MEASUREMENT REPORT

(FCC : Part 15 Subpart C (15.247) / ANSI C63.4-2014)
Classification : (DTS) Digital Transmission System

Testing Laboratory
1288

Product	:	mVoice G2
Trade Name	:	Martian
Model No.	:	MVS04
Applicant	:	SilverPlus Inc.
Applicant Address	:	2F., No.288, Ruei-Guang Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)

Report Number	MLT1711P15002-2
Applicant	SilverPlus Inc.
Product	mVoice G2
Sample Received Date	2017/11/6
Sample Tested Date	2017/11/6 ~ 2018/2/21

Report Prepared By	Jesse Tien
Signature	
Date Prepared	2018/2/22

Report Authorized By	Roger Chen
Signature	
Date Authorized	2018/2/22

Test By

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History of Test Report

Original Report Issue Date: 2018/2/22

■ No additional attachment

☐ additional attachments were issued as in the following record:

Attachment No.	Issue Date	Description
MLT1711P15002-2	2018/2/22	Original report

1. General

1.1 Introduction

The following measurement report is submitted on behalf of SilverPlus Inc. In support of a Class B Digital Device certification in accordance with Part2 Subpart J and Part 15 Subpart C of the Commission's and Regulations.

1.2 Customer Details

Applicant Name	SilverPlus Inc.
Applicant Address	2F., No.288, Ruei-Guang Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)
Manufacturer Name	SilverPlus Inc.
Manufacturer Address	2F., No.288, Ruei-Guang Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)

1.3 Technical data of EUT

Equipment	mVoice G2
Model No	MVS04
FCC ID	X4L-MVS04
Power Type	Battery 3.7V
Type of Modulation	Bluetooth 4.0 – LE : GFSK
Carrier Frequency of Each Channel	40 Channel (37 Hopping + 3 advertising channel)
Type of Antenna	Monopole antenna
Frequency of Channel	See Next page

During testing the EUT was operated at Tx or Rx mode for each emission measured. This was done in order to ensure that maximum emission levels were attained.

Frequency of Each Channel (Working Frequency)

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

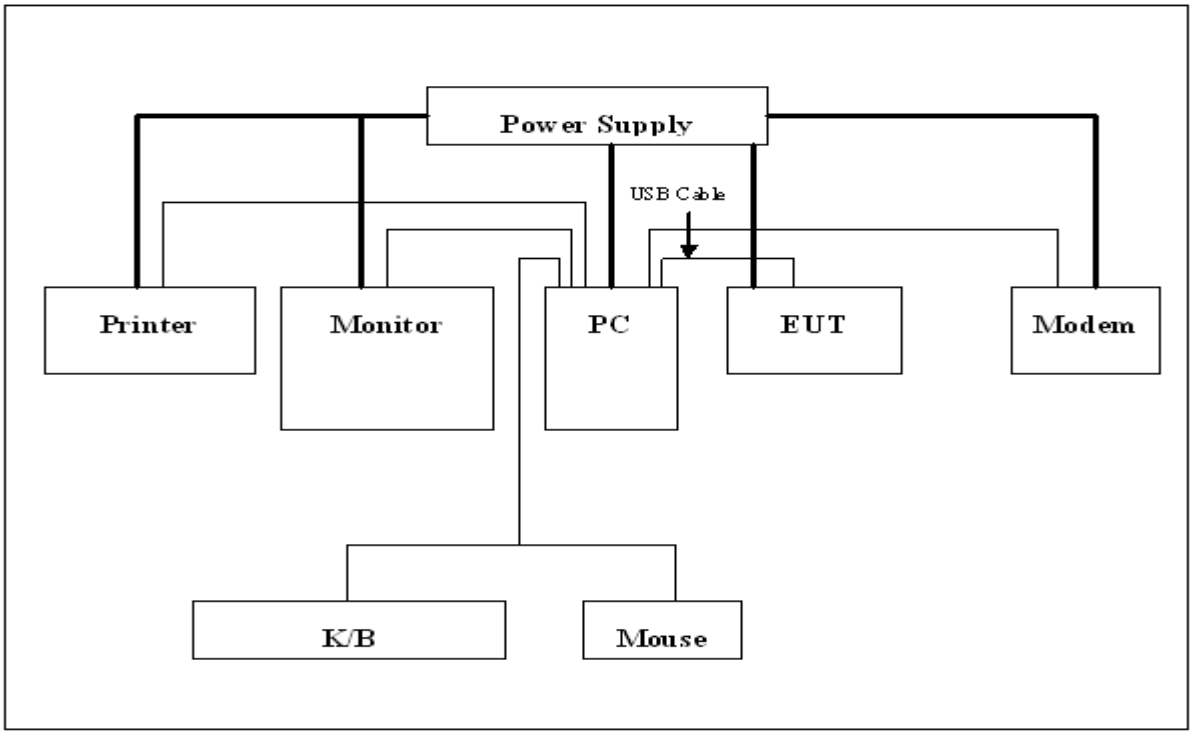
1.4 Summary Of Tests

47 CFR Part 15 Subpart C			
Reference	**Test**	**Results**	**Note**
15.207	Conducted Emission	PASS	
15.209	Radiated Emission	PASS	
15.247(c)	Transmitter Radiated Emissions	PASS	
15.247(b)	Max. Output Power	PASS	
15.247(a)(2)	6dB RF Bandwidth	PASS	
15.247(e)	Max. Power Density	PASS	
15.247(c)	Out of Band Conducted Spurious Emission	PASS	
15.247(d)	Band Edge Measurement	PASS	
15.203	Antenna Requirement	PASS	

1.5 Description of Support Equipment

In order to construct the minimum system which required by the ANSI C63.4-2014, following equipments were used as the support units.

1.6 Configuration of System Under Test



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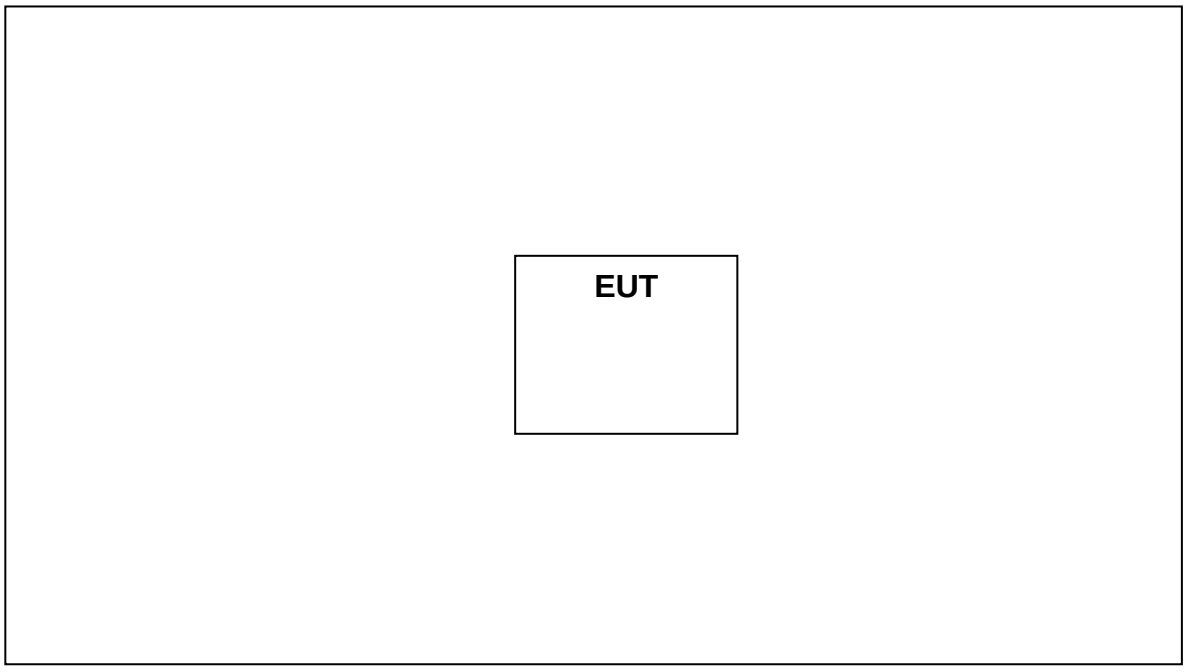


Operate

1.7 Test Procedure

All measurements contained in this report were performed according to the techniques described in Measurement procedure ANSI C63.4-2014 followed KDB 558074 v04 and KDB 662911 for this testing.

1.8 General Test Condition

The conditions under which the EUT operates were varied to determine their effect on the equipment's emission characteristics. The final configuration of the test system and the mode of operation used during these tests were chosen as that which produced the highest emission levels. However, only those conditions which the EUT was considered likely to encounter in normal use were investigated. The systems radiated and conducted emissions were investigated while the computer alternately transferred data to the EUT as well as to the monitor and printer. Using a test program which sent a continuous data and transferred data to and from the EUT was proven to worst case emissions. The system's physical layout and cabling was randomly arranged to ensure that maximum emission levels were attained.

This assessment of the maximum conducted output power tests is base on the minimum transfer rate will produce a maximum output power.

2. Conducted Emissions Requirements

2.1 General & Setup:

The power line conducted emission measurements were performed in a shielded enclosure. The EUT was assembled on a wooden table which is 80 centimeters high, was placed 40 centimeters from the back wall and at least 1 meter from the sidewall.

Power was fed to the EUT from the public utility power grid through a line filter and EMCO Model 3825/2 Line Impedance Stabilization Networks (LISN). The LISN housing, measuring instrumentation case, ground plane, etc., were electrically bonded together at the same RF potential. The Spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the LISN was connected to the spectrum analyzer directly. Conducted emission levels were in the CISPER quasi-peak detection mode. The analyzer's 6 dB bandwidth was set to 9 KHz. No post-detector video filter was used.

The spectrum was scanned from 150 KHz to 30 MHz. The physical arrangement of the test system and associated cabling was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude and frequency. All spurious emission frequencies were observed. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in paragraph 2.5.

2.2 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	R & S	EMI Receiver	100085	ESPI	2017/12/15	2018/12/15
2.	EMCO	LISN	2658	3825/2	2017/12/11	2018/12/11
3.	EMCO	LISN	2654	3825/2	2018/01/04	2019/01/04

2.3 Test condition:

EUT tested in accordance with the specifications given by the manufacturer, and exercised in the most unfavorable manner.

2.4 Conducted Emissions Limits:

FCC Part 15

Frequency range (MHz)	Limits (dBuV)			
	Class A		Class B	
	QP	Avg.	QP	Avg.
0.15 to 0.50	79	66	66 to 56	56 to 46
0.50 to 5.0	73	60	56	46
5.0 to 30	73	60	60	50

2.5 Measurement Data Of Conducted Emissions:

2.5.1 Conducted Emissions

The following table show a summary of the highest emissions of power line conducted emissions to the HOT and NEUTRAL conductor of the EUT power.

