



BreezeAIR

Installation and Operation Instructions

September 2021

The information contained in this document is of commercial value, proprietary to Telrad Networks. It is conveyed to the recipient solely for the purpose of evaluation. Reproduction of this document, disclosure of its contents or any other use of the information herein is strictly forbidden unless expressly authorized in writing by Telrad Networks.

Telrad Networks Ltd.
1 Bat Sheva Street
P.O.Box 6118
Lod 7120101, ISRAEL
Tel: 844-4-TEL RAD
marketing@telrad.com

Notices

Radio Frequency Statement

BreezeAIR has been tested and found to comply with part 15 of the FCC rules and EN 301 489-1 rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment notwithstanding use in commercial, business and industrial environments. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT!	The device must be installed only for fixed, Point-to-Point or Point-to-Multipoint operations per 15.247(c)(1)(iii)
-------------------	---

IMPORTANT!	It is the responsibility of the installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), 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 to FCC rules CFR47 part 15.204.
-------------------	--

IMPORTANT!	Outdoor units 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 the product warranty and may expose the end user or the service provider to legal and financial liabilities. Telrad Networks and its resellers or distributors of this equipment are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.
-------------------	--

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

R&TTE Declaration on Conformity



Hereby, Telrad Networks Ltd, declares that BreezeAIR is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity may be consulted through Telrad Networks Ltd., 1 Bat Sheva Street, Lod 7120101, ISRAEL.

Compliance with European Union WEEE Directives

In January 2003, the European Union adopted an important environmental directive -- the Directive on Waste Electrical and Electronic Equipment (WEEE). It represents an important milestone in providing a safer environment for future generations.

The WEEE label and instructions for disposal are as follows:

Instructions for Disposal of Waste Equipment by Users in the European Union

This symbol on the product or its packaging indicates that this product must not be disposed of with other waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact Telrad Networks.



Caution! Hot surface – Instructional safeguard

BreezeAir is designed to operate also in high temperature environment. On such conditions, do not touch the device without taking care.



Warranty

Telrad Networks warrants that this product shall be free from defects in workmanship and materials for a period of one year from the date of original purchase. If the product should fail to operate correctly in normal use during the warranty period, Telrad Networks will replace or repair it free of charge. No liability can be accepted for damage due to misuse or circumstances outside Telrad Networks's control. Telrad Networks will not be responsible for any loss, damage or injury arising directly or indirectly from the use of this product. Telrad Networks's total liability under the terms of this warranty shall in all circumstances be limited to the replacement value of this product.

If any difficulty is experienced in the installation or use of this product that you are unable to resolve, please contact Telrad Networks.

TABLE OF CONTENTS

NOTICES.....	2
1. INTRODUCTION	6
1.1 BREEZEAIR APPLICATIONS	6
2. INSTALLATION	7
2.1 PACKING LIST	7
2.2 ADDITIONAL PART LIST – REQUIRED FOR INSTALLATION	7
2.3 INSTALLATION OVERVIEW	8
2.3.1 <i>Select the best location</i>	9
2.3.2 <i>Mounting</i>	10
2.3.3 <i>Antennas</i>	12
2.3.4 <i>Alignment</i>	15
2.3.5 <i>Sealing</i>	16
2.3.6 <i>Cables</i>	17
2.3.7 <i>Indoor POE installation</i>	18
2.3.8 <i>Grounding</i>	19
2.4 CONSECUTIVE AP CONNECTION	20
2.5 SYNCHRONIZATION	21
3. BREEZEAIR TECHNICAL SPECIFICATIONS.....	22
4. BREEZEAIR NET THROUGHPUT (MBPS)	23
4.1 BREEZEAIR 8000 MIMO & SISO	23
4.2 BREEZEAIR ACE	23
5. APPENDIX A – OUTDOOR CABLES SCHEME	24
6. APPENDIX B – RF CHANNEL LISTS	25
6.1 BREEZEAIR 8000 FCC OPERATING BAND: 5725-5850MHZ	25
6.2 BREEZEAIR 8000 FCC OPERATING BAND: 4940-4990MHZ	25
6.3 BREEZEAIR 8000 FCC OPERATING BAND: 2496-2690MHZ	26
6.4 BREEZEAIR ACE FCC OPERATING BAND: 5725-5850MHZ	26
6.5 BREEZEAIR OPERATING BANDS IN MEXICO	26
7. APPENDIX C – FCC APPROVED ANTENNAS	27
8. APPENDIX D – LIGHTNING PROTECTION	28
8.1 BREEZEGUARD LIGHTNING PROTECTION	29

TABLE OF FIGURES

Figure 1-1: BreezeAIR PTMP (blue) and PTP (red)	6
Figure 2-1: General System View	7
Figure 2-2: BreezeAIR - General Installation Scheme.....	8
Figure 2-3: BreezeAIR basic mounting kit.....	10
Figure 2-4: BreezeAIR advanced mounting kit	11
Figure 2-5: Cable preparation for Outdoor Unit	17
Figure 2-6: Cable connection to Outdoor Unit	17
Figure 2-7: BreezeAIR PoE	18
Figure 2-8: Ground Connection to Outdoor Unit	19
Figure 2-9: Consecutive link principle	20
Figure 2-10: External time synchronization	21
Figure 2-11: Internal time synchronization	21
Figure 4-1: BreezeAIR 8000 MIMO & SISO net capacity	23
Figure 4-2: BreezeAIR ACE net capacity	23
Figure 5-1: Outdoor Cables Scheme	24
Figure 6-1: BreezeAIR 8000 FCC 5GHz RF channel List	25
Figure 6-2: BreezeAIR ACE FCC 5GHz RF channel List.....	26
Figure 7-1: BreezeAIR 5GHz integrated/external antennas	27
Figure 7-2: BreezeAIR 2.5GHz integrated/external antennas	27
Figure 8-1: Lightning protection scheme	28
Figure 8-2: BreezeGuard ports.....	29

1. Introduction

Thank you for purchasing BreezeAIR solution. Telrad Networks's BreezeAIR series is a carrier-grade point-to-point and Point-to-multipoint broadband wireless solution that sets a benchmark of unrivaled performance, reliability, capacity, latency and RF robustness, making it the ultimate choice for future-proof wireless system.

1.1 BreezeAIR applications

Point-to-Point (PTP):

The basic subsystem is composed of a Master Unit (MU) and a Slave Unit (SU).

Typical applications:

- IP data backhaul of:
 - WiMAX/LTE operators
 - Metro WiFi Networks
 - Cellular and 3G
- Video surveillance networks
- Multi-hop solutions

Point-to-Multipoint (PTMP):

The basic subsystem is composed of one Master Unit (MU) and multiple Slave Units (SUs).

