



CERTIFICATION TEST REPORT

Report Number. : 12554903-E4V2

Applicant : Dish Technologies LLC
9601 Meridian Blvd
Englewood, CO, 80112
USA

Model : 915

FCC ID : DKN915M

EUT Description : IoT 915MHz Module

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C

Date Of Issue:
January 16, 2019

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888



REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	01/16/2019	Initial Issue	---
V2	01/29/2019	Updated sections 7.1.2 & 8	E.Yu

TABLE OF CONTENTS

REPORT REVISION HISTORY	2
1. ATTESTATION OF TEST RESULTS	4
2. TEST METHODOLOGY	5
3. FACILITIES AND ACCREDITATION	5
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>6</i>
4.3. <i>MEASUREMENT UNCERTAINTY.....</i>	<i>6</i>
5. EQUIPMENT UNDER TEST	7
5.1. <i>DESCRIPTION OF EUT</i>	<i>7</i>
5.2. <i>MAXIMUM OUTPUT E-FIELD STRENGTH</i>	<i>7</i>
5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>7</i>
5.4. <i>SOFTWARE AND FIRMWARE</i>	<i>7</i>
5.5. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>7</i>
5.6. <i>DESCRIPTION OF TEST SETUP</i>	<i>8</i>
6. TEST AND MEASUREMENT EQUIPMENT	11
7. TEST RESULTS.....	12
7.1. <i>ANTENNA PORT TEST RESULTS</i>	<i>12</i>
7.1.1. <i>ON TIME AND DUTY CYCLE</i>	<i>12</i>
7.1.2. <i>99% and 20dB BANDWIDTH</i>	<i>13</i>
7.2. <i>RADIATED EMISSIONS.....</i>	<i>14</i>
7.2.1. <i>FUNDAMENTAL FREQUENCY RADIATED EMISSION</i>	<i>15</i>
7.2.2. <i>HARMONICS AND SPURIOUS EMISSIONS BELOW 1GHz</i>	<i>16</i>
7.2.3. <i>HARMONICS AND SPURIOUS EMISSIONS ABOVE 1GHz</i>	<i>22</i>
7.2.4. <i>WORST-CASE BELOW 30 MHz.....</i>	<i>28</i>
7.3. <i>AC POWER LINE CONDUCTED EMISSIONS</i>	<i>29</i>
8. SETUP PHOTOS.....	32

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Dish Technologies LLC
9601 Meridian Blvd
Englewood, CO, 80112
USA

EUT DESCRIPTION: IoT 915MHz Module

MODEL: DKN915M

SERIAL NUMBER: 1-018

DATE TESTED: DECEMBER 10 – JANUARY 29, 2018

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



Francisco de Anda
Operations Leader
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Eric Yu
Test Engineer
Consumer Technology Division
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, 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	47658 Kato Rd
☐ Chamber A (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☒ Chamber I (ISED:2324A-5)
☒ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☒ Chamber J (ISED:2324A-6)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	☐ Chamber K (ISED:2324A-1)
	☐ Chamber G (ISED:22541-4)	☒ Chamber L (ISED:2324A-3)
	☐ Chamber H (ISED:22541-5)	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

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

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

36.5 dBuV + 0 dB + 10.1 dB + 0 dB = 46.6 dBuV

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case 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 IoT 915MHz Module.

5.2. MAXIMUM OUTPUT E-FIELD STRENGTH

The transmitter has a maximum output peak E-field as follows:

Frequency Range (MHz)	Mode	Output PK E-field Strength (dBuV/m)
902-928	RFID	93.33

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dipole antenna, with a maximum gain of 2.6 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was FCC v0.2.1

The test utility software used during testing was RabbitMQ SPI Console.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission below 30MHz was performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
Laptop	HP	EliteBook 8470p	CNU342CL9Z
Laptop AC/DC Adapter	HP	PPP009L-E	PA-1650-32HJ
Module test card	Dish technologies LLC	N/A	N/A
DC Power Supply	PHIHONG	AM05A-050B	N/A

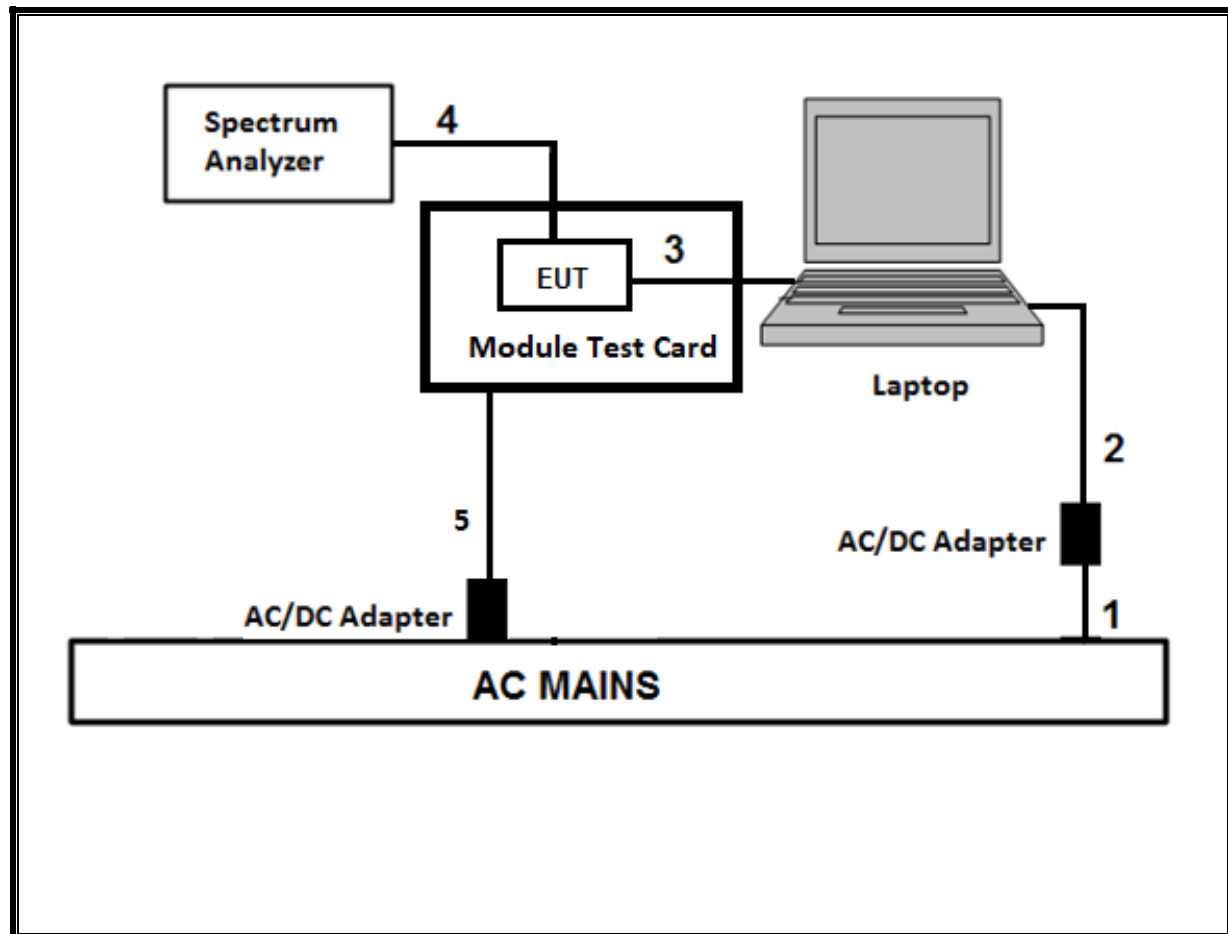
I/O CABLES (CONDUCTED TEST)

Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Unshielded	1.8	AC Mains to AC/DC Adapter
2	DC	1	DC	Unshielded	1.8	AC/DC Adapter to Laptop
3	USB	1	USB-Serial	Unshielded	0.5	EUT to Laptop
4	Antenna	1	SMA	unshielded	0.25	To spectrum analyzer
5	DC	1	DC	unshielded	1.5	Adapter to Module test card

TEST SETUP- ANTENNA PORT CONDUCTED TESTS

The EUT is connected with a host laptop computer by USB to Serial cable, and powered by AC adapter during the tests. Test software exercised the radio.

