

SpotCell[™] 612

Adaptive Repeater

User Manual

Utility Pole Application





Technical Support

The SpotCell™ serial number must be available to authorize technical support and/or to establish a return authorization for defective units. The serial number is located on the back of the High Power Coverage Unit (HPCU), Adaptive Repeater Unit (ARU) and Donor Unit (DU), as well as the box in which they were delivered. Support information may be obtained by accessing the Spotwave Wireless Inc. website at www.spotwave.com. To contact support by telephone, call your local Spotwave vendor, or if you are unable to do so, call Spotwave Wireless at 1-877-610-9586.

Important Safety Information



.....
Warning! For your safety, beware of power lines and ensure appropriate separation distances, and safety measures, are maintained at all times during the SpotCell equipment installation. If equipment supplied by others is to be used during installation or mounting, follow all equipment manufacturer's instructions to ensure injury is avoided.
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If you are installing the SpotCell near high voltage power lines, or in any way are not sure about a safe installation, do not attempt to install it yourself. Call a professional installer for help.

The DU and HPCU of the SpotCell are low power transmitters. As with a cell phone antenna, avoid unnecessary contact with the front of the units after installed. Mount the units in a location where people will not approach within 1 meter of the front of the DU or HPCU.



Limited Warranty and Limitation of Warranty

1. What is Covered and for How Long?

Spotwave Wireless Inc. ("Spotwave") warrants to the original Purchaser that the Spotwave SpotCell System (the "System") is free from defects in material and workmanship under normal use and service for a period of 12 months from the date of shipment from Spotwave (the "Limited Warranty Period").

2. What is Not Covered?

This Limited Warranty is conditioned upon proper use of the System by the Purchaser. This Limited Warranty does not cover (and will become null and void in the event of): (a) defects or damage resulting from accident, misuse, abuse, neglect, unusual physical, electrical or electromechanical stress, modification of the System or any part thereof, or cosmetic damage; (b) removal, alteration or defacing of the serial number or other identifying marks on the System; (c) all plastic surfaces and other externally exposed components that are scratched or damaged due to normal use; (d) malfunctions resulting from the use of the System in conjunction with accessories, products or (ancillary) or peripheral equipment not provided by Spotwave; or (e) defects or damage from unauthorized or improper testing, operation, maintenance, installation, servicing or adjustment of the System. Any repairs or replacements provided by Spotwave outside of the Limited Warranty Period (including repairs to or replacement after the end of the Warranty Period), or in excess of the services provided during the Limited Warranty Period, will subject to Spotwave's then prevailing rates.

3. What are Spotwave's Obligations and how do you make a claim?

During the Limited Warranty Period, Spotwave will repair or replace, at Spotwave's sole option, without charge to Purchaser, any defective component of the System, provided that the System is returned promptly upon discovery of the defect and during the Limited Warranty Period. To obtain service, Systems must be returned to an authorized service facility in the original packaging or packaging adequate for shipping, accompanied by Purchaser's sales receipt or comparable substitute proof of sale showing the date of purchase and the serial number of the System. A valid RMA is required prior to any return.

To locate your nearest authorized service facility, call Spotwave Customer Service at 1-877-610-9586.

Spotwave may, at Spotwave's sole option, use rebuilt, reconditioned, or new parts or components when repairing any System or replace a System with a rebuilt, reconditioned or new System. Repaired Systems will be warranted for a period equal to the remainder of the original Limited Warranty Period for the original System or for 90 days, whichever is longer. All replaced parts, components, boards or equipment shall become the property of Spotwave. If Spotwave determines that any System is not covered by this Limited Warranty, Purchaser must pay the costs for all parts, shipping, and labor charges for the repair or return of such System.

4. What are the Limits on Spotwave's Liability?



EXCEPT FOR THE WARRANTY IN PARAGRAPH 1, THE SYSTEMS AND ANY ASSOCIATED SERVICES ARE PROVIDED BY SPOTWAVE ON AS 'AS IS' BASIS AND THERE ARE NO OTHER REPRESENTATIONS, WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, WRITTEN OR ORAL, ARISING BY STATUTE, OPERATION OF LAW, COURSE OF DEALING, USAGE OF TRADE OR OTHERWISE, REGARDING THEM OR ANY OTHER PRODUCT OR SERVICE PROVIDED HEREUNDER OR IN CONNECTION HERewith BY SPOTWAVE. SPOTWAVE DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OF DURABILITY, MERCHANT ABILITY, MERCHANTABLE QUALITY, SATISFACTORY QUALITY, NON-INFRINGEMENT OR FITNESS FOR A PARTICULAR PURPOSE. SPOTWAVE DOES NOT REPRESENT OR WARRANT THAT THE SYSTEMS WILL MEET ANY OR ALL OF PURCHASERS' PARTICULAR REQUIREMENTS, THAT THE SYSTEMS WILL OPERATE ERROR-FREE OR UNINTERRUPTED OR THAT ALL ERRORS OR DEFECTS IN THE SYSTEMS CAN BE FOUND TO BE CORRECTED. System performance is dependant upon the performance and availability of services or technology provided by third parties and Spotwave is not responsible for service continuity and reliability, reception, or other performance related limitations associated with use of the Systems. NO AGREEMENTS VARYING OR EXTENDING THE TERMS OF THIS LIMITED WARRANTY WILL BE BINDING ON SPOTWAVE UNLESS IN WRITING AND SIGNED BY AN AUTHORIZED SIGNING OFFICER OF SPOTWAVE THIS LIMITED WARRANTY SHALL NOT EXTEND TO ANYONE OTHER THAN THE ORIGINAL PURCHASER OF THE SYSTEM. SPOTWAVE'S MAXIMUM AGGREGATE LIABILITY TO PURCHASER SHALL NOT EXCEED THE AMOUNTS PAID BY PURCHASER FOR THE SYSTEM GIVING RISE TO THE CLAIM. SPOTWAVE SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL, INDIRECT OR SIMILAR DAMAGES, LOSS OF USE, DATA OR PROFITS, DAMAGES TO PURCHASER'S PROPERTY, OR INJURY TO PURCHASER OR OTHERS ARISING OUT OF THE USE, MISUSE OR INABILITY TO USE ANY SYSTEM, WHETHER OR NOT SUCH DAMAGE ARISES OUT OF CONTRACT OR TORT (INCLUDING WITHOUT LIMITATION, NEGLIGENCE) OR CLAIMS BY A THIRD PARTY, EVEN IF SPOTWAVE HAS BEEN ADVISED OF SUCH DAMAGES OR THEY ARE FORESEEABLE

5. This Limited Warranty allocates risk between Purchaser and Spotwave, and the Spotwave System pricing reflects this allocation of risk and the limitations of liability contained in this Limited Warranty. The agents, employees, distributors, dealers or representative of Spotwave are not authorized to make modifications to this Limited Warranty, or make additional warranties binding on Spotwave. Accordingly, additional statements such as advertising or presentations, whether oral or written, do not constitute warranties by Spotwave and should not be relied upon.



Ownership and Risk of Loss

6. Who Owns the rights in the System?

The System is protected by Canadian, US and international copyright law and other intellectual property protection laws and treaties. Purchaser acknowledges that Spotwave and its licensors are the owner of all intellectual property, including, without limitation, patents and copyright,

relating to the System and the trademarks used in association with the System. Purchaser agrees that it will not (and will not attempt to) modify, prepare derivative works of, reverse engineer, decompile, disassemble, or other attempt to derive the source code of any software contained within the System.