Test Mode : PC Charge

Conducted Emissions (Class B)										
Test Port	Freq (MHz)	Read(dBuV)		Factor	Limits (dBuV)		Amplitude (dBuV)		Margin (dBuV)	
		QP	AV		QP	AV	QP	AV	QP	AV
L1	0.1731	41.06	--	0.00	64.81	54.81	41.06	--	-23.75	--
	0.3692	35.65	--	0.00	58.52	48.52	35.65	--	-22.87	--
	0.6936	34.46	--	0.00	56.00	46.00	34.46	--	-21.54	--
	0.9891	34.59	--	0.00	56.00	46.00	34.59	--	-21.41	--
	1.1170	35.75	--	0.00	56.00	46.00	35.75	--	-20.25	--
	15.6350	38.65	--	0.00	60.00	50.00	38.65	--	-21.35	--
	22.8960	38.89	--	0.00	60.00	50.00	38.89	--	-21.11	--
L2	0.1712	43.75	--	0.00	64.90	54.90	43.75	--	-21.15	--
	0.2061	41.59	--	0.00	63.36	53.36	41.59	--	-21.77	--
	0.3339	35.76	--	0.00	59.35	49.35	35.76	--	-23.59	--
	0.7876	34.87	--	0.00	56.00	46.00	34.87	--	-21.13	--
	1.2490	33.78	--	0.00	56.00	46.00	33.78	--	-22.22	--
	15.6350	36.24	--	0.00	60.00	50.00	36.24	--	-23.76	--
	22.0630	40.08	--	0.00	60.00	50.00	40.08	--	-19.92	--

Notes : 1.L1: One end & Ground L2: The other end & Ground

2. Height of table on which the EUT was placed : 0.8 m.
3. The Quasi-Peak Value have already met the Average Value Limit showed on above limits.
4. The above test results are obtained under the normal condition.
5. Amplitude = Read + Factor

3. Radiated Emissions Requirements (Below 1GHz)

3.1 General & Setup:

Prior to open-field testing, the EUT was placed in a shielded enclosure and scanned at a close distance to determine its emission characteristics. The physical arrangement of the EUT was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude, directivity, and frequency. The exact system configuration which produced the highest emissions was noted so it could be reproduced later during the open-field tests. This was done to ensure that the final measurements would demonstrate the worst-case interference potential of the EUT. The radiated emissions test is made at a 10 meters open site from 30MHz to 1GHz. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The spectrum was examined from 30 MHz to 1000 MHz using an Hewlett Packard E7403A Spectrum Analyzer, EMCO Biconilog Antenna (Model 3142C) for 30MHz -1GHz. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization. Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post-detector video filters were used in the test. The spectrum analyzer's 6 dB bandwidth was set to 120 KHz, and the analyzer was operated in the quasi-peak detection mode. The highest emission amplitudes relative to the appropriate limit were measured and recorded in paragraph 3.5.

3.2 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US40240137	E7403A	2017/03/15	2018/03/15
2.	Agilent	Spectrum Analyzer	US39240419	4407B	2017/05/03	2018/05/03
3.	EMCO	Biconilog Antenna	00044568	3142C	2017/11/02	2018/11/02
4.	MLT	Pre Amplifier	20110301	PREAMP6G-02	2017/03/29	2018/03/29
5.	MLT	Pre Amplifier	20110209	PREAMP6G-01	2017/03/29	2018/03/29

3.3 Test Condition:

EUT tested in accordance with the specifications given by the manufacturer, and exercised in the most unfavorable manner.

3.4 Radiated Emissions Limits:

CISPR 22

Frequency range (MHz)	Limits (dBuV)			
	Class A		Class B	
	Distance (Meter)	Limits (dBuV/m)	Distance (Meter)	Limits (dBuV/m)
30 to 230	10	40	10	30
230 to 1000	10	47	10	37

FCC Part 15

Frequency range (MHz)	Limits (dBuV)			
	Class A		Class B	
	Distance (Meter)	Limits (dBuV/m)	Distance (Meter)	Limits (dBuV/m)
30 to 88	10	39	3	40
88 to 216	10	43.5	3	43.5
216 to 960	10	46.5	3	46
960 to 1000	10	49.5	3	54

3.5 Measurement Data Of Radiated Emissions:

3.5.1 Open Field Radiated Emissions

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : PC Charge

Radiated Emissions (VERTICAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
31.00	56.00	-19.50	100	0	36.50	40	-3.50
142.60	58.69	-30.76	100	10	27.93	43.5	-15.57
160.00	62.60	-29.02	100	60	33.58	43.5	-9.92
200.00	62.11	-27.82	100	0	34.29	43.5	-9.21
299.80	57.30	-24.45	100	100	32.85	46	-13.15
480.00	58.10	-18.09	110	0	40.01	46	-5.99
641.00	51.79	-14.51	110	30	37.28	46	-8.72
780.00	51.60	-10.48	100	50	41.12	46	-4.88
800.00	51.10	-10.46	100	90	40.64	46	-5.36

Radiated Emissions (HORIZONTAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
30.60	52.20	-18.51	400	0	33.69	40	-6.31
99.90	63.10	-29.78	400	60	33.32	43.5	-10.18
142.00	58.41	-30.70	390	90	27.71	43.5	-15.79
160.00	58.30	-29.12	400	30	29.18	43.5	-14.32
200.00	54.51	-28.12	390	0	26.39	43.5	-17.11
480.00	53.10	-18.07	300	60	35.03	46	-10.97
600.00	52.80	-15.39	120	0	37.41	46	-8.59
640.00	52.11	-14.36	110	30	37.75	46	-8.25
720.00	50.30	-11.93	100	100	38.37	46	-7.63

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter

3.Height of table for EUT placed: 0.8 Meter.

4.Amplitude= Reading Amplitude –Amplifier gain+ Cable loss + Antenna factor

5.Pre amplifier Gain :38dB to 42dB

3.5.2 Open Field Radiated Emissions

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : Worst case(Z Axis)2402MHz BLE Mode

Radiated Emissions (VERTICAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
40.00	57.29	-24.11	100	0	33.18	40	-6.82
50.20	60.90	-28.36	100	100	32.54	40	-7.46
182.00	60.80	-27.68	100	30	33.12	43.5	-10.38
199.00	59.60	-27.78	100	60	31.82	43.5	-11.68
267.60	58.39	-24.59	100	90	33.80	46	-12.20
332.00	58.69	-22.61	100	60	36.08	46	-9.92
458.00	53.30	-19.11	100	0	34.19	46	-11.81
643.00	52.09	-14.74	110	0	37.35	46	-8.65
664.00	55.09	-13.63	120	60	41.46	46	-4.54

Radiated Emissions (HORIZONTAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
60.00	59.50	-30.04	400	10	29.46	40	-10.54
173.10	60.70	-28.25	400	0	32.45	43.5	-11.05
216.00	58.30	-27.71	400	0	30.59	43.5	-12.91
268.00	58.30	-24.90	400	30	33.40	46	-12.60
332.00	59.99	-22.68	200	0	37.31	46	-8.69
520.00	55.60	-16.98	150	30	38.62	46	-7.38
640.00	51.01	-14.36	100	10	36.65	46	-9.35
643.00	51.60	-14.53	100	0	37.07	46	-8.93
664.00	52.50	-13.43	110	20	39.07	46	-6.93

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter

3.Height of table for EUT placed: 0.8 Meter.

4.Amplitude= Reading Amplitude –Amplifier gain+ Cable loss + Antenna factor

5.Pre amplifier Gain :38dB to 42dB

3.5.3 Open Field Radiated Emissions

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : Worst case(Z Axis)2440MHz BLE Mode

Radiated Emissions (VERTICAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
30.00	52.10	-18.89	100	0	33.21	40	-6.79
40.00	56.59	-24.11	100	0	32.48	40	-7.52
176.00	61.60	-27.68	100	20	33.92	43.5	-9.58
207.00	60.70	-27.42	100	60	33.28	43.5	-10.22
267.60	60.79	-24.59	100	90	36.20	46	-9.80
332.00	59.69	-22.61	100	50	37.08	46	-8.92
640.00	51.41	-14.63	100	10	36.78	46	-9.22
644.00	52.29	-14.74	110	0	37.55	46	-8.45
666.00	55.29	-13.63	120	40	41.66	46	-4.34

Radiated Emissions (HORIZONTAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
155.00	61.40	-29.65	400	100	31.75	43.5	-11.75
168.00	60.40	-28.60	400	90	31.80	43.5	-11.70
175.00	60.70	-28.25	400	10	32.45	43.5	-11.05
184.00	61.50	-27.70	400	10	33.80	43.5	-9.70
268.00	59.10	-24.90	400	20	34.20	46	-11.80
519.00	55.80	-16.98	150	20	38.82	46	-7.18
640.00	50.91	-14.36	100	10	36.55	46	-9.45
645.00	51.90	-14.53	100	10	37.37	46	-8.63
664.00	52.80	-13.43	110	0	39.37	46	-6.63

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter

3.Height of table for EUT placed: 0.8 Meter.

4.Amplitude= Reading Amplitude –Amplifier gain+ Cable loss + Antenna factor

5.Pre amplifier Gain :38dB to 42dB

3.5.4 Open Field Radiated Emissions

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : Worst case(Z Axis)2480MHz BLE Mode

Radiated Emissions (VERTICAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
30.00	51.50	-18.89	100	0	32.61	40	-7.39
40.00	57.29	-24.11	100	0	33.18	40	-6.82
120.00	59.50	-30.95	100	0	28.55	43.5	-14.95
173.60	61.60	-27.68	100	20	33.92	43.5	-9.58
210.00	63.30	-27.59	100	70	35.71	43.5	-7.79
458.00	53.30	-19.11	100	0	34.19	46	-11.81
460.00	53.11	-19.02	100	10	34.09	46	-11.91
650.00	51.69	-14.74	120	0	36.95	46	-9.05
664.00	55.29	-13.63	120	50	41.66	46	-4.34

Radiated Emissions (HORIZONTAL)Class B							
Frequency (MHz)	Read (dBuV/m)	Factor	Ant. (cm)	Table (Degree)	Amplitude (dBuV/m)	Limits (dBuV/m)	Margin (dB)
120.00	58.90	-30.95	400	30	27.95	43.5	-15.55
177.00	60.30	-28.01	400	100	32.29	43.5	-11.21
197.00	58.49	-28.01	400	0	30.48	43.5	-13.02
268.00	58.10	-24.90	400	40	33.20	46	-12.80
332.90	60.40	-22.61	220	0	37.79	46	-8.21
480.00	56.70	-18.07	130	60	38.63	46	-7.37
640.00	51.01	-14.36	100	10	36.65	46	-9.35
644.40	52.00	-14.32	100	0	37.68	46	-8.32
664.00	53.50	-13.43	100	20	40.07	46	-5.93

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter

3.Height of table for EUT placed: 0.8 Meter.

4.Amplitude= Reading Amplitude –Amplifier gain+ Cable loss + Antenna factor

5.Pre amplifier Gain :38dB to 42dB

4. Maximum Conducted Output Power Requirements

4.1 Test Condition & Setup:

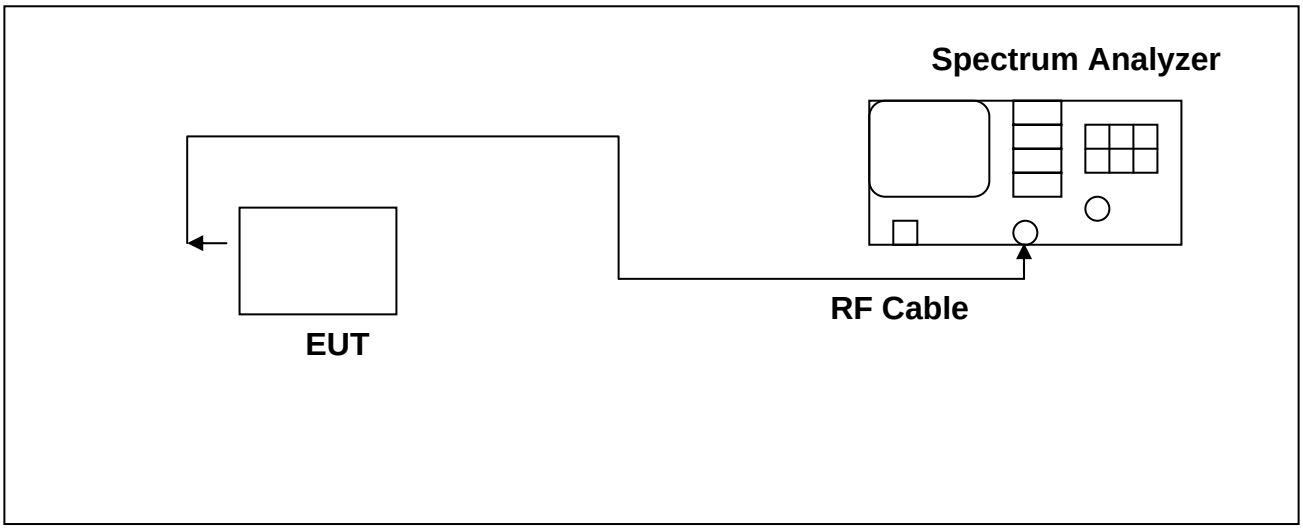
While testing, EUT was set to transmit continuously. Remove the Subjective device's antenna and connect the RF output port to spectrum analyzer. The maximum peak output power shall not exceed 1 watt.

