

JAPAN MIC

Radio Test Report

FOR

Product Name: BLE and 802.15.4 module

Brand Name: Texas Instruments Incorporated

Model Name: CC2650MODA

Model Differences: N/A

Report No: E2/2016/40064

Issue Date: May 25, 2016

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

Prepared by: SGS Taiwan Ltd.
Electronics & Communication Laboratory
No.2, Keji 1st Rd., Guishan District,
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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: E2/2016/40064

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

Date of EUT Received: May 04, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
ARIB STD T-66	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
E2/2016/40064	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

Zigbee

Operation Frequency:	2405MHz ~ 2480MHz
Number of Channels:	16 channels
Channel Spacing:	5MHz
Modulation Type:	O-QPSK
Rated Transmit Power:	2.737mW/MHz
Antenna Designation:	Chip Antenna, Gain: 1.256dBi

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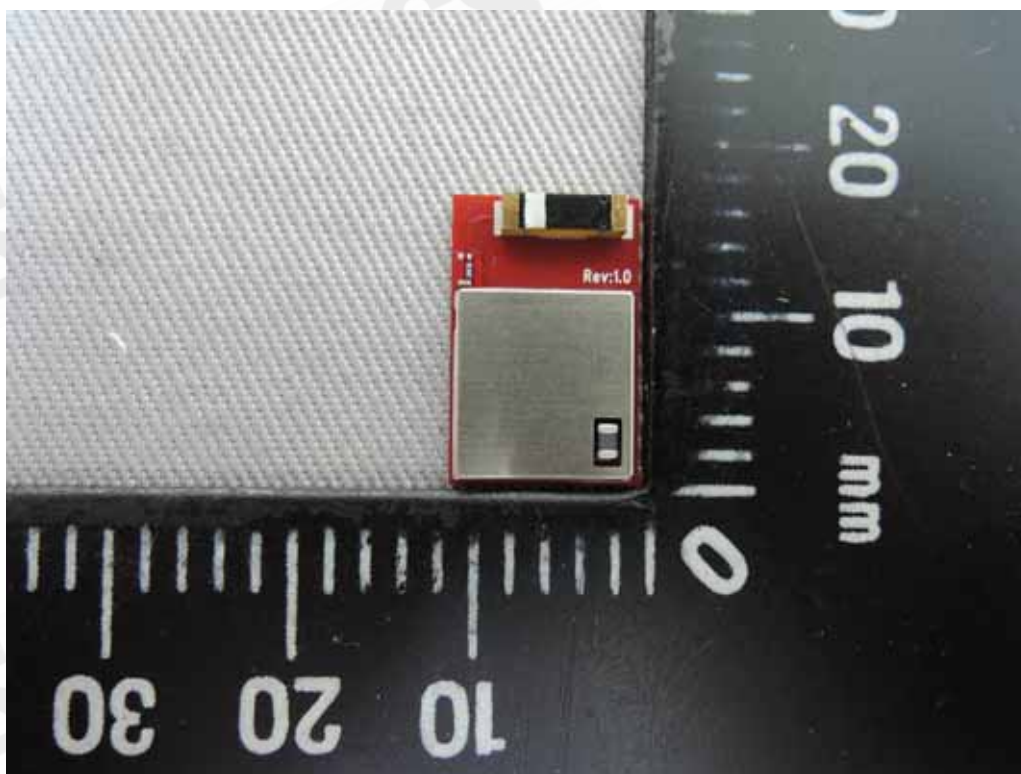
1.2 ANTENNA SPECIFICATION

Zigbee

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

The EUT has been tested under at TX and RX modes. And software was used to control the EUT for staying in above description test modes.

The EUT has 16 channels. Channel low, mid and High with highest data rate was chosen for testing.

A software tool or a built-in test-mode needs to be reported with the parameter settings for creating the appropriate selection. The software settings shall be reported because of the traceability requirement of the measurements. The settings are depending upon the IEEE standard & mode and the applied modulation. Most common settings are:

Channel low (2405MHz)、mid (2440MHz) and high (2480MHz) with highest data rate are chosen for full testing.

Test channels

	TX	RX
Channel Low	2405MHz	2405MHz
Channel Mid	2440MHz	2440MHz
Channel High	2480MHz	2480MHz

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

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(ISO 17025 of TAF code 0513)

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5. SUPPORT EQUIPMENT

Fig. 5-1 Configuration of Tested System

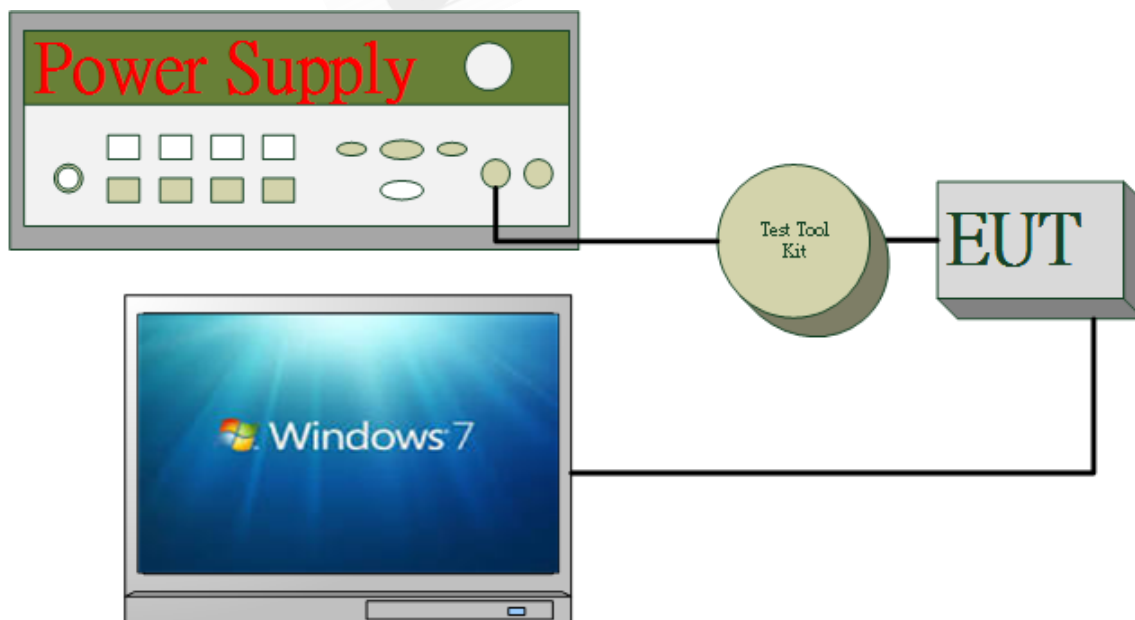


Table 5-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	MY53130054	N/A	N/A
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
14.2	--	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)	6.7	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	C
49.20(1); i	6.4	Spreading factor	C
49.20(1); j	6.8	Frequency retention time (FH employed)	N/A
Note 1: C=Confirm NC=Not Confirm NT=Not Tested NA= Not Applicable			

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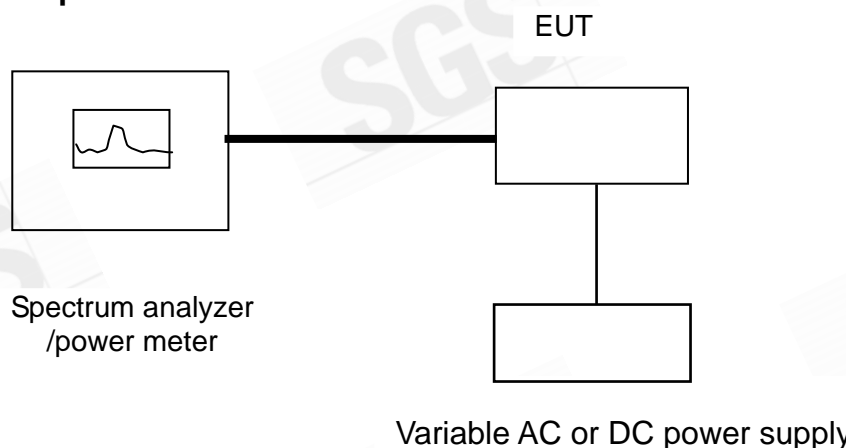
6.1. ANTENNA POWER AND TOLERANCE**6.1.1. Limit:**

Antenna power: 10mW/MHz

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.
6. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.

