

EMCE Engineering

CERTIFICATE OF COMPLIANCE FCC / ISCED Certification

Applicant Name:
Universal Electronics, Inc.

Address:
201 E. Sandpointe Drive, 8th Floor
Santa Ana, CA 92707 USA

Date of Issue:

03/26/2018

Test Site/Location:

EMCE Engineering

1726 Ringwood Avenue San Jose, California USA

Report No.: 4376-1

EMCE FRN: 007198120

FCC ID	: MG3-97200
IC	: 2575A-97200
APPLICANT	: Universal Electronics, Inc..

FCC Model(s): 97200BC0-00-R

Additional Model(s): -

EUT Type: Bluetooth LE – DTS Device

Max. RF Output Power: BLE 7.35 dBm / 5.432 mW

Frequency Range: 2402 MHz - 2480 MHz

Modulation type GSFK

FCC Classification: Digital Transmission System(DTS)

FCC Rule Part(s): Part 15.247

ISED Rule Part(s): RSS-247, Issue 2

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the applicable limits. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all personnel taking them.

EMCE Engineering Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S.C. 853(a)



Report prepared by:
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Administrative Assistant,
EMCE Engineering



Approved by:
Bob Cole
President,
EMCE Engineering

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FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID:MG3-97200
Test Report No. 4376	Date of Issue: 03/26/2018	EUT Type: Bluetooth DTS device	IC :2575A-97200

Version

TEST REPORT NO.	DATE	DESCRIPTION
4376	03/26/2018	- First Approval Report

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID:MG3-97200
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1. GENERAL INFORMATION

Applicant: Universal Electronics, Inc..
Address: 201 Sandpointe Avenue, 8th Floor
Santa Ana, CA 92707 USA

FCC ID: MG3-97200
EUT Type: Bluetooth LE
Product Name: INSINQVOICE+ PLATFORM RCU 2017
Model name(s): 97200BC0-00-R
Additional Model name(s): -
Date(s) of Tests: 02/20/2018 – 3/20/2018
Place of Tests: EMCE Engineering
1726 Ringwood Ave. San Jose, CA 95131 USA
(IC Recognition No. : 3324A)

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2. EUT DESCRIPTION

EUT Type	Bluetooth LE – DTS Device	
FCC Model Name	97200BC0-00-R	
Additional FCC Model Name	-	
Power Supply	Battery	
Battery type	2 AAA Alkaline (Standard)	
Frequency Range	TX	2402 – 2480 MHz
	RX	2402 – 2480 MHz
Max. RF Output Power	Peak	7.35dBm (5.432mW)
Modulation Type	GFSK	
Antenna Specification	Antenna type: PCB trace Peak Gain : 1.0 (numeric)	

3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas. Guidance v4 dated April 04, 2017 entitled “Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2010) Operating Under §15.247” were used in the measurement.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.3.1 of ANSI C63.10 – 2010. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane for the range of .009 – 1000 MHz, 1.5 Meters above the ground plane for measurements >1000 MHz. According to the requirements in Section 6.3.1 of ANSI C63.10 – 2010. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in ANSI C63.10. - 2010

Conducted Antenna Terminal

See Section from 9.1 to 9.2.(558074 D01 DTS Meas Guidance v04)

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3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 1726 Ringwood Ave. San Jose, CA 95131 USA. The site is constructed in conformance with the requirements of ANSI C63.4 - 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the NVLAP, designated US0125.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

* The antenna of this E.U.T. is a trace antenna.

*The E.U.T Complies with the requirement of §15.203

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7. SUMMARY TEST OF RESULTS

Test Description	FCC / ISSED Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth 99% Bandwidth	§15.247(a)(2) RSS 247 5.2(1)	> 500 kHz For Info Purpose Only	CONDUCTED	PASS
Conducted Maximum Peak Output Power	§15.247(b)(3) RSS 247 5.4(4)	< 1 Watt		PASS
Power Spectral Density	§15.247(e) RSS 247 5.2(2)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§15.247(d) RSS 247 5.5	Conducted < 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 8.6		N/A
Radiated Spurious Emissions	§15.205, 15.209 RSS 247 5.5	cf. Section 8.5.1	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209 RSS 247 5.5	cf. Section 8.5.2		PASS

8. TEST RESULT

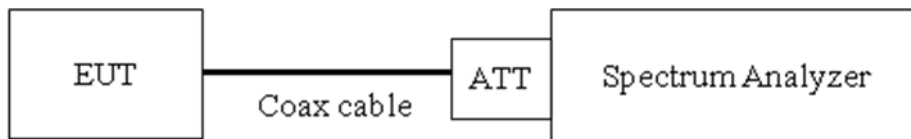
8.1 6dB BANDWIDTH / 99% BANDWIDTH

Test Requirements and limit, §15.247(a)(2)

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The 6dB bandwidth limit is ≤ 500 kHz.

■ TEST CONFIGURATION



■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Page 5 in KDB 558074, issued 04/09/2013)

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

Note : 6 dB bandwidth tested using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

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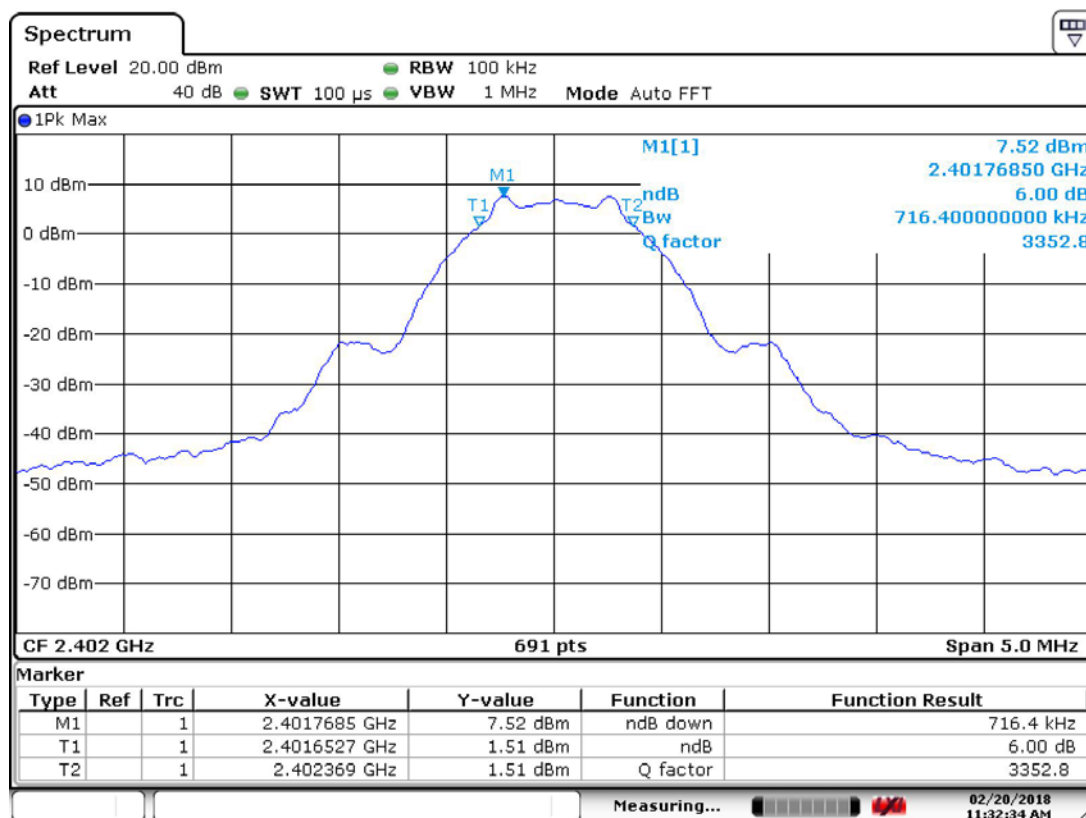
TEST RESULTS

