

JAPAN MIC Radio Test Report

FOR

Product Name: BLE and 802.15.4 module

Brand Name: Texas Instruments Incorporated

Model No.: CC2650MODA

Model Difference: N/A

Report No.: E2/2016/40068

Issue Date: May 25, 2016

Prepared for: Texas Instruments Incorporated
12500 TI Boulevard, M/S 8751, Dallas, TX75243,
USA
SGS Taiwan Ltd.

Prepared by: Electronics & Communication Laboratory
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VERIFICATION OF COMPLIANCE

Applicant: Texas Instruments Incorporated
12500 TI Boulevard, M/S 8751, Dallas, TX75243, USA

Product Name: BLE and 802.15.4 module

Brand Name: Texas Instruments Incorporated

Model No.: CC2650MODA

Model Difference: N/A

File Number: E2/2016/40068

Date of test: May 04, 2016 ~ May 13, 2016

Date of EUT Received: May 04, 2016

APPLICABLE STANDARDS

STANDARD	TEST RESULT
ARIB STD-T66	Complied

The above equipment was tested by SGS Taiwan Ltd. for compliance with the requirements in the Radio equipment stipulated in the certification ordinance Article 2, Item (19) Appendix 43, B-1 (2). Item 19 of Article 2 Paragraph 1. The results of testing in this report apply to the product system that was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Test By:

Jerry Lu

Date:

May 25, 2016

Jerry Lu / Sr. Engineer

Prepared By:

Violetta Tang

Date:

May 25, 2016

Violetta Tang / Clerk

Approved By:

Jim Chang

Date:

May 25, 2016

Jim Chang / Asst. Manager

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Revision History

Report Number	Revision	Description	Issue Date
E2/2016/40068	Rev.00	Initial creation of document	May 25, 2016

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1. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

1.1 GENERAL INFORMATION

General:

Product Name:	BLE and 802.15.4 module
Brand Name:	Texas Instruments Incorporated
Model No.:	CC2650MODA
Model Difference:	N/A
Product HW version:	N/A
Product SW version:	N/A
Power Supply:	3.3V from DC Power Supply

Bluetooth:

Bluetooth Version:	V4.1 single mode
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	2.897mW for Normal Mode
Frequency Range:	2.402GHz – 2.480GHz
Antenna Designation:	Chip Antenna, Gain: 1.256dBi

The EUT is compliance with Bluetooth Standard.

This report applies for Bluetooth function.

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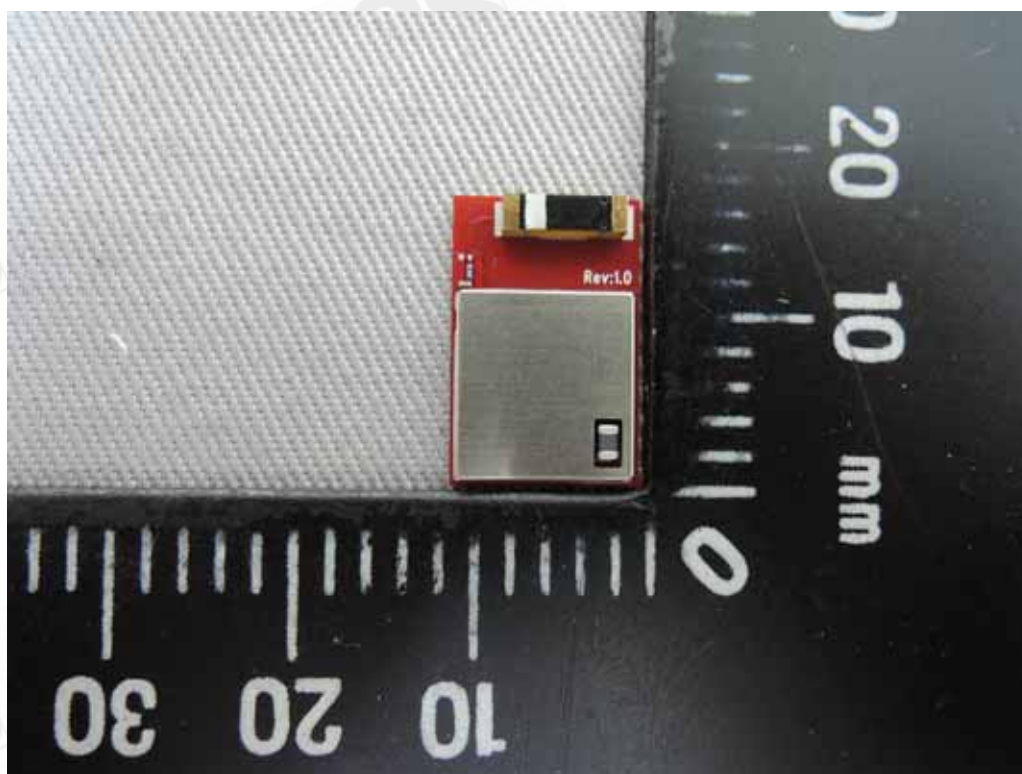
1.2 ANTENNA SPECIFICATION

Bluetooth

Antenna Type:	Chip Antenna
Part number:	WAN7020L245M0X
Manufacturer:	OneWave Electronic Co., Ltd
Peak Gain:	1.256dBi
Radiation pattern:	Omni

1.3 ASSEMBLE

This IC Package consists of shield cover technology. The structure inner is shown in the illustration below.



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2. DESCRIPTION OF TEST MODES**2.1. OPERATED IN 2400 ~ 2483.5MHZ BAND**

40 channels are provided for Bluetooth LE

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

2.2. THE WORST TEST MODES AND CHANNEL DETAILS

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

For Bluetooth LE:

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1.0

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2.3. TEST CONDITIONS

Temperature & humidity	Normal
Normal voltage	3.0Vdc
Lower extreme voltage	2.97Vdc
Higher extreme voltage	3.63Vdc

3. GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT According to the Specifications, it must comply with the requirements of the following standards:

Radio equipment stipulated in the certification ordinance Article 2, Item (19) Appendix 43, B-1 (2) and Item 19 of Article 2 Paragraph 1.

4. TEST FACILITY

SGS Taiwan Ltd. Electronics & Communication Laboratory
No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333
(ISO 17025 of TAF code 0513)

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5. SUPPORT EQUIPMENT

Fig. 5-1 Configuration of Tested System

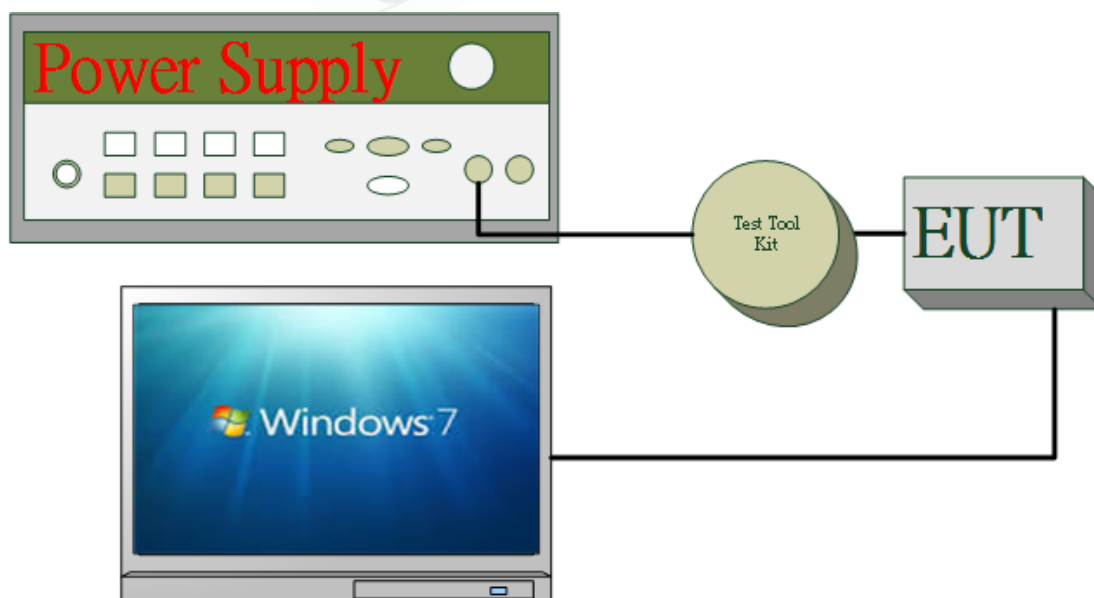


Table 5-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	MY53130054	N/A	Un-Shielded
3.	Notebook	Lenovo	L440	R9-007LAZ	Shielded	Un-Shielded