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6.1.5. Test results:

Ambient temperature: 24Relative humidity: 63 %

Test Date: 05/05/2016

Test Result:

Rated Power Density = 2.737 mW/MHz

Antenna Gain = 1.256 dBi

		CH 2405	CH 2440	CH 2480	Limit
Normal Voltage (3.3Vdc)	Antenna Power (dBm/MHz)	4.140	3.935	3.686	N/A
	Antenna Power (mW/MHz)	2.594	2.474	2.337	10mW/MHz
	Power Tolerance	-5.20	-9.58	-14.61	+20% to -80%
Upper Voltage (3.63Vdc)	Antenna Power (dBm/MHz)	4.367	3.935	3.686	N/A
	Antenna Power (mW/MHz)	2.733	2.474	2.337	10mW/MHz
	Power Tolerance	-0.13	-9.58	-14.61	+20% to -80%
Lower Voltage (2.97Vdc)	Antenna Power (dBm/MHz)	4.372	4.225	3.653	N/A
	Antenna Power (mW/MHz)	2.737	2.646	2.319	10mW/MHz
	Power Tolerance	0.00	-3.32	-15.25	+20% to -80%

Remark:

1. Conducted Power (mW)= 10^{(Conducted Power(dBm)/10)}

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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 ETU 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.
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.

6.2.5. Test results:Ambient temperature: 24 Relative humidity: 65 % Test Date: 05/05/2016**Test Result:**

Unit	Upper Voltage + 10% (3.63 V)			Limit
	2405	2440	2480	
Frequency	2404.92073	2439.91847	2479.91829	
ppm	32.960	33.414	32.948	50ppm
Unit	Normal Voltage (3.3 V)			Limit
	2405	2440	2480	
Frequency	2404.92072	2439.91839	2479.91830	
ppm	32.965	33.447	32.944	50ppm
Unit	Lower Voltage - 10% (2.97 V)			Limit
	2405	2440	2480	
Frequency	2404.92070	2439.91842	2479.91832	
ppm	32.973	33.434	32.935	50ppm

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

802.15.4 < 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 ETU operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer RBW = 300kHz, VBW=300kHz, center frequency = 2405MHz, 2440MHz, 2480MHz and Span = 26MHz
4. Turn on 99% spectrum OBW function on, Max hold, View, and snap the screen and record the mark.
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.

6.3.5. Test results:Ambient temperature: 24 Relative humidity: 65 % Test Date: 05/05/2016**Test Result:**

Unit	Upper Voltage + 10% (3.63 V)			Limit
	2405	2440	2480	
Occupied Bandwidth	2.615	2.601	2.627	26MHz
Unit	Normal Voltage (3.3 V)			Limit
	2405	2440	2480	
Occupied Bandwidth	2.622	2.631	2.640	26MHz
Unit	Lower Voltage - 10% (2.97 V)			Limit
	2405	2440	2480	
Occupied Bandwidth	2.607	2.624	2.619	26MHz

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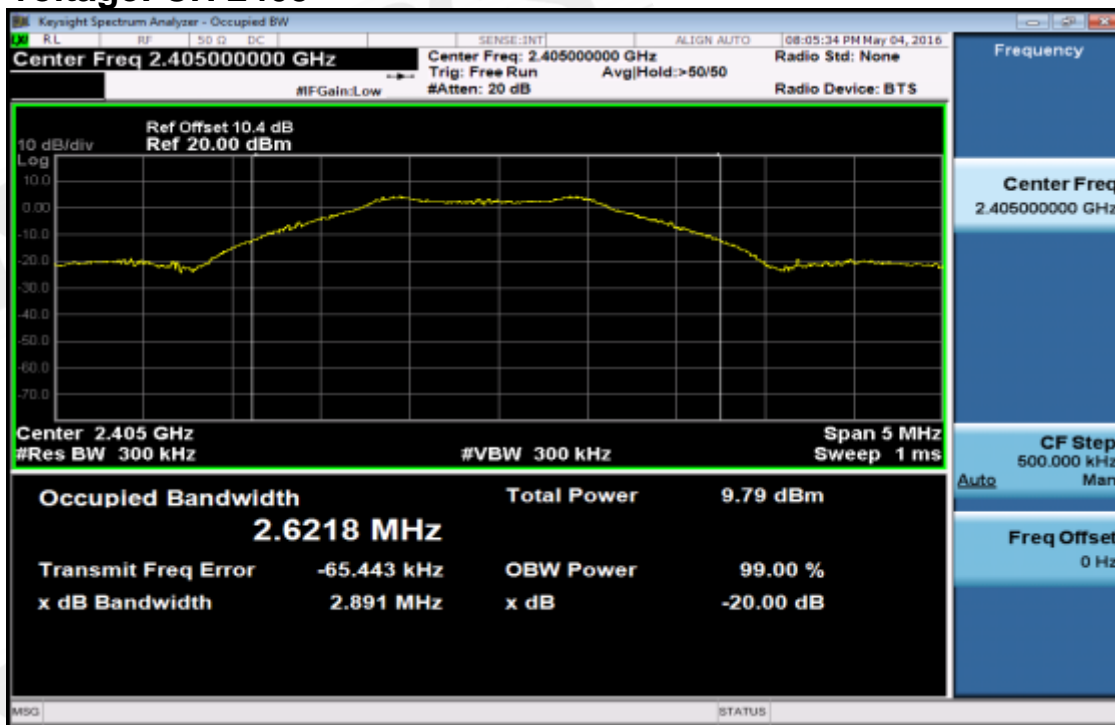
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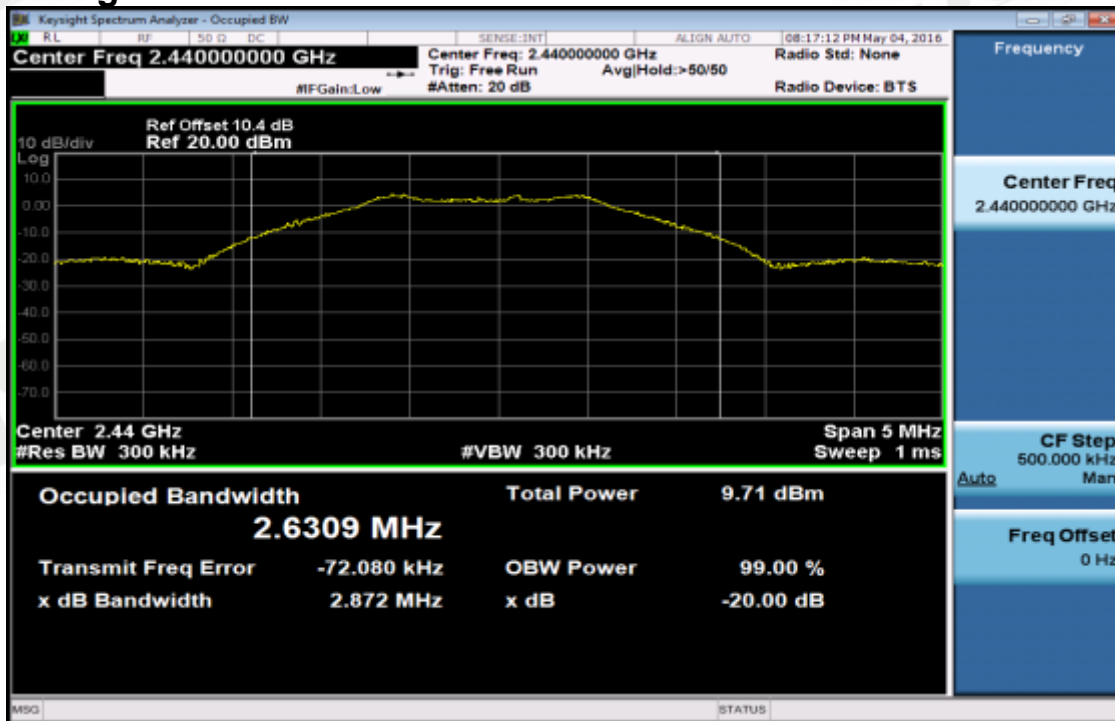
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Normal voltage: CH 2405



