166 South Carter, Genoa City, WI 53128

| | |
|---|---|
| Company: | Cambium Networks |
| Model Tested: | C054045A001A |
| Report Number: | 22419 |
| DLS Project: | 8599 |

# Code of Federal Regulations 47 Part 15 – Radio Frequency Devices

Subpart E – Unlicensed National Information Infrastructure Devices
Section 15.407
General Technical Requirements.

THE FOLLOWING **MEETS** THE ABOVE TEST SPECIFICATION
FOR A **CLASS III** PERMISSIVE CHANGE
(to add 40 MHz channel bandwidth to 5.4 GHz band)
(DFS not tested by DLS Electronic Systems Inc.)

**FCC ID: Z8H89FT0002**

| | |
|---|---|
| Formal Name: | PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio |
| Kind of Equipment: | Point-to-Multipoint Digital Transmission Transceiver |
| Frequency Range: | **5495 to 5700 MHz (5.4 GHz xcvr in this report)**<br>5475 to 5720 MHz (5.4 GHz xcvr reported to the FCC in CFR 47 Part 15 Subpart C Section 15.247 report # 18191)<br>5730 to 5845 MHz (5.7 GHz xcvr reported to the FCC in CFR 47 Part 15 Subpart C Section 15.247 reports # 17897 & 17898) |
| Test Configuration: | Stand-alone |
| Model Number(s): | C054045A001A and C054045A002A |
| Model(s) Tested: | C054045A001A |
| Serial Number(s): | 0A003EA03DA1 |
| Date of Tests: | December 13-14, 2016 |
| Test Conducted For: | Cambium Networks<br>3800 Golf Road, Suite 360<br>Rolling Meadows, IL 60008, USA |

**NOTICE**: "This test report relates only to the items tested and must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government". Please see the "Description of Test Sample" page listed inside of this report.

166 South Carter, Genoa City, WI 53128

| | |
|---|---|
| Company: | Cambium Networks |
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SIGNATURE PAGE

Report By:

Craig Brandt
Test Engineer

Reviewed By:

William Stumpf
OATS Manager

Approved By:

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General Manager

166 South Carter, Genoa City, WI 53128

Company: Cambium Networks
Model Tested: C054045A001A
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DLS Project: 8599

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United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

# Certificate of Accreditation to ISO/IEC 17025:2005

**NVLAP LAB CODE: 100276-0**

**D.L.S. Electronic Systems, Inc.**
Wheeling, IL

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:*

**Electromagnetic Compatibility & Telecommunications**

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2016-08-16 through 2017-09-30
*Effective Dates*

*For the National Voluntary Laboratory Accreditation Program*

**ELECTROMAGNETIC COMPATIBILITY & TELECOMMUNICATIONS**

**NVLAP LAB CODE 100276-0**

## Emissions

| ***Designation*** | ***Description*** |
|---|---|
| Off-site test location | D.L.S. Electronics performs radiated emissions testing at an additional location, 166 South Carter Street, Genoa City, WI 53128. |

## 1.0 Summary of Test Report

It was determined that the Cambium Networks PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio, Model C054045A001A, complies with the requirements of CFR 47 Part 15 Subpart E Section 15.407. The purpose of this test was to show FCC compliance of the PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio, pursuant to a Class III Permissive Change to FCC ID: Z8H89FT0002. The original device was certified as a 5.7 GHz MIMO/Combo Radio, tested to CFR 47 Part 15 Subpart C, Section 15.247. A previous Class III Permissive Change added the 5.4 GHz software package to the device. This report is being generated to show compliance of a 40 MHz channel bandwidth for the 5.4 GHz MIMO/Combo Radio being added to the software package of the device. Original testing of the 5.7 GHz MIMO/Combo Radio determined that QPSK is the worst case modulation of the OFDM transceiver. This modulation was tested to show compliance to CFR 47 Part 15 Subpart E Section 15.407 for the Class III Permissive Change.

NOTE: AC line conducted emissions were reported to the FCC in CFR 47 Part 15 Subpart C Section 15.247 reports # 17897 & 17898.

Radiated emission in the frequency range 30 MHz to 1000 MHz were reported to the FCC in CFR 47 Part 15 Subpart E Section 15.407 report # 18191)

**Subpart E Section 15.407 Applicable Technical Requirements Tested:**

| Section | Description | Procedure | Note | Compliant? |
|---|---|---|---|---|
| Informative | Emission Bandwidth – 26 dB bandwidth | ANSI C63.10-2013 Section 12.4.1 | 1 | NA |
| 15.407(a)(2) | Maximum Conducted Output Power | ANSI C63.10-2013 Section 12.3.3.1 | 1 | Yes |
| 15.407(a)(2) | Peak Power Spectral Density - Conducted | ANSI C63.10-2013 Section 12.5 - PPSD Section 12.3.2.4 SA-2 | 1 | Yes |
| 15.407(b)(3), 15.407(b)(5) | Unwanted Emission Levels – Band-Edge | ANSI C63.10 Section 12.7.3 | 1 | Yes |
| 15.407(b)(3), 15.407(b)(6), 15.407(b)(7) | Unwanted Emission Levels – RF Conducted | ANSI C63.10-2013 Section 12.7.2 Section 12.7.3 | 1 | Yes |
| 15.407(b)(3), 15.407(b)(7) | Unwanted Emission Levels – Radiated from cabinet | ANSI C63.10-2013 Section 6.6 | 2 | Yes |
| 15.407(h)(2) | Dynamic Frequency Selection (DFS) | Not tested by DLS | | NA |

Note 1: RF Conducted emission measurement.
Note 2: Radiated emission measurement.

## 2.0 Introduction

On December 13-14, 2016 the PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio, Model C054045A001A, as provided from Cambium Networks, was tested to the requirements of CFR 47 Part 15 Subpart E Section 15.407 to be added to FCC ID: Z8H89FT0002 as a Class III Permissive Change. Testing was performed to show compliance of a 40 MHz channel bandwidth in the 5.4 GHz band. To meet these requirements, the procedures contained within this report were performed by personnel of D.L.S Electronic Systems, Inc.

## 3.0 Test Facilities

D.L.S. Electronic Systems, Inc. is a full service EMC/Safety Testing Laboratory accredited to ISO 17025. NVLAP Certificate and Scope can be viewed at http://www.dlsemc.com/certificate. Our facilities are registered with the FCC, Industry Canada, and VCCI.

**Wisconsin Test Facility:**
D.L.S. Electronic Systems, Inc.
166 S. Carter Street
Genoa City, Wisconsin 53128

**Wheeling Test Facility:**
D.L.S. Electronic Systems, Inc.
1250 Peterson Drive
Wheeling, IL 60090

**FCC Registration #90531**

## 4.0 Description of Test Sample

**Description:**

Point-to-Multipoint 5.4 GHz & 5.7 GHz DTS/UNII Transceiver with either OMNI (13 dBi) or Sector (17 dBi) external antenna with 10 MHz or 20 MHz channel bandwidth. Point-to-Multipoint 5.4 GHz UNII Transceiver with external 17 dBi Sector antenna with 40 MHz channel bandwidth.

**Type of Equipment / Frequency Range:**

Stand-Alone / **5495 to 5700 MHz (40 MHz bandwidth) (in this report)**

5475 to 5720 MHz (10 MHz bandwidth) (reported to the FCC in report #18191)
5480 to 5715 MHz (20 MHz bandwidth) (reported to the FCC in report #18191)

5730 to 5845 MHz (5.7 GHz xcvr reported to the FCC in reports # 17897 & 17898)

## 4.0 Description of Test Sample (continued)

**Physical Dimensions of Equipment Under Test:**

Length: 9 in. Width: 9 in. Height: 3 in.

**Power Source:**

30 VDC (Power Over Ethernet to Radio)
120 Vac, 60 Hz using Phihong power supply model: PSA15A-295 (MOT)
or Phihong power supply model: PSA15M-300(SM)

**Internal Frequencies:**

150 kHz, 75 kHz (Switching Power Supply Frequencies)
40 MHz, 25 MHz, 20 MHz

**Transmit / Receive Frequencies Used For Test Purpose:**

40 MHz Channel Bandwidth: Low channel: 5495 MHz
Middle channel: 5575 MHz
High channel: 5700 MHz

**Type of Modulation(s):**

OFDM: QPSK, 16-QAM, 64-QAM **(QPSK is worst case)**

**Description of Circuit Board(s) / Part Number:**

| | |
|---|---|
| Cambium Networks PC Board | 84010120001 Issue A |
| 17 dBi Dipole Sector antenna | SKM540045-17 |
| Connector | 09010084001 |
| Cables x 2 | 30009406002 |
| OMNI 13 dBi antenna | AMO-5G13 |

## 5.0 Test Equipment

A list of the equipment used can be found in the table below. All primary equipment was calibrated against known reference standards with a verified traceable path to NIST.

**D.L.S. Wisconsin**

| Description | Manufacturer | Model Number | Serial Number | Frequency Range | Cal Dates | Cal Due Dates |
|---|---|---|---|---|---|---|
| Receiver | Rohde & Schwarz | ESI 40 | 837808/005 | 20 Hz – 40 GHz | 6-23-16 | 6-23-17 |
| Preamp | Ciao | CA118-4010 | 101 | 1GHz-18GHz | 1-20-16 | 1-20-17 |
| Preamp | Planar | PTB-60-2040-5R0-10-115VAC-292FF | PL3292 | 18-40GH | 6-6-16 | 6-6-17 |
| High Pass Filter | K & L | 50140 11SH10-18000/T40000-K-K | 8 | 18-40GHz | 1-27-16 | 1-27-18 |
| 20 dB attenuator | MCE/weinschel | 5955A-20 | 2056 | DC – 40 GHz | 6-5-16 | 6-5-17 |
| Thermal Power Sensor | Rohde & Schwarz | NRP-Z51 | 1138.0005.03-104290-Wq | DC - 18GHz | 6-23-16 | 6-23-17 |
| 20 dB attenuator | Anritsu | 42N50-20 | 000451 | DC-18GHz | 5-11-16 | 5-11-17 |
| Horn Antenna | EMCO | 3115 | 9502-4451 | 1-18GHz | 6-1-15 | 6-1-17 |
| Horn Antenna | A.H. Systems | SAS-574 | 222 | 18 – 40GHz | 3-14-16 | 3-14-18 |
| Test Software | Rohde & Schwarz | ESK-1 | V1.7.1 | N/A | N/A | N/A |

## 6.0 Test Arrangements

### RF Conducted Emissions Measurement Arrangement:

All RF conducted emission measurements were performed at D.L.S. Electronic Systems, Inc. and set up according to ANSI C63.10-2013, unless otherwise noted. Description of procedures and measurements can be found in Appendix B – Measurement Data. See Appendix A for additional photos of the test set up. See Appendix C for measurement uncertainty.

## 6.0 Test Arrangements (continued)

### Radiated Emissions Measurement Arrangement:

All radiated emission measurements were performed at D.L.S. Electronic Systems, Inc. and set up according to ANSI C63.10-2013, unless otherwise noted. Description of procedures and measurements can be found in Appendix B – Measurement Data. See Appendix A for additional photos of the test set up. See Appendix C for measurement uncertainty.

Unless otherwise noted, the bandwidth of the measuring receiver / analyzer used during testing is shown below.

| Frequency Range | Bandwidth (-6 dB) |
|---|---|
| 10 to 150 kHz | 200 Hz |
| 150 kHz to 30 MHz | 9 kHz |
| 30 MHz to 1 GHz | 120 kHz |
| Above 1 GHz | 1 MHz |

## 7.0 Test Conditions

### Normal Test Conditions:

**Temperature and Humidity:**

69°F at 26% RH

**Supply Voltage:**

30 VDC (Power Over Ethernet to Radio)
120 Vac, 60 Hz using Phihong power supply model: PSA15M-300(SM)

## 8.0 Modifications Made To EUT For Compliance

The lowest channel to be used was changed from 5490 MHz to 5495 MHz.
The highest channel to be used was changed from 5705 MHz to 5700 MHz.
Output power settings were lowered. The final power settings used are listed on the data.

## 9.0 Additional Descriptions

Test software was used to set the frequency, modulation, and output power of the EUT. Transmitter parameters are software controlled and set to Cambium Networks' specifications. Any new software will not enable any features/operations which would violate regulatory requirements.

## 10.0 Results

Measurements were performed in accordance with ANSI C63.10-2013. Graphical and tabular data can be found in Appendix B at the end of this report.

## 11.0 Conclusion

Dynamic Frequency Selection (DFS) testing was not performed by DLS Electronic Systems,Inc. Otherwise, the PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio, Model C054045A001A, as provided from Cambium Networks tested on December 13-14, 2016 **meets** the requirements of CFR 47 Part 15 Subpart E Section 15.407, to have 5.4 GHz 40 MHz channel bandwidth added to FCC ID: Z8H89FT0002 as a Class III Permissive Change.

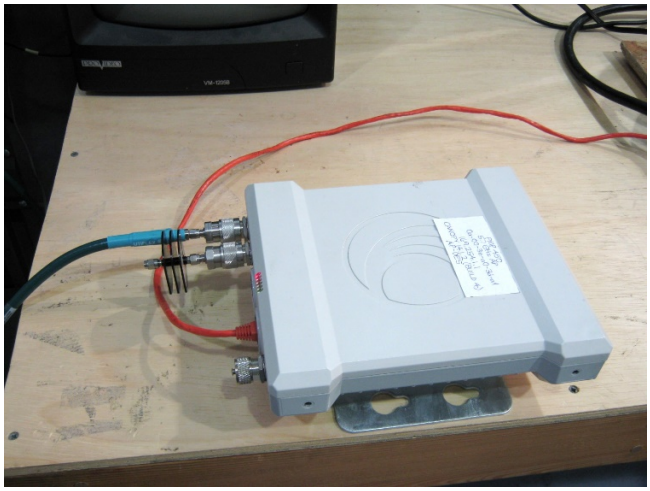
166 South Carter, Genoa City, WI 53128

Company: Cambium Networks
Model Tested: C054045A001A
Report Number: 22419
DLS Project: 8599

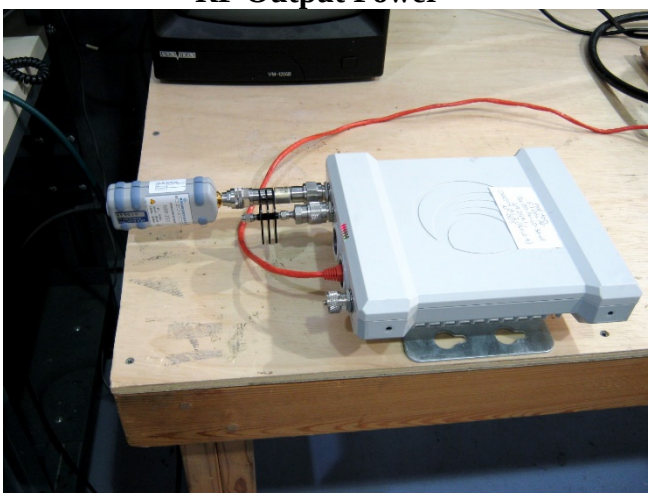
## Appendix A – Test Setup Photos

PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio
Cat 5e Power-Over-Ethernet cable (power supply to radio). (10 meter un-shielded with plastic connectors)
Cat 5e Ethernet data cable (power supply to computer). (1.5 meter un-shielded with plastic connectors)
Phihong power supply model: PSA15M-300(SM)

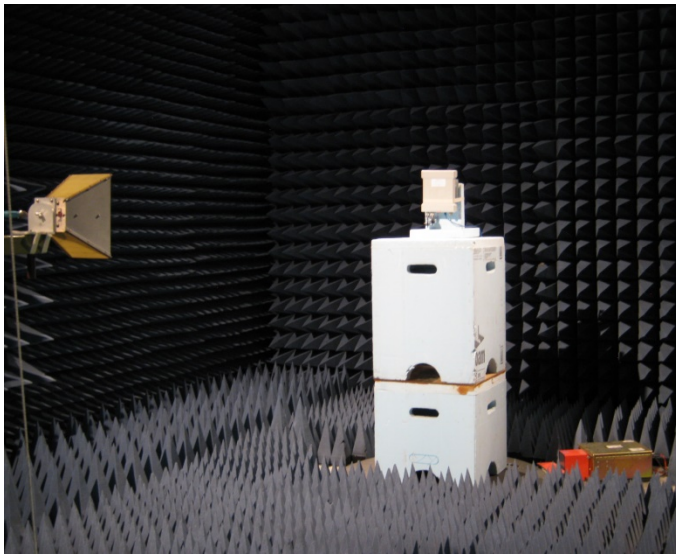
**RF Conducted**



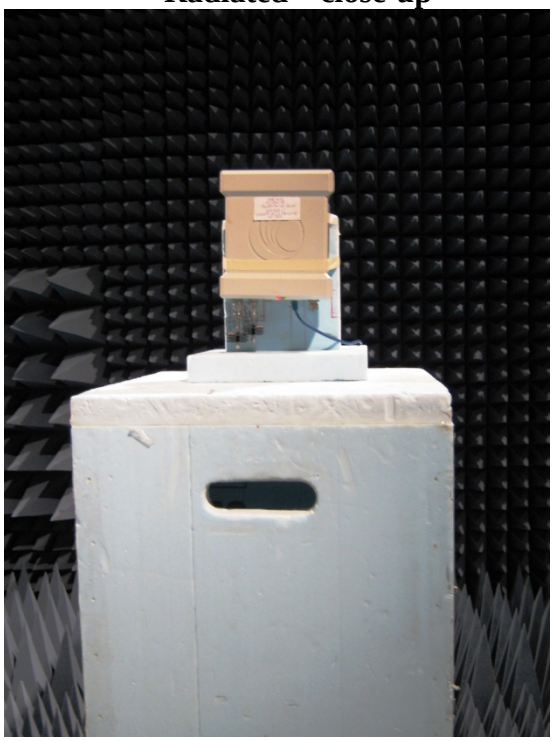
**RF Output Power**



**Radiated**



**Radiated – close-up**



## Appendix B – Measurement Data

### B1.0 Emission Bandwidth – 26 dB bandwidth

**Rule Section**: Informative

**Test Procedure**: ANSI C63.10-2013
Section 12.4.1

**Description**: RBW = approximately 1% of EBW
VBW > RBW
Detector = Peak
Trace mode = max hold

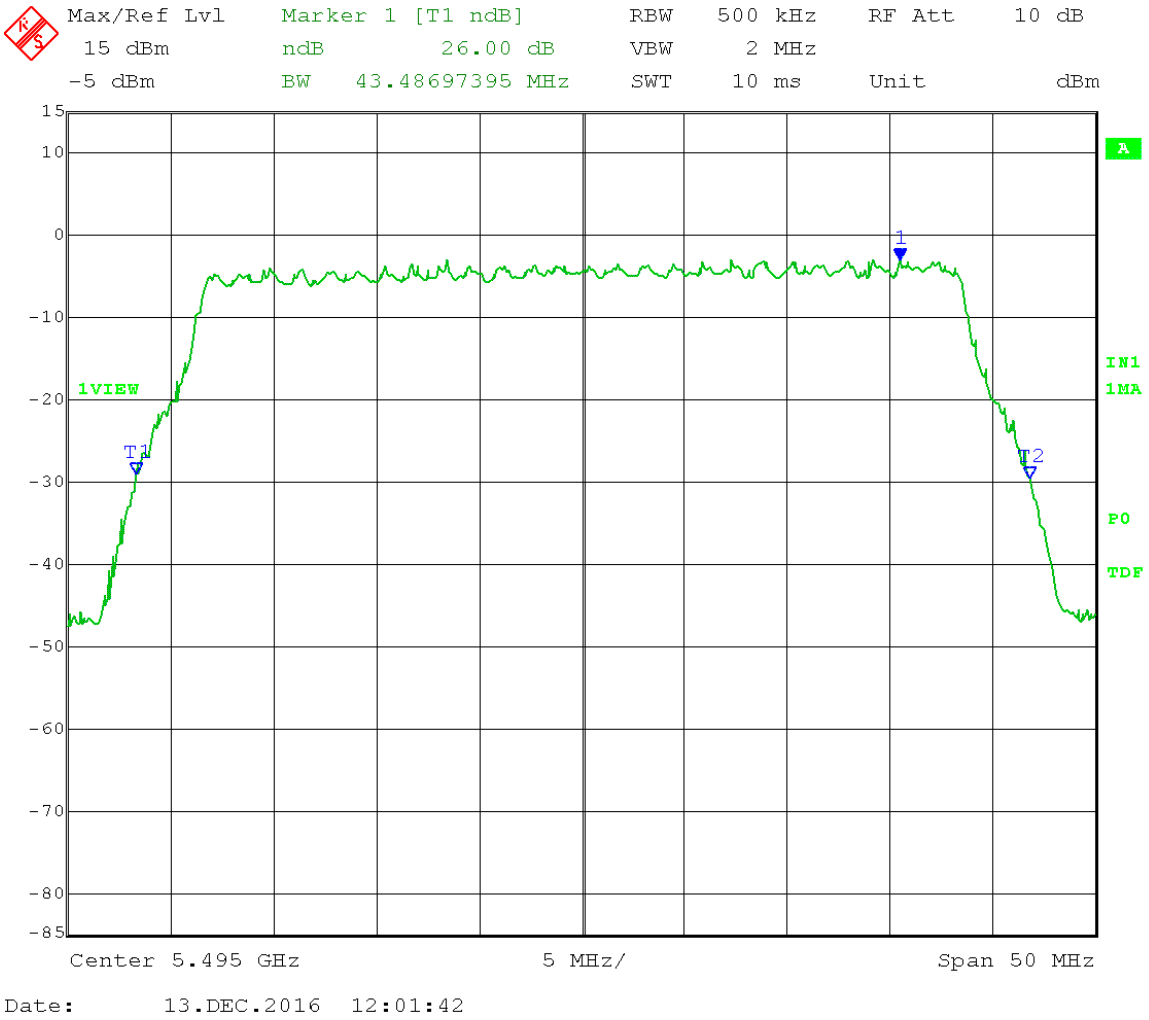
Measure the maximum width of the emission between the lower and upper frequencies that measure 26 dB below the maximum level of the in-band emission.

