166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C054045C005A
Report Number:	22407
DLS Project:	8600

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: Z8H89FT0001

Formal Name:	PMP450SM 5.4 & 5.7 GHz OFDM Radio with cross-polarized antenna
Kind of Equipment:	Point-to-Point 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 # 18193) 5730 to 5845 MHz (5.7 GHz xcvr reported to the FCC in CFR 47 Part 15 Subpart C Section 15.247 reports # 17831 & 17833)
Test Configuration:	Stand-alone
Model Number(s):	C054045C001A, C054045C002A, C054045C003A, C054045C004A, C054045C005A
Model(s) Tested:	C054045C005A
Serial Number(s):	0A003EA1DD0D
Date of Tests:	December 8-9, 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.

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166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C054045C005A
Report Number:	22407
DLS Project:	8600

SIGNATURE PAGE

Report By:

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Test Engineer

Reviewed By:

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Brian Mattson
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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

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

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 PMP450SM 5.4 & 5.7 GHz OFDM Radio with cross-polarized antenna, Model C054045C005A, 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 PMP450SM 5.4 & 5.7 GHz OFDM Radio with cross-polarized antenna, pursuant to a Class III Permissive Change to FCC ID: Z8H89FT0001. The original device was certified as a 5.7 GHz OFDM Radio with cross-polarized antenna, 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 OFDM Radio with cross-polarized antenna being added to the software package of the device. Original testing of the PMP450SM 5.7 GHz OFDM Radio with cross-polarized antenna 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 # 17831 & 17833.

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 # 18193)

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 8-9, 2016 the PMP450SM 5.4 & 5.7 GHz OFDM Radio with cross-polarized antenna, Model C054045C005A, 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: Z8H89FT0001 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

4.0 Description of Test Sample

Description:

Point-to-Point 5.4 & 5.7 GHz DTS Transceiver with either integrated Patch (9 dBi) and external Cassegrain Lens (9 dBi) antennas or integrated Patch (9 dBi) and Reflector Dish (18 dBi) antennas with 10 MHz, or 20 MHz channel bandwidth. Point-to-Point 5.4 GHz DTS Transceiver with integrated Patch (9 dBi) 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 #18193)
5480 to 5715 MHz (20 MHz bandwidth) (reported to the FCC in report #18193)

5730 to 5845 MHz (5.7 GHz xcvr reported to the FCC in reports # 17831 & 17833)

4.0 Description of Test Sample (continued)

Physical Dimensions of Equipment Under Test:

Length: 10 in x Width: 3 in x Height: 1 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 (Switching Power Supply Frequencies)
25 MHz, 20 MHz

Transmit / Receive Frequencies Used For Test Purpose:

40 MHz Channel Bandwidth: Low channel: 5490 MHz, 5495 MHz
Middle channel: 5575 MHz,
High channel: 5705 MHz, 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	84010124001 P6
Patch Antenna	85015000001
2 x Connector (for test unit only)	0989419C01

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
Preamp	Ciao	CA118-4010	101	1GHz-18GHz	1-20-16	1-20-17
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 27% 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.

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.

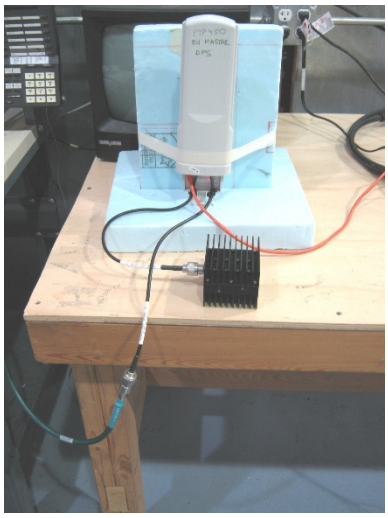
11.0 Conclusion

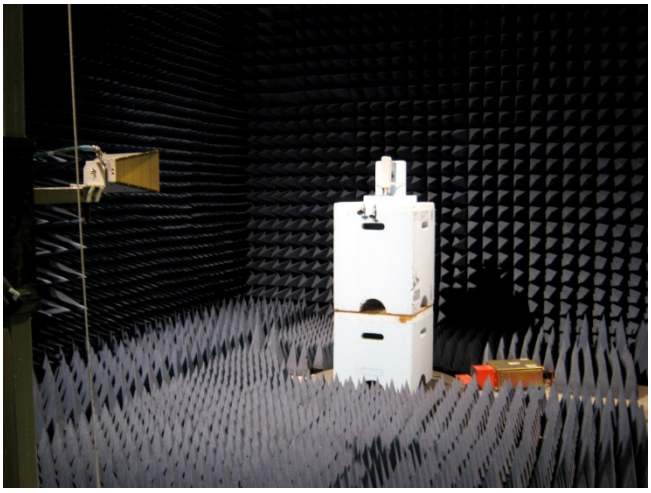
Dynamic Frequency Selection (DFS) testing was not performed by DLS Electronic Systems,Inc. Otherwise, the PMP450SM 5.4 & 5.7 GHz OFDM Radio with cross-polarized antenna, Model C054045C005A, as provided from Cambium Networks tested on December 8-9, 2016 **meets** the requirements of CFR 47 Part 15 Subpart E Section 15.407, to have 5.4 GHz 40 MHz channel bandwidth added to FCC ID: Z8H89FT0001 as a Class III Permissive Change.

Appendix A – Test Setup Photos

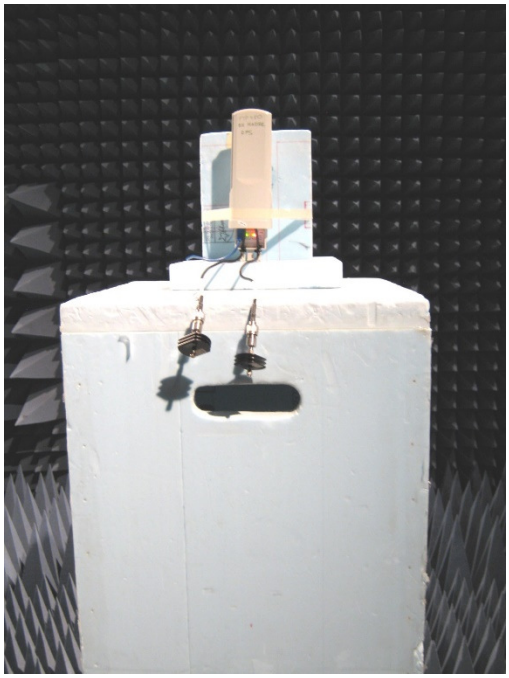
PMP450SM 5.4 & 5.7 GHz OFDM Radio
Cat 5e Power-Over-Ethernet cable (power supply to radio). (10 meter un-shielded with plastic connectors)
Cat 5e Ethernet data cable (power supply to computer). (1.5 meter un-shielded with plastic connectors)
Phihong power supply model: PSA15M-300(SM)

RF Conducted

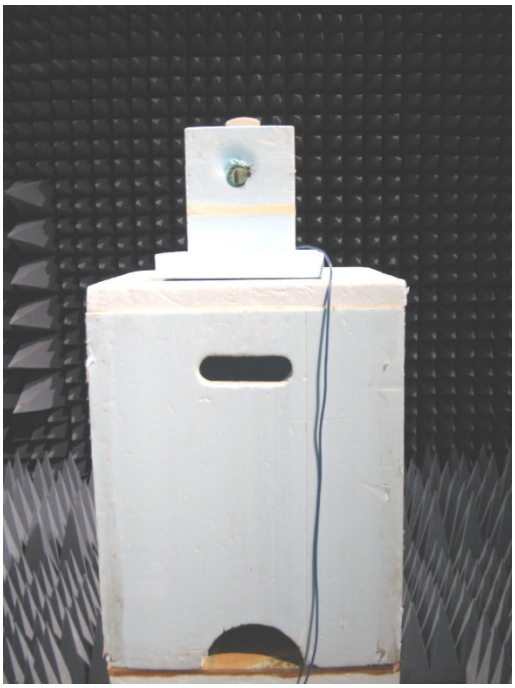




Radiated – front



Radiated – back



Radiated – above 1 GHz

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.

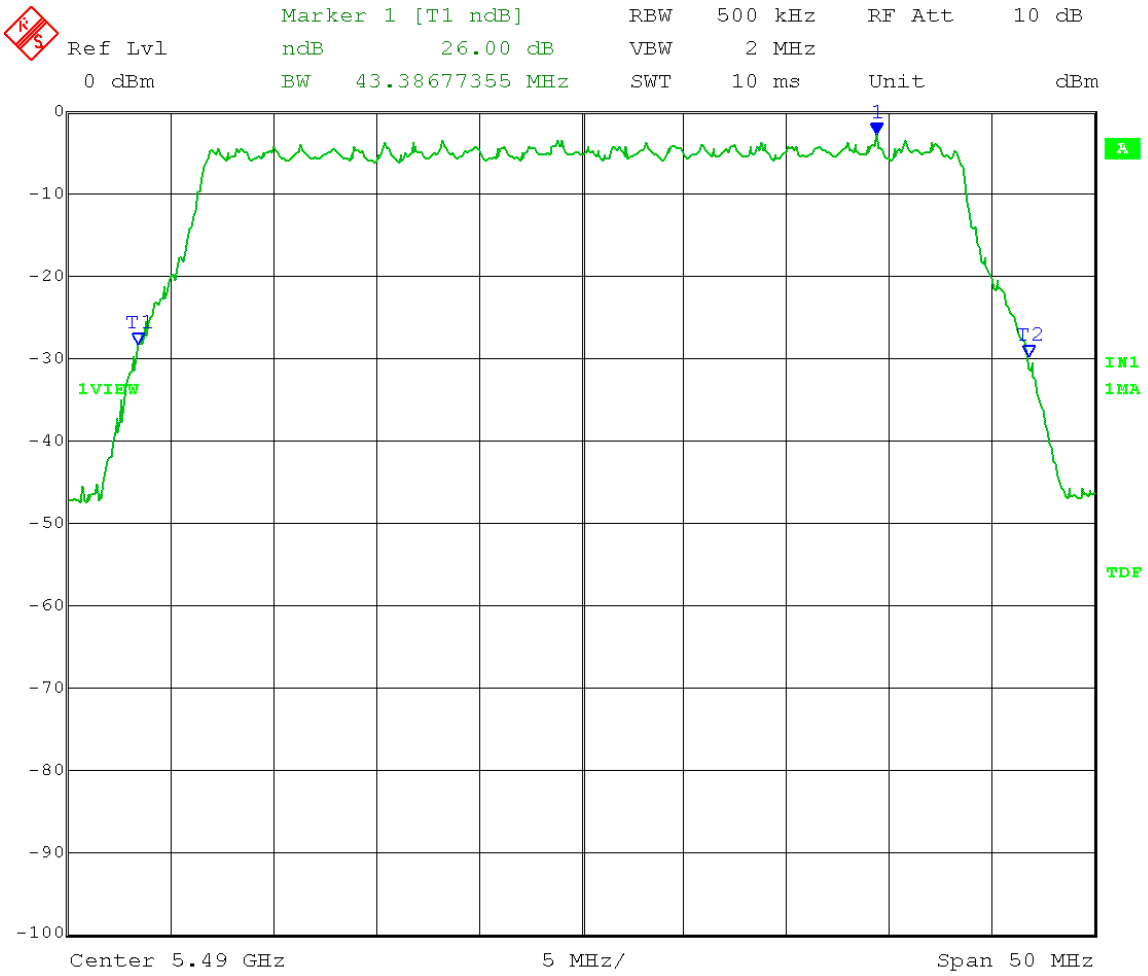
Limit: Informative

Notes: Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with 64% duty cycle.

The low channel was measured at 5490 MHz and the high channel was measured at 5705 MHz. It was later determined that the low channel frequency had to be changed to 5495 MHz and the high channel frequency had to be changed to 5700 MHz to pass the band-edge emission level requirement.

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: 26 dB Emission Bandwidth
Operator: Craig B
Comment: ANSI C63.10, 12.4.1
Low Channel: Transmit = 5490 MHz 40 MHz BW
Power setting 22 Port B QPSK

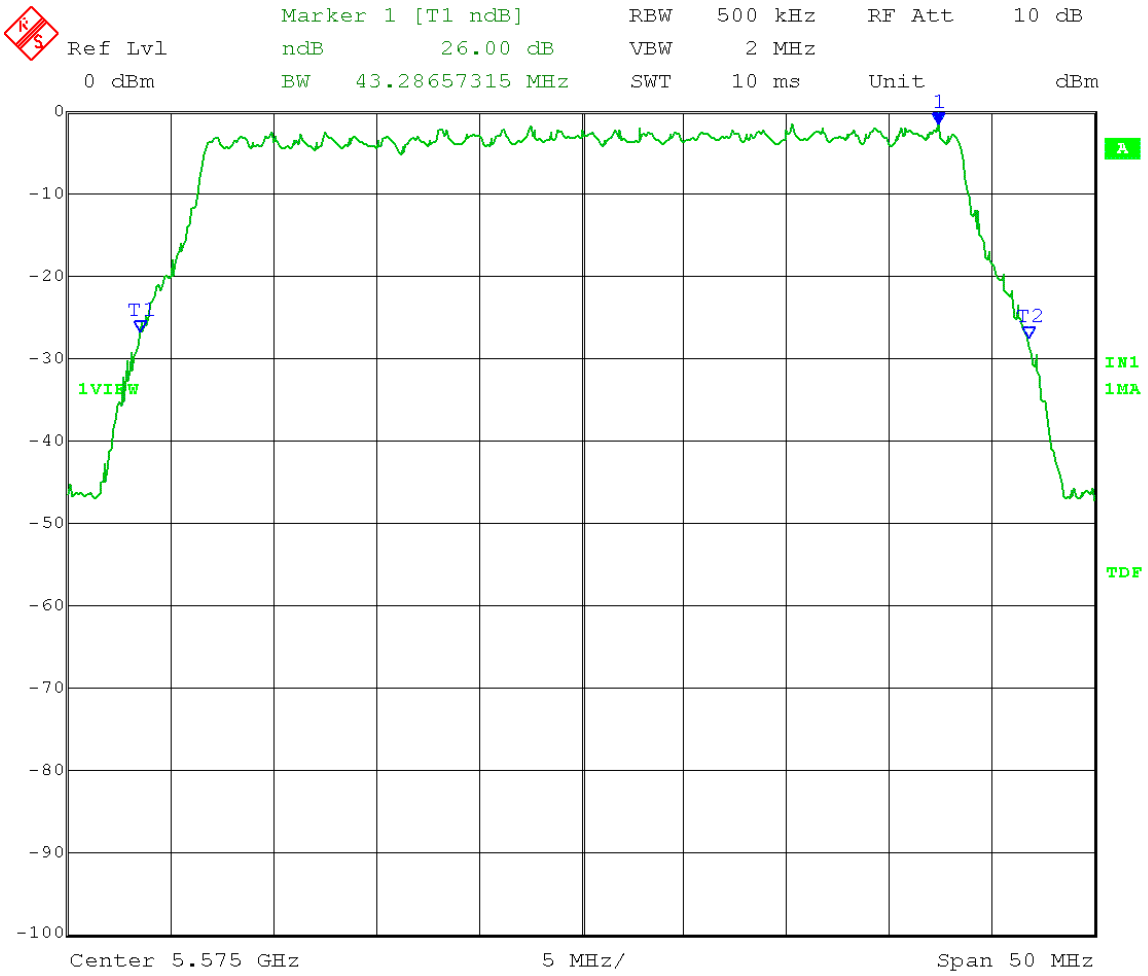
26 dB Emission Bandwidth = 43.4 MHz



Date: 8.DEC.2016 10:45:20

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 22 Port B QPSK

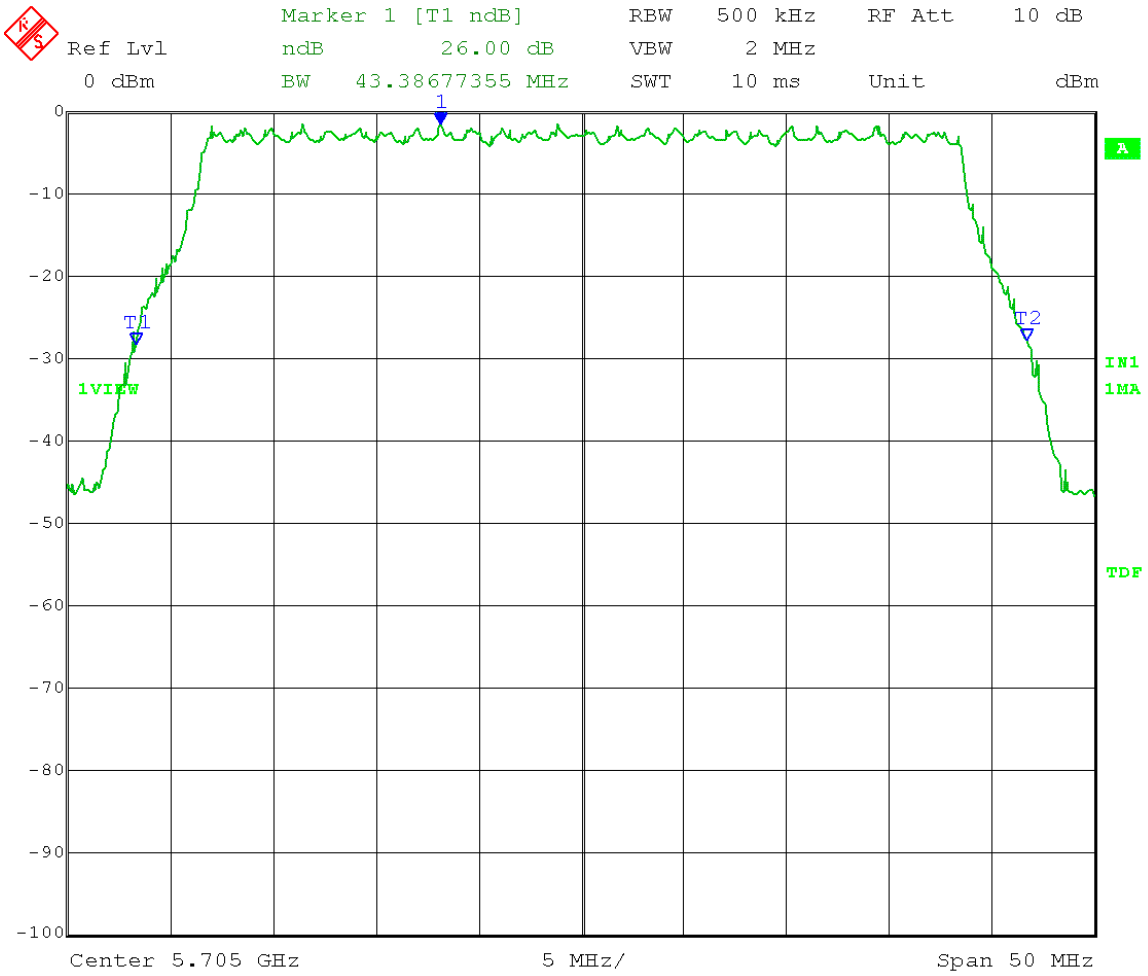
26 dB Emission Bandwidth = 43.3 MHz



Date: 8.DEC.2016 10:42:08

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: 26 dB Emission Bandwidth
Operator: Craig B
Comment: ANSI C63.10, 12.4.1
High Channel: Transmit = 5705 MHz 40 MHz BW
Power setting 22 Port B QPSK

26 dB Emission Bandwidth = 43.4 MHz



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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.