2.4 GHz Band

Conducted 6dB Bandwidth Measurements

GFSK	Measured Bandwidth	Minimum Bandwidth	Pass / Fail
Frequency [MHz]	[kHz]	[kHz]	
2402	716.4	500	Pass
2440	716.4	500	Pass
2480	716.4	500	Pass

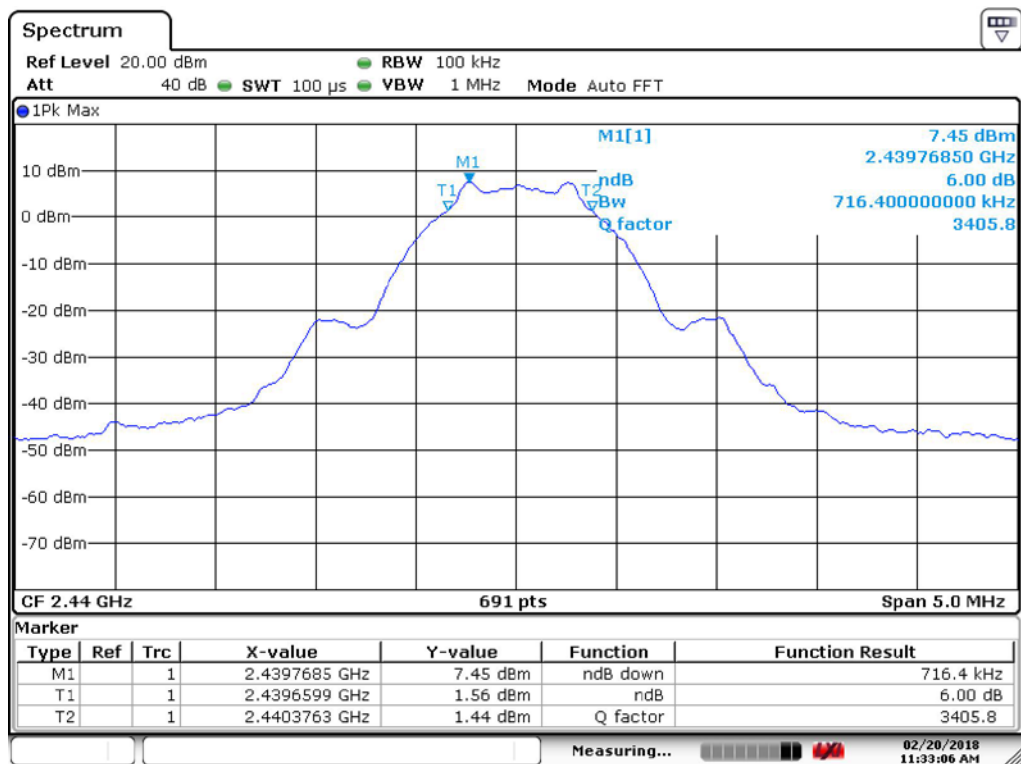
2402 MHz



Date: 20.FEB.2018 11:32:35

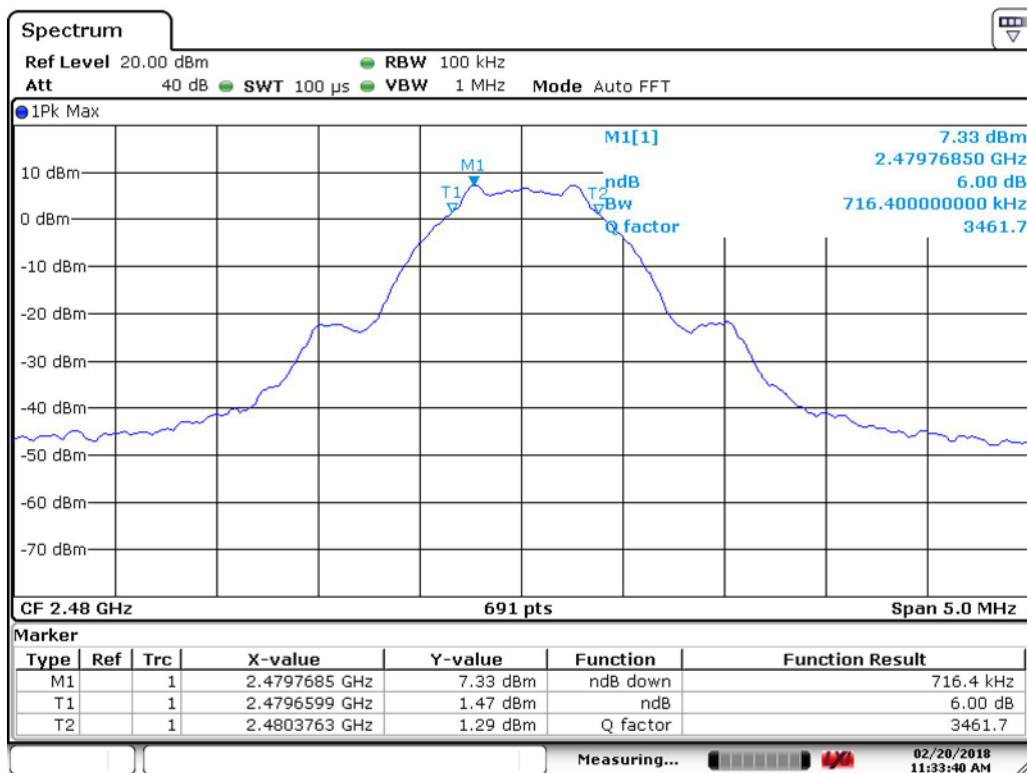
FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID:MG3-97200
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2440



Date: 20.FEB.2018 11:33:06

2480 MHz



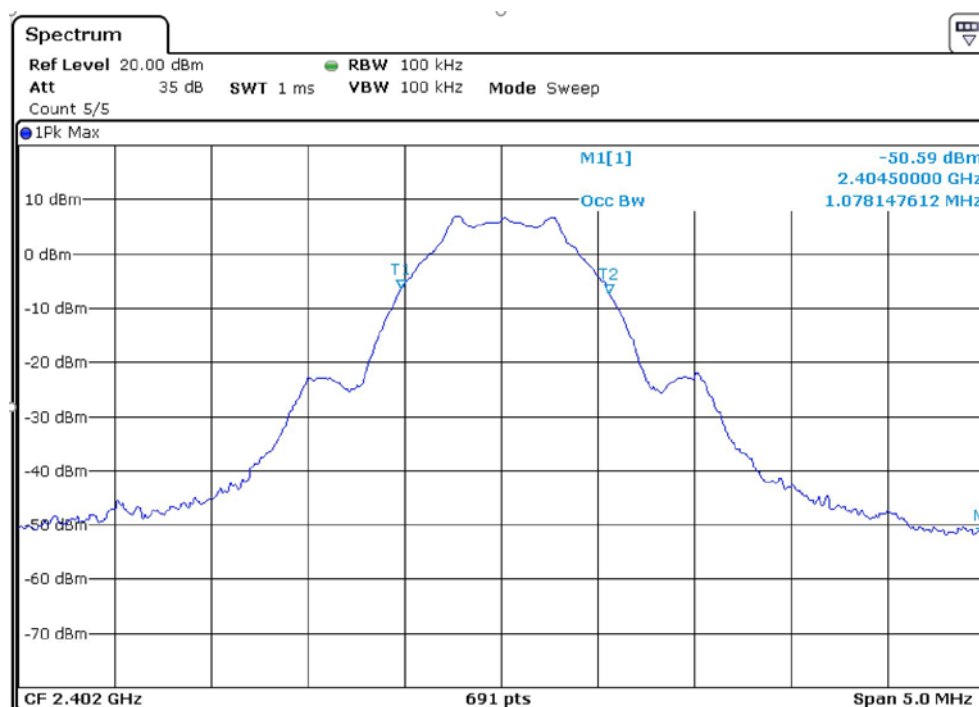
Date: 20.FEB.2018 11:33:41

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Conducted 99% Bandwidth Measurements – For Information Purpose Only

