



FCC 47 CFR PART 15 SUBPART C

CLASS II PERMISSIVE CHANGE

FOR

BLUETOOTH MODULE

MODEL NUMBER: BT301

FCC ID: YRWDATECSBT301

REPORT NUMBER: 11603522-E2V2

ISSUE DATE: 05/03/2017

Prepared for

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	04/10/17	Initial Issue	D. Corona
V2	05/03/17	Revised Report based on TCB Comments: Updated Sec. 8.	B. Bayani

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: DATECS Ltd.
DEPARTMENT OF INNOVATIVE TECHNOLOGIES
4 "Datecs" Str.
1592 SOFIA, BULGARIA

EUT DESCRIPTION: Bluetooth Module

MODEL: BT301

SERIAL NUMBER: 1117900006

DATE TESTED: March 13 to 30, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
<input checked="" type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F
	<input type="checkbox"/> Chamber G
	<input type="checkbox"/> Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth module.

5.2. MAXIMUM OUTPUT POWER

Please refer to report no.: *JQA Report no. 400-140056 FCCID YRWDATECSBT301* for output power results.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a chip antenna, with a maximum gain of - 2.0 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was FTDI, rev. 2.12.16.0.

The test utility software used during testing was RF Test Tool, rev. 1.2.2.

5.5. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Original Filing was for Limited Modular Approval. Only worst-case mode was tested based on original *Report no. 400-140056* installed in new host sleeve (BLUEPAD-500).

The GFSK mode was considered as worst-case mode and only radiated emission was performed. Please see section 8 for Radiated Test Results.

5.6. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that the Z-orientation was the worst-case orientation, therefore, all final radiated testing was performed with the EUT in the Z-orientation while generating continuous emissions.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC adapter	Apple	A1265	1X1132QX28QZ	-
Laptop	Lenovo	T420	PB-FBKHK 12/07	-
AC/DC Adapter	Lenovo	ADLX65NCC2A	-	-

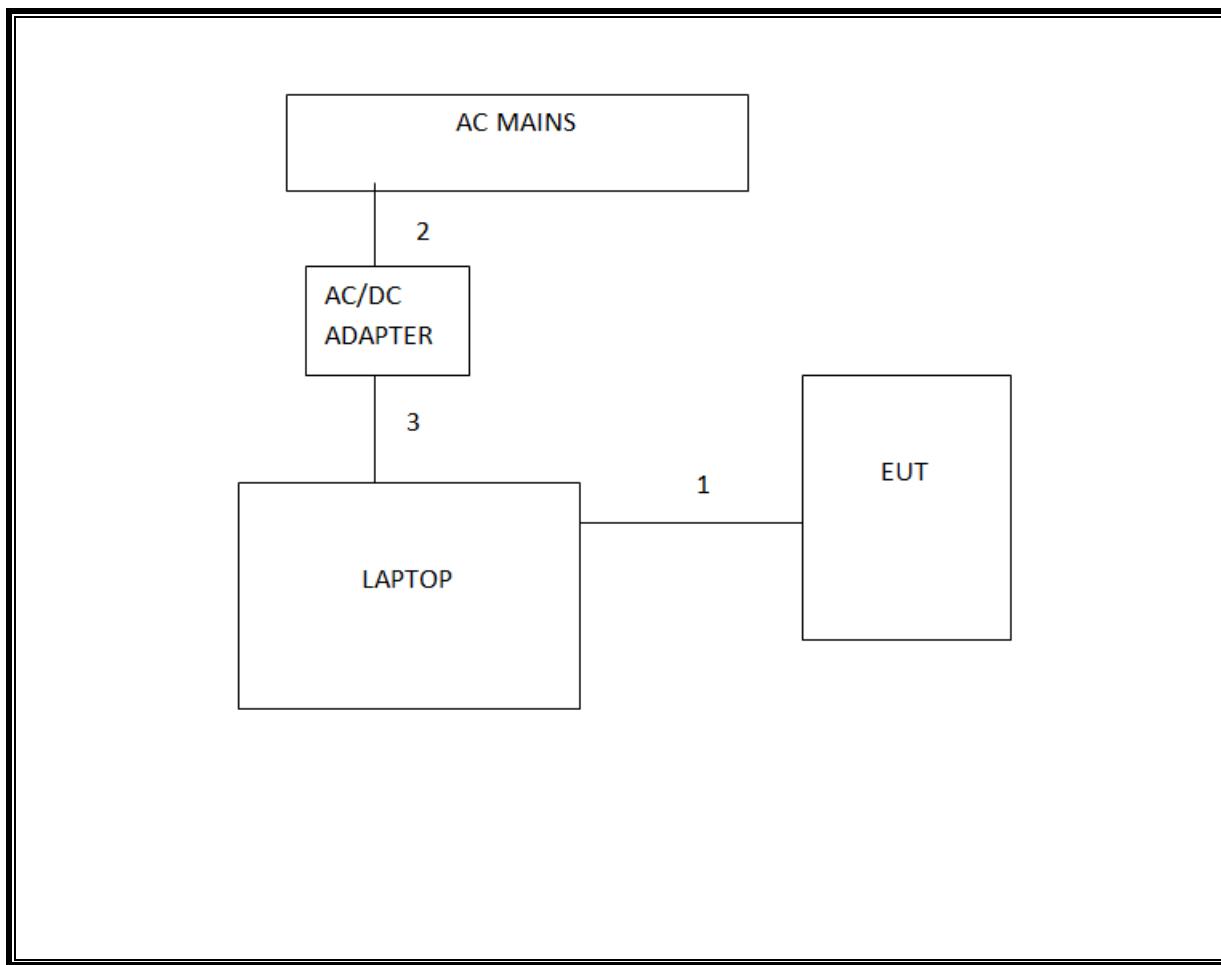
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	USB	Unshielded	1	EUT to Laptop
2	AC Power	1	AC	Unshielded	1	
3	DC Power	1	DC	Unshielded	1	

TEST SETUP

The EUT is connected to the AC/DC charger via USB cable. Test software exercised the EUT.

SETUP DIAGRAM FOR TESTS



Note: Test laptop is disconnected and removed during the radiated emissions tests. EUT is connected to Apple AC/DC adapter.

