

# TEST REPORT

of

## FCC Part 15 Subpart C AND CANADA RSS-210

New Application;  Class I PC;  Class II PC

Full Modular Approval

**Product :** **BT 4.0 Low Energy Single Mode Module**

**Brand:** **BlueRadios**

**Model:** **BR-SS-S2A**

**Model Difference:** **N/A**

**FCC ID:** **XDU-SS-S2**

**IC:** **8456A-SSS2**

**FCC Rule Part:** **§15.247, Cat: DTS**

**IC Rule Part:** **RSS-210 issue 8:2010, Annex 8**

**Applicant:** **BlueRadios, Inc.**

**Address:** **7173 S. Hanava Street, Suite 600, Englewood, CO/USA**

### **Test Performed by:**

**International Standards Laboratory**

<Lung-Tan LAB>

\*Site Registration No.

BSMI: SL2-IN-E-0013; MRA TW1036; TAF: 0997; IC: IC4067B-3;

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**Report No.: ISL-13LR037FC**

**Issue Date : 2013/04/18**

Test results given in this report apply only to the specific sample(s) tested and are traceable to national or international standard through calibration of the equipment and evaluating measurement uncertainty herein.

This report MUST not be used to claim product endorsement by TAF, NVLAP or any agency of the Government.

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## VERIFICATION OF COMPLIANCE

**Applicant:** BlueRadios, Inc.  
**Product Description:** BT 4.0 Low Energy Single Mode Module  
**Brand Name:** BlueRadios  
**Model No.:** BR-SS-S2A  
**Model Difference:** N/A  
**FCC ID:** XDU-SS-S2  
**IC:** 8456A-SSS2  
**Date of test:** 2013/03/04 ~ 2013/04/10  
**Date of EUT Received:** 2013/03/04

**We hereby certify that:**

All the tests in this report have been performed and recorded in accordance with the standards described above and performed by an independent electromagnetic compatibility consultant, International Standards Laboratory.

The test results contained in this report accurately represent the measurements of the characteristics and the energy generated by sample equipment under test at the time of the test. The sample equipment tested as described in this report is in compliance with the limits of above standards.

**Test By:**



**Date:**

2013/04/18

*Dion Chang / Engineer*

**Prepared By:**



**Date:**

2013/04/18

*Eva Kao / Technical Supervisor*

**Approved By:**



**Date:**

2013/04/18

*Vincent Su / Technical Manager*

## Version

Version No.	Date	Description
00	2013/04/18	Initial creation of document

## Table of Contents

<b>1</b>	<b>GENERAL INFORMATION .....</b>	<b>6</b>
1.1	Related Submittal(s) / Grant (s) .....	7
1.2	Test Methodology .....	7
1.3	Test Facility .....	7
1.4	Special Accessories .....	7
1.5	Equipment Modifications .....	7
<b>2</b>	<b>SYSTEM TEST CONFIGURATION .....</b>	<b>8</b>
2.1	EUT Configuration .....	8
2.2	EUT Exercise .....	8
2.3	Test Procedure .....	8
2.4	Configuration of Tested System .....	9
<b>3</b>	<b>SUMMARY OF TEST RESULTS .....</b>	<b>10</b>
<b>4</b>	<b>DESCRIPTION OF TEST MODES .....</b>	<b>10</b>
<b>5</b>	<b>AC POWER LINE CONDUCTED EMISSION TEST .....</b>	<b>11</b>
5.1	Standard Applicable: .....	11
5.2	Measurement Equipment Used: .....	11
5.3	EUT Setup: .....	11
5.4	Measurement Procedure: .....	12
5.5	Measurement Result: .....	12
<b>6</b>	<b>PEAK OUTPUT POWER MEASUREMENT .....</b>	<b>15</b>
6.1	Standard Applicable: .....	15
6.2	Measurement Equipment Used: .....	16
6.3	Test Set-up: .....	16
6.4	Measurement Procedure: .....	16
6.5	Measurement Result: .....	16
<b>7</b>	<b>6dB Bandwidth &amp; 99% Bandwidth .....</b>	<b>17</b>
7.1	Standard Applicable: .....	17
7.2	Measurement Equipment Used: .....	17
7.3	Test Set-up: .....	17
7.4	Measurement Procedure: .....	17
7.5	Measurement Result: .....	18
<b>8</b>	<b>100KHz BANDWIDTH OF BAND EDGES MEASUREMENT .....</b>	<b>21</b>
8.1	Standard Applicable: .....	21
8.2	Measurement Equipment Used: .....	22
8.3	Test SET-UP: .....	23
8.4	Measurement Procedure: .....	24
8.5	Field Strength Calculation: .....	24
8.6	Measurement Result: .....	24
<b>9</b>	<b>SPURIOUS RADIATED EMISSION TEST .....</b>	<b>27</b>
9.1	Standard Applicable .....	27
9.2	Measurement Equipment Used .....	27
9.3	Test SET-UP: .....	27
9.4	Measurement Procedure: .....	28
9.5	Field Strength Calculation .....	28
9.6	Measurement Result: .....	28

<b>10</b>	<b>Peak Power Spectral Density .....</b>	<b>38</b>
10.1	Standard Applicable: .....	38
10.2	Measurement Equipment Used: .....	38
10.3	Test Set-up: .....	38
10.4	Measurement Procedure: .....	38
10.5	Measurement Result: .....	39
<b>11</b>	<b>ANTENNA REQUIREMENT .....</b>	<b>42</b>
11.1	Standard Applicable: .....	42
11.2	Antenna Connected Construction: .....	42
<b>12</b>	<b>RF EXPOSURE .....</b>	<b>43</b>
12.1	Standard Applicable .....	43
12.2	Measurement Result: .....	43
<b>APPENDIX 1 PHOTOGRAPHS OF SET UP .....</b>		<b>44</b>
<b>APPENDIX 2 PHOTOGRAPHS OF EUT .....</b>		<b>47</b>

## 1 GENERAL INFORMATION

General:

Product Name	BT 4.0 Low Energy Single Mode Module
Brand Name	BlueRadios
Model Name	BR-SS-S2A
Model Difference	N/A
Power Supply	5Vdc from USB of host

Bluetooth:

Frequency Range:	2402 – 2480MHz
Bluetooth Version:	V4.0
Channel number:	40 channels, 2MHz step
Modulation type:	GFSK
Transmit Power:	3.24 dBm Peak
Dwell Time:	N/A
Antenna Designation:	Chip Antenna, 0.9dBi
Type of Emission:	2M40FXD

The EUT is compliance with Bluetooth 4.0 Standard.

**Remark:** The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

### 1.1 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: XDU-SS-S2** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and **IC: 8456A-SSS2** filing to comply with Industry Canada RSS-210 issue 8: 2010 Annex 8. The composite system (digital device) is in compliance with Subpart B is authorized under a DoC procedure.

### 1.2 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 (2003). and RSS-Gen: 2010. Radiated testing was performed at an antenna to EUT distance 3 meters. Radiated testing was performed at an antenna to EUT distance 3 meters.

KDB Document:

558074 D01 DTS Meas Guidance v03r01

### 1.3 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of **International Standards Laboratory** <Lung-Tan LAB> No. 120, Lane 180, San Ho Tsuen, Hsin Ho Rd., Lung-Tan Hsiang, Tao Yuan County 325, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2003. FCC Registration Number is: TW1036, Canada Registration Number: 4067B-3.

### 1.4 Special Accessories

Not available for this EUT intended for grant.

### 1.5 Equipment Modifications

Not available for this EUT intended for grant.

## 2 SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

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

### 2.2 EUT Exercise

The EUT (Transmitter) was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

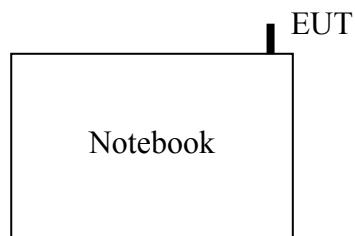
The EUT is placed on a turn table which is 0.8 m above ground plane. According to the requirements in Section 7 and 13 of ANSI C63.4-2003. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m 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 and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” Is still within the 3dB illumination BW of the measurement antenna. According to the requirements in Section 8 and 13 and Subclause 8.3.1.2 of ANSI C63.4-2003.