7. Who bears the Risk of Loss?

Risk of loss for the System passes to Purchaser upon the delivery to Purchaser or to a carrier for shipment, whichever is earlier. Title to the Systems (excluding any software) will pass upon payment in full for the Systems. Title to any software shall always remain with Spotwave or its licensors. As security for payment, Purchaser grants to Spotwave a purchase money security interest in the Systems (together with any proceeds, including insurance proceeds) and agrees that a copy of this letter of agreement or any other appropriate document may be registered as required to perfect the security interest granted. Systems may be resold by Purchaser in normal course of business, but until paid for in full, Purchaser will not pledge or otherwise encumber the Systems. Purchaser agrees to immediately report to Spotwave, any seizure or attachment of the Systems by creditors; (ii) any petition in bankruptcy, insolvency, receivership or similar proceedings filed by, or against Purchaser; or (iii) any arrangement, composition or similar agreement for the benefit of creditors. Systems held for Purchaser by Spotwave are at Purchaser's sole risk and expense.

OTHER TERMS:

8. What terms govern our relationship?

These terms and any software license or warranty documentation accompanying the Systems constitute the complete and exclusive statement of the terms and conditions between us regarding the Systems and cannot be altered, amended or modified except in writing executed by Spotwave. This letter of agreement and any disputes arising hereunder shall be governed by and interpreted in accordance with the laws of the Province of Ontario, Canada. The United Nations Convention on Contracts for the International Sale of Goods and any legislation implementing such Convention, if otherwise applicable is expressly excluded. Any terms and conditions of any purchase order or other instrument issued by Purchaser which are in addition to or inconsistent with the terms and conditions of this letter of agreement shall not be binding and shall not apply, even if accepted by Spotwave.



Manual Disclaimer

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Chapter 1 – Introduction

1.1 This Manual

The contents of this manual complements the Quick Install Guide, and provides specific details that may be referred to if necessary during installation of the SpotCell™ system.

1.2 Installer Qualifications

1.2.1 Work Near High-Tension Power Lines



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Warning! If your installation requires the SpotCell adaptive repeater to be located near high voltage power lines, such as on or near an electrical power pole or tower, the installation of the Donor Unit (DU), Coverage Unit (HPCU) and associated coaxial cables and ground wire must be done by a trained high-tension



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power-line professional. This professional must be knowledgeable and experienced in high voltage electrical safety, including safe separation distances and safety measures.

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The trained professional shall maintain appropriate separation distances from high voltage lines and follow applicable safety measures at all times during the installation.

1.2.2 Connection of AC Power

The connection of AC power to the SpotCell Adaptive Repeater Unit (ARU) shall be done only by a fully qualified, licensed electrician in full accordance with local and national code requirements.

1.2.3 Repeater Set-up and Alignment

The SpotCell 612 adaptive repeater installation does not require any specialized radio frequency technical knowledge. It requires no special RF installation tools. For some installations the following may be required:

- GPS satellite receiver (most current models are suitable)
- A good quality magnetic compass

To complete the work quickly and efficiently it is recommended that the installer have completed the Spotwave Wireless installer training program, and be Level I Certified.



1.3 Product Overview

The purpose of the SpotCell 612 is to enable personal wireless communications in specific locations within a wireless service area where cell phones do not work, or works poorly, for example along a highway right-of-way where it dips down into a valley, coulee or draw, or the signal is obstructed by buildings or trees.

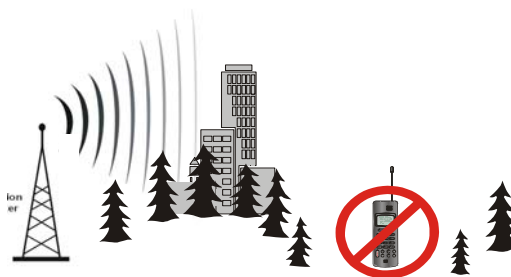


Figure 1.1 Base station signal does not reach wireless subscriber

The SpotCell system receives signals from a wireless base station and re-transmits them to areas where cell phones do not work well due to obstructions or the remoteness of the location.

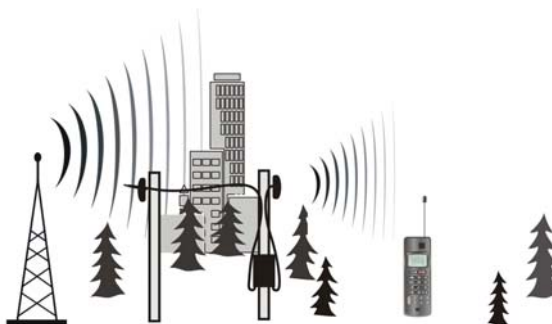


Figure 1.2 SpotCell improves wireless communications

The SpotCell™ 612 is a fully adaptive repeater that provides



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band-selective, on-frequency, out-of-building (and for specific applications - in-building) coverage in the PCS Band. It uses proprietary, patent-pending, adaptive techniques that allow SpotCell to be installed and operated without engineering intervention or support.



Chapter 2 – Getting Started

2.1 Required Equipment and Material

2.1.1 SpotCell 612 Adaptive Repeater Standard Kit

The SpotCell standard kit is shipped in 3 boxes containing:

- 1-Donor Unit (DU) - this unit communicates with the service provider's (Carrier's) existing mobile communications network.
- 1-HP Coverage Unit (HPCU) - this unit extends coverage to a nearby area where service is required.
- 1-Adaptive Repeater Unit (ARU) - this unit provides DC power to the DU and HPCU, automatically and adaptively controls gain so as to provide consistent coverage and protect the spectrum by guaranteeing protection from instability, provides a user interface for set-up and trouble shooting and a wireless network operations interface.
- 1-HPCU to ARU RG-11 Coaxial Cable (40-ft)
- 1-stand-by battery c/w thermal isolator



GETTING STARTED

- Mounting Kit which includes:
 - 1- ARU mounting bracket
 - 2- antenna pipe mount kits (for DU and HPCU)
 - 1- bag of hardware

Figure 2.1 below shows the SpotCell 612 system components.

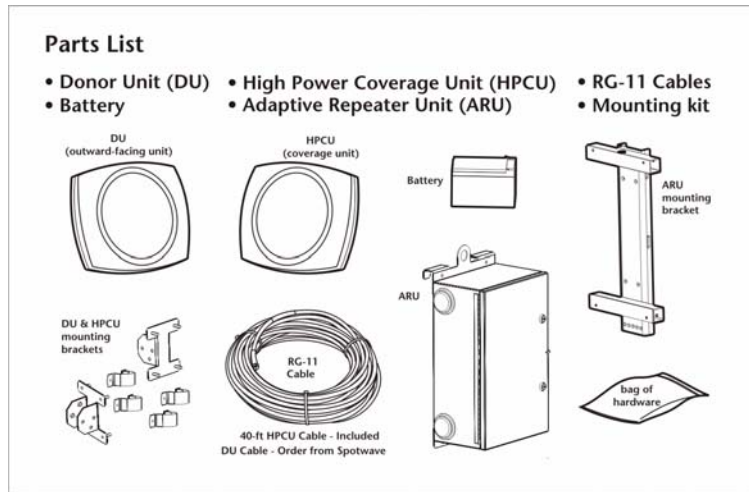


Figure 2.1 SpotCell 612 Adaptive Repeater Parts List

2.1.2 Required Additional Material - Order from Spotwave

- 1-DU to ARU RG-11 Coaxial Cable - this cable is ordered for the required length and application. Cable suitable for conduit installation is stocked. Inquire about the availability of aerial and direct bury cables.



