



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 1 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

ISSUE	ORIGINATOR	DETAIL SPEC CHANGES	DATE
A	HAMMEL, BRANDON; CALHOUN, ALEC; GRADA, SAMUEL	PRODUCTION RELEASE	NOV 03, 2016
B	HAMMEL, BRANDON; CALHOUN, ALEC; GRADA, SAMUEL	UPDATE CABLE TO PFP-195 ON AN000163A02  ADDED PN: AN000163A05	JAN 17, 2017

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 2 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

TABLE OF CONTENTS

1. SCOPE..... 3

2. APPLICABLE DOCUMENTS..... 3

3. REQUIREMENTS..... 3

    3.1 GENERAL AND ENVIRONMENTAL ..... 3

4. EXCEPTIONS AND WAIVERS..... 8

5. ANTENNA DIAGRAM ..... 9

6. TYPICAL VSWR FOR REFERENCE ..... 12

7. TYPICAL PEAK GAIN FOR REFERENCE ..... 13

8. TYPICAL EFFICIENCY FOR REFERENCE..... 15

9. TYPICAL RADIATION PATTERNS..... 17

10. OTHER ANTENNA PARAMETERS..... 23

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 3 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

1. SCOPE

This document contains specifications pertinent to the AXP8500 GPS/BT/WIFI antenna for use in mobile radios. It includes General, Mechanical and Electrical Requirements, VQA/Final tests, and Qualification tests.

2. APPLICABLE DOCUMENTS

- 12M02897W18    Controlled and Reportable Materials Disclosure
- 12M05022A87    Motorola Quality Procedure Outsourced Assembled Kits
- 12M05041A30    Motorola Barcode and Label Applications Standard
- 12M80967A78    Motorola Vendor Material Quality Control
- 12S10601A       Motorola Packaging Rules for Vendors
- 12S10616A       Motorola Marking and Containers for Consumer Products Division
- 12G13933A01    Motorola Receiving Bar Code Specification for Vendors

3. REQUIREMENTS

3.1 General

Manufacturer needs to report any change in process/ material that would affect the electrical/ mechanical performance of the antenna.

GPS/BT/WIFI ANTENNA DEFINED IN THIS DOCUMENT	
Part Number	Description
AN000163A01	GPS/BT/WIFI Vehicle Mount Antenna 17ft Low Loss Cable
AN000163A02	GPS/BT/WIFI Motorcycle Mount Antenna 6ft Flexible Cable
AN000163A05	GPS/BT/WIFI Vehicle Mount Antenna 17ft Flexible Cable

3.1.1 Application: This antenna is used with vehicle mount and motorcycle mount mobile radios.

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 4 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

3.1.2 Mechanical Requirements: Table 1. See Antenna diagram on page 8.

Part Number	Description	WIFI Antenna Cable	GNSS Antenna Cable	Install Manual
AN000163A01	GPS/BT/WIFI Vehicle Mount	PVC Free PFP-240 17ft QMA Plug (QMA Plug: Amphenol 134104 or Motorola Approved Equivalent)	PVC Free PFP-100A 17ft QMA Plug (QMA Plug: Amphenol 930-129-51S or Motorola Approved Equivalent)	PD003891A01: Install Manual GPS/BT/WIFI Vehicle Mount
AN000163A02	GPS/BT/WIFI Motorcycle Mount	PVC Free PFP-195 6ft QMA Plug (QMA Plug: Amphenol 930-120P-51S) or Motorola Approved Equivalent)	PVC Free PFP-100A 6ft QMA Plug (QMA Plug: Amphenol 930-129-51S or Motorola Approved Equivalent)	PD003891A02: Install Manual GPS/BT/WIFI Motorcycle Mount
AN000163A05	GPS/BT/WIFI Vehicle Mount	PVC Free PFP-195 17ft QMA Plug (QMA Plug: Amphenol 930-120P-51S or Motorola Approved Equivalent)	PVC Free PFP-100A 17ft QMA Plug (QMA Plug: Amphenol 930-129-51S or Motorola Approved Equivalent)	PD003891A01: Install Manual GPS/BT/WIFI Vehicle Mount

Table 1: Mechanical Requirements

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



## Material or Methods Specification

Number: AN000163A

Issue: B

Page 5 of 23

Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

### 3.1.2 Mechanical:

**Random Vibration Test:** Per MIL-STD-810E, Method 514.4, Procedure I-3.3

**Temperature Cycle Test:** In temperature/humidity chamber and perform 5 contiguous cycles of the following temperature cycle:

- a. Begin test at room temperature (+23°C).
- b. Ramp up to 70°C in 94 + 15/-0 minutes (0.5°C/min).
- c. Soak at 70°C for 60 +30/-0 minutes.
- d. Ramp down to -40°C in 220 + 15 minutes/-0 (0.5°C/min).
- e. Soak at -40°C for 60 +30/-0 minutes.
- f. Ramp back to room temperature in 126 + 15 minutes/-0 (0.5°C/min).

**Humidity Cycle Test:** In temperature/humidity chamber and perform the following 24-hour temperature/humidity profile:

- a. Begin test at 25°C/50% relative humidity.
- b. Ramp temperature to 40°C + 5°C and relative humidity to 95% + 5% in 3 hours + 30 minutes/-0.
- c. Hold at 40°C + 5°C and 95% + 5% relative humidity for 6 hours + 30 minutes/-0.
- d. Ramp temperature to 25°C + 5°C and relative humidity to 80% + 5% in 3 hours + 30 minutes/-0.
- e. Ramp relative humidity to 95% + 5% while maintaining temperature at 25°C + 5°C in 3 hours + 30 minutes/-0.
- f. Soak at 25°C + 5°C and 95% + 5% relative humidity for 6 hours.
- g. Ramp temperature to 40°C + 5°C while maintaining relative humidity at 95% + 5% in 3 hours + 30 minutes/-0.
- h. Repeat steps c through g for a total of 6 cycles.

**Salt Spray (Fog) Test:** Per MIL-STD-810E, Procedure I, Method 509.3

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 6 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

3.1.3 Electrical Requirements:

Table 2: BT/WLAN Specifications

Motorola P/N	Freq Range (GHz)	Nominal Impedance (Ohms)	Max. Power (Watts)	Peak Gain (dBi)	Nominal VSWR (over 90 %BW)	MAX. VSWR
AN000163A01	2.40- 2.50	50	1	2.5 – 3.5 <sup>3</sup>	< 1.6:1 <sup>1</sup>	< 2.0:1 <sup>1</sup>
	4.9-5.9			(-0.3) – 3.3 <sup>3</sup>	< 1.5:1 <sup>1</sup>	<2.0:1 <sup>1</sup>
AN000163A02	2.40- 2.50	50	1	4.0 – 5.0 <sup>3</sup>	< 2.1:1 <sup>2</sup>	< 2.5:1 <sup>2</sup>
	4.9 – 5.9			2.0 – 5.25 <sup>3</sup>	< 2.0:1 <sup>2</sup>	< 2.5:1 <sup>2</sup>
AN000163A05	2.40- 2.50	50	1	1.5– 2.5 <sup>3</sup>	< 1.5:1 <sup>4</sup>	< 2.0:1 <sup>4</sup>
	4.9-5.9			(-1.9) – 1.6 <sup>3</sup>	< 1.4:1 <sup>4</sup>	<2.0:1 <sup>4</sup>

<sup>1</sup> Measured in an anechoic setup/ open space with no interference, with the antenna mounted on a 36”diameter ground plane. A 17-foot PFP-240 cable from the antenna mount was connected to a male N-type connector.