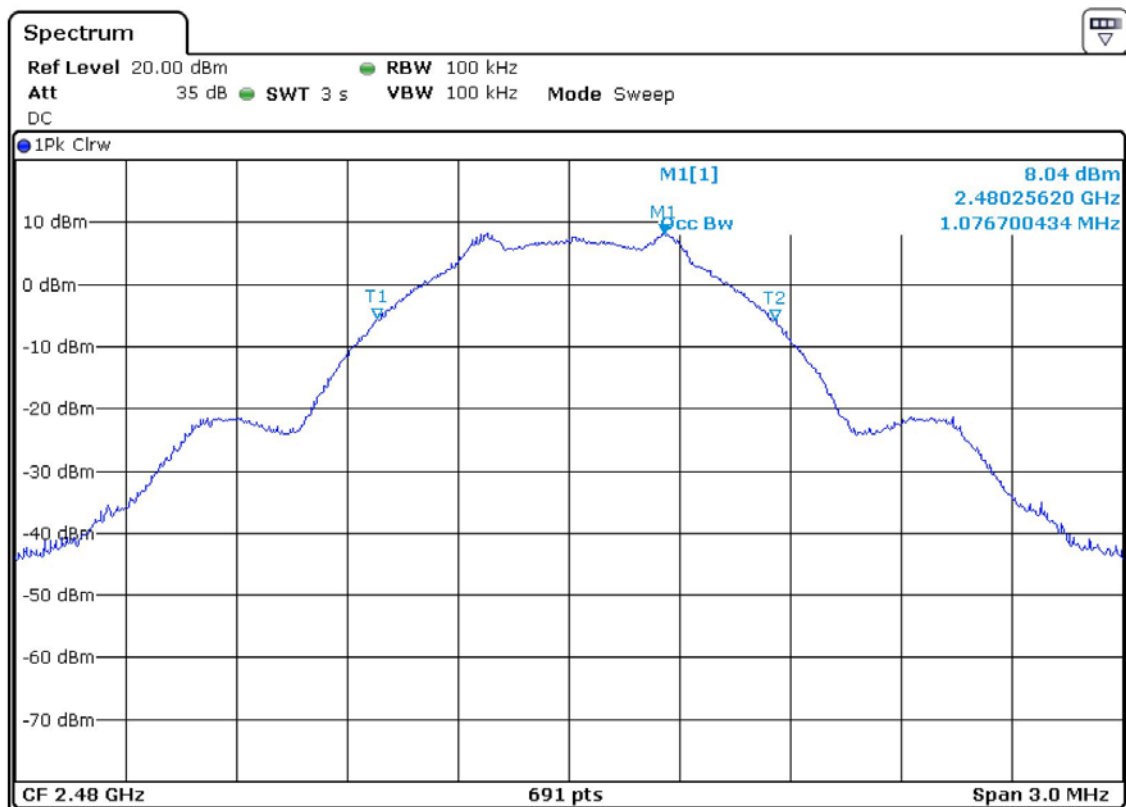
GFSK	Measured Bandwidth	Minimum Bandwidth	Pass / Fail
Frequency [MHz]	[MHz]	[MHz]	
2402	1.078	N/A	N/A
2440	1.078	N/A	N/A
2480	1.078	N/A	N/A

2402 MHz

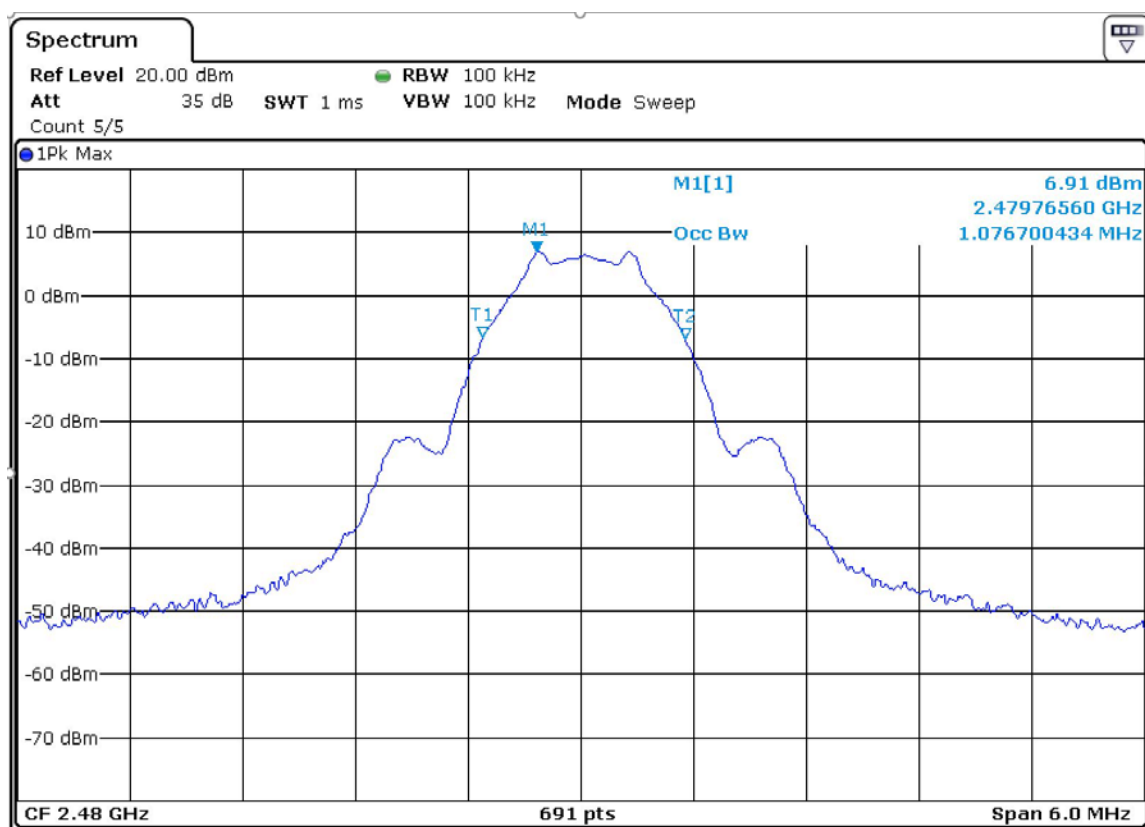


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2440 MHz



2480 MHz



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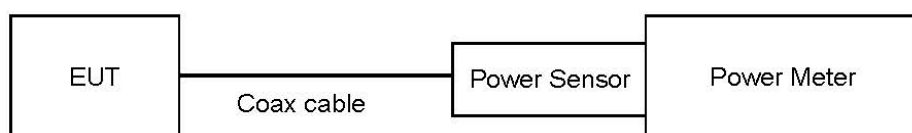
8.2 OUTPUT POWER (802.11 b/g/n 20)