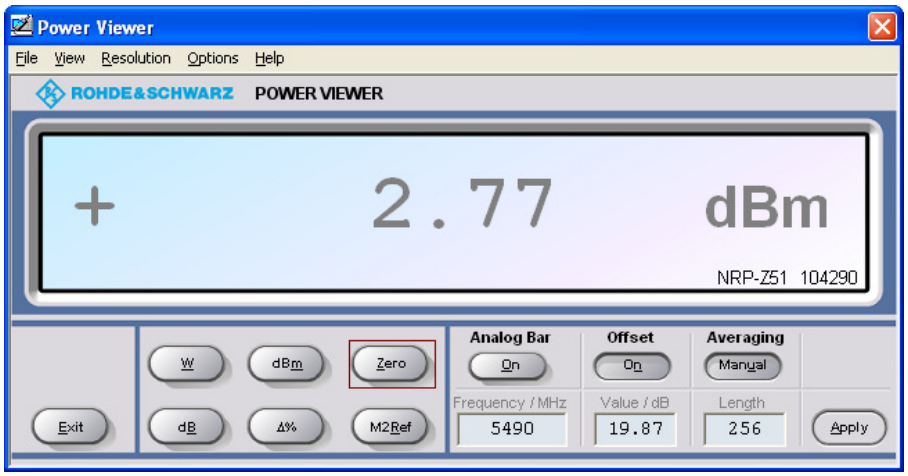
Results: Passed

Notes: Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with a 64% duty cycle.

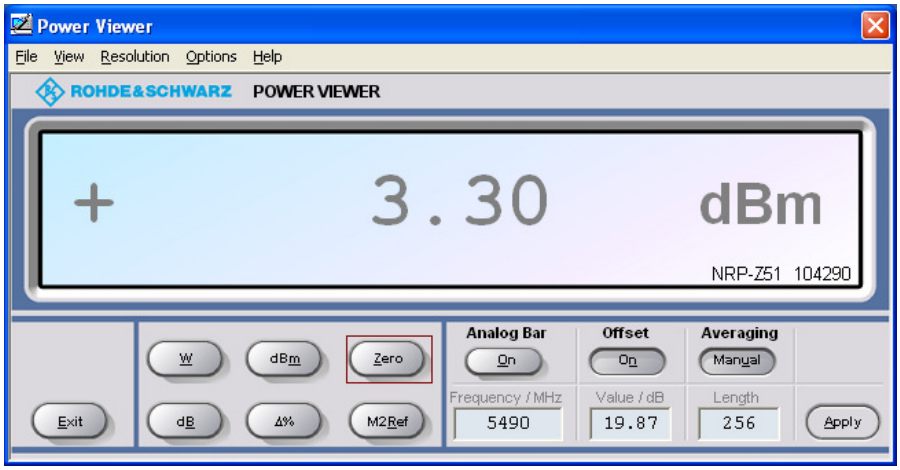
The low channel was measured at 5490 MHz and the high channel was measured at 5705 MHz. It was later determined that the low channel frequency had to be changed to 5495 MHz and the high channel frequency had to be changed to 5700 MHz to pass the band-edge emission level requirement.

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Maximum conducted output power
Operator: Craig B
Comment: ANSI C63.10, 12.3.3.1 power meter method
Low Channel: Transmit = 5490 MHz 40 MHz BW
Power setting 22 QPSK
Antenna gain: 9 dBi
Conducted limit: 24 dBm - (9-6) = 21 dBm
e.i.r.p. limit: 30 dBm

Port A:
Maximum conducted output power = 2.77 dBm + 1.94 dB duty cycle correction + 1 dB Cambium cable loss = 5.71 dBm = 3.724 mW



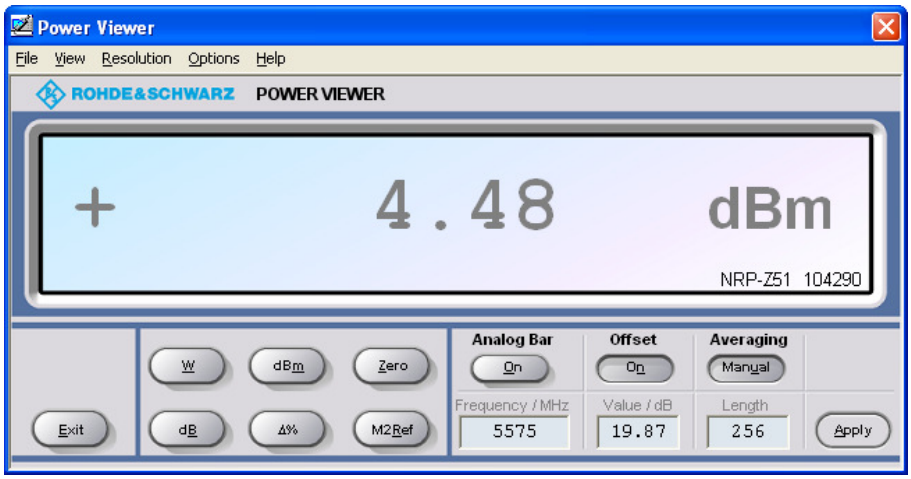
Port B:
Maximum conducted output power = 3.30 dBm + 1.94 dB duty cycle correction + 1 dB Cambium cable loss = 6.24 dBm = 4.207 mW



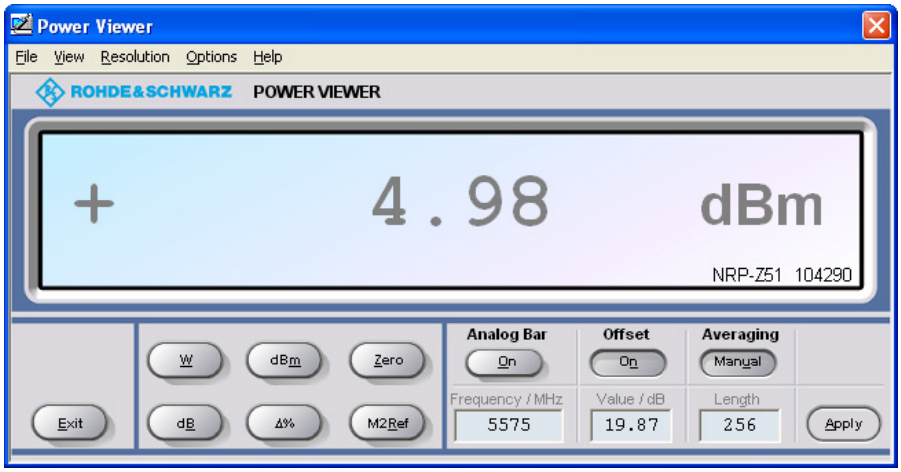
Total output power = 3.724 mW + 4.207 mW = 7.931 mW = **8.99 dBm**
Total e.i.r.p. = 8.99 dBm + 9 dBi = **17.99 dBm**

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 22 QPSK
Antenna gain: 9 dBi
Conducted limit: 24 dBm - (9-6) = 21 dBm
e.i.r.p. limit: 30 dBm

Port A:
Maximum conducted output power = 4.48 dBm + 1.94 dB duty cycle correction + 1 dB Cambium cable loss = 7.42 dBm = 5.521 mW



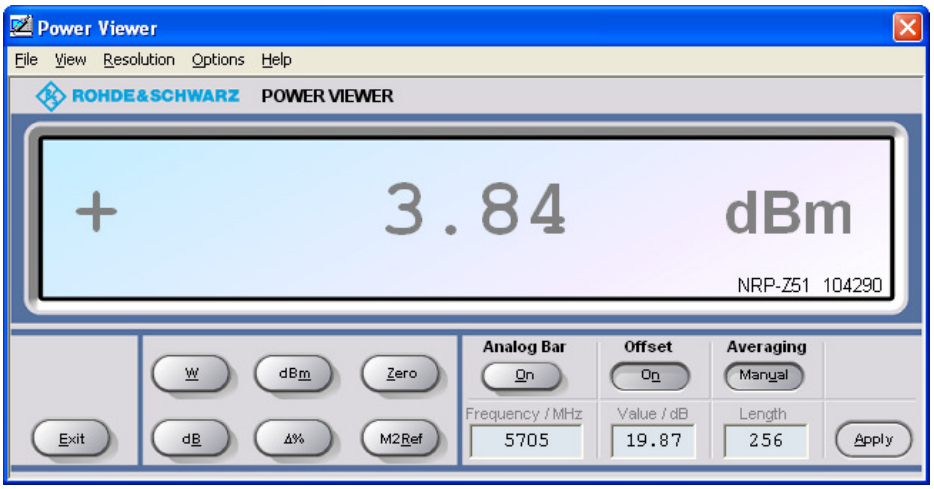
Port B:
Maximum conducted output power = 4.98 dBm + 1.94 dB duty cycle correction + 1 dB Cambium cable loss = 7.92 dBm = 6.194 mW



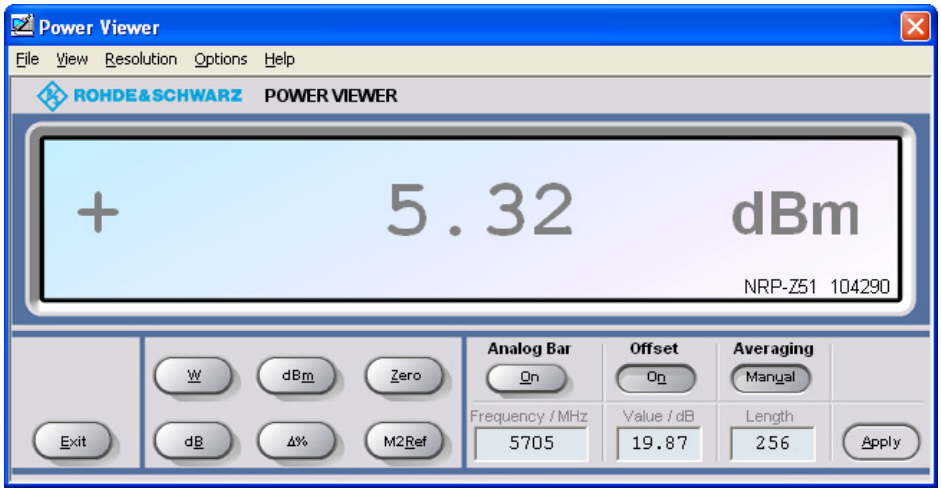
Total output power = 5.521 mW + 6.194 mW = 11.715 mW = **10.69 dBm**
Total e.i.r.p. = 10.69 dBm + 9 dBi = **19.69 dBm**

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Maximum conducted output power
Operator: Craig B
Comment: ANSI C63.10, 12.3.3.1 power meter method
High Channel: Transmit = 5705 MHz 40 MHz BW
Power setting 22 QPSK
Antenna gain: 9 dBi
Conducted limit: 24 dBm - (9-6) = 21 dBm
e.i.r.p. limit: 30 dBm

Port A:
Maximum conducted output power = 3.84 dBm + 1.94 dB duty cycle correction + 1 dB Cambium cable loss = 6.78 dBm = 4.764 mW



Port B:
Maximum conducted output power = 5.32 dBm + 1.94 dB duty cycle correction + 1 dB Cambium cable loss = 8.26 dBm = 6.699 mW



Total conducted output power = 4.764 mW + 6.699 mW = 11.463 mW = **10.59 dBm**
Total e.i.r.p. = 10.59 dBm + 9 dBi = **19.59 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

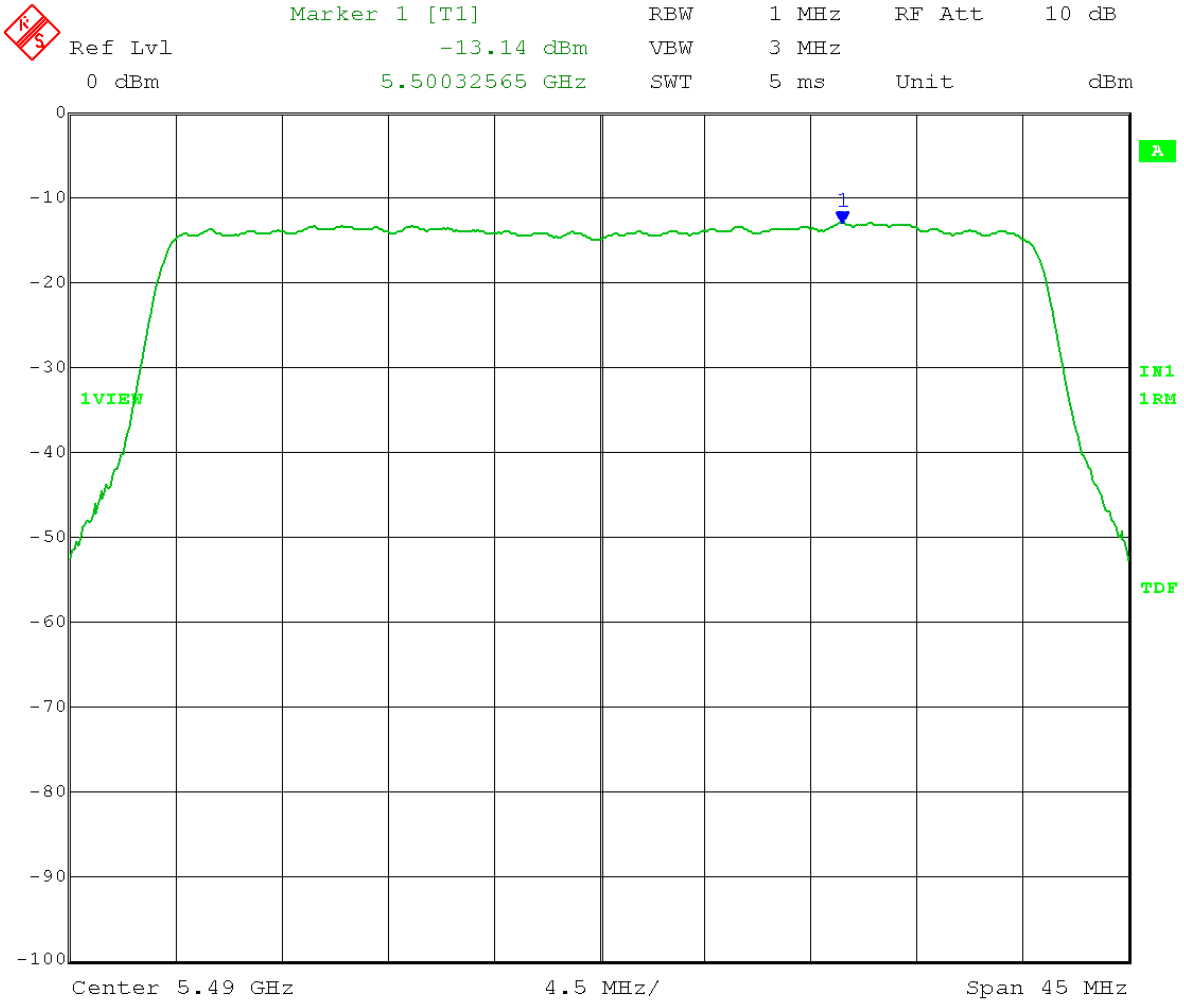
Notes: Measurements were taken for QPSK at the lowest, middle, and highest channels of operation. EUT was set to transmit continuously with 64% duty cycle.

The low channel was measured at 5490 MHz and the high channel was measured at 5705 MHz. It was later determined that the low channel frequency had to be changed to 5495 MHz and the high channel frequency had to be changed to 5700 MHz to pass the band-edge emission level requirement.

