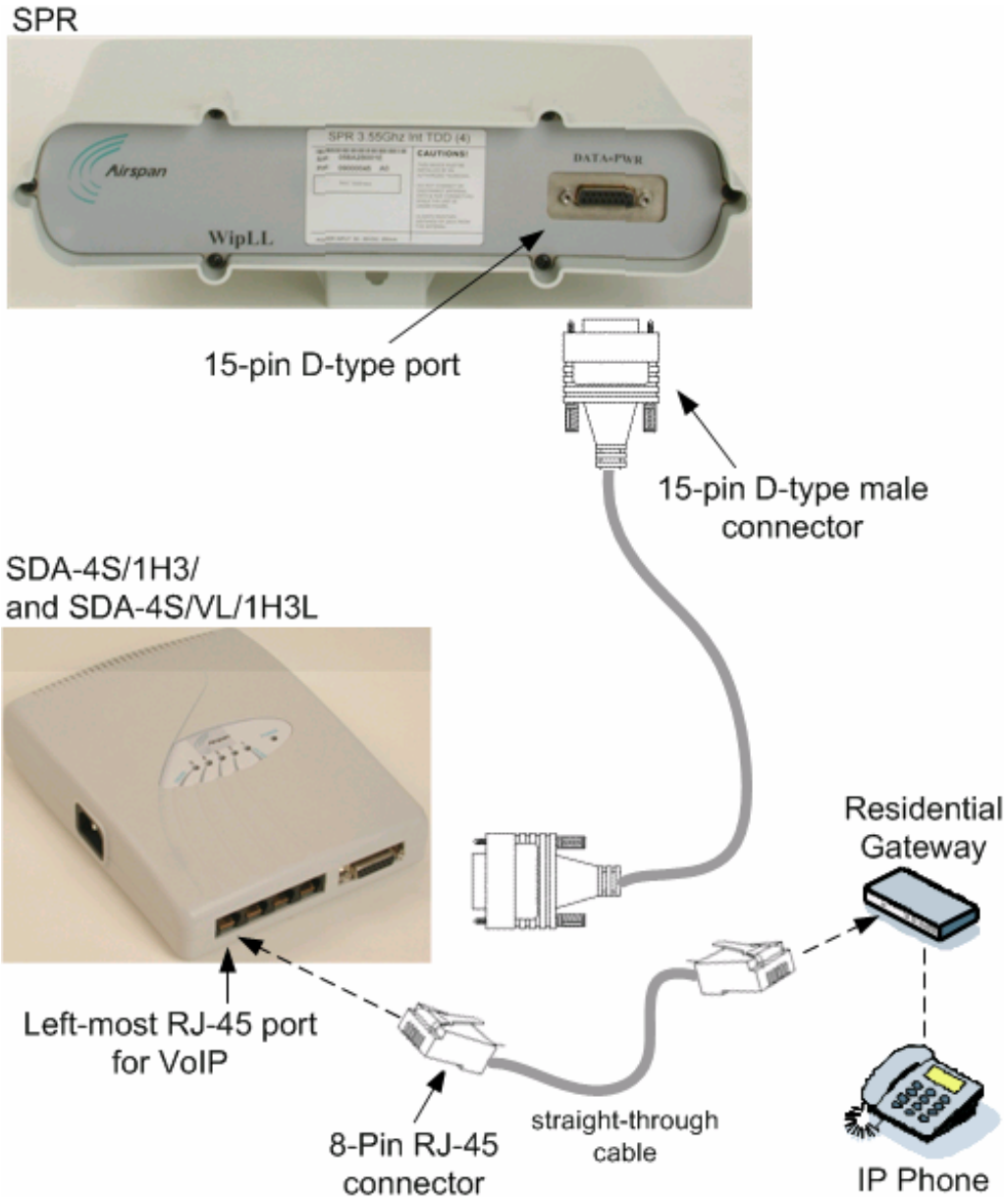


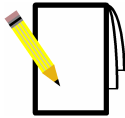
Figure 14-7: Connecting SDA-4S/1H3L and SDA-4S/VL/1H3L to VoIP network

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Serial Cabling

The SPR's 15-pin D-type port provides serial interface with a PC for configuring the SPR through an RS-232 communication mode. The 15-pin D-type port uses three pins for serial interface with a PC, and six pins for interfacing with the SDA (with which the SPR is connected). A Y-cable (splitter) is used to connect the SPR's 15-pin D-type port to both the PC and the SDA.