Test Requirements and limit, §15.247(b)(3)

The transmitter output is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

■ TEST CONFIGURATION (20 MHz BW)



■ TEST PROCEDURE (20 MHz BW)

- Peak Power (Procedure 9.1.3 in KDB 558074, issued 04/09/2013)
 1. Measure the peak power of the transmitter.
- Average Power (Procedure 9.2.3.1 in KDB 558074, issued 04/09/2013)
 1. Measure the duty cycle.
 2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
 3. Add $10 \log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

Output Power = Reading Value + ATT loss + Cable loss(1 ea)

Output Power = 10 dBm + 20 dB + 0.8 dB + 0.2 dB = 31.0 dBm

■ TEST RESULTS – RMS

Mode	Channel	Power (dBm)	Power (mW)
GFSK	2402	7.35	5.432
GFSK	2440	7.27	5.337
GFSK	2480	7.12	5.152

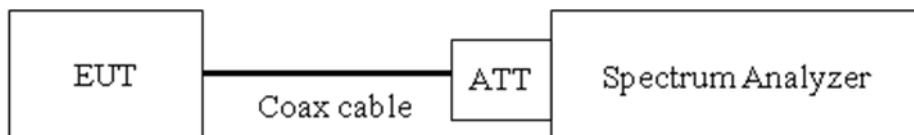
8.4 POWER SPECTRAL DENSITY (802.11 b/g/n 20)

Test Requirements and limit, §15.247(e)

The peak power spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard – the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

■ TEST CONFIGURATION



■ TEST PROCEDURE

We tested according to Procedure 10.2 in KDB 558074, issued 04/09/2013

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 × RBW.

Sweep = auto couple

Detector = peak

Trace Mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

■ Sample Calculation

$$\begin{aligned} \text{PSD} &= \text{Reading Value} + \text{ATT loss} + \text{Cable loss}(1 \text{ ea}) \\ &= -5 \text{ dBm} + 10 \text{ dB} + 0.8 \text{ dB} = 5.8 \text{ dBm} \end{aligned}$$

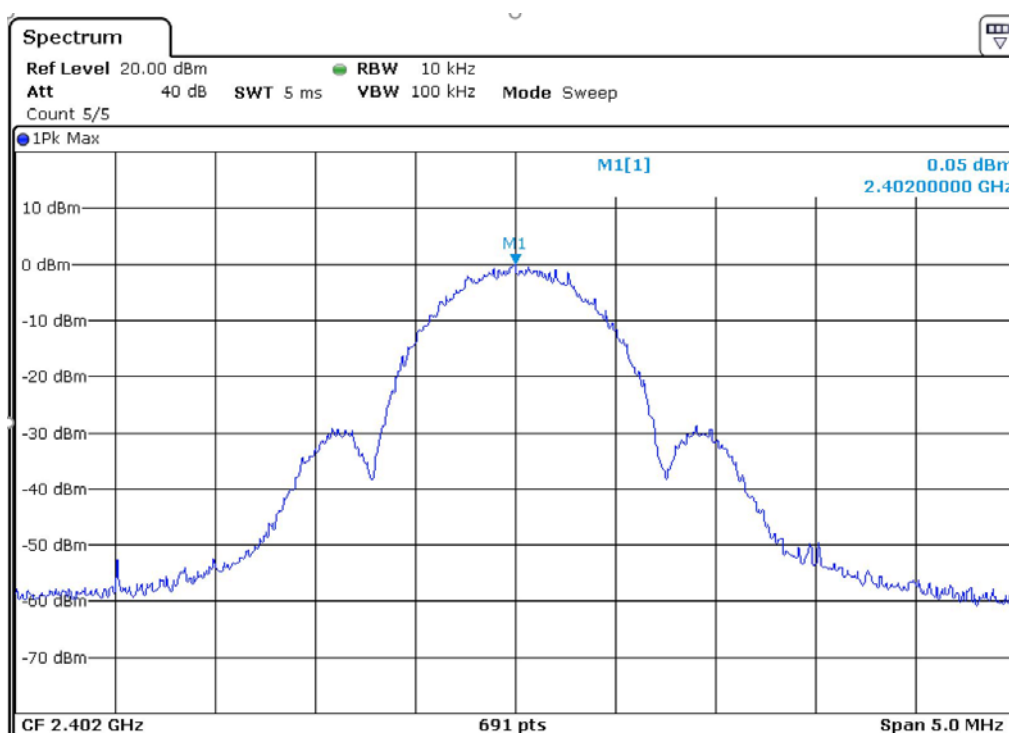
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TEST RESULTS

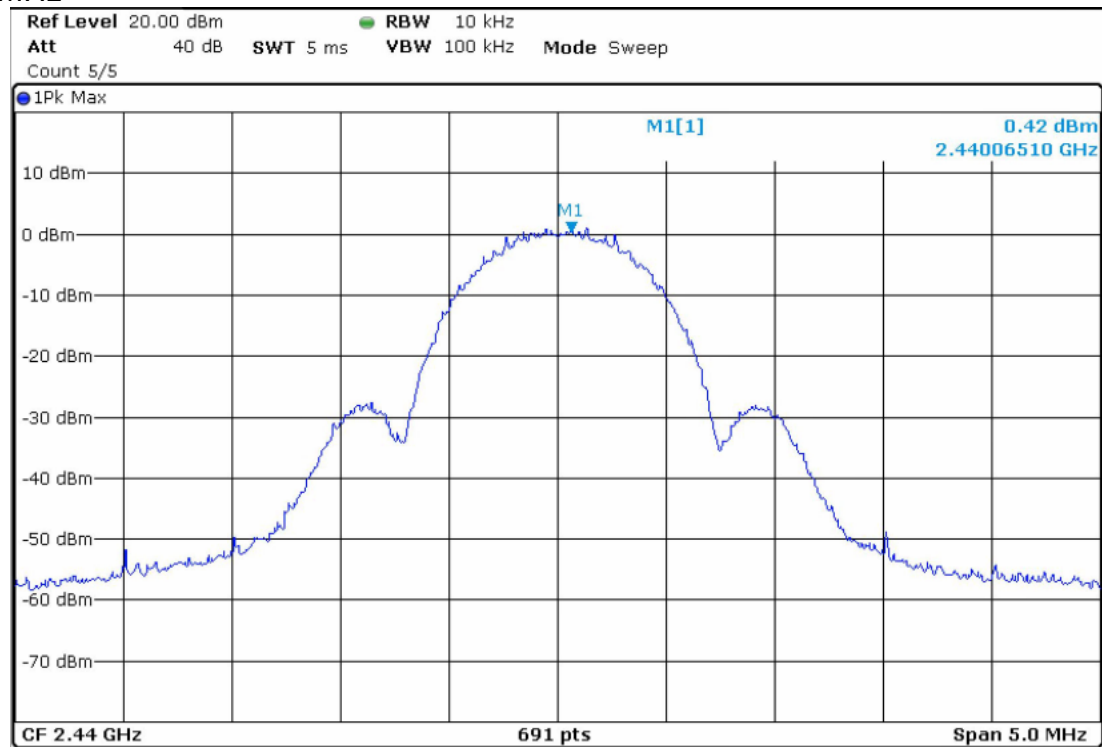
Conducted Power Spectral Density Measurements

