Electromagnetic Compatibility
Class 2 Permissive Change Test Report

Tested to: FCC Part 15.247, RSS-247 issue 2 and ANSI C63.10:2013

On

Wi-Fi Module

CAM-CC3200M

Airgas, USA, LLC
180 Sandbank Road
Cheshire CT 06410-1521 USA

Prepared by:

TUV Rheinland of North America, Inc.

Manufacturer's statement - attestation

The manufacturer; Airgas, USA, LLC, as the responsible party for the equipment tested, hereby affirms:

a) That he has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;

b) That the device in this test report will be representative of production units;

c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.

d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

Robert Shock	Rob Shock
Printed name of official	Signature of official
180 Sandbank Road Cheshire CT 06410-1521 USA	5/9/2017
Address	Date
203-272-5800 x222	rob.shock@airgas.com
Telephone number	Email address of official

Client:	Airgas, USA, LLC 180 Sandbank Road Cheshire CT 06410-1521 USA	Robert Shock 203-272-5800 x222 rob.shock@airgas.com	
Identification:	Wi-Fi Module	***Serial No.:***	C4:BE:84:E9:F3:B9
Test item:	CAM-CC3200M	***Date tested:***	22 March 2017
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.	Tel: (919) 554-3668 Fax: (919) 554-3542	
Test specification:	**Emissions:** FCC Part 15C:2017, RSS-247 Issue 2:2017: FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 Clause 5.5 and RSS-GEN FCC Part 15.247 and RSS-247 Clause 5,		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		
tested by: Mark Ryan		***reviewed by:*** Robert Richards	
10 May 2017 ***Signature***		10 May 2017 ***Signature***	
Other Aspects:	**None**		

Abbreviations: OK, Pass, Compliant, Complies = passed
Fail, Not Compliant, Does Not Comply = failed
N/A = not applicable

90552 and 100881	**Testing Cert #3331.05**	**Industry Canada** **2932H-1 and 2932H-2**

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the standard(s), based on the results of testing performed on 22 March 2017 on the Wi-Fi Module, Model No. CAM-CC3200M, manufactured by Airgas, USA, LLC. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

The Class 2 Permissive Change (C2PC) application is to add a 2.4 GHz Swivel Rubber Dipole Antenna not originally certified with the Modular Device.

1.3 Revision History

Revision	Date	Description of Revision
.001		Initial Release

1.4 *Summary of Test Results*

Applicant	Airgas, USA, LLC 180 Sandbank Road Cheshire CT 06410-1521 USA	**Tel**	203-272-5800 x222	**Contact**	Robert Shock
		Fax	203-272-5833	**e-mail**	rob.shock@airgas.com

Description	Wi-Fi Module	**Model Number**	CAM-CC3200M
Serial Number	C4:BE:84:E9:F3:B9	**Test Voltage/Freq.**	5 VDC (USB Powered)
Test Date Completed:	22 March 2017	**Test Engineer**	Mark Ryan

Standards	Description	Severity Level or Limit	Criteria	Test Result
FCC Part 15C:2017 Standard	Radio Frequency Devices-Subpart C: Intentional Radiators	See called out parts below	See Below	**Complies**
RSS-247 Issue 2:2017 Standard	DTS, FHS and Licence-Exempt Local Area Network Devices	See called out parts below	See Below	**Complies**
FCC Part 15.247 and RSS-247 Clause 5	Operation within the band 2400 to 2483.5 MHz	See called out parts below	Below Limit	Complies
FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 Clause 5.5 and RSS-GEN	Out-of-Band Spurious and Harmonic Emissions (EUT in Transmit Mode)	Below the applicable limits	Below Limit	Complies
FCC Part 15.247(d) and RSS-247 clause 5.5	Band Edge Radiated Emission	Per requirements of the standard	Below Limit	Complies

Note: Only the parts listed above are included in this report. All Other tests are included in the in the original test report:
Reference: FCC ID: Z64-CAM-CC3200MR1 and IC ID: 4511-CAM-CC3200MR1

2 Laboratory Information

2.1 Accreditations and Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 ILAC / A2LA

The laboratory has been assessed and accredited by A2LA in accordance with ISO Standard 17025:2005 (Certificate Number: 3331.05, Master Code: 134288). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: 2932H-1 The OATS has been accepted by Industry Canada to perform testing to 3 and to 10 meters, based on the test procedures described in ANSI C63.4-2009.

Registration No.: 2932H-2 The 5 meter chamber has been accepted by Industry Canada to perform testing to 3 meters, based on the test procedures described in ANSI C63.4-2009.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Laboratory Registration No: A-0034).

2.1.5 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBµV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBµV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

2.1.1 Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBµV/m)

25 dBµV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBµV/m

2.2 Measurement Uncertainty for Conducted Transmitter Testing

The following tables list the uncertainty contributors, their distribution and the associated uncertainties for vertically polarized radiated fields over the frequency range 9kHz -40 GHz.

Combined standard uncertainty $u_C(y)$ can be computed from this as:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k-1}^{n} (q_k - \bar{q})^2}$$

Unless the repeatability of the EUT is particularly poor and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore: $U = 2\, u_C(y)$

2.2.1 Total Measurement Uncertainty

Total uncertainty

Band 1 uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency	Unit conver'n	Std uncertainty	
		+x	-x			multiplier	divisor	+u(Hz)	-u(Hz)
Time base	Time base drift (1x10-9 = 0.001ppm)	0.05	0.05	Rectangular	1.73	1.00	1.00	0.03	0.03
Counter	Counter (±20pHz/Hz+0.6Hz)	0.60	0.60	Rectangular	1.73	1.00	1.00	0.35	0.35
Temp	Ambient temperature uncertainty	1.00	1.00	Rectangular	1.73	1.12	1.00	0.65	0.65
							Combined (RSS) Standard Uncertainty (U_c):	**0.73**	**0.73**
							Expanded Uncertainty (U_{95}):	**1.44**	**1.44**

Band 2 uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency	Unit conver'n	Std uncertainty	
		+x	-x			multiplier	divisor	+u(Hz)	-u(Hz)
Time base	Time base drift (1x10-9 = 0.001ppm)	0.92	0.92	Rectangular	1.73	1.00	1.00	0.53	0.53
Counter	Counter (±20pHz/Hz+0.6Hz)	0.62	0.62	Rectangular	1.73	1.00	1.00	0.36	0.36
Temp	Ambient temperature uncertainty	1.00	1.00	Rectangular	1.73	1.12	1.00	0.65	0.65
							Combined (RSS) Standard Uncertainty (U_c):	**0.91**	**0.91**
							Expanded Uncertainty (U_{95}):	**1.78**	**1.78**

Band 3 uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency	Unit conver'n	Std uncertainty	
		+x	-x			multiplier	divisor	+u(Hz)	-u(Hz)
Time base	Time base drift (1x10-9 = 0.001ppm)	2.45	2.45	Rectangular	1.73	1.00	1.00	1.41	1.41
Counter	Counter (±20pHz/Hz+0.6Hz)	0.65	0.65	Rectangular	1.73	1.00	1.00	0.37	0.37
Temp	Ambient temperature uncertainty	1.00	1.00	Rectangular	1.73	1.12	1.00	0.65	0.65
							Combined (RSS) Standard Uncertainty (U_c):	**1.60**	**1.60**
							Expanded Uncertainty (U_{95}):	**3.13**	**3.13**

Total uncertainty (all bands)	Combined (RSS) Standard Uncertainty (U_c):	**1.98**	**1.98**
	Expanded Uncertainty (U_{95}):	**3.88**	**3.88**

2.2.2 Total Carrier Power Measurement Uncertainty

Total uncertainty

Power meter & sensor

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency multiplier	Unit conver'n divisor	Std uncertainty	
		+x	-x					+u(dB)	-u(dB)
Meter ref	Power meter reference level	1.500	1.500	Rectangular	1.732	1.000	23.000	0.038	0.038
Cal fact	Cal factor uncert	2.300	2.300	Rectangular	1.732	1.000	23.000	0.058	0.058
Range err	Range to range change error	0.500	0.500	Rectangular	1.732	1.000	23.000	0.013	0.013
Meter lin	Power meter linearity	0.500	0.500	Rectangular	1.732	1.000	23.000	0.013	0.013
	Mismatch when calibrating	0.022	0.022		1.000	1.000	1.000	0.022	0.022
					1.000	1.000	1.000	0.000	0.000
							Combined (RSS) Standard Uncertainty (u_{c1}):	**0.074**	**0.074**

