

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

	OF
Applicant:	Sharp Corporation, Mobile Communication B.U. 2-13-1, Hachihonmatsu-Iida, Higashi-hiroshima-shi, Hiroshima 739-0192, Japan
Manufacturer:	Sharp Corporation 1 Takumi-cho, Sakai-ku, Sakai-Shi, Osaka 590-8522, Japan
Product Name:	Smart Phone
Report Number:	ER/2018/30015
FCC ID:	APYHRO00259
FCC Rule Part:	§15.247, Cat: DTS
Issue Date:	Mar. 28, 2018
Date of Test:	Mar. 05, 2018 ~ Mar. 21, 2018

Date of EUT Received: Mar. 05, 2018

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.

Marcus Iseng

Tested By:

Approved By:

Marcus Tsena / Sr. Engineer

Jim Chang / Manager





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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
ER/2018/30015	Rev.00	Initial creation of document	All	Mar. 28, 2018	Violetta Tang

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1. GENERAL INFORMATION

1.1 Product Description

General:

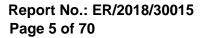
Product Name:	Smart Phone	
Hardware Version:	DVT	
Software Version:	N/A	
	3.85V from Rechargeable Li-ion Battery	
Power Supply:	Battery:	Model No.: UBATIA286AFN2, Supplier: SCUD (FUJIAN) Electronics Co., Ltd.

Bluetooth Low Energy:

Frequency Range:	2402 – 2480MHz
Bluetooth Version	BT V5.0 (dual mode)
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	6.63dBm (BT 4.0) 6.99dBm (BT 5.0)
Antenna Designation:	IFA Antenna, Gain: -2.5dBi

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

KDB 558074 D01 v04 DTS Meas. Guidance

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 / TW0001

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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2. SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

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 hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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 0.4dB.

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2.5 Configuration of Tested System

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Fig. 2-1 Radiated & AC Power Line Conducted Emission
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Fig. 2-2 Conducted (Antenna Port) Emission

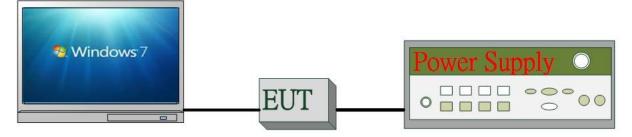


Table 2-1 Equipment Used in Tested System

ltem	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Anritsu	E3640A	MY52410006	N/A	Unshielded
3.	Notebook	Lenovo	T440	P0000564	Shielded	Unshielded

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3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(a)(2)	6dB Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	Peak Power Density	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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4. DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

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

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4.2 The Worst Test Modes and Channel Details

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

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE	TESTED	MODULATION	DATA RATE
MODE	CHANNEL	CHANNEL	WODULATION	(Mbps)
Bluetooth LE	0 to 39	19	GFSK	1
Bluetooth LE	0 to 39	19	GFSK	2
	RADIATE	ED EMISSION	TEST (ABOVE 1 GHz)	
MODE	AVAILABLE	TESTED		DATA RATE
MODE	CHANNEL	CHANNEL	MODULATION	(Mbps)
Bluetooth LE	0 to 39	0,19,39	GFSK	1
Bluetooth LE	0 to 39	0,19,39	GFSK	2

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 LE Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,19,39	GFSK	1
Bluetooth LE	0 to 39	0,19,39	GFSK	2

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5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
6dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Peak Power Density	+/- 1.3 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

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

	9kHz – 30MHz: +/- 2.87 dB		
	30MHz - 167MHz: +/- 4.22dB		
Measurement uncertainty (Polarization : Horizontal)	167MHz -500MHz: +/- 3.44dB		
	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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6. CONDUCTED EMISSION TEST

6.1 Standard Applicable:

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

	Limits				
Frequency range	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					

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.

6.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100760	2017/06/06	2018/06/05
Coaxial Cables	N/A	WK CE Cable	N/A	2018/01/02	2019/01/01
Notebook	Lenovo	T440P	P0000564	N/A	N/A
LISN	SCHWARZBECK	NSLK 8127	8127-649	2017/05/22	2018/05/21

6.3 EUT Setup:

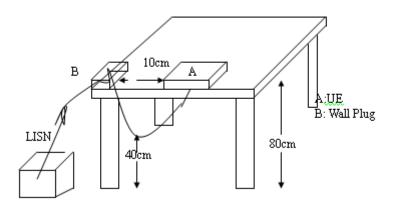
- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
- 2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- 3. The LISN was connected with 120Vac/60Hz power source.

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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 phases of power being supplied by given UE are completed

6.6 Measurement Result:

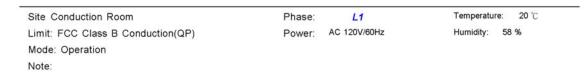
Note: Refer to next page for measurement data and plots. Note2: The * reveals the worst-case results that closet to the limit

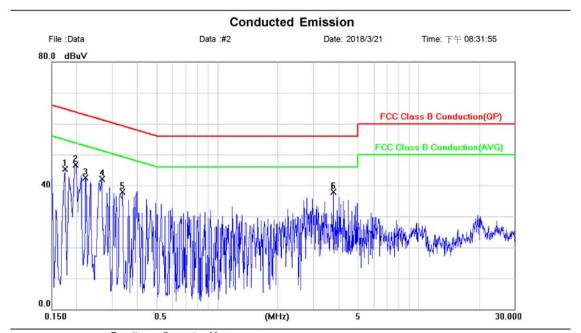
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AC POWER LINE CONDUCTED EMISSION TEST DATA





No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over			
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment	
1		0.1740	45.27	0.00	45.27	64.77	-19.50	peak		
2	*	0.1965	46.79	0.00	46.79	63.76	-16.97	peak		
3		0.2220	42.44	0.00	42.44	62.74	-20.30	peak		
4		0.2660	42.20	0.00	42.20	61.24	-19.04	peak		
5		0.3380	37.84	0.00	37.84	59.25	-21.41	peak		
6		3.7660	37.94	0.06	38.00	56.00	-18.00	peak		

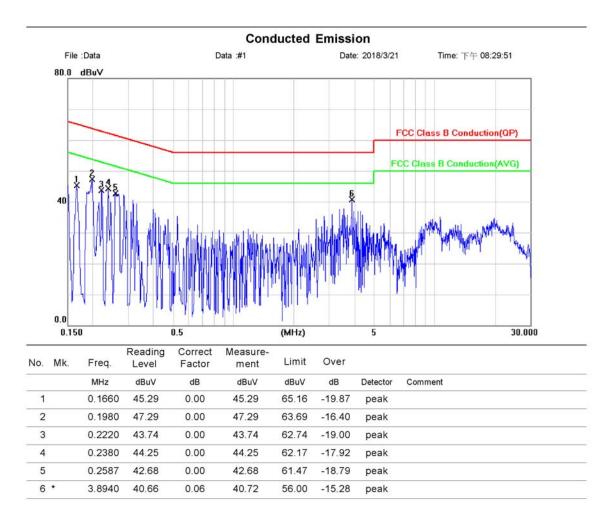
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Temperature: 20 °C Phase: N Site Conduction Room 58 % Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: Mode: Operation Note:



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7. PEAK OUTPUT POWER MEASUREMENT

7.1 Standard Applicable:

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

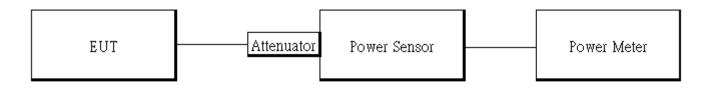
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

7.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1242004	2017/10/16	2018/10/15
DC Power Supply	Anritsu	E3640A	MY52410006	2017/11/28	2018/11/27
Attenuator	Mini-Circuit	BW-S10W2+	2	2018/01/02	2019/01/01
Notebook	Lenovo	T440	P0000564	N/A	N/A

7.3 Test Set-up:



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7.4 Measurement Procedure:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

Power Meter:

It is used as the auxiliary test equipment to conduct the output power measurement.

