



166 South Carter, Genoa City, WI 53128

Company: Cambium Networks
Model Tested: C036045A001A
Report Number: 22540
DLS Project: 8686

Code of Federal Regulations 47

PART 90—PRIVATE LAND MOBILE RADIO SERVICES

Subpart Z—Wireless Broadband Services in the 3650-3700 MHz Band

THE FOLLOWING **MEETS** THE ABOVE TEST SPECIFICATION
FOR A **CLASS III** PERMISSIVE CHANGE
(to add a 40 MHz channel bandwidth)

FCC ID: Z8H89FT0010

Formal Name: PMP450AP 3.65GHz OFDM Radio

Kind of Equipment: Point-to-Multipoint Digital Transmission Transceiver

Frequency Range: **3670 to 3680 MHz (40 MHz bandwidth) (in this report)**
3652.5 to 3697.5 MHz (5 MHz bandwidth) (in report #19784)
3655 to 3695 MHz (10 MHz bandwidth) (in report #19784)
3660 to 3690 MHz (20 MHz bandwidth) (in report #19784)

Test Configuration: Stand-alone

Model Number(s): C036045A001A, C036045A002A, C036045A003A, C036045A004A

Model Tested: C036045A001A

Serial Number: 0A003E407EEE

Date of Tests: February 3rd – 7th, 2017

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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Company:
Model Tested:
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Cambium Networks
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SIGNATURE PAGE

Report By:

A handwritten signature in black ink that reads "Craig Brandt". The signature is written in a cursive style with a long horizontal stroke at the end.

Craig Brandt
Test Engineer

Reviewed By:

A handwritten signature in black ink that reads "William Stumpf". The signature is written in a cursive style with a long horizontal stroke at the end.

William Stumpf
OATS Manager

Approved By:

A handwritten signature in black ink that reads "Brian J. Mattson". The signature is written in a cursive style with a long horizontal stroke at the end.

Brian Mattson
General Manager



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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.



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Model Tested: C036045A001A
Report Number: 22540
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1.0 Summary of Test Report

It was determined that the Cambium Networks PMP450AP 3.65GHz OFDM Radio, Model C036045A001A, complies with the requirements of CFR 47 Part 90 Subpart Z. The purpose of this test was to show FCC compliance of the PMP450AP 3.65GHz OFDM Radio, pursuant to a Class III Permissive Change to FCC ID: Z8H89FT0010. This report is being generated to show compliance of a 40 MHz channel bandwidth for the PMP450AP 3.65GHz OFDM Radio with an external 17 dBi Sector antenna being added to the software package of the device.

NOTE: AC line conducted emissions were reported to the FCC in report # 19784.

Radiated emissions in the frequency range 30 MHz to 1000 MHz were reported to the FCC in report # 19784.

Applicable Technical Requirements Tested:

Section	Description	Procedure	Note	Compliant?
Pt 90.1321 (a)	Duty Cycle of Test Unit - for RMS measurements	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02	3	NA
Pt 90.1321 (a) Pt 2.1046	Transmitter Output Power and Power Density	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 5.2.2.2	1	Yes
Pt 2.1049	Occupied Channel Bandwidth (99% power bandwidth)	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 4.2	1	Yes
Pt 90.1323 Pt 2.1051	Band Edge compliance – RF Conducted	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 6.0	1	Yes
Pt 90.1323 Pt 2.1053	Band Edge compliance – Radiated (cabinet radiation)	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 5.8	2	Yes
Pt 90.1323 (a) Pt 2.1051	Transmitter Unwanted Emissions – RF conducted	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 6.0	1	Yes
Pt 90.1323 Pt 2.1053	Transmitter Unwanted Emissions – Radiated (cabinet radiation)	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 5.8	2	Yes
Pt 2.1055	Frequency Stability	FCC KDB 971168 D01: Power Meas License Digital Systems v02r02, Section 9	1	Yes

Note 1: RF conducted measurement.

Note 2: Radiated emission measurement.

Note 3: Informative.



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2.0 Introduction

On February 3rd – 7th, 2017 the PMP450AP 3.65GHz OFDM Radio, Model C036045A001A, as provided from Cambium Networks, was tested to the requirements of CFR 47 Part 90 Subpart Z to be added to FCC ID: Z8H89FT0010 as a Class III Permissive Change. Testing was performed to show compliance of a 40 MHz channel bandwidth. 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

ISED Registration: 2060A-1

4.0 Description of Test Sample

Description:

Point-to-Multipoint 3.65 GHz Fixed Access Wireless Transceiver with Sector (17 dBi) external antenna with 5 MHz, 10 MHz, 20 MHz, or 40 MHz channel bandwidth. The 17 dBi antenna operates with OFDM modulation.

Type of Equipment / Frequency Range:

Stand-Alone /	3670 to 3680 MHz (40 MHz bandwidth)	(in this report)
	3652.5 to 3697.5 MHz (5 MHz bandwidth)	(in report #19784)
	3655 to 3695 MHz (10 MHz bandwidth)	(in report #19784)
	3660 to 3690 MHz (20 MHz bandwidth)	(in report #19784)



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4.0 Description of Test Sample (continued):

Physical Dimensions of Equipment Under Test:

Length: 8 in. Width: 2.25 in. Height: 9.5 in.

Power Source:

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

Internal Frequencies:

292kHz, 940-1000kHz, 4MHz (Switching Power Supply Frequencies)
40 MHz, 25 MHz, 20MHz

Transmit / Receive Frequencies Used For Test Purpose:

40 MHz Channel Bandwidth: Low channel: 3670 MHz
Middle channel: 3675 MHz
High channel: 3680 MHz

Type of Modulation(s):

OFDM: QPSK (worst case) used for testing, 16QAM, 64QAM, 256QAM

Description of Circuit Board(s) / Part Number:

Cambium Networks PC Board	P035000
17 dBi Sector Antenna	Laird C030045D901A revAA



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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.

RADIATED EMISSIONS 1-18 GHz

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Dates	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 40	837808/006	20 Hz – 40 GHz	6-23-16	6-23-17
Preamp	Ciao	CA118-4010	101	1GHz-18GHz	1-9-17	1-9-18
Horn Antenna	EMCO	3115	9502-4451	1-18GHz	6-1-15	6-1-17
Test Software	Rohde & Schwarz	ESK-1	V1.7.1	N/A	N/A	N/A

Additional 18-40 GHz

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Dates	Cal Due Dates
High Pass Filter	K & L	50140 11SH10-18000/T40000-K-K	8	18GHz-40GHz	1-9-17	1-9-18
Preamp	Planar	PTB-60-2040-5R0-10-115VAC-292FF	PL3292	18GHz-40GHz	6-6-16	6-6-17
Horn Antenna	A.H. Systems	SAS-574	222	18GHz-40GHz	3-14-16	3-14-18
Test Software	Rohde & Schwarz	ESK-1	V1.7.1	N/A	N/A	N/A

Temperature Chamber

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Dates	Cal Due Dates
Temperature Chamber	Test Equity	1007C	R035716	-73° C to +175° C	N/A	N/A
Digital Thermometer	Tenma	72-2060	723662	-50° C to +200° C	9-1-16	9-1-17
Digital Multimeter	Fluke	115	18741295	N/A	6-10-16	6-10-17



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5.0 Test Equipment (continued)

RF Conducted

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Dates	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 40	837808/006	20 Hz – 40 GHz	6-23-16	6-23-17
Attenuator 20 dB	MCE/WEINSCHL	5955A-20	0256	DC-40GHz	6-5-16	6-5-17

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 FCC Publication KDB 971168 D01 Power Meas License Digital Systems v02r02, 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.

Radiated Emissions Measurement Arrangement:

All radiated emission measurements were performed at D.L.S. Electronic Systems, Inc. and set up according to FCC Publication KDB 971168 D01: Power Meas License Digital Systems v02r02, 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



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7.0 Test Conditions

Temperature and Humidity:

70°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

At a temperature of -20 °C, the power setting for the low channel was changed from 13 to 12 in order to meet the -13 dBm lower band-edge limit.

At a temperature of -20 °C, the power setting for the high channel was changed from 16 to 15 in order to meet the -13 dBm upper band-edge limit.

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.

Mode of operation: Measurements were taken for QPSK modulation (as worst case) at the lowest, middle, and highest channels of operation. Output Port A & Port B were tested. Port A was tested as representative of Port B. Port A was equal to/or worst case over Port B. 40 MHz channel bandwidth was tested.

Emission Designators: 5M0X1D, 10M0X1D, 20M0X1D, 40M0X1D

10.0 Results

Measurements were performed in accordance with FCC Publication KDB 971168 D01: Power Meas License Digital Systems v02r02. Graphical and tabular data can be found in Appendix B at the end of this report.



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11.0 Conclusion

The PMP450AP 3.65GHz OFDM Radio, Model C036045A001A, as provided from Cambium Networks tested on February 3rd – 7th, 2017 **meets** the requirements of CFR 47 Part 90 Subpart Z to have a 40 MHz channel bandwidth added to FCC ID: Z8H89FT0010 as a Class III Permissive Change.



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Model Tested:
Report Number:
DLS Project:

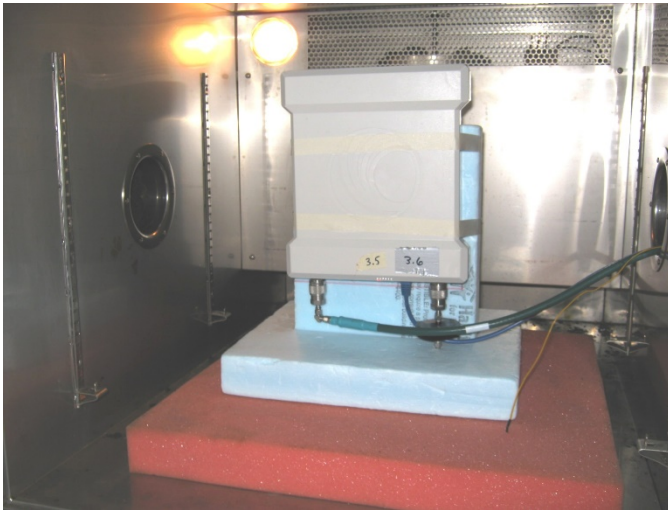
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Appendix A – Test Photos

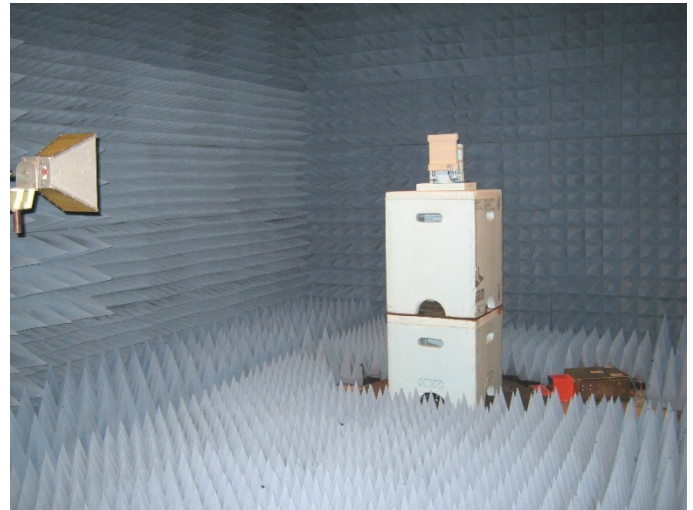
Photo Information and Test Setup

PMP450AP 3.65GHz OFDM Radio
Cat 5e Ethernet cable. (10 meter un-shielded with plastic connectors)

RF Conducted



Radiated



Radiated - front



Radiated - back





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Appendix B – Measurement Data

B1.0 Duty Cycle of test unit

Rule Part: Informational

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02

Limits: Informational

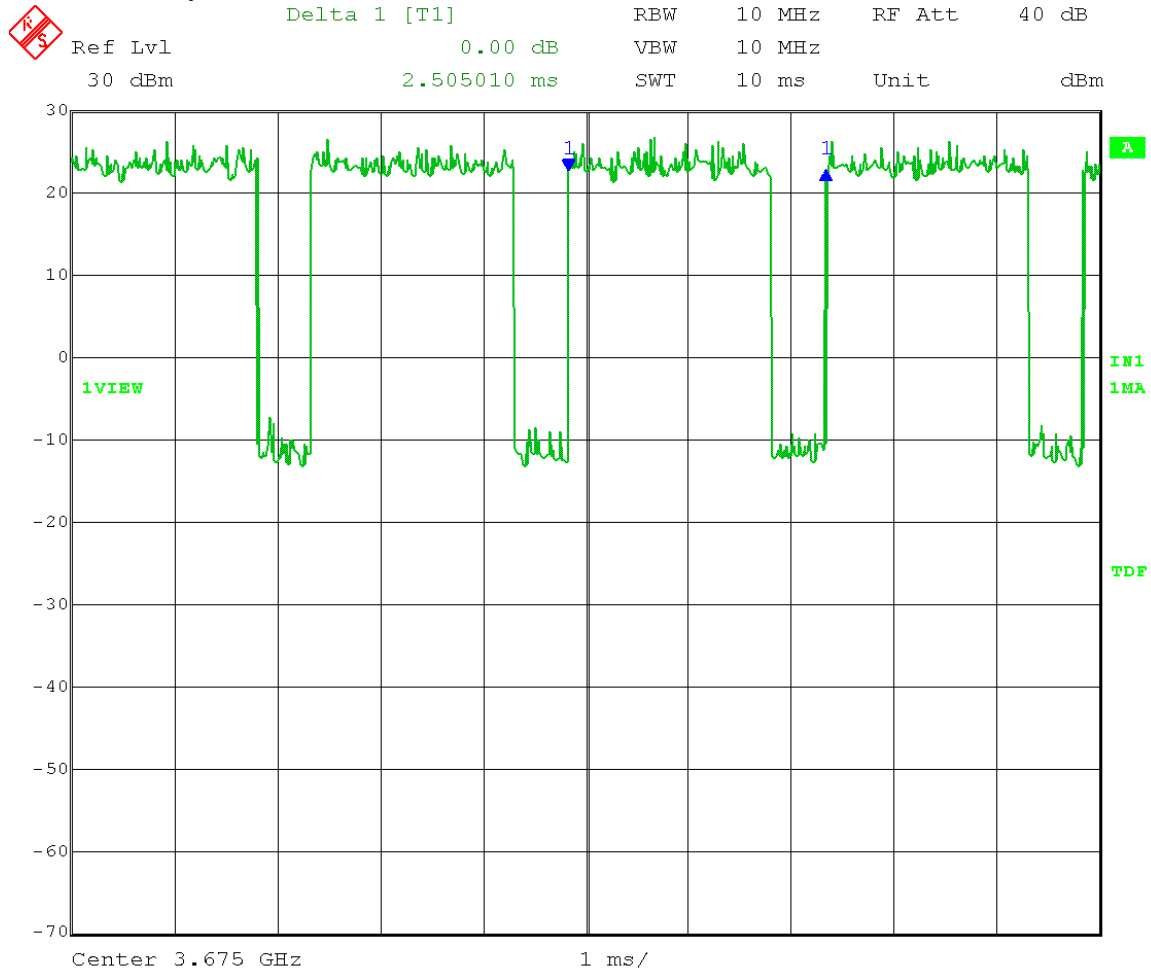
Results: Duty cycle = $(1.983968 \text{ ms}) / (2.505010 \text{ ms}) \times 100 = 79.2\%$
Duty cycle correction for power measurements = $10 \log (1/0.792) = \mathbf{1.01 \text{ dB}}$

Notes: None

Test Date: 02-03-2017
 Company: Cambium Networks
 EUT: PMP450 3.65 GHz AP
 Test: Duty Cycle during testing
 Operator: Craig B
 40 MHz channel bandwidth; QPSK
 Comment: Duty cycle = (1.983968 ms) / (2.505010 ms) x 100 = 79.2%

Duty cycle correction for power measurements = $10 \log (1/0.792) = 1.01 \text{ dB}$

Time of one cycle: 2.505010 ms

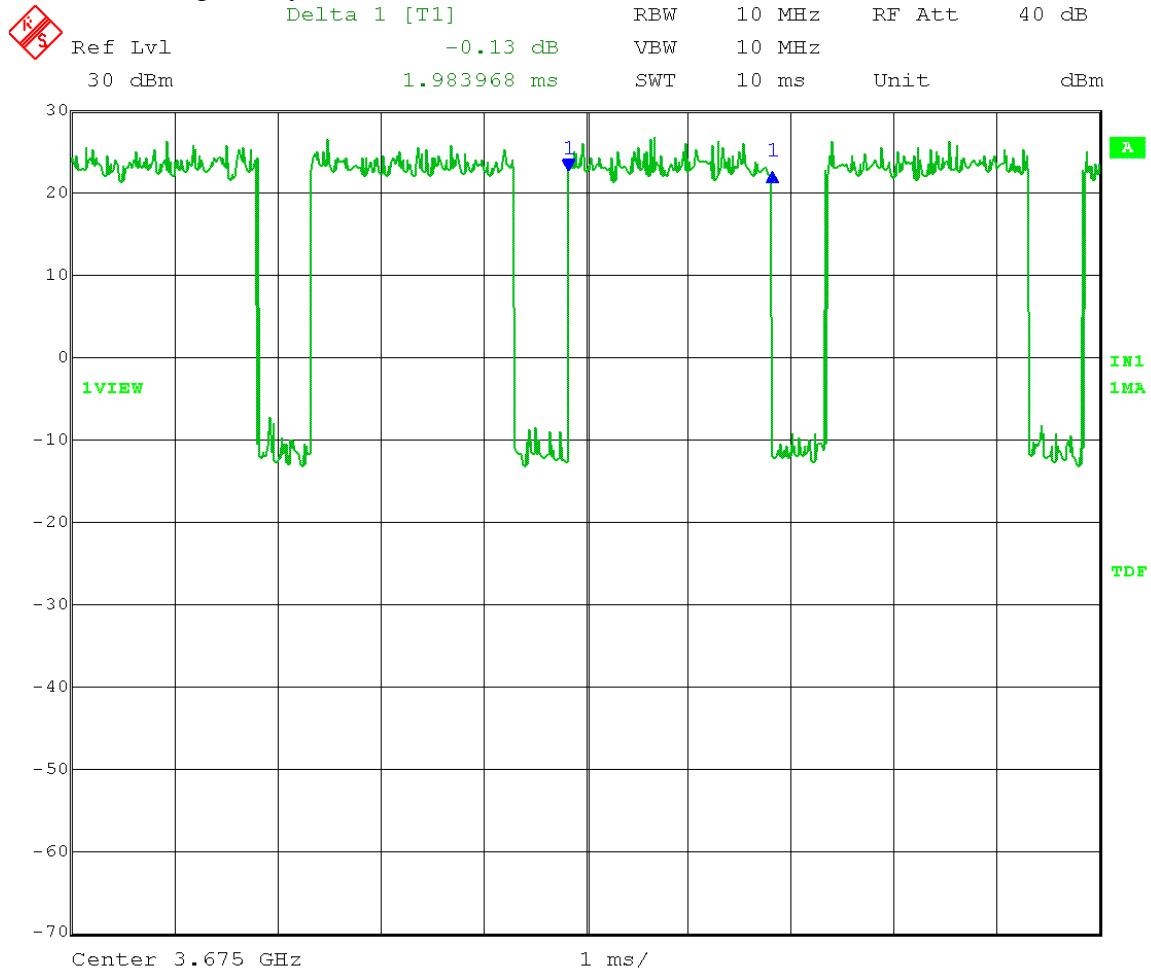


Date: 3.FEB.2017 16:28:47

Test Date: 02-03-2017
 Company: Cambium Networks
 EUT: PMP450 3.65 GHz AP
 Test: Duty Cycle during testing
 Operator: Craig B
 40 MHz channel bandwidth; QPSK
 Comment: Duty cycle = (1.983968 ms) / (2.505010 ms) x 100 = 79.2%

Duty cycle correction for power measurements = $10 \log (1/0.792) = 1.01 \text{ dB}$

ON time during one cycle: 1.983968 ms



Date: 3.FEB.2017 16:29:21



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Appendix B – Measurement Data

B2.0 Transmitter Output Power and Power Density

Rule Part: FCC Part 90.1321(a)
FCC Part 2.1046

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02
Section 5.2.2.2 – Power integration with spectrum analyzer
followed by duty cycle correction

Limit: FCC Part 90.1321(a), base and fixed stations
e.i.r.p.: 25 W (44 dBm) in any 25 MHz bandwidth
e.i.r.p.: 1 W (30 dBm) in any 1 MHz bandwidth

Results: Compliant

Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks. Only tested output port A as determined worst case.

Test Date: 02-03-2017, 02-06-2017
 Company: Cambium Networks
 EUT: PMP450 3.65 GHz AP
 Tests: Transmitter Maximum E.I.R.P.
 Operator: Craig B
 Comment: 40 MHz channel BW mode; Port A
 Antenna Gain = 17 dBi
 Recorded levels are measured RF conducted levels + 17 dBi antenna gain
 + 3 dB (2-port MIMO operation) + 1.01 dB (correction for duty cycle)

EIRP Limit: 25 W / 25 MHz; 1 W / 1 MHz
 = 44 dBm / 25 MHz; 30 dBm / 1 MHz

RBW = 1 MHz; VBW = 3 MHz; **Detector = RMS**
 Trace mode = max hold; **Sweep time = 10 seconds per Cambium Networks**
 Span = 1.5 x nominal channel bandwidth
 Measurement using peak-search function of spectrum analyzer

Band power integrated over a 25 MHz bandwidth for EIRP / 25 MHz measurement
 (span = 60 MHz)

Peak EIRP Power (dBm): **Low channel (3670 MHz)**

Power setting 13

Modulation Type	120 V +20 °C	
QPSK	EIRP / 25 MHz	EIRP / 1 MHz
	27.54	14.70

Peak EIRP Power (dBm): **Mid channel (3675 MHz)**

Power setting 25

Modulation Type	120 V +20 °C	
QPSK	EIRP / 25 MHz	EIRP / 1 MHz
	39.23	26.46

Peak EIRP Power (dBm): **High channel (3680 MHz)**

Power setting 16

Modulation Type	120 V +20 °C	
QPSK	EIRP / 25 MHz	EIRP / 1 MHz
	30.11	17.48



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Appendix B – Measurement Data

B3.0 Channel Bandwidth

Rule Part: FCC Part 2.1049

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02
Section 4.2 – power bandwidth (99%)

Limit: Informational

Results: 40 MHz channel measured 36.91 MHz

Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks. Only tested output port A as determined worst case.

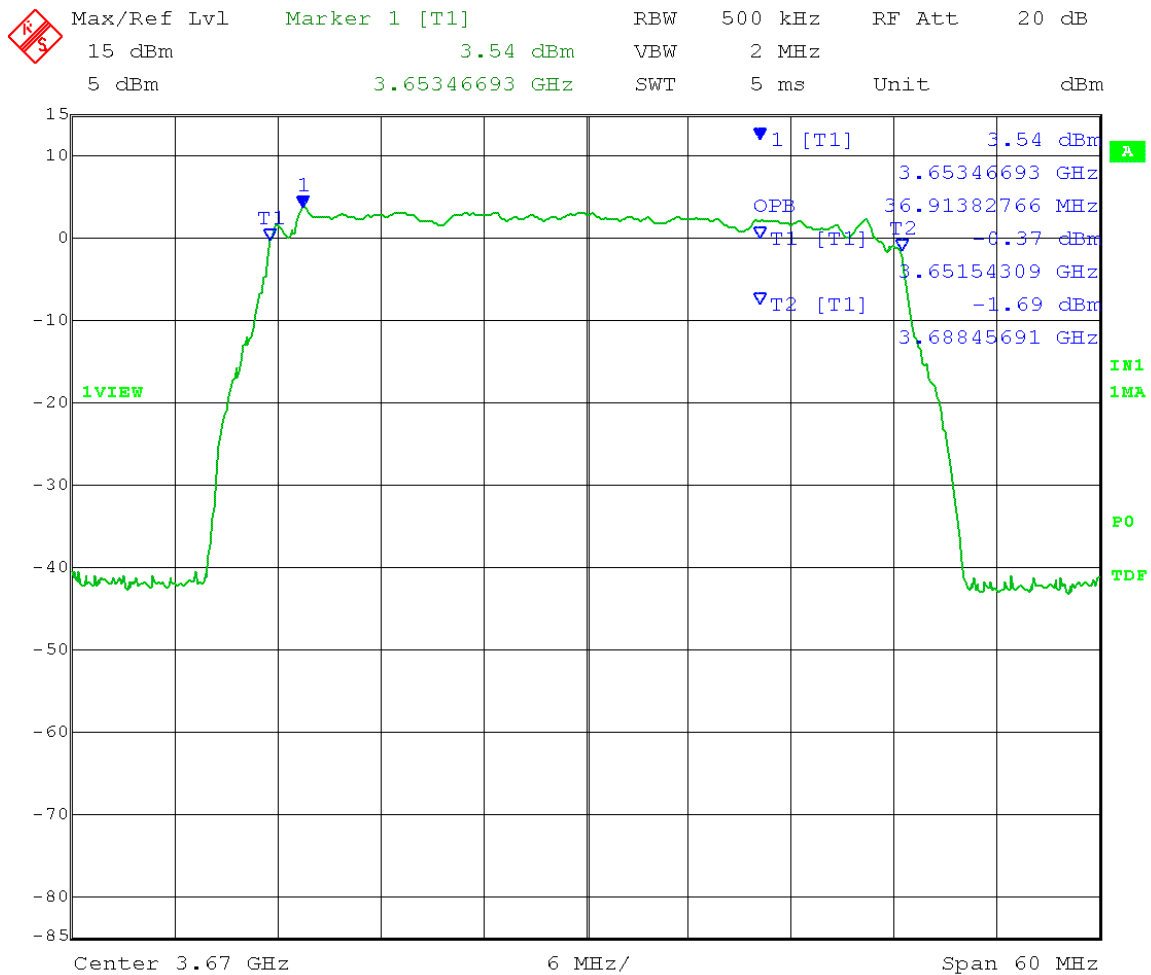
Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Occupied Bandwidth (99% power) - Conducted
Operator: Craig B

Comment: **Low Channel: Transmit = 3670 MHz**

Output power setting: 13
Output port A

40 MHz channel BW
Modulation: QPSK

Occupied Bandwidth = 36.91 MHz



Date: 6.FEB.2017 12:03:08

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Occupied Bandwidth (99% power) - Conducted
Operator: Craig B

