



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) 5475 to 5720 MHz (5.4 GHz xcvr reported to the FCC in CFR 47 Part 15 Subpart C Section 15.247 report # 18191) 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 3800 Golf Road, Suite 360 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.

© Copyright 1983 – 2016, D.L.S. Electronic Systems, Inc. - FCC Registration #90531

COPYRIGHT NOTICE

This report must not be reproduced (except in full), without the approval of D.L.S. Electronic Systems, Inc.



166 South Carter, Genoa City, WI 53128

Company:
Model Tested:
Report Number:
DLS Project:

Cambium Networks
C054045A001A
22419
8599

SIGNATURE PAGE

Report By:

A handwritten signature in black ink that reads "Craig Brandt". The signature is fluid and cursive.

Craig Brandt
Test Engineer

Reviewed By:

A handwritten signature in black ink that reads "William Stumpf". The signature is fluid and cursive.

William Stumpf
OATS Manager

Approved By:

A handwritten signature in black ink that reads "Brian J. Mattson". The signature is fluid and cursive.

Brian Mattson
General Manager



166 South Carter, Genoa City, WI 53128

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

Table of Contents

i. Cover Page	1
ii. Signature Page.....	2
iii. Table of Contents	3
iv. NVLAP Certificate of Accreditation.....	4
1.0 Summary of Test Report	5
2.0 Introduction.....	6
3.0 Test Facilities	6
4.0 Description of Test Sample.....	6
5.0 Test Equipment	8
6.0 Test Arrangements	8
7.0 Test Conditions	9
8.0 Modifications Made To EUT For Compliance.....	9
9.0 Additional Descriptions	10
10.0 Results.....	10
11.0 Conclusion	10
Appendix A – Test Setup Photos	11
Appendix B – Measurement Data.....	12
B1.0 Emission Bandwidth – 26 dB bandwidth	12
B2.0 Maximum Conducted Output Power	16
B3.0 Peak Power Spectral Density – Conducted.....	20
B4.0 Band-Edge – Unwanted Emission Levels	24
B5.0 Unwanted Emission Levels – RF Conducted	28
B6.0 Unwanted Emission Levels – Radiated from cabinet.....	50
B7.0 Duty Cycle of Test Unit.....	63
Appendix C – Measurement Uncertainty	66



166 South Carter, Genoa City, WI 53128

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

United States Department of Commerce
National Institute of Standards and Technology



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



[Signature]
For the National Voluntary Laboratory Accreditation Program

**ELECTROMAGNETIC
COMPATIBILITY &
TELECOMMUNICATIONS**

NVLAP LAB CODE 100276-0

Emissions

Designation

Off-site test location

Description

D.L.S. Electronics performs radiated emissions testing at an additional location, 166 South Carter Street, Genoa City, WI 53128.



166 South Carter, Genoa City, WI 53128

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

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.



166 South Carter, Genoa City, WI 53128

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

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)



166 South Carter, Genoa City, WI 53128

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

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



166 South Carter, Genoa City, WI 53128

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

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
Preamplifier	Ciao	CA118-4010	101	1GHz-18GHz	1-20-16	1-20-17
Preamplifier	Planar	PTB-60-2040-5R0-10-115VAC-292FF	PL3292	18-40GHz	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.



166 South Carter, Genoa City, WI 53128

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

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.



166 South Carter, Genoa City, WI 53128

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

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.

Appendix A – Test Setup Photos

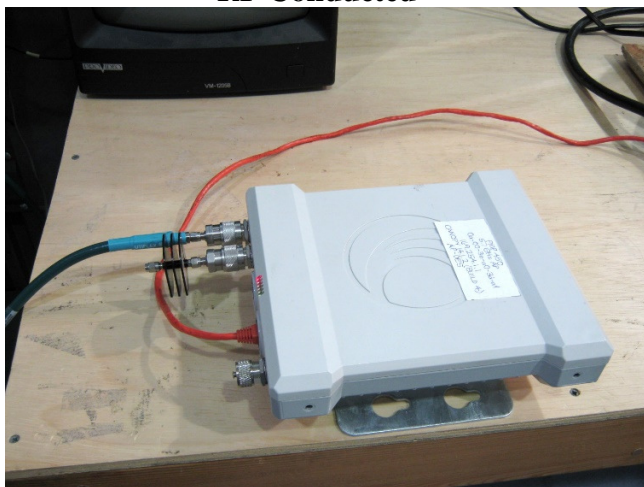
PMP450AP 5.4 & 5.7 GHz MIMO/Combo Radio

Cat 5e Power-Over-Ethernet cable (power supply to radio). (10 meter un-shielded with plastic connectors)

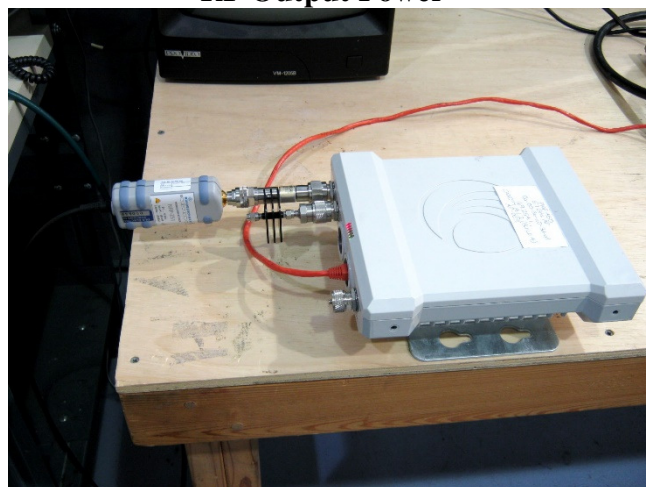
Cat 5e Ethernet data cable (power supply to computer). (1.5 meter un-shielded with plastic connectors)

Phihong power supply model: PSA15M-300(SM)

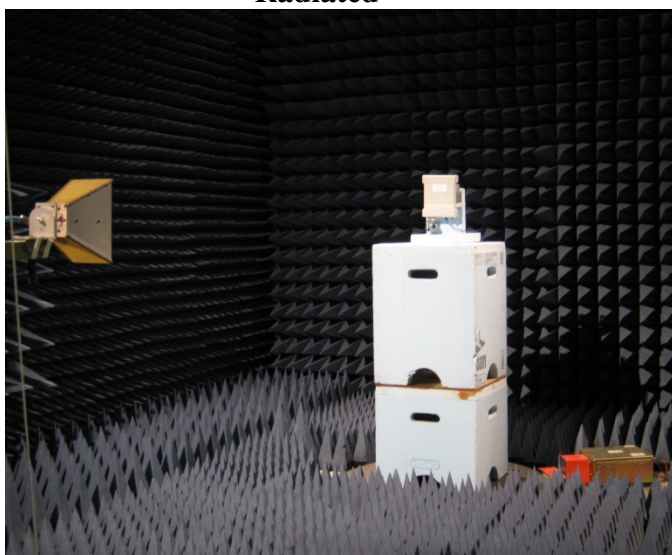
RF Conducted



RF Output Power



Radiated



Radiated – close-up





166 South Carter, Genoa City, WI 53128

Company:
Model Tested:
Report Number:
DLS Project:

Cambium Networks
C054045A001A
22419
8599

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

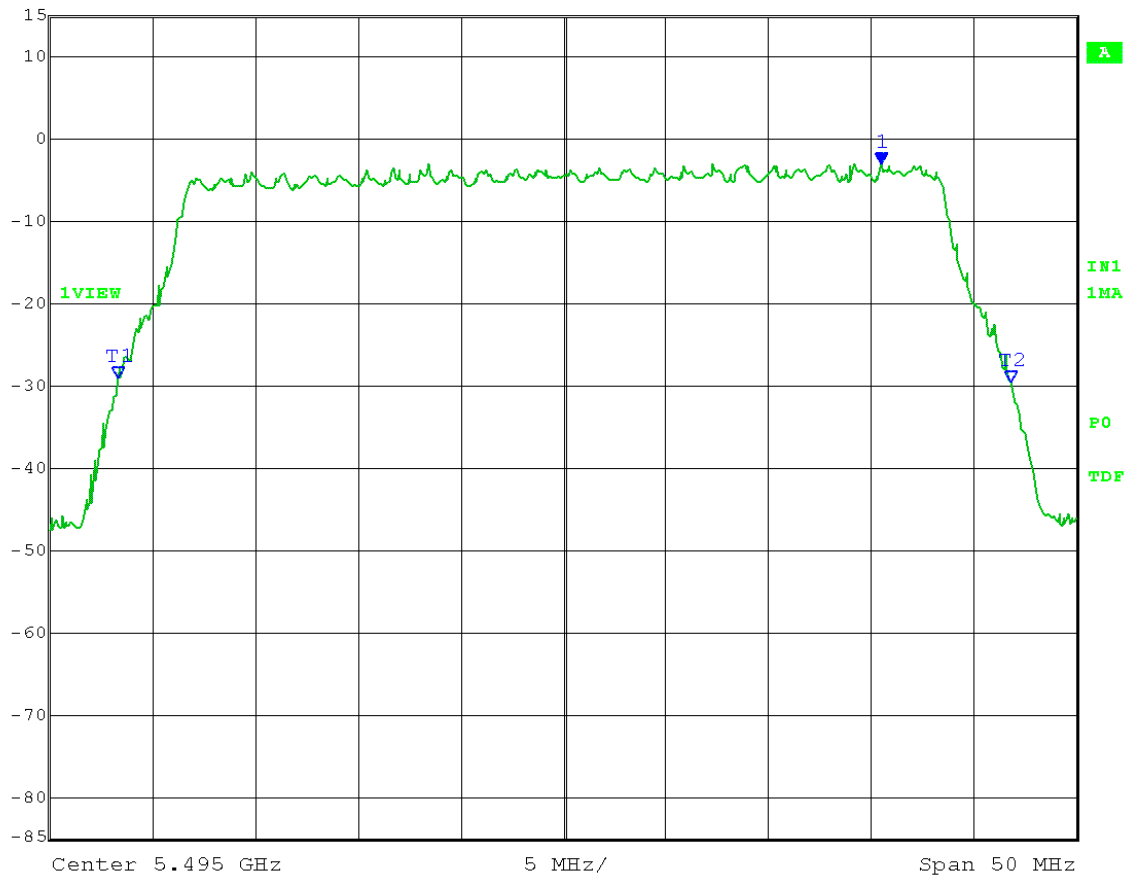
Port V

QPSK

26 dB Emission Bandwidth = 43.5 MHz



Max/Ref Lvl	Marker 1 [T1 ndB]	RBW	500 kHz	RF Att	10 dB
15 dBm	ndB 26.00 dB	VBW	2 MHz		
-5 dBm	BW 43.48697395 MHz	SWT	10 ms	Unit	dBm



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

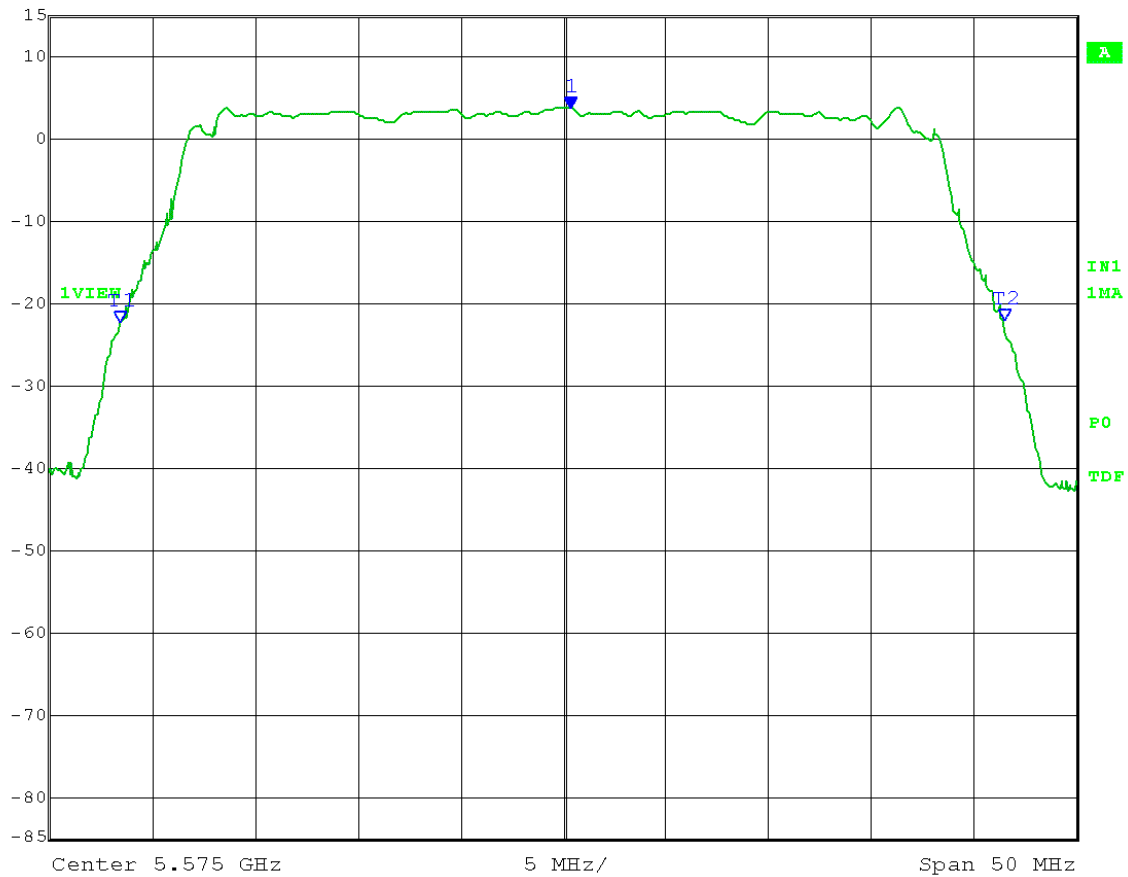
Port V

QPSK

26 dB Emission Bandwidth = 43.1 MHz



Max/Ref Lvl	Marker 1 [T1 ndB]	RBW	500 kHz	RF Att	10 dB
15 dBm	ndB 26.00 dB	VBW	2 MHz		
-5 dBm	BW 43.08617234 MHz	SWT	10 ms	Unit	dBm



Date: 13.DEC.2016 11:59:00

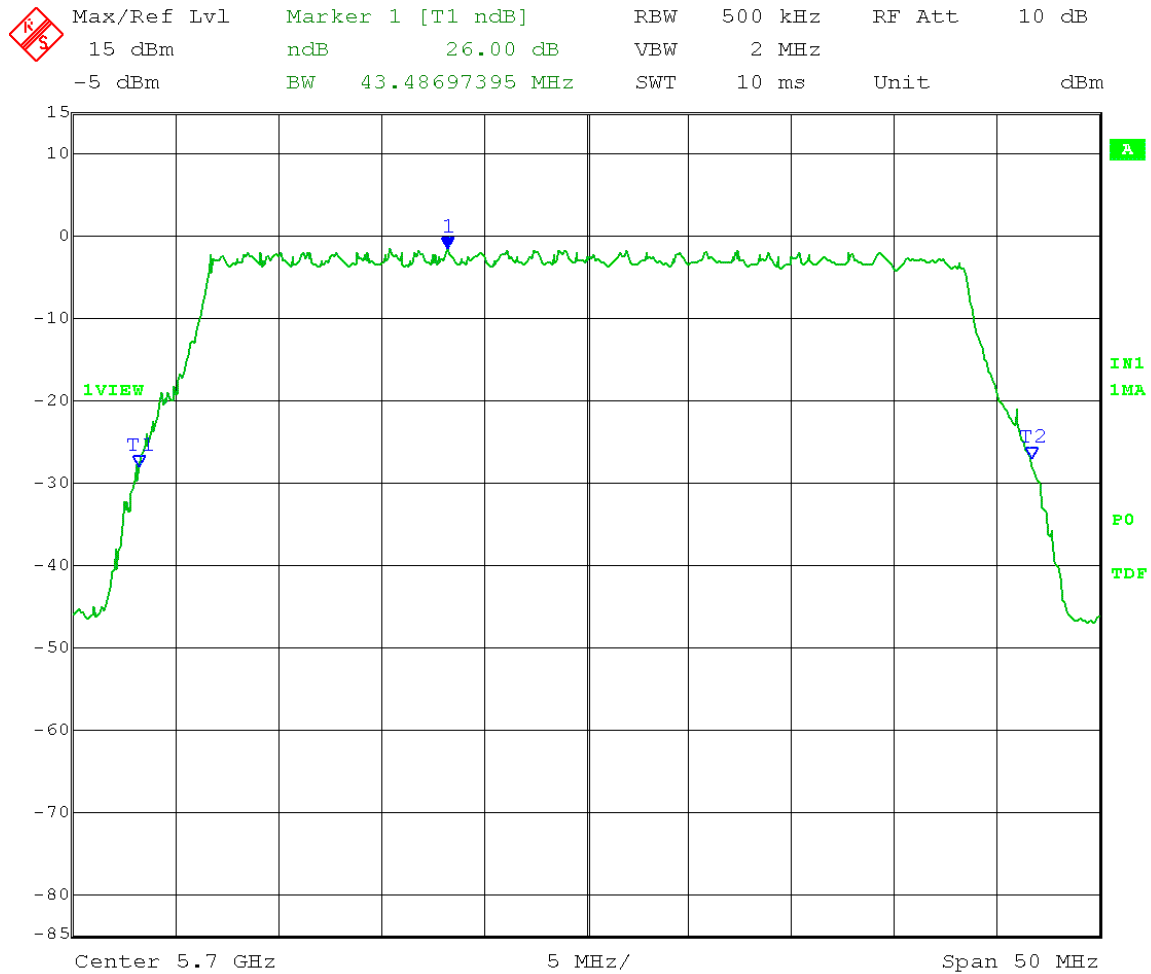
Test Date: 12-13-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz AP
Test: 26 dB Emission Bandwidth
Operator: Craig B
Comment: ANSI C63.10, 12.4.1