Normal voltage: CH 2440



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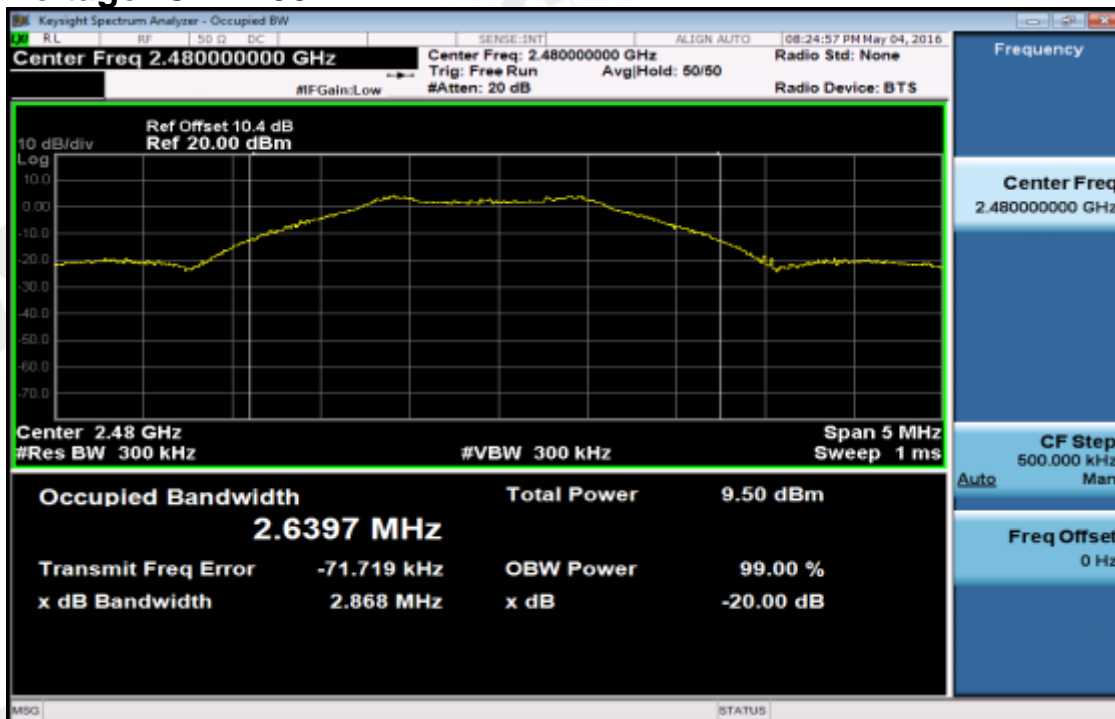
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Normal voltage: CH 2480



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

> 500kHz

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 ETU operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer RBW = 300kHz, VBW=300kHz, center frequency =2405MHz, 2440MHz, 2480MHz and Span = 5MHz
4. Turn on 90% spectrum OBW function, Max hold, View, and snap the screen and record the mark.
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.

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

Unit	Upper Voltage + 10% (3.63 V)			Limit
	2405	2440	2480	
Spread Bandwidth	1.570	1.588	1.611	N/A
Unit	Normal Voltage (3.3 V)			Limit
	2405	2440	2480	
Spread Bandwidth	1.594	1.610	1.602	N/A
Unit	Lower Voltage - 10% (2.97 V)			Limit
	2405	2440	2480	
Spread Bandwidth	1.578	1.602	1.585	N/A

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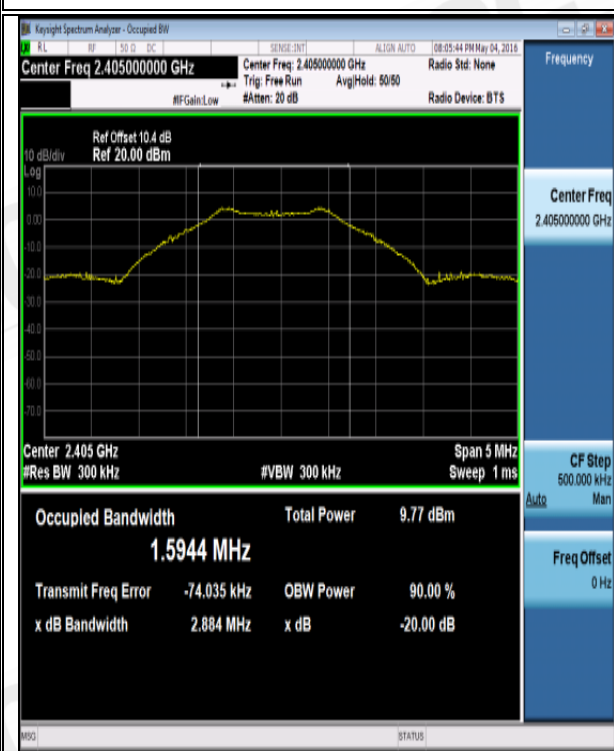
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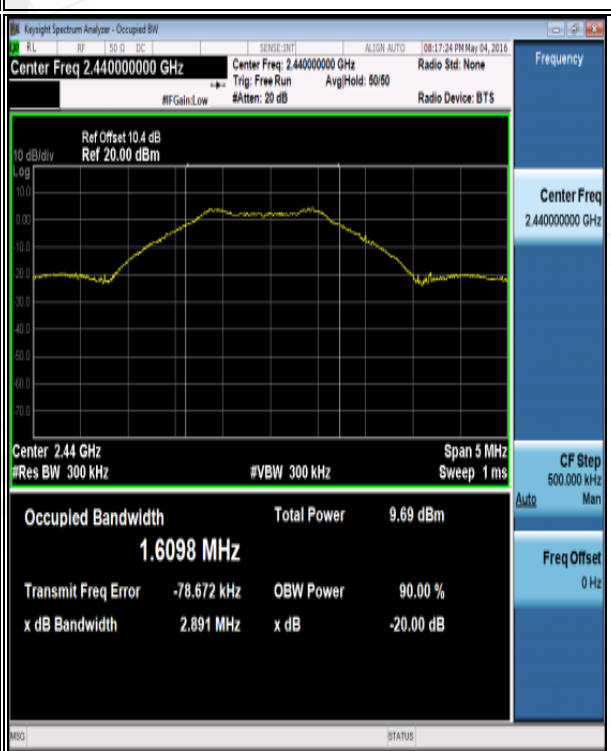
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Test Plots: Normal Voltage