Comment: Mid Channel: Transmit = 3675 MHz

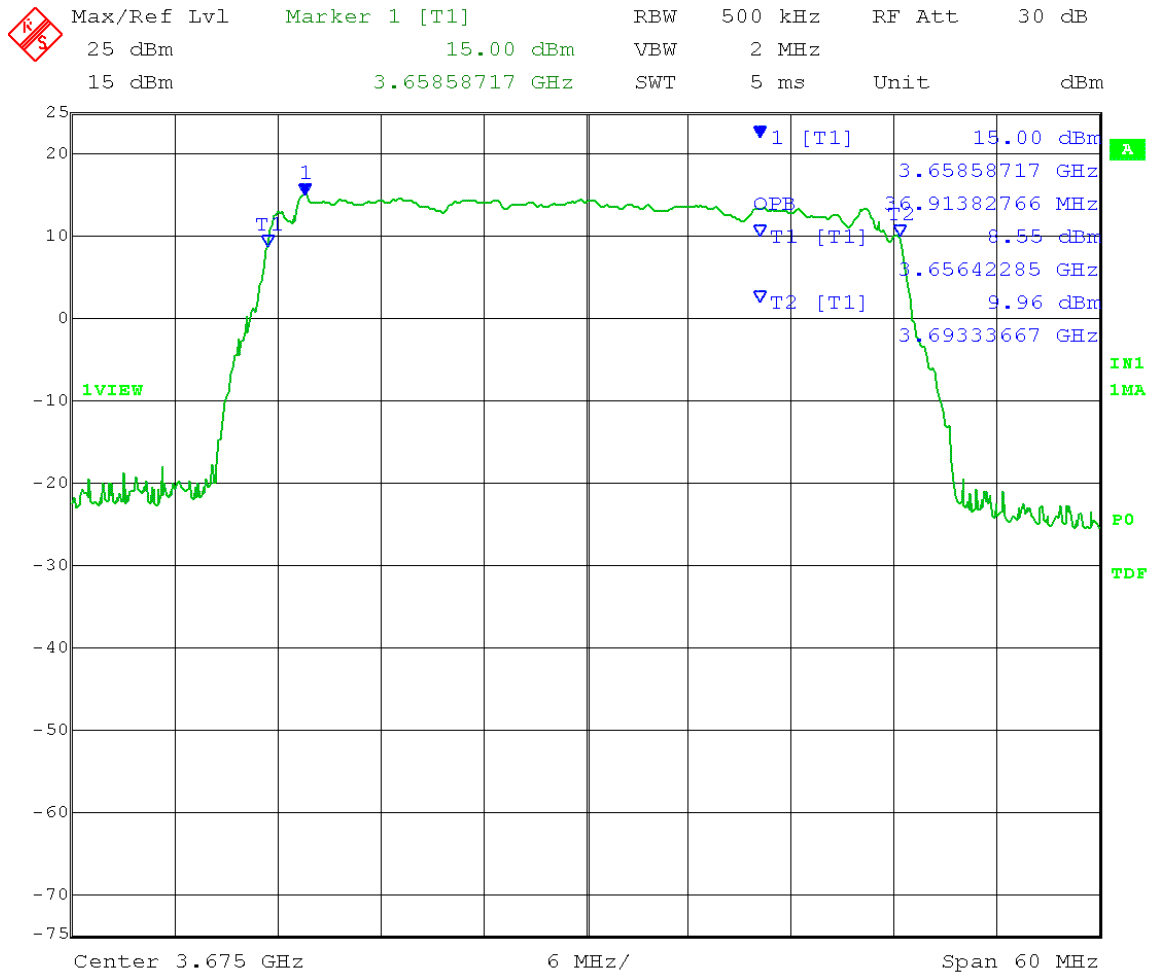
Output power setting: 25

Output port A

40 MHz channel BW

Modulation: QPSK

Occupied Bandwidth = 36.91 MHz



Date: 6.FEB.2017 12:05:24

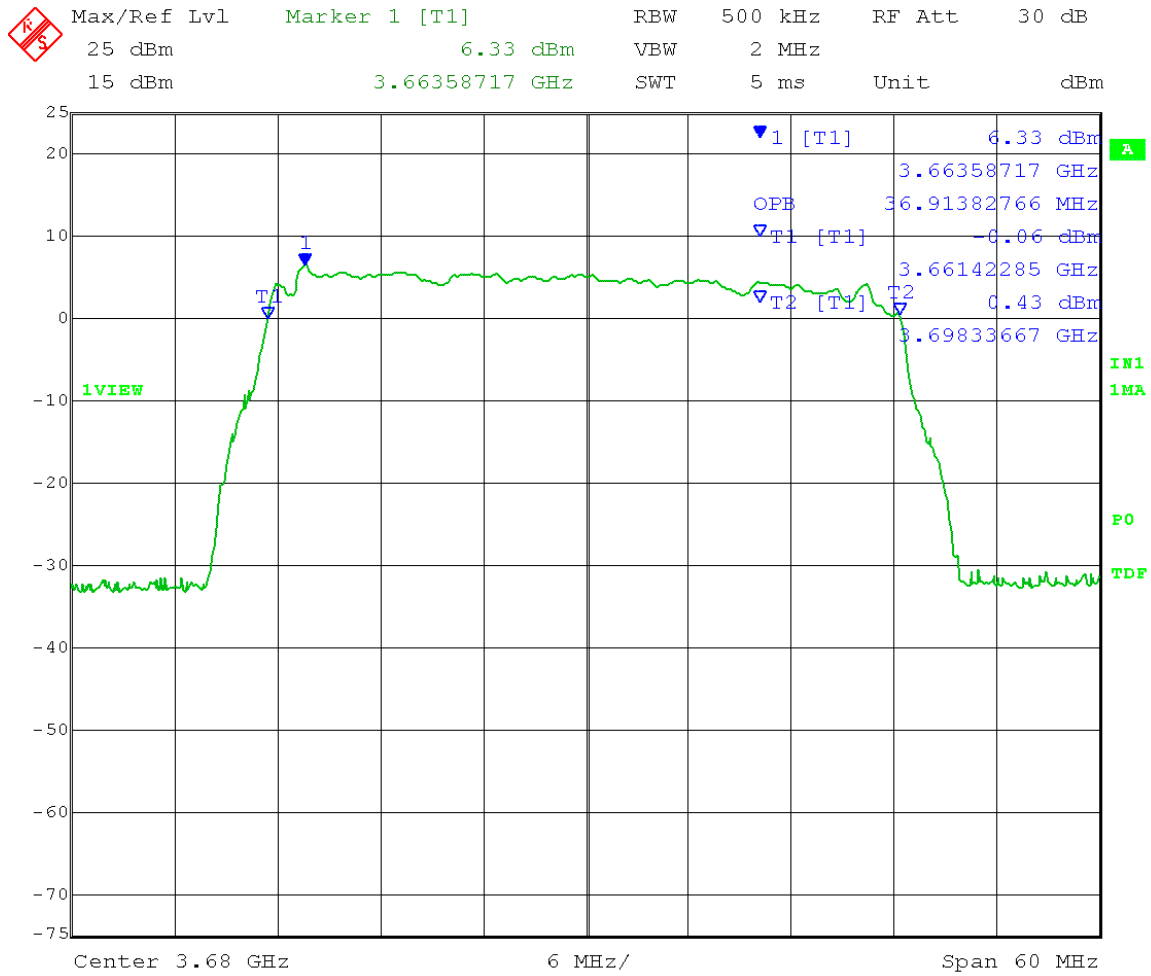
Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Occupied Bandwidth (99% power) - Conducted
Operator: Craig B

Comment: High Channel: Transmit = 3680 MHz

Output power setting: 16
Output port A

40 MHz channel BW
Modulation: QPSK

Occupied Bandwidth = 36.91 MHz



Date: 6.FEB.2017 12:08:50



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Appendix B – Measurement Data

B4.0 Band Edge compliance – RF Conducted

Rule Part: FCC Part 90.1323
FCC Part 2.1051

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02
Section 6.0 – at Antenna Terminals

The EUT was connected to a spectrum analyzer through a cable and 20 dB attenuator.
The output power set to the same level as was used in the Transmitter Output Power test.

Limit: FCC Part 90.1323
The power of any emission outside the frequency band 3650-3700 MHz shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10} (P)$ dB, where P is measured in watts.

Sample calculation: Measured mean output power of one port = 22.04 dBm.
 $22.04 \text{ dBm} + 17 \text{ dBi antenna gain} + 3 \text{ dB (because there are 2 output ports)}$
 $= 42.04 \text{ dBm} = 15.996 \text{ Watts}$
 $\text{Limit (dBc)} = 43 + 10 \log (15.996) = 55.04 \text{ dB}$
 $42.04 \text{ dBm} - 55.04 \text{ dB} = \mathbf{-13 \text{ dBm}}$

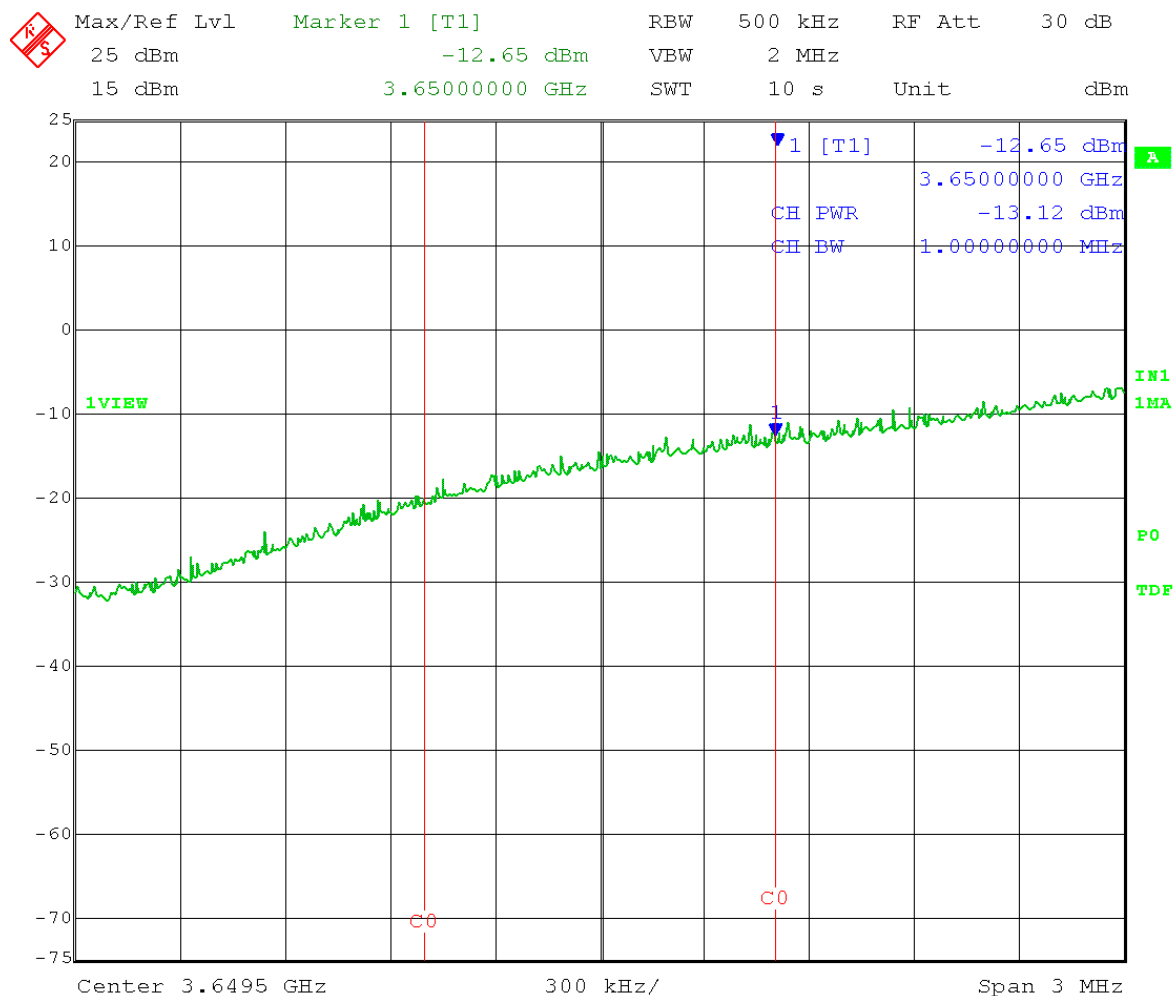
Results: Compliant

Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks. Only tested output port A as determined worst case.

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

Power level at band edge = -13.12 dBm/MHz

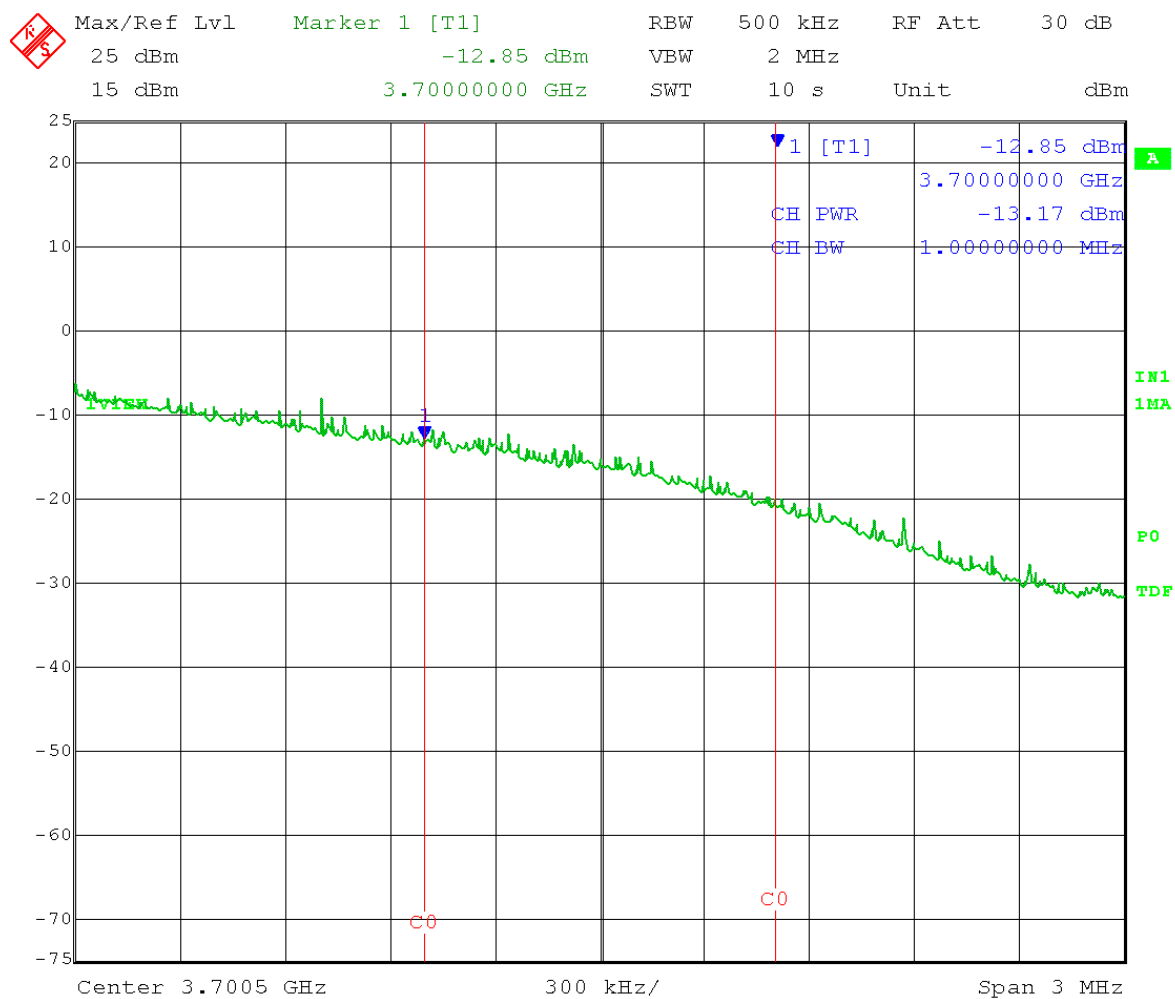


Date: 6.FEB.2017 10:54:02

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Upper Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

Power level at band edge = -13.17 dBm/MHz



Date: 6.FEB.2017 11:03:22

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold

Mid Channel: Transmit = 3675 MHz

Output power setting: 25

Channel bandwidth: 40 MHz

Output port: A

Lower band edge frequency = 3650 MHz

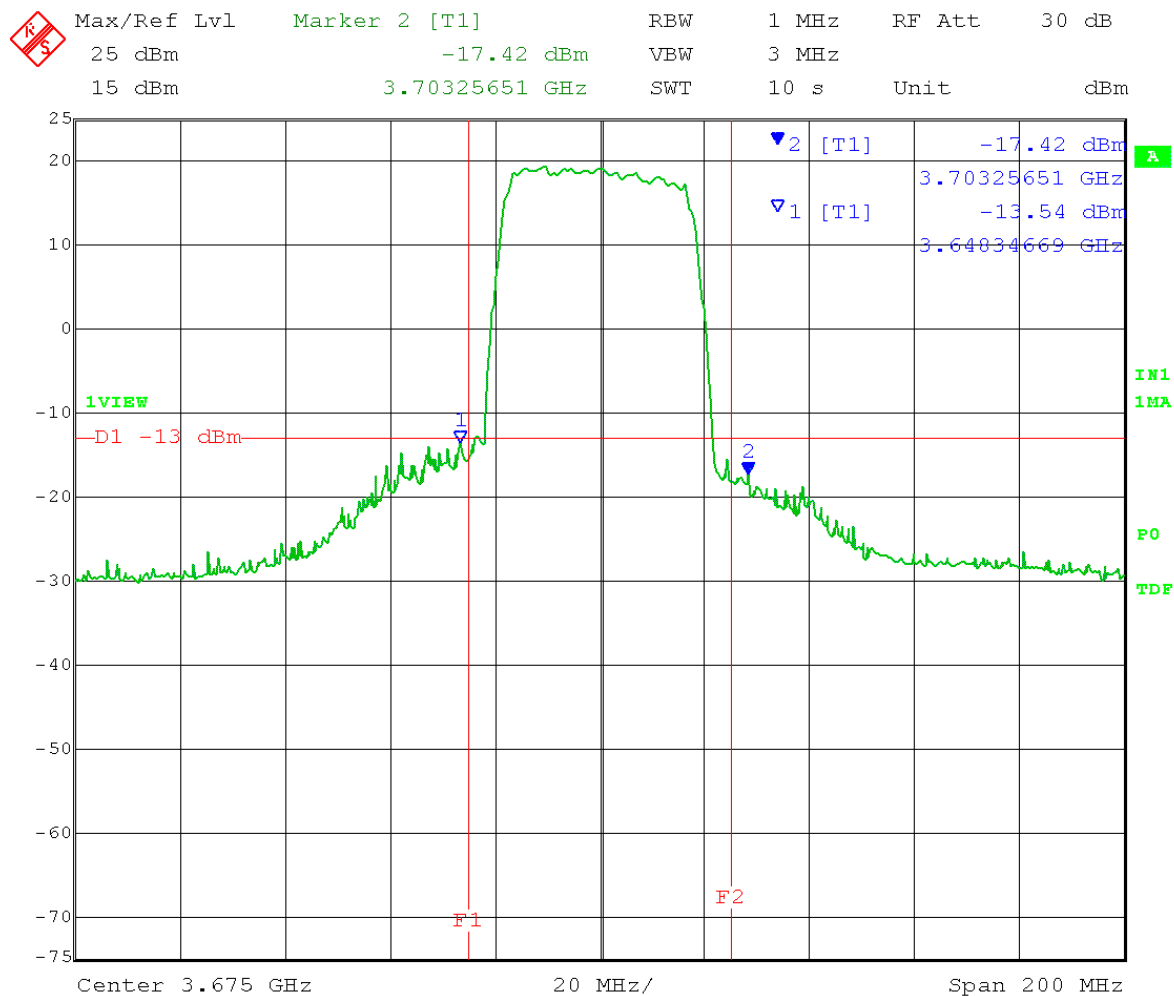
Upper band edge frequency = 3700 MHz

Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz

F1 = 3650 MHz; F2 = 3700 MHz

Power level at lower band edge = -13.54 dBm/MHz

Power level at upper band edge = -17.42 dBm/MHz



Date: 6.FEB.2017 11:22:29



166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C036045A001A
Report Number:	22540
DLS Project:	8686

Appendix B – Measurement Data

B5.0 Band Edge compliance - Radiated With 50 Ohm terminations on antenna ports (cabinet radiation)

Rule Part: FCC Part 90.1323
FCC Part 2.1053

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02
Section 5.8 – Radiated measurements

Limit: FCC Part 90.1323
The power of any emission outside the frequency band 3650-3700 MHz shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB, where P is measured in watts.

Sample calculation: Measured mean output power of one port = 22.04 dBm.
 $22.04 \text{ dBm} + 17 \text{ dBi antenna gain} + 3 \text{ dB (because there are 2 output ports)}$
 $= 42.04 \text{ dBm} = 15.996 \text{ Watts}$
 $\text{Limit (dBc)} = 43 + 10 \log(15.996) = 55.04 \text{ dB}$
 $42.04 \text{ dBm} - 55.04 \text{ dB} = \mathbf{-13 \text{ dBm}}$

Results: Compliant

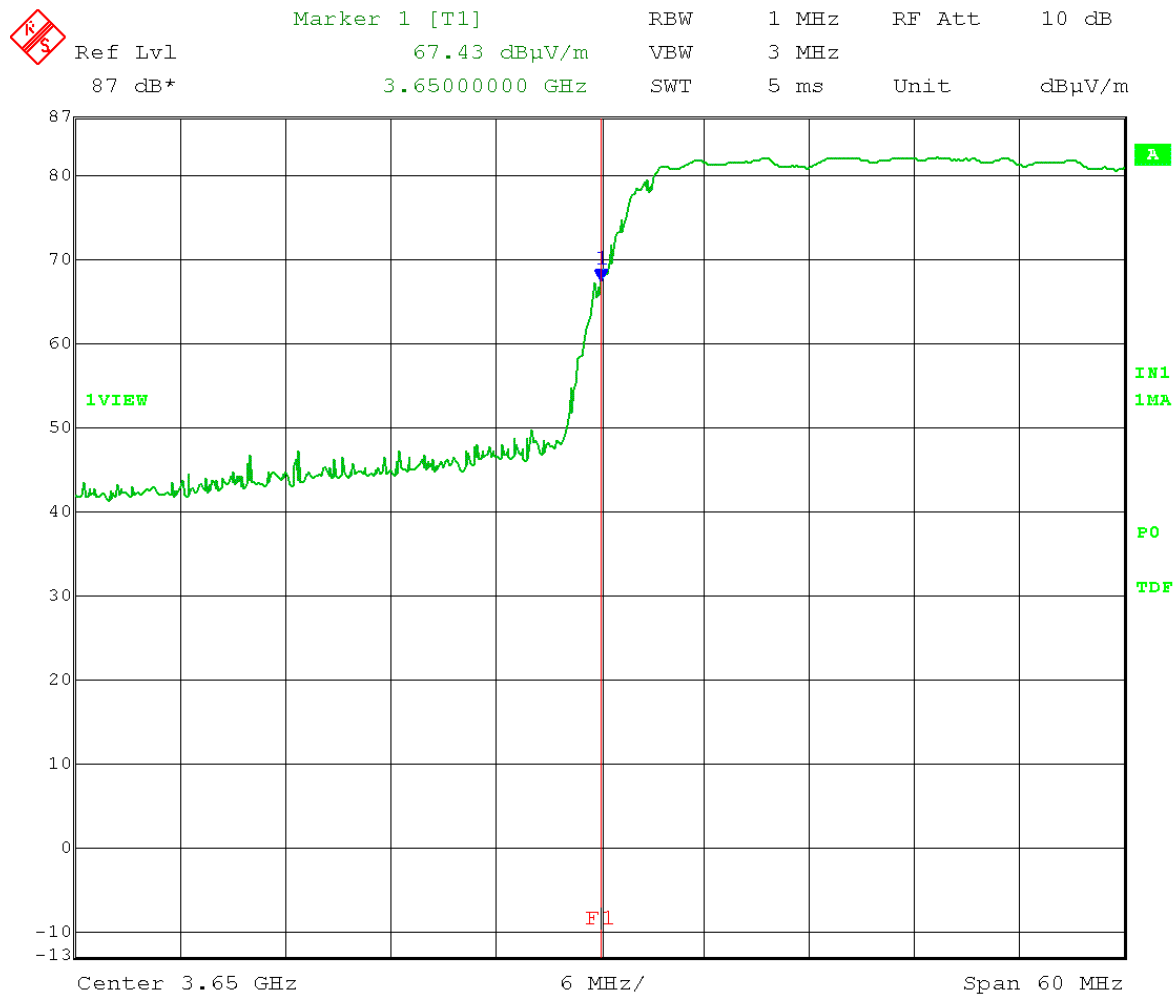
Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks. Both ports were active during this test.

Test Date: 02-06-2017
 Company: Cambium Networks
 EUT: PMP450 3.65 GHz AP
 Test: Lower Band-Edge Measurements – Radiated from cabinet
 Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
 Detector = Peak Sweep = auto couple
 Trace = max hold
 Low Channel: Transmit = 3670 MHz Output power setting: 25
 Channel bandwidth: 40 MHz Both ports active and 50Ω terminated
 Lower band edge frequency = 3650 MHz
 Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
 EIRP(dBm) = $E(\text{dB}\mu\text{V/m}) + 20\log(d) - 104.8$ where d is the measurement distance in meters.

Power level at band edge = $67.43 + 20\log(3) - 104.8 = -27.83 \text{ dBm/MHz}$

Vertical:



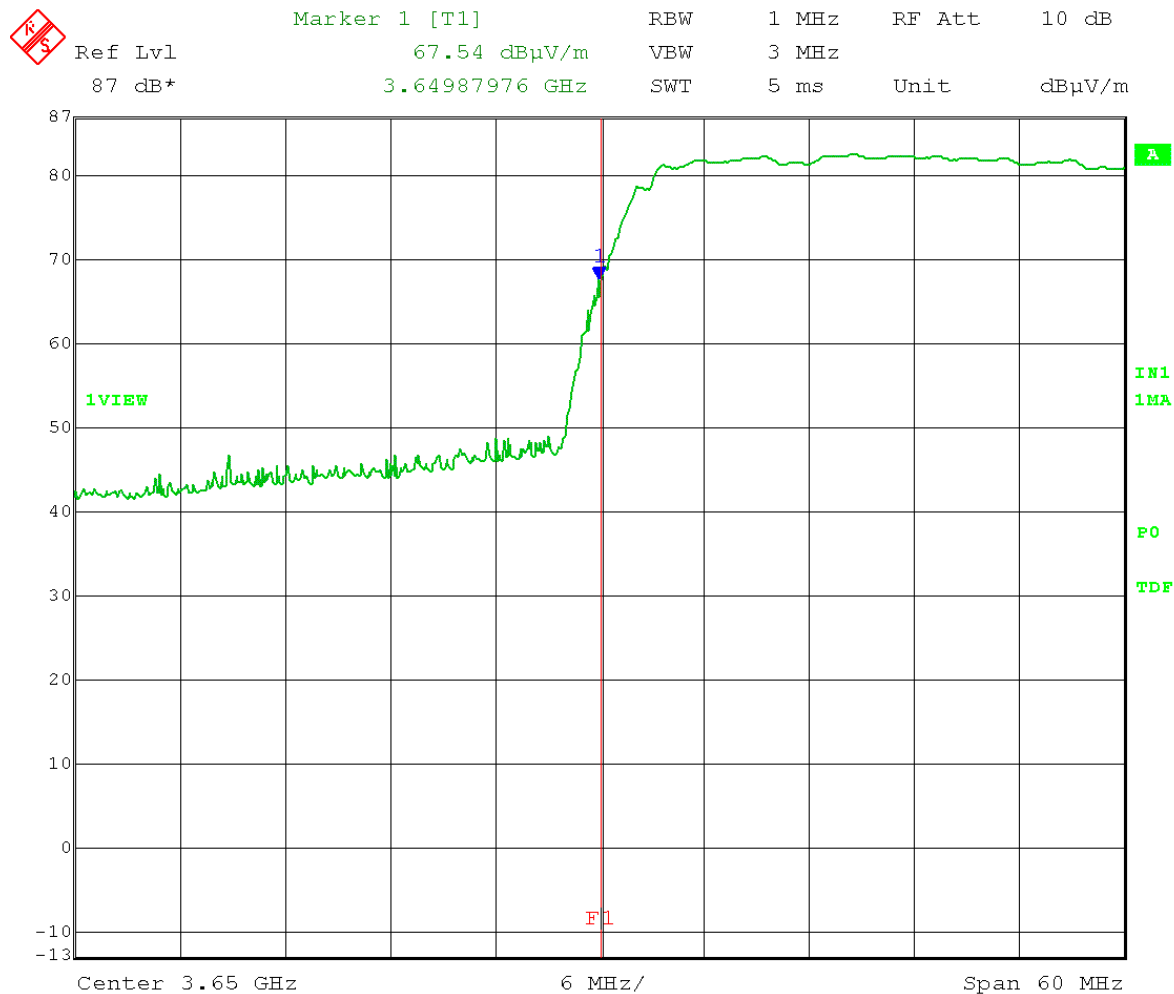
Date: 6.FEB.2017 14:06:50

Test Date: 02-06-2017
 Company: Cambium Networks
 EUT: PMP450 3.65 GHz AP
 Test: Lower Band-Edge Measurements – Radiated from cabinet
 Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
 Detector = Peak Sweep = auto couple
 Trace = max hold
 Low Channel: Transmit = 3670 MHz Output power setting: 25
 Channel bandwidth: 40 MHz Both ports active and 50Ω terminated
 Lower band edge frequency = 3650 MHz
 Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
 EIRP(dBm) = $E(\text{dB}\mu\text{V/m}) + 20\log(d) - 104.8$ where d is the measurement distance in meters.