- 4. Record the max. Reading as observed from Power Meter.
- 5. Repeat above procedures until all test default channel measured was complete.

Duty Factor

DATA RATE 1 Mbps:

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE	62.66	2.03	2.55	3.00



Duty Cycle Factor:10*log(1/(62.66/100))=2.03

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DATA RATE 2 Mbps (BT 5.0):

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE	56.77	2.46	0.94	1.00

	rum Analyzer - Swept SA						
Center F	reg 2.440000000		SBNSE	A	vg Type: Log-Pwr	12:27:52 PM Mar 16, 2018 TRACE 1 2 3 4 5 6 TYPE	Frequency
10 dB/div	Ref Offset 0.4 dB Ref 20.40 dBm	PNO: Fast = IFGain:Low	 Trig: Free F #Atten: 30 d 			∆Mkr3 1.874 ms -2.43 dB	Auto Tune
10.4 0.400		^{1∆2}	•	3Δ4			Center Freq 2.440000000 GHz
-19.6 -29.6 -39.6		Vyjeliserske	hep-transart-later				Start Freq 2.440000000 GHz
-49.6 -59.6 -69.6							Stop Freq 2.44000000 GHz
Res BW 8	RC SCL X		W 8.0 MHz	FUNCTION		Span 0 Hz 3.733 ms (1001 pts)	CF Step 8.000000 MHz Auto Man
1 Δ2 1 2 F 1 3 Δ4 1 4 F 1 5 6 7 8	t (Δ) t (Δ) t (Δ)	1.064 ms (Δ 7.467 μs 1.874 ms (Δ 7.467 μs	4,73 dBn	3			Freq Offset 0 Hz
10 11 MBG					STAT	3	

Duty Cycle Factor:10*log(1/(56.77/100))=2.46

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7.5 Measurement Result:

DATA RATE 1 Mbps:

BLE mode:

	Frequency	Peak Power Output					
СН	(MHz)	(dBm)	Required Limit				
0	2402	6.05	1 Watt = 30 dBm				
19	2440	5.53	1 Watt = 30 dBm				
39	2480	6.63	1 Watt = 30 dBm				
BLE mode:	BLE mode:						
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit				
0	2402	5.96	1 Watt = 30 dBm				
19	2440	5.45	1 Watt = 30 dBm				
39	2480	6.54	1 Watt = 30 dBm				

*Note: Measured by power meter, cable loss as 0.4 dB that offsets on the power meter *Note: Measured by power meter, as Duty cycle factor that offsets on the power meter in Peak. *Note: Max. Output include tune up tolerance Power is average power

DATA RATE 2 Mbps (BT 5.0):

BLE mode:							
СН	Frequency (MHz)	Peak Power Output (dBm)	Required Limit				
0	2402	6.56	1 Watt = 30 dBm				
19	2440	5.95	1 Watt = 30 dBm				
39	2480	6.99	1 Watt = 30 dBm				
BLE mode:	BLE mode:						
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit				
0	2402	6.03	1 Watt = 30 dBm				
19	2440	5.84	1 Watt = 30 dBm				
39	2480	6.89	1 Watt = 30 dBm				

*Note: Measured by power meter, cable loss as 0.4 dB that offsets on the power meter

*Note: Measured by power meter, as Duty cycle factor that offsets on the power meter in Peak. *Note: Max. Output include tune up tolerance Power is average power

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8. 6DB BANDWIDTH MEASUREMENT

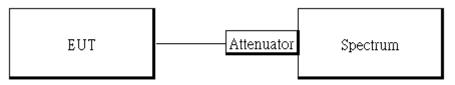
8.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY54200716	2017/10/16	2018/10/15
DC Power Supply	Anritsu	E3640A	MY52410006	2017/11/28	2018/11/27
Attenuator	Mini-Circuit	BW-S10W2+	2	2018/01/02	2019/01/01
Notebook	Lenovo	T440	P0000564	N/A	N/A

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 the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. For 6dB Bandwidth:

Set the spectrum analyzer as RBW=100 kHz, VBW= 3*RBW, Span = 5MHz, Detector=Peak, Sweep=auto.

- 5. Mark the peak frequency and -6dB (upper and lower) frequency.
- 6. Repeat above procedures until all test default channel is completed

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8.5 Measurement Result:

DATA RATE 1 Mbps:

BLE mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	0.681	> 0.5	PASS
2440	0.684	> 0.5	PASS
2480	0.687	> 0.5	PASS

DATA RATE 2 Mbps (BT 5.0):

BLE mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	1.17	> 0.5	PASS
2440	1.168	> 0.5	PASS
2480	1.165	> 0.5	PASS

Note: Refer to next page for plots.

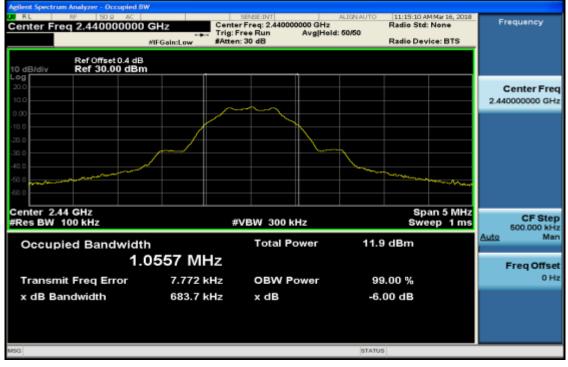
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BLE mode DATA RATE 1 Mbps: 6dB Band Width Test Data CH-Low



6dB Band Width Test Data CH-Mid

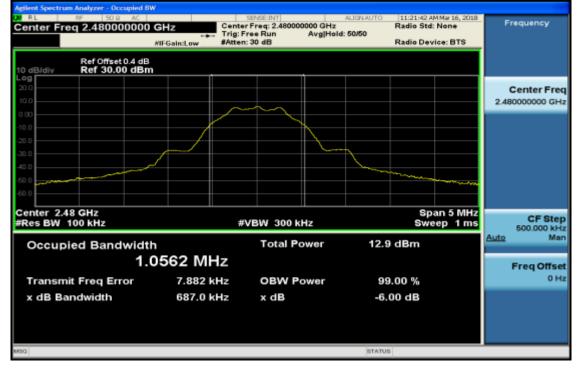


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6dB Band Width Test Data CH-High



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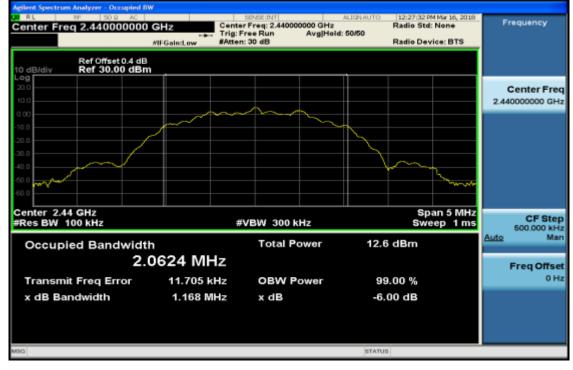
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DATA RATE 2 Mbps (BT 5.0): 6dB Band Width Test Data CH-Low