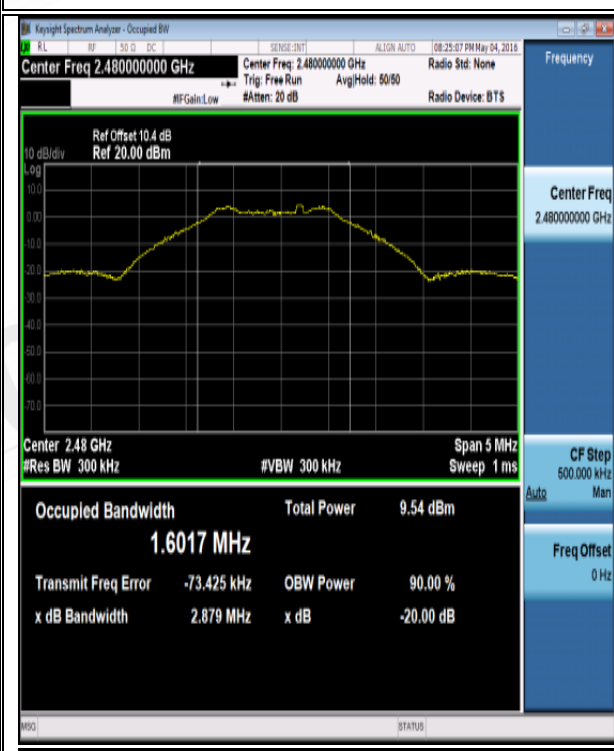
Channel 2405



Channel 2440



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 ETU operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer Ref level= -10dBm; attenuation=0dB;RBW=100KHz, BW=100KHz , Sweep = auto Start=10MHz, Stop=1000MHz. Max hold view, mark highest level.
4. Set the spectrum analyzer Ref level= -10dBm; attenuation=0dB;RBW=1MHz, BW=1MHz , Sweep = auto Start=1000MHz, Stop=2387MHz for 2405MHz, 2440MHz, 2480MHz. Start=1000MHz, Stop=2458MHz for 2484MHz. Max hold view, mark highest level.
5. Set the spectrum analyzer Ref level= -10dBm; attenuation=0dB;RBW=1MHz, RBW=1MHz, Sweep = auto, Start=2387MHz, Stop=2400MHz for 2405MHz, 2440MHz, 2480MHz. Start=2458MHz, Stop=2471MHz for 2484MHz. Max hold view, mark highest level.
6. Set the spectrum analyzer Ref level= -10dBm; attenuation=0dB; RBW=1MHz, BW=1MHz, Sweep = auto Start=2483.5MHz, Stop=2496.5MHz for 2405MHz, 2440MHz, 2480MHz. Start=2497MHz, Stop=2510MHz for 2484MHz. Max hold view, mark highest level.
7. Set the spectrum analyzer Ref level= -10dBm; attenuation=0dB; RBW=1MHz, BW=1MHz, Sweep = auto, Start=2496.5MHz, Stop=26.5GHz for 2405MHz, 2440MHz, 2480MHz. Start=2510MHz, Stop=26GHz for 2484MHz. Max hold view, mark highest level.
8. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 7 again.
9. The Worst data was report.

6.5.5. Test Results:

Ambient temperature: 24

Relative humidity: 65 %

Test Date: 05/05/2016

Refer to next page for plots.

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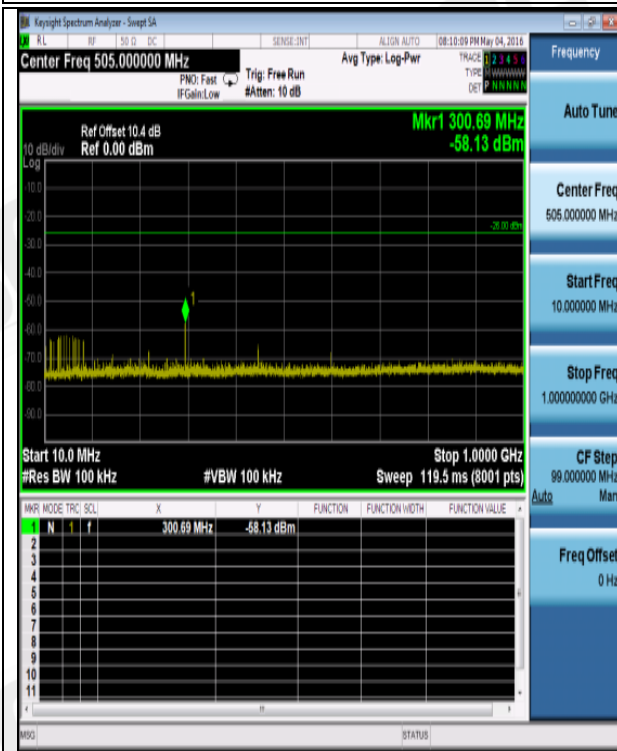
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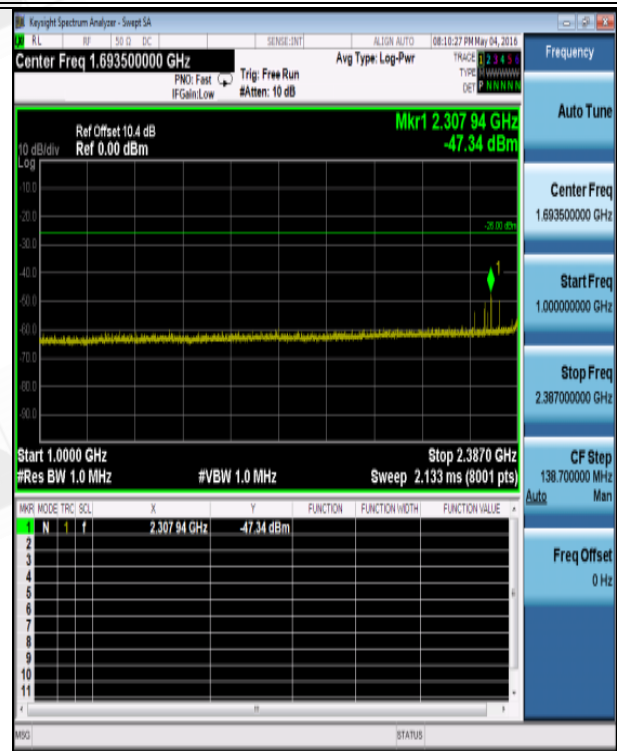
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Test Plots: Normal Voltage: Channel 2405