**Limit:** Informative

**Notes:** Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with 65.6% duty cycle.

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: 26 dB Emission Bandwidth
Operator: Craig B
Comment: ANSI C63.10, 12.4.1
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK

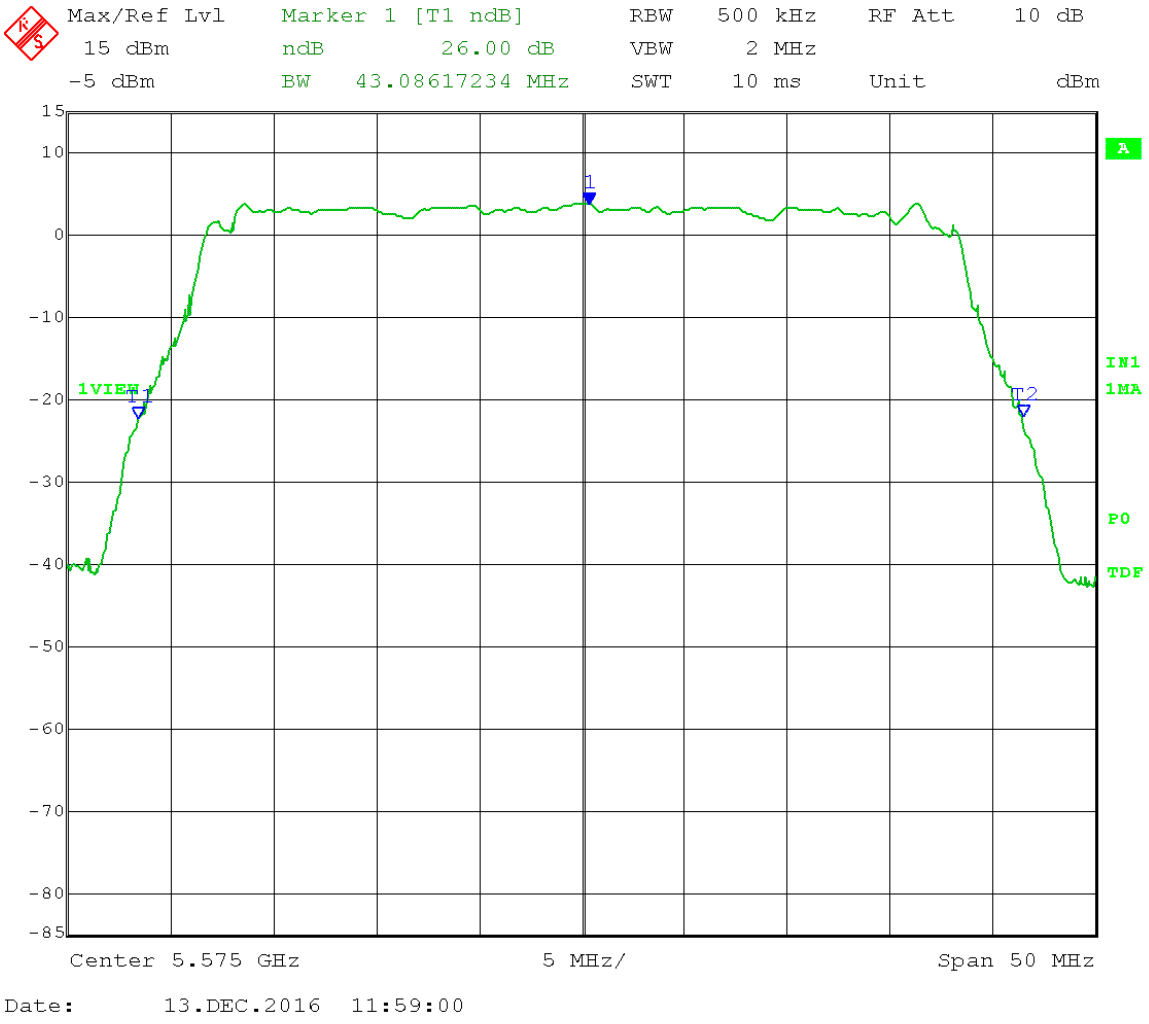
26 dB Emission Bandwidth = 43.5 MHz




Date: 13.DEC.2016 12:01:42

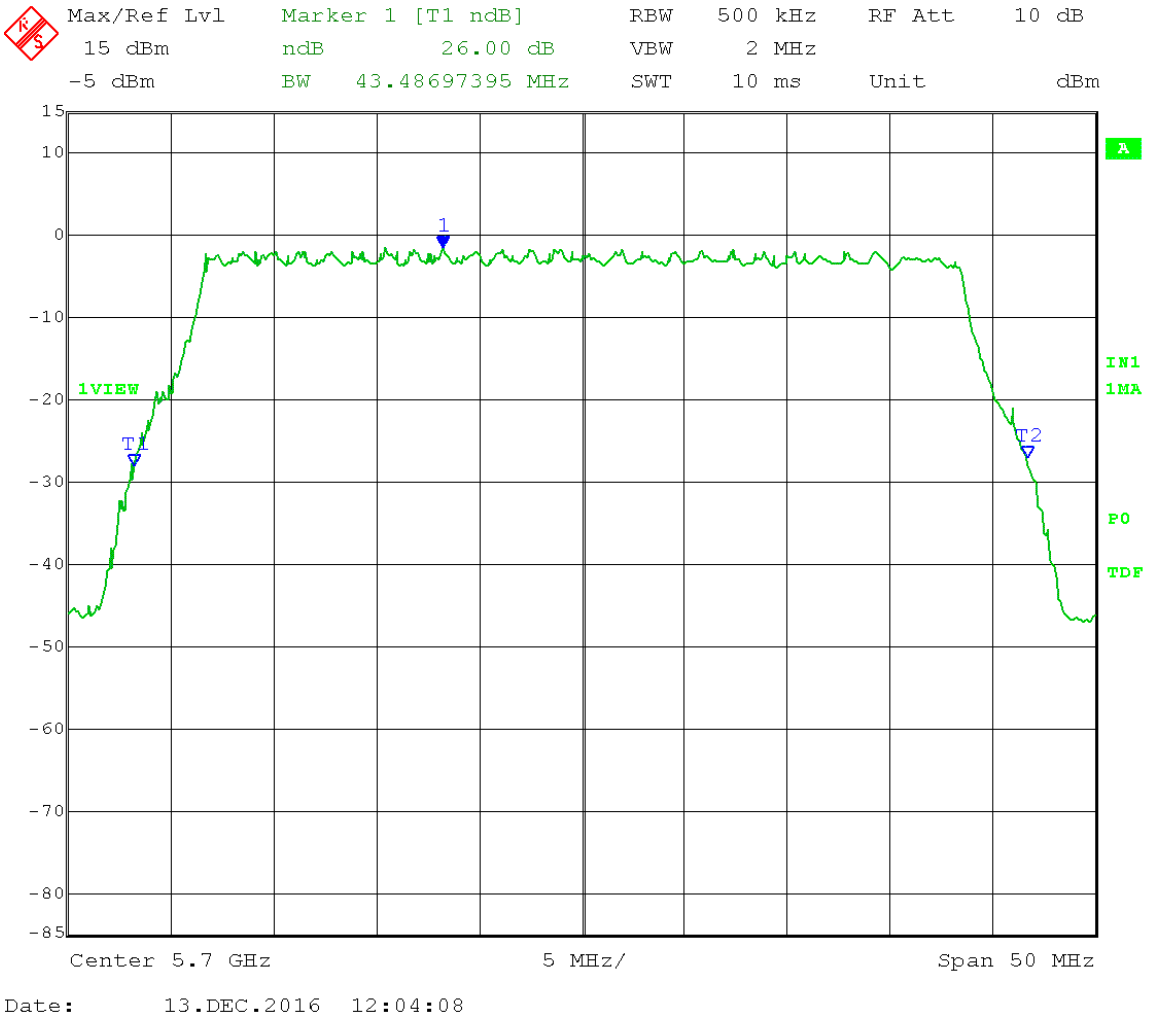
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: 26 dB Emission Bandwidth
Operator: Craig B
Comment: ANSI C63.10, 12.4.1
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK

26 dB Emission Bandwidth = 43.1 MHz



Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: 26 dB Emission Bandwidth
Operator: Craig B
Comment: ANSI C63.10, 12.4.1
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK

26 dB Emission Bandwidth = 43.5 MHz



## Appendix B – Measurement Data

### B2.0 Maximum Conducted Output Power

**Rule Section**: FCC 15.407(a)(2)

**Test Procedure:** ANSI C63.10-2013
Section 12.3.3.1 – Average power meter with correction for duty cycle

**Description:** Measure using a wideband RF power meter with a thermocouple detector.
Add 10 log (1/x), where x is the duty cycle, to the measured power.
Sum the power of both output ports.

**Limit:** 250 mW (24 dBm) RF conducted
Limit shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

1.0 Watts e.i.r.p.

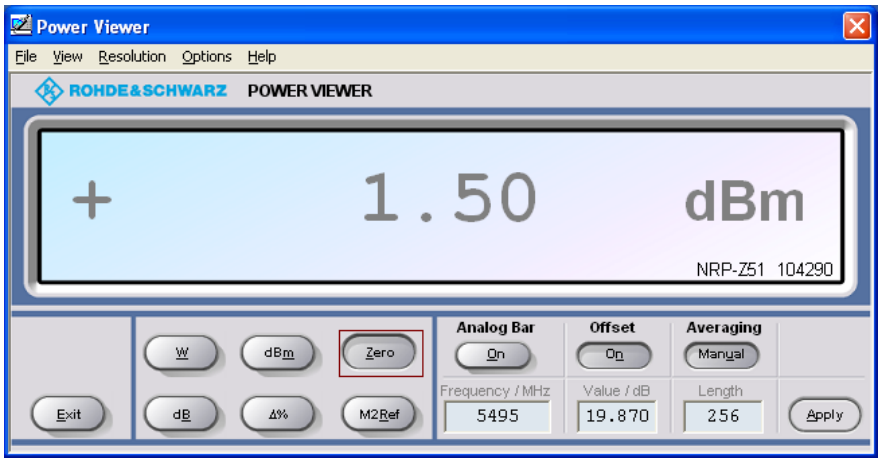
**Results:** Passed

**Notes:** Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with a 65.6% duty cycle.

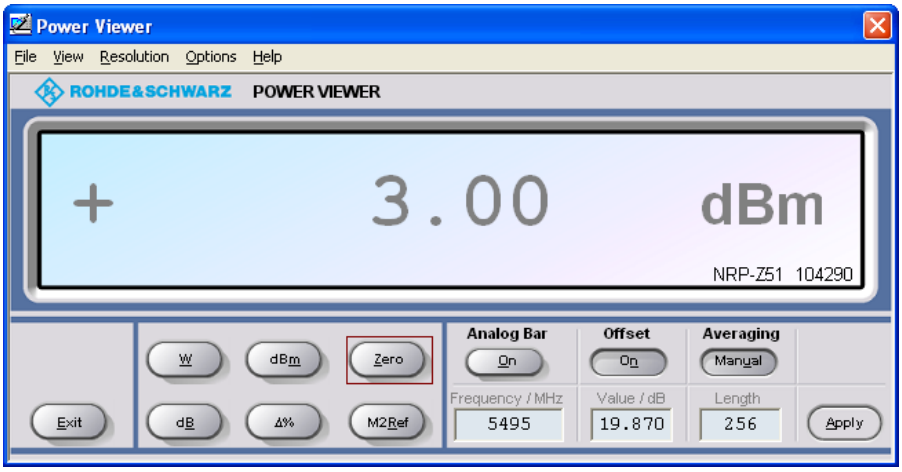
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Maximum conducted output power
Operator: Craig B
Comment: ANSI C63.10, 12.3.3.1 power meter method

Low Channel: Transmit = 5495 MHz — 40 MHz BW
Power setting 13 — QPSK
Antenna gain: 17 dBi
Conducted limit: 24 dBm - (17-6) = 13 dBm
e.i.r.p. limit: 30 dBm

Port H:
Maximum conducted output power = 1.50 dBm + 1.83 dB duty cycle correction = 3.33 dBm = 2.153 mW



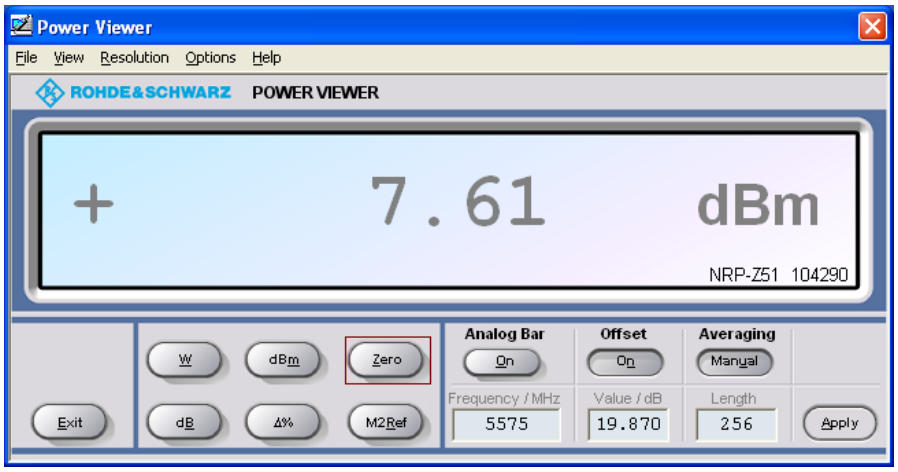

Port V:
Maximum conducted output power = 3.00 dBm + 1.83 dB duty cycle correction = 4.83 dBm = 3.041 mW



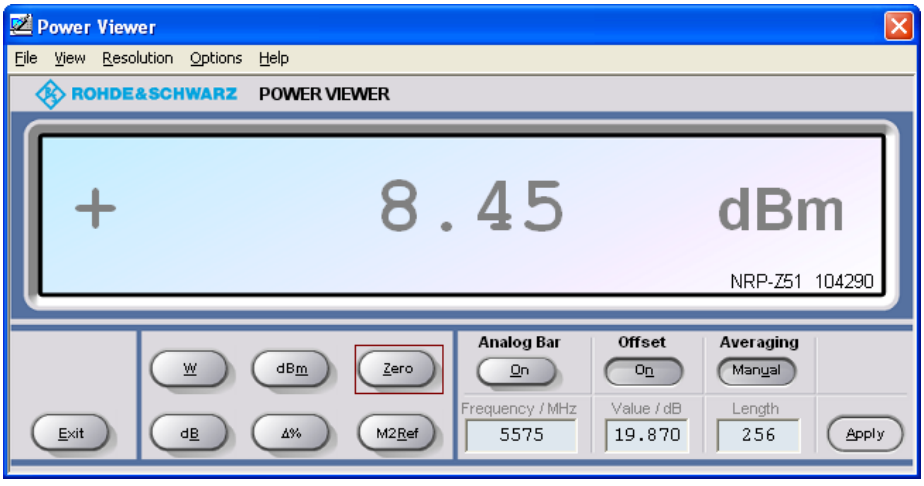

Total output power = 2.153 mW + 3.041 mW = 5.194 mW = **7.16 dBm**
Total e.i.r.p. = 7.16 dBm + 17 dBi = **24.16 dBm**

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Maximum conducted output power
Operator: Craig B
Comment: ANSI C63.10, 12.3.3.1 power meter method
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 QPSK
Antenna gain: 17 dBi
Conducted limit: 24 dBm - (17-6) = 13 dBm
e.i.r.p. limit: 30 dBm

Port H:
Maximum conducted output power = 7.61 dBm + 1.83 dB duty cycle correction = 9.44 dBm = 8.790 mW



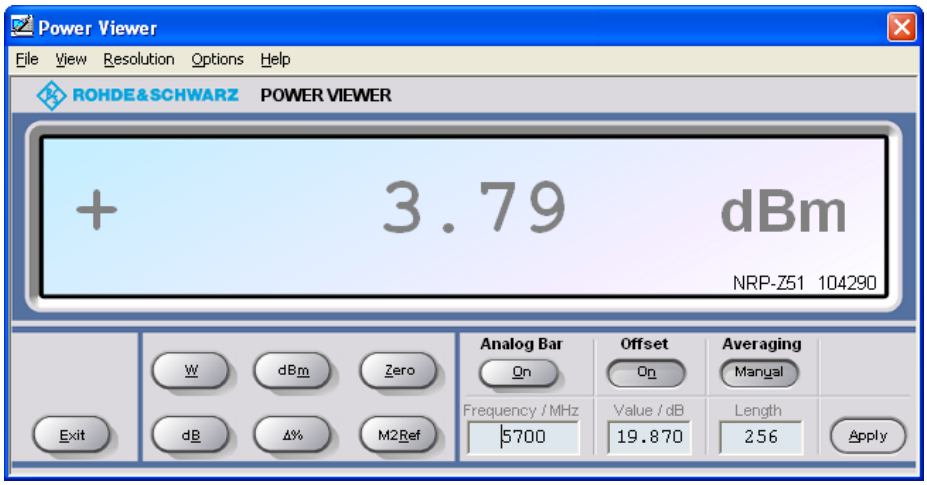

Port V:
Maximum conducted output power = 8.45 dBm + 1.83 dB duty cycle correction = 10.28 dBm = 10.666 mW



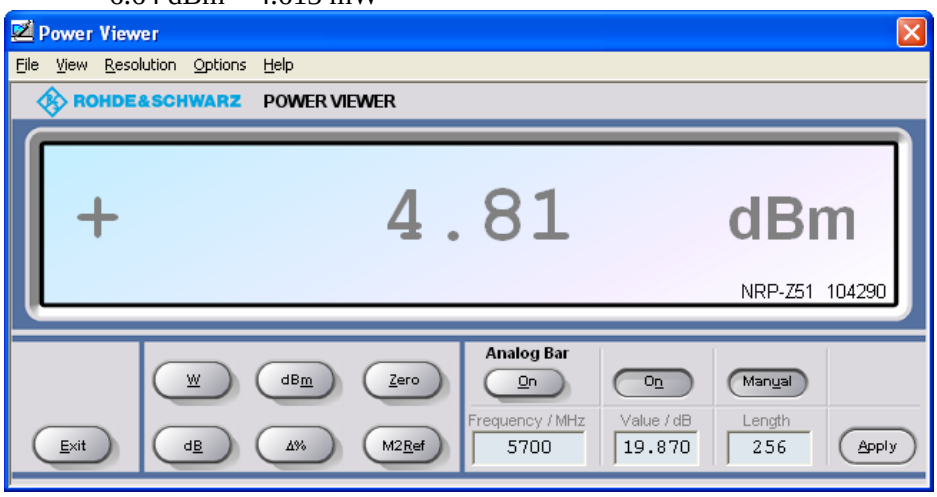

Total output power = 8.790 mW + 10.666 mW = 19.456 mW = **12.89 dBm**
Total e.i.r.p. = 12.89 dBm + 17 dBi = **29.89 dBm**

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Maximum conducted output power
Operator: Craig B
Comment: ANSI C63.10, 12.3.3.1 power meter method
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 QPSK
Antenna gain: 17 dBi
Conducted limit: 24 dBm - (17-6) = 13 dBm
e.i.r.p. limit: 30 dBm

Port H:
Maximum conducted output power = 3.79 dBm + 1.83 dB duty cycle correction = 5.62 dBm = 3.648 mW




Port V:
Maximum conducted output power = 4.81 dBm + 1.83 dB duty cycle correction = 6.64 dBm = 4.613 mW




Total conducted output power = 3.648 mW + 4.613 mW = 8.261 mW = **9.17 dBm**
Total e.i.r.p. = 9.17 dBm + 17 dBi = **26.17 dBm**

## Appendix B – Measurement Data

### B3.0 Peak Power Spectral Density – Conducted

**Rule Section**: FCC 15.407(a)(2)

**Test Procedure**: ANSI C63.10-2013
Section 12.5 - PPSD
Section 12.3.2.4 SA-2 – trace averaging followed by duty cycle correction

**Description**: SPAN: set to encompass entire emission bandwidth
RBW = 1 MHz
VBW ≥ 3 MHz
Number of points ≥ 2 x Span/RBW
Sweep time: auto
Detector = RMS
Sweep: Average 200 traces
Use peak search to find the peak of the spectrum
Add 10 log (1/x), where x is the duty cycle, to the peak of the spectrum
Add 3 dB to account for two-port MIMO operation [10 log (number of ports)]