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 = 5490 MHz — 40 MHz BW
Power setting 22 — Port B — QPSK
RBW = 1 MHz — VBW = 3 MHz
Detector = RMS — Trace = AVG
Sweep Time = Auto — Sweep counts = 200
Antenna gain = 9 dBi
Limit: 11 dBm/MHz – (9-6) = 8 dBm/MHz

PPSD = -13.14 dBm + 1.94 dB (duty cycle correction) + 3 dB (2-port MIMO) + 1 dB Cambium cable loss = -7.20 dBm/MHz

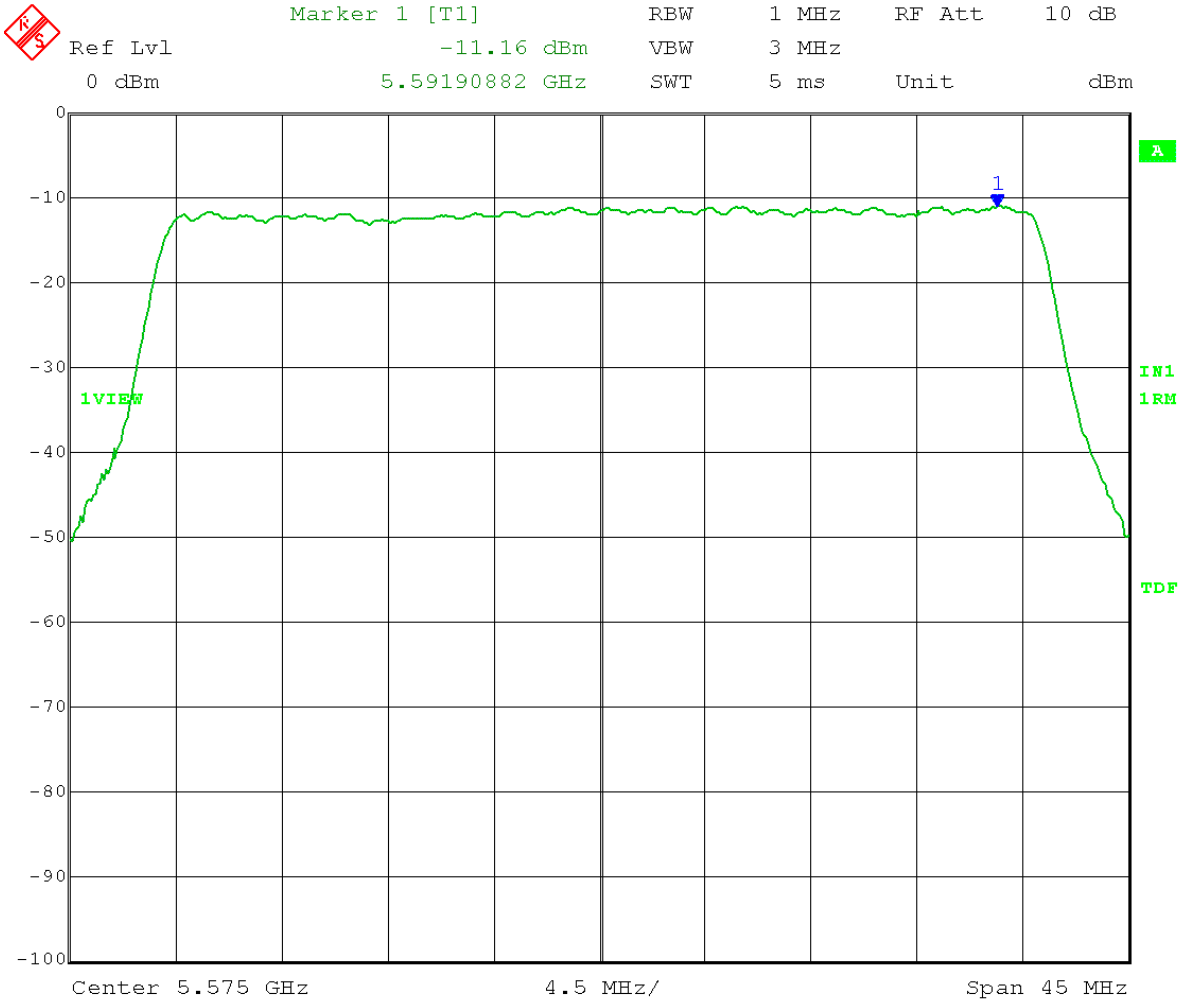


Date: 8.DEC.2016 12:59:50

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 22 — Port B — QPSK
RBW = 1 MHz — VBW = 3 MHz
Detector = RMS — Trace = AVG
Sweep Time = Auto — Sweep counts = 200
Antenna gain = 9 dBi
Limit: 11 dBm/MHz – (9-6) = 8 dBm/MHz

PPSD = -11.16 dBm + 1.94 dB (duty cycle correction) + 3 dB (2-port MIMO) + 1 dB Cambium cable loss = -5.22 dBm/MHz

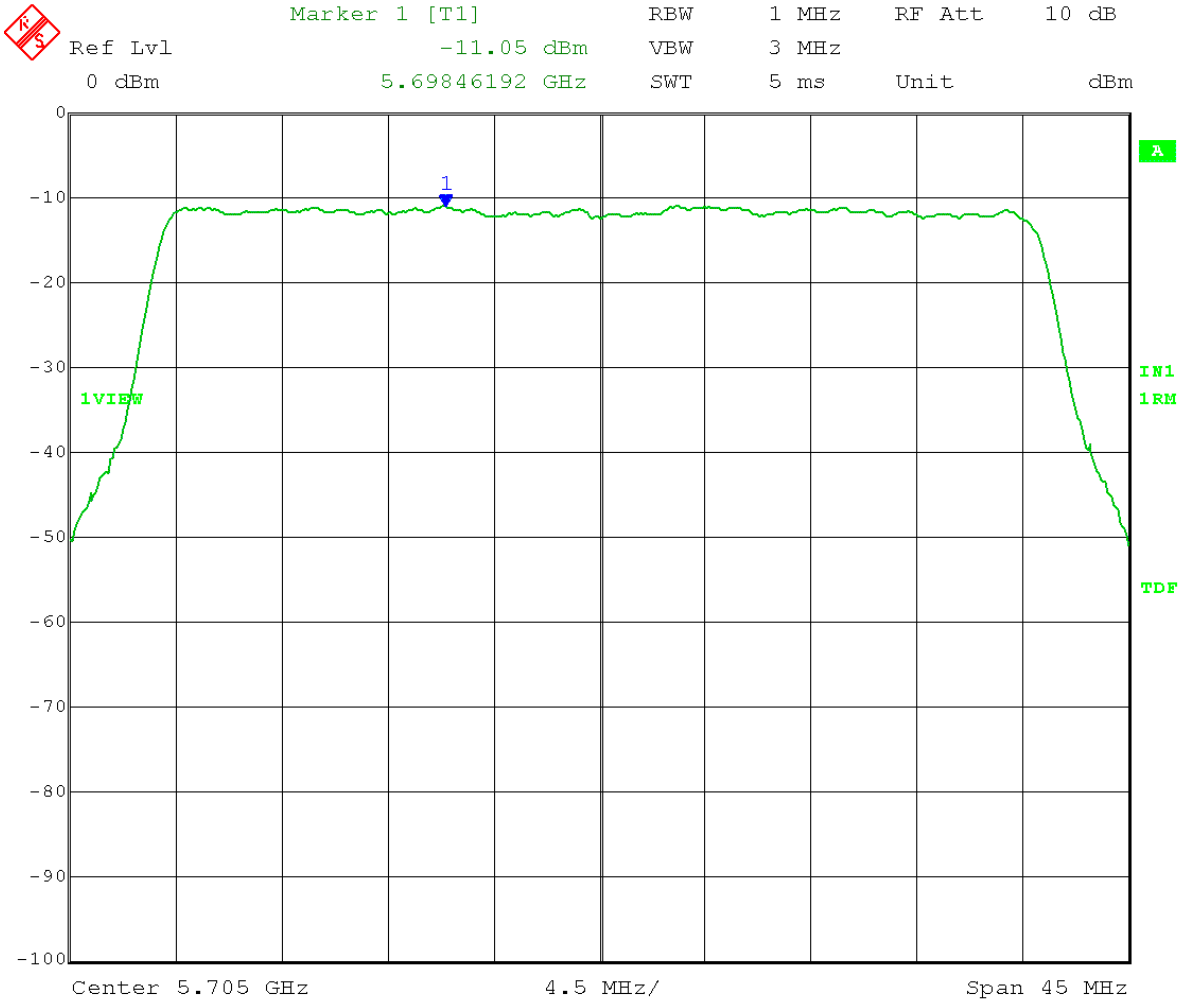


Date: 8.DEC.2016 14:11:15

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 = 5705 MHz — 40 MHz BW
Power setting 22 — Port B — QPSK
RBW = 1 MHz — VBW = 3 MHz
Detector = RMS — Trace = AVG
Sweep Time = Auto — Sweep counts = 200
Antenna gain = 9 dBi
Limit: 11 dBm/MHz – (9-6) = 8 dBm/MHz

PPSD = -11.05 dBm + 1.94 dB (duty cycle correction) + 3 dB (2-port MIMO) + 1 dB Cambium cable loss = -5.11 dBm/MHz



Date: 8.DEC.2016 14:16:26

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

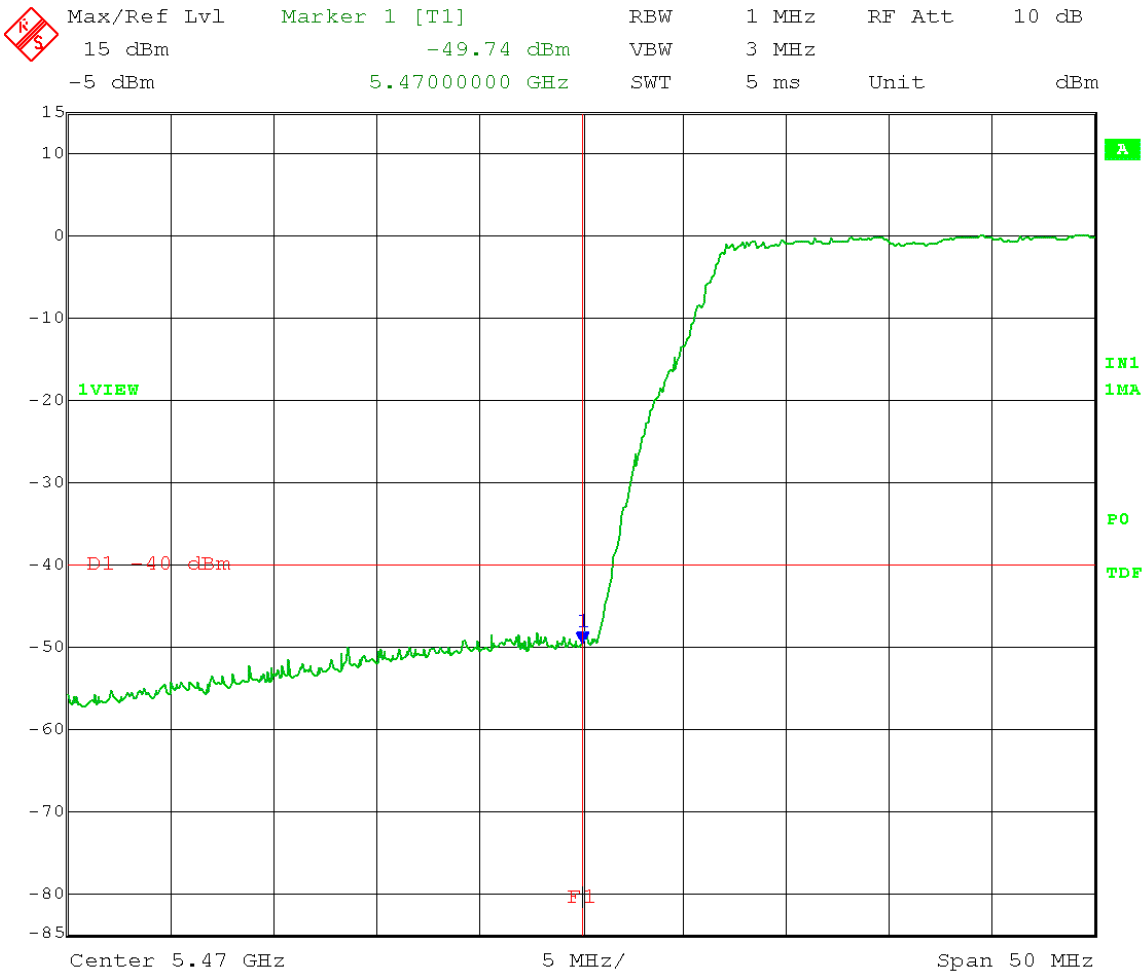
Limit: EIRP of -27 dBm/MHz
RF conducted limit lowered to account for two-port MIMO operation, Cambium cable loss (from circuit board to measurement connector), and antenna gain.

Results: Passed

Notes: Measurements were taken for QPSK at the lowest and highest channels of operation. EUT was set to transmit continuously with 64% duty cycle.

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

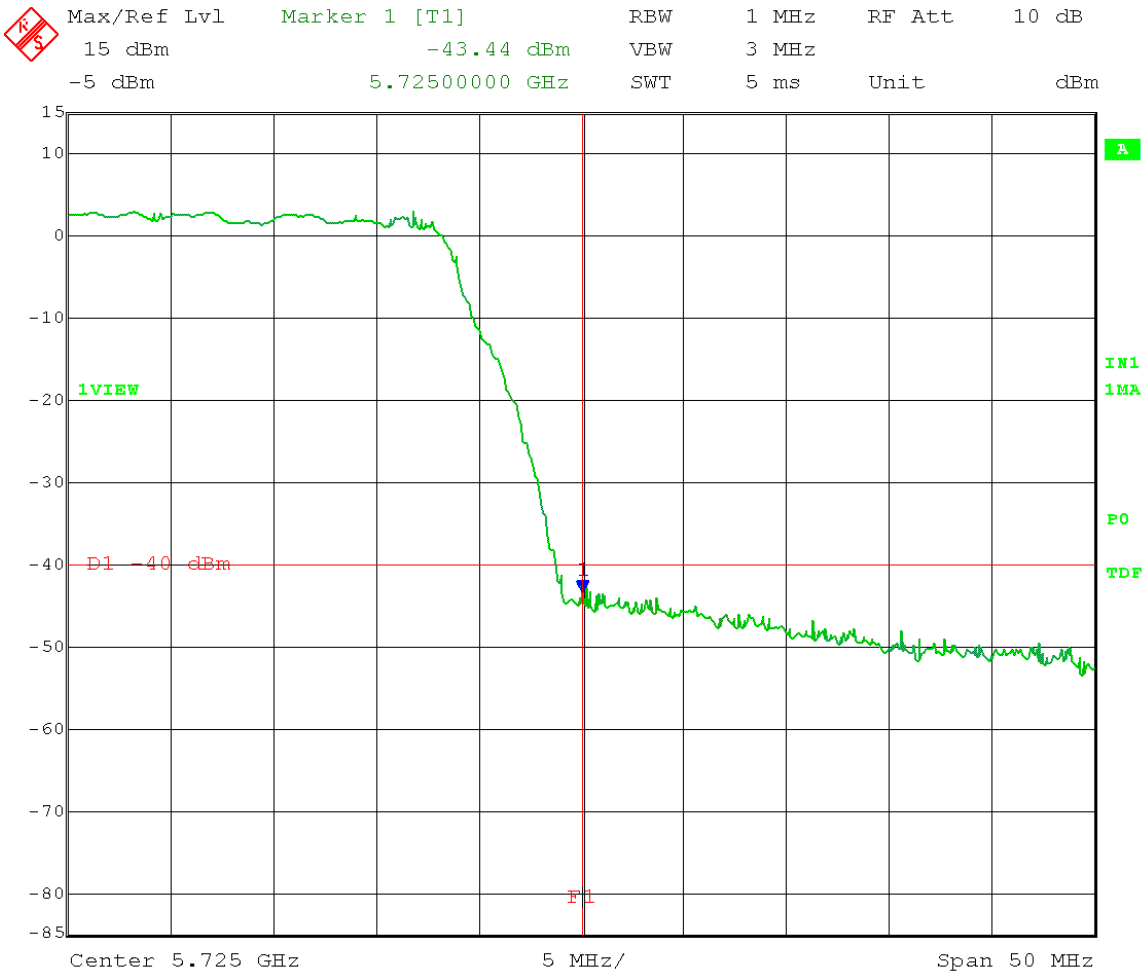
Limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz



Date: 8.DEC.2016 18:04:24

Test Date: 12-08-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
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 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz



Date: 8.DEC.2016 18:01:43

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, Cambium cable loss (from circuit board to measurement connector), 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 64% duty cycle.