6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List						
Description	Manufacturer	Model	T No.	Cal Date	Cal Due	
Spectrum Analyzer 44GHz	Agilent	N9030A	908	04/13/16	04/13/17	
Loop Antenna	ETS Lindgren	6502	1683	02/17/17	03/17/18	
Bilog Antenna 30-1000MHz	Sunol	JB1	899	05/26/16	05/26/17	
Horn Antenna 1-18GHz	ETS Lindgren	3117	711	01/30/17	01/30/18	
Preamp 10kHz-1000MHz	Sonoma	310	300	11/10/16	11/10/17	
Amplifier, 1 to 18 GHz	Miteq	AFS43-00101800-25-S-42	493	03/09/17	03/09/18	
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016			

7. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

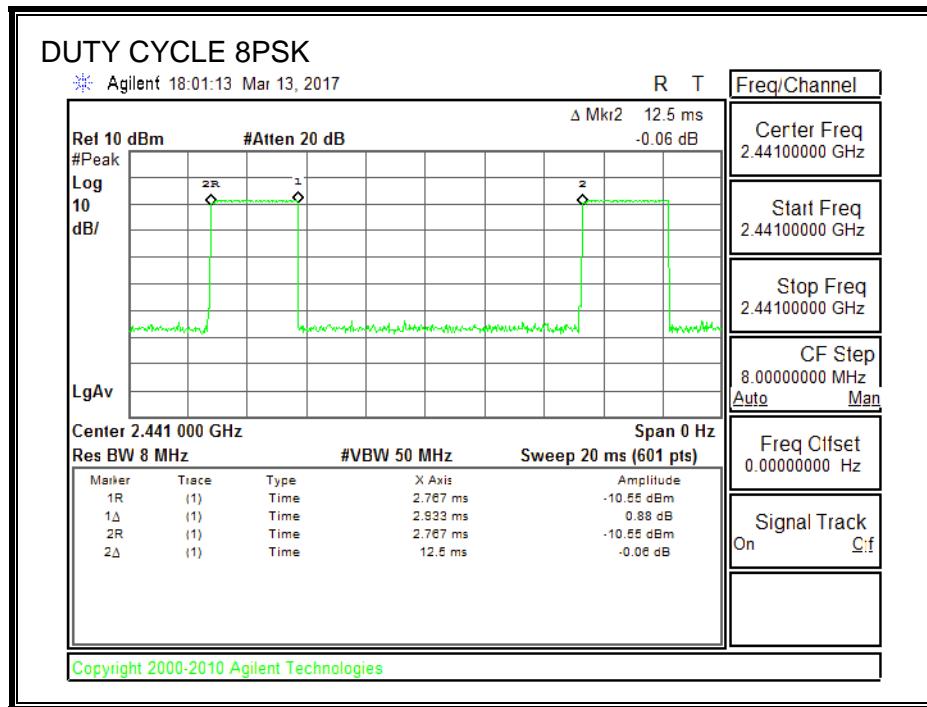
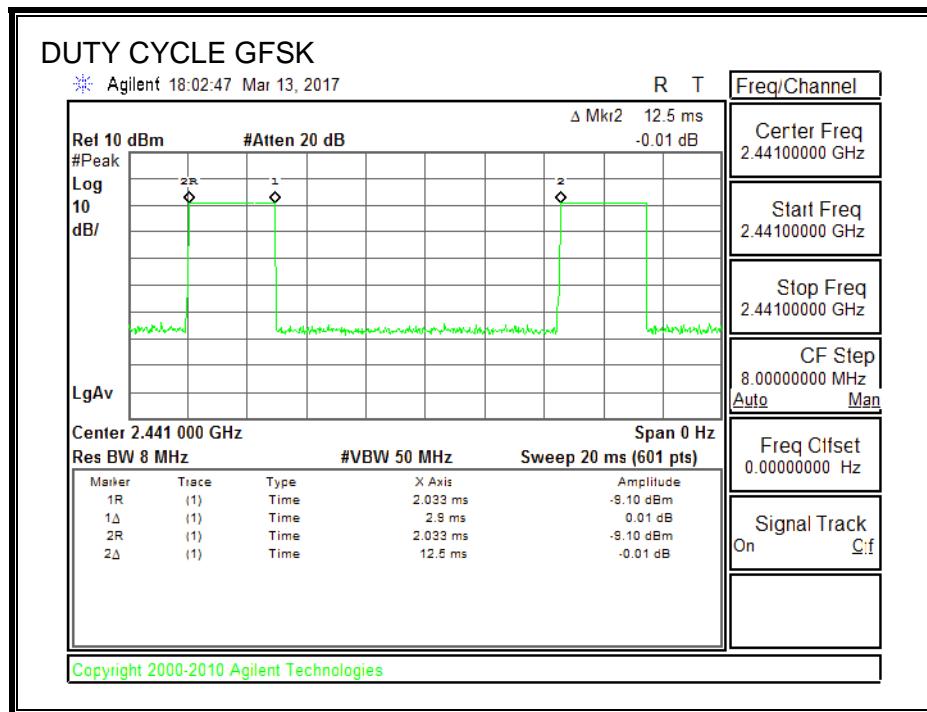
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
GFSK	2.900	12.500	0.232	23.20%	6.35	0.345
8PSK	2.933	12.500	0.235	23.46%	6.30	0.341

DUTY CYCLE PLOTS



8. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300m	2400/F(kHz) @ 300m
0.490-1.705	24000/F(kHz) @ 30m	24000/F(kHz) @ 30m
1.705-30.0	30 @ 30m	30 @ 30m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

NOTE: KDB 414788 OATS and Chamber Correlation Justification

- Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T (10 Hz) video bandwidth with peak detector for average measurements.

Note: The pre-scan measurements above 1GHz the VBW is set to 30 kHz

Below 1G and 18-26GHz radiated emission tests were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