2.1.3 Required Additional Material - Supplied by Installation Contractor

- DU and HPCU support structures (poles or towers)
- Stub pole for mounting ARU (where not installed on the HPCU support pole)
- All grounding network material (ground rods, ground wire, ground lugs, ground wire clamps, etc.)
- Conduit, ducts or poly-pipe as specified by the Carrier
- Antenna support pipes and hardware, these pipes attach to the antenna support poles, the DU and HPCU units attach to these pipes using the supplied pipe mounts.
- AC electrical service material (wire, conduit and disconnect switch, and if required - meter, meter socket, service wire, transformer, etc.)



2.2 Unpacking and Inspecting

Physically inspect the box for shipping damage before unpacking the SpotCell.

1. Remove the SpotCell components from the box.
2. Remove all packing material from the Donor Unit (DU) and the Coverage Unit (HPCU) and ARU (Adaptive Repeater Unit). Save the packaging in case the SpotCell is ever stored or shipped to SpotWave for service.
3. Check the contents of the package to make sure you have received everything ordered and verify that the mounting kit contains all the listed parts.
4. Check the DU, HPCU and ARU for shipping damage.



Chapter 3 – Performance Considerations

3.1 Overview

The DU is typically attached to a utility pole or tower, a non-penetrating roof mount support pipe, or the exterior wall of a building.

The HPCU is typically attached to a second utility pole or tower, a second non-penetrating roof mount support pipe, or the exterior wall of a building. For inside building coverage the HPCU may be wall or ceiling mounted.

This document focuses on applications using two utility poles. The use of two utility poles is typical for a 'right-of-way' (ROW) application. The goal of a ROW application is typically that of



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adding coverage to street and highway routes where coverage was previously not provided, such as down in a dip in the road for example.

There are 4 elements to an installation, 1) infrastructure installation, 2) HPCU and ARU installation, 3) DU alignment and system optimization and 4) installation completion.

Because utility pole installations often do not have AC power available at the pole, the infrastructure work is usually greater than for a roof-top application. Where this is the case, it would be best to have the infrastructure work complete before the SpotCell repeater installation begins. This permits the repeater installers to complete the installation in one visit and in minimum time.

However for locations where the repeater location is uncertain, the performance at two or more locations may wish to be checked and compared before any installation work starts.

3.1.1 Aerial Cable vs. Buried Cable

For some installations aerial coaxial cable c/w a steel support wire will be used. The steel support wire is attached to the pole using Carrier recommended hardware and methods. The aerial span is

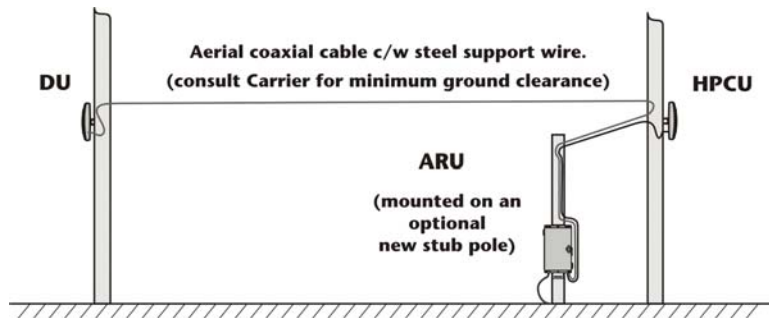


Figure 3.1 Aerial Installation c/w ARU Stub Pole



installed such that the Carrier specified ground clearance and power line separation distances are strictly observed. Figure 3.1 shows an aerial cable installation c/w the ARU mounted on an optional new stub pole.

Alternatively the ARU would be mounted on the HPCU support pole where permitted by the utility pole owner.

Other installations will use direct bury type coaxial cable - see Figure 3.2.

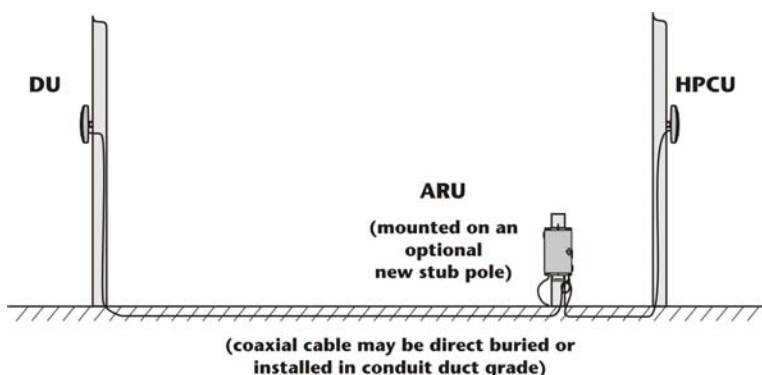


Figure 3.2 Buried cable c/w ARU Stub Pole

Said cable may be direct buried or installed in duct below grade. Consult the Carrier with respect to the requirements for the specific installation location.

For the vertical runs of the coaxial cable and ground wire, the Carrier may require one or both to be strapped directly to the pole, or installed in conduit attached to the pole. The means and method for attaching the cable to the pole, or the conduit to the pole may also be specifically specified by the Carrier.



3.1.2 ROW Infrastructure Installation

Includes:

1. Site acquisition.
2. New pole installation (if required).
3. New electrical service installation (if required).
4. Grounding network preparation.
5. DU and HPCU support pipe installation.
6. Installation of conduit or duct for the coaxial cable (as required).



3.2 Performance Factors

The following should be considered when installing a SpotCell system.

3.2.1 Mounting Height

Locating the DU as high as possible often provides a better connection to the service provider's PCS basestation. A DU mounting height above 18-ft above ground level (AGL) is recommended.

Locating the HPCU at a high height also usually improves coverage. The standard ARU to HPCU cable is 40-ft in length.

The ARU is located on or adjacent to the HPCU support pole.

In addition, increasing the DU to HPCU separation distance will increase isolation - this may also increase the coverage.

3.2.2 Signal Strength

The SpotCell system brings signals from an area of adequate coverage to an area with poor or non-existent coverage. It is the DU which captures a good signal, and the HPCU that provides the signal to the area with poor cell phone coverage.



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Note: For maximum coverage, a receive signal strength (RSS) of -85-dBm at the DU or higher is preferred. Although, not all installations require maximum coverage a RSS below -90-dBm is NOT recommended.
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3.2.3 Unwanted Obstacles

General placement of the DU and HPCU must be in unobstructed areas. Neither the front of the DU or the front of the HPCU should be directly obscured by buildings or trees. Large metal



apparatus such as transformers on utility poles or HVAC equipment found on building rooftops may also degrade performance.

3.2.4 Power Source

To reduce cost the SC612 repeater should be close to a suitable AC power source. If this is not practical, install a solar power system.

3.2.5 Azimuth Differential

Although ideally the DU and HPCU should face in opposite directions, i.e. a back to back configuration and azimuth differential of 180-dg. an azimuth difference between the two units of 90-dg or greater is recommended.

3.2.6 Wanted Obstacles

For a pole mounted SC612 repeater, the opportunity of selecting pole locations in order to take advantage of a physical obstacle between the DU and HPCU to improve RF isolation is not often practical.

