Grandstream Networks, Inc.

GWN7660EM Access Point

Antenna Radiation Patterns

Introduction

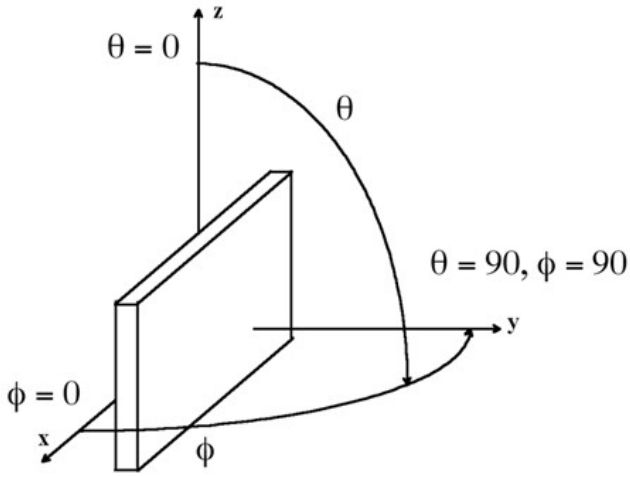
The GWN7660EM is an AX3000 Wi-Fi 6 access point with a socket design, enabling simple deployment and superior performance. It can be used as a wireless extender, which works with the GWN7062E(ET)/GWN7062M routers to quickly build a home wireless mesh network to expand network coverage. It offers 2×2:2 MU-MIMO technology on the 2.4G band and 3×3:2 MU-MIMO on the 5G band, as well as a sophisticated antenna design and uses XTRA Range technology with beamforming for maximum network throughput and expanded Wi-Fi coverage range. To ensure easy installation and management, the GWN7660EM uses a controller-less distributed network management design in which the controller is embedded within the product's Web user interface. The GWN7660EM is also supported by GDMS Networking and GWN Manager, Grandstream's cloud and on-premise Wi-Fi management platform. It is the ideal Wi-Fi AP for voiceover-Wi-Fi deployments and offers a seamless connection with Grandstream's Wi-Fi-capable IP phones. With support for advanced QoS, low-latency real-time applications, mesh networks, captive portals, 128 concurrent clients per AP, and 1 x 1 Gigabit network port, GWN7660EM is an ideal Wi-Fi access point for small and medium household users to achieve high-speed Wi-Fi coverage in the whole house.

This datasheet presents the antenna radiation patterns of the GWN7660EM access point model, for both the 2.4GHz and 5GHz bands, in addition to some other information and specifications about the interfaces of the device.

Terminology

In this first part, we will provide a quick, brief review of some fundamental concepts related to antennas and radio propagation:

- **Antenna:** An antenna is a transducer between a feed signal and a radiated wave over space. It is usually attached to a transmitter/receiver unit, and the radiated energy is characterized by the antenna's radiation pattern.
- **Antenna pattern:** The radiation pattern or antenna pattern is the graphical representation of the radiation properties of the antenna and how it radiates energy out into space or how it receives energy (reciprocity). An antenna radiates energy in all directions, at least to some extent, so the antenna pattern is three-dimensional. It is common, however, to describe this 3D pattern with planar patterns called the principal plane patterns. These principal plane plots are commonly referred to as antenna radiation patterns.
- **Isotropic radiator**: An isotropic radiator is a hypothetical lossless antenna that radiates its energy equally in all directions. This imaginary antenna would have a spherical radiation pattern, and the principal plane cuts would both be circles since any plane cut through a sphere would be a circle.
- **Gain**: The gain of an antenna (in a given direction) is defined as the ratio of the power gain in that direction to the power gain of a reference antenna in the same direction. Usually, an isotropic radiator is set as the reference, and the value of the gain is expressed in dBi. It is important to state that an antenna with gain doesn't generate power, and it simply directs the way the radiated power is distributed relative to radiating the power equally in all directions, thus the gain is just a characterization of the way the power is radiated.
- **Efficiency**: The efficiency of an antenna is the ratio of the power delivered to the antenna relative to the power radiated from the antenna. A high-efficiency antenna has most of the power present at the antenna's input radiated away. A low-efficiency antenna has most of the power absorbed as losses within the antenna or reflected away due to impedance mismatch Which causes an antenna to not have an efficiency of 100%.
    1. Antenna efficiency losses are typically due to:
    2. Conduction losses (due to the finite conductivity of the metal that forms the antenna).
    3. Dielectric losses (due to the conductivity of a dielectric material near an antenna).
    4. Impedance mismatch loss.