Uncertainty when measuring atten/cable

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency multiplier	Unit conver'n divisor	Std uncertainty	
		+x	-x					+u(dB)	-u(dB)
	measurement	0.175	0.175		1.000	1.000	1.000	0.175	0.175
Range err	Range to range change error	0.500	0.500	Rectangular	1.732	1.000	23.000	0.013	0.013
Meter lin	Power meter linearity	0.500	0.500	Rectangular	1.732	1.000	23.000	0.013	0.013
							Combined (RSS) Standard Uncertainty (U_{c2}):	**0.175**	**0.175**

Carrier power measurement

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency multiplier	Unit conver'n divisor	Std uncertainty	
		+x	-x					+u(dB)	-u(dB)
	Mismatch during power measurement	0.643	0.643		1.000	1.000	1.000	0.643	0.643
Atten PI	Attenuator power influence	0.750	0.750	Rectangular	1.732	1.000	1.000	0.433	0.433
Temp	Temperature uncertainty	1.000	1.000	Rectangular	1.732	4.176	23.000	0.105	0.105
Supply	Supply uncertainty	0.100	0.100	Rectangular	1.732	10.440	23.000	0.026	0.026
Random	Random uncertainty (see note in section 6.4.7 , Part 1)	0.010	0.010	Normal	1.000	1.000	1.000	0.010	0.010
Time duty	Time duty cycle	2.000	2.000	Normal	1.000	1.000	23.000	0.087	0.087
					1.000	1.000	1.000	0.000	0.000
							Combined (RSS) Standard Uncertainty (U_{c3}):	**0.788**	**0.788**

Total uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution	divisor	Dependency multiplier	Unit conver'n divisor	Std uncertainty	
		+u or x	-u or x					+u(dB)	-u(dB)
Uc1	Power meter & sensor	0.074	0.074		1.000	1.000	1.000	0.074	0.074
Uc2	Uncertainty when measuring atten/cable	0.175	0.175		1.000	1.000	1.000	0.175	0.175
Uc3	Carrier power measurement	0.788	0.788		1.000	1.000	1.000	0.788	0.788
					1.000	1.000	1.000	0.000	0.000
							Combined (RSS) Standard Uncertainty (U_c):	**0.810**	**0.810**
							Expanded Uncertainty (U_{95}):	**1.588**	**1.588**

2.2.3 Total Adjacent channel power Measurement Uncertainty

Total uncertainty

Total relative RF level uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution divisor		Dependency multiplier	Unit conver'n divisor	Std uncertainty	
		+x	-x					+u(dB)	-u(dB)
Filter pwr bw	Filter power bw	0.200	0.200	Rectangular	1.732	1.000	1.000	0.115	0.115
Relative acc	Relative accuracy	0.500	0.500	Rectangular	1.732	1.000	1.000	0.289	0.289
Random	Random uncertainty (see note in section 6.4.7 , Part 1)	0.110	0.110	Normal	1.000	1.000	1.000	0.110	0.110
Deviation	Deviation uncertainty	30.000	30.000	Rectangular	1.732	0.054	23.000	0.041	0.041
6dB pt unc	Uncertainty of 6dB point	0.075	0.075	Rectangular	1.732	15.524	1.000	0.672	0.672
					1.000	0.000	23.000	0.000	0.000
					1.000	1.000	1.000	0.000	0.000
					1.000	1.000	1.000	0.000	0.000
					1.000	1.000	1.000	0.000	0.000
							Combined (RSS) Standard Uncertainty (u_c):	**0.750**	**0.750**
							Expanded Uncertainty (U_{95}):	**1.470**	**1.470**

2.2.4 Total Conducted Spurious Emissions Measurement Uncertainty

Total uncertainty

Total uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution divisor		Dependency multiplier	Unit conversion divisor	Std uncertainty	
		+x	-x					+u(dB)	-u(dB)
	Total Mismatch EUT to Spectrum Anal.	1.01	1.01		1.00	1.00	1.00	1.01	1.01
	Total Mismatch cal of Spectrum Analyzer	0.30	0.30		1.00	1.00	1.00	0.30	0.30
SA Cal ref	Spec. Ana. Cal output reference level	0.30	0.30	Rectangular	1.73	1.00	1.00	0.17	0.17
SA freq res.	Spec. Ana. frequency response	2.50	2.50	Rectangular	1.73	1.00	1.00	1.44	1.44
SA BW Sw	Spec. Ana. Bandwidth switching	0.50	0.50	Rectangular	1.73	1.00	1.00	0.29	0.29
SA Log Fid	Spec. Ana. Log fidelity	1.50	1.50	Rectangular	1.73	1.00	1.00	0.87	0.87
Supply Volt	Supply voltage uncertainty	0.10	0.10	Rectangular	1.73	10.44	23.00	0.03	0.03
Fltr loss unc	Filter loss uncertainty	0.15	0.15	Rectangular	1.73	1.00	1.00	0.09	0.09
Atten unc	Attenuator loss uncertainty	0.15	0.15	Rectangular	1.73	1.00	1.00	0.09	0.09
SA i/p att sw	SA atten switching uncertainty	0.20	0.20	Rectangular	1.73	1.00	1.00	0.12	0.12
Att pwr coef	Attenuator power coefficient	0.30	0.30	Rectangular	1.73	1.00	1.00	0.17	0.17
Cable	Measurement cable loss uncert	0.20	0.20	Normal	1.00	1.00	1.00	0.20	0.20
Rnd	Random contribution (see note in section 6.4.7 , Part 1)	0.20	0.20	Normal	1.00	1.00	1.00	0.20	0.20
							Combined (RSS) Standard Uncertainty (u_c):	**2.05**	**2.05**
							Expanded Uncertainty (U_{95}):	**4.01**	**4.01**

2.2.5 Total Frequency Deviation Measurement Uncertainty

Total uncertainty

Total deviation uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution		Dependency	Unit conver'n	Std uncertainty	
		+x	-x	divisor		multiplier	divider	+u(%)	-u(%)
Dev Unc	Deviation uncertainty	1.00	1.00	Rectangular	1.73	1.00	1.00	0.58	0.58
Last Digit	+/- last digit of deviation meter display	0.25	0.25	Rectangular	1.73	1.00	1.00	0.14	0.14
Res mod	Residual modulation	0.50	0.50	Rectangular	1.73	1.00	1.00	0.29	0.29
Rand unc	Random uncertainty (see note in section 6.4.7 , Part 1)	0.00	0.00	Normal	1.00	1.00	1.00	0.00	0.00
							Combined (RSS) Standard Uncertainty (u_c):	**0.66**	**0.66**
							Expanded Uncertainty (U_{95}):	**1.30**	**1.30**

2.2.6 Total Response Measurement Uncertainty

Deviation uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution		Dependency	Unit conver'n	Std uncertainty	
		+x	-x	divisor		multiplier	divider	+u(%)	-u(%)
Dev Unc	Deviation uncertainty	1.00	1.00	Rectangular	1.732	1.00	1.00	0.58	0.58
AF Osc	AF oscillator uncertainty	0.70	0.70	Rectangular	1.732	1.00	1.00	0.40	0.40
AC volt mtr	AC Volt meter uncertainty	4.00	4.00	Rectangular	1.732	1.00	1.00	2.31	2.31
AF gain unc	AF gain uncertainty	2.00	2.00	Rectangular	1.732	1.00	1.00	1.15	1.15
Rand unc	Random uncertainty (see note in section 6.4.7 , Part 1)	0.00	0.00	Normal	1.000	1.00	1.00	0.00	0.00
							Combined (RSS) Standard Uncertainty (u_{c1}):	**2.68**	**2.68**

Total uncertainty

Symbol	Source of uncertainty	Uncertainty value		Distribution		Dependency	Unit conver'n	Std uncertainty	
		+u or x	-u or x	divisor		multiplier	divider	+u(dB)	-u(dB)
Uc1	Deviation uncertainty	2.68	2.68		1.000	1.00	11.50	0.23	0.23
					1.000	1.00	1.00	0.00	0.00
					1.000	1.00	1.00	0.00	0.00
					1.000	1.00	1.00	0.00	0.00
							Combined (RSS) Standard Uncertainty (U_c):	**0.23**	**0.23**
							Expanded Uncertainty (U_{95}):	**0.46**	**0.46**

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.4 Software Used

Manufacturer	Name	Version
Quantum Change/EMC Systems LLC.	Tile	3.2U
TUV	Alt "R"	1
TUV	Alt "C"	1
ETS-Lindgren	EMPower	1.0.2.11

2.5 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated and Conducted RF Emissions (5 Meter Chamber)					
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	16-Aug-16	16-Aug-17
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	16-Aug-16	16-Aug-17
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	20-Aug-15	20-Aug-17
Antenna Horn 1-18GHz	EMCO	3115	2236	18-Nov-15	18-Nov-17
18-40GHz Horn and Amp	COM-POWER	AHA-B40	105002	12-Sep-16	12-Sep-16
Cable, Coax	MicroCoax	MKR300C-0-0-1200-500500	002	17-Aug-16	17-Aug-17
Cable, Coax	MicroCoax	MKR300C-0-1968-500310	005	17-Aug-16	17-Aug-17
Cable, Coax	MicroCoax	UFB29C-1-5905-50U-50U	009	17-Aug-16	17-Aug-17
Notch Filter: 2.4-2.4835GHz	Micro-Tronics	BRM50702	049	18-Aug-16	18-Aug-17
USB RF Power Sensor	ETS-Lindgren	7002-006	14I000SNO054	18-Aug-16	18-Aug-17
USB RF Power Sensor	ETS-Lindgren	7002-006	14I000SNO055	18-Aug-16	18-Aug-17
General Laboratory Equipment					
Meter, Multi	Fluke	179	90580752	18-Aug-16	18-Aug-17
Meter, Temp/Humid/Barom	ExTech	SD700	Q677933	21-Dec-15	21-Dec-17
Meter, Temp/Humid/Barom	ExTech	SD700	Q677942	21-Dec-15	21-Dec-17

3 Product Information

3.1 Product Description

See Appendix A of this report

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

3.3 Equivalent Models

No additional models covered by test report.