The antenna port of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm). For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6)/3 dBm.

Measurement procedure is followed KDB 558074 v04 (9.1.2 : Integrated band power method)

4.2 Test Instruments Configuration:



4.3 Test Equipment List:

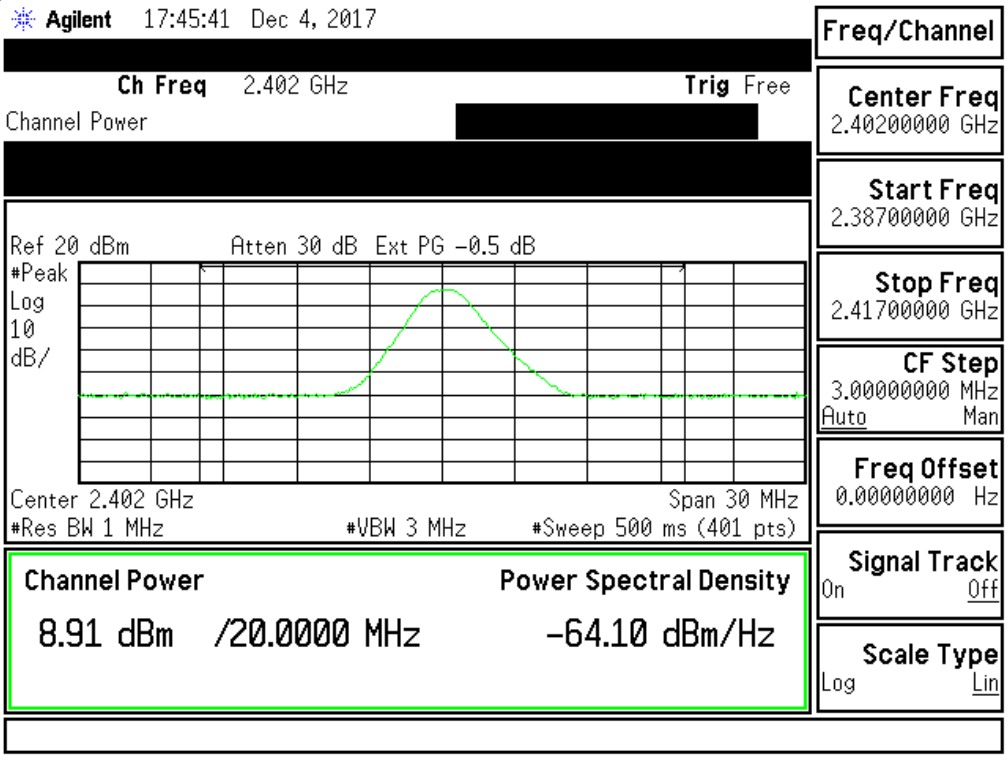
Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US39240419	E4407B	2017/05/03	2018/05/03

4.4 Test Result:

Channel	Frequency (MHz)	Results (dBm)	Limit (dBm)
0	2402	8.91	<30
19	2440	8.98	<30
39	2480	9.30	<30

Note : 1. Cable Loss = 0.5dB.
2. Result= Instrument reading value + Cable Loss.

(2402MHz)



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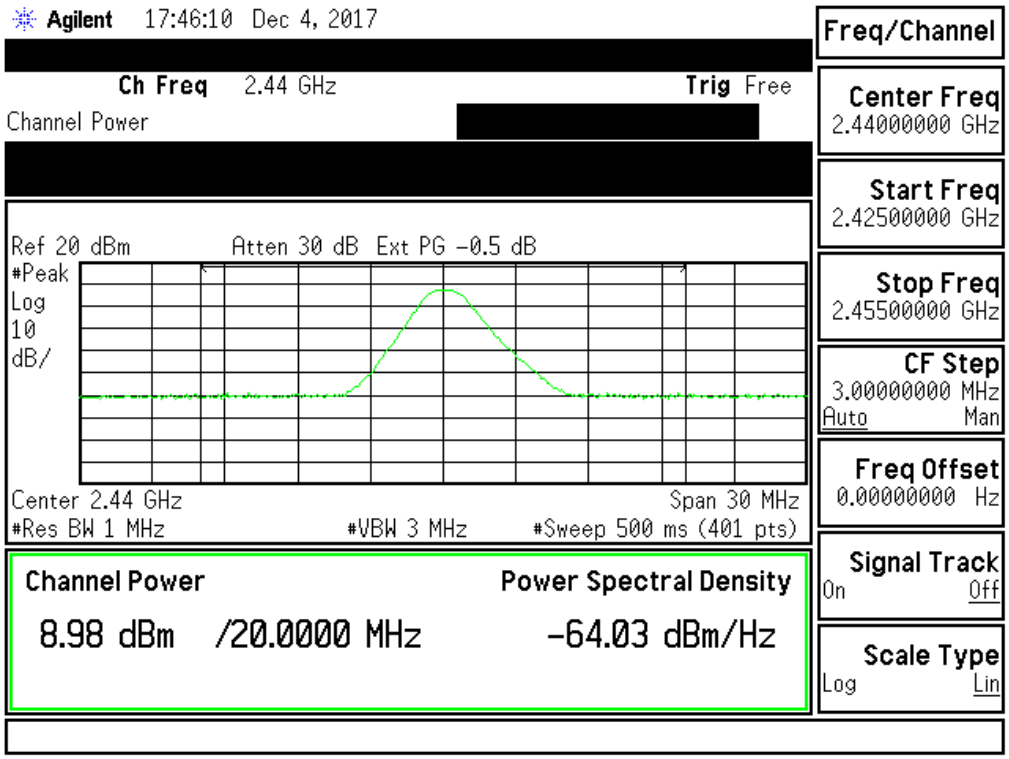
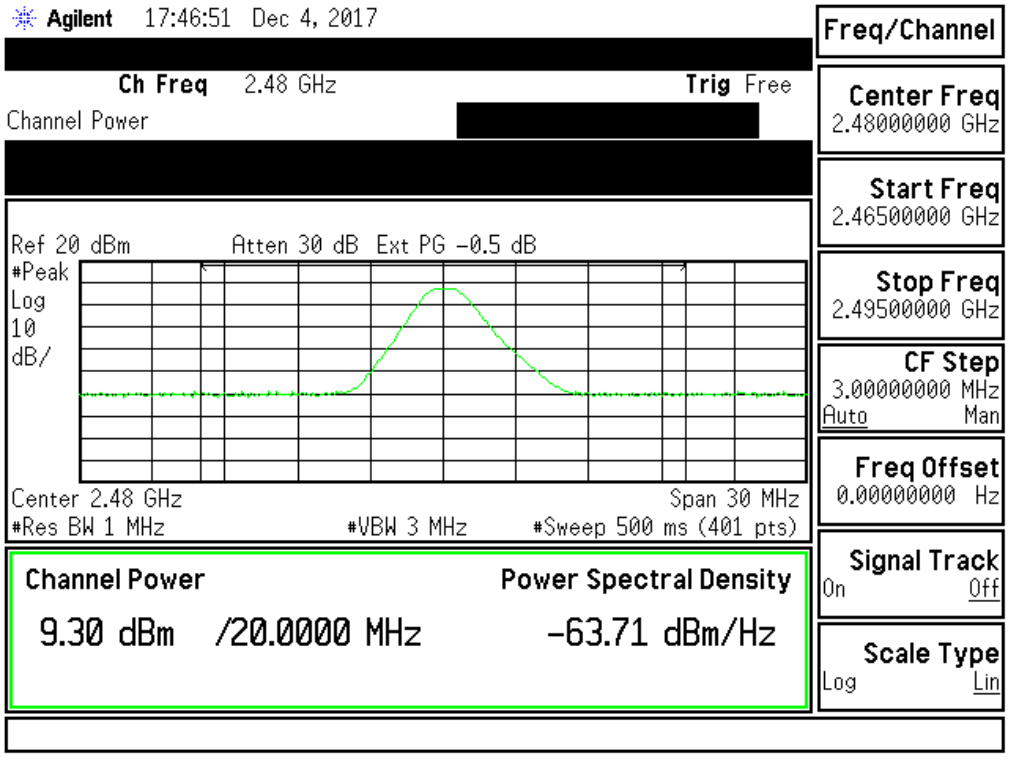


(2480MHz)



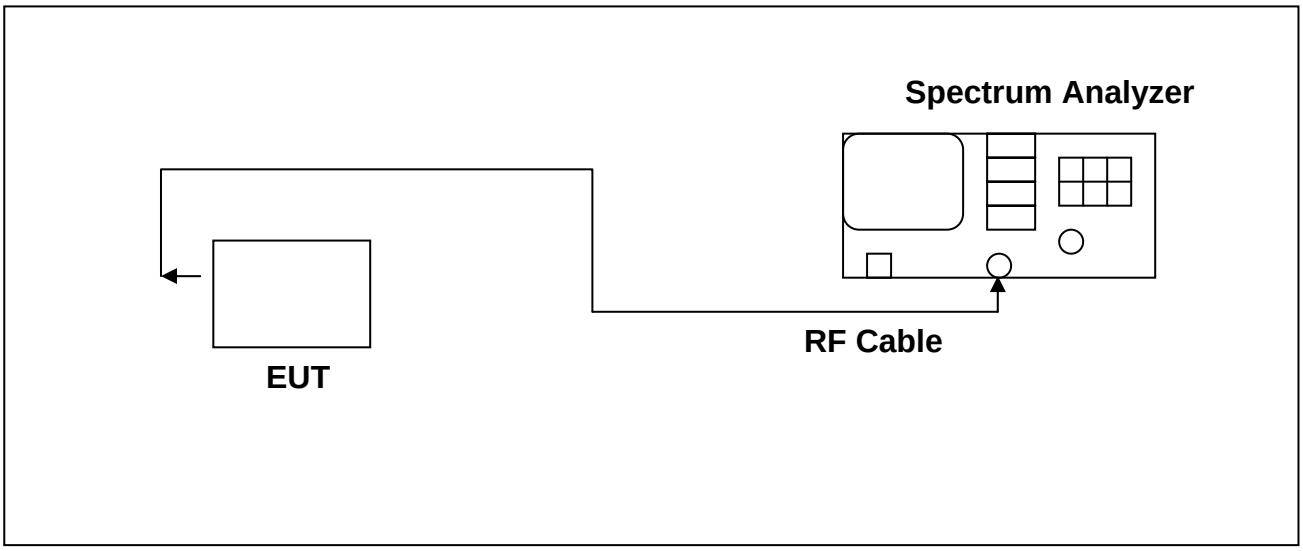
5. Minimum 6dB RF Bandwidth Requirements

5.1 Test Condition & Setup:

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW set to 100 kHz .VBW set to 300kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

The test was performed at 3 channels (Channel 0, 19, 39)
Measurement procedure is followed KDB 558074 v04 (8.1 option 1: DTS bandwidth)