<sup>2</sup> Measured in an anechoic setup/ open space with no interference, with the antenna mounted on a 36”diameter ground plane. A 6-foot PFP-240 cable from the antenna mount was connected to a male N-type connector. Theoretical values were then calculated, taking into account the difference in cable loss between LMR-240 and LMR195.

<sup>3</sup> Measured in an anechoic setup/ open space with no interference, with the antenna mounted on a 36”diameter ground plane. Measured gain is corrected for the appropriate cable loss.

<sup>4</sup> Using setup from note (1) above, theoretical values were then calculated, taking into account the difference in cable loss between LMR-240 and LMR195.

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 7 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

Table 3: GNSS Specifications

Characteristics	Minimum Value	Typical Value	Maximum Value	Units
Operating Temperature	-40	-	+85	C
Frequency	1565	Fc=1586	1608	MHz
Polarization	-	Right Hand Circular	-	-
Bandwidth (3dB)	36	43		MHz
Attenuation, Fc-25MHz	NA	NA	-	dB
Attenuation, Fc-45MHz	56	65	-	dB
Attenuation, Fc-70MHz	60	60	-	dB
Attenuation, Fc-200MHz	60	60	-	dB
Attenuation, Fc-600MHz	65	65	-	dB
Attenuation, Fc-1000MHz	70	70	-	dB
Noise Figure	-	2.0	4.5	-
Output VSWR	-	1.5	2.5	-
Output Return Loss	-	-	-10	dB
Power Supply	2.8	5	6	V
Current	-	23	26	mA

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 8 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

Current Over Temperature	-	25	30	mA
LNA Gain (without Antenna Element and Cable)	24	26	28	dB
Gain variation over temperature	-4	-	3	dB
1 dB Input Compression Point	-23	-	-	dBm

4. EXCEPTIONS AND WAIVERS

No change shall be allowed on production material, regardless of whether such change affects requirements specified, without prior explicit written permission of Motorola Development Engineering and Purchasing departments.

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.





Material or Methods Specification

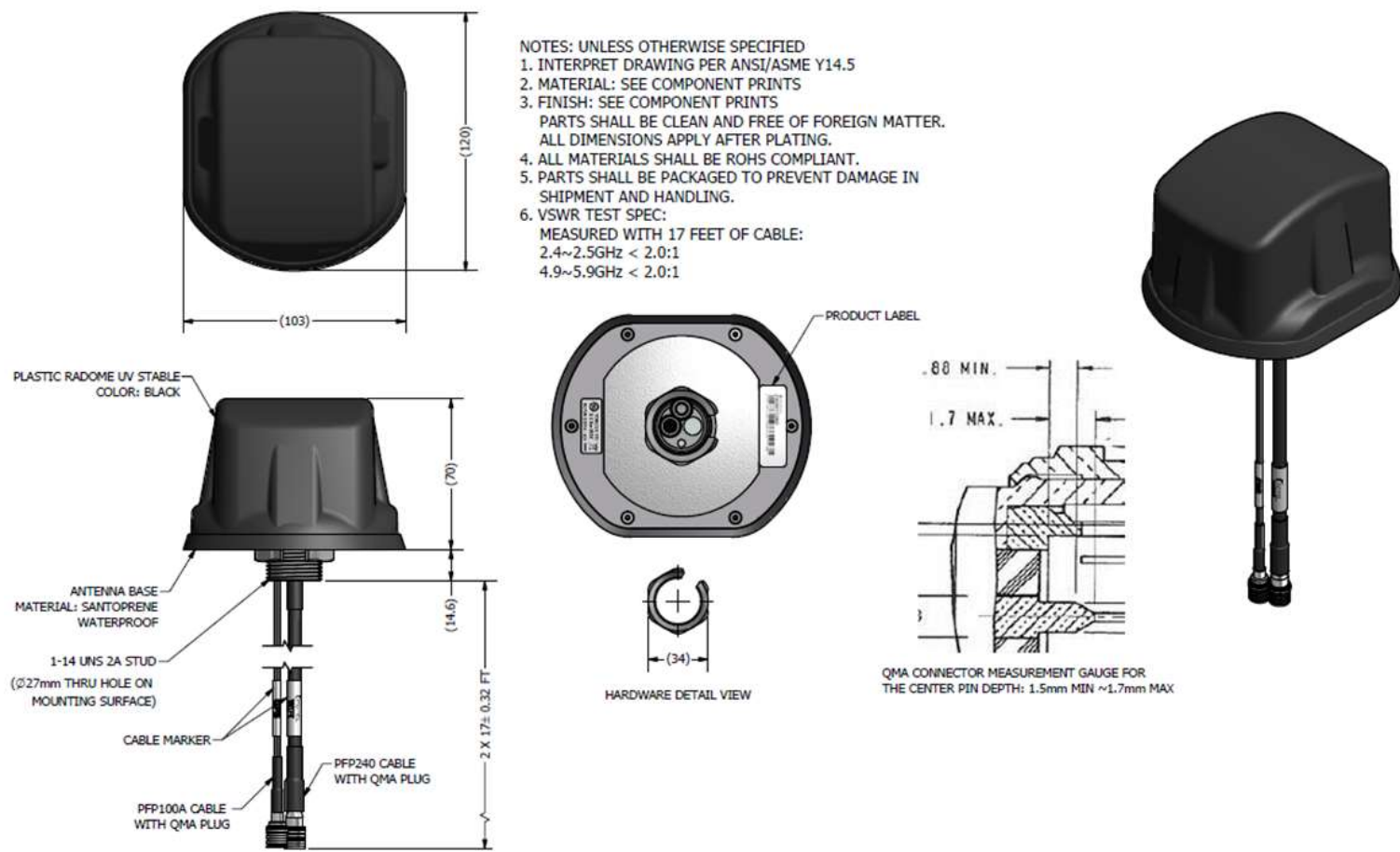
Number: AN000163A  
Issue: B  
Page 9 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