High Channel: Transmit = 5700 MHz

40 MHz BW

Power setting 14 Port V QPSK

26 dB Emission Bandwidth = 43.5 MHz



Date: 13.DEC.2016 12:04:08



166 South Carter, Genoa City, WI 53128

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

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
QPSK

Power setting 13

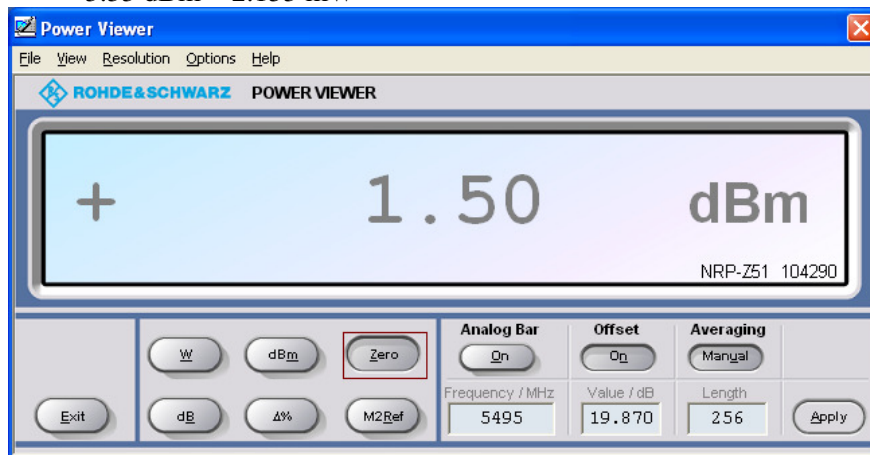
Antenna gain: 17 dBi

Conducted limit: 24 dBm - (17-6) = 13 dBm

e.i.r.p. limit: 30 dBm

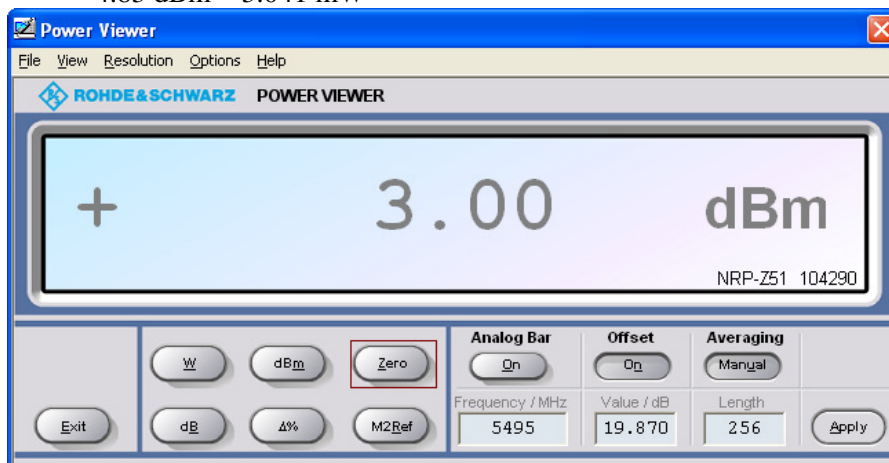
Port H:

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
QPSK

Power setting 21

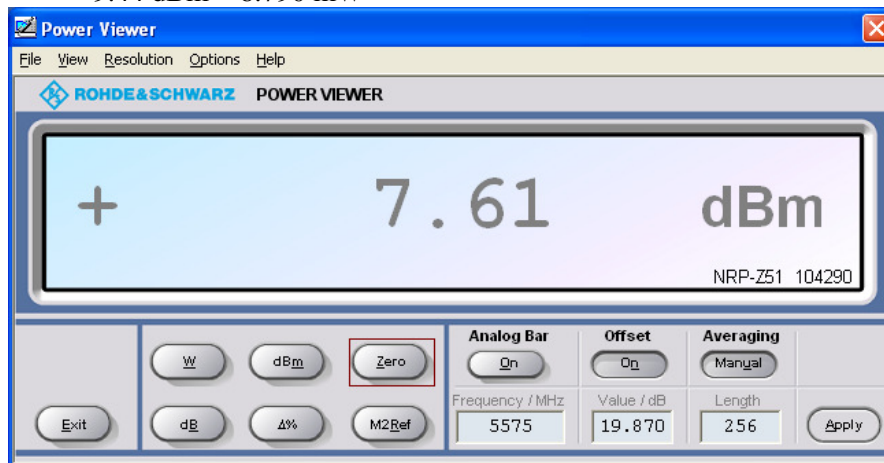
Antenna gain: 17 dBi

Conducted limit: 24 dBm - (17-6) = 13 dBm

e.i.r.p. limit: 30 dBm

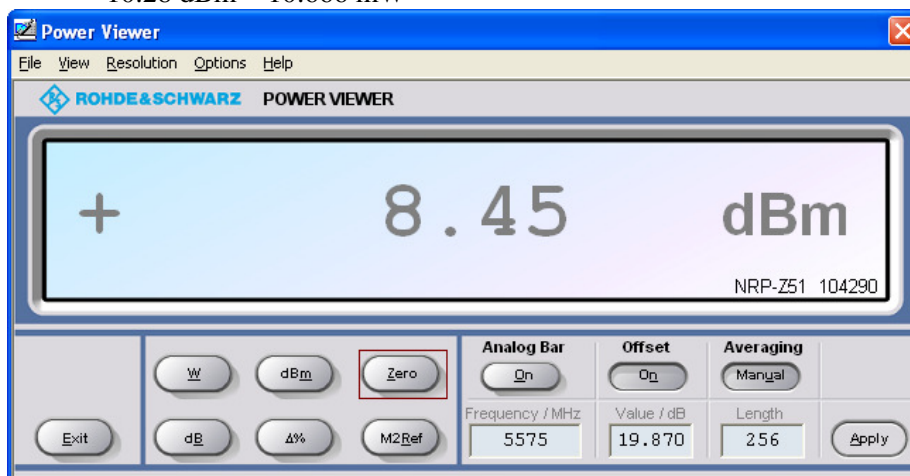
Port H:

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
QPSK

Power setting 14

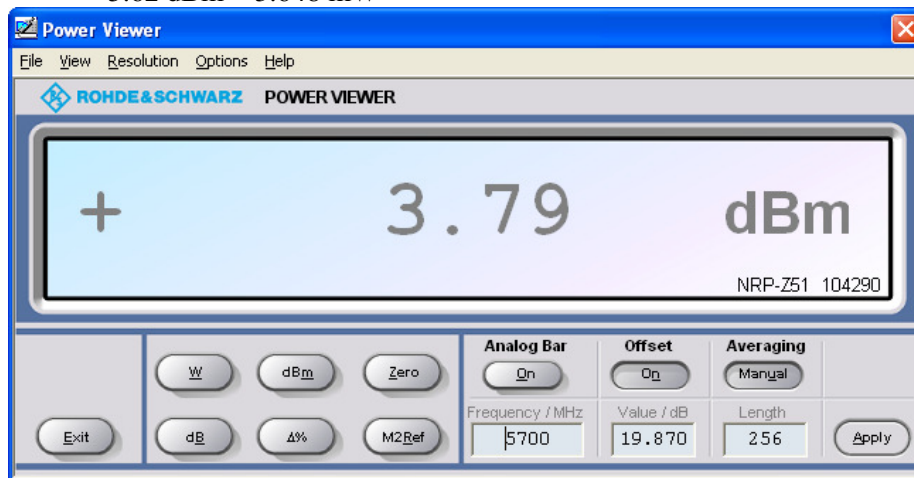
Antenna gain: 17 dBi

Conducted limit: 24 dBm - (17-6) = 13 dBm

e.i.r.p. limit: 30 dBm

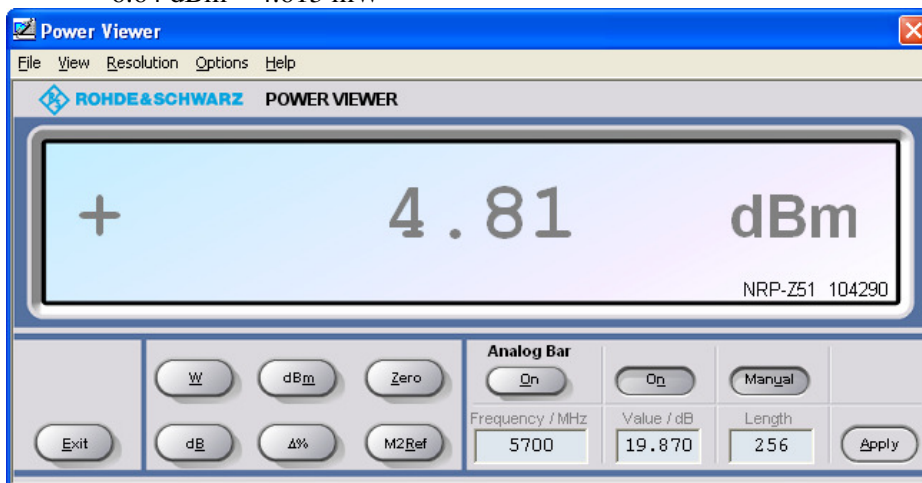
Port H:

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**



166 South Carter, Genoa City, WI 53128

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

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 $\geq$ 3 MHz
Number of points $\geq$ 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
[$10 \log(\text{number of ports})$]

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

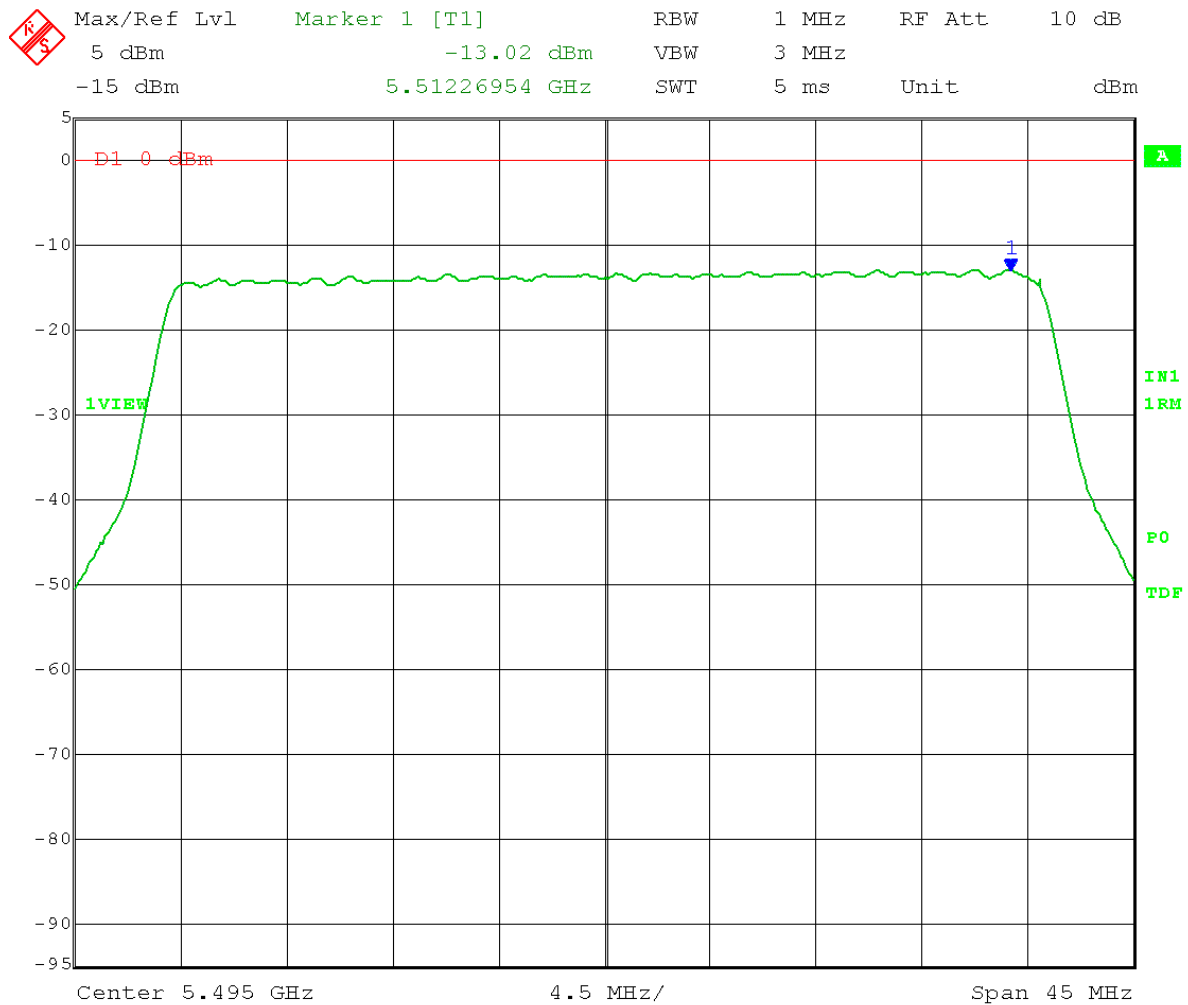
Results: Passed

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



Date: 13.DEC.2016 11:46:11

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

Power setting 21 Port V

RBW = 1 MHz

Detector = RMS

Sweep Time = Auto

Antenna gain = 17 dBi

Limit: 11 dBm/MHz – (17-6) = 0 dBm/MHz

40 MHz BW

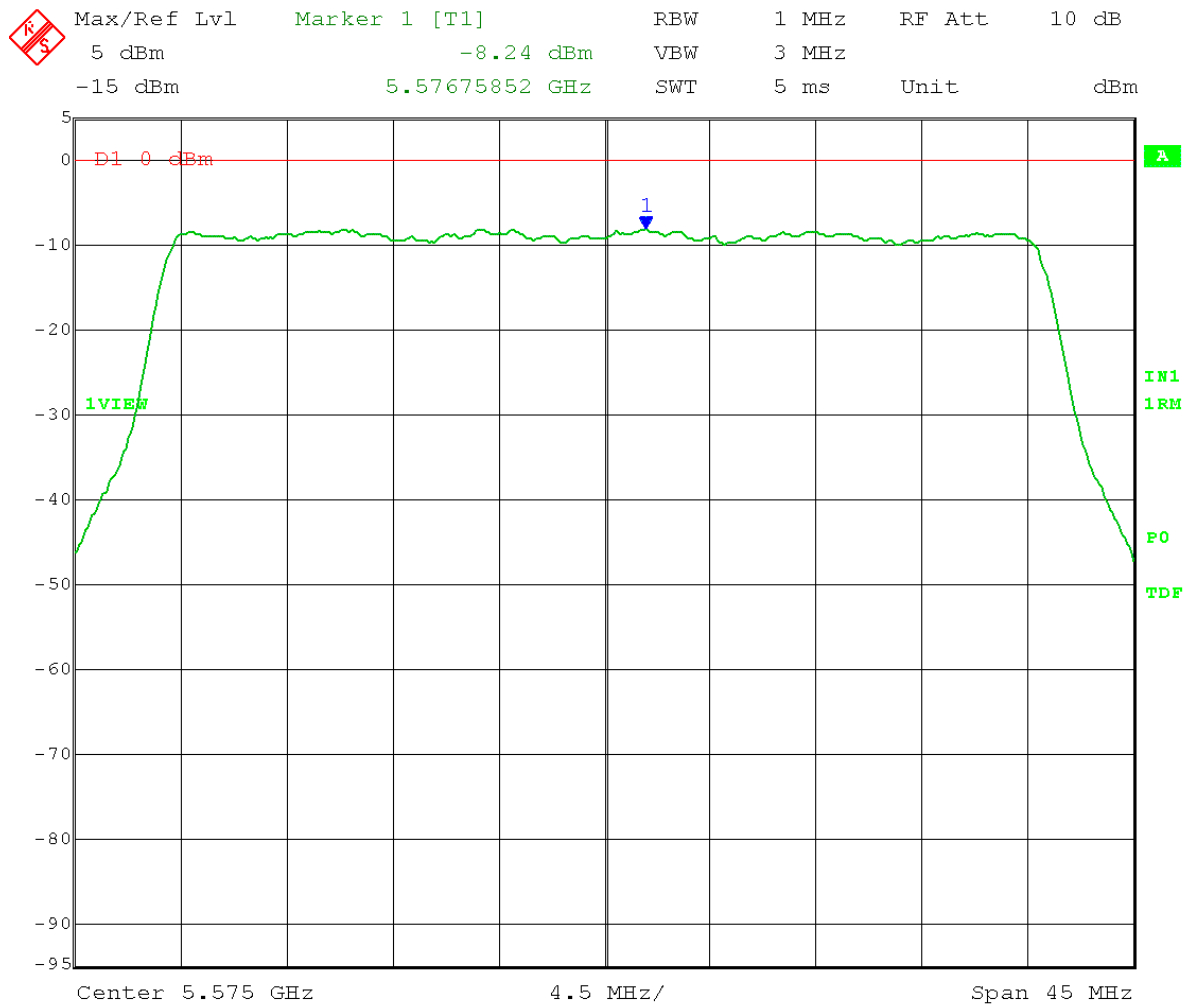
QPSK

VBW = 3 MHz

Trace = AVG

Sweep counts = 200

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

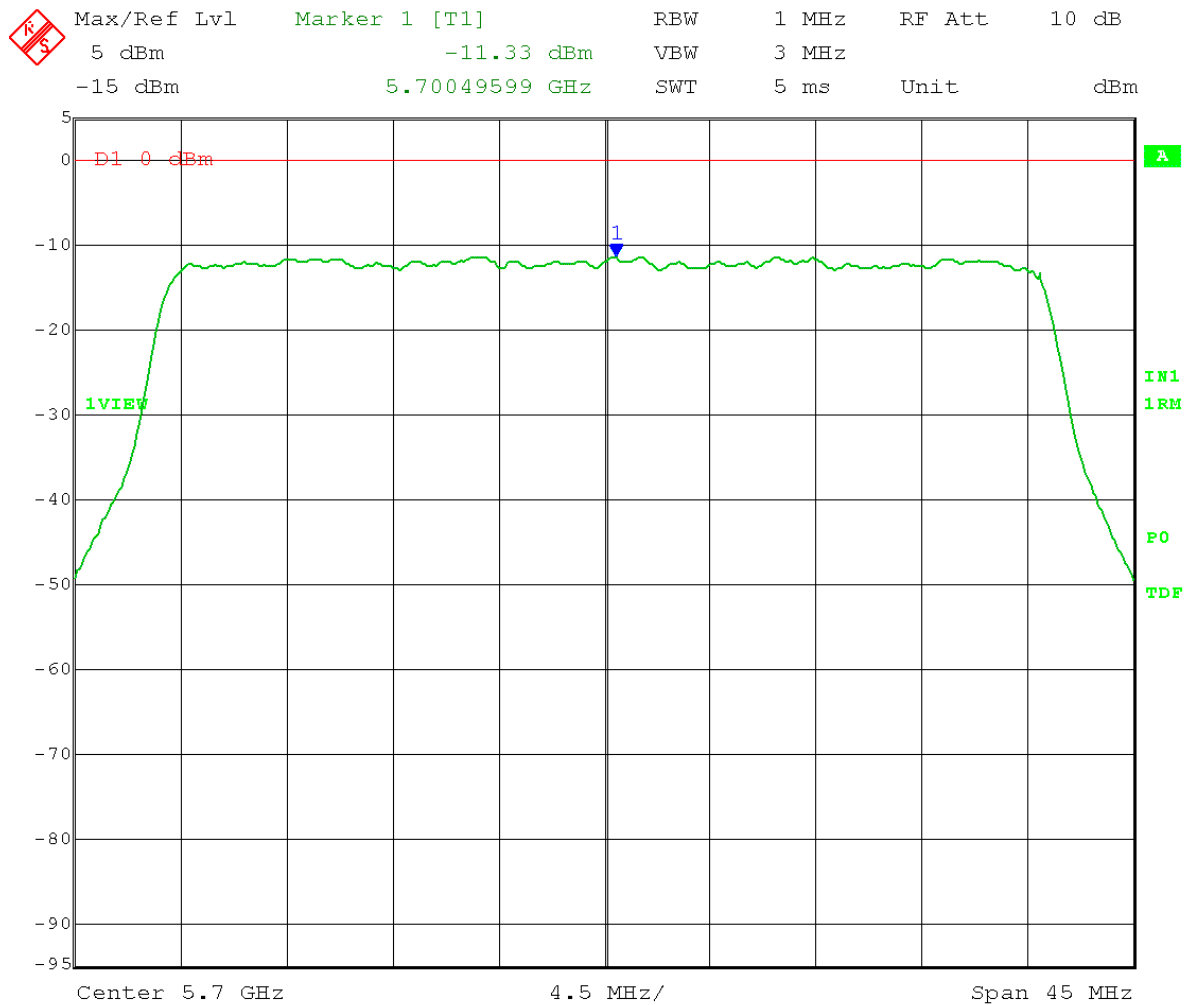


Date: 13.DEC.2016 11:53:38

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



Date: 13.DEC.2016 11:42:19



166 South Carter, Genoa City, WI 53128

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

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 $\geq$ [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