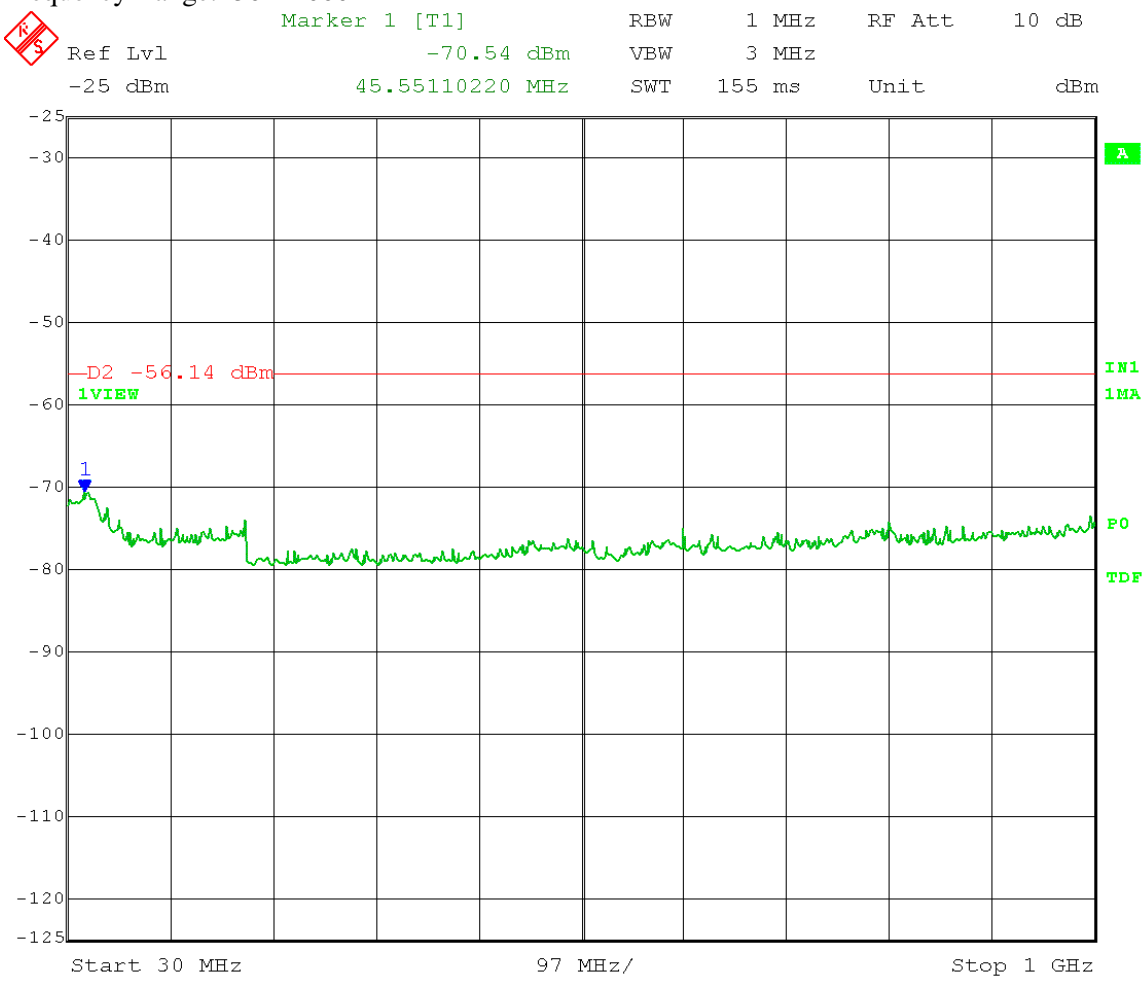
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 30 – 1000 MHz



Date: 9.DEC.2016 10:04:26

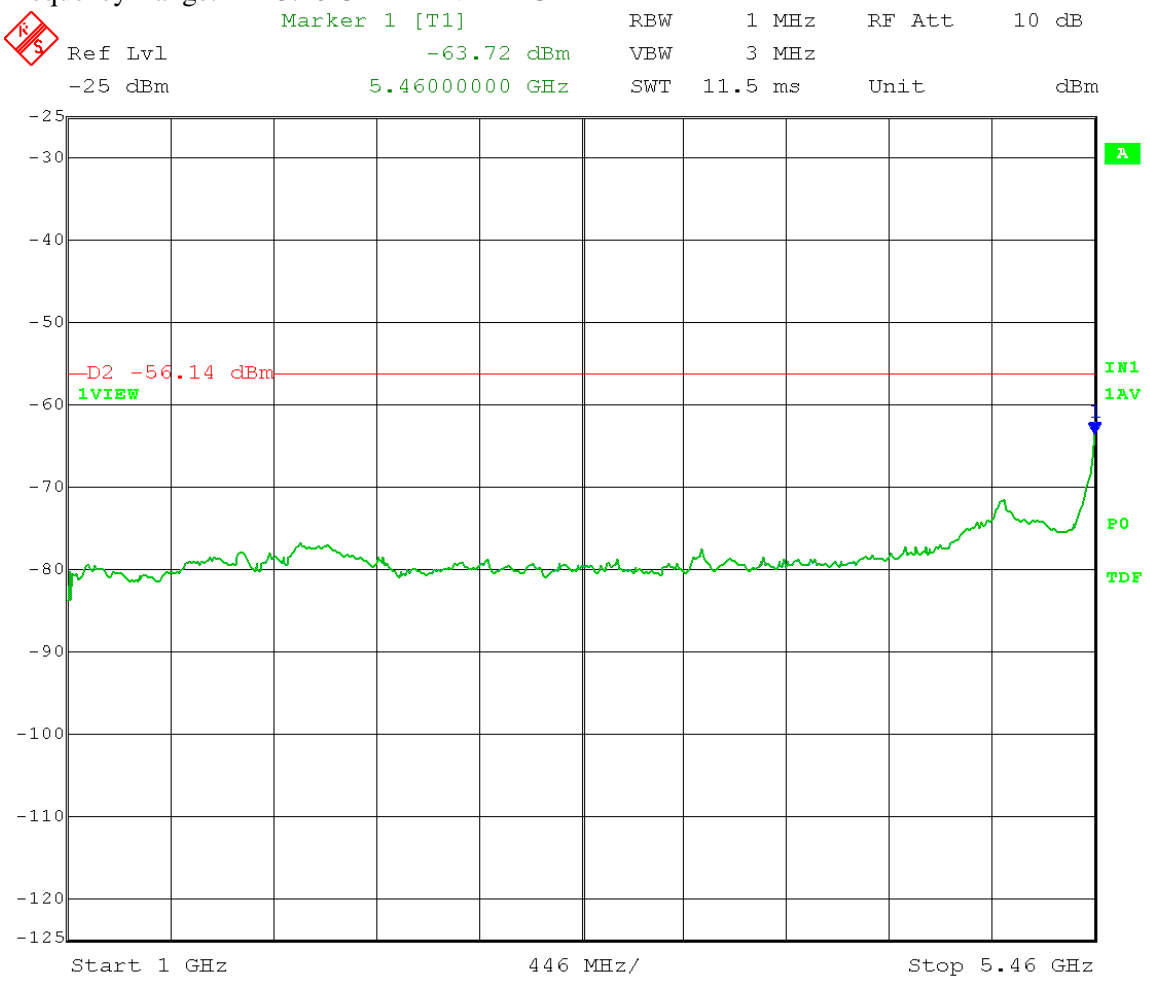
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Average

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz AVERAGE



Date: 9.DEC.2016 10:01:50

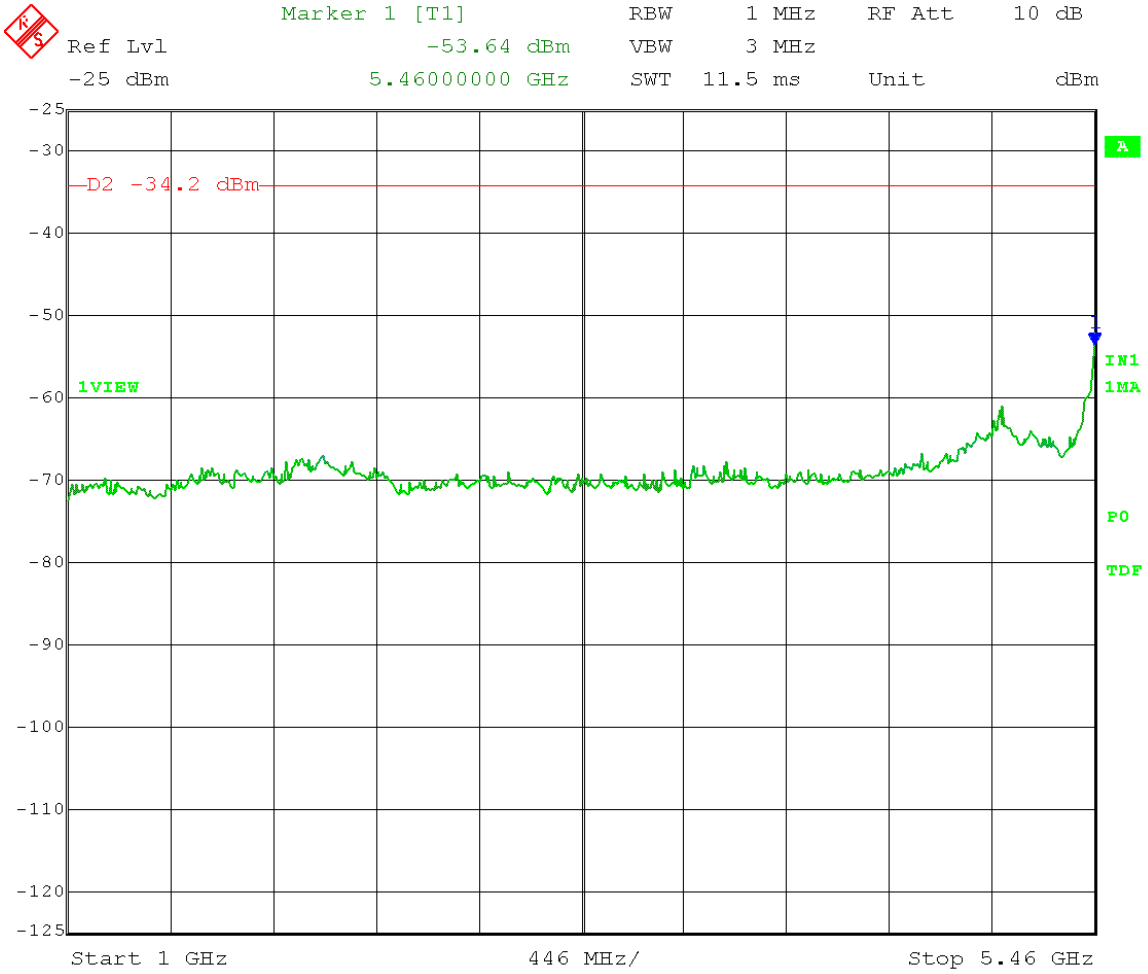
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz PEAK



Date: 9.DEC.2016 10:02:43

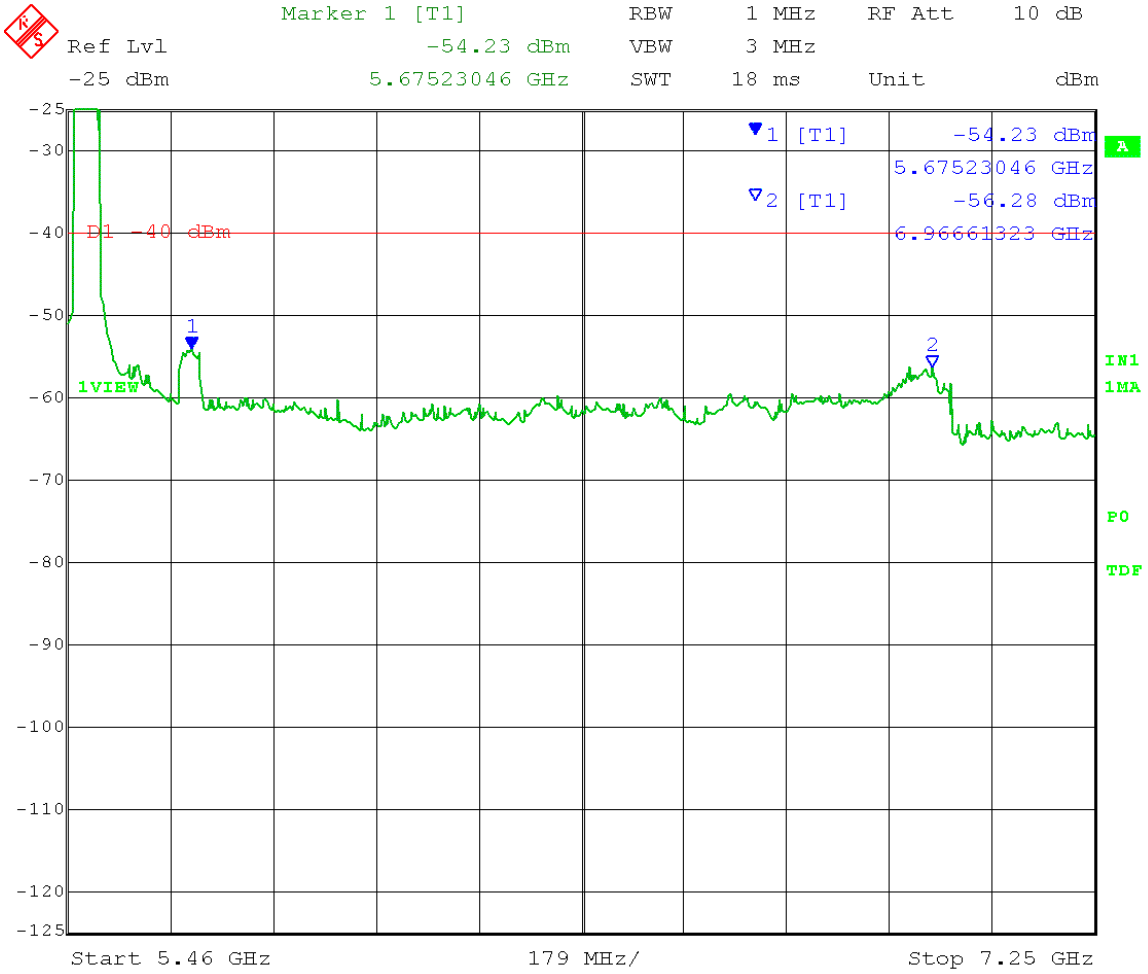
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 5.46 – 7.25 GHz



Date: 9.DEC.2016 10:07:27

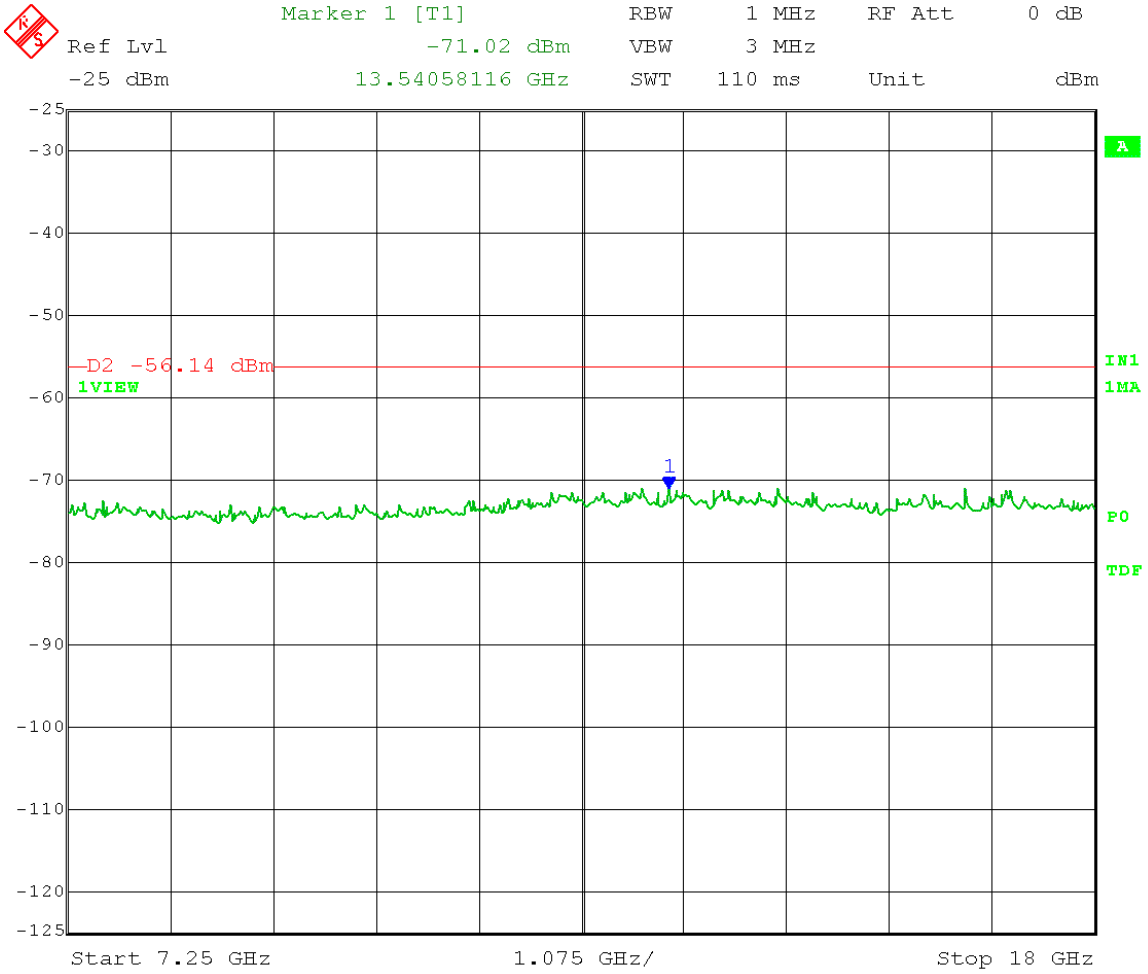
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 7.25 – 18 GHz



