Outdoor/External Cellular Antenna Reference Guide

For Tempered Airwall Gateways

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Introduction

This antenna reference is intended to assist in selecting antennas for cellular-equipped Airwall Gateways. These lists include antennas based on their apparent suitability for Tempered cellular-equipped Airwall Gateways. Please see the Disclaimer for further information.
Note: Tempered Airwall Gateways are not suitable for installation in an outdoor environment.

This reference includes:

- **Vendors of External Antennas** – A list of vendors that sell external antennas
- **Antenna Evaluation** – Recommendations for evaluating an external antenna for your Airwall system.
- **Antenna Accessories** – Recommendations for accessories for antennas used with an Airwall system.

Vendors of External Antennas

Here are some vendors of external antennas:

- Taoglas
- 2J Antennas
- Laird Connectivity
- Panorama Antennas
- Airgain
- Parsec Technologies
- Pulse Electronics

Refer to **Antenna Evaluation** for suggestions on evaluating your chosen external antenna. See also **Antenna Accessories** for suggestions for Lightning protection or Amplifiers.

Antenna Evaluation

Three specifications to evaluate for antennas used with the Airwall system are:

- The EIRP of the combined system must be less the limit imposed in your country.
- Antenna efficiency should be at least 20% in the bands in use by the target carrier.
- Voltage standing wave ratio should be less than 2.0 : 1.

EIRP Calculation

EIRP may be calculated for each band by taking the worst case conducted RF power (25 dBm typically) and adding the net gain of the antenna system. When determining net gain, you may take into account any connector insertion loss, cable losses, and losses from lightning protection devices.

Antenna gain and EIRP

Since EIRP limits vary significantly depending on the country, modem model, and specific band in use, you need to check the regulatory limits on EIRP (Effective Isotropic Radiated Power) in your jurisdiction.

Some definitions:

- **EIRP regulations** specify the maximum emitted "power" for spectrum management purposes.
- **MPE (Maximum Permissible Exposure) limits** – Specify the maximum radiation an uninformed person can be exposed to without notification at a specific distance. Typically MPE is determined at a 20cm (~8in) exclusion distance, but this may be increased in some cases if necessary.

Installers generally need to use an antenna system that meets the lower of the two limits for a given band. Below are the antenna gain limits for our currently-supported cellular Airwall Gateways in the US and Canada at a 20cm exclusion distance. These limits take into account both types of restrictions.

United States

LTE Band	WCDMA Band	Uplink (MHz)	Airwall 110g	Airwall 150 w/ SFFMODEG25	Airwall 150 w/ SFFMODEC25AF	Airwall 150 w/ SFFMODS7588	Airwall 250g	Airwall 250gd
LTE B2	WCDMA B2	1850 - 1910	8.0 dBi	8.0 dBi	8.0 dBi	7.5 dBi	7.5 dBi	7.5 dBi
LTE B4	WCDMA B4	1710 - 1755	5.0 dBi	5.0 dBi	5.0 dBi	5.0 dBi	5.0 dBi	5.0 dBi
LTE B5	WCDMA B5	824 - 849	9.4 dBi	9.4 dBi	9.4 dBi	9.0 dBi	9.0 dBi	6.5 dBi
LTE B7		2500 - 2570	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B12		698 - 716	8.7 dBi	8.7 dBi	8.7 dBi	N/A	N/A	N/A
LTE B13		777 - 787	9.1 dBi	9.1 dBi	9.1 dBi	9.0 dBi	9.0 dBi	6.0 dBi
LTE B14		788 - 798	N/A	N/A	9.2 dBi	N/A	N/A	N/A
LTE B17		704 - 716	N/A	N/A	N/A	9.0 dBi	9.0 dBi	6.0 dBi
LTE B25		1850 - 1915	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B26		814 - 849	9.3 dBi	9.3 dBi	N/A	N/A	N/A	N/A
LTE B38		2570 - 2620	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B41		2496 - 2690	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B66		1710 - 1780	N/A	N/A	5.0 dBi	N/A	N/A	N/A
LTE B71		663 - 698	N/A	N/A	8.5 dBi	N/A	N/A	N/A