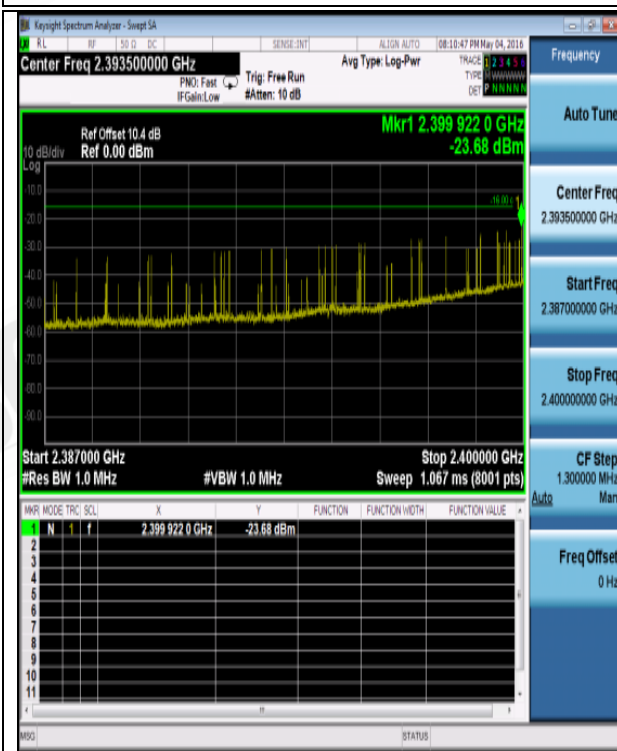
10MHz – 1000MHz



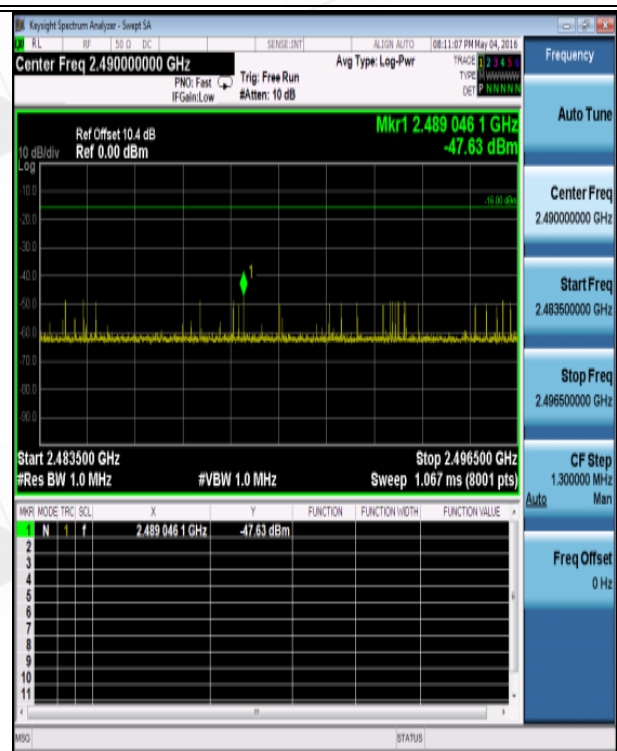
1000MHz – 2387MHz



2387MHz – 2400MHz



2483.5MHz – 2496.5MHz



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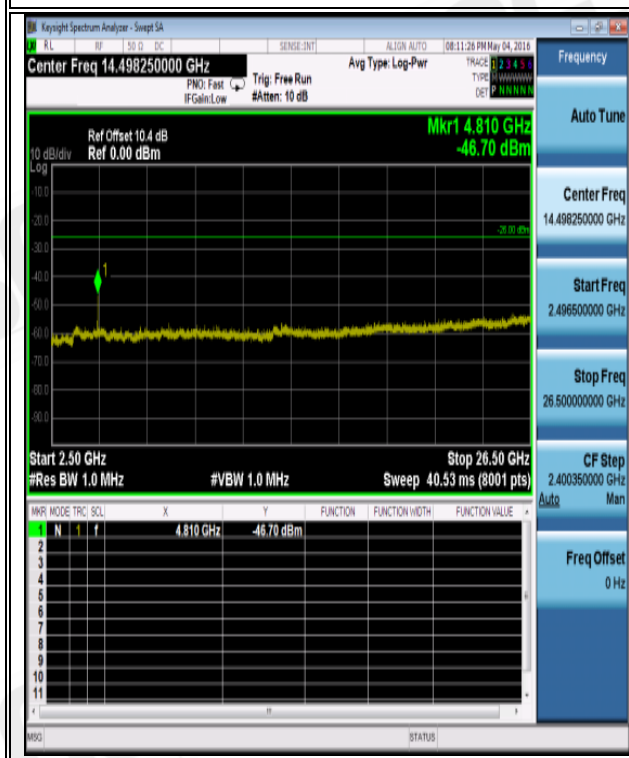
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2496.5MHz –26.5GHz

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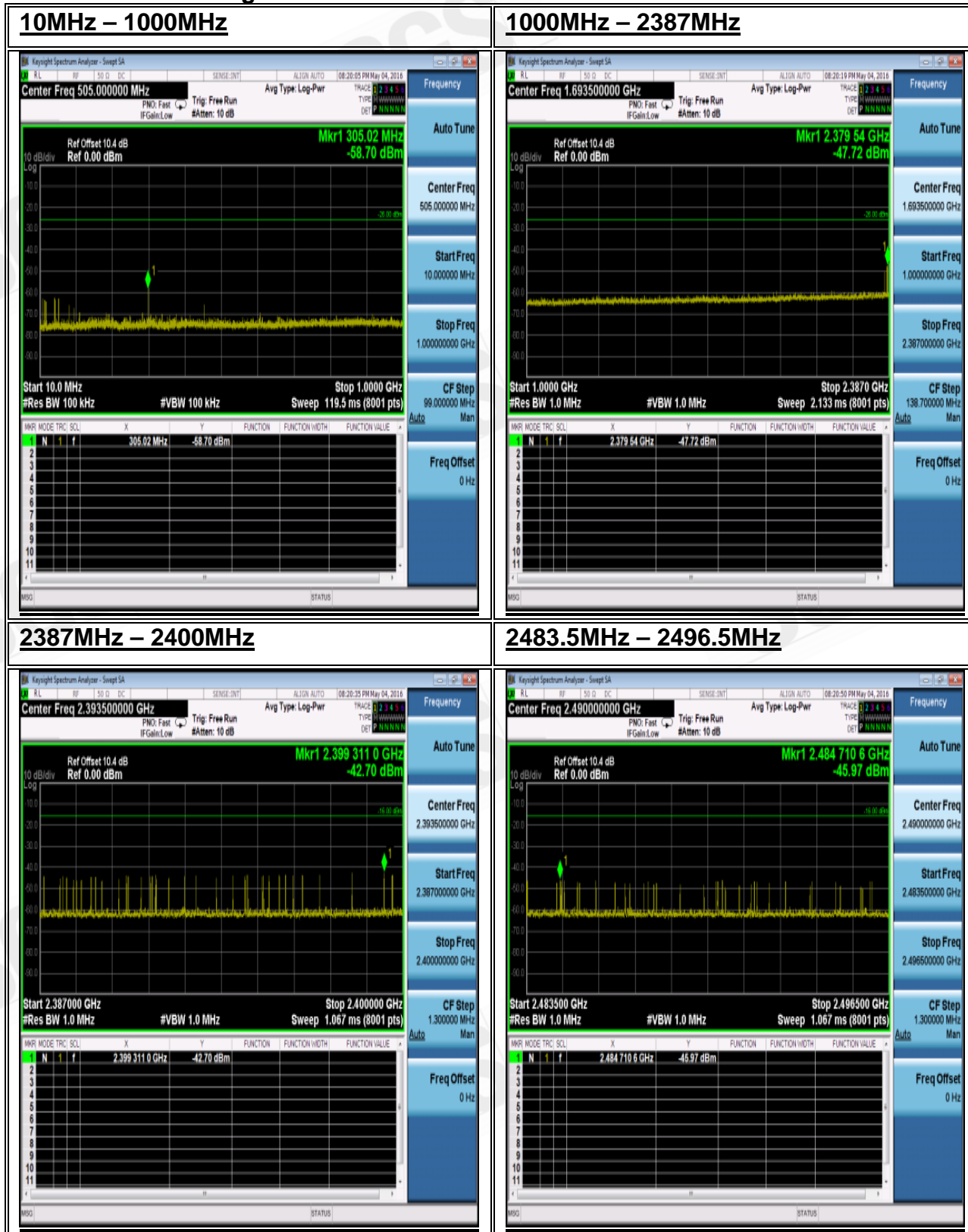
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Test Plots: Normal Voltage: Channel 2440