Date: 9.DEC.2016 10:09:54

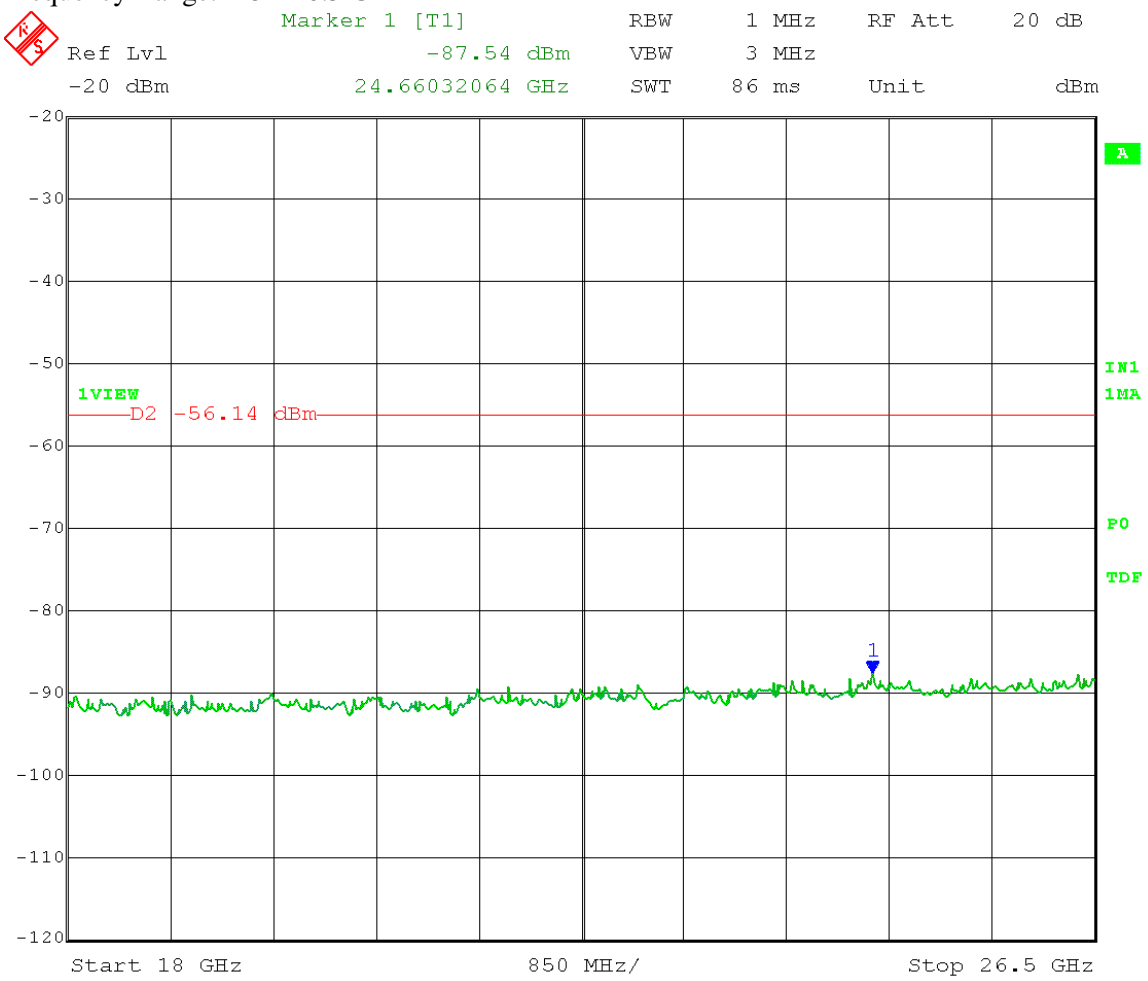
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 18 – 26.5 GHz



Date: 9.DEC.2016 10:49:14

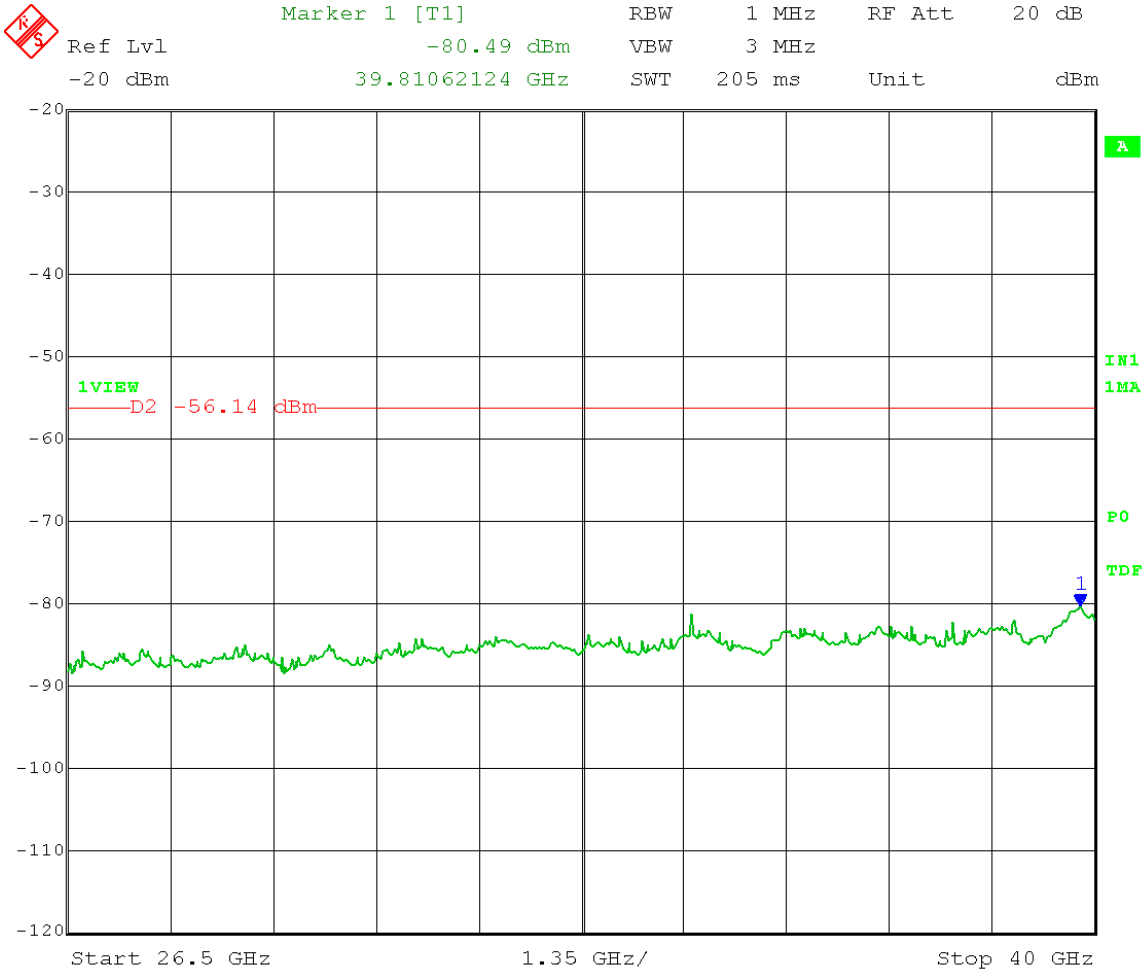
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Low Channel: Transmit = 5495 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 26.5 – 40 GHz



Date: 9.DEC.2016 10:51:03

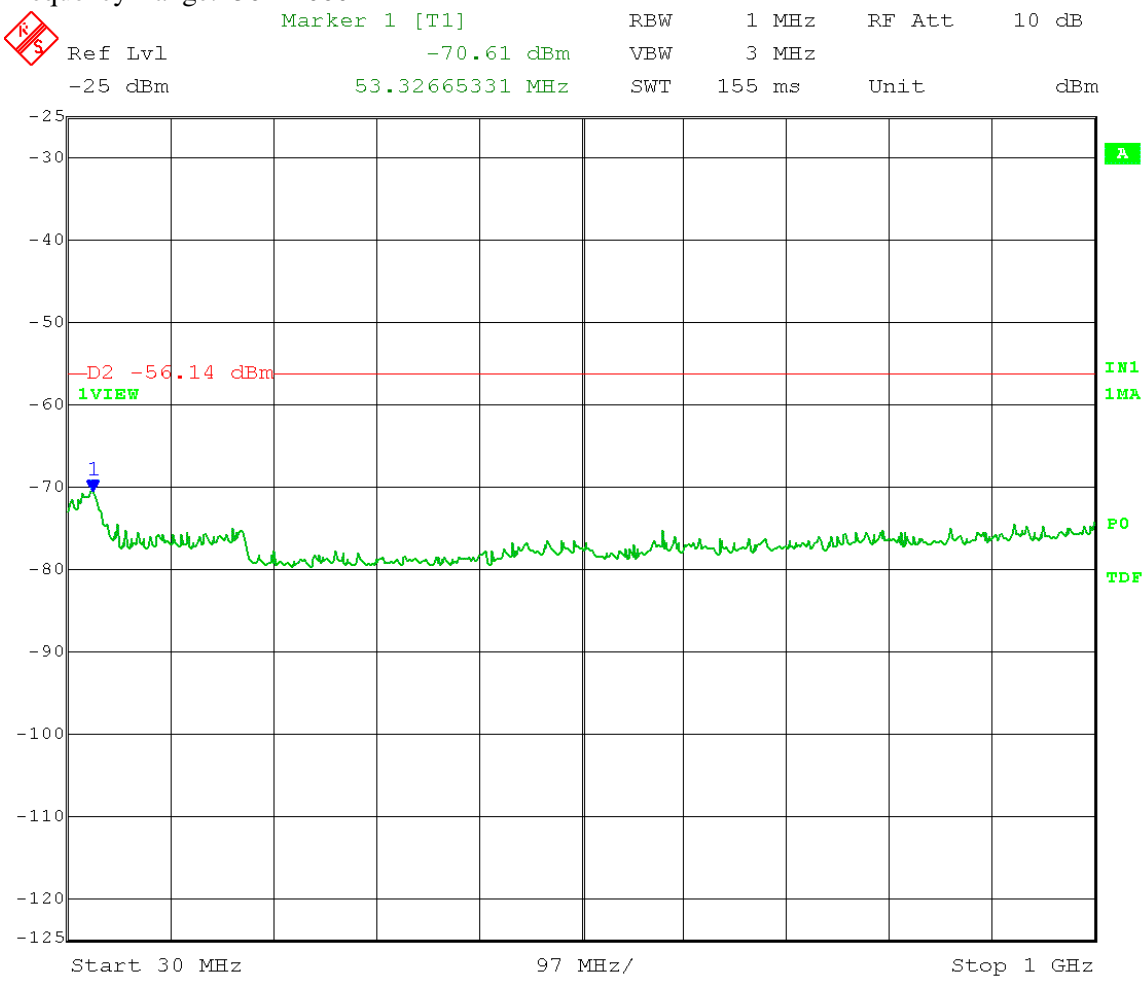
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 30 – 1000 MHz



Date: 9.DEC.2016 10:12:59

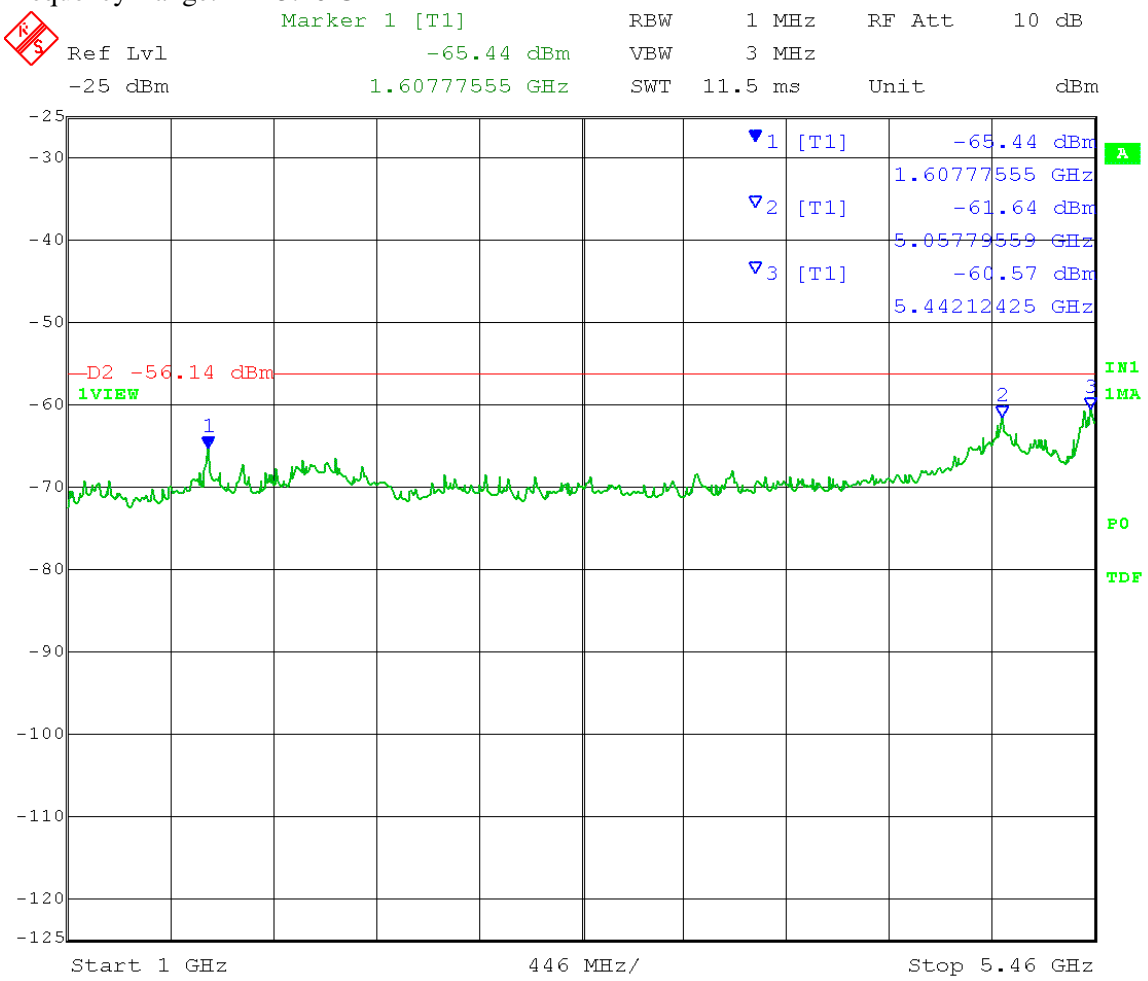
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz



Date: 9.DEC.2016 10:15:43

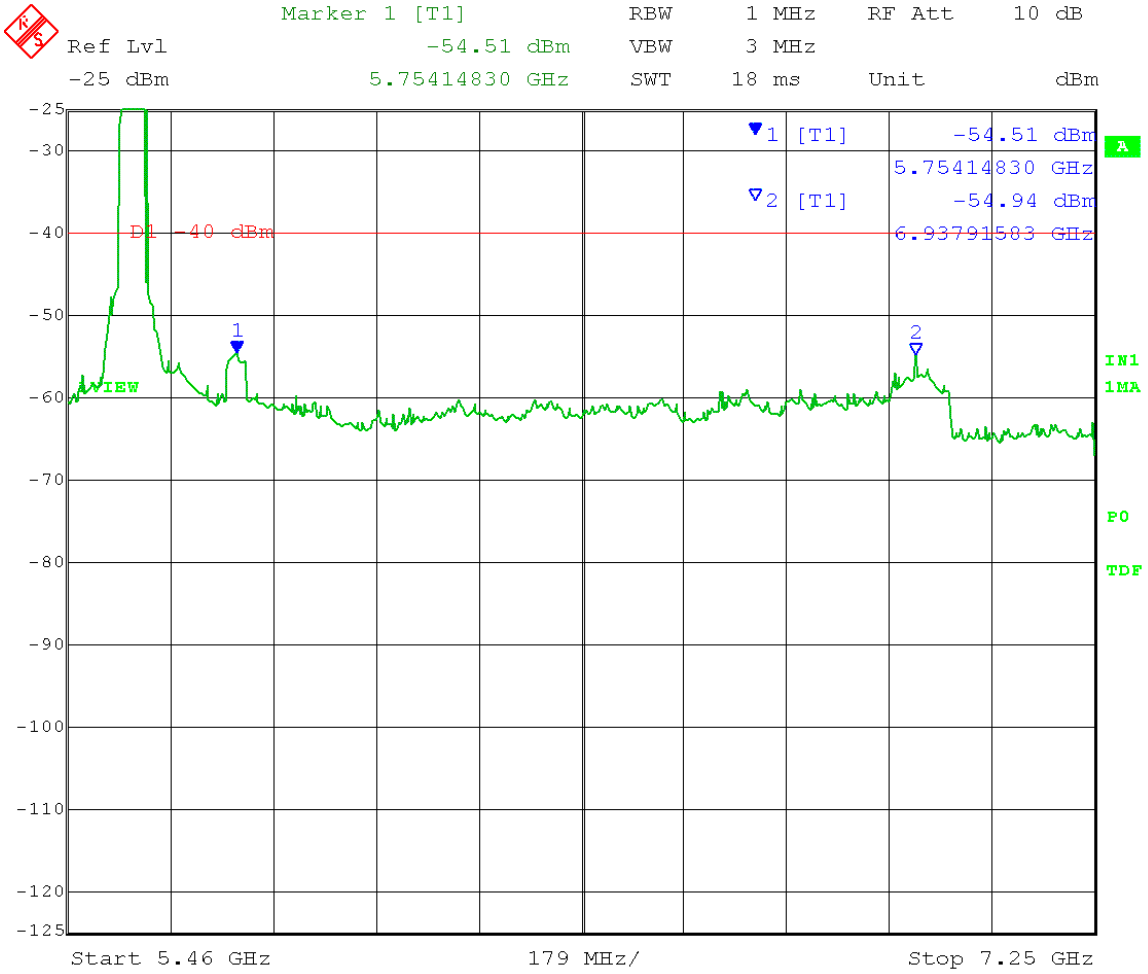
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 5.46 – 7.25 GHz