Notes:

- 1) SPR initial configuration is performed using Airspan's WipConfig program (refer to the *ASWipLL WipConfig User's Guide*).
 - 2) For customers with previous SPR models providing a 9-pin D-type port, the serial cabling is identical to BSR serial cabling (see Part I, Chapter 9, "Serial Cabling").
-

The SPR-to-PC and SDA cable connections for SPR serial configuration are as follows:

■ **Connectors:**

- **SPR side:** 15-pin D-type male (only 6 pins used)
- **PC side:** 9-pin D-type (RS-232)
- **SDA side:** 15-pin D-type male

- **Cable:** straight-through Y-cable (see figure below)

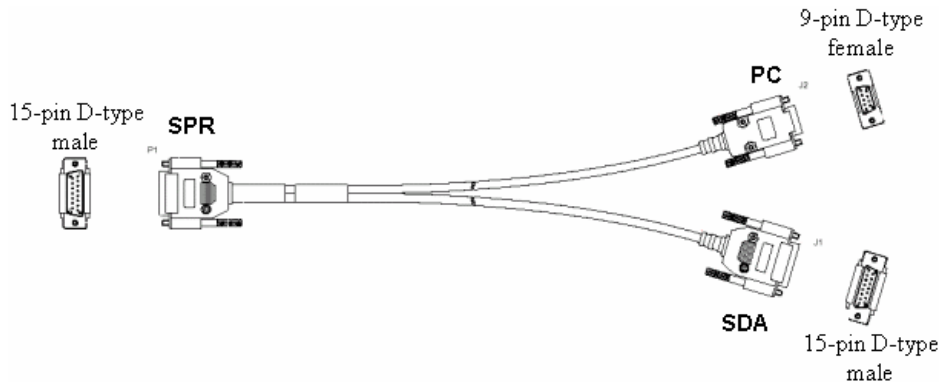


Figure 15-1: Y-cable for serial connection

- **Connector pinouts:**

Table 15-1: Y-cable connector pinouts

Straight-through Y-cable					
SPR			SDA		
15-pin D-type male	Pin	Function	Pin	Function	15-pin D-type male
	1	+48 VDC	1	+48 VDC	
	2	48 RTN	2	48 RTN	
	3	Ethernet Tx+	3	Rx+	
	4	Ethernet Tx-	4	Rx-	
	5	Ethernet Rx+	5	Tx+	
	6	Ethernet Rx-	6	Tx-	
SPR			PC		
	Pin	Function	Pin	Function	9-pin D-type female
	12	GND	5	GND	
	14	RS232 Rx	3	Rx	
	15	RS232 Tx	2	Tx	

To connect the SPR to a PC for serial configuration (see Figure 15-2):

1. Connect the **15-pin D-type male** connector, at the one end of the Y-cable, to the SPR.
2. Connect the **15-pin D-type male** connector, at the other end of the Y-cable, to the SDA.
3. Connect the **9-pin D-type female** (RS232) connector, at the other end of the Y-cable, to the PC's serial port.

