Grandstream Networks, Inc.

GWN7052

Antenna Radiation Patterns

One of the major components of a wireless router is the antenna. These radio components come with different shapes and sizes to fit specific deployment needs, and each wireless router can bundle multiple antennas for sending and receiving signals in order to benefit from the MIMO (Multiple Input/Multiple Output) technology and obtain higher throughput and signal resilience, also the arrangement of multiple antennas internally to a single WLAN can be used to influence the shape and behavior of the wireless signal (both on transmit and receive). To better understand how each GWN wireless router broadcasts wireless signal, this paper provides radiation patterns to help engineers during the deployment process.

The GWN7052 is a secure dual-band router powered by 802.11ac Wi-Fi technology. Ideal for small offices, home offices and remote workers, the GWN7052 provides dual-band 2×2 MU-MIMO and supports wireless Mesh networking and wired AP connections. Powered by a dual-core 880MHz processor, the GWN7052 provides Wi-Fi speeds of up to 1.266 Gbps to 100 wireless devices, enabling bandwidth demanding applications such as 4K Ultra HD video streaming, web meeting, video conference, online gaming, and more. It supports VPN to allow remote employees to securely connect to the corporate network from home or branch offices. The GWN7052 also provides enterprise-grade security features to ensure secure Wi-Fi and VPN access, including unique security certificates and random default passwords. By supporting triple-play, different services such as Internet, IPTV and VoIP can be assigned with different VLANs and priorities. To ensure easy installation and management, the GWN7052 includes a built-in controller embedded within the product's web user interface. It is also supported by GWN.Cloud, Grandstream's free cloud Wi-Fi management platform. By combining accelerated Wi-Fi speeds, mesh networking and wired AP connections with advanced features including VPN and advanced QoS, the GWN7052 is the ideal router for a growing a home and small business network.

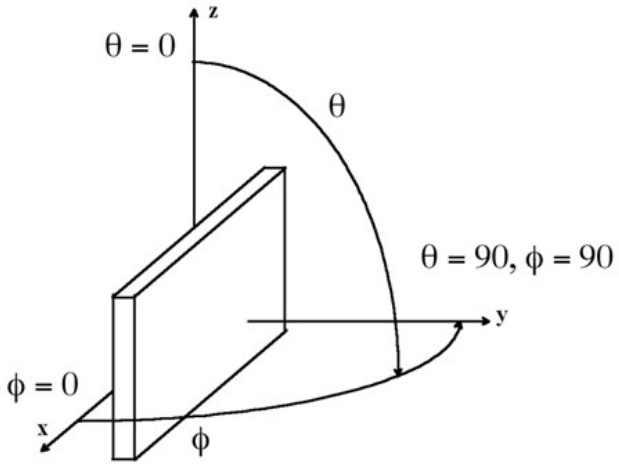
We begin this report with a glossary of basic definitions related to antennas radio characteristics and then progress through the specific radiation patterns for GWN7052 Wireless router series.

TERMINOLOGY

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

Antenna: An antenna is a transducer between a feed signal and radiated wave over the 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 actually 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 the antenna radiation patterns.



Polar Coordinates

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 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 does simply direct 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 a 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 What causes an antenna to not have an efficiency of 100%.

Antenna efficiency losses are typically due to:

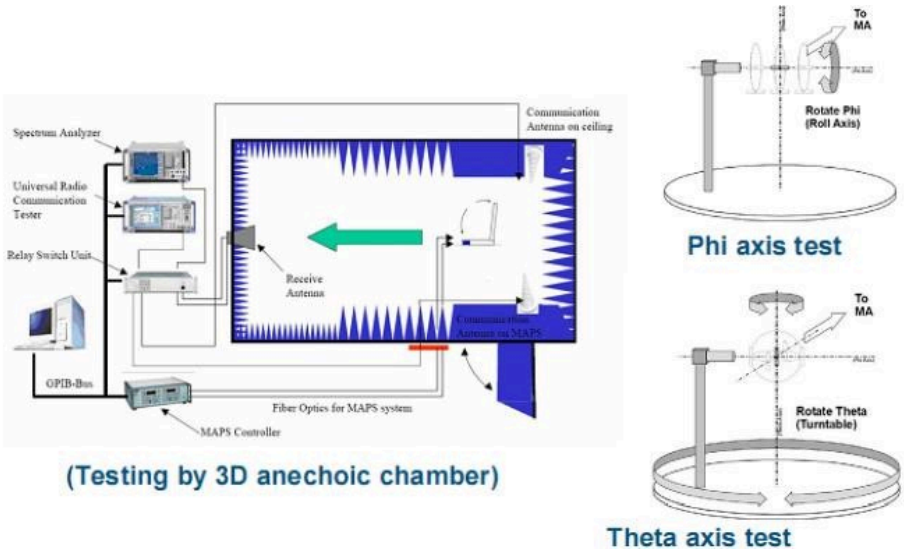
- Conduction losses (due to finite conductivity of the metal that forms the antenna).
- Dielectric losses (due to conductivity of a dielectric material near an antenna).
- Impedance mismatch loss.

TEST ENVIRONMENT

This test report gives schematic diagrams with antennas distribution of GWN wireless routers series, along with the antenna radiation patterns both 2.4Ghz and 5Ghz frequencies in order to help engineers during 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.

Below figure gives an overview of the used test environment:



Test environment

GWN7052 ANTENNA CHARACTERISTICS

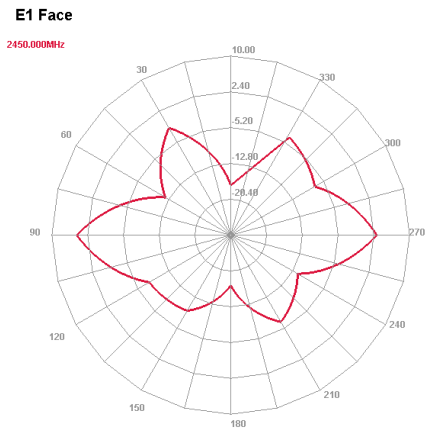
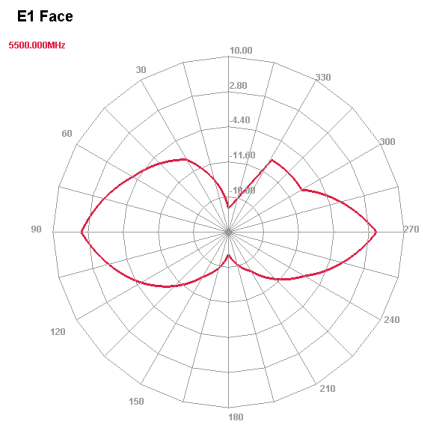
Antenna Patterns