6dB Band Width Test Data CH-Mid

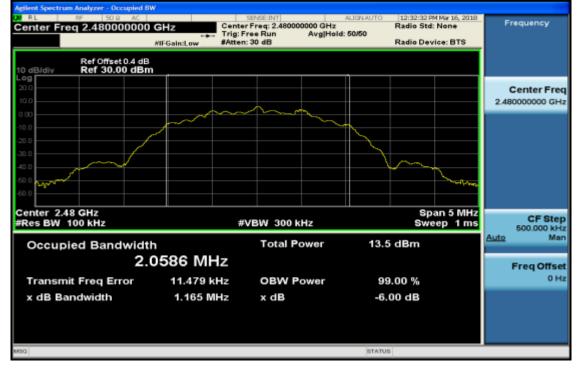


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6dB Band Width Test Data CH-High



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9. CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

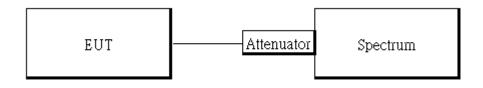
9.1 Standard Applicable

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:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY54200716	2017/10/16	2018/10/15
DC Power Supply	Anritsu	E3640A	MY52410006	2017/11/28	2018/11/27
Attenuator	Mini-Circuit	BW-S10W2+	2	2018/01/02	2019/01/01
Notebook	Lenovo	T440	P0000564	N/A	N/A

9.3 Test SET-UP:



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9.4 Measurement Procedure

Conducted Band Edge:

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 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 start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
- 5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
- 6. Mark the highest reading of the emission as the reference level measurement.
- Set DL as the limit = reading on marker 1 20dBm
- 8. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5) be attenuated by 20dB at least relative to the maximum emission of power.
- 9. Repeat above procedures until all default test channel (low, middle, and high) was complete.

Conducted Spurious Emission:

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 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.
- 6. Repeat above procedures until all default test channel measured were complete.

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9.5 Measurement Result: DATA RATE 1 Mbps:

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	5.56	-14.44
2480	6.00	-14.00

NOTE: cable loss as 0.4dB that offsets in the spectrum NOTE: Refer to next page for plots.

DATA RATE 2 Mbps (BT 5.0):

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	5.48	-14.52
2480	5.95	-14.05

NOTE: cable loss as 0.4dB that offsets in the spectrum NOTE: Refer to next page for plots.

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DATA RATE 1 Mbps:

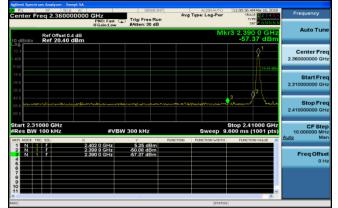
Reference Level of Emission Limit (CH-Low)



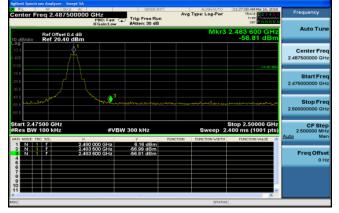
Reference Level of Emission Limit (CH-High)



Band Edges Test Data CH-Low



Band Edges Test Data CH-High



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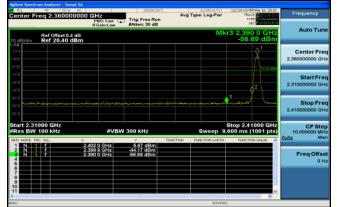
DATA RATE 2 Mbps (BT 5.0): Reference Level of Emission Limit (CH-Low)



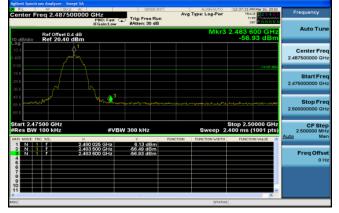
Reference Level of Emission Limit (CH-High)



Band Edges Test Data CH-Low



Band Edges Test Data CH-High

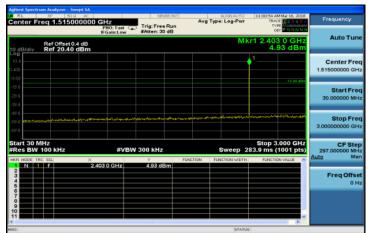


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Conducted Spurious Emission Measurement Result DATA RATE 1 Mbps: CH-Low 30MHz - 3GHz

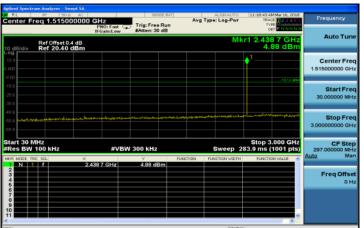


CH-Low 3GHz – 26.5GHz

	um Analyzer - Swept SA					
Center Fi	req 14.7500000		SENSE:INT	Avg Type: Log-Pwr	11:01:08 AM Mar 16, 2018 TRACE 1 2 3 4 5 6 TYPE	Frequency
10 dB/div	Ref Offset 0.4 dB Ref 20.40 dBm	PN0: Fast G IFGain:Low	#Atten: 30 dB	Mkr	1 24.714 0 GHz -36.29 dBm	Auto Tune
.0g 10.4 .400 9.60						Center Free 14.750000000 GH
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	100 kHz	#VB\	V 300 KHz		Stop 26.50 GHz 2.246 s (1001 pts)	CF Step 2.35000000 GH Auto Ma
INDE T		.714 0 GHz	-36.29 dBm	NCTION FUNCTION WIDTH	FUNCTION VALUE	
2346						Freq Offse 0 H
6 7 8 9						
11					×	
93				STATUS	1	

CH-Mid 30MHz - 3GHz

CH-Mid 3GHz – 26.5GHz



enter Freq 14.750000000 GHz ALIGNAUTO Trig: Free Run Auto Tu Ref Offset 0.4 dB Ref 20.40 dBm Center Fre Start Fre Stop Fre Stop 26.50 GHz Sweep 2.246 s (1001 pts) CF Step #VBW 300 kH 26 335 5 CH Freq Offset 0 Ha

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CH-High 30MHz – 3GHz

RL RF	1.515000000 G	PNO: East () Irig	SENSE:INT	ALIGNAUTO Avg Type: Log-Pwr	11:27:32 AMM# 16, 201 TRACE 1 2 3 4 TYPE MUSAUM OFT P NNNN	Frequency
0 dB/div Re	f Offset 0.4 dB f 20.40 dBm	Gaintow Pro		Mk	r1 2.480 3 GH: 4.54 dBn	
og 10.4 400 9.60					↓ ¹	Center Fre 1.515000000 GH
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tart 30 MHz Res BW 100	L X	#VBW 300	/ FUNC		Stop 3.000 GH2 83.9 ms (1001 pts FUNCTION VALUE	CF Ste 297.000000 MH Auto Ma
2 3 4 5 6 7	2,495) 3 GHz 4	.54 dBm			Freq Offse 0 H
8						

