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ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND RSS 247 REQUIREMENT

FCC Applicant: Bushnell Performance Optics

9200 Cody, Overland Park, Kansas 66214 United States

IC Applicant: **Bushnell Performance Optics**

9200 Cody, Overland Park, Kansas 66214 United States

Product Name: Hybrid Laser/GPS Rangefinder

Brand Name: Bushnell Model No.: 201835 **Model Difference:** N/A

FCC ID: 2ABQG-1835 IC: 5830A-1835 **Report Number:** E2/2018/30061 **FCC Rule Part:** §15.247, Cat: DTS

IC Rule: RSS-247 issue 2 Feb. 2017

Issue Date: Apr. 13, 2018 Date of Test: Apr. 02, 2018 Date of EUT Received: Mar. 22, 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.

Tested By: Vito Pei / Engineer

Approved By:

Jim Chang / Manager





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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/30061	Rev.00	Initial creation of docu- ment	All	Apr. 13, 2018	Elle Chang

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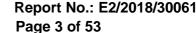




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Proceedings

Procedure

**Procedure

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GENERAL INFORMATION

1.1 Product Description

General:

Ocheral.		
Product Name:	Hybrid La	aser/GPS Rangefinder
Brand Name:	Bushnell	
Model No.:	201835	
Model Difference:	N/A	
Product SW/HW version:	N/A	
Radio SW/HW version:	N/A	
Test SW Version:	N/A	
RF power setting in TEST SW:	N/A	
Power Supply:	3.7Vdc or 3.0Vdc from Rechargeable Li-polymer Battery 5V USB port.	
Fower Suppry.	Battery:	Model No.: PL462430 Supplier: Coppercell Technology Co., Ltd

Bluetooth Low Energy:

Frequency Range:	2402 – 2480MHz
Bluetooth Version: Bluetooth V4.1 single Mode	
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	1.01 dBm
Antenna Designation:	Embedded 2.4GHz Antenna, Antenna Gain: 1.72 dBi P/N: 1001312

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 DTS Meas. Guidance v04

RSS-247 issue 2 Feb. 2017

Canada RSS-Gen issue 4: 2014

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.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)

FCC Registration Numbers are: 735305 / TW0002

Canada Registration Number: 4620A-5

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 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 0.3dB.

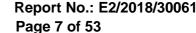
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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission Configuration

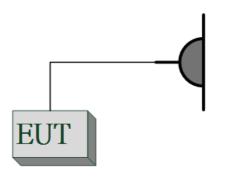


Fig 2-2 Conducted Emission (AC power line) Configuration

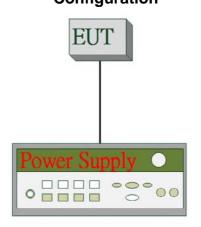


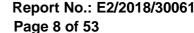
Table 2-1 Equipment Used in Tested System

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.	DC Power Supply	Agilent	E3640A	MY53140006	N/A	Un-Shielded

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SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4(4)	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 (1) RSS-Gen §6.6	6dB & 99% Bandwidth	Compliant
§15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	RSS-247 §5.5	Radiated Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2(2)	Peak Power Density	Compliant
§15.203 §15.247(b)	RSS- Gen §8.3	Antenna Requirement	Compliant

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 CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	
Bluetooth LE	0 to 39	0,20,39	GFSK	1	
	RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE AVAILABLE TESTED MODULATION DATA RATE (Mbps)					
Bluetooth LE	0 to 39	0,20,39	GFSK	1	

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.

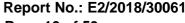
ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	
Bluetooth LE	0 to 39	0,20,39	GFSK	1	

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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	

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

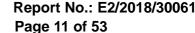
This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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CONDUCTED EMISSION TEST

6.1 Standard Applicable:

Frequency range within 150kHz 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 TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
Spectrum Analyzer	Agilent	N9010A	MY51440113	_	2018/6/20		
Attenuator	Marvelous	MVE2213-10	RF30	2017/12/26	2018/12/25		
DC Block	PASTER- NACK	PE8210	RF29	2017/12/26	2018/12/25		
Notebook	Lenovo	L420	S0011721	N/A	N/A		

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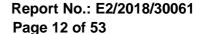
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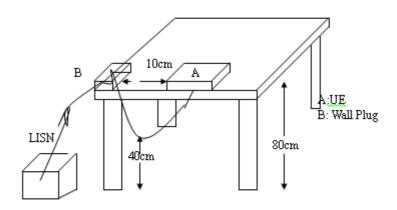
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^{1.} The lower limit shall apply at the transition frequencies

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



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:

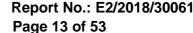
Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit

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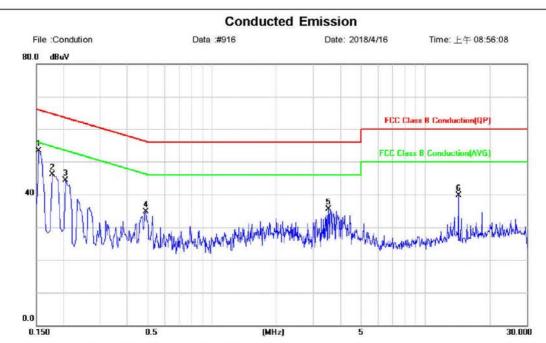


AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test By:	Jerry
-----------------	----------------	----------	-------

Site: Conduction Room Phase: L1 Temperature: 21 °C AC 120V/60Hz Limit: FCC Class B Conduction(QP) Humidity: 45 % Power:

Mode: Note:



Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
*	0.1540	33.58	19.65	53.23	65.78	-12.55	peak	
	0.1780	26.52	19.64	46.16	64.58	-18.42	peak	
	0.2060	24.74	19.65	44.39	63.37	-18.98	peak	
	0.4900	14.52	20.11	34.63	56.17	-21.54	peak	
	3.5260	15.12	20.32	35.44	56.00	-20.56	peak	
	14.3380	19.61	20.08	39.69	60.00	-20.31	peak	
	*	* 0.1540 0.1780 0.2060 0.4900 3.5260	* 0.1540 33.58 0.1780 26.52 0.2060 24.74 0.4900 14.52 3.5260 15.12	* 0.1540 33.58 19.65 0.1780 26.52 19.64 0.2060 24.74 19.65 0.4900 14.52 20.11 3.5260 15.12 20.32	* 0.1540 33.58 19.65 53.23 0.1780 26.52 19.64 46.16 0.2060 24.74 19.65 44.39 0.4900 14.52 20.11 34.63 3.5260 15.12 20.32 35.44	* 0.1540 33.58 19.65 53.23 65.78 0.1780 26.52 19.64 46.16 64.58 0.2060 24.74 19.65 44.39 63.37 0.4900 14.52 20.11 34.63 56.17 3.5260 15.12 20.32 35.44 56.00	* 0.1540 33.58 19.65 53.23 65.78 -12.55 0.1780 26.52 19.64 46.16 64.58 -18.42 0.2060 24.74 19.65 44.39 63.37 -18.98 0.4900 14.52 20.11 34.63 56.17 -21.54 3.5260 15.12 20.32 35.44 56.00 -20.56	* 0.1540 33.58 19.65 53.23 65.78 -12.55 peak 0.1780 26.52 19.64 46.16 64.58 -18.42 peak 0.2060 24.74 19.65 44.39 63.37 -18.98 peak 0.4900 14.52 20.11 34.63 56.17 -21.54 peak 3.5260 15.12 20.32 35.44 56.00 -20.56 peak

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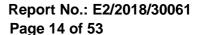
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Temperature: 21 °C Site: Conduction Room Phase:

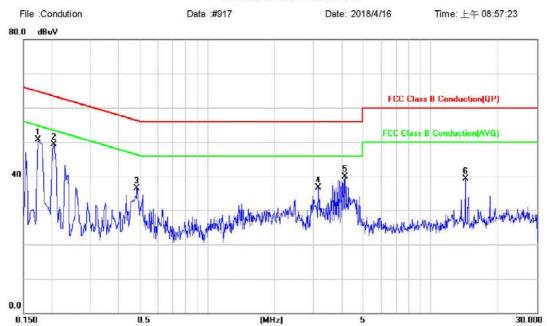
Limit: FCC Class B Conduction(QP)

AC 120V/60Hz Power:

Humidity: 45 %

Mode: Note:

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure- ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1740	30.99	19.63	50.62	64.77	-14.15	peak	
2	*	0.2060	29.67	19.63	49.30	63.37	-14.07	peak	
3		0.4860	16.50	20.10	36.60	56.24	-19.64	peak	
4		3.1500	16.31	20.36	36.67	56.00	-19.33	peak	
5		4.1500	19.77	20.20	39.97	56.00	-16.03	peak	
6		14.3380	19.18	20.09	39.27	60.00	-20.73	peak	

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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 and the e.i.r.p. shall not exceed 4 W.

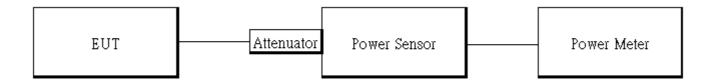
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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:

Conducted Emission Test Site						
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.	
TYPE		NUMBER	NUMBER	CAL.		
Power Meter	Anritsu	ML2496A	1326001	2017/07/26	2018/7/25	
Power Sensor	Anritsu	MA2411B	1315048	2017/07/26	2018/7/25	
Power Sensor	Anritsu	MA2411B	1315049	2017/07/26	2018/7/25	

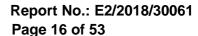
7.3 Test Set-up:



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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. Guid-
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