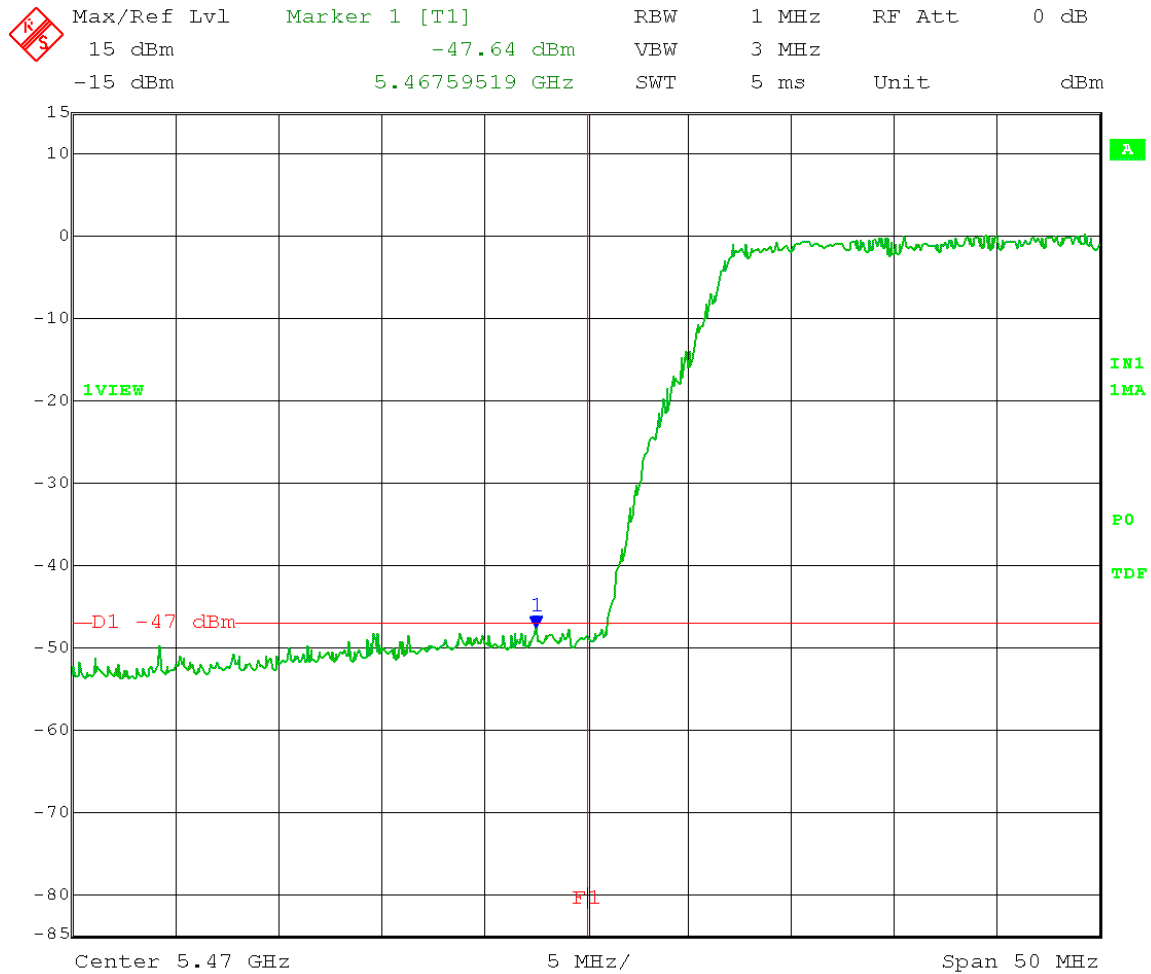
40 MHz BW

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



Date: 13.DEC.2016 10:52:32

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

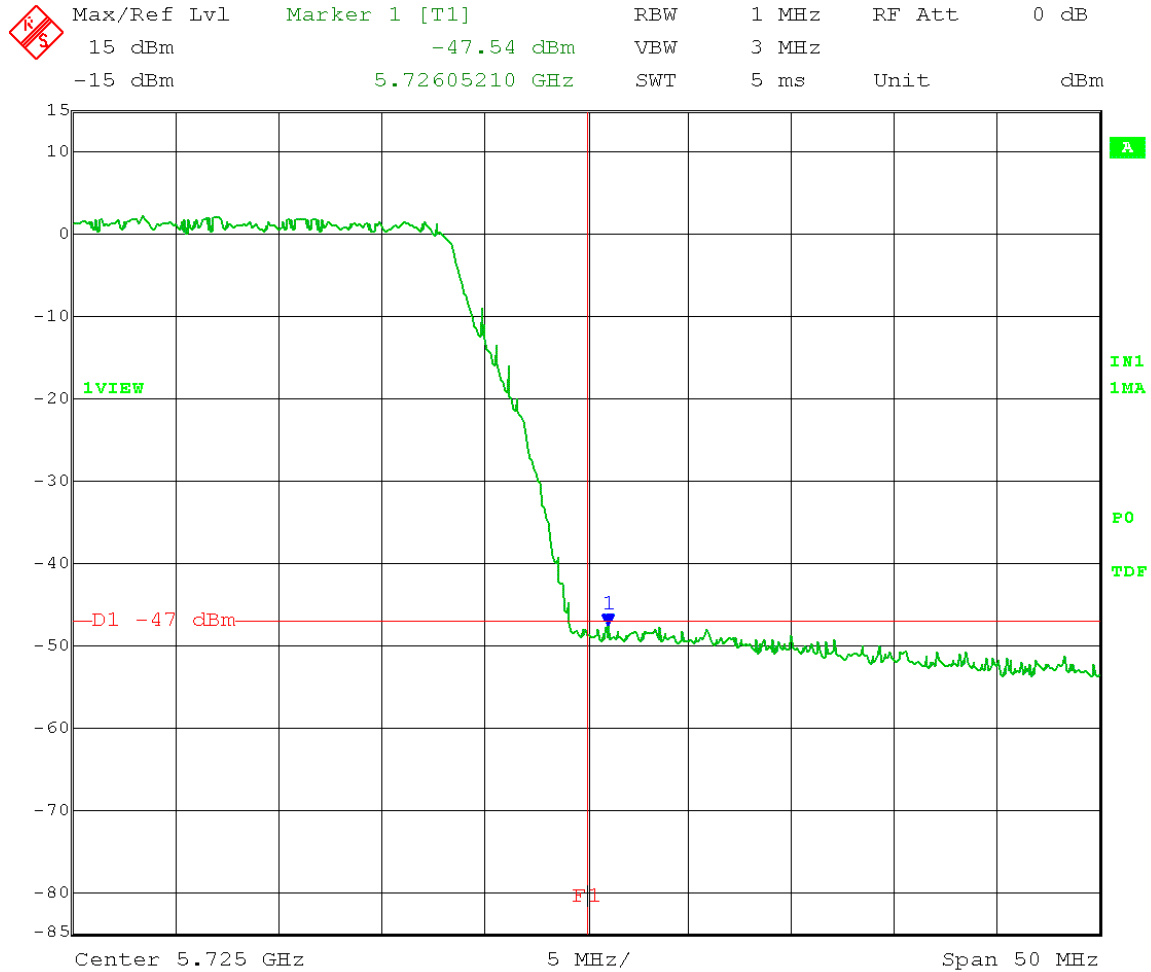
40 MHz BW

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



Date: 13.DEC.2016 10:59:07

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

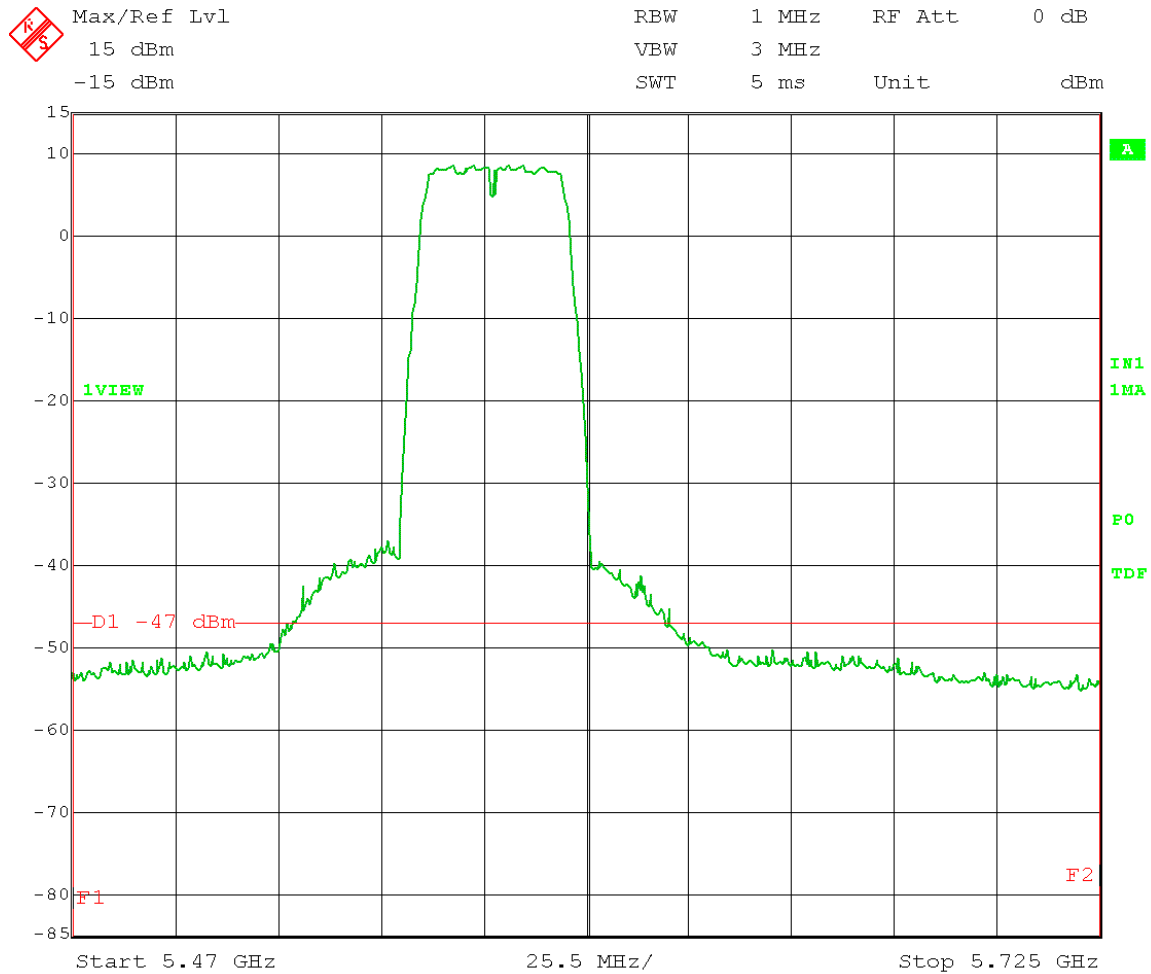
40 MHz BW

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



166 South Carter, Genoa City, WI 53128

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

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 $\geq$ 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 $\geq$ 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:

$E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20 \log(d\{\text{meters}\}) + 104.77$

Below 1 GHz:

$E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20 \log(d\{\text{meters}\}) + 104.77 + 4.7 \text{ dB}$

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

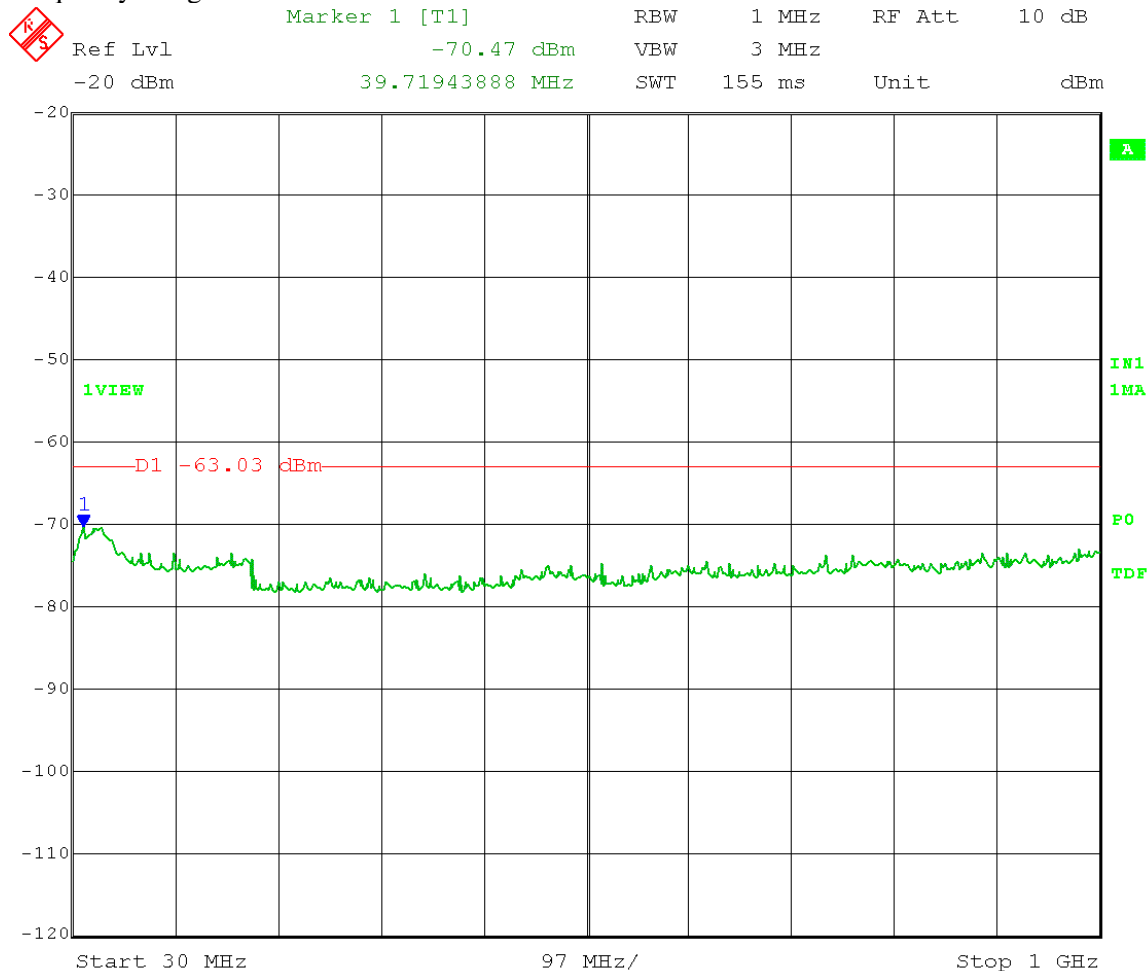
Restricted band Average limit: 54 dB μ V/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB

(MIMO) - 17 dBi antenna gain - 1.83 duty cycle correction = -63.03 dBm/MHz

Restricted band Peak limit: 74 dB μ V/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 12:33:54