Date: 9.DEC.2016 10:18:38

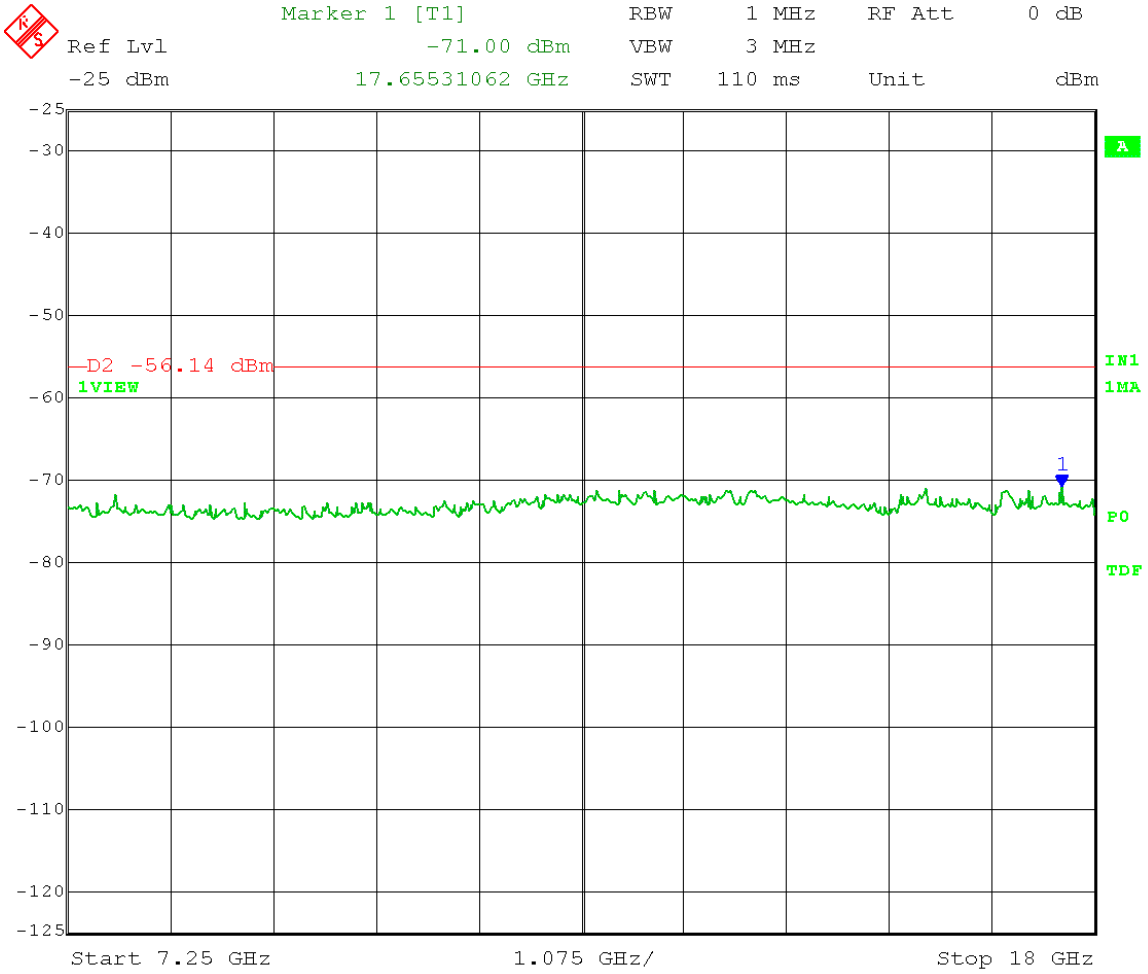
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 7.25 – 18 GHz



Date: 9.DEC.2016 10:20:26

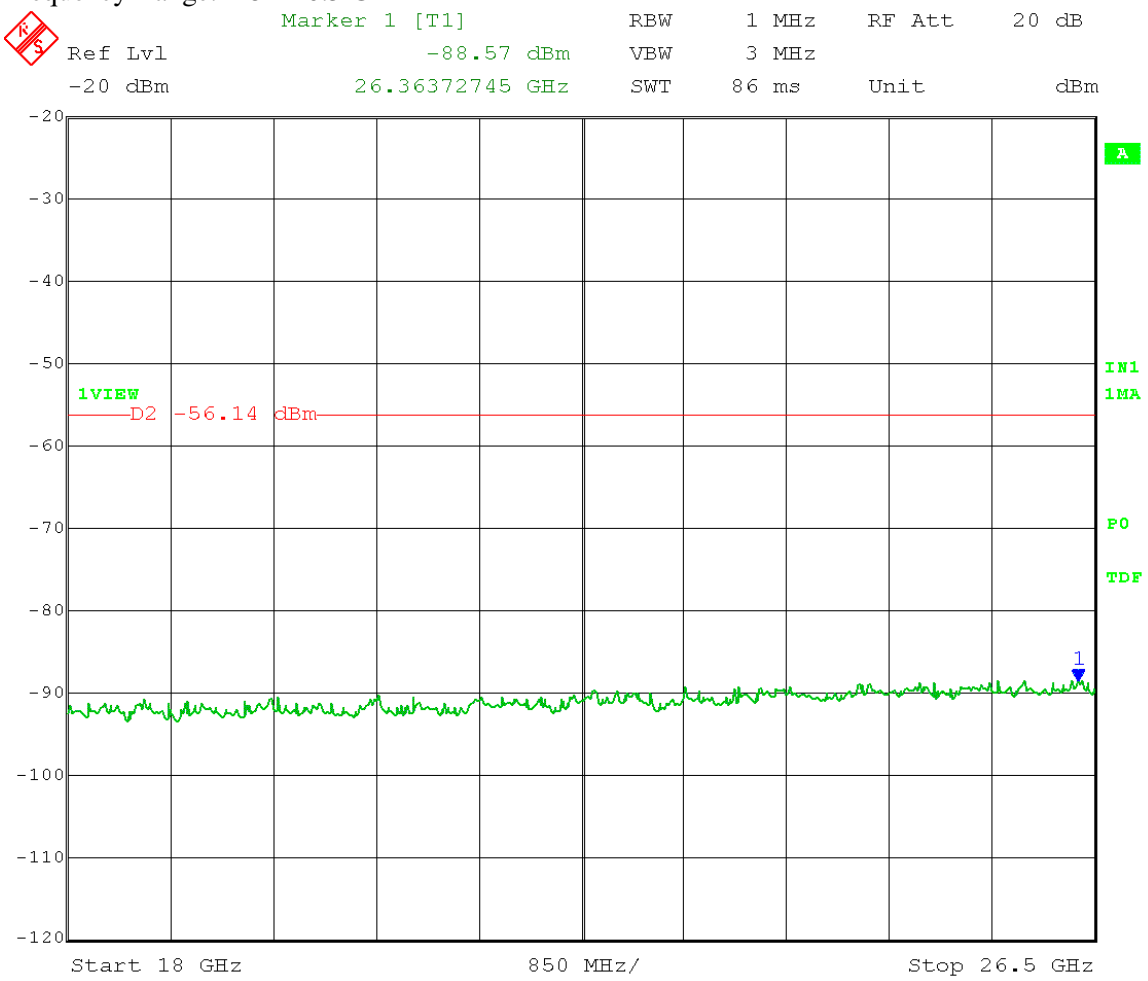
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 18 – 26.5 GHz



Date: 9.DEC.2016 10:52:55

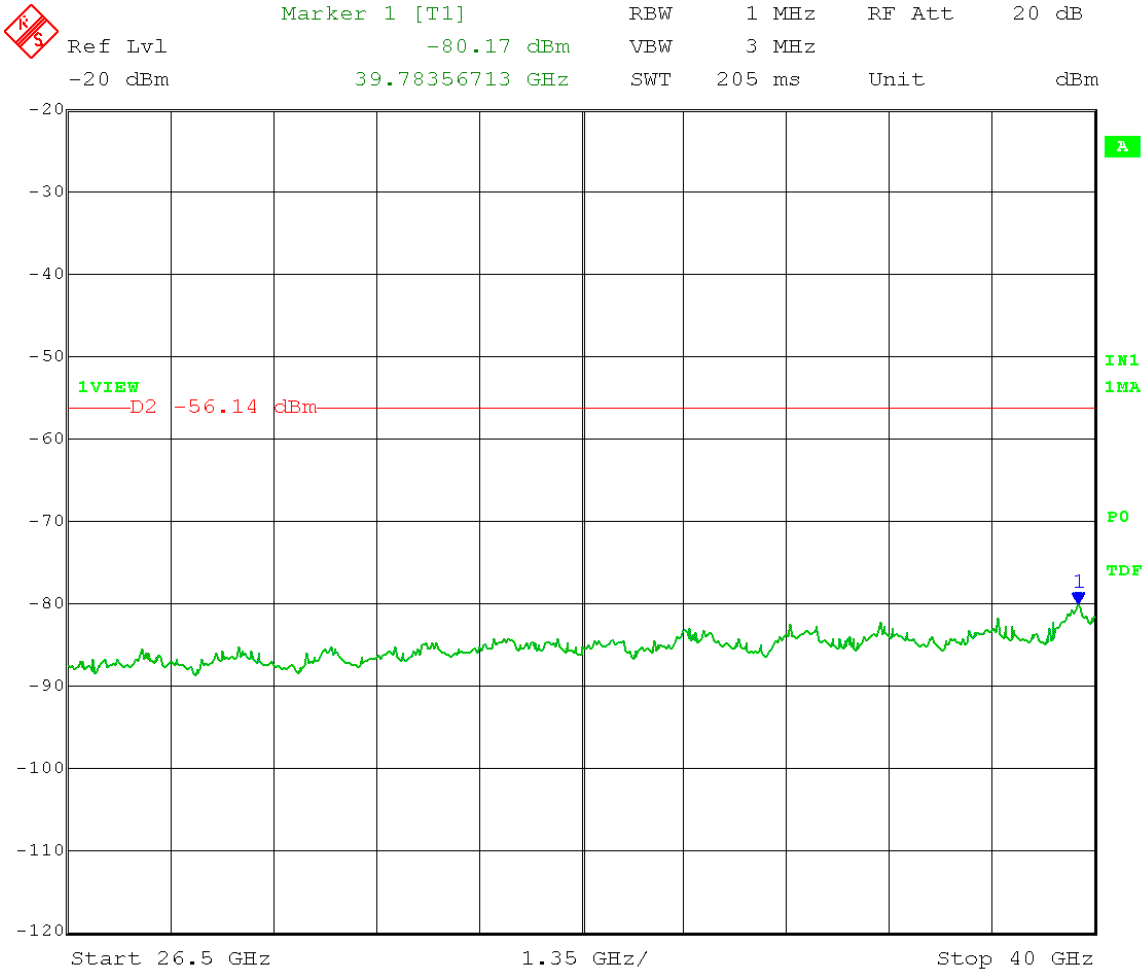
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
Mid Channel: Transmit = 5575 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 26.5 – 40 GHz



Date: 9.DEC.2016 10:54:38

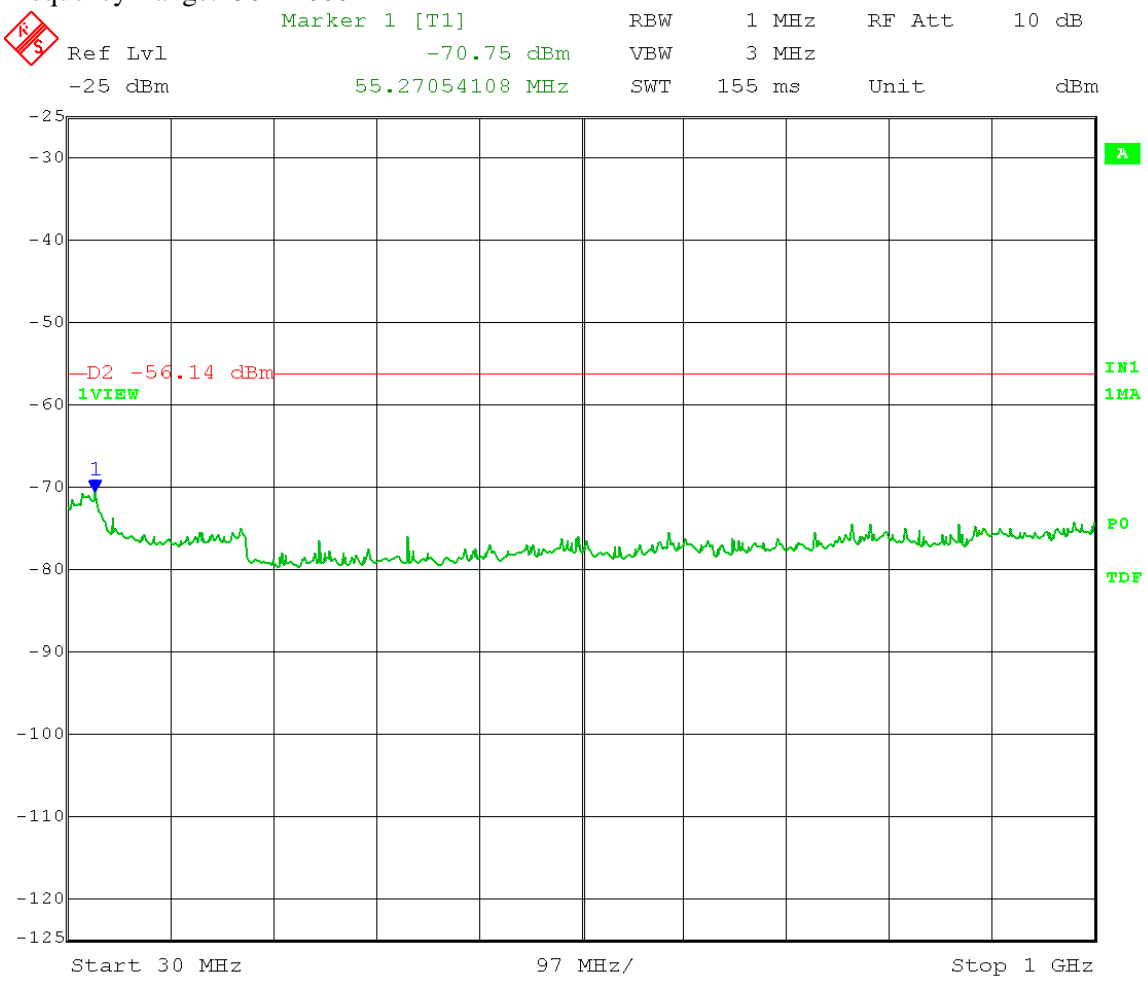
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 30 – 1000 MHz



Date: 9.DEC.2016 10:22:02

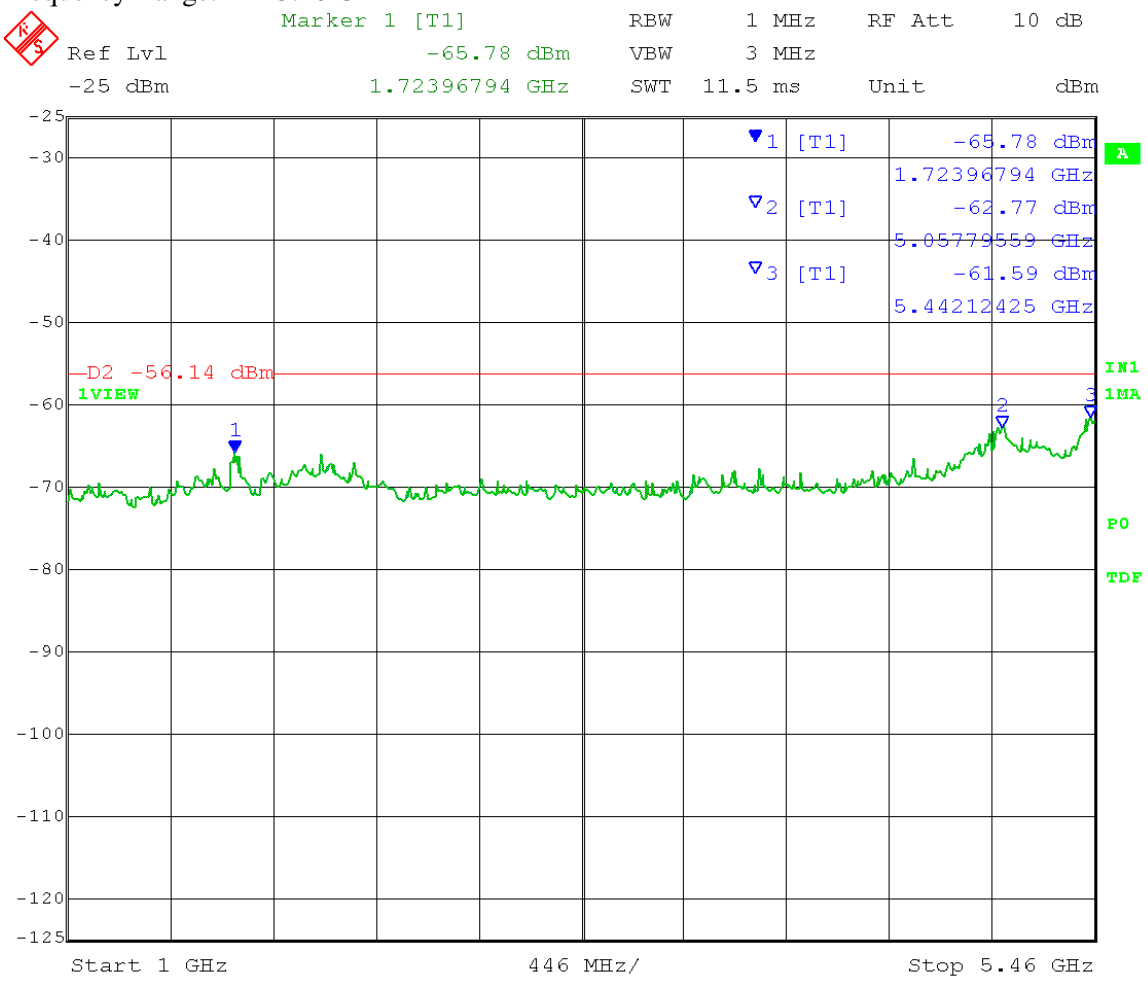
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 1 – 5.46 GHz