5.2 Test Instruments Configuration:



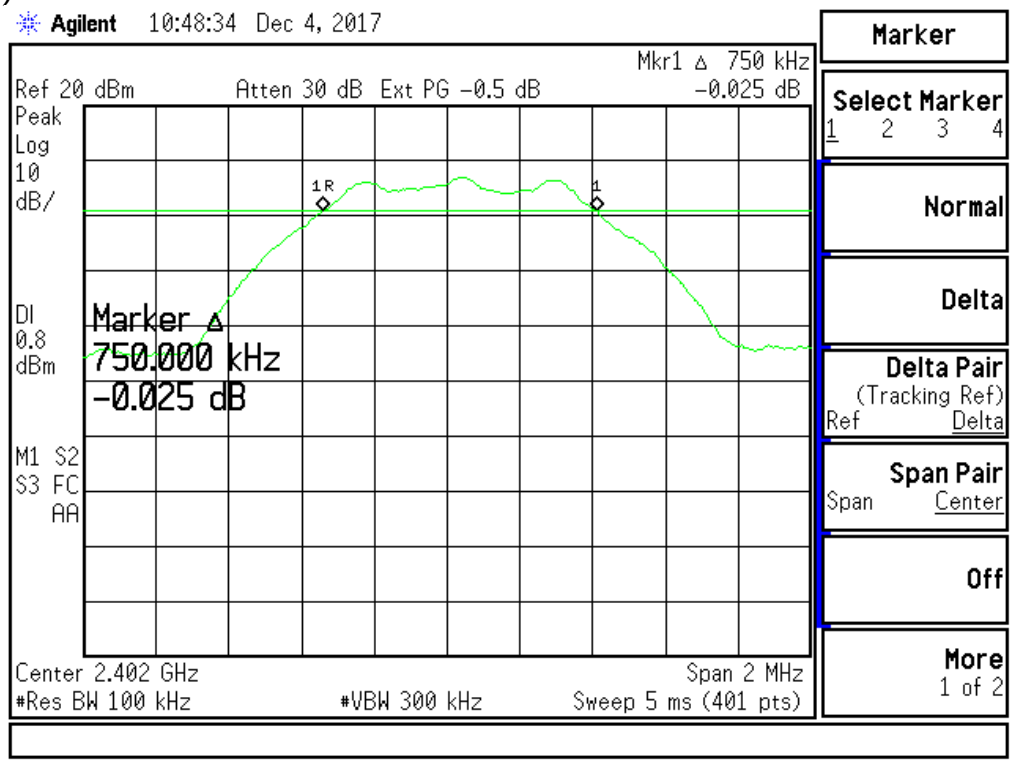
5.3 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US39240419	E4407B	2017/05/03	2018/05/03

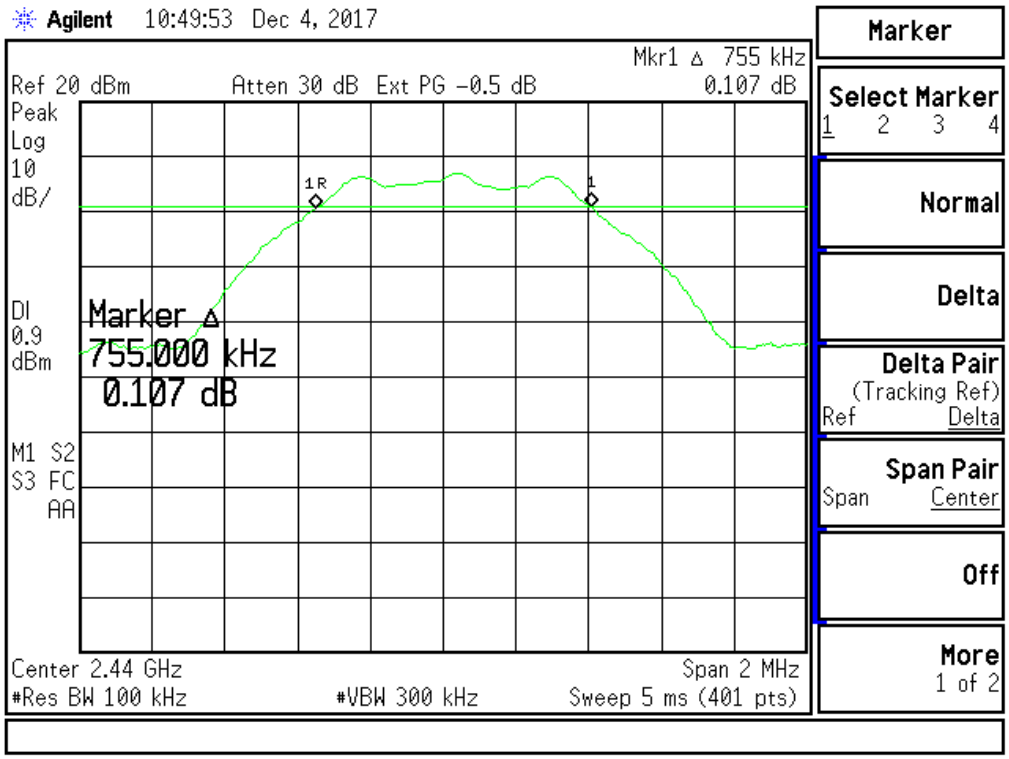
5.4 Test Result:

Channel	Frequency (MHz)	Results (MHz)	Limit
0	2402	0.757500	>500kHz
19	2440	0.755000	>500kHz
39	2480	0.755000	>500kHz

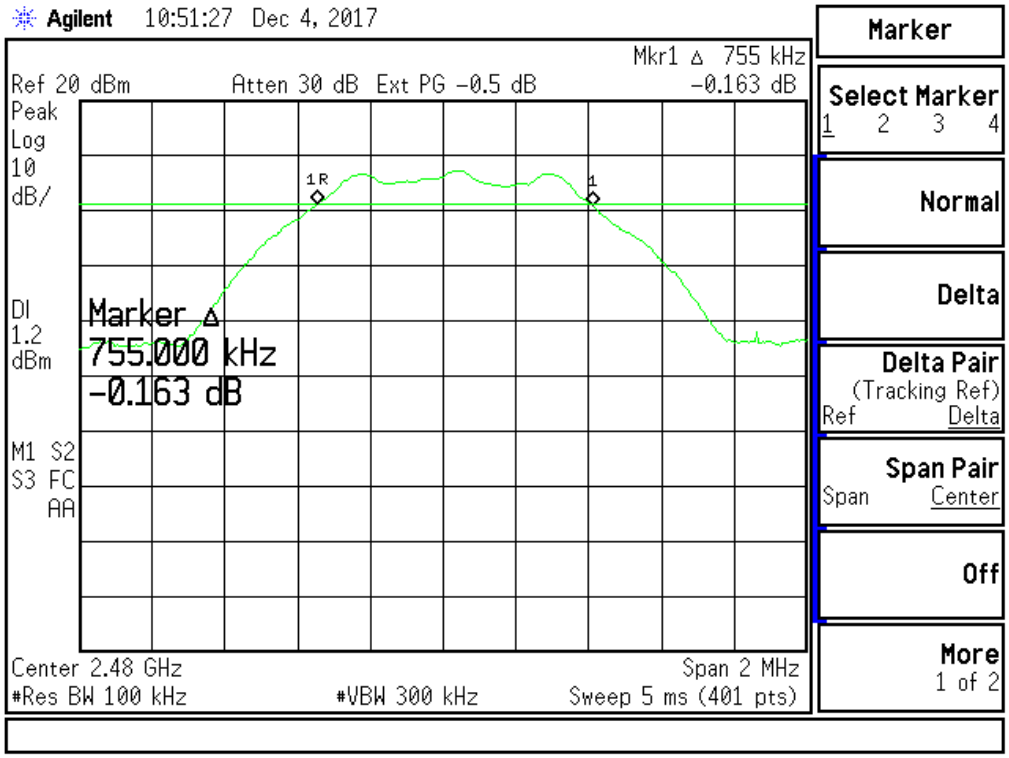
(2402MHz)



(2440MHz)



(2480MHz)



6. Maximum Power Density Requirements

6.1 Test Condition & Setup:

For digitally modulated systems, 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.

RBW =3kHz , VBW=10kHz ,

Detector = peak , Sweep time = auto couple , Trace Mode = max hold , Allow trace to fully stabilize. Use the peak marker function to determine the maximum amplitude level in any 3kHz band segment within the fundamental EBW.

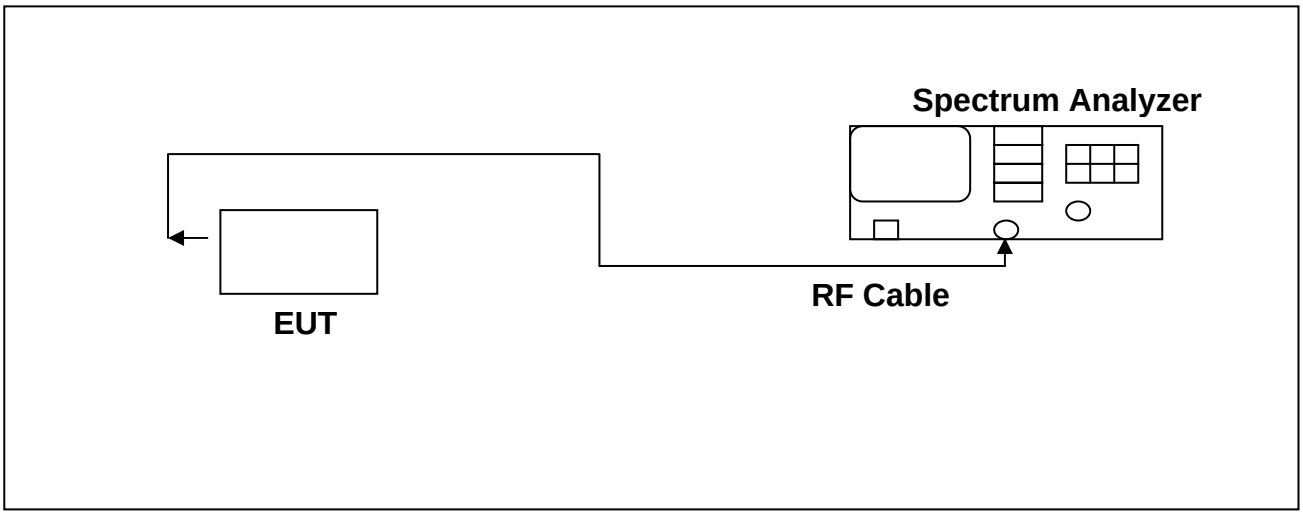
Measurement procedure is followed KDB 558074 v04 (10.2 Method PKPSD (peak PSD)

2) In-Band Power Spectral Density (PSD) Measurements

a) Measure and sum the spectra across the outputs.

c) add 10 log(Nant) dB .