Typical applications:

- Multiple backhauls solutions
- IP video surveillance and security networks
- Business grade wireless access
- Backbone for Metro WiFi Networks
- High bandwidth campus solutions

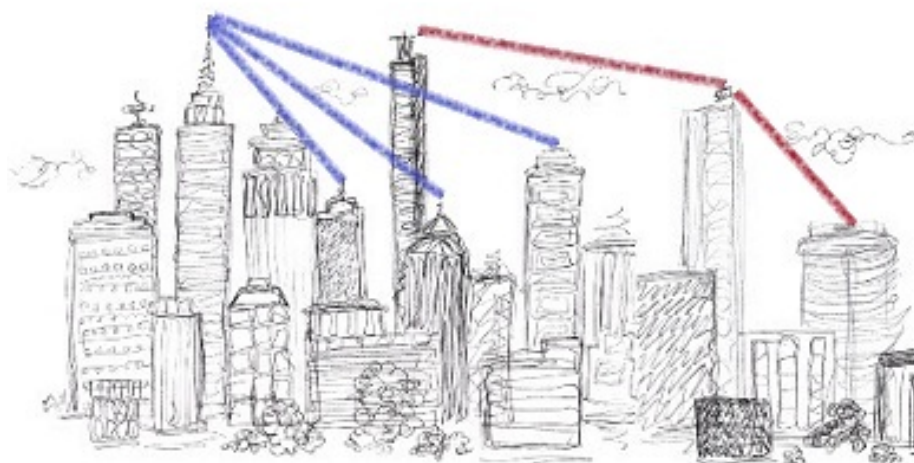


Figure 1-1: BreezeAIR PTMP (blue) and PTP (red)

2. Installation

2.1 Packing list

When you first open the package, verify that the unit is complete with the following components:

1. Outdoor Unit – BreezeAIR MU or SU.
2. Indoor PoE power supply.
3. Pole mounting kit (will not be added for units that require advanced mounting kit).

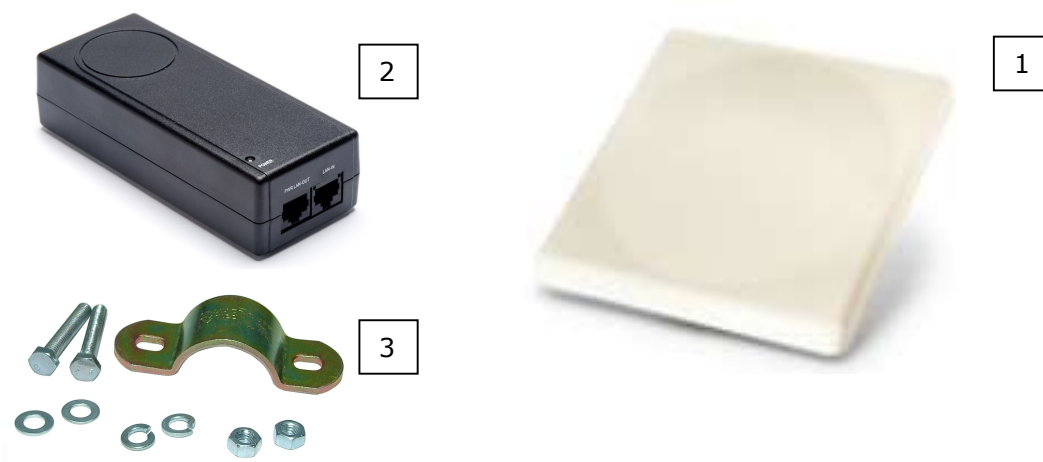


Figure 2-1: General System View

2.2 Additional part list – required for installation

- Outdoor Unit grounding cable
- Outdoor-to-Indoor shielded CAT5 cable (up to 100 meters).
- Indoor CAT5 cable.
- RJ-45 - Installation KIT.
- RJ-45 - Crimping tool.
- Adjustable wrench + screwdriver.

2.3 Installation overview

This section provides installation information for BreezeAIR system.

Note: Outdoor units 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 the product warranty and may expose the end user or the service provider to legal and financial liabilities. Telrad Networks and its resellers or distributors of this equipment are not liable for injury, damage or violation of regulations associated with the installation of outdoor units or antennas.

Typical installation scheme:

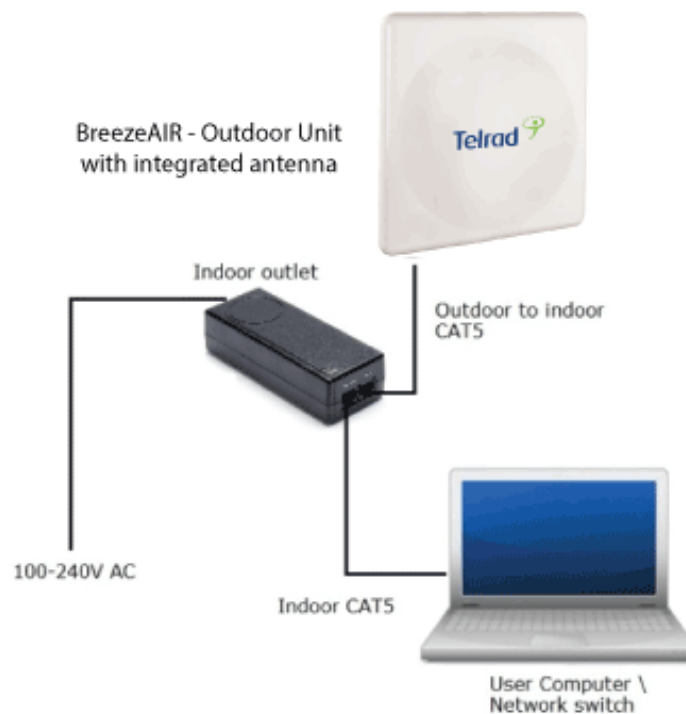


Figure 2-2: BreezeAIR - General Installation Scheme

Installation process summary:

- 1) Select the appropriate location for the Outdoor unit and the indoor PoE Outlet.
- 2) Mount the Outdoor unit (RJ-45 ports facing down). When using external antenna, mount the antenna and connect it to the Outdoor unit.
- 3) Connect a ground cable between the Outdoor unit and an appropriate grounding point.

- 4) Connect the Outdoor-to-Indoor shielded CAT5 cable to the Outdoor unit and route it to the selected location of the PoE. Assemble the enclosed connector on the cable.
- 5) Mount the Indoor POE and connect:
 - Outdoor-to-Indoor cable to the '*PWR LAN-OUT*' port.
 - CAT5 Ethernet cable (from network) to the '*LAN-IN*' port.
 - AC Input to the power (100-240VAC).
- 6) Align the antenna and secure the unit by fastening the mounting screws.

2.3.1 Select the best location

Select the best location for the outdoor unit using the following guidelines:

- The outdoor unit can be pole or wall mounted.
- The location should allow easy access to the unit for installation.
- When using an external antenna, the unit should be installed as near as possible to the antenna.
- Make sure clear Line of Sight between the sites.

Path of clearest propagation

A propagation path is the path that signals traverse between the antennas of any two bridges. The "line" between two antenna sites is an imaginary straight line, which may be drawn between the two antennas. Any obstacles in the path of the "line" degrade the propagation path. The best propagation path is, therefore, a clear line of sight with good clearance between the "line" and any physical obstacle.