3.4 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in appendix A of this report

4 Radiated Emissions

4.1 Spurious Emissions Outside the band - FCC 15.247(d), RSS-247 Clause 5.2

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	17 March 2017
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.247(d), RSS-247, and RSS-GEN						
Product Model	CAM-CC3200M			**Serial#**	C4:BE:84:E9:F3:B9		
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	5 V DC USB Powered	**Temp**	73º F	**Humidity**	29%	**Pressure**	1008 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

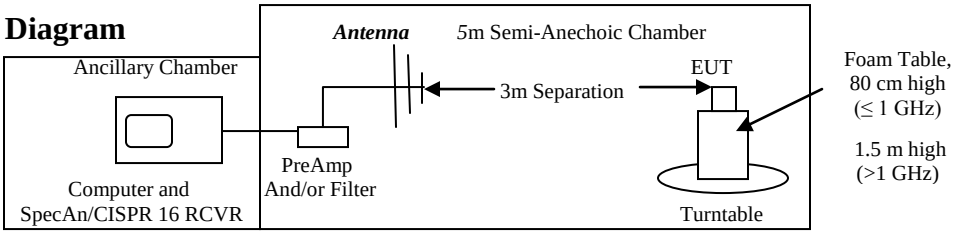
4.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

4.1.4 Test Setup Block Diagram



4.1.5 Final Test

All final radiated spurious emissions measurements were below (in compliance) the limits.

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

4.1.5.1 Emissions Outside the Frequency Band

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

Emissions inside the Frequency Band to find worst-case reference:

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)
Orientation A:								
2412.00	V	1.4	143	43.55	0.00	5.90	28.55	77.99
2412.00	V	1.4	143	70.02	0.00	5.90	28.55	104.46
2437.00	H	2.1	160	41.31	0.00	5.94	28.64	75.90
2437.00	H	2.1	160	67.55	0.00	5.94	28.64	102.14
2437.00	V	1.8	123	46.41	0.00	5.94	28.64	81.00
2437.00	V	1.8	123	73.26	0.00	5.94	28.64	107.85
2462.00	V	1.7	144	43.49	0.00	5.96	28.72	78.17
2462.00	V	1.7	144	69.88	0.00	5.96	28.72	104.56
Orientation B:								
2437.00	H	3.2	180	46.39	0.00	5.94	28.64	80.98
2437.00	H	3.2	180	73.39	0.00	5.94	28.64	107.98
2437.00	V	1.4	232	40.98	0.00	5.94	28.64	75.57
2437.00	V	1.4	232	67.55	0.00	5.94	28.64	102.14
Orientation C:								
2437.00	H	1.7	87	46.31	0.00	5.94	28.64	80.90
2437.00	H	1.7	87	73.01	0.00	5.94	28.64	107.60
2437.00	V	1.6	158	36.62	0.00	5.94	28.64	71.21
2437.00	V	1.6	158	62.81	0.00	5.94	28.64	97.40

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: **GREEN = Average Detector, Blue = Peak Detector**
The Limit using the Peak Detector is 20dB higher than the Average Detector limit.
EUT in Orientation A is worst case as shown. All other data is on file at TUV Rheinland.

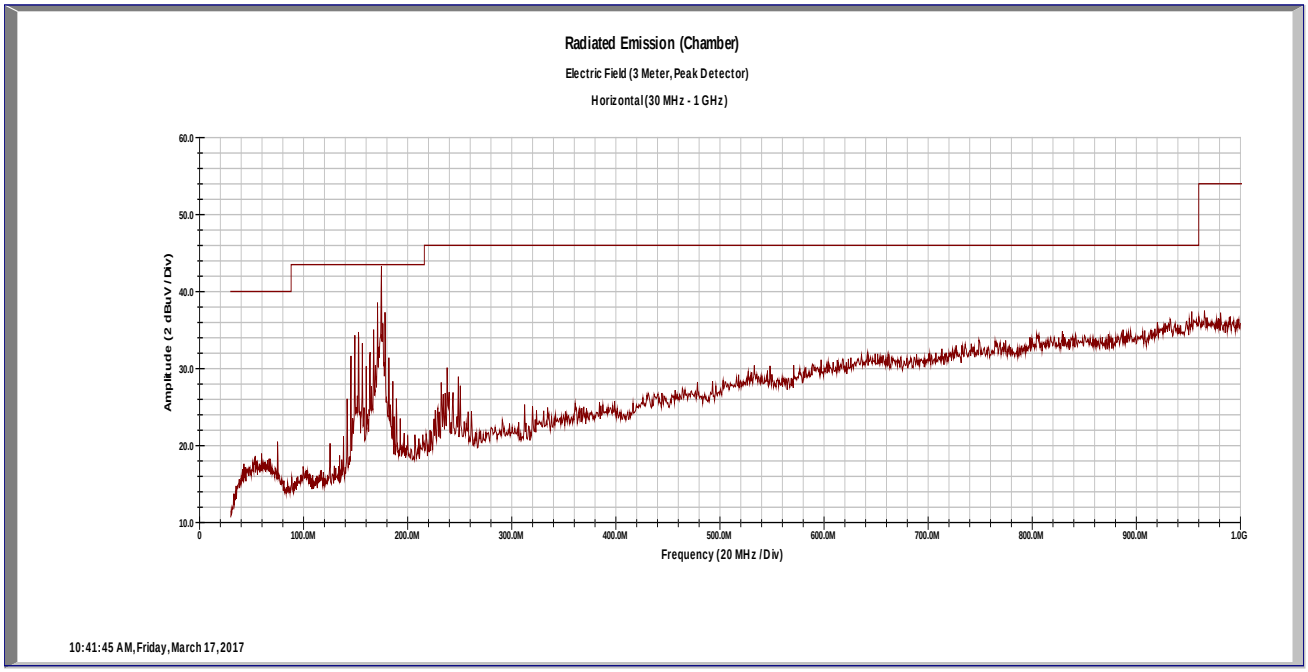
The highest measured emission is 81 dBµV/m (Avg) and 107.85 dBµV/m (Peak):

This highlighted frequency and orientation was Highest Emission (2440 MHz, Orientation A, Vertical).

