



Page 1 of 77

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

0F

Product Name: Bluetooth Dock

Brand Name: SIRIUS XM

Model No.: SXBTD1

Model Difference: N/A

FCC ID: RS2SXBTD1

Report No.: ER/2017/80028

Issue Date: Aug. 14, 2017

FCC Rule Part: §15.247, Cat: DSS

Prepared for: Sirius XM Radio Inc.

1500 Eckington Place, NE Washington Dist

of Columbia USA

Prepared by: SGS Taiwan Ltd.

> **Electronics & Communication Laboratory** No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City,

Taiwan 24803





lesting Laboratory 0513

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Page 2 of 77

VERIFICATION OF COMPLIANCE

Applicant: Sirius XM Radio Inc.

1500 Eckington Place, NE Washington Dist of Columbia USA

Product Name: Bluetooth Dock

Brand Name: SIRIUS XM

Model No.: SXBTD1

Model Difference: N/A

FCC ID: RS2SXBTD1

Report Number: ER/2017/80028

Date of test: Aug. 03, 2017 ~ Aug. 18, 2017

Date of EUT Received: Aug. 03, 2017

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Test By:	Marcus Tseng	Date:	Aug. 18, 2017	
_	Marcus Tseng / Engineer			
Prepared By:	Yuri Tsou	Date:	Aug. 18, 2017	
Approved By:	Yuri Tsai/ Clerk Jim Chang / Asst. Manager	Date:	Aug. 18, 2017	

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Page 3 of 77

Revision History

Report Number	Revision	Description	Issue Date
ER/2017/80028	Rev.00	Initial creation of document	Aug. 18, 2017

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Table of Contents

1	GENERAL INFORMATION	5
2	SYSTEM TEST CONFIGURATION	7
3	UMMARY OF TEST RESULTS	9
4	DESCRIPTION OF TEST MODES	10
5	MEASUREMENT UNCERTAINTY	12
6	CONDUCTED EMISSION TEST	13
7	PEAK OUTPUT POWER MEASUREMENT	15
8	20dB BANDWIDTH MEASUREMENT	17
9	CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT	20
10	RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT	32
11	FREQUENCY SEPARATION	65
12	NUMBER OF HOPPING FREQUENCY	67
13	TIME OF OCCUPANCY (DWELL TIME)	69
14	ANTENNA REQUIREMENT	77

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Page 5 of 77

GENERAL INFORMATION

1.1 Product description

General:

<u> </u>	
Product Name:	Bluetooth Dock
Brand Name:	SIRIUS XM
Model No.:	SXBTD1
Model Difference:	N/A
Product SW/HW version:	N/A
Power Supply:	9-16Vdc

Bluetooth_BR+EDR:

Bluetooth Version:	Bluetooth V4.1
Channel number:	79 channels
Modulation type:	GFSK + π/4DQPSK + 8DPSK (BR+EDR)
Transition Rate:	GFSK: 1Mbps / π/4DQPSK: 2Mbps / 8DPSK: 3Mbps
Transmit Power:	7.28 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	<= 0.4s
Antenna Designation:	PIFA Antenna, Peak Gain:1.57dBi

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Page 6 of 77

1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC Public Notice DA 00-705 Measurement Guidelines

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)

FCC Registration Numbers are: 509634

1.4 Special Accessories

There is no special accessory used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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Page 7 of 77

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

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plan. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz,. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plan. For emission measurements above 1 GHz, the table height shall be 1.5 m. 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 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.

2.4 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

Note:

The spectrum analyzer offset is derived from RF cable loss 0.5dB

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Page 8 of 77

2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 Conducted (Antenna Port) Emission & AC Power Line Conducted Emission



Table 2-1 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	Notebook	Lenovo	L420	LR-7HXZA	N/A	N/A
3.	DC Power Supply	N/A	N/A	N/A	N/A	N/A

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UMMARY OF TEST RESULTS

FCC Rules	FCC Rules Description Of Test	
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(a)(1)	20dB & 99% Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	§15.247(a)(1)(iii) Number of hopping frequency	
§15.247(a)(1)(iii)	Time of Occupancy	Compliant
§15.203 §15.247(b) Antenna Requirement		Compliant



DESCRIPTION OF TEST MODES

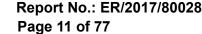
4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

СН	FREQUENCY	СН	FREQUENCY	СН	FREQUENCY	СН	FREQUENCY
0	2402 MHz	20	2422 MHz	40	2442 MHz	70	2462 MHz
1	2403 MHz	21	2423 MHz	41	2443 MHz	71	2463 MHz
2	2404 MHz	22	2424 MHz	42	2444 MHz	72	2464 MHz
3	2405 MHz	23	2425 MHz	43	2445 MHz	73	2465 MHz
4	2406 MHz	24	2426 MHz	44	2446 MHz	74	2466 MHz
5	2407 MHz	25	2427 MHz	45	2447 MHz	75	2467 MHz
6	2408 MHz	26	2428 MHz	46	2448 MHz	76	2468 MHz
7	2409 MHz	27	2429 MHz	47	2449 MHz	77	2469 MHz
8	2410 MHz	28	2430 MHz	48	2450 MHz	78	2470 MHz
9	2411 MHz	29	2431 MHz	49	2451 MHz	79	2471 MHz
10	2412 MHz	30	2432 MHz	50	2452 MHz	70	2472 MHz
11	2413 MHz	31	2433 MHz	51	2453 MHz	71	2473 MHz
12	2414 MHz	32	2434 MHz	52	2454 MHz	72	2474 MHz
13	2415 MHz	33	2435 MHz	53	2455 MHz	73	2475 MHz
14	2416 MHz	34	2436 MHz	54	2456 MHz	74	2476 MHz
15	2417 MHz	35	2437 MHz	55	2457 MHz	75	2477 MHz
16	2418 MHz	36	2438 MHz	56	2458 MHz	76	2478 MHz
17	2419 MHz	37	2439 MHz	57	2459 MHz	77	2479 MHz
18	2420 MHz	38	2440 MHz	58	2460 MHz	78	2480 MHz
19	2421 MHz	39	2441 MHz	59	2461 MHz		

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4.2 The Worst Test Modes and Channel Details

- The EUT has been tested under operating condition.
- Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- Investigation has been done on all the possible configurations for searching the worst case.

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)						
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE		
Bluetooth	0 to 78	0,39,78	GFSK	DH5		
	RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE		
Bluetooth	0 to 78	0,39,78	GFSK	DH5		

Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth BR+EDR Transmitter for channel Low, Mid and High, the worst case H position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

	CONDUCTED TEST					
	Peak Output Power, 20dB Band Width					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE		
	0 to 78	0,39,78	GFSK	DH5		
Bluetooth	0 to 78	0,39,78	π/4-DQPSK	DH5		
	0 to 78	0,39,78	8-DQPK	DH5		
Band Edge						
Bluetooth	0 to 78	0,78	GFSK	DH5		
		Frequen	cy Separation			
Bluetooth	0 to 78	0,1,2	GFSK	DH5		
		Number of h	opping frequency			
Bluetooth	0 to 78	0 to 78	GFSK	DH5		
Time of Occupancy (Dwell time)						
Bluetooth	0 to 78	0,39,78	GFSK	DH1/DH3/DH5		
Bluetooth	0 to 78	39	π/4-DQPSK	DH1/DH3/DH5		
Bluetooth	0 to 78	39	8-DPSK	DH1/DH3/DH5		

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Page 12 of 77



MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
20dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Frequency Separation	+/- 51.33 Hz
Number of hopping frequency	+/- 51.33 Hz
Time of Occupancy	+/- 51.33 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
(Polarization : Vertical)	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 167MHz: +/- 4.22dB
Measurement uncertainty	167MHz -500MHz: +/- 3.44dB
(Polarization : Horizontal)	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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Page 13 of 77

CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range	Limits dB(uV)			
MHz	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

6.2 Measurement Equipment Used

Conducted Emission Test Site								
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018			
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/22/2017	05/21/2018			
LISN	MESS TEC	FCC-LISN-50/250-25 -2-01	4034	03/19/2017	03/18/2018			
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2016	11/25/2017			

6.3 EUT Setup

- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
- 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.

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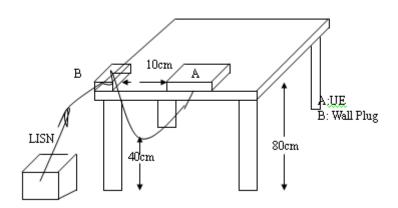
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^{1.} The lower limit shall apply at the transition frequencies

^{2.} The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.



6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

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

6.6 Measurement Result

N/A

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f (886-2) 2298-0488

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Page 15 of 77

PEAK OUTPUT POWER MEASUREMENT

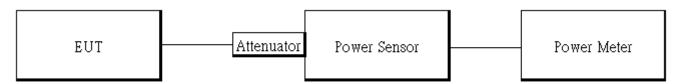
7.1 Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 -2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts.

7.2 Measurement Equipment Used

	Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.			
Power Meter	Anritsu	ML2495A	1005007	12/15/2016	12/14/2017			
Power Sensor	Anritsu	MA2411B	917032	12/15/2016	12/14/2017			
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018			
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018			
Coaxial Cable	HU- BER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018			
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018			
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018			
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017			
Temperature Chamber	TERCHY	MHG-120LF	911009	05/19/2017	05/18/2018			

7.3 Test Set-up:



7.4 Measurement Procedure:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
- 4. Record the max. reading.
- 5. Repeat above procedures until all default test channel is completed.