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

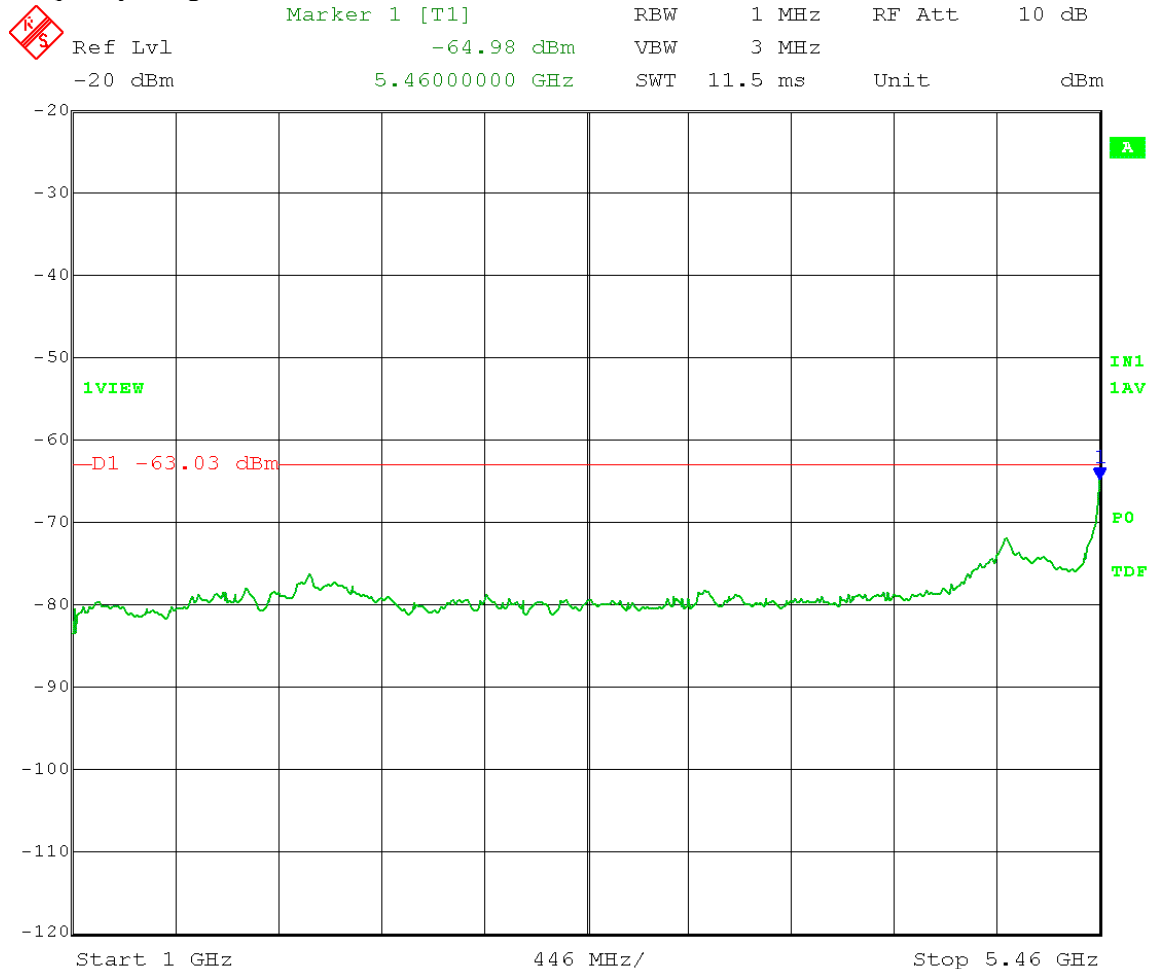
Detector: Average

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



Date: 13.DEC.2016 12:30:33

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

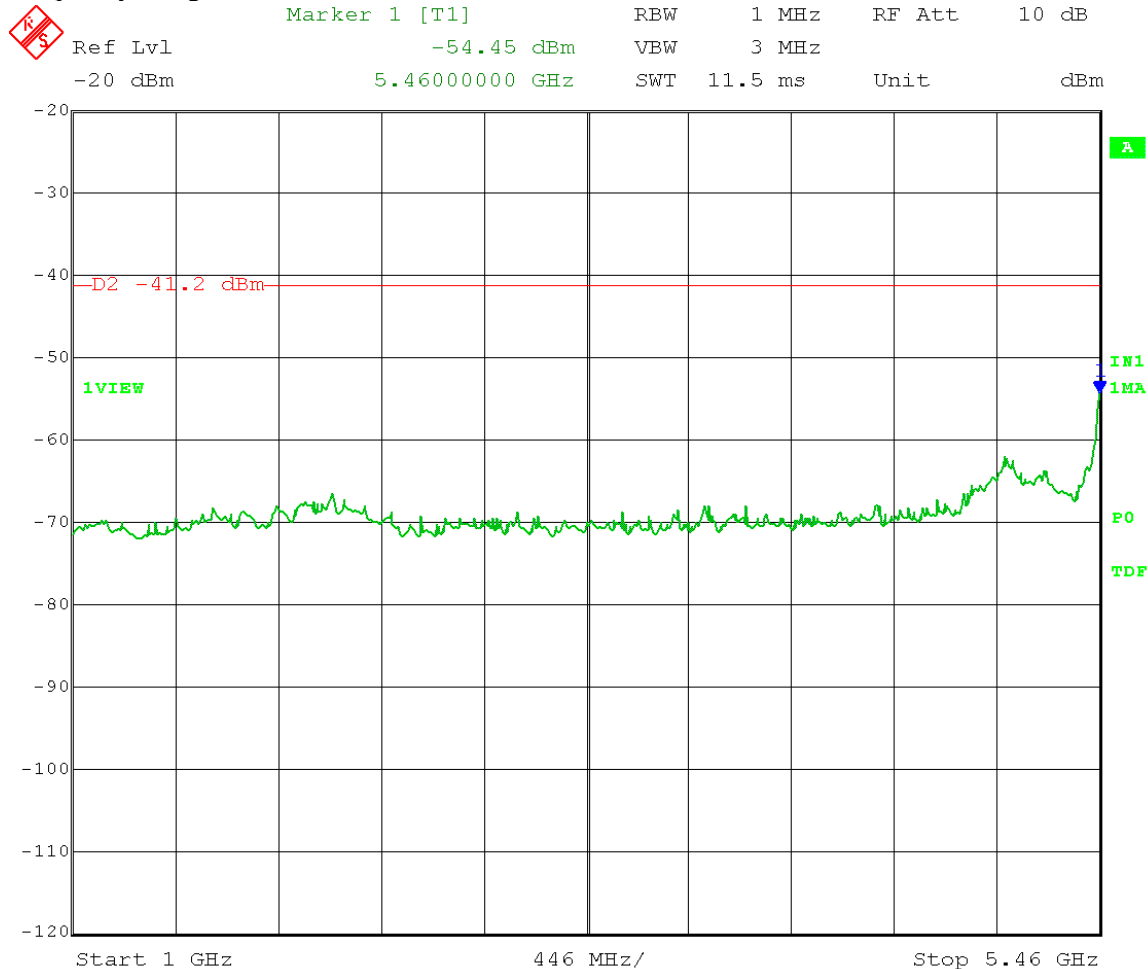
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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

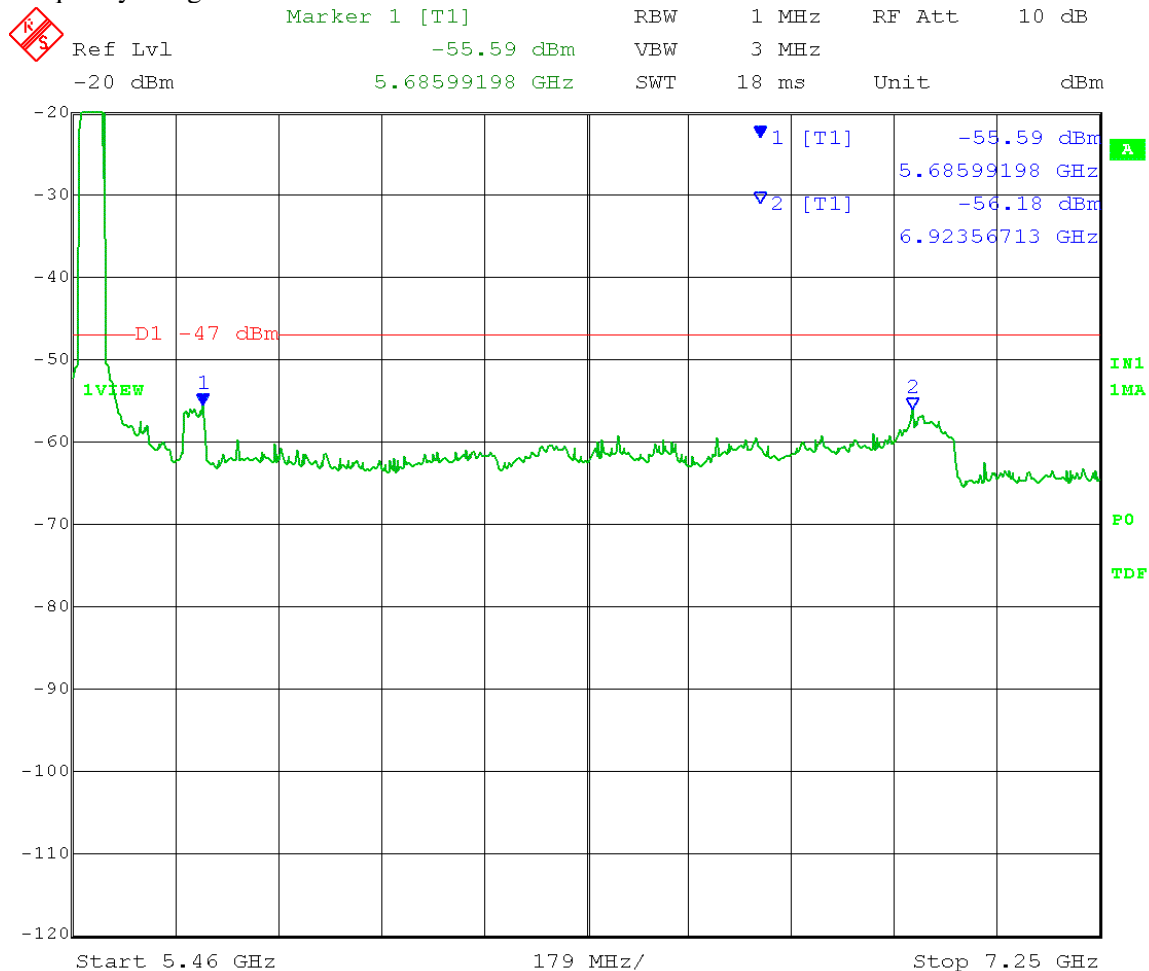
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 12:38:29

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

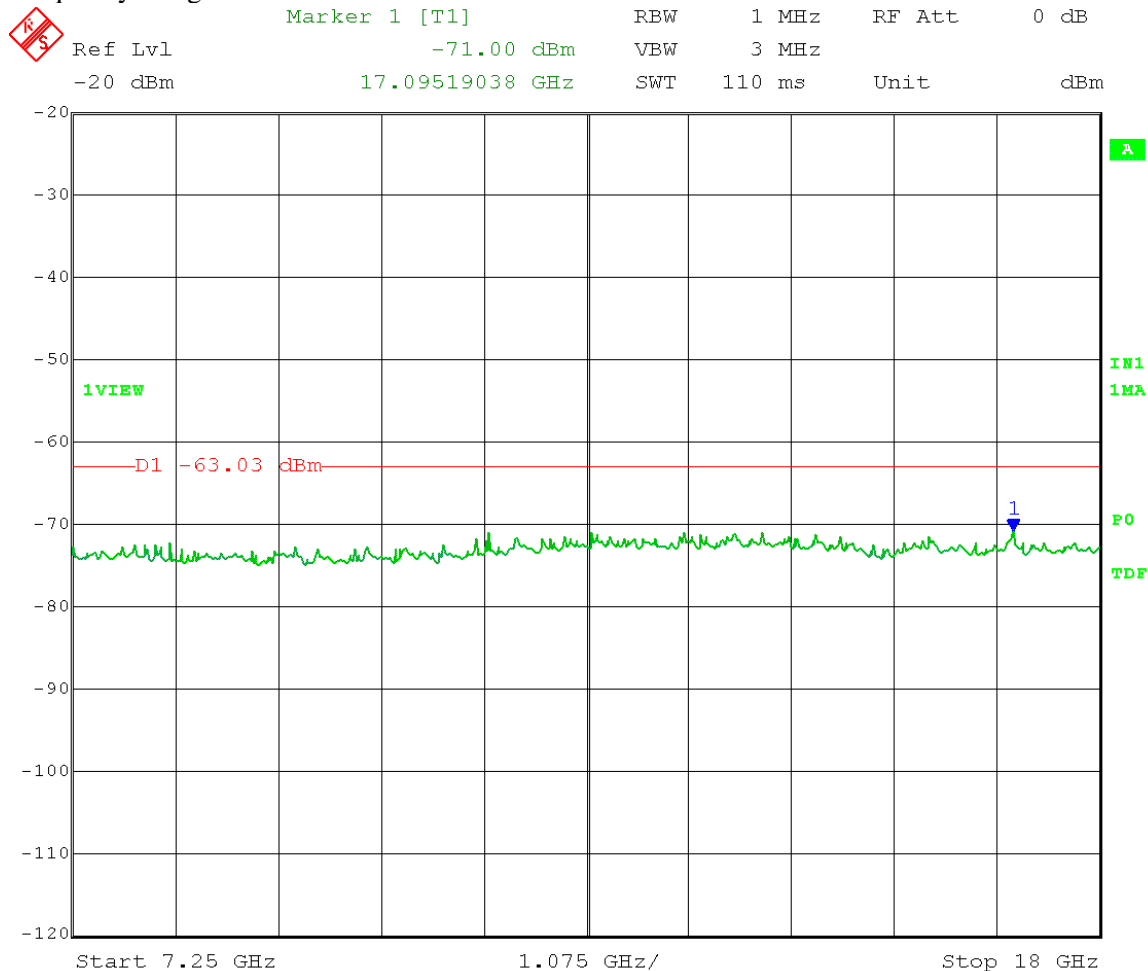
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 13:31:48

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

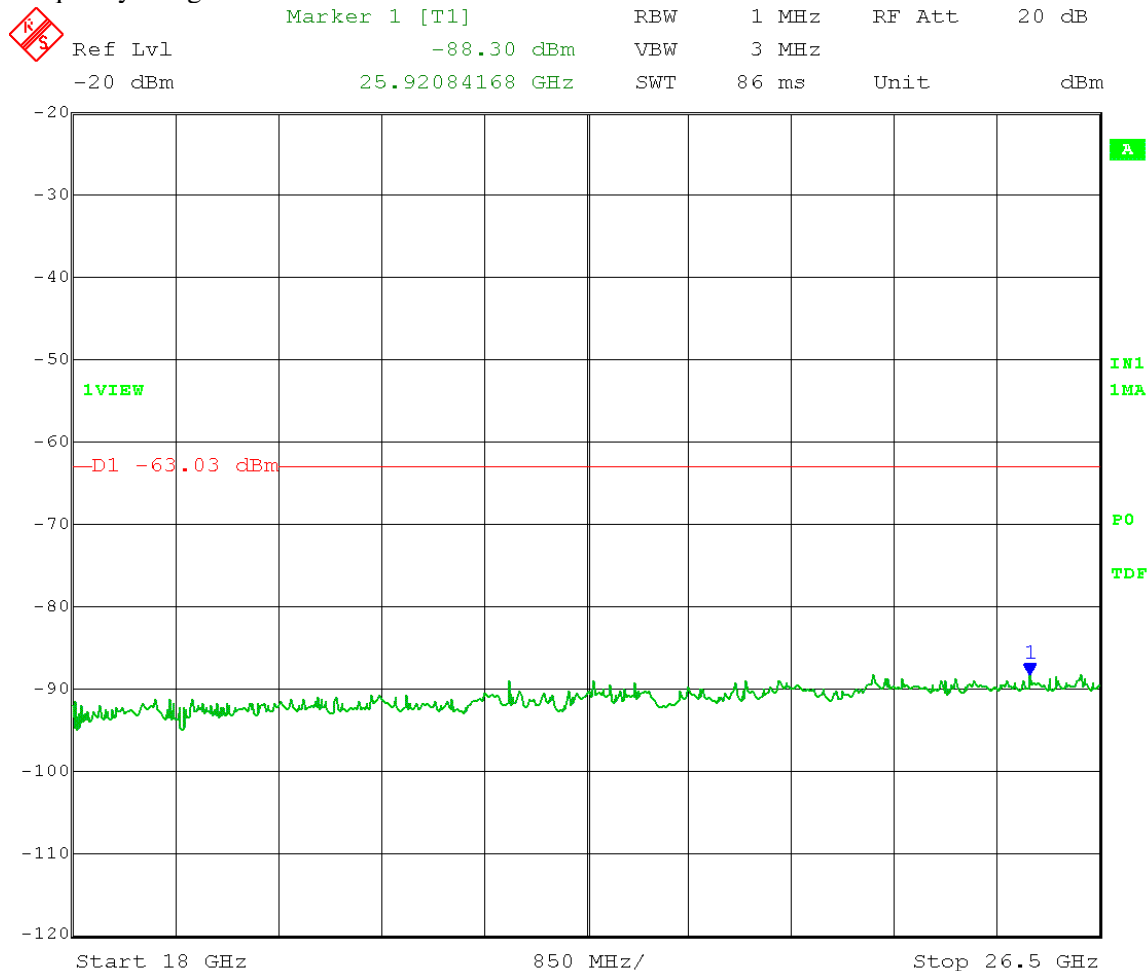
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 14:49:54

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

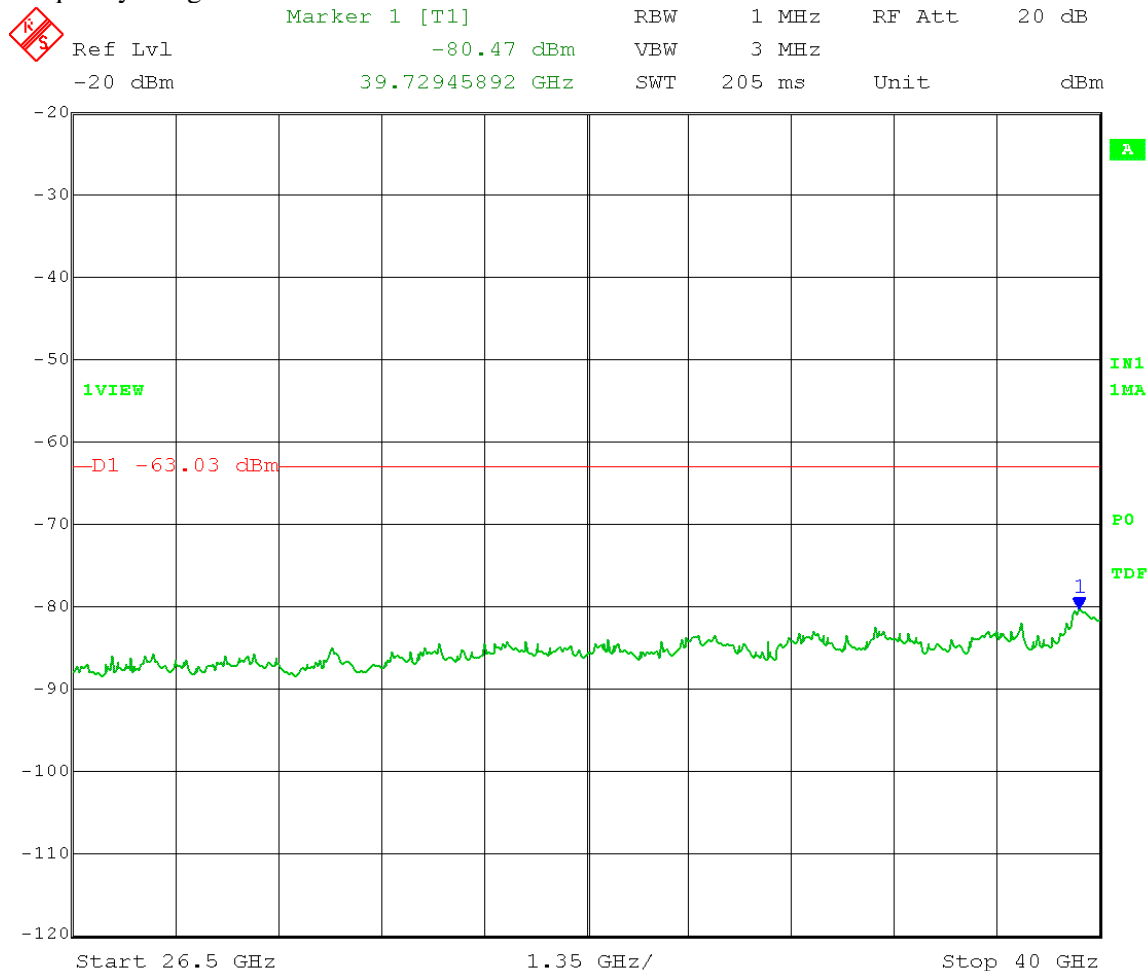
Power setting 13 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 14:52:01