5. ANTENNA DIAGRAM

AN000163A01

Note: Dimensions in Millimeters



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



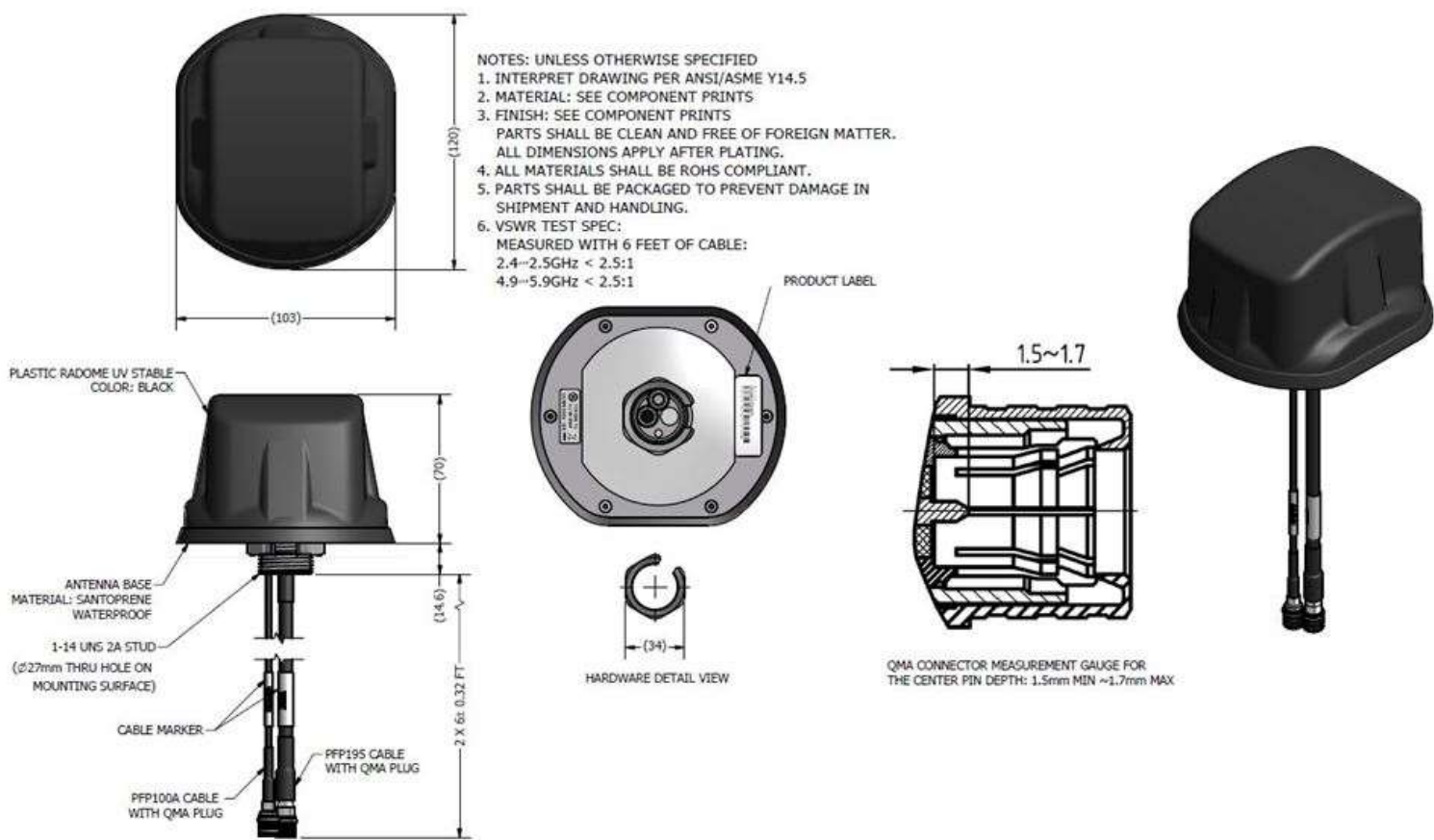
Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 10 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

AN000163A02

Note: Dimensions in Millimeters



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



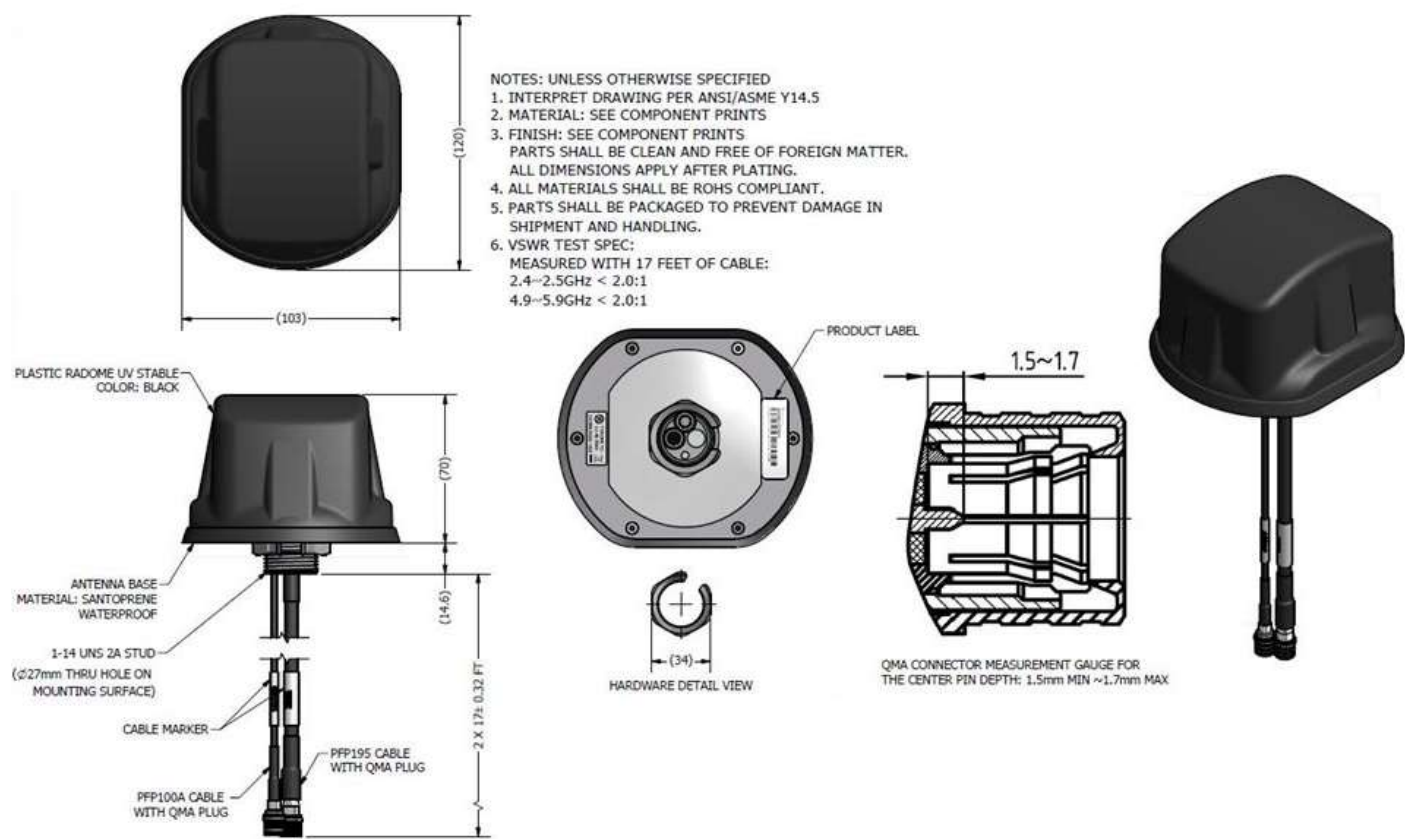
Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 11 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

AN000163A05

Note: Dimensions in Millimeters



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.

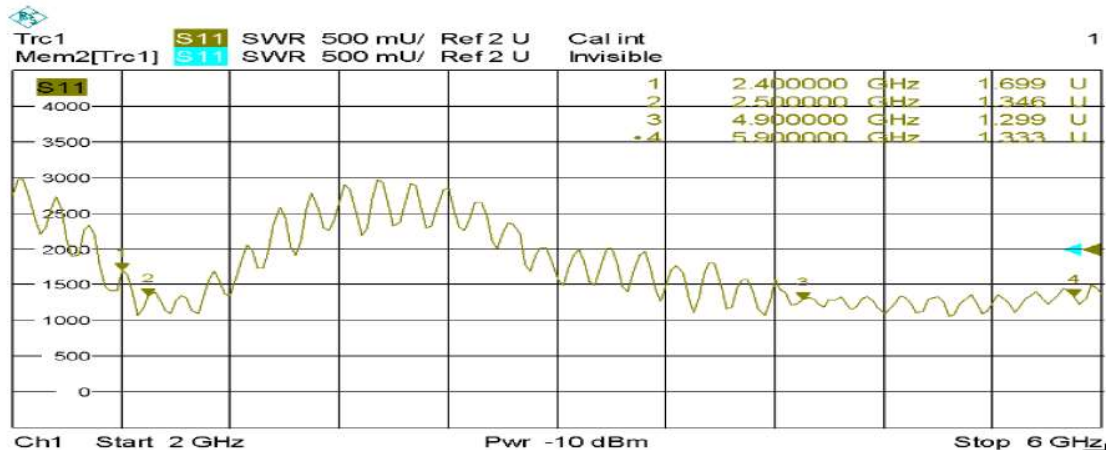


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 12 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

6. TYPICAL VSWR FOR REFERENCE, (with 17ft Cable)



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.