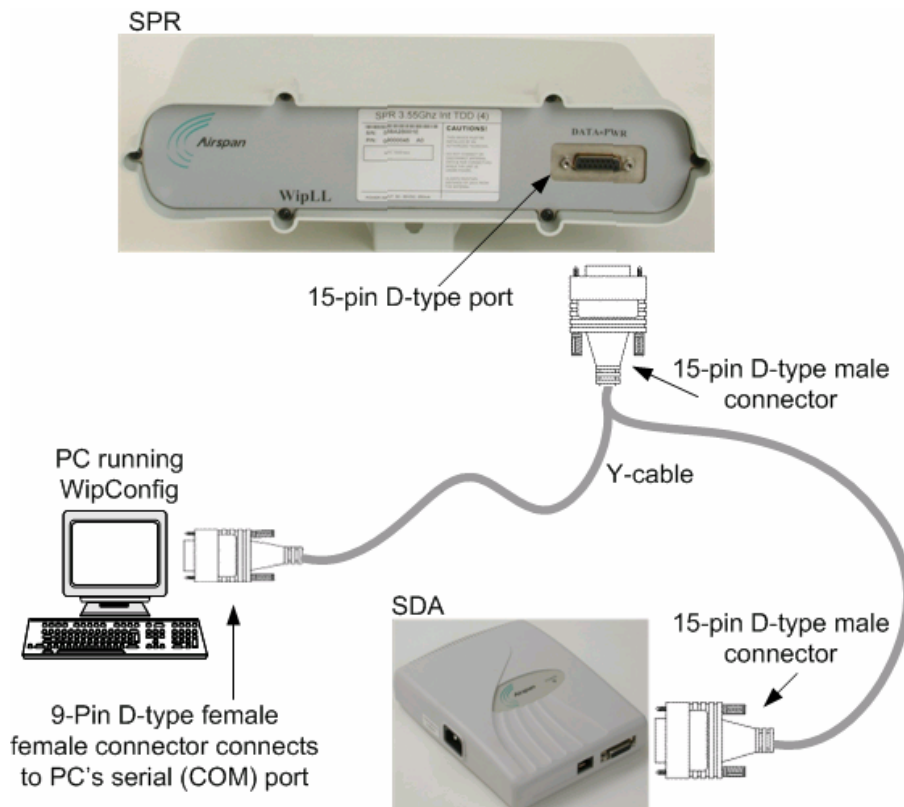


Figure 15-2: SPR serial cable connections using a Y-cable



Notes: For SPR serial configuration, the SPR remains connected to the SDA.

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Connecting Third-Party External Antenna

The SPR model without a built-in antenna provides an N-type port for connecting a third-party external antenna. The addition of an external antenna allows greater RF sector coverage than the standard SPR built-in antenna models.



Warning: Before connecting the external antenna, ensure that the SPR is NOT connected to the power source.



Warning: Before powering on the SPR, ensure that some type of equipment such as an antenna or an RF attenuator is connected to the N-type receptacle. This eliminates the risk of damaging the SPR device.



Warning: It is the responsibility of the person installing the ASWipLL system to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), that only those antennas certified with the product are used. The use of any antenna other than those certified with the product is expressly forbidden in accordance with FCC rules CFR47 part 15.204. The installer should configure the output power level of antennas according to country regulations and per antenna type.



Warning: In accordance with FCC regulations, ensure that for external antennas, the maximum EIRP is 36 dBm. The EIRP is defined as: $\text{Max. Power Output} + \text{Antenna Gain} + \text{Cable Loss} \leq 36 \text{ dBm (EIRP)}$



Notes:

- 1) SPR models that provide N-type connectors for attaching a third-party external antenna do not contain an internal, built-in antenna.
 - 2) It is recommended that the same antenna polarization (i.e. horizontal/vertical) exists at both ends of the link (i.e. Base Station and subscriber site).
 - 3) For crimping RF coaxial cables, see Appendix C, "Cable Crimping".
-
-

The following lists the SPR-to-third party external antenna cable setup:

- **Cable:** RF coaxial
- **Connector:** N-type male

To connect the SPR to a third-party external antenna:

- Connect an **N-type male** connector of the third-party antenna to the N-type port located on the SPR's front panel, as displayed below.