CH- High 3GHz – 26.5GHz

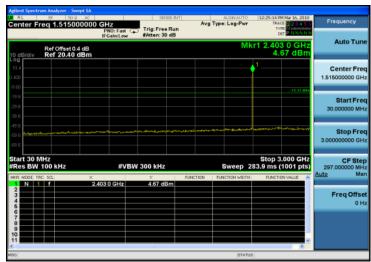
nt Spectrum Analyzer - Swept S					
ter Freq 14.750000	0000 GHz	Trig: Free Run	Aug Type: Log-Pwr	11:27:49 AM Mar 16, 2018 TRACE 1 2 3 4 5 6 TYPE	Frequency
	PNO: Fast C IFGain:Low	#Atten: 30 dB		DET PINNNN	Auto Tun
Ref Offset 0.4 dE			IVIKI	1 24.737 5 GHz -36.49 dBm	
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and the bart of the state of the		and have been and the second	14 - 4 - F		
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5	~~ <u>~</u> يبومانيونيوني	and the state of t			26.500000000 GF
		W 300 kHz		Stop 26.50 GHz 2.246 s (1001 pts)	26.50000000 GF CF Ste 2.350000000 GF
rt 3.00 GHz es BW 100 kHz		W 300 kHz		Stop 26.50 GHz	26.50000000 GF CF Ste 2.35000000 GF
rt 3.00 GHz es BW 100 kHz	#VB	W 300 kHz	Sweep	Stop 26.50 GHz 2.246 s (1001 pts)	26.50000000 GF 2.35000000 GF <u>Auto</u> Ma
rt 3.00 GHz es BW 100 kHz	#VB	W 300 kHz	Sweep	Stop 26.50 GHz 2.246 s (1001 pts)	26.50000000 GF 2.35000000 GF <u>Auto</u> Ma
rt 3.00 GHz es BW 100 kHz	#VB	W 300 kHz	Sweep	Stop 26.50 GHz 2.246 s (1001 pts)	26.50000000 GF 2.35000000 GF <u>Auto</u> Ma
rt 3.00 GHz es BW 100 kHz	#VB	W 300 kHz	Sweep	Stop 26.50 GHz 2.246 s (1001 pts)	26.50000000 GF 2.35000000 GF <u>Auto</u> Ma
rt 3.00 GHz es BW 100 kHz	#VB	W 300 kHz	Sweep	Stop 25.50 CHz 2.246 s (1001 pts) FUNCTION VALLE	Stop Fre 26.50000000 GH 2.350000000 GH 2.35000000 GH Auto Ma Freq Offse 0 H

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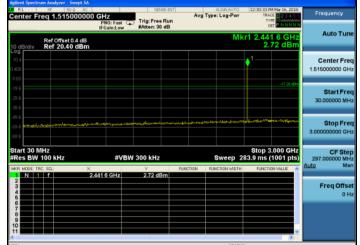
DATA RATE 2 Mbps (BT 5.0): CH-Low 30MHz - 3GHz



CH-Low 3GHz – 26.5GHz

Agilent Spectrum Analyzer - Swept SA				
RL NF 50.0 AC	0 GHz	ALIGNAUTO Avg Type: Log-Pwr	12:25:47 PM Mar 16, 2018 TRACE 1 2 3 4 5 6	Frequency
Ref Offset 0.4 dB	PN0: Fast Trig: Free Run IFGain:Low #Atten: 30 dB	Mkr	1 26.476 5 GHz -34.76 dBm	Auto Tun
0.400				Center Fre 14.750000000 GH
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49.5	Adamaka panaka panaka panaka panaka			Stop Fre 26.50000000 GF
Start 3.00 GHz Res BW 100 kHz	#VBW 300 kHz		Stop 26.50 GHz 2.246 s (1001 pts)	CF Ste 2.35000000 GF Auto Ma
	476 5 GHz 34.76 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offs
80		STATU	>	

CH-Mid 30MHz – 3GHz



CH-Mid 3GHz – 26.5GHz

RL Center Fr		9 AC 0000000 GH PN0: IFGali	Fast 😱	Trig: Free #Atten: 30		Avg Typ	e: Log-Pwr	TRA	M Mar 16, 2018 CE 1 2 3 4 5 6 PE Monorototore ET P N N N N N	Frequency
0 dB/div	Ref Offset 0 Ref 20.40).4 dB I dBm					Mkr	1 26.40 -35.	6 0 GHz 32 dBm	Auto Tun
- og 10.4 1400										Center Fre 14.750000000 GH
19.6 29.6 39.8							the state of the s	and a start	-17.29.001	Start Fre 3.000000000 GF
49.6 69.6	and the second s	and the state of the	4. Mar 1. 19 Mar 1. 1	haarahatan	and the second	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.				Stop Fre 26.50000000 GH
Start 3.00 Res BW	100 kHz	×	#VBW (Y		CTION FL	Sweep	2.246 s	6.50 GHz 1001 pts)	CF Ste 2.35000000 GH Auto Ma
1 N 1 2 3 4 5 6		26,406.0 G	iHz.	-35.32 dB	m					Freq Offs 01
7 9 10 11										
							STATUS			

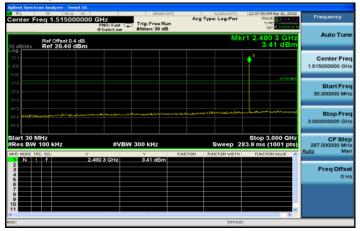
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CH-High 30MHz - 3GHz



CH- High 3GHz – 26.5GHz

BI		9 AC			NEEINT		ALION AUTO	10.00.10	PM Mar 16, 2018	-
	reg 14.750		GHz				Log-Pwr	TR	ACE 1 2 3 4 5 5	Frequency
	Ref Offset	0.4 dB	PNO: Fast FGain:Low	Trig: Fre #Atten: \$	e Run 10 dB		Mkr	1 26.35	9 0 GHz 34 dBm	Auto Tur
	Ref 20.40	dBm						-35	34 GBM	Center Fre
00										14.75000000 G
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										Stop Fr
art 3.00				W 300 KH;				Stop	26.50 GHz (1001 pts)	26.500000000 G
art 3.00 Res BW	GHz 100 kHz	×	#VB	W 300 KH	Put Put			Stop 2.246 s	26.50 GHz	26.500000000 G CF Sto 2.350000000 G
art 3.00 Res BW	GHz 100 kHz	×			Put Put		Sweep	Stop 2.246 s	26.50 GHz (1001 pts)	26.50000000 G CF Str 2.35000000 G <u>Auto</u> M Freq Offs
Art 3.00 Res BW	GHz 100 kHz	×	#VB	W 300 KH	Put Put		Sweep	Stop 2.246 s	26.50 GHz (1001 pts)	26.50000000 G CF Sto 2.35000000 G <u>Auto</u> M Freq Offs
A MODE TR 1 N 1 2 3 4 5 5 7 8 9	GHz 100 kHz	×	#VB	W 300 KH	Put Put		Sweep	Stop 2.246 s	26.50 GHz (1001 pts)	26.50000000 G CF Sto 2.35000000 G <u>Auto</u> M Freq Offs
A 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	GHz 100 kHz	×	#VB	W 300 KH	Put Put		Sweep	Stop 2.246 s	26.50 GHz (1001 pts)	Stop Frr 26.50000000 Gi CF Sto 2.35000000 Gi <u>Auto</u> Mi Freq Offs 0 I

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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

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	2017/12/29	2018/12/28
Horn Antenna	Schwarzbeck	BBHA9120D	1441	2017/08/04	2018/08/03
Horn Antenna	Schwarzbeck	BBHA9170	184	2017/12/12	2018/12/11
Loop Antenna	ETS.LINDGREN	6502	148045	2017/09/26	2018/09/25
Spectrum Analyzer	Agilent	E4446A	MY51100003	2017/05/10	2018/05/09
EMI Test Receiver	R&S	ESCI7	100760	2017/06/06	2018/06/05
Pre-Amplifier	HP	8449B	3008A00578	2018/01/02	2019/01/01
Pre-Amplifier	HP	8447D	2944A07676	2018/01/02	2019/01/01
Pre-Amplifier	EMC Instru- ments Corp.	EMC0126530	980038	2018/01/02	2019/01/01
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	2018/01/02	2019/01/01
Low Loss Cable	Huber Suhner	966_RX	9	2018/01/02	2019/01/01
Notebook	Lenovo	T440	P0000564	N/A	N/A

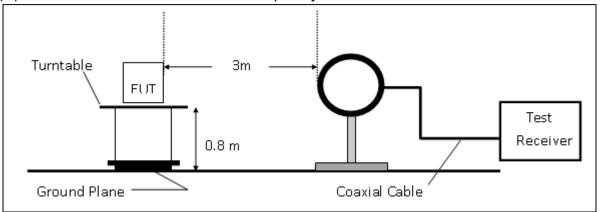
Note: N.C.R refers to Not Calibrated Required.