Power level at band edge = $67.54 + 20\log(3) - 104.8 = -27.72 \text{ dBm/MHz}$

Horizontal:



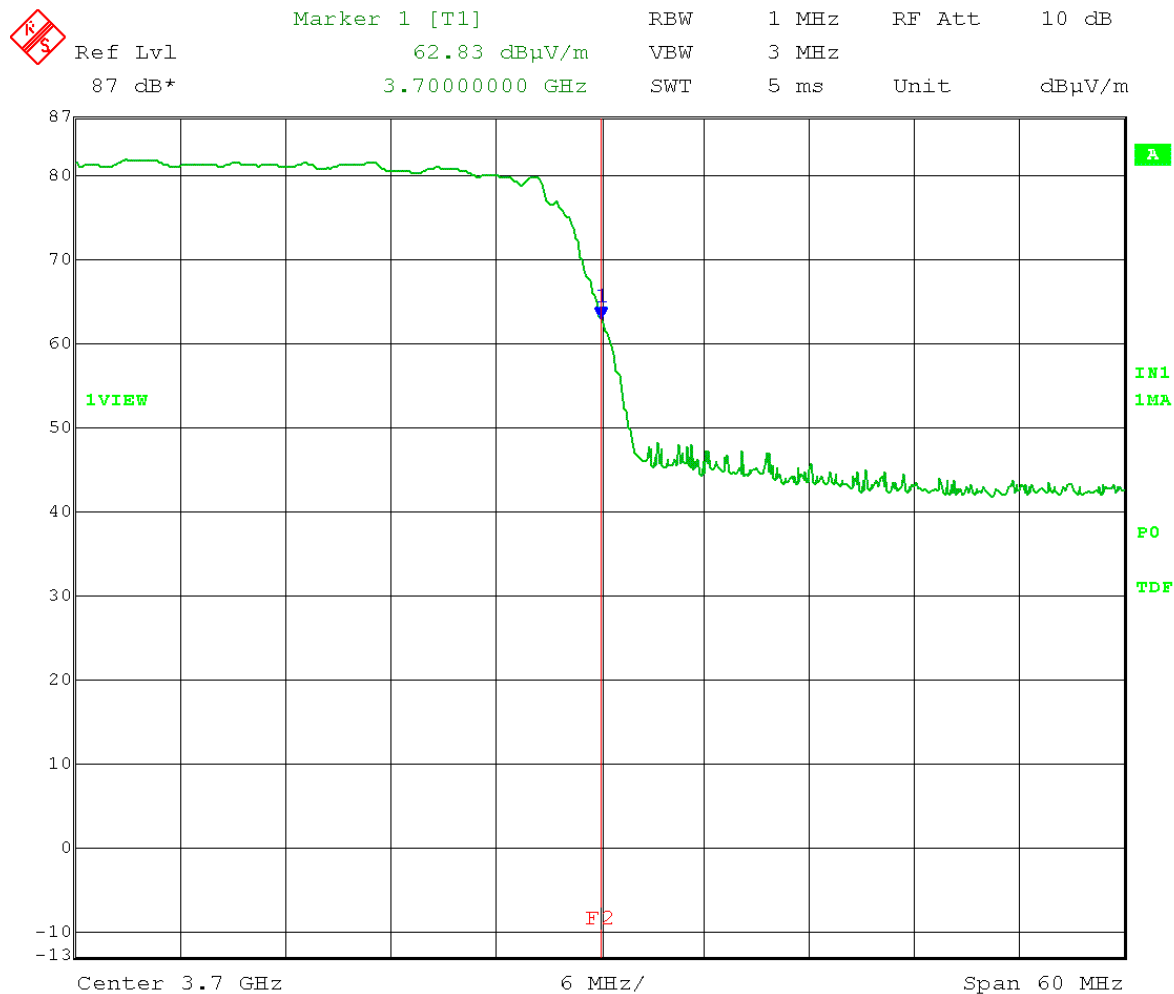
Date: 6.FEB.2017 14:15:11

Test Date: 02-06-2017
 Company: Cambium Networks
 EUT: PMP450 3.65 GHz AP
 Test: Upper Band-Edge Measurements – Radiated from cabinet
 Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
 Detector = Peak Sweep = auto couple
 Trace = max hold
 High Channel: Transmit = 3680 MHz Output power setting: 25
 Channel bandwidth: 40 MHz Both ports active and 50Ω terminated
 Upper band edge frequency = 3700 MHz
 Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
 EIRP(dBm) = $E(\text{dB}\mu\text{V/m}) + 20\log(d) - 104.8$ where d is the measurement distance in meters.

Power level at band edge = $62.83 + 20\log(3) - 104.8 = -32.43 \text{ dBm/MHz}$

Vertical:



Date: 6.FEB.2017 14:27:40

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Upper Band-Edge Measurements – Radiated from cabinet
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 25
Channel bandwidth: 40 MHz Both ports active and 50Ω terminated
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
 $EIRP(dBm) = E(dB\mu V/m) + 20\log(d) - 104.8$ where d is the measurement distance in meters.

Power level at band edge = $65.10 + 20\log(3) - 104.8 = -30.16$ dBm/MHz

Horizontal:



Date: 6.FEB.2017 14:22:31



166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C036045A001A
Report Number:	22540
DLS Project:	8686

Appendix B – Measurement Data

B6.0 Transmitter Unwanted Emissions – RF conducted

Rule Part: FCC Part 90.1323
FCC Part 2.1051

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02
Section 6.0 – at Antenna Terminals

The EUT was connected to a spectrum analyzer through a cable and 20 dB attenuator.
The output power set to the same level as was used in the Transmitter Output Power test.

Limit: FCC Part 90.1323
The power of any emission outside the frequency band 3650-3700 MHz shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB, where P is measured in watts.

Sample calculation: Measured mean output power of one port = 22.04 dBm.
 $22.04 \text{ dBm} + 17 \text{ dBi antenna gain} + 3 \text{ dB (because there are 2 output ports)}$
 $= 42.04 \text{ dBm} = 15.996 \text{ Watts}$
 $\text{Limit (dBc)} = 43 + 10 \log(15.996) = 55.04 \text{ dB}$
 $42.04 \text{ dBm} - 55.04 \text{ dB} = \mathbf{-13 \text{ dBm}}$

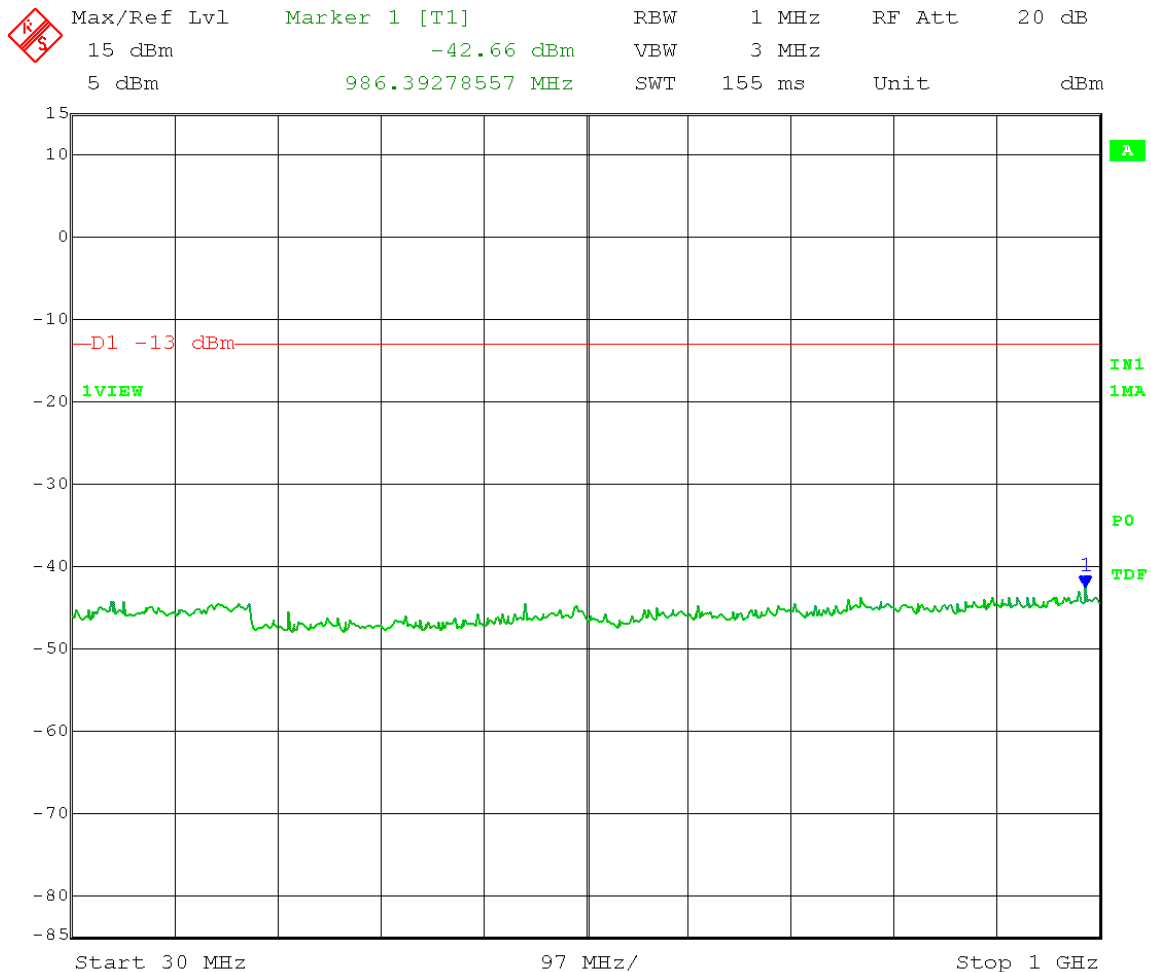
Results: Compliant

Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks. Only tested output port A as determined worst case.

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Low Channel: 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz Output port: A
Limit: 43 + 10log (P) below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 30 – 1000 MHz

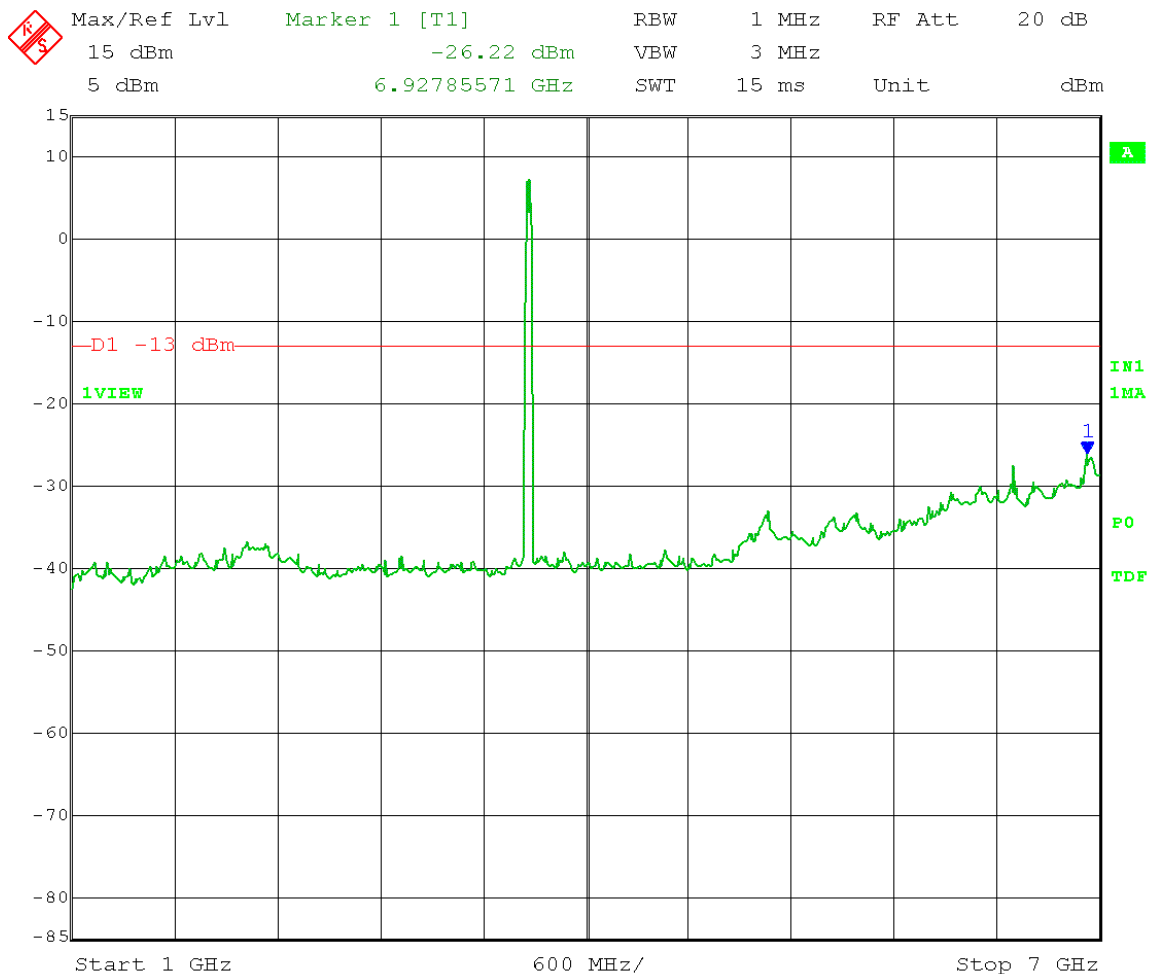


Date: 6.FEB.2017 12:14:41

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Low Channel: 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 1 – 7 GHz

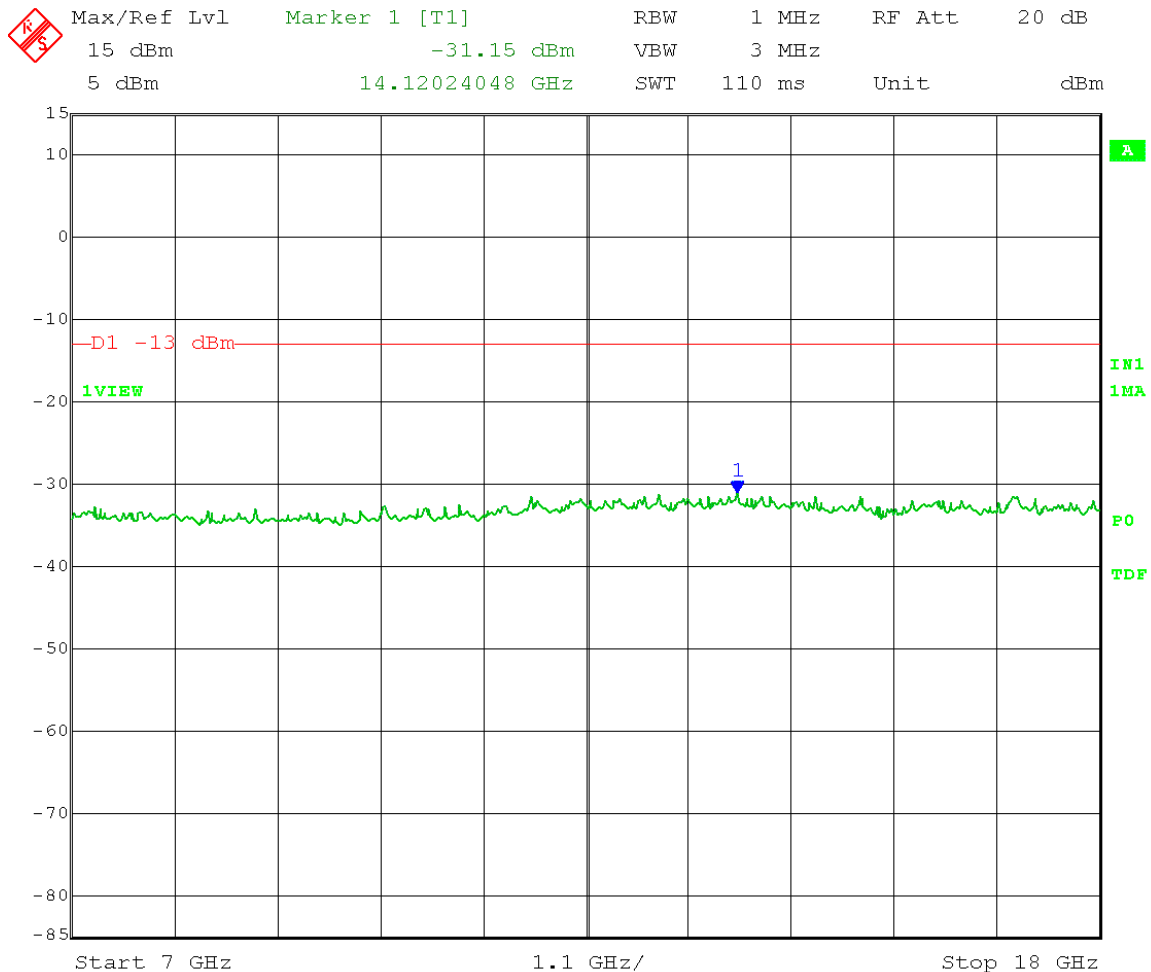


Date: 6.FEB.2017 12:16:59

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Low Channel: 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 7 – 18 GHz

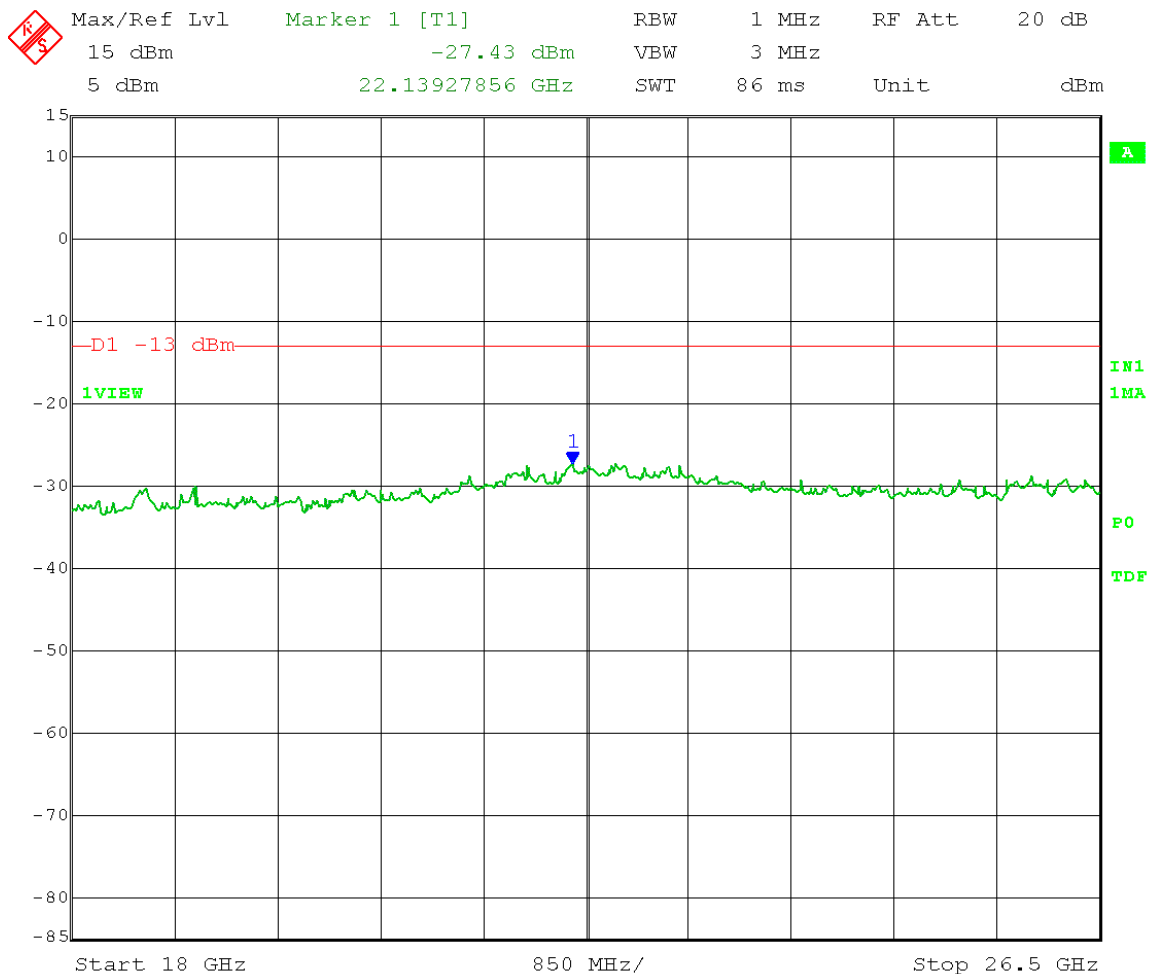


Date: 6.FEB.2017 12:18:52

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Low Channel: 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 18 – 26.5 GHz

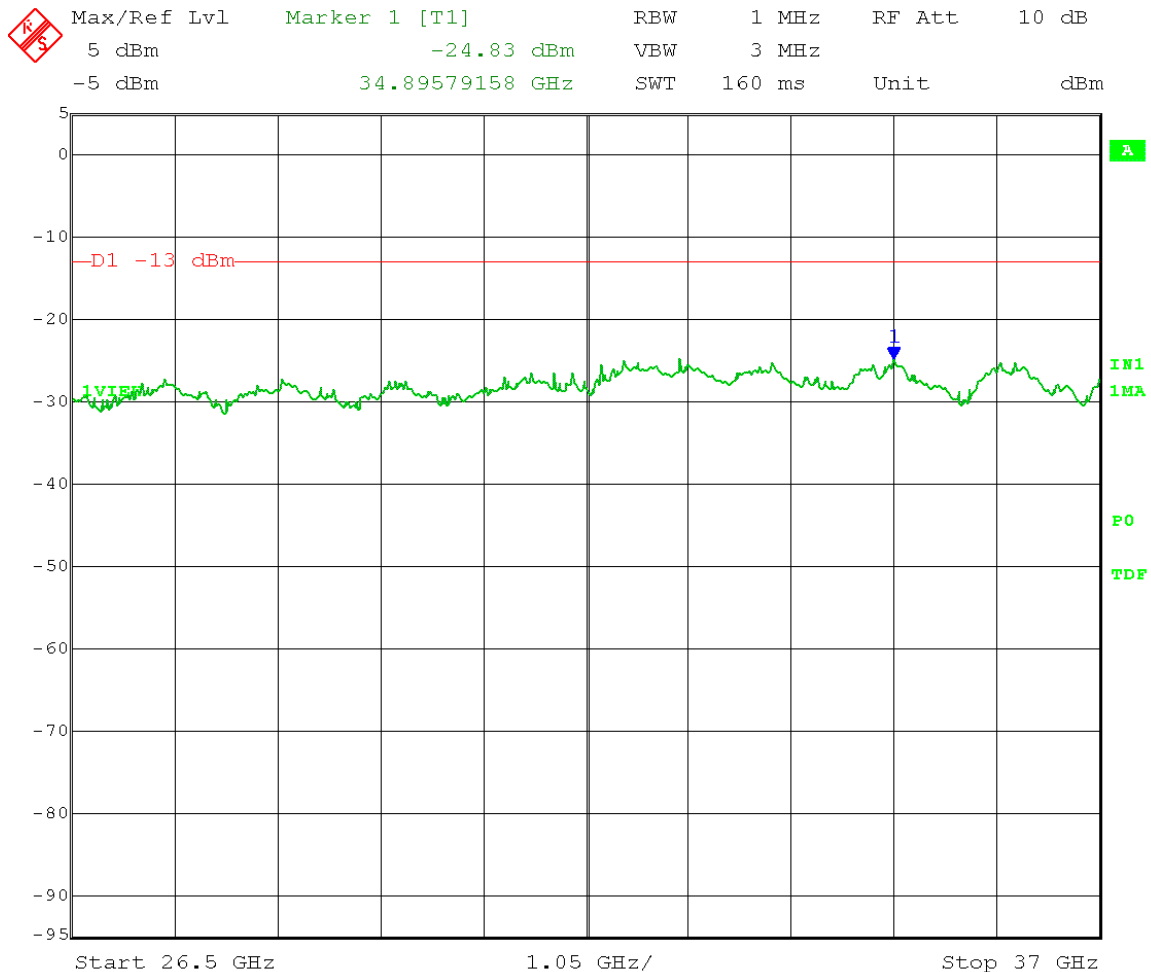


Date: 6.FEB.2017 12:21:39

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Low Channel: 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz Output port: A
Limit: 43 + 10log (P) below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 26.5 – 37 GHz

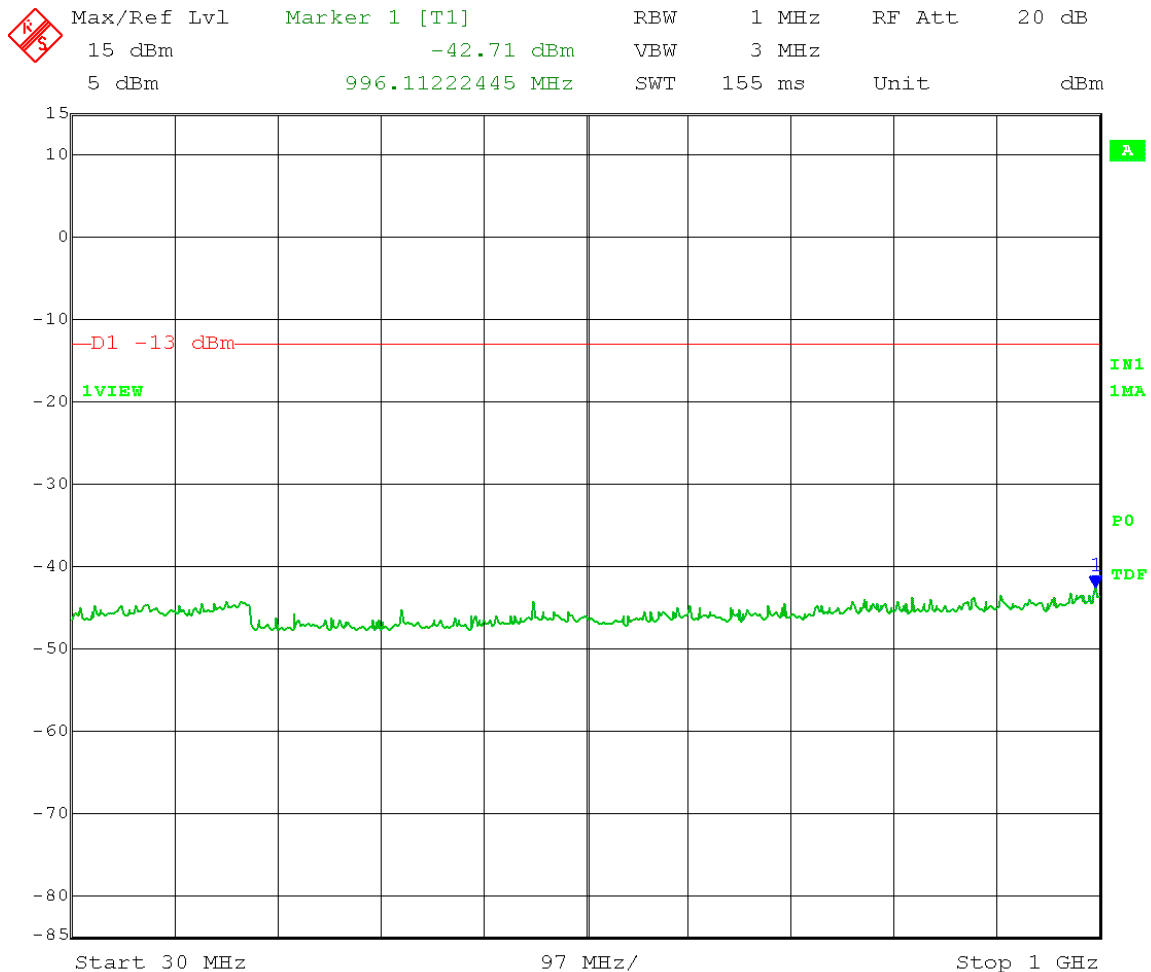


Date: 6.FEB.2017 12:23:28

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Mid Channel: 3675 MHz Output power setting: 25
Channel bandwidth: 40 MHz Output port: A
Limit: 43 + 10log (P) below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 30 – 1000 MHz