Physical obstacles

Any physical object in the path between MU and SU may cause signal attenuation. Common obstructions are buildings, trees and hills located in the path between the two sites. Install outdoor antennas high enough to avoid any obstacles, which may block the signal.

Minimal path loss

Path loss is determined by several factors:

- **Distance between sites** – Path loss is lower when distance between sites is shorter.
- **Clearance** – Path loss is minimized when there is a clear line of sight. The number, location, and size of obstacles determine their contribution to path loss.
- **Antenna height** – Path loss is lower when antennas are positioned higher. Antenna height is the distance from the imaginary line connecting the antennas at the two sites to "ground" level. "Ground" level in an open area is the actual ground. In dense urban areas, "ground" level is the average height of the buildings between the antenna sites.

Minimizing path loss maximizes link's signal strength, throughput and availability.

2.3.2 Mounting

Note: A distance of at least 250cm between the equipment and all persons should be maintained during the operation of the equipment.
Une distance d'au moins 250cm entre l'équipement et toutes les personnes devraient être maintenues pendant le fonctionnement de l'équipement

2.3.2.1 Basic mounting kit

BreezeAIR basic mounting kit features:

- Azimuth Adjustable Mount
- Suitable for pole mounting 1-2"
- Made of galvanized steel
- Heavy duty

Packing list

Item	Qty	Description
1	1	Mounting Bracket 1.25"
2	2	Spring Lock Washer 5/16"
3	2	Plain Washer 5/16"
4	2	Hex Nut 5/16"
5	2	Hex Cap Screw 5/16-18 x 2"



Basic mounting kit installation

- Place the bracket on the pole, as illustrated in the picture
- Attach the bracket to the radio's enclosure using the screws and washers.

Note: The depth of the enclosure's threads is about 1cm. Do not use excessive force when tightening the screws. you may damage the enclosure.

- In case of narrow pole, the screws might be too long. In such case, use the Hex Nuts prior to securing the screws into the enclosure.



Figure 2-3: BreezeAIR basic mounting kit

2.3.2.2 Advanced mounting kit

BreezeAIR advanced mounting kit features:

- Azimuth and Elevation Adjustable Mount
- Suitable for pole or wall mounting
- Made of Die Cast Aluminum
- Heavy duty

Packing list

Item	Qty	Description
1	1	MK1 (End Mounting Member)
2	1	MK2 (Middle Mounting Member)
3	1	MK3 (base Member)
4	1	MK4 (Back Member)
5	1	Pole 1"-4" (not supplied)
6	6	Helical Spring Lock Washer 5/16
7	6	Plain Washer 5/16
8	4	Hex Cap Screw 5/16-18 x 1"
9	2	Hex Cap Screw 5/16-18 x 5"

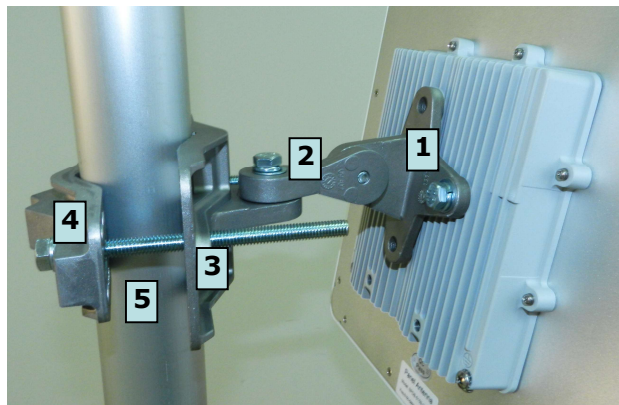


Figure 2-4: BreezeAIR advanced mounting kit

Advanced mounting kit installation

- Place MK1 (1) on the unit, as illustrated in the picture. Align the holes with the screw studs.
- Connect MK1 (1) to the unit with spring washers (6), plain washers (7) and screws (8). Tighten the screws at a torque of 30 Lbs·In.
- Connect MK2 (2) to MK1 (1) with spring washer (6), plain washer (7) and screw (8). Leave the screw slightly loose.
- Connect MK3 (3) to MK1 (2) with spring washer (6), plain washer (7) and screw (8). Leave the screw slightly loose.
- Attach MK3 (3) and MK4 (4) to the pole (5) as illustrated, and connect them using spring washers (6), plain washers (7) and screws (9). Close screws (9) together (in turns), up to tightening torque of 30 Lbs·In.
- Distance between ends of MK3 (3) and MK4 (4) on both sides must be equal. No skewness is allowed.
- Adjust the desired angle, and fully tighten the loose screws (of MK2) at a torque of 30 Lbs·In.

2.3.3 Antennas

2.3.3.1 General

BreezeAIR system supports two types of antennas:

- Integrated antenna
- External antenna

Selecting the antenna model is according to the required range and performance.

Note: To comply with the regulation EIRP limits, the outdoor unit-transmit power needs to be adjusted according to the installed antenna gain. Therefore a professional installation of the transmitter is required. The outdoor unit must be configured at the time of installation by qualified personnel. Fail to comply with regulation rules may expose the installer to legal liabilities.

IMPORTANT! On lab/office tests of links with external antennas, connection should be done via the antennas. In case direct connection is required (with RF cables), make sure to have a minimum of 50dB attenuation on the RF cables to avoid any damage to the radios.

2.3.3.2 Tx power

The outdoor unit transmit power is configurable. The unit limits the max transmit power according to the antenna gain, the regulation and the frequency band. The installer, if needed, can select a lower power.

Regulation of the unit defines the frequency band supported by the units:

- FCC: 2.5GHz, 4.9GHz, 5.8 GHz.
- ETSI: 3.x GHz, 5.4 GHz and 5.8 GHz.
- Mexico: 4.95-4.99 GHz, 5.15-5.35 GHz, 5.8 GHz and 10GHz.
- Other regulation.

The unit supports two levels of privilege password: regular user and administrator user. Since Tx power level affect compliance of the unit with regulation rules, precautions are built into the system to keep the end user from adjusting the Tx power level above the regulation limits. Therefore, the following parameters are Configurable only by administrator user:

- Antenna gain and cable loss.
- Tx Power.

Please refer to [BreezeAIR_configuration_manual.pdf](#) for more information.

FCC - 5.8 GHz

IMPORTANT!

Antennas must be selected from a list of Telrad Networks approved antennas. Please refer to [Appendix C – FCC approved antennas](#). It is the responsibility of the installer to ensure that when using the outdoor antenna kits in the United States (or where FCC rules apply), 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 to FCC rules CFR47 part 15.204.

According to FCC part 15.247(b):

(1) *The maximum peak output power of intentional radiator shall not exceed 1 Watt (+30 dBm).*

(3) *If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the maximum peak power (of +30 dBm) as appropriate, by the amount in dB that the directional gain of antenna exceeds 6 dBi.*

That is to say that the maximum EIRP (Effective Isotropic Radiated Power) shall not exceed +36 dBm.