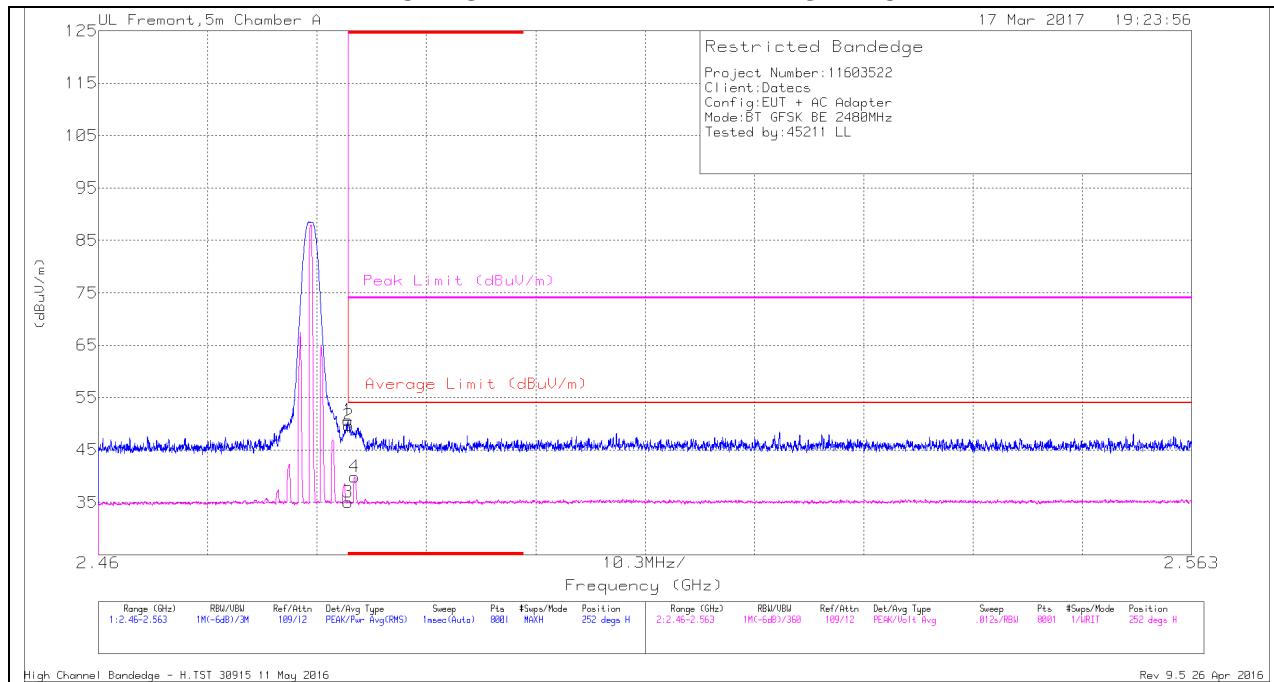
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS

8.1. TRANSMITTER ABOVE 1 GHz

AUTHORIZED BANDEDGE (HIGH CHANNEL)

HORIZONTAL PEAK AND AVERAGE PLOT



HORIZONTAL DATA

Trace Markers

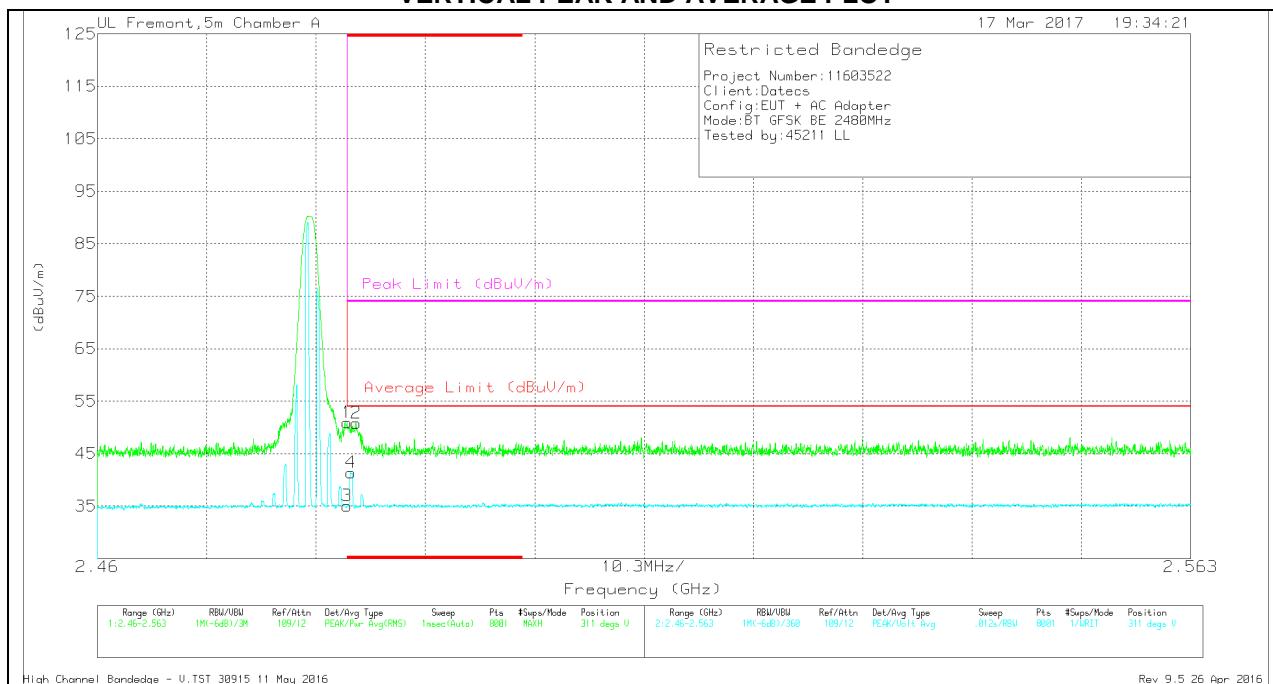
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.79	PK	32.5	-23.6	50.69	-	-	74	-23.31	252	101	H
2	* 2.484	40.72	PK	32.5	-23.6	49.62	-	-	74	-24.38	252	101	H
3	* 2.484	26.08	VA1T	32.5	-23.6	34.98	54	-19.02	-	-	252	101	H
4	* 2.484	30.94	VA1T	32.5	-23.6	39.84	54	-14.16	-	-	252	101	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL PEAK AND AVERAGE PLOT



VERTICAL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	42	Pk	32.5	-23.6	50.9	-	-	74	-23.1	311	177	V
2	* 2.484	41.83	Pk	32.6	-23.6	50.83	-	-	74	-23.17	311	177	V
3	* 2.484	26.11	VA1T	32.5	-23.6	35.01	54	-18.99	-	-	311	177	V
4	* 2.484	32.48	VA1T	32.5	-23.6	41.38	54	-12.62	-	-	311	177	V