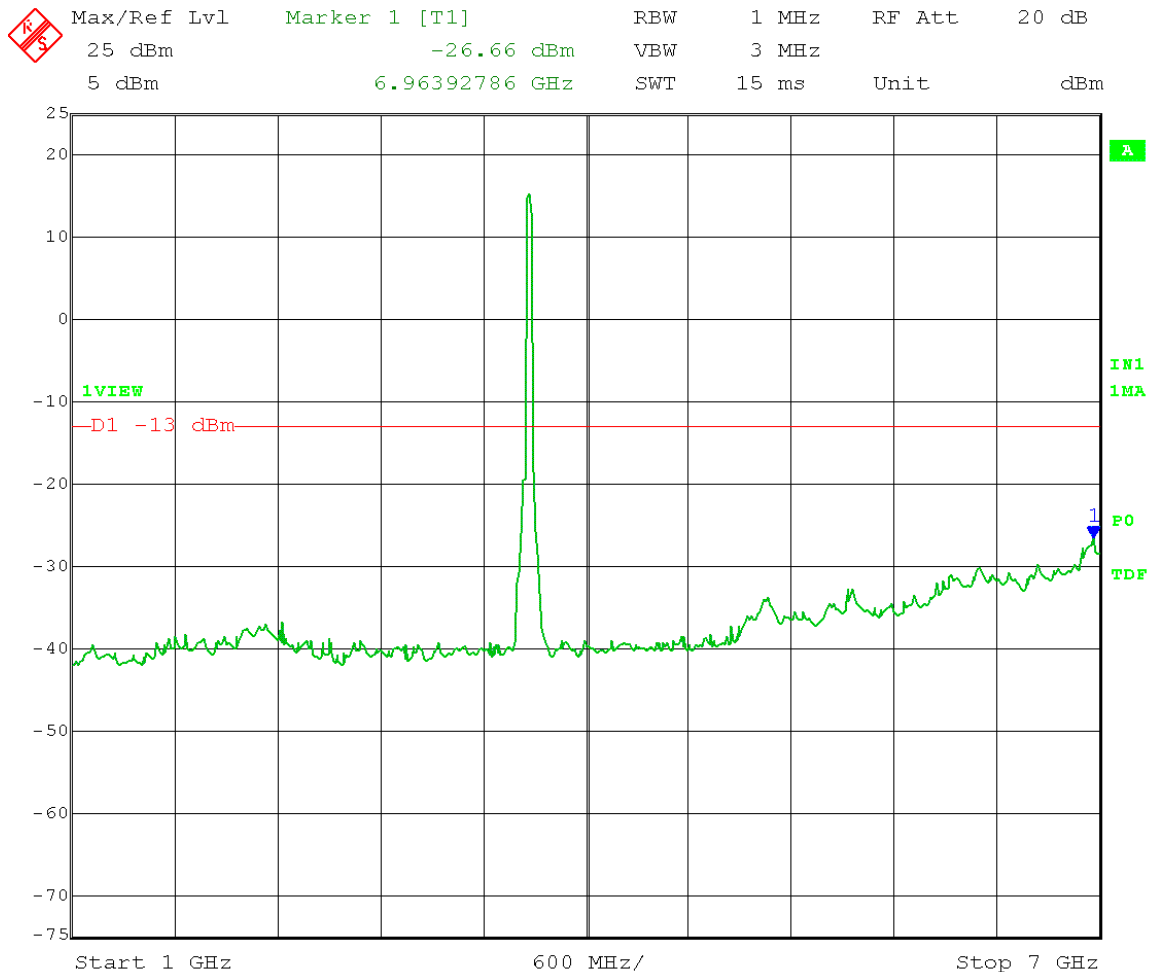


Date: 6.FEB.2017 12:26:44

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Mid Channel: 3675 MHz Output power setting: 25
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 1 – 7 GHz

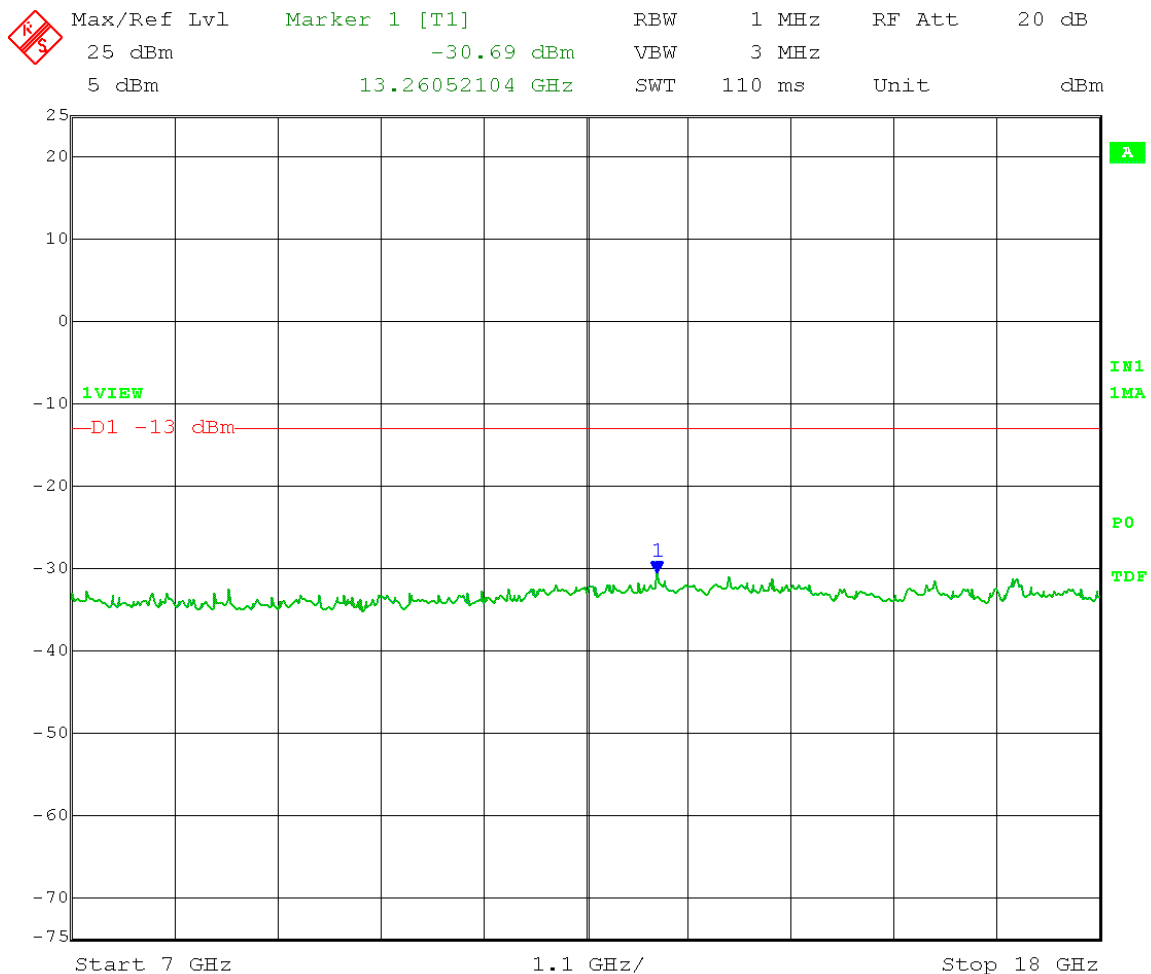


Date: 6.FEB.2017 12:28:27

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Mid Channel: 3675 MHz Output power setting: 25
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 7 – 18 GHz

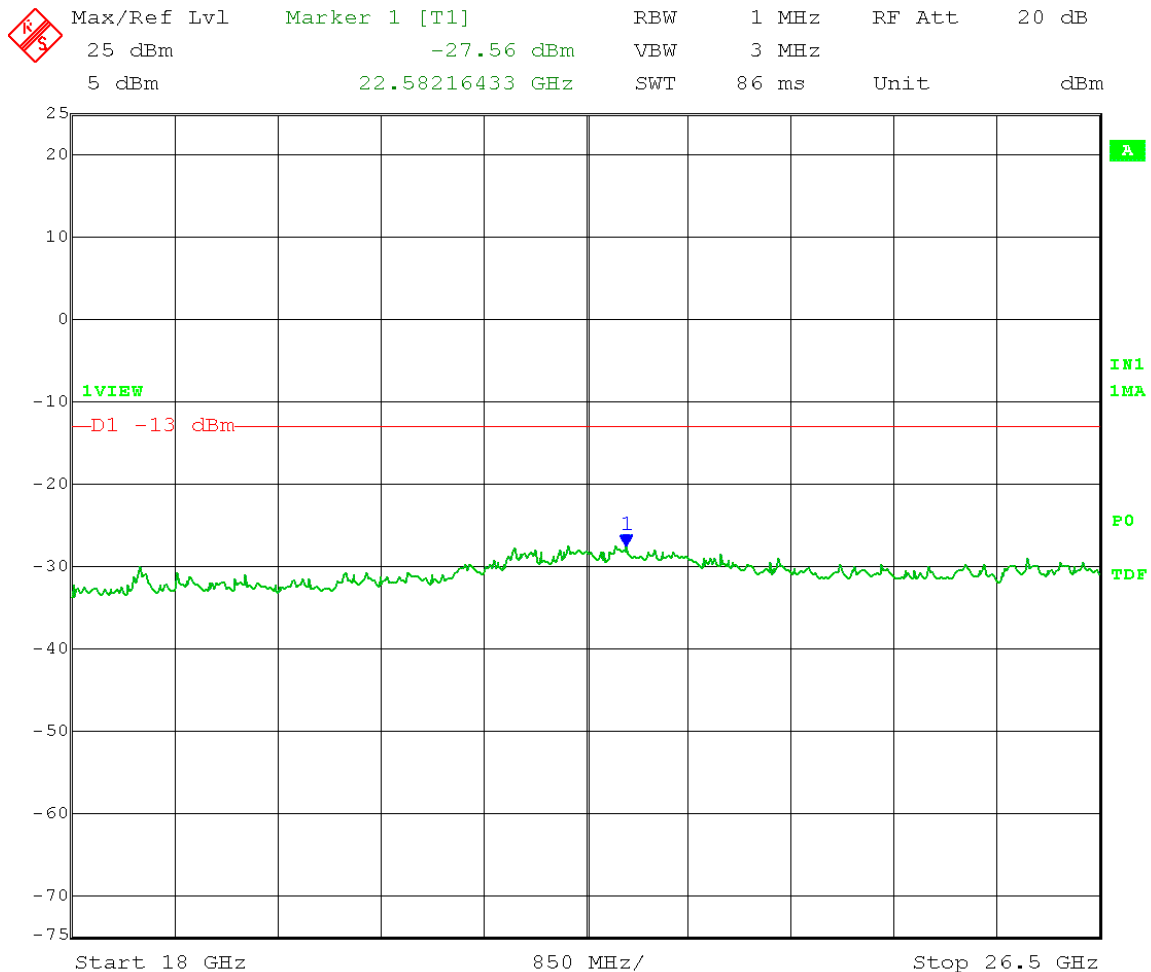


Date: 6.FEB.2017 12:30:17

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Mid Channel: 3675 MHz Output power setting: 25
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 18 – 26.5 GHz

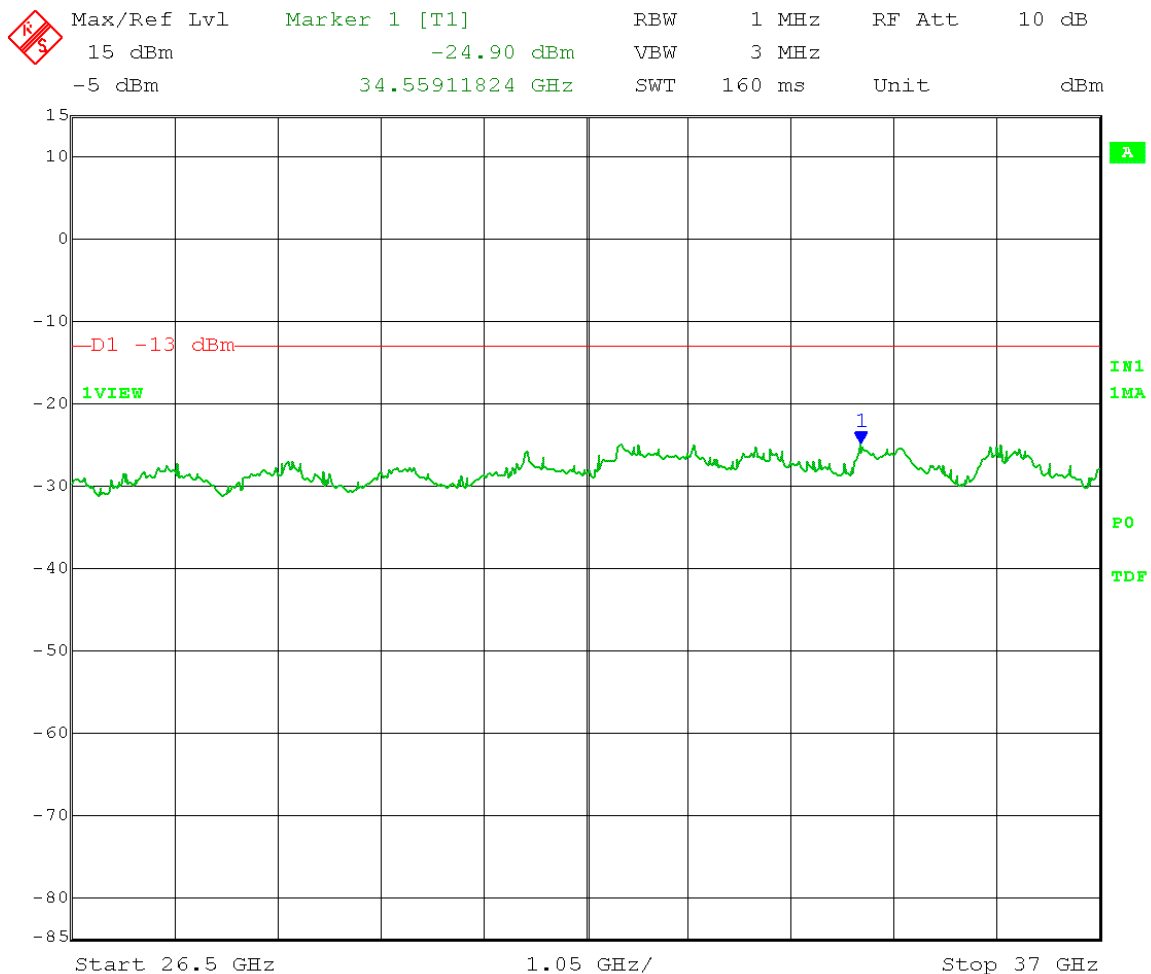


Date: 6.FEB.2017 12:31:55

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
Mid Channel: 3675 MHz Output power setting: 25
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 26.5 – 37 GHz

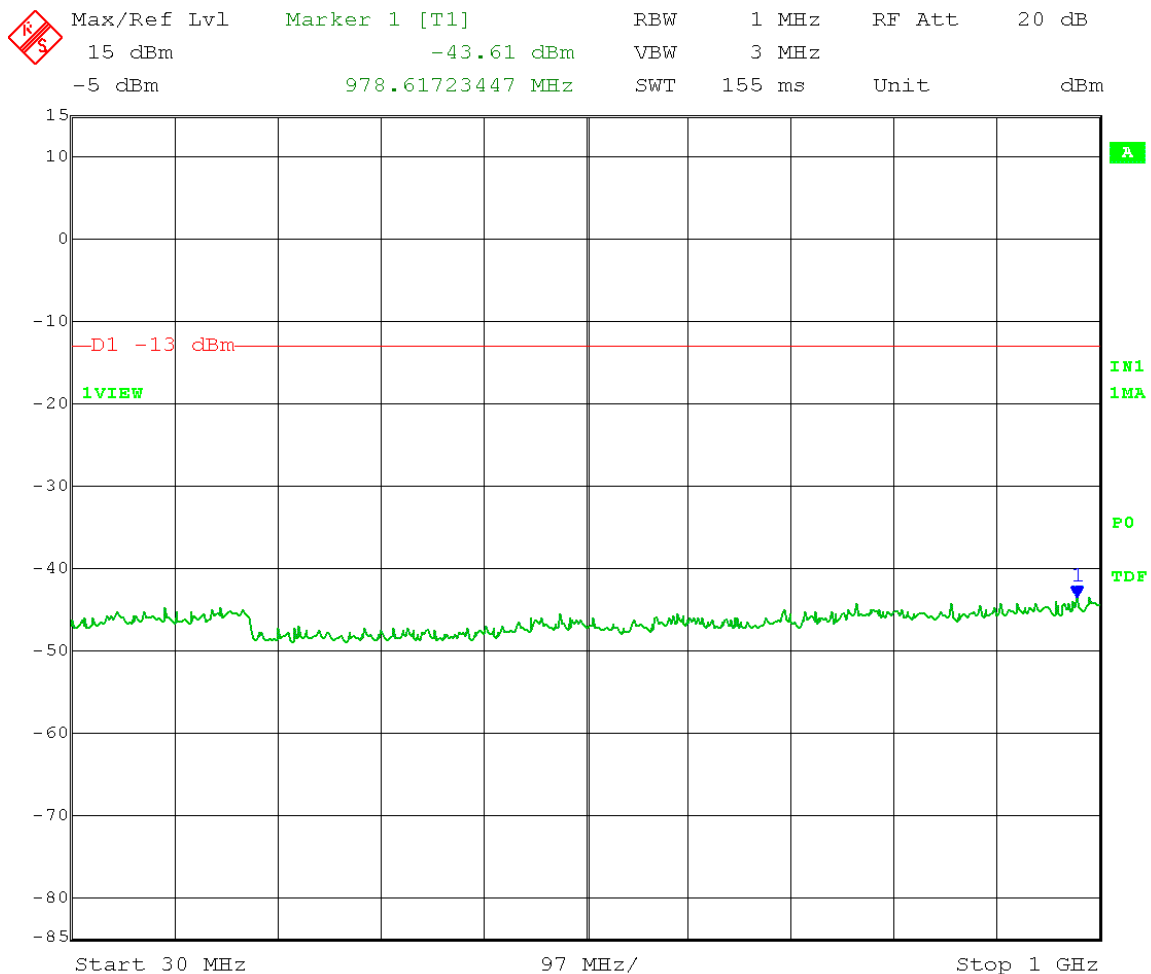


Date: 6.FEB.2017 12:33:32

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
High Channel: 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 30 – 1000 MHz

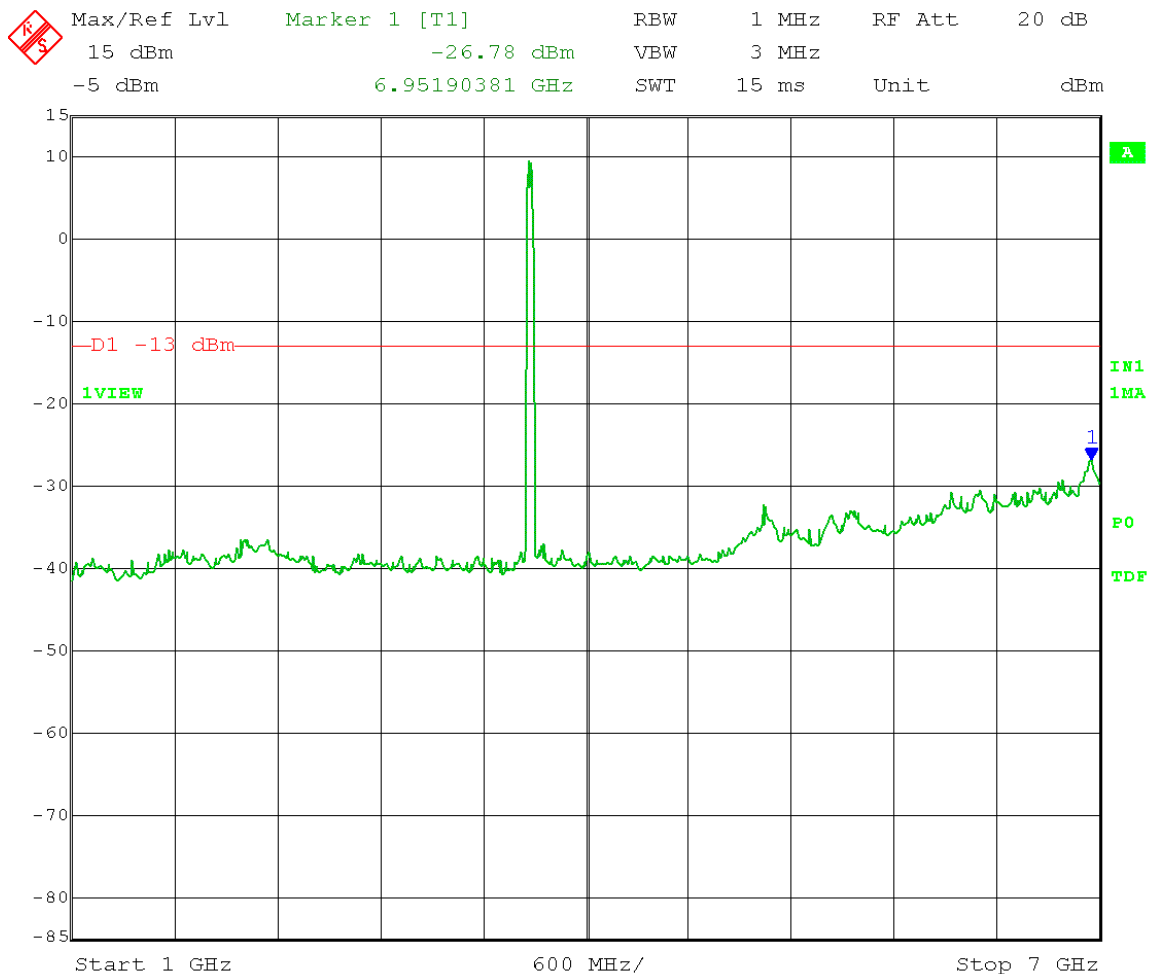


Date: 6.FEB.2017 12:35:36

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
High Channel: 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz Output port: A
Limit: 43 + 10log (P) below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 1 – 7 GHz

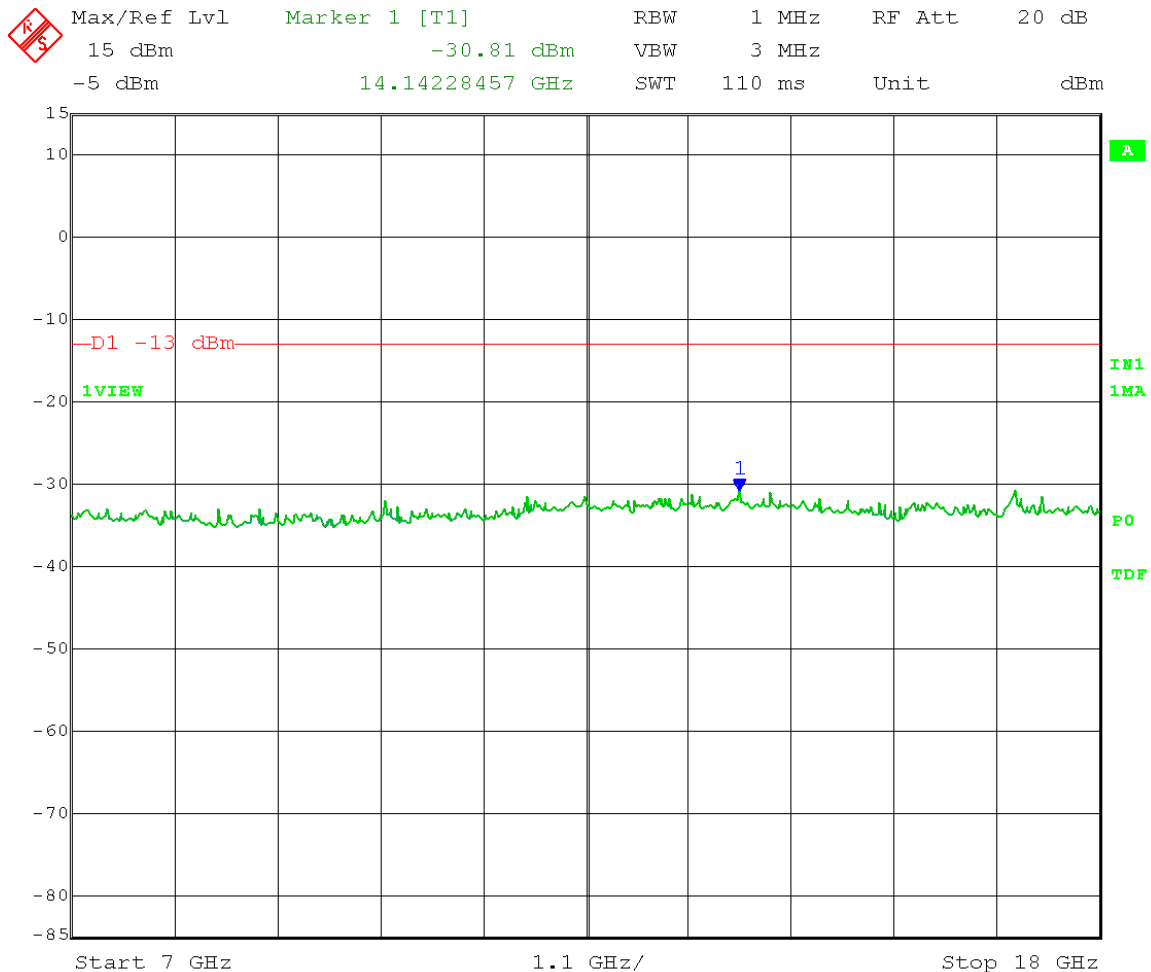


Date: 6.FEB.2017 12:37:27

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
High Channel: 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 7 – 18 GHz

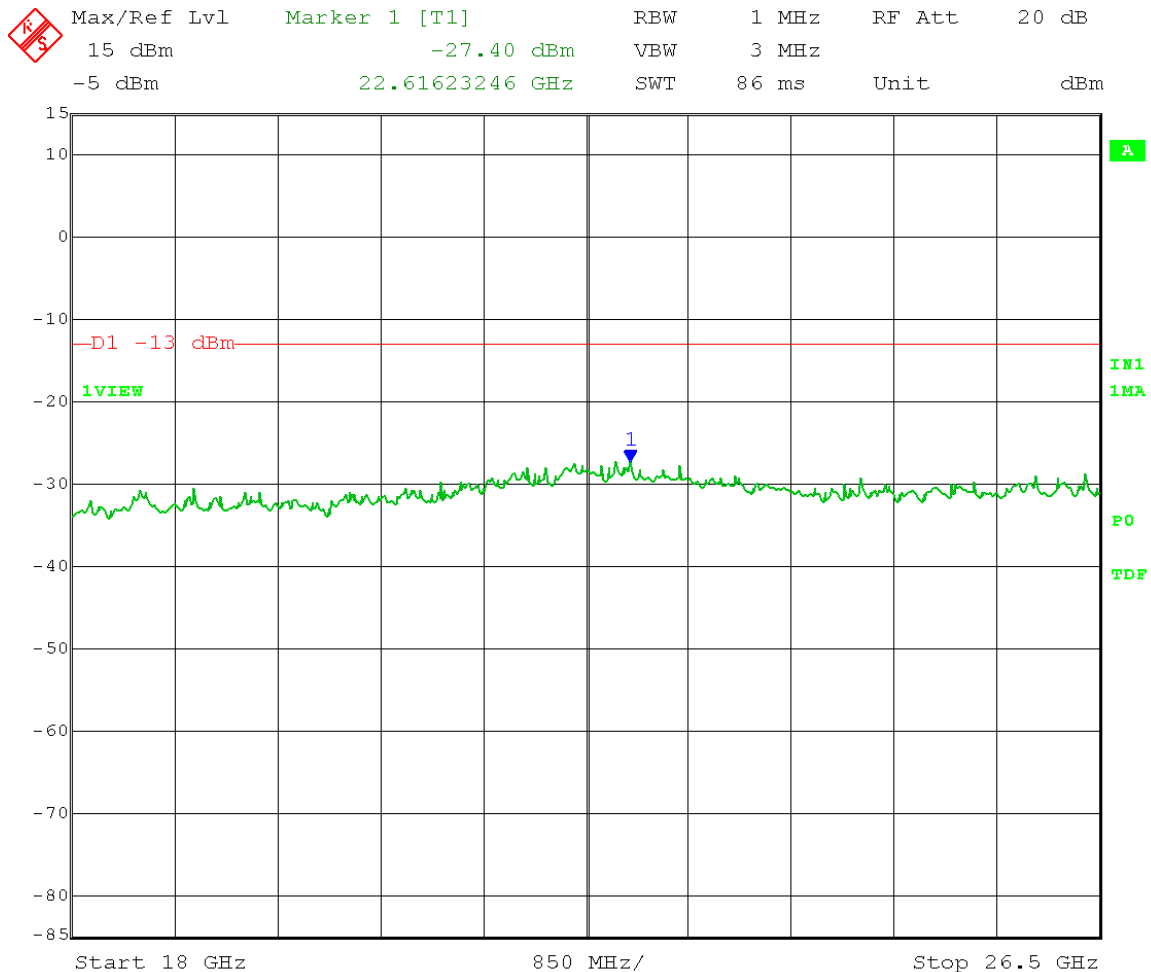


Date: 6.FEB.2017 12:39:10

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
High Channel: 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz Output port: A
Limit: $43 + 10\log(P)$ below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 18 – 26.5 GHz