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Page 16 of 77



7.5 Measurement Result

1M BR mode (Peak):

	, ,					
СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)		
0	2402	4.26	2.667	125		
39	2441	4.45	2.786	125		
78	2480	4.96	3.133	125		

1M BR mode (Average):

וט וווו	This bit mode (Average).							
СН	Freq. (MHz)	Average Output Power (dBm)	Output Power (mW)	Limit (mW)				
0	2402	4.22	2.642	125				
39	2441	4.41	2.761	125				
78	2480	4.92	3.105	125				

2M EDR mode (Peak):

		Peak			2M ED	R mode (A	Average):		
СН	Freq. (MHz)	Output Power (dBm)	Output Power (mW)	Limit (mW)	CH	Freq. (MHz)	Average Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	6.39	4.355	125	0	2402	3.76	2.377	125
39	2441	6.61	4.581	125	39	2441	3.97	2.495	125
78	2480	6.94	4.943	125	78	2480	4.41	2.761	125

3M EDR mode (Peak):

		Peak			3M ED	R mode (A	Average):		
СН	Freq. (MHz)	Output Power (dBm)	Output Power (mW)	Limit (mW)	СН	Freq. (MHz)	Average Output Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	6.89	4.887	125	0	2402	3.77	2.382	125
39	2441	7.07	5.093	125	39	2441	4.00	2.512	125
78	2480	7.28	5.346	125	78	2480	4.48	2.805	125

*Note: Max. Output include tune up tolerance Power measured by using average detector.

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Page 17 of 77



20DB BANDWIDTH MEASUREMENT

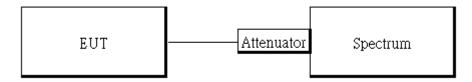
8.1 Standard Applicable

For frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB band-

8.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018		
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018		
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018		

8.3 Test Set-up



8.4 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set the spectrum analyzer as RBW=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= 3MHz, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
- 5. Mark the peak frequency and -20dB (upper and lower) frequency
- 6. Repeat above procedures until all test default channel is completed

NOTE: For the plot of bandwidth measurement, the marker of the 20dB BW is arrow-mark

8.5 Measurement Result

GFSK	π/4-DQPSK	8-DPSK

СН	20 dB BW (MHz)	2/3 BW (MHz)	СН	20 E (N
Low	0.9214	0.61	Low	1.
Mid	0.9208	0.61	Mid	1.
High	0.921	0.61	High	1.

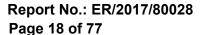
	20 dB	2/3
СН	BW	BW
	(MHz)	(MHz)
Low	1.350	0.90
Mid	1.350	0.90
High	1.352	0.90

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.352	0.90
Mid	1.353	0.90
High	1.372	0.91

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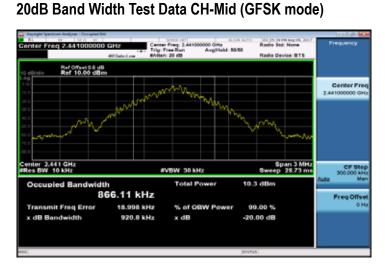
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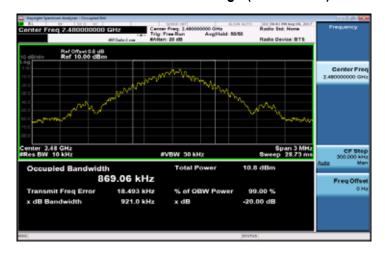


20dB Band Width Test Data CH-Low (GFSK mode)

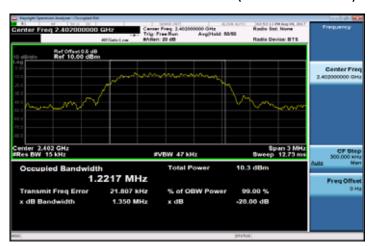




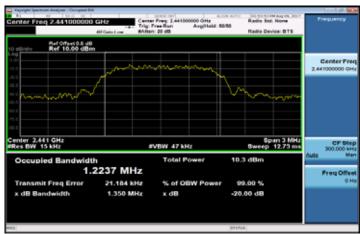
20dB Band Width Test Data CH-High (GFSK mode)



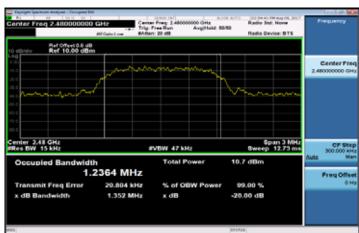
20dB Band Width Test Data CH-Low (π/4-DQPSK mode)



20dB Band Width Test Data CH-Mid (π/4-DQPSK mode)



20dB Band Width Test Data CH-High (π/4-DQPSK mode)



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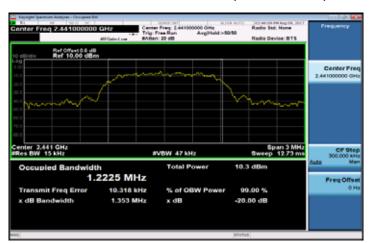
Page 19 of 77



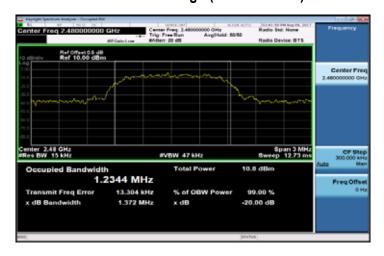
20dB Band Width Test Data CH-Low (8-DPSK mode)



20dB Band Width Test Data CH-Mid (8-DPSK mode)



20dB Width Test Data CH-High (8-DPSK mode)

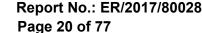


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CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

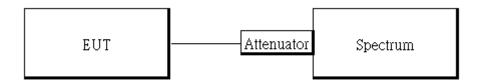
9.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. 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).

9.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018

9.3 Test SET-UP



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Page 21 of 77

9.4 Measurement Procedure

Conducted Band Edge:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = operating frequency.
- 5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
- 6. Mark Peak, 2.3999GHz and 2.4836GHz and record the max. level.
- 7. Repeat above procedures until all frequency measured were complete.

Conducted Spurious Emission:

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Set RBW = 100 kHz & VBW = 300 kHz, Detector = Peak, Sweep = Auto
- 4. Allow trace to fully stabilize.
- 5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
- Repeat above procedures until all default test channel measured were complete.

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	S	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

9.5 Measurement Result

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

- 1. Cable loss as 5.1dB that offsets in the spectrum
- 2. The occurrence of the spike on the conducted emission is the signal of the fundamental emission.

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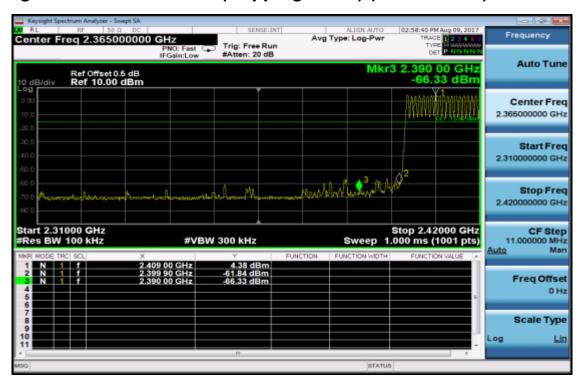
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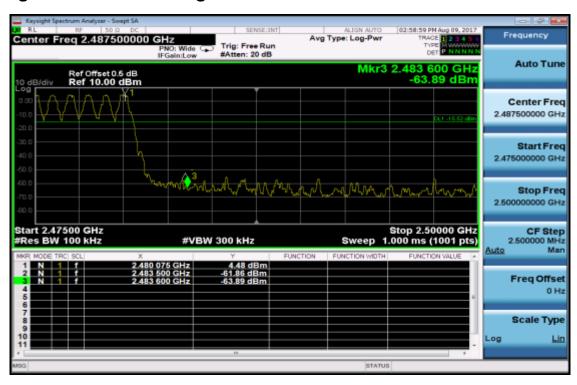
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Band Edges Test Data CH-Low (Hopping mode) (GFSK mode)



Band Edges Test Data CH-High



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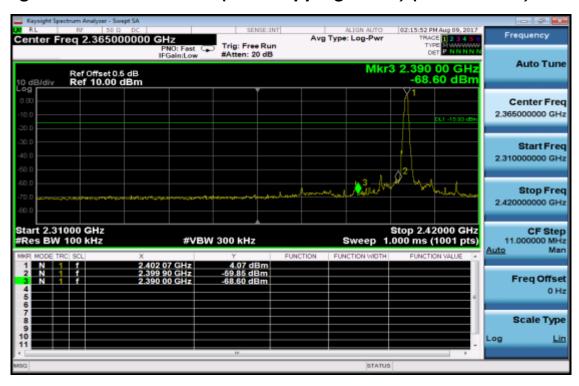
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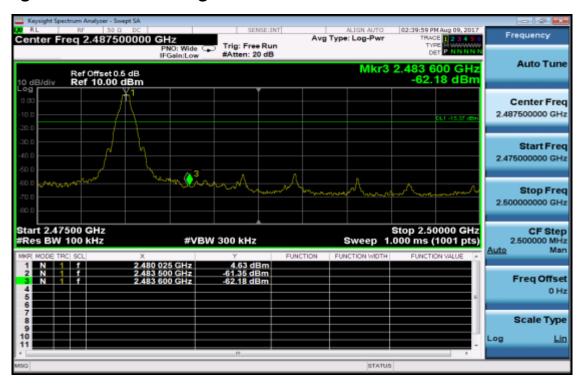
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Band Edges Test Data CH-Low (Non-Hopping mode) (GFSK mode)