For a roof-top located SC612 this is possible and should be done. The two units should be located on opposite exterior walls of the building, or opposite exterior walls on the roof-top penthouse.

For the two utility pole application with no obstacle between the poles, separate the poles 85-ft or more apart. The standard DU to ARU cable is 164-ft in length.

Walls constructed of dense materials (concrete, brick or metal) provide high isolation. However, such walls may also be a source of reflections and antenna pattern degradation. When locating the DU and HPCU avoid placement where such adjacent walls are significantly within the view of the antenna.



3.2.7 Aerial or Direct Bury Cable

Standard cable for the SC612 is RG-11. When ordering from Spotwave be sure to inquire about the cable installation type preferred.



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Note: Some Carriers prefer that cable installed below grade be placed within a conduit, duct or poly-pipe to simplify replacement and protect against ground freezing.
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Aerial cable requires an integrated steel support wire for hanging the cable between utility poles. Alternatively cable may be installed in steel supported duct.

‘Filled’ cable is needed for direct burial below grade, i.e. not in conduit, duct or poly-pipe. Such cable is flooded with a petroleum compound or a dry-fill powder for protection from water ingress.

The supply of suitable aerial and direct bury cables is limited. Call Spotwave for availability.



3.3 Approved Installation Methods

When planning an installation, consult the Carrier for approved installation methods. When arranging for the use of utility poles the Carrier and utility company will have developed a set of approved methods. Such methods may define:

1. Procedures for contacting and coordinating work with local Carrier or Utility personnel.
1. Minimum separation distances between SpotCell equipment and high voltage electrical lines.
2. Acceptable locations for new support poles and procedures for approval and installation.
3. Grounding network materials and installation methods - ground wire, ground rod, lightning arrestor and bonding.
4. Pole attachment methods for coaxial cables, ground wire and SpotCell equipment (DU, HPCU and ARU), and approved methods for aerial and direct buried cable installation.
5. AC power equipment, solar power equipment and installation methods.



3.4 Geographic Coordinates and Azimuth

The Carrier will specify the existing utility poles to be used. The general location may be defined using town names and street addresses, but the specific location is defined using geographic coordinates. GPS accuracy is to a resolution of 30-ft. Pole numbers will also usually be provided.

Geographic coordinates are needed as not all streets or roads are named or numbered, and poles do not have addresses. Also the Carrier's engineering database uses geographic coordinates.

Latitude and longitude coordinates have 3 parts - Latitude, Longitude and Datum. UTM coordinates have 4 parts - Northing, Easting, UTM Zone and Datum. UTM coordinates permit fast map location.

3.4.1 Map Datum

The earth is not a perfect sphere. The map datum is a means for adjusting for this. For the USA and Canada 2 map datums are used NAD27 and NAD82. The default datum for the world is WGS84. For the USA and Canada WGS84 and NAD83 are usually identical.

When using coordinates to find your location on a map you need to have your GPS receiver set to the datum that is printed on the map that you are using.

If the Carrier provides the coordinates in a datum different from the map datum, your GPS receiver may be used to translate them for you. This is done by entering the coordinates as a waypoint with the GPS configured for the datum which the carrier uses, then reconfiguring the GPS to the map datum and then recalling the waypoint from memory. The waypoint will then show the coordinates as per the map datum.



3.4.2 Lat./Long - Degrees Minutes Seconds Format

Lat.: 40° 37' 54.9", Long: 104° 56' 15.2", Datum: NAD27, or

Lat.: 40.37549, Long: -104.56152, Datum: NAD27

Both of the above formats are used. Disregard the Longitude sign.

3.4.3 Lat./Long - Decimal Degrees Format

Lat.: 40.63192, Long: 104.93756, Datum: NAD27

This is the same location as above but in decimal degree format.

3.4.4 UTM Coordinates

UTMs are sometimes referred to as military grid references. The following is the same location as given above:

Northing: 4497.687, Easting: 505.300, Zone:13, Datum: NAD27

Northing is the distance in kilometers from the equator, Easting is the distance in kilometers from the East boundary of Zone 13. Topographic maps are divided up into 1-km squares with Northings and Eastings labelled. Using a scale of 2-cm = 1-km any location can be quickly and accurately plotted on the map. This is difficult using Latitude and Longitude.

3.4.5 Topographic Map and GPS Receiver

Prior to visiting a site it is recommended that you acquire the applicable 1:50,000 scale topographic map and become familiar with setting your GPS receiver to NAD27 and NAD83 Datums.



3.4.6 Azimuth (Bearing)

The azimuth of a DU or HPCU is the direction that it points. It is given in degrees East (clockwise) from True North. True North is typically several degrees different from Magnetic North. This is called magnetic declination. It varies by location and changes a small amount each year.

The Carrier typically gives you the Azimuth in degrees relative to True North. This doesn't help if you want to align the HPCU using your magnetic compass. and you don't know what the declination is. However there is a method of determining the declination using your GPS receiver.

If you know the coordinates for the basestation that the Carrier wants the DU to be served by and the coordinates for the DU location, your GPS will tell you the magnetic azimuth that the DU should be aimed at, if your GPS is set for magnetic azimuths. On this setting it automatically takes into account the magnetic declination. So, if the Carrier specifies the azimuth for the DU to be 90-dg relative to true North (i.e. aimed due East) but your GPS gives you an azimuth of 100-dg magnetic. Then the declination is 10-dg.

So if the Carrier specifies that the HPCU is to be aimed at 270-dg (i.e. due West) then you will use you compass to aim the HPCU at an azimuth of 280-dg magnetic.

When using a compass be sure not to be close to large steel objects or a false alignment will result.



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Chapter 4 – Installation

This section is for typical for a typical ‘right-of-way’ application, where the DU and HPCU are to be mounted on separate utility poles, where the Carrier has specified the required azimuth and mounting heights, and where the required infrastructure work is already complete.

4.1 Safety

4.1.1 Work Site Safety



Warning! Before any work is started at the work site, take note of overhead and underground power lines, and any other dangers at the work site. Ensure safe separation distances from power lines, and safe working practices are followed at all times. When working near roads wear safety vests, white coveralls, and orange hardhats; also place warning signs, flags and traffic cones to warn motorists. Work facing traffic whenever possible and make use of a barrier vehicle for added protection.



Caution! If you are installing the SpotCell near high voltage power lines, or in any way are not sure about a safe installation, do not attempt to install it yourself. Call a professional installer, with the appropriate training and skills, for help.

4.1.2 RF Safety Statement

The SpotCell 612 repeater uses RF energy and complies with 47 CFR, Part 1.1310 , Radiofrequency Exposure Limits for fixed installations, pursuant to 47 CFR, Part 24.52 of the FCC rules and regulation for PCS equipment and 47 CFR, Part 1.1310(b).

Mount the intentional radiators, the DU and the HPCU, in locations where the general public will not approach within 1 meter (3.28-ft) of the location of either.



Caution! Occupational workers, such as electrical utility personnel and repeater service personnel, who are in a transient in front of the DU or HPCU should not be within 4-cm (1.6-in) of the front of the operating intentional radiator for more than 4.6-minutes.



4.2 ARU Installation

1. Mount the ARU hanger bracket on the HPCU support pole, or a near alternative. Consult the Carrier with respect to specific requirements. The bracket can be attached with four screws or three steel bands - see Figure 4.1.