Final Data and Graphs

Radiated Emissions - 30 to 1000 MHz

Horizontal



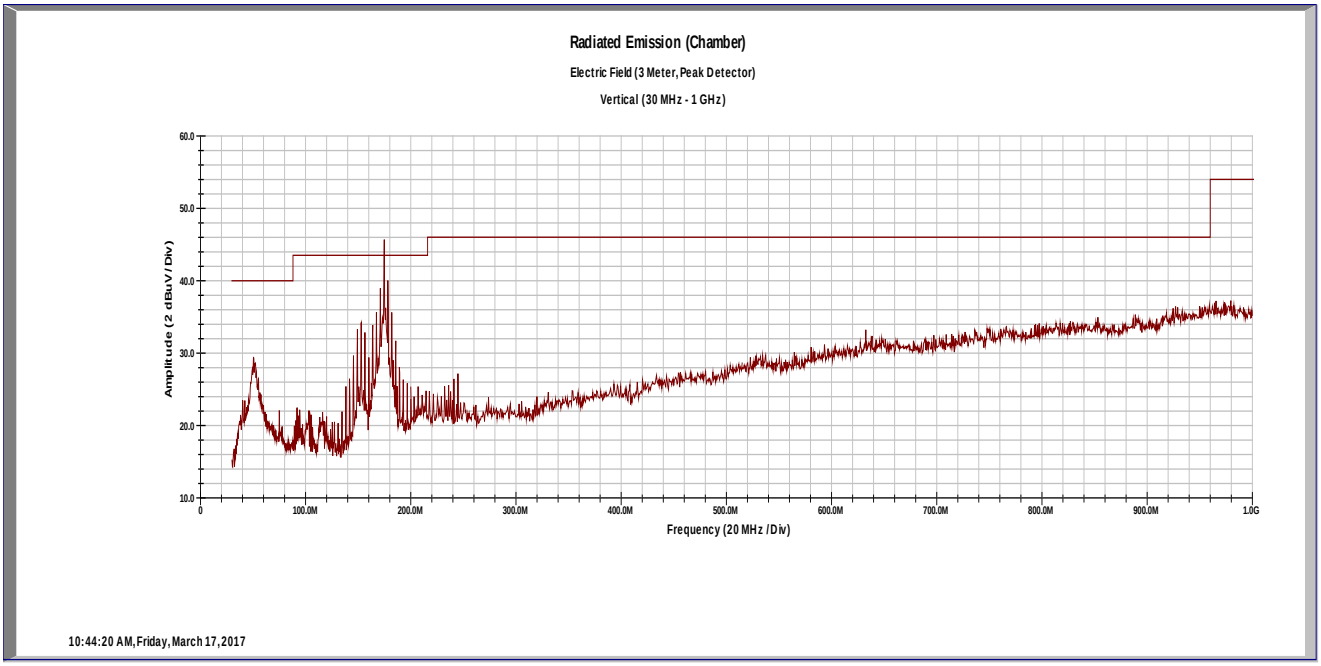
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)
152.72	H	1.5	140	21.38	0.00	1.41	11.90	34.69	43.50	-8.81
174.00	H	1.7	295	27.05	0.00	1.51	13.06	41.62	43.50	-1.88
236.36	H	1.7	342	9.98	0.00	1.77	15.21	26.95	46.00	-19.05

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes:

Radiated Emissions - 1 to 10 GHz

Vertical



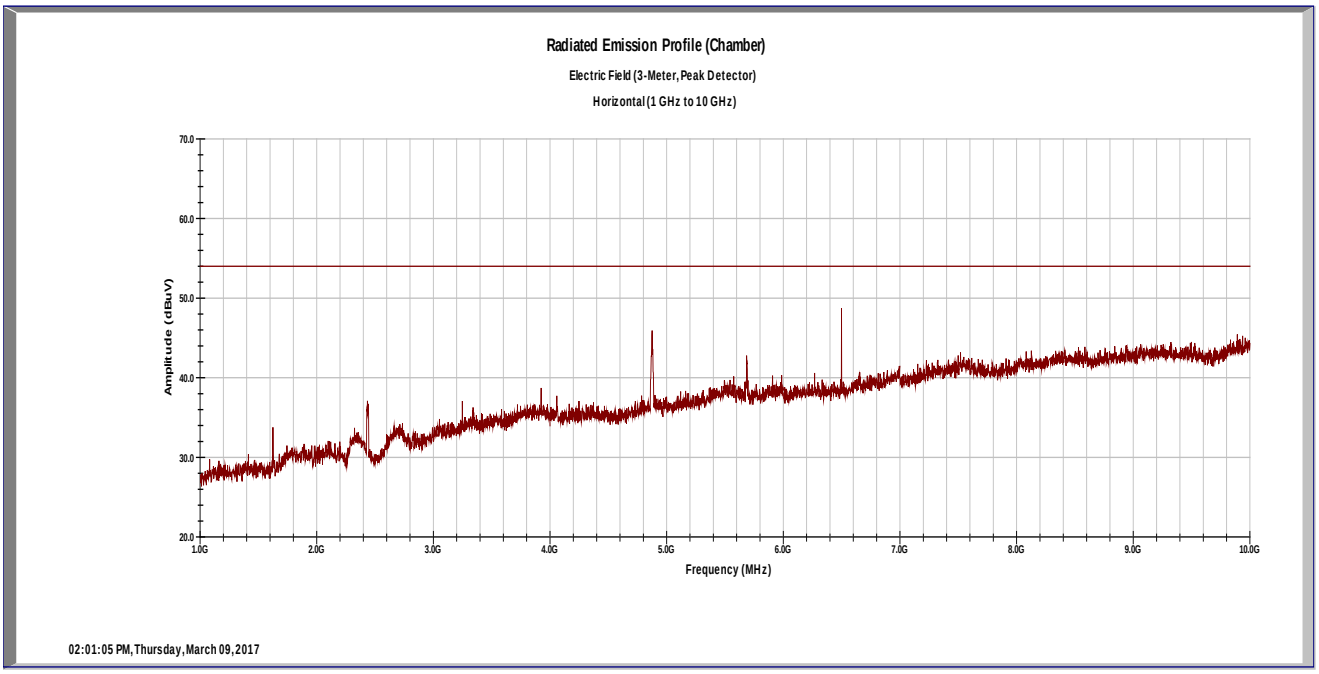
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)
52.00	V	1	0	9.44	0.00	0.84	14.08	24.36	40.00	-15.64
152.72	V	1	81	21.01	0.00	1.41	11.90	34.32	43.50	-9.18
174.52	V	1	246	27.58	0.00	1.51	13.08	42.17	43.50	-1.33

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes:

Radiated Emissions - 1 to 10 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)
4875.00	H	1.9	6	25.73	33.77	11.70	32.99	36.66	54.00	-17.34
4875.00	H	1.9	6	45.78	33.77	11.70	32.99	56.71	74.00	-17.29
6499.00	H	1.3	243	26.35	33.61	13.74	34.71	41.19	54.00	-12.81
6499.00	H	1.3	243	40.60	33.61	13.74	34.71	55.44	74.00	-18.56

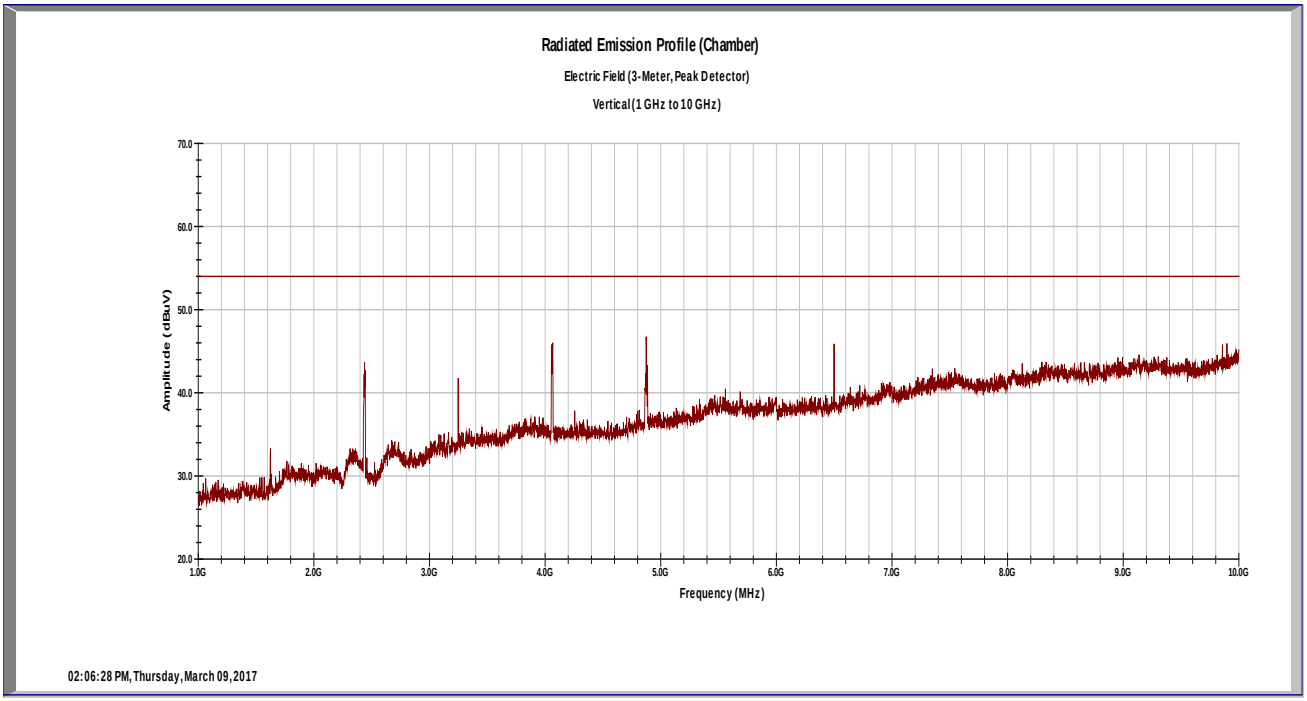
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: Above 1 GHz requires that both the **Peak** and **Average** values are below the respective limits.
The signal level of the fundamental was high enough to require the use of a Notch filter.