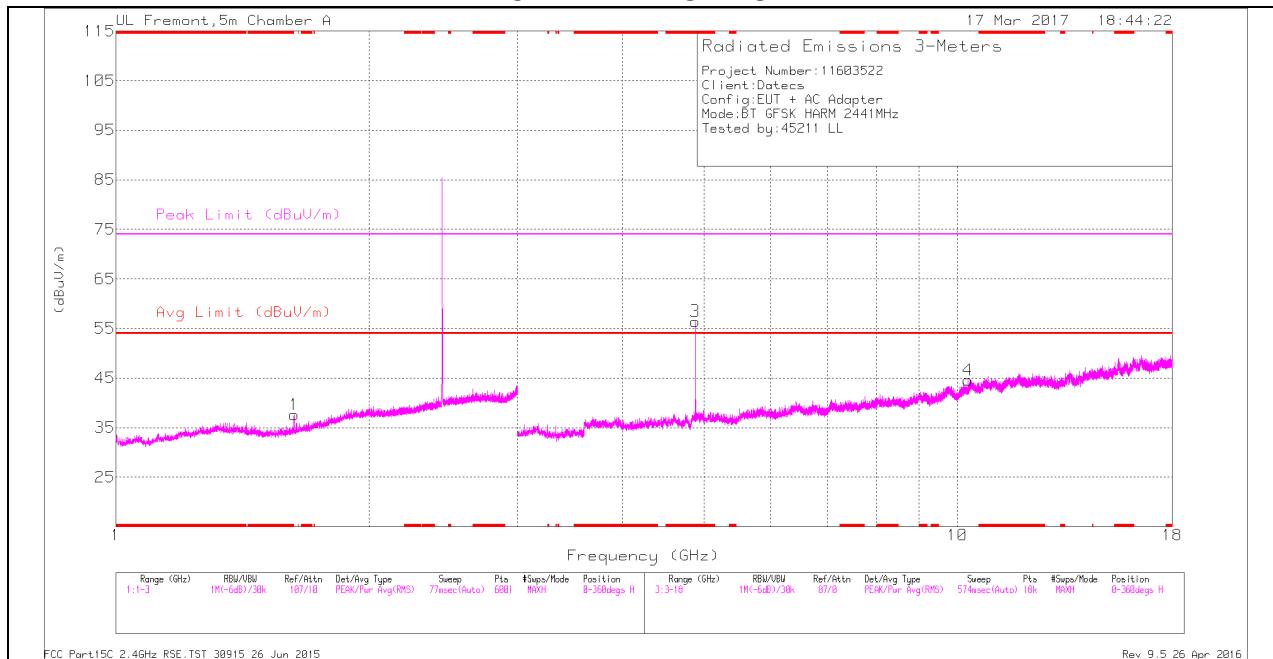
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

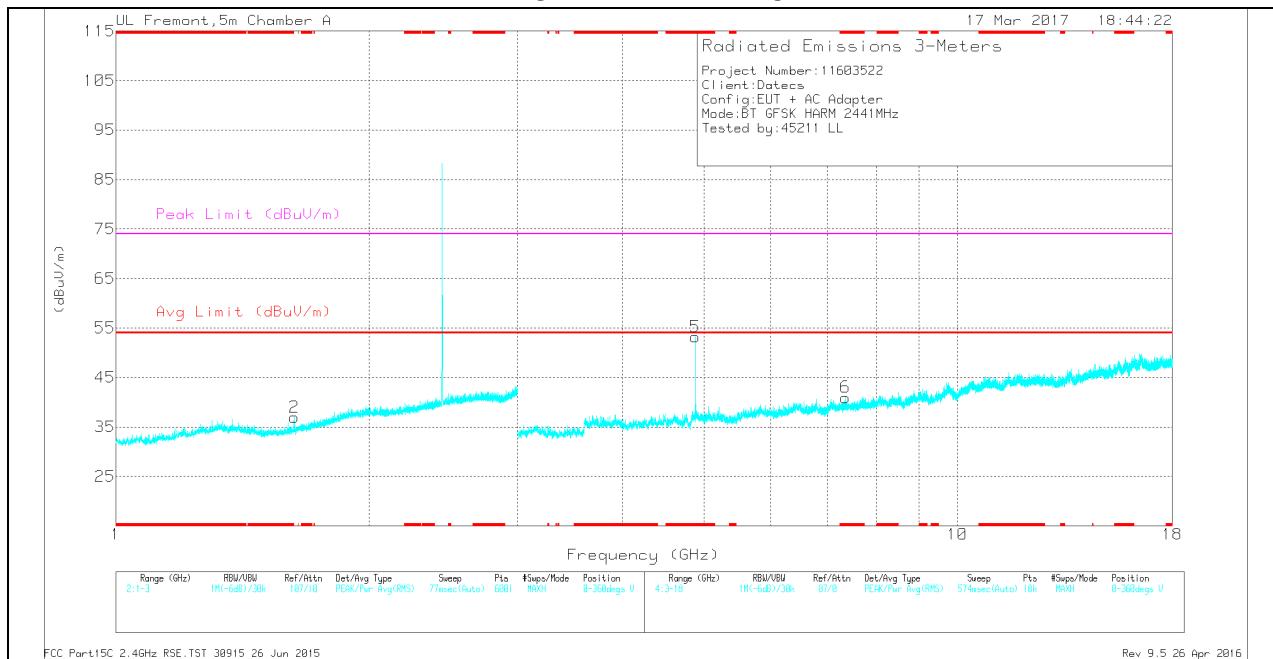
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



MID CHANNEL DATA

<p>Project No: 11603522 Company: Datecs Test Configuration: EUT + AC Adapter Tx Mode: BT GFSK 2441MHz Tested By: 45211 LL</p>												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl /Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.882	53.68	PK2	34	-27.8	59.88	-	-	74	-14.12	198	240	H
* 4.882	-	AVG	-	-	39.88	54	-14.12	-	-	198	240	H
* 4.882	49.84	PK2	34	-27.8	56.04	-	-	74	-17.96	274	110	V
* 4.882	-	AVG	-	-	36.04	54	-17.96	-	-	274	110	V
1.628	38.29	PK2	28.5	-23.6	43.19	-	-	74	-30.81	247	146	H
1.628	-	AVG	-	-	23.19	54	-30.81	-	-	247	146	H
1.628	38.34	PK2	28.5	-23.7	43.14	-	-	74	-30.86	243	169	V
1.628	-	AVG	-	-	23.14	54	-30.86	-	-	243	169	V
AVG Reading = PK Reading - 20*LOG(100/Ton)												

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Note: All other emissions up to 26GHz were at noise floor level.