## 2.4 Configuration of Tested System

Fig. 1 Configuration



**Table 1 Equipment Used in Tested System**

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	Notebook	DELL	D620	N/A	Shield	Non-shield

### 3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)/ RSS-Gen §7.2.4	AC Power Line Conducted Emission	Compliant
§15.247(b) (3),(4))/ RSS-210 §A8.4(4)	Peak Output Power	Compliant
§15.247(a)(2) §A8.2(a) RSS-Gen §4.6.1	6dB Bandwidth & 99% Power Bandwidth	Compliant
§15.247(d)/ RSS-210 §A8.5	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(d)/ RSS-210 §A8.5	Spurious Emission	Compliant
§15.247(e)/ RSS-210 §A8.2(b) & §A8.3(2)	Peak Power Density	Compliant
§15.203/ RSS-210 issue 8,§A8.4	Antenna Requirement	Compliant
§2.1091 RSS 102 Issue 4	RF EXPOSURE	Compliant

### 4 DESCRIPTION OF TEST MODES

The EUT has been tested under engineering operating condition.

Test program used to control the EUT for staying in continuous transmitting mode is programmed.

BT LE mode: Channel low (2402MHz), mid (2440MHz) and high (2480MHz) are chosen for full testing.

## 5 AC POWER LINE CONDUCTED EMISSION TEST

### 5.1 Standard Applicable:

According to §15.207 and RSS-Gen §7.2.4, frequency range within 150KHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	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

Note

1. The lower limit shall apply at the transition frequencies
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

### 5.2 Measurement Equipment Used:

AC Power Line Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Conduction 03 -1 Cable	WOKEN	CFD 300-NL	Conduction 0-1	06/28/2012	06/28/2013
EMI Receiver 12	ROHDE & SCHWARZ	ESCI	100804	07/13/2012	07/13/2013
LISN 07	FCC Inc.	FCC-LISN-50-100-4 -02	07040	07/13/2012	07/13/2013
LISN 08	FCC	FCC-LISN50-25-2-0 1	07039	07/13/2012	07/13/2013

### 5.3 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4-2003.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

#### 5.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

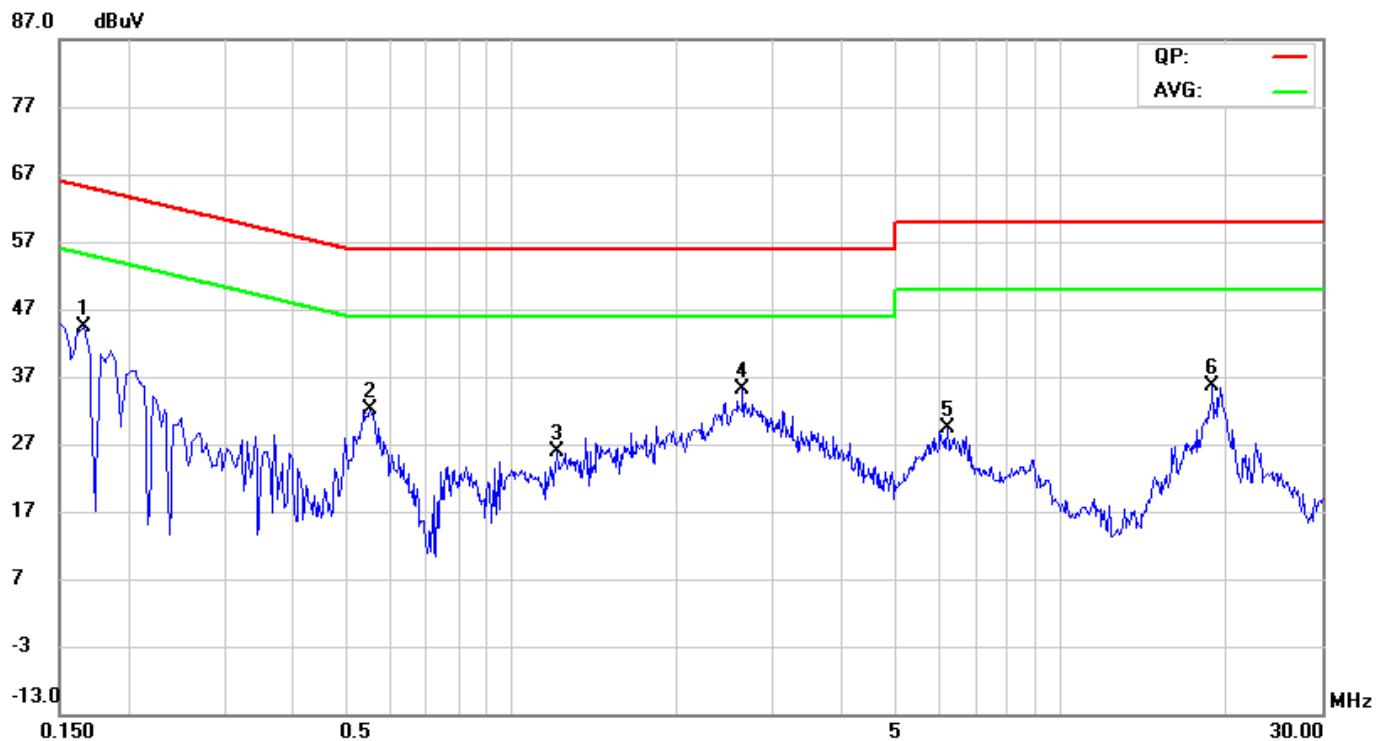
#### 5.5 Measurement Result:

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Note: Refer to next page for measurement data and plots.

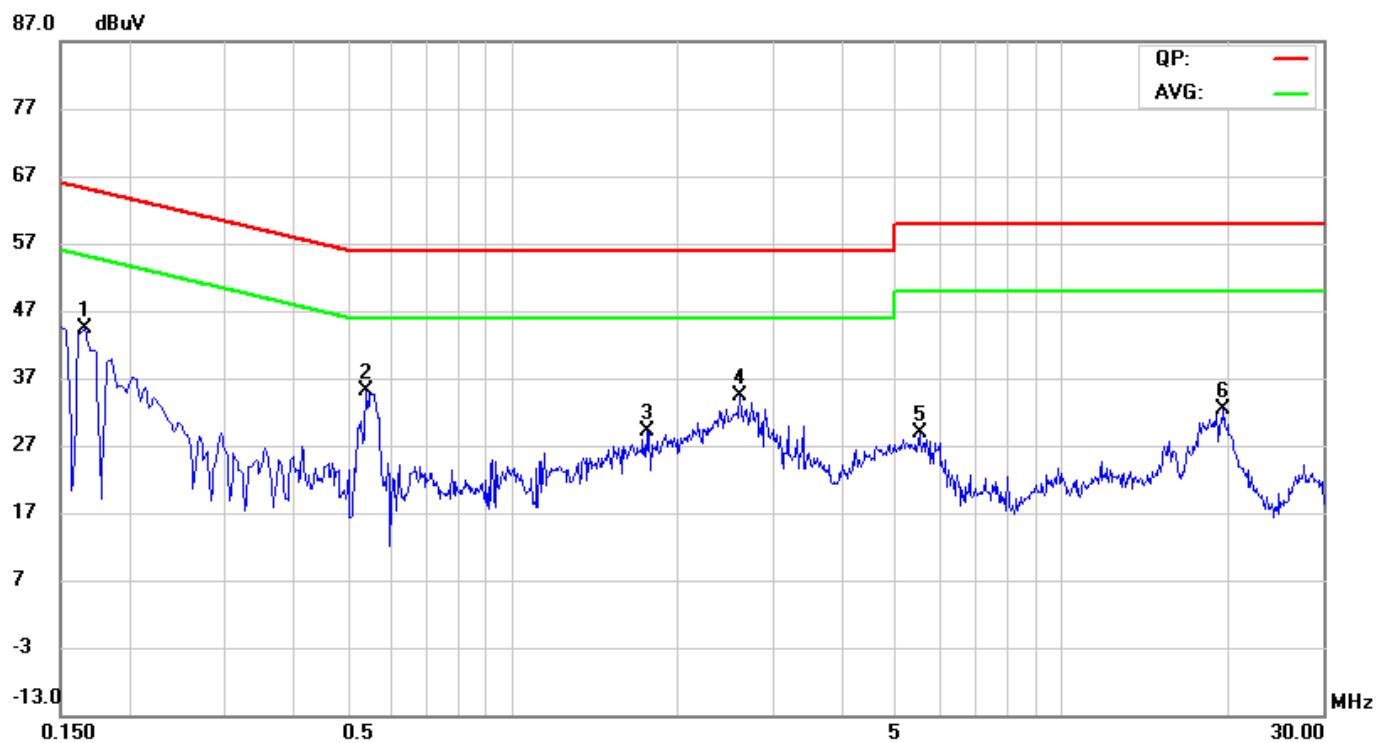
## AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation Mode	Test Date:	2013/03/11
Test By:	Lake		