The signal at 2.44 GHz is the fundamental frequency of the transmitter

Radiated Emissions - 1 to 10 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)
3248.80	V	2.3	0	26.75	34.10	9.56	31.06	33.27	54.00	-20.73
3248.80	V	2.3	0	41.36	34.10	9.56	31.06	47.88	74.00	-26.12
4062.00	V	1.7	26	25.89	33.55	10.70	32.36	35.40	54.00	-18.60
4062.00	V	1.7	26	44.48	33.55	10.70	32.36	53.99	74.00	-20.01
4872.80	V	2.5	222	25.44	33.77	11.70	32.99	36.36	54.00	-17.64
4872.80	V	2.5	222	44.21	33.77	11.70	32.99	55.13	74.00	18.87
6498.80	V	1.6	355	25.30	33.61	13.74	34.71	40.14	54.00	-13.86
6498.80	V	1.6	355	39.63	33.61	13.74	34.71	54.47	74.00	-19.53

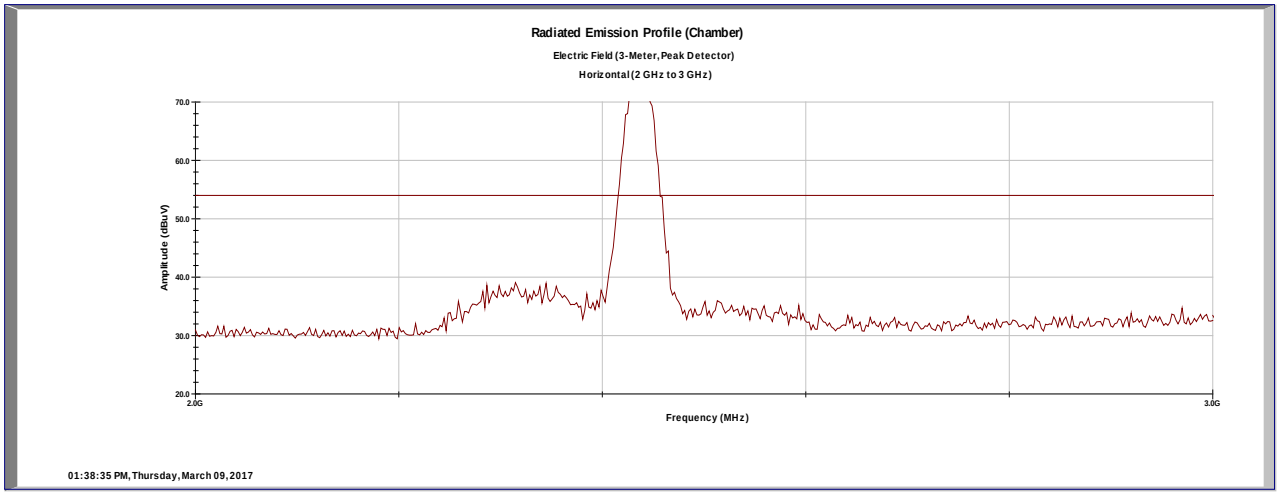
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: Above 1 GHz requires that both the **Peak** and **Average** values are below the respective limits.
The signal level of the fundamental was high enough to require the use of a Notch filter.

The signal at 2.44 GHz is the fundamental frequency of the transmitter

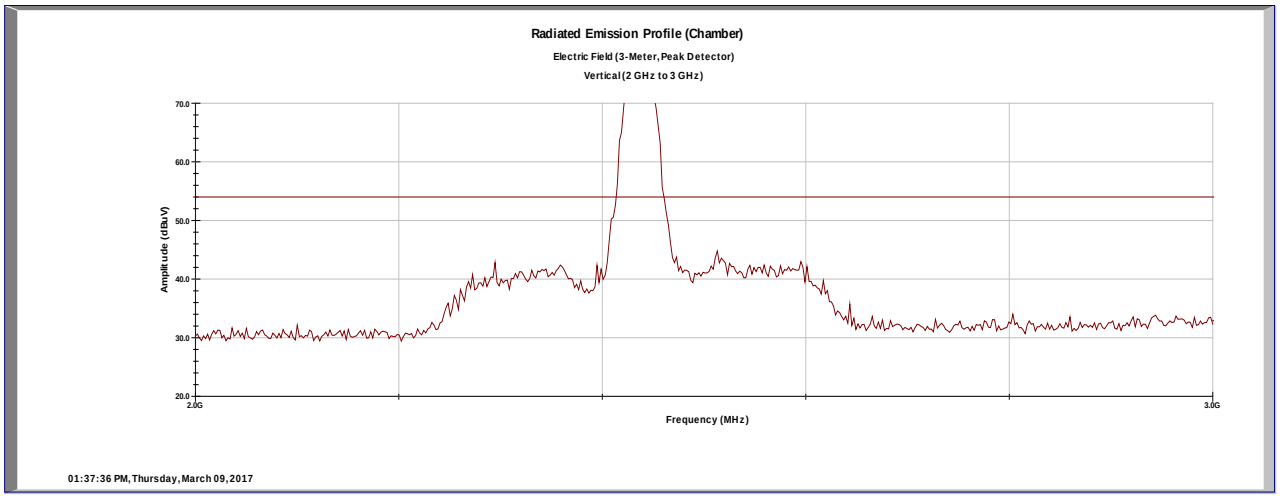
Worst-Case Radiated Emissions 2GHz to 3GHz

Horizontal



Worst-Case Radiated Emissions 2GHz to 3GHz

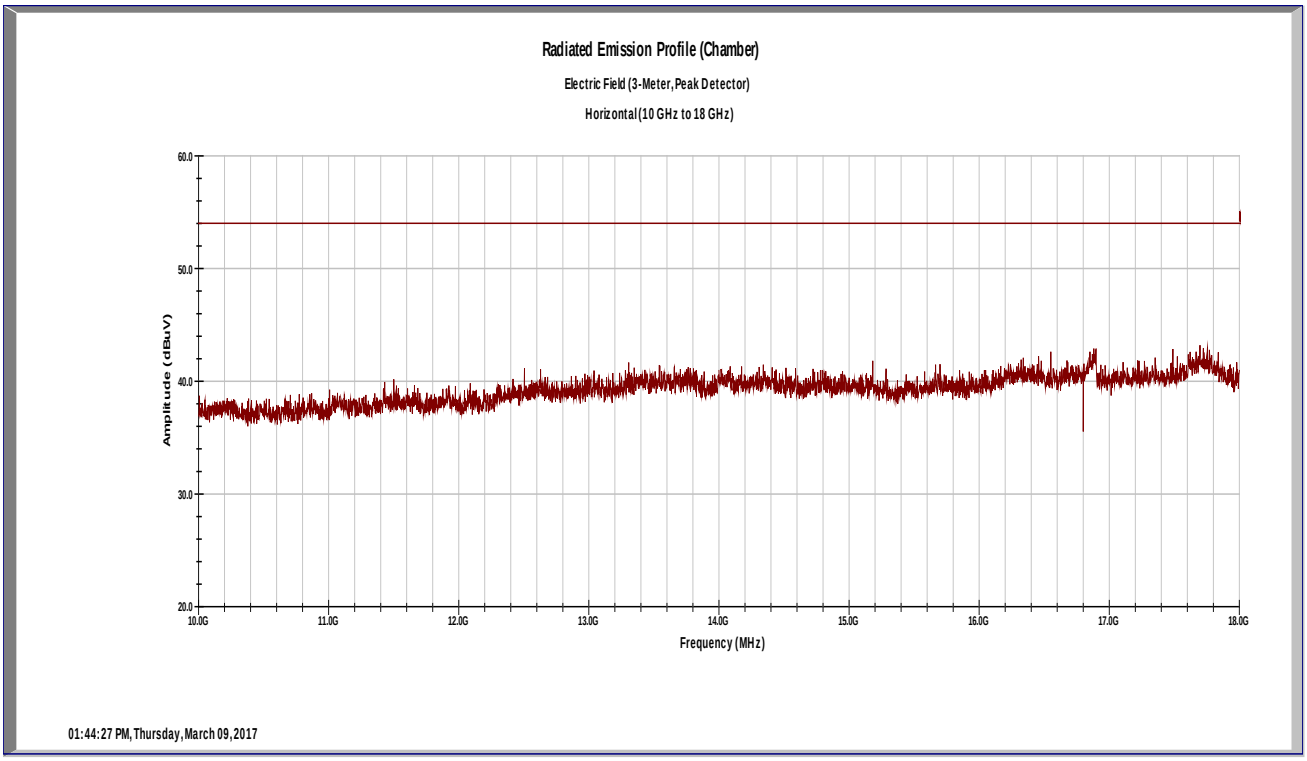
Vertical



Vertical Emissions were worst case.
All Peak in-band emissions other than the fundamental frequency are below the restricted-band average limits.
These plots were made without the 2.4 GHz notch filter for in-band emissions.