Date: 9.DEC.2016 10:24:24

Test Date: 12-09-2016
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 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 5.46 – 7.25 GHz

Date: 9.DEC.2016 10:26:18

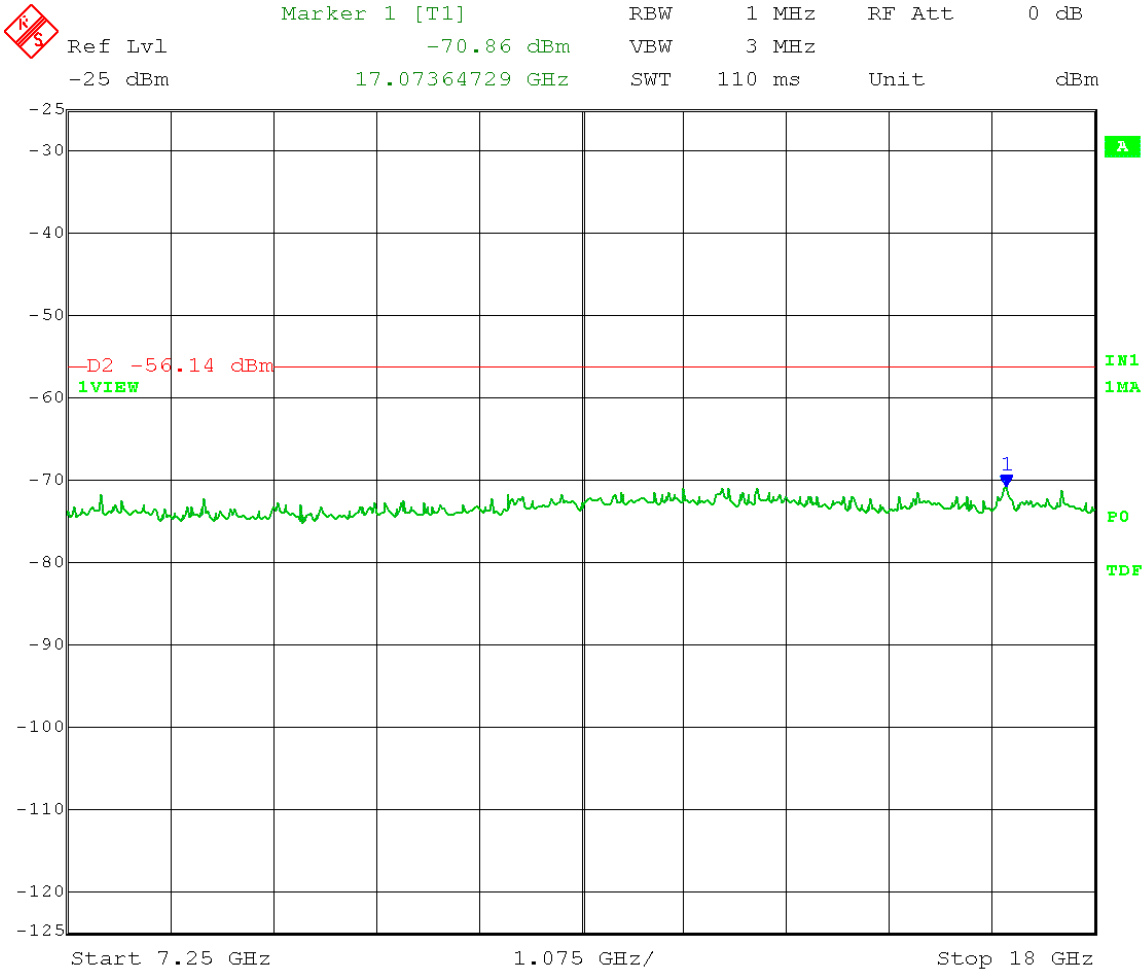
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 7.25 – 18 GHz



Date: 9.DEC.2016 10:27:43

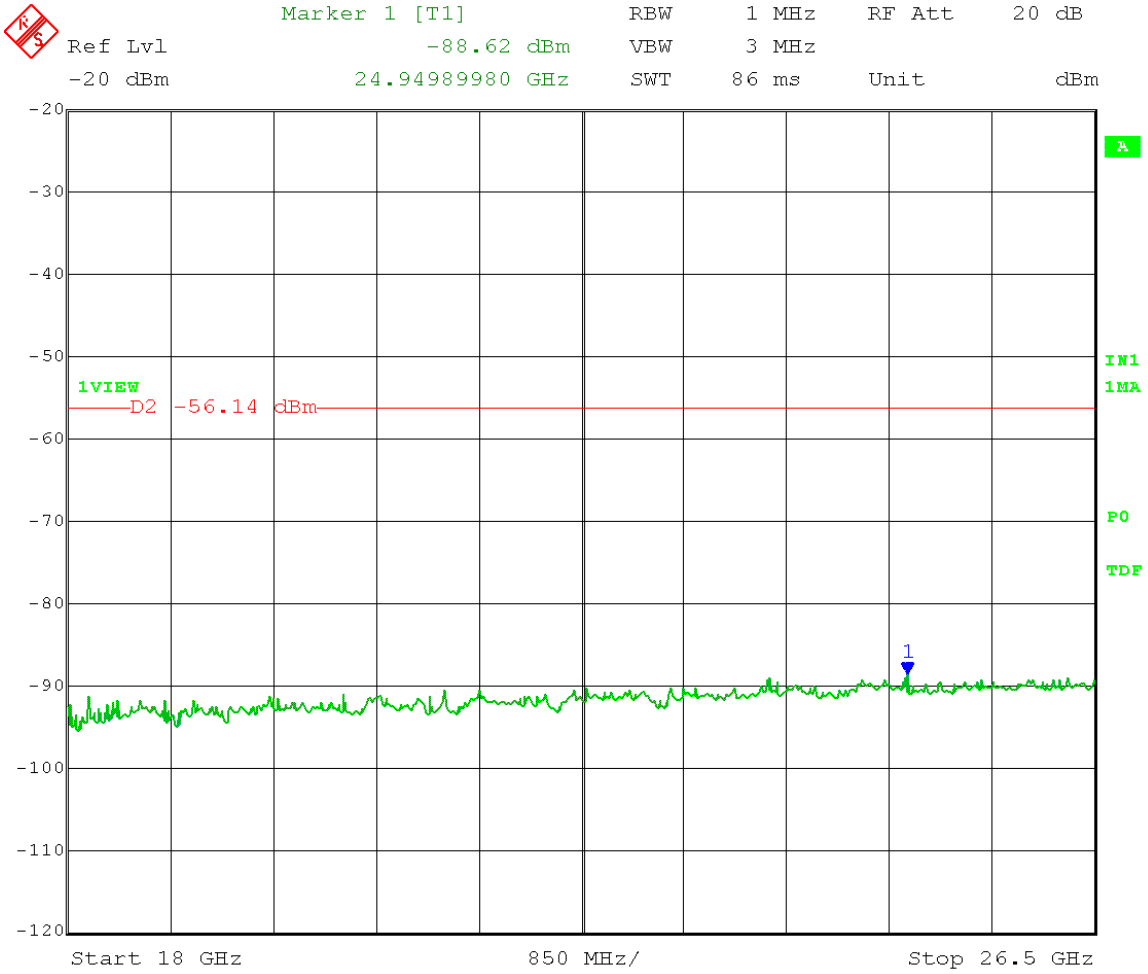
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 18 – 26.5 GHz



Date: 9.DEC.2016 11:08:35

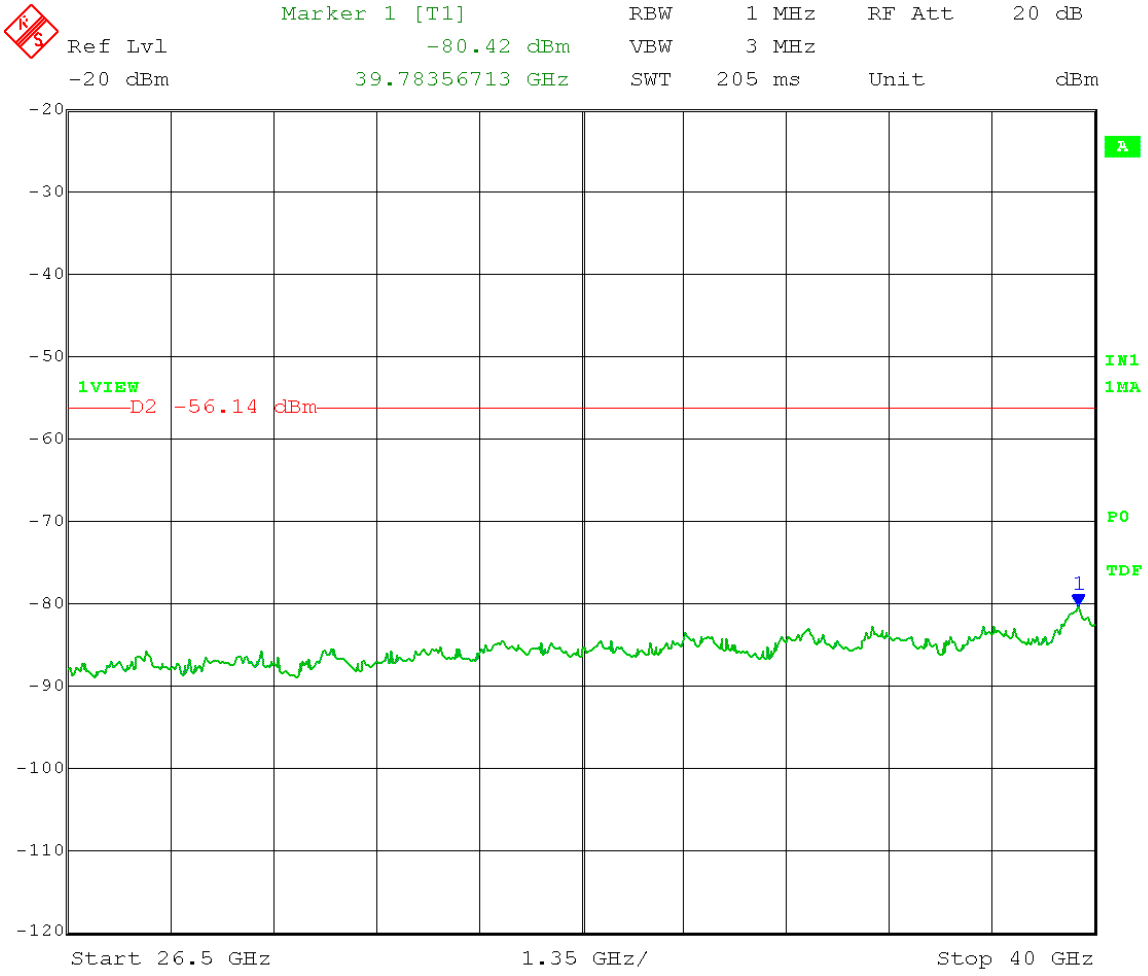
Test Date: 12-09-2016
Company: Cambium Networks
EUT: PMP450 5.4GHz SM
Test: Unwanted emissions
Operator: Craig B
Comment: ANSI C63.10, 12.7.2 and 12.7.3
High Channel: Transmit = 5700 MHz 40 MHz BW
Power setting 22 Port B QPSK
Antenna gain: 9 dBi
Detector: Peak

Non-restricted band limit: -27 dBm/MHz - 3 dB (MIMO) - 1 dB Cambium cable loss – 9 dBi antenna gain = -40 dBm/MHz

Restricted band Average limit: 54 dBµV/m at 3 meters; Conducted limit = 54 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain - 1.94 duty cycle correction = -56.14 dBm/MHz

Restricted band Peak limit: 74 dBµV/m at 3 meters; Conducted limit = 74 - 95.2 - 3 dB (MIMO) - 1 dB Cambium cable loss - 9 dBi antenna gain = -34.2 dBm/MHz

Frequency Range: 26.5 – 40 GHz



Date: 9.DEC.2016 11:10:00

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 (RSS-Gen, section 8.9)

Both transmit chains were active and at power setting 22 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 64% duty cycle.

RSS-247 & FCC Part 15.407

Electric Field Strength

EUT: PMP450 5.4 GHz SM
Manufacturer: Cambium Networks
Operating Condition: 69 deg C 27% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8600
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 64% duty cycle @ pwr setting 22 L,M,H channels
Date: 12-09-2016

TEXT: "Vert 3 meters"

Short Description: Test Set-up

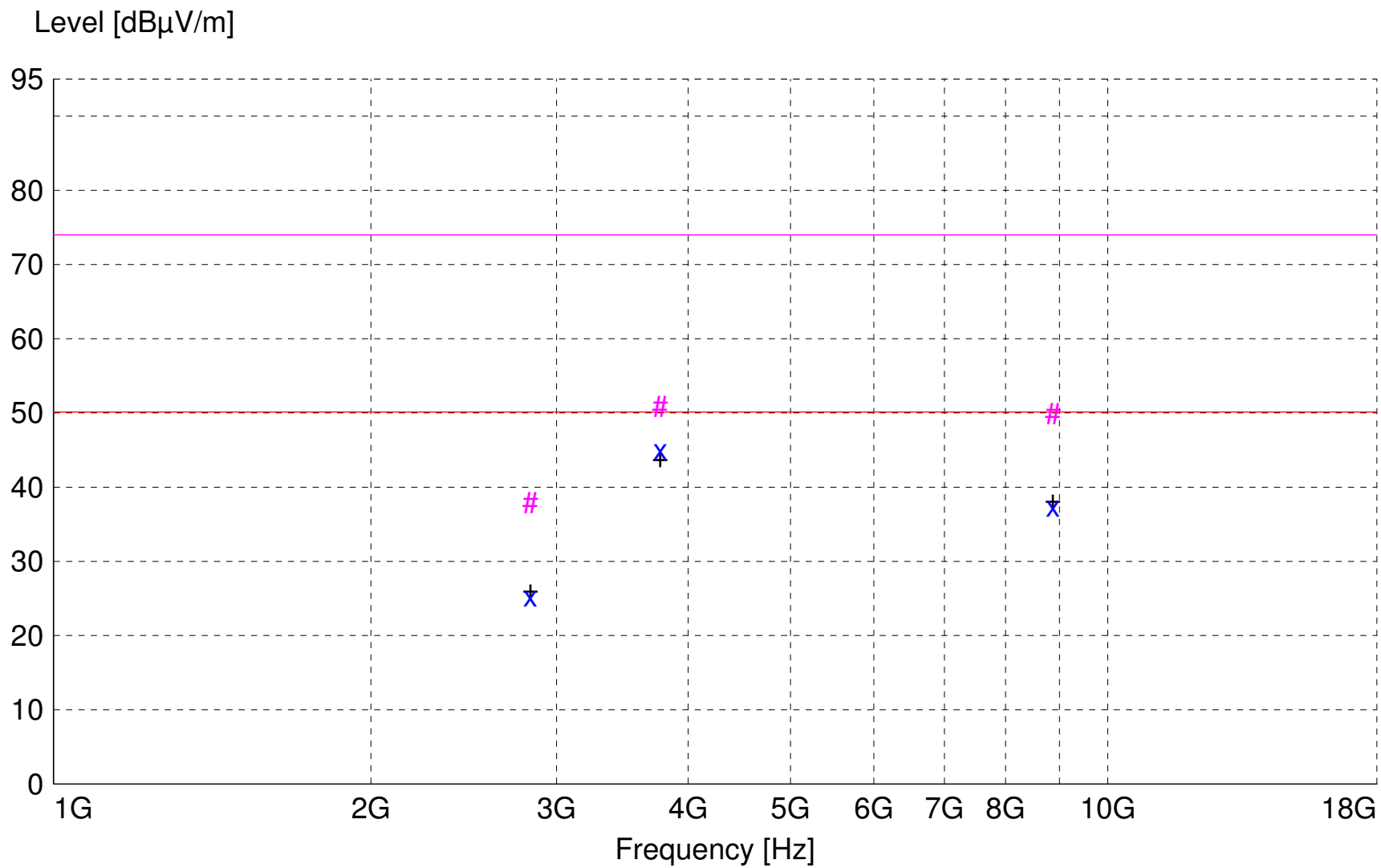
Test Set-up: EUT Measured at 3 Meters with VERTICAL Antenna Polarization

Sample Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)
24.6 = 35.51 + (-22.1) + 11.20

Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)
15.4 = 40 - 24.6

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
-	Background Scan Peak Detector (Optional)
-	Background Scan Average Detector (Optional)



x x : MES A129a_sv_Average
: MES A129a_sv_Peak
+ + : MES A129a_sv_Peak_List
——— LIM FCC Class B 3m AVG c 3m AVG lim corr for duty cycle
——— LIM FCC Class B F 3m PK Field Strength PEAK Limit 3m

MEASUREMENT RESULT: "A129a_sv_Final"

12/9/2016 11:23AM

Frequency MHz	Level dBµV	Antenna Factor dBµV/m	System Loss dB	Total Level dBµV/m	Limit dBµV/m	Margin dB	Height Ant. m	EuT Angle deg	Final Detector	Comment
3763.300000	51.74	32.49	-39.2	45.0	50.1	5.1	1.88	190	AVERAGE	None
8872.000000	34.86	38.04	-35.5	37.4	50.1	12.8	1.50	0	AVERAGE	noise floor
3763.300000	57.59	32.49	-39.2	50.9	74.0	23.1	1.88	190	MAX PEAK	None
8872.000000	47.42	38.04	-35.5	49.9	74.0	24.1	1.50	0	MAX PEAK	noise floor
2833.900000	36.58	28.98	-40.3	25.2	50.1	24.9	1.50	0	AVERAGE	noise floor
2833.900000	49.28	28.98	-40.3	37.9	74.0	36.1	1.50	0	MAX PEAK	noise floor