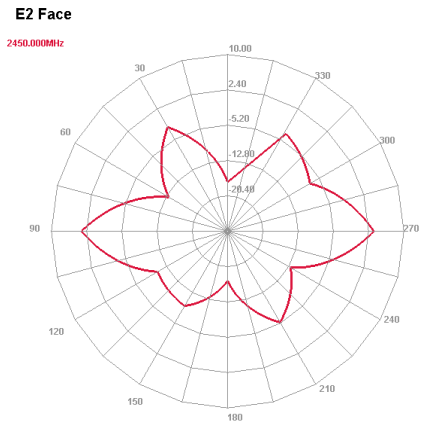
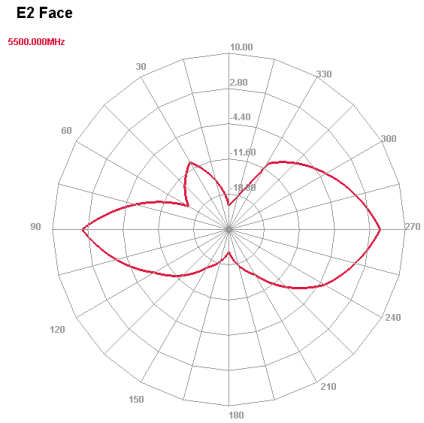
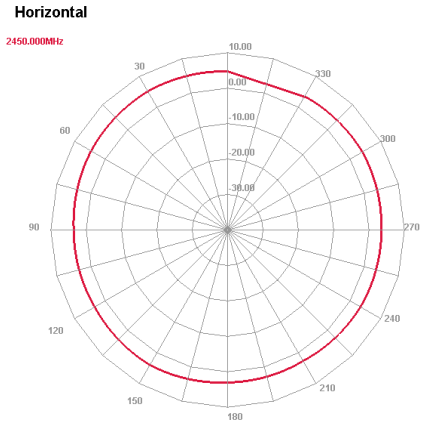
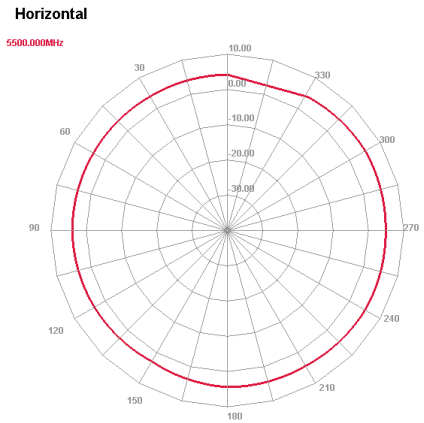
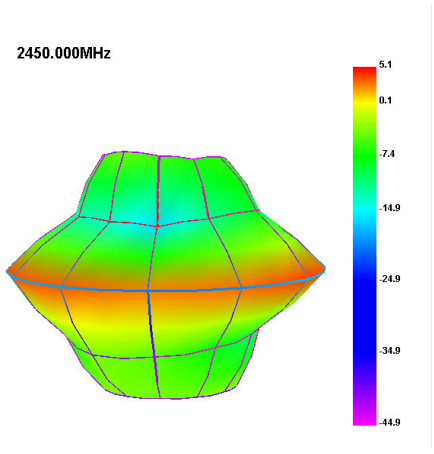
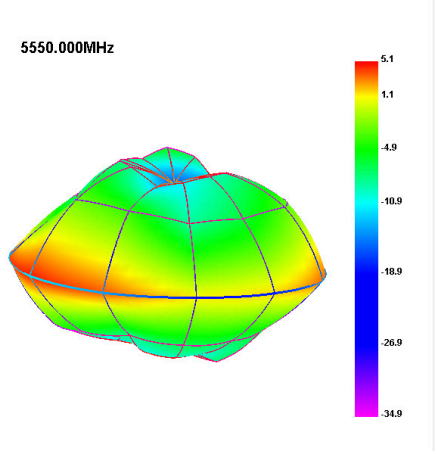
On this section, we provide the resulting antenna radiation patterns for GWN7052 wireless router from the conducted test, the pattern plots provided are for elevation (vertical) plane and azimuth (horizontal) plane as well as the 3D mapped model.

2.4G		
Freq (MHz)	**Effi(%)**	**Gain(dBi)**
2400	71.04	5.32
2410	74.89	5.51
2420	79.5	5.2

2430	81.83	5.34
2440	81.55	5.34
2450	77.93	5.14
2460	79.11	5.17
2470	73.69	5.37
2480	72.85	5.29
2490	75.52	5.41
2500	73.38	5.32
5G		
5150	82.28	5.14
5250	82.76	5.49
5350	76.78	5.02
5450	78.7	5.25
5550	80.94	5.15
5650	74.96	5.38
5750	75.89	5.24
5850	72.07	5.18

GWN7052 antenna characteristics

Label	**2.4G**	**5G**
E1 Face		

E2 Face		
Azimuth		
3D model		

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