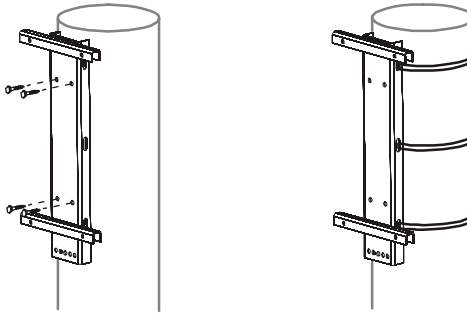


Figure 4.1 ARU Mounting Bracket Options (screw mount or steel band mount)

2. If necessary use a rope attached to the ARU eye bolt to lift and hold it while fastening it to the mounting bracket with the provided 4 bolts, nuts and washers as shown in Figure 4.2.

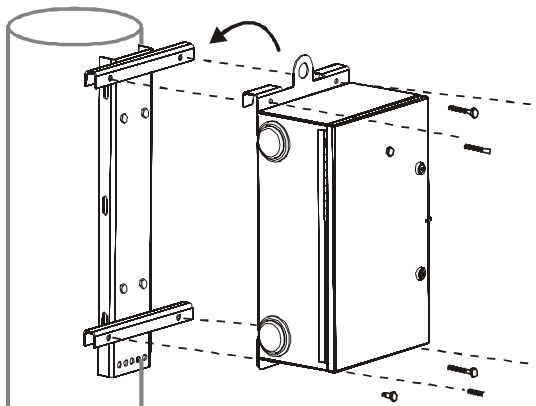


Figure 4.2 ARU Mounting



Caution! Connection of AC power to the ARU shall be done by a fully qualified licensed electrician (Steps 3 and 4).

3. Before connecting the AC power to the ARU ensure that the AC power source is de-energized and the disconnect switch feeding the ARU power circuit and cable is locked OFF.
4. Open the ARU front door using an Allen wrench and ensure that the ARU circuit breaker is in the open or OFF position. Loosen the two front panel screws and remove the lower front panel - see Figure 4.3.

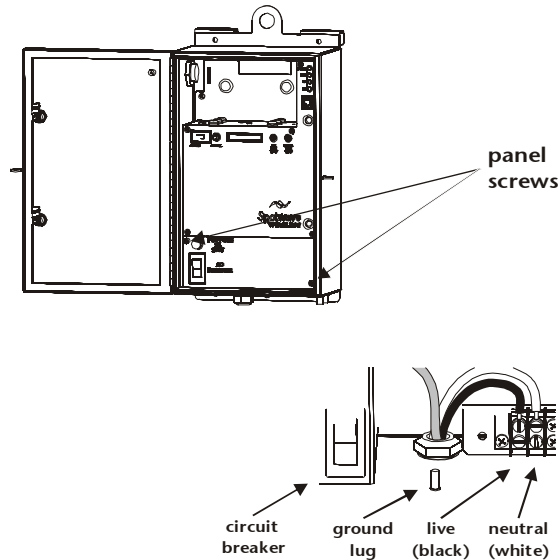


Figure 4.3 ARU Interior Panel and AC Power Connection

Loosen the dome nut on the weather proof 3/4-in conduit fitting at the bottom of the ARU cabinet. Route the AC electrical supply conduit and wire through the fitting. Tighten the dome nut until mild resistance is felt then tighten 1/4-turn additional for conduit (1/2-turn additional for cable not in conduit).



Connect the live (normally black) wire to the left side of the connector block, the neutral (normally white) wire to the right side of the connector block, and the ground (normally green) wire to the ground stud on the bottom of the ARU cabinet using a suitable ground lug.

Follow all local electrical code requirements.

5. Loosen the back-up battery clip screws and remove the battery clip - see Figure 4.4.

Connect the red wire to the battery positive (+) terminal and the black wire to the negative (-) terminal. Place the battery on the tray in the ARU cabinet and place the thermal insulator behind the battery.

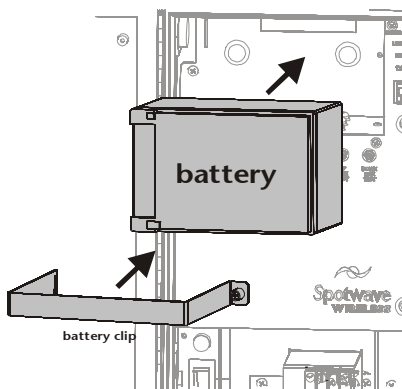


Figure 4.4 Battery installation

Replace and fasten the battery clip. Replace the ARU panel and fasten the panel screws.



Note: A fully discharged battery takes 6-hr to charge in the ARU. Batteries are shipped charged.

6. Bond the external ARU cabinet ground stud to the HPCU support pole ground network if the ARU and HPCU are collocated on the same pole, i.e. not collocated but



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connected below grade by buried cable or cable in duct and are less than 12-ft apart - see Figure 4.5. Use a suitable ground lug.

Otherwise bond the ground wire to an ARU ground rod installed at the base of the ARU support. For addition details - see the Grounding Note below.



Note: If the grounding infrastructure work was not done earlier, contact the Carrier to confirm ground wire size and type, and the grounding network requirements for both the HPCU and DU. In general the minimum is #6-AWG bare copper ground wire bonded to a 5/8-in x 10-ft copper clad ground rod c/w suitable ground pipe clamp placed at or near the base of both the HPCU and DU support poles. Mechanical protection of the ground wire may be required. Ensure that local code requirements are met.

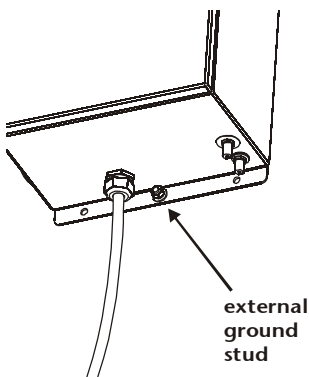


Figure 4.5 ARU Cabinet Ground Stud



4.3 HPCU Installation

1. Fasten the HPCU mount to the HPCU mounting pipe at the Carrier specified mounting height, using the provided clamps - see Figure 4.6 (same mounting hardware for both the HPCU and the DU).

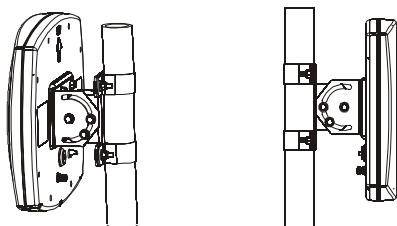


Figure 4.6 HPCU and DU Pipe Mount

Using a magnetic compass orient the mounting bracket so that when the HPCU is attached it will be aimed at the Carrier specified azimuth. Provide for the angular difference between True North and Magnetic North. When aimed correctly tighten the pipe clamp.

2. Fasten the HPCU to the pipe mount bracket using the provided nuts and washers.
3. Install the provided 40-ft RG-11 ARU to HPCU coaxial cable, and supply and install the HPCU ground wire, as per the Carrier specified requirements.



Note: *The maximum recommended HPCU cable length is 50-ft.*

For some installations the coaxial cable and ground wire will be strapped directly to the pole, for others it will be installed in conduit attached to the pole. If the ground wire is inside a metallic conduit then both ends of the conduit must be bonded to the ground wire.



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4. Connect the HPCU coaxial cable (the 40-ft cable with green boots) to the green RF port on the underside of the ARU cabinet - see Figure 4.7.

A drip loop in the coaxial cable is needed if the cable at the back of the HPCU does not slope down from the HPCU. Maintain a minimum bend radius of 3-in. A drip loop is shown on the right in Figure 4.7.