Mode	Channel	Power (dBm)
GFSK	2402	0.05
GFSK	2440	0.42
GFSK	2480	0.28

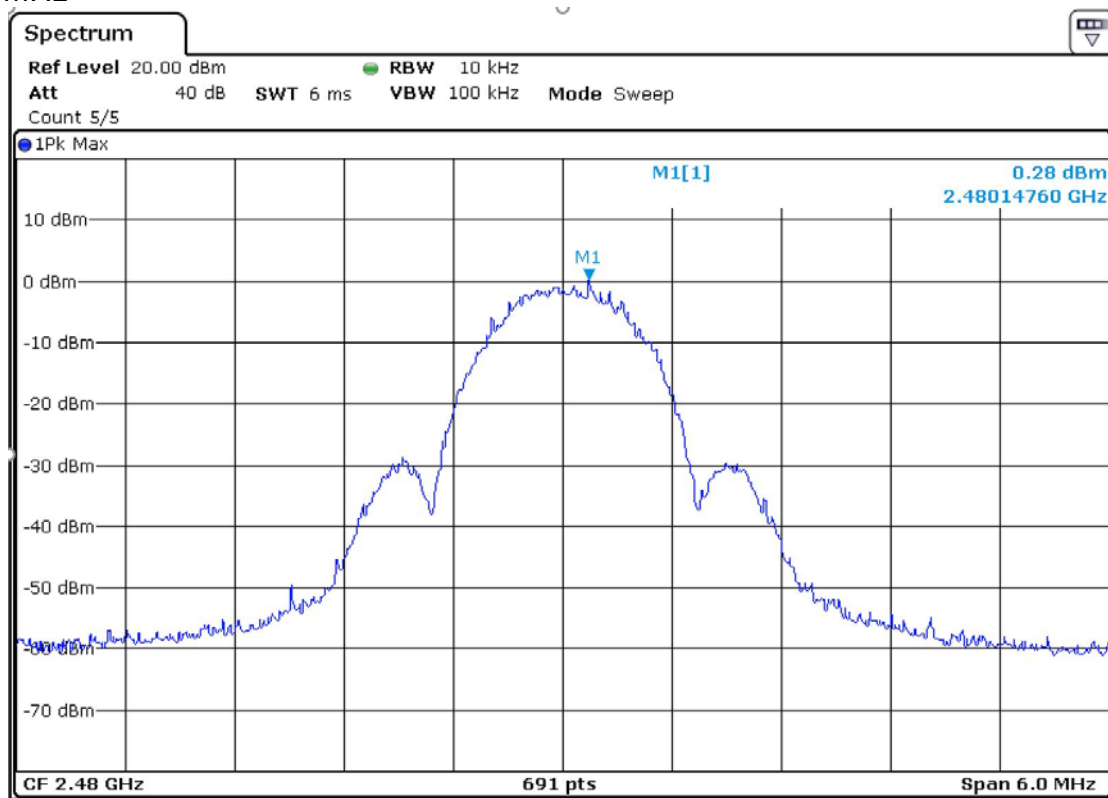
2402 MHz



2440 MHz



2480 MHz



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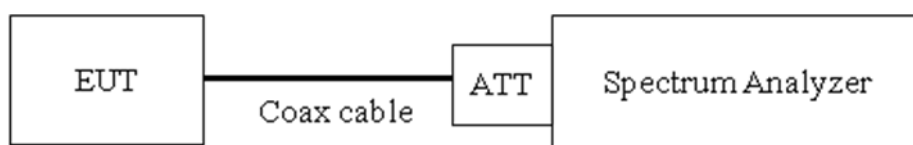
8.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Requirements and limit, §15.247(d)

In any 100 kHz 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 the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limit : 20 dBc

■ TEST CONFIGURATION



■ TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074, issued 04/09/2013)

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Set span to encompass the spectrum to be examined

Detector = Peak

Trace Mode = max hold

Sweep time = auto couple

Ensure that the number of measurement points $\geq 2 \times \text{Span} / \text{RBW}$

Allow trace to fully stabilize.

Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10th harmonic range with the transmitter set to the lowest, middle, and highest channels.

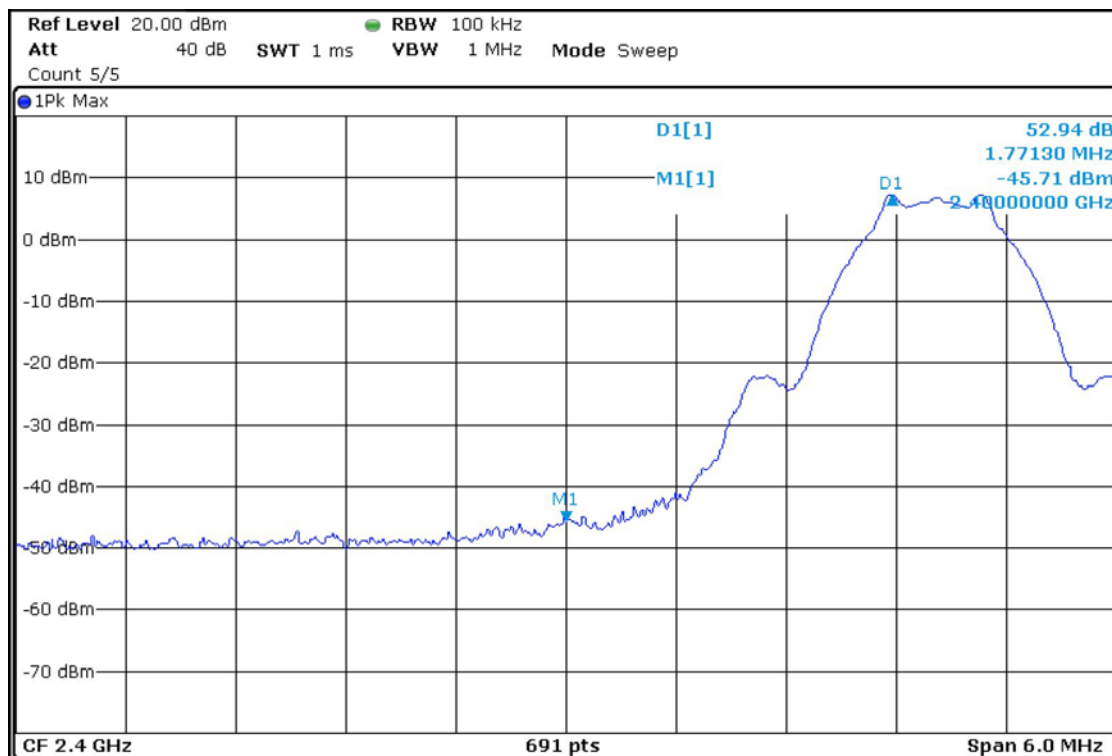
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CONDUCTED BAND EDGE DATA