6.2 Test Instruments Configuration:



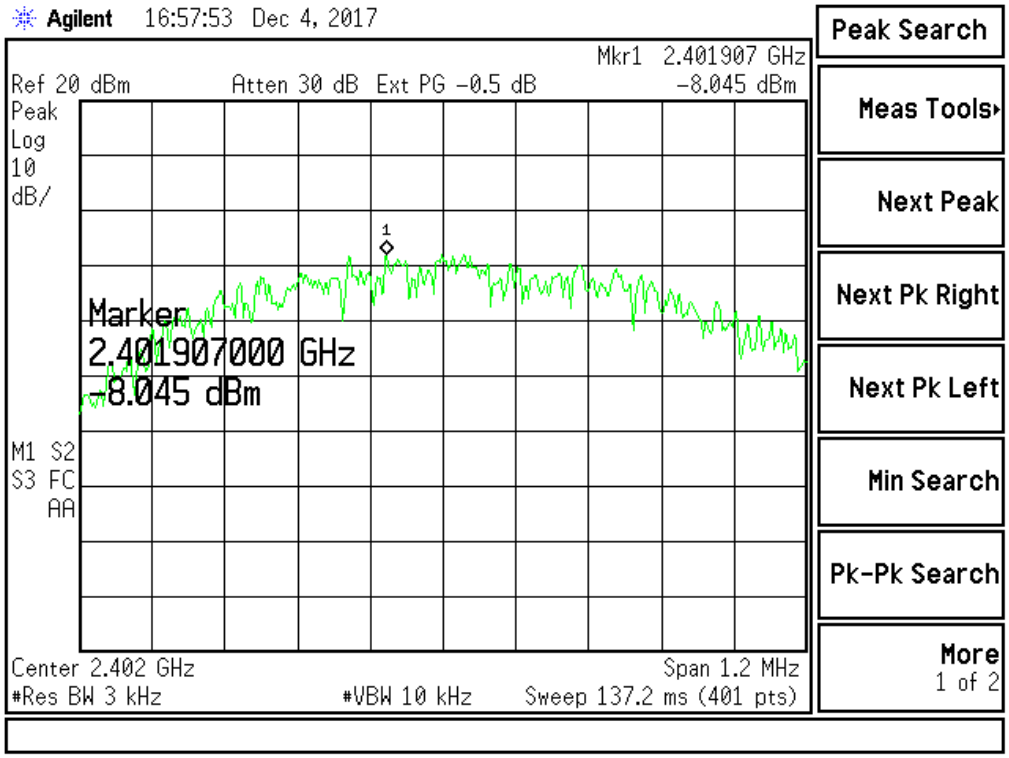
6.3 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US39240419	E4407B	2017/05/03	2018/05/03

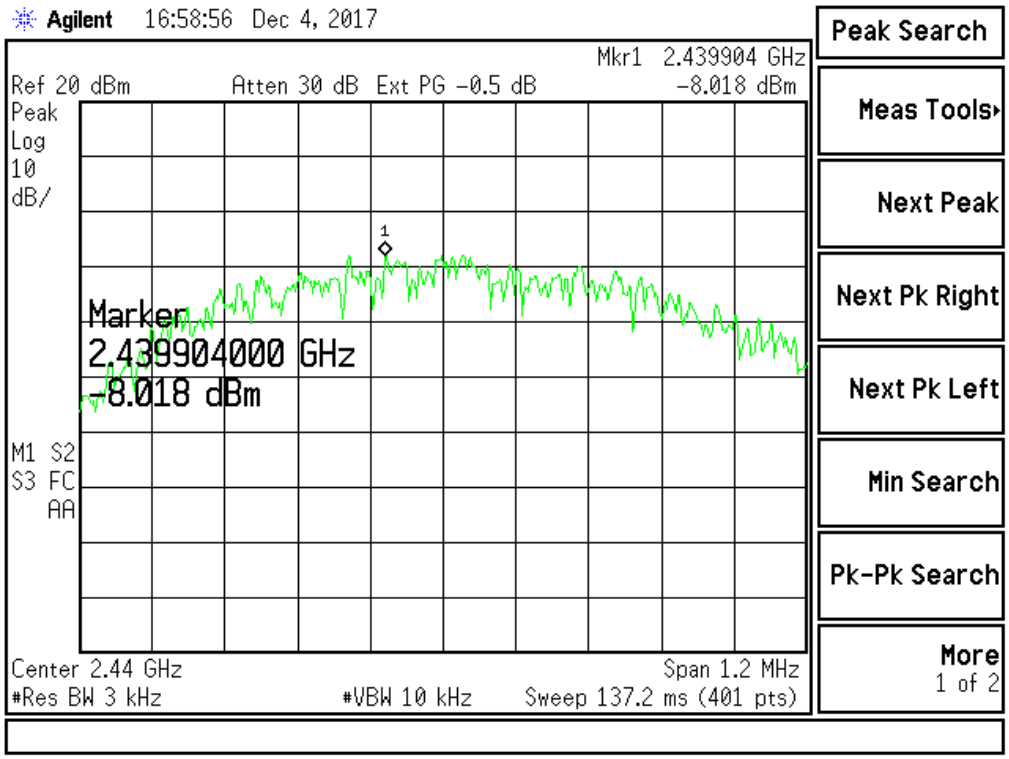
6.4 Test Result:

Frequency (MHz)	Power Density (dBm)	Limit
2402	-8.045	<8dBm
2440	-8.018	<8dBm
2480	-7.692	<8dBm

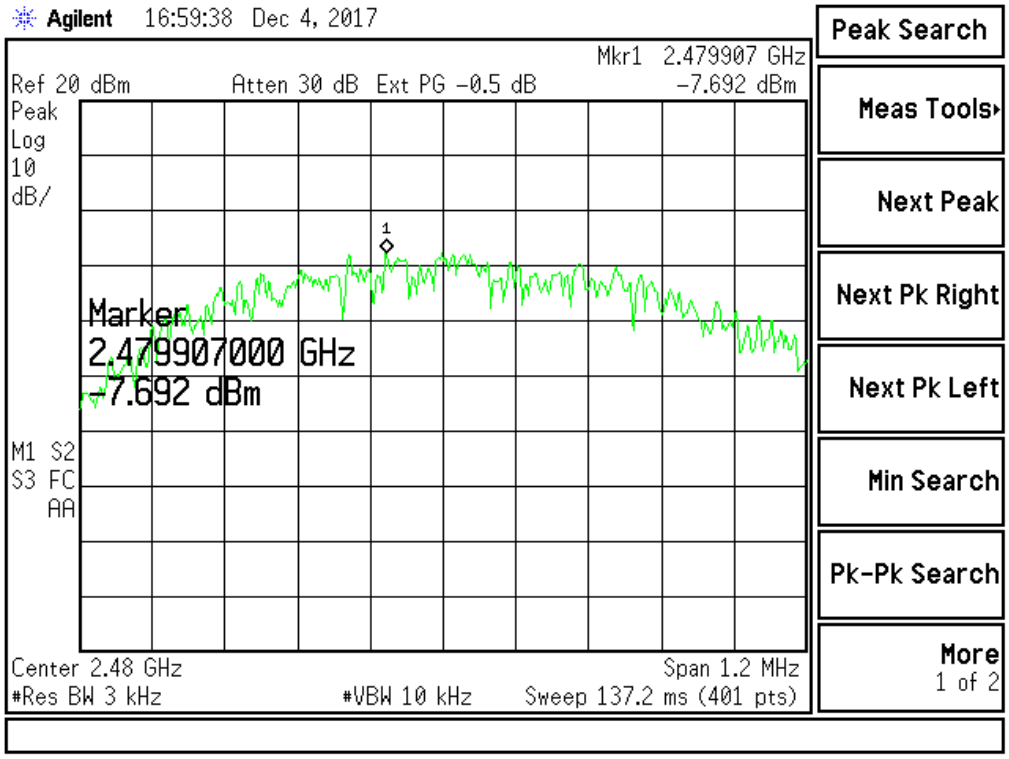
(2402MHz)



(2440MHz)



(2480MHz)



7. Out of Band Conducted Spurious Emissions Requirements

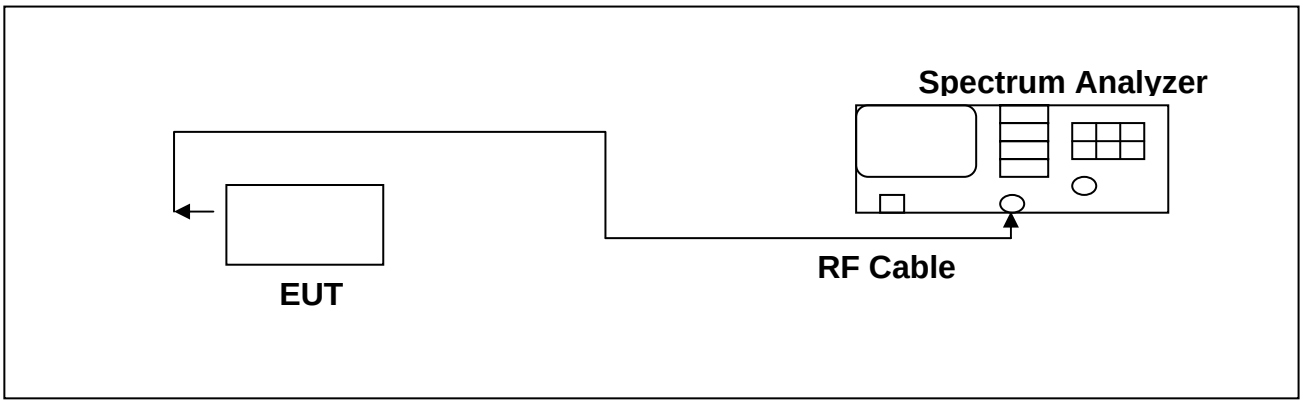
7.1 Test Condition & Setup:

In any 100 kHz bandwidth outside the EUT pass band, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the pass band. The test was performed at 3 channels.

Measurement procedure is followed KDB 558074 v04 (11.3 Emission level measurement)

7.2 Test Instruments Configuration:



7.3 Test Equipment List:

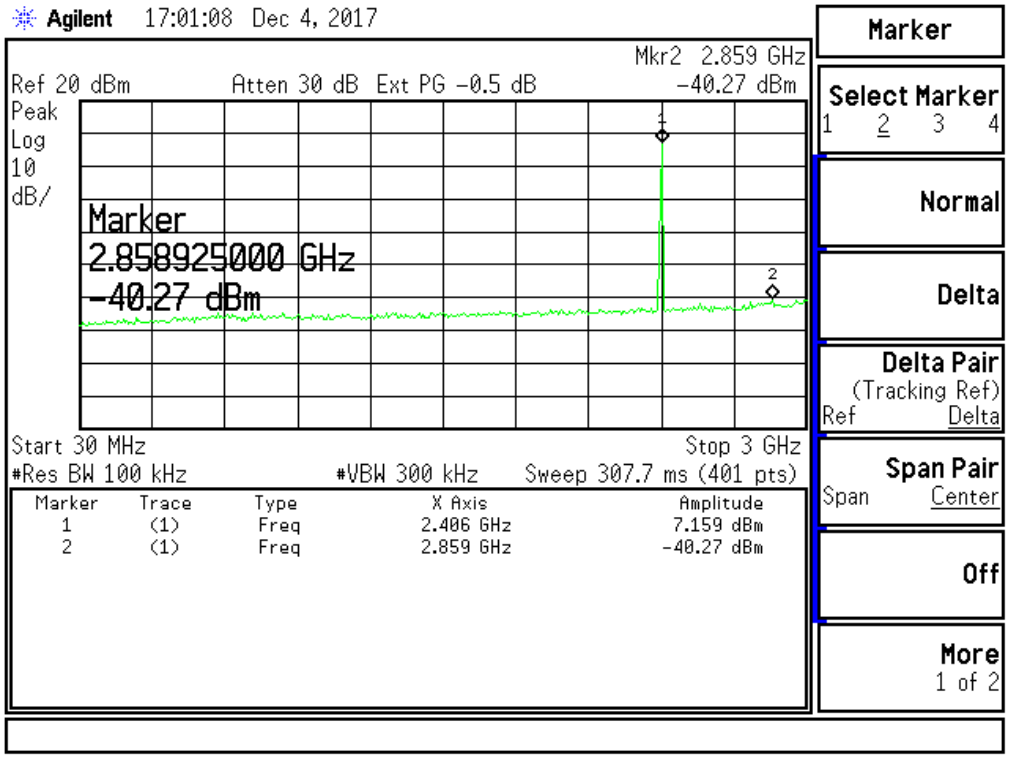
Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US39240419	E4407B	2017/05/03	2018/05/03