(ii) *Systems operating in 5.8 GHz exclusively for fixed, **point-to-point** operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.*

That is to say that the maximum EIRP can exceed +36 dBm in point-to-point applications.

Dynamic range of Tx power in BreezeAIR is 40 dB.

In Point-to-Multipoint mode, the unit will automatically reduce the Tx power according to the antenna gain and regulatory. For example:

- For integrated antenna of 23 dBi, the max allowed Tx power is 13 dBm (10 dBm in MIMO) to meet the EIRP limitation of 36 dBm.
- For integrated antenna of 28.5 dBi, the max allowed Tx power is 7 dBm (4 dBm in MIMO) to meet the EIRP limitation of 36 dBm.

FCC – 4.9 GHz

According to FCC part 90.1215:

(a)(1) *The maximum conducted output power should not exceed:*

<i>Channel bandwidth (MHz)</i>	<i>High power maximum conducted output power (dBm)</i>
5	27
10	30
20	33

(2) High power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power or spectral density. Corresponding reduction in the maximum conducted output power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

FCC – 2.5 GHz

According to FCC 47 CFR part 27.50:

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW $10\log(X/Y)$ dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

As such, the following limits apply

<i>Channel bandwidth (MHz)</i>	<i>High power maximum conducted output power (dBm)</i>
5	62.2
10	65.2
14	66.67
20	68.2

2.3.3.3 Antenna polarization

BreezeAIR transmission is polarized according to the antenna:

- BreezeAIR SISO:
 - Vertical
 - Horizontal
- BreezeAIR MIMO:
 - Dual polarization (Vertical + Horizontal)
 - Dual slant (+/- 45 degrees)

The MU and its SUs must be on the same polarization.

To verify antenna polarization, please refer to the assembly instructions supplied with the antenna set.

The polarization of integrated antenna is marked on the backside:

- Vertical polarization - marked with arrow pointing up or down.
- Horizontal polarization - marked with arrow pointing left or right.

2.3.4 Alignment

Power up the unit:

1. Plug the Power Supply into a wall outlet or other standard AC power source. This is only for use prior to permanent mounting, so any available wall outlet in close proximity to your mounting location is suitable.
2. Connect the Outdoor-to-Indoor cable to the PoE '*PWR LAN-OUT*' port (this port supplies 48 VDC in addition to the Ethernet data).

BreezeAIR is aligned using 2 methods:

2.3.4.1 Using the WEB interface

1. Connect a CAT5 Ethernet cable from a PC to the PoE '*LAN-IN*' port.

Note: Do not attach standard CAT5 cable from the Outdoor Unit directly to the PC. Connecting the PC directly to the Outdoor Unit may cause damaged to the PC Ethernet NIC.

2. Connect to the radio's WEB interface, monitoring tab.
 3. Set Monitoring Rate to 1 second.
 4. Rotate the antenna for maximum RSSI with zero PER. To avoid saturation, make sure the RSSI level does not exceed -25 dBm.
-

Note: Do not stand in front of transmitting antenna. Rotate the antenna from the rear side.

5. Mount and secure the unit by fastening the mounting screws.

2.3.4.2 Using the built in RSSI buzzer

BreezeAIR units have a built in RSSI buzzer that indicates the best mounting location.

The buzzer is beeping at four tone levels:

- Fast – highest signal obtained so far.
- Medium – the current RSSI is lower than the highest signal obtained so far.
- Slow – the current RSSI is much lower than the highest signal obtained so far.
- No sound – no reception of the base station at all (or the buzzer is off).

To align the unit using the RSSI buzzer, please perform the following steps.

1. When the unit is first connected to power, the buzzer will be automatically activated in one of the following modes:
 - No sound – there is no reception.
 - Fast beep – there is a reception (which is currently the maximum signal obtained).
2. Set the MU at fixed modulation of BPSK ½ in both uplink and downlink.

3. Take the unit to the selected location and align the antenna in the link's direction. Listen to the buzzer tone level. Any sound (fast, medium or slow) indicates a reception.
4. Change and rotate the antenna to the left, right, up and down, scanning for the maximum reception point.
5. After the scan is complete, align the antenna to the location where the buzzer beeps at the fast rate, indicating the maximum reception.
6. Mount and secure the unit by fastening the mounting screws.
7. Set the MU back to adaptive modulation (AUTO) for both uplink and downlink.
8. Disable the RSSI buzzer.

To activate/deactivate the buzzer manually, use the Link Manager advanced window.

Note: During this procedure, do not disconnect the unit from power.

2.3.5 Sealing

The outdoor unit must be sealed against rain with the metal glands.

RJ-45 ports of the outdoor unit must be facing down.

Note: All Units are factory sealed, seal needed only on Ethernet ports. Opening the unit will void BreezeAIR product warranty.

RJ-45 ports must be facing down. If installed to the side, the bending of the CAT5 cable damages BreezeAIR sealing and voids product warranty.

2.3.6 Cables

The outdoor unit is connected to straight CAT5 Gauge 24-shielded outdoor rated cable. The cable should be UV resistant, flame retardant, **UL listed** and contain at least 4 twisted pairs.

The outdoor cables scheme is indicated in [Appendix A – Outdoor Cables Scheme](#).

The Indoor PoE Outlet side and Outdoor Unit side are crimped using RJ-45 tool.

Total length of the CAT5 cables must not exceed 100 meters

The Outdoor Unit side is assembled according to the following steps (figure 2-5):

- Insert sealing nut on the cable.
- Insert claw and rubber seal on the cable.
- Crimp the RJ-45 Plug.



Figure 2-5: Cable preparation for Outdoor Unit

- Insert the RJ-45 to the Outdoor Unit (Figure 2-6).
- Fasten the seal nut to the gland Body
- The unused port should be left sealed.

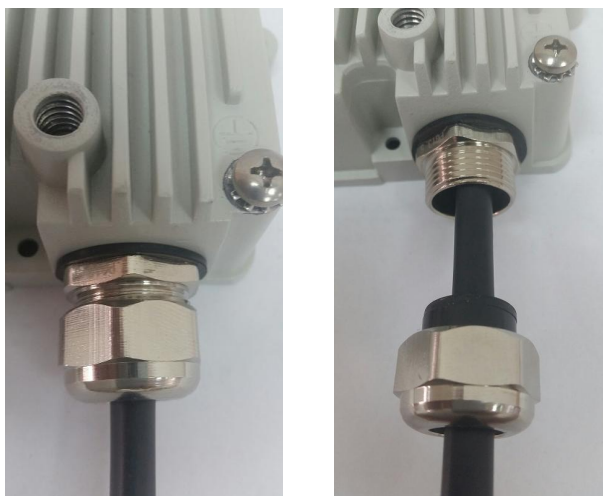


Figure 2-6: Cable connection to Outdoor Unit

2.3.7 Indoor POE installation

The indoor PoE is assembled as follows:

1. Crimp the RJ-45 Plugs on cable ends to form the Outdoor Unit cable.
2. Plug the Outdoor Unit cable to the RJ-45 Jack marked "*PWR LAN-OUT*".
3. Plug standard CAT5 cable from the PC to the RJ-45 Jack marked "*LAN-IN*".
4. Plug the AC Input to the power (100-240VAC).