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

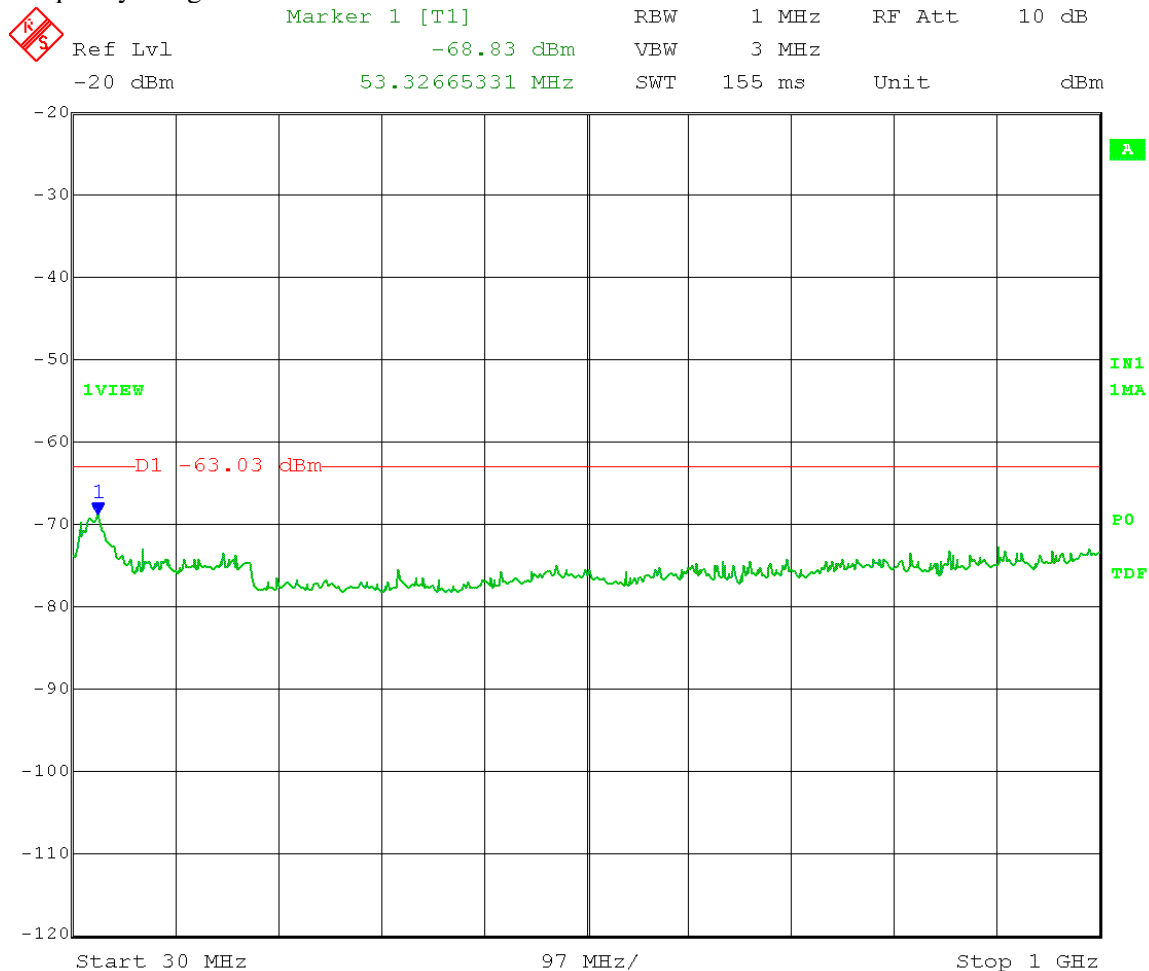
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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

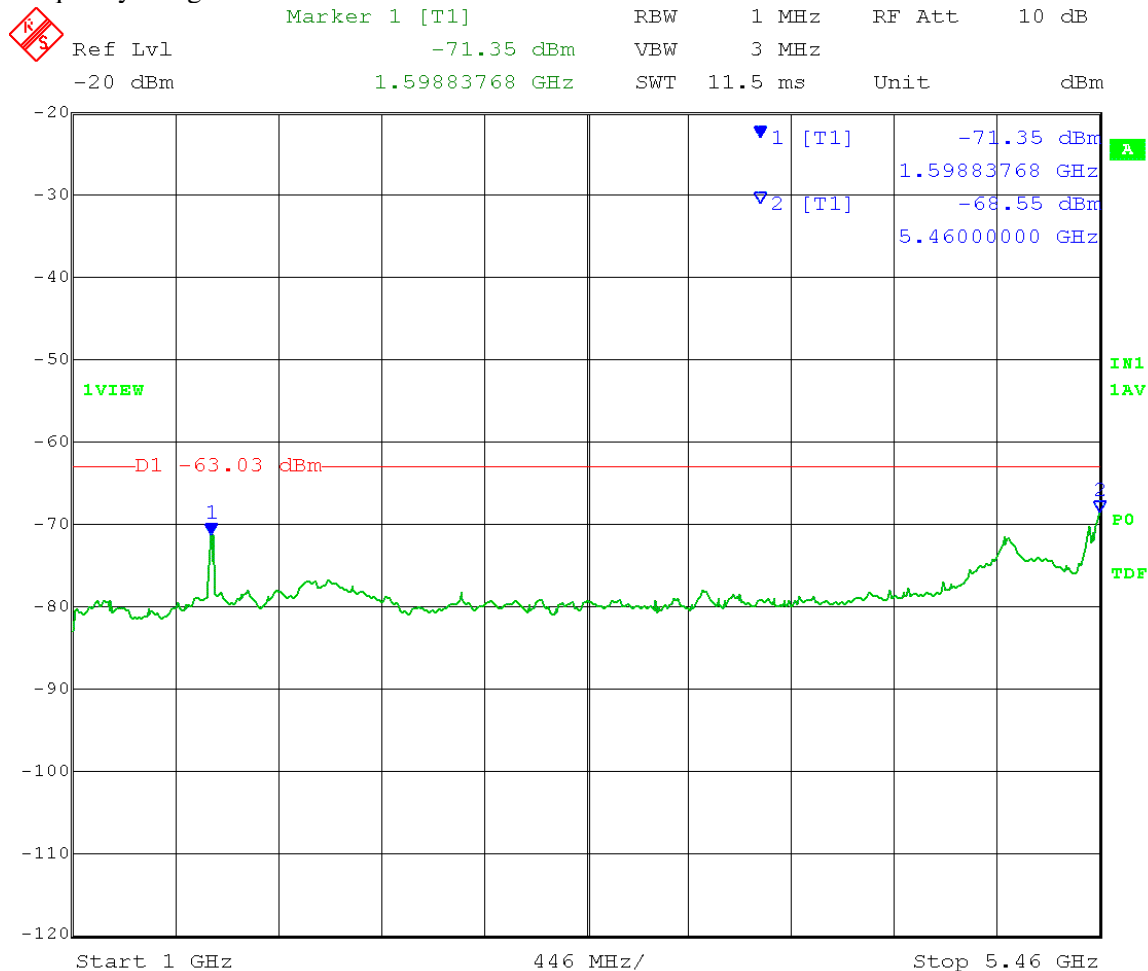
Detector: Average

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

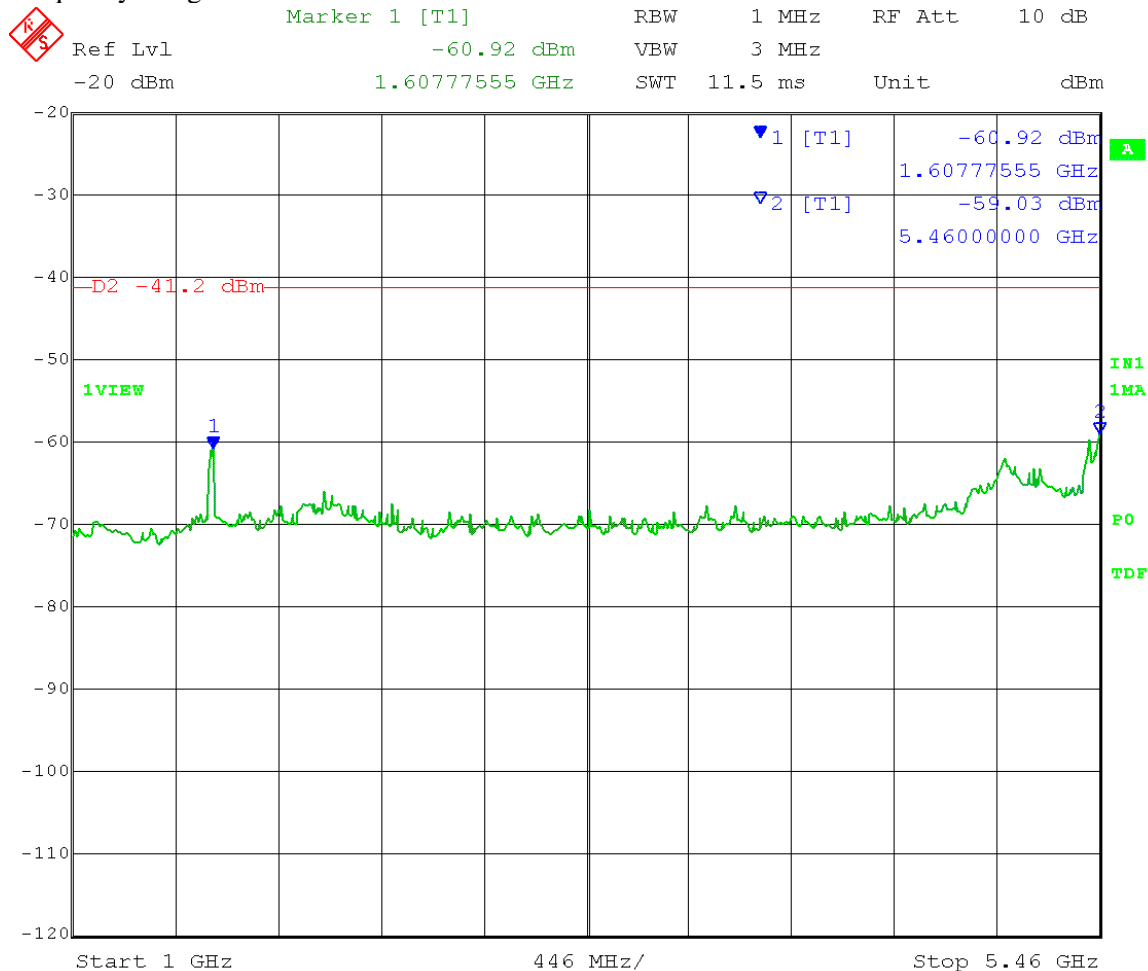
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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

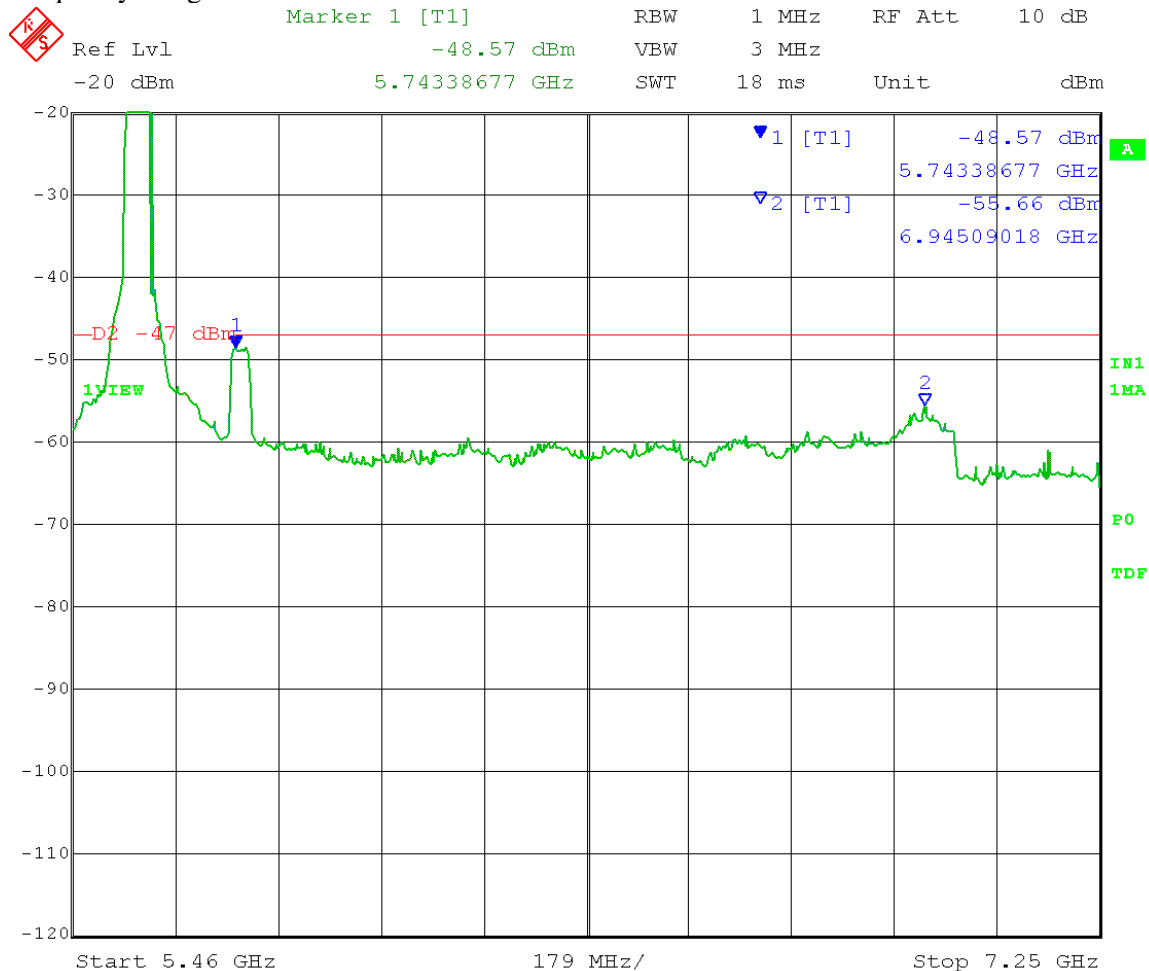
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 14:20:46

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

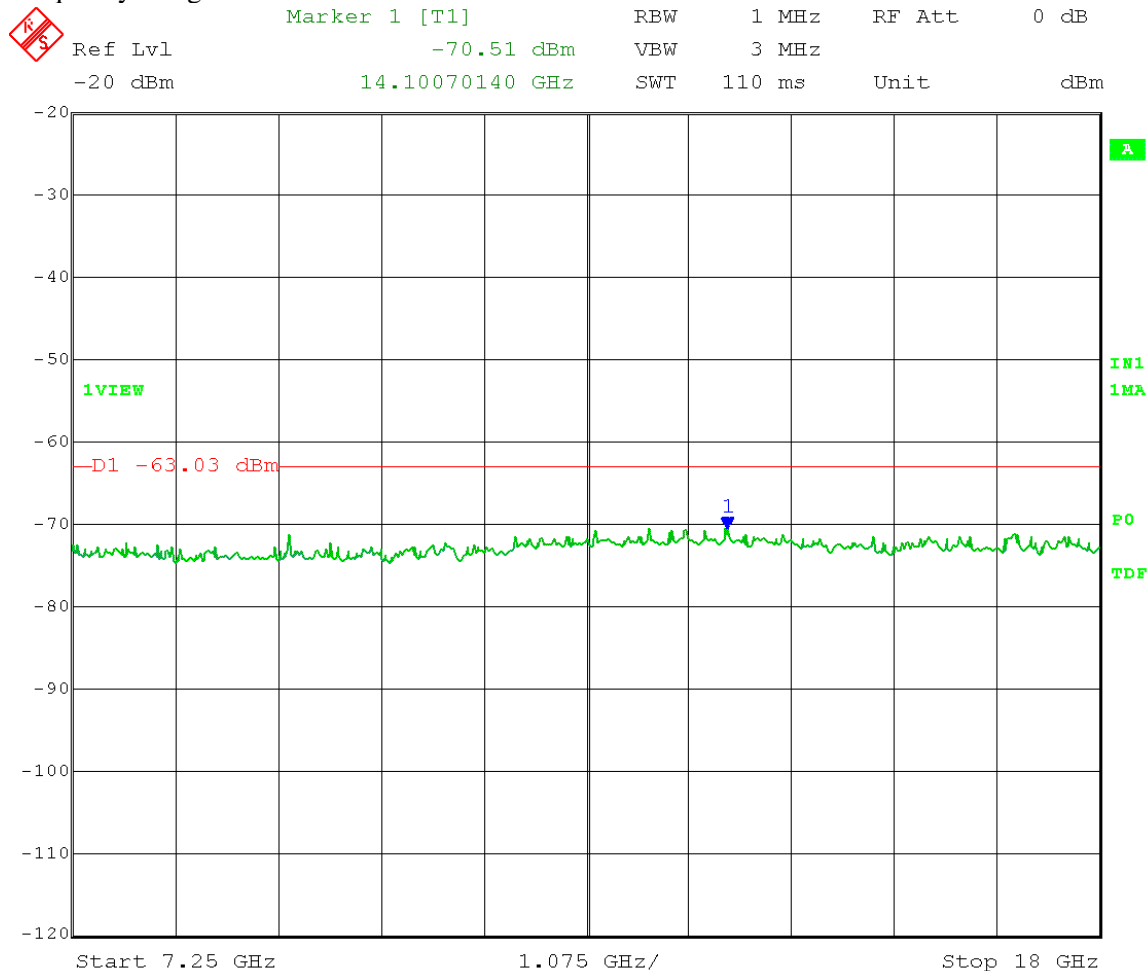
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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