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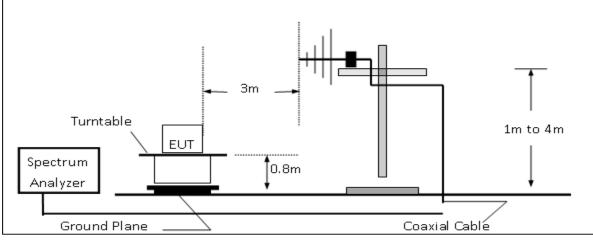


10.3 Test SET-UP

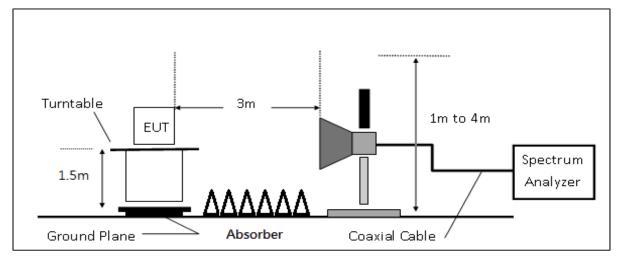
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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

- 1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 0.8m for frequen-2. cy> 1GHz above ground plan.
- The turn table shall rotate 360 degrees to determine the position of maximum emission level. 3.
- EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the 4. highest emissions.
- 5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
- 8. 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.
- 9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
- 11. Repeat above procedures until all default test channel measured were complete.

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

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 (BLE mode)

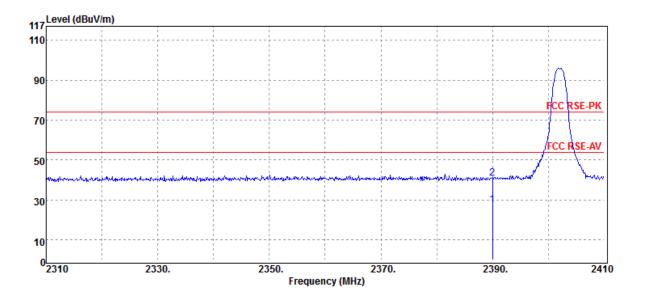
DATA RATE 1 Mbps: **Operation Band** Fundamental Frequency

Operation Mode EUT Pol.

:BLE :2402 MHz :Bandedge CH LOW :E1 Plane

Test Date Temp./Humi. Engineer Measurement Antenna Pol.

:2018-03-15 :21 deg C / 61 RH :Kane :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Average	27.21	0.20	27.41	54.00	-26.59
2390.00	Е	Peak	40.62	0.20	40.82	74.00	-33.18

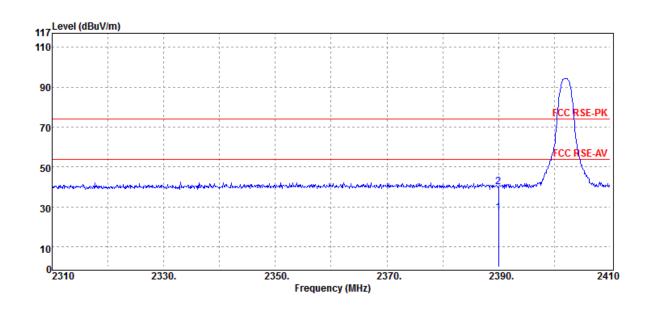
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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:BLE **Operation Band** Fundamental Frequency :2402 MHz **Operation Mode** :Bandedge CH LOW EUT Pol. :E1 Plane

Test Date :2018-03-15 Temp./Humi. :21 deg_C / 61 RH Engineer :Kane :HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Average	27.02	0.20	27.22	54.00	-26.78
2390.00	Е	Peak	39.93	0.20	40.13	74.00	-33.87

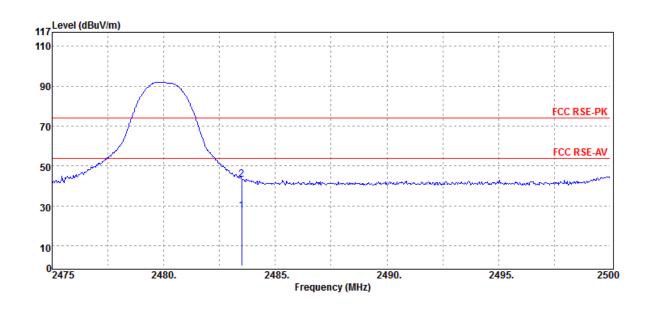
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:BLE **Operation Band** Fundamental Frequency :2480 MHz **Operation Mode** :Bandedge CH HIGH EUT Pol. :E1 Plane

Test Date :2018-03-15 Temp./Humi. :21 deg_C / 61 RH Engineer :Kane :VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Е	Average	26.83	0.53	27.36	54.00	-26.64
2483.50	Е	Peak	42.96	0.53	43.49	74.00	-30.51

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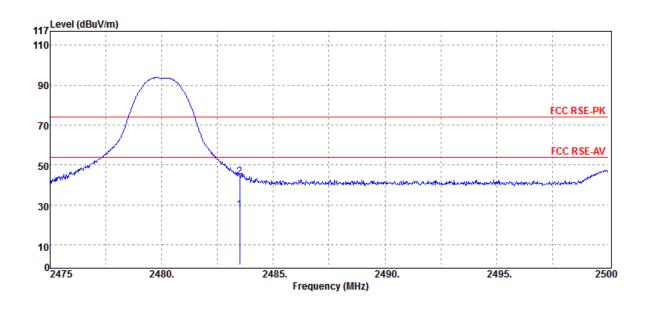
Report No.: ER/2018/30015 Page 43 of 70



:BLE **Operation Band** Fundamental Frequency :2480 MHz **Operation Mode** :Bandedge CH HIGH EUT Pol. :E1 Plane

Test Date Temp./Humi. Engineer :Kane Measurement Antenna Pol.