Canada

LTE Band	WCDMA Band	Uplink (MHz)	Airwall 110g	Airwall 150 w/ SFFMODEG25	Airwall 150 w/ SFFMODEC25AF	Airwall 150 w/ SFFMODS7588	Airwall 250g	Airwall 250gd
LTE B2	WCDMA B2	1850 - 1910	8.0 dBi	8.0 dBi	8.0 dBi	7.5 dBi	7.5 dBi	7.5 dBi
LTE B4	WCDMA B4	1710 - 1755	5.0 dBi	5.0 dBi	5.0 dBi	5.0 dBi	5.0 dBi	5.0 dBi
LTE B5	WCDMA B5	824 - 849	8.2 dBi	8.2 dBi	6.1 dBi	9.0 dBi	9.0 dBi	6.5 dBi
LTE B7		2500 - 2570	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B12		698 - 716	7.7 dBi	7.7 dBi	5.6 dBi	N/A	N/A	N/A
LTE B13		777 - 787	8.0 dBi	8.0 dBi	5.9 dBi	9.0 dBi	9.0 dBi	6.0 dBi
LTE B14		788 - 798	N/A	N/A	5.9 dBi	N/A	N/A	N/A
LTE B17		704 - 716	N/A	N/A	N/A	9.0 dBi	9.0 dBi	6.0 dBi
LTE B25		1850 - 1915	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B26		814 - 849	8.2 dBi	8.2 dBi	N/A	N/A	N/A	N/A
LTE B38		2570 - 2620	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B41		2496 - 2690	8.0 dBi	8.0 dBi	N/A	N/A	N/A	N/A
LTE B66		1710 - 1780	N/A	N/A	5.0 dBi	N/A	N/A	N/A
LTE B71		663 - 698	N/A	N/A	N/A	N/A	N/A	N/A

Japan

When used in Japan, the antenna specified must be reviewed by the radio's certification body and appear on their list before such an antenna may be used. Typically, MIC radio grants limit the peak gain of a cellular antenna to 3 dBi. It is advisable to use an antenna already on the list for a given product. Contact Tempered Support for an updated list of antennas approved for use in Japan.

Maximum Conducted RF output Power

The following table lists the transmit power rating for each product for use in EIRP calculations in other markets:

Product	Expansion	WCDMA	FDD LTE	TDD LTE
Airwall 110g		24 dBm +1 / -3 dB	23 dBm ± 2dB	23 dBm ± 2dB
Airwall 150	SFFMODS7588	23 dBm ± 2dB	23 dBm ± 2dB	23 dBm ± 2dB
Airwall 150	SFFMODEC25AF	24 dBm +1 / -3 dB	23 dBm ± 2dB	23 dBm ± 2dB
Airwall 150	SFFMODEG25	24 dBm +1 / -3 dB	23 dBm ± 2dB	23 dBm ± 2dB
Airwall 250g/gd		23 dBm ± 2dB	23 dBm ± 2dB	23 dBm ± 2dB

RF Safety / MPE Exclusion calculations

Be sure to:

- Evaluate the gain of your chosen antenna system by comparing the net gain of your antenna system to the maximum antenna gain listed in the table above for your country.
- If the antenna gain is greater than the gain listed in the table above for your country for a band that will be in use, re-evaluate the MPE exclusion distance according to FCC KDB 447498 D01.

Note: You can find the MPE report of the radio module used in a given Airwall by looking up the FCCID listed on the Airwall Gateway or Airwall Gateway expansion module at fccid.io or https://www.fcc.gov/oet/ea/fccid.

The following table lists the RF module used in each cellular Airwall gateway offering:

Product	Module Vendor	Module Model	FCCID
Airwall 110g	Quectel	EG25-G	XMR201903EG25G
SFFMODS7588	Sierra Wireless	HL7588	N7NHL7588
SFFMODEC25AF	Quectel	EC25-AF	XMR201808EC25AF
SFFMODEG25	Quectel	EG25-G	XMR201903EG25G
Airwall 250g / 250gd	Sierra Wireless	HL7588	N7NHL7588
HIPswitch-100	Sierra Wireless	MC7354	N7NMC7355

Antenna Accessories

This section provides guidance on Antenna accessories you may need for your installation.

Lightning protection

When installing an outdoor antenna, it's important to include some kind of lightning protection in the system such as a "Discharge Tube Surge Arrestor." Always check and follow the manufacturer's recommendations for your antenna, but here are some important specifications required for your chosen lighting protection:

- Design impedance of 50 Ohms
- Design frequency range that the includes the bands to be used
- Low insertion loss (less than 0.5 dB is ideal)
- Voltage Standing Wave Ratio (VSWR) as close to 1:1 as possible. Preferably less than 1.2:1 over the frequency range used.

Suggested Lightning Protection Vendors

- Phoenix Contact
- Laird Connectivity
- Polyphaser
- Fairview Microwave
- L-com
- Bel Fuse

There are also "generic" brand surge arrestors available on amazon.com.

Amplifiers

Amplifiers are not usually needed. If an amplifier is needed, your carrier must approve the use of any amplifiers and sites where amplifiers are in use are subject to FCC registration requirements.

Two vendors to consider for Amplifier purchases are:

- https://www.wilsonpro.com/products/wilsonpro-iot-5-band
- https://www.surecall.com/.