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6. SUMMARY OF TESTS

Article reference	Report reference	Parameter	Status (Note 1)
General provisions			
5	6.2	Frequency tolerance	C
6	6.3	Occupied bandwidth	C
7	6.5	Spurious emission	C
Transmitting equipment			
14	6.1	Antenna Power	C
14.07	--	SAR	N/A
15	6.2	Frequency stabilization	C
Transmitting equipment			
20	1.2	Type configuration etc of transmitting antenna	C
22	1.2	Directional pattern of transmitting antenna	C
Receiving equipment			
24	6.6	Spurious emission of receiver	C
26	1.2	Refer to all articles for transmitting antenna	C
Operating frequency 2400-2483.5MHz			
49.20(1); a	1.3	High Frequency/modulation section cannot be operated easily	C
49.20(1); b	1.1	Communication method	C
49.20(1); c	1.1	Communication method	C
49.20(1); d	1.1	Spread Spectrum method	C
49.20(1); e	6.1	Antenna Power	C
49.20(1); f(1)	1.2	Absolute gain of transmitting antenna	C
49.20(1); f(2)	6.8	Angular width of principal radiation (AWPR)	C
49.20(1); g		Number of carriers within 1MHz bandwidth in OFDM	N/A
49.20(1); h	6.4	Diffusion bandwidth	N/A
49.20(1); i	6.4	Spreading factor	N/A
49.20(1); j	6.7	Frequency retention time (FH employed)	C
Note 1: C=Confirm NC=Not Confirm NT=Not Tested NA= Not Applicable			

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6.1. ANTENNA POWER AND TOLERANCE**6.1.1. Limit:**

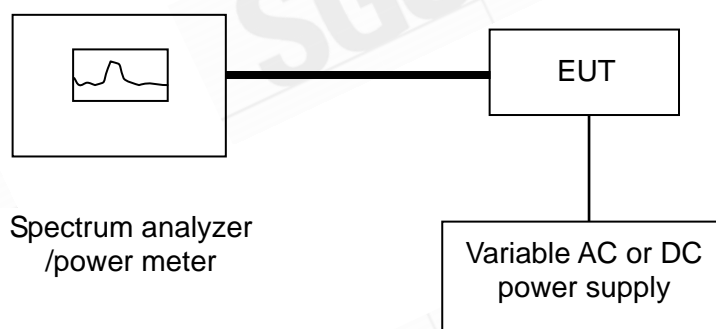
FHSS: Antenna power: 3mW/MHz

DSSS: Antenna power: 10mW

Antenna power tolerance: + 20% to – 80%

6.1.2. Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	04/14/2016	04/13/2017
Power Meter	Anritsu	ML2496A	1326001	06/23/2015	06/22/2016
Power Sensor	Anritsu	MA2411B	1315048	06/23/2015	06/22/2016
Power Sensor	Anritsu	MA2411B	1315049	06/23/2015	06/22/2016
Temperature Chamber	TERCHY	MHK-120LK	1020582	06/23/2015	06/22/2016
Coaxial Cable 30cm	WOKEN	00100A1F1A 195C	RF01	12/12/2015	12/11/2016
DC Block	PASTERNAK	PE8210	RF29	12/12/2015	12/11/2016
Splitter	RF-LAMBAD	RFLT2W1G1 8G	RF35	12/12/2015	12/11/2016
Attenuator	WOKEN	218FS-10	RF23	12/12/2015	12/11/2016
DC Power Supply	Agilent	E3640A	MY53140006	05/04/2016	05/03/2017

6.1.3. Test Setup:**6.1.4. Test Procedure:**

1. Set the EUT modulation on.
2. Set the ETU operates at channel low, mid and high and normal/Upper/Lower voltage.
3. Connect the EUT to Spectrum IF output
4. Spectrum IF output to power meter.
5. Record the power level.

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6.1.5. Test results:

Ambient temperature: 24Relative humidity: 63 %

Test Date: 05/04/2016

Bluetooth LE :

Rated Power Density = 2.897 mW

Antenna Gain = 1.256 dBi

		CH 2402	CH 2442	CH 2480	Limit
Normal Voltage (3.3Vdc)	Antenna Power (dBm)	4.620	4.490	4.300	N/A
	Antenna Power (mW)	2.897	2.812	2.692	10mW
	Power Tolerance	0.00	-2.95	-7.10	+20% to -80%
Upper Voltage (3.63Vdc)	Antenna Power (dBm)	4.570	4.510	4.220	N/A
	Antenna Power (mW)	2.864	2.825	2.642	10mW
	Power Tolerance	-1.14	-2.50	-8.80	+20% to -80%
Lower Voltage (2.97Vdc)	Antenna Power (dBm)	4.360	4.420	4.320	N/A
	Antenna Power (mW)	2.729	2.767	2.704	10mW
	Power Tolerance	-5.81	-4.50	-6.67	+20% to -80%

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6.2. FREQUENCY TOLERANCE**6.2.1. Limit:**

50ppm

6.2.2. Measurement Equipment Used:

Refer to section 6.1.2 for detail.

6.2.3. Test Setup:

Refer to section 6.1.3 for detail.

6.2.4. Test Procedure:

1. Set the EUT modulation off.
2. Set the EUT operates at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer RBW = 300Hz, VBW=300Hz and Span = 20kHz
4. Max hold, View, Peak High, Mark and snap the screen and record the mark.

6.2.5. Test Results:Ambient temperature: 24 Relative humidity: 65 % Test Date: 05/04/2016**Bluetooth LE**

Unit	Upper Voltage + 10% (3.63 V)			Limit
	2402	2442	2480	
Frequency	2401.91840	2441.92008	2479.91586	
ppm	33.972	32.727	33.927	50ppm
Unit	Normal Voltage (3.3 V)			Limit
	2402	2442	2480	
Frequency	2401.91846	2441.92017	2479.91592	
ppm	33.947	32.690	33.903	50ppm
Unit	Lower Voltage - 10% (2.97 V)			Limit
	2402	2442	2480	
Frequency	2401.91855	2441.91937	2479.91596	
ppm	33.909	33.018	33.887	50ppm

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6.3. OCCUPIED BANDWIDTH**6.3.1. Limit:**

Bluetooth LE < 26MHz

6.3.2. Measurement Equipment Used:

Refer to section 6.1.2 for detail.

6.3.3. Test Setup:

Refer to section 6.1.3 for detail.

6.3.4. Test Procedure:

1. Set the EUT modulation on.
2. Set the EUT operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer RBW = 300kHz, VBW=300kHz, center frequency = Bluetooth=2441MHz, BLE =2402MHz, 2442MHz, 2480MHz with Hopping Function and Span, Bluetooth =100MHz, BLE=5MHz
4. Turn on 99% spectrum OBW function on, Max hold, View, and snap the screen and record the mark.

6.3.4. Test Results:Ambient temperature: 24Relative humidity: 65 % Test Date: 05/04/2016**Bluetooth LE**

Unit	Upper Voltage + 10% (3.63 V)			Limit
	2402	2442	2480	
Occupied Bandwidth	1.389	1.284	1.338	26MHz
Unit	Normal Voltage (3.3 V)			Limit
	2402	2442	2480	
Occupied Bandwidth	1.426	1.349	1.337	26MHz
Unit	Lower Voltage - 10% (2.97 V)			Limit
	2402	2442	2480	
Occupied Bandwidth	1.394	1.274	1.323	26MHz