Radiated Emissions – 10 to 18 GHz

Horizontal



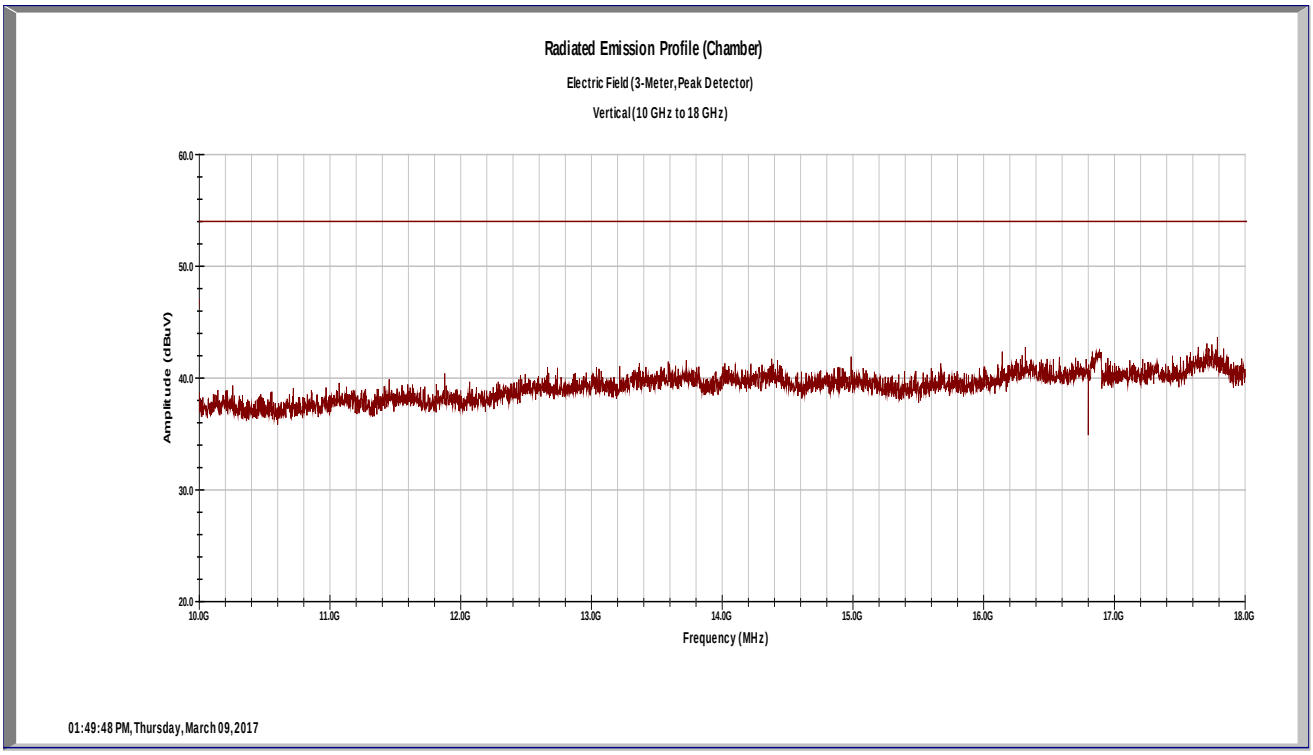
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: No measurable signals found.

Radiated Emissions - 10 to 18 GHz

Vertical



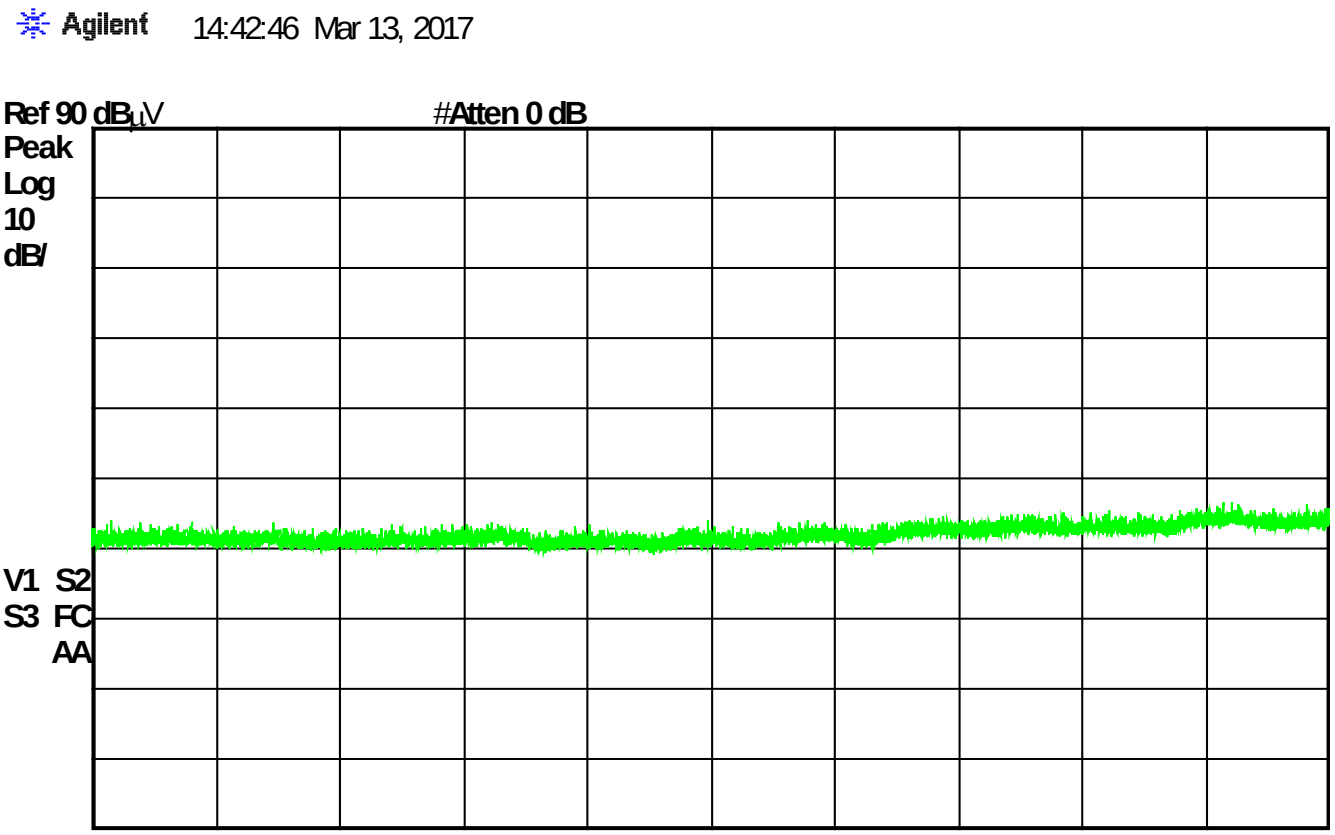
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: No measureable signals found.