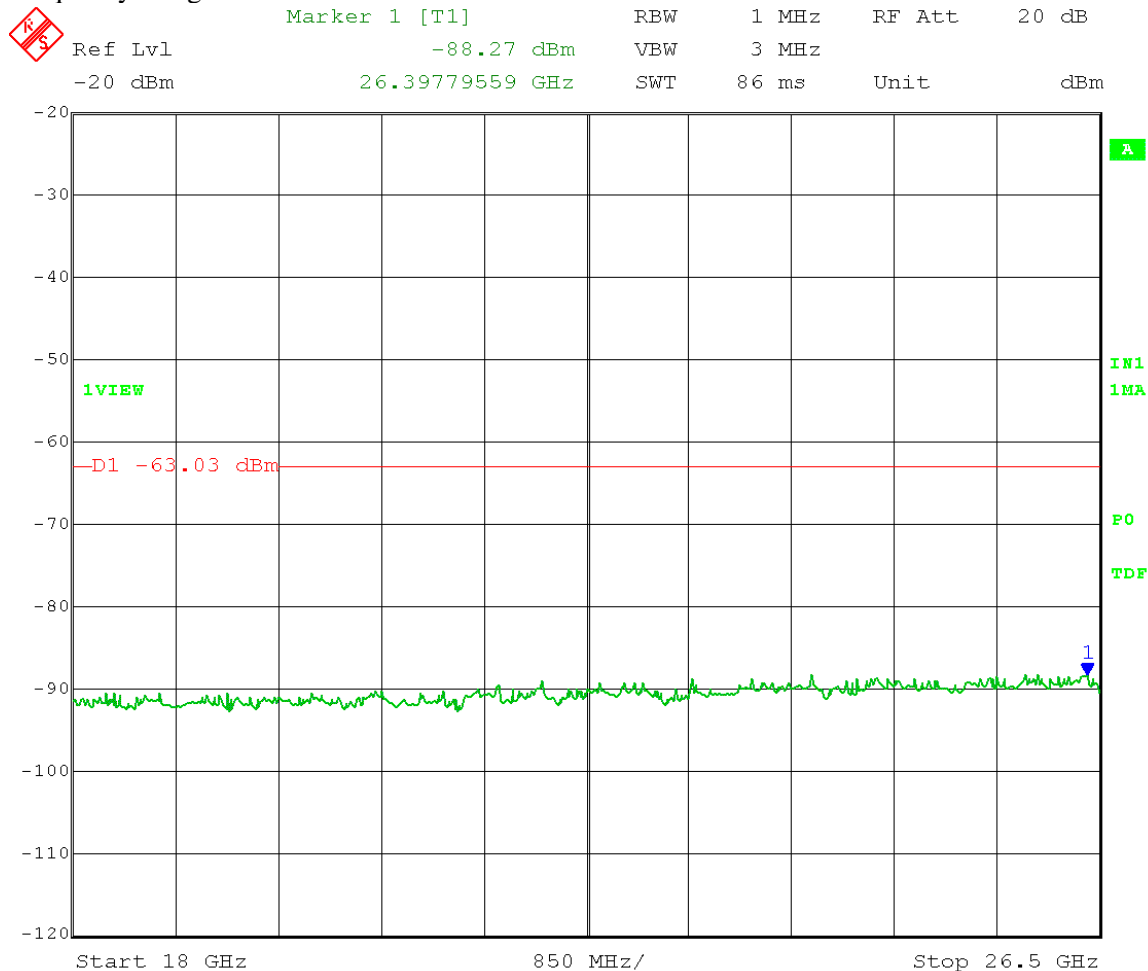
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 14:36:45

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

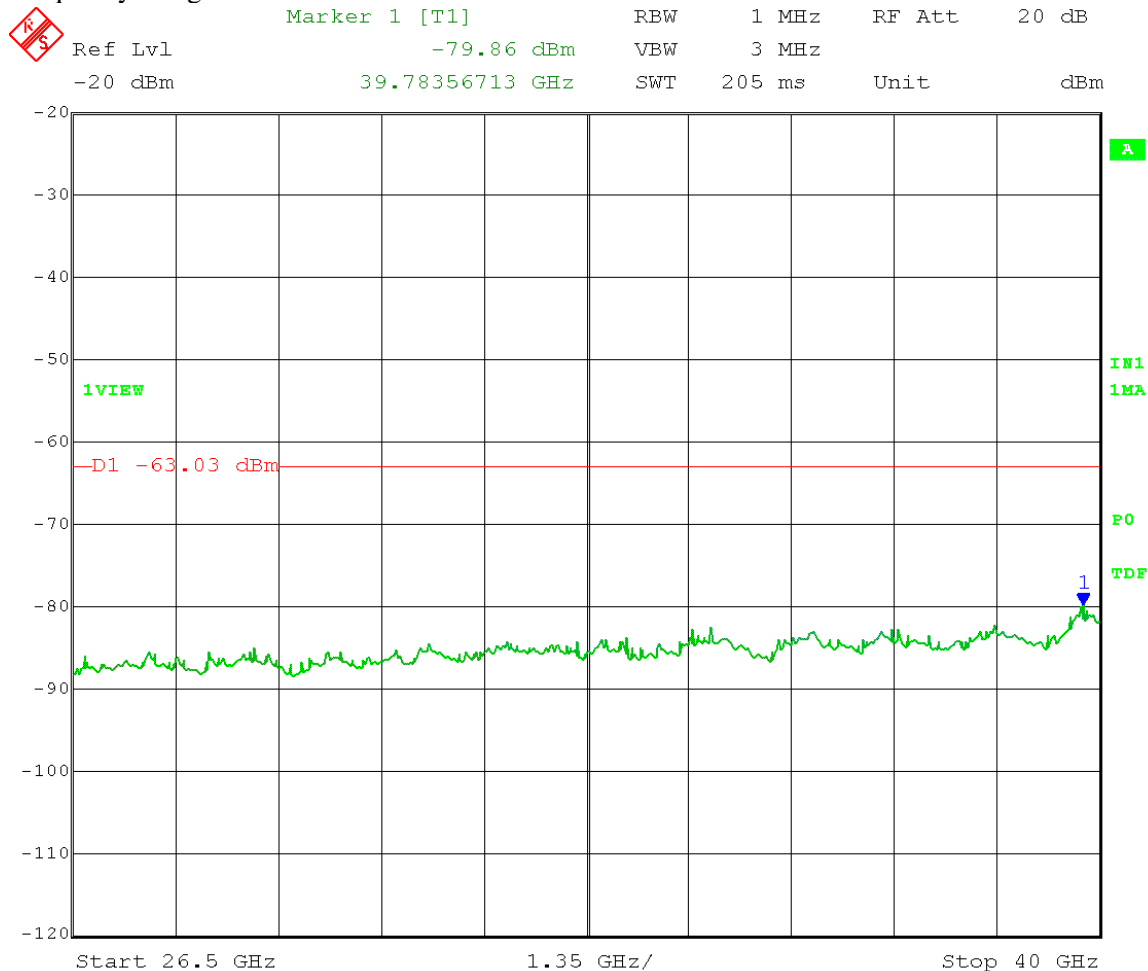
Power setting 21 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 14:38:16

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

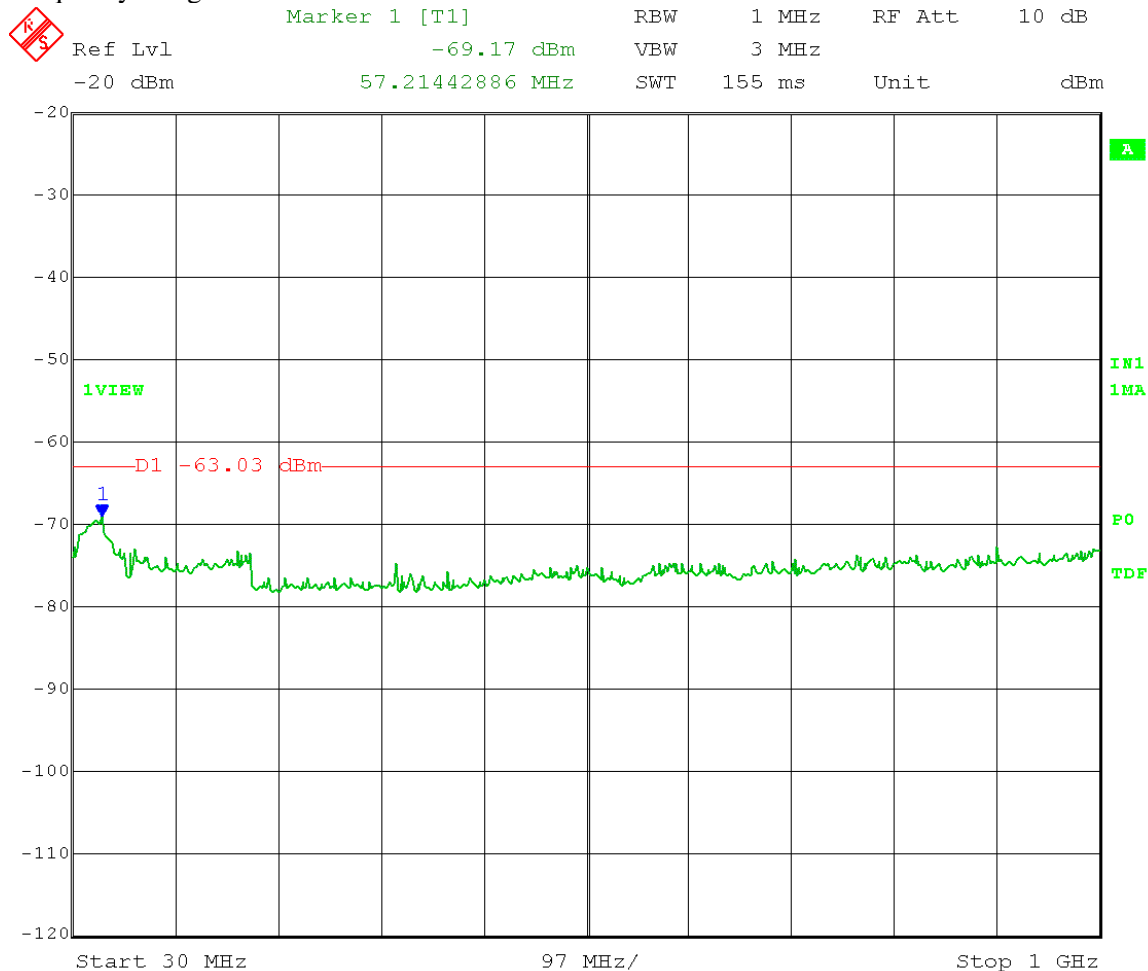
Power setting 14 Port V QPSK
Antenna gain: 17 dBi
Detector: Peak