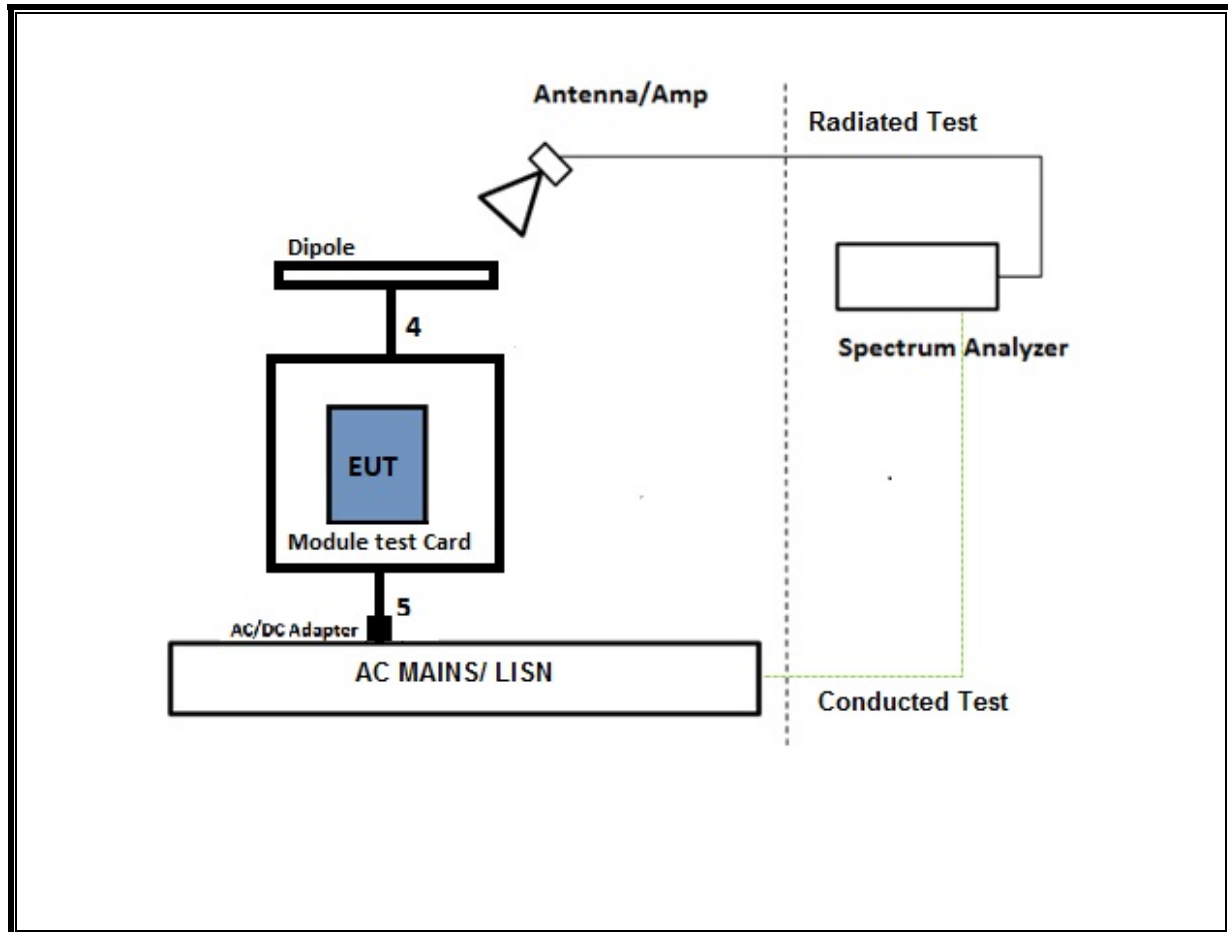
SETUP DIAGRAM FOR TESTS



TEST SETUP- AC LINE CONDUCTED TEST AND RADIATED EMISSIONS TEST

The EUT is powered by AC adapter during the tests. Test software exercised the radio.

SETUP DIAGRAM FOR TESTS



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	Asset	Cal Due
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T862	05/24/2019
RF Amplifier, 1-18GHz	MITEQ	AFS42-00101800-25-S-42	171460	08/01/2019
EMI TEST RECEIVER	Rohde&Schwarz	ESW44	PRE0179367	04/28/2019
Antenna, Horn 1-18GHz	ETS Lindgren	3117	EMC4294	04/30/2019
Amplifier, 1 - 18GHz	MITEQ	AFS42-00101800-25-S-42	T1568	06/21/2019
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179522	05/11/2019
Hybrid Antenna, 30MHz to 3GHz	SunAR rf motion	JB3	PRE0181575	08/01/2019
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179372	05/04/2019
Hybrid Antenna, 30MHz to 3GHz	SunAR rf motion	JB3	PRE0184052	10/24/2019
Amplifier	HEWLET PACKARD	8447D	T64	06/25/2019
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179377	05/03/2019
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T757	09/25/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1454	01/08/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T339	09/11/2019
AC Line Conducted				
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/21/2019
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	06/15/2019
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, June 22, 2018	
Antenna Port Software	UL	UL RF	Ver 8.8.1, Sep 26, 2018	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

7. TEST RESULTS

7.1. ANTENNA PORT TEST RESULTS

7.1.1. ON TIME AND DUTY CYCLE

LIMITS

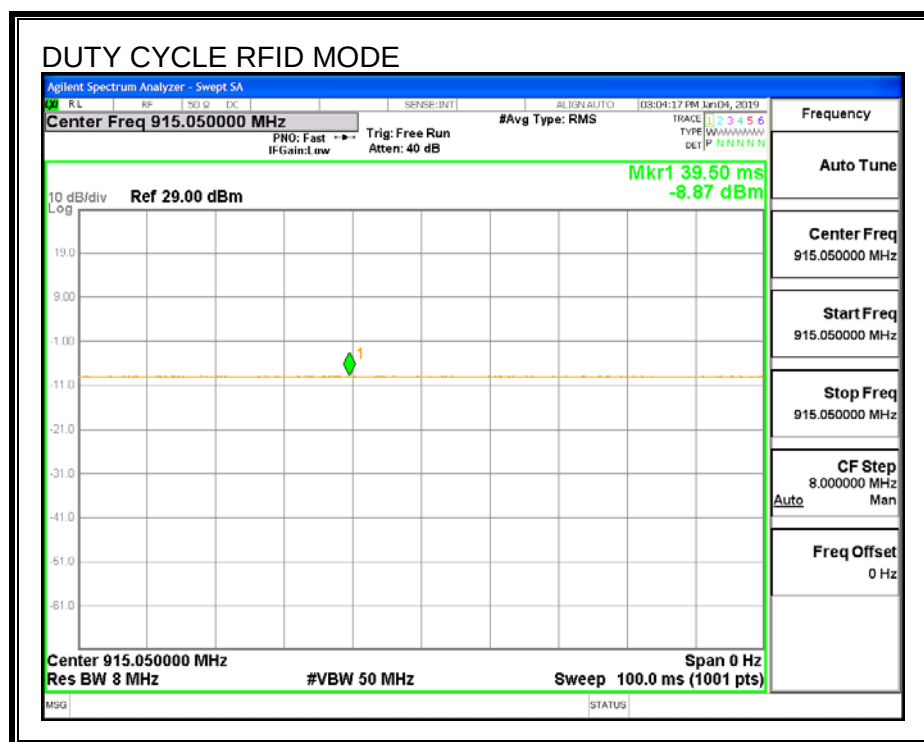
None; for reporting purposes only.

RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
RFID	100.0000	100.0000	1.000	100.00%	0.00

DUTY CYCLE PLOT

Test Engineer: 10629, RL



7.1.2. 99% and 20dB BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
Low	902.05	25.831	21.32
Middle	915.05	25.827	21.46
High	927.85	25.833	21.81

Test Engineer: 10629, RL



7.2. RADIATED EMISSIONS

LIMIT

FCC 15.205(a), 15.209 (a), FCC 15.249 (a)(d)(e)

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following @ 3 meter:

Fundamental frequency	Field strength of fundamental at 3 m		Field strength of harmonics at 3 m	
	mV/m	dBuV/m	uV/m	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	107.95	2500	67.95

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

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	-
0.490-1.705	24000/F(kHz) @ 30m	-
1.705-30.0	30 @ 30m	-
30 - 88	100**	40**
88 - 216	150**	43.5**
216 - 960	200**	46**
Above 960	500**	54**

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

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 pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

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.

KDB 414788 OATS and Chamber Correlation Justification

Base 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.