Site:	Conduction 04	Phase:	L1	Temperature(°C):	26(°C)
Condition:	CISPR13 Class B Conduction			Humidity:	54%
		Power:		AC 110V/60Hz	

No.	Frequency) (MHz)	reading(dBuV)			Factor(dB)` (dB)	Measurement(dBuV)			limit(dBuV)		margin(dB)		Comment
		Peak	QP	AVG		Peak	QP	AVG	P/Q	AVG	P/Q	AVG	
1	0.1660	38.55	32.43	16.49	9.58	48.13	42.01	26.07	65.16	55.16	-23.15	-29.09	
2	0.5540	23.40	20.64	16.47	9.59	32.99	30.23	26.06	56.00	46.00	-25.77	-19.94	
3	1.2100	15.99	13.01	8.86	9.60	25.59	22.61	18.46	56.00	46.00	-33.39	-27.54	
4	2.6460	24.71	19.95	15.28	9.60	34.31	29.55	24.88	56.00	46.00	-26.45	-21.12	
5	6.2420	20.76	13.53	8.56	9.62	30.38	23.15	18.18	60.00	50.00	-36.85	-31.82	
6	18.9700	25.64	16.75	7.92	9.73	35.37	26.48	17.65	60.00	50.00	-33.52	-32.35	



Site:	Conduction 04	Phase: N	Temperature(°C):26(°C)
-------	---------------	----------	------------------------

| Condition: | CISPR13 Class B Conduction | Humidity:54% |  |
| Power: | AC 110V/60Hz |  |  |

No.	Frequency) (MHz)	reading(dBuV)			Factor(dB)` (dB)	Measurement(dBuV)			limit(dBuV)		margin(dB)		Comment
		Peak	QP	AVG		Peak	QP	AVG	P/Q	AVG	P/Q	AVG	
1	0.1660	40.13	31.82	17.21	9.59	49.72	41.41	26.80	65.16	55.16	-23.75	-28.36	
2	0.5420	26.40	22.62	18.19	9.59	35.99	32.21	27.78	56.00	46.00	-23.79	-18.22	
3	1.7540	19.73	13.17	7.59	9.60	29.33	22.77	17.19	56.00	46.00	-33.23	-28.81	
4	2.6020	24.54	19.03	14.20	9.60	34.14	28.63	23.80	56.00	46.00	-27.37	-22.20	
5	5.5180	18.99	13.64	8.17	9.62	28.61	23.26	17.79	60.00	50.00	-36.74	-32.21	
6	19.8060	22.46	15.69	8.42	9.75	32.21	25.44	18.17	60.00	50.00	-34.56	-31.83	

## 6 PEAK OUTPUT POWER MEASUREMENT

### 6.1 Standard Applicable:

According to §15.247(b)(3),(4)(b)

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

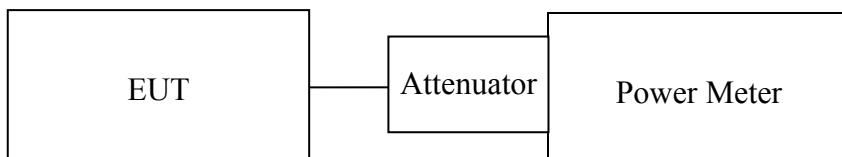
(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

According to RSS-210 issue 8,§A8.4(4), For systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz, the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section A8.4(5), the e.i.r.p. shall not exceed 4 W.

## 6.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter 05	Anritsu	ML2495A	1116010	04/17/2012	04/16/2013
Power Sensor 05	Anritsu	MA2411B	34NKF50	04/16/2012	04/15/2013
Temperature Chamber	KSON	THS-B4H100	2287	03/15/2013	03/14/2014
DC Power supply	ABM	51850	N/A	06/17/2012	06/16/2013
AC Power supply	EXTECH	CFC105W	NA	12/19/2012	12/18/2013
Splitter	MCLI	PS4-199	12465	07/18/2012	07/17/2013
Spectrum analyzer	Agilent	N9030A	MY51360021	03/29/20123	03/28/2014

## 6.3 Test Set-up:



## 6.4 Measurement Procedure:

Refer to section 9.1.3 and 9.2.3 Peak and Average Conducted Output Power Measurement Procedure of KDB Document: 558074 D01 DTS Meas Guidance v03r01

## 6.5 Measurement Result:

### LE Mode

Frequency (MHz)	Peak Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2402.00	3.24	0.00	3.24	0.00211	1
2440.00	3.22	0.00	3.22	0.00210	1
2480.00	3.01	0.00	3.01	0.00200	1

Note: offset 0.5dB for cable loss.

## 7 6dB Bandwidth & 99% Bandwidth

### 7.1 Standard Applicable:

According to §15.247(a)(2), Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500kHz.

According to RSS 210 issue 8, §8.2(a) Systems employing digital modulation techniques (which includes direct sequence) can now be certified under RSS-210 provided they comply with the following requirements: The minimum -6 dB bandwidth shall be at least 500 kHz.

### 7.2 Measurement Equipment Used:

Refer to section 6.2 for details.

### 7.3 Test Set-up:

Refer to section 6.3 for details.

### 7.4 Measurement Procedure:

**Refer to section 8.1 DTS bandwidth Measurement Procedure of KDB Document: 558074 D01 DTS Meas Guidance v03r01**

1. Set resolution bandwidth (RBW) = 100KHz.
2. Set the video bandwidth (VBW) =300KHz.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5 %.

### 7.5 Measurement Result:

CH	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (KHZ)
2402.00	0.6786	2.398	>500
2440.00	0.683	2.068	>500
2480.00	0.6923	1.974	>500

Note: Refer to next page for plots.

## 99% &amp; 6dB Bandwidth Test Data CH-Low



## 99% &amp; 6dB Bandwidth Test Data CH-Mid



**99% & 6dB Bandwidth Test Data CH-High**



## 8 100KHz BANDWIDTH OF BAND EDGES MEASUREMENT

### 8.1 Standard Applicable:

According to §15.247(c), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power. 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).

According to RSS-210 issue 8, §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

## 8.2 Measurement Equipment Used:

### 8.2.1 Conducted Emission at antenna port:

Refer to section 6.2 for details.

### 8.2.2 Radiated emission:

Chamber 14(966)					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer 21(26.5GHz)	Agilent	N9010A	MY49060537	07/17/2012	07/16/2013
Spectrum Analyzer 20(6.5GHz)	Agilent	E4443A	MY48250315	05/24/2012	05/23/2013
Spectrum Analyzer 22(43GHz)	R&S	FSU43	100143	04/25/2012	04/24/2013
Dipole antenna	SCHWARZBECK	VHAP,30-300	919	11/16/2011	11/15/2013
Dipole antenna	SCHWARZBECK	UHAP,300-1000	1195	10/25/2011	10/24/2013
Loop Antenna9K-30M	A.H.SYSTEM	SAS-564	294	03/07/2013	03/06/2015
Bilog Antenna30-1G	Schaffner	CBL 6111B	2756	01/13/2013	01/12/2014
Horn antenna1-18G(06)	EMCO	3117	0006665	10/15/2012	10/14/2013
Horn antenna18-26G(04)	Com-power	AH-826	081001	05/04/2011	05/03/2013
Preamplifier9-1000M	HP	8447D	NA	02/19/2013	02/18/2014
Preamplifier1-18G	MITEQ	AFS44-001018 00-25-10P-44	1329256	07/23/2012	07/22/2013
Preamplifier1-26G	EM	EM01M26G	NA	02/26/2013	02/25/2014
Cable1-18G	HUBER SUHNER	Sucoflex 106	NA	09/07/2012	09/06/2013
Cable UP to 1G	HUBER SUHNER	RG 214/U	NA	10/08/2012	10/07/2013
SUCOFLEX 1GHz~40GHz cable	HUBER SUHNER	Sucoflex 102	27963/2&3742 1/2	09/21/2011	09/20/2013
Signal Generator	R&S	SMU200A	102330	02/19/2013	02/18/2014
Signal Generator	Anritsu	MG3692A	20311	09/18/2012	09/17/2013
2.4G Filter	Micro-Tronics	Brm50702	76	12/27/2012	12/26/2013