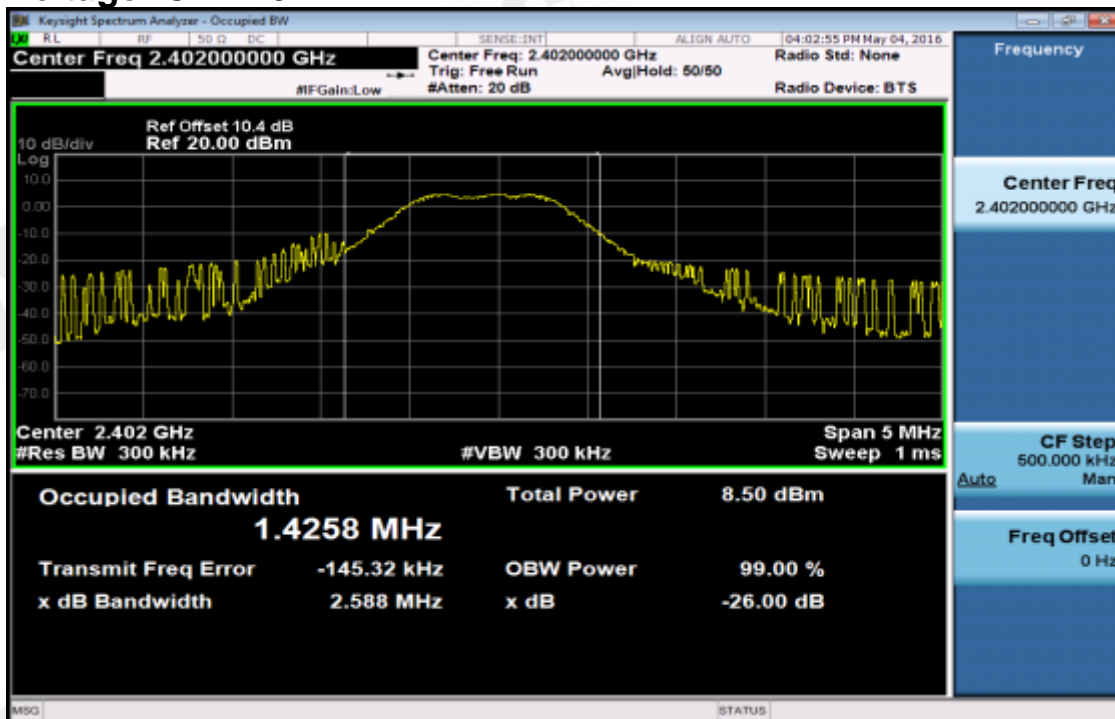
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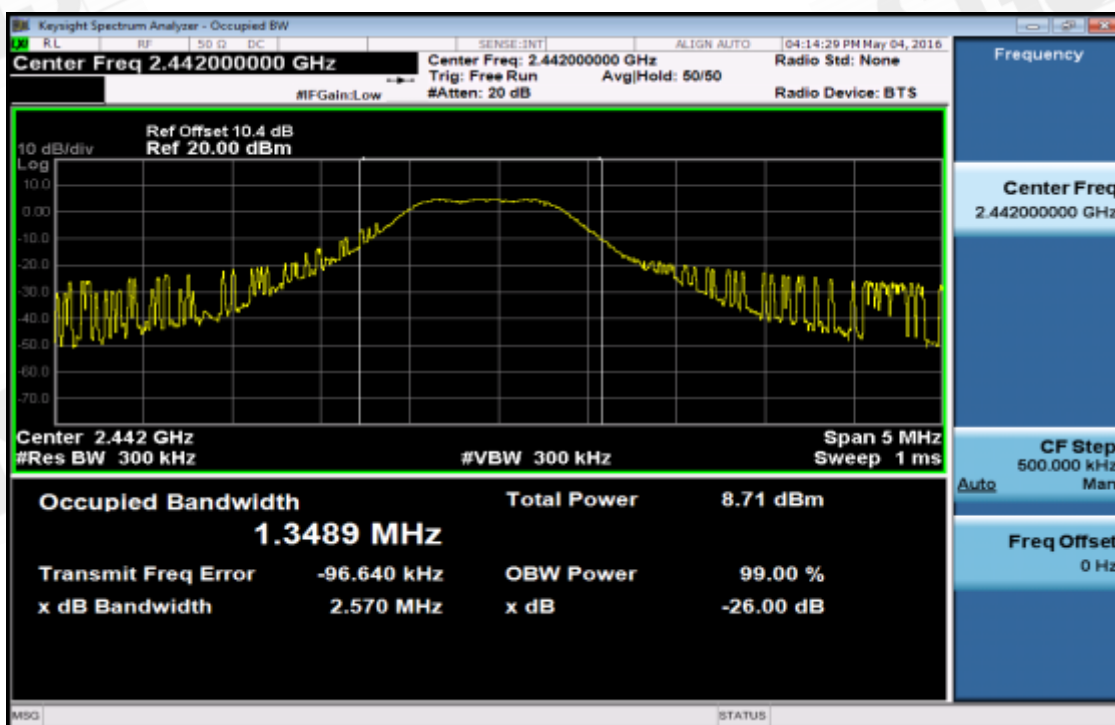
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Normal voltage: CH 2402



Normal voltage: CH 2442



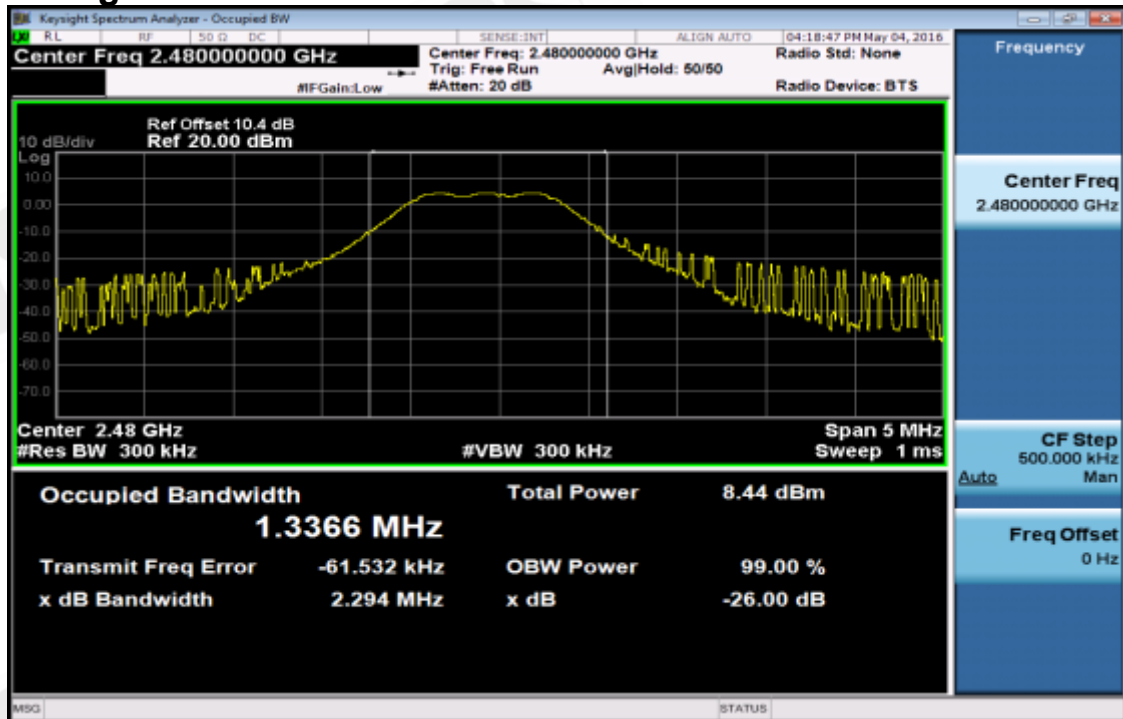
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Normal voltage: CH 2480



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6.4. SPREADING BANDWIDTH (90%)**6.4.1. Limit:**

Spread Factor: 1~13ch>5, 14ch >10 for WLAN

6.4.2. Measurement Equipment Used:

Refer to section 6.1.2 for detail.

6.4.3. Test Setup:

Refer to section 6.1.3 for detail.

6.4.4. Test Procedure:

1. Set the EUT modulation on.
2. Set the EUT operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer RBW = 300kHz, VBW=300kHz, center frequency = Bluetooth=2441MHz, BLE =2402MHz, 2442MHz, 2480MHz with Hopping Function and Span =, Bluetooth=100MHz, BLE=5MHz
4. Turn on 99% spectrum OBW function on, Max hold, View, and snap the screen and record the mark.

6.4.5. Test results:Ambient temperature: 24 Relative humidity: 65 % Test Date: 05/04/2016**Bluetooth LE**

Unit	Upper Voltage + 10% (3.63 V)			Limit
	2402	2442	2480	
Spread Bandwidth	0.854	0.845	0.855	N/A
Unit	Normal Voltage (3.3 V)			Limit
	2402	2442	2480	
Spread Bandwidth	0.859	0.841	0.861	N/A
Unit	Lower Voltage - 10% (2.97 V)			Limit
	2402	2442	2480	
Spread Bandwidth	0.865	0.844	0.860	N/A