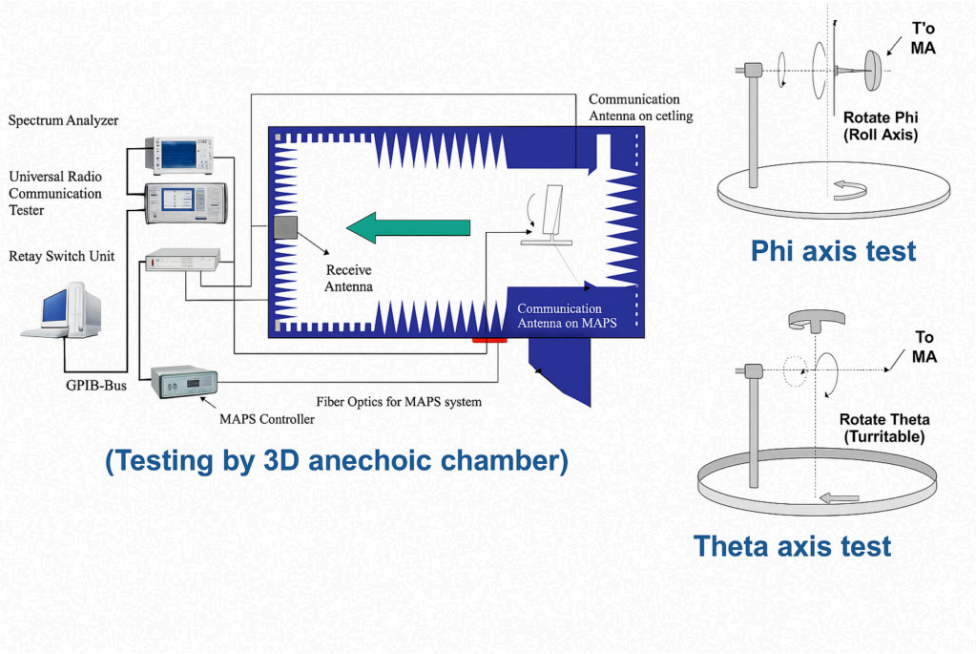
Polar Coordinates

Test environment

This test report gives schematic diagrams with the antenna distribution of the GWN76xx access points series, along with the antenna radiation patterns of both 2.4Ghz and 5Ghz frequencies to help engineers during the deployment process.

Please note that these radiation patterns are gathered in a fully anechoic environment. Their shape will change in installed environments depending on the obstacles that the wireless signal might face. Every deployment will behave differently due to materials, geometries of structures, etc, and how these materials behave at 2.4GHz and 5GHz.

The following figure gives an overview of the test environment:



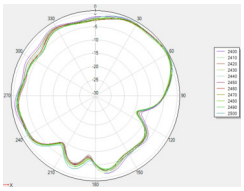
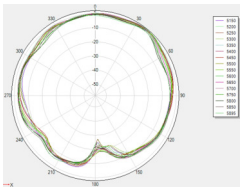
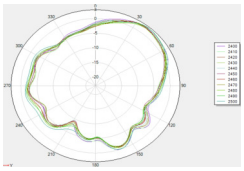
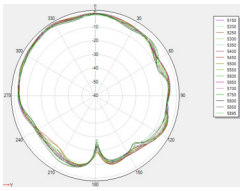
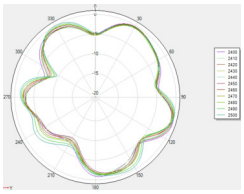
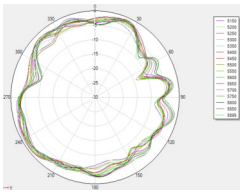
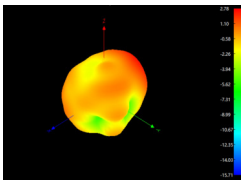
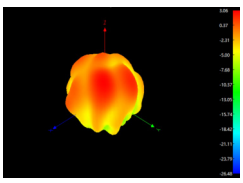
Test Environment

Antenna Radiation Patterns

First Antenna

- ***Antenna Radiation Patterns*** **(First Antenna)**:

Axis	2.4	5G

phi = 0deg		
phi = 90deg		
theta = 90deg		
3D		

Antenna Radiation Patterns (First Antenna)