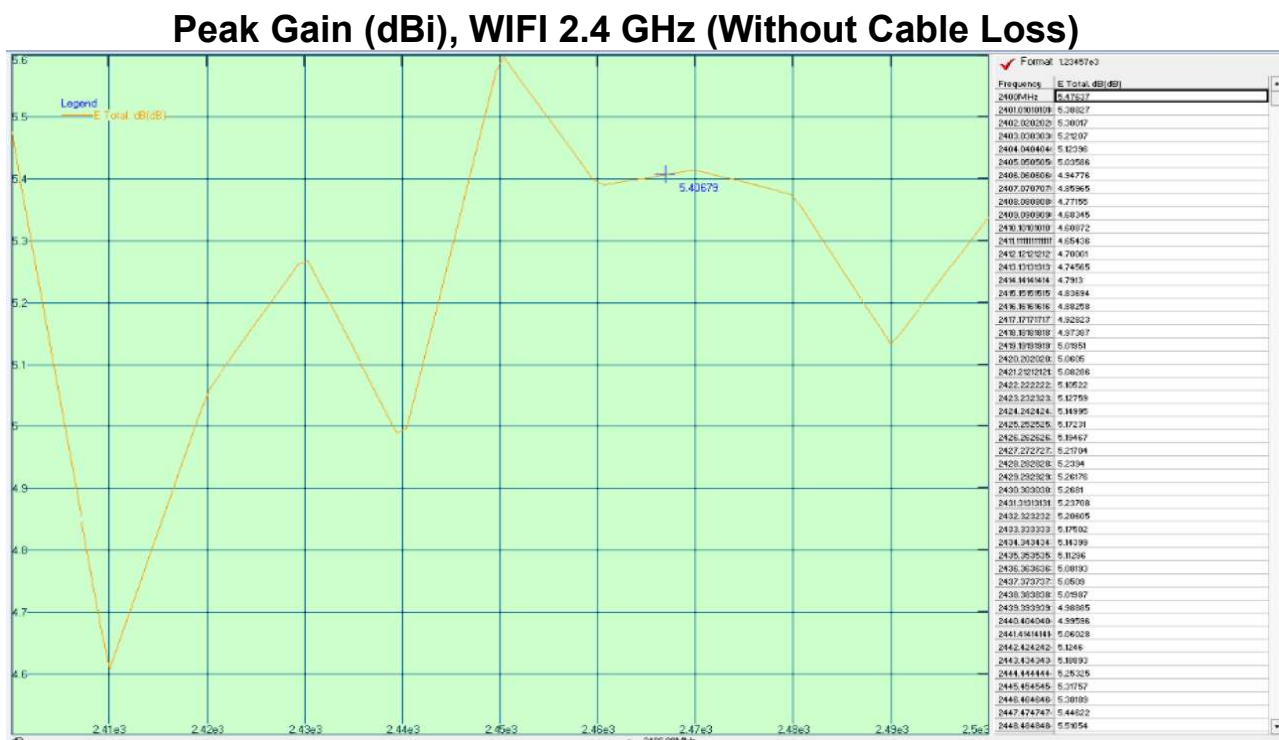


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 13 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

7. TYPICAL PEAK GAIN FOR REFERENCE



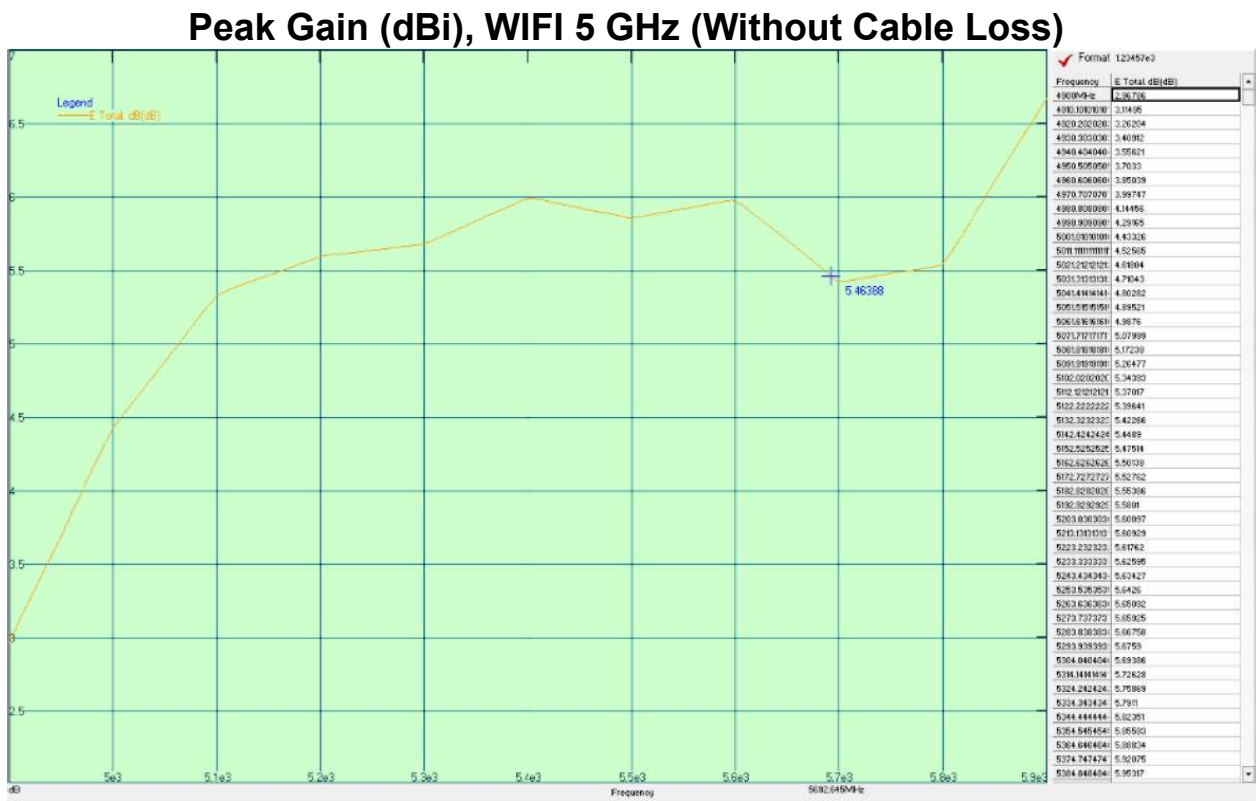
The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 14 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