Ton in 100ms Period

2.9

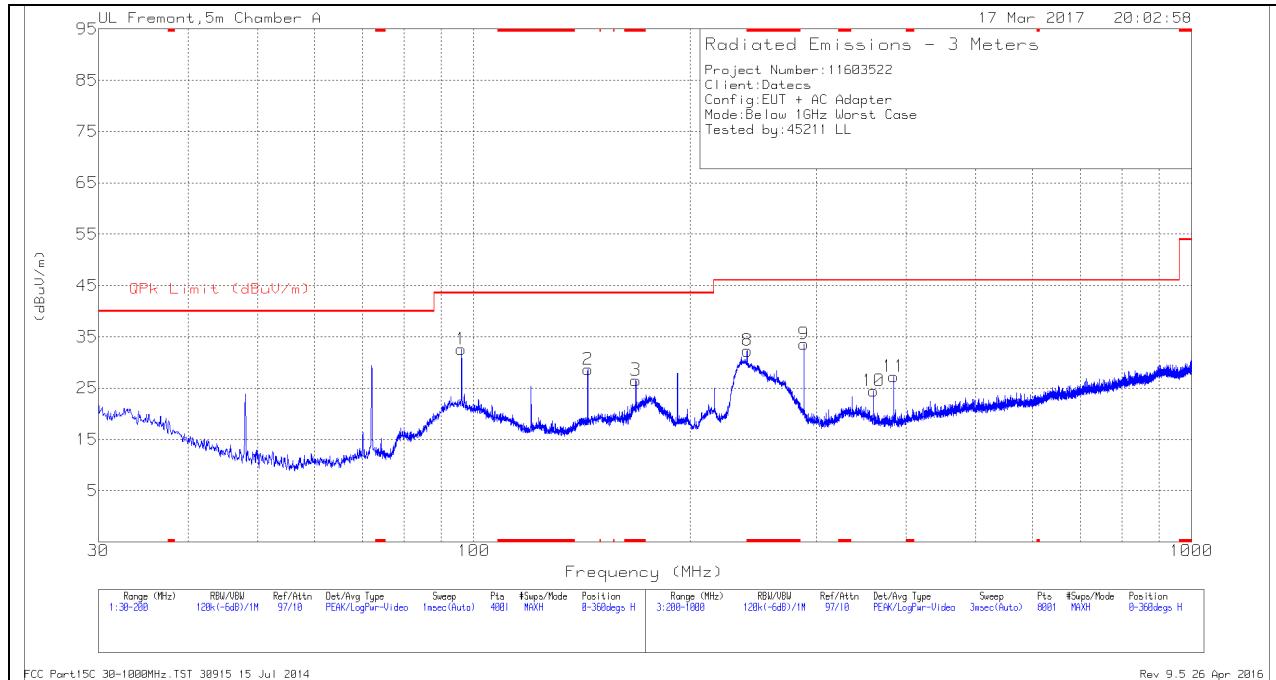
Duty Cycle Correction Factor (DCCF)