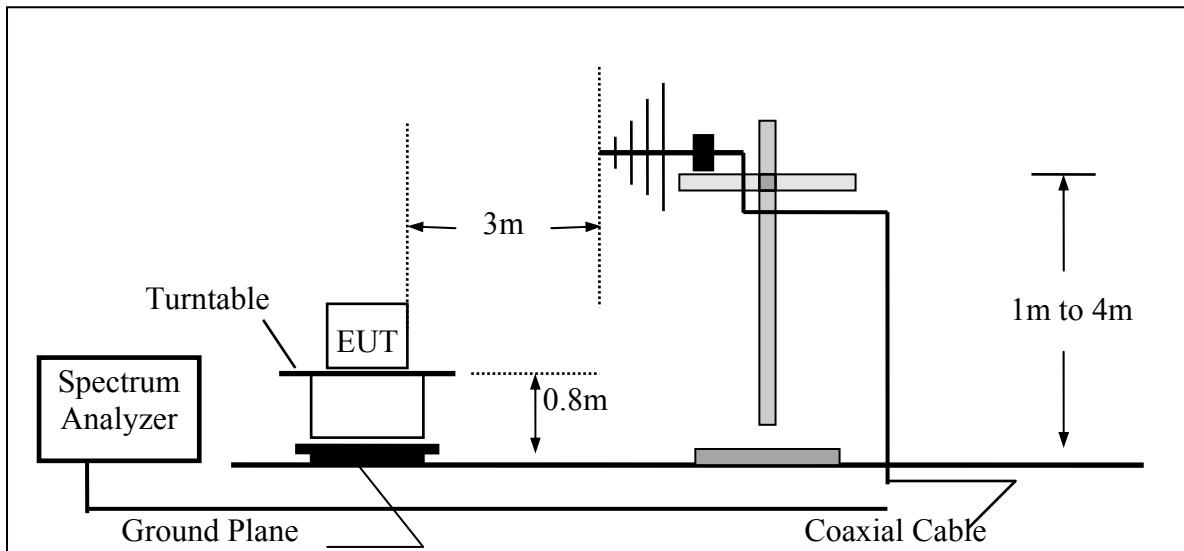
### 8.3 Test SET-UP:

#### 8.3.1 Conducted Emission at antenna port:

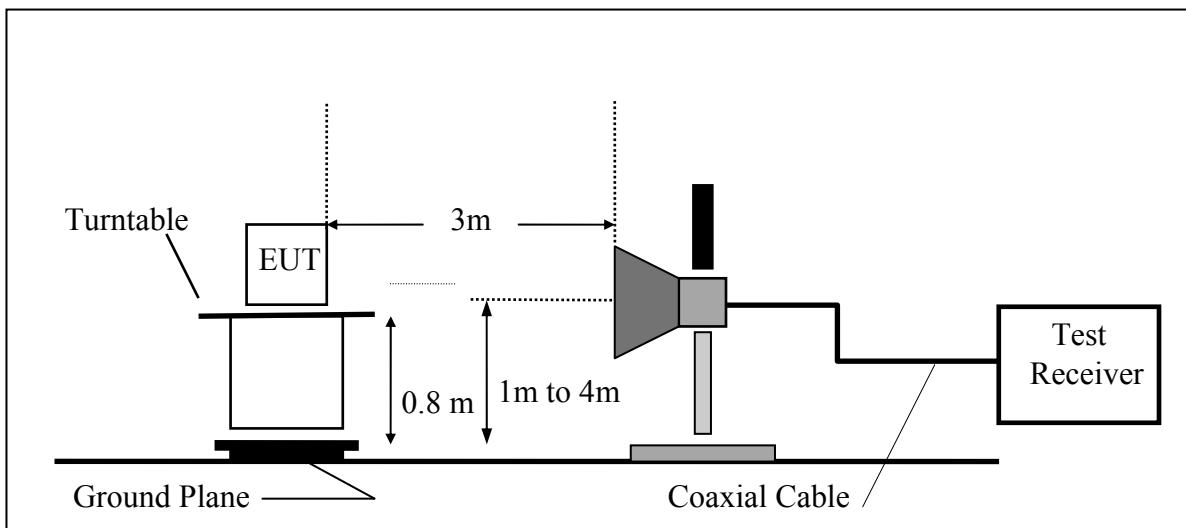
Refer to section 6.3 for details.

#### 8.3.2 Radiated emission:

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(B) Radiated Emission Test Set-UP Frequency Over 1 GHz



#### 8.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span=25MHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

**Refer to section 11 and 12 emissions in restricted and non-estricted frequency bands Measurement Procedure of KDB Document: 558074 D01 DTS Meas Guidance v03r01**

The measurement of unwanted emissions at the edge of the authorized frequency bands can be complicated by the leakage of RF energy from the fundamental emission into the RBW pass band. Thus, for measurements at the band edges, a narrower resolution bandwidth (no less than 10 kHz) can be used within the first 1 MHz beyond the fundamental emission, provided that that measured energy is subsequently integrated over the appropriate reference bandwidth (i.e., 100 kHz or 1 MHz). This integration can be performed using the band power function of the spectrum analyzer or by summing the spectral levels (in linear power units) over the appropriate reference bandwidth.

#### 8.5 Field Strength Calculation:

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

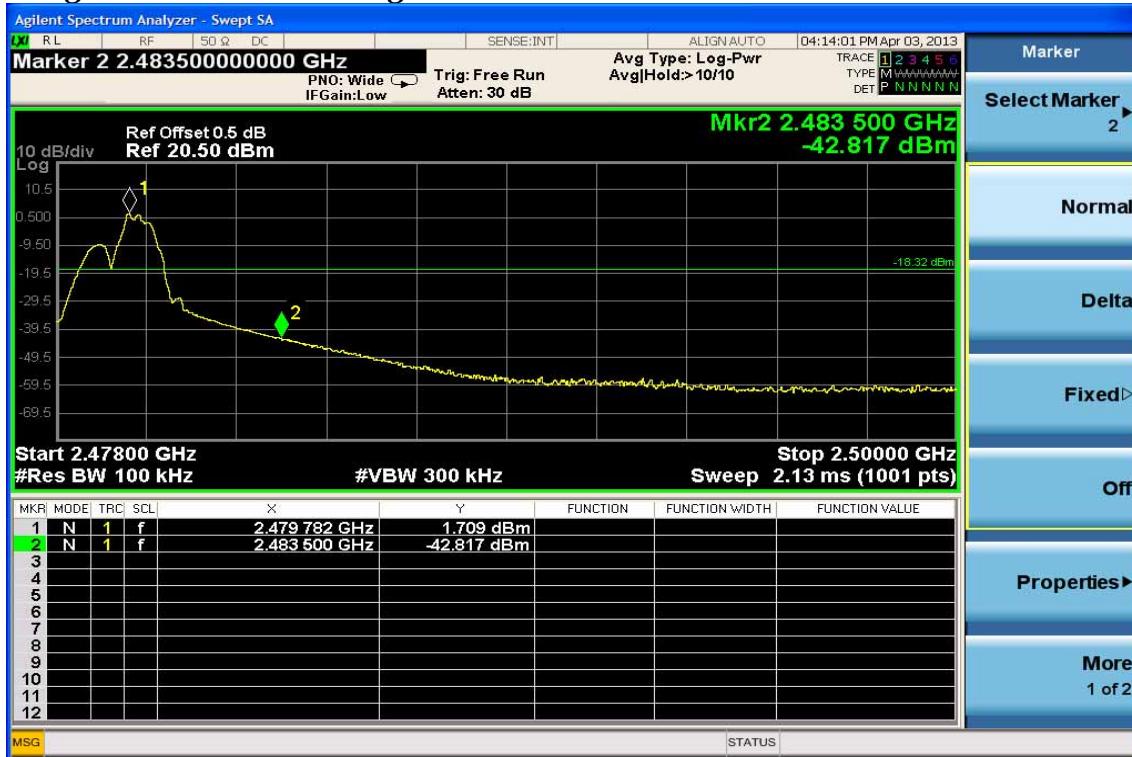
#### 8.6 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

## Band Edges Test Data CH-Low



## Band Edges Test Data CH-High



**Radiated Emission:**

Operation Mode	TX CH Low	Test Date	2013/04/06
Fundamental Frequency	2402 MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2363.30	50.96	-11.32	39.64	74.00	-34.36	Peak	VERTICAL
2	2390.00	48.15	-11.25	36.90	74.00	-37.10	Peak	VERTICAL
1	2369.60	50.61	-11.30	39.31	74.00	-34.69	Peak	HORIZONTAL
2	2390.00	48.80	-11.25	37.55	74.00	-36.45	Peak	HORIZONTAL

Operation Mode	TX CH High	Test Date	2013/04/06
Fundamental Frequency	2480 MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	2483.50	48.75	-11.01	37.74	74.00	-36.26	Peak	VERTICAL
2	2493.62	50.35	-10.98	39.37	74.00	-34.63	Peak	VERTICAL
1	2483.50	47.87	-11.01	36.86	74.00	-37.14	Peak	HORIZONTAL
2	2489.88	50.60	-11.00	39.60	74.00	-34.40	Peak	HORIZONTAL

**Remark:**

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 4 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 5 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

## 9 SPURIOUS RADIATED EMISSION TEST

### 9.1 Standard Applicable

According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

According to RSS-210 issue 8, §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

### 9.2 Measurement Equipment Used:

#### 9.2.1 Conducted Emission at antenna port:

Refer to section 6.2 for details.