**Limit:** 11 dBm in any 1 MHz band
Limit shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

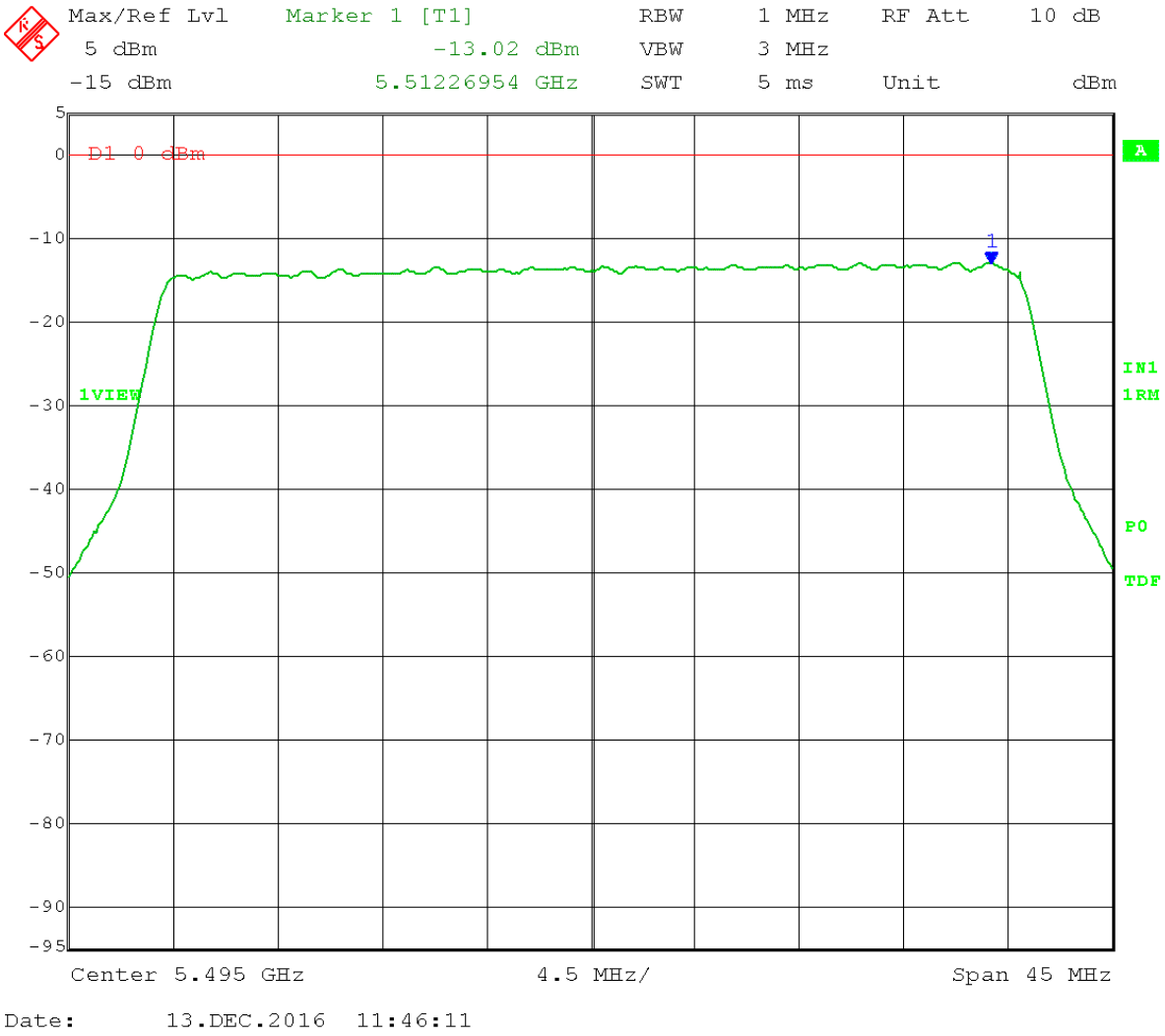
**Results:** Passed

**Notes:** Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with 65.6% duty cycle.

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Peak power spectral density
Operator: Craig B
Comment: ANSI C63.10, 12.5 and 12.3.2.4 SA-2 trace averaging followed by duty cycle correction

Low Channel: Transmit = 5495 MHz — 40 MHz BW
Power setting 13 — Port V — QPSK
RBW = 1 MHz — VBW = 3 MHz
Detector = RMS — Trace = AVG
Sweep Time = Auto — Sweep counts = 200
Antenna gain = 17 dBi
Limit: 11 dBm/MHz – (17-6) = 0 dBm/MHz

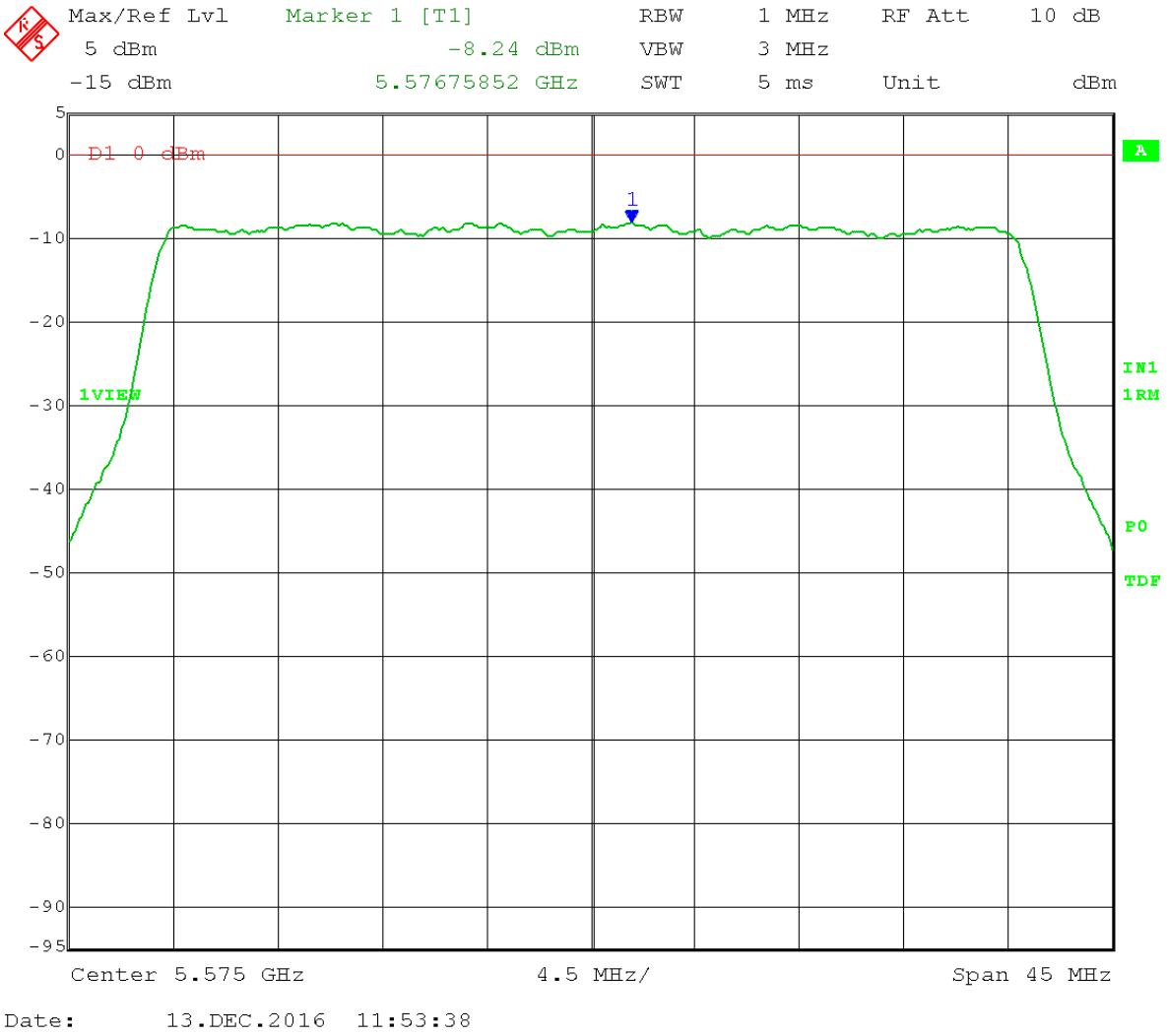
PPSD = -13.02 dBm + 1.83 dB (duty cycle correction) + 3 dB (2-port MIMO)
= -8.19 dBm/MHz



Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Peak power spectral density
Operator: Craig B
Comment: ANSI C63.10, 12.5 and 12.3.2.4 SA-2 trace averaging followed by duty cycle correction

Mid Channel: Transmit = 5575 MHz — 40 MHz BW
Power setting 21 — Port V — QPSK
RBW = 1 MHz — VBW = 3 MHz
Detector = RMS — Trace = AVG
Sweep Time = Auto — Sweep counts = 200
Antenna gain = 17 dBi
Limit: 11 dBm/MHz – (17-6) = 0 dBm/MHz

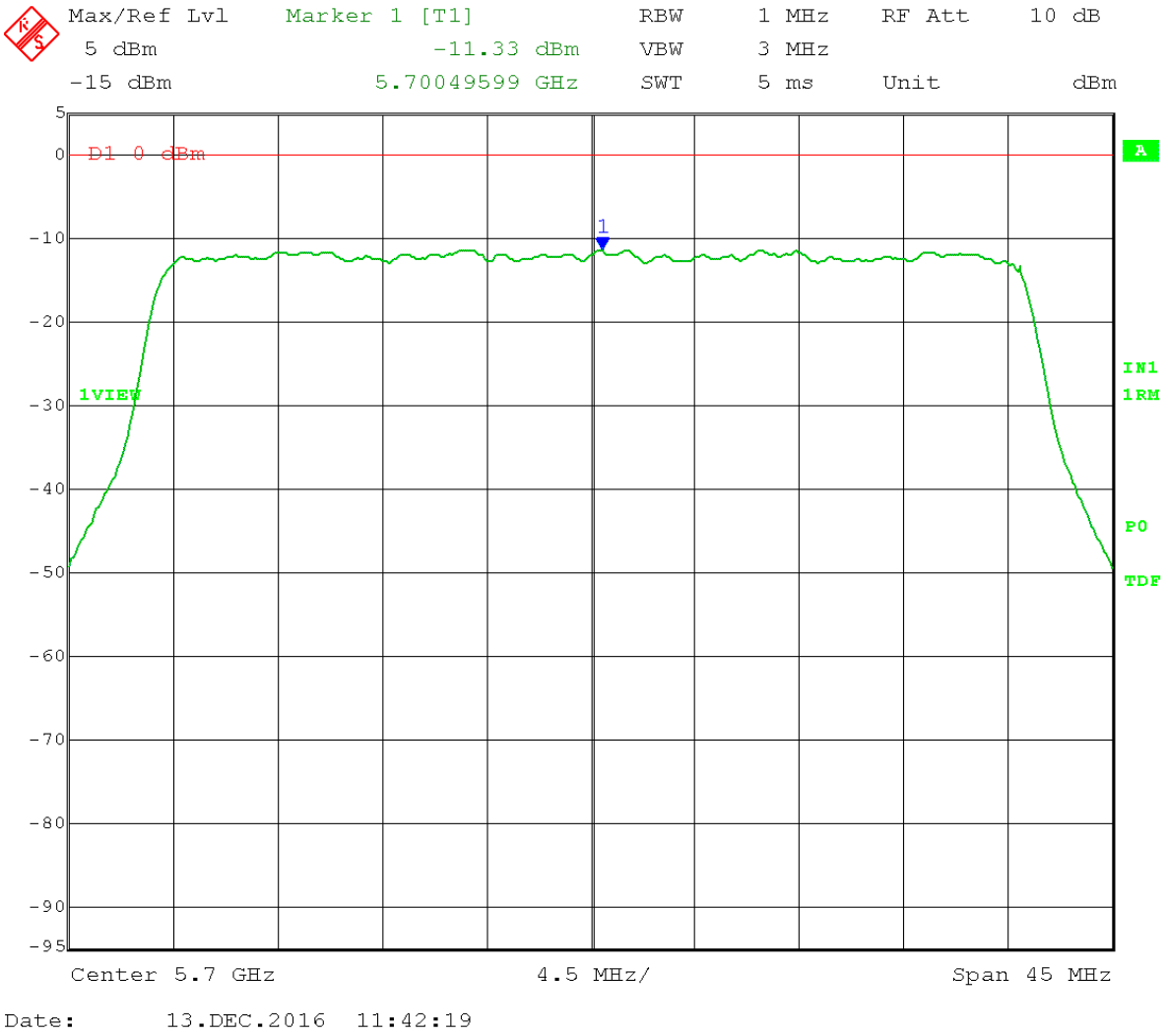
PPSD = -8.24 dBm + 1.83 dB (duty cycle correction) + 3 dB (2-port MIMO)
= -3.41 dBm/MHz



Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Peak power spectral density
Operator: Craig B
Comment: ANSI C63.10, 12.5 and 12.3.2.4 SA-2 trace averaging followed by duty cycle correction

High Channel: Transmit = 5700 MHz — 40 MHz BW
Power setting 14 — Port V — QPSK
RBW = 1 MHz — VBW = 3 MHz
Detector = RMS — Trace = AVG
Sweep Time = Auto — Sweep counts = 200
Antenna gain = 17 dBi
Limit: 11 dBm/MHz – (17-6) = 0 dBm/MHz

PPSD = -11.33 dBm + 1.83 dB (duty cycle correction) + 3 dB (2-port MIMO)
= -6.50 dBm/MHz



**Appendix B – Measurement Data**

**B4.0 Band-Edge – Unwanted Emission Levels**
RF Conducted

**Rule Section**: FCC 15.407(b)(3) and 15.407(b)(5)

**Test Procedure**: ANSI C63.10
Section 12.7.3

**Description**: Unwanted emissions that fall outside of the restricted bands

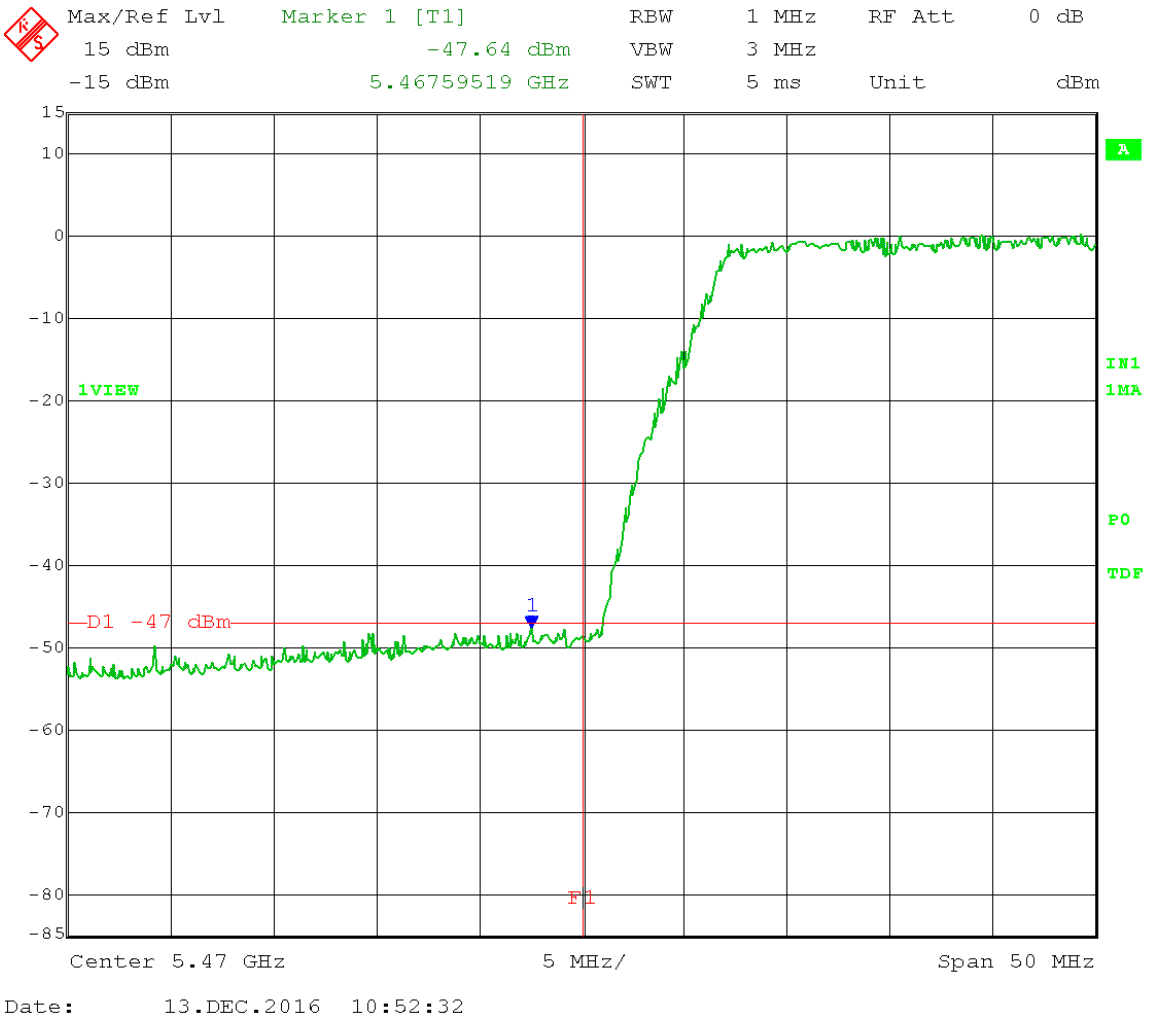
Measure the band-edge emission level using the following settings
RBW = 1 MHz
VBW ≥ [3 x RBW]
Detector = peak
Sweep time = auto
Trace mode = max hold until trace stabilizes

**Limit:** EIRP of -27 dBm/MHz
RF conducted limit lowered to account for two-port MIMO operation and antenna gain.

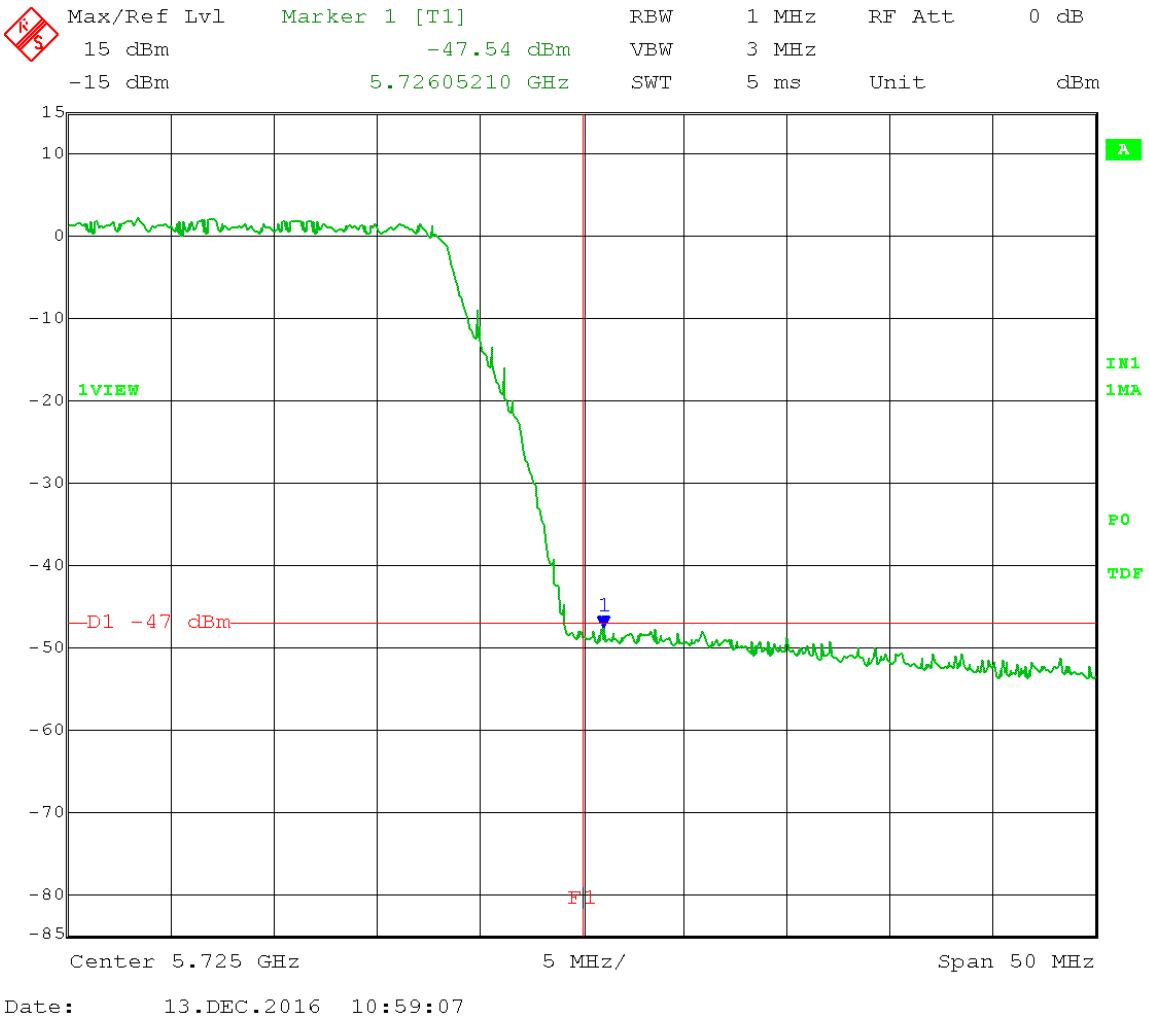
**Results:** Passed

**Notes:** Measurements were taken for QPSK at the lowest and highest channels of operation. EUT was set to transmit continuously with 65.6% duty cycle.