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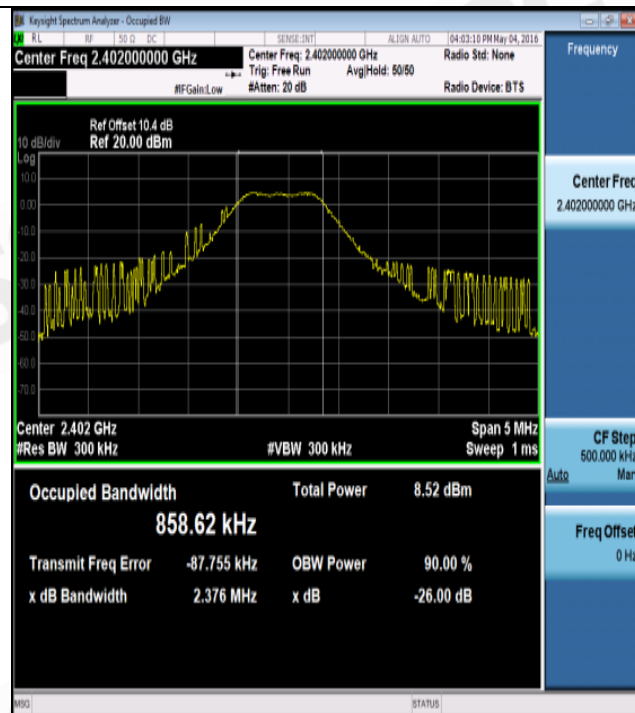
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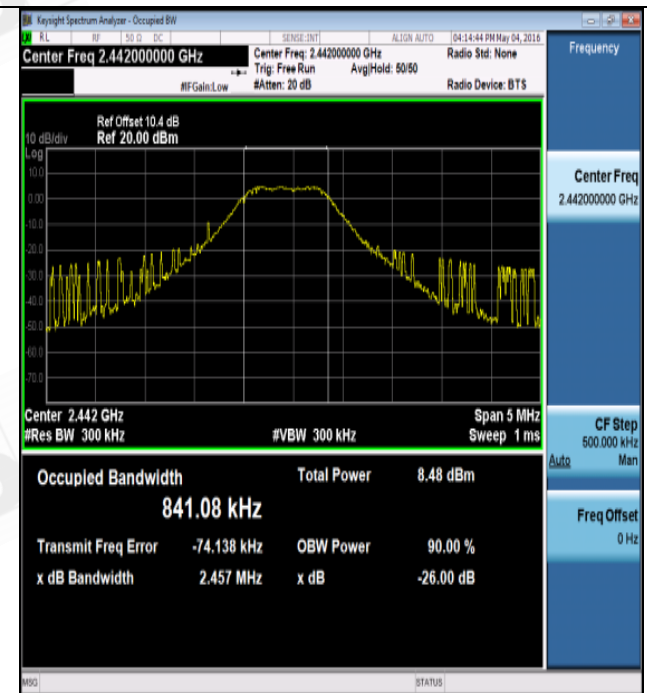
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Test Plots: Normal Voltage BLE

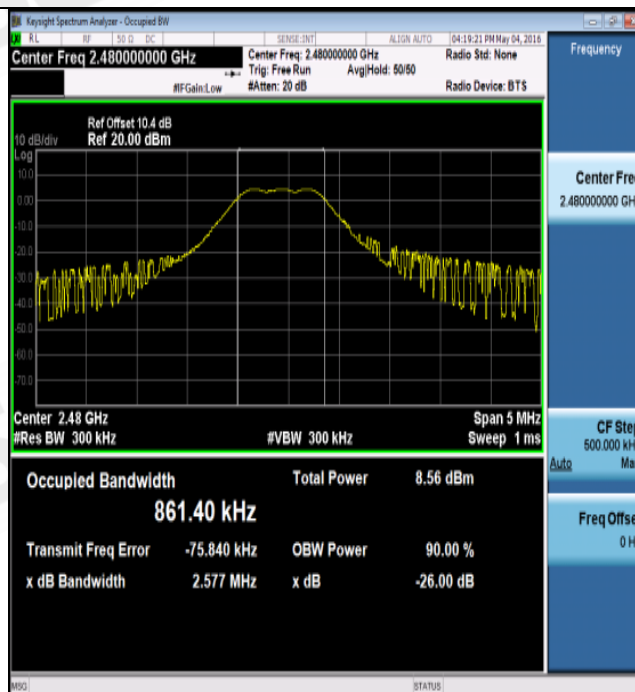
Channel 2402



Channel 2442



Channel 2480



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6.5. TRANSMITTER SPURIOUS EMISSIONS

6.5.1. Limit:

Frequency below 2.387 and above 2.4965GHz :2.5uW

Frequency between 2.387 – 2.400GHz, 2.4835-2.4965GHz: 25uW

6.5.2. Measurement Equipment Used:

Refer to section 6.1.2 for detail.

6.5.3. Test Setup:

Refer to section 6.1.3 for detail.

6.5.4. Test Procedure:

1. Set the EUT modulation on.
2. Set the EUT operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer Ref level= peak ratio; RBW=100KHz, BW=100KHz , Sweep = auto Start=10MHz, Stop=1000MHz. Max hold view, mark highest level.
4. Set the spectrum analyzer Ref level= peak ratio; RBW=1MHz, BW=1MHz , Sweep = auto Start=1000MHz, Stop=2387MHz. Max hold view, mark highest level.
5. Set the spectrum analyzer Ref level= peak ratio; RBW=1MHz, BW=1MHz, Sweep = auto, Start=2387MHz, Stop=2400MHz. Max hold view, mark highest level.
Set the spectrum analyzer Ref level= peak ratio; RBW=1MHz, BW=1MHz, Sweep = auto Start=2483.5MHz, Stop=2496.5MHz.. Max hold view, mark highest level.
Set the spectrum analyzer Ref level= peak ratio; RBW=1MHz, BW=1MHz, Sweep = auto, Start=2496.5MHz, Stop=26.5GHz. Max hold view, mark highest level.
6. The Worst data was report.

6.5.5. Test Results:

Ambient temperature: 24

Relative humidity: 65 % Test Date: 05/04/2016

Refer to next page for plots.

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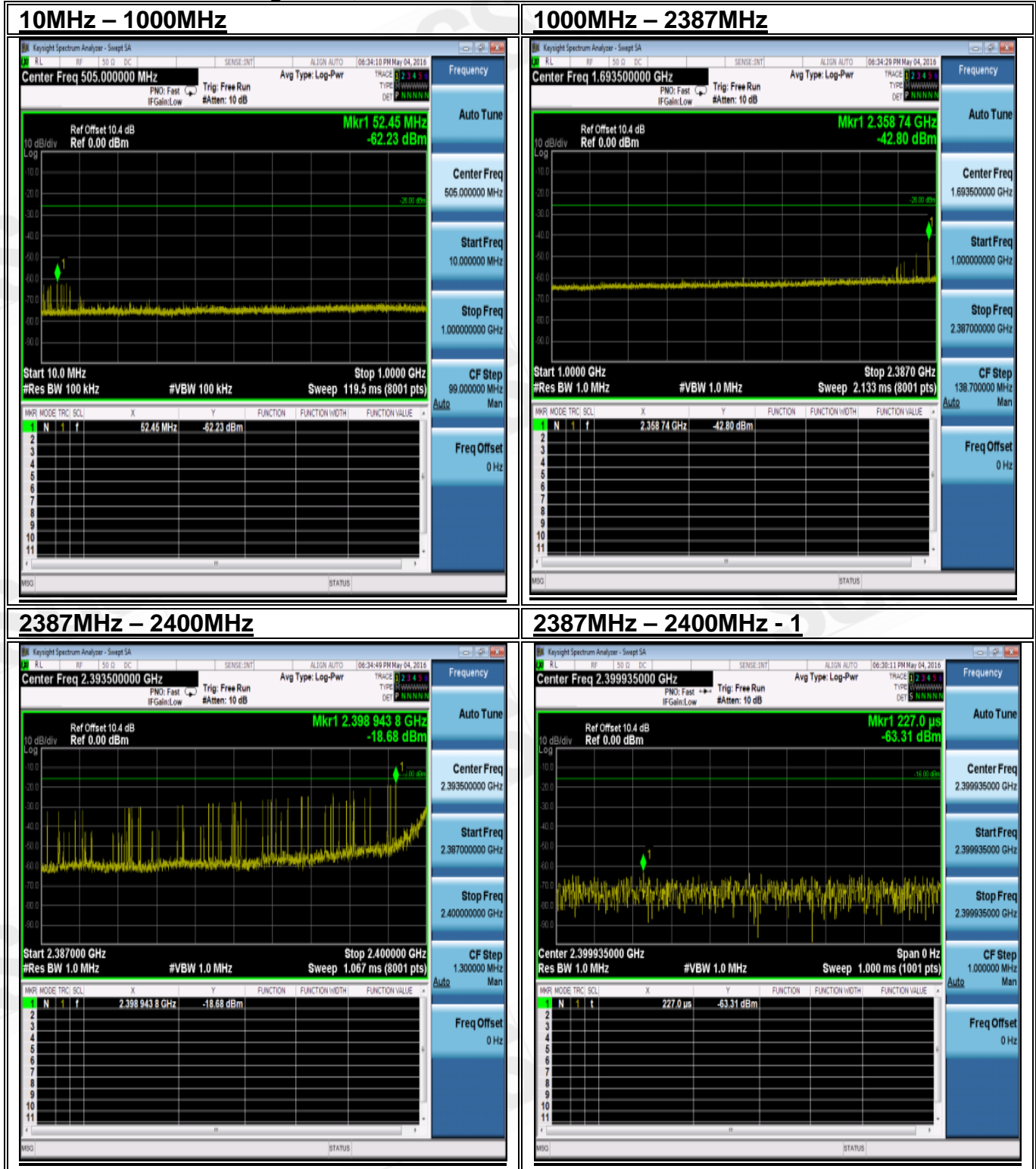
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Test Plots: Normal Voltage BLE, GFSK Channel 2402