Radiated Emissions – 18 to 25 GHz

Horizontal



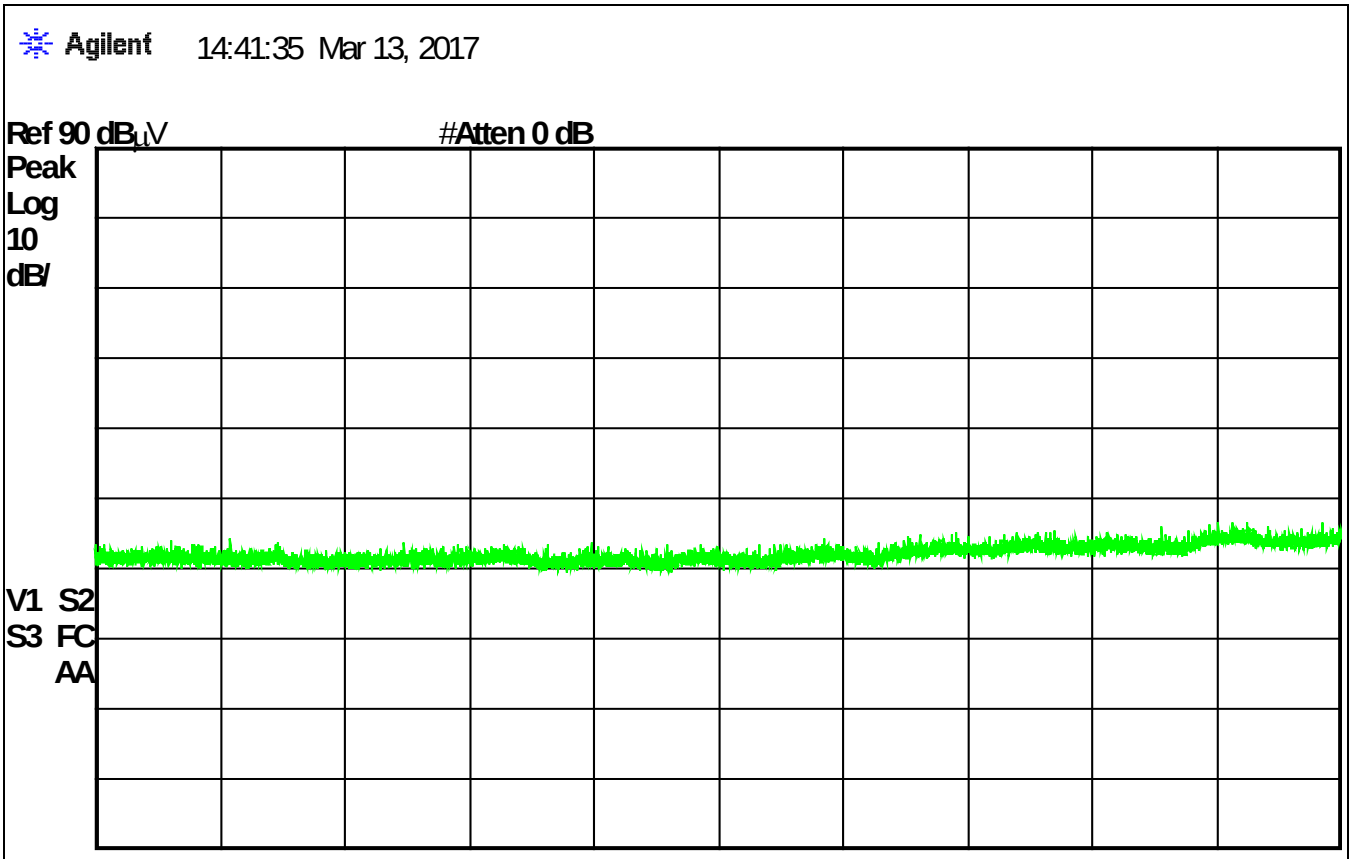
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: No measurable signals found.

Radiated Emissions - 18 to 25 GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBµV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBµV/m)	Spec Limit (dBµV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor

Notes: No measureable signals found.

4.2 Band Edge

4.2.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	13 March 2017
Standard	FCC Part 15.247(d), RSS 247 Clause 5.5						
Product Model	CAM-CC3200M			**Serial#**	C4:BE:84:E9:F3:B9		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	5 VDC (USB)	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.2.2 Test Procedure

Intentional radiators operating under the alternative provisions to the general emission limits must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

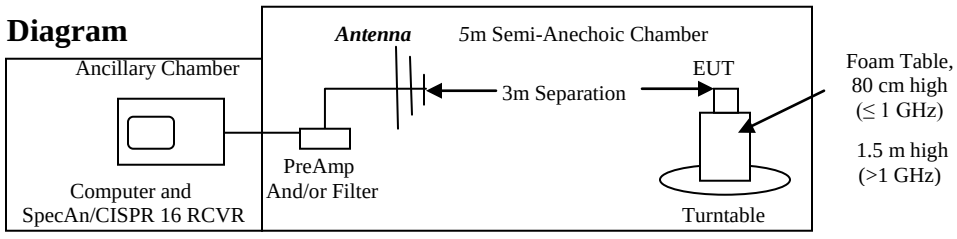
4.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

4.2.4 Final Test

The EUT met the performance criteria requirement as specified in this report and in the standards.

4.2.1 Test Setup Block Diagram



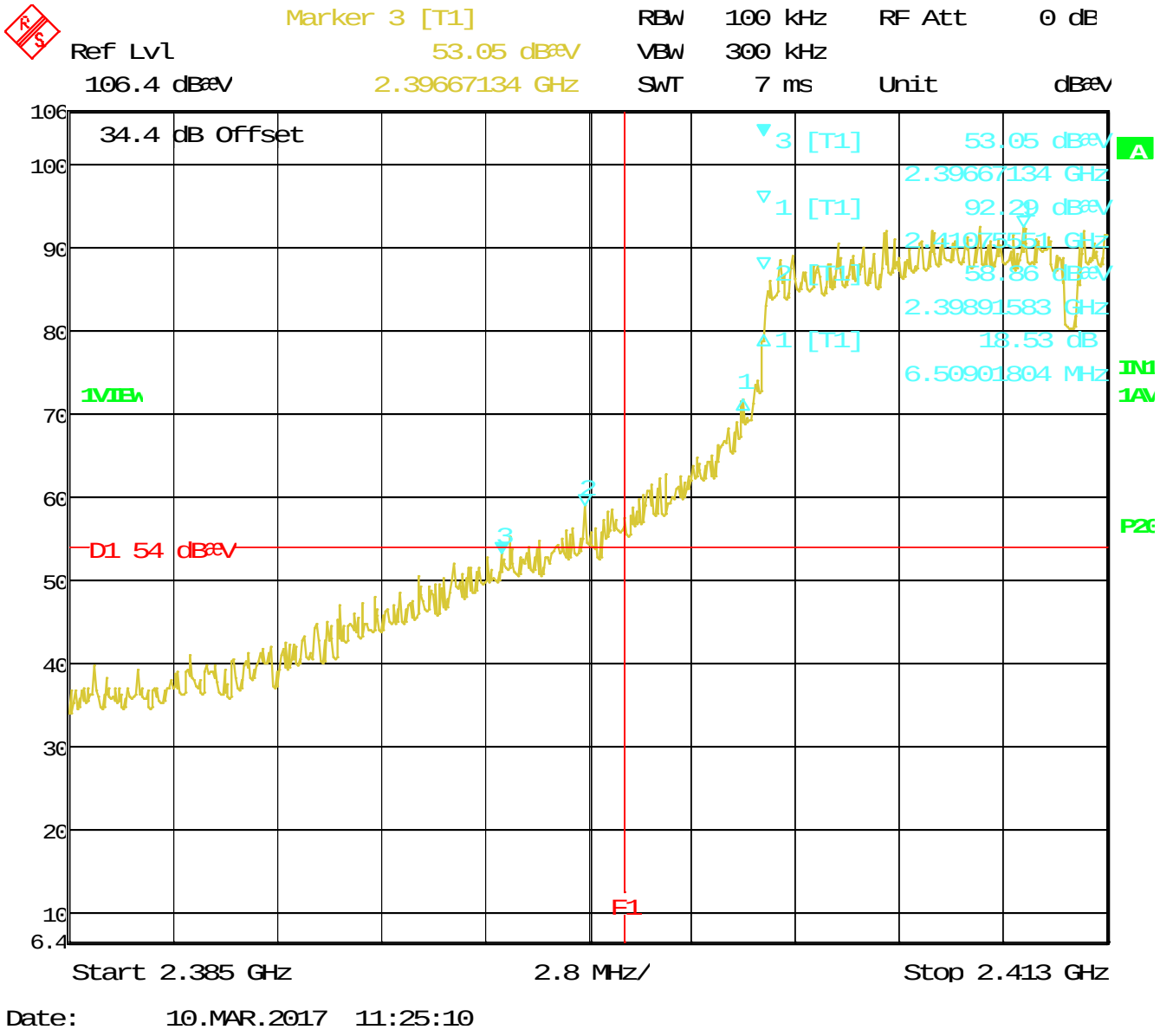


Figure 1: Lower Band Edge Average Measurement (Radiated Emission)

Note: Band Edge is at 2.4 GHz, and the nearest restricted band (2390MHz) is 10 MHz away.

The Highest emissions outside the band (Not in a restricted band) is 58.66 dBµV/m at 2398.92 MHz

At the lowest channel, the 20dB down point is at 2404.25 MHz. The EUT is compliant with the rules.