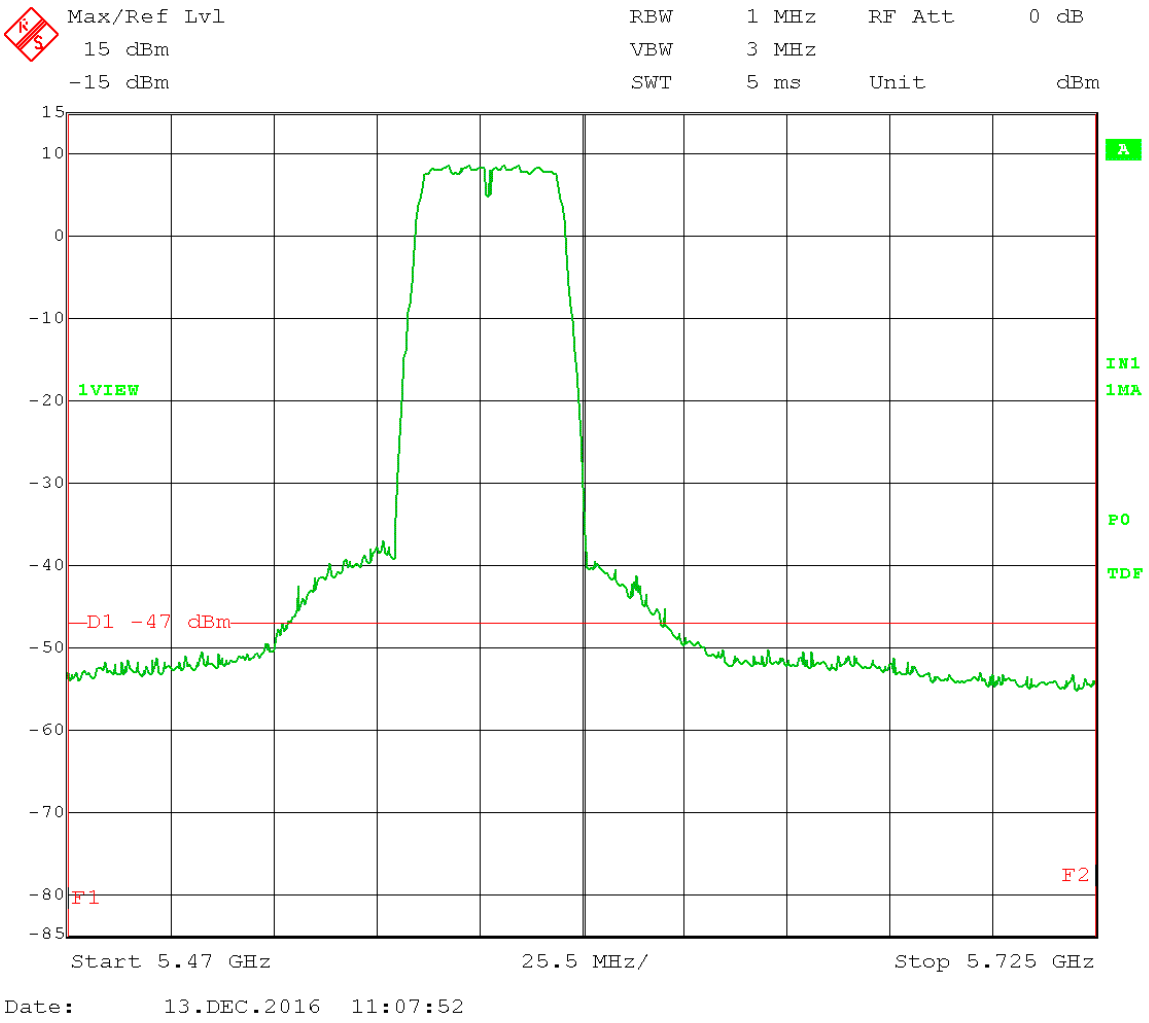
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Lower Band-edge (5470 MHz)
Operator: Craig B
Comment: ANSI C63.10, 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak
Limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz



Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Upper Band-edge (5725 MHz)
Operator: Craig B
Comment: ANSI C63.10, 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak
Limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz



Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Lower & Upper Band-edges (5470 MHz & 5725 MHz)
Operator: Craig B
Comment: ANSI C63.10, 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak
Limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz




Date: 13.DEC.2016 11:07:52

## Appendix B – Measurement Data

### B5.0 Unwanted Emission Levels – RF Conducted

**Rule Section**: FCC 15.407(b)(3), 15.407(b)(6), and 15.407(b)(7)

**Test Procedure**: ANSI C63.10-2013
Sections 12.7.2 and 12.7.3

Below 1000 MHz
Detector = quasi-peak
Alternately, peak detector is permitted

Peak measurements above 1000 MHz
RBW = 1 MHz
VBW ≥ 3 MHz
Detector = peak
Trace mode = max hold

Average measurements above 1000 MHz (required for peak emissions that are above the average limits)
RBW = 1 MHz
VBW ≥ 3 MHz
Detector = Average (linear)
Trace mode = max hold

EIRP calculation:
Add upper bound on out-of-band antenna gain to measured antenna port conducted emission power. (This is the maximum in-band gain or 2 dBi, whichever is greater)
Add 10 log(N), where N is the number of outputs, for MIMO operation

Field strength calculation:
Above 1 GHz:
E (dBµV/m) = EIRP (dBm) – 20 log (d{meters}) + 104.77
Below 1 GHz:
E (dBµV/m) = EIRP (dBm) – 20 log (d{meters}) + 104.77 + 4.7 dB

**Limits:** Outside restricted bands: Peak EIRP shall not exceed -27 dBm/MHz
Inside restricted bands: Peak and Average limits of FCC Part 15.209

RF conducted limits lowered to account for duty cycle, two-port MIMO operation, and antenna gain.

**Notes:** Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with 65.6% duty cycle.

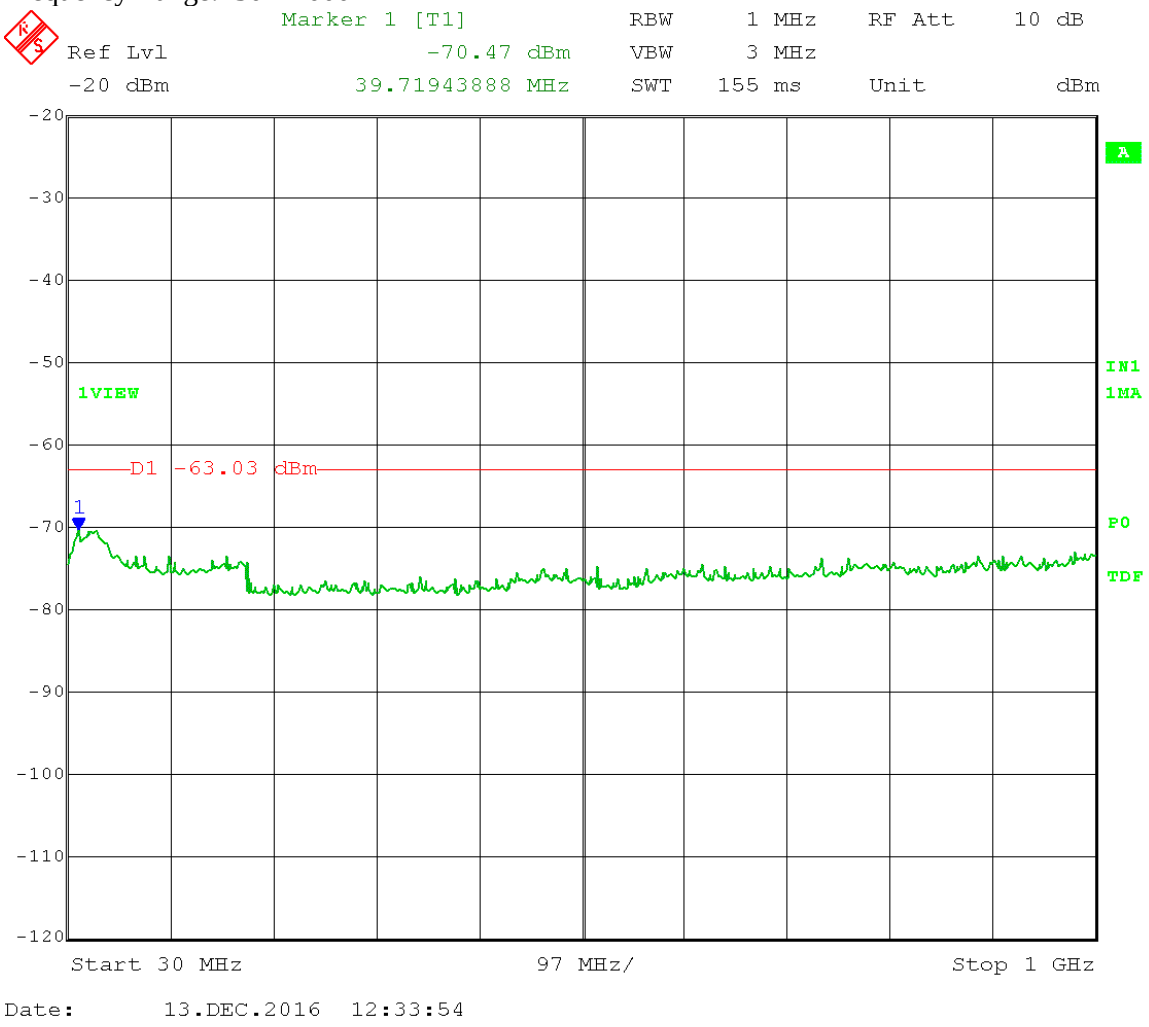
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 30 – 1000 MHz



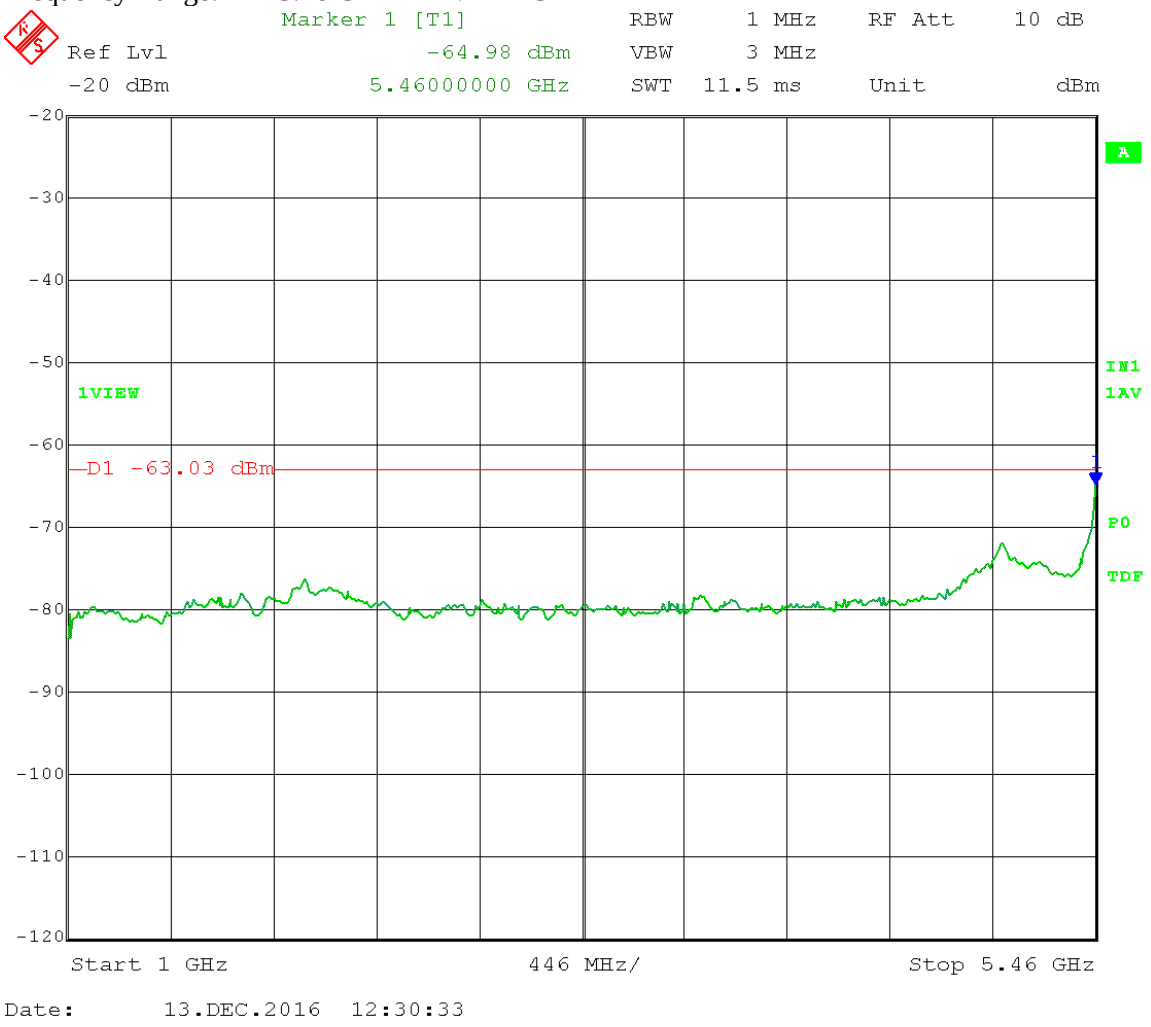
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Average

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz AVERAGE



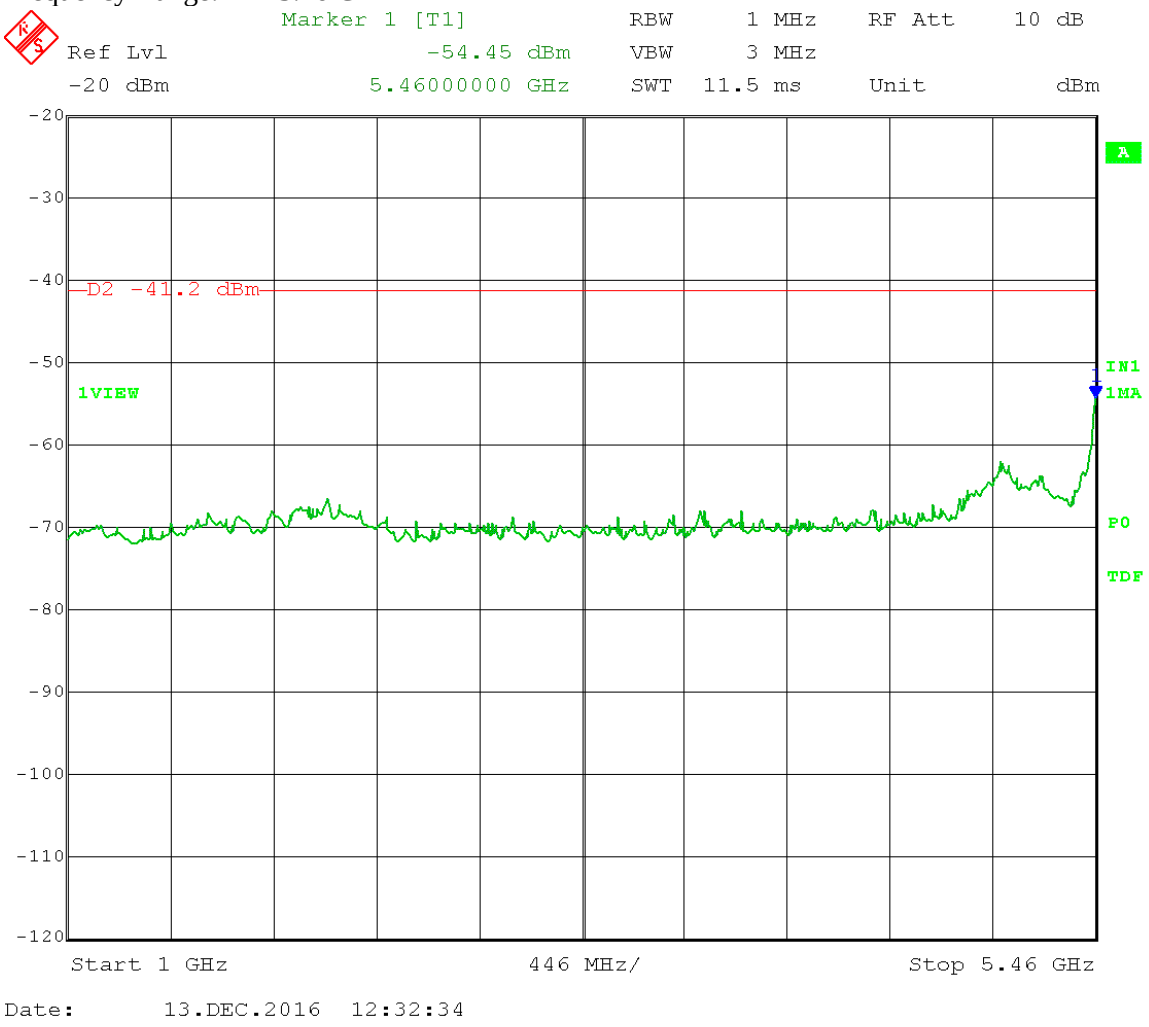
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz PEAK




Date: 13.DEC.2016 12:32:34

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 5.46 – 7.25 GHz

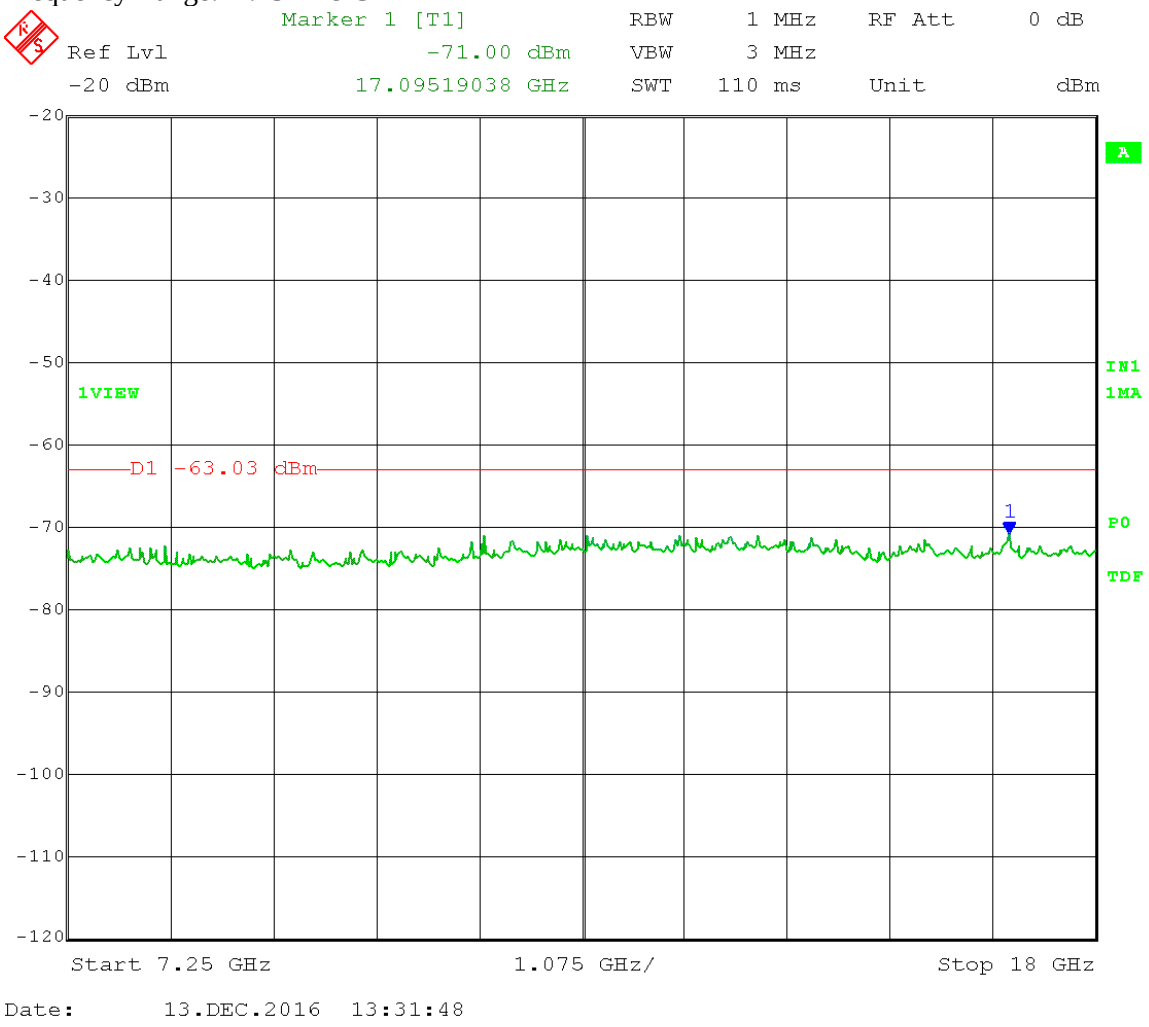
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 7.25 – 18 GHz



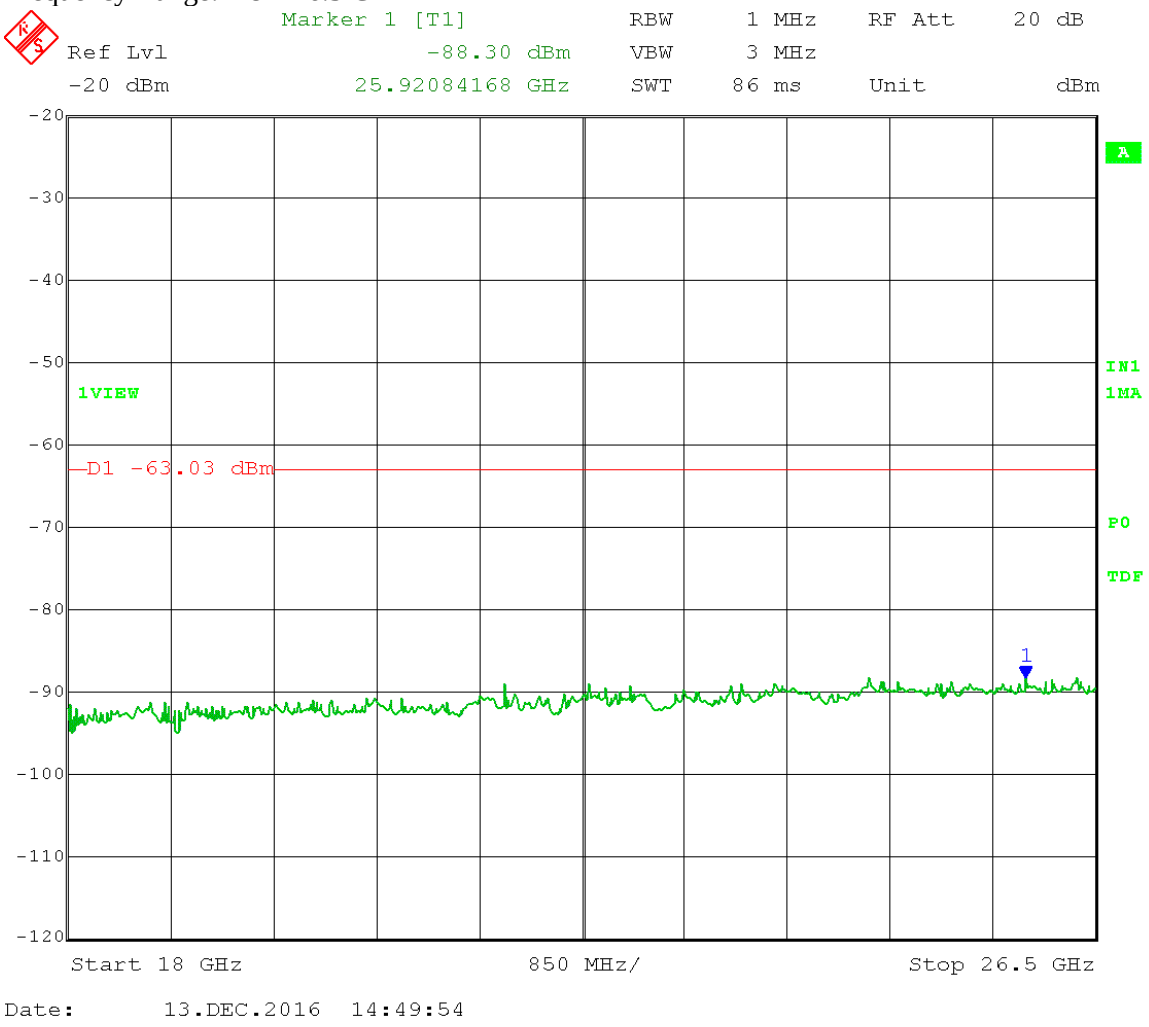
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 18 – 26.5 GHz