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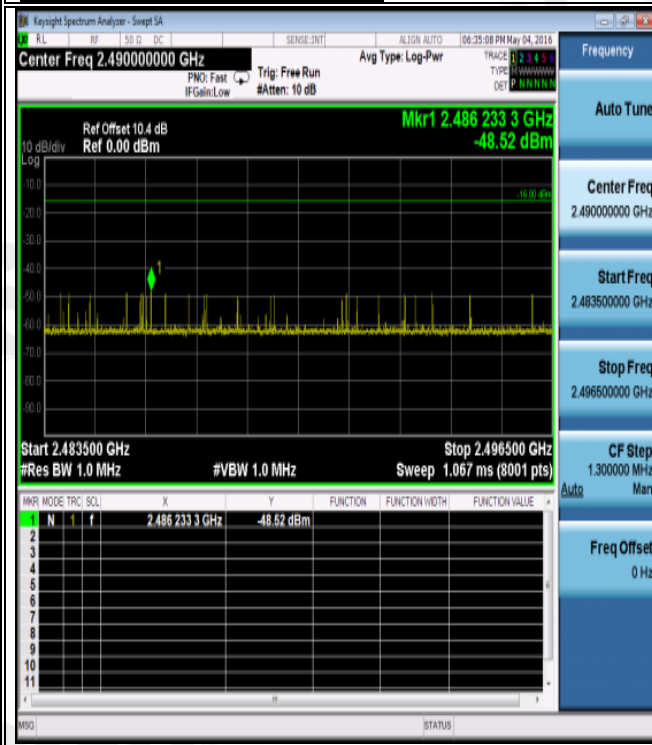
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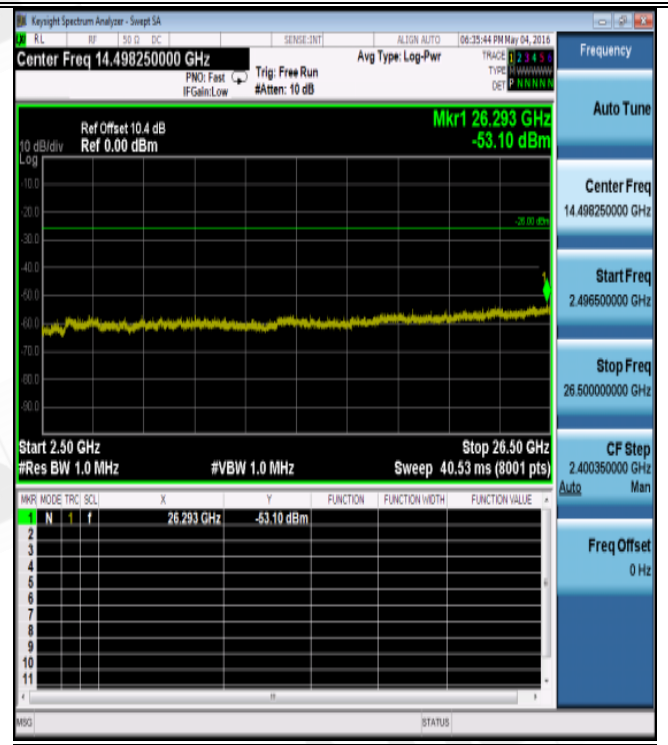
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2483.5MHz – 2496.5MHz



2496.5MHz~26.5GHz



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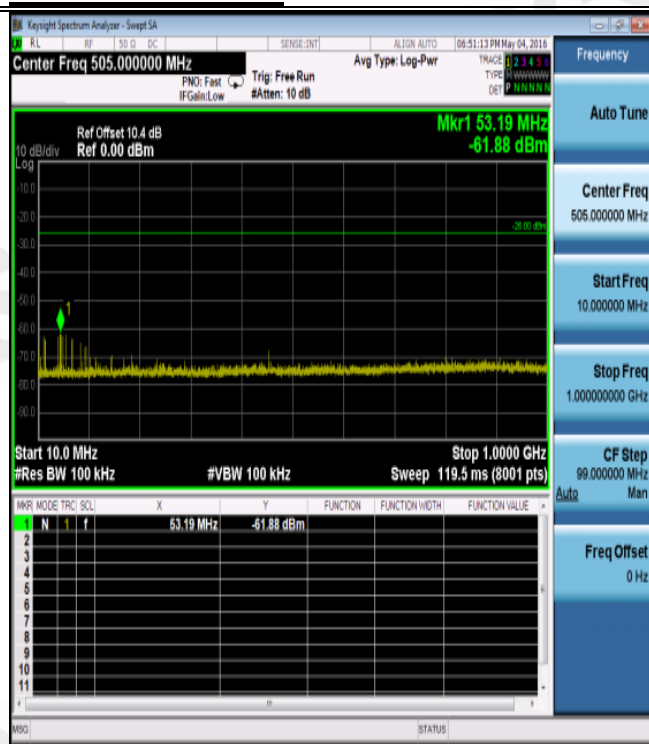
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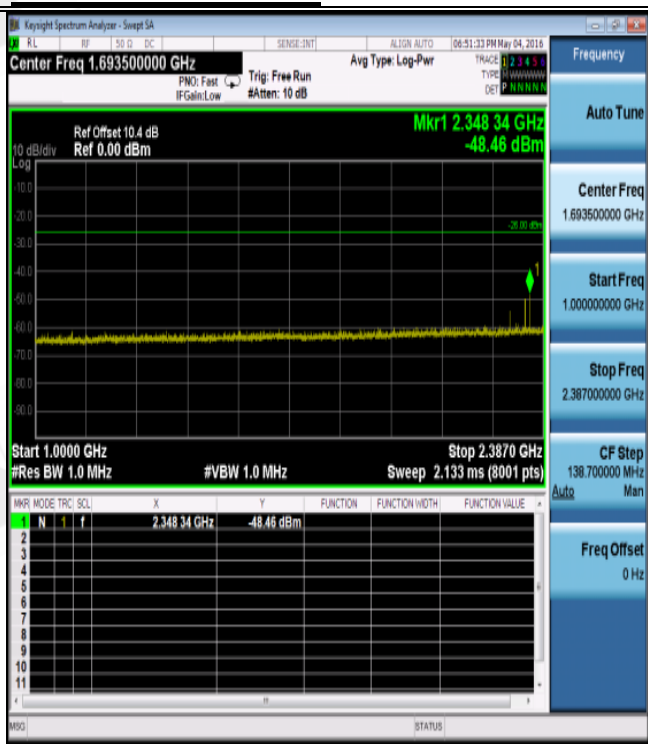
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Test Plots: Normal Voltage BLE, GFSK Channel 2442