Band Edges Test Data CH-High



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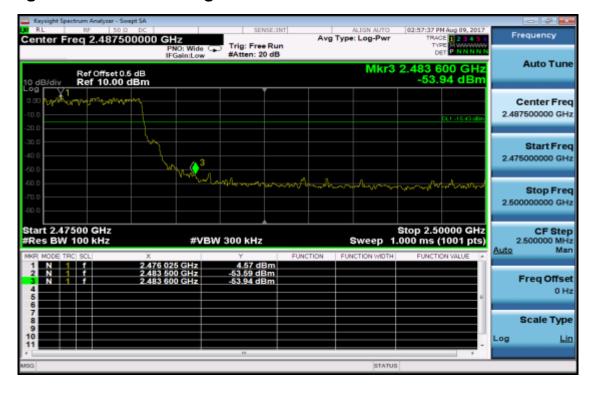
t (886-2) 2299-3279



Band Edges Test Data CH-Low (Hopping mode) (8-DPSK mode)



Band Edges Test Data CH-High



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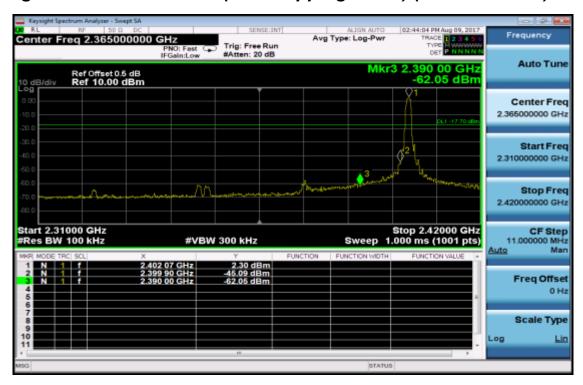
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Band Edges Test Data CH-Low (Non-Hopping mode) (8-DPSK mode)



Band Edges Test Data CH-High



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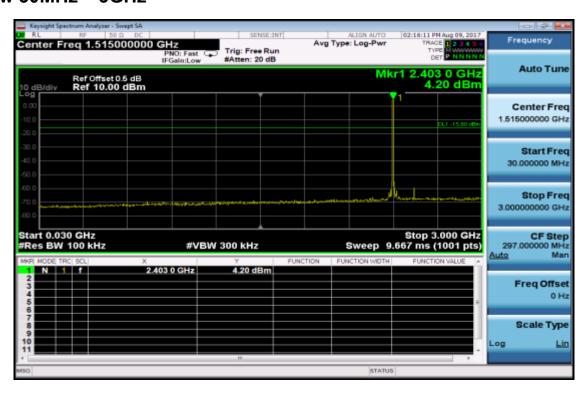
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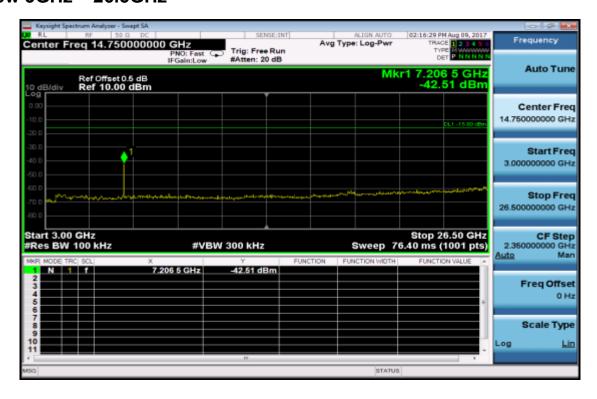
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Conducted Spurious Emission Measurement Result (GFSK mode) Ch Low 30MHz - 3GHz



Ch Low 3GHz - 26.5GHz



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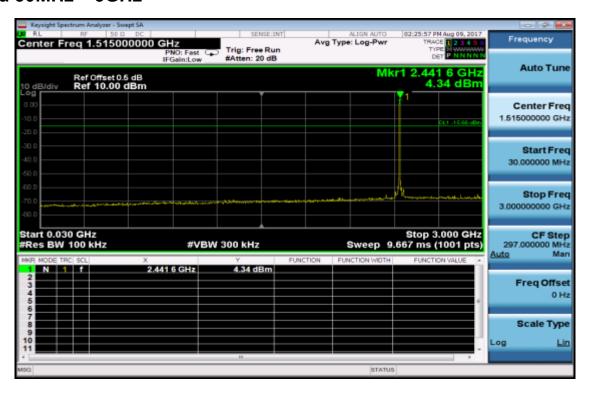
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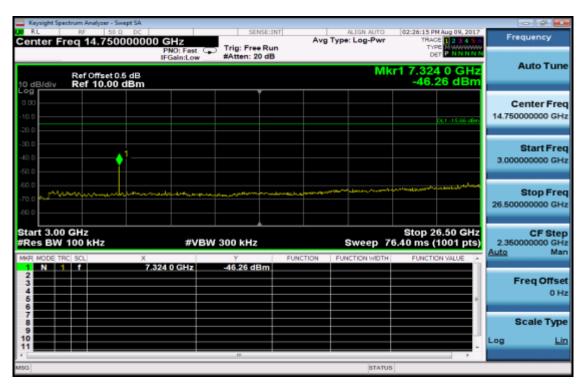
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Ch Mid 30MHz - 3GHz



Ch Mid 3GHz - 26.5GHz



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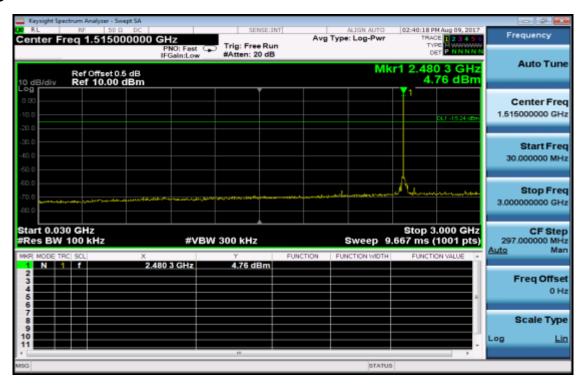
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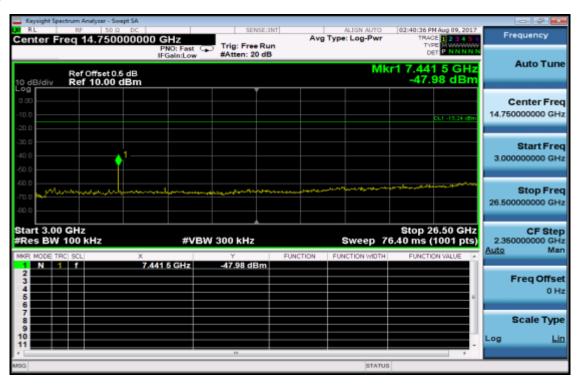
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Ch High 30MHz - 3GHz



Ch High 3GHz - 26.5GHz



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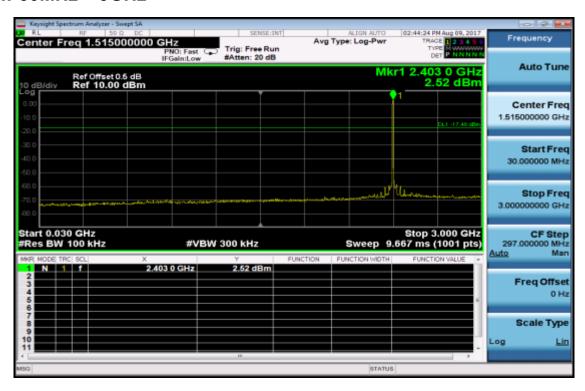
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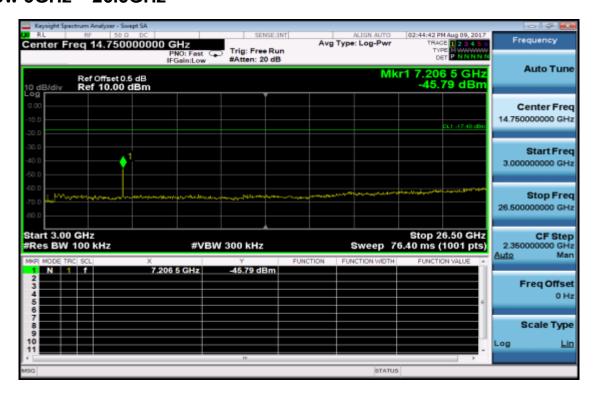
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Conducted Spurious Emission Measurement Result (8DPSK mode) Ch Low 30MHz - 3GHz



Ch Low 3GHz - 26.5GHz



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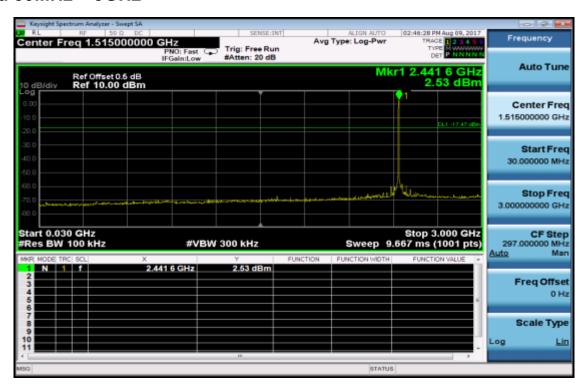
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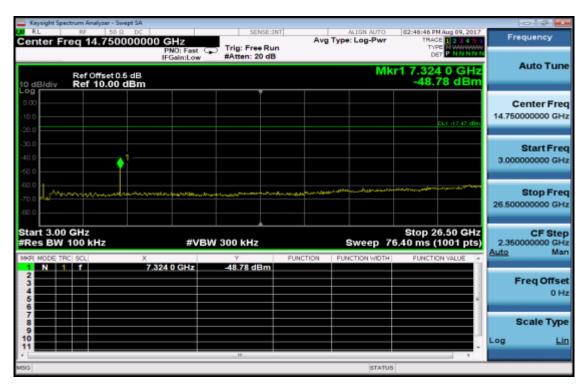
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Ch Mid 30MHz - 3GHz