Note: Do not attach standard CAT5 cable from the PC (or other network device) to the Indoor Unit RJ-45 jack marked "*PWR LAN-OUT*". It may damage the PC's Ethernet interface.



Figure 2-7: BreezeAIR PoE

2.3.8 Grounding

2.3.8.1 Grounding the outdoor unit (MU /SU)

The outdoor unit shall be connected to a protective earth with not less than 10 AWG conductors having green-yellow insulation. The following figure shows the grounding cable from outdoor unit external screw to adjacent grounding rod. The cable should be long enough to reach from the mounting pole to the grounding rod with 3 to 6 feet extra to allow for strain relief.

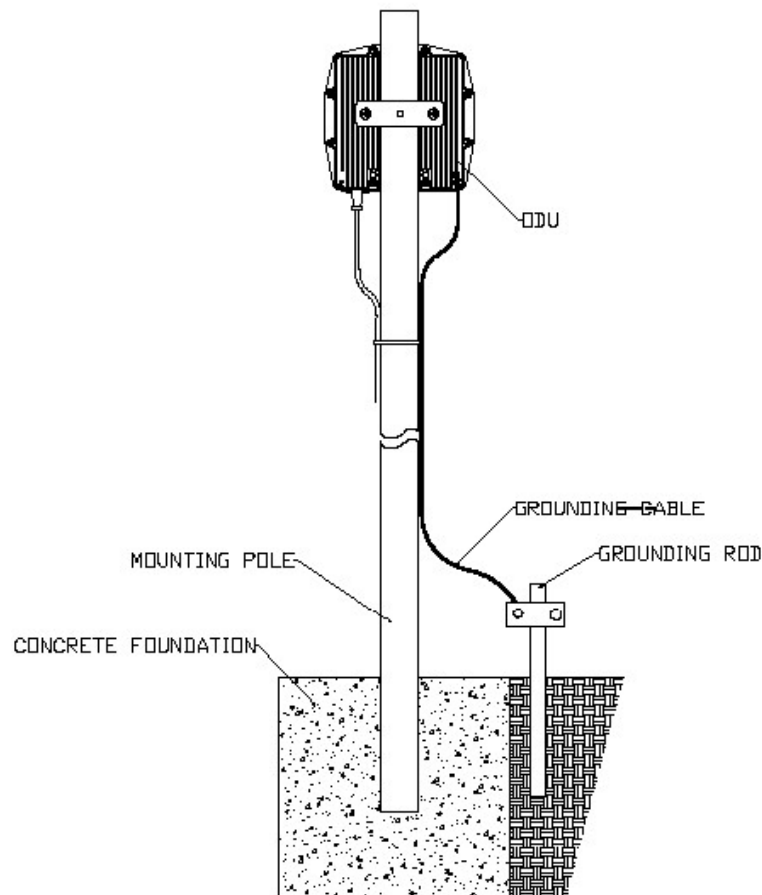


Figure 2-8: Ground Connection to Outdoor Unit

Protection from lightning

US National Electric Department of Energy Handbook 1996 specifies that radio and television lead-in cables must have adequate surge protection at or near the point of entry to the building. The code specifies that any shielded cable from a detached antenna must have the shield directly connected to a 10 AWG wire that connects to the building ground electrode.

The ground wire shall be terminated with **UL listed** lug with a diameter of 0.2 inch (5.2 mm).

The ground lug will need to be suitable for terminating on aluminum materials, such as the use of an aluminum connector and aluminum ground conductor.

FCC Notice

This equipment has been tested and found to comply with the limits for 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 particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

This device must accept any interference received including interference that may cause undesired operation. Any unauthorized modification or changes to this device without the express approval of Telrad Networks may void the user's authority to operate this device. Furthermore, this device intended to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user's authority to operate this device and/or the manufacturer's warranty

2.4 Consecutive AP connection

Consecutive connection is done by plugging CAT5 cable between SU and consecutive MU. This cable also provides power redundancy to the units.

Total length of all wires should not exceed 100 meters.

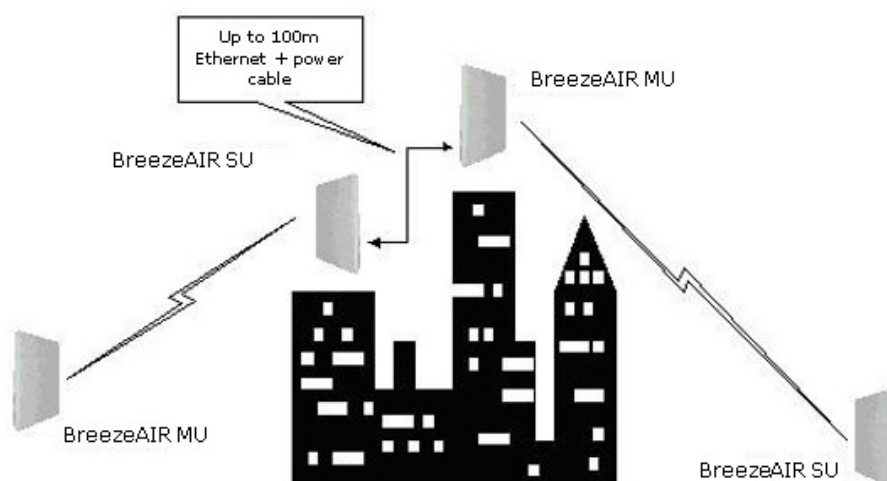


Figure 2-9: Consecutive link principle

2.5 Synchronization

BreezeAIR is designed to work with co-located radios. This means that two or more units can be mounted close to each other.

Time synchronization allows reusing frequencies between co-located links and configured with the Link Manager advanced window.

The synchronization signal is generated by an external GPS (1 PPS) when synchronizing multiple towers, or by a master MU when synchronizing units on the same tower.

External synchronization:

Synchronize multiple towers with one GPS unit per tower.

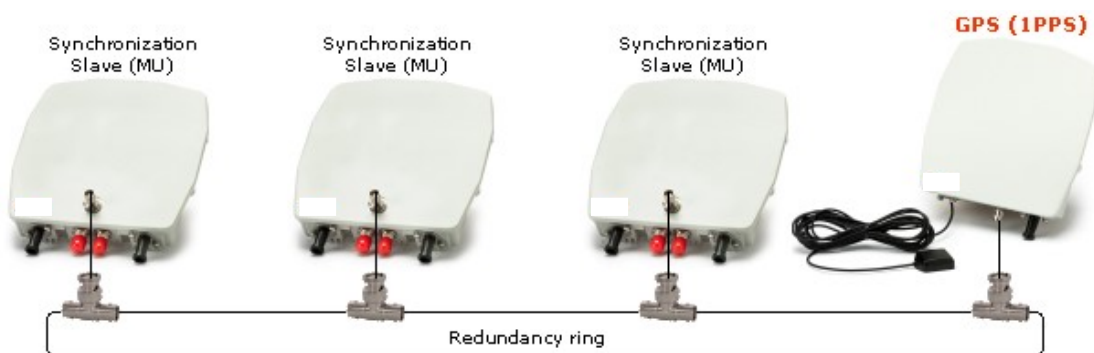


Figure 2-10: External time synchronization

Internal synchronization:

Synchronize multiple MUs on one tower without any external device.