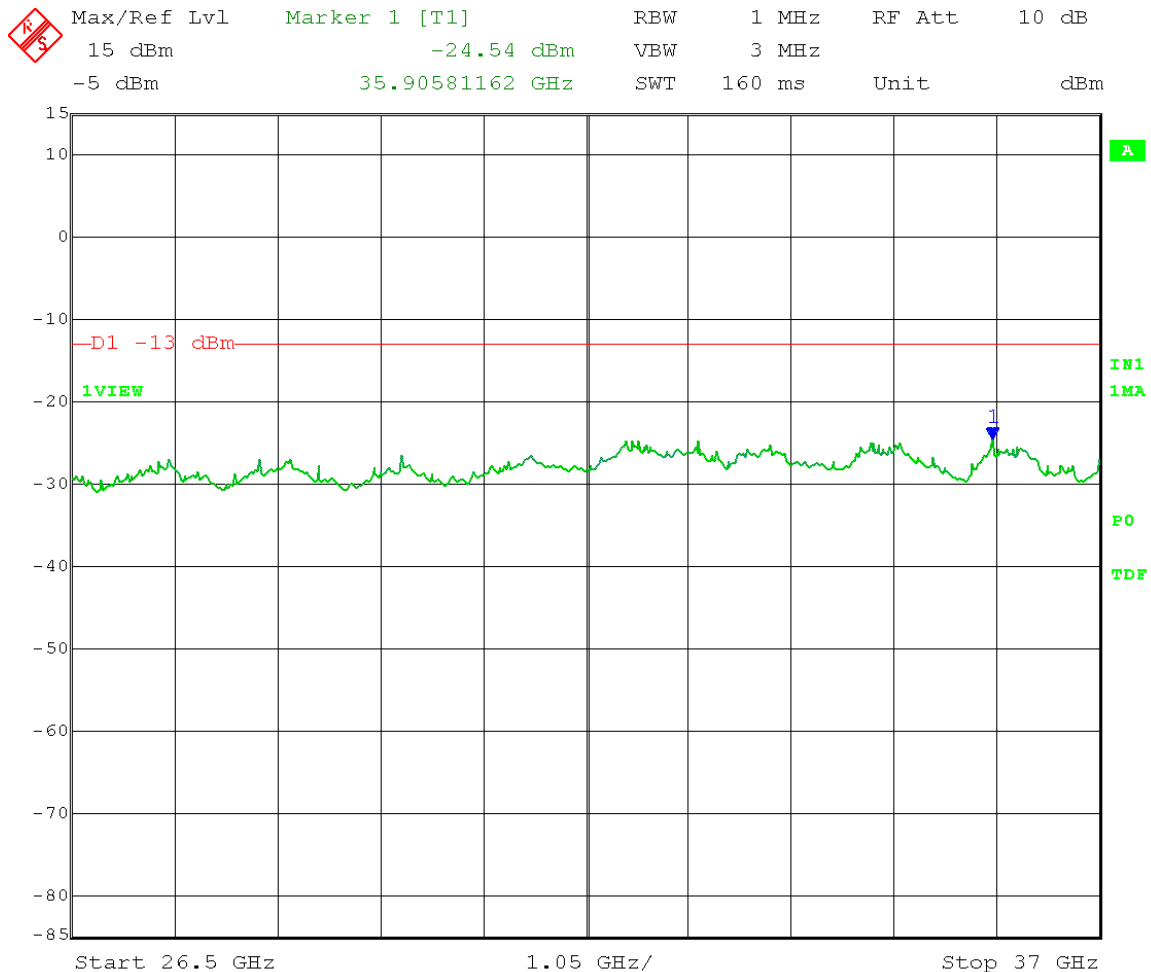


Date: 6.FEB.2017 12:40:14

Test Date: 02-06-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Transmitter Unwanted Emissions – RF Conducted
Operator: Craig B

Comment: RBW = 1 MHz VBW = 3 MHz
Detector = Peak Sweep = auto couple
Trace = max hold
High Channel: 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz Output port: A
Limit: 43 + 10log (P) below the channel transmitter power
= -13 dBm/MHz

Frequency Range: 26.5 – 37 GHz



Date: 6.FEB.2017 12:42:19



166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C036045A001A
Report Number:	22540
DLS Project:	8686

Appendix B – Measurement Data

B7.0 Transmitter Unwanted Emissions – Radiated With 50 Ohm terminations on antenna ports (cabinet radiation)

Rule Part: FCC Part 90.1323
FCC Part 2.1053

Test Procedure: FCC KDB 971168 D01: Power Meas License Digital Systems v02r02
Section 5.8 – Radiated measurements

Limit: FCC Part 90.1323
The power of any emission outside the frequency band 3650-3700 MHz shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10} (P)$ dB, where P is measured in watts.

Sample calculation: Measured mean output power of one port = 22.04 dBm.
 $22.04 \text{ dBm} + 17 \text{ dBi antenna gain} + 3 \text{ dB (because there are 2 output ports)}$
 $= 42.04 \text{ dBm} = 15.996 \text{ Watts}$
 $\text{Limit (dBc)} = 43 + 10 \log (15.996) = 55.04 \text{ dB}$
 $42.04 \text{ dBm} - 55.04 \text{ dB} = \mathbf{-13 \text{ dBm}}$

Results: Compliant

Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks. Both ports were active during this test.

RSS-197 & FCC Part 90, Subpart Z

Electric Field Strength

EUT: PMP450 3.65 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 70 deg C 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8686
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 79.2% @ pwr setting 25 L,M,H channels
Date: 02-06-2017

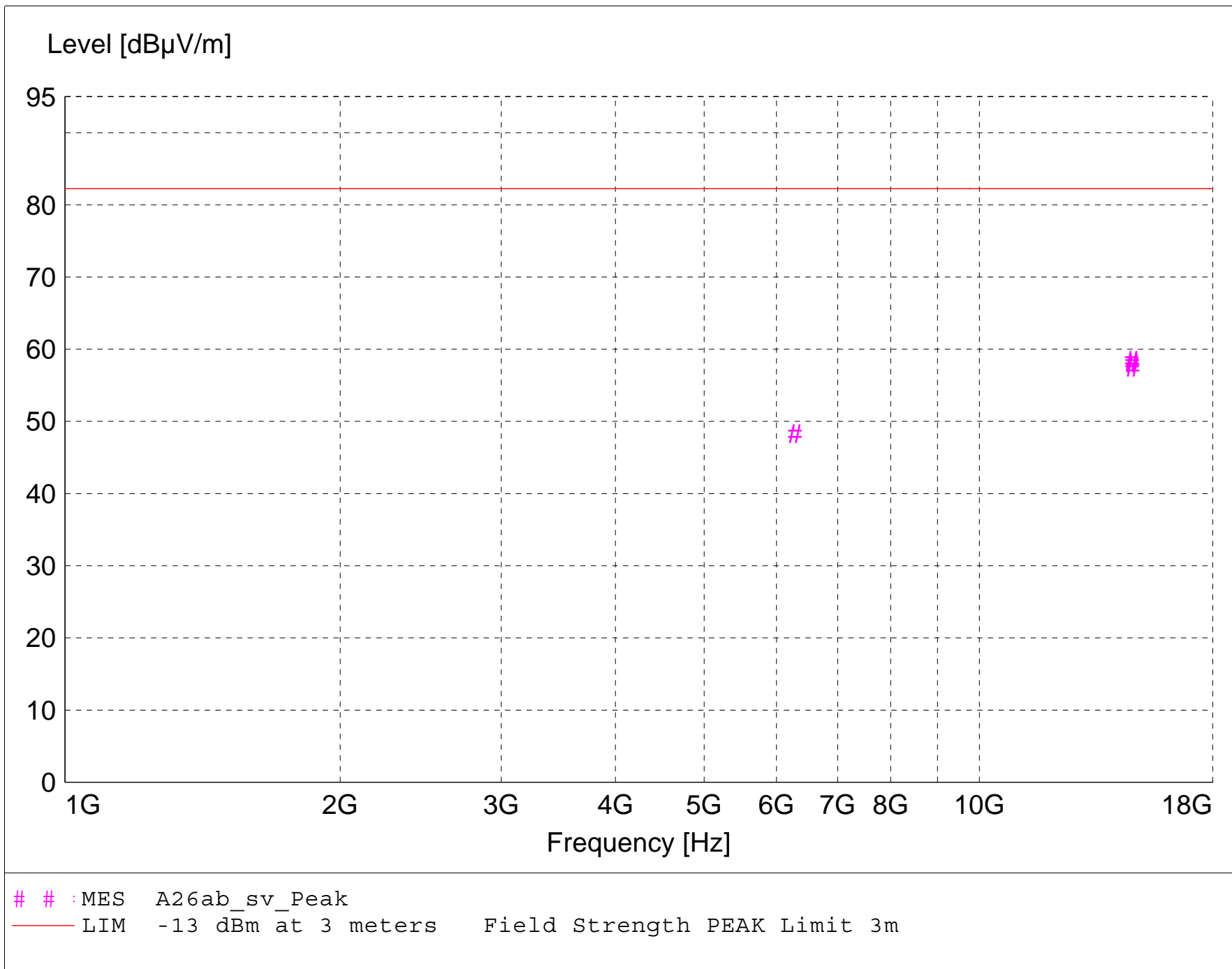
TEXT: "Vert 3 meters"

Short Description: Test Set-up

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

Sample Equations:
$$\begin{array}{rclclcl} \text{Total Level (dB}\mu\text{V/m)} & = & \text{Level (dB}\mu\text{V)} & + & \text{System Loss (dB)} & + & \text{Antenna Factor (dB}\mu\text{V/m)} \\ 24.6 & & = 35.51 & + & (-22.1) & + & 11.20 \end{array}$$
$$\begin{array}{rclcl} \text{Margin (dB)} & = & \text{Limit (dB}\mu\text{V/m)} & - & \text{Total Level (dB}\mu\text{V/m)} \\ 15.4 & = & 40 & - & 24.6 \end{array}$$

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



MEASUREMENT RESULT: "A26ab_sv_Final"

2/6/2017 2:35PM

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		
14680.000000	52.73	42.15	-36.5	58.4	82.3	23.8	1.82	341	MAX PEAK	None
14700.000000	52.32	42.22	-36.5	58.1	82.3	24.2	1.81	329	MAX PEAK	None
14720.000000	51.91	42.03	-36.5	57.5	82.3	24.8	2.32	348	MAX PEAK	None
6285.400000	51.37	34.55	-37.6	48.3	82.3	33.9	1.00	3	MAX PEAK	None

RSS-197 & FCC Part 90, Subpart Z

Electric Field Strength

EUT: PMP450 3.65 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 70 deg C 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8686
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 79.2% @ pwr setting 25 L,M,H channels
Date: 02-06-2017

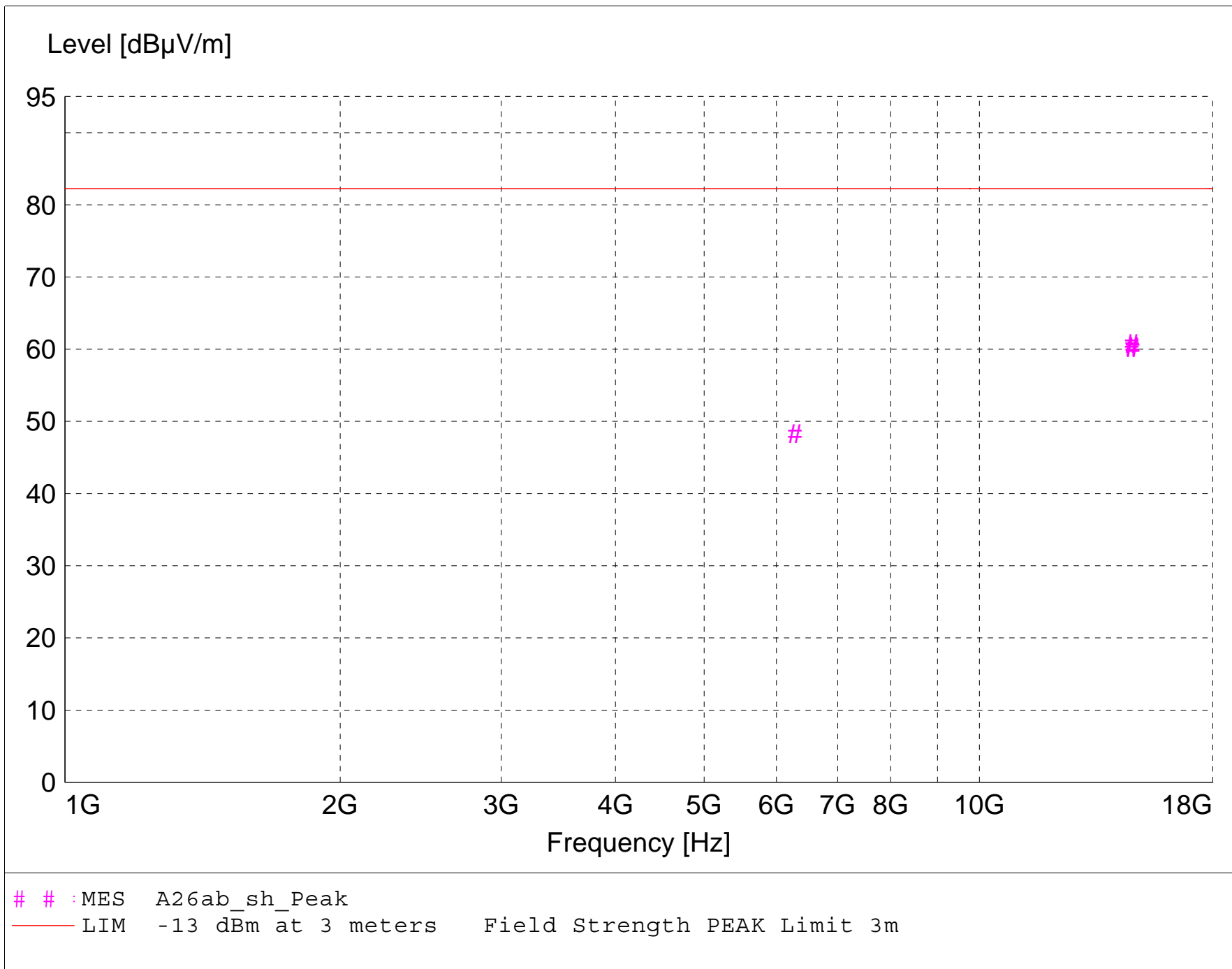
TEXT: "Horz 3 meters"

Short Description: Test Set-up

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

Sample Equations:
$$\begin{array}{rclclcl} \text{Total Level (dB}\mu\text{V/m)} & = & \text{Level (dB}\mu\text{V)} & + & \text{System Loss (dB)} & + & \text{Antenna Factor (dB}\mu\text{V/m)} \\ 24.6 & & = 35.51 & + & (-22.1) & + & 11.20 \end{array}$$
$$\begin{array}{rclcl} \text{Margin (dB)} & = & \text{Limit (dB}\mu\text{V/m)} & - & \text{Total Level (dB}\mu\text{V/m)} \\ 15.4 & = & 40 & - & 24.6 \end{array}$$

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



MEASUREMENT RESULT: "A26ab_sh_Final"

2/6/2017 2:35PM

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		
14680.000000	55.10	42.15	-36.5	60.8	82.3	21.5	1.00	338	MAX PEAK	None
14699.985000	54.70	42.22	-36.5	60.5	82.3	21.8	1.00	344	MAX PEAK	None
14720.000000	54.70	42.03	-36.5	60.3	82.3	22.0	1.00	352	MAX PEAK	None
6285.400000	51.37	34.55	-37.6	48.3	82.3	33.9	1.74	349	MAX PEAK	None

RSS-197 & FCC Part 90, Subpart Z

Electric Field Strength

EUT: PMP450 3.65 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 70 deg C 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8686
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 79.2% @ pwr setting 25 L,M,H channels
Date: 02-07-2017

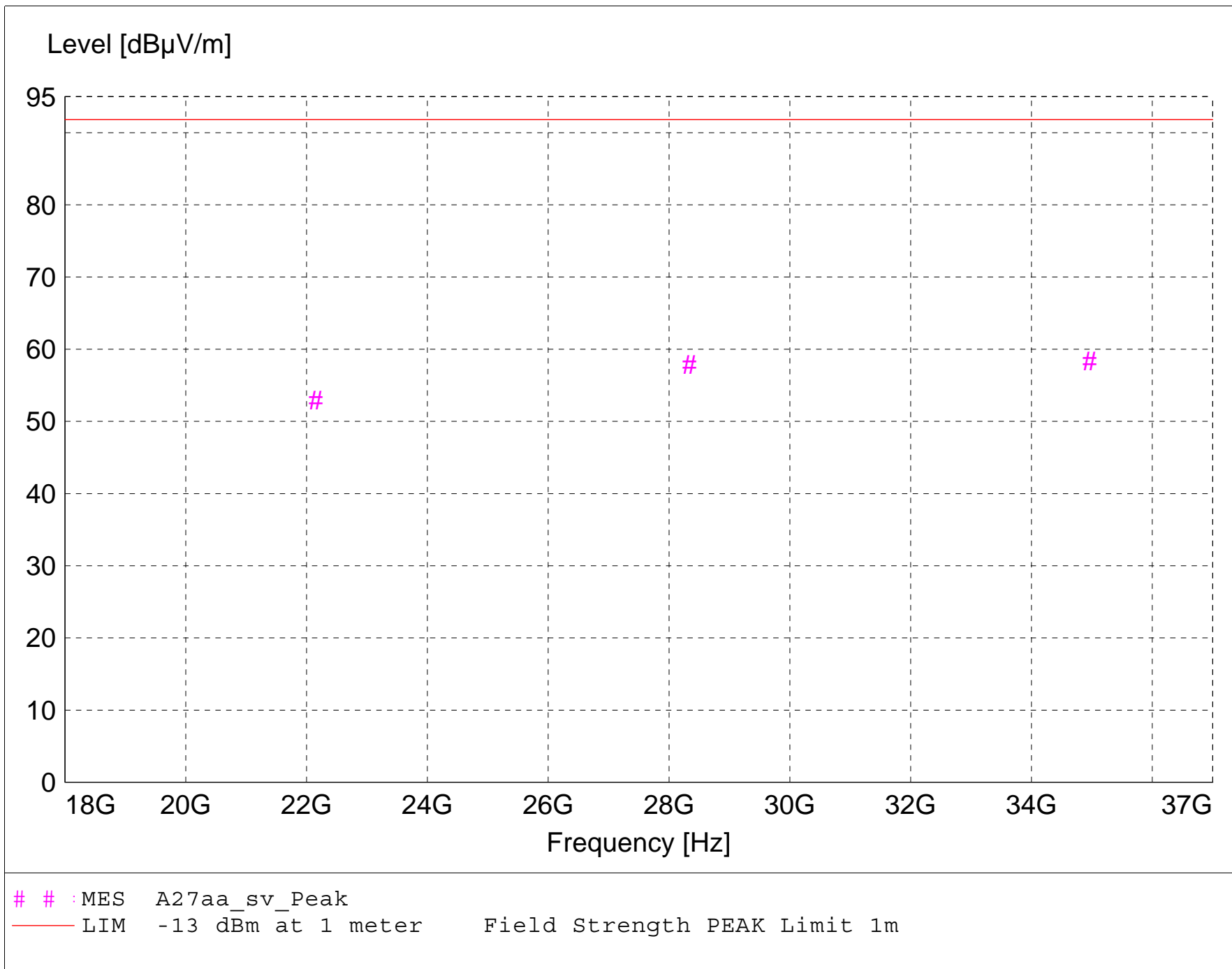
TEXT: "Vert 1 meters"

Short Description: Test Set-up

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

Sample Equations:
$$\begin{array}{rclclcl} \text{Total Level (dB}\mu\text{V/m)} & = & \text{Level (dB}\mu\text{V)} & + & \text{System Loss (dB)} & + & \text{Antenna Factor (dB}\mu\text{V/m)} \\ 24.6 & & = & 35.51 & + & (-22.1) & + & 11.20 \end{array}$$
$$\begin{array}{rclcl} \text{Margin (dB)} & = & \text{Limit (dB}\mu\text{V/m)} & - & \text{Total Level (dB}\mu\text{V/m)} \\ 15.4 & = & 40 & - & 24.6 \end{array}$$

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



MEASUREMENT RESULT: "A27aa_sv_Final"

2/7/2017 8:57AM

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		
34963.600000	62.56	40.81	-45.0	58.4	91.8	33.4	1.50	0	MAX PEAK	noise floor
28337.600000	63.49	40.47	-46.1	57.9	91.8	33.9	1.50	0	MAX PEAK	noise floor
22151.600000	63.23	40.15	-50.4	52.9	91.8	38.9	1.50	0	MAX PEAK	noise floor

RSS-197 & FCC Part 90, Subpart Z

Electric Field Strength

EUT: PMP450 3.65 GHz AP
Manufacturer: Cambium Networks
Operating Condition: 70 deg C 26% R.H.
Test Site: DLS O.F. G1
Operator: Craig B #8686
Test Specification: Transmitter Spurious; with 50 Ohm terminations on ant ports
Comment: 40 MHz ch BW; Tx 79.2% @ pwr setting 25 L,M,H channels
Date: 02-07-2017

TEXT: "Horz 1 meters"

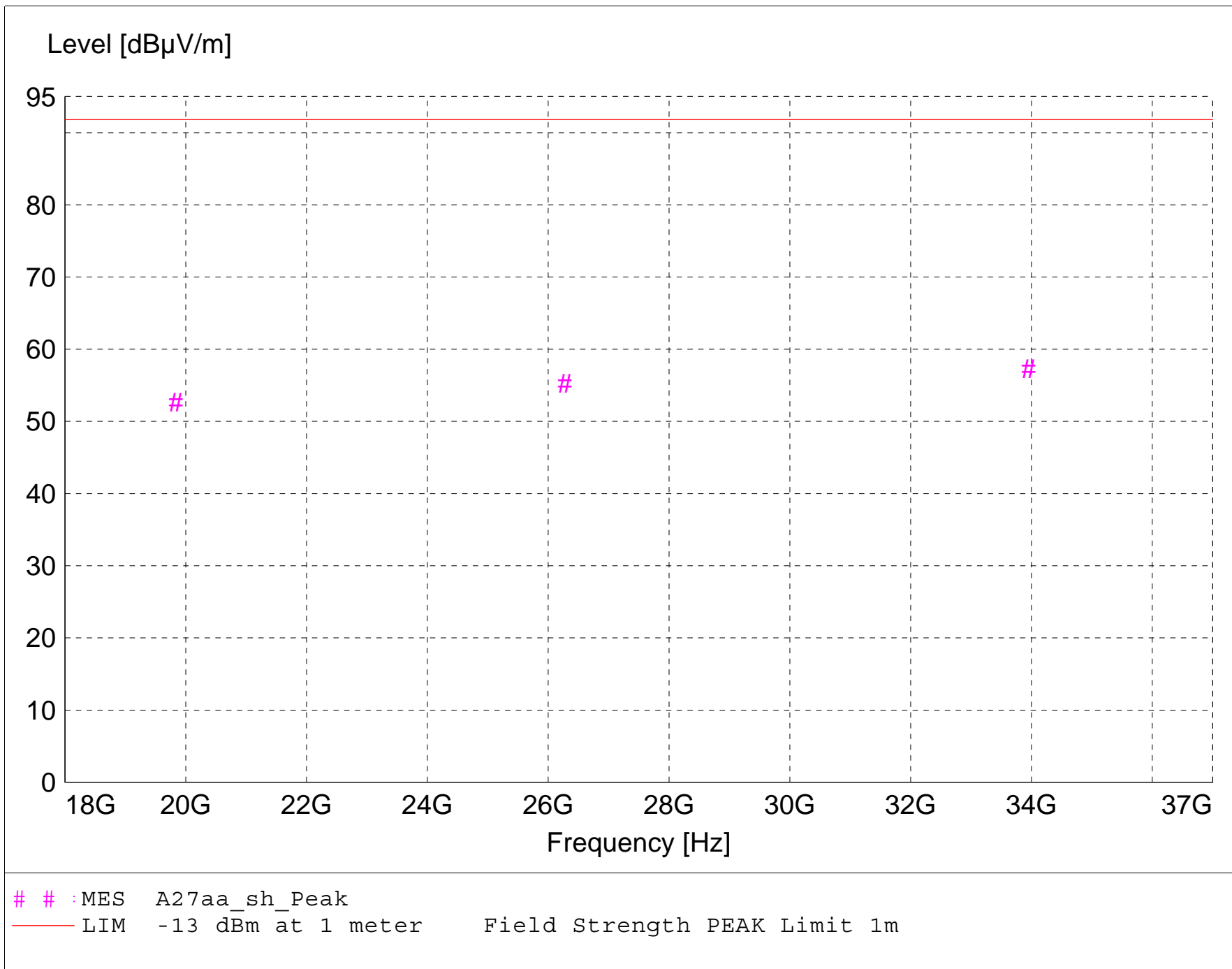
Short Description: Test Set-up

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

Sample Equations:
$$\begin{array}{rclclcl} \text{Total Level (dB}\mu\text{V/m)} & = & \text{Level (dB}\mu\text{V)} & + & \text{System Loss (dB)} & + & \text{Antenna Factor (dB}\mu\text{V/m)} \\ 24.6 & & = & 35.51 & + & (-22.1) & + & 11.20 \end{array}$$

$$\begin{array}{rclcl} \text{Margin (dB)} & = & \text{Limit (dB}\mu\text{V/m)} & - & \text{Total Level (dB}\mu\text{V/m)} \\ 15.4 & = & 40 & - & 24.6 \end{array}$$

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



MEASUREMENT RESULT: "A27aa_sh_Final"

2/7/2017 8:57AM

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		
33952.000000	62.29	40.47	-45.4	57.3	91.8	34.5	1.50	0	MAX PEAK	noise floor
26277.600000	60.70	40.60	-46.0	55.3	91.8	36.5	1.50	0	MAX PEAK	noise floor
19837.600000	63.49	40.41	-51.2	52.7	91.8	39.1	1.50	0	MAX PEAK	noise floor



166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C036045A001A
Report Number:	22540
DLS Project:	8686

Appendix B – Measurement Data

B8.0 Transmitter Frequency Stability

Rule Part: FCC Part 2.1055

Test Procedure:

The EUT was connected to a spectrum analyzer through a cable and 20 dB attenuator. The output power was set to the same level as was used in the Transmitter Output Power test. The power level at the band edge was measured by integrating over a 1 MHz bandwidth. The measured power level at the band edge was then compared to the out-of-band emission limit (-13 dBm) to show that under extreme environmental conditions (temperature and supply voltage), the EUT does not violate the emission limit at the lower and upper operating band edges.

Limit: The wanted emission must stay within the 3650-3700 MHz band.
At the band edge frequencies, the emission must be \leq -13 dBm.

Notes: Only tested QPSK modulation mode as determined worst case by Cambium Networks.

At a temperature of -20 °C, the power setting for the low channel was changed from 13 to 12 in order to meet the -13 dBm lower band-edge limit.