:2018-03-15 :21 deg_C / 61 RH :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2483.50	Е	Average	27.18	0.53	27.71	54.00	-26.29
2483.50	Е	Peak	43.66	0.53	44.19	74.00	-29.81

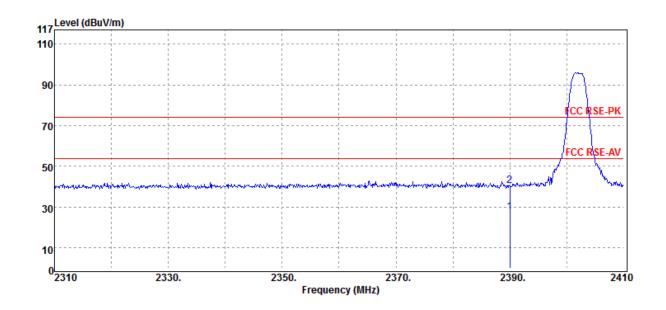
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DATA RATE 2 Mbps (BT 5.0):

Operation Band :BLE(2M) **Fundamental Frequency** :2402 MHz **Operation Mode** :Bandedge CH LOW EUT Pol. :E1 Plane

Test Date Temp./Humi. Engineer Measurement Antenna Pol. :2018-03-15 :21 deg C / 61 RH :Kane :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Average	27.30	0.20	27.50	54.00	-26.50
2390.00	Е	Peak	40.30	0.20	40.50	74.00	-33.50

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2390.00

Е

Operation Band Fundamental Frequency Operation Mode EUT Pol.		:BLE(2M) :2402 MHz :Bandedge CH LOW :E1 Plane		Test Date Temp./Humi. Engineer Measurement Antenna Pol.		:Kane	03-15 g_C / 61 RH ZONTAL
Level (d	BuV/m)						
117							
90						Λ	
70						FCC RSE-PK	
50		er en	ne man han san she she has been a san		2	FCC RSE-AV	
30							
10							
0 <mark></mark> 2310	233	30.	2350. Frequency (MH	2370. z)	2390.	241	10
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Average	27.00	0.20	27.20	54.00	-26.80

Peak

40.75

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0.20

40.95

74.00

-33.05



Operation Band :BLE(2M) Test Date :2018-03-15 Fundamental Frequency :21 deg_C / 61 RH :2480 MHz Temp./Humi. **Operation Mode** :Bandedge CH HIGH Engineer :Kane EUT Pol. :E1 Plane :VERTICAL Measurement Antenna Pol. Level (dBuV/m) 117 110 90 FCC RSE-PK 70 FCC RSE-AV 50 2 30 10 0 2475 2480. 2485. 2495. 2500 2490. Frequency (MHz)

	Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
			Mode	Reading Level		FS	@3m	Margin	
_	MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
	2483.50	Е	Average	27.07	0.53	27.60	54.00	-26.40	
	2483.50	Е	Peak	44.53	0.53	45.06	74.00	-28.94	

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Operation Band Test Date :2018-03-15 :BLE(2M) **Fundamental Frequency** :2480 MHz Temp./Humi. :21 deg_C / 61 RH **Operation Mode** :Bandedge CH HIGH Engineer :Kane EUT Pol. :E1 Plane :HORIZONTAL Measurement Antenna Pol. Level (dBuV/m) 117 110 90 FCC RSE-PK 70 FCC RSE-AV 50 30 10 0 2475 2500 2480. 2485. 2495. 2490. Frequency (MHz) Detector Spectrum Safe Freq. Note Factor Actual Limit Mode **Reading Level** FS @3m Margin

					_		- 5	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
2483.50	Е	Average	27.38	0.53	27.91	54.00	-26.09	
2483.50	Е	Peak	44.97	0.53	45.50	74.00	-28.50	

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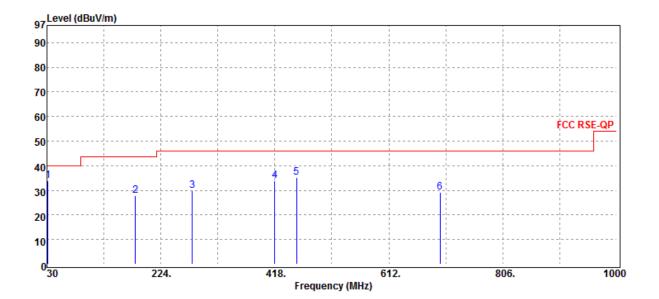


Radiated Spurious Emission Measurement Result: (BLE mode) For Frequency from 30MHz to 1000MHz

DATA RATE 1 Mbps: **Operation Band Fundamental Frequency Operation Mode** EUT Pol.

:BLE :2442 MHz :Tx CH MID :E1 Plane

Test Date :2018-03-19 Temp./Humi. :21 deg_C / 61 RH Engineer :Kane :VERTICAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
31.94	S	Peak	42.64	-8.88	33.76	40.00	-6.24
180.35	S	Peak	35.91	-8.18	27.73	43.50	-15.77
277.35	S	Peak	36.10	-6.27	29.83	46.00	-16.17
418.00	S	Peak	36.91	-2.84	34.07	46.00	-11.93
454.86	S	Peak	37.55	-2.33	35.22	46.00	-10.78
699.30	S	Peak	27.62	1.74	29.36	46.00	-16.64

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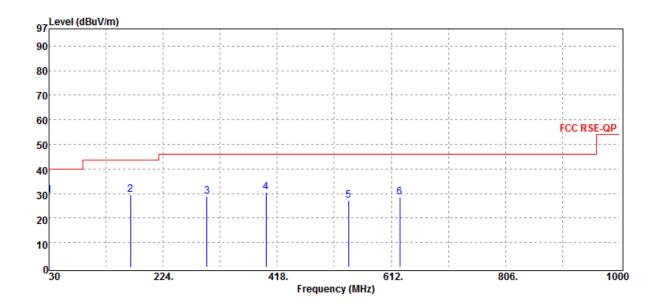
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Operation Band :BLE Fundamental Frequency :2442 MHz **Operation Mode** :Tx CH MID EUT Pol. :E1 Plane

Test Date :2018-03-19 Temp./Humi. :21 deg_C / 61 RH Engineer :Kane :HORIZONTAL Measurement Antenna Pol.



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
30.00	S	Peak	38.12	-8.96	29.16	40.00	-10.84
168.71	S	Peak	36.96	-7.31	29.65	43.50	-13.85
298.69	S	Peak	34.47	-5.55	28.92	46.00	-17.08
398.60	S	Peak	33.87	-3.41	30.46	46.00	-15.54
539.25	S	Peak	28.34	-1.31	27.03	46.00	-18.97
626.55	S	Peak	27.67	0.79	28.46	46.00	-17.54

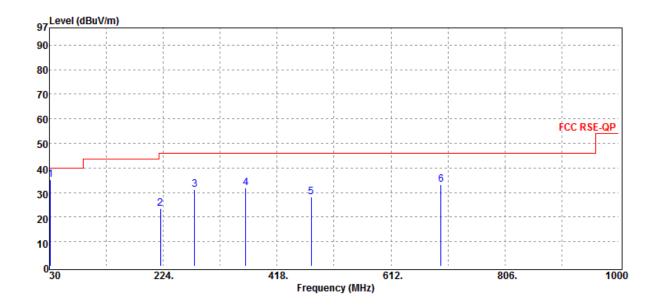
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



DATA RATE 2 Mbps (BT5.0):

Operation Band :BLE(2M) Fundamental Frequency :2442 MHz :Tx CH MID **Operation Mode** EUT Pol. :E1 Plane

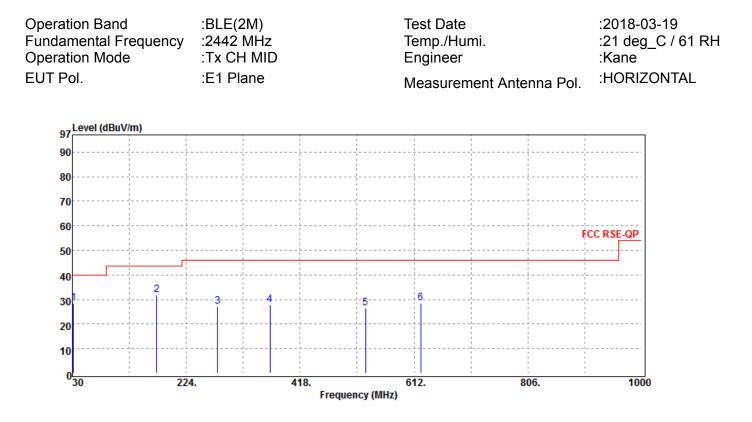
Test Date Temp./Humi. Engineer Measurement Antenna Pol. :2018-03-19 :21 deg_C / 61 RH :Kane :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
31.94	S	Peak	44.23	-8.88	35.35	40.00	-4.65
219.15	S	Peak	32.54	-9.08	23.46	46.00	-22.54
277.35	S	Peak	37.42	-6.27	31.15	46.00	-14.85
364.65	S	Peak	35.95	-4.07	31.88	46.00	-14.12
476.20	S	Peak	30.66	-2.30	28.36	46.00	-17.64
697.36	S	Peak	31.79	1.33	33.12	46.00	-12.88