#### 9.2.2 Radiated emission:

Refer to section 7.2 for details.

### 9.3 Test SET-UP:

#### 9.3.1 Conducted Emission at antenna port:

Refer to section 6.3 for details.

#### 9.3.2 Radiated emission:

Refer to section 7.3 for details.

#### 9.4 Measurement Procedure:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency measured were complete.

**Refer to section 11 and 12 emissions in restricted and non-estricted frequency bands Measurement Procedure of KDB Document: 558074 D01 DTS Meas Guidance v03r01**

#### 9.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

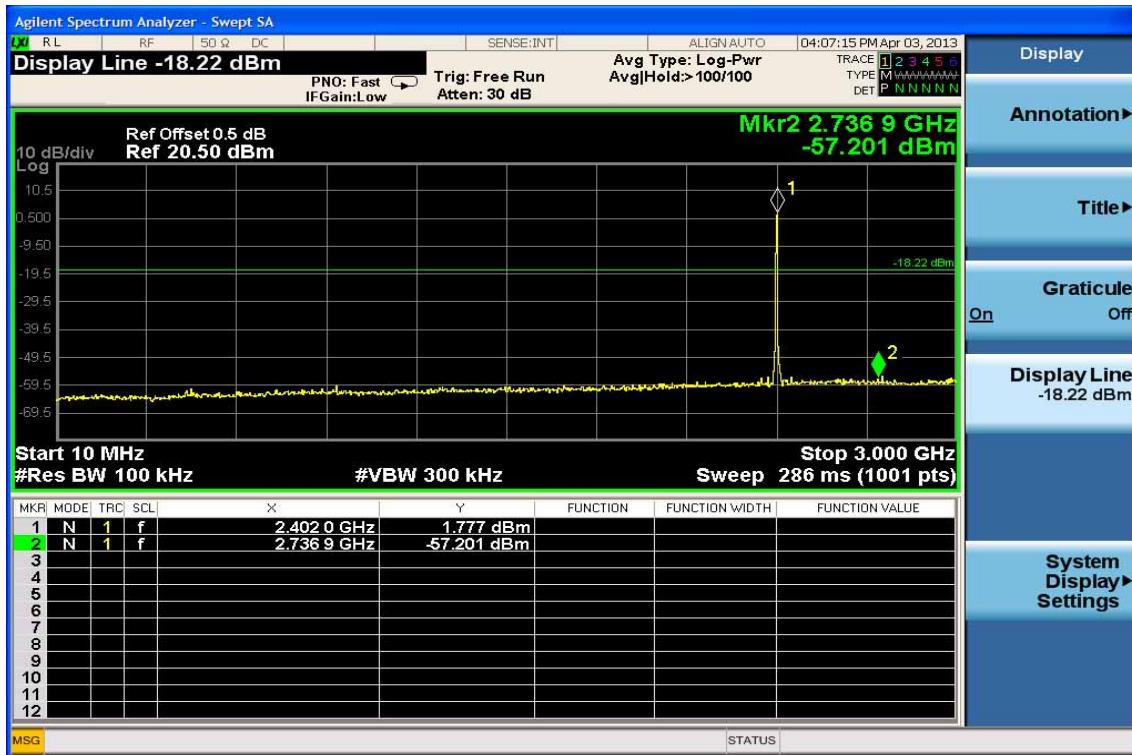
Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

#### 9.6 Measurement Result:

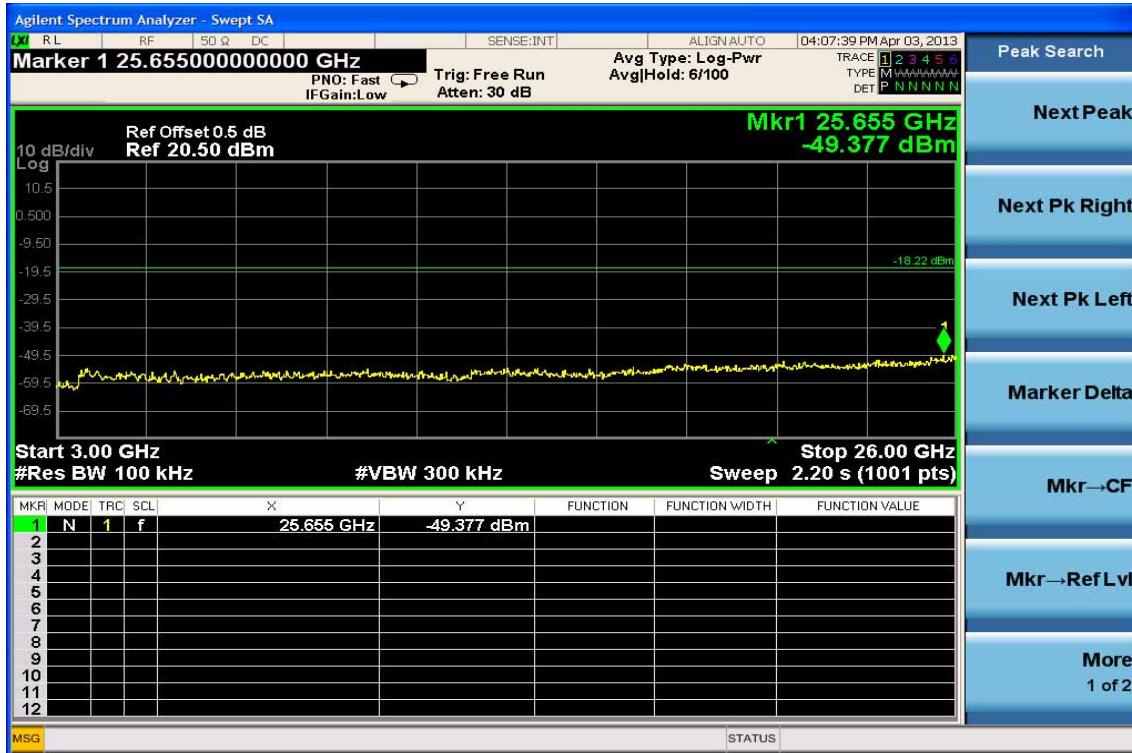
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