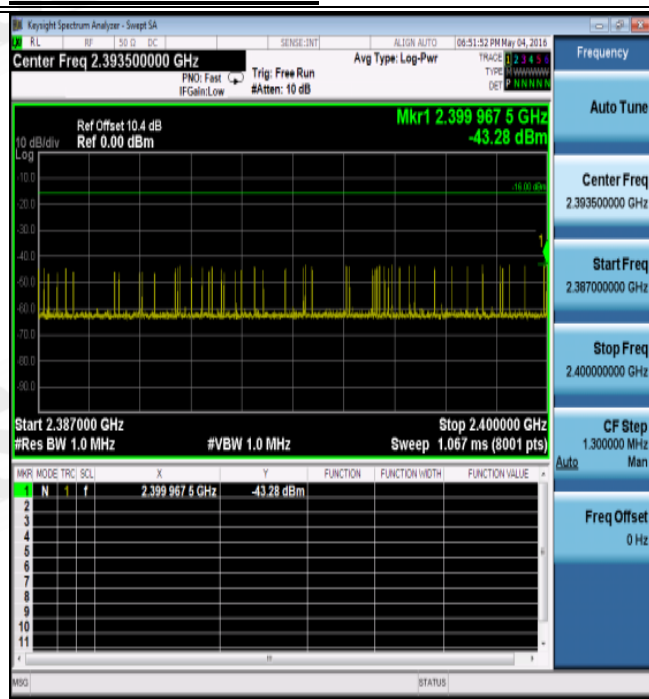
10MHz – 1000MHz



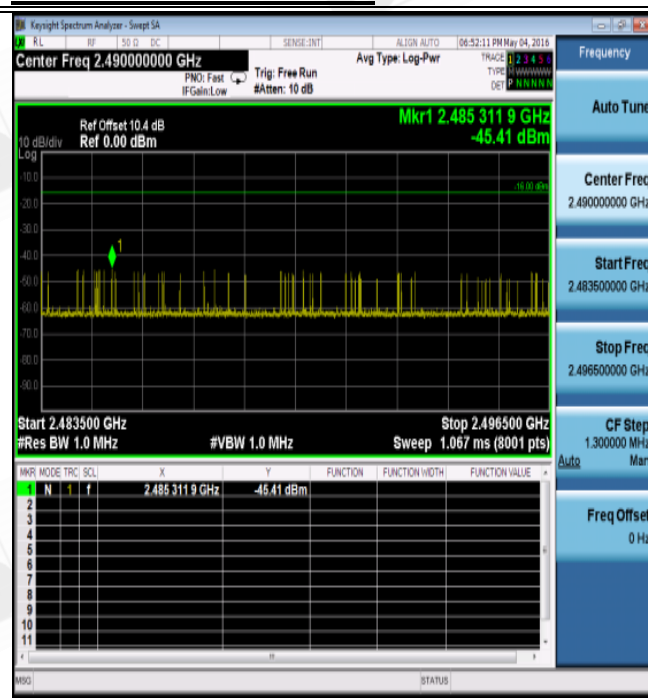
1000MHz – 2387MHz



2387MHz – 2400MHz



2483.5MHz – 2496.5MHz



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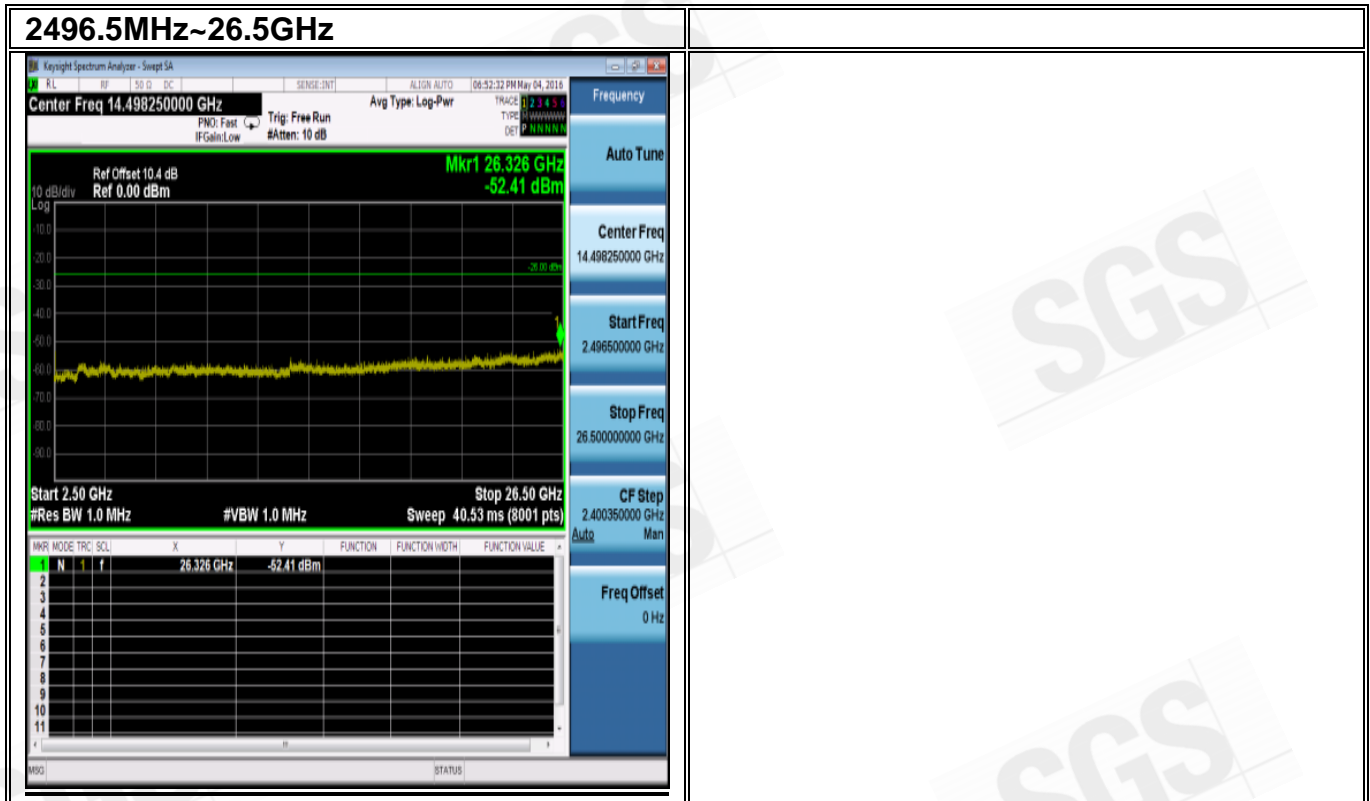
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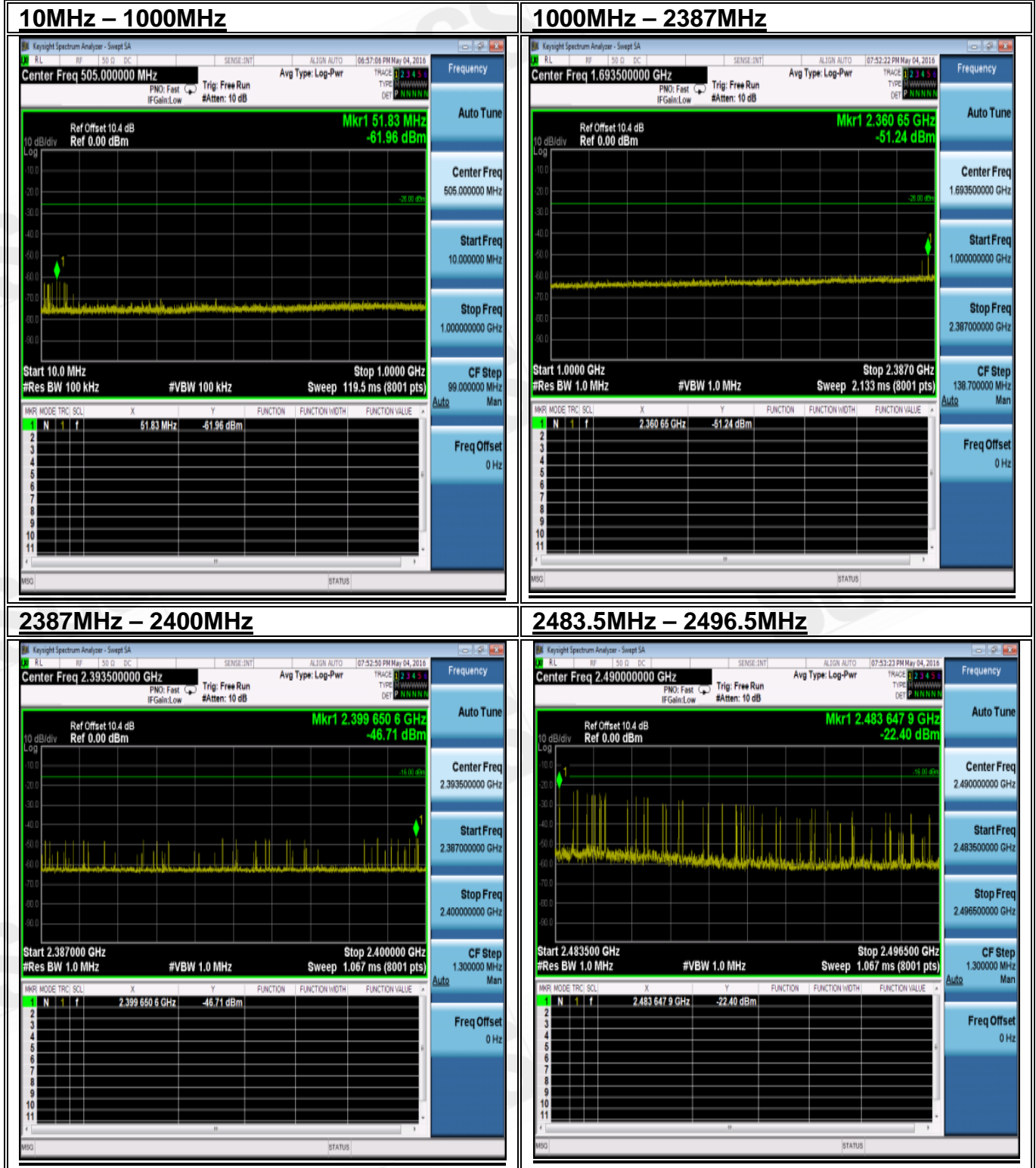
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Test Plots: Normal Voltage BLE, GFSK Channel 2480