- **Frequency, Gain, and Efficiency (First Antenna 2.4GHz):**

Freq	**Gain(dBi)**	**Effi**
2400MHz	2.78	73.28
2410MHz	1.87	65.31
2420MHz	2.0	73.11
2430MHz	1.99	59.43
2440MHz	2.14	65.31
2450MHz	2.34	69.02
2460MHz	2.14	66.37
2470MHz	2.74	66.07
2480MHz	1.9	65.77
2490MHz	2.31	69.66
2500MHz	2.33	67.45

Frequency, Gain, and Efficiency (First Antenna 2.4GHz)

- **Frequency, Gain, and Efficiency (First Antenna 5GHz):**

Freq	Gain(dBi)	Effi
5150MHz	1.56	67.45
5200MHz	1.54	64.27
5250MHz	1.66	64.57
5300MHz	1.78	67.61
5350MHz	2.05	71.78
5400MHz	1.74	75.86
5450MHz	1.66	72.61
5500MHz	1.91	71.29
5550MHz	2.49	70.79
5600MHz	2.52	68.23
5650MHz	2.55	71.29
5700MHz	3.06	71.29
5750MHz	2.96	68.39
5800MHz	2.12	62.66
5850MHz	2.32	68.08
5895MHz	1.76	67.61

Frequency, Gain, and Efficiency (First Antenna 5GHz)

Second Antenna

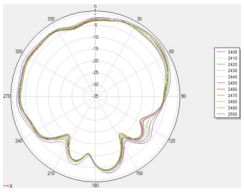
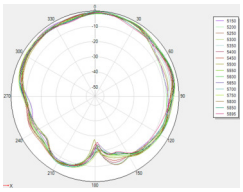
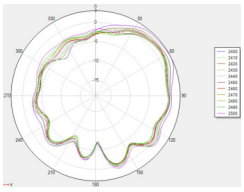
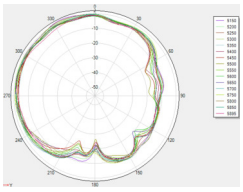
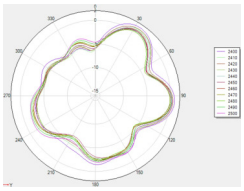
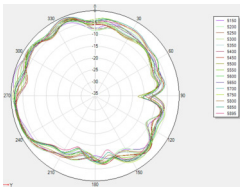
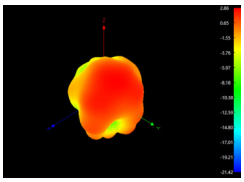
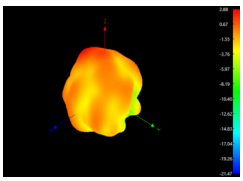
- **Specifications (Second Antenna):**

Parameter	Specification
Frequency Range (2.4G)	2400–2500 MHz
Frequency Range (5G)	5150–5850 MHz
VSWR	≤ 2.0 : 1
Peak Gain (2.4G)	2.86 dBi
Peak Gain (5G)	2.88 dBi
Antenna Type	PIFA Antenna

Radiation Pattern	Omni-directional
Max Input Power	2 W
Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Relative Humidity	40% to 95%
RoHS Compliant	Yes

Specifications (Second Antenna)

- ***Antenna Radiation Patterns*** **(Second Antenna):**

Axis	**2.4**	**5G**
phi = 0deg		
phi = 90deg		
theta = 90deg		
3D		

Antenna Radiation Patterns (Second Antenna)

- **Frequency, Gain, and Efficiency (Second Antenna 2.4GHz):**

Freq	**Gain(dBi)**	**Effi**
2400MHz	1.73	72.61
2410MHz	1.56	62.95
2420MHz	1.68	70.31
2430MHz	1.67	55.98

2440MHz	1.86	60.26
2450MHz	2.14	63.39
2460MHz	2.18	60.95
2470MHz	2.85	60.26
2480MHz	2.28	60.26
2490MHz	2.78	64.27
2500MHz	2.86	61.94

Frequency, Gain, and Efficiency (Second Antenna 2.4GHz)

- **Frequency, Gain, and Efficiency (Second Antenna 5GHz):**

Freq	**Gain(dBi)**	**Effi**
5150MHz	1.52	70.96
5200MHz	1.74	73.79
5250MHz	1.78	73.96
5300MHz	1.83	75.51
5350MHz	2.2	77.45
5400MHz	2.02	77.27
5450MHz	2.21	75.51
5500MHz	2.12	73.45
5550MHz	2.63	75.34
5600MHz	2.52	71.94
5650MHz	2.64	73.79
5700MHz	2.88	75.51
5750MHz	2.5	75.86
5800MHz	1.59	73.11
5850MHz	2.03	76.56
5895MHz	1.15	69.66