RESULTS

7.2.1. FUNDAMENTAL FREQUENCY RADIATED EMISSION

Test Engineer:10629, RL

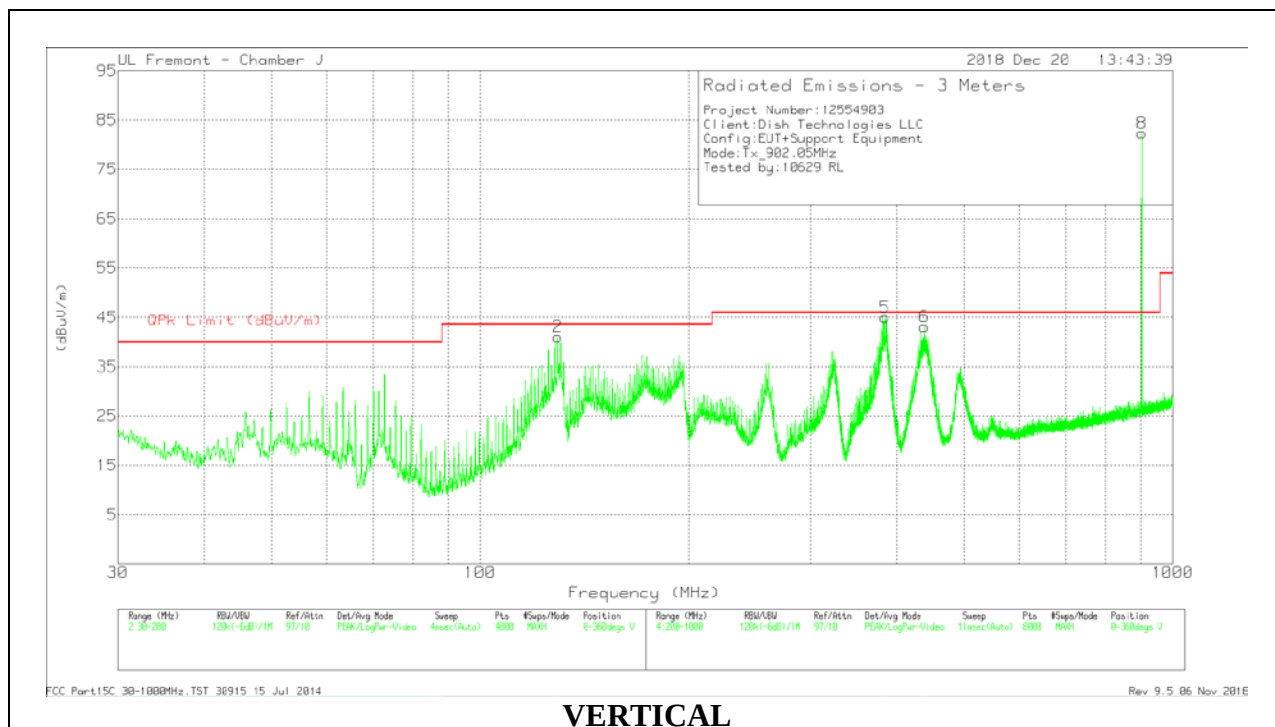
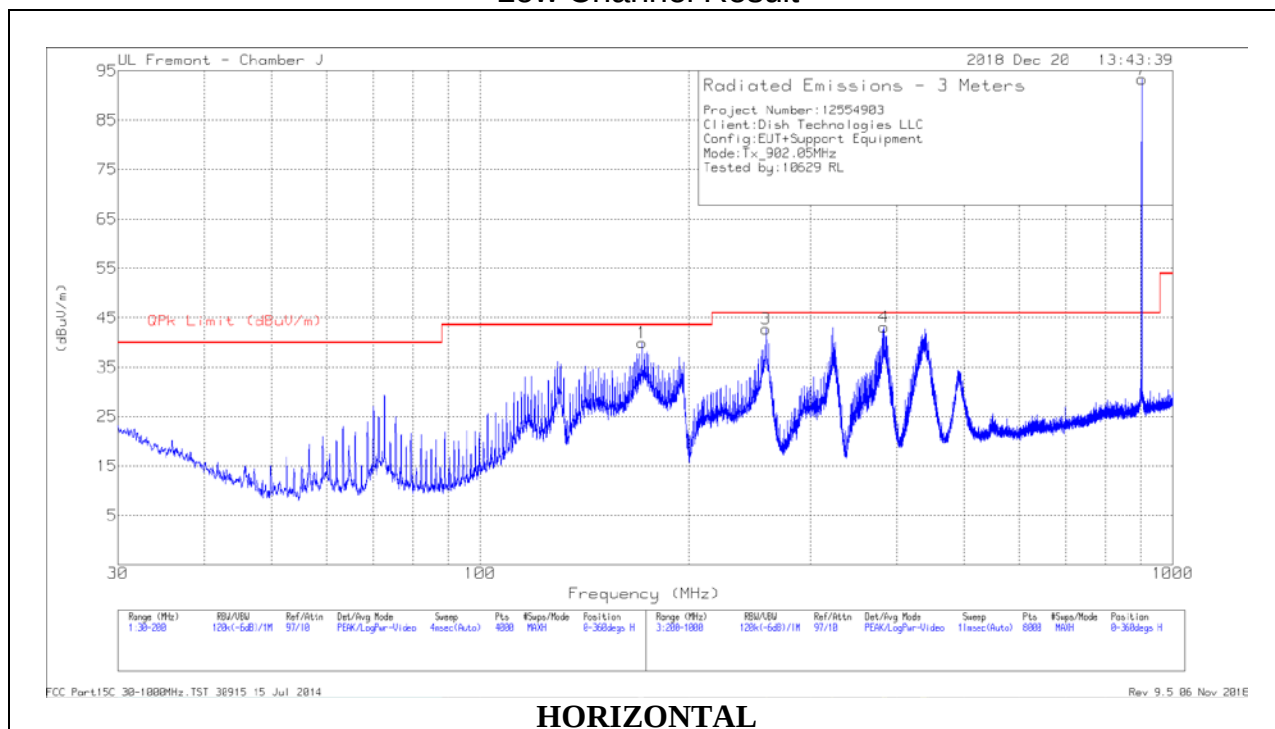
Date: 21/20/2018

Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0184970 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
Low Ch_902.05MHz												
902.0411	92.32	PKFH	28.3	-27.3	93.32	-	-	114	-20.68	159	132	H
902.0550	92.33	VA1T	28.3	-27.3	93.33	94	-0.67	-	-	159	132	H
902.0422	81.90	PKFH	28.3	-27.3	82.90	-	-	114	-31.10	83	105	V
902.0516	81.91	VA1T	28.3	-27.3	82.91	94	-11.09	-	-	83	105	V
Mid Ch_915.05MHz												
915.0433	92.08	PKFH	28.3	-27.3	93.08	-	-	114	-20.92	356	130	H
915.0488	92.11	VA1T	28.3	-27.3	93.11	94	-0.89	-	-	356	130	H
915.0533	83.38	PKFH	28.3	-27.3	84.38	-	-	114	-29.62	70	106	V
915.0488	83.40	VA1T	28.3	-27.3	84.40	94	-9.60	-	-	70	106	V
High Ch_927.85MHz												
927.8522	91.60	PKFH	28.5	-27.1	93.00	-	-	114	-21	0	126	H
927.8477	91.60	VA1T	28.5	-27.1	93.00	94	-1.00	-	-	0	126	H
927.8511	82.94	PKFH	28.5	-27.1	84.34	-	-	114	-29.66	71	104	V
927.8483	82.94	VA1T	28.5	-27.1	84.34	94	-9.66	-	-	71	104	V

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

7.2.2. HARMONICS AND SPURIOUS EMISSIONS BELOW 1GHz

Low Channel Result



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 171.179	52.89	Pk	17.6	-30.5	39.99	43.52	-3.53	0-360	199	H
2	* 129.3907	52.13	Pk	19.7	-30.7	41.13	43.52	-2.39	0-360	101	V
3	* 258.8076	54.9	Pk	17.9	-30.1	42.7	46.02	-3.32	0-360	101	H
4	382.7238	51.82	Pk	21	-29.7	43.12	46.02	-2.9	0-360	101	H
7	**902.0913	92.22	Pk	28.3	-27.3	93.22	--	--	0-360	101	H
5	384.1239	53.61	Pk	21	-29.6	45.01	46.02	-1.01	0-360	101	V
6	438.131	50.12	Pk	22.6	-29.6	43.12	46.02	-2.9	0-360	101	V
8	**902.0913	81.29	Pk	28.3	-27.3	82.29	--	--	0-360	101	V