Ch Mid 3GHz - 26.5GHz



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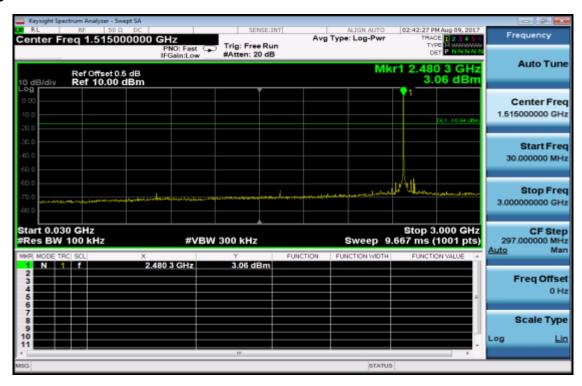
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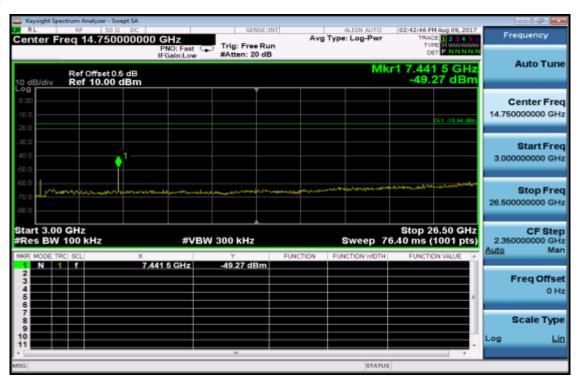
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Ch High 30MHz - 3GHz



Ch High 3GHz - 26.5GHz



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Page 32 of 77

10 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

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.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level $(dB\mu V/m) = 20 \log Emission level (dB\mu V/m)$

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10.2 Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/25/2017	04/24/2018
Loop Antenna	ETS.LINDGREN	6502	148045	09/20/2016	09/19/2017
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/19/2016	12/18/2017
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/04/2017	08/03/2018
Pre-Amplifier	Agilent	8447D	2944A07676	01/03/2017	01/02/2018
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/03/2017	01/02/2018
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	ChamPro	AM-BS-4500-B	060776-ABS	N.C.R	N.C.R
Controller	ChamPro	EM1000	60776	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_RX	9	01/05/2017	01/04/2018
3m Site NSA	SGS	966 chamber	N/A	07/01/2017	06/30/2018
Low Loss Cable	Huber Suhner	966 TX	1	01/05/2017	01/04/2018

NOTE: N.C.R refers to Not Calibrated Required.

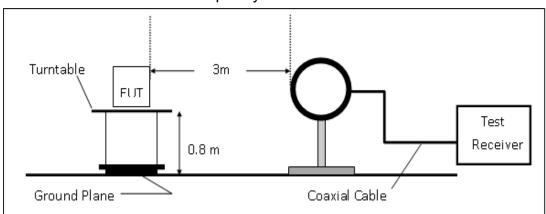
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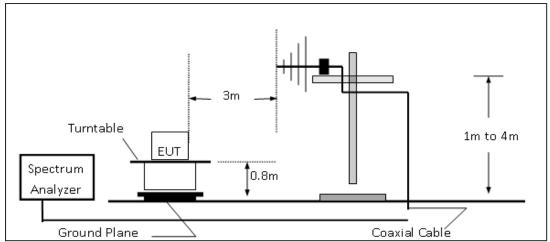


10.3 Test SET-UP

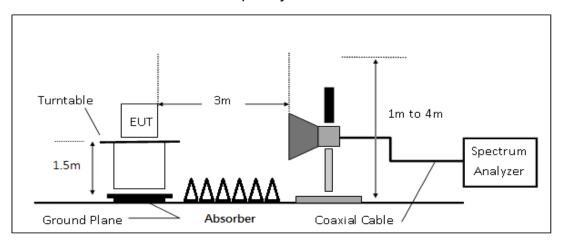
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



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



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10.4 Measurement Procedure

Radiated Emission

- 1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 0.8m for frequency> 1GHz above ground plan.
- 3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 5. Use the follow spectrum analyzer setting:
 - (1) Span = wide enough to fully capture the emission being measured
 - (2) RBW = 1 MHz for $f \ge 1$ GHz, 100 kHz for f < 1 GHz, VBW \ge RBW, Sweep = auto, Detector function = peak, Trace = max hold
 - (3) For average measurement: use duty cycle correction factor method per 15.35(c) Duty Cycle = On time/100 milliseconds

On time = N1*L1=N2*L2+...+N(n-1)*LN(n-1)+N(n)*L(n)

Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.

Average Emission Level = Peak Emission Level + 20*log (duty Cycle)

- 6. 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.
- 7. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 8. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 9. Repeat above procedures until all frequency of the interest measured were complete.

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Page 36 of 77

10.5 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	G	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)

Actual FS(dB μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre Amplifier Gain(dB)

Note:

"F": denotes Fundamental Frequency.; "H": denotes Harmonic Frequency.

"E": denotes Band Edge Frequency.; "S": denotes Spurious Frequency.

10.6 Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

10.7 Measurement Result

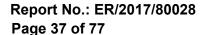
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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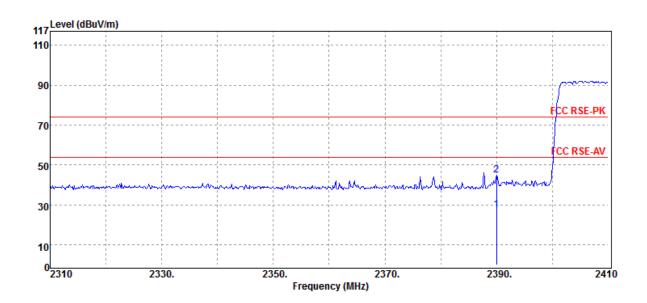


Radiated Band Edge Measurement Result: (Hopping Mode)

:2017-08-08 **Operation Band** :BR Hopping Test Date

Fundamental Frequency :2402 MHz Temp./Humi. :23 deg_C / 62 RH **Operation Mode** :Bandedge CH LOW Engineer :Mike

EUT Pol. :H Plane Measurement Antenna Pol. :VERTICAL

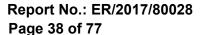


	Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
	MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dΒμV/m	dB
_	2390.00	E	Average	29.45	-1.74	27.71	54.00	-26.29
	2390.00	E	Peak	46.84	-1.74	45.10	74.00	-28.90

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EUT Pol.

:BR Hopping :2402 MHz :Bandedge CH LOW

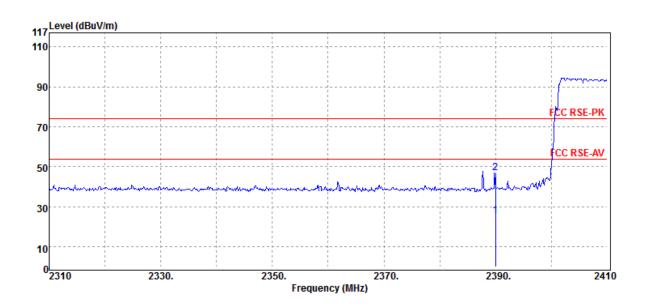
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

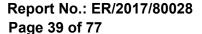
:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	27.29	-1.74	25.55	54.00	-28.45
2390.00	E	Peak	48.78	-1.74	47.04	74.00	-26.96

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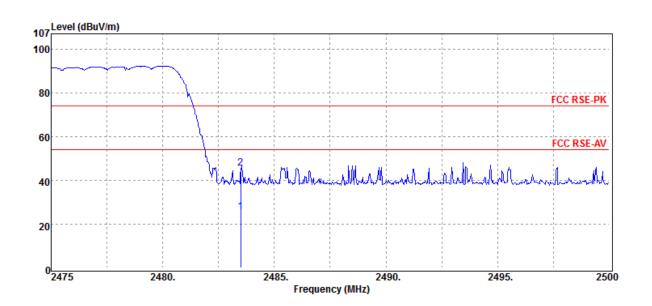
:BR Hopping :2480 MHz

:Bandedge CH HIGH :H Plane

Test Date :2017-08-08 Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.

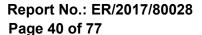


Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Average	27.31	-1.62	25.69	54.00	-28.31
2483.50	Е	Peak	46.98	-1.62	45.36	74.00	-28.64

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:BR Hopping :2480 MHz :Bandedge CH HIGH

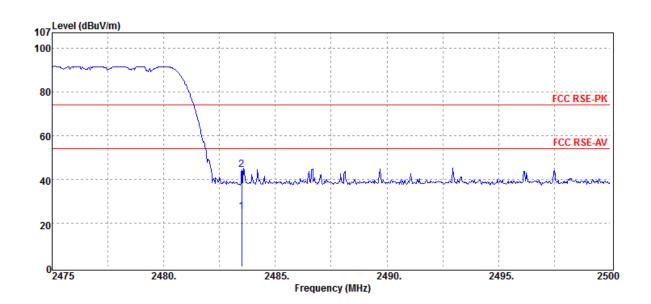
:H Plane

Test Date Temp./Humi. Engineer

:2017-08-08 :23 deg_C / 62 RH

:Mike

:HORIZONTAL Measurement Antenna Pol.

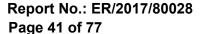


Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Average	26.69	-1.62	25.07	54.00	-28.93
2483.50	Е	Peak	46.01	-1.62	44.39	74.00	-29.61

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:EDR Hopping :2402 MHz :Bandedge CH LOW

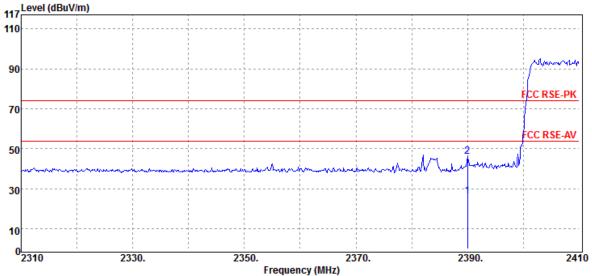
:H Plane

Test Date Temp./Humi. Engineer

:2017-08-08

:23 deg_C / 62 RH

:Mike :VERTICAL Measurement Antenna Pol.