RSS-247 & FCC Part 15.407

Electric Field Strength

EUT: PMP450 5.4 GHz SM
Manufacturer: Cambium Networks
Operating Condition: 69 deg C 27% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8600
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 64% duty cycle @ pwr setting 22 L,M,H channels
Date: 12-09-2016

TEXT: "Horz 3 meters"

Short Description: Test Set-up

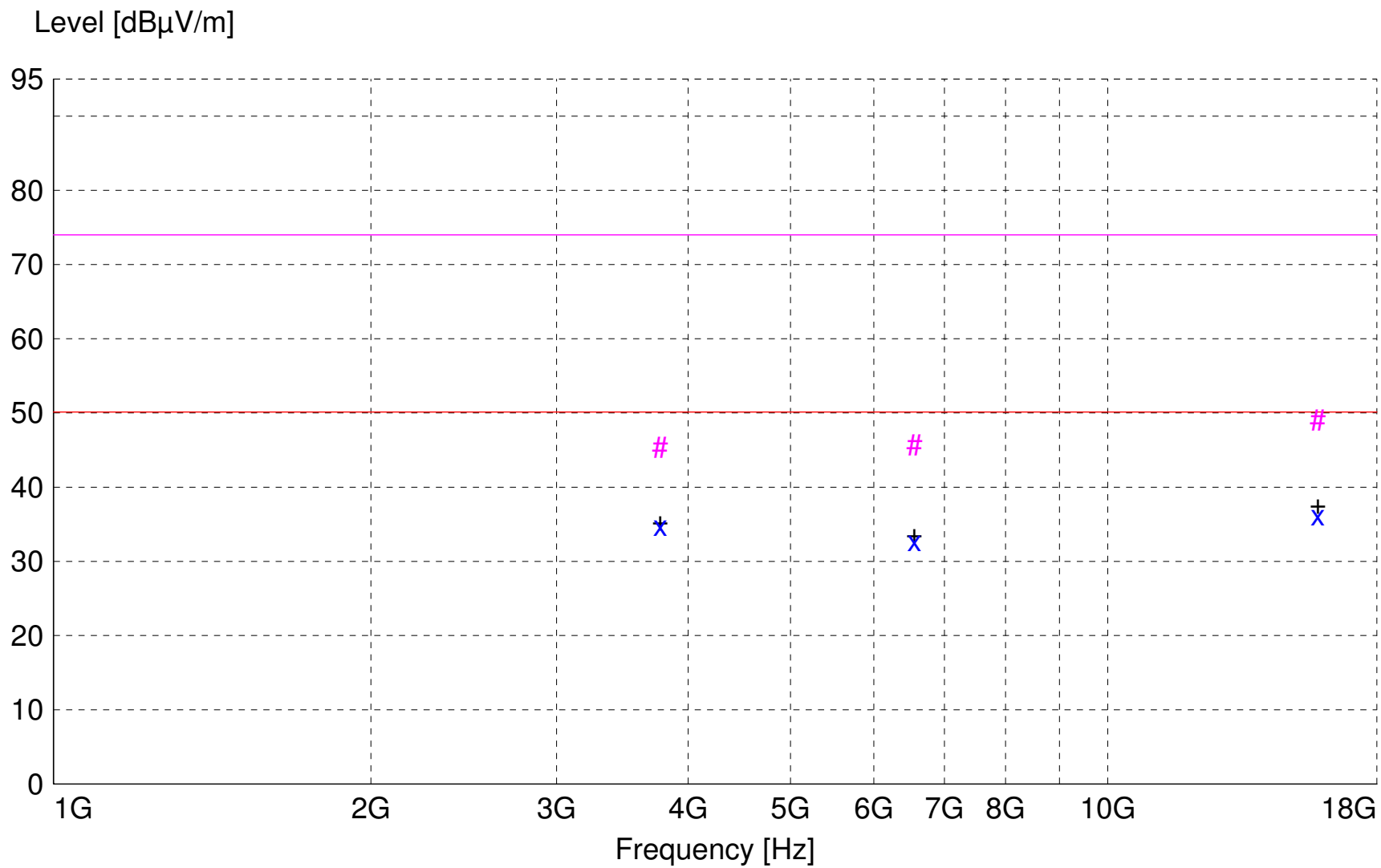
Test Set-up: EUT Measured at 3 Meters with HORIZONTAL Antenna Polarization

Sample Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)
24.6 = 35.51 + (-22.1) + 11.20

Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)
15.4 = 40 - 24.6

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
-	Background Scan Peak Detector (Optional)
-	Background Scan Average Detector (Optional)



x x : MES A129a_sh_Average
: MES A129a_sh_Peak
+ + : MES A129a_sh_Peak_List
——— LIM FCC Class B 3m AVG c 3m AVG lim corr for duty cycle
——— LIM FCC Class B F 3m PK Field Strength PEAK Limit 3m

MEASUREMENT RESULT: "A129a_sh_Final"

12/9/2016 11:05AM

Frequency MHz	Level dBµV	Antenna Factor dBµV/m	System Loss dB	Total Level dBµV/m	Limit dBµV/m	Margin dB	Height Ant. m	EuT Angle deg	Final Detector	Comment
15827.200000	36.16	37.28	-37.2	36.2	50.1	13.9	1.50	0	AVERAGE	noise floor
3763.300000	41.56	32.49	-39.2	34.8	50.1	15.3	2.12	177	AVERAGE	None
6556.300000	35.65	34.39	-37.3	32.8	50.1	17.4	1.50	0	AVERAGE	noise floor
15827.200000	49.02	37.28	-37.2	49.1	74.0	24.9	1.50	0	MAX PEAK	noise floor
6556.300000	48.62	34.39	-37.3	45.7	74.0	28.3	1.50	0	MAX PEAK	noise floor
3763.300000	52.07	32.49	-39.2	45.4	74.0	28.6	2.12	177	MAX PEAK	None

RSS-247 & FCC Part 15.407

Electric Field Strength

EUT: PMP450 5.4 GHz SM
Manufacturer: Cambium Networks
Operating Condition: 69 deg C 27% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8600
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 64% duty cycle @ pwr setting 22 L,M,H channels
Date: 12-09-2016

TEXT: "Vert 1 meters"

Short Description: Test Set-up

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

Sample Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)
24.6 = 35.51 + (-22.1) + 11.20

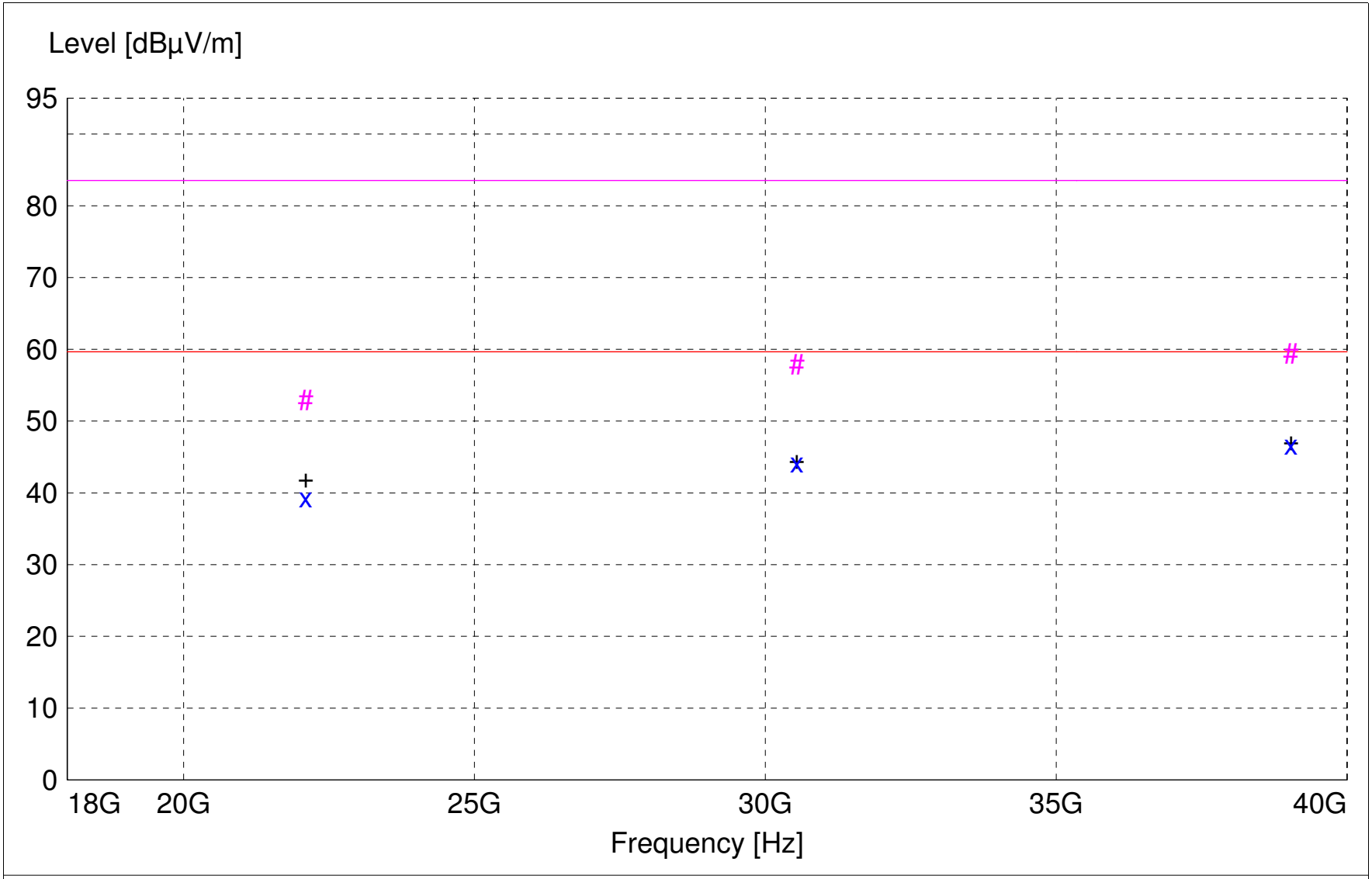
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)
15.4 = 40 - 24.6

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 A129b_sv_Average
: MES A129b_sv_Peak
+ + : MES A129b_sv_Peak_List
——— LIM FCC Class B 1m AVG c 1m AVG lim corr for duty cycle
——— LIM FCC Class B F 1m PK Field Strength Peak Limit 1m

MEASUREMENT RESULT: "A129b_sv_Final"

12/9/2016 1:04PM

Frequency MHz	Level dBµV	Antenna Factor dBµV/m	System Loss dB	Total Level dBµV/m	Limit dBµV/m	Margin dB	Height Ant. m	EuT Angle deg	Final Detector	Comment
39039.300000	49.78	41.60	-44.7	46.7	59.7	12.9	1.50	0	AVERAGE	noise floor
30542.700000	48.72	40.52	-45.0	44.2	59.7	15.4	1.50	0	AVERAGE	noise floor
22101.300000	49.72	40.15	-50.5	39.3	59.7	20.3	1.50	0	AVERAGE	noise floor
39039.300000	62.56	41.60	-44.7	59.5	83.5	24.0	1.50	0	MAX PEAK	noise floor
30542.700000	62.42	40.52	-45.0	57.9	83.5	25.6	1.50	0	MAX PEAK	noise floor
22101.300000	63.36	40.15	-50.5	53.0	83.5	30.6	1.50	0	MAX PEAK	noise floor

RSS-247 & FCC Part 15.407

Electric Field Strength

EUT: PMP450 5.4 GHz SM
Manufacturer: Cambium Networks
Operating Condition: 69 deg C 27% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8600
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 64% duty cycle @ pwr setting 22 L,M,H channels
Date: 12-09-2016

TEXT: "Horz 1 meters"

Short Description: Test Set-up

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

Sample Equations: Total Level(dBµV/m) = Level(dBµV) + System Loss(dB) + Antenna Factor(dBµV/m)
24.6 = 35.51 + (-22.1) + 11.20

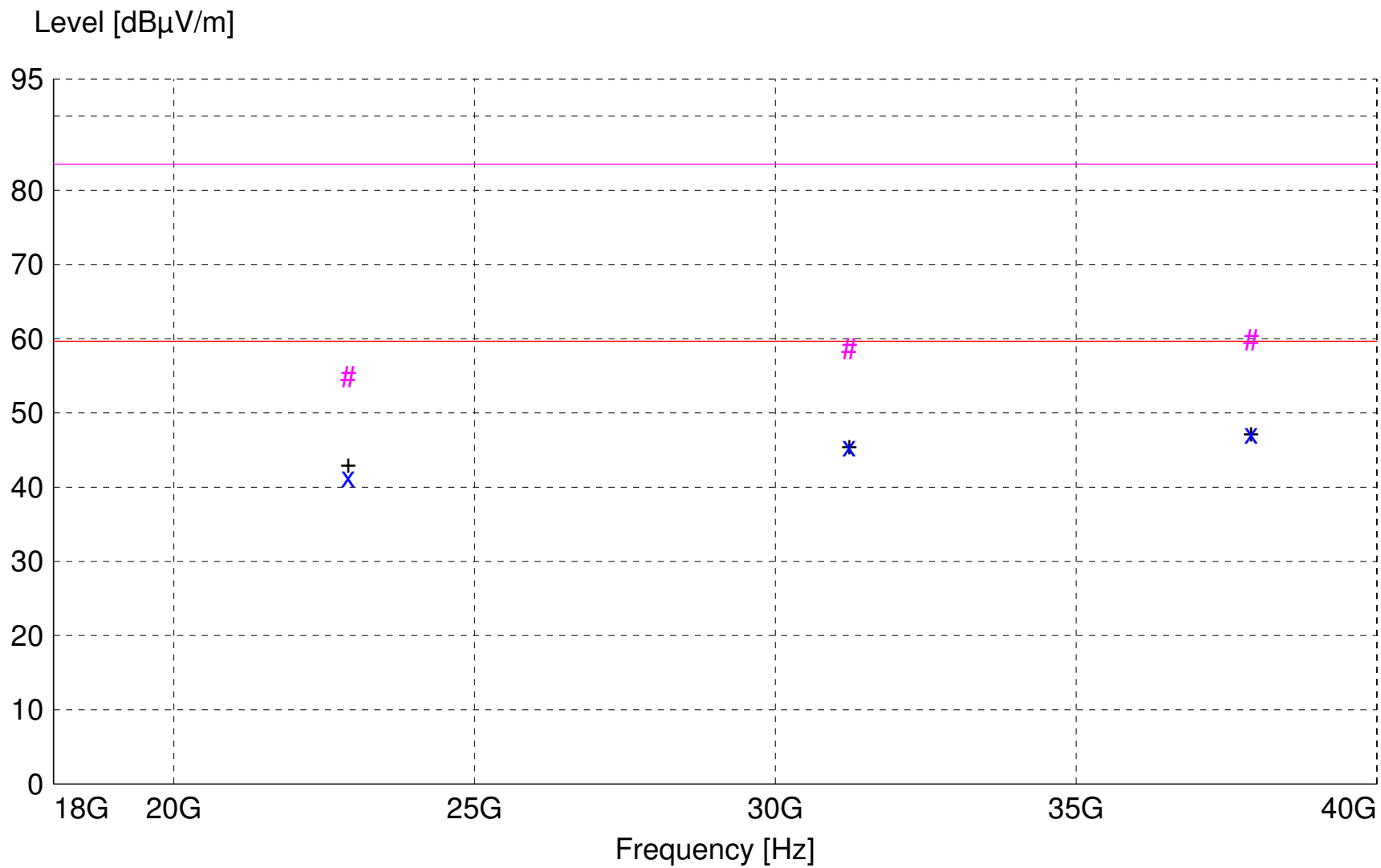
Margin(dB) = Limit(dBµV/m) - Total Level(dBµV/m)
15.4 = 40 - 24.6

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 A129b_sh_Average
: MES A129b_sh_Peak
+ + : MES A129b_sh_Peak_List
——— LIM FCC Class B 1m AVG c 1m AVG lim corr for duty cycle
——— LIM FCC Class B F 1m PK Field Strength Peak Limit 1m

MEASUREMENT RESULT: "A129b_sh_Final"

12/9/2016 1:53PM

Frequency MHz	Level dBµV	Antenna Factor dBµV/m	System Loss dB	Total Level dBµV/m	Limit dBµV/m	Margin dB	Height Ant. m	EuT Angle deg	Final Detector	Comment
37911.600000	49.87	41.54	-44.2	47.2	59.7	12.4	1.50	0	AVERAGE	noise floor
31229.700000	50.14	40.58	-45.3	45.4	59.7	14.2	1.50	0	AVERAGE	noise floor
22901.400000	50.23	40.13	-49.0	41.4	59.7	18.3	1.50	0	AVERAGE	noise floor
37911.600000	62.56	41.54	-44.2	59.9	83.5	23.6	1.50	0	MAX PEAK	noise floor
31229.700000	63.36	40.58	-45.3	58.7	83.5	24.9	1.50	0	MAX PEAK	noise floor
22901.400000	63.75	40.13	-49.0	54.9	83.5	28.6	1.50	0	MAX PEAK	noise floor

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 (1/0.64)
= **1.94 dB**

Duty cycle correction for voltage measurements = 20 log (1/0.64)
= **3.88 dB**

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%

END OF REPORT

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