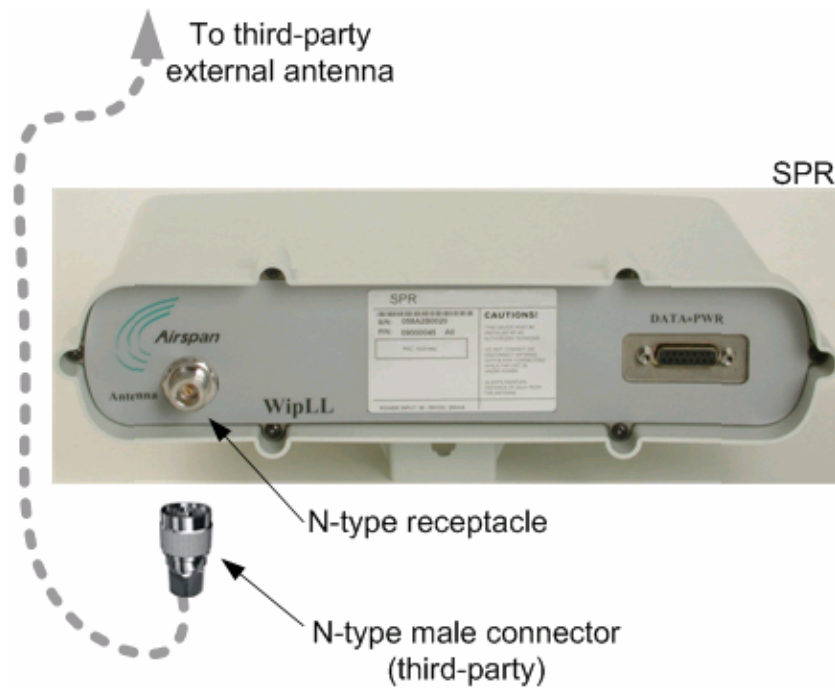


Figure 16-1: SPR model with N-type connector for attaching an external antenna



Declaration of FCC Conformity

We, Airspan Networks Inc., declare that the ASWipLL radio devices listed in the table below comply with FCC Rules. We further declare that only the antenna installation configurations shown in the table below are used in specific installations.

Table J-1: FCC compliancy for ASWipLL radios

ASWipLL device	Operating frequency	Product description (antenna configuration)	FCC rules
BSR (outdoor radio)	700 MHz	Only external antenna	Part 27
	900 MHz	Either external or internal antenna	Part 15
	1.9 GHz	Either external or internal antenna	Part 24
	2.4 GHz	Only internal antenna	Part 15
	2.5 GHz	Only internal antenna	Part 21
	5.8 GHz	Only internal antenna	Part 15
SPR (outdoor radio)	700 MHz	Only external antenna	Part 27
	900 MHz	Either external or internal antenna	Part 15
	1.9 GHz	Either external or internal antenna	Part 24
	2.4 GHz	Only internal antenna	Part 15
	2.5 GHz	Only internal antenna	Part 21
	5.8 GHz	Only internal antenna	Part 15
IDR (indoor radio)	900 MHz	Either external or internal antenna	Part 15
	2.4 GHz	Only internal antenna	Part 15

The table below lists the ASWipLL radio compliancy to FCC for maximum transmit power output at the antenna connector.

Table J-2: ASWipLL radio FCC compliancy for Tx power and EIRP

Frequency	Mode	Max. Tx power at antenna connector	Max. EIRP	System mode
700 MHz	3 Mbps / 4 Mbps	31.8 dBm	According to FCC approved antenna gain	Digital
900 MHz	3 Mbps	17.5 dBm	36 dBm	Hybrid
	4 Mbps	23 dBm	36 dBm	Hybrid
1.9 GHz	3 Mbps / 4 Mbps	31 dBm (BSR); 29.8 dBm (SPR)	According to FCC approved antenna gain	Digital
2.4 GHz	3 Mbps / 4 Mbps	23 dBm	36 dBm	Hybrid
2.5 GHz (MMDS)	3 Mbps / 4 Mbps	28.8 dBm	According to FCC approved antenna gain	Digital
5.8 GHz	3 Mbps	17.6 dBm	36 dBm	Hybrid
	4 Mbps	21 dBm	36 dBm	Hybrid

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