20.00

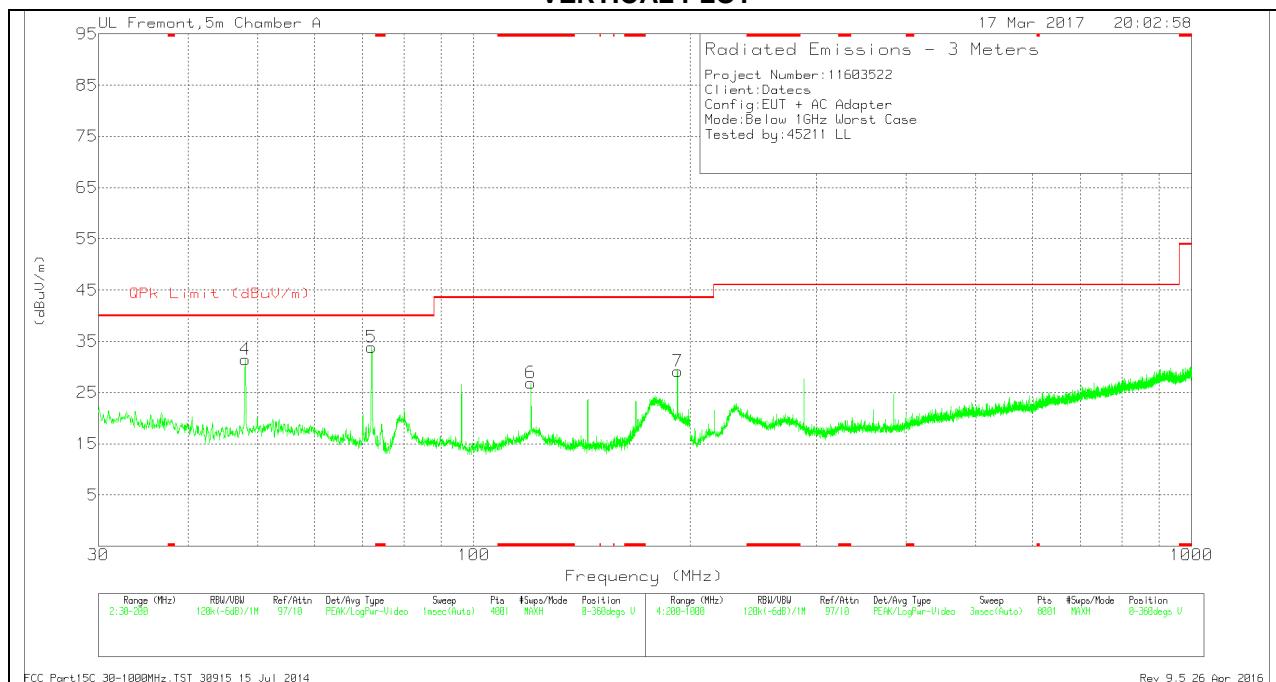
8.2. WORST-CASE BELOW 1 GHz

GFSK SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



VERTICAL PLOT



BELOW 1 GHz TABLE

Trace Markers

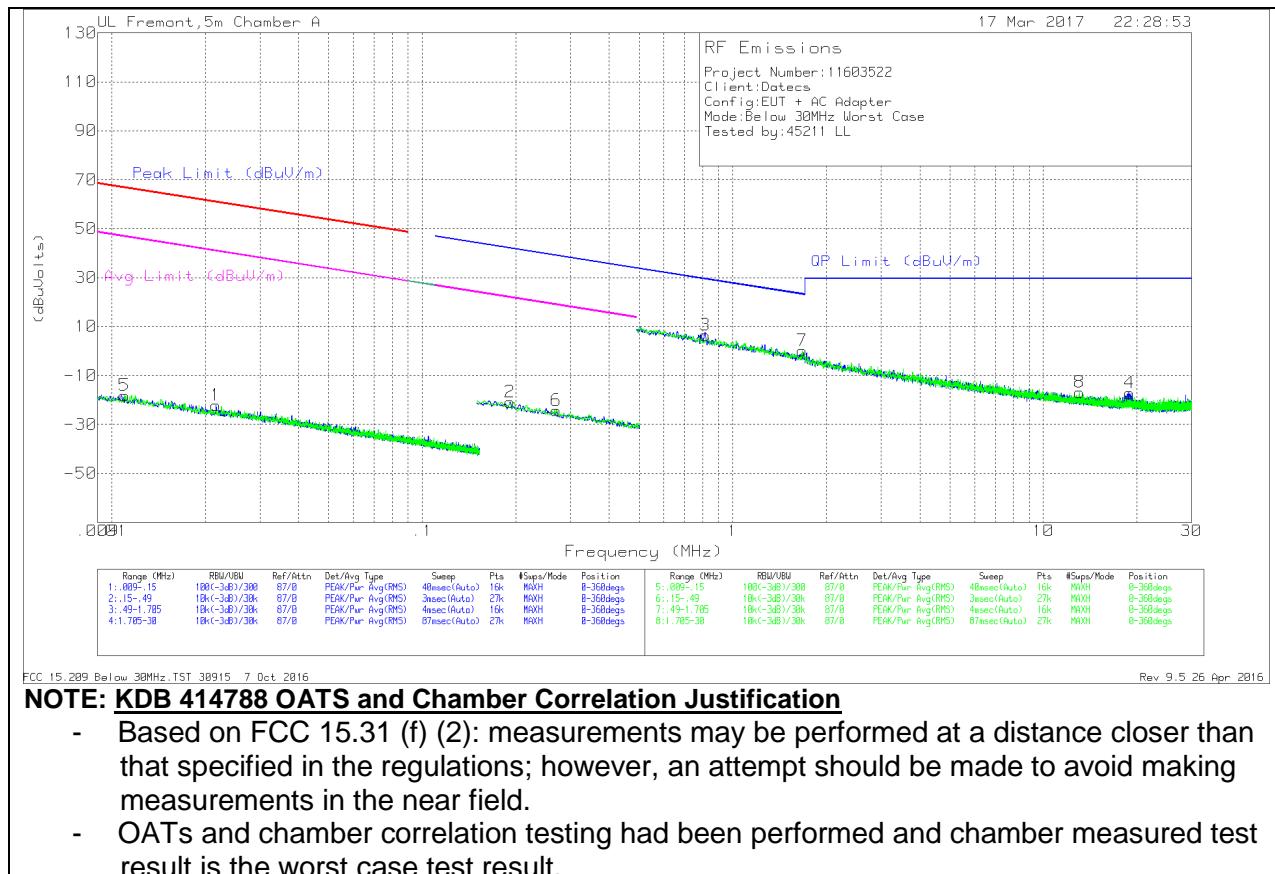
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 168.1675	40.75	Pk	15.9	-30.1	26.55	43.52	-16.97	0-360	100	H
6	* 120.1	39.51	Pk	17.8	-30.4	26.91	43.52	-16.61	0-360	100	V
8	* 240.3	46.37	Pk	15.6	-29.7	32.27	46.02	-13.75	0-360	100	H
4	48.0625	50.09	Pk	12.4	-31.1	31.39	40	-8.61	0-360	100	V
5	72.075	52.16	Pk	12.5	-30.8	33.86	40	-6.14	0-360	100	V
1	96.0875	50.07	Pk	13.1	-30.6	32.57	43.52	-10.95	0-360	300	H
2	144.155	42.09	Pk	16.9	-30.3	28.69	43.52	-14.83	0-360	200	H
7	192.2225	43.55	Pk	15.6	-30	29.15	43.52	-14.37	0-360	100	V
9	288.3	45.72	Pk	17.3	-29.4	33.62	46.02	-12.4	0-360	100	H
10	360.4	34.95	Pk	18.7	-29.2	24.45	46.02	-21.57	0-360	100	H
11	384.4	37.25	Pk	19.1	-29.1	27.25	46.02	-18.77	0-360	100	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

8.3. WORST-CASE BELOW 30 MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
5	.01099	43.24	Pk	18.5	.1	-80	-18.16	66.77	-84.93	46.77	-64.93	-	-	-	-	0-360
1	.02168	43.1	Pk	14.5	.1	-80	-22.3	60.86	-83.16	40.86	-63.16	-	-	-	-	0-360
2	.19184	47.19	Pk	11.8	.1	-80	-20.91	-	-	-	-	41.96	-62.87	21.96	-42.87	0-360
6	.27032	43.95	Pk	11.7	.1	-80	-24.25	-	-	-	-	38.98	-63.23	18.98	-43.23	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.81627	34.48	Pk	11.8	.1	-40	6.38	29.38	-23	-	-	-	-	0-360
7	1.6748	28.06	Pk	11.9	.2	-40	.16	23.15	-22.99	-	-	-	-	0-360
8	13.0517	11.74	Pk	10.7	.6	-40	-16.96	29.5	-46.46	-	-	-	-	0-360
4	18.92574	12.18	Pk	10	.6	-40	-17.22	29.5	-46.72	-	-	-	-	0-360