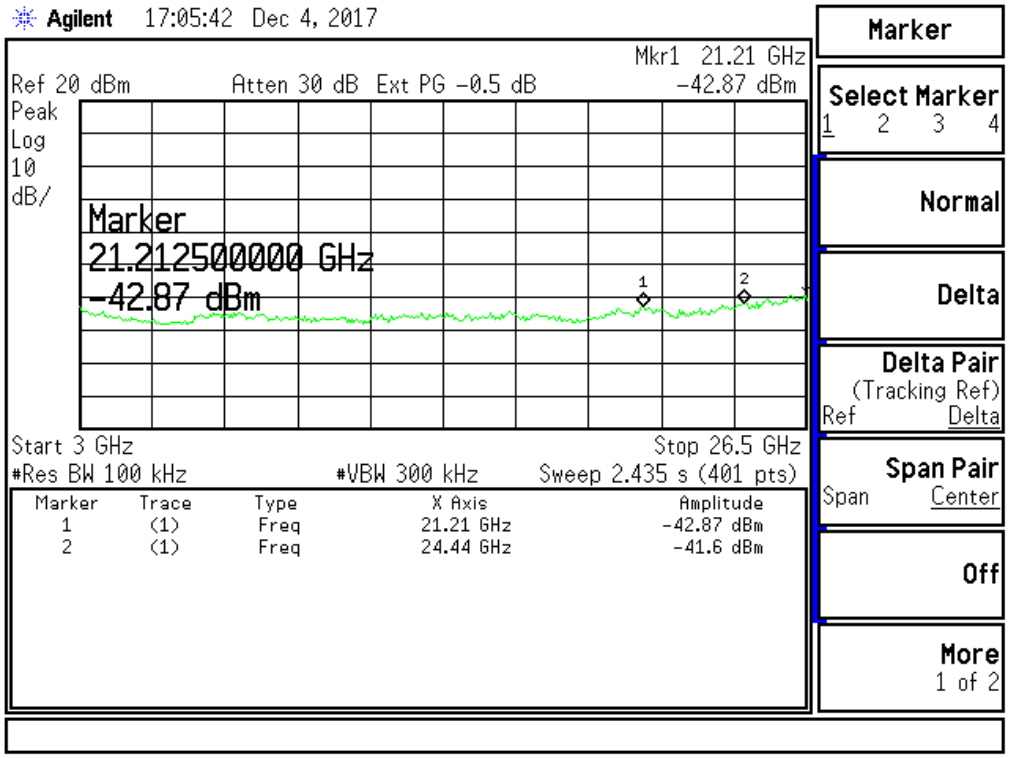
7.4 Test Result:

Refer to attached data sheets. Data shows out of band emissions are suppressed well below the -20 dBc minimum required by the Rules.

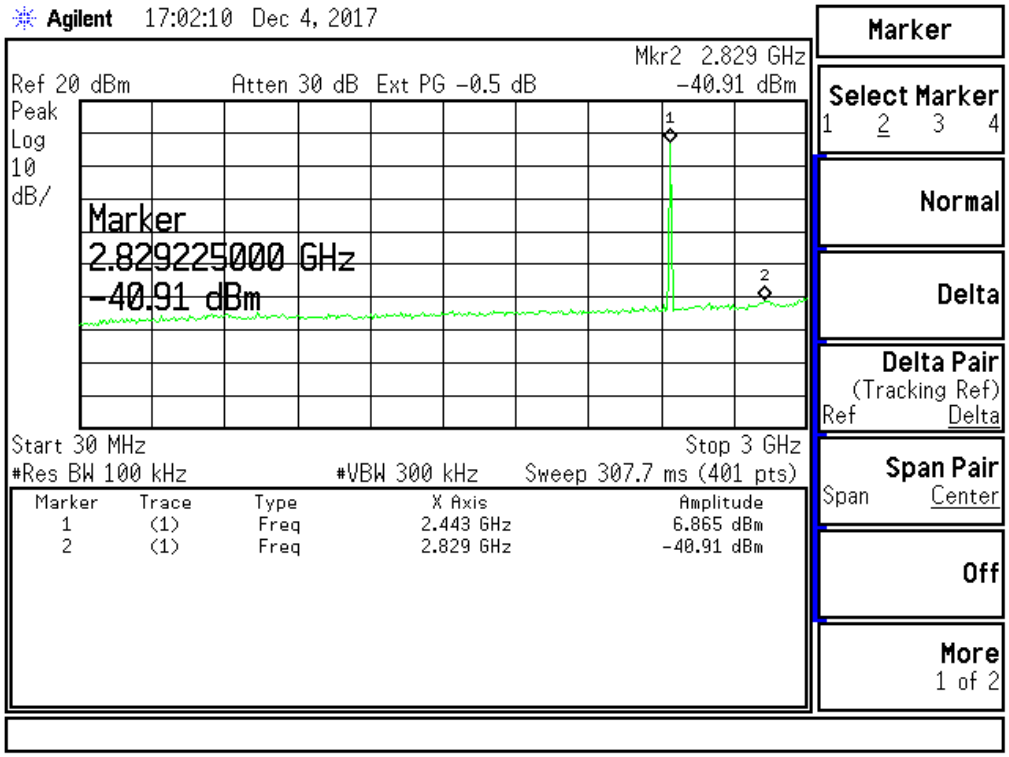
For the result, if the spurious emission of two antennas have the same frequency, we choice the worst one and add 3dB to be the final result, otherwise, use the graph to represent it.

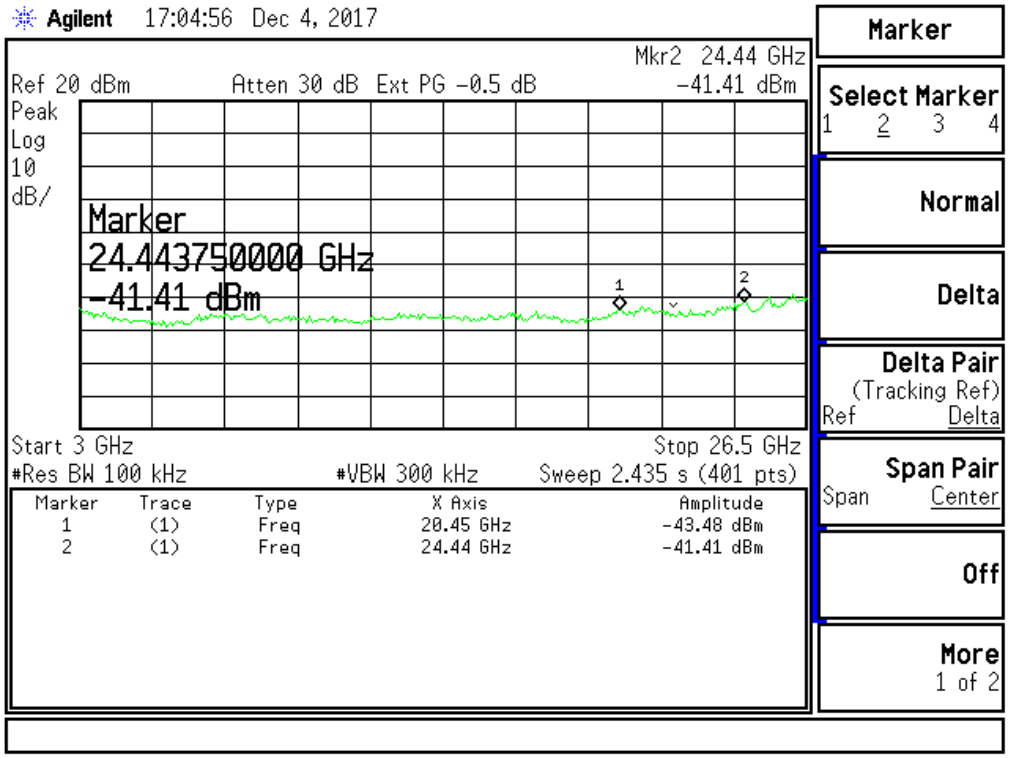
(2402MHz)



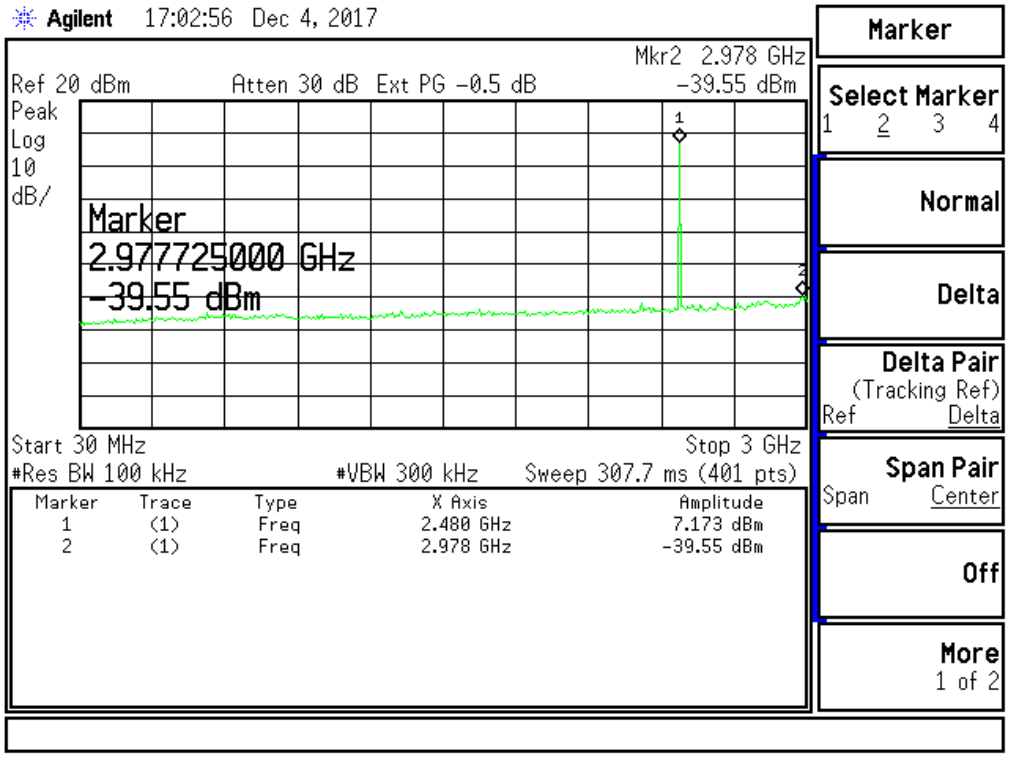

Agilent 17:05:42 Dec 4, 2017
Mkr1 21.21 GHz
Ref 20 dBm
Atten 30 dB Ext PG -0.5 dB
-42.87 dBm
Peak
Log
10
dB/
Marker
21.212500000 GHz
-42.87 dBm
Start 3 GHz
Stop 26.5 GHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 2.435 s (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 21.21 GHz -42.87 dBm
2 (1) Freq 24.44 GHz -41.6 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

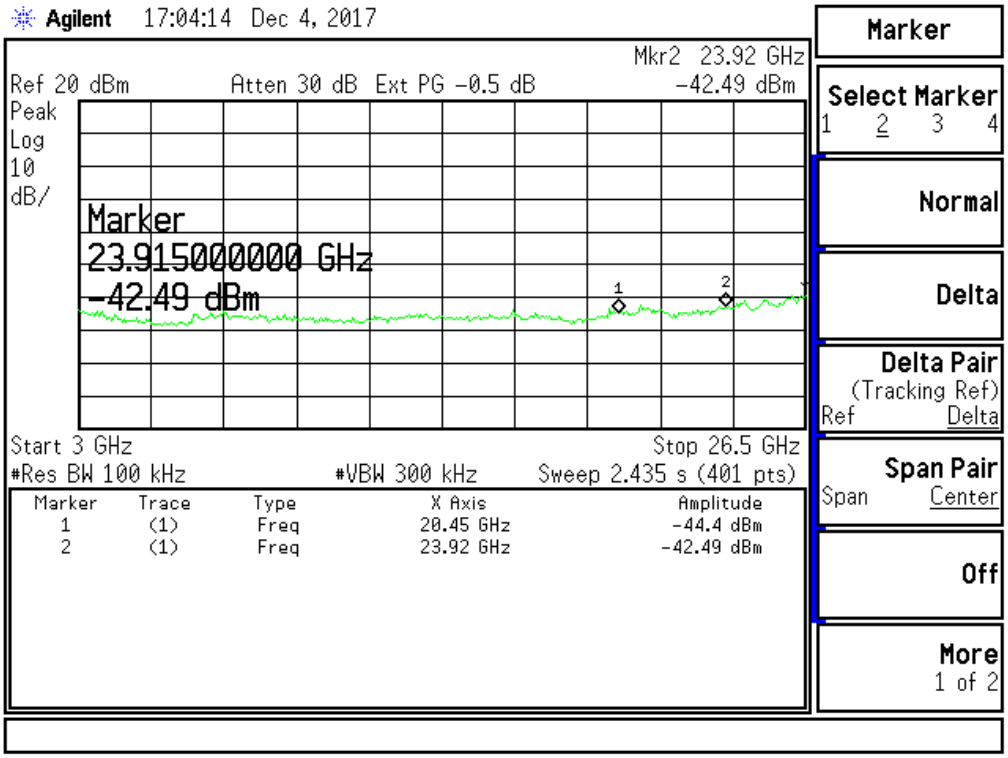
(2440MHz)