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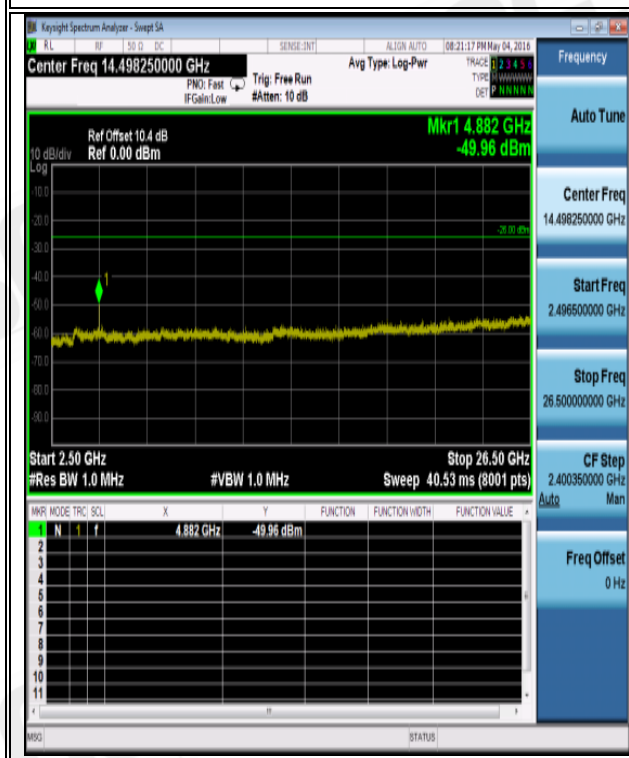
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2496.5MHz –26.5GHz

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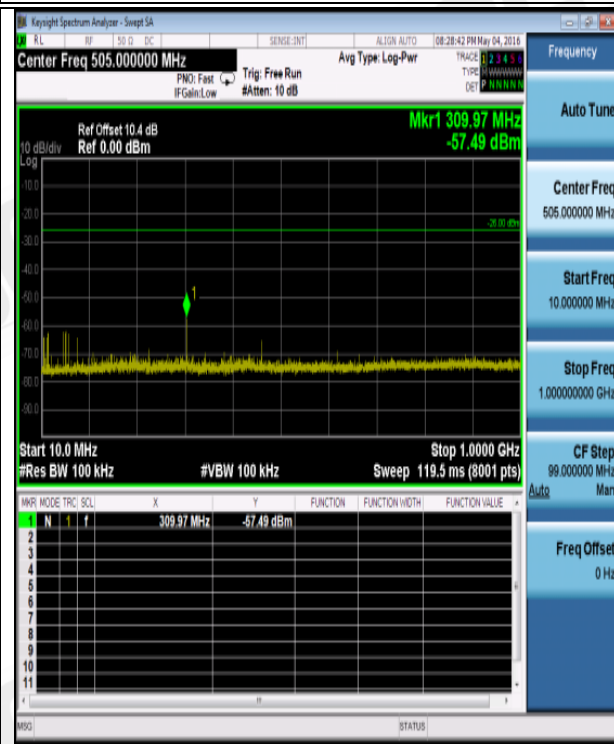
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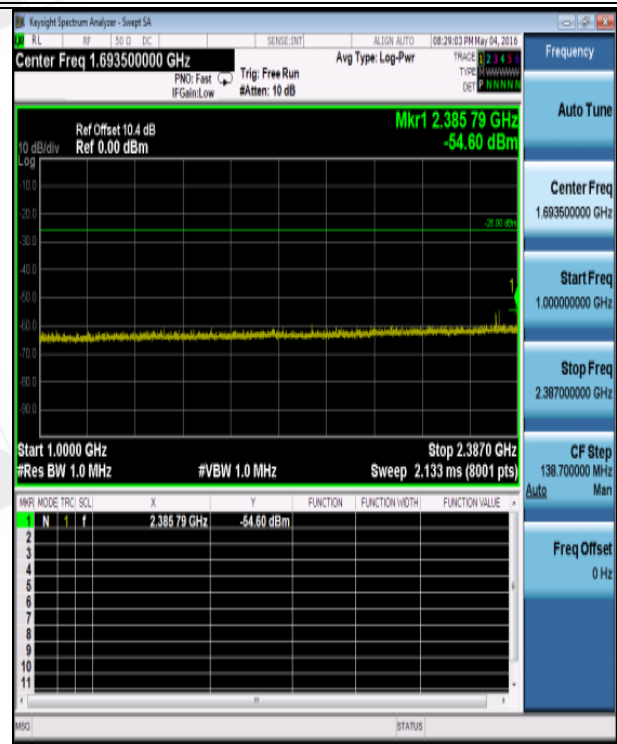
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Test Plots: Normal Voltage: Channel 2480