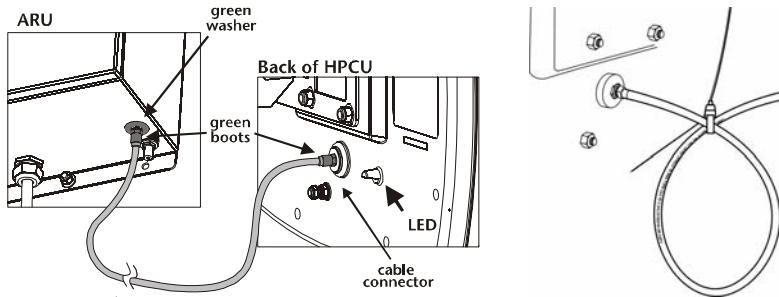


Figure 4.7 ARU to HPCU Cable and Drip Loop

Include slack for minor alignment adjustments. Use a wrench to tighten all coax connectors 1/4 turn past finger tight.

5. Bond the HPCU to ground using the installed ground wire.

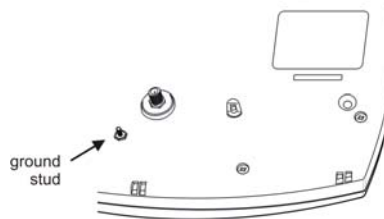


Figure 4.8 Ground stud (HPCU and DU)



At the base of the HPCU pole the ground wire is bonded to the ground rod or network, at the HPCU the ground wire is attached to the ground stud on the HPCU, see Figure 4.8. Use suitable ground lugs and ground rod clamp.



4.4 Alignment

4.4.1 Preparation

1. Temporarily connect the ARU to DU coaxial cable - see Figure 4.9. The DU support pole is typically over 80-ft from the HPCU support pole. Connect one end of the provided 160-ft RG-11 cable to the remaining RF port on the ARU, and the other end to the back of the DU. During alignment testing the DU will be handheld.

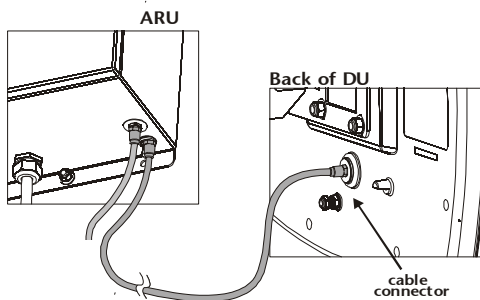


Figure 4.9 ARU to DU Coaxial Cable Connection

2. Set the ARU Mode switch to INSTALL mode (right position - opposite of ACTIVE). Energize the AC power cable feeding the ARU, and set the ARU circuit breaker to the closed (ON) position - see Figure 4.10.

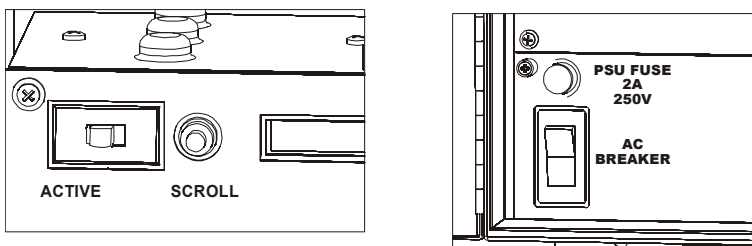


Figure 4.10 ARU Mode Switch, Scroll Push button and Circuit Breaker/Power Switch

The HPCU LED turns green and stays on as long as it has power.



4.4.3 Alignment Overview

This work locates and aims the DU so that for maximum coverage potential is provided. For some installations this work may also result in a minor HPCU alignment change being made.

A bucket truck is recommended for lifting the DU and installer up to the proposed DU location(s). Observe all appropriate safety measures.

4.4.4 Coverage Potential

For maximum coverage potential, a receive signal strength (RSS) of -85-dBm at the DU or better is needed. When the RSS is weak DU to HPCU isolation is very important. The more the DU and HPCU approach a back-to-back orientation and/or the further the two units are apart, the greater the isolation and coverage potential.

4.4.5 Alignment Options

If the Carrier has specified that the DL basestation signal that the DU is to use will be a non-dominant signal (i.e. non-dominant PN code), then skip Section 3.5 (Dominant Alignment) and jump to Section 3.6 (Non-Dominant Alignment).



4.5 Dominant Alignment

1. **ROTATION #1.** At the proposed DU mounting location and height, hold the DU upright pointing away from your body. Rotate it in a full circle - see Figure 4.11. A time of 20 seconds is appropriate to complete the rotation. Ignore the DU LED indication - see Figure 4.11.

If a full rotation is not practical rotate it within the constraints allowed, but be sure to include the azimuth specified by the Carrier for the DU.

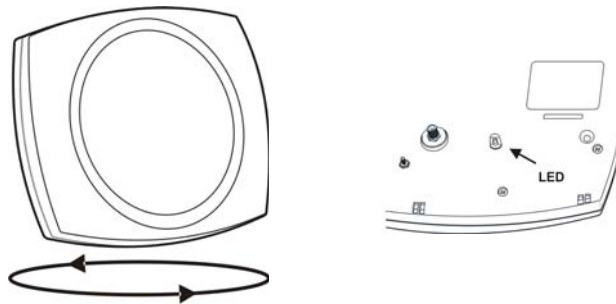


Figure 4.11 DU Alignment Using LED Indicator

2. **ROTATION #2.** Repeat the rotation of the DU but now monitor the LED - see Figure 4.11. Take note of the azimuths that show a GREEN LED - there may be more than one range of azimuths where the LED is GREEN.

Table 1. DU LED Indications

RED LED	Unusable DU DL signal
YELLOW LED	Usable DU DL signal
GREEN LED	Better DU DL signal



Note: For a dominant carrier the Carrier specified azimuth for the DU will fall within the GREEN. If this is not the case jump to Section 3.6, Non-Dominant Alignment.



3. Have your assistant use the SCROLL button on the ARU to access the ACT/ALT indication on the ARU LCD display, then monitor the ACT signal level. The ACT reading is the wanted downlink RSS in dBm.
4. **OPTIMIZE SIGNAL STRENGTH.** Start by holding the DU at the proposed mounting location and height, and aimed to receive a GREEN LED indication. This alignment should roughly approximate the carrier specified azimuth. Have your assistant read out for you the ACT signal level while you fine tune the aim of the DU so as to optimize the signal strength.
5. **OPTIMIZE COVERAGE.** While holding the DU where the RSS is maximum, have your assistant set the ARU Mode switch to ACTIVE mode then SCROLL the ARU display to the RSS/Coverage bar graph display as shown below. Carefully adjust the aim of the DU to increase the number of coverage bars.



Note: Maximum coverage potential is indicated when 5 bars are displayed on the Coverage bar graph (see left - lower display). Coverage is proportional to both the RSS (the top bar graph display) and the DU to HPCU isolation.

6. HPCU and DU optimization. If maximum coverage cannot be achieved by modest DU positioning adjustments alone, make a modest adjustment to the HPCU orientation then repeat steps 1 to 5. Limit the HPCU azimuth change to 15-dg, maximum.
7. Alternate DU mounting height and/or location. Return the HPCU to the original position and try a higher or lower DU mounting height then repeat steps 1 to 5. Do not work at locations which are unsafe. Always maintain minimum power line clearance distances.
8. When an optimum DU position and alignment is determined, attach the DU to its mounting pipe using the provided hardware, then tighten the mounting bolts for both it and the HPCU - while ensuring that both the DU and the HPCU remains optimally aligned. Jump to Section 4.7.