Pk - Peak detector

8.4. SPURIOUS RADIATED EMISSION OF COMPOSITE SYSTEM

LIMITS

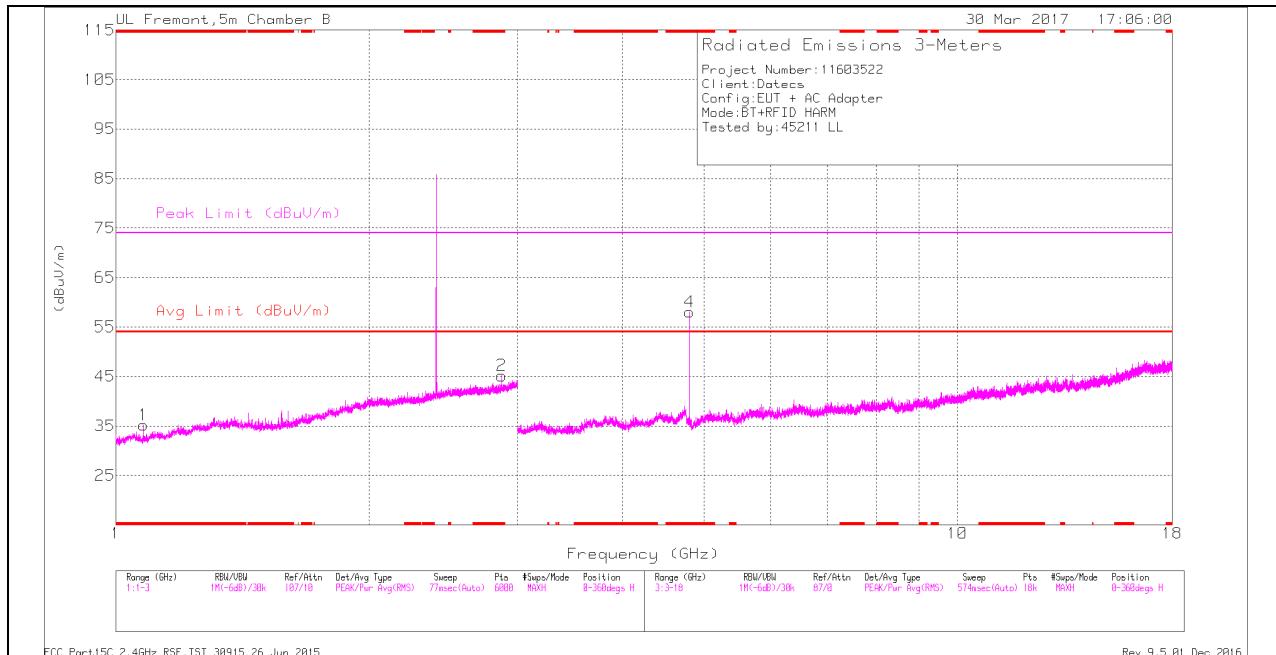
FCC: §15.209

Section CFR 47 15.31 (h)

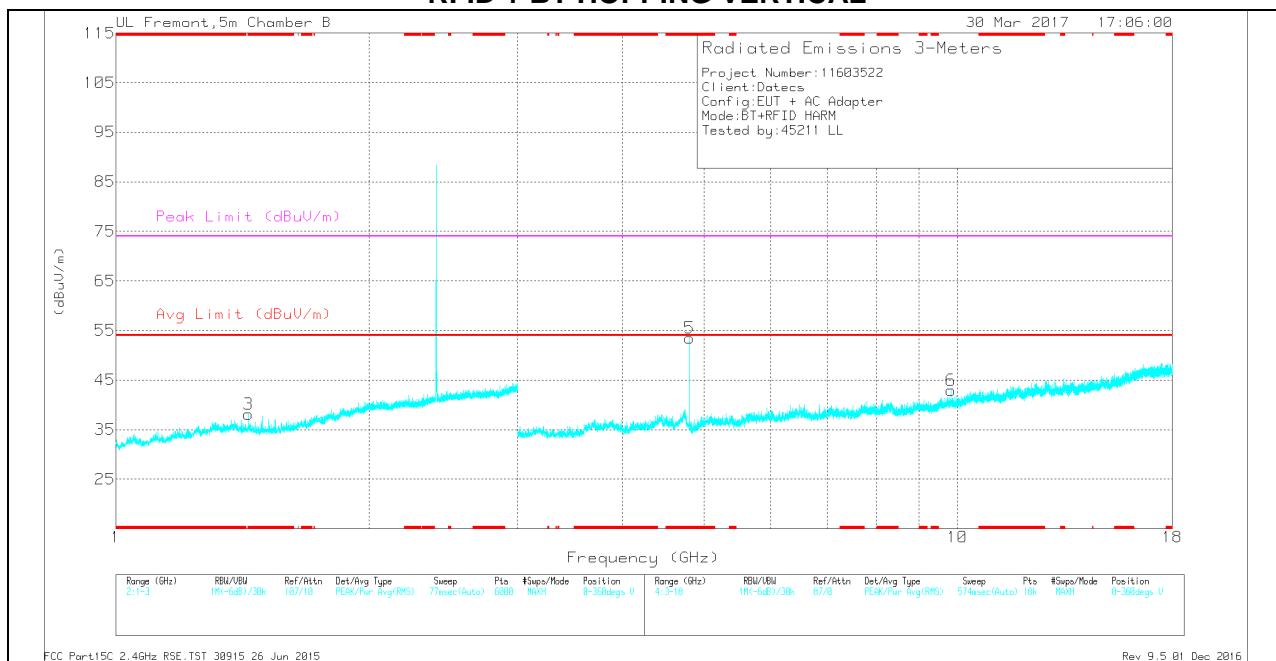
RESULTS

HARMONICS AND SPURIOUS EMISSIONS

RFID + BT HOPPING HORIZONTAL



RFID + BT HOPPING VERTICAL



RFID + BT HOPPING DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.078	30.55	Pk	27.9	-23.2	35.25	-	-	74	-38.75	0-360	102	H
2	* 2.873	32.86	Pk	32.4	-20.1	45.16	-	-	74	-28.84	0-360	199	H
3	* 1.437	31.16	Pk	28.4	-21.5	38.06	-	-	74	-35.94	0-360	199	V
4	* 4.804	53.22	Pk	33.8	-29	58.02	-	-	74	-15.98	0-360	102	H
5	* 4.804	48.64	Pk	33.8	-29	53.44	-	-	74	-20.56	0-360	102	V
6	9.826	29.97	Pk	37.1	-24.1	42.97	-	-	-	-	0-360	102	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.079	33.92	PKFH	27.9	-23.2	38.62	-	-	74	-35.38	261	186	H
* 1.079	21.49	VA1T	27.9	-23.2	26.19	54	-27.81	-	-	261	186	H
* 2.871	35.35	PKFH	32.4	-20.1	47.65	-	-	74	-26.35	96	354	H
* 2.872	23.2	VA1T	32.4	-20.1	35.5	54	-18.5	-	-	96	354	H
* 1.439	34.42	PKFH	28.4	-21.4	41.42	-	-	74	-32.58	288	175	V
* 1.438	23.77	VA1T	28.4	-21.4	30.77	54	-23.23	-	-	288	175	V
* 4.804	55.23	PKFH	33.8	-29	60.03	-	-	74	-13.97	14	102	H
* 4.804	42.92	VA1T	33.8	-29	47.72	54	-6.28	-	-	14	102	H
* 4.804	51.96	PKFH	33.8	-29	56.76	-	-	74	-17.24	5	102	V
* 4.804	40.24	VA1T	33.8	-29	45.04	54	-8.96	-	-	5	102	V
9.827	33.72	PKFH	37.1	-24.1	46.72	-	-	-	-	88	119	V
9.827	21.43	VA1T	37.1	-24.1	34.43	-	-	-	-	88	119	V