## Conducted Spurious Emission Measurement Result

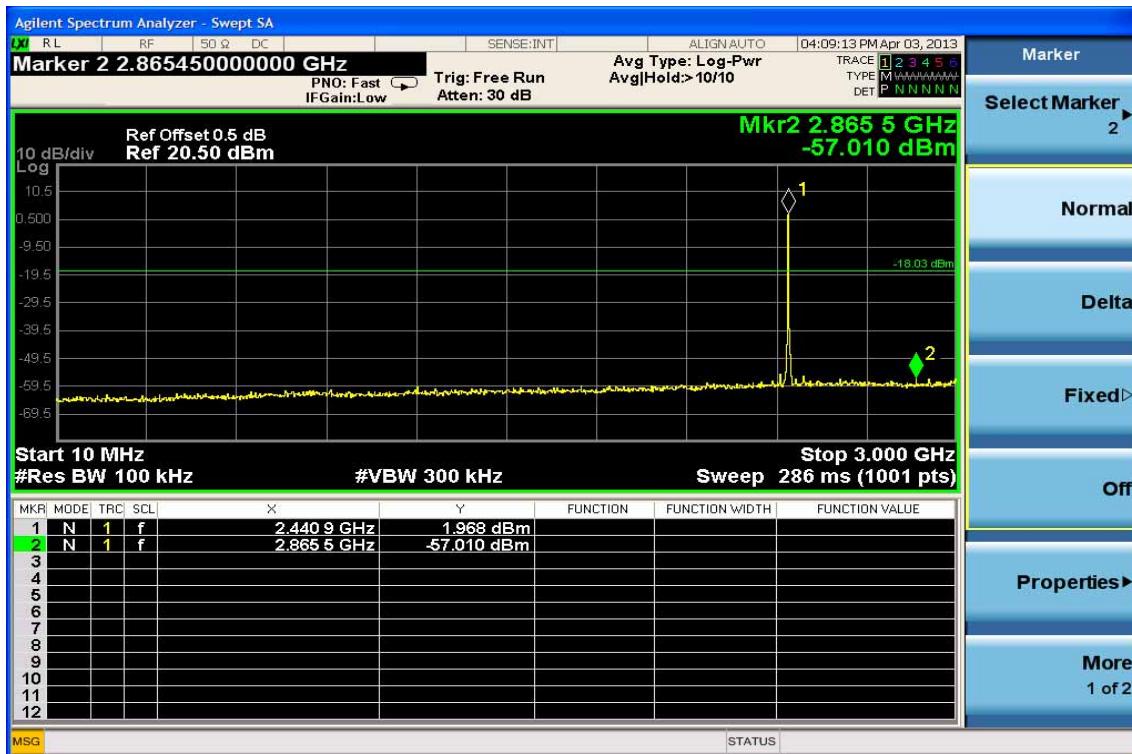
### Ch Low 30MHz – 3GHz



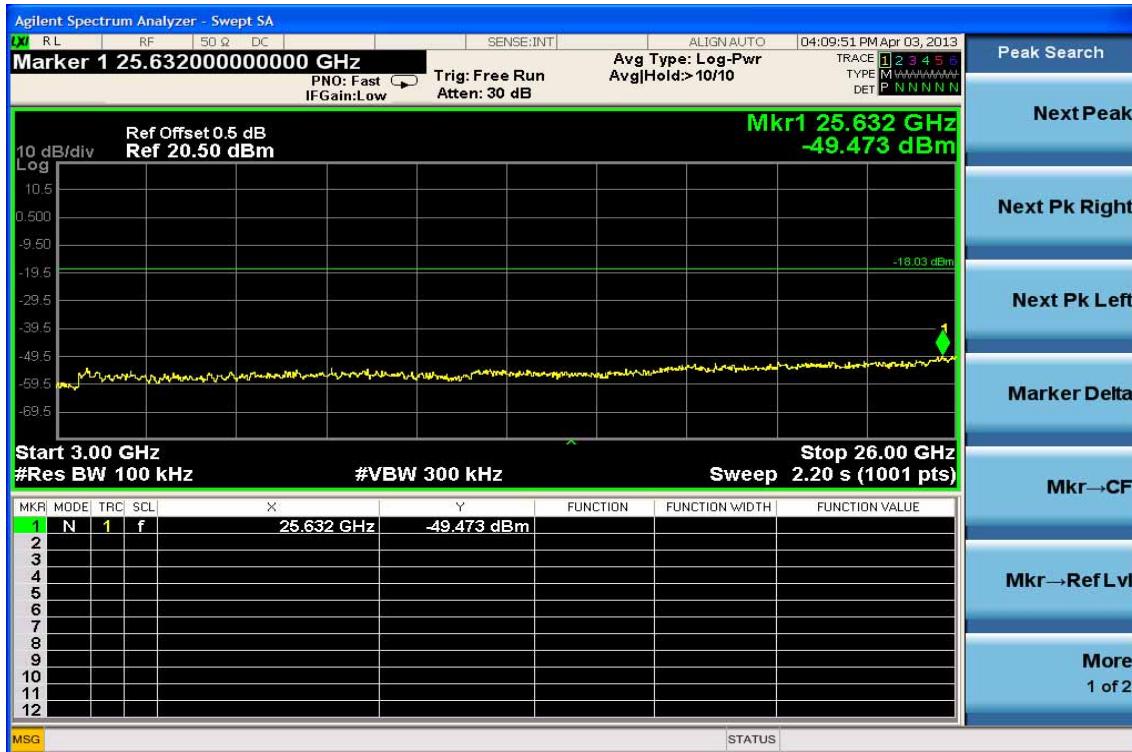
### Ch Low 3GHz – 26.5GHz



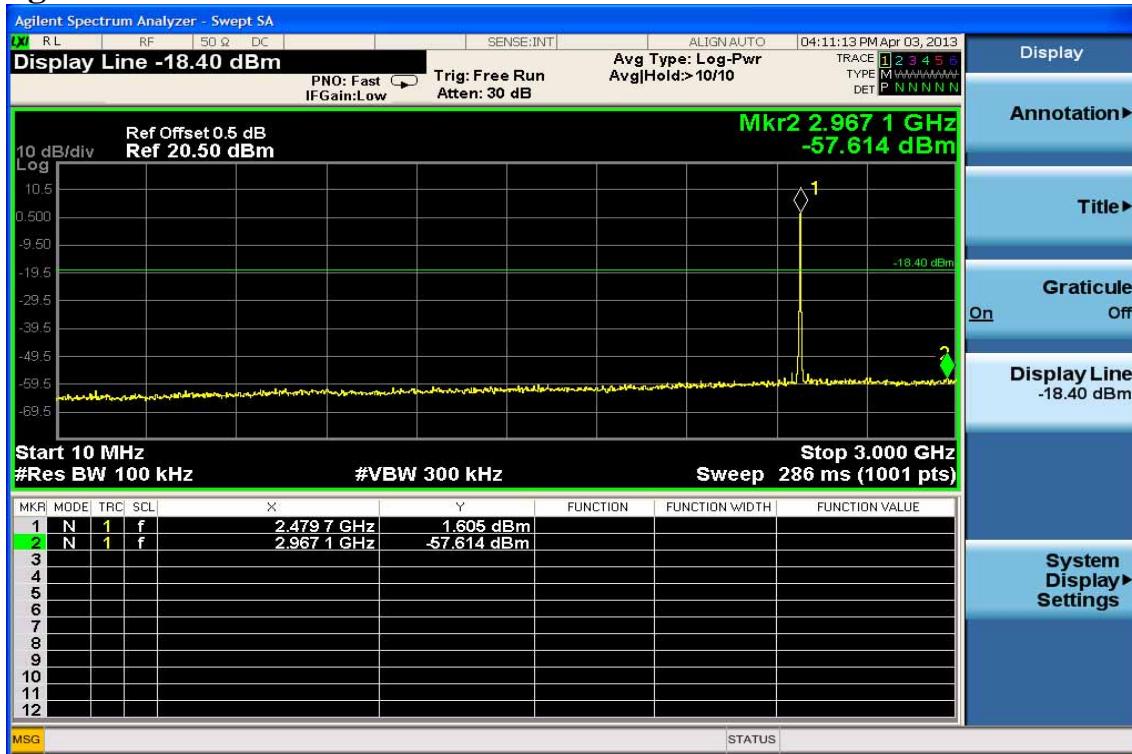
## Ch Mid 30MHz – 3GHz



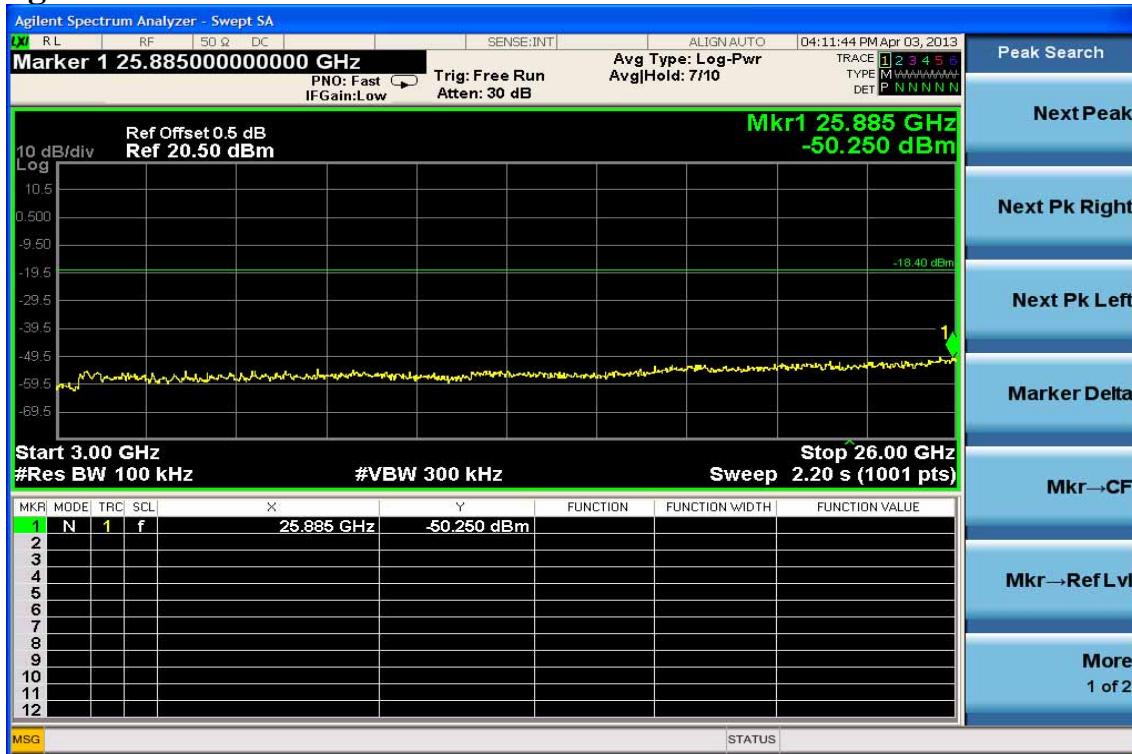
## Ch Mid 3GHz – 26.5GHz



## Ch High 30MHz – 3GHz



## Ch High 3GHz – 26.5GHz



## Radiated Spurious Emission Measurement Result: (below 1GHz)

Operation Mode	TX CH Low	Test Date	2013/04/06
Fundamental Frequency	2402MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	120.21	37.99	-15.34	22.65	43.50	-20.85	Peak	VERTICAL
2	296.75	40.63	-12.56	28.07	46.00	-17.93	Peak	VERTICAL
3	334.58	42.82	-11.75	31.07	46.00	-14.93	Peak	VERTICAL
4	444.19	36.07	-9.61	26.46	46.00	-19.54	Peak	VERTICAL
5	591.63	31.59	-6.95	24.64	46.00	-21.36	Peak	VERTICAL
6	668.26	39.38	-5.70	33.68	46.00	-12.32	Peak	VERTICAL
1	120.21	29.95	-15.34	14.61	43.50	-28.89	Peak	HORIZONTAL
2	333.61	38.28	-11.75	26.53	46.00	-19.47	Peak	HORIZONTAL
3	371.44	35.07	-10.98	24.09	46.00	-21.91	Peak	HORIZONTAL
4	445.16	31.71	-9.60	22.11	46.00	-23.89	Peak	HORIZONTAL
5	504.33	31.93	-8.96	22.97	46.00	-23.03	Peak	HORIZONTAL
6	594.54	32.67	-6.88	25.79	46.00	-20.21	Peak	HORIZONTAL

## Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz, VBW=300KHz.

## Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH Mid	Test Date	2013/04/06
Fundamental Frequency	2440MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	120.21	37.34	-15.34	22.00	43.50	-21.50	Peak	VERTICAL
2	222.06	38.31	-15.55	22.76	46.00	-23.24	Peak	VERTICAL
3	334.58	41.42	-11.75	29.67	46.00	-16.33	Peak	VERTICAL
4	498.51	34.41	-9.06	25.35	46.00	-20.65	Peak	VERTICAL
5	665.35	39.80	-5.76	34.04	46.00	-11.96	Peak	VERTICAL
6	740.04	32.15	-4.12	28.03	46.00	-17.97	Peak	VERTICAL
1	120.21	31.87	-15.34	16.53	43.50	-26.97	Peak	HORIZONTAL
2	332.64	39.92	-11.77	28.15	46.00	-17.85	Peak	HORIZONTAL
3	371.44	38.87	-10.98	27.89	46.00	-18.11	Peak	HORIZONTAL
4	445.16	34.33	-9.60	24.73	46.00	-21.27	Peak	HORIZONTAL
5	504.33	32.72	-8.96	23.76	46.00	-22.24	Peak	HORIZONTAL
6	594.54	34.80	-6.88	27.92	46.00	-18.08	Peak	HORIZONTAL

## Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz, VBW=300KHz.

## Radiated Spurious Emission Measurement Result (below 1GHz)

Operation Mode	TX CH High	Test Date	2013/04/06
Fundamental Frequency	2480MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	120.21	35.48	-15.34	20.14	43.50	-23.36	Peak	VERTICAL
2	222.06	37.68	-15.55	22.13	46.00	-23.87	Peak	VERTICAL
3	296.75	38.12	-12.56	25.56	46.00	-20.44	Peak	VERTICAL
4	332.64	41.88	-11.77	30.11	46.00	-15.89	Peak	VERTICAL
5	444.19	35.99	-9.61	26.38	46.00	-19.62	Peak	VERTICAL
6	668.26	39.22	-5.70	33.52	46.00	-12.48	Peak	VERTICAL
1	296.75	32.04	-12.56	19.48	46.00	-26.52	Peak	HORIZONTAL
2	333.61	34.99	-11.75	23.24	46.00	-22.76	Peak	HORIZONTAL
3	371.44	37.89	-10.98	26.91	46.00	-19.09	Peak	HORIZONTAL
4	594.54	33.08	-6.88	26.20	46.00	-19.80	Peak	HORIZONTAL
5	665.35	29.82	-5.76	24.06	46.00	-21.94	Peak	HORIZONTAL
6	740.04	29.86	-4.12	25.74	46.00	-20.26	Peak	HORIZONTAL

## Remark:

- 1 No further spurious emissions detected from the lowest internal frequency and 30MHz.
- 2 Measuring frequencies from the lowest internal frequency to the 1GHz.
- 3 Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak / QP detector mode.
- 4 Measurement result within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 The IF bandwidth of SPA between 30MHz to 1GHz was 100KHz, VBW=300KHz.

## Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Low	Test Date	2013/04/06