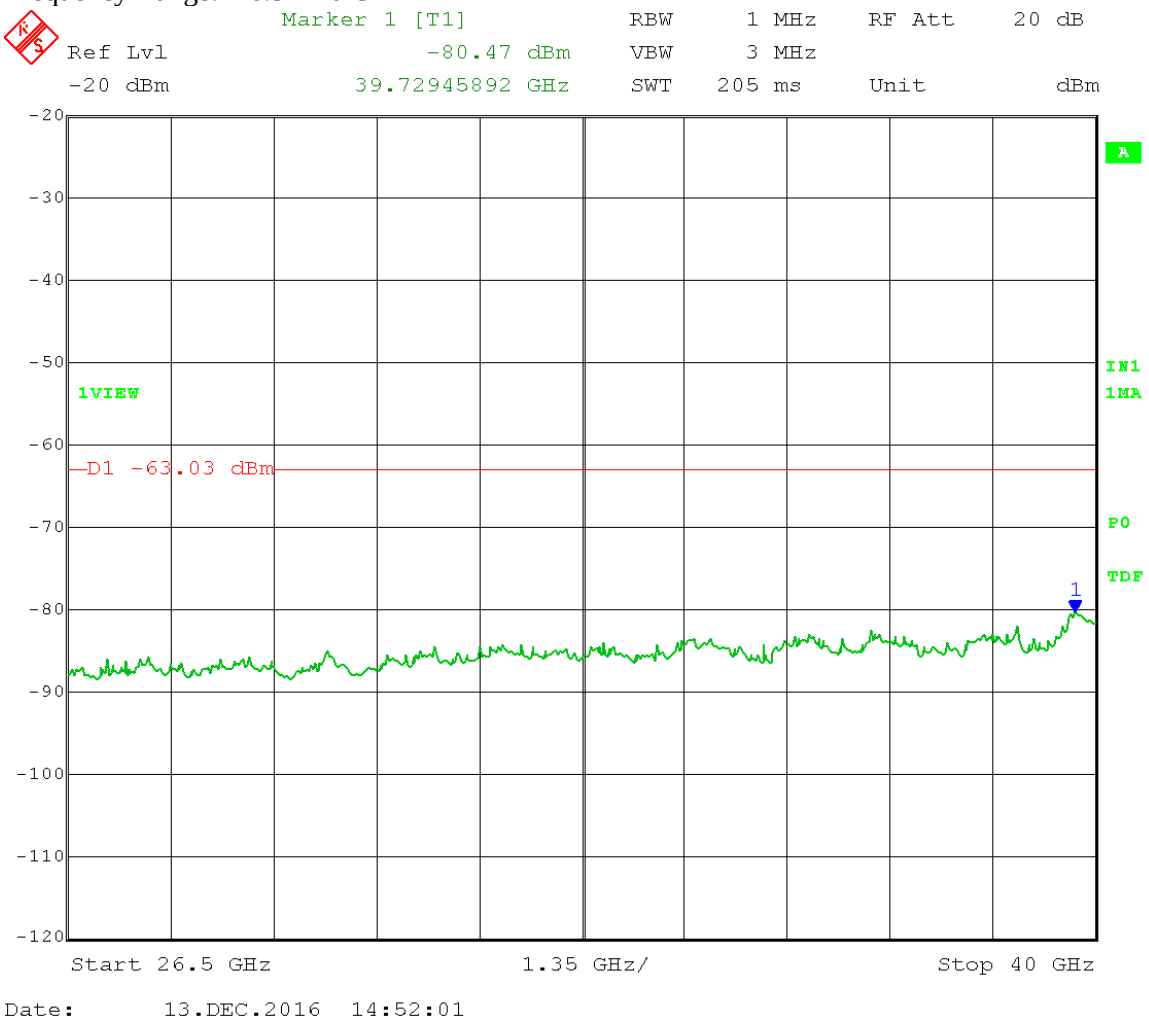
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 26.5 – 40 GHz



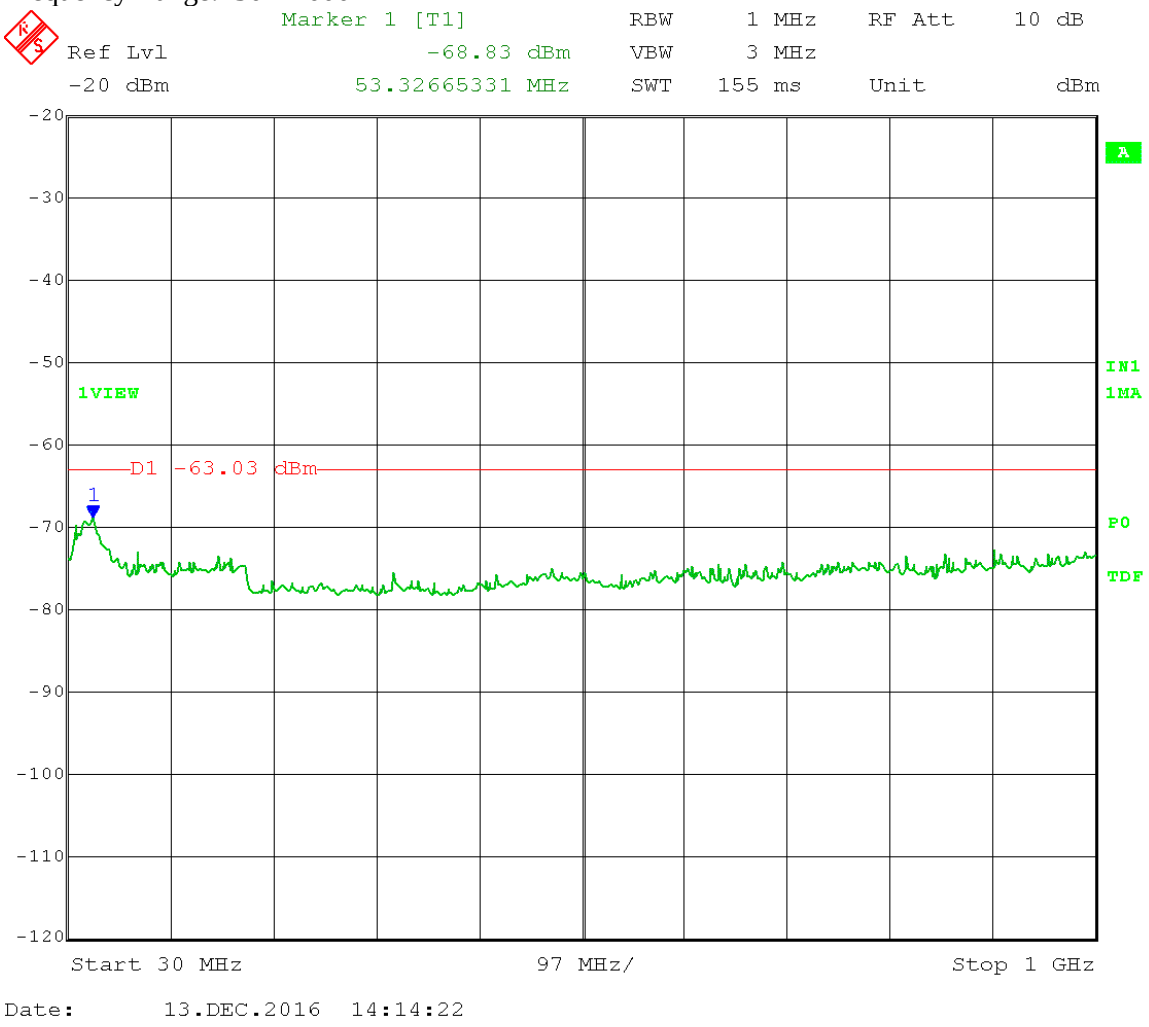
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 30 – 1000 MHz




Date: 13.DEC.2016 14:14:22

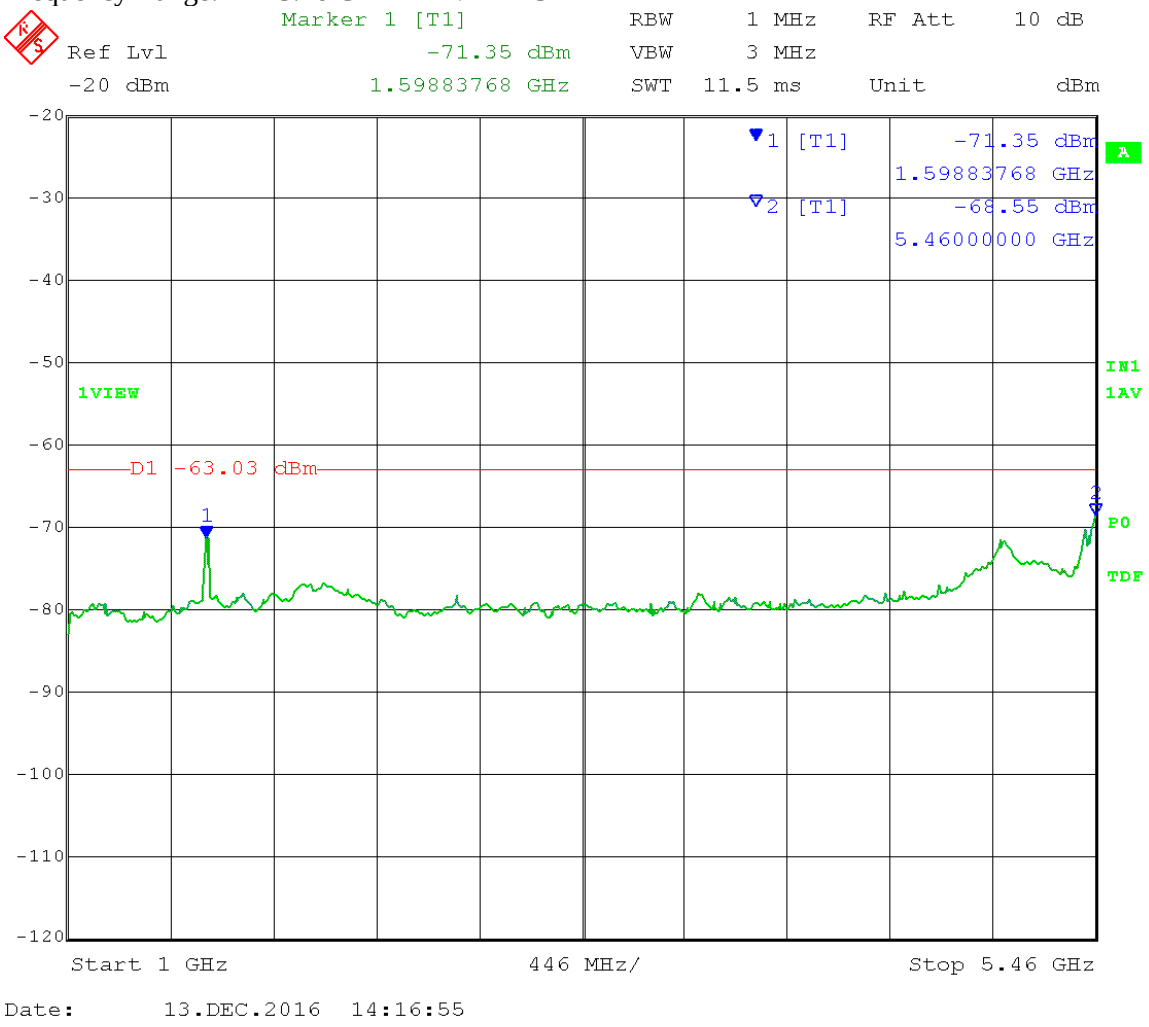
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Average

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz AVERAGE




Date: 13.DEC.2016 14:16:55

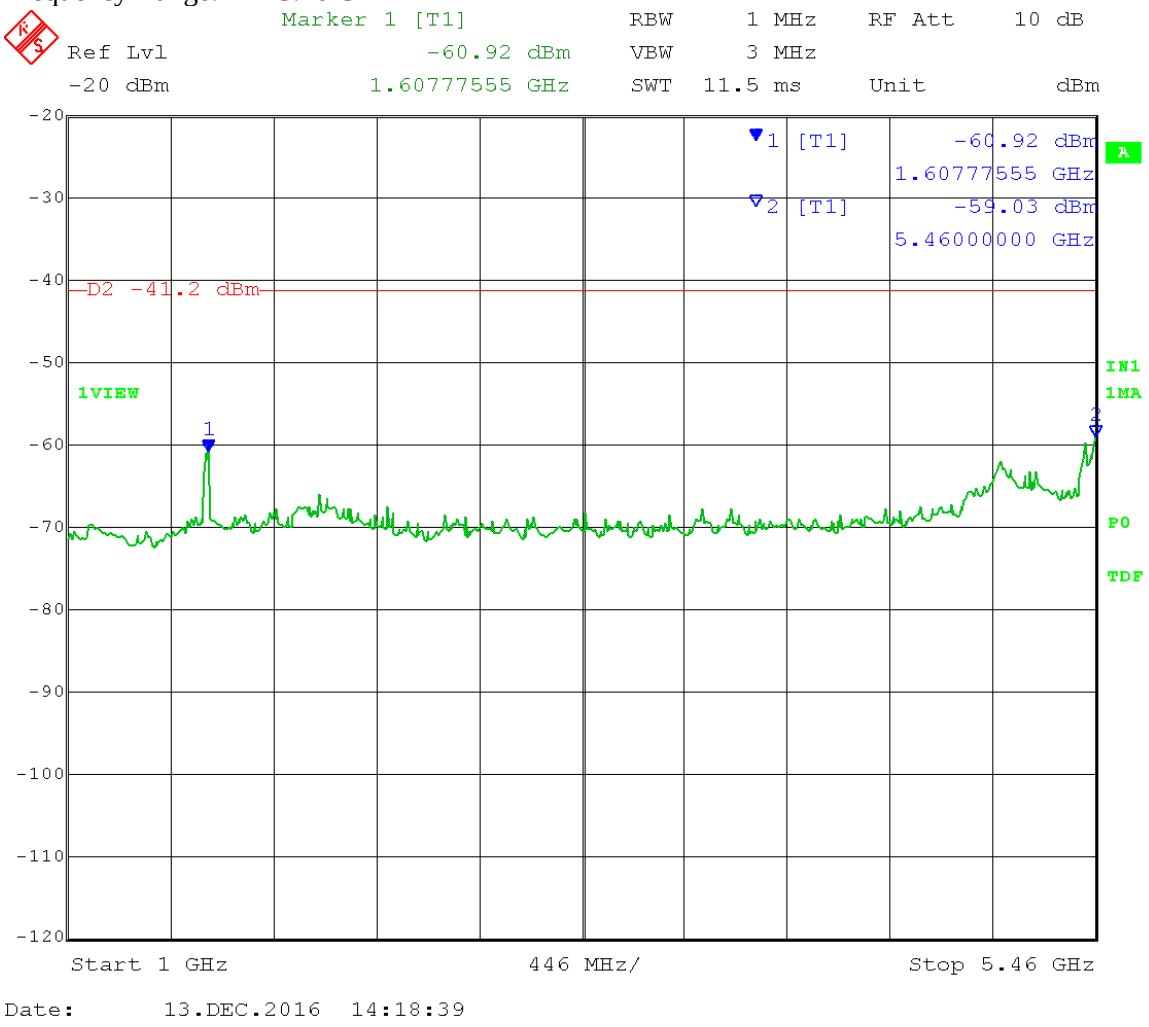
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz PEAK




Date: 13.DEC.2016 14:18:39

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 5.46 – 7.25 GHz

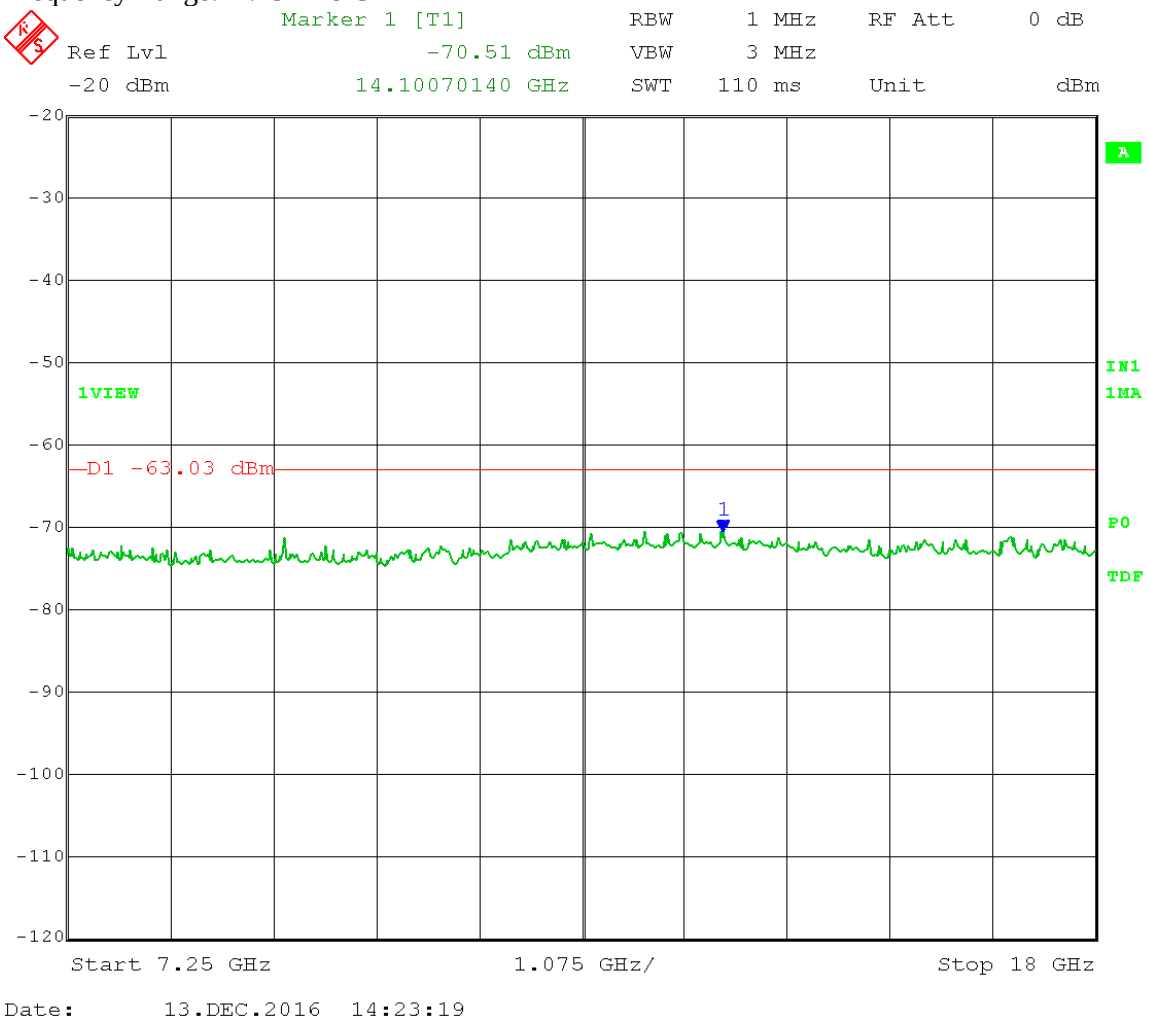
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 7.25 – 18 GHz




Date: 13.DEC.2016 14:23:19

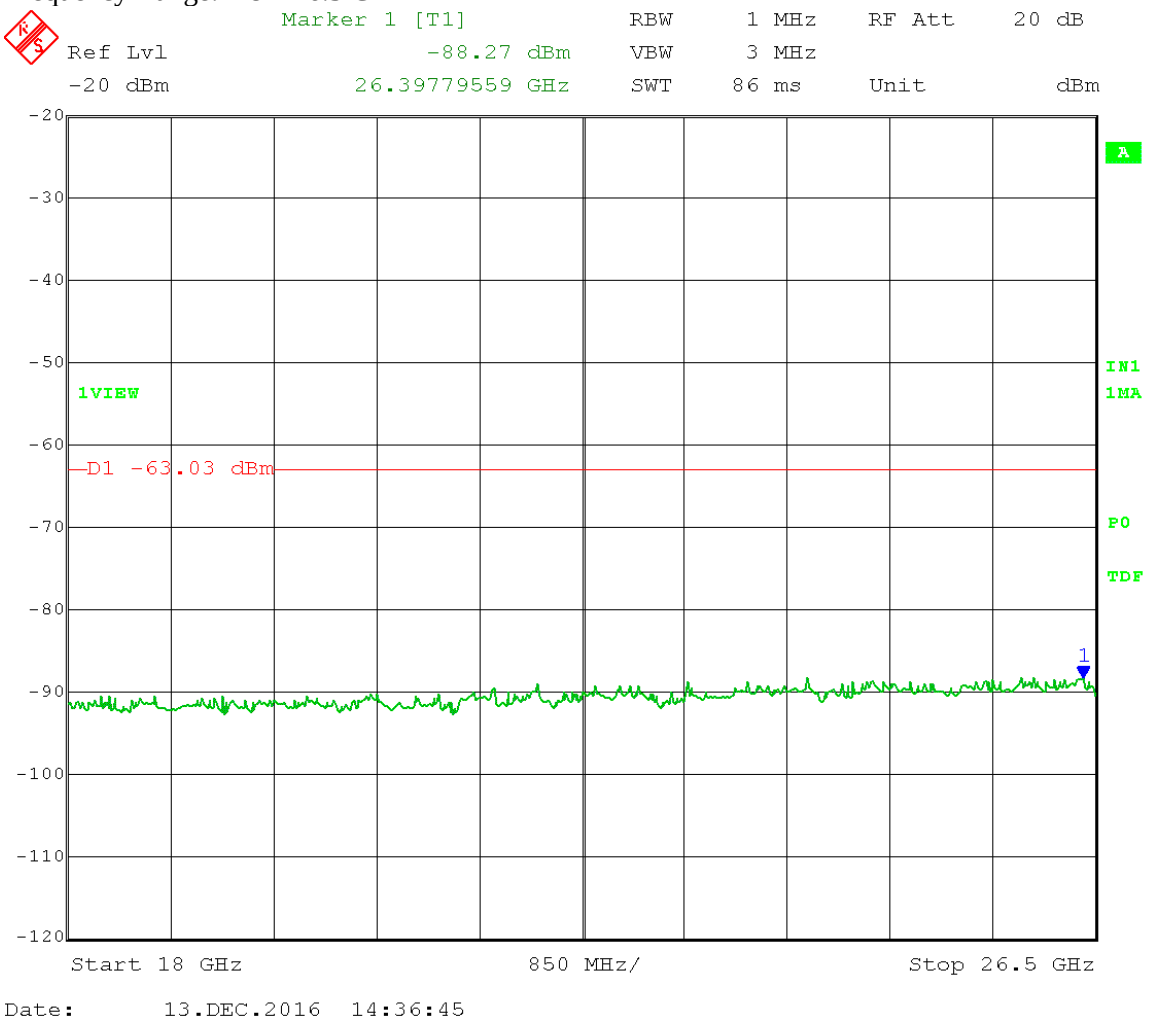
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 18 – 26.5 GHz