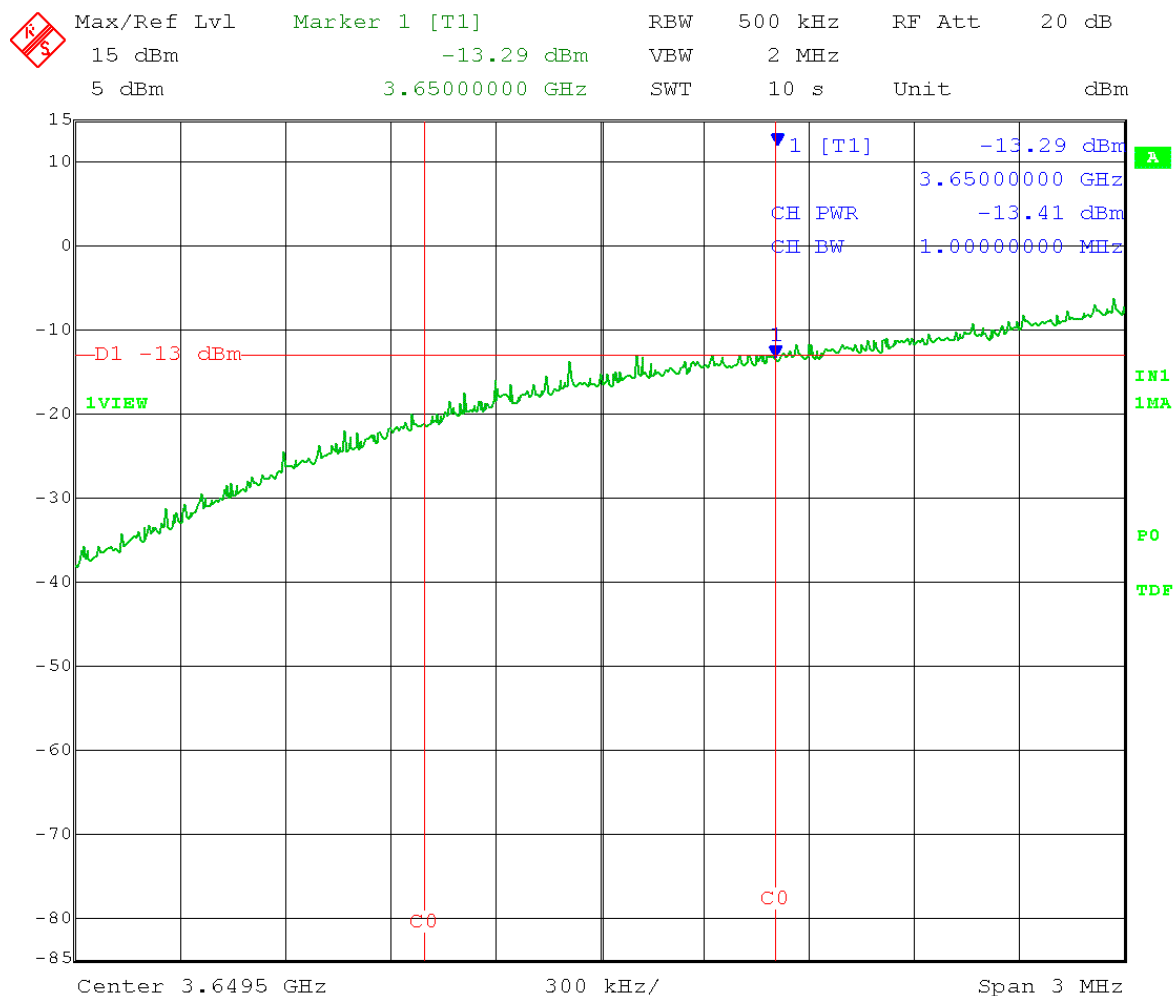
At a temperature of -20 °C, the power setting for the high channel was changed from 16 to 15 in order to meet the -13 dBm upper band-edge limit.

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, -30 °C

Power level at band edge = -13.41 dBm/MHz



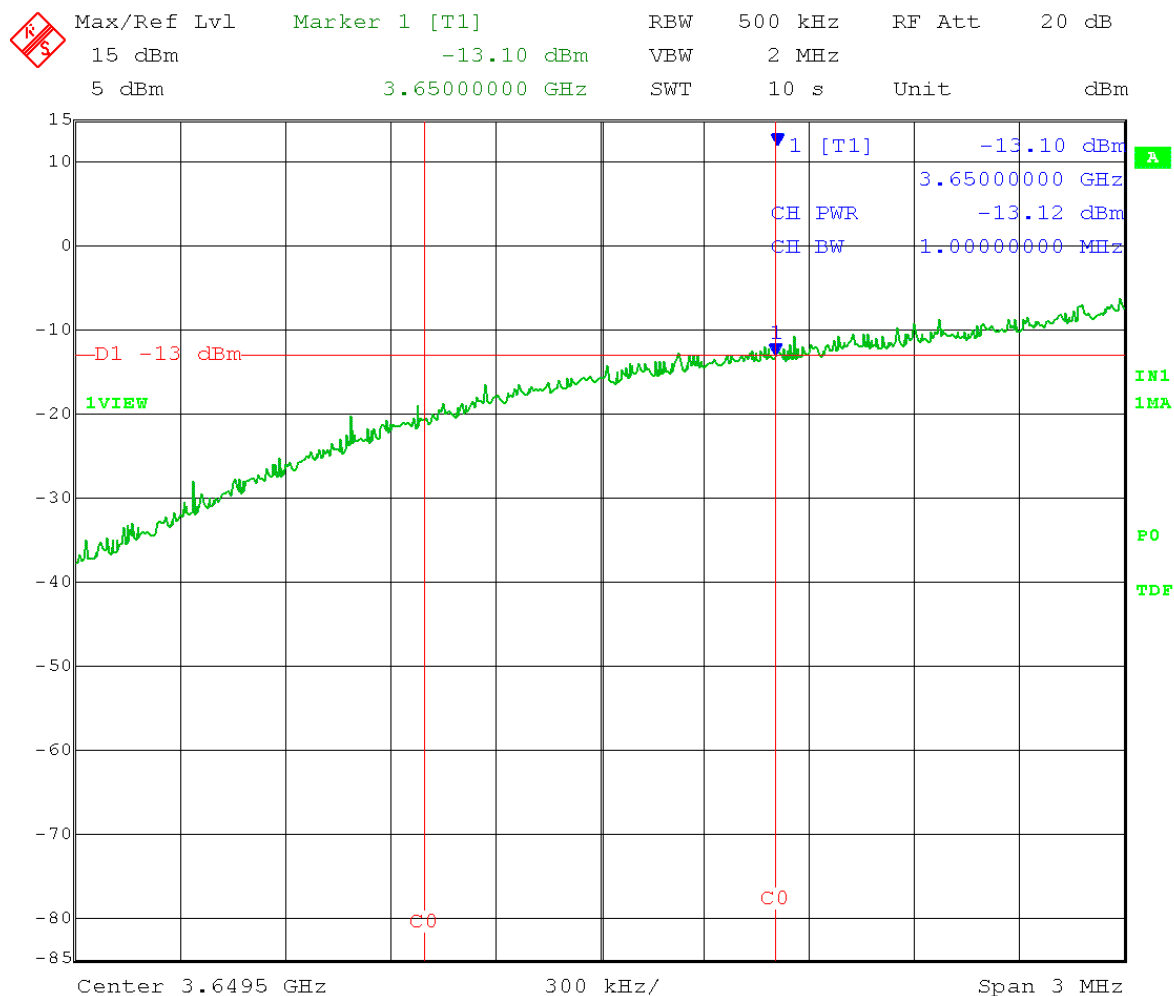
Date: 7.FEB.2017 17:32:43

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 12
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, -20 °C