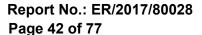
Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2390.00	E	Average	27.98	-1.74	26.24	54.00	-27.76
2390.00	E	Peak	47.90	-1.74	46.16	74.00	-27.84

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:EDR Hopping :2402 MHz

:Bandedge CH LOW

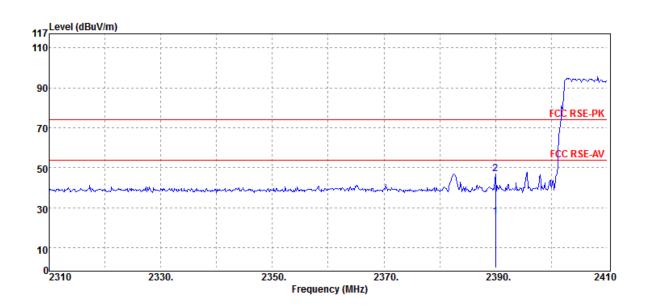
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

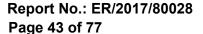
:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBμV/m	dBµV/m	dB
2390.00	Е	Average	27.36	-1.74	25.62	54.00	-28.38
2390.00	E	Peak	48.51	-1.74	46.77	74.00	-27.23

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:EDR Hopping :2480 MHz

:Bandedge CH HIGH

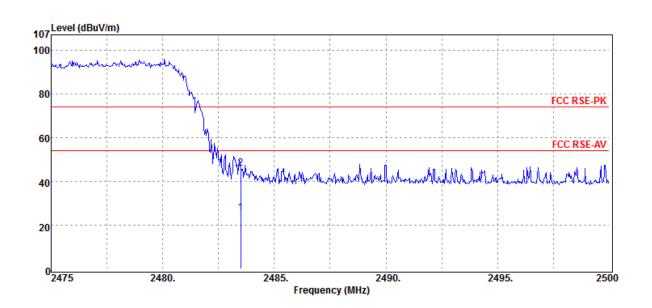
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

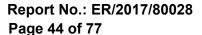
:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2483.50	E	Average	27.21	-1.62	25.59	54.00	-28.41
2483.50	E	Peak	47.46	-1.62	45.84	74.00	-28.16

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:EDR Hopping :2480 MHz

:Bandedge CH HIGH

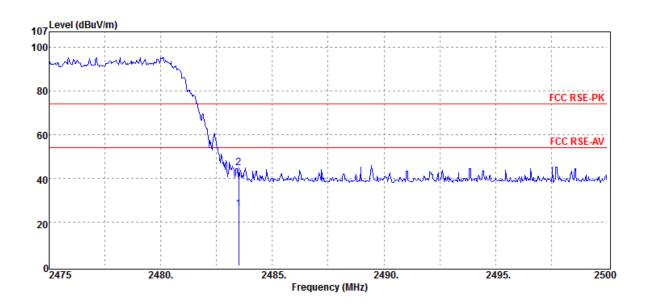
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dΒμV/m	dBμV/m	dB
2483.50	Е	Average	27.41	-1.62	25.79	54.00	-28.21
2483.50	E	Peak	46.34	-1.62	44.72	74.00	-29.28

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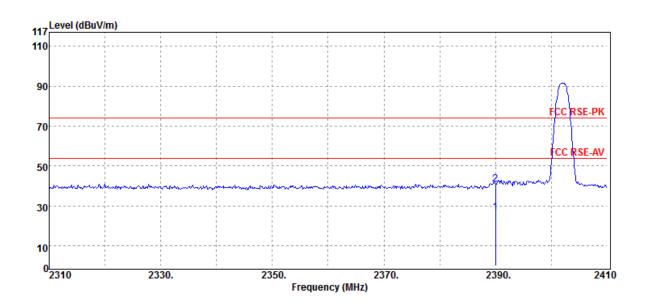


Radiated Band Edge Measurement Result: (Non-Hopping Mode)

Operation Band :BR(1M) **Test Date** :2017-08-08 Fundamental Frequency :2402 MHz Temp./Humi. :23 deg_C / 62 RH

Operation Mode :Bandedge CH LOW Engineer :Mike

:VERTICAL EUT Pol. :H Plane Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Average	28.28	-1.74	26.54	54.00	-27.46
2390.00	Е	Peak	42.72	-1.74	40.98	74.00	-33.02

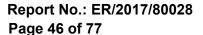
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EUT Pol.

:BR(1M) :2402 MHz

:Bandedge CH LOW

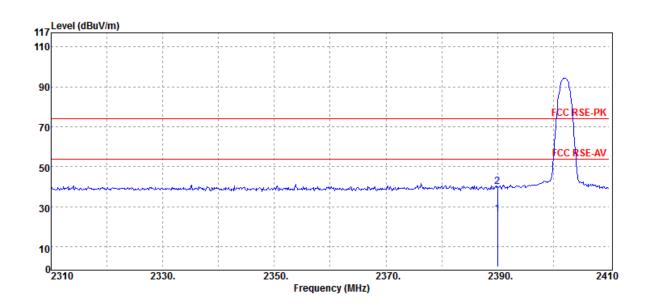
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

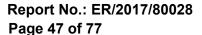
:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμ̈V	dB	dBµV/m	dBμV/m	dB
2390.00	E	Average	28.11	-1.74	26.37	54.00	-27.63
2390.00	E	Peak	41.99	-1.74	40.25	74.00	-33.75

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EUT Pol.

:BR(1M) :2480 MHz

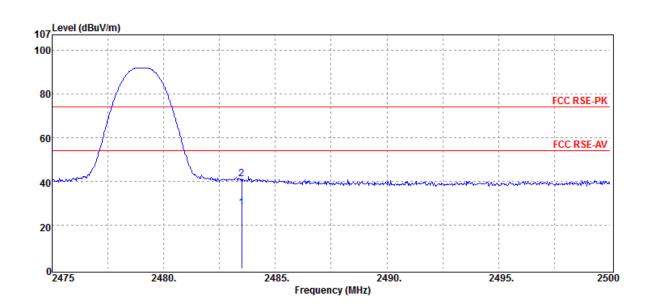
:Bandedge CH HIGH

:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH Engineer :Mike

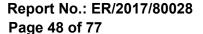
:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Average	29.37	-1.62	27.75	54.00	-26.25
2483.50	E	Peak	42.62	-1.62	41.00	74.00	-33.00

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:BR(1M) :2480 MHz

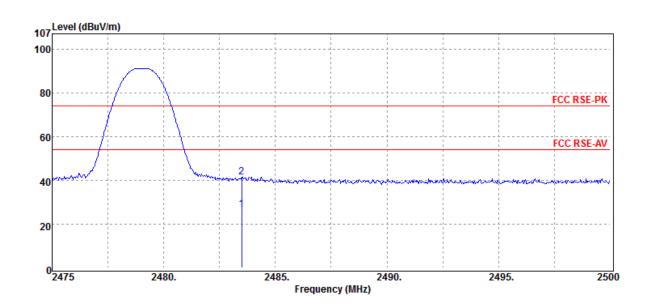
:Bandedge CH HIGH

:H Plane

Test Date :2017-08-08 Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

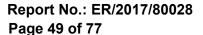
:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2483.50	E	Average	28.39	-1.62	26.77	54.00	-27.23
2483.50	Е	Peak	43.02	-1.62	41.40	74.00	-32.60

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Operation Band Fundamental Frequency

Operation Mode EUT Pol.

:EDR(3M) :2402 MHz

:Bandedge CH LOW

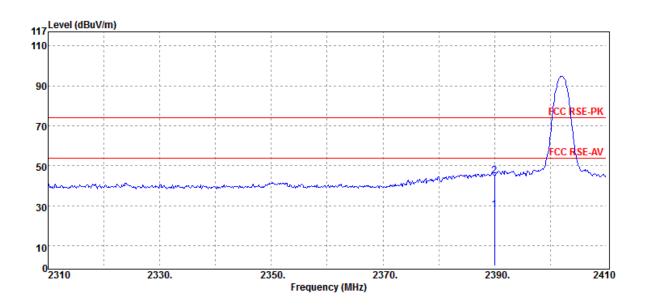
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

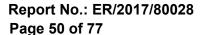
:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	29.70	-1.74	27.96	54.00	-26.04
2390.00	E	Peak	46.78	-1.74	45.04	74.00	-28.96

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EUT Pol.

:EDR(3M) :2402 MHz

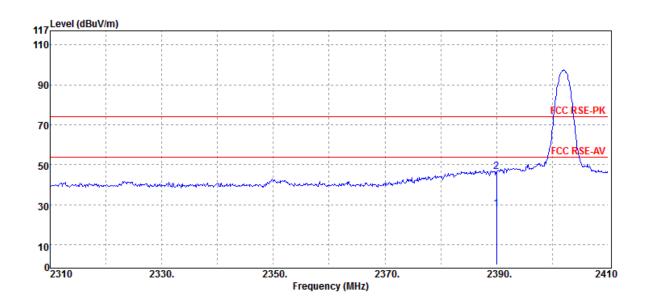
:Bandedge CH LOW

:H Plane

Test Date :2017-08-08 Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

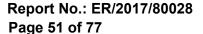
:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
2390.00	E	Average	29.64	-1.74	27.90	54.00	-26.10
2390.00	E	Peak	48.10	-1.74	46.36	74.00	-27.64

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EUT Pol.