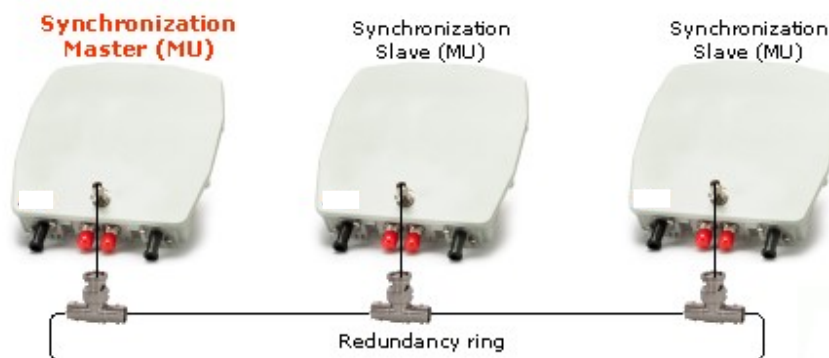


Figure 2-11: Internal time synchronization

Please refer to [BreezeAIR_configuration_manual.pdf](#) for more information.

Note: The distance between any two antennas should be at least 50 cm.

3. BreezeAIR Technical Specifications

Radio	BreezeAIR ACE	BreezeAIR 8000 MIMO	BreezeAIR 8000 SISO
Radio Frequency	4.8-6.1GHz	700MHz, 900MHz, 2.0-2.3GHz, 2.3-2.7GHz, 3.3-3.8GHz, 4.4-4.8GHz, 4.8-6.0GHz, 6.0-7.0GHz, 7.0-8.0GHz, 10.0-10.7GHz	
Net Throughput	2x2 – up to 750Mbps	Up to 310Mbps [ET model – up to 200Mbps]	Up to 150Mbps
TDM E1/T1	Up to 16		
Range	More than 130Km NLOS operation up to 5Km *actual range depend on multipath/reflections/insertion loss at the specific location		
Channel Size	5/10/20/40/80 MHz	3.5/5/7/10/14/20/28/40/50 MHz	
Waveform	Advanced OFDM 2x2 MIMO	Advanced OFDM 2x2 MIMO	Advanced OFDM SISO
Modulation	10 levels - BPSK, QPSK, 16QAM, 64QAM, 256QAM	8 levels - BPSK, QPSK, 16QAM, 64QAM	
Output Power	Up to 30dBm		
Time Synchronization	Internal and external (GPS), unlimited number of synchronized radios		
Service Protection	1+1 hot standby for Ethernet and TDM, Ring protection and power protection		
Handling Interference	AIS – Automatic Interference Sensibility ACM – Adaptive Coding & Modulation ACS – Automatic Channel Selection DFS – Dynamic Frequency Selection FEC – Forward Error Correction, k = 1/2, 2/3, 3/4, 5/6 Fastest ARQ – Automatic Retransmit reQuest		
Encryption & Security	128-bit AES & MAC level authentication, FIPS 197		
Networking & Management			
Topology	Point-to-Point (PTP), Point-to-Multipoint (PTMP) - software configurable		
Access Technology	Time Division Duplex (TDD) Time Division Multiple Access (TDMA)	Time Division Duplex (TDD) & Frequency Division Duplex (FDD) Time Division Multiple Access (TDMA)	
Asymmetric TDD	Dynamic and Automatic		
Data Latency	1ms Typical		
Jumbo Frames	2048 Bytes	3584 Bytes	
Network Modes	Layer 2 Bridge, VLAN, QinQ, VLAN / broadcast / IP filters, DHCP server, IGMP multicast, DHCP option 82 and RADIUS/TACACS authentication		
QoS	8 priority queues based on 802.1q, 802.1p, TOS, DiffServ and DSCP		
Management	ViewAir NMS, Cloud-based NMS, WEB (HTTP/HTTPS), SNMPv1, SNMPv2, SNMPv3, Telnet, NBI CORBA, EMS (Link Manager). Built in throughput test, RF Analyzer and path profiling tools		
Performance Data	Real time & history – logs and counters of traffic and radio data		
Physical & Environmental			
Physical Interface	2x 10/100/1000 Base-T (ODU) [ET model – 1x 10/100Base-T]		
Connector Type	RJ-45		
Mechanical	19 x 19 x 4 cm, <1Kg (connectorized) 19 x 19 x 8 cm, <1.5Kg (17.5dBi @ 5.xGHz, 13dBi @ 3.xGHz, 23dBi @ 10.xGHz) 30 x 30 x 6 cm, <2Kg (23 dBi @ 5.xGHz, 16dBi @ 2.xGHz, 20dBi @ 3.xGHz) 37 x 37 x 7 cm, <3Kg (17.5dBi @ 2.xGHz, 24dBi @ 6.xGHz)		
Power Consumption	<10Watt	<7Watt	
Power Adapter AC-DC	Input power 100-240VAC, 47-63Hz, 12x6x3.5cm		
Power Adapter DC-DC	Input power 10-60VDC, 16x6x3cm		
Power	Power over Ethernet (PoE) – 48VDC		
IP rating	IP67		
Operating Temperature	-40c to 60c [ET model - -55c to 65c]		
Operating Humidity	100% non condensing (Rainproof)		

4. BreezeAIR NET Throughput (Mbps)

4.1 BreezeAIR 8000 MIMO & SISO

	50MHz	40MHz	28MHz	20MHz	14MHz	10MHz	7MHz	5MHz	3.5MHz
BreezeAIR 8000 MIMO									
BPSK 1/2	30.6	26.8	16.1	11.5	8.8	6.3	3.2	2.3	1.6
QPSK 1/2	61.7	54.1	32.6	23.3	15.3	10.9	6.9	4.9	3.4
QPSK 3/4	92.6	81.2	48.7	34.8	23.4	16.7	10.5	7.5	5.3
16QAM 1/2	124.7	109.4	65.2	46.6	31.4	22.4	14.1	10.1	7.1
16QAM 3/4	185.0	162.3	98.4	70.3	47.0	33.6	21.4	15.3	10.7
64QAM 2/3	247.4	217.0	131.2	93.7	62.4	44.6	28.7	20.5	14.4
64QAM 3/4	278.3	244.1	147.3	105.2	70.6	50.4	32.2	23.0	16.1
64QAM 5/6	308.9	271.0	162.7	116.2	78.4	56.0	36.0	25.7	18.0
BreezeAIR 8000 SISO									
BPSK 1/2	15.2	13.3	7.7	5.5	3.5	2.5	1.4	1.0	0.7
QPSK 1/2	30.7	26.9	16.1	11.5	7.4	5.3	3.2	2.3	1.6
QPSK 3/4	46.2	40.5	24.4	17.4	11.5	8.2	5.0	3.6	2.5
16QAM 1/2	61.8	54.2	32.6	23.3	15.4	11.0	7.0	5.0	3.5
16QAM 3/4	92.5	81.1	48.9	34.9	23.4	16.7	10.6	7.6	5.3
64QAM 2/3	123.5	108.3	65.2	46.6	31.4	22.4	14.3	10.2	7.1
64QAM 3/4	138.9	121.8	73.5	52.5	35.1	25.1	16.1	11.5	8.1
64QAM 5/6	154.4	135.4	81.8	58.4	39.2	28.0	18.1	12.9	9.0