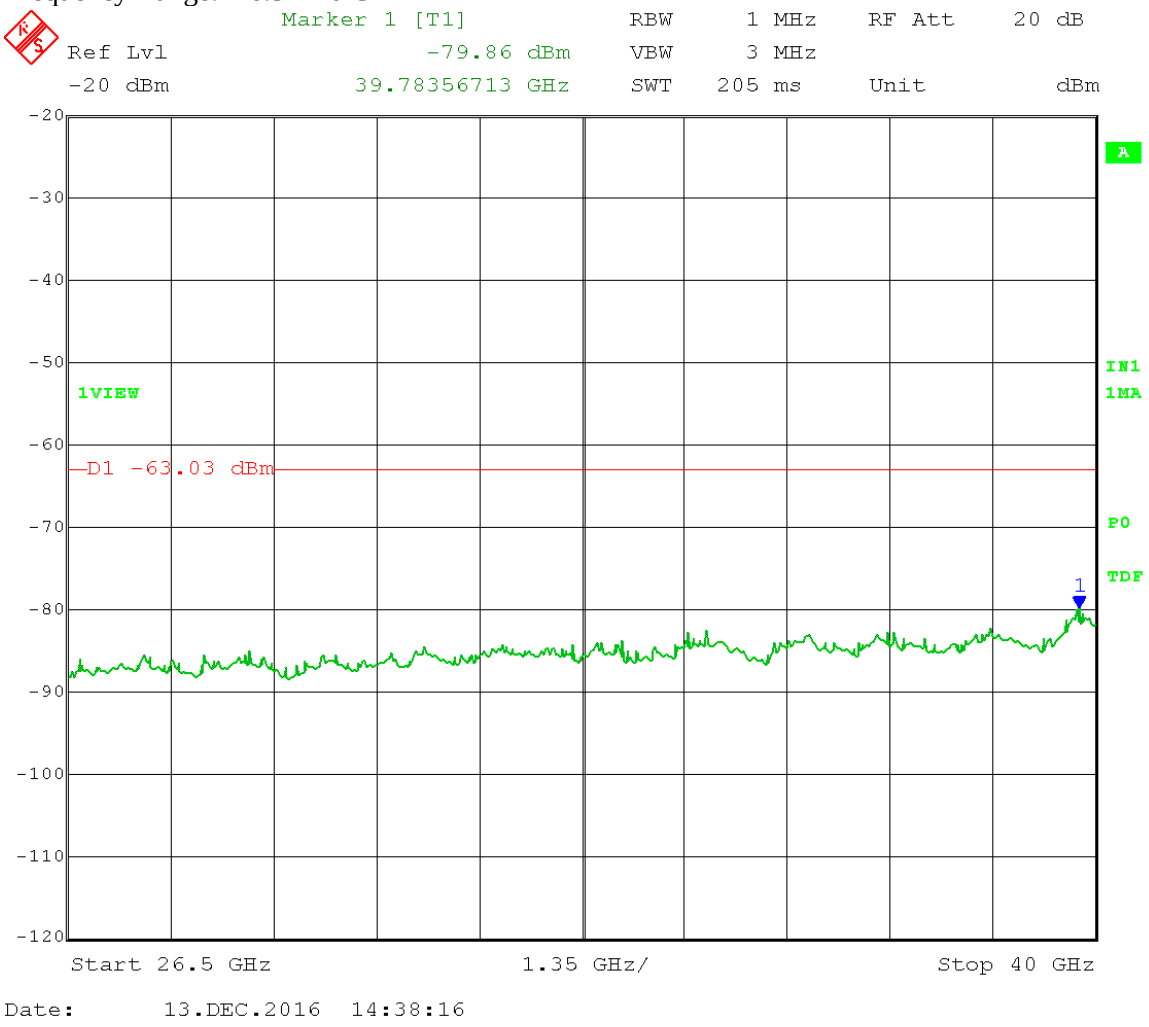
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 26.5 – 40 GHz



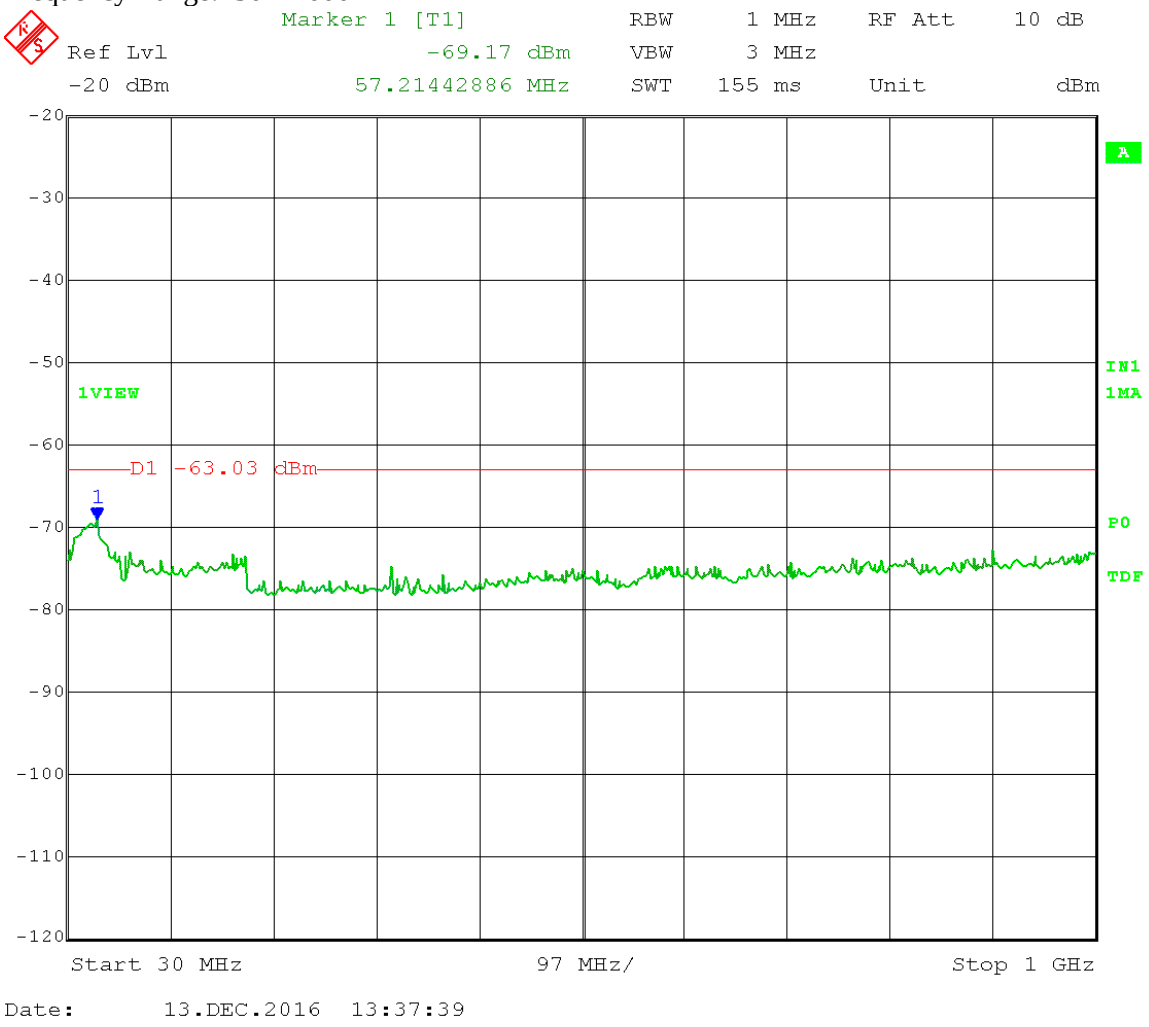
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 30 – 1000 MHz



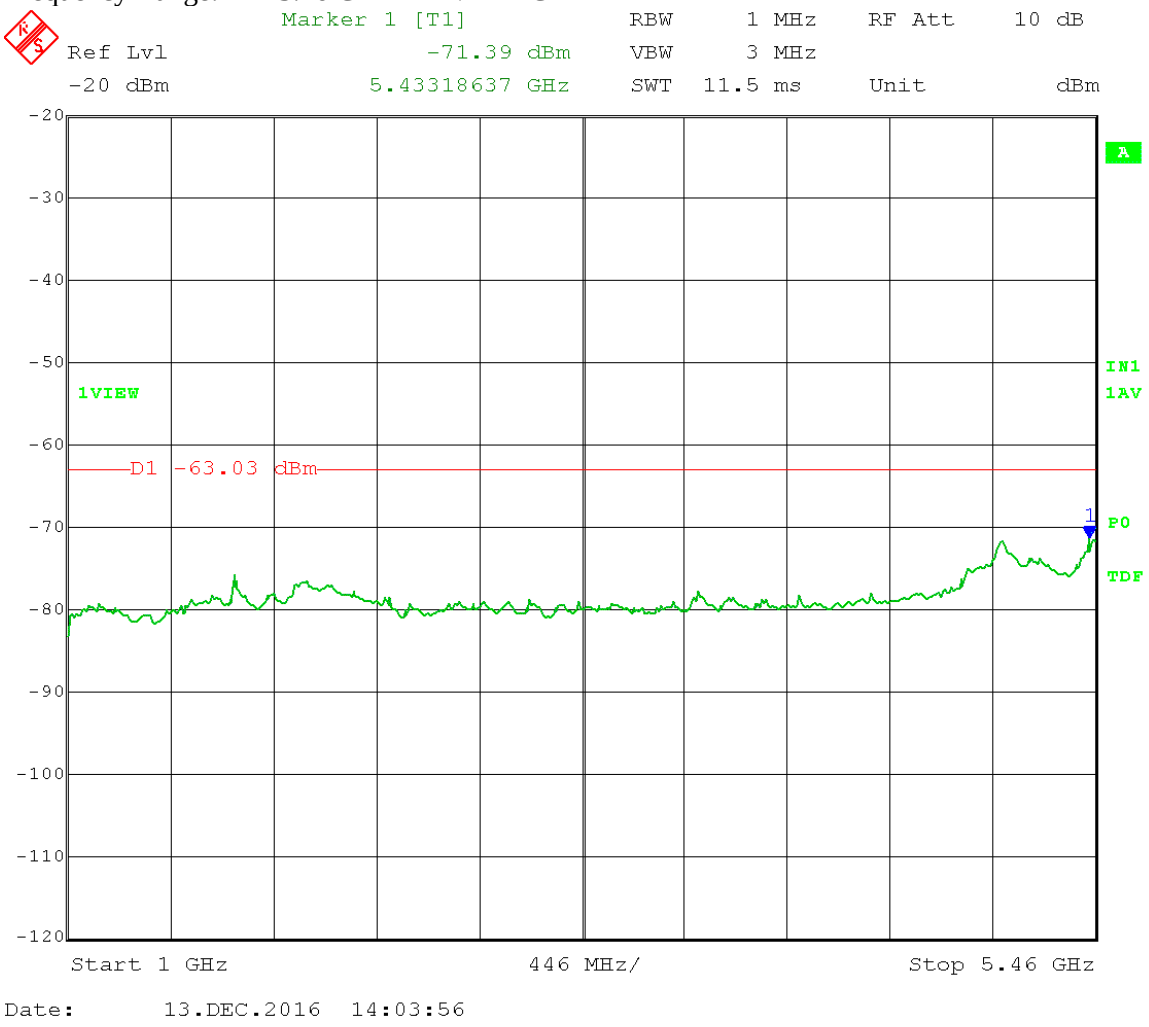
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Average

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz AVERAGE




Date: 13.DEC.2016 14:03:56

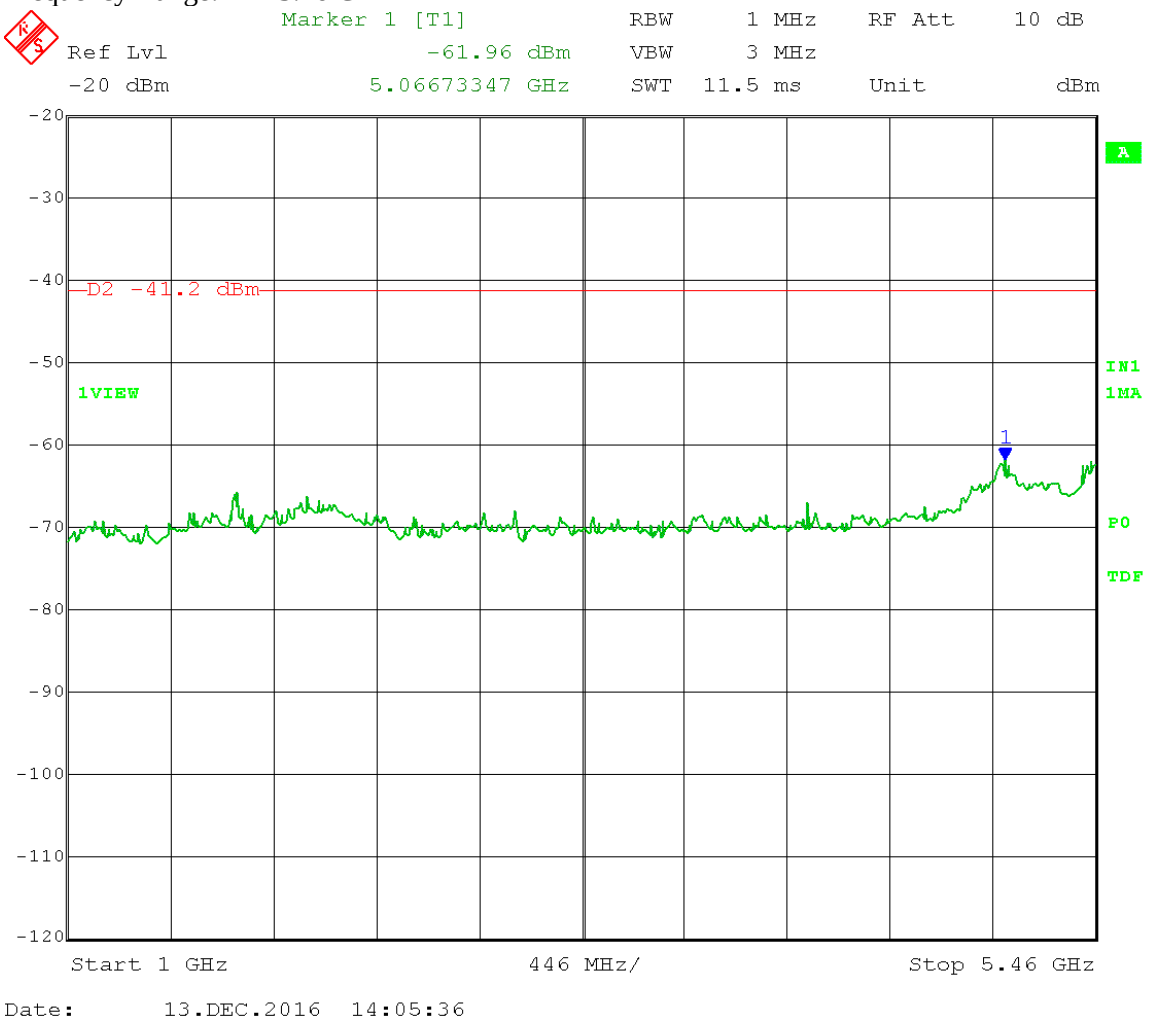
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz PEAK




Date: 13.DEC.2016 14:05:36

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 5.46 – 7.25 GHz

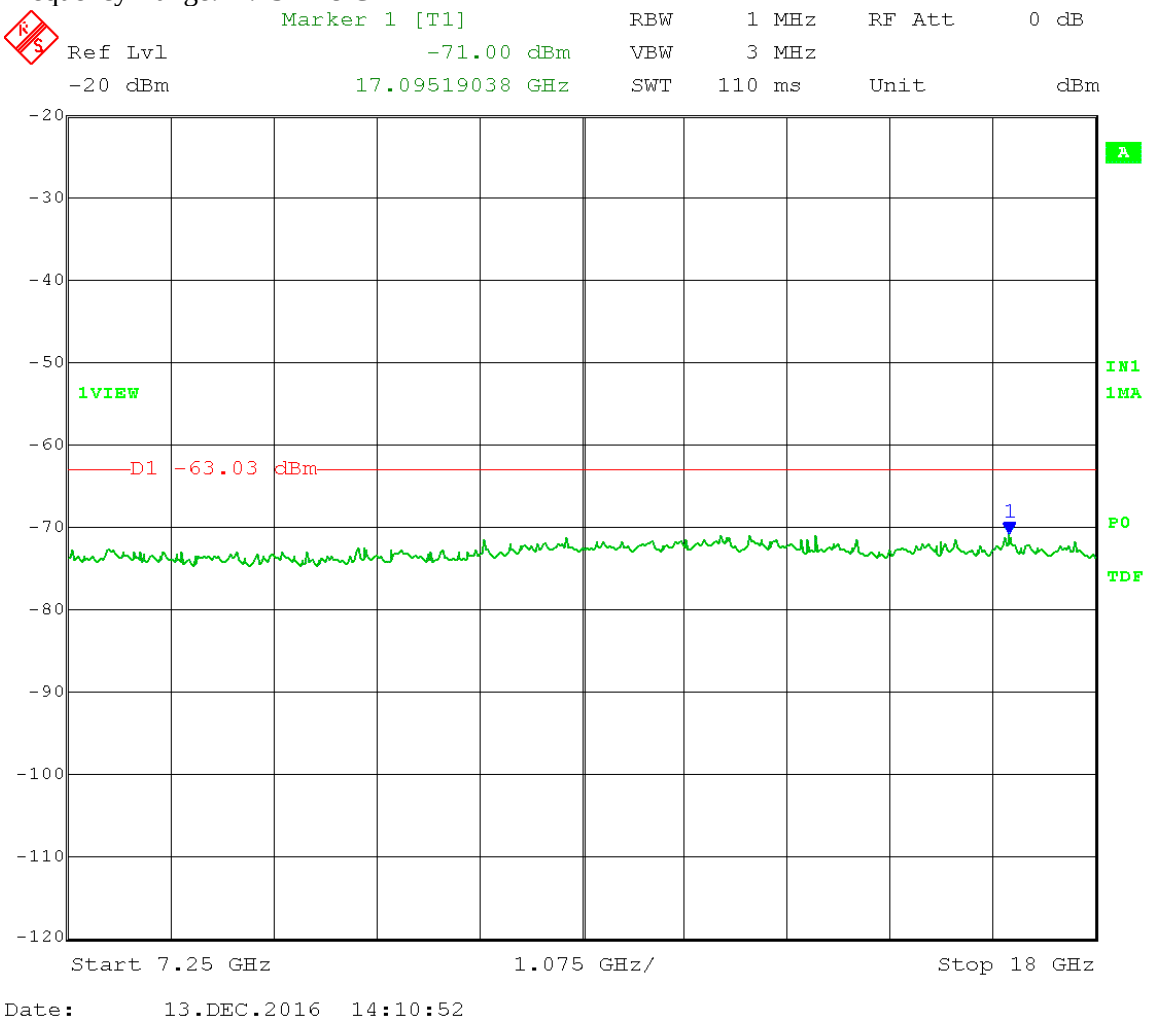
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 7.25 – 18 GHz