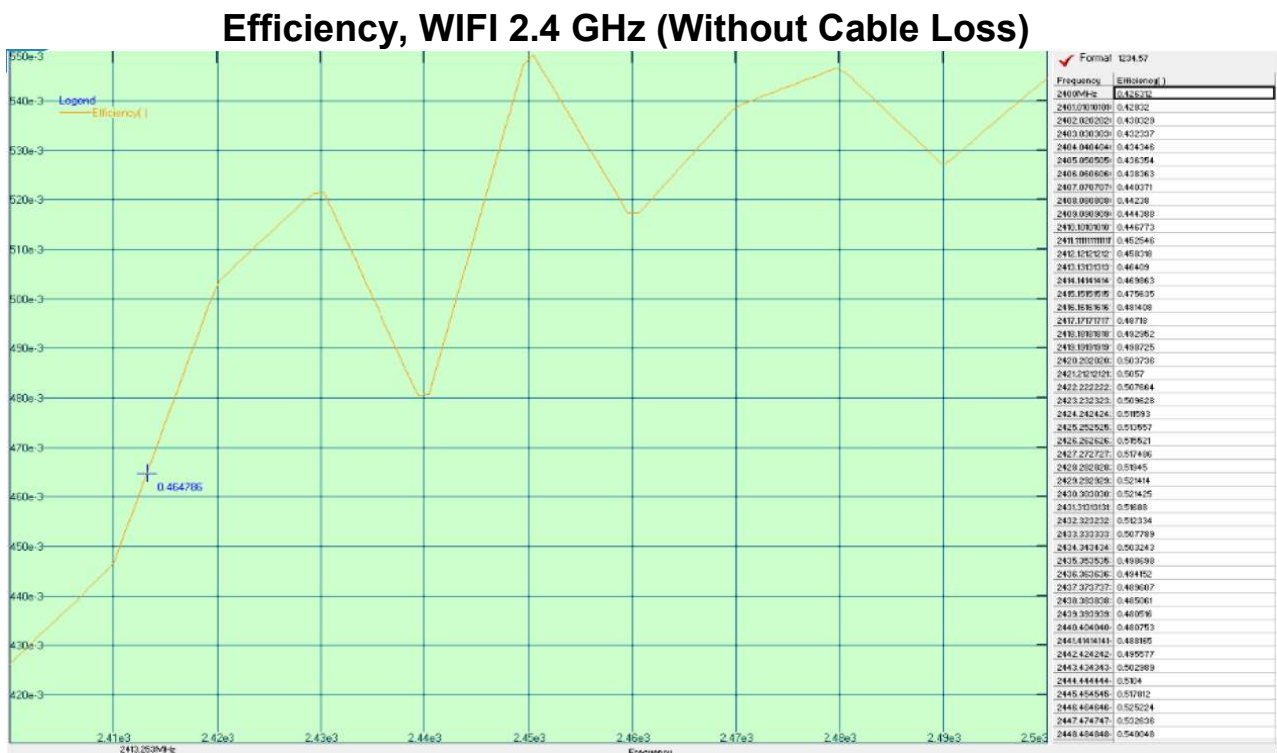


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 15 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

8. TYPICAL EFFICIENCY FOR REFERENCE



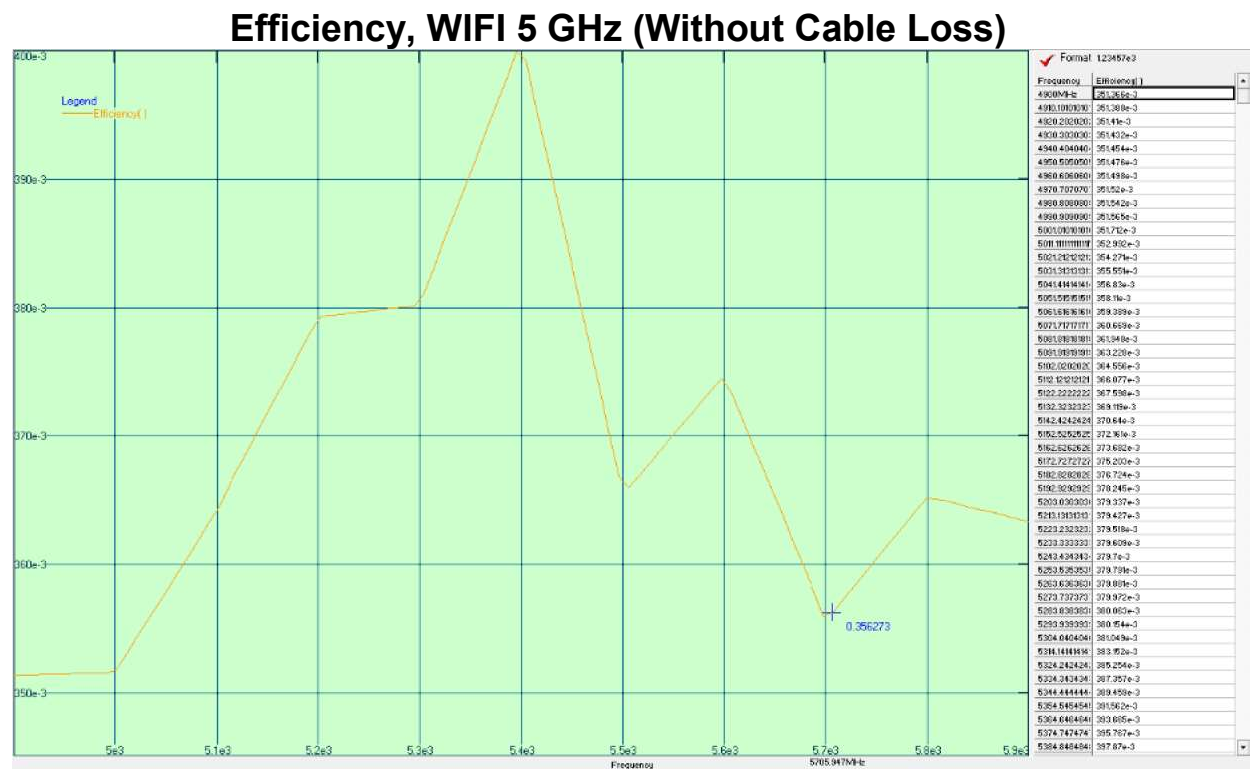
The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 16 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