Figure 4-1: BreezeAIR 8000 MIMO & SISO net capacity

4.2 BreezeAIR ACE

BreezeAIR ACE 2x2					
	80MHz	40MHz	20MHz	10MHz	5MHz
BPSK 1/2	52	26	14	6	3
QPSK 1/2	106	50	26	12	6
QPSK 3/4	160	70	39	19	9
16QAM 1/2	207	89	53	26	13
16QAM 3/4	315	142	79	39	19
64QAM 2/3	425	194	106	52	26
64QAM 3/4	477	215	120	60	31
64QAM 5/6	522	245	134	76	37
256QAM 3/4	630	284	143	78	37
256QAM 5/6	750	322	158	89	44

Figure 4-2: BreezeAIR ACE net capacity

5. Appendix A – outdoor cables scheme

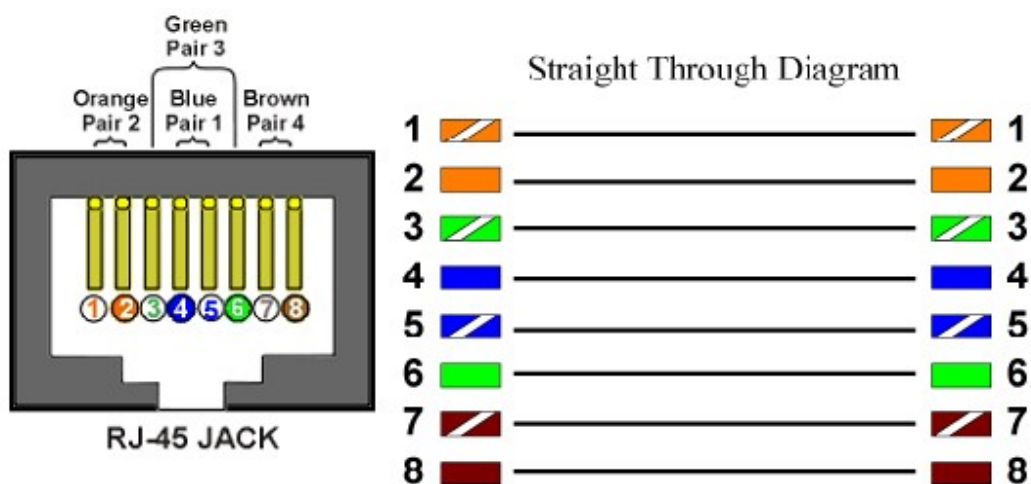


Figure 5-1: Outdoor Cables Scheme

Note: In order to comply with 100 meter CAT5 cable

- Pins 1,2 must be a twisted pair wire.
- Pins 3,6 must be a twisted pair wire.
- Pins 4,5 must be a twisted pair wire.
- Pins 7,8 must be a twisted pair wire.

Recommended cable length:

- 10/100/1000Base-T – 75m.
- 10/100Base-T – 100m.

6. Appendix B – RF channel lists

6.1 BreezeAIR 8000 FCC operating Band: 5725-5850MHz

FCC ID: QQ2-WA8K5X

Channel No.	5 MHz Channel Frequency [MHz]	10 MHz Channel Frequency [MHz]	20 MHz Channel Frequency [MHz]	40 MHz Channel Frequency [MHz]
1	5730			
2	5735	5735	5735	
3	5740	5740	5740	
4	5745	5745	5745	5745
5	5750	5750	5750	5750
6	5755	5755	5755	5755
7	5760	5760	5760	5760
8	5765	5765	5765	5765
9	5770	5770	5770	5770
10	5775	5775	5775	5775
11	5780	5780	5780	5780
12	5785	5785	5785	5785
13	5790	5790	5790	5790
14	5795	5795	5795	5795
15	5800	5800	5800	5800
16	5805	5805	5805	5805
17	5810	5810	5810	5810
18	5815	5815	5815	5815
19	5820	5820	5820	5820
20	5825	5825	5825	5825
21	5830	5830	5830	5830
22	5835	5835	5835	
23	5840	5840	5840	
24	5845			

Figure 6-1: BreezeAIR 8000 FCC 5GHz RF channel List

6.2 BreezeAIR 8000 FCC operating Band: 4940-4990MHz

FCC ID: QQ2-WA8K5X

- 5MHz channel – 4942.5 – 4987.5 MHz.
- 10MHz channel – 4945 – 4985 MHz.
- 20MHz channel – 4950 – 4980 MHz.

6.3 BreezeAIR 8000 FCC operating Band: 2496-2690MHz

FCC ID: QQ2-WA8K25X

- 5MHz channel – 2500 – 2687 MHz.
- 10MHz channel – 2501 – 2685 MHz.
- 14MHz channel – 2503 – 2682 MHz.
- 20MHz channel – 2506 – 2680 MHz.

6.4 BreezeAIR ACE FCC operating Band: 5725-5850MHz

FCC ID: ARA-BACE5X

Hardware Version Identification Number (HVIN) - BACE5X

Firmware Version Identification Number (FVIN) - x15.xxxx (x = any number between 0-9)

Channel No.	20 MHz Channel Frequency [MHz]	40 MHz Channel Frequency [MHz]	80 MHz Channel Frequency [MHz]
1	5740		
2	5745		
3	5750	5750	
4	5755	5755	
5	5760	5760	
6	5765	5765	
7	5770	5770	5770
8	5775	5775	5775
9	5780	5780	5780
10	5785	5785	5785
11	5790	5790	5790
12	5795	5795	5795
13	5800	5800	5800
14	5805	5805	5805
15	5810	5810	
16	5815	5815	
17	5820	5820	
18	5825	5825	
19	5830		
20	5835		

Figure 6-2: BreezeAIR ACE FCC 5GHz RF channel List

6.5 BreezeAIR Operating Bands in Mexico

- 5150 – 5350 MHz
- 5725 – 5850 MHz
- 4.95 – 4.99 GHz (Public Safety bands)