Fundamental Frequency	2402 MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	4804.00	38.99	-2.32	36.67	74.00	-37.33	Peak	VERTICAL
2	7206.00	37.66	4.36	42.02	74.00	-31.98	Peak	VERTICAL
1	4804.00	41.52	-2.32	39.20	74.00	-34.80	Peak	HORIZONTAL
2	7206.00	33.84	4.36	38.20	74.00	-35.80	Peak	HORIZONTAL

## Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 “F” denotes fundamental frequency; “H” denotes harmonics frequency. “S” denotes spurious frequency.
- 4 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

## Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH Mid	Test Date	2013/04/06
Fundamental Frequency	2440 MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	4880.00	35.80	-2.07	33.73	74.00	-40.27	Peak	VERTICAL
2	7320.00	39.09	4.50	43.59	74.00	-30.41	Peak	VERTICAL
1	4880.00	35.18	-2.07	33.11	74.00	-40.89	Peak	HORIZONTAL
2	7320.00	38.47	4.50	42.97	74.00	-31.03	Peak	HORIZONTAL

## Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 “F” denotes fundamental frequency; “H” denotes harmonics frequency. “S” denotes spurious frequency.
- 4 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 5 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 6 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

## Radiated Spurious Emission Measurement Result (above 1GHz)

Operation Mode	TX CH High	Test Date	2013/04/06
Fundamental Frequency	2480 MHz	Test By	Dino
Temperature	25 °C	Humidity	60 %

No	Freq MHz	Reading dBuV	Factor dB	Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark	Pol V/H
1	4960.00	35.61	-1.80	33.81	74.00	-40.19	Peak	VERTICAL
2	7440.00	37.02	4.64	41.66	74.00	-32.34	Peak	VERTICAL
1	4960.00	34.83	-1.80	33.03	74.00	-40.97	Peak	HORIZONTAL
2	7440.00	39.35	4.64	43.99	74.00	-30.01	Peak	HORIZONTAL

## Remark:

- 1 Measuring frequencies from the lowest internal frequency to the 10th of fundamental frequency
- 2 Field strength limits for frequency above 1000MHz are based on average limits. However, Peak mode field strength shall not exceed the average limits specified plus 20dB.
- 3 Measurement of data within this frequency range shown “ - ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 4 Spectrum Peak mode IF bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, Sweep time= 200 ms., the VBW setting was 3 MHz.
- 5 Spectrum AV mode if bandwidth Setting : 1GHz- 26GHz, RBW= 1MHz, VBW= 10Hz, Sweep time= 200 ms.

## 10 Peak Power Spectral Density

### 10.1 Standard Applicable:

According to §15.247(e) 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

According to RSS-210 issue 8, §A8.2(b) and §A8.3(2), The transmitter power spectral density (into the antenna) shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

### 10.2 Measurement Equipment Used:

Refer to section 6.2 for details.

### 10.3 Test Set-up:

Refer to section 6.3 for details.

### 10.4 Measurement Procedure:

**Refer to section 10.2 Peak Power Density(PKPPSD) Measurement Procedure of KDB Document: 558074 D01 DTS Meas Guidance v03r01**

- 1 Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
- 2 Set the RBW = 100 kHz.
- 3 Set the VBW  $\geq$  300 kHz.
- 4 Set the span to 5-30 % greater than the EBW.
- 5 Detector = peak.
- 6 Sweep time = auto couple.
- 7 Trace mode = max hold.
- 8 Allow trace to fully stabilize.
- 9 Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
- 10 Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where  $BWCF = 10\log(3 \text{ kHz}/100\text{kHz}) = -15.2 \text{ dB}$ ).
- 11 The resulting peak PSD level must be  $\leq 8 \text{ dBm}$ .