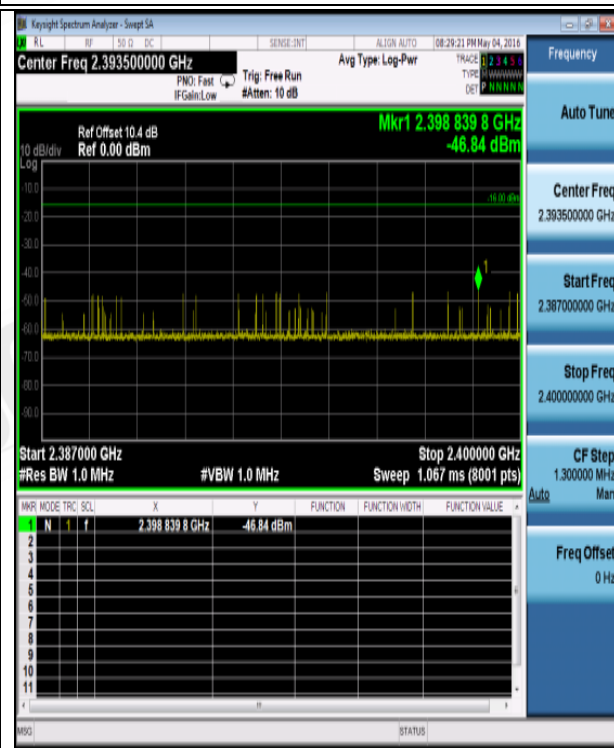
10MHz – 1000MHz



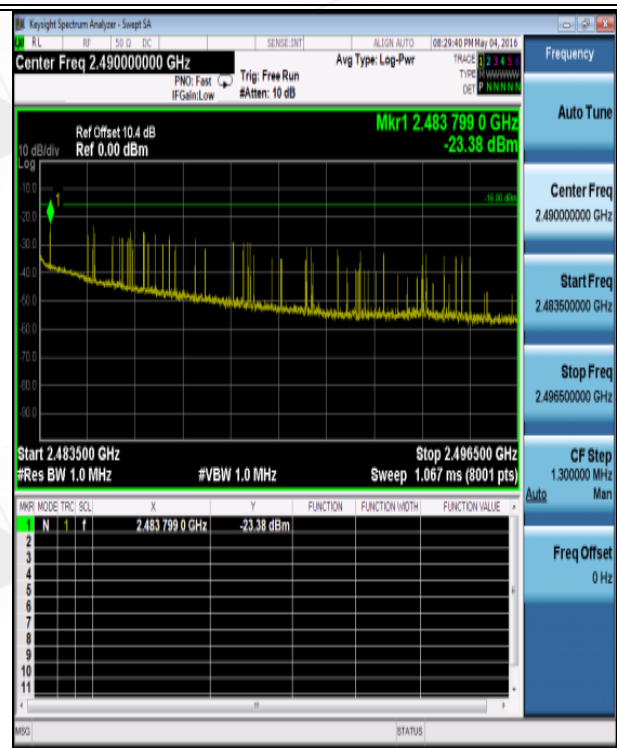
1000MHz – 2387MHz



2387MHz – 2400MHz



2483.5MHz – 2496.5MHz



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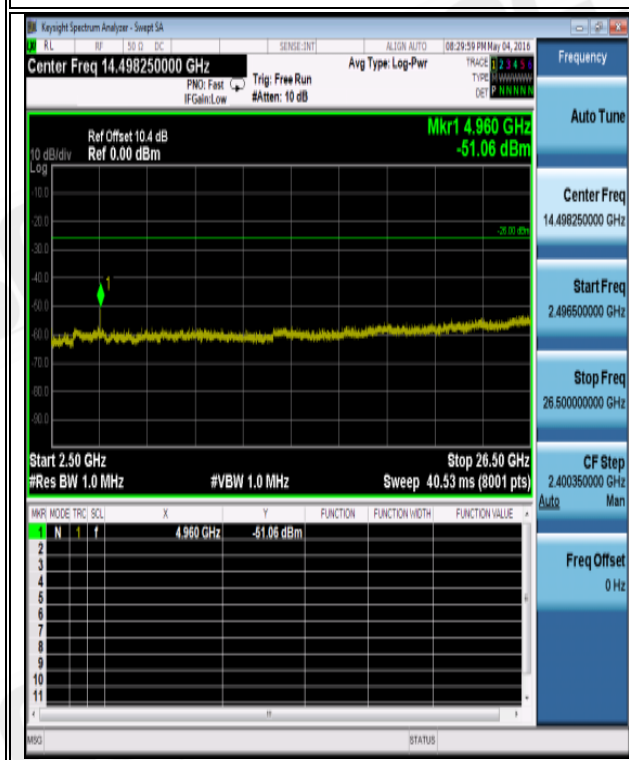
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2496.5MHz –26.5GHz

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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 ETU operate at channel low, mid and high and normal voltage.
3. Set the spectrum analyzer Ref level: -10dBm; attenuation=0dB;RBW=100KHz, VBW=100KHz, Sweep = auto, Start=10MHz, Stop=1GHz. Max hold view, mark highest level.
4. Set the spectrum analyzer Ref level: -10dBm, attenuation=0dB;RBW=1MHz, VBW=1MHz, Sweep = auto, Start=1GHz, Stop=13GHz. Max hold view, mark highest level
5. Varied input voltage to + 10% and - 10% normal voltage and repeat procedure 1 to 4 again.
6. The Worst data was report.

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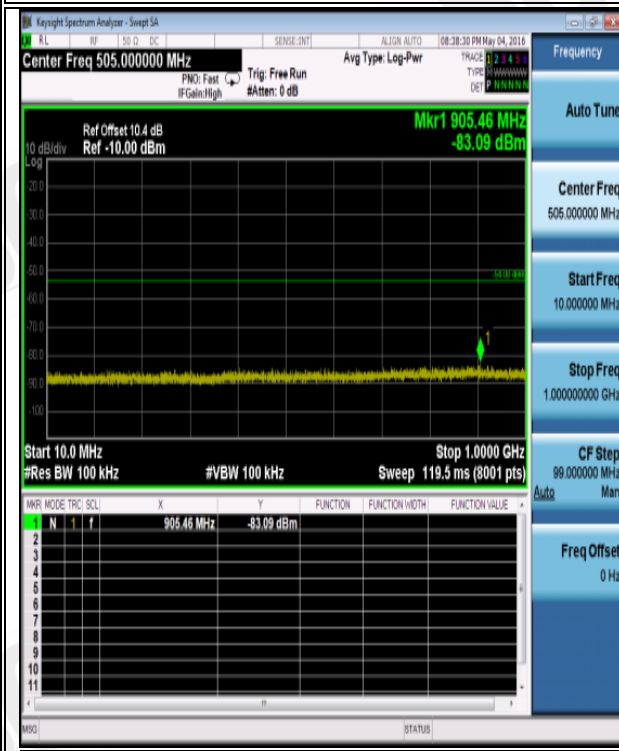
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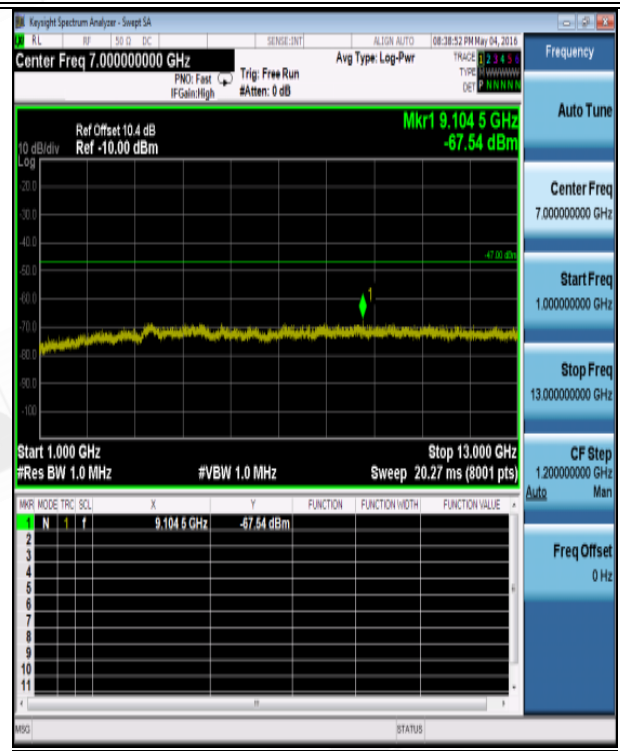
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6.6.5. Test Results: Test Plots: Normal Voltage:

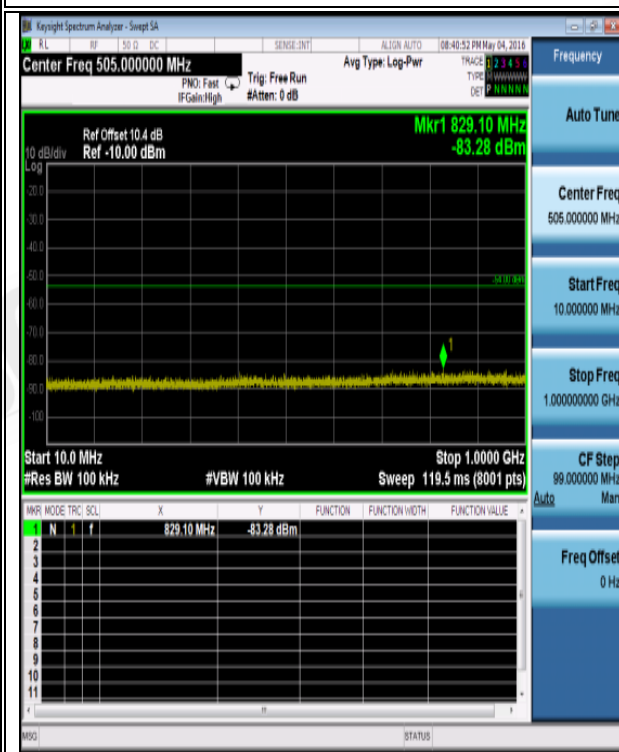
Below 1GHz (Channel 2405)



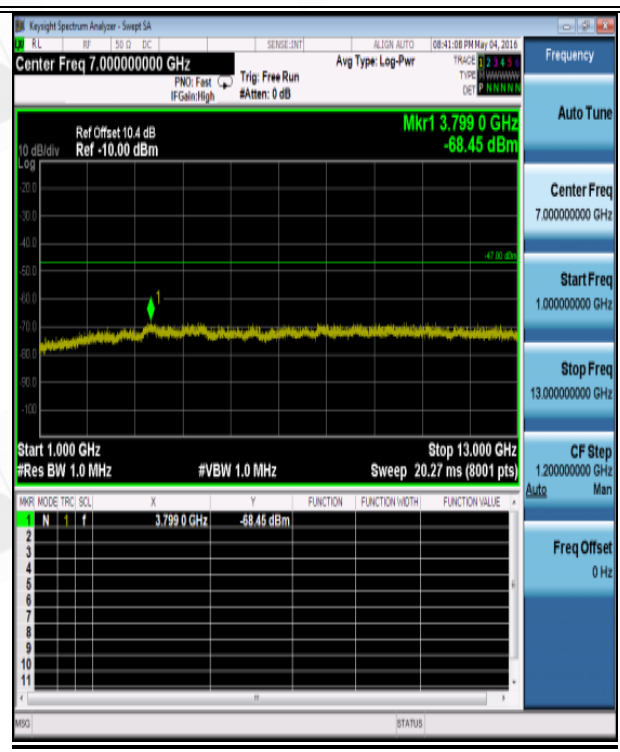
Above 1GHz (Channel 2405)