7. Appendix C – FCC approved antennas

Antenna Type	Model	Gain [dBi]	Dimension [mm]
Flat panel	B-5X23S010F	23	305x305x15
	B-5X23D009F	23	371x371x40
	B-5X23D010F	23	305x305x40
	B-5X17D020F	17.5	200x200x15
	B-5X15D120S	15	430x165x35
	B-5X17D090S	17	430x165x35
	B-5X17D060S	17	430x165x35
	B-5X15V120S	15	450x165x35
	B-5X17V090S	17	450x165x35
	B-5X18V060S	18	450x165x35
Dish	B-5X29D005P	28 (27 dBi @ 4.9 GHz)	2ft
	B-5X30D005P	30 (29 dBi @ 4.9 GHz)	2ft

Figure 7-1: BreezeAIR 5GHz integrated/external antennas

Antenna Type	Model	Gain [dBi]	Dimension [mm]
Flat panel	B-2413S045F	13.5	200x200x15
	B-2416S020F	16	305x305x15
	B-2417D020F	17.5	371x371x40
	B-2415D060S	15	430x165x35
	B-2414D090S	14	430x165x35
	B-2416D090S	16	700x133x57
	B-2415D120S	15	700x133x57
	B-2415V060S	15	450x165x35
	B-2414V090S	14	450x165x35
	B-2413V120S	13	450x165x35
	B-2418V060S	18	1000x160x60
	B-2417V090S	17	1000x160x60
	B-2416V120S	16	1000x160x60
Grid	B-2424S010G	24	600x300
Dish	B-2422D011P	22	2ft
	B-2427D006P	27	4ft

Figure 7-2: BreezeAIR 2.5GHz integrated/external antennas

8. Appendix D – Lightning Protection

All outdoor wireless equipment is susceptible to lightning damage from a direct hit or induced current from a near strike. A direct lightning strike may cause serious damage even if these guidelines are followed. Lightning protection and grounding practices in local and national electrical codes serve to minimize equipment damage, service outages, and serious injury.

Possible reasons for lightning damage:

1. Poorly grounded antenna sites that can conduct high lightning strike energy into equipment.
2. Lack of properly installed lightning protection equipment can cause equipment failures from lightning induced currents.

A lightning protection system provides a means by which the energy may enter earth without passing through and damaging parts of a structure. A lightning protection system does not prevent lightning from striking, and instead provides a means for preventing damage to equipment by providing a low resistance path for the discharge of energy to travel safely to ground. Improperly grounded connections are also a source of noise that can cause sensitive equipment to malfunction.

A good grounding system disperses most of the surge energy from a lightning strike away from the building and equipment. The remaining energy on the Ethernet cable shield and conductors can be directed safely to ground by installing a lightning arrestor in series with the cable.

If you have determined that it is appropriate to install lightning protection for your system, the following general industry practices are provided as a guideline only:

1. The AC wall outlet ground for the indoor POE adapter should be connected to the building grounding system.
2. Install a lightning arrestor in series with the Ethernet cable at the point of entry to the building. The grounding wire should be connected to the same termination point used for the tower or mast.
3. Provide direct grounding from the unit, the mounting bracket, the antenna, and the Ethernet cable surge protection to the same ground bus on the building. Use the grounding screws provided for terminating the ground wires.

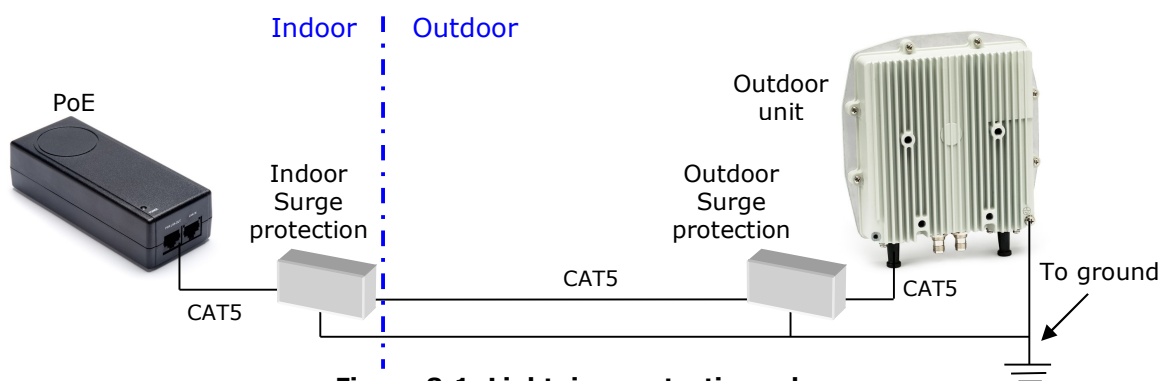


Figure 8-1: Lightning protection scheme

Note: BreezeAIR wireless equipment should be installed by a qualified professional installer who is knowledgeable of and follows local and national codes for electrical grounding and safety. Failure to meet safety requirements and/or use of non-standard practices and procedures could result in personal injury and damage to equipment.

8.1 BreezeGuard lightning protection

Telrad Networks BreezeGuard is 1000Mbps PoE Outdoor Surge Protector, is designed to protect BreezeAIR PoE network from lightning over-voltage, transient over-voltage and static discharge. The protector implements multi-level protection circuit with advanced manufacturing process, and has excellent performance on discharge current, limiting voltage, response time, stability and over-all reliability.

BreezeGuard features

- 10/100/1000Base-T PoE Gigabit Ethernet protection
- Multi protection circuits - Gas-Tube + TVS technology
- Dual protection - Common and differential modes
- TVS array technology, low capacitance
- Multi-Strike Capability
- IP67 enclosure - full outdoor solution
- CAT6, CAT5e and CAT5 compatible

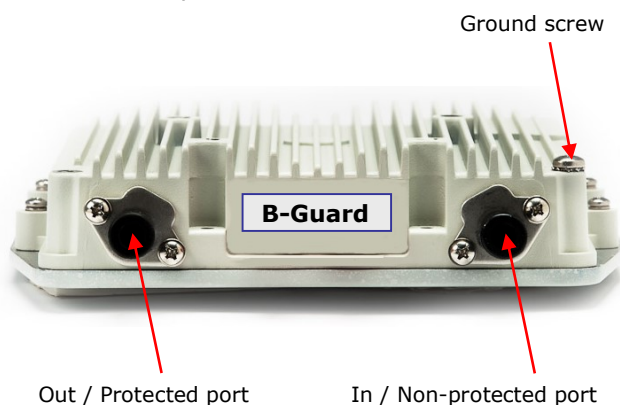


Figure 8-2: BreezeGuard ports

BreezeGuard Specifications	
Nominal operating voltage	48V
Max. continuous operating voltage	57V
Nominal discharge current (8/20us) In	3kA
Max. discharge current (8/20us) Imax	5kA
Limiting voltage:	
• Line-line (@6kV, 10/700us)	≤150V
• Line-line (@3kV, 8/20us)	≤150V
Transmission rate	10/100/1000Mbps
Insertion loss	≤0.5dB
Protection line	01-Aug
Response time	1ns
Load current	350mA
Protection grade	IP67
Dimensions	19x19x4 cm
Weight	<1Kg
Temperature	-40oc to 85oc
Relative humidity	100% non condensing (rainproof)