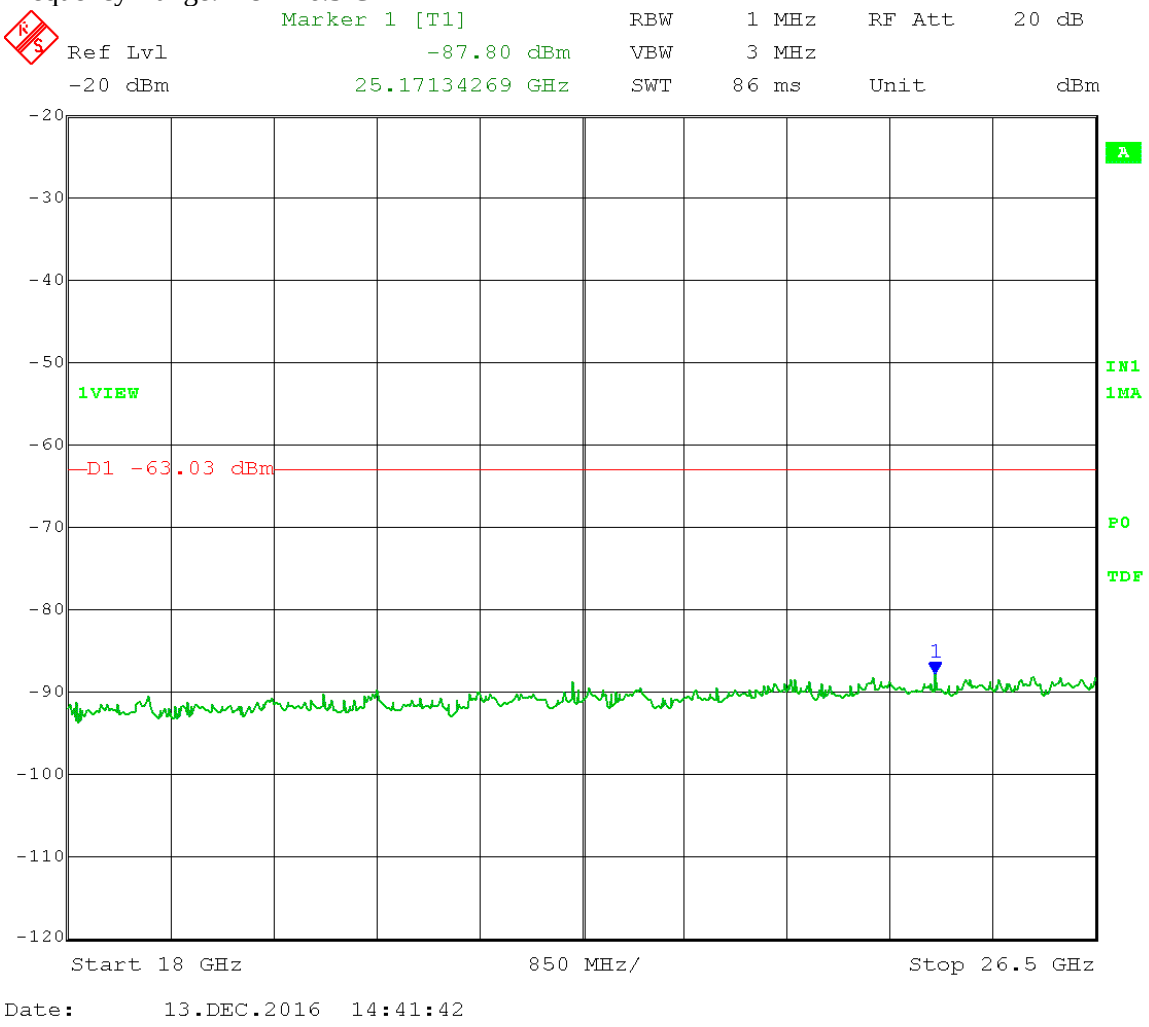
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 18 – 26.5 GHz



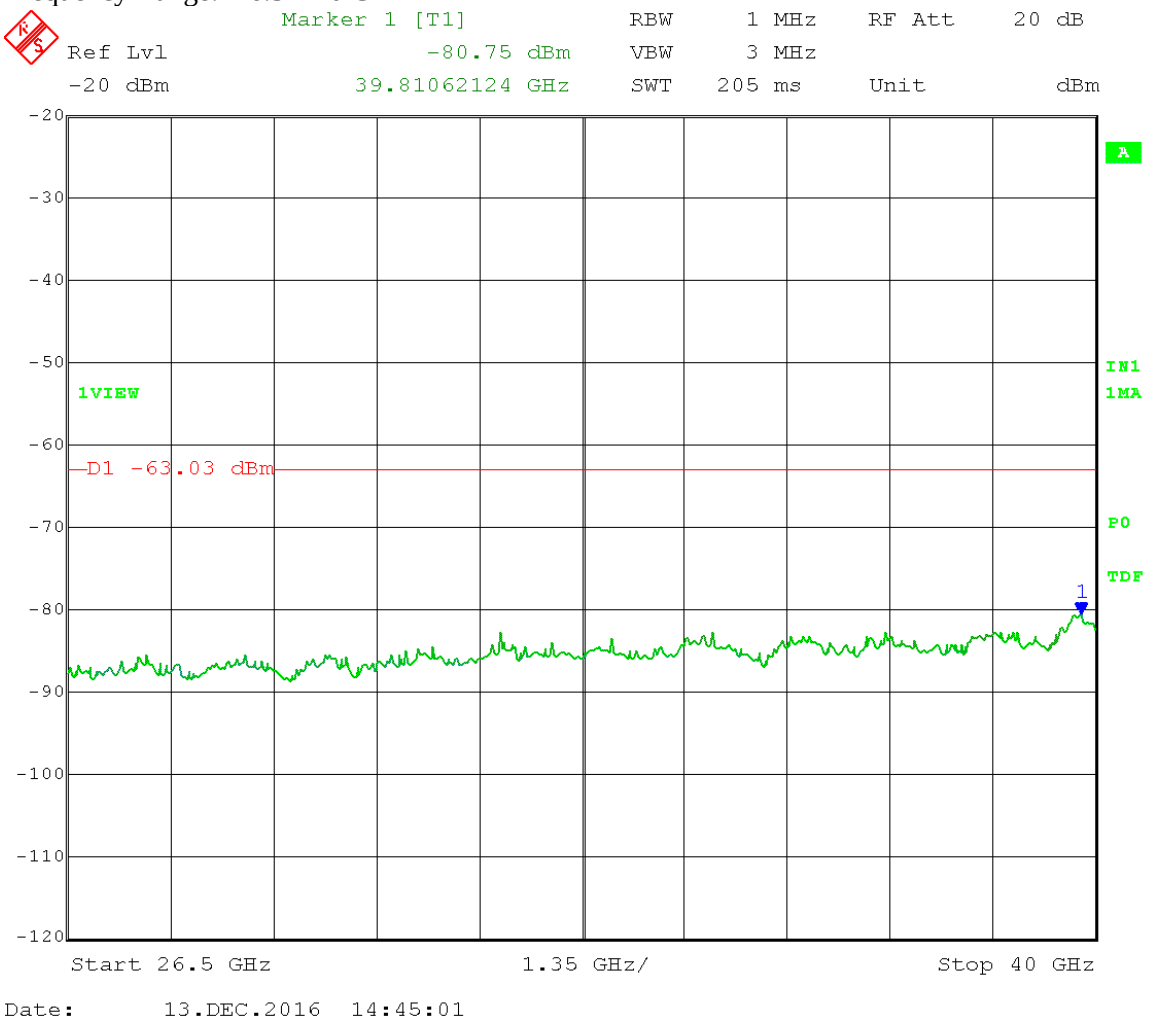
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 17 dBi antenna gain = -47 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 17 dBi antenna gain = -41.2 dBm/MHz

Frequency Range: 26.5 – 40 GHz



## Appendix B – Measurement Data

### B6.0 Unwanted Emission Levels – Radiated from cabinet

**Rule Section**: FCC 15.407(b)(3) and 15.407(b)(7)

**Test Procedure**: ANSI C63.10-2013
Section 6.6 – Radiated emissions from unlicensed wireless devices above 1 GHz

Peak measurements above 1000 MHz
RBW = 1 MHz
VBW ≥ 3 MHz
Detector = peak
Trace mode = max hold

Average measurements above 1000 MHz (required for peak emissions that are above the average limits)
RBW = 1 MHz
VBW ≥ 3 MHz
Detector = Average (linear)
Trace mode = max hold

EIRP calculation:
EIRP (dBm) = E + 20 log (d) – 104.77
E = field strength in dBµV/m
d = the measurement distance in meters

**Limits:** Outside restricted bands: Peak EIRP shall not exceed -27 dBm/MHz
Inside restricted bands: Peak and Average limits of FCC Part 15.209

Average limit was lowered to account for duty cycle.

**Results:** Passed

**Notes:** All radiated emissions were tested to the restricted band limits of FCC Part 15.209

Both transmit chains were active and at power setting 21 during test.

Antenna ports were terminated with 50 Ohm terminations.

Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with 65.6% duty cycle.

***RSS-247 & FCC Part 15.407***

***Electric Field Strength***

EUT: PMP450 5.4 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 69 deg. F; 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8599
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 65.6% duty cycle @ pwr setting 21 L,M,H channels
Date: 12-14-2016

***TEXT: "Vert 3 meters"***

Short Description: Test Set-up

Test Set-up: EUT Measured at 3 Meters with VERTICAL Antenna Polarization

Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)

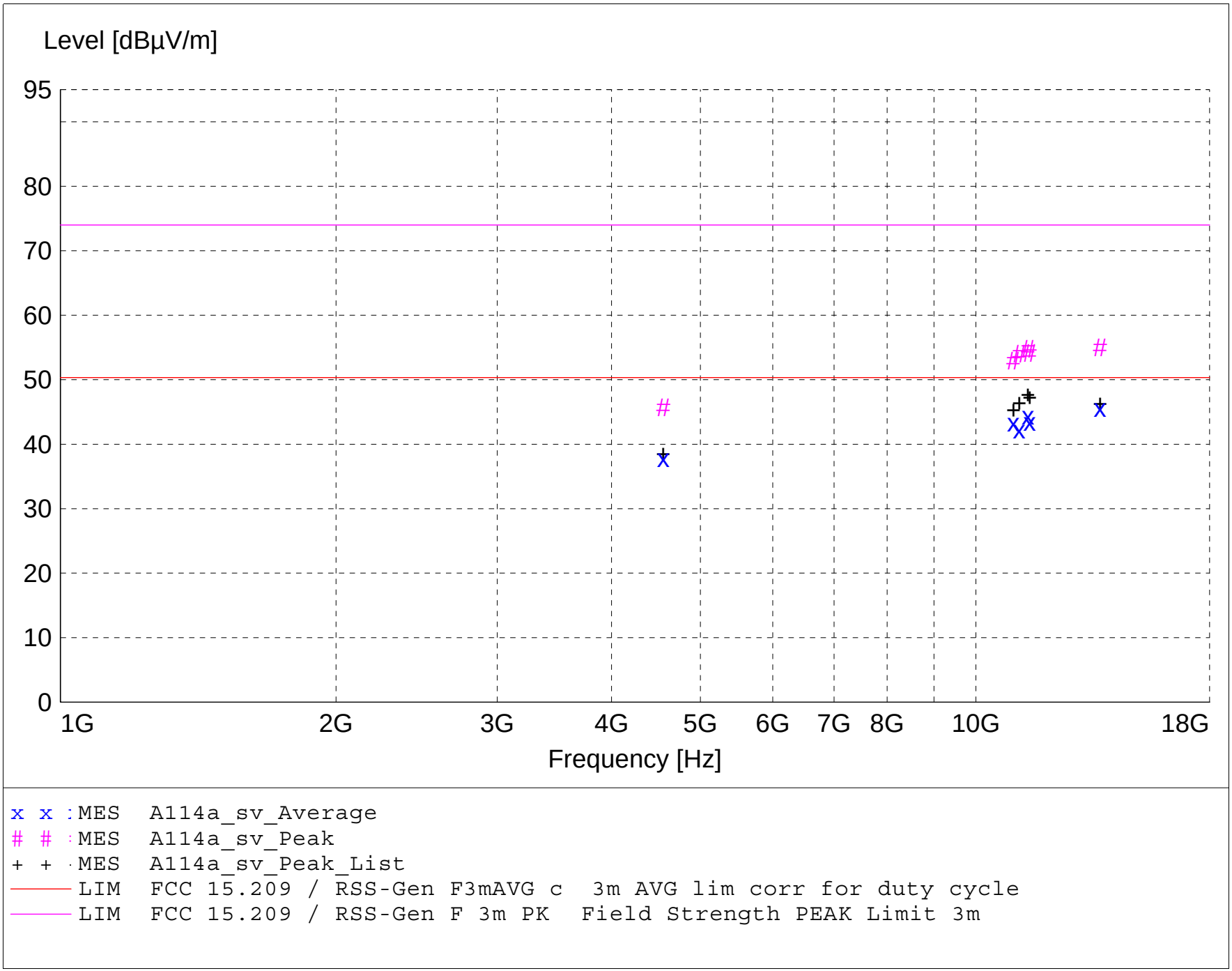
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)

Graph Markers: + Frequency marker (Level of marker not related to final level)

| Final maximized level using Quasi-Peak detector

X Final maximized level using Average dector

# Final maximized level using Peak detector




x x : MES A114a_sv_Average
# # : MES A114a_sv_Peak
+ + : MES A114a_sv_Peak_List
——— LIM FCC 15.209 / RSS-Gen F3mAVG c 3m AVG lim corr for duty cycle
——— LIM FCC 15.209 / RSS-Gen F 3m PK Field Strength PEAK Limit 3m

***MEASUREMENT RESULT: "A114a_sv_Final"***

12/14/2016 9:10AM

| Frequency | Level | Antenna Factor | System Loss | Total Level | Limit | Margin | Height Ant. | EuT Angle | Final Detector | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV | dBµV/m | dB | dBµV/m | dBµV/m | dB | m | deg | | |
| 13666.040000 | 41.20 | 40.54 | -36.1 | 45.6 | 50.3 | 4.7 | 1.64 | 320 | AVERAGE | None |
| 11399.980000 | 41.16 | 38.49 | -35.3 | 44.4 | 50.3 | 6.0 | 1.63 | 18 | AVERAGE | None |
| 11449.940000 | 40.15 | 38.57 | -35.3 | 43.5 | 50.3 | 6.9 | 1.63 | 17 | AVERAGE | None |
| 10990.060000 | 40.54 | 38.12 | -35.4 | 43.3 | 50.3 | 7.0 | 1.73 | 8 | AVERAGE | None |
| 11149.960000 | 39.34 | 38.22 | -35.3 | 42.3 | 50.3 | 8.0 | 1.71 | 11 | AVERAGE | None |
| 4556.000000 | 43.68 | 32.39 | -38.2 | 37.8 | 50.3 | 12.5 | 1.60 | 349 | AVERAGE | None |
| 13666.040000 | 50.60 | 40.54 | -36.1 | 55.0 | 74.0 | 19.0 | 1.64 | 320 | MAX PEAK | None |
| 11399.980000 | 51.63 | 38.49 | -35.3 | 54.8 | 74.0 | 19.2 | 1.63 | 18 | MAX PEAK | None |
| 11449.940000 | 50.87 | 38.57 | -35.3 | 54.2 | 74.0 | 19.8 | 1.63 | 17 | MAX PEAK | None |
| 11149.960000 | 51.13 | 38.22 | -35.3 | 54.1 | 74.0 | 19.9 | 1.71 | 11 | MAX PEAK | None |
| 10990.060000 | 50.21 | 38.12 | -35.4 | 53.0 | 74.0 | 21.0 | 1.73 | 8 | MAX PEAK | None |
| 4556.000000 | 51.63 | 32.39 | -38.2 | 45.8 | 74.0 | 28.2 | 1.60 | 349 | MAX PEAK | None |

***RSS-247 & FCC Part 15.407***

***Electric Field Strength***

EUT: PMP450 5.4 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 69 deg. F; 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8599
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 65.6% duty cycle @ pwr setting 21 L,M,H channels
Date: 12-14-2016

***TEXT: "Horz 3 meters"***

Short Description: Test Set-up

Test Set-up: EUT Measured at 3 Meters with HORIZONTAL Antenna Polarization

Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)

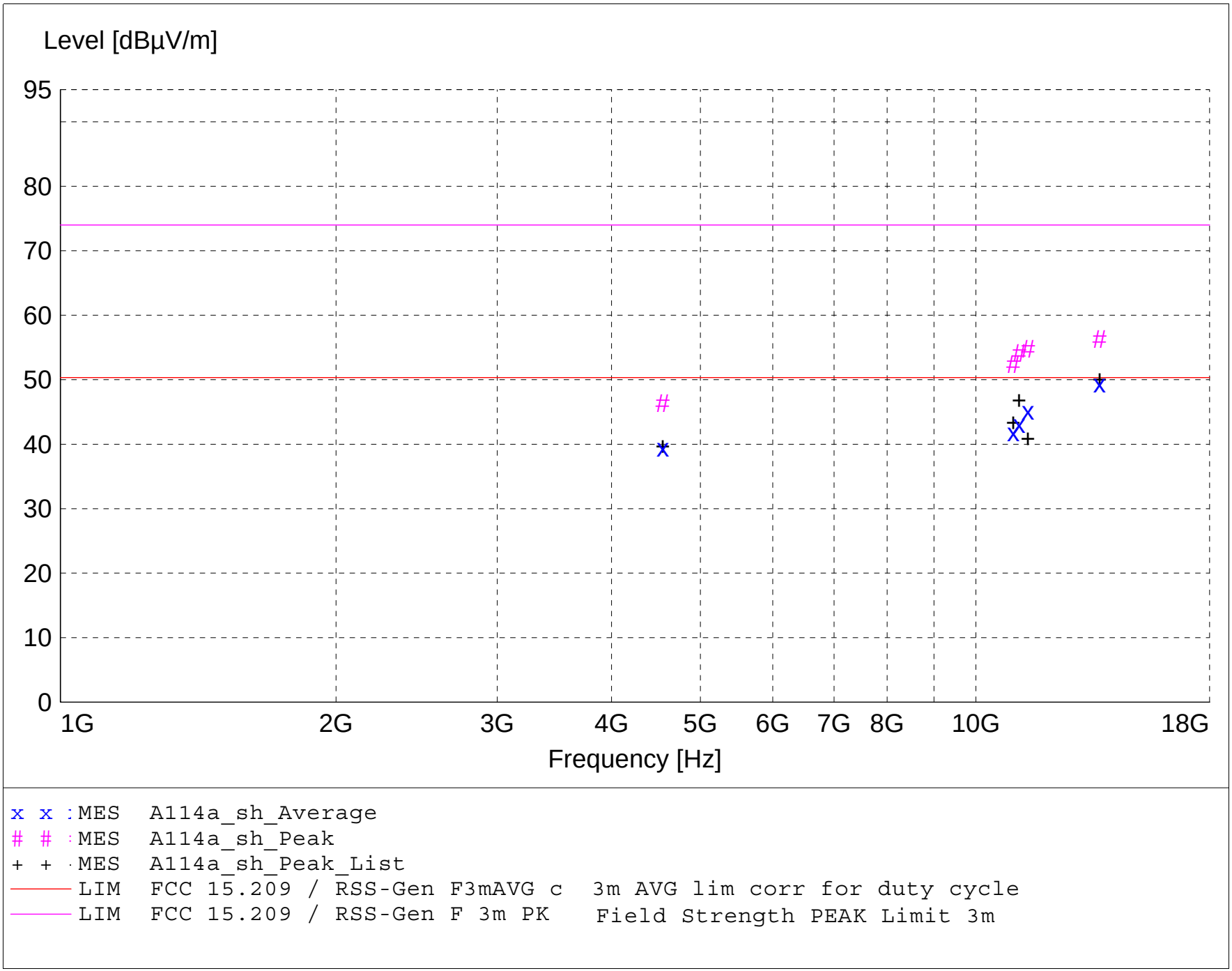
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)

Graph Markers: + Frequency marker (Level of marker not related to final level)

| Final maximized level using Quasi-Peak detector

X Final maximized level using Average dector

# Final maximized level using Peak detector




x x : MES A114a_sh_Average
# # : MES A114a_sh_Peak
+ + : MES A114a_sh_Peak_List
——— LIM FCC 15.209 / RSS-Gen F3mAVG c 3m AVG lim corr for duty cycle
——— LIM FCC 15.209 / RSS-Gen F 3m PK Field Strength PEAK Limit 3m

***MEASUREMENT RESULT: "A114a_sh_Final"***

12/14/2016 10:06AM

| Frequency | Level | Antenna Factor | System Loss | Total Level | Limit | Margin | Height Ant. | EuT Angle | Final Detector | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV | dBµV/m | dB | dBµV/m | dBµV/m | dB | m | deg | | |
| 13650.060000 | 44.96 | 40.52 | -36.1 | 49.4 | 50.3 | 1.0 | 1.63 | 293 | AVERAGE | None |
| 11400.000000 | 41.93 | 38.49 | -35.3 | 45.1 | 50.3 | 5.2 | 2.40 | 353 | AVERAGE | None |
| 11149.980000 | 40.15 | 38.22 | -35.3 | 43.1 | 50.3 | 7.2 | 2.25 | 10 | AVERAGE | None |
| 10989.980000 | 39.09 | 38.12 | -35.4 | 41.9 | 50.3 | 8.5 | 1.00 | 342 | AVERAGE | None |
| 4549.600000 | 45.27 | 32.38 | -38.2 | 39.4 | 50.3 | 10.9 | 1.00 | 303 | AVERAGE | None |
| 13650.060000 | 51.88 | 40.52 | -36.1 | 56.3 | 74.0 | 17.7 | 1.63 | 293 | MAX PEAK | None |
| 11400.000000 | 51.63 | 38.49 | -35.3 | 54.8 | 74.0 | 19.2 | 2.40 | 353 | MAX PEAK | None |
| 11149.980000 | 51.13 | 38.22 | -35.3 | 54.1 | 74.0 | 19.9 | 2.25 | 10 | MAX PEAK | None |
| 10989.980000 | 49.67 | 38.12 | -35.4 | 52.4 | 74.0 | 21.6 | 1.00 | 342 | MAX PEAK | None |
| 4549.600000 | 52.27 | 32.38 | -38.2 | 46.4 | 74.0 | 27.6 | 1.00 | 303 | MAX PEAK | None |

## *Electric Field Strength*

EUT: PMP450 5.4 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 69 deg. F; 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8599
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 65.6% duty cycle @ pwr setting 21 L,M,H channels
Date: 12-14-2016

## *TEXT: "Vert 1 meters"*

Short Description: Test Set-up

Test Set-up: EUT Measured at 1 Meters with VERTICAL Antenna Polarization

Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)