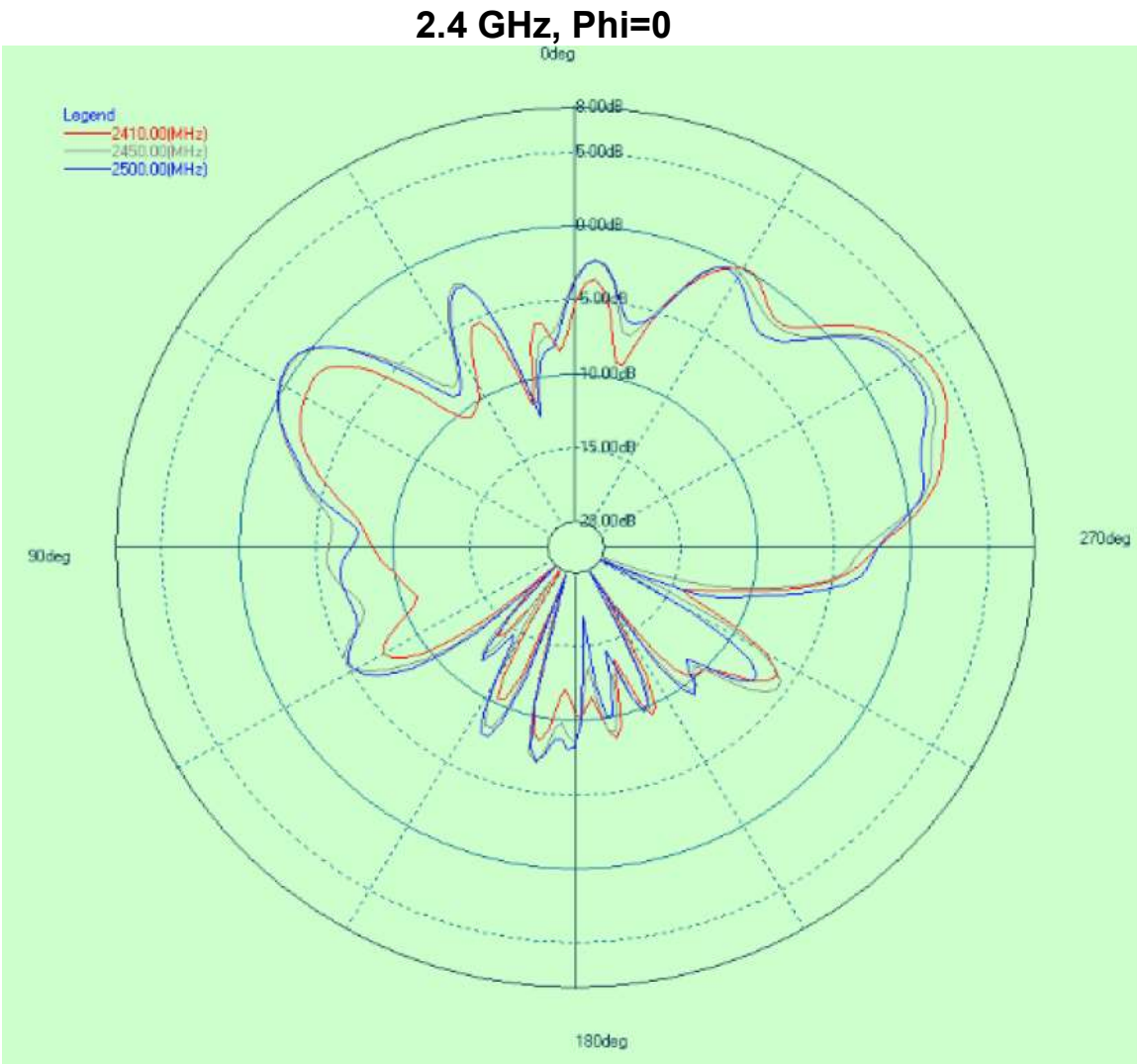


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 17 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

9. TYPICAL RADIATION PATTERNS



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.

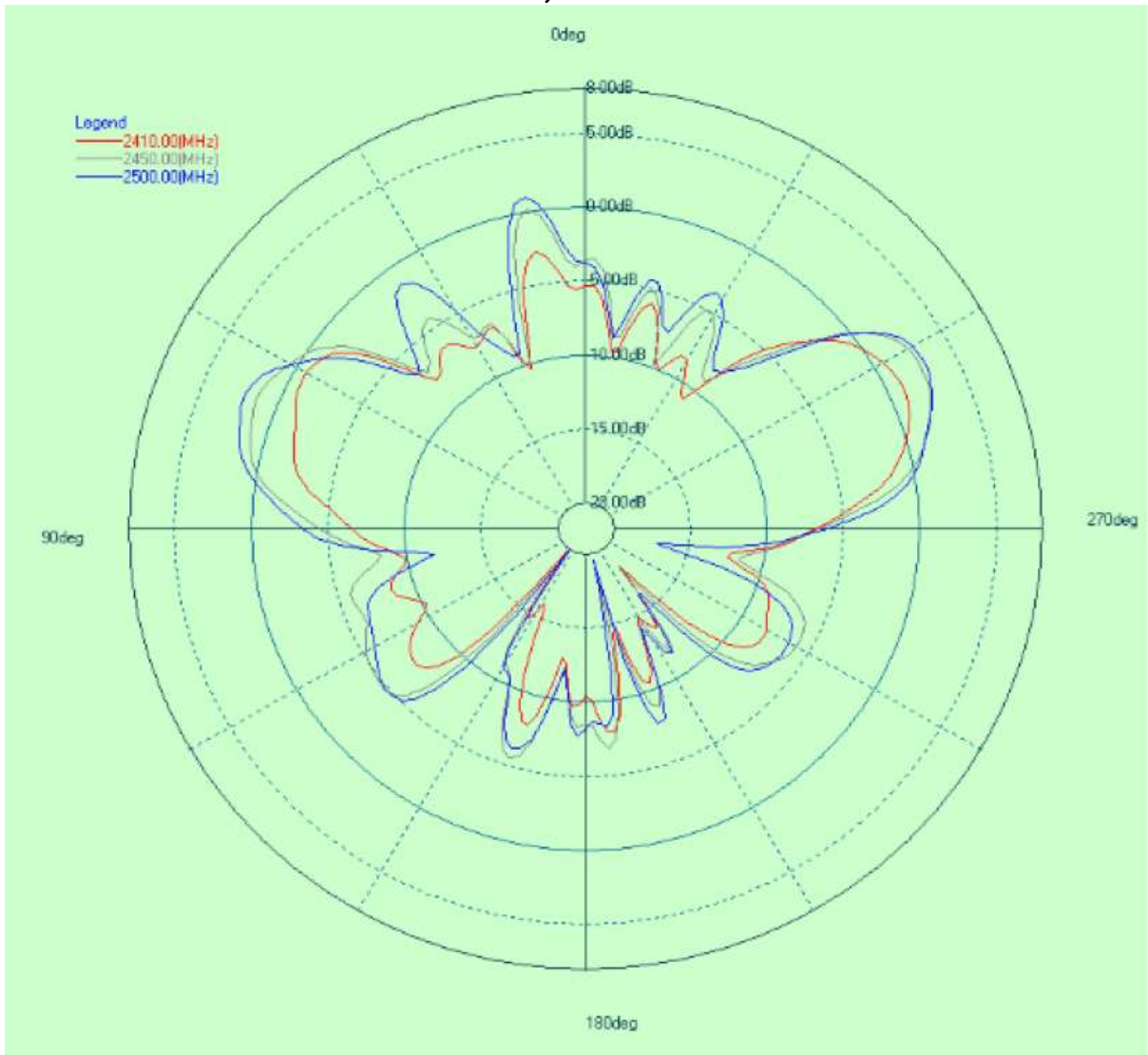


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 18 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

2.4 GHz, Phi=90



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.