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

** - Fundamental Frequencies

Pk - Peak detector

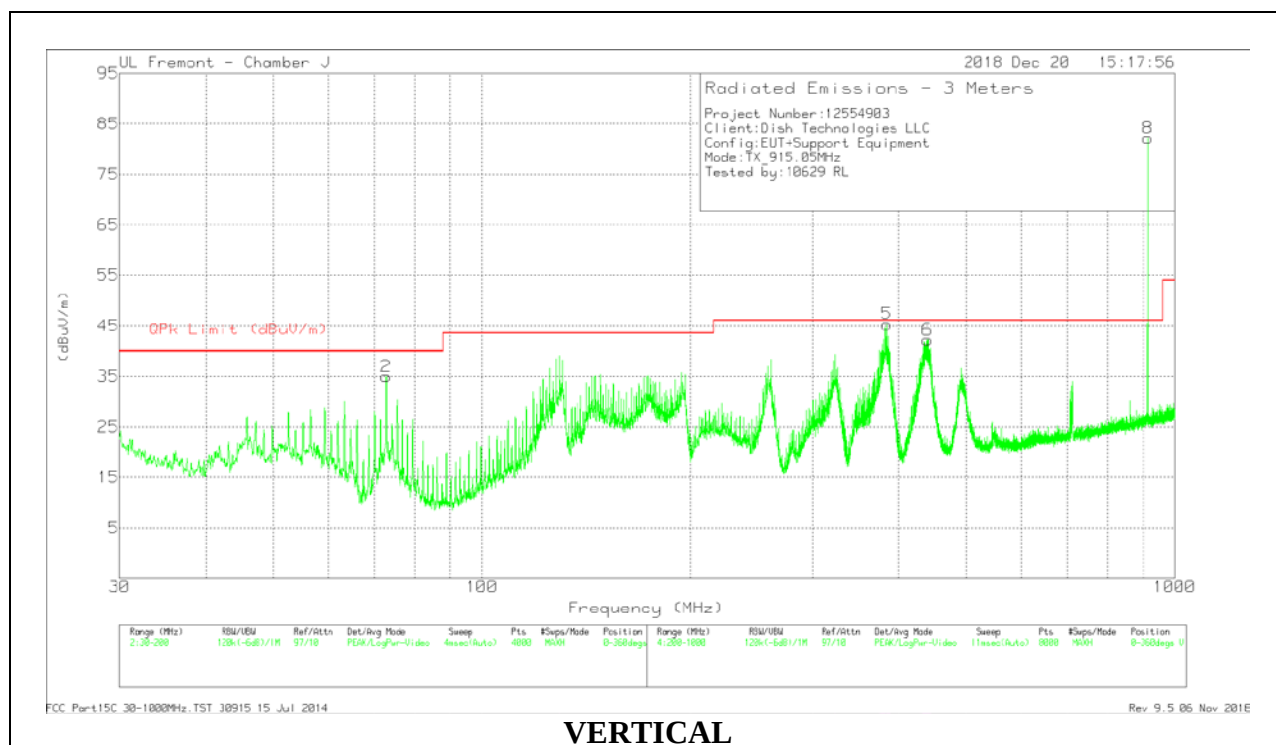
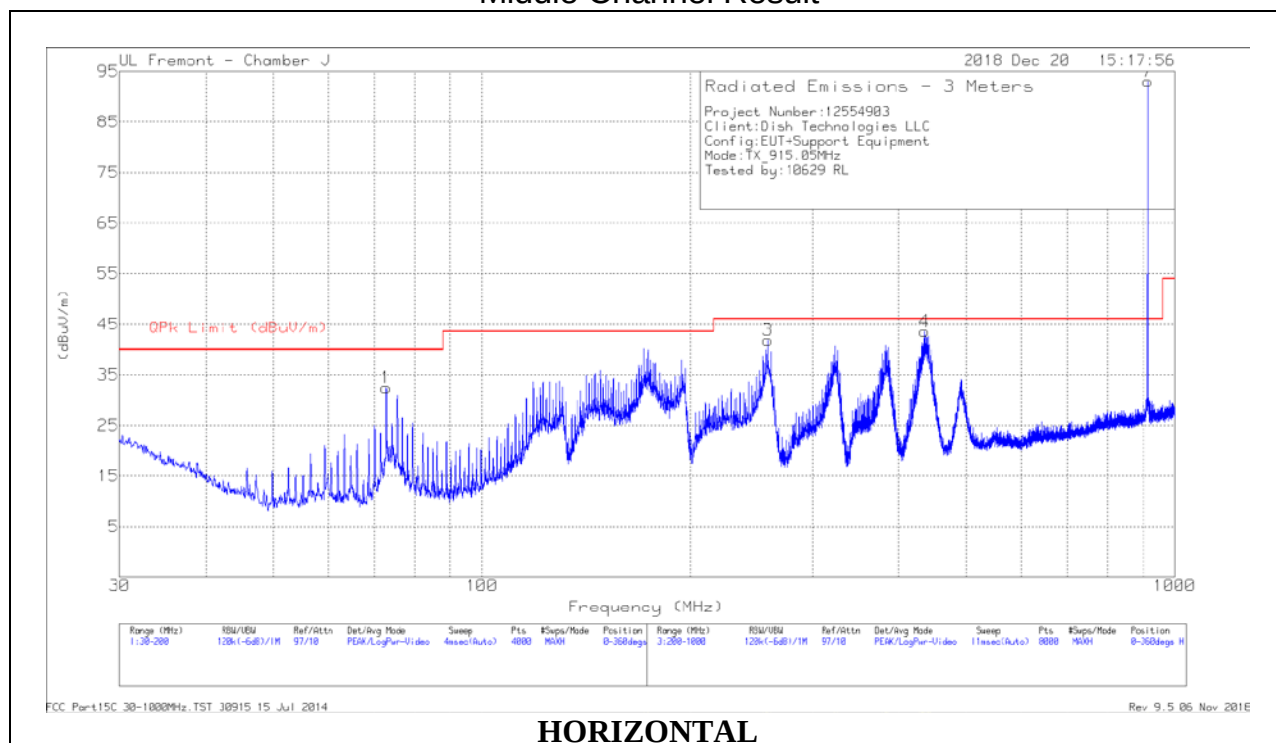
Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 171.2217	52.7	Qp	17.6	-30.5	39.8	43.52	-3.72	109	155	H
* 129.4142	51.37	Qp	19.7	-30.7	40.37	43.52	-3.15	293	103	V
* 258.8215	53.84	Qp	17.9	-30.1	41.64	46.02	-4.38	53	117	H
382.8519	50.26	Qp	21	-29.7	41.56	46.02	-4.46	133	104	H
384.1843	53.08	Qp	21	-29.6	44.48	46.02	-1.54	98	102	V
438.1431	48.85	Qp	22.6	-29.6	41.85	46.02	-4.17	132	128	V

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

Qp - Quasi-Peak detector

Middle Channel Result



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	72.7661	49.77	Pk	13.9	-31.2	32.47	40	-7.53	0-360	298	H
2	72.7661	52.26	Pk	13.9	-31.2	34.96	40	-5.04	0-360	101	V
3	* 258.7076	54.06	Pk	17.9	-30.1	41.86	46.02	-4.16	0-360	101	H
4	435.3306	50.68	Pk	22.5	-29.6	43.58	46.02	-2.44	0-360	198	H
7	**915.093	92.01	Pk	28.3	-27.3	93.01	--	--	0-360	101	H
5	384.1239	53.95	Pk	21	-29.6	45.35	46.02	-6.7	0-360	101	V
6	439.5311	49.23	Pk	22.6	-29.6	42.23	46.02	-3.79	0-360	101	V
8	**915.093	81.16	Pk	28.3	-27.3	82.16	--	--	0-360	298	V

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

** - Fundamental Frequencies

Pk - Peak detector

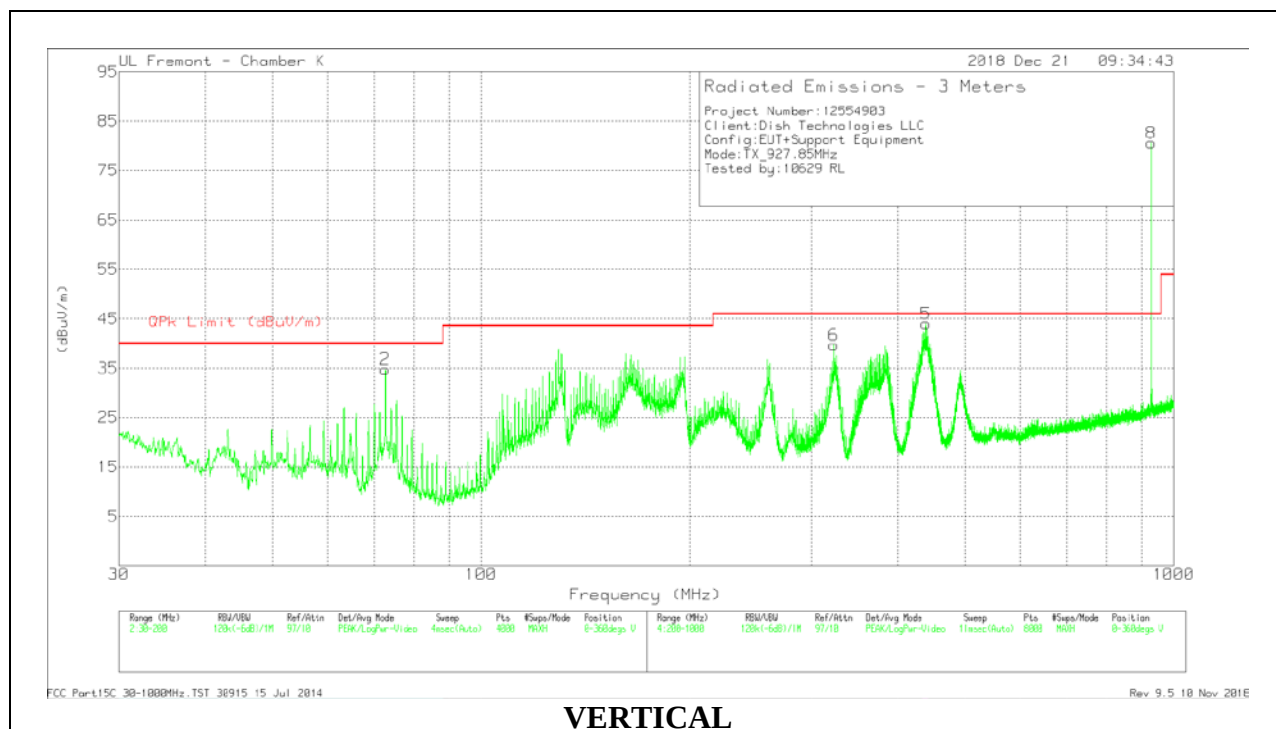
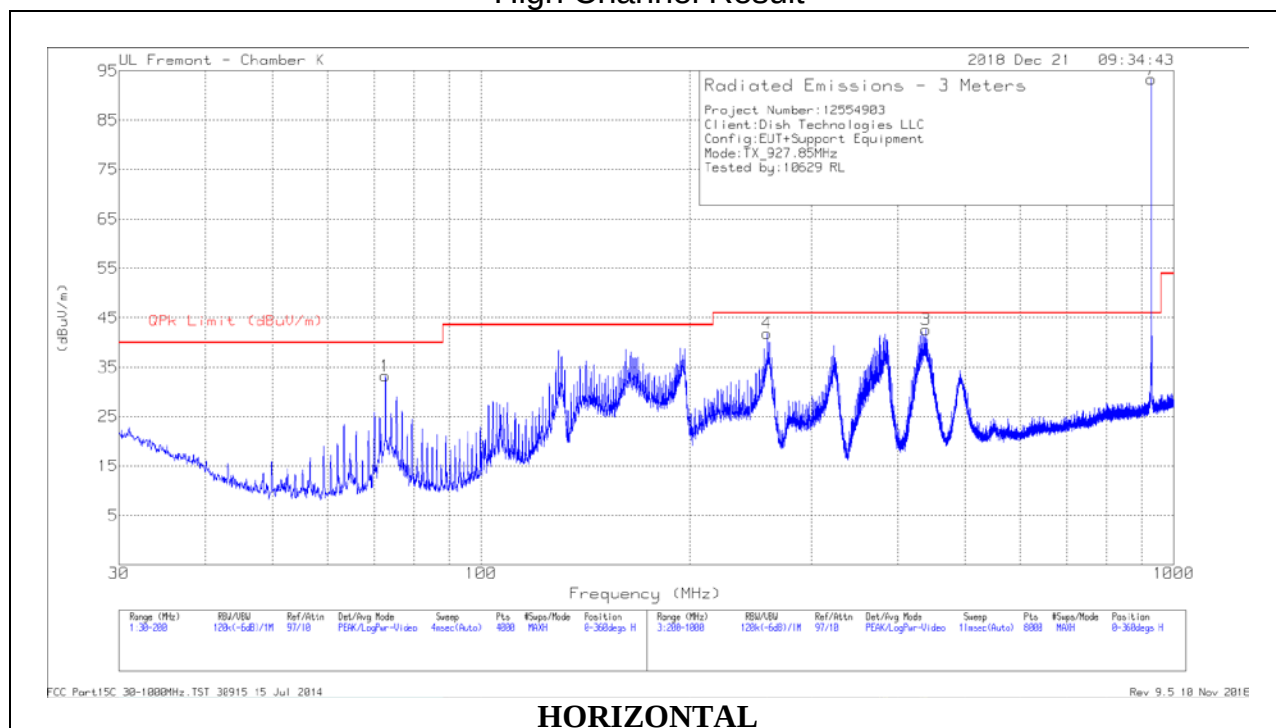
Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
72.7978	49.91	Qp	13.9	-31.2	32.61	40	-7.39	199	271	H
72.7982	51.57	Qp	13.9	-31.2	34.27	40	-5.73	37	102	V
* 258.8162	52.79	Qp	17.9	-30.1	40.59	46.02	-5.43	51	129	H
435.4282	49.2	Qp	22.5	-29.6	42.1	46.02	-3.92	172	213	H
384.233	50.72	Qp	21	-29.6	42.12	46.02	-3.9	97	103	V
439.4415	49.14	Qp	22.6	-29.6	42.14	46.02	-3.88	126	105	V