:EDR(3M) :2480 MHz

:Bandedge CH HIGH

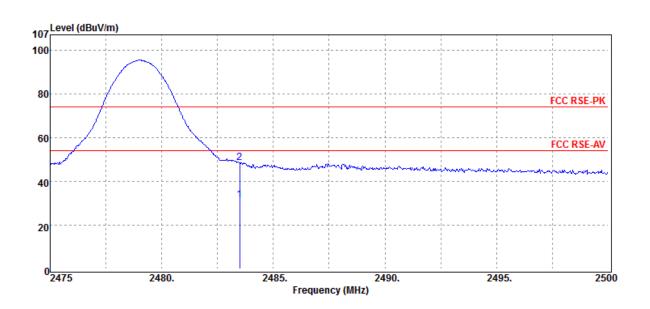
:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

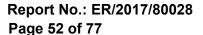
:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2483.50	E	Average	33.26	-1.62	31.64	54.00	-22.36
2483.50	Е	Peak	50.25	-1.62	48.63	74.00	-25.37

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EUT Pol.

:EDR(3M) :2480 MHz

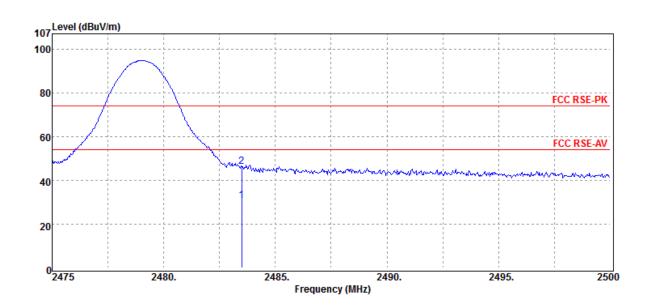
:Bandedge CH HIGH

:H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



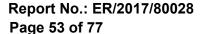
Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBμV/m	dB
2483.50	E	Average	32.18	-1.62	30.56	54.00	-23.44
2483.50	Е	Peak	47.78	-1.62	46.16	74.00	-27.84

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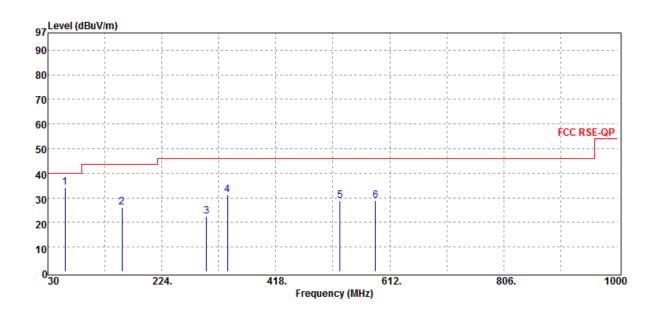
Radiated Spurious Emission Measurement Result:

Operation Band :EDR(3M) :2017-08-08 **Test Date**

Fundamental Frequency :2402 MHz Temp./Humi. :23 deg_C / 62 RH

Operation Mode :Tx CH LOW Engineer :Mike

EUT Pol. :H Plane Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
							_
59.10	S	Peak	42.21	-8.03	34.18	40.00	-5.82
156.10	S	Peak	33.79	-7.61	26.18	43.50	-17.32
299.66	S	Peak	28.55	-5.93	22.62	46.00	-23.38
335.55	S	Peak	36.44	-5.32	31.12	46.00	-14.88
527.61	S	Peak	30.18	-1.32	28.86	46.00	-17.14
587.75	S	Peak	28.82	-0.05	28.77	46.00	-17.23

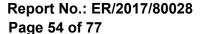
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EUT Pol.

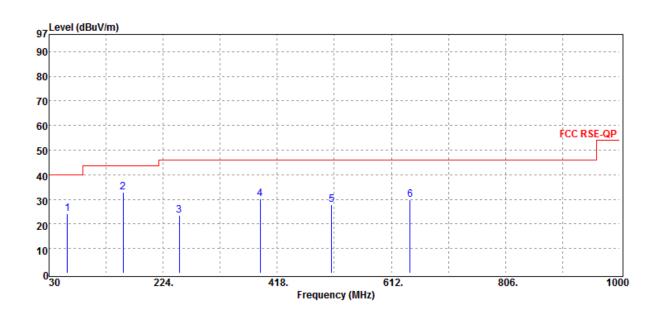
:EDR(3M) :2402 MHz :Tx CH LOW :H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



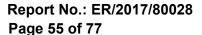
Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
61.04	S	Peak	32.48	-8.25	24.23	40.00	-15.77
156.10	S	Peak	40.39	-7.61	32.78	43.50	-10.72
251.16	S	Peak	31.38	-7.89	23.49	46.00	-22.51
388.90	S	Peak	34.56	-4.29	30.27	46.00	-15.73
510.15	S	Peak	30.01	-2.19	27.82	46.00	-18.18
644.01	S	Peak	29.07	0.65	29.72	46.00	-16.28

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Operation Band Fundamental Frequency

Operation Mode EUT Pol.

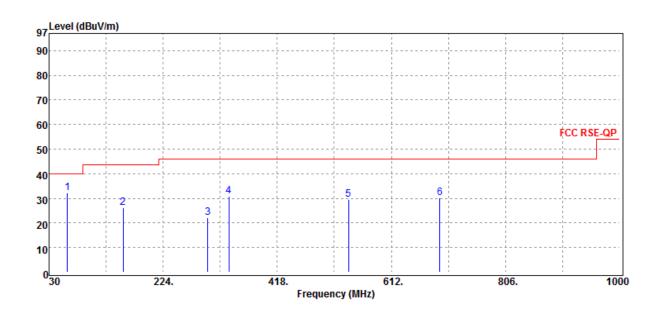
:EDR(3M) :2441 MHz :Tx CH MID :H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.

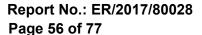


Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
61.04	S	Peak	40.50	-8.25	32.25	40.00	-7.75
156.10	S	Peak	33.86	-7.61	26.25	43.50	-17.25
299.66	S	Peak	28.07	-5.93	22.14	46.00	-23.86
335.55	S	Peak	36.17	-5.32	30.85	46.00	-15.15
539.25	S	Peak	30.97	-1.58	29.39	46.00	-16.61
694.45	S	Peak	28.82	1.36	30.18	46.00	-15.82

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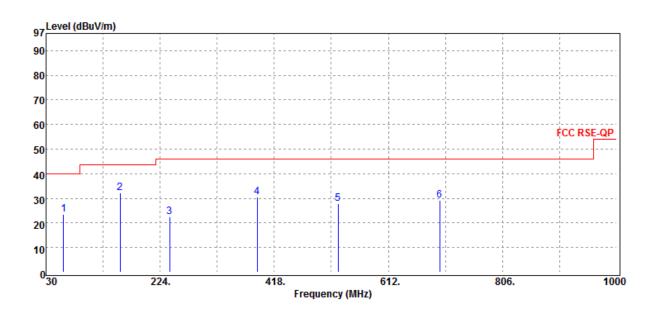
:EDR(3M) :2441 MHz :Tx CH MID :H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.

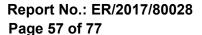


Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
							_
60.07	S	Peak	31.46	-8.05	23.41	40.00	-16.59
156.10	S	Peak	39.96	-7.61	32.35	43.50	-11.15
240.49	S	Peak	30.61	-8.04	22.57	46.00	-23.43
388.90	S	Peak	34.72	-4.29	30.43	46.00	-15.57
526.64	S	Peak	29.17	-1.44	27.73	46.00	-18.27
699.30	S	Peak	27.90	1.44	29.34	46.00	-16.66

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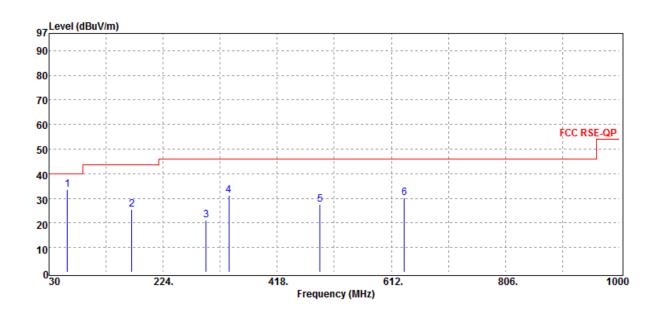
:EDR(3M) :2480 MHz :Tx CH HIGH :H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
61.04	S	Peak	41.71	-8.25	33.46	40.00	-6.54
170.65	S	Peak	33.08	-7.66	25.42	43.50	-18.08
296.75	S	Peak	27.14	-5.98	21.16	46.00	-24.84
335.55	S	Peak	36.61	-5.32	31.29	46.00	-14.71
490.75	S	Peak	30.14	-2.53	27.61	46.00	-18.39
634.31	S	Peak	29.63	0.51	30.14	46.00	-15.86

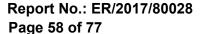
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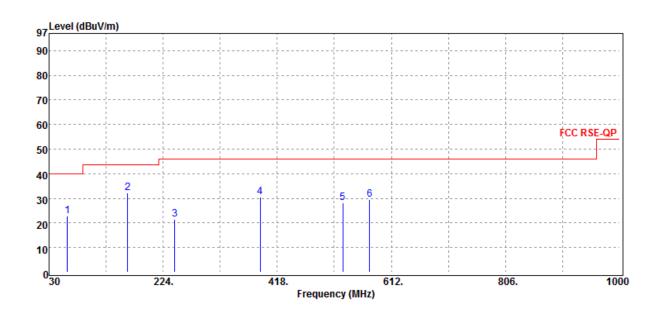
:EDR(3M) :2480 MHz :Tx CH HIGH :H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
61.04	S	Peak	31.12	-8.25	22.87	40.00	-17.13
163.86	S	Peak	39.72	-7.45	32.27	43.50	-11.23
243.40	S	Peak	29.55	-8.02	21.53	46.00	-24.47
388.90	S	Peak	34.83	-4.29	30.54	46.00	-15.46
529.55	S	Peak	29.30	-1.25	28.05	46.00	-17.95
575.14	S	Peak	30.24	-0.80	29.44	46.00	-16.56