Agilent 17:02:10 Dec 4, 2017
Mkr2 2.829 GHz
Ref 20 dBm
Atten 30 dB Ext PG -0.5 dB
-40.91 dBm
Peak
Log
10
dB/
Marker
2.829225000 GHz
-40.91 dBm
Start 30 MHz
Stop 3 GHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 307.7 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.443 GHz 6.865 dBm
2 (1) Freq 2.829 GHz -40.91 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2


Agilent 17:04:56 Dec 4, 2017
Mkr2 24.44 GHz
Ref 20 dBm
Atten 30 dB Ext PG -0.5 dB
-41.41 dBm
Peak
Log
10
dB/
Marker
24.443750000 GHz
-41.41 dBm
Start 3 GHz
Stop 26.5 GHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 2.435 s (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 20.45 GHz -43.48 dBm
2 (1) Freq 24.44 GHz -41.41 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

(2480MHz)


Agilent 17:02:56 Dec 4, 2017
Mkr2 2.978 GHz
Ref 20 dBm
Atten 30 dB Ext PG -0.5 dB
-39.55 dBm
Peak
Log
10
dB/
Marker
2.977725000 GHz
-39.55 dBm
Start 30 MHz
Stop 3 GHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 307.7 ms (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 2.480 GHz 7.173 dBm
2 (1) Freq 2.978 GHz -39.55 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2


Agilent 17:04:14 Dec 4, 2017
Mkr2 23.92 GHz
Ref 20 dBm
Atten 30 dB Ext PG -0.5 dB
-42.49 dBm
Peak
Log
10
dB/
Marker
23.915000000 GHz
-42.49 dBm
Start 3 GHz
Stop 26.5 GHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 2.435 s (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 20.45 GHz -44.4 dBm
2 (1) Freq 23.92 GHz -42.49 dBm
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

8. Band Edges Requirements

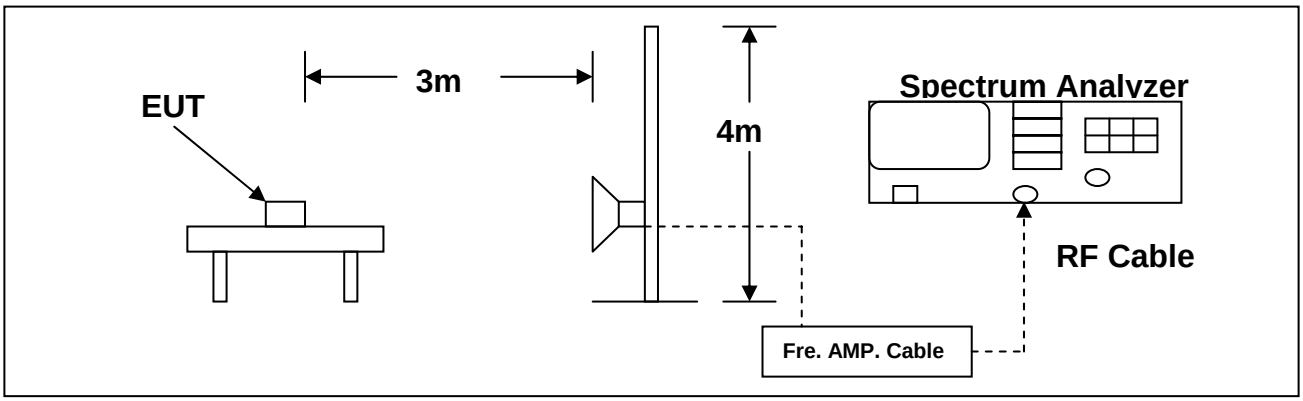
8.1 Test Condition & Setup:

The emissions on the harmonics frequencies, the limits, and the margin of compliance are presented. These tests were made when the transmitter was in full radiated power. The additional test was performed to show compliance with the requirement at the band edge frequency 2400 MHz and up to 2483.5 MHz.

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.

Measurement procedure followed KDB 558074 v04 (12.2.7 Radiated spurious emission test)

8.2 Test Instruments Configuration:



8.3 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US44300422	E4446A	2017/02/16	2018/02/16
2.	TA	Pre Amplifier	RF01	0.10~19.1GHz 60dBm	2017/03/02	2018/03/02
3.	SCHWARZBECK	Horn Antenna	304	BBHA 9120 D	2017/12/13	2018/12/13
4.	Agilent	Spectrum Analyzer	US39240419	E4407B	2017/05/03	2018/05/03
5.	MLT	Pre Amplifier	20110209	PREAMP6G-01	2017/03/29	2018/03/29

8.4 Test Result: Worst case (X Axis)

Radiated Emissions (HORIZONTAL) CH00						
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2397.5	34.3 (PK)	1	195	0	74.0(PK)	-39.7
2397.5	20.8 (AV)	1	195	0	54.0(AV)	-33.2

Radiated Emissions (VERTICAL) CH00						
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2398.5	36.9 (PK)	1	350	0	74.0(PK)	-37.1
2398.5	21.2 (AV)	1	350	0	54.0(AV)	-32.8

Radiated Emissions (HORIZONTAL) CH39						
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2484.4	33.3 (PK)	1	270	0	74.0(PK)	-40.8
2484.4	20.0 (AV)	1	270	0	54.0(AV)	-34.0

Radiated Emissions (VERTICAL) CH39						
Frequency (MHz)	Amplitude (dBuV/m)	Ant. (m)	Table (Degree)	Duty (dB)	Limit (dBuV/m)	Margin (dB)
2486.8	33.3 (PK)	1	70	0	74.0(PK)	-40.7
2486.8	20.1 (AV)	1	70	0	54.0(AV)	-34.0

Notes : 1.Margin= Amplitude - Limits

2. Height of table for EUT placed: 0.8 Meter.
3. ANT= Antenna height.
4. Duty= Duty cycle correction factor.
5. Amplitude= Reading Amplitude – Amplifier gain+ Cable loss+ Antenna factor (Auto calculate in spectrum analyzer)

9. Radiated Emissions Requirements (Above 1GHz)

9.1 General and setup:

Prior to open-field testing, the EUT was placed in a shielded enclosure and scanned at a close distance to determine its emission characteristics. The physical arrangement of the EUT was varied (within the scope of arrangements likely to be encountered in actual use) to determine the effect on the unit's emanations in amplitude, directivity, and frequency. The exact system configuration which produced the highest emissions was noted so it could be reproduced later during the open field tests. This was done to ensure that the final measurements would demonstrate the worst-case interference potential of the EUT.

Final radiation measurements were made on a three-meter, open-field test site. The EUT system was placed on a nonconductive turntable which was 1.5 meters height, top surface 1.0 x 1.5 meter. During the test, EUT was set to transmit continuously & measurements spectrum range from 30 MHz to 26.5 GHz is investigated.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer’s 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvlt (dBuV) into field intensity in microvolts pre meter(uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in microcolts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

Amplitude (dBuV/m)= FI(dBuV)+AF(dBuV)+CL(dBuV)-Gain(dB)

FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.

P.S Amplitude is auto calculate in spectrum analyzer.

The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:

(1) For fundamental frequency : Transmitter Output < +30dBm

(2) For spurious frequency : Spurious emission limits = fundamental emission limit /10

9.2 Test Equipment List:

Item	Mfr/Brand	Instruments	Serial No.	Model/Type No.	Calibrated Date	Next Cal. Date
1.	Agilent	Spectrum Analyzer	US44300422	E4446A	2017/02/16	2018/02/16
2.	TA	Pre Amplifier	RF01	0.10~19.1GHz 60dBm	2017/03/02	2018/03/02
3.	Herotek	Pre Amplifier	30690	A402-417	2017/12/15	2018/12/15
4.	SCHWARZBECK	Horn Antenna	181	BBHA 9170	2017/04/27	2018/04/27
5.	SCHWARZBECK	Horn Antenna	304	BBHA 9120 D	2017/12/13	2018/12/13
6.	Agilent	Spectrum Analyzer	US39240419	E4407B	2017/05/03	2018/05/03
7.	MLT	Pre Amplifier	TA010-190-30	RF03	2017/08/02	2018/08/02

9.3 Test Condition:

EUT tested in accordance with the specifications given by the manufacturer , and exercised in the most unfavorable manner.

Peak Measurement RBW set to 1MHz , VBW set to 1MHz

Average Measurement RBW set to 1MHz , VBW set to 10Hz

The X axial at Pre-test procedure is the worst case, the final result shown on this report is based on this condition.

9.4 Radiated Emissions Limits:

Frequency range (MHz)	Peak (dBuV/m)	Average (dBuV/m)
Above 1000	74	54

9.5 Measurement Data Of Radiated Emissions:

9.5.1 Open Field Radiated Emissions (Subpart C)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : Worst case (X Axis)BLE 2402MHz

Radiated Emissions (VERTICAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
4800.0	76.05	67.41	-28.09	47.96	39.32	74.00	54.00	-26.04	-14.68
7200.0	63.40	56.86	-21.27	42.13	35.59	74.00	54.00	-31.87	-18.41
9615.0	57.46	50.51	-14.90	42.56	35.61	74.00	54.00	-31.44	-18.39

Radiated Emissions (HORIZONTAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
4800.0	78.26	74.05	-28.09	50.17	45.96	74.00	54.00	-23.83	-8.04
7200.0	62.09	56.15	-21.27	40.82	34.88	74.00	54.00	-33.18	-19.12
9615.0	59.25	53.46	-14.90	44.35	38.56	74.00	54.00	-29.65	-15.44

Notes : 1.Margin= Amplitude - Limits

2.Distance of Measurement : 3 Meter

3.Height of table for EUT placed: 1.5 Meter.

4.Amplitude= Reading Amplitude – Amplifier gain + Cable loss + Antenna factor (Auto calculate in spectrum analyzer)

5.The other emission levels were very low against the limit.