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	Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
			Mode	Reading Level		FS	@3m	Margin	
_	MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
	31.94	S	Peak	37.32	-8.88	28.44	40.00	-11.56	
	173.56	S	Peak	39.74	-7.70	32.04	43.50	-11.46	
	277.35	S	Peak	33.55	-6.27	27.28	46.00	-18.72	
	366.59	S	Peak	31.86	-4.02	27.84	46.00	-18.16	
	529.55	S	Peak	27.62	-1.18	26.44	46.00	-19.56	
	623.64	S	Peak	28.04	0.64	28.68	46.00	-17.32	

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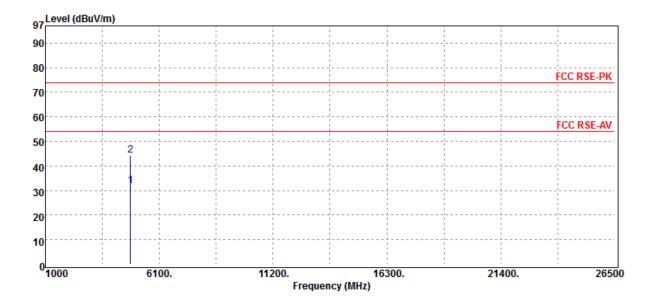


Radiated Spurious Emission Measurement Result: (BLE mode)

For Frequency above 1 GHz

DATA RATE 1 Mbps:

Operation Band	:BLE	Test Date	:2018-03-15
Fundamental Frequency	:2402 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Kane
EUT Pol.	:E1 Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
4804.00	Н	Average	24.60	7.38	31.98	54.00	-22.02	
4804.00	Н	Peak	37.04	7.38	44.42	74.00	-29.58	

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



Operation Band Fundamental Frequency Operation Mode EUT Pol.		:2402 MHz :Tx CH LOW		Test Date Temp./Hu Engineer Measurer	ımi.	:Kane	03-15 _C / 61 RH CONTAL
97 Level (dE	BuV/m)						
90							
80						FCC RSE-PK	
70							
60						FCC RSE-AV	
50	2						
40		· · · · · · · · · · · · · · · · · · ·		1 1 			
30			·····	1 1 1 1		 	
20		·····		 		 	
10		 		 		 	
0 <mark></mark> 1000	610	0.	11200. Frequency (MH	16300. z)	21400.	2650	0
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Н	Average	24.57	7.38	31.95	54.00	-22.05
4804.00	Н	Peak	37.40	7.38	44.78	74.00	-29.22



Operation Band Fundamental Frequency Operation Mode EUT Pol.		:2442 MHz :Tx CH MID		Test Date Temp./Hu Engineer Measurer		:Kane	_C / 61 RH
97	l (dBuV/m)						
90				 			
80				 		FCC RSE-PK	
70			· · · · · · · · · · · · · · · · · · ·	 			
60			· · · · · · · · · · · · · · · · · · ·			FCC RSE-AV	
50	2		· · · · · · · · · · · · · · · · · · ·	 			
40			· · · · · · · · · · · · · · · · · · ·				
30				 		 	
20							
10							
0 <mark>0</mark> 0) <u>610</u>	0.	11200. Frequency (MH	16300. z)	21400.	2650	0
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.00	Н	Average	24.40	7.66	32.06	54.00	-21.94
4884.00	Н	Peak	37.06	7.66	44.72	74.00	-29.28



Operation Band Fundamental Frequency Operation Mode EUT Pol.		:2442 MHz :Tx CH MID		Test Date Temp./Hu Engineer Measurer		:Kane	_C / 61 RH
97	BuV/m)						
90							
80						FCC RSE-PK	
70							
60						FCC RSE-AV	
50	2						
40							
30							
20							
10							
0 <mark></mark> 1000	610	0.	11200. Frequency (MH	16300. z)	21400.	26500)
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.00	Н	Average	24.37	7.66	32.03	54.00	-21.97
4884.00	Н	Peak	36.56	7.66	44.22	74.00	-29.78



4960.00

Н

Operation Band Fundamental Frequency Operation Mode EUT Pol.		:BLE :2480 MHz :Tx CH HIG :E1 Plane	Н	Test Date Temp./Hu Engineer Measure	umi.	:Kane	_C / 61 RH
97 Level (dE	BuV/m)				- <u>;</u> ;		
90							
80						FCC RSE-PK	
70							
60						FCC RSE-AV	
50	2						
40							
30							
20							
10		 		 			
0 <mark></mark> 1000	610	0.	11200. Frequency (MHz	16300.)	21400.	2650	0
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Н	Average	24.34	7.80	32.14	54.00	-21.86
		-					

Peak

36.31

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7.80

44.11

74.00

-29.89



4960.00

Н

Operation Band Fundamental Frequency Operation Mode EUT Pol.		:BLE :2480 MHz :Tx CH HIG :E1 Plane	Н	Test Date Temp./Hu Engineer Measure	umi.	:Kane	03-15 g_C / 61 RH ZONTAL
97 Level (dE	BuV/m)						1
90							
80						FCC RSE-PK	
70						FUC KJE-PK	
60	· · · · · · · · · · · · · · · · · · ·					FCC RSE-AV	
50	2						
40						·	
30							
20						 	
10						 	
0 <mark>0</mark>	610	0.	11200.	16300.	21400.	2650]
			Frequency (MH)		21100		
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Н	Average	24.36	7.80	32.16	54.00	-21.84
			~ ~ ~ ~				~~ ~~

Peak

36.70

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7.80

44.50

74.00

-29.50

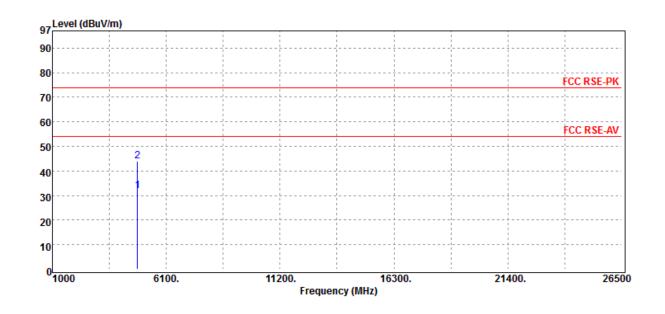


DATA RATE 2 Mbps (BT5.0):

Operation Band :BLE(2M) Fundamental Frequency :2402 MHz :Tx CH LOW **Operation Mode** EUT Pol. :E1 Plane

Test Date Temp./Humi. Engineer Measurement Antenna Pol.