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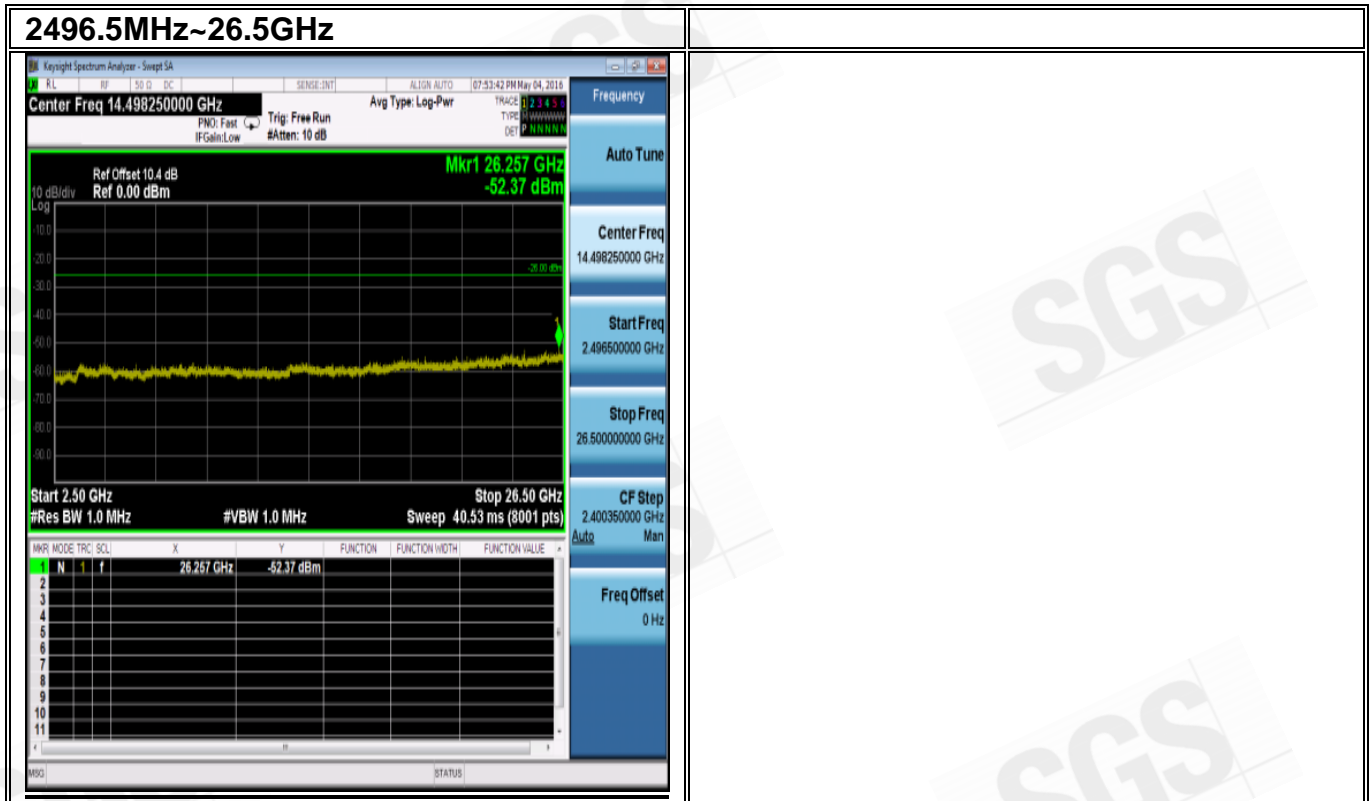
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6.6. LIMITATION OF COLLATERAL EMISSION OF RECEIVER

6.6.1. Limit:

Frequency below 1GHz : 4nW
Frequency above 1GHz : 20nW

6.6.2. Measurement Equipment Used:

Refer to section 6.1.2 for detail.

6.6.3. Test Setup:

Refer to section 6.1.3 for detail.

6.6.4. Test Procedure:

1. Setup the EUT modulation on.
2. Setup the EUT operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer Ref level: peak ratio; RBW= 100KHz, VBW=100KHz, Sweep = auto, Start=10MHz, Stop=1GHz. Max hold view, mark highest level.
4. Set the spectrum analyzer Ref level: peak ratio; RBW=1MHz, VBW=1MHz, Sweep = auto, Start=1GHz, Stop=13GHz. Max hold view, mark highest level
5. The Worst data was report.

6.6.5. Test Results:

Refer to next page for plots.

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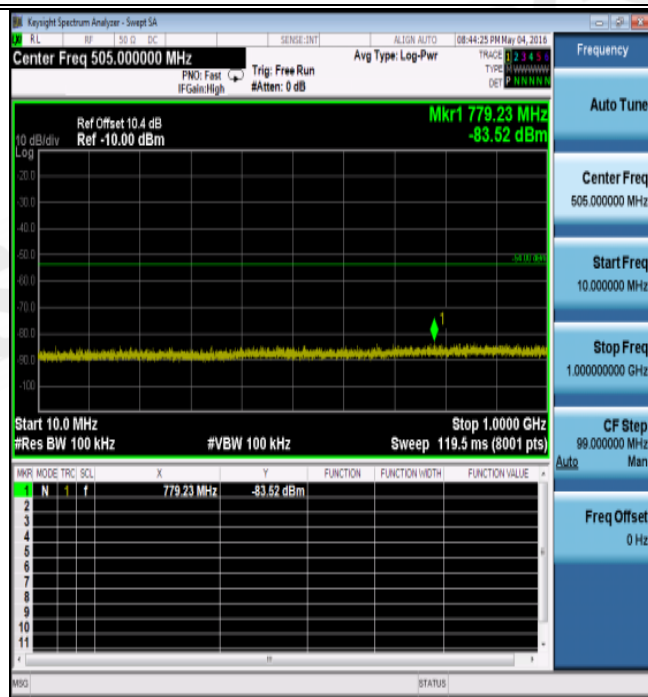
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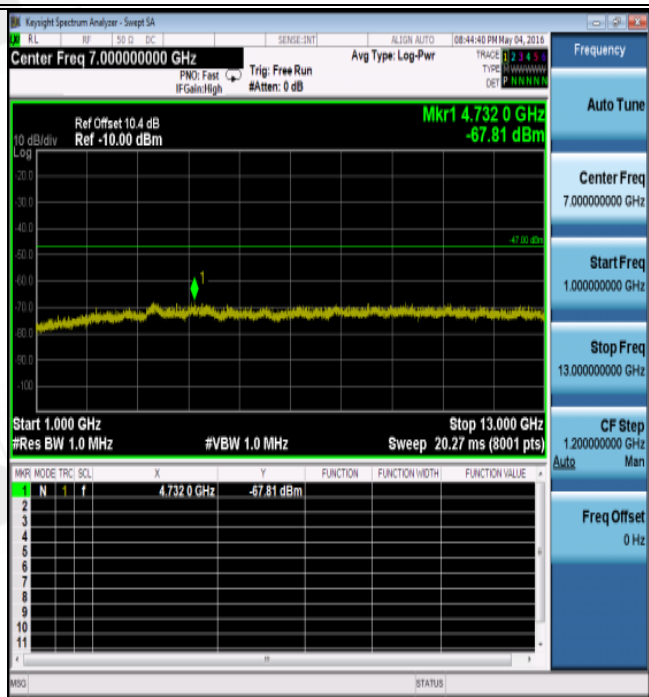
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Test Results: BLE GFSK Normal Voltage