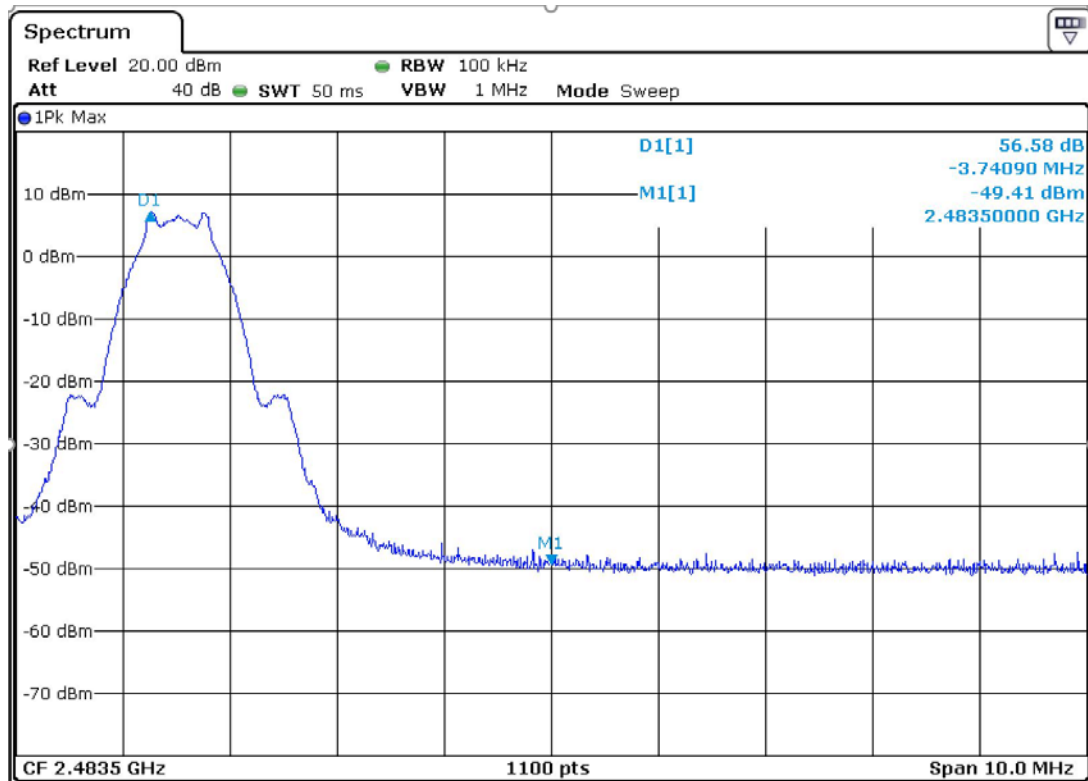
Mode	Frequency	Delta Measured	Delta Limit (dB)
2.4 GHz			
GFSK	2400	45.71	>20
	2483.5	49.41	>20

RESULT PLOTS

2400 MHz Band Edge



2483.5 MHz Band Edge



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Conducted Spurious Emissions

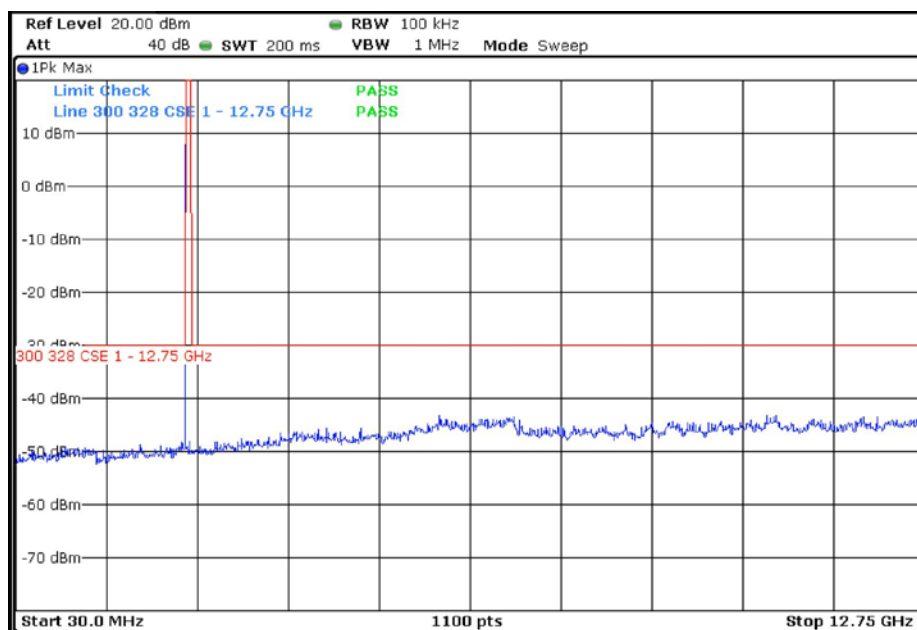
9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Cable loss	Total	Limit	Margin
MHz	dBm	dBm	dBm	dBm	dB
No Critical Peaks Detected					