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



Date: 13.DEC.2016 13:37:39

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

High Channel: Transmit = 5700 MHz

40 MHz BW

Power setting 14 Port V QPSK

Antenna gain: 17 dBi

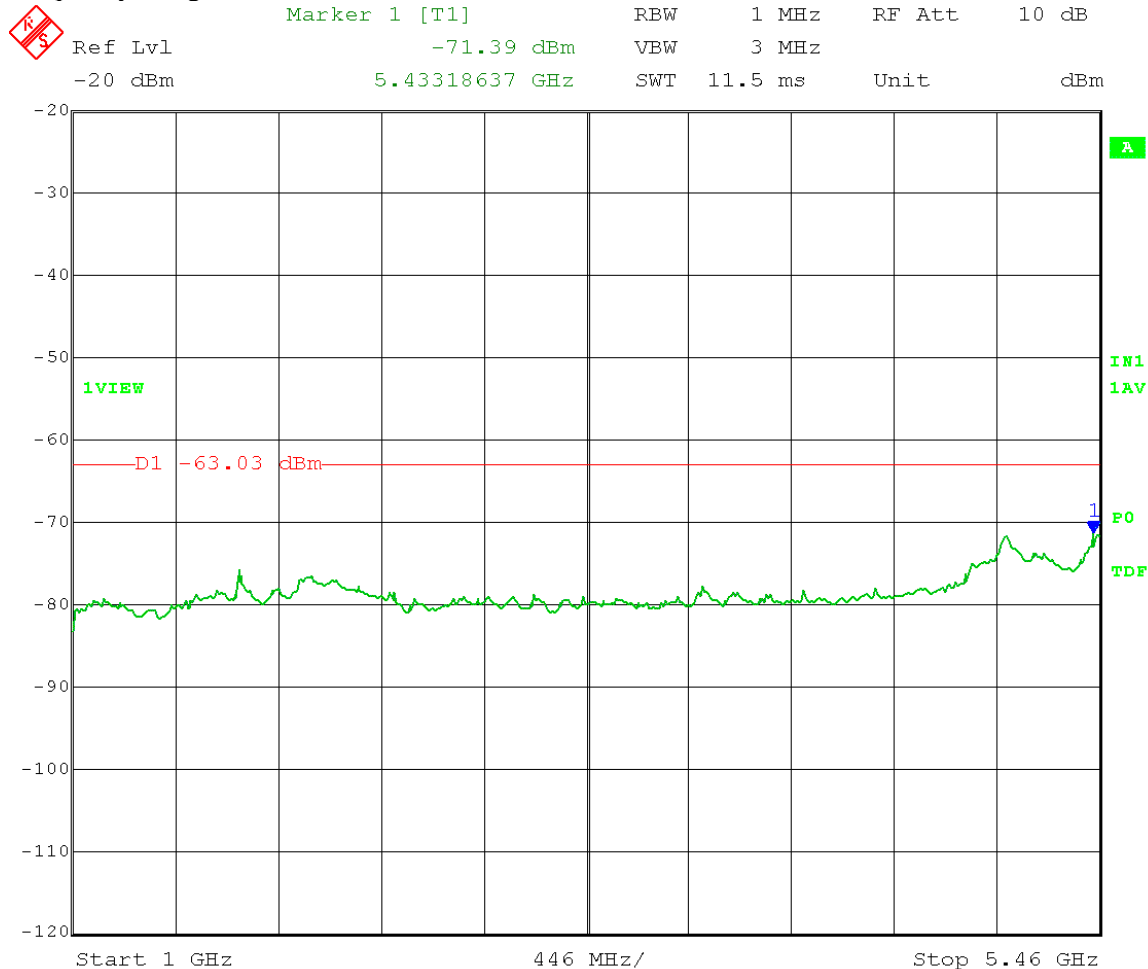
Detector: Average

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

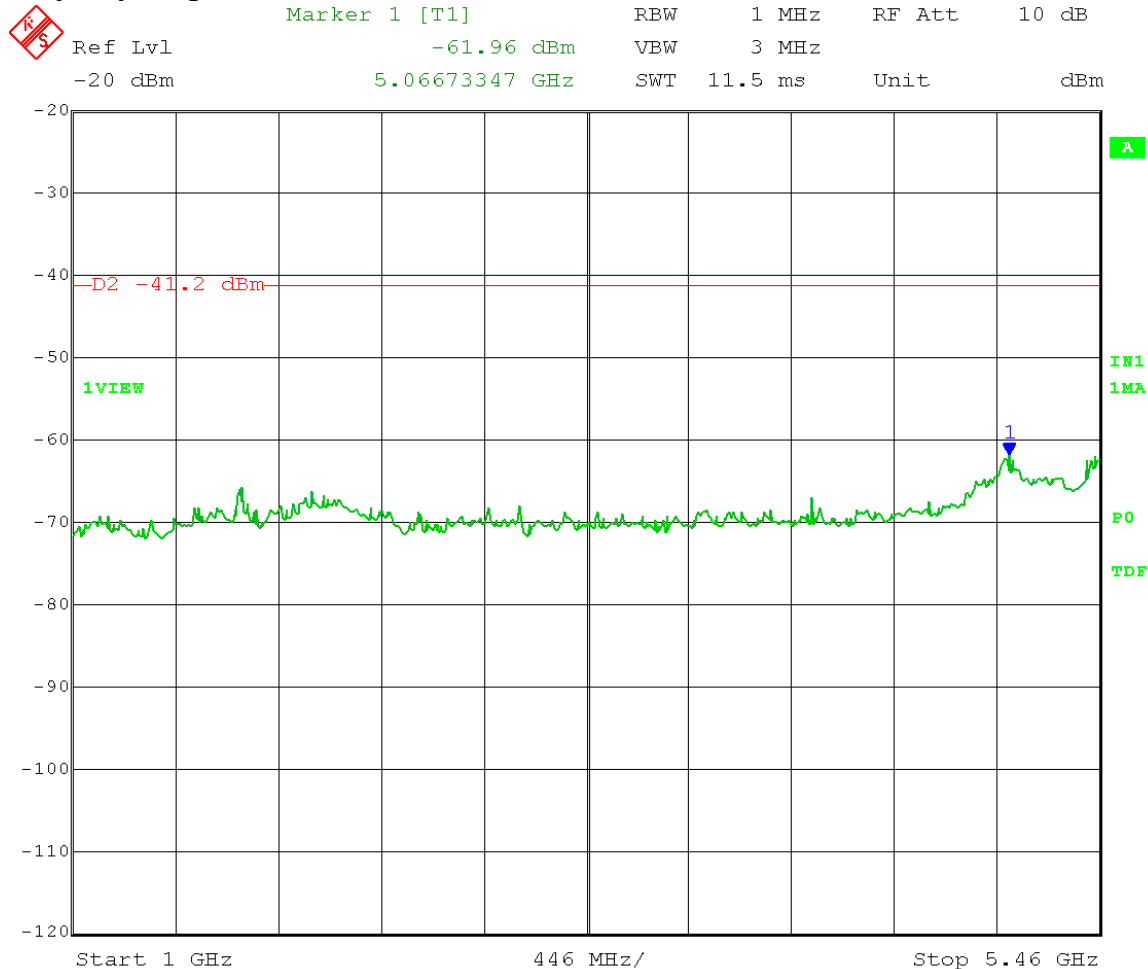
Detector: Peak

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



Date: 13.DEC.2016 14:08:27

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

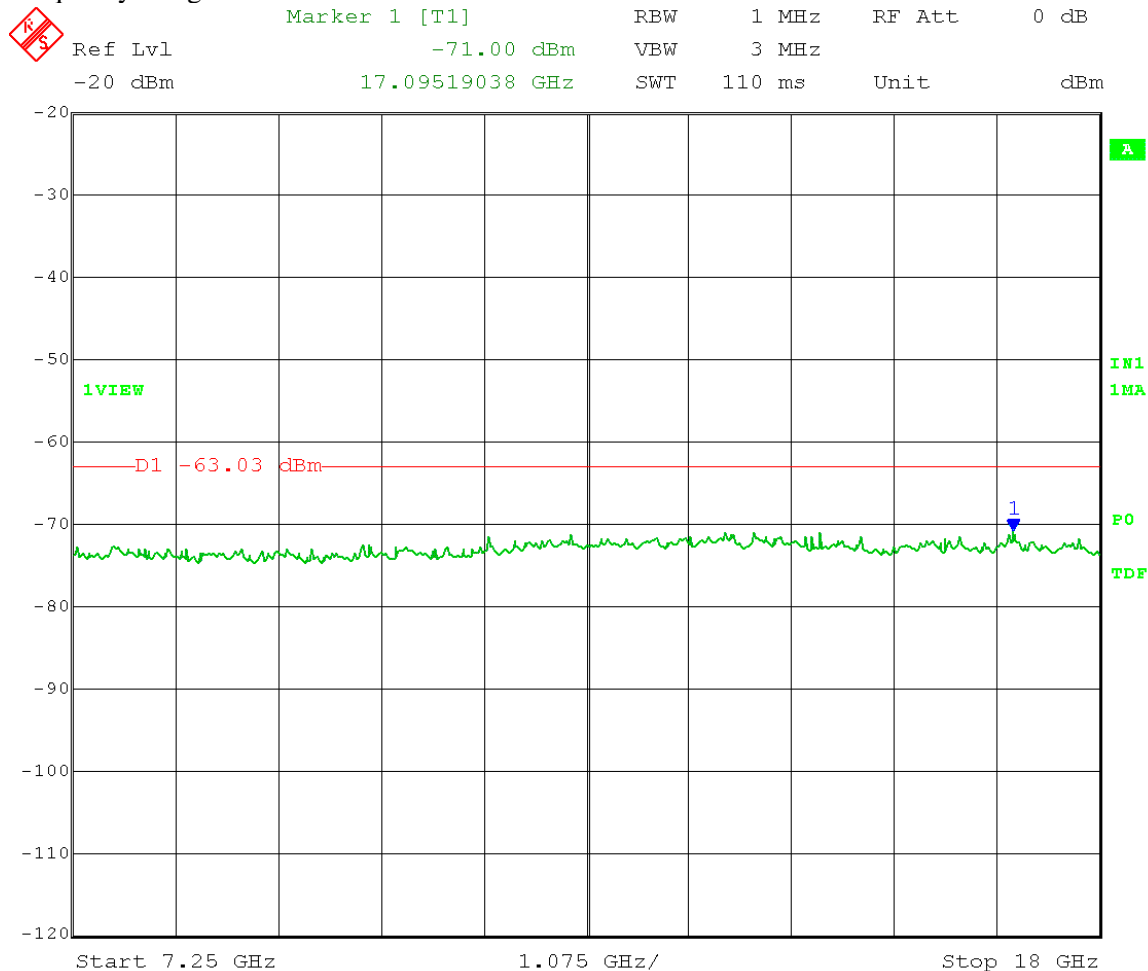
Detector: Peak

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



Date: 13.DEC.2016 14:10:52

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

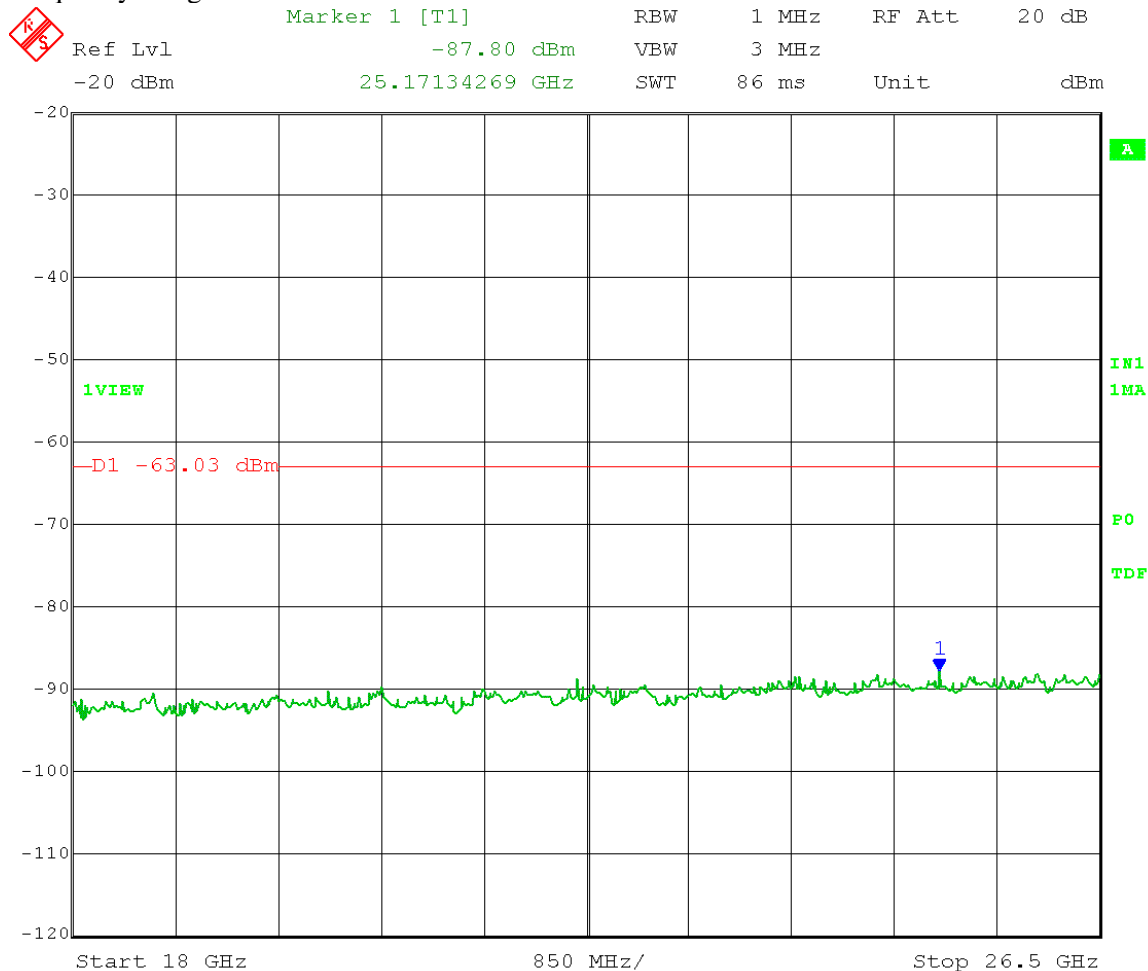
Detector: Peak

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



Date: 13.DEC.2016 14:41:42

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

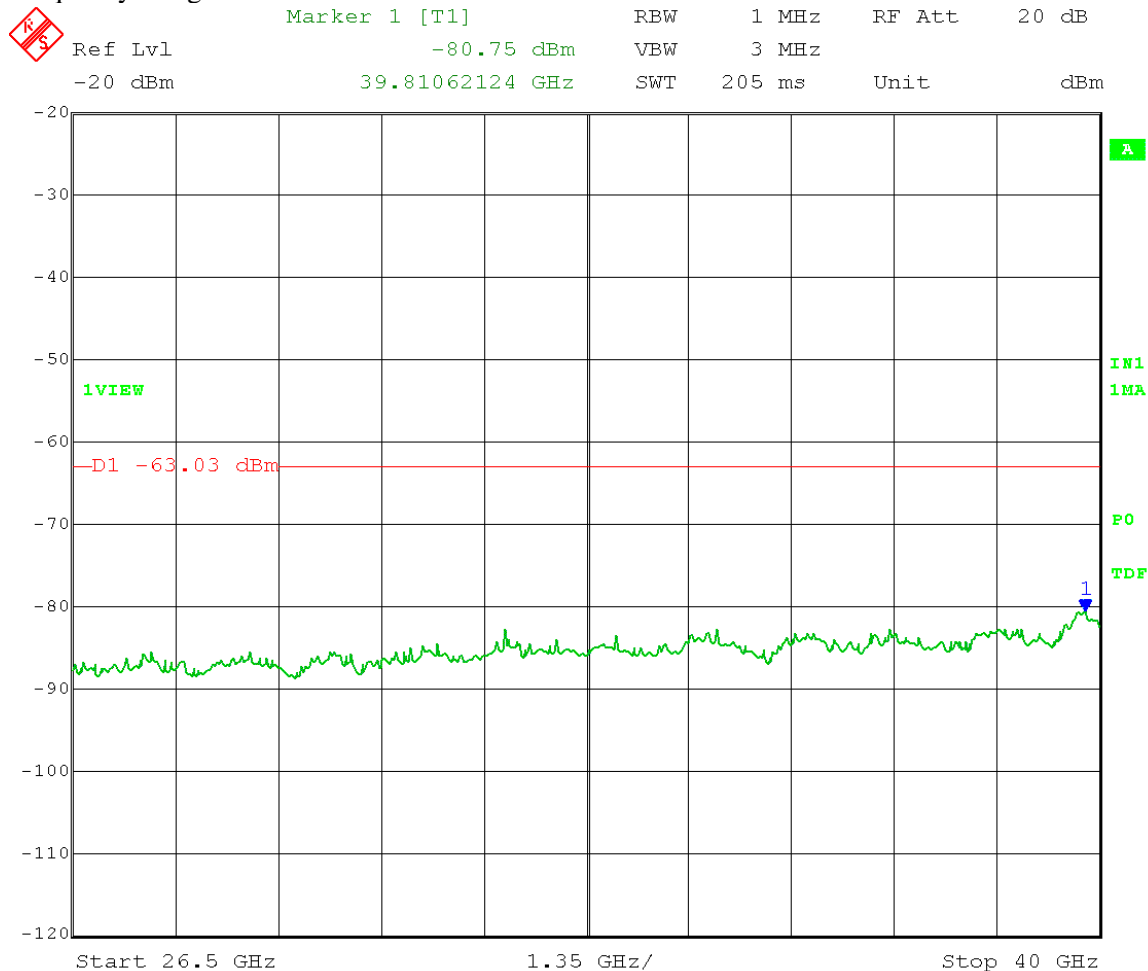
Detector: Peak

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



Date: 13.DEC.2016 14:45:01



166 South Carter, Genoa City, WI 53128

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

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 $\geq$ 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 $\geq$ 3 MHz

Detector = Average (linear)

Trace mode = max hold

EIRP calculation:

$EIRP (dBm) = E + 20 \log (d) - 104.77$

E = field strength in dB μ V/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.

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

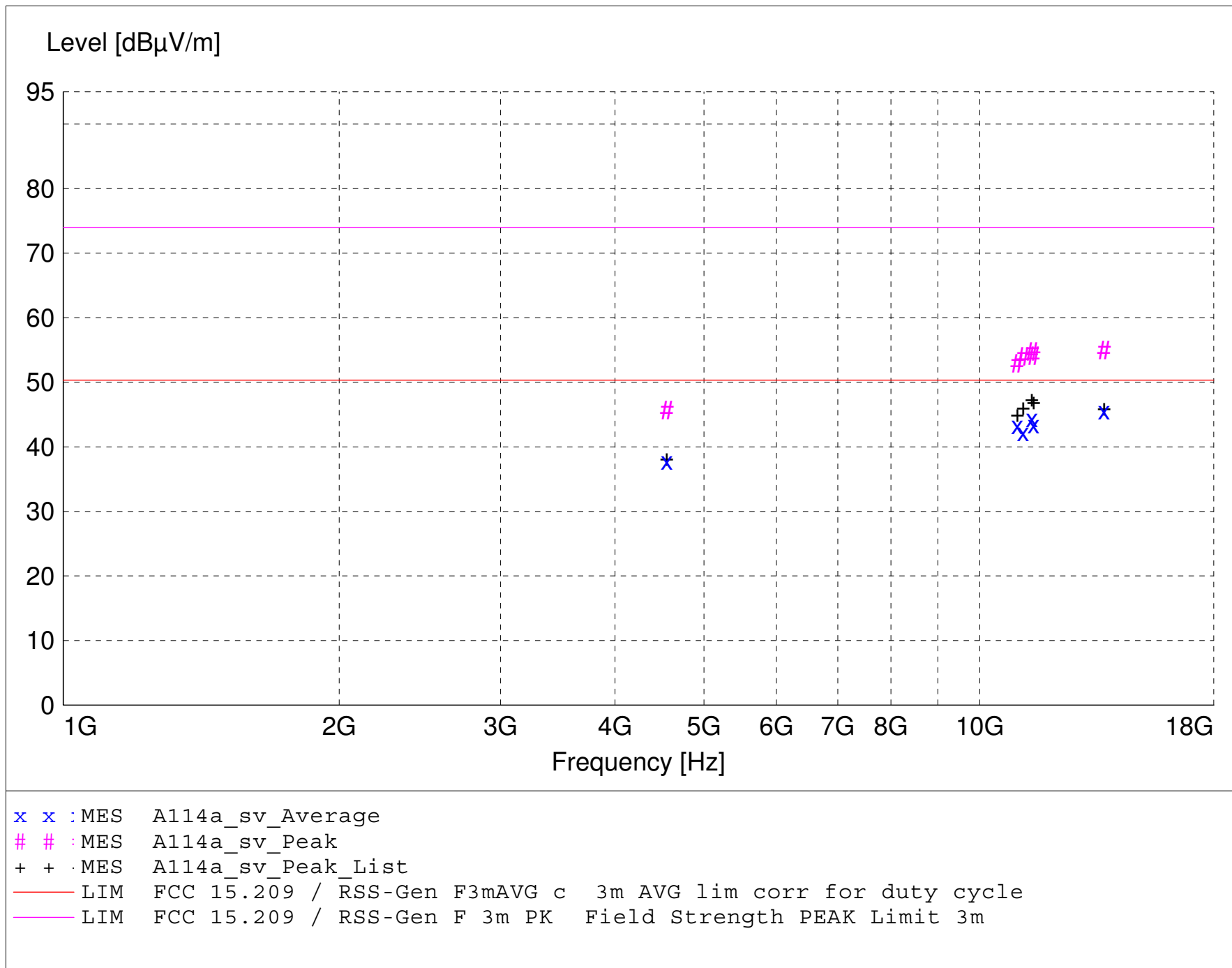
TEXT: "Vert 3 meters"

Short Description: Test Set-up

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

Equations:
$$\text{Total Level (dB}\mu\text{V/m)} = \text{Level (dB}\mu\text{V)} + \text{System Loss (dB)} + \text{Antenna Factor (dB}\mu\text{V/m)}$$
$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

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 detector
Final maximized level using Peak detector



MEASUREMENT RESULT: "A114a_sv_Final"

12/14/2016 9:10AM

Frequency	Level	Antenna	System	Total	Limit	Margin	Height	EuT	Final	Comment
MHz	dBμV	Factor	Loss	Level			Ant.	Angle	Detector	
		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

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

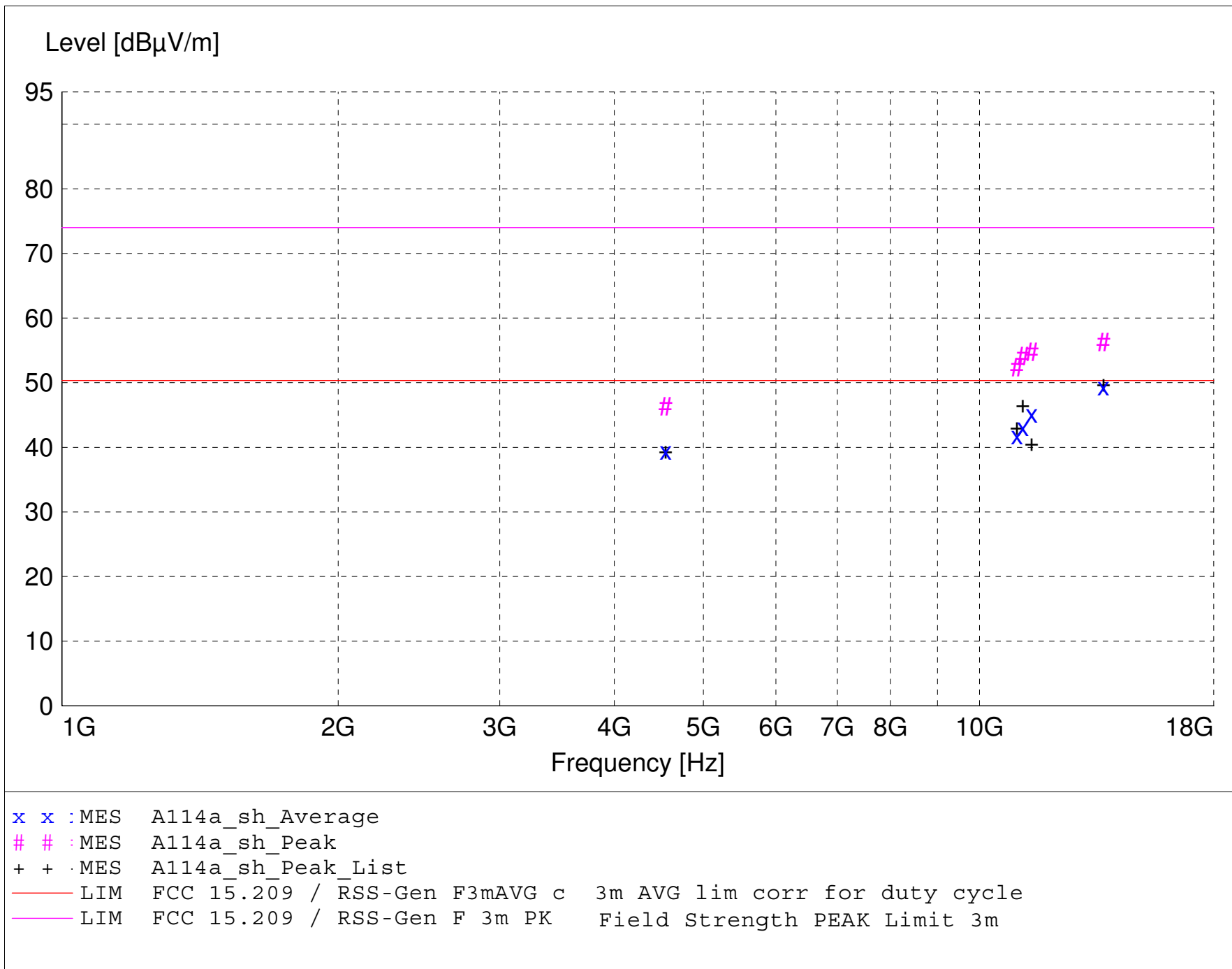
TEXT: "Horz 3 meters"