6. Pre Amplifier (RF01) Gain :63dB to 69dB

7. Pre Amplifier (30690) Gain :38dB to 50dB

9.5.2 Open Field Radiated Emissions (Subpart C)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : BLE 2440MHz

Radiated Emissions (VERTICAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
4875.0	73.97	68.23	-28.14	45.83	40.09	74.00	54.00	-28.17	-13.91
7320.0	63.76	57.23	-21.44	42.32	35.79	74.00	54.00	-31.68	-18.21
9765.0	60.53	52.60	-14.63	45.90	37.97	74.00	54.00	-28.10	-16.03

Radiated Emissions (HORIZONTAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
4875.0	76.80	71.84	-28.14	48.66	43.70	74.00	54.00	-25.34	-10.30
7320.0	64.28	58.95	-21.44	42.84	37.51	74.00	54.00	-31.16	-16.49
9765.0	60.35	53.53	-14.63	45.72	38.90	74.00	54.00	-28.28	-15.10

Notes : 1.Margin= Amplitude - Limits
2.Distance of Measurement : 3 Meter
3.Height of table for EUT placed: 1.5 Meter.
4.Amplitude= Reading Amplitude – Amplifier gain + Cable loss + Antenna factor
(Auto calculate in spectrum analyzer)
5.The other emission levels were very low against the limit.
6. Pre Amplifier (RF01) Gain :63dB to 69dB
7. Pre Amplifier (30690) Gain :38dB to 50dB

9.5.3 Open Field Radiated Emissions (Subpart C)

The highest peak values of radiated emissions from the EUT at various antenna heights, antenna polarization, EUT orientation, etc. are recorded on the following

Test Mode : BLE 2480MHz

Radiated Emissions (VERTICAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1962.0	43.07	36.98	-2.60	40.47	34.38	74.00	54.00	-33.53	-19.62
4965.0	69.01	62.05	-28.07	40.94	33.98	74.00	54.00	-33.06	-20.02
9915.0	59.34	52.96	-13.63	45.71	39.33	74.00	54.00	-28.29	-14.67

Radiated Emissions (HORIZONTAL)									
Frequency (MHz)	Read (dBuV/m)		Factor	Amplitude (dBuV/m)		Limits (dBuV/m)		Margin (dB)	
	PK	AV		PK	AV	PK	AV	PK	AV
1962.0	50.80	45.12	-2.60	48.20	42.52	74.00	54.00	-25.80	-11.48
7440.0	62.20	56.09	-20.90	41.30	35.19	74.00	54.00	-32.70	-18.81
9915.0	57.40	52.18	-13.63	43.77	38.55	74.00	54.00	-30.23	-15.45

Notes : 1.Margin= Amplitude - Limits
2.Distance of Measurement : 3 Meter
3.Height of table for EUT placed: 1.5 Meter.
4.Amplitude= Reading Amplitude – Amplifier gain + Cable loss + Antenna factor
(Auto calculate in spectrum analyzer)
5.The other emission levels were very low against the limit.
6. Pre Amplifier (RF01) Gain :63dB to 69dB
7. Pre Amplifier (30690) Gain :38dB to 50dB

10. Antenna Requirements

10.1 Standard Applicable:

For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

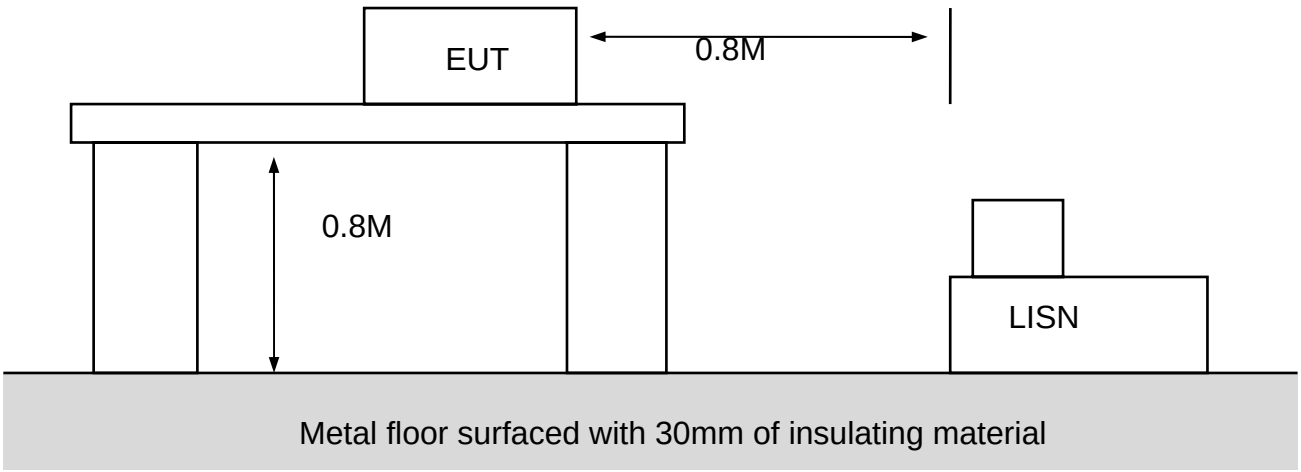
And According to 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

10.2 Antenna Construction:

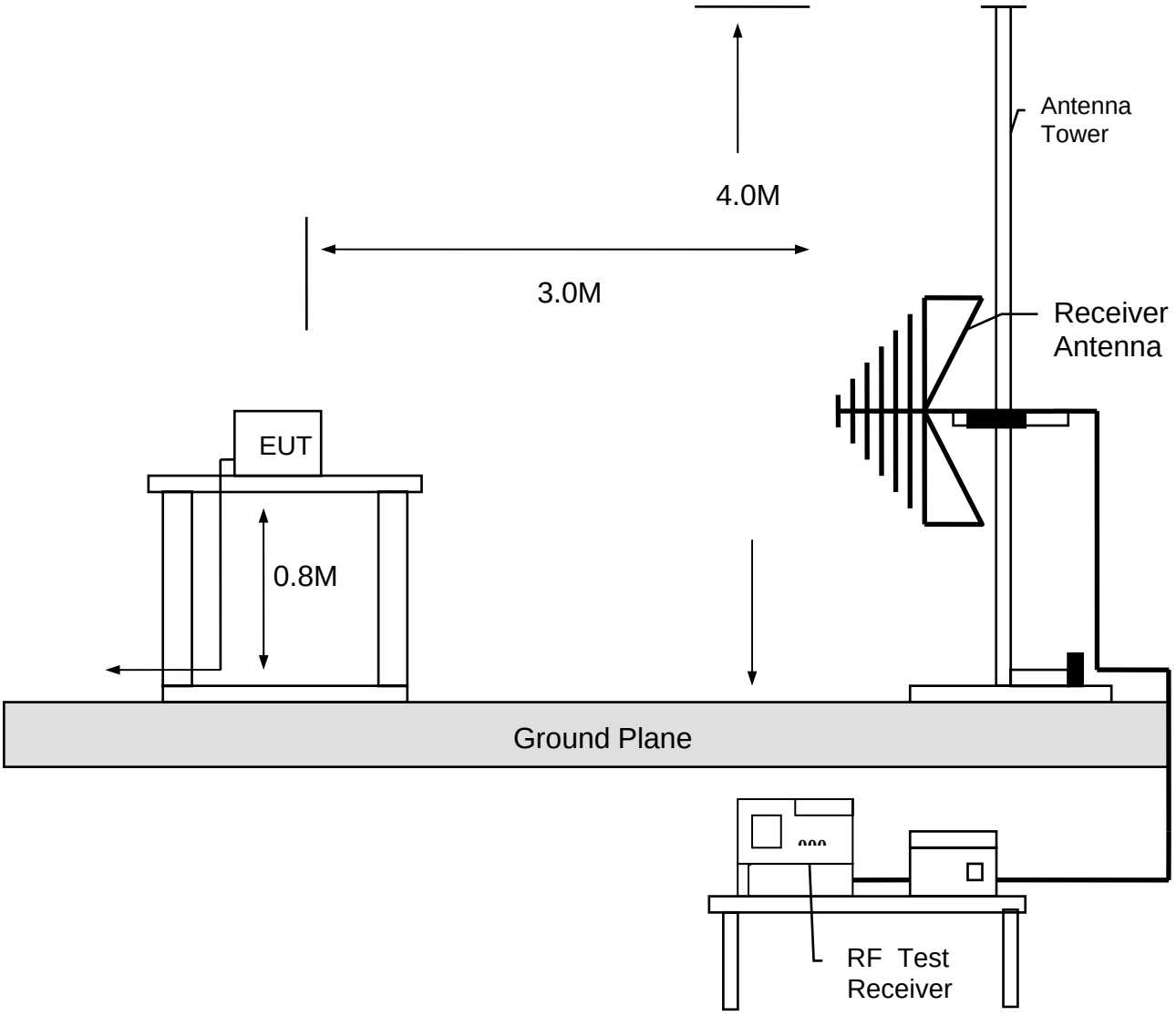
Ant. Type	Gain	type of connector
Monopole antenna	-7.24 dBi	Chip

Appendix I - EUT Test Setup

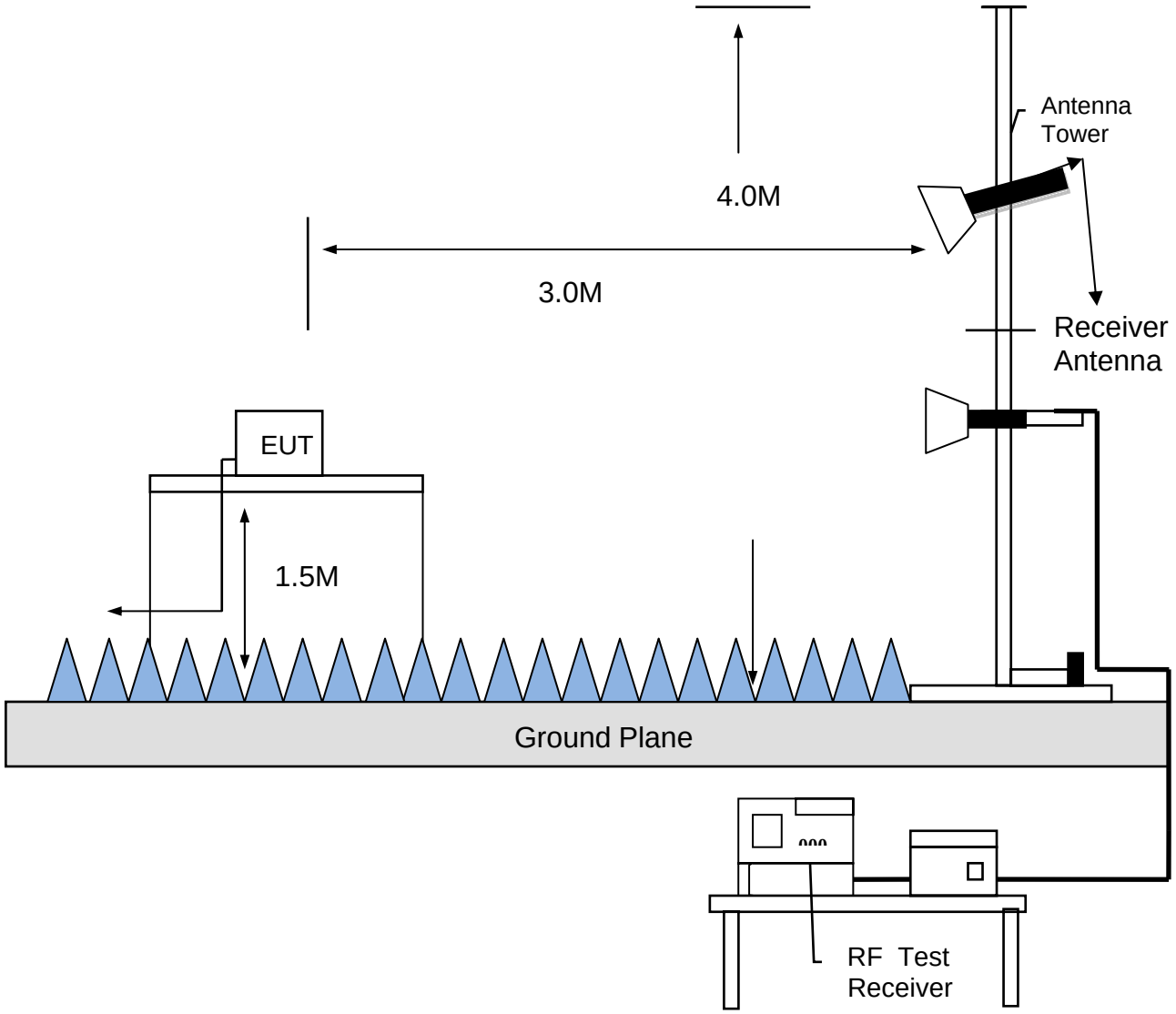
MEASUREMENT OF POWER LINE CONDUCTED RFI VOLTAGE



MEASUREMENT OF RADIATED EMISSION (Below 1GHz)



MEASUREMENT OF RADIATED EMISSION (above > 1GHz)



Appendix II - Brand / Trade Name & Model No. Multiple Listee

Model No.	Trade Name
N/A	N/A