Power level at band edge = -13.12 dBm/MHz



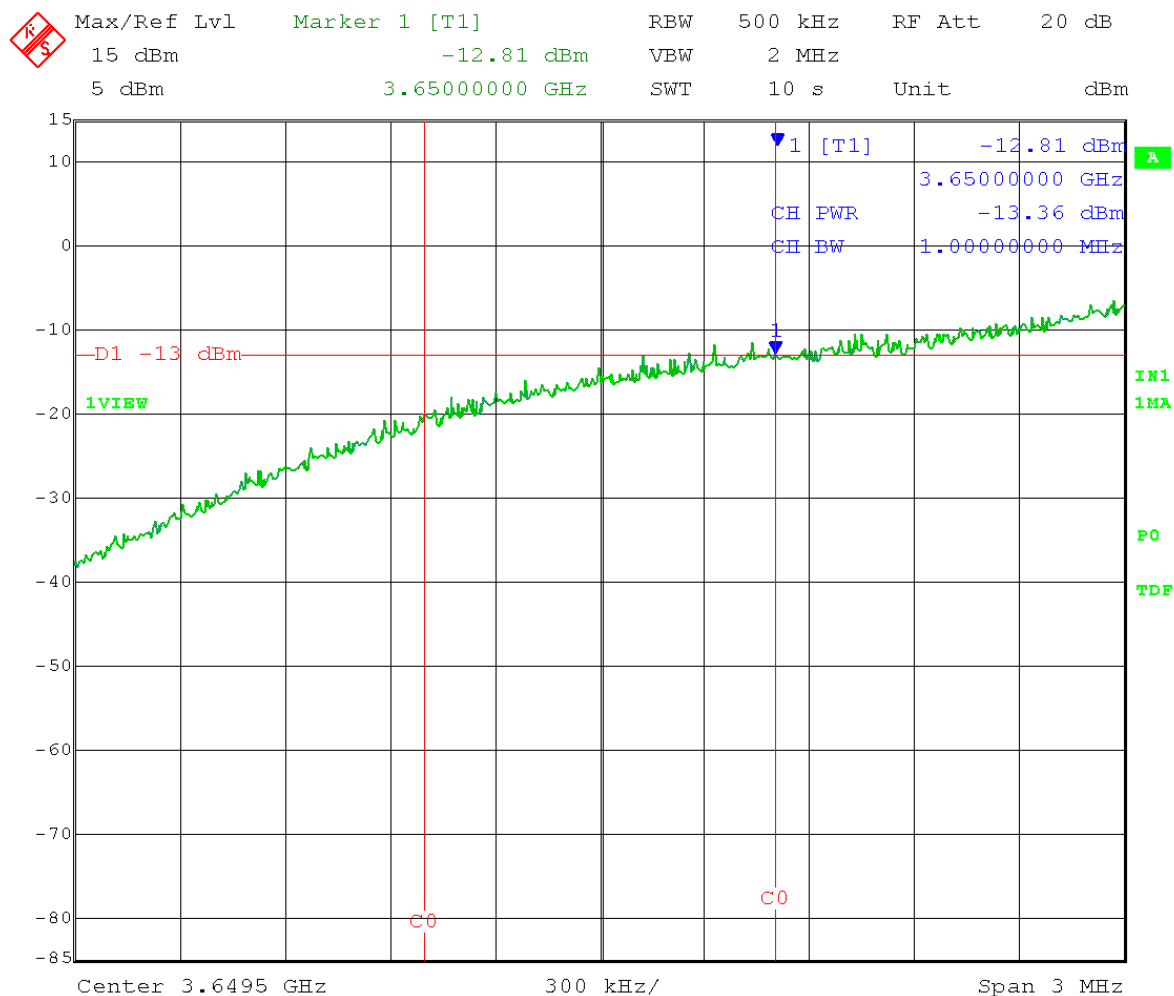
Date: 7.FEB.2017 16:51:32

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, -10 °C

Power level at band edge = -13.36 dBm/MHz



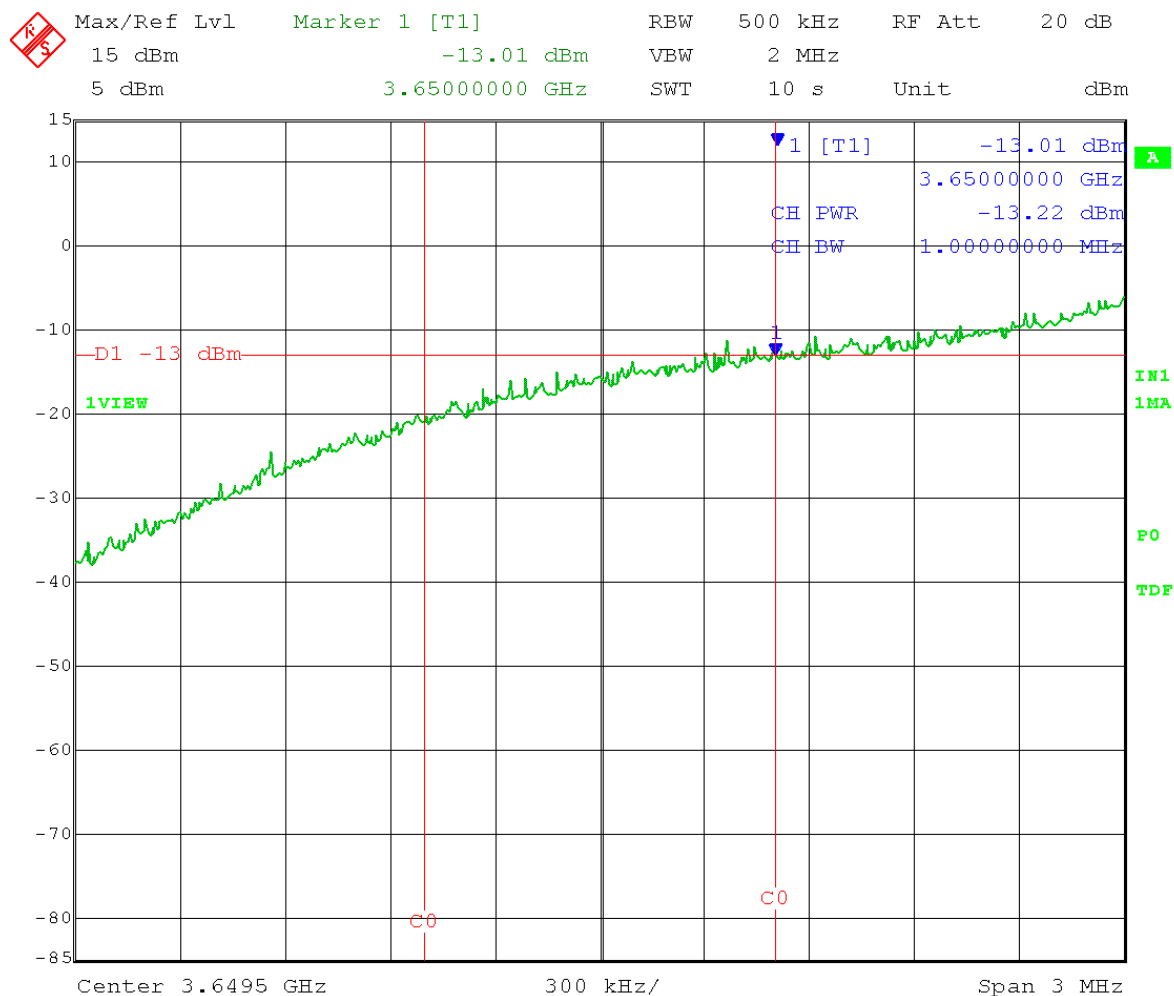
Date: 7.FEB.2017 16:10:41

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, 0 °C

Power level at band edge = -13.22 dBm/MHz



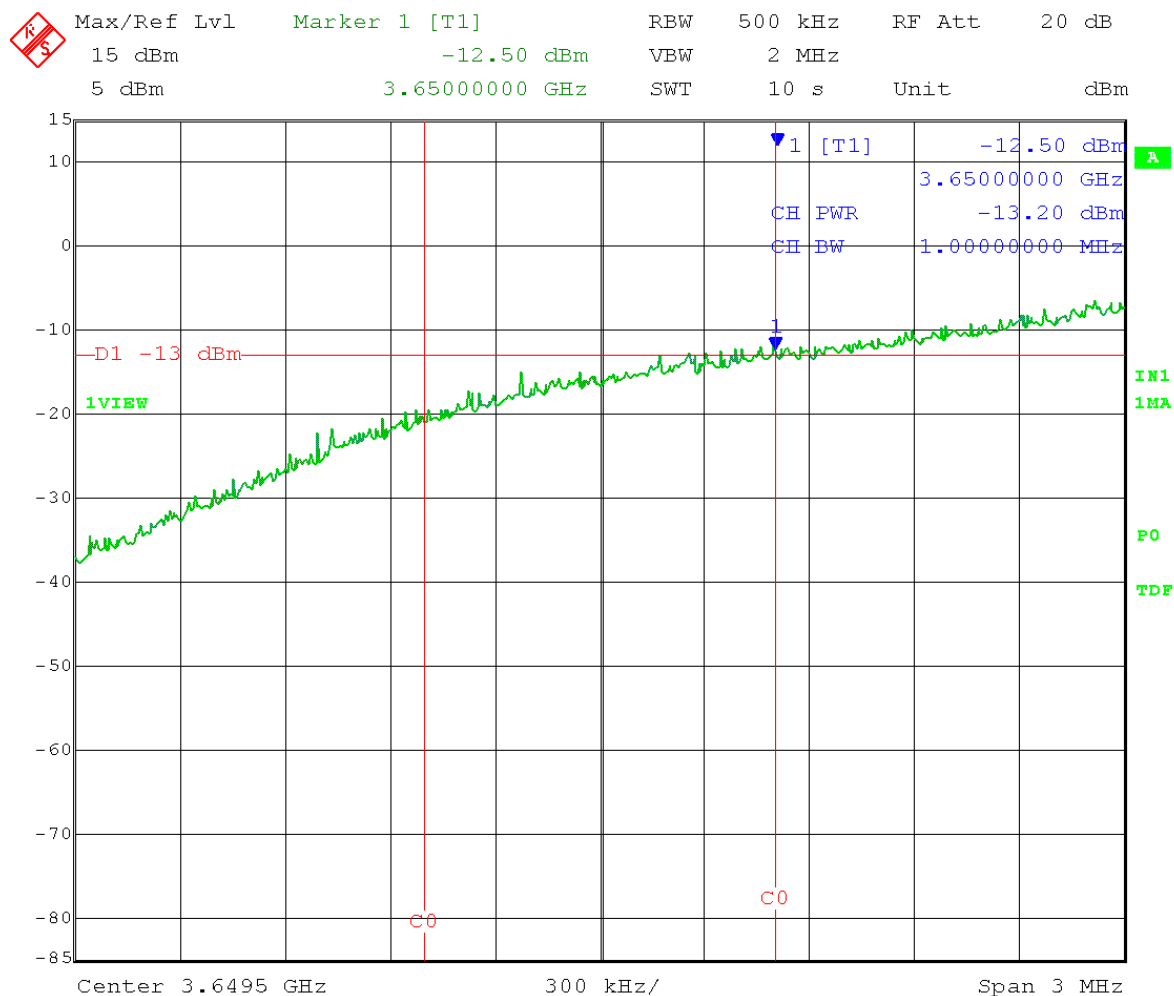
Date: 7.FEB.2017 15:26:04

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +10 °C

Power level at band edge = -13.20 dBm/MHz



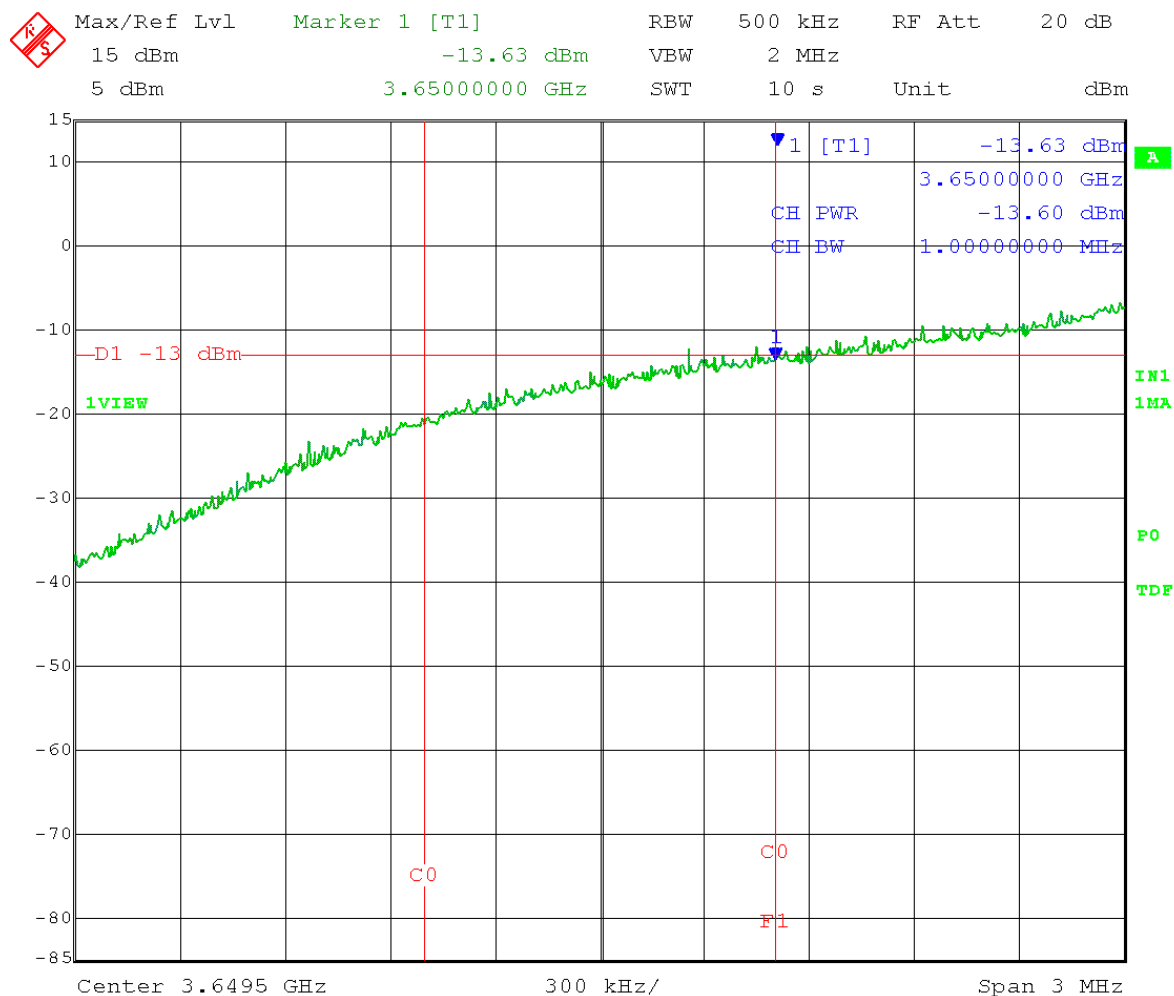
Date: 7.FEB.2017 14:49:58

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

102 V, +20 °C

Power level at band edge = -13.60 dBm/MHz



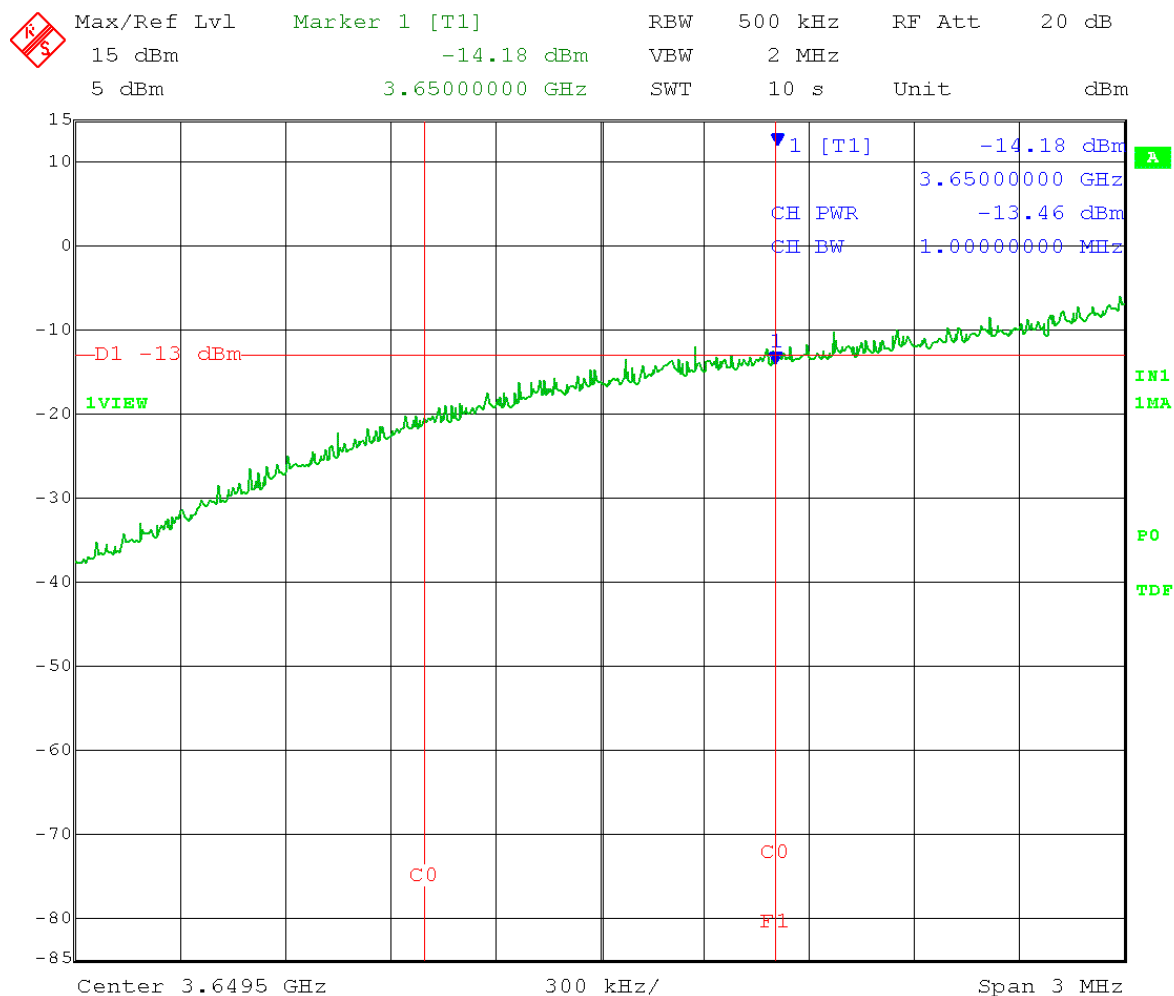
Date: 7.FEB.2017 11:04:43

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +20 °C

Power level at band edge = -13.46 dBm/MHz



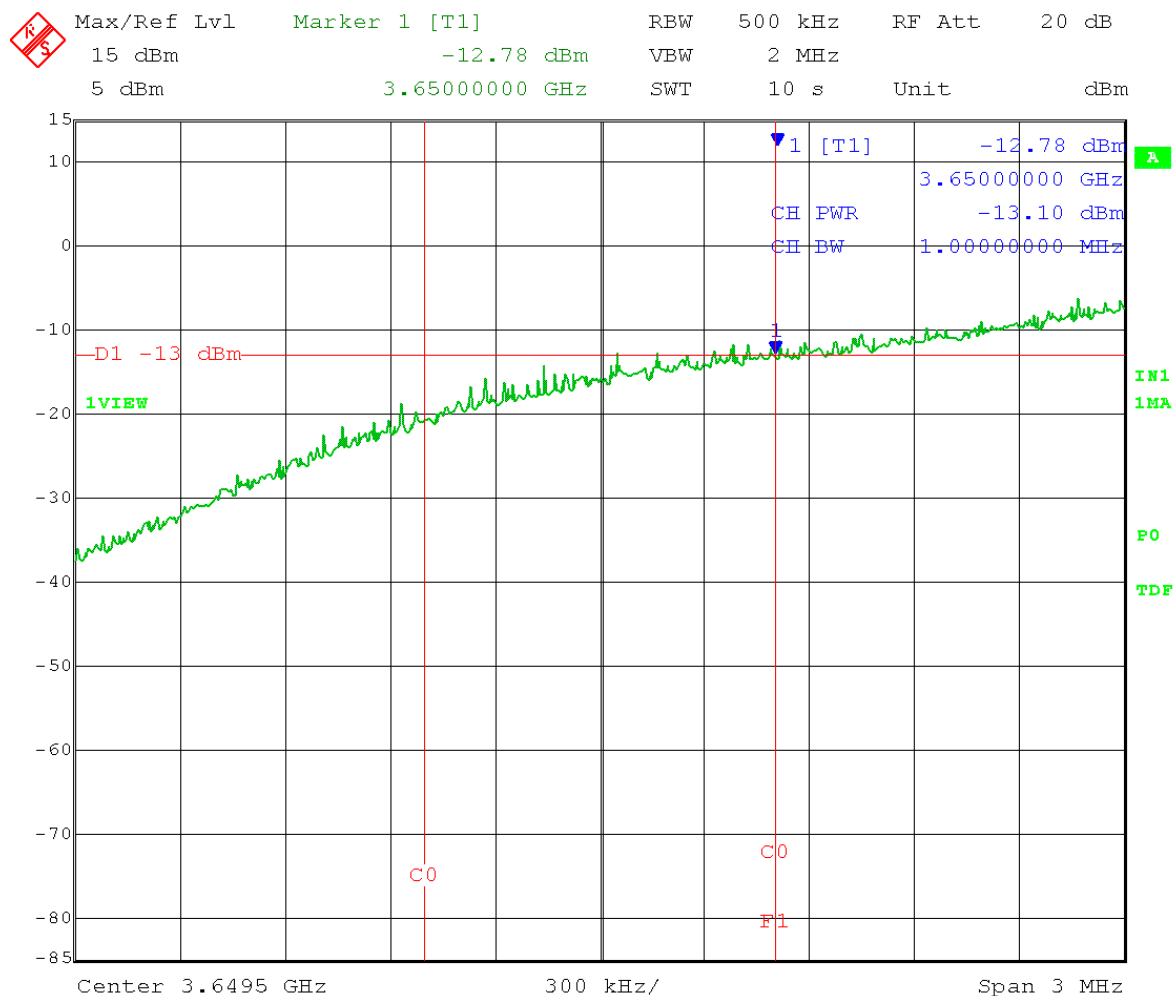
Date: 7.FEB.2017 11:02:26

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

138 V, +20 °C

Power level at band edge = -13.10 dBm/MHz



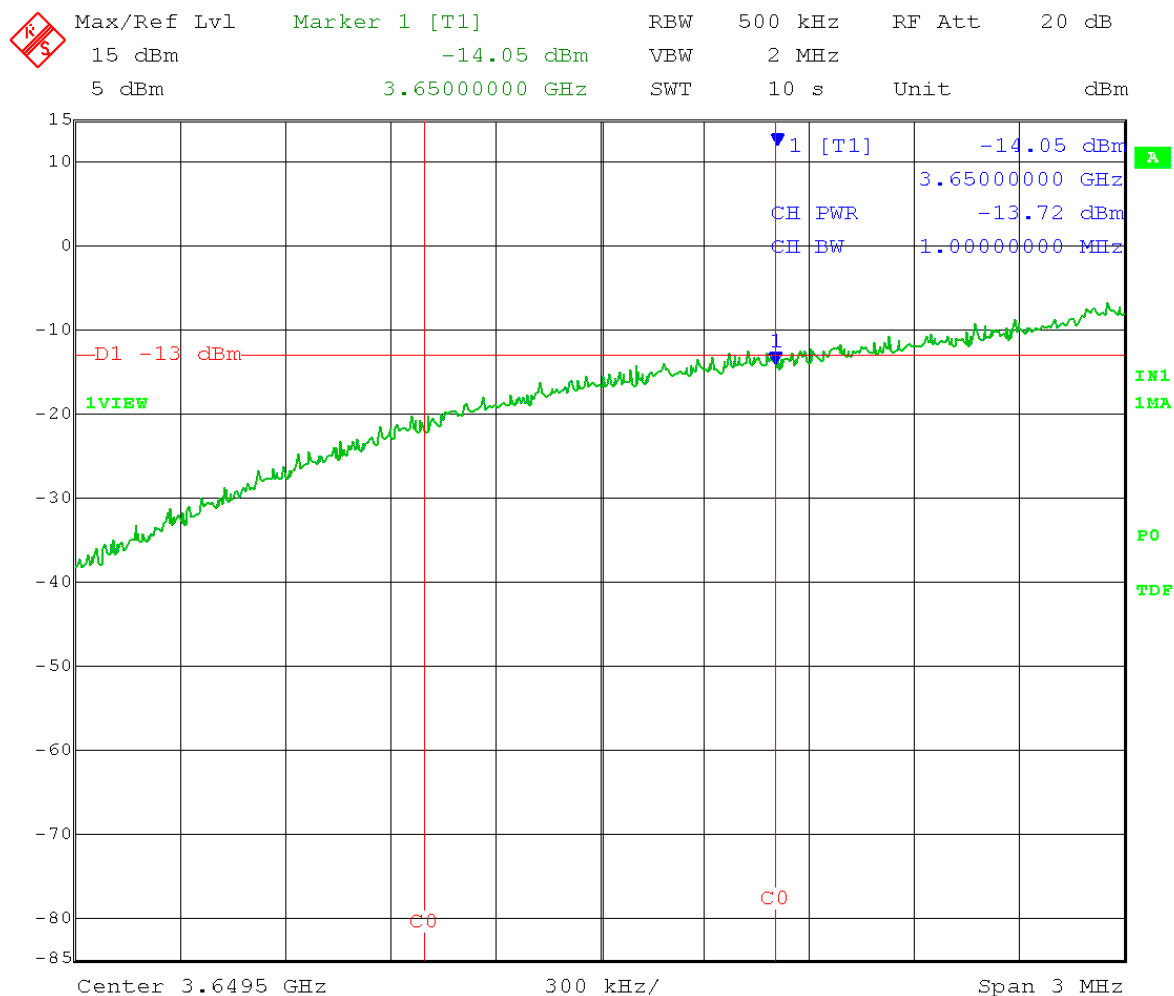
Date: 7.FEB.2017 11:06:44

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +30 °C

Power level at band edge = -13.72 dBm/MHz



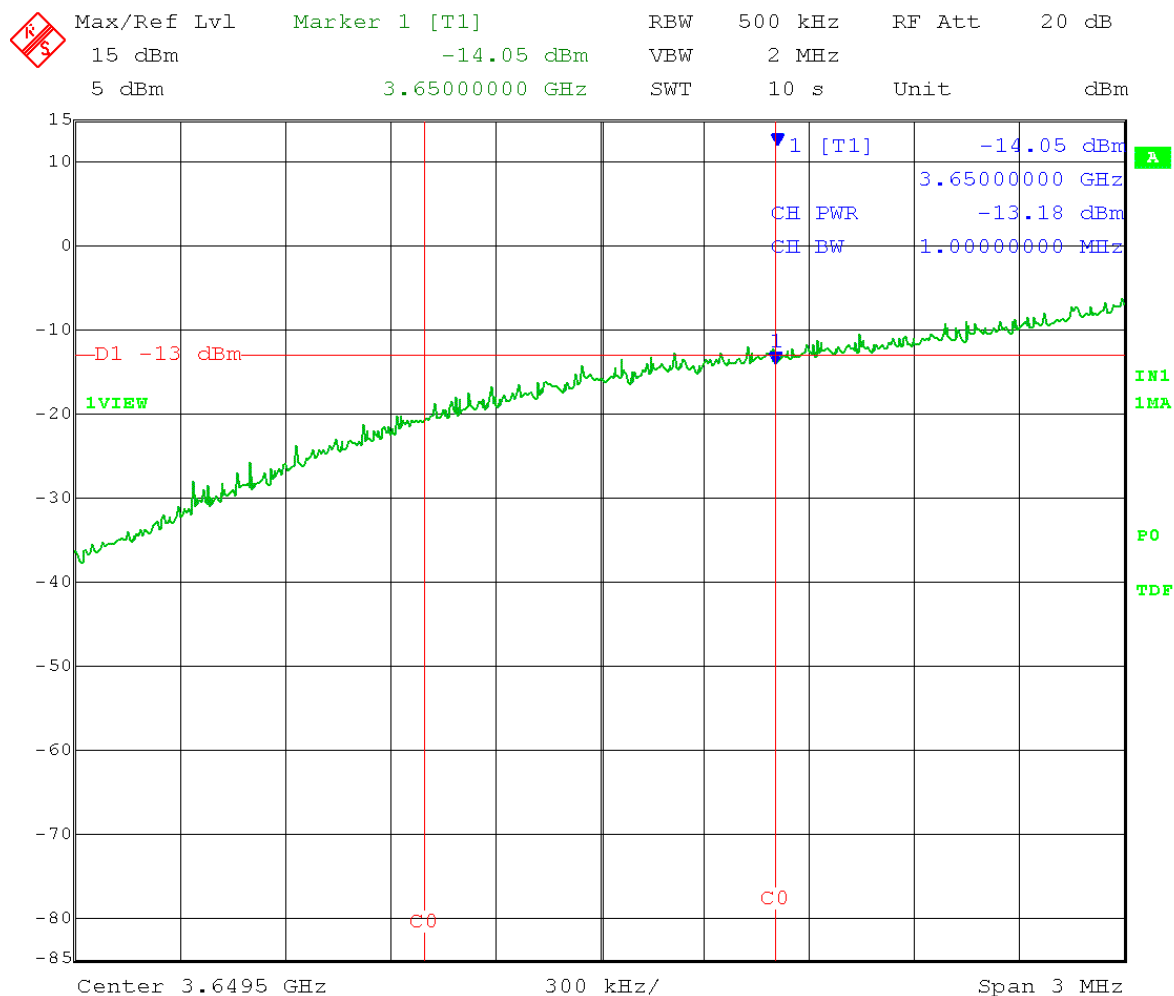
Date: 7.FEB.2017 12:20:10

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +40 °C

Power level at band edge = -13.18 dBm/MHz



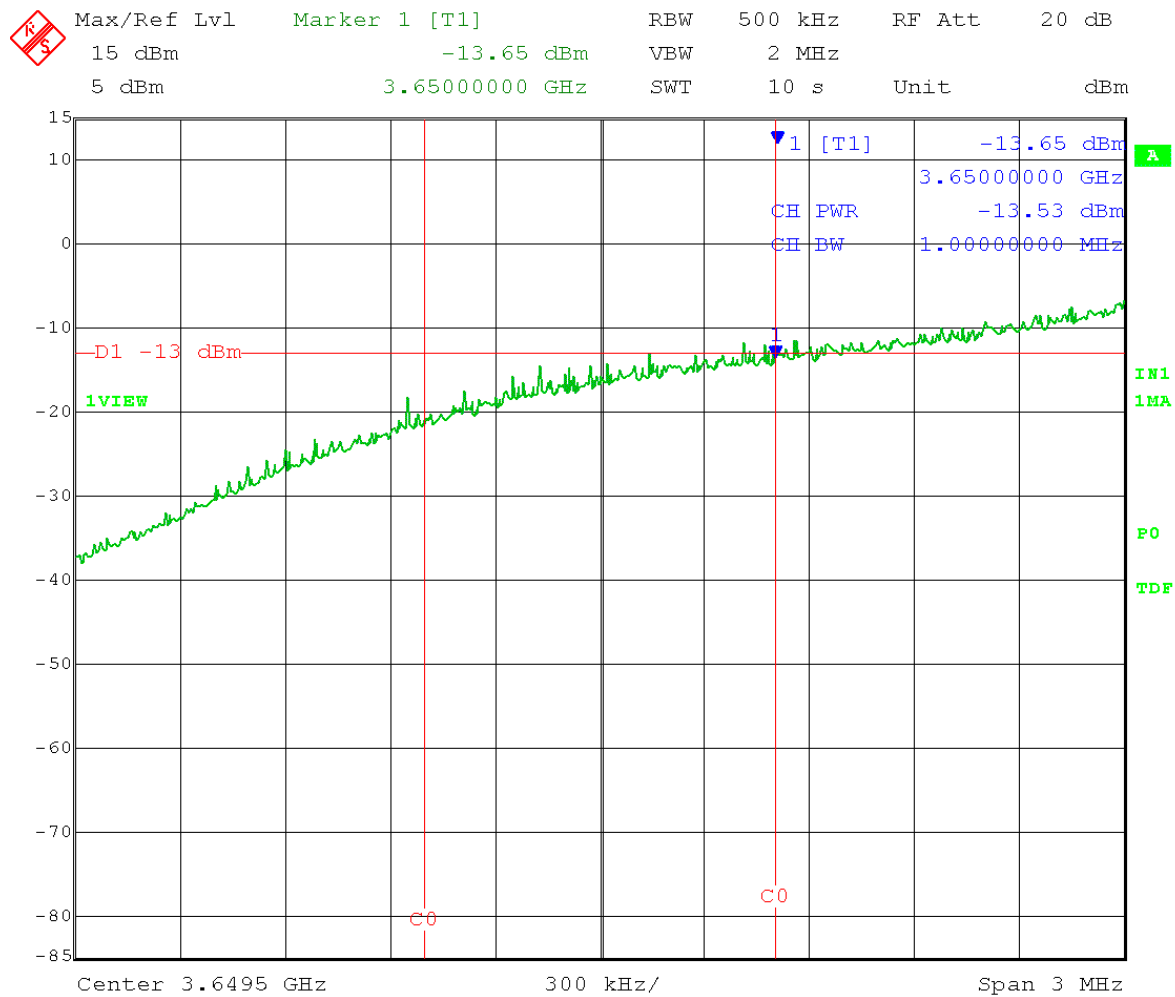
Date: 7.FEB.2017 13:08:27

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Lower Band-Edge Measurements - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
Low Channel: Transmit = 3670 MHz Output power setting: 13
Channel bandwidth: 40 MHz
Output port: A
Lower band edge frequency = 3650 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +50 °C

Power level at band edge = -13.53 dBm/MHz



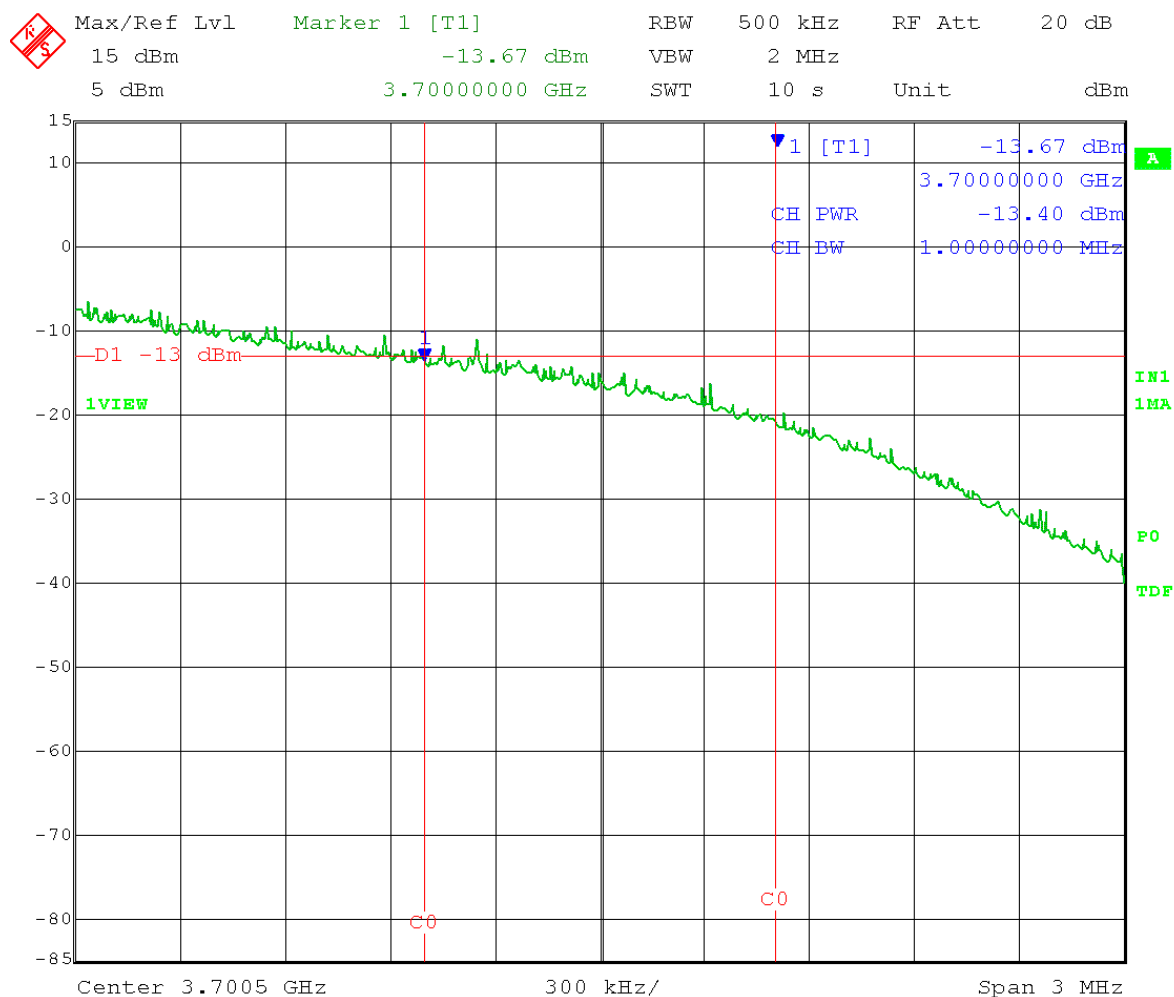
Date: 7.FEB.2017 13:44:50

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, -30 °C

Power level at band edge = -13.40 dBm/MHz



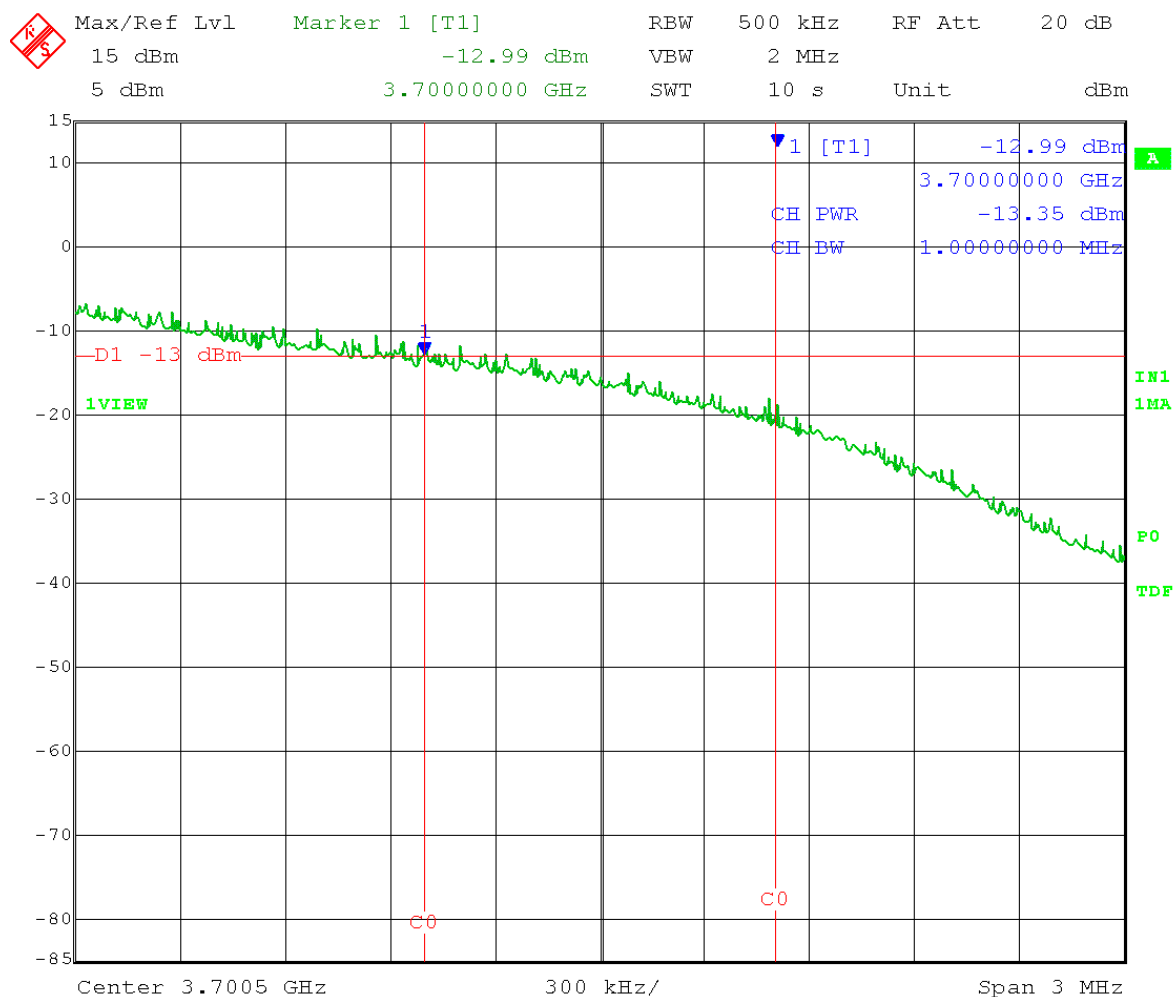
Date: 7.FEB.2017 17:30:29

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 15
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, -20 °C