:2018-03-15 :21 deg_C / 61 RH :Kane :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
4804.00	Н	Average	24.62	7.38	32.00	54.00	-22.00	
4804.00	Н	Peak	36.62	7.38	44.00	74.00	-30.00	

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



Operation Band Fundamental Frequency Operation Mode EUT Pol.		:2402 MHz :Tx CH LOW		Test Date Temp./Hu Engineer Measurer		:Kane	03-15 _C / 61 RH CONTAL
97 Level (dE	BuV/m)						
90							
80	· · · · · · · · · · · · · · · · · · ·		·			FCC RSE-PK	
70			·	 			
60						FCC RSE-AV	
50	2						
40							
30							
20							
10							
0 <mark></mark> 1000	610	0.	11200. Frequency (MH	16300. z)	21400.	2650	0
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Н	Average	24.62	7.38	32.00	54.00	-22.00
4804.00	Н	Peak	36.67	7.38	44.05	74.00	-29.95



Operation Band Fundamental Frequency Operation Mode EUT Pol.		:2442 MHz :Tx CH MID		Test Date Temp./Hu Engineer Measurer		:Kane	_C / 61 RH
97	uV/m)				· · ·	· · · · · · · · · · · · · · · · · · ·	
90							
80						FCC RSE-PK	
70			·				
60						FCC RSE-AV	
50	2						
40							
30		· · · · · · · · · · · · · · · · · · ·					
20			· · · · · · · · · · · · · · · · · · ·		 	1 	
10		 				 	
0 <mark>.</mark> 1000	610	0.	11200. Frequency (MHz	16300. :)	21400.	26500)
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.00	Н	Average	24.38	7.66	32.04	54.00	-21.96
4884.00	Н	Peak	36.56	7.66	44.22	74.00	-29.78



Operation Band Fundamental Frequency Operation Mode EUT Pol.				Test Date Temp./Hu Engineer Measurer		:Kane	_C / 61 RH
97	BuV/m)						
90	·						
80						FCC RSE-PK	
70							
60						FCC RSE-AV	
50	2						
40							
30							
20							
10	·	 	· · · · · · · · · · · · · · · · · · ·				
0 <mark></mark> 1000	610	0.	11200. Frequency (MH	16300. z)	21400.	26500)
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4884.00	Н	Average	24.35	7.66	32.01	54.00	-21.99
4884.00	Н	Peak	36.74	7.66	44.40	74.00	-29.60



4960.00

Н

Operation Ba Fundamental Operation Mo EUT Pol.	Frequency	:BLE(2M) :2480 MHz :Tx CH HIG :E1 Plane	Н	Test Date Temp./Hu Engineer Measurer		:Kane	J_C / 61 RH
97	3uV/m)						
90							
80				1 1 1 1 1		FCC RSE-PK	
70	· · · · · · · · · · · · · · · · · · ·		· · · · · · · · · · · · · · · · · · ·				
60				1 1 1 1 1		FCC RSE-AV	
50	2						
40							
30				1 			
20		 					
10		 		 		 	
0 <mark>.</mark> 1000	610	0.	11200. Frequency (M	16300. Hz)	21400.	2650	0
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	н	Average	24.28	7.80	32.08	54.00	-21.92

Peak

36.89

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7.80

44.69

74.00

-29.31



4960.00

Н

Operatior Fundame Operatior EUT Pol.	ntal Frequency	:BLE(2M) :2480 MHz :Tx CH HIG :E1 Plane	Н	Test Date Temp./Hu Engineer Measure	umi.	:Kane	03-15 g_C / 61 RH ZONTAL
97	vel (dBuV/m)						-
90							
80						FCC RSE-PK	
70			· · · · · · · · · · · · · · · · · · ·				
60						FCC RSE-AV	
50	2		· · · · · · · · · · · · · · · · · · ·				
40							
30							
20							
10							
0 <mark></mark> 100	: 00 61	00.	11200. Frequency (MH	16300. Iz)	21400.	2650	_ 00
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	о н	Average	24.31	7.80	32.11	54.00	-21.89

Peak

36.75

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7.80

44.55

74.00

-29.45



11. PEAK POWER SPECTRAL DENSITY

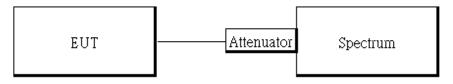
11.1 Standard Applicable:

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

11.2 Measurement Equipment Used:

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1242004	2017/10/16	2018/10/15
DC Power Supply	Anritsu	E3640A	MY52410006	2017/11/28	2018/11/27
Attenuator	Mini-Circuit	BW-S10W2+	2	2018/01/02	2019/01/01
Notebook	Lenovo	T440	P0000564	N/A	N/A

11.3 Test Set-up:



11.4 Measurement Procedure:

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 3 kHz & VBW = 10 kHz.
- 5. For defining Restricted Band Edge Limit: Set the RBW = 100kHz & VBW = 300 kHz.
- 6. Detector = peak.
- 7. Sweep time = auto couple.
- 8. Trace mode = max hold.
- 9. Allow trace to fully stabilize.
- 10. Use the peak marker function to determine the maximum amplitude level.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only

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11.5 Measurement Result: DATA RATE 1 Mbps:

BLE mode

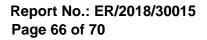
1							
	Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result			
	2402	-9.04	8	PASS			
	2442	-9.46	8	PASS			
	2480	-8.67	8	PASS			

NOTE: cable loss as 0.4dB that offsets in the spectrum

DATA RATE 2 Mbps (BT 5.0):

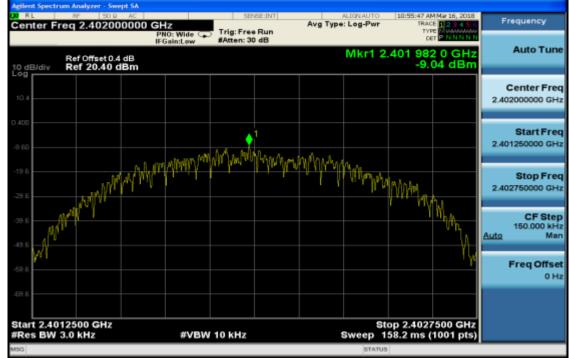
BLE mode							
Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result				
2402	-13.02	8	PASS				
2442	-13.53	8	PASS				
2480	-12.61	8	PASS				

NOTE: cable loss as 0.4dB that offsets in the spectrum





DATA RATE 1 Mbps: Power Spectral Density Test Plot (CH-Low)



Power Spectral Density Test Plot (CH-Mid)



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Power Spectral Density Test Plot (CH-High)



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DATA RATE 2 Mbps (BT5.0): **Power Spectral Density Test Plot (CH-Low)**

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Power Spectral Density Test Plot (CH-Mid)



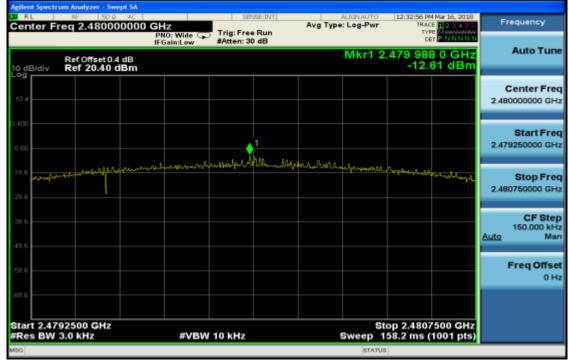
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Power Spectral Density Test Plot (CH-High)



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12. ANTENNA REQUIREMENT

12.1 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.

In case of point-to-point operation, the power shall be reduced by the one dB for every 3 dB that the directional gain of antenna exceeds 6dBi.

12.2 Antenna Connected Construction:

An embedded-in antenna design is used.

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo and antenna spec. for details.

The antenna gain is less than 6dBi. Therefore, it is not necessary to reduce maximum output power limit.

~ End of Report ~

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