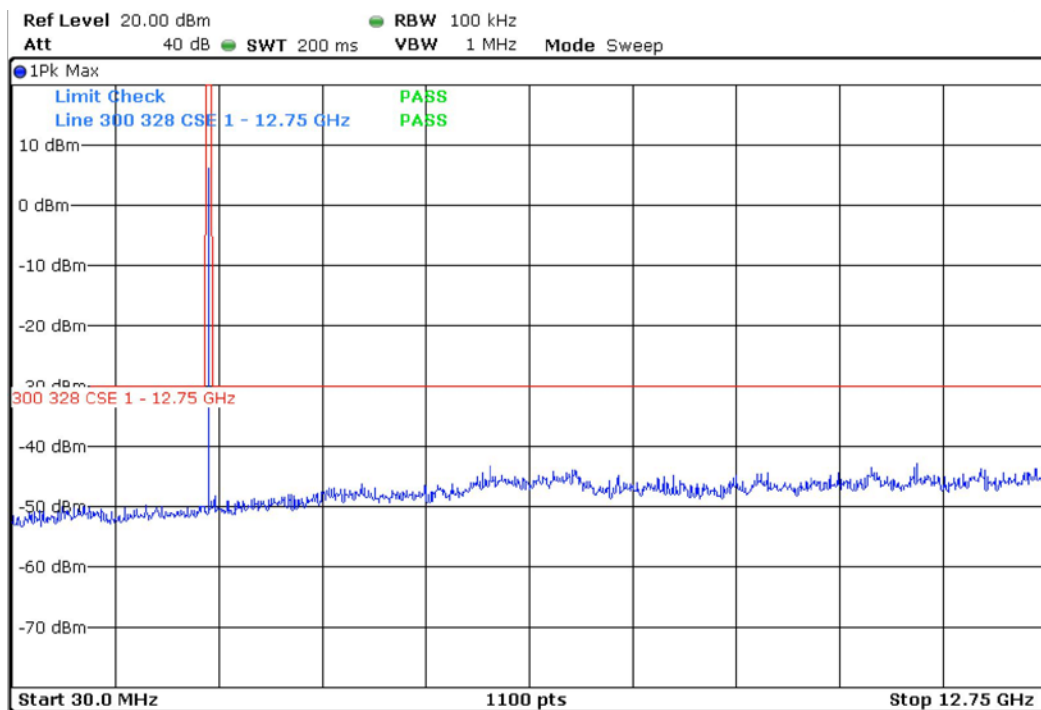
30 MHz – 12.75 GHz

2402 Xmit

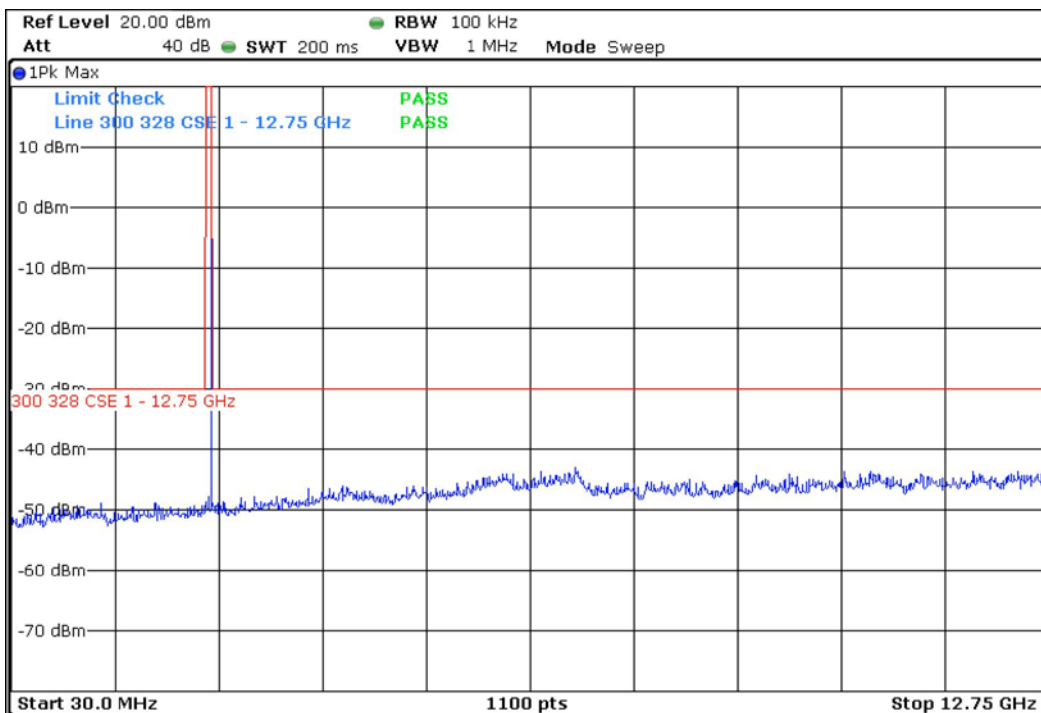


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2440 Xmit



2480 Xmit



12.75 – 25 GHz

Frequency	Reading	Cable loss	Total	Limit	Margin
MHz	dBm	dBm	dBm	dBm	dB
No Critical Peaks Detected					

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8.6 RADIATED MEASUREMENT

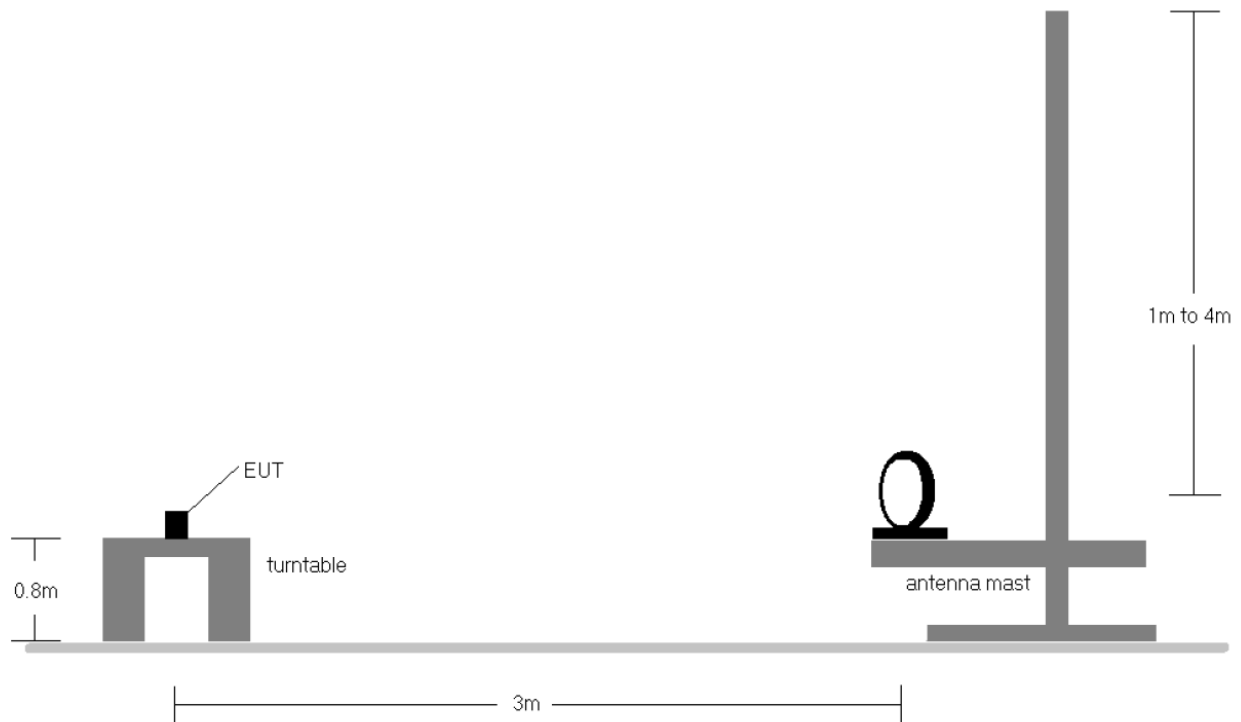
8.6.1 RADIATED SPURIOUS EMISSIONS.