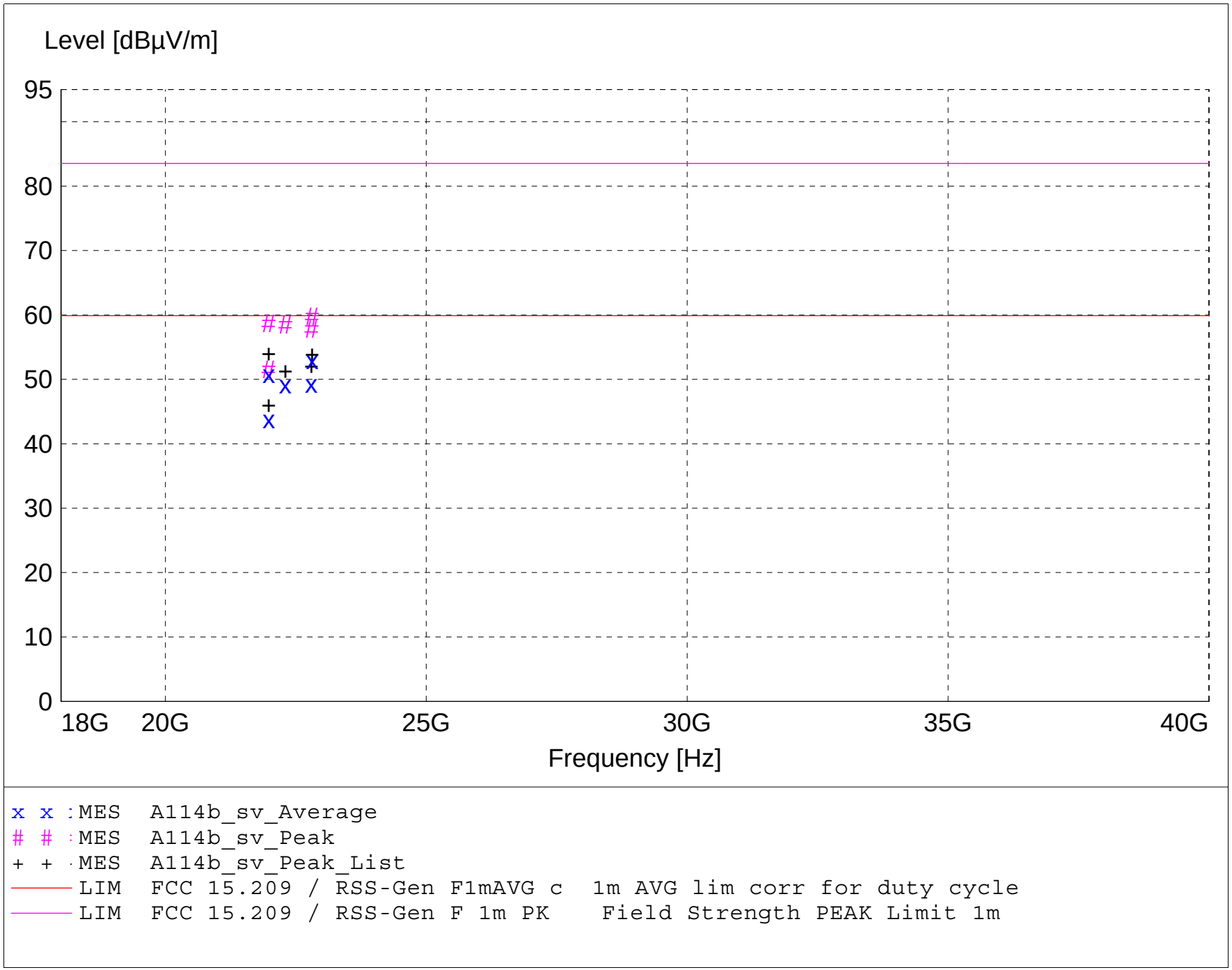
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)

Graph Markers: + Frequency marker (Level of marker not related to final level)

| Final maximized level using Quasi-Peak detector

X Final maximized level using Average dector

# Final maximized level using Peak detector


Level [dBµV/m]
95
80
70
60
50
40
30
20
10
0
18G
20G
25G
30G
35G
40G
Frequency [Hz]
x x : MES A114b_sv_Average
# # : MES A114b_sv_Peak
+ + : MES A114b_sv_Peak_List
LIM FCC 15.209 / RSS-Gen F1mAVG c 1m AVG lim corr for duty cycle
LIM FCC 15.209 / RSS-Gen F 1m PK Field Strength PEAK Limit 1m

***MEASUREMENT RESULT: "A114b_sv_Final"***

12/14/2016 11:08AM

| Frequency | Level | Antenna Factor | System Loss | Total Level | Limit | Margin | Height Ant. | EuT Angle | Final Detector | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV | dBµV/m | dB | dBµV/m | dBµV/m | dB | m | deg | | |
| 22814.100000 | 62.91 | 40.13 | -50.0 | 53.0 | 59.9 | 6.9 | 1.40 | 330 | AVERAGE | None |
| 21980.100000 | 62.67 | 40.15 | -52.0 | 50.8 | 59.9 | 9.0 | 1.40 | 55 | AVERAGE | None |
| 22799.980000 | 59.29 | 40.13 | -50.1 | 49.3 | 59.9 | 10.6 | 1.50 | 40 | AVERAGE | None |
| 22300.020000 | 59.68 | 40.16 | -50.6 | 49.2 | 59.9 | 10.6 | 1.50 | 45 | AVERAGE | None |
| 21979.980000 | 55.61 | 40.15 | -52.0 | 43.8 | 59.9 | 16.1 | 1.40 | 55 | AVERAGE | None |
| 22814.100000 | 69.66 | 40.13 | -50.0 | 59.7 | 83.5 | 23.8 | 1.40 | 330 | MAX PEAK | None |
| 21980.100000 | 70.51 | 40.15 | -52.0 | 58.7 | 83.5 | 24.9 | 1.40 | 55 | MAX PEAK | None |
| 22300.020000 | 68.96 | 40.16 | -50.6 | 58.5 | 83.5 | 25.0 | 1.50 | 45 | MAX PEAK | None |
| 22799.980000 | 67.87 | 40.13 | -50.1 | 57.9 | 83.5 | 25.7 | 1.50 | 40 | MAX PEAK | None |
| 21979.980000 | 63.41 | 40.15 | -52.0 | 51.6 | 83.5 | 32.0 | 1.40 | 55 | MAX PEAK | None |

***RSS-247 & FCC Part 15.407***

***Electric Field Strength***

EUT: PMP450 5.4 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 69 deg. F; 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8599
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 65.6% duty cycle @ pwr setting 21 L,M,H channels
Date: 12-14-2016

***TEXT: "Horz 1 meters"***

Short Description: Test Set-up

Test Set-up: EUT Measured at 1 Meters with HORIZONTAL Antenna Polarization

Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)

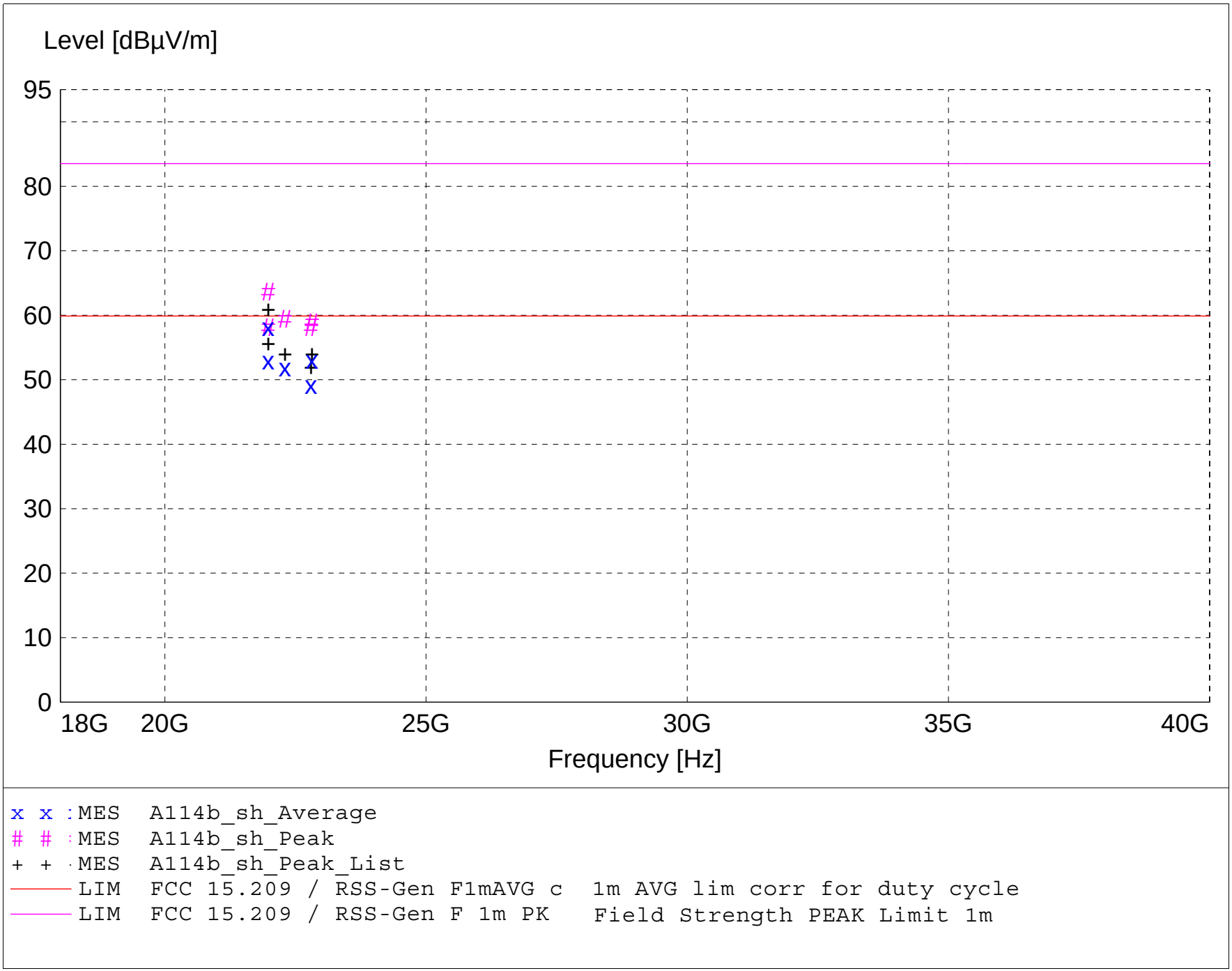
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)

Graph Markers: + Frequency marker (Level of marker not related to final level)

| Final maximized level using Quasi-Peak detector

X Final maximized level using Average dector

# Final maximized level using Peak detector


Level [dBµV/m]
95
80
70
60
50
40
30
20
10
0
18G
20G
25G
30G
35G
40G
Frequency [Hz]
x x : MES A114b_sh_Average
# # : MES A114b_sh_Peak
+ + : MES A114b_sh_Peak_List
LIM FCC 15.209 / RSS-Gen F1mAVG c 1m AVG lim corr for duty cycle
LIM FCC 15.209 / RSS-Gen F 1m PK Field Strength PEAK Limit 1m

***MEASUREMENT RESULT: "A114b_sh_Final"***

12/14/2016 12:50PM

| Frequency | Level | Antenna Factor | System Loss | Total Level | Limit | Margin | Height Ant. | EuT Angle | Final Detector | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV | dBµV/m | dB | dBµV/m | dBµV/m | dB | m | deg | | |
| 21979.960000 | 70.01 | 40.15 | -52.0 | 58.2 | 59.9 | 1.7 | 1.40 | 0 | AVERAGE | None |
| 22816.220000 | 62.94 | 40.13 | -50.0 | 53.0 | 59.9 | 6.9 | 1.40 | 350 | AVERAGE | None |
| 21980.020000 | 64.82 | 40.15 | -52.0 | 53.0 | 59.9 | 6.9 | 1.40 | 0 | AVERAGE | None |
| 22299.940000 | 62.36 | 40.16 | -50.6 | 51.9 | 59.9 | 8.0 | 1.40 | 355 | AVERAGE | None |
| 22799.980000 | 59.17 | 40.13 | -50.1 | 49.2 | 59.9 | 10.7 | 1.50 | 40 | AVERAGE | None |
| 21979.960000 | 75.44 | 40.15 | -52.0 | 63.6 | 83.5 | 19.9 | 1.40 | 0 | MAX PEAK | None |
| 22299.940000 | 69.90 | 40.16 | -50.6 | 59.4 | 83.5 | 24.1 | 1.40 | 355 | MAX PEAK | None |
| 22816.220000 | 68.84 | 40.13 | -50.0 | 58.9 | 83.5 | 24.6 | 1.40 | 350 | MAX PEAK | None |
| 21980.020000 | 70.01 | 40.15 | -52.0 | 58.2 | 83.5 | 25.4 | 1.40 | 0 | MAX PEAK | None |
| 22799.980000 | 68.11 | 40.13 | -50.1 | 58.1 | 83.5 | 25.4 | 1.50 | 40 | MAX PEAK | None |

## Appendix B – Measurement Data

### B7.0 Duty Cycle of Test Unit

**Rule Part:** Informative

**Test Procedure:** ANSI C63.10-2013
Section 12.2(b)(2) zero-span on spectrum analyzer

**Description:** SPAN: zero span
RBW ≥ EBW (or to the largest available value)
Detector = peak
RBW and VBW must be > 50/*T*
Number of sweep points across *T* must be > 100
(*T* = Transmit duration at maximum power level)

**Limits:** Informative

Duty cycle (x) is the fraction of time over which the transmitter is on and transmitting at its maximum power control level.

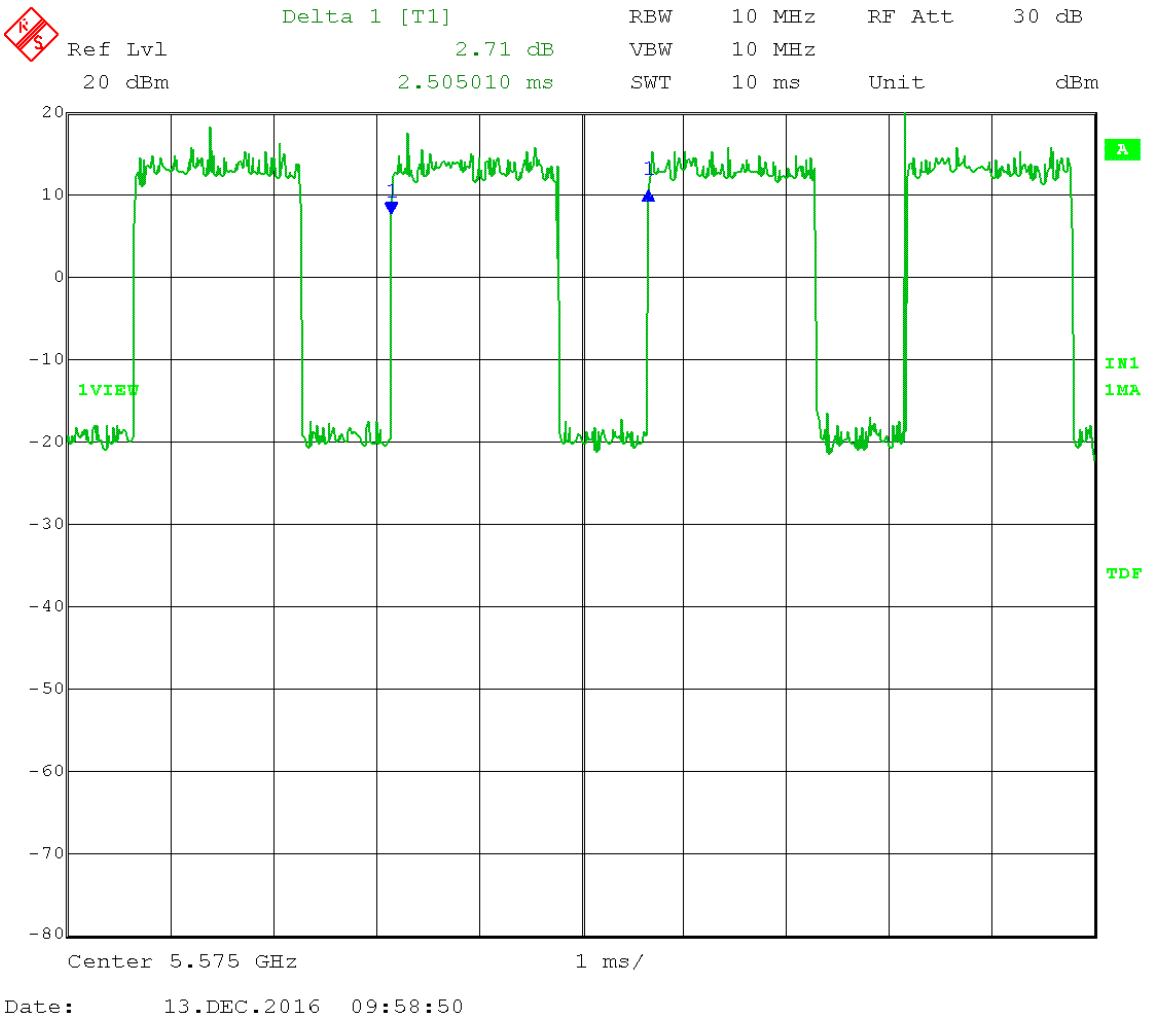
**Results:** Duty cycle correction for power measurements = 10 log (1/0.656)
= **1.83 dB**

Duty cycle correction for voltage measurements = 20 log (1/0.656)
= **3.66 dB**

Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Duty Cycle during testing
Operator: Craig B
Comment: ANSI C63.10, 12.2(b)(2) zero-span on spectrum analyzer
Mid Channel: Transmit = 5575 MHz 40 MHz BW

Duty cycle = (1.643287 ms) / (2.505010 ms) x 100 = 65.6%
Duty cycle correction for power measurements = 10 log (1/0.656) = **1.83 dB**
Duty cycle correction for voltage measurements = 20 log (1/0.656) = **3.66 dB**

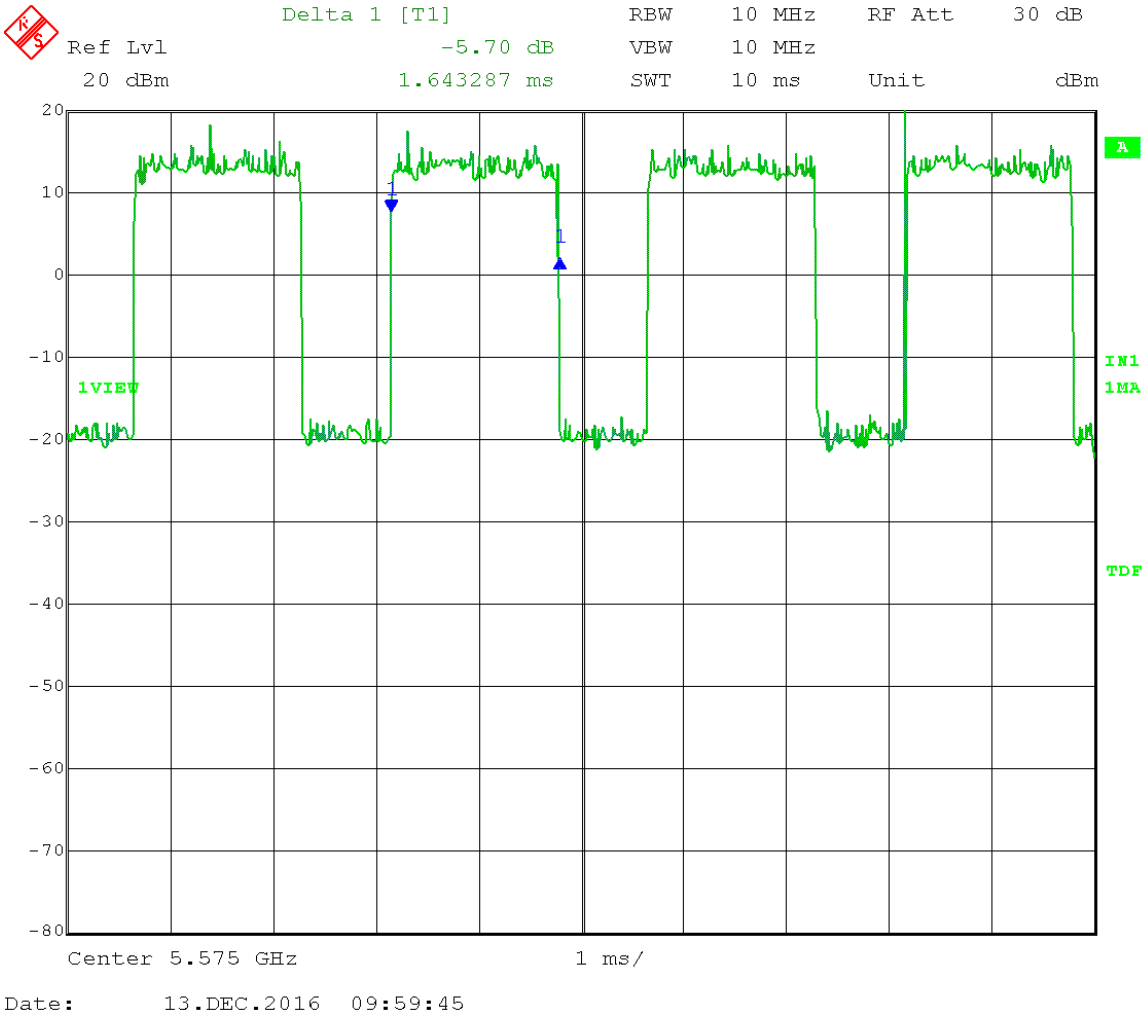
Time of one cycle: 2.505010 ms



Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: Duty Cycle during testing
Operator: Craig B
Comment: ANSI C63.10, 12.2(b)(2) zero-span on spectrum analyzer
Mid Channel: Transmit = 5575 MHz 40 MHz BW

Duty cycle = (1.643287 ms) / (2.505010 ms) x 100 = 65.6%
Duty cycle correction for power measurements = 10 log (1/0.656) = **1.83 dB**
Duty cycle correction for voltage measurements = 20 log (1/0.656) = **3.66 dB**

ON time during one cycle: 1.643287 ms



## Appendix C – Measurement Uncertainty

Compliance with the limits in this standard are based on the results of the compliance measurement. Our calculated measurement uncertainty including the measurement instrumentation, associated connections between the various instruments in the measurement chain, and other contributions, are provided in this section of the test report.

| Parameter | | Expanded Uncertainty (K=2) |
|---|---|---|
| Emission Bandwidth, Conducted | | +/- 1.14% |
| RF Output Power, Conducted | | +/- 1.36dB |
| Power Spectral Density, Conducted | | +/- 1.26dB |
| All Emissions, Radiated | | +/- 5.69dB |
| All Emissions, RF Conducted | | +/- 3.31dB |
| Duty Cycle | | +/- 0.05% |

166 South Carter, Genoa City, WI 53128

Company: Cambium Networks
Model Tested: C054045A001A
Report Number: 22419
DLS Project: 8599

# END OF REPORT

| Revision # | Date | Comments | By |
|---|---|---|---|
| 1.0 | 12-15-2016 | Initial Release | CB |
| | | | |
| | | | |
| | | | |
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| | | | |