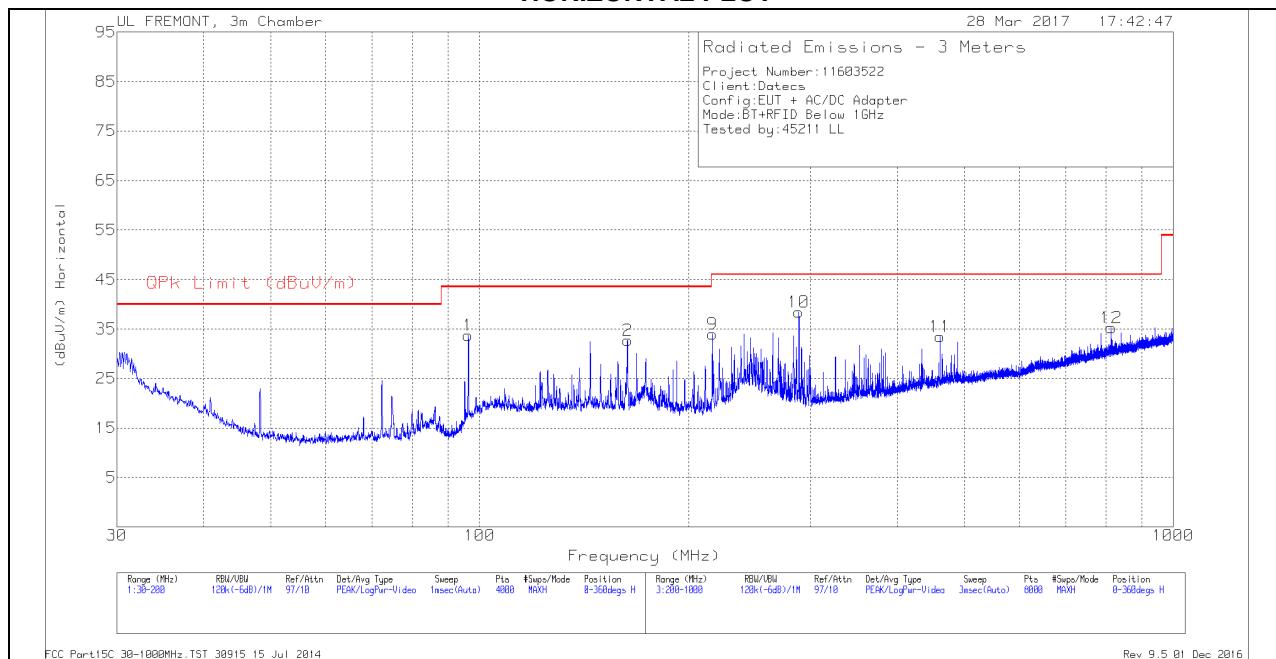
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

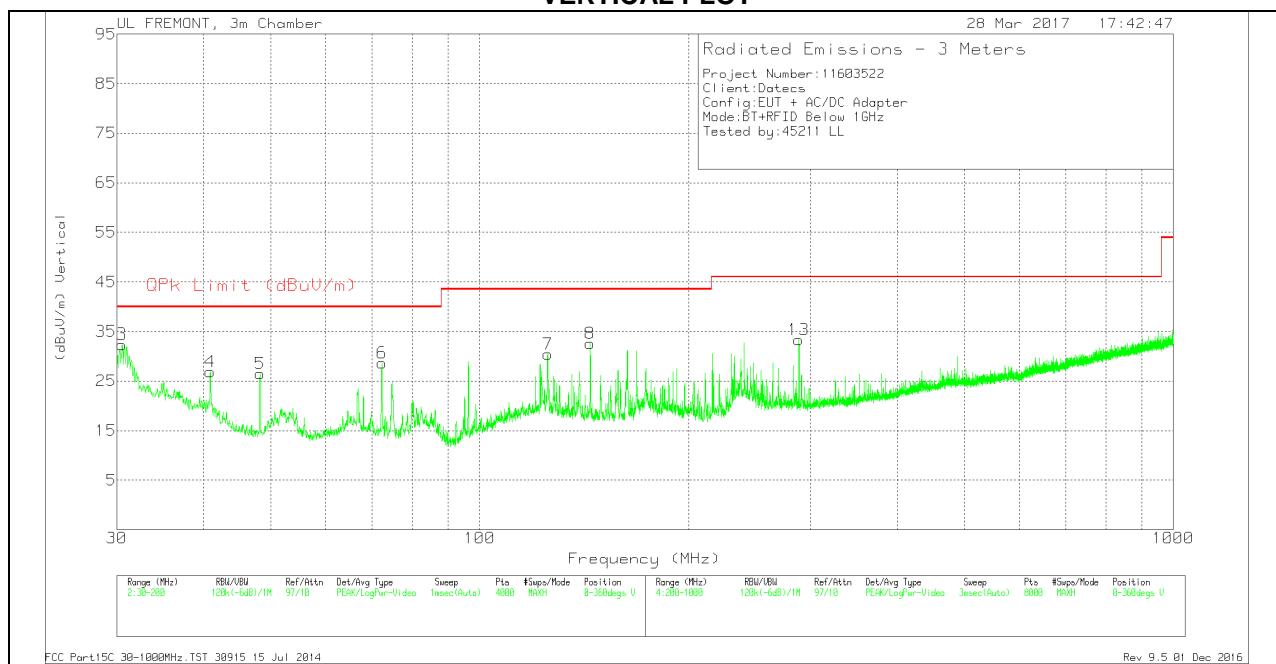
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

RFID + BT HOPPING SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)

HORIZONTAL PLOT



VERTICAL PLOT



BELOW 1 GHz TABLE

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	30.5101	34.69	Pk	24.9	-27.2	32.39	40	-7.61	0-360	100	V
4	40.8828	36.73	Pk	17.2	-27.1	26.83	40	-13.17	0-360	100	V
5	48.2372	41.01	Pk	12.5	-27	26.51	40	-13.49	0-360	100	V
6	72.2984	43.18	Pk	12.1	-26.6	28.68	40	-11.32	0-360	100	V
1	96.3172	46.87	Pk	13.2	-26.3	33.77	43.52	-9.75	0-360	200	H
7	125.3522	38.6	Pk	17.8	-26	30.4	43.52	-13.12	0-360	100	V
8	144.3546	41.54	Pk	16.8	-25.7	32.64	43.52	-10.88	0-360	100	V
2	163.357	42.06	Pk	16.2	-25.5	32.76	43.52	-10.76	0-360	200	H
9	216.5021	44.29	Pk	14.6	-24.9	33.99	46.02	-12.03	0-360	100	H
10	288.6115	45.4	Pk	17.2	-24.2	38.4	46.02	-7.62	0-360	100	H
13	288.6115	40.37	Pk	17.2	-24.2	33.37	46.02	-12.65	0-360	100	V
11	461.384	36.93	Pk	21.1	-24.6	33.43	46.02	-12.59	0-360	200	H
12	813.9798	32.47	Pk	25.5	-22.7	35.27	46.02	-10.75	0-360	100	H

Pk - Peak detector