Short Description: Test Set-up

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

Equations:
$$\text{Total Level (dB}\mu\text{V/m)} = \text{Level (dB}\mu\text{V)} + \text{System Loss (dB)} + \text{Antenna Factor (dB}\mu\text{V/m)}$$
$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

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 detector
Final maximized level using Peak detector



MEASUREMENT RESULT: "A114a_sh_Final"

12/14/2016 10:06AM

Frequency	Level	Antenna	System	Total	Limit	Margin	Height	EuT	Final	Comment
MHz	dBμV	Factor	Loss	Level			Ant.	Angle	Detector	
		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

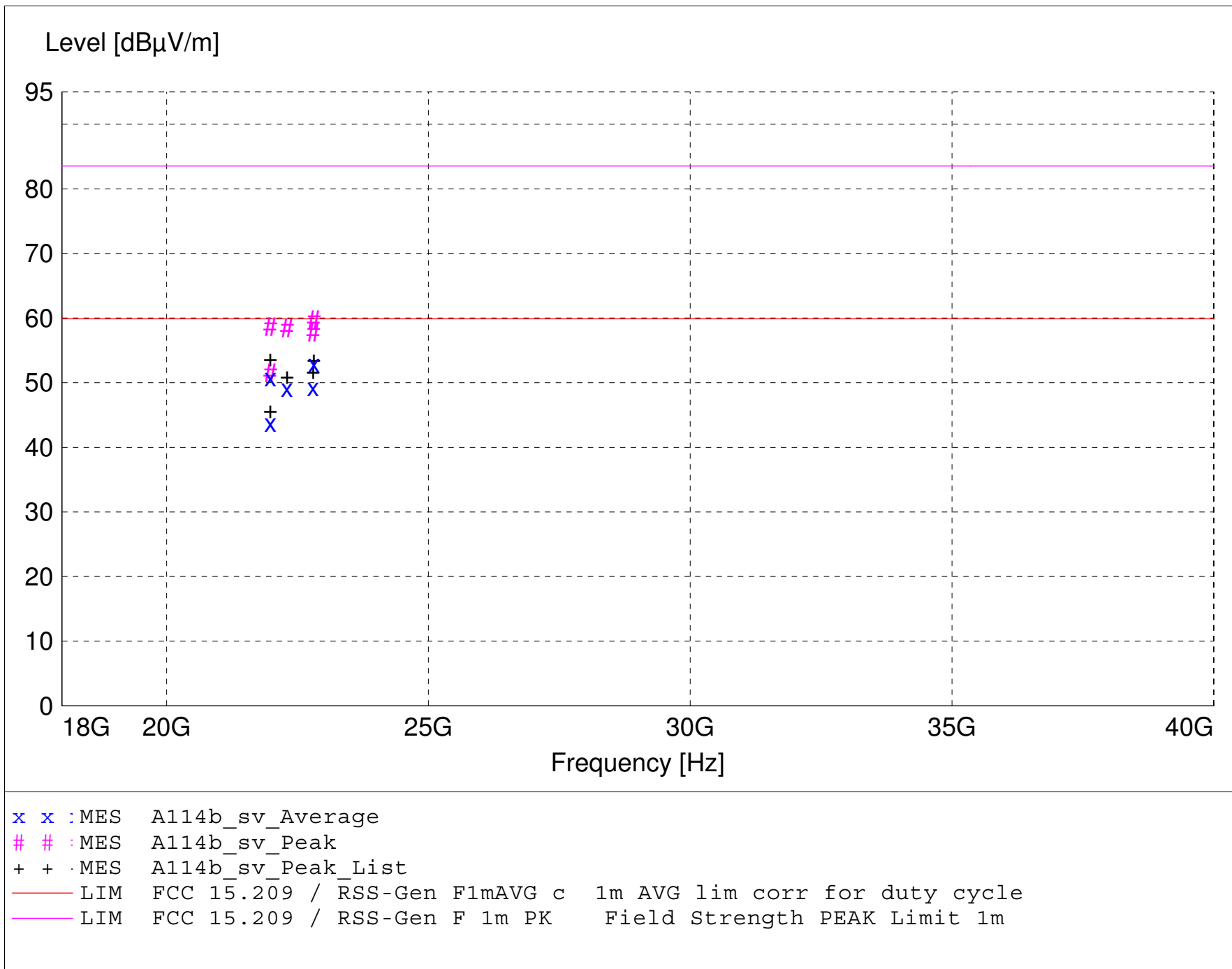
TEXT: "Vert 1 meters"

Short Description: Test Set-up

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

Equations:
$$\text{Total Level (dB}\mu\text{V/m)} = \text{Level (dB}\mu\text{V)} + \text{System Loss (dB)} + \text{Antenna Factor (dB}\mu\text{V/m)}$$
$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

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 detector
Final maximized level using Peak detector



MEASUREMENT RESULT: "A114b_sv_Final"

12/14/2016 11:08AM

Frequency	Level	Antenna	System	Total	Limit	Margin	Height	EuT	Final	Comment
MHz	dBμV	Factor	Loss	Level			Ant.	Angle	Detector	
		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

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

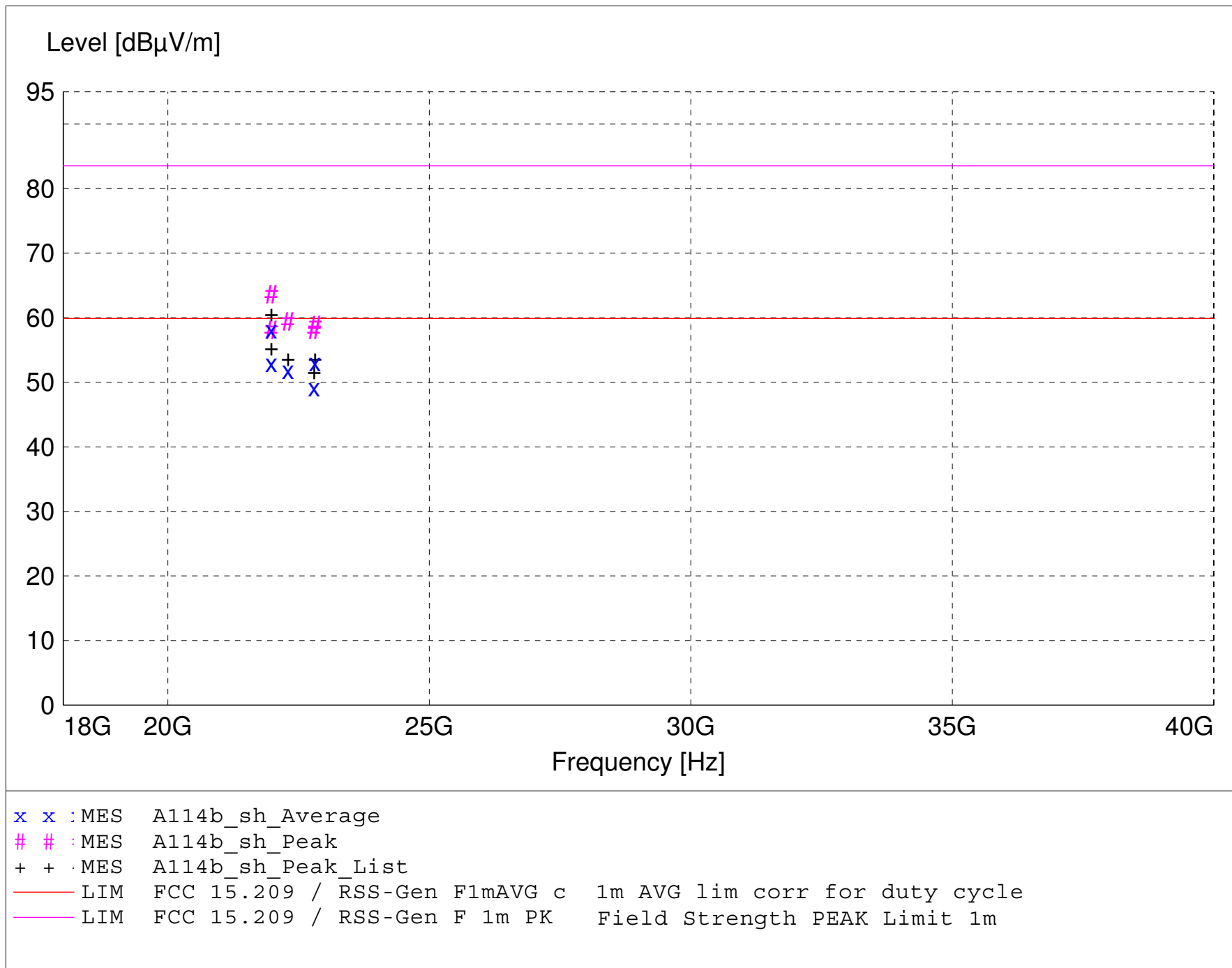
TEXT: "Horz 1 meters"

Short Description: Test Set-up

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

Equations:
$$\text{Total Level (dB}\mu\text{V/m)} = \text{Level (dB}\mu\text{V)} + \text{System Loss (dB)} + \text{Antenna Factor (dB}\mu\text{V/m)}$$
$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

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 detector
Final maximized level using Peak detector



MEASUREMENT RESULT: "A114b_sh_Final"

12/14/2016 12:50PM

Frequency	Level	Antenna	System	Total	Limit	Margin	Height	EuT	Final	Comment
MHz	dBμV	Factor	Loss	Level			Ant.	Angle	Detector	
		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



166 South Carter, Genoa City, WI 53128

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

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 $\geq$ 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**

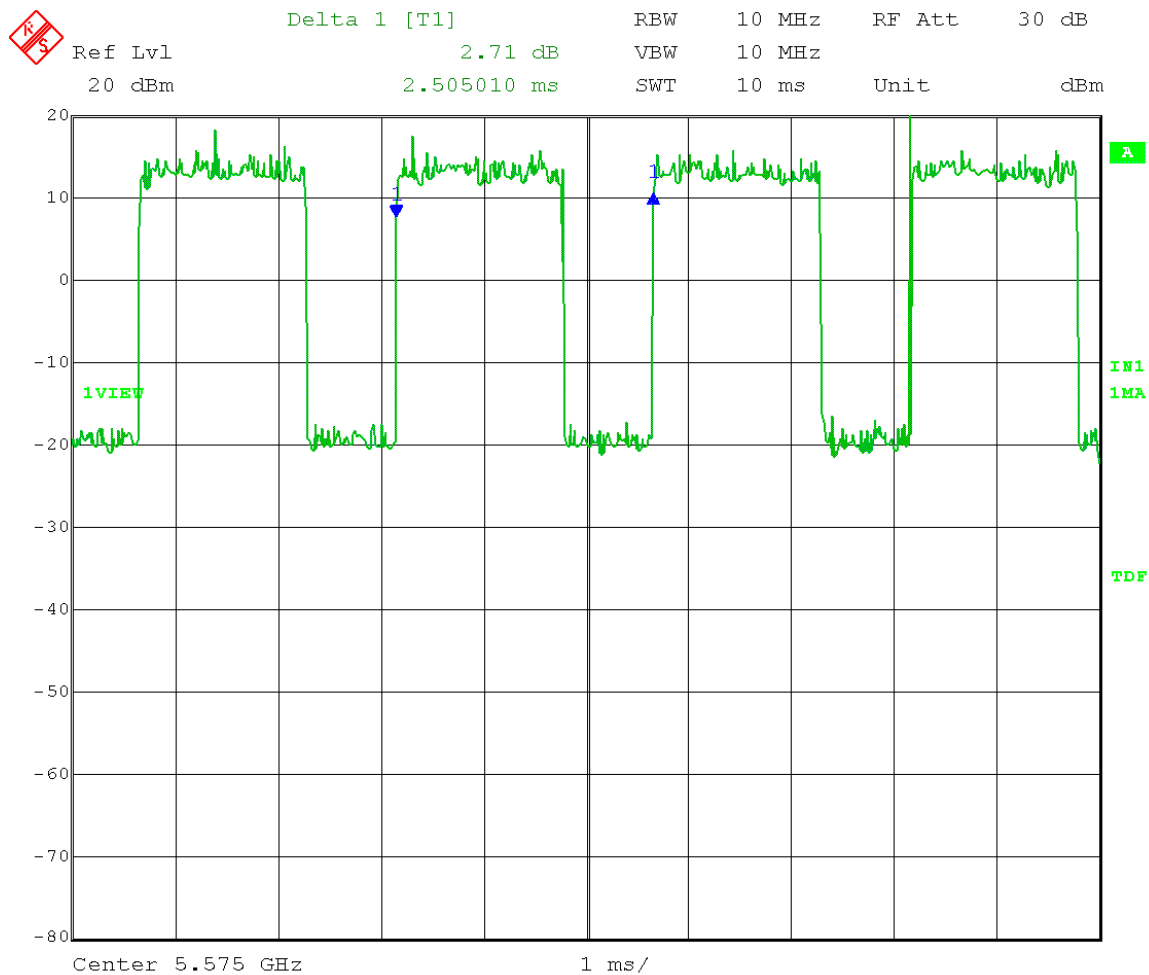
Test Date: 12-13-2016
 Company: Cambium Networks
 EUT: PMP450 5.4GHz AP
 Test: Duty Cycle during testing
 Operator: Craig B
 Comment: ANSI C63.10, 12.2(b)(2) zero-span on spectrum analyzer
 Mid Channel: Transmit = 5575 MHz 40 MHz BW

Duty cycle = (1.643287 ms) / (2.505010 ms) x 100 = 65.6%

Duty cycle correction for power measurements = $10 \log (1/0.656) = 1.83 \text{ dB}$

Duty cycle correction for voltage measurements = $20 \log (1/0.656) = 3.66 \text{ dB}$

Time of one cycle: 2.505010 ms



Date: 13.DEC.2016 09:58:50

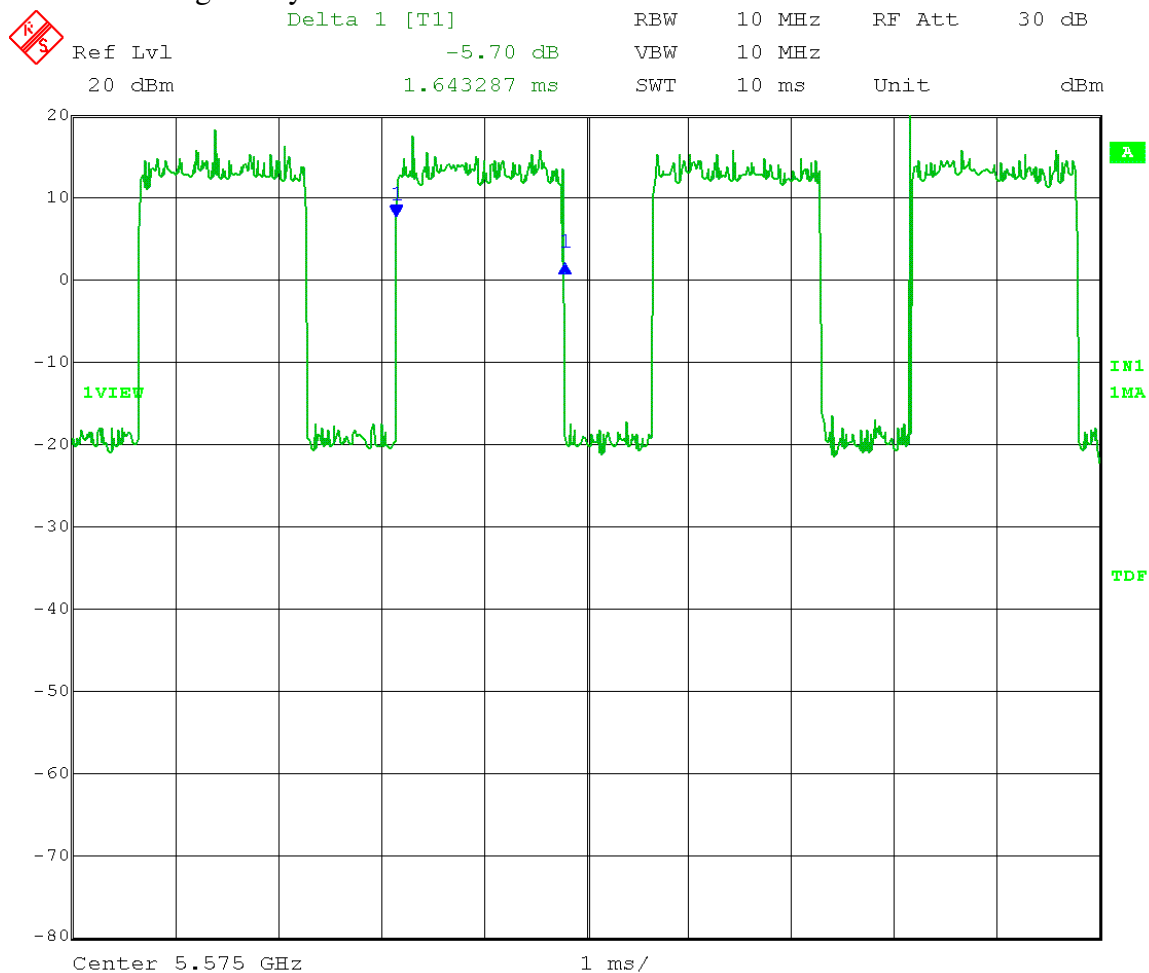
Test Date: 12-13-2016
 Company: Cambium Networks
 EUT: PMP450 5.4GHz AP
 Test: Duty Cycle during testing
 Operator: Craig B
 Comment: ANSI C63.10, 12.2(b)(2) zero-span on spectrum analyzer
 Mid Channel: Transmit = 5575 MHz 40 MHz BW

Duty cycle = (1.643287 ms) / (2.505010 ms) x 100 = 65.6%

Duty cycle correction for power measurements = $10 \log (1/0.656) = 1.83 \text{ dB}$

Duty cycle correction for voltage measurements = $20 \log (1/0.656) = 3.66 \text{ dB}$

ON time during one cycle: 1.643287 ms



Date: 13.DEC.2016 09:59:45



166 South Carter, Genoa City, WI 53128

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

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:
Model Tested:
Report Number:
DLS Project:

Cambium Networks
C054045A001A
22419
8599

END OF REPORT

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