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

Qp - Quasi-Peak detector

High Channel Result



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0184052 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	72.7661	50.31	Pk	14	-31.1	33.21	40	-6.79	0-360	299	H
2	72.7661	51.9	Pk	14	-31.1	34.8	40	-5.2	0-360	100	V
3	439.3311	49.16	Pk	22.6	-29.2	42.56	46.02	-3.46	0-360	199	H
4	* 258.7076	53.8	Pk	17.9	-29.9	41.8	46.02	-4.22	0-360	100	H
7	**927.8946	91.72	Pk	28.5	-26.9	93.32	--	--	0-360	100	H
5	439.3311	50.56	Pk	22.6	-29.2	43.96	46.02	-2.06	0-360	100	V
6	* 323.416	49.54	Pk	19.9	-29.7	39.74	46.02	-6.28	0-360	100	V
8	**927.8946	78.97	Pk	28.5	-26.9	80.57	--	--	0-360	299	V

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

** - Fundamental Frequencies

Pk - Peak detector

Radiated Emissions

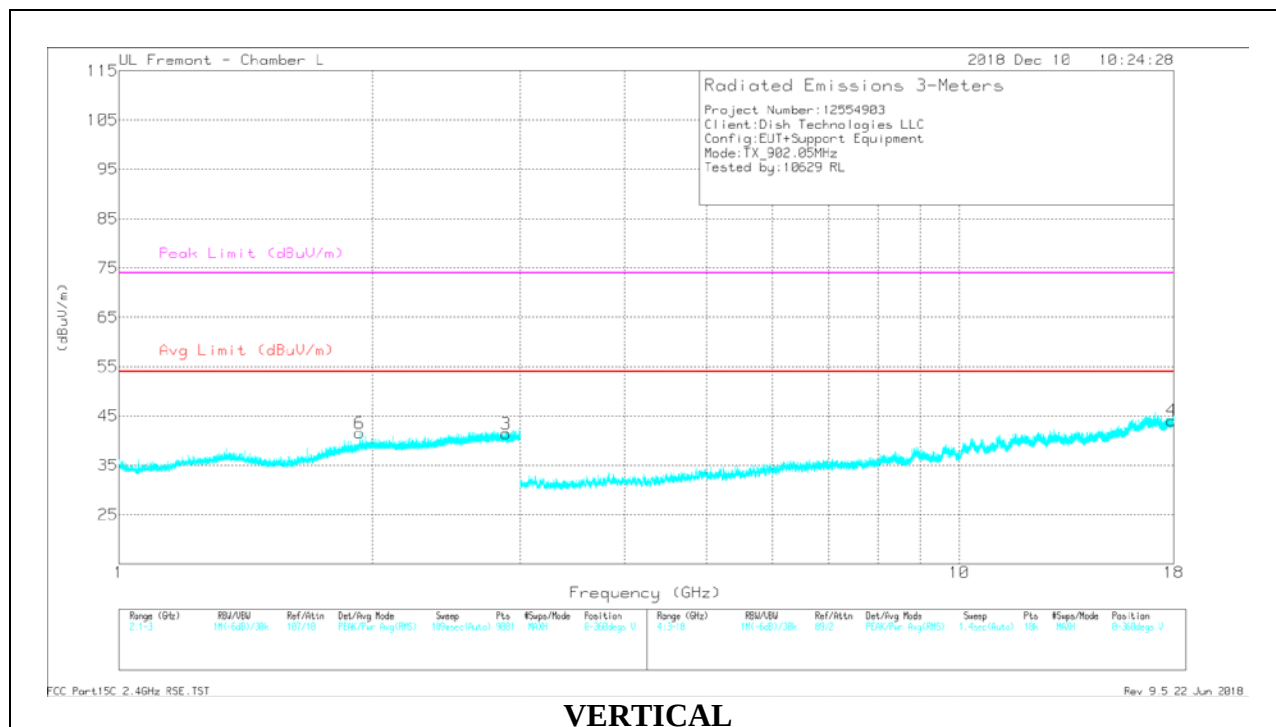
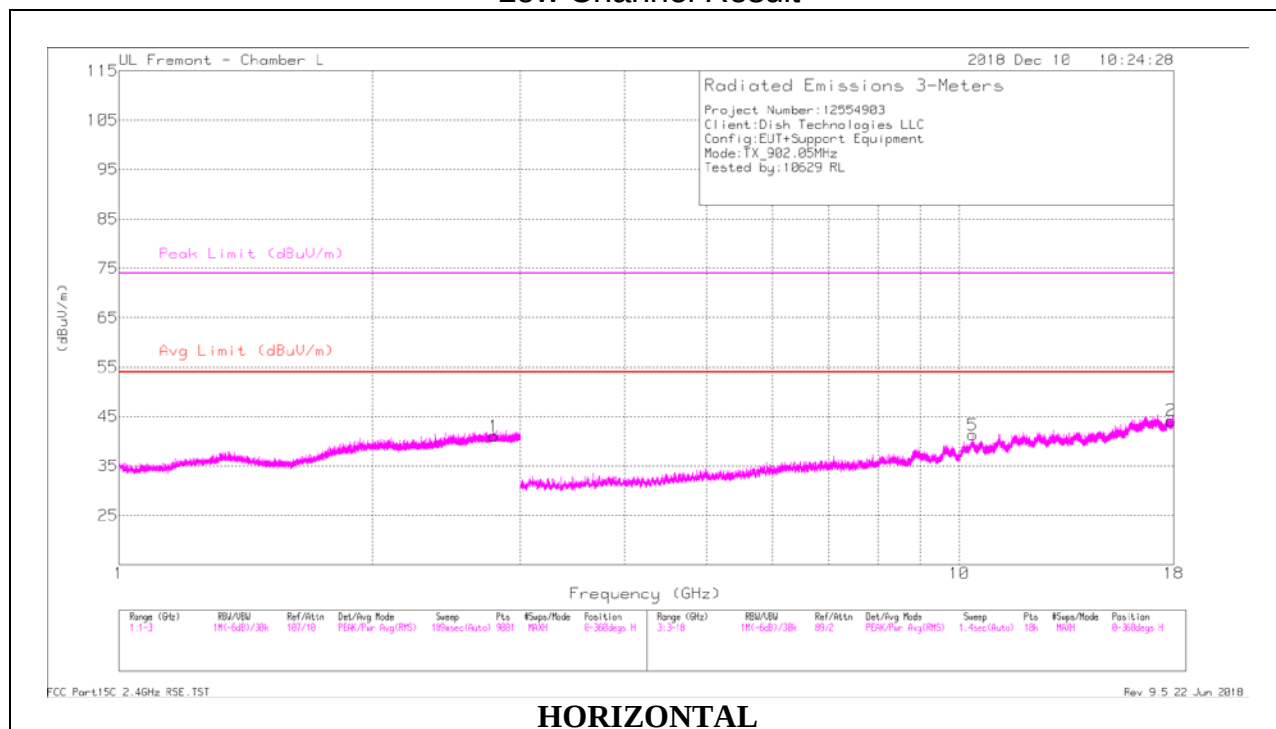
Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0184052 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
72.7954	50.08	Qp	14	-31.1	32.98	40	-7.02	333	275	H
72.7853	51.67	Qp	14	-31.1	34.57	40	-5.43	189	101	V
439.4572	48.79	Qp	22.6	-29.3	42.09	46.02	-3.93	230	172	H
* 258.8222	54.22	Qp	17.9	-29.9	42.22	46.02	-3.8	128	117	H
439.4125	49.22	Qp	22.6	-29.3	42.52	46.02	-3.5	284	103	V
* 323.5433	48.95	Qp	19.9	-29.8	39.05	46.02	-6.97	227	102	V

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

Qp - Quasi-Peak detector

7.2.3. HARMONICS AND SPURIOUS EMISSIONS ABOVE 1GHz

Low Channel Result



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.793	30.65	Pk	32.6	-22.2	41.05	-	-	74	-32.95	0-360	100	H
3	* 2.89	31.17	Pk	32.4	-22.1	41.47	-	-	74	-32.53	0-360	101	V
6	1.934	33.9	Pk	31.3	-23.7	41.5	-	-	-	-	0-360	200	V
2	* 17.874	21.73	Pk	40.6	-18.1	44.23	-	-	74	-29.77	0-360	200	H
5	10.371	23.48	Pk	37.5	-19.7	41.28	-	-	-	-	0-360	101	H
4	* 17.907	21.54	Pk	40.6	-18.1	44.04	-	-	74	-29.96	0-360	200	V