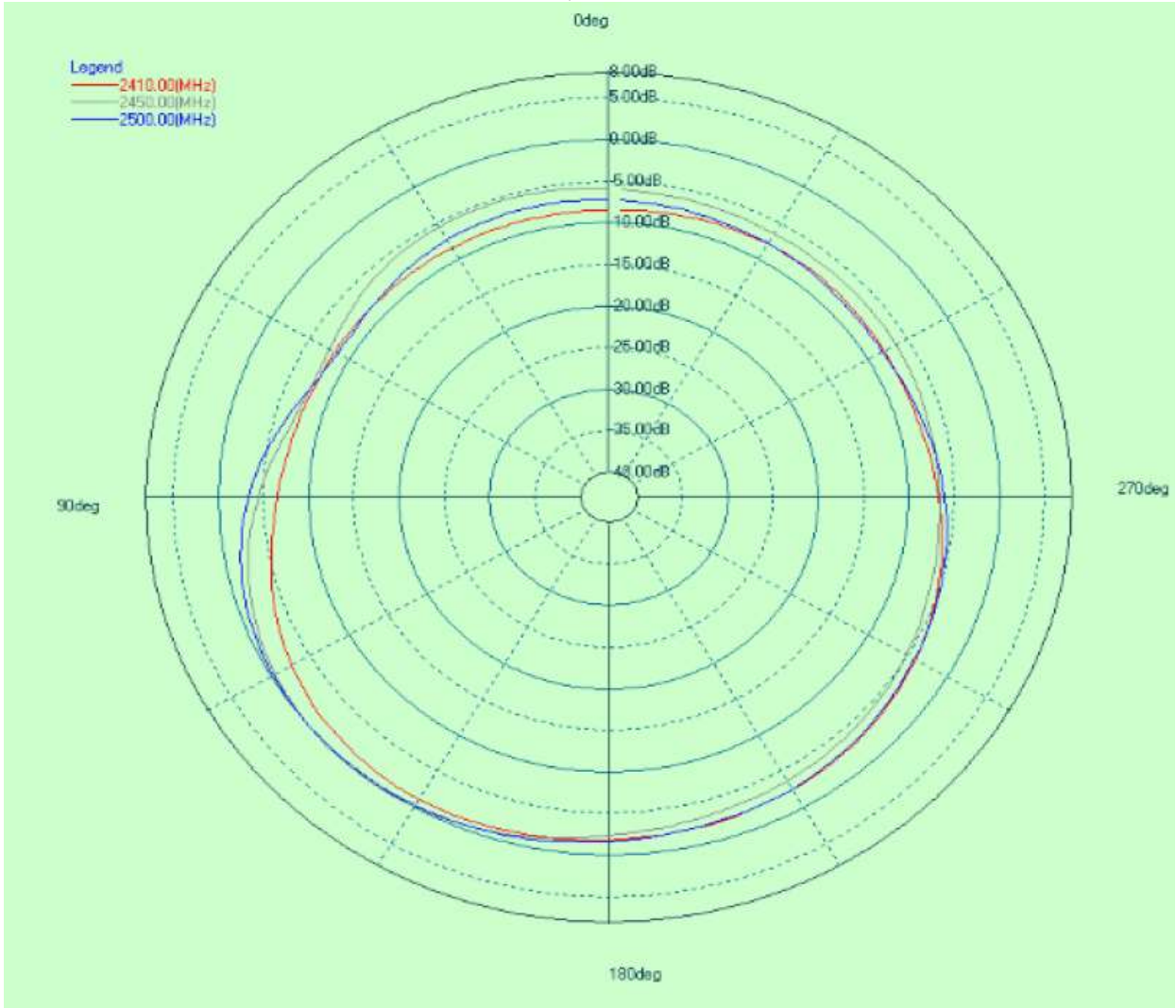


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 19 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

2.4 GHz, Theta=90



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.

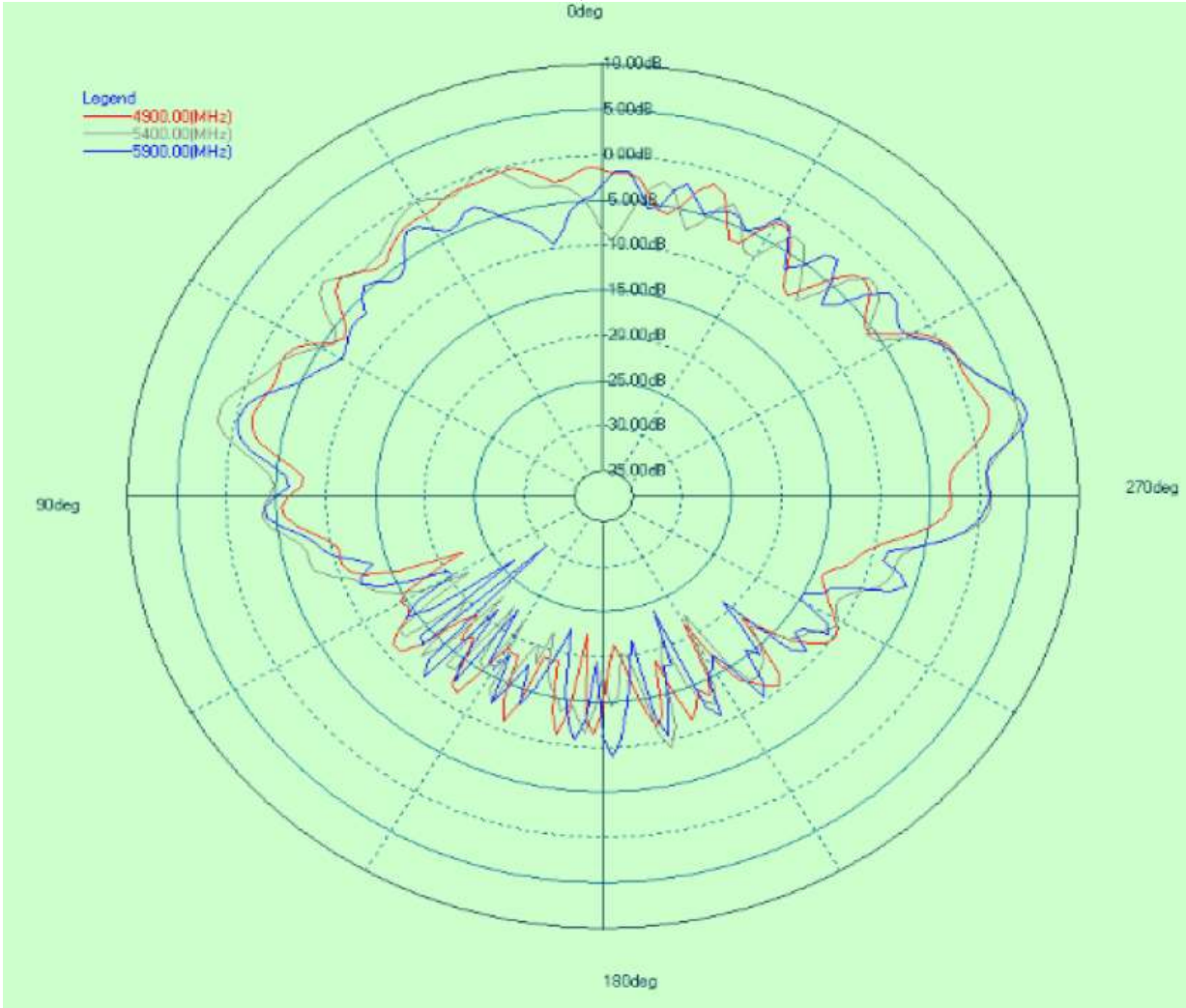


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 20 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