Test Requirements and limit, §15.205, §15.209

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

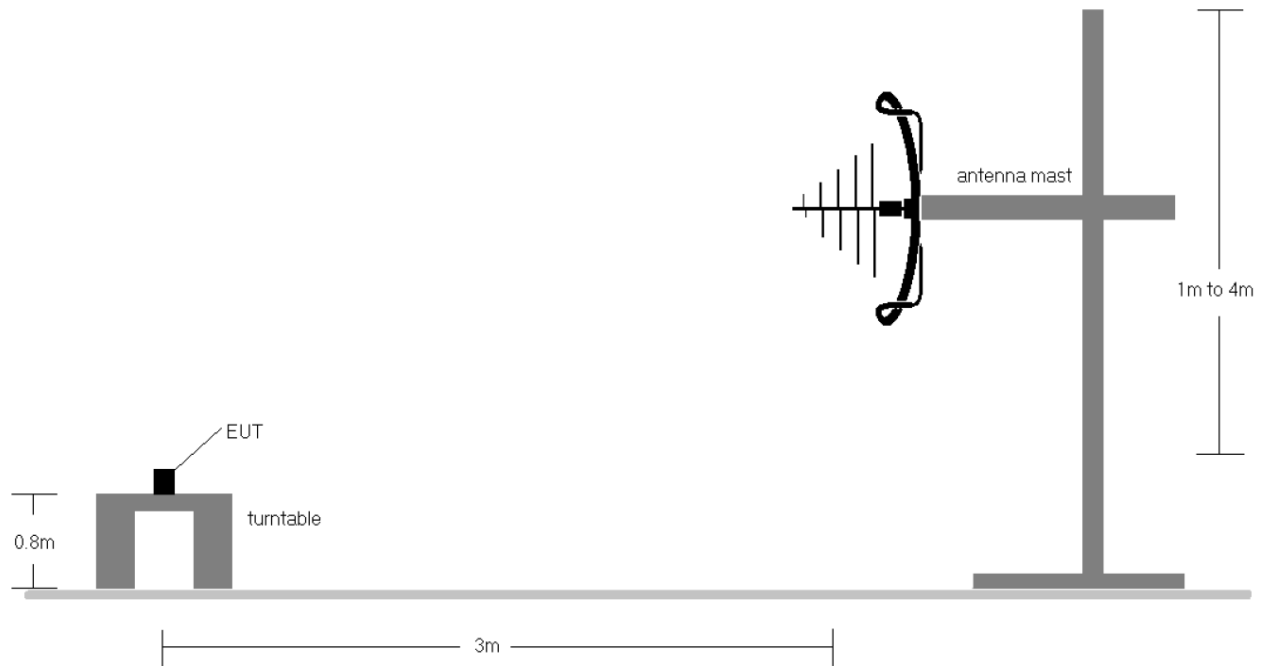
Test Configuration

Below 30 MHz

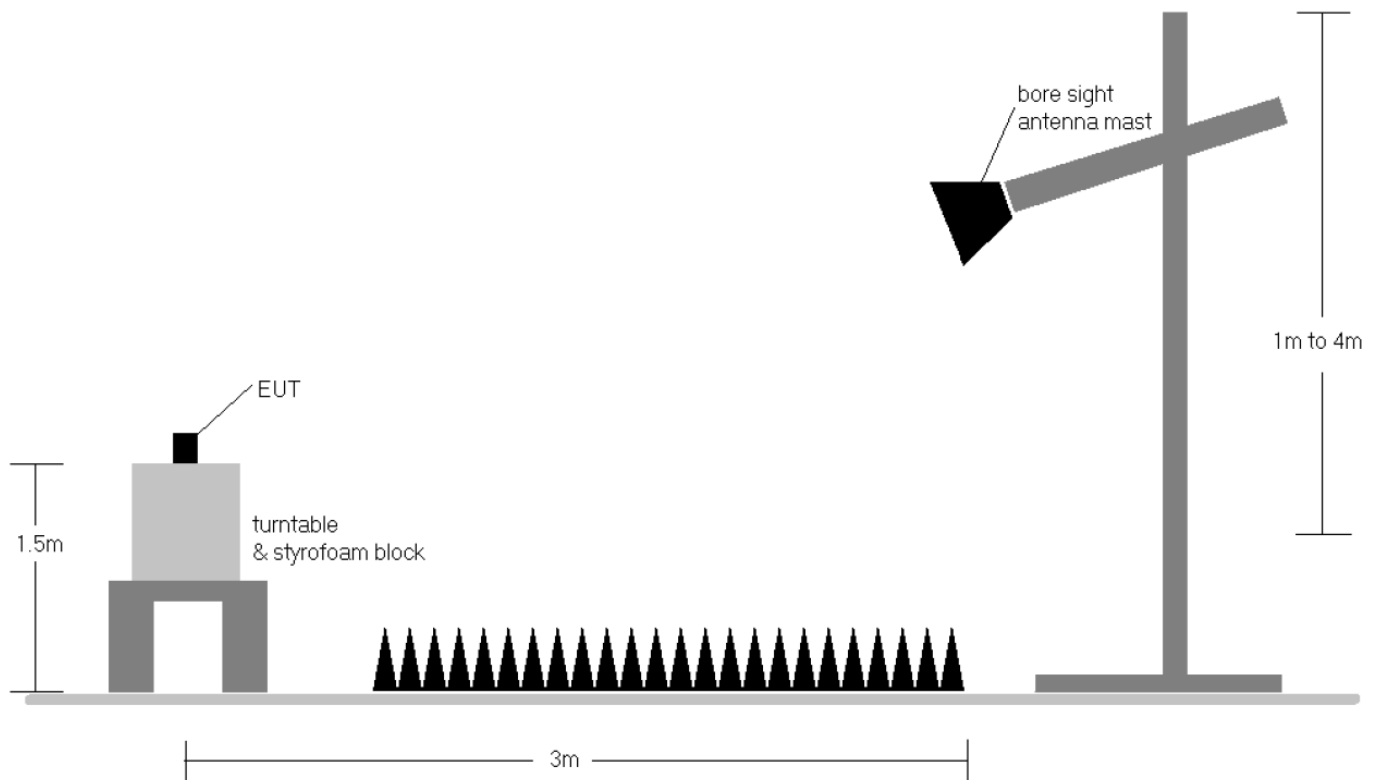


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30 MHz - 1 GHz



Above 1 GHz



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TEST PROCEDURE

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum Setting
 - a. Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
 - b. AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz $\geq 1/\tau$ Hz, where τ = pulse width in seconds.

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V/m	dBm /m	dBm	(H/V)	dB μ V/m	dB μ V/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

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TEST RESULTS

30 MHz - 1 GHz

Operation Mode: Normal Mode

Frequency [MHz]	Pol	Reading QP [dB(uV)]	Factor [dB(1/m)]	Level QP [dB(uV/m)]	Limit\QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
902.42	V	37.5	-0.9	39.6	46.0	9.4	117.7	161.0
31.18	V	37.5	-7.2	33.3	40.0	9.7	135.0	226.0
896.32	H	36.5	-1.1	38.4	46.0	10.6	101.2	76.8
896.71	V	35.6	-1.1	37.5	46.0	11.5	117.0	158.8
902.17	H	33.2	-0.9	35.3	46.0	13.7	252.4	117.5
31.10	H	32.7	-7.1	28.6	40.0	14.4	101.3	53.5

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

TEST RESULTS

1 - 25 GHz

Frequency [MHz]	Pol	Reading [dB(uV)]	Factor [dB(1/m)]	Level PK [dB(uV/m)]	Level AV [dB(uV/m)]	Limit AV [dB(uV/m)]	Limit PK [dB(uV/m)]	Margin PK [dB]	Margin AV [dB]	Height [cm]	Angle [deg]
6919.192	H	38.60	5.90		44.50	54.00	74.00		9.50	281.40	188.50
6941.009	H	38.10	5.90	44.00		54.00	74.00	28.70		219.20	92.40
4882.338	V	40.50	4.80	45.30		54.00	74.00	26.00		188.50	274.80
4881.559	H	43.20	4.80	48.00		54.00	74.00	26.00		250.20	155.90
1017.992	V	40.70	-1.80		38.90	54.00	74.00		15.10	155.70	288.50

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or fewer if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. Worst case data is shown from x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna

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8.6.2 RADIATED RESTRICTED BAND EDGES

Test Requirements and limit, §15.247(d) §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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 the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

Frequency (MHz)	Meter dBμV/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance
2402 Tx								
2390	41.22	10.37	51.59	74	22.41	PK	V	3 Meters
2390	28.58	10.37	38.95	54	15.05	AVE	V	3 Meters
2390	39.55	10.37	49.92	74	24.08	PK	H	3 Meters
2390	30.91	10.37	41.28	54	12.72	AVE	H	3 Meters
2480 Tx								
2483.5	40.47	10.5	50.97	74	23.03	PK	V	3 Meters
2483.5	30.49	10.5	40.99	54	13.01	AVE	V	3 Meters
2483.5	40.59	10.5	51.09	74	22.91	PK	H	3 Meters
2483.5	31.16	10.5	41.66	54	12.34	AVE	H	3 Meters

8.7 POWERLINE CONDUCTED EMISSIONS

Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.
5. We are performed the AC Power Line Conducted Emission test for 13 Mbps, Ch.6 and 802.11n_20 MHz BW. Because 802.11n_20 MHz BW mode is worst case.

Test Results:

Not Applicable – Battery Powered

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9. LIST OF TEST EQUIPMENT

Equipment	Serial Number	Last Calibration Date	Calibration Due
Omega-IBTHXBP Temp / Humidity Meter	14490199	7/8/2016	7/8/2018
ETS – EmPower Power Sensor	141000-48SNO051	6/9/2017	6/9/2018
Fluke-87 DMM	64920001	6/28/2016	6/28/2018
EMCO-3816-2 LISN	9809-1089	6/12/2017	6/12/2018
Rohde & Schwarz- FSV40 Spectrum Analyzer	101424	6/20/2016	6/20/2018
Sunol Sciences-JB6 BiConilog Antenna	A042610	6/8/2017	6/8/2018
A.H. Systems-SAS- 571 Horn Antenna	236	6/13/2017	6/13/2018

END OF REPORT