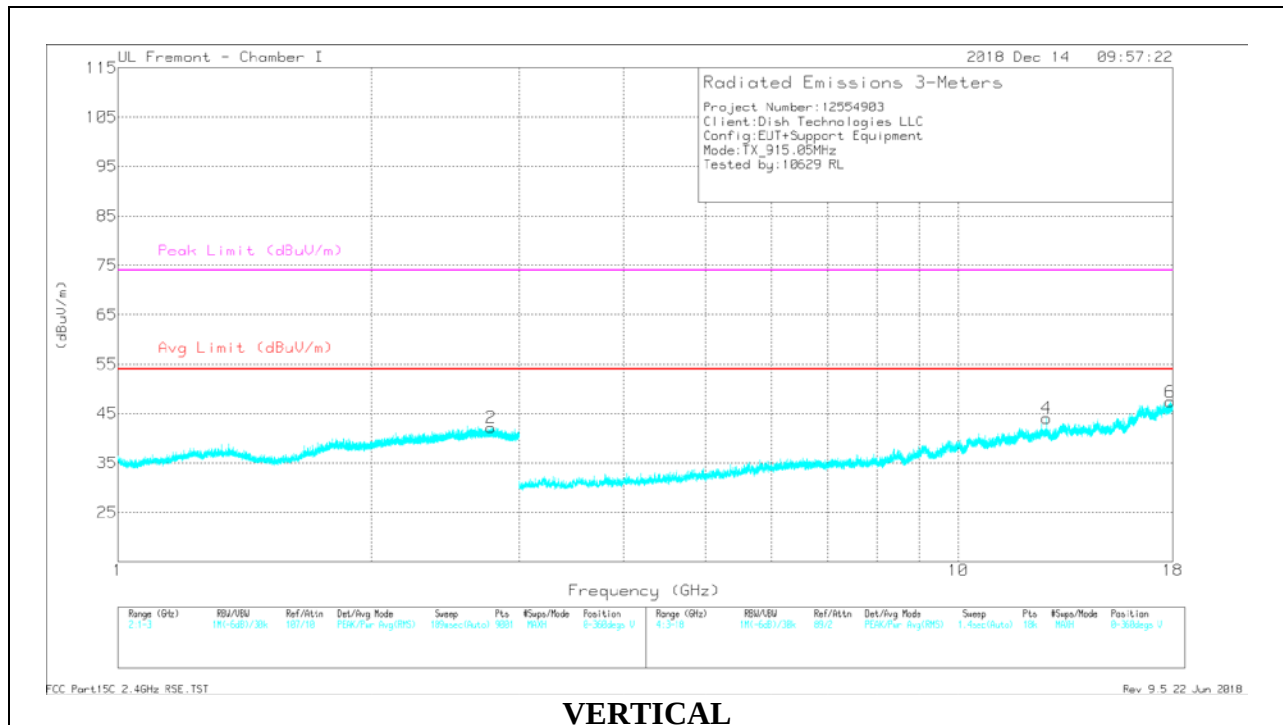
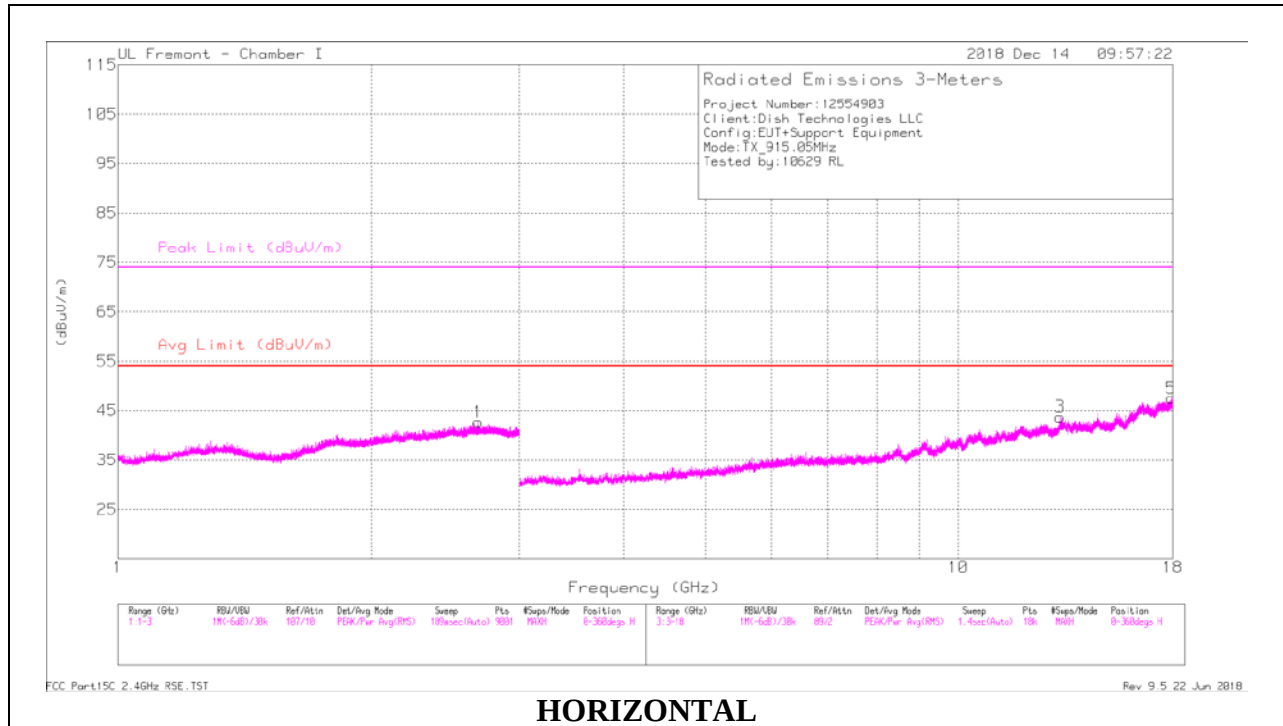
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.795	37.87	PKFH	32.6	-22.2	48.27	-	-	74	-25.73	32	214	H
* 2.794	25.55	VA1T	32.6	-22.2	35.95	54	-18.05	-	-	32	214	H
* 2.891	38.55	PKFH	32.4	-22.1	48.85	-	-	74	-25.15	217	183	V
* 2.889	25.62	VA1T	32.4	-22.1	35.92	54	-18.08	-	-	217	183	V
* 17.872	29.45	PKFH	40.6	-18.1	51.95	-	-	74	-22.05	180	352	H
* 17.875	16.49	VA1T	40.6	-18.1	38.99	54	-15.01	-	-	180	352	H
* 17.907	30.36	PKFH	40.6	-18.1	52.86	-	-	74	-21.14	343	315	V
* 17.908	16.44	VA1T	40.6	-18.1	38.94	54	-15.06	-	-	343	315	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

Middle Channel Result



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Filtr/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	* 2.685	31.48	Pk	32.4	-21.2	42.68	-	-	74	-31.32	0-360	102	H
2	* 2.779	30.64	Pk	32.4	-20.9	42.14	-	-	74	-31.86	0-360	100	V
3	13.216	25.36	Pk	39.5	-21.1	43.76	-	-	-	-	0-360	100	H
5	* 17.936	21.34	Pk	41.6	-15.4	47.54	-	-	74	-26.46	0-360	198	H
4	12.746	26.25	Pk	39.2	-21.4	44.05	-	-	-	-	0-360	199	V
6	* 17.861	20.45	Pk	41.7	-14.8	47.35	-	-	74	-26.65	0-360	102	V