## 10.5 Measurement Result:

### LE mode

Frequency MHz	Power Density Reading (dBm)/100KHz	BWCF (dB)	Power Density Level (dBm)/3KHz	Maximum Limit (dBm)
2402	1.779	-15.2	-13.421	8
2440	1.942	-15.2	-13.258	8
2480	1.726	-15.2	-13.474	8

BWCF(bandwidth correction factor)= $10\log\left(\frac{3\text{ kHz}}{100\text{ KHz}}\right)$   
= -15.2 dB

## LT mode

### Power Spectral Density Test Plot (CH-Low)



### Power Spectral Density Test Plot (CH-Mid)



## Power Spectral Density Test Plot (CH-High)



## 11 ANTENNA REQUIREMENT

### 11.1 Standard Applicable:

According to §15.203, Antenna requirement.

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. 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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

According to RSS-GEN 7.1.2, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

### 11.2 Antenna Connected Construction:

The directional gain of antenna used for transmitting is 0.9dBi, and the antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

## 12 RF EXPOSURE

### 12.1 Standard Applicable

According to §2.1093 this is a Portable device.

For the radiation source included into the device the output power is taken from a corresponding RF test report. If needed the output power is converted to source based, time-average out power. Finally the output power is compared to FCC and IC low power SAR evaluation exemption level.

#### FCC SAR test exclusion:

According to KDB 447498 D01 V5, Appendix A: SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and  $\leq 50$  mm, the thresholds power level is 10mW (10dBm) at 5 mm.

The 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distance  $\leq 50$ mm are determined by

$$\frac{\text{max. power of channel [mW]}}{\text{min. test separation distance [mm]}} \cdot \sqrt{f[\text{GHz}]} \leq \begin{cases} 3.0 & 1g \text{ SAR} \\ 7.5 & 10g \text{ SAR} \end{cases}$$

- $f$  [GHz] is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

#### IC Exemption from Routine Evaluation Limits – SAR Evaluation: RSS 102 Issue 4

SAR evaluation is required if the separation distance between the user and the radiating element of the device is less than or equal to 20 cm, except when the device operates as follows:

above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use;

### 12.2 Measurement Result:

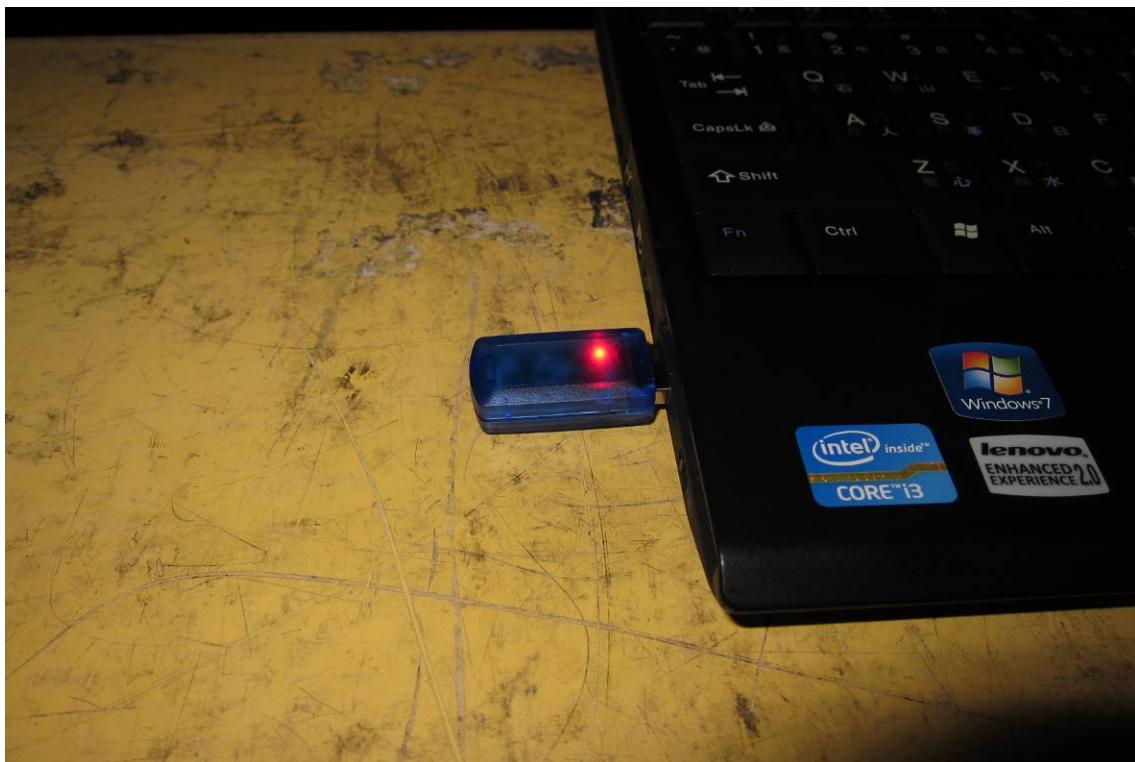
The Measured Max. peak output power is 3.24dBm (0.002 W), which is lower than the threshold power level 10 mW (24.48mW) at 5mm (KDB 447498 D01 V5, Appendix A) in general population category ; and 20mW in RSS 102 issue 4.

The SAR measurement is not necessary.

## APPENDIX 1

## PHOTOGRAPHS OF SET UP

### Radiated Emission Setup Photos



### Conducted Emission Setup Photos



## APPENDIX 2

## PHOTOGRAPHS OF EUT

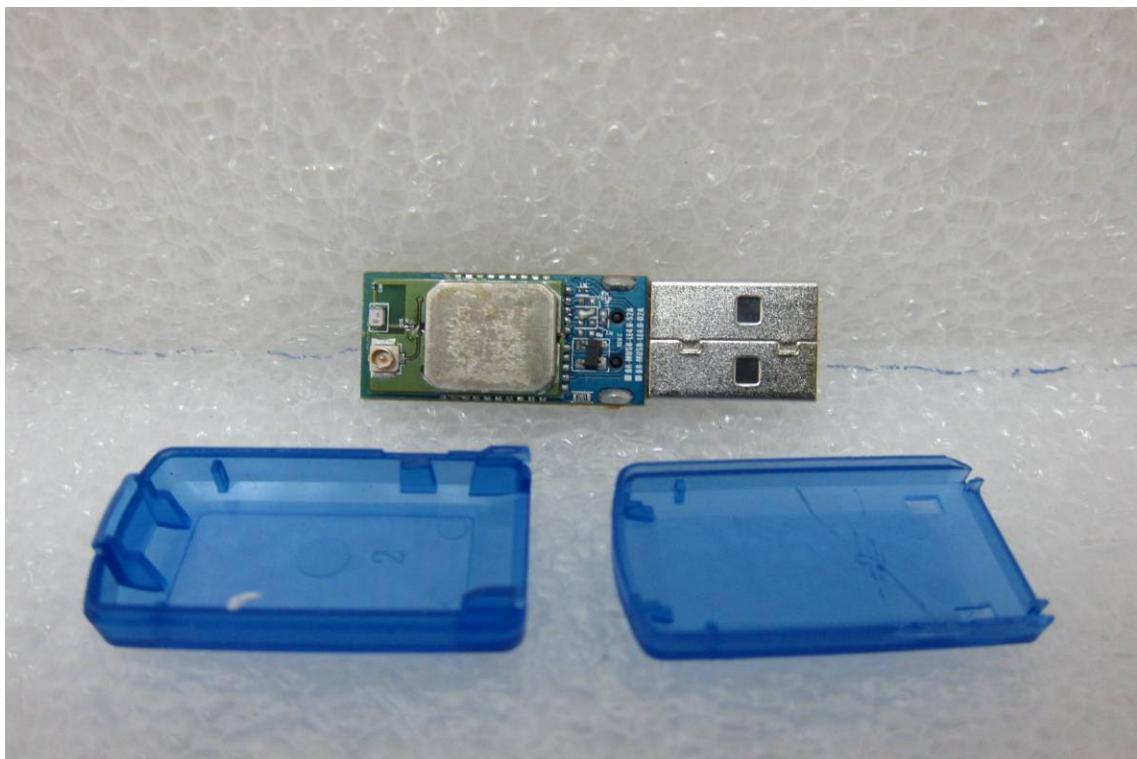
**EUT 1**



**EUT 2**



**EUT 3**



**EUT 4**



**EUT 5**



*~ End of Report ~*