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Page 59 of 77

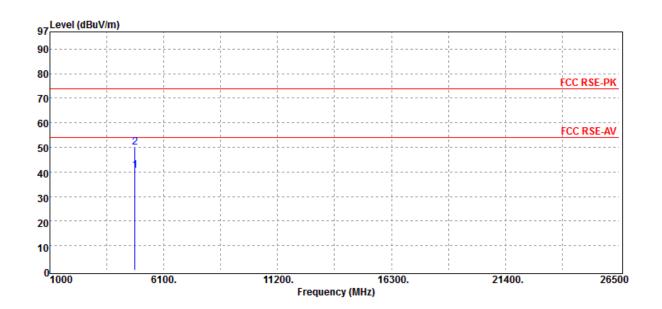
Radiated Spurious Emission Measurement Result:

For Frequency above 1 GHz

Operation Band :EDR(3M) :2017-08-08 **Test Date**

Fundamental Frequency :2402 MHz Temp./Humi. :23 deg C / 62 RH

Operation Mode :Tx CH LOW Engineer :Mike EUT Pol. :H Plane :VERTICAL Measurement Antenna Pol.



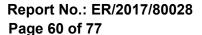
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@ 3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4804.00	Н	Average	35.74	4.92	40.66	54.00	-13.34
4804.00	Н	Peak	45.17	4.92	50.09	74.00	-23.91

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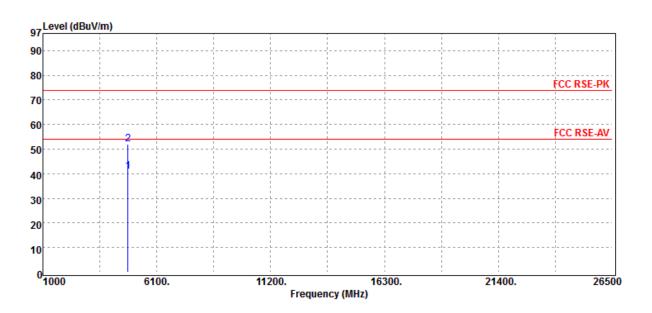


:EDR(3M) :2402 MHz :Tx CH LOW :H Plane

Test Date :2017-08-08 Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.

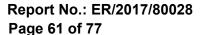


Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
							_
4804.00	Н	Average	36.12	4.92	41.04	54.00	-12.96
4804.00	Н	Peak	47.12	4.92	52.04	74.00	-21.96

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Operation Band Fundamental Frequency

Operation Mode EUT Pol.

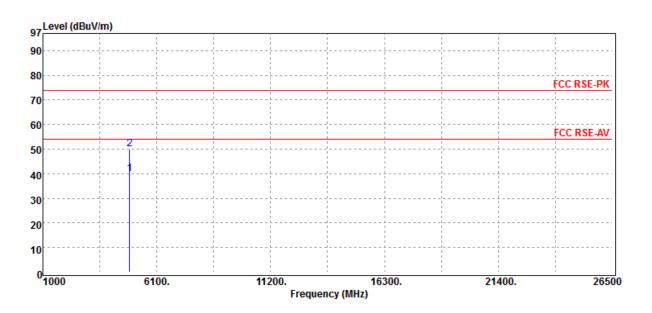
:EDR(3M) :2441 MHz :Tx CH MID :H Plane

Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:VERTICAL Measurement Antenna Pol.

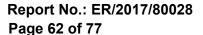


Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
							_
4882.00	Н	Average	34.64	5.18	39.82	54.00	-14.18
4882.00	Н	Peak	44.87	5.18	50.05	74.00	-23.95

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Operation Band Fundamental Frequency

Operation Mode EUT Pol.

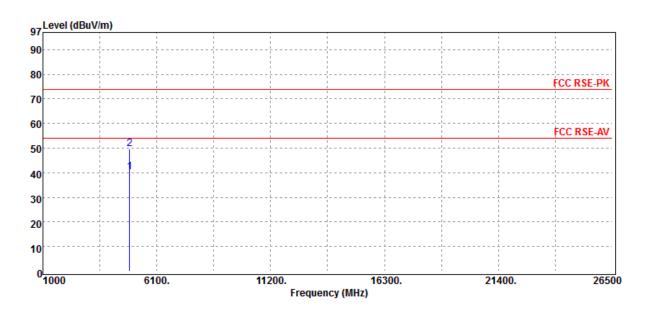
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Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



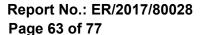
Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
							_
4882.00	Н	Average	35.16	5.18	40.34	54.00	-13.66
4882.00	Н	Peak	44.56	5.18	49.74	74.00	-24.26

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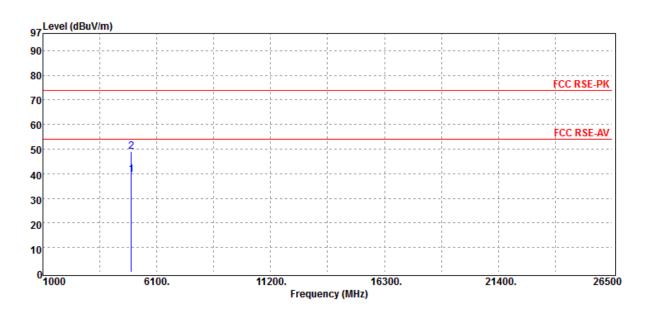
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Test Date :2017-08-08

Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

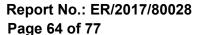
:VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
							_
4960.00	Н	Average	34.21	5.29	39.50	54.00	-14.50
4960.00	Н	Peak	43.81	5.29	49.10	74.00	-24.90

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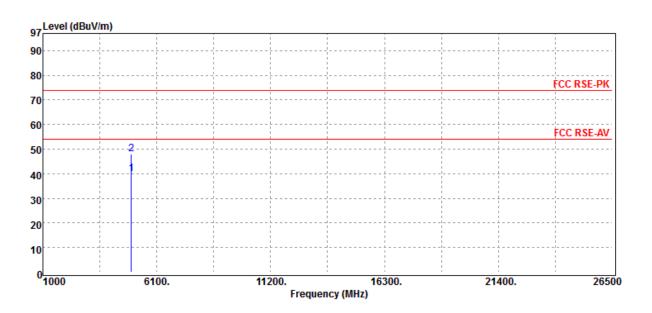


:EDR(3M) :2480 MHz :Tx CH HIGH :H Plane

Test Date :2017-08-08 Temp./Humi. :23 deg_C / 62 RH

Engineer :Mike

:HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Safe Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBμV/m	dB
							_
4960.00	Н	Average	34.51	5.29	39.80	54.00	-14.20
4960.00	Н	Peak	42.60	5.29	47.89	74.00	-26.11

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Page 65 of 77

11 FREQUENCY SEPARATION

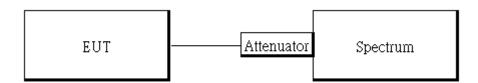
11.1 Standard Applicable

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

11.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018		
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018		
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018		

11.3 Test Set-up



11.4 Measurement Procedure

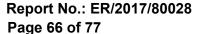
- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = middle of hopping channel.
- 5. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
- 6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

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11.5 Measurement Result

Channel separation (MHz)	Limit	Result
1	>=25 kHz or 2/3 times 20dB bandwidth	PASS

Frequency Separation Test Data



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Page 67 of 77

12 NUMBER OF HOPPING FREQUENCY

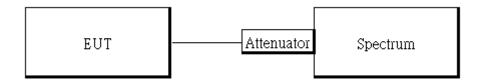
12.1 Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

12.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018		
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018		
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018		

12.3 Test Set-up



12.4 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
- 5. Set the spectrum analyzer as RBW=430 kHz, VBW=1.5MHz., Detector = Peak
- 6. Max hold, view and count how many channel in the band.

12.5 Measurement Result

Tabular Data of Total Channel Number

	Channel Number	Limit
2.4 GHz – 2.441GHz	40	
2.441 GHz – 2.4835GHz	39	>15
2.4GHz ~2.4835GHz	(40+39) = 79	

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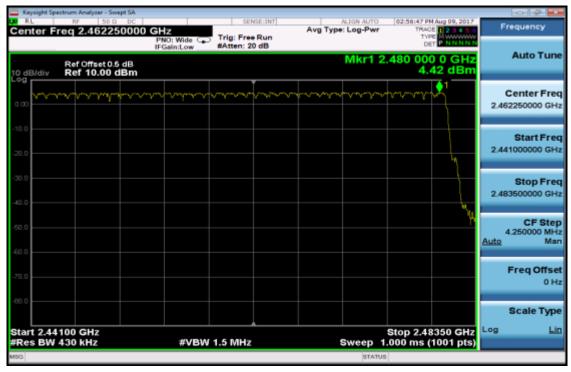


Channel Number

2.4GHz - 2.441GHz



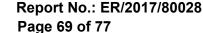
2.441 GHz - 2.4835GHz



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TIME OF OCCUPANCY (DWELL TIME)

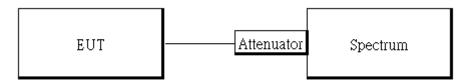
13.1 Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

13.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018		
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018		
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018		

13.3 Test Set-up



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Report No.: ER/2017/80028

Page 70 of 77

13.4 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = operating frequency.
- 5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz, Detector = Peak, Adjust Sweep = $2\sim8$ ms.
- 6. Repeat above procedures until all frequency of the interest measured were complete.