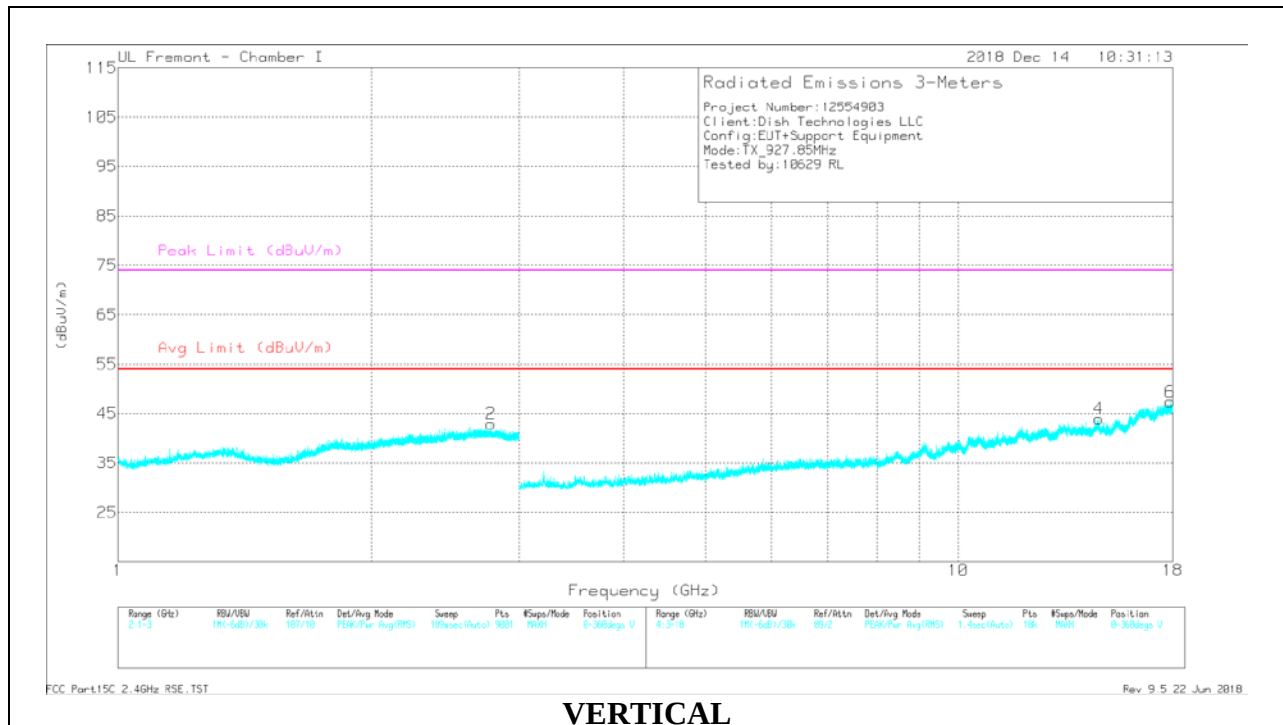
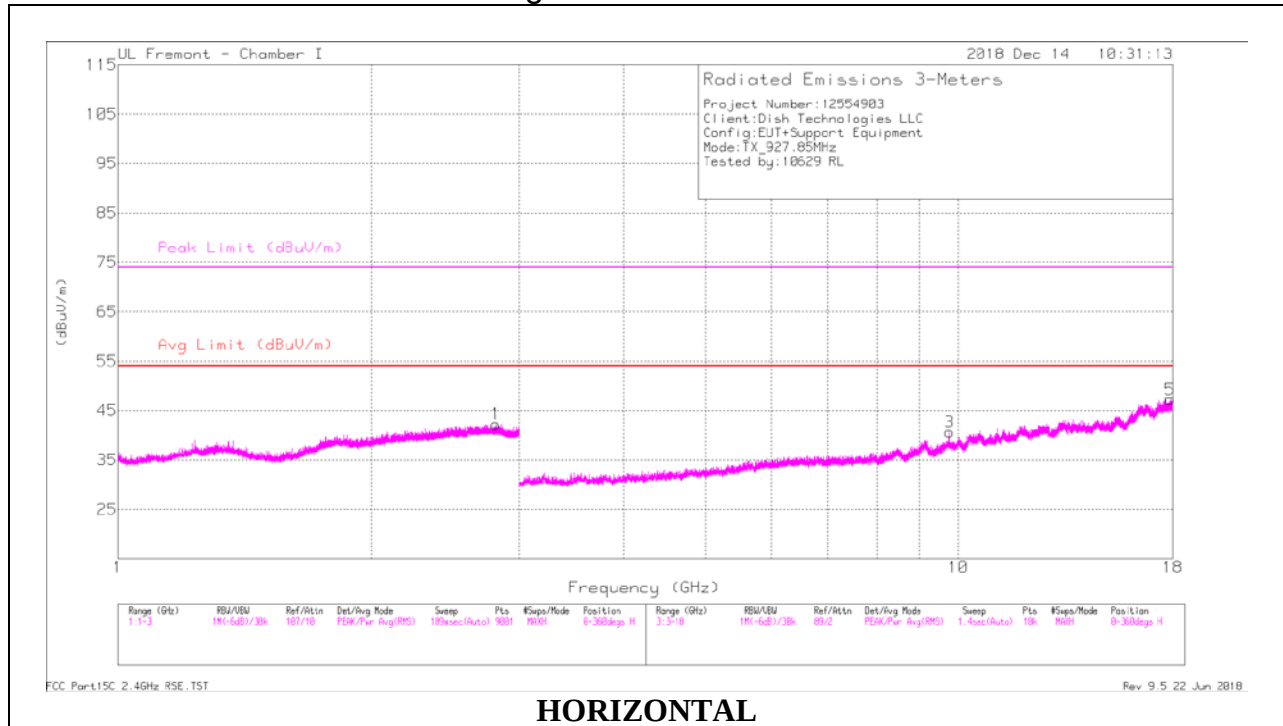
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.687	34.92	PKFH	32.4	-21.2	46.12	-	-	74	-27.88	227	310	H
* 2.687	24.87	VA1T	32.4	-21.2	36.07	54	-17.93	-	-	227	310	H
* 2.779	27.76	PKFH	32.4	-20.9	39.26	-	-	74	-34.74	335	260	V
* 2.781	24.71	VA1T	32.4	-20.9	36.21	54	-17.79	-	-	335	260	V
* 17.936	9.23	PKFH	41.6	-15.4	35.43	-	-	74	-38.57	136	129	H
* 17.934	15.32	VA1T	41.6	-15.4	41.52	54	-12.48	-	-	136	129	H
* 17.863	17.69	PKFH	41.7	-14.8	44.59	-	-	74	-29.41	330	318	V
* 17.86	14.32	VA1T	41.7	-14.7	41.32	54	-12.68	-	-	330	318	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

High Channel Result



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Filtr/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	* 2.816	30.84	Pk	32.3	-20.9	42.24	-	-	74	-31.76	0-360	199	H
2	* 2.779	31.47	Pk	32.4	-20.9	42.97	-	-	74	-31.03	0-360	100	V
3	9.76	24.28	Pk	36.9	-20.5	40.68	-	-	-	-	0-360	199	H
5	* 17.876	20.53	Pk	41.6	-14.9	47.23	-	-	74	-26.77	0-360	100	H
4	14.708	25.35	Pk	40	-21.4	43.95	-	-	-	-	0-360	199	V
6	* 17.871	20.45	Pk	41.6	-14.7	47.35	-	-	74	-26.65	0-360	100	V

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

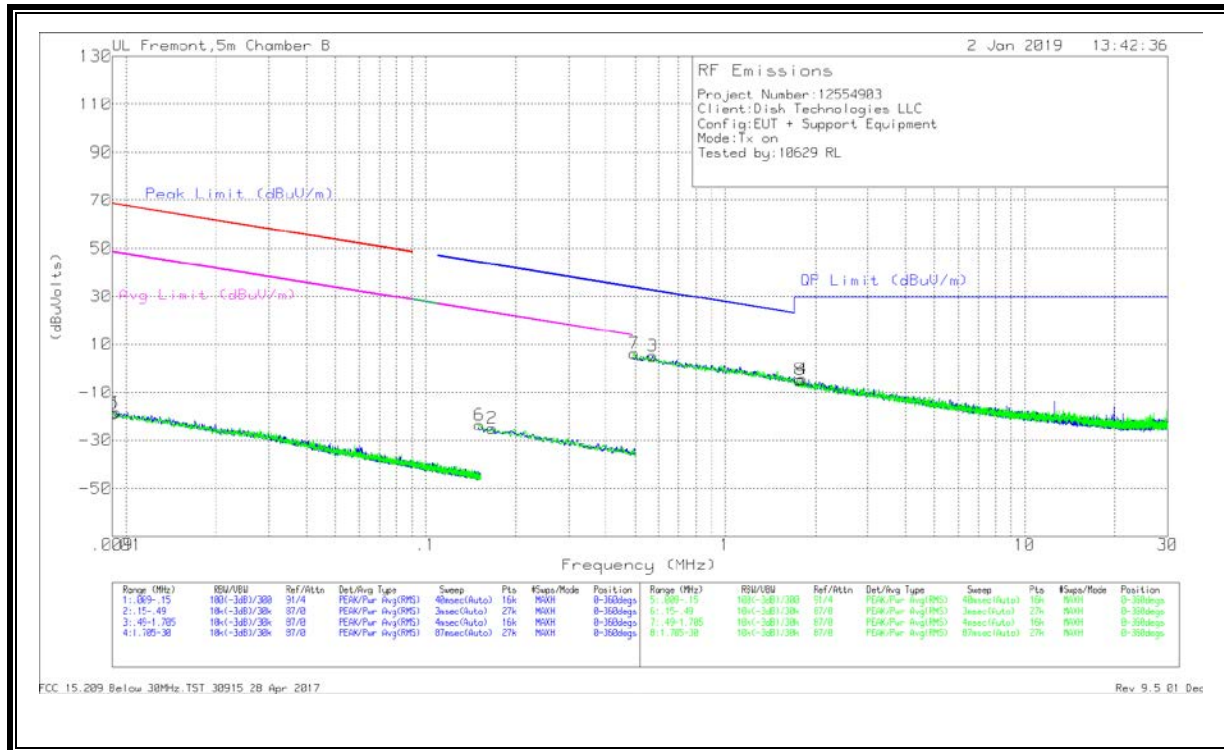
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.814	30.29	PKFH	32.3	-20.9	41.69	-	-	74	-32.31	169	151	H
* 2.818	24.7	VA1T	32.3	-20.9	36.1	54	-17.9	-	-	169	151	H
* 2.781	22.86	PKFH	32.4	-20.9	34.36	-	-	74	-39.64	44	322	V
* 2.781	24.68	VA1T	32.4	-20.9	36.18	54	-17.82	-	-	44	322	V
* 17.875	11.86	PKFH	41.6	-14.9	38.56	-	-	74	-35.44	93	111	H
* 17.874	14.75	VA1T	41.7	-14.8	41.65	54	-12.35	-	-	93	111	H
* 17.869	3.1	PKFH	41.6	-14.7	30	-	-	74	-44	343	257	V
* 17.87	14.52	VA1T	41.6	-14.7	41.42	54	-12.58	-	-	343	257	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