5 GHz, Phi=0



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



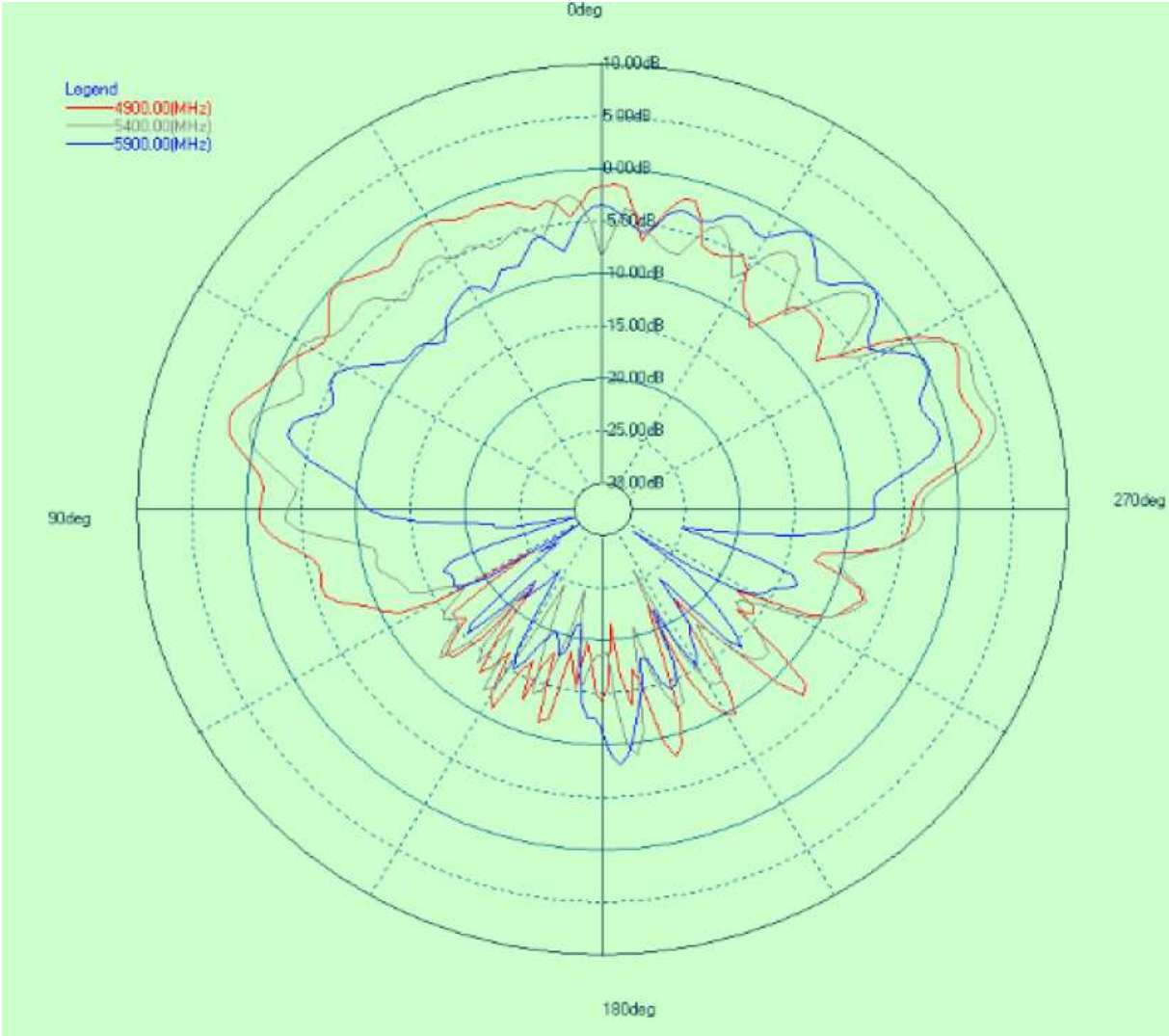


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 21 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

5 GHz, Phi=90



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.

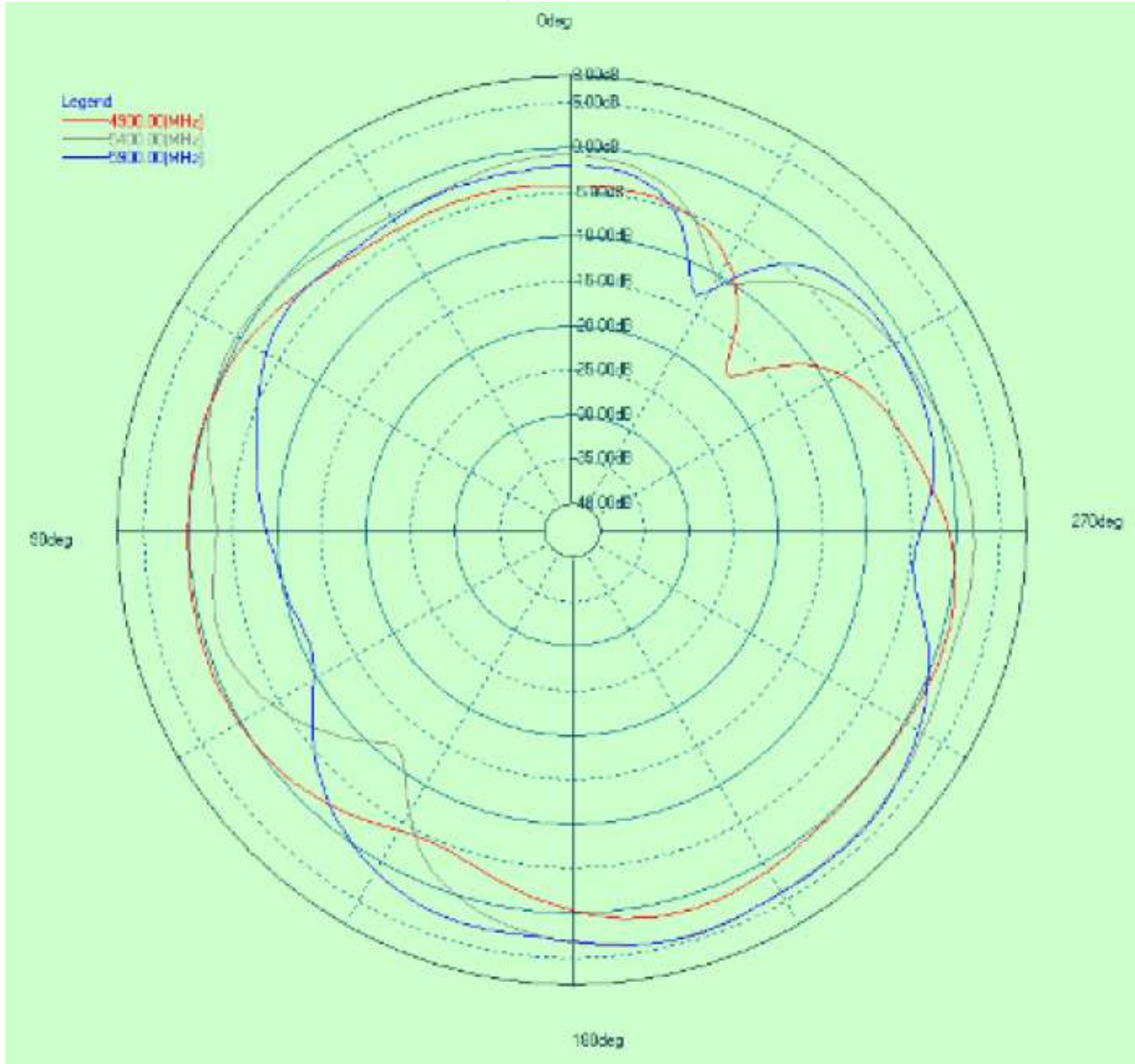


Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 22 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

5 GHz, Theta=90



The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.



Material or Methods Specification

Number: AN000163A  
Issue: B  
Page 23 of 23  
Date: NOV 03, 2016

TITLE: APX8500 GPS/BT/WIFI ANTENNA

10. OTHER ANTENNA PARAMETERS

Band	Frequency (GHz)	3 dB Vertical Beamwidth (degrees)	Peak Gain Angle from Horizon (degrees)
2.4 GHz	2.45	20	27
5 GHz	5.85	18 typical	15 typical

The information contained in this document is proprietary to Motorola Solutions and shall not be reproduced or used in whole or in part without Motorola Solutions written consent.