4.6 Non-Dominant Alignment

1. Have your assistant use the SCROLL button on the ARU to access the ACT/ALT indication on the ARU LCD display, then monitor the ACT signal level. The ACT reading is the wanted downlink RSS in dBm.
2. Using a magnetic compass identify an object several hundred feet from the DU pole that is on the azimuth that the Carrier has specified for the DU to be aligned at.
3. While initially aiming the DU at the previously said identified object and holding it at the proposed mounting location and height, have your assistant read out for you the ACT signal level while you fine tune the aim of the DU so as to optimize the signal strength. Limit the DU azimuth variance with respect to the Carrier specified azimuth to 15-dg, maximum.
4. While holding the DU where the RSS is maximum, have your assistant set the ARU Mode switch to ACTIVE mode then SCROLL the ARU display to the RSS/Coverage bar graph display as shown below. Carefully adjust the aim of the DU to increase the number of coverage bars.



Note: Maximum coverage potential is indicated when 5 bars are displayed on the Coverage bar graph (see left - lower display). Coverage is proportional to both the RSS (the top bar graph display) and the DU to HPCU isolation.

5. If maximum coverage cannot be achieved by modest DU positioning adjustments alone, make a modest adjustment to the HPCU orientation then repeat steps 1 to 4. Limit the HPCU azimuth change to 15-dg, maximum.
6. Alternate DU mounting height and/or location. Return the HPCU to the original position and try a higher or lower DU mounting height then repeat steps 1 to 4. Do not work at locations which are unsafe. Always maintain minimum power line clearance distances.



-
7. When an optimum DU position and alignment is determined, attach the DU to its mounting pipe using the provided hardware, then tighten the mounting bolts for both it and the HPCU - while ensuring that both the DU and the HPCU remains optimally aligned.



4.7 Installation Completion

1. Install the RG-11 ARU to DU coaxial cable, as per the Carrier specified requirements. This cable is typically 164-ft in length. It is not in the SpotCell system kit. It is ordered from Spotwave at the same time the system is ordered.
2. Connect the DU end of the coaxial cable to the DU as shown on the left in Figure 4.12. If the cable runs directly down the pole from the DU a drip loop is not required. Connect the ARU end of the ARU-DU cable to the remaining RF port on the ARU.

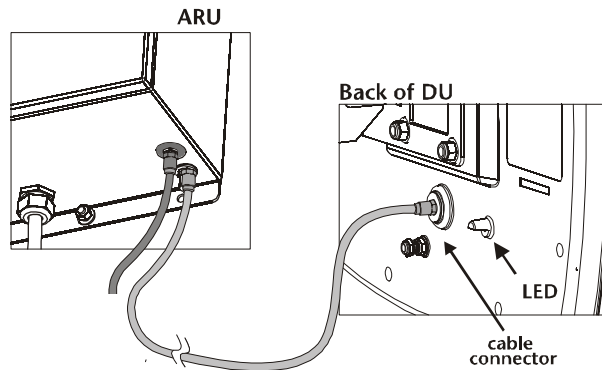


Figure 4.12 ARU to DU Cable (the long cable)

Use a wrench to tighten all coax connectors 1/4 turn past finger tight.

3. Bond the DU to ground using the installed ground wire. At the base of the DU pole the ground wire is bonded to the ground rod or network, at the DU the ground wire is attached to the ground stud on the DU, see Figure 4.8. Use suitable ground lugs and ground rod clamp.



Chapter 5 – Display Information

5.1 DU & HPCU LED Indicators

5.1.1 DU

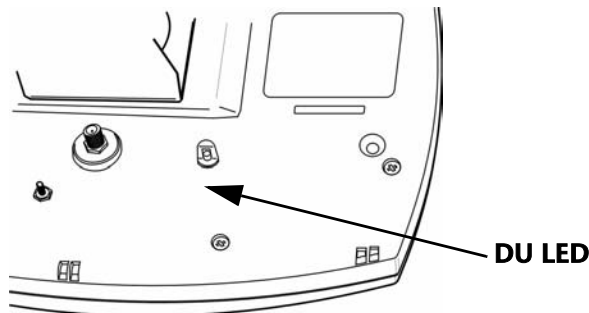


Figure 5.1 DU and HPCU LED locations

The following DU LED indications are only valid during the second complete rotation of the DU.

- **LED is RED:** the DU is not capturing an adequate enough signal for the system to operate. Will also show RED when signal is too strong (not expected to be a common situation).



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- **LED is YELLOW:** the captured signal is within range and the system will function, but the DU is NOT aligned to capture the strongest signal available at its current location. NOTE: the service provider (Carrier) may specify that the DU be aligned to a basestation site (azimuth) that does not produce the strongest signal.
- **LED is GREEN:** during the second rotation of the DU this indicates that the DU is nearly optimally aligned for the current location. A minor alignment adjustment may be needed, using the ARU LCD signal strength and coverage display as indicators of optimum alignment.

5.1.2 HPCU

The HPCU LED also indicates three conditions. They are:

- **LED is OFF:** no DC power supply present
- **LED is RED:** power present + system alarm condition
- **LED is GREEN:** power present + no alarm condition



5.2 ARU LCD Action Messages

The ARU LCD display shows two types of messages. Action messages and standard messages.

Action messages provide guidance to the installer. Their display on the LCD is controlled by the adaptive algorithm. Examples were given previously in this Chapter.

The ARU LCD displays system status and signal strength. The signal strength is indicated by the signal strength bars (▽ ▯▯▯) and the coverage strength is indicated by the coverage bars (▣ ▯▯▯).

Table 1 shows the various action messages, and if necessary what action should be taken.

TABLE 1. LCD Action Messages

MESSAGE 1	MESSAGE 2 (alternates with Message 1)	ACTION REQUIRED or COMMENTS
▽ ▯▯▯ CHxxx INSTALL MODE	Weak Signal Try turning DU	DU is not optimally positioned. Realign the DU to another azimuth.
Poor Signal INSTALL MODE	Poor Signal Try Turning DU	System will not function. Realign the DU to another azimuth.
Signal Overdrive INSTALL MODE	Signal Overdrive Try Turning DU	RSS too strong. Realign the DU to another azimuth.
OUT OF SERVICE System Fault	CHECK CABLE CONNECTIONS	
OUT OF SERVICE System Fault	CALL PRODUCT SUPPORT	Telephone Service Line: 1-877-610-9586
▽ ▯▯▯ CHxxx ▣ ▯▯▯ MOVE HPCU	none	Increase isolation by moving HPCU.
▽ ▯▯▯ CHxxx ▣ ▯▯▯ In Service	none	Signal weak and coverage poor. Improve RSS & improve isolation.
▽ ▯▯▯ CHxxx ▣ ▯▯▯ In Service	none	Signal weak but coverage good. No action required.
OUT OF SERVICE Poor Isolation	OUT OF SERVICE Try moving HPCU	Increase isolation by moving the HPCU (DU only if necessary).



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TABLE 1. LCD Action Messages

 CHxxx In Service	none	All OK No action required
OUT OF SERVICE Loss of Signal	OUT OF SERVICE Searching.. .	Temporary loss of service. No action required.
OUT OF SERVICE Loss of Signal	OUT OF SERVICE Try turning DU	24 hr loss of service. Realign or relocate the DU.