Power level at band edge = -13.35 dBm/MHz



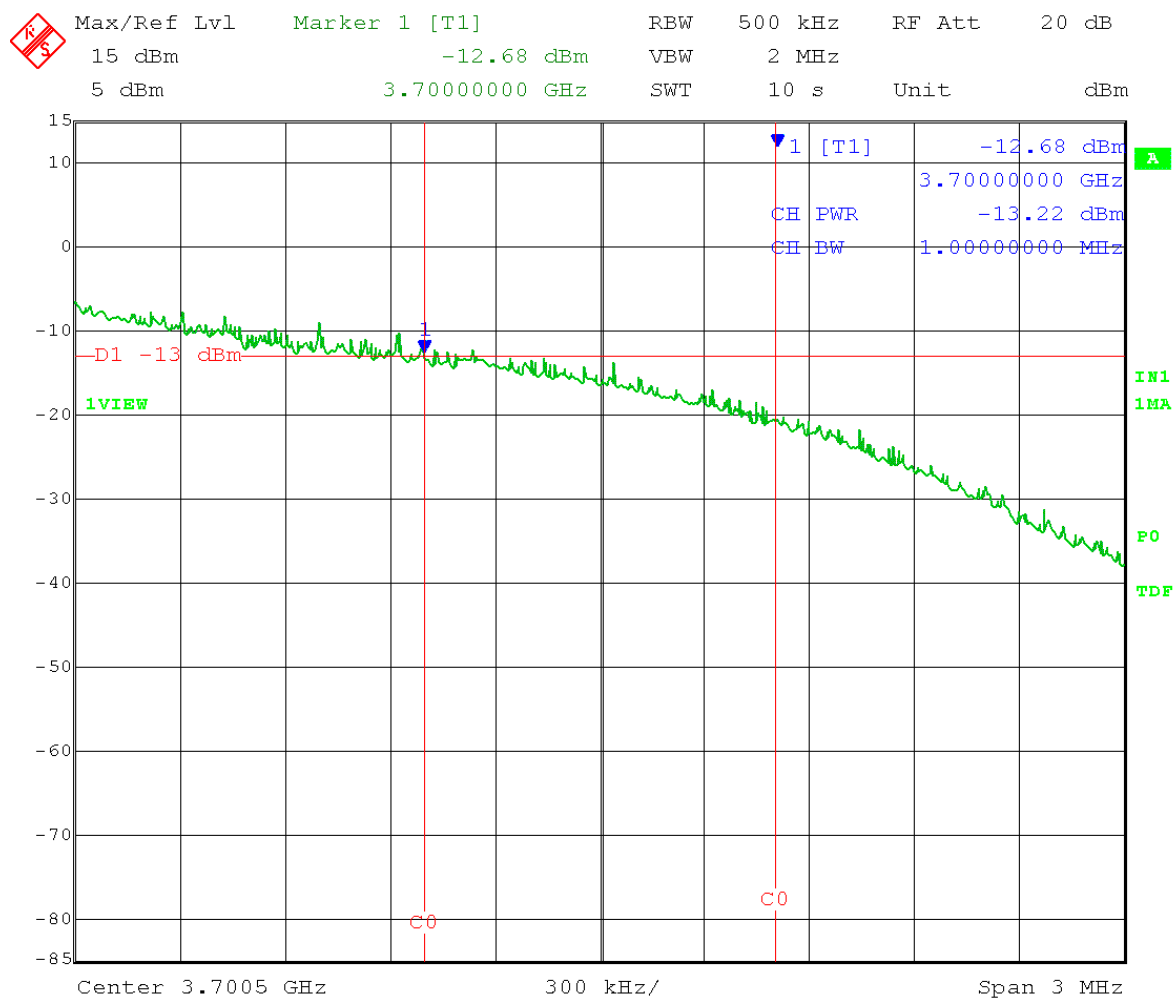
Date: 7.FEB.2017 16:53:43

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, -10 °C

Power level at band edge = -13.22 dBm/MHz



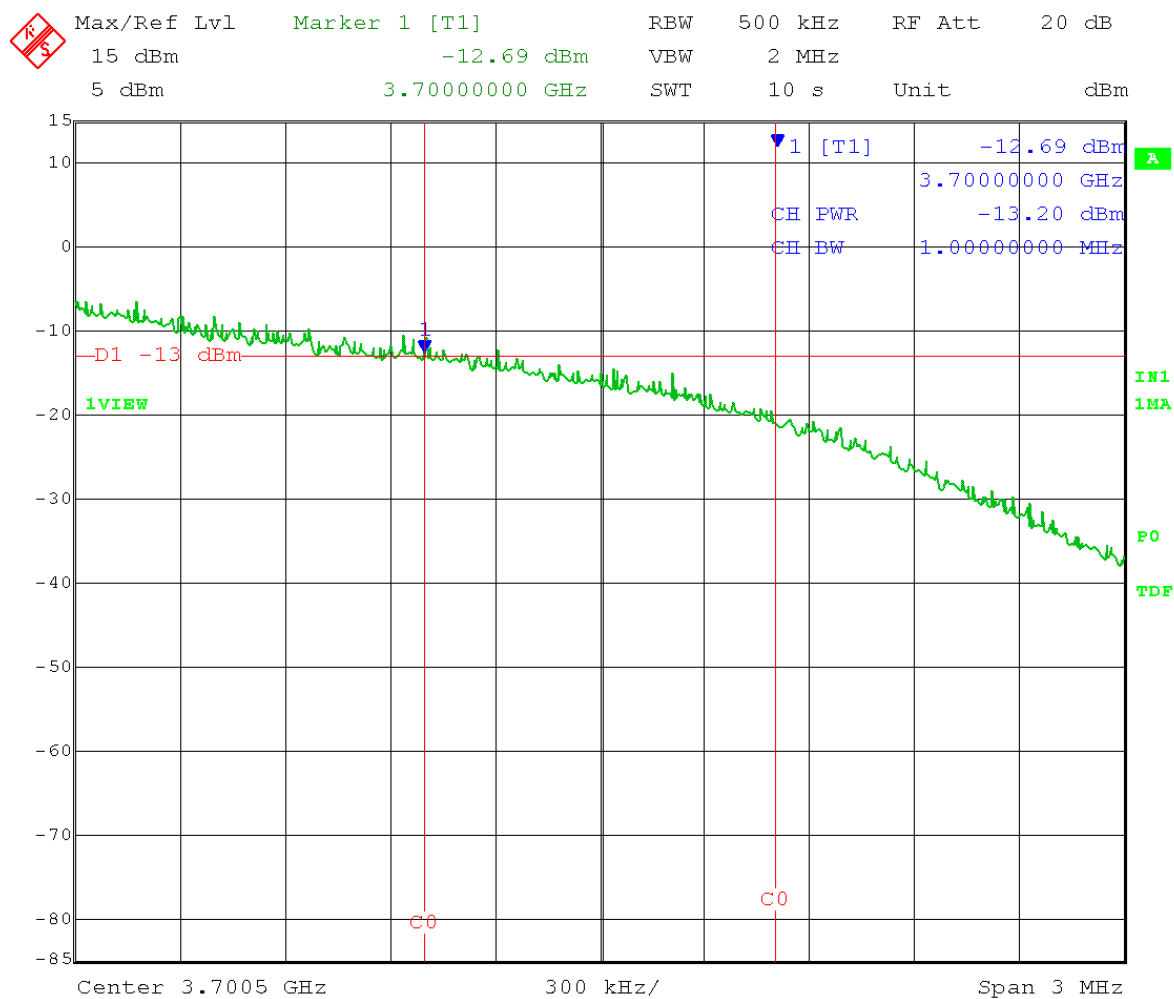
Date: 7.FEB.2017 16:08:51

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, 0 °C

Power level at band edge = -13.20 dBm/MHz



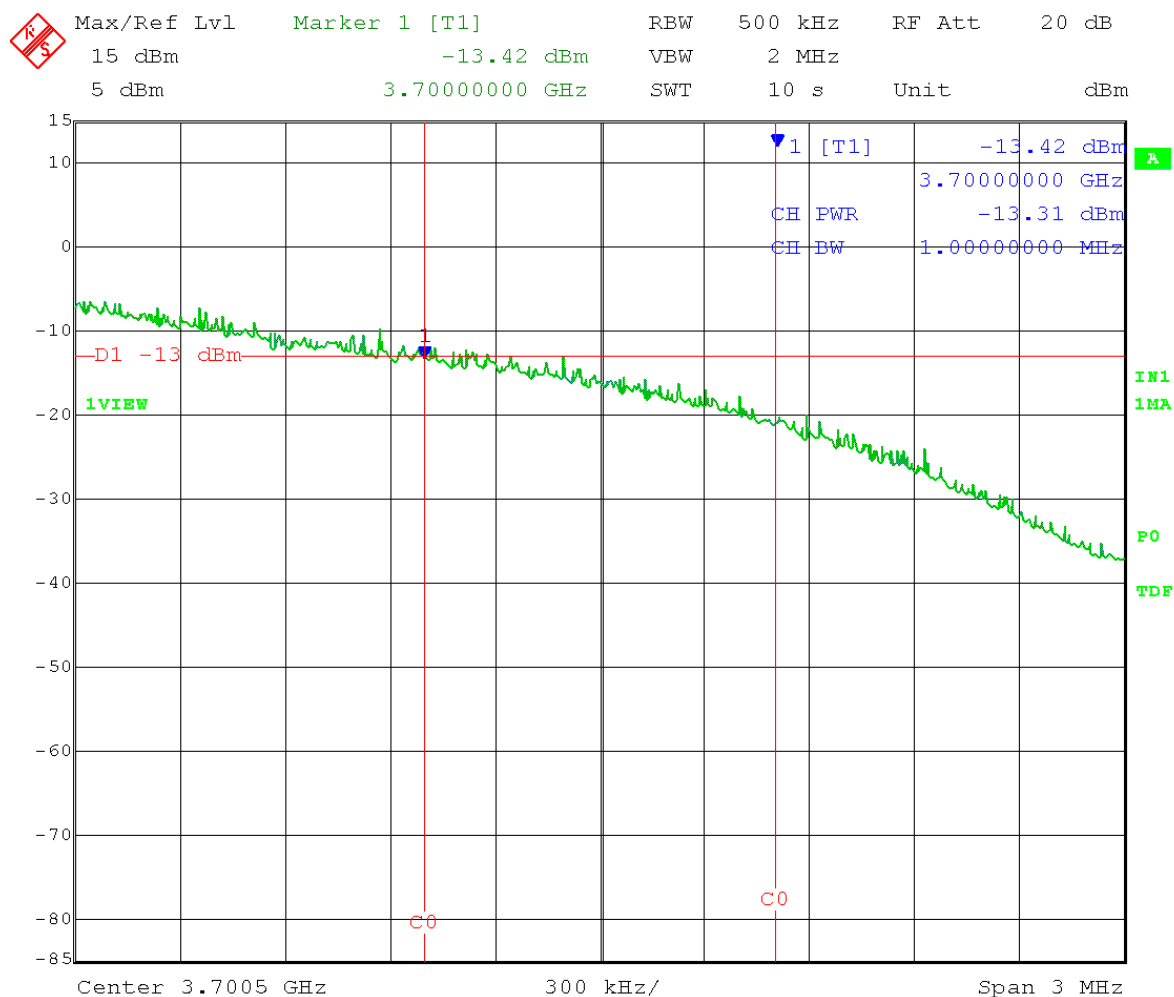
Date: 7.FEB.2017 15:27:44

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +10 °C

Power level at band edge = -13.31 dBm/MHz



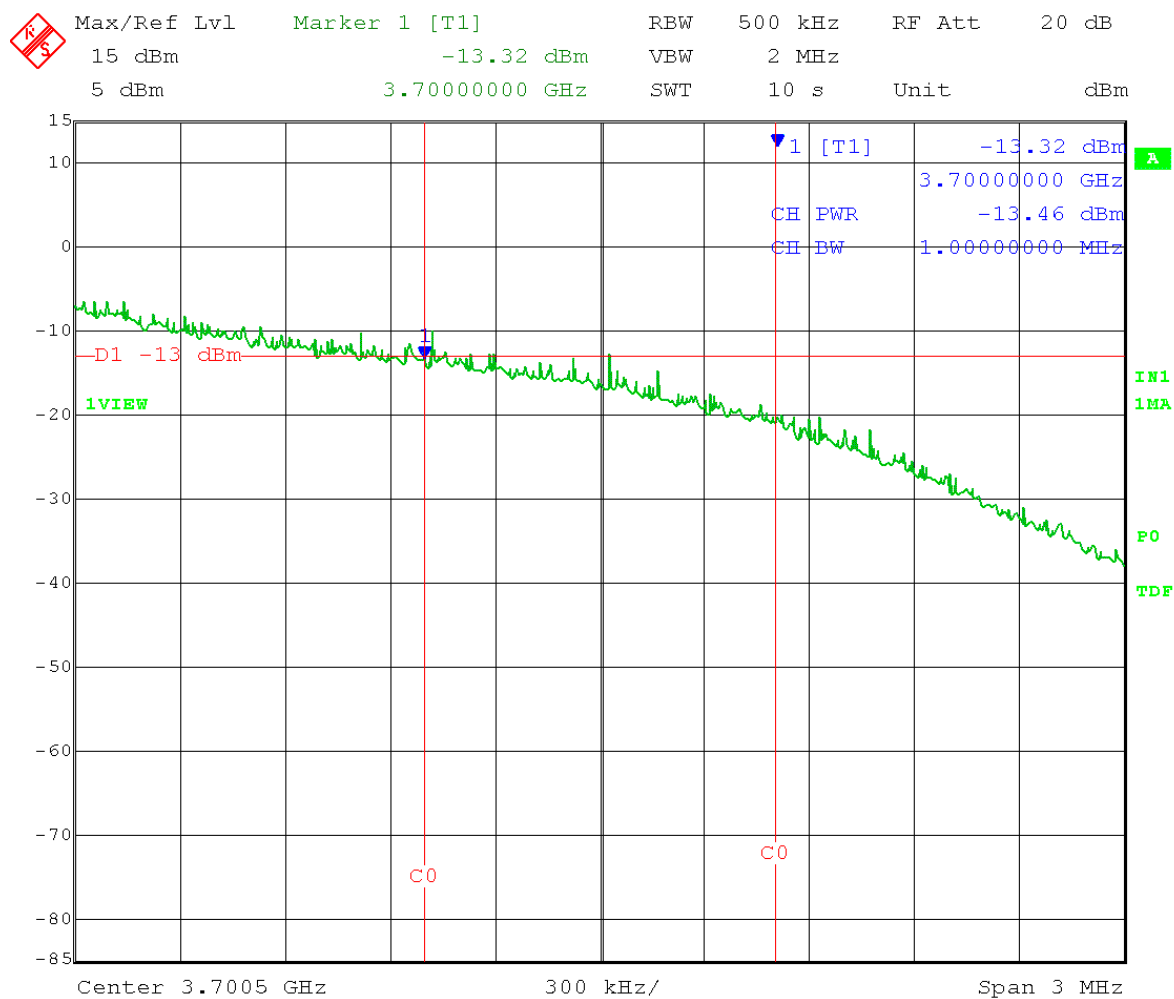
Date: 7.FEB.2017 14:47:55

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

102 V, +20 °C

Power level at band edge = -13.46 dBm/MHz



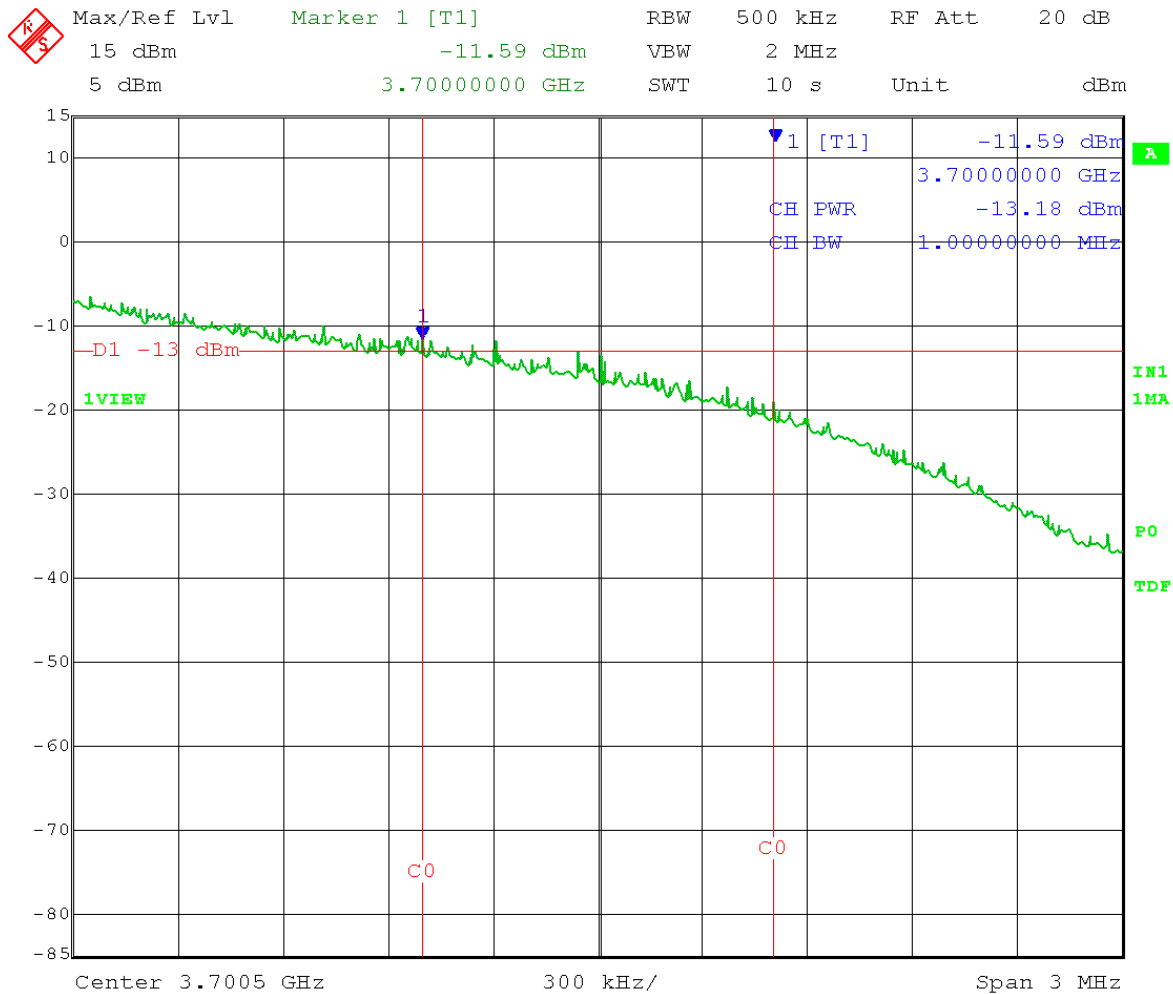
Date: 7.FEB.2017 11:12:54

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +20 °C

Power level at band edge = -13.18 dBm/MHz



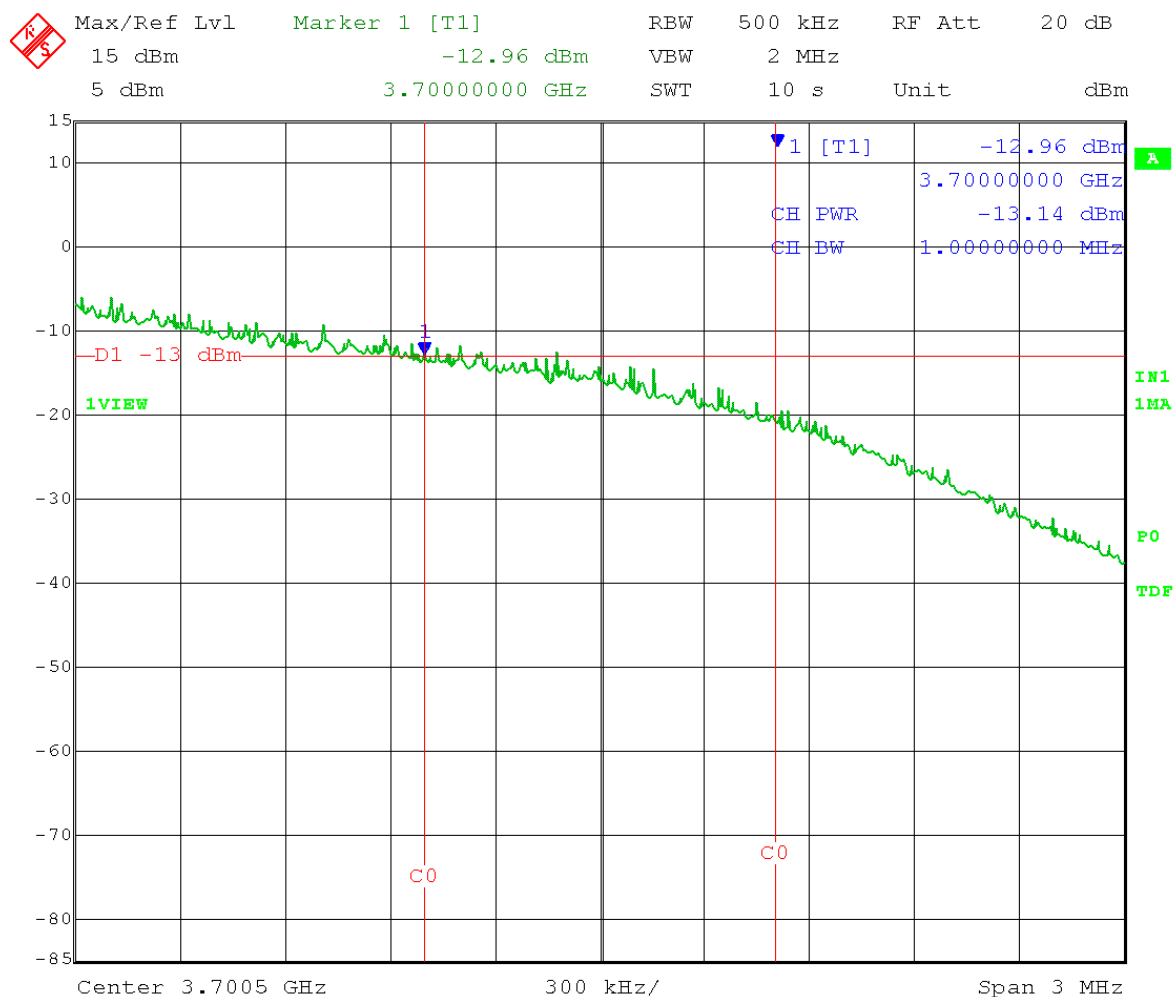
Date: 7.FEB.2017 11:15:34

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

138 V, +20 °C

Power level at band edge = -13.14 dBm/MHz



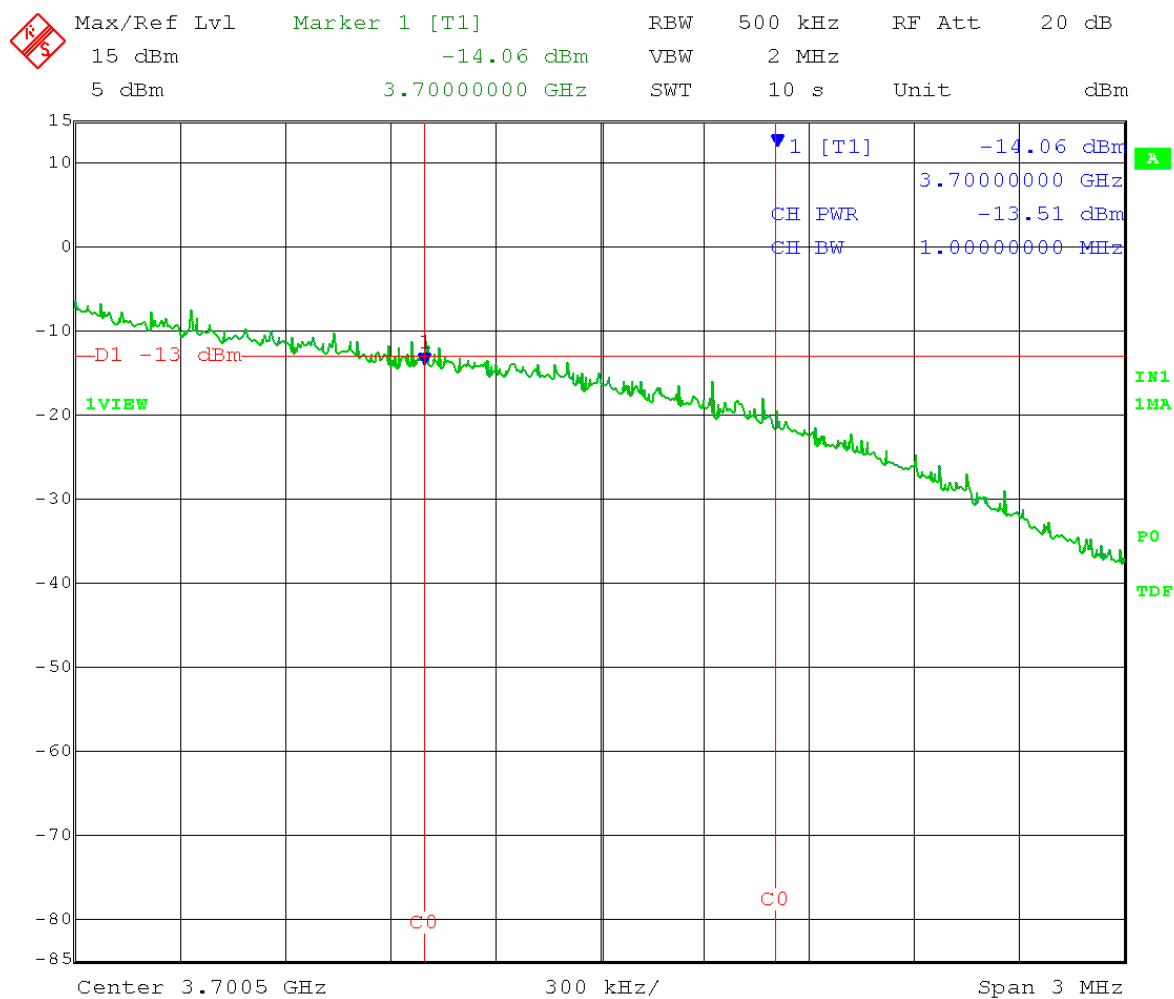
Date: 7.FEB.2017 11:11:11

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +30 °C

Power level at band edge = -13.51 dBm/MHz



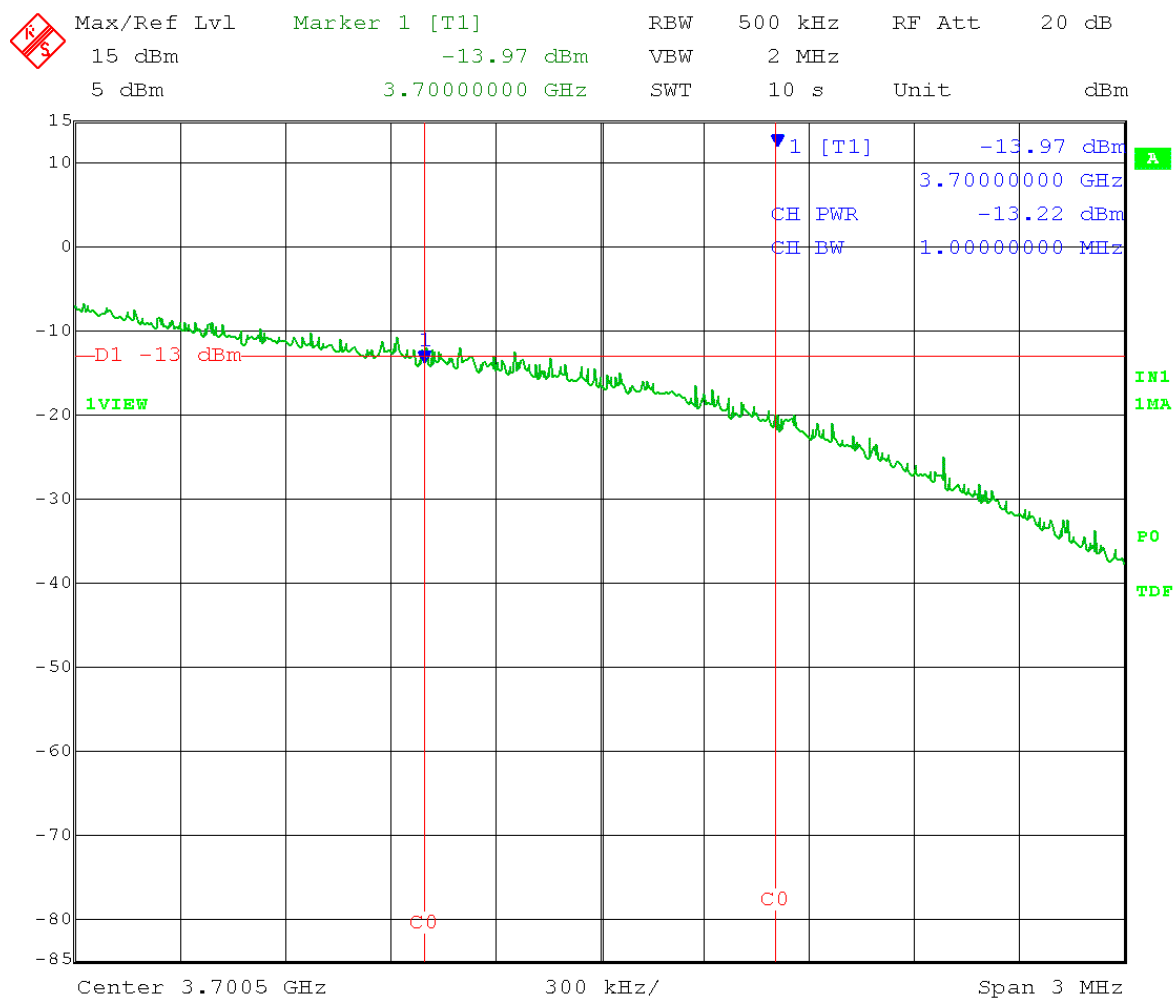
Date: 7.FEB.2017 12:22:13

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW \geq 1% OBW VBW \geq 3 x RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +40 °C

Power level at band edge = -13.22 dBm/MHz



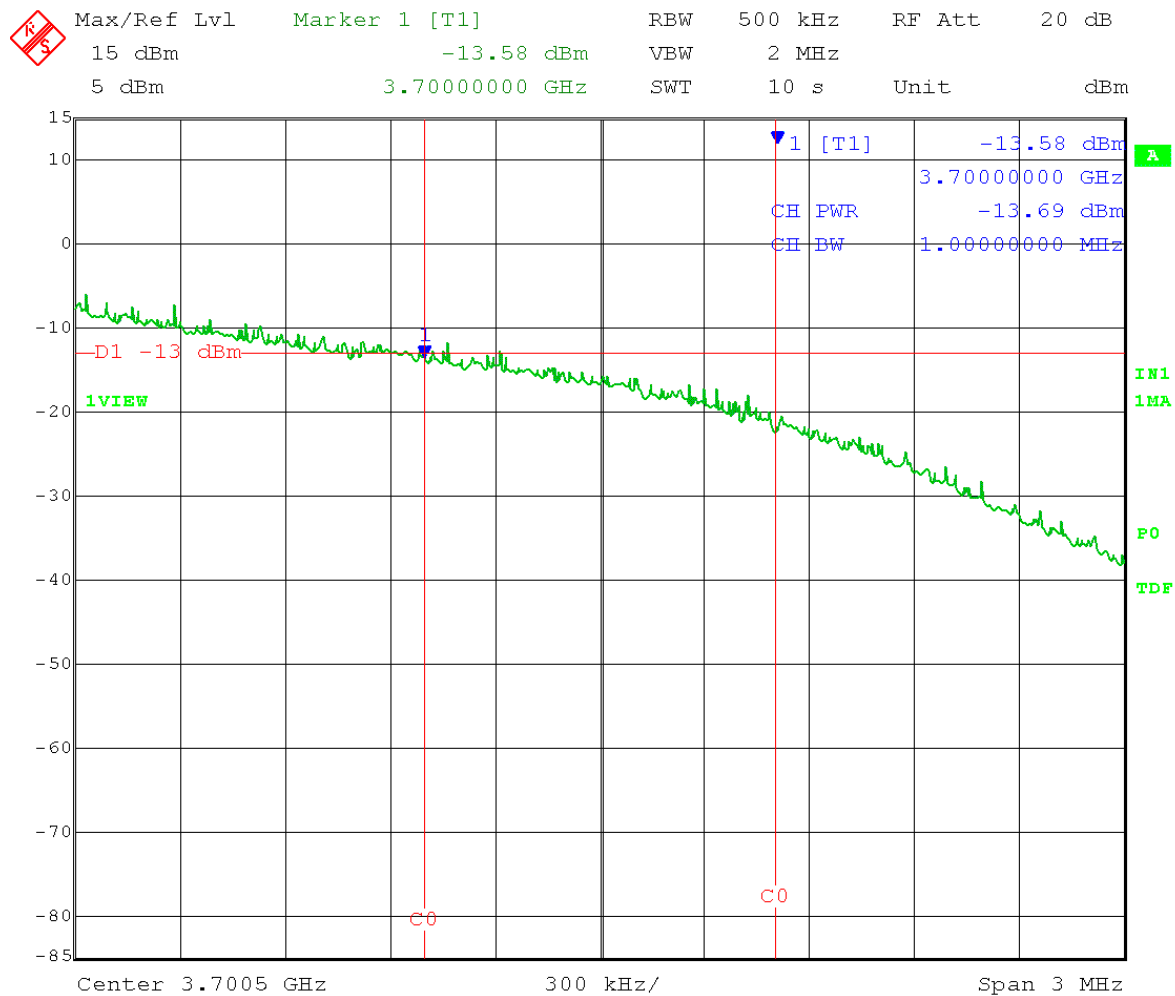
Date: 7.FEB.2017 13:06:39

Test Date: 02-07-2017
Company: Cambium Networks
EUT: PMP450 3.65 GHz AP
Test: Frequency Stability - Upper Band-Edge Measurement - Conducted
Operator: Craig B

Comment: RBW $\geq 1\%$ OBW VBW $\geq 3 \times$ RBW
Detector = Peak Sweep = 10 s
Trace = max hold
High Channel: Transmit = 3680 MHz Output power setting: 16
Channel bandwidth: 40 MHz
Output port: A
Upper band edge frequency = 3700 MHz
Limit: $43 + 10\log(P)$ below the channel transmitter power = -13 dBm/MHz
Measured power at band edge is integrated over a 1 MHz bandwidth

120 V, +50 °C

Power level at band edge = -13.69 dBm/MHz



Date: 7.FEB.2017 13:46:40



166 South Carter, Genoa City, WI 53128

Company:	Cambium Networks
Model Tested:	C036045A001A
Report Number:	22540
DLS Project:	8686

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%
Power Spectral Density, Conducted	+/- 1.26dB
Spurious Emissions, Radiated	+/- 5.69dB
Spurious 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
C036045A001A
22540
8686

END OF REPORT

Revision #	Date	Comments	By
1.0	02-08-2017	Initial Release	CB