7.2.4. WORST-CASE BELOW 30 MHz

SPURIOUS EMISSIONS BELOW 30 MHz



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
5	.00915	40.86	Pk	20.3	.1	-80	-18.74	68.35	-87.09	48.35	-67.09	-	-	0-360
1	.00929	41.31	Pk	20.2	.1	-80	-18.39	68.23	-86.62	48.23	-66.62	-	-	0-360
6	.15151	45.13	Pk	11.3	0	-80	-23.57	44.01	-67.58	24.01	-47.58	-	-	0-360
2	.16685	43.74	Pk	11.2	.1	-80	-24.96	43.17	-68.13	23.17	-48.13	-	-	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
7	.49551	35.03	Pk	11.1	.1	-40	5.23	-	-	-	-	33.7	-27.47	0-360
3	.57463	33.99	Pk	11.1	.1	-40	5.19	-	-	-	-	32.42	-27.23	0-360
8	1.78098	23.8	Pk	11.3	.2	-40	-4.7	-	-	-	-	29.5	-34.2	0-360
4	1.8119	23.92	Pk	11.3	.2	-40	-4.58	-	-	-	-	29.5	-34.08	0-360

Pk - Peak detector

7.3. AC POWER LINE CONDUCTED EMISSIONS

LIMIT

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

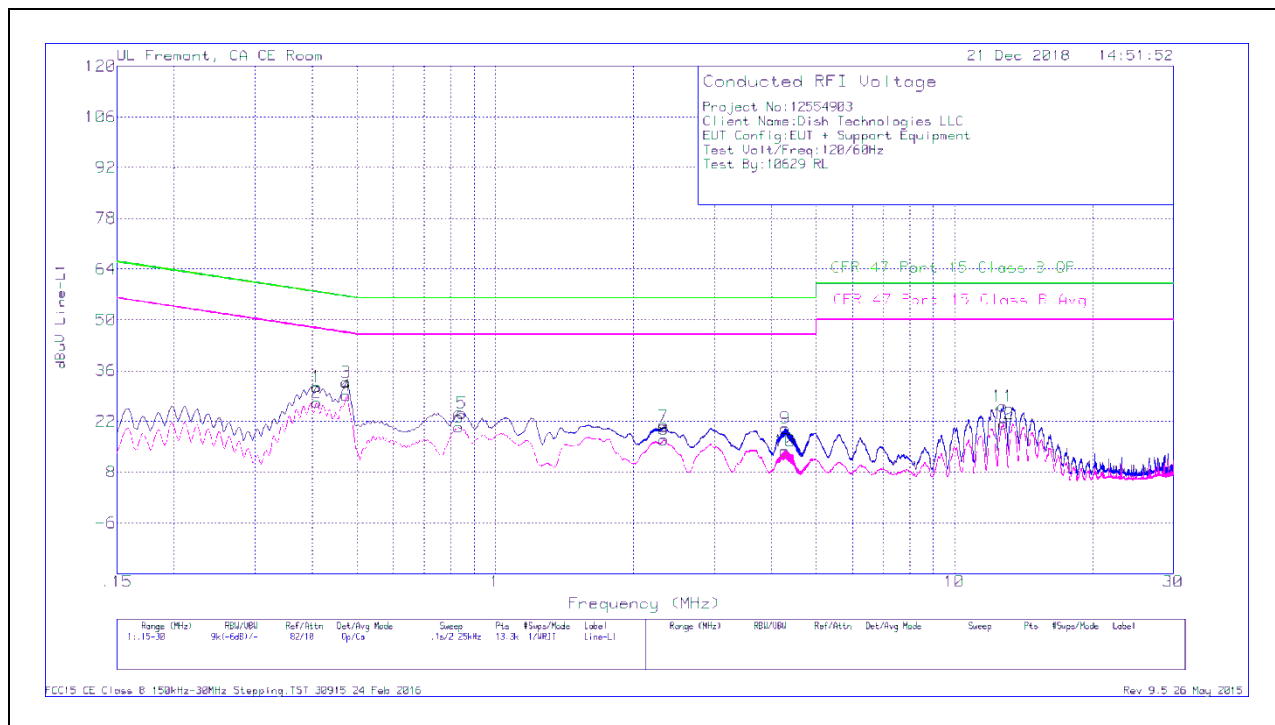
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both Line 1 (HOT) and Line 2 (NEUTRAL).

RESULTS

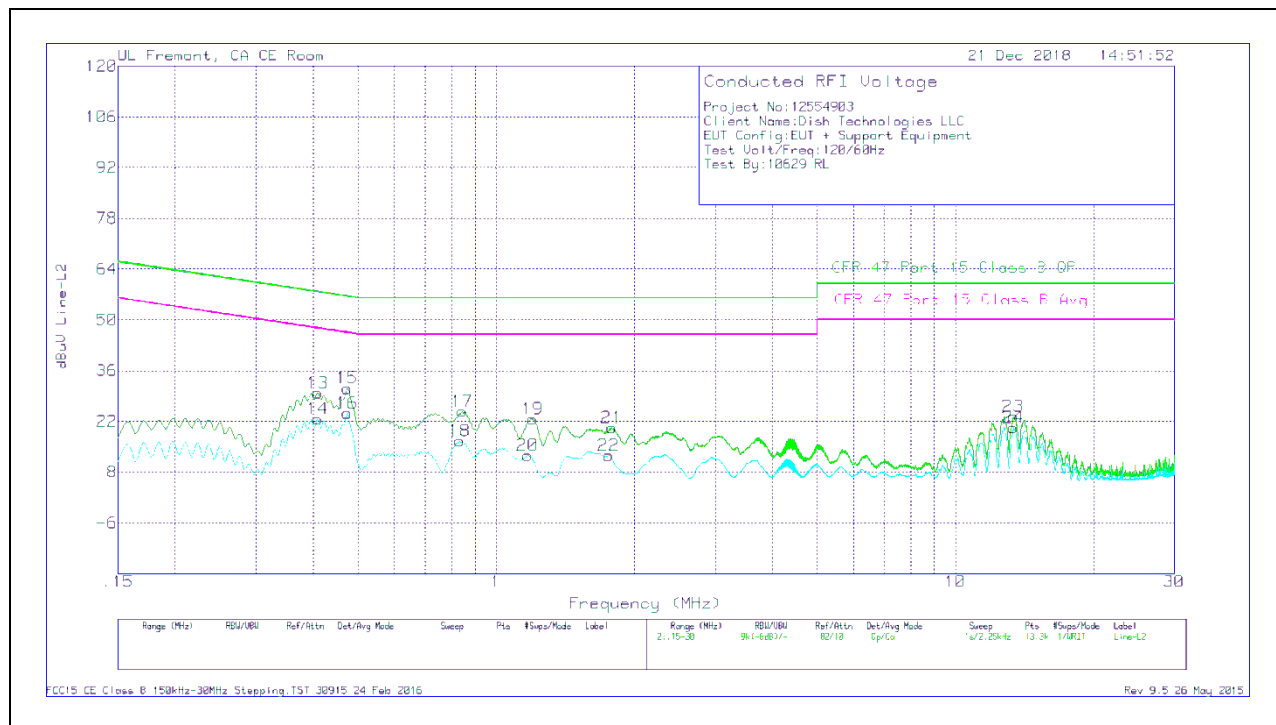
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBUV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.40875	21.53	Qp	0	0	10.1	31.63	57.67	-26.04	-	-
2	.40875	17.09	Ca	0	0	10.1	27.19	-	-	47.67	-20.48
3	.474	22.67	Qp	0	0	10.1	32.77	56.44	-23.67	-	-
4	.474	18.97	Ca	0	0	10.1	29.07	-	-	46.44	-17.37
5	.84525	14.18	Qp	0	0	10.1	24.28	56	-31.72	-	-
6	.83175	10.37	Ca	0	0	10.1	20.47	-	-	46	-25.53
7	2.328	10.35	Qp	0	.1	10.1	20.55	56	-35.45	-	-
8	2.32575	6.7	Ca	0	.1	10.1	16.9	-	-	46	-29.1
9	4.29	9.86	Qp	0	.1	10.1	20.06	56	-35.94	-	-
10	4.2765	3.71	Ca	0	.1	10.1	13.91	-	-	46	-32.09
11	12.777	15.7	Qp	.1	.2	10.2	26.2	60	-33.8	-	-
12	12.786	10.87	Ca	.1	.2	10.2	21.37	-	-	50	-28.63

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
13	.40875	19.74	Qp	0	0	10.1	29.84	57.67	-27.83	-	-
14	.40875	12.64	Ca	0	0	10.1	22.74	-	-	47.67	-24.93
15	.474	21.04	Qp	0	0	10.1	31.14	56.44	-25.3	-	-
16	.474	14.14	Ca	0	0	10.1	24.24	-	-	46.44	-22.2
17	.843	14.65	Qp	0	0	10.1	24.75	56	-31.25	-	-
18	.83175	6.52	Ca	0	0	10.1	16.62	-	-	46	-29.38
19	1.20075	12.54	Qp	0	.1	10.1	22.74	56	-33.26	-	-
20	1.1715	2.44	Ca	0	.1	10.1	12.64	-	-	46	-33.36
21	1.78575	10.08	Qp	0	.1	10.1	20.28	56	-35.72	-	-
22	1.75875	2.48	Ca	0	.1	10.1	12.68	-	-	46	-33.32
23	13.39575	12.9	Qp	.1	.2	10.2	23.4	60	-36.6	-	-
24	13.39575	9.85	Ca	.1	.2	10.2	20.35	-	-	50	-29.65

Qp - Quasi-Peak detector

Ca - CISPR average detection