Below 1GHz (Channel 2440)



Above 1GHz (Channel 2440)



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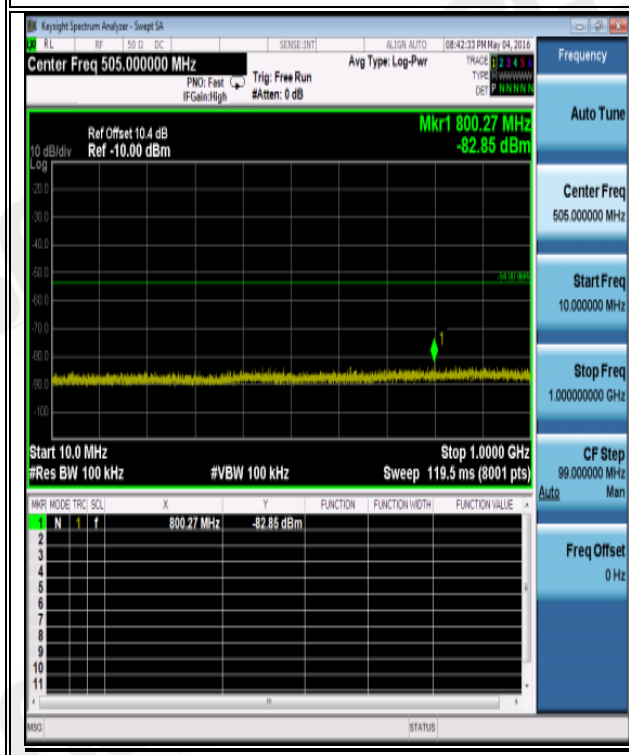
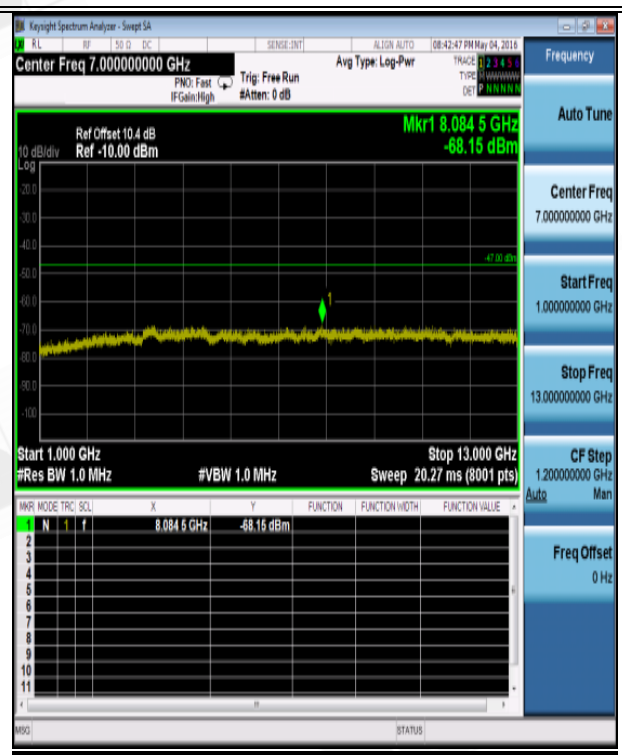
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Below 1GHz (Channel 2480)**Above 1GHz (Channel 2480)**

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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 10 mW to the transmitting antenna with its absolute gain being 2.14 dBi.

Test Result:

Antenna gain=		1.256	dBi		
			Channel Low	Channel Mid	Channel High
Normal Voltage (3.3Vdc)	Conducted power(mW)		2.594	2.474	2.337
	Radiated power(dBm)		5.40	5.19	4.94
	Radiated power(mW)		3.464	3.304	3.120
	Constant A		3.464 /16.4<1	3.304 /16.4<1	3.120 /16.4<1
Upper Voltage (3.63Vdc)	Conducted power(mW)		2.733	2.474	2.337
	Radiated power(dBm)		5.62	5.19	4.94
	Radiated power(mW)		3.650	3.304	3.120
	Constant A		3.650 /16.4<1	3.304 /16.4<1	3.120 /16.4<1
Lower Voltage (2.97Vdc)	Conducted power(mW)		2.737	2.646	2.319
	Radiated power(dBm)		5.63	5.48	4.91
	Radiated power(mW)		3.654	3.533	3.097
	Constant A		3.654 /16.4<1	3.533 /16.4<1	3.097 /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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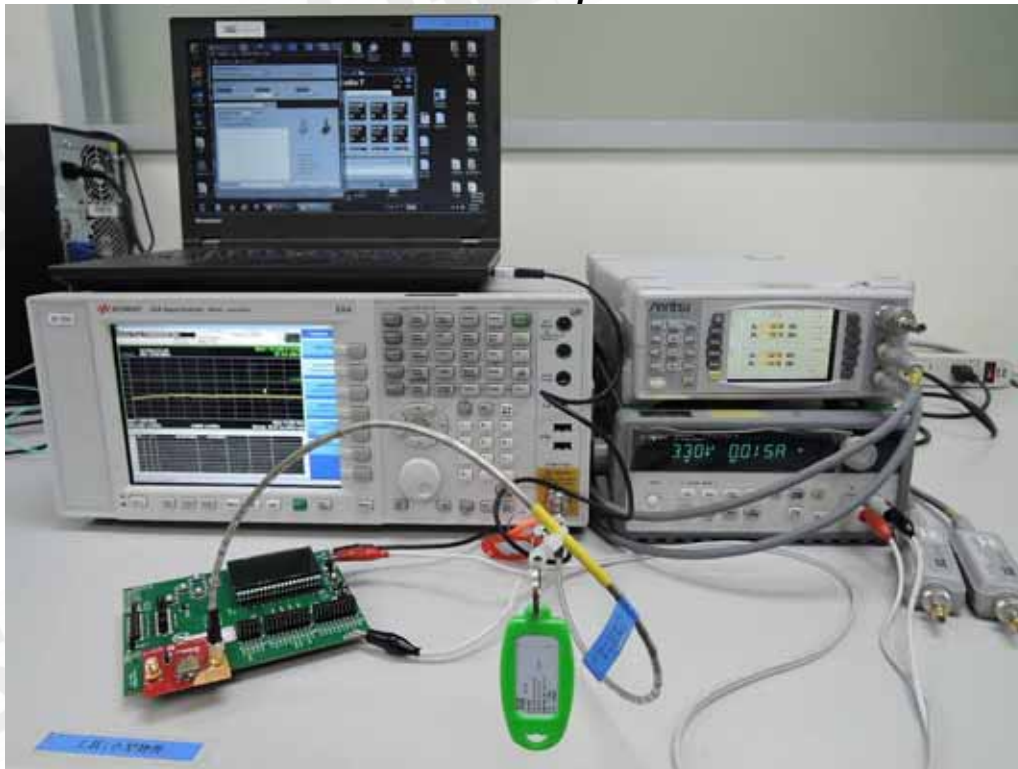
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PHOTOGRAPHS OF SET UP

Test Setup

PHOTOGRAPHS OF EUT

Please refer to the attached file(EUT Photo)

~ End of Report ~

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