5.3 ARU LCD Standard Messages

Standard messages are available at all times. They are shown in Table 2.

Standard LCD displays are those that are available at all times. An example is given below. The actual displays may change with the Software version.

There are 15 standard displays. Only one display is available at a time. The displays appear in the order shown. They are accessed by pressing the ARU SCROLL push button. The order of the displays is as shown in Table 2.

TABLE 2. ARU LCD Standard Messages

MESSAGE (with example)	DESCRIPTION
ACT SIG: -85dBm ALT SIG: -79dBm	In-band (ACTive) signal level (at DU, measured at HPCU) In-band (ALTerate) signal level (at DU, measured at HPCU)
ISOLATION (15) BACK-OFF: 0dB	(nn) Downlink Signal Quality Index ^{a,b,c,d} (SQI) Downlink gain reduction due to limited DU to HPCU isolation
DL GAIN: 109dB UL GAIN: 99dB	System gain on downlink System gain on uplink (approx. 10-dB less than downlink gain)
DVOUT: nnnmV UVOUT: nnnmV	Spotwave Use
DVSET: nnnmV UVSET: nnnmV	Spotwave Use
DVCTL: nnnmV UVCTL: nnnmV	Spotwave Use
START: 1950.00MHz STOP: 1965.00MHz	Indicates start frequency of downlink in-band signal Indicates stop frequency of downlink in-band signal
PCB TEMPERATURE 55 ° C	Spotwave Use
WORKING TIME 0d 00h15:44	Indicates days/hours/minutes since last power up
ELAPSED TIME 10days 13hr	Indicates total time in days/hours for system operation
HPCU V 8.08 V DU V 10.5 V	Indicates DC supply voltage at input to the HPCU and DU coaxial cables respectively.



TABLE 2. ARU LCD Standard Messages

- For $SQI > 80$, do not install the DU at this position.
- For $SQI > 59$, try another DU location
- For $SQI < 60$, < 3 -dB back-off. Good downlink signal quality.
- For $SQI < 20$, 0-dB back-off. Excellent downlink signal quality.

Display 1 indicates the carrier level into the DU as measured at the ARU. The ACTIVE carrier is the wanted in-band signal and the ALTERNATE is the unwanted out-of-band signal level (before filtering).

Display 2 confirms the quality of the installation with respect to its potential to deliver rated coverage. Coverage may require the installer to optimize the DU and HPCU locations. An optimal DU location will deliver a strong, high quality downlink signal that exhibits minimum fading. Success in this is indicated on the ARU display via the Signal Quality Index or SQI on Display 2 (as shown in Table 2). On the LCD, SQI is labelled as “ISOLATION (nn)”. High quality downlink signals have an SQI less than 60.

Where available isolation is less than the gain required to achieve rated output power, the system gain is reduced by the adaptive algorithm to ensure stability. The resulting gain reduction is



labelled as back-off on the LCD Display 2. Back-off is displayed in dB units.

When isolation is high, ACT RSS is high, ALT RSS is not excessive and fading is minimum, and isolation is adequate - the adaptive algorithm will deliver rated output power. However, maximum coverage will be delivered, if and only if, the installer has located and oriented the HPCU such that it provides the coverage where it is needed. That is, located where the HPCU antenna pattern matches the required coverage area with no significant RF dense materials in the way.

Standard Display 3 - Downlink & Uplink Gain

Display 3 in Table 2 indicates the actual gain provided for both the downlink and uplink directions. The indicated gain will be high only if high gain is needed (due to a low downlink RSS) and the SQI is good.

Standard Displays 4 to 15

Displays 4 to 13 shown in Table 2 are not important to the installer and not discussed here. Display 15 identifies the Spot-Cell™ Software version.



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Appendix A – SpotCell 612 Specifications



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Note: Spotwave Wireless has the right to change specifications without notice.
.....

A.1 Compliance

The SpotCell 612 repeater uses RF energy and complies with 47 CFR, Part 1.1310, Radiofrequency Exposure Limits for fixed installations, pursuant to 47 CFR, Part 24.52 of the FCC rules and regulation for PCS equipment and 47 CFR, Part 1.1310(b).



A.2 Antennas:

TABLE A1. Antenna Specifications

	DU Antenna	HPCU Antenna
Gain (dBi)	11.5	11.5
Elevation Beamwidth - typical (dg)	36	36
Azimuth Beamwidth - typical (dg)	46	46
Front-to-Back Ratio (dB)	26	26
Polarization	Vertical	Vertical

A.3 Architecture

TABLE A2. System Specifications

Frequency Band of Operation	Uplink: 1850-1890 MHz Downlink: 1930-1970 MHz
Formats Supported	PCS CDMA
Coverage	Fully adaptive, supports multiple simultaneous users Outdoor Range: to 825-ft Indoor Range: Up to 50,000-ft ² in large open areas
System Gain	Automatic, fully adaptive, Maximum 115-dB downlink (for Downlink input of -91 dBm EIRP), Maximum 105-dB uplink Minimum 68-dB downlink (for Downlink input of -44 dBm EIRP), Minimum 58-dB uplink Rated Downlink output per carrier is always +24 dBm
Downlink Operating Range	-96 to -44 dBm (receive isotropic power) - coverage reduced at levels below -91 dBm
Input Overload Protection	Uplink: Fully adaptive Downlink: Fully adaptive
Maximum Output Levels (radiated)	Uplink: 30-dBm EIRP maximum (composite) Downlink: 30-dBm max (composite), managed per channel at 24-dBm per channel) Rated Downlink output per carrier is +24 dBm (for a maximum of four carriers. If number of carriers exceeds four, per carrier power is reduced such that composite downlink output is always +30 dBm EIRP)
Typical 20dB BW	Customer specific: 5.37-MHz, 10.74-MHz, 16.1-MHz (nominally 5-MHz, 10-MHz and 15-MHz respectively)
Third Order Intercept (radiated)	Uplink: 45-dBm EIRP Downlink: 45-dBm EIRP
Power Supply	AC Input Voltage Range: 90-V to 130-V rms, 50 to 60-Hz



TABLE A2. System Specifications

Power Consumption	50-W (heater OFF) 125-W (heater ON)
Standby Battery Time	2-hr. (heater disabled)



A.4 Physical

TABLE A3. I Physical Specifications

Operating Temperature	DU & HPCU: -40° to +55° C ARU: -40° to +55° C (with heater)
Size	DU & HPCU: 14"w 10.5" h 3.5" d ARU: 10" w 18"h 7" d
Weight	DU & HPCU: 4-lb. ARU c/w battery: 25-lb.
RF Connectors & Impedance	Type F 75-ohm
RF Cable	2-RG-11 Quad shielded required, 1-41'supplied 1- ordered for required length (System supports up to 164 ft. or 50 m)

A.5 Installation

TABLE A4. Installation Requirements

Installation Time	Less than one hour typical
Outdoor Unit Alignment	No prior knowledge of base station location required Built in alignment algorithm (LED Indicator on outdoor unit)
Test Equipment	None required No RF knowledge required for installation
User Controls	None, setup and operation is fully automatic

Diagnostics

TABLE A5. Diagnostic Tools

Fault Indicators	LED on DU (installation only) LED on HPCU (during normal operation) ARU (wireless modem, LCD display, AC power light)
Remote Connectivity	Ethernet port on ARU and wireless modem
System Interrogation	Multifunction LCD indicator ARU



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