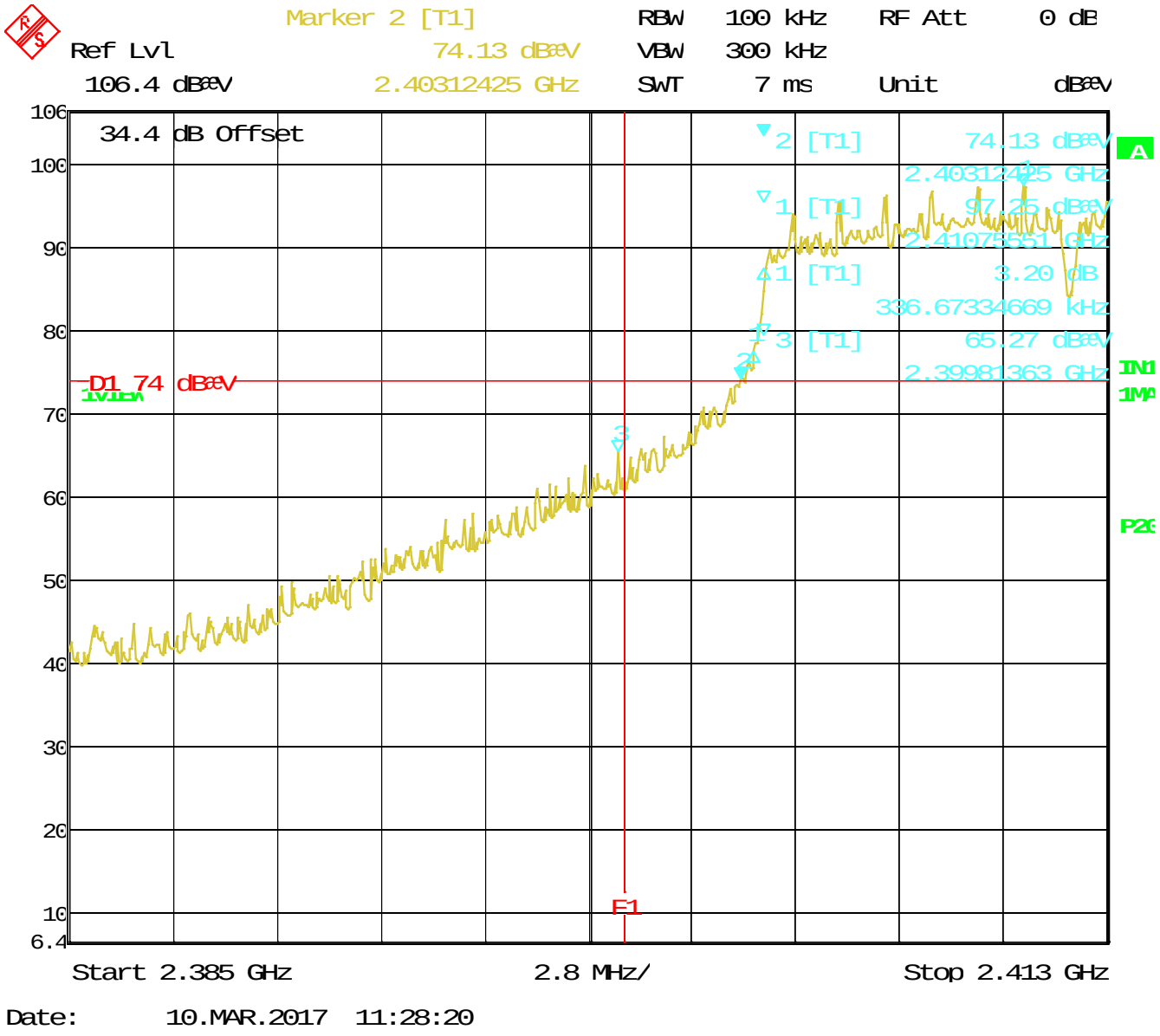


Figure 2: Lower Band Edge Peak Measurement (Radiated Emission)

Note: Band Edge is at 2.4 GHz, and the nearest restricted band (2390MHz) is 10 MHz away.

All emissions outside the band are well below the peak limits.

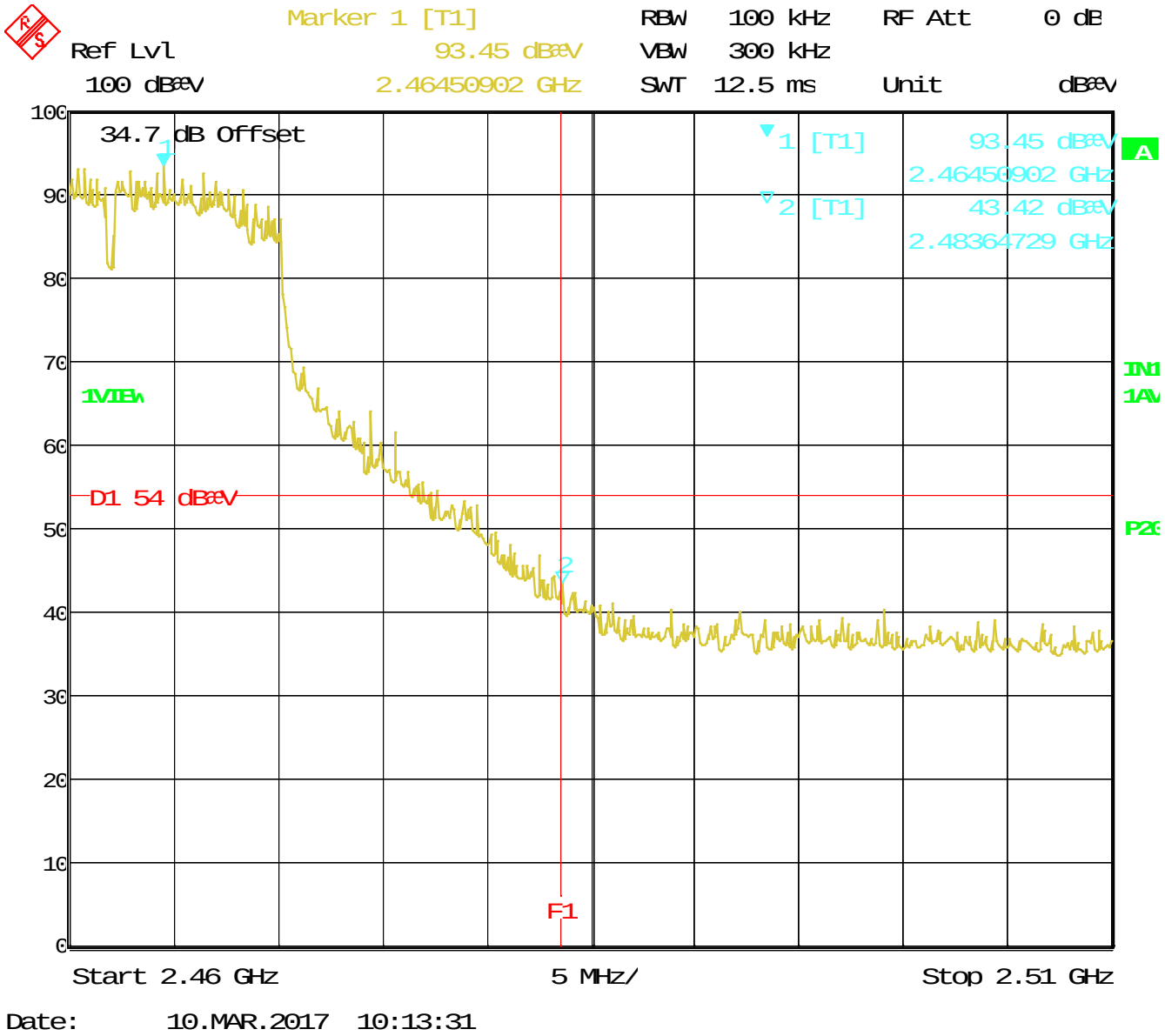


Figure 3: Upper Band Edge Average Measurement (Radiated Emission)

Note: Band edge (F1) at 2483.5 MHz is also the start of a restricted band, so the rules for restricted bands apply.

The highest channel frequency outside the band-edge (2464.51 MHz) is 43.42 dBµV/m (average) which is 10.56dB below the 54 dB restricted-band limit.

The EUT is compliant with the rules.

Appendix A

5 Test Plan

This test report is intended to follow this test plan outlined here in unless otherwise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

5.1 General Information

Client	Airgas USA, Inc.
Address	180 Sandbank Road
Address	Cheshire, Connecticut 06410
Contact Person	Robert Shock
Telephone	203-272-5800 x222
Fax	203-250-6842
e-mail	Rob.Shock@airgas.com

5.2 Product Name

Cylinder Asset Monitor (CAM)

5.3 Model(s) Name

CAM Wi-Fi Concentrator

5.4 Equipment Under Test (EUT) Description

CAM system consists of 2 main components:

- CAM Pressure Remote
- CAM Wi-Fi Concentrator
- The Pressure Remote is typically connected to a regulator of a compressed gas cylinder and acquires cylinder pressure, voltage, and temperature data. It then sends this data to the CAM Wi-Fi Concentrator. The CAM Pressure Remote under test has the model number CAM_PR.
- The CAM Wi-Fi Concentrator collects and forwards the data acquired to the Airgas Cloud Services Database. This device connects to the end users Wi-Fi Access Point (AP) and "Remote" while displaying the current connectivity and time.
- The CAM Wi-Fi Concentrator under test has the model number CC – WF25.

5.5 Test Preparation

Please refer to the *Technical Description – Concentrator* document for details of the test setup, configuration, and execution.

Please refer to user manual for instructions on how to operate the CAM Wi-Fi Concentrator and CAM Pressure Remote.