Frequency, Gain, and Efficiency (Second Antenna 5GHz)

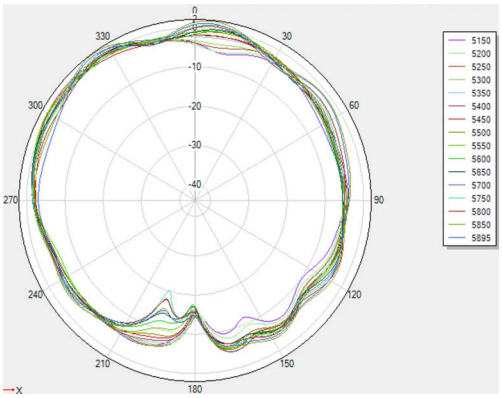
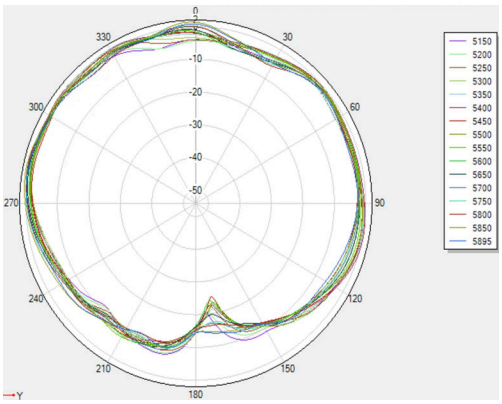
Third Antenna

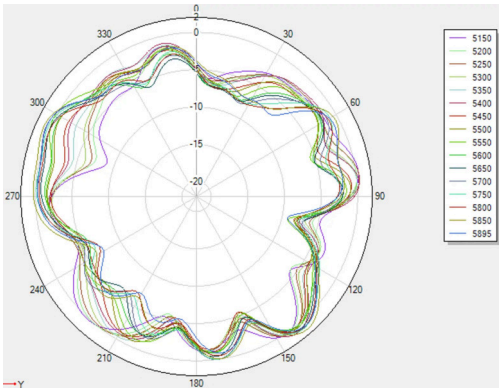
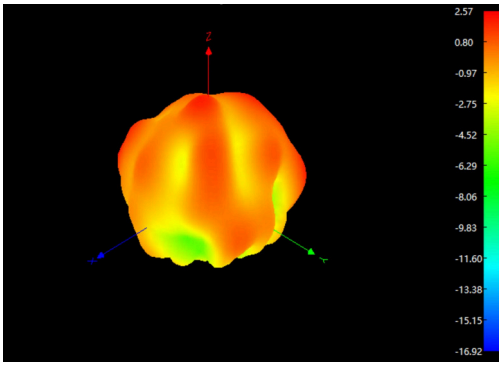
- **Specifications (Third Antenna):**

Parameter	Specification
Frequency Range	5150–5850 MHz
VSWR	≤ 2.0 : 1
Peak Gain	2.57 dBi
Antenna Type	PIFA Antenna
Radiation Pattern	Omni-directional
Max Input Power	2 W
Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Relative Humidity	40% to 95%
RoHS Compliant	Yes

Specifications (Third Antenna)

- ***Antenna Radiation Patterns*** **(Third Antenna):**

Axis	5G
phi = 0deg	
phi = 90deg	

theta = 90deg	
3D	

Antenna Radiation Patterns (Third Antenna)

- **Frequency, Gain, and Efficiency (Third Antenna):**

Freq	**Gain(dBi)**	**Effi**
5150MHz	1.79	68.39
5200MHz	1.85	69.34
5250MHz	1.9	69.98
5300MHz	2.05	70.63
5350MHz	2.13	71.78
5400MHz	2.15	78.16
5450MHz	2.05	76.21
5500MHz	2.16	76.56
5550MHz	2.45	77.27
5600MHz	1.88	72.61
5650MHz	1.96	74.47
5700MHz	2.08	76.38
5750MHz	2.06	77.62
5800MHz	1.65	74.99

5850MHz	2.57	81.66
5895MHz	2.34	79.8

Frequency, Gain, and Efficiency (Third Antenna)