Formula Deduced: time occupancy of one time slot X Hopping rate / total slot in one channel / total channel that hops X period of working channels.

Where, standard hopping rate is 1600 hops/s, slot in one channel for DH1, DH3, and DH5 is 2, 4, and 6, respectively.

DH1 consists of single time slot of the uplink, and one slot of the downlink Total Slot: 2 DH3 consists of three time slot of the uplink, and one slot of the downlink. Total Slot: 4 DH5 consists of five time slot of the uplink, and one slot of the downlink. Total Slot: 6

In AFH mode, hopping rate is 800 hop/s with 6 slots in 20 hopping channels with channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 * 20) (S), Hop Over Occupancy Time comes to (800 / 6 / 20)*(0.4 *20) =53.33

Note: the result of the complete test default channel at 1Mbps is recorded on the test report. 2Mbps, and 3Mbps only records the measurement result at middle channel that reveals no much deviation.

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Page 71 of 77

13.5 Tabular Result of the Measurement

GESK (1Mbps)

GFSK (TWIDPS)			
Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
	DH1	117.12	400ms
0	DH3	257.12	400ms
	DH5	302.61	400ms
	DH1	118.72	400ms
39	DH3	257.12	400ms
	DH5	302.61	400ms
	DH1	118.40	400ms
78	DH3	256.32	400ms
	DH5	302.61	400ms

π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
	2DH1	119.68	400ms
39	2DH3	257.60	400ms
	2DH5	302.61	400ms

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
	3DH1	120.96	400ms
39	3DH3	257.60	400ms
	3DH5	302.61	400ms

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A period time = 0.4 (s) * 79 = 31.6 (s)

GFSK (1Mbps):

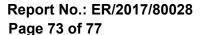
CH Low	DH1 time slot =	0.366 *	(1600/2/79) *	31.6 =	117.12 (ms)		
	DH3 time slot =	1.607 *	(1600/4/79) *	31.6 =	257.12 (ms)		
	DH5 time slot =	2.837 *	(1600/6/79) *	31.6 =	302.61 (ms)		
OLLM: 4		0.074 *	(4.000/0/70\ *	24.0 -	440.70 ()		
CH Mid	DH1 time slot =	0.371 *	(1600/2/79) *	31.6 =	118.72 (ms)		
	DH3 time slot =	1.607 *	(1600/4/79) *	31.6 =	257.12 (ms)		
	DH5 time slot =	2.837 *	(1600/6/79) *	31.6 =	302.61 (ms)		
CH High	DH1 time slot =	0.370 *	(1600/2/79) *	31.6 =	118.40 (ms)		
· ·	DH3 time slot =	1.602 *	(1600/4/79) *	31.6 =	256.32 (ms)		
	DH5 time slot =	2.837 *	(1600/6/79) *	31.6 =	302.61 (ms)		
π/4 -DQPSK (2Mbps):							
CH Mid	2DH1 time slot=	0.374 *	(1600/2/79) *	31.6 =	119.68 (ms)		
	2DH3 time slot=	1.610 *	(1600/4/79) *	31.6 =	257.60 (ms)		
	2DH5 time slot=	2.837 *	(1600/6/79) *	31.6 =	302.61 (ms)		

8-DPSK (3Mbps):

CH Mid	3DH1 time slot=	0.378 *	(1600/2/79) *	31.6 =	120.96 (ms)
	3DH3 time slot=	1.610 *	(1600/4/79) *	31.6 =	257.60 (ms)
	3DH5 time slot=	2 837 *	(1600/6/79) *	316 =	302 61 (ms)

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GFSK (1Mbps) for AFH Mode					
Hopping Channel Number	PACKET TYPE	Measurement Result (ms)	Limit (ms)		
20	DH5	151.31	400ms		
π/4 DQPSK (2Mbps) for AFH Mode					
Hopping Channel Number	PACKET TYPE	Measurement Result (ms)	Limit (ms)		
20	2DH5	151.31	400ms		
8-DPSK (3Mbps) for AFH Mode					
Hopping Channel Number	PACKET TYPE	Measurement Result (ms)	Limit (ms)		
20	3DH5	151.31	400ms		

GFSK (1Mbps):

DH5 time sl =	2 837	(ms)	*	(800/6/20) * 8 =	151 31 (ms))
		(1110)		(0 0 0	101.01	,	/

π/4 -DQPSK (2Mbps

2DH5 time := 2.837 (800/6/20)*8 =151.31

8-DPSK (3Mbps):

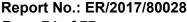
3DH5 time := 2.837 (ms) * (800/6/20)* 8 = 151.31 (ms)

13.6 Measurement Result

Note: Refer to next page for plots.

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Page 74 of 77



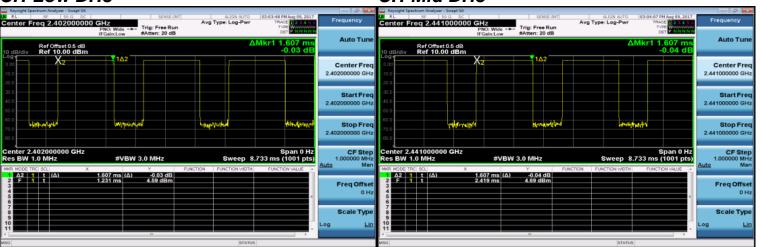
CH-Low DH1

CH-Mid DH1



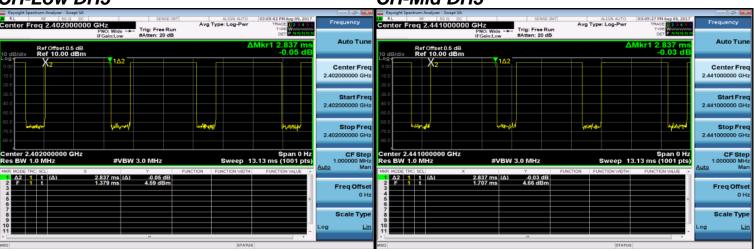
CH-Low DH3

CH-Mid DH3



CH-Low DH5

CH-Mid DH5



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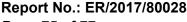
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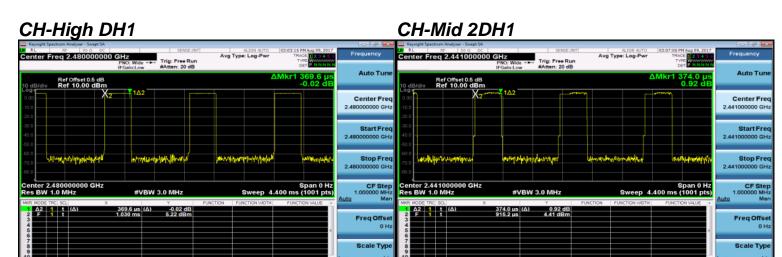
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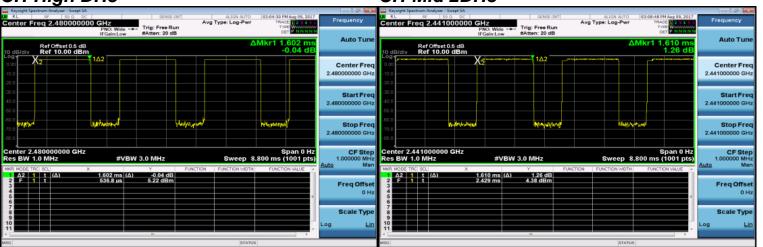
Page 75 of 77





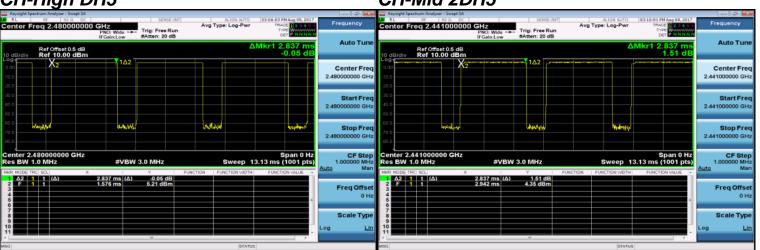
CH-High DH3





CH-High DH5

CH-Mid 2DH5



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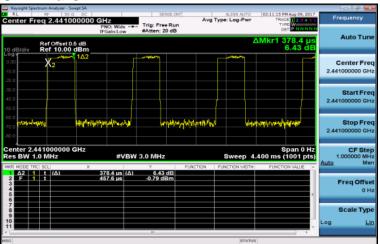
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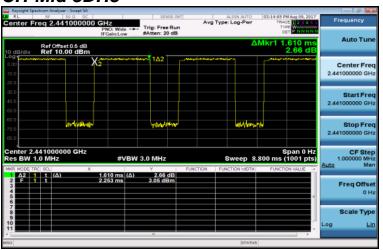
Page 76 of 77

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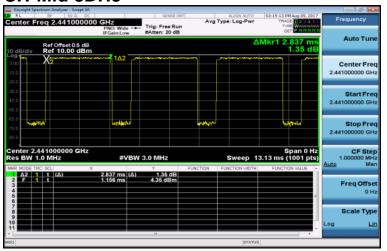
CH-Mid 3DH1



CH-Mid 3DH3



CH-Mid 3DH5



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SGS Taiwan Ltd. No.134, WuKungRoad, NewTaipeiIndustrialPark, WukuDistrict, NewTaipeiCity, Taiwan 24803/新北市五股區新北產業園區五工路 134 號



Report No.: ER/2017/80028

Page 77 of 77

14 ANTENNA REQUIREMENT

14.1 Standard Applicable

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

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

14.2 Antenna Connected Construction

An embedded-in antenna design is used.

The antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

~ End of Report ~

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