Channel 2402 Below 1GHz



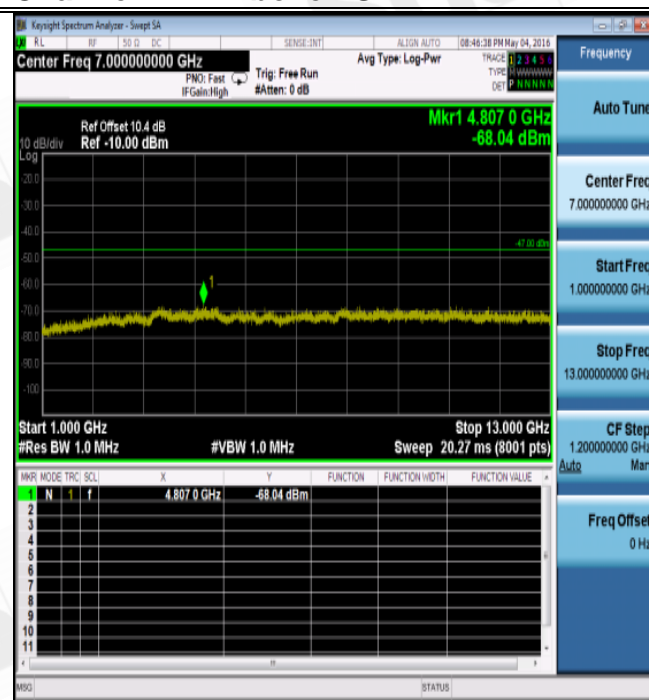
Channel 2402 Above 1GHz



Channel 2442 Below 1GHz



Channel 2442 Above 1GHz



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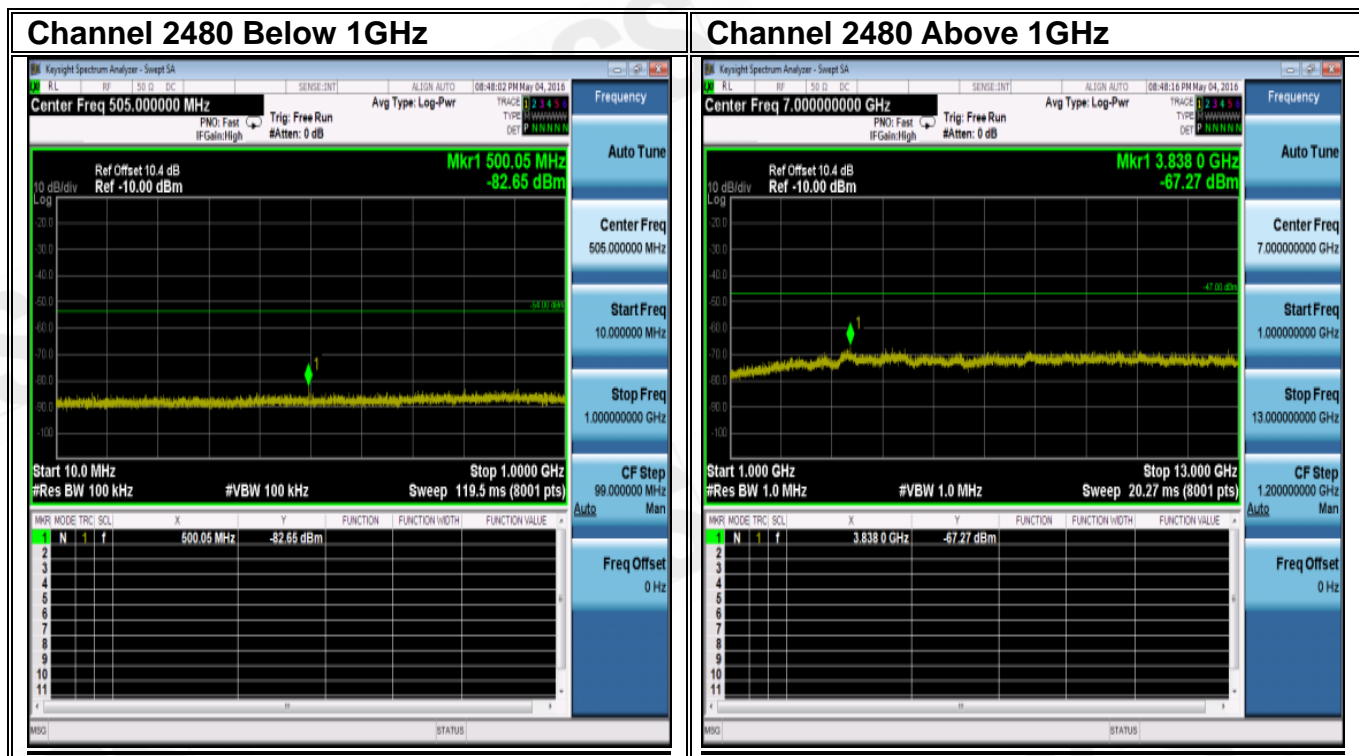
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6.7. Angular width of principal radiation (AWPR)

The angular width of principal radiation (AWPR), which follows from the antenna pattern specifications, shall satisfy the expression $360/A$ degree.

To be assessed:

$AWPR < 360/A$ (degree)

A represent the value determined by dividing equivalent isotropic radiated power by the value obtained by applying an antenna power with the mean power of 3 mW for Bluetooth and 10 mW for WLAN to the transmitting antenna with its absolute gain being 2.14 dBi.

6.7.1 Result:

Result: BLE mode:

Antenna gain =		1.256	dBi		
			Channel Low	Channel Mid	Channel High
Normal Voltage (3.3Vdc)	Conducted power(mW)		2.897	2.812	2.692
	Radiated power(dBm)		5.88	5.75	5.56
	Radiated power(mW)		3.869	3.755	3.594
	Constant A		3.869 /16.4<1	3.755 /16.4<1	3.594 /16.4<1
Upper Voltage (3.63Vdc)	Conducted power(mW)		2.864	2.825	2.642
	Radiated power(dBm)		5.83	5.77	5.48
	Radiated power(mW)		3.825	3.772	3.529
	Constant A		3.825 /16.4<1	3.772 /16.4<1	3.529 /16.4<1
Lower Voltage (2.97Vdc)	Conducted power(mW)		2.729	2.767	2.704
	Radiated power(dBm)		5.62	5.68	5.58
	Radiated power(mW)		3.644	3.695	3.611
	Constant A		3.644 /16.4<1	3.695 /16.4<1	3.611 /16.4<1

In these cases, according to article 49.20 (f)(2) of the Regulations the constant A should be equalized

As a result AWPR, 360 degrees, which is always satisfied.

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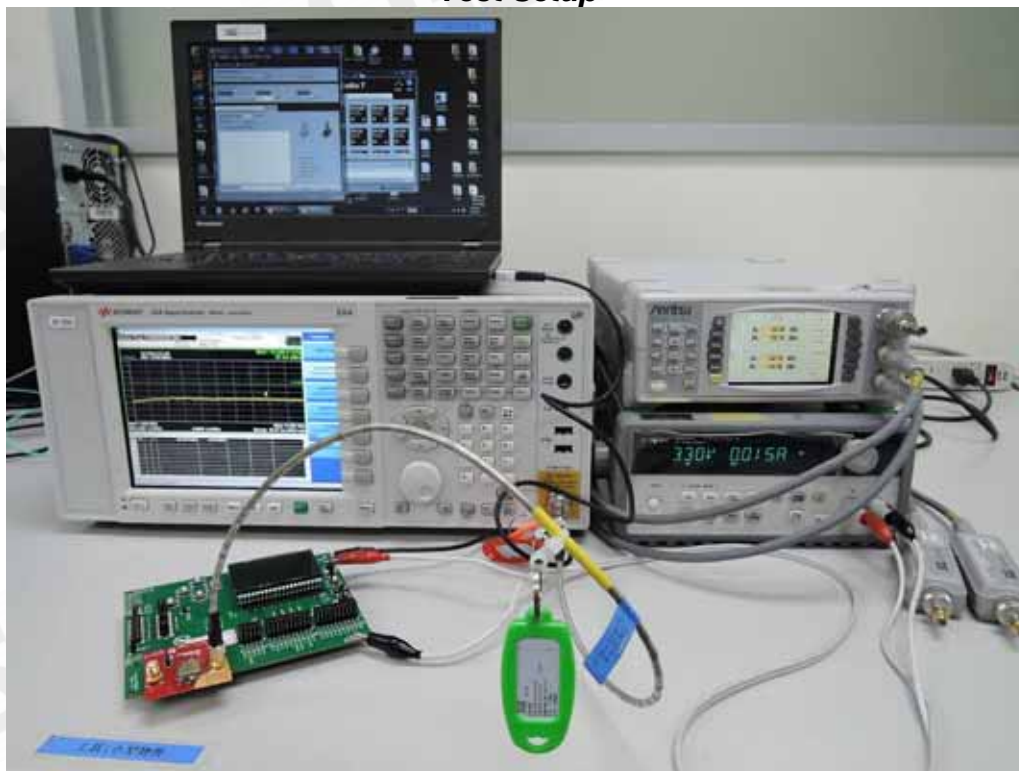
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PHOTOGRAPHS OF SET UP

Test Setup



PHOTOGRAPHS OF EUT

Please refer to the attached file (EUT Photo)

~ End of Report ~

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