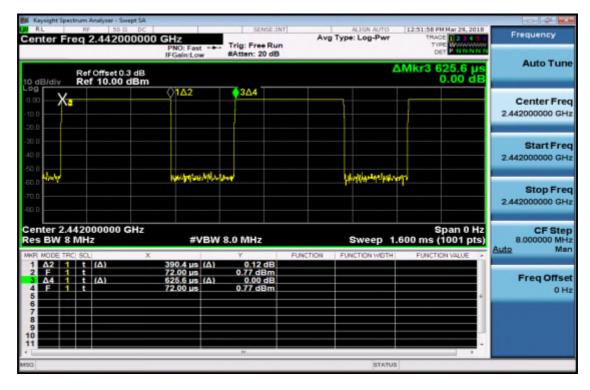
Power Meter:

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:

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE	63.17	1.99	2.56	3.00



Duty Cycle Factor:10*log(1/(63.17/100))=1.99

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7.5 **Measurement Result:**

BI F mode

DLE IIIC	ue.						
СН	Frequency (MHz)	Peak Power Output (dBm)	Required Limit				
0	2402	1.01	1 Watt = 30 dBm				
20	2442	0.82	1 Watt = 30 dBm				
39	2480	0.68	1 Watt = 30 dBm				
BLE mo	BLE mode:						
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit				
0	2402	0.77	1 Watt = 30 dBm				
20	2442	0.63	1 Watt = 30 dBm				
39	2480	0.44	1 Watt = 30 dBm				

^{*}Note: Measured by power meter, cable loss as 0.3 dB that offsets on the power meter in Peak

EIRP

СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
0	2402	0.77	1.72	2.49	4W= 36 dBm
20	2442	0.63	1.72	2.35	4W= 36 dBm
39	2480	0.44	1.72	2.16	4W= 36 dBm

* Note: EIRP = Average Power + Gain

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^{*}Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter

^{*}Note: Max. Output include tune up tolerance Power is average power



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8 6DB & 99% BANDWIDTH MEASUREMENT

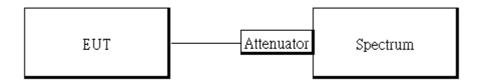
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.		
TYPE		NUMBER	NUMBER	CAL.			
Spectrum Analyzer	Agilent	N9010A	MY51440113	2017/06/21	2018/06/20		
Attenuator	Marvelous	MVE2213-10	RF30	2017/12/26	2018/12/25		
DC Block	PASTER- NACK	PE8210	RF29	2017/12/26	2018/12/25		
Notebook	Lenovo	L420	S0011721	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. Set the spectrum analyzer as RBW=100 kHz, VBW= 3*RBW, Span = 5MHz, D7etector=Peak, Sweep=auto.
- 5. Mark the peak frequency and –6dB (upper and lower) frequency.
- 6. Turn on the 99% bandwidth function, max reading.
- 7. Repeat above procedures until all test default channel is completed

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8.5 Measurement Procedure of 99% Bandwidth:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows the Measurement Procedure of ANSI C63.10.
- 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=1%~5% of the OBW, VBW= 3*RBW, Span = 2MHz, Detector=Peak, Sweep=auto.
- 5. Turn on the 99% bandwidth function, max reading.
- 6. Repeat above procedures until all test default channel is completed

8.6 Measurement Result:

BLE mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	0.71	> 0.5	PASS
2442	0.721	> 0.5	PASS
2480	0.723	> 0.5	PASS

BLE mode

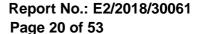
Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0567
2442	1.0662
2480	1.0684

Note: Refer to next page for plots.

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6dB Band Width Test Data CH-Low



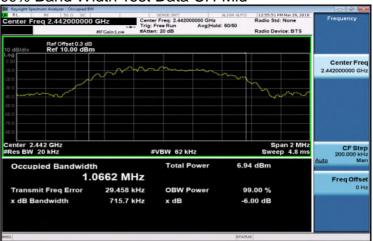
99% Band Width Test Data CH-Low



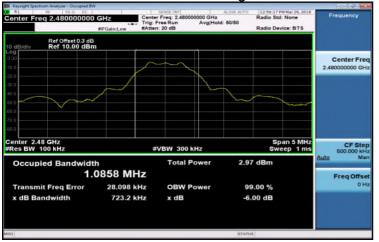
6dB Band Width Test Data CH-Mid



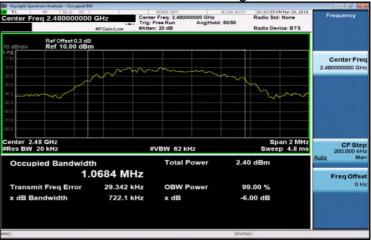
99% Band Width Test Data CH-Mid



6dB Band Width Test Data CH-High



99% Band Width Test Data CH-High



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CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

9.1 Standard Applicable

As per KDB 558074 D01 11.1 a)

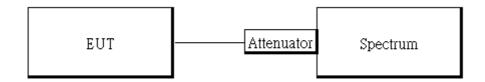
If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc)

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) & RSS-Gen §8.10 Table 6.

9.2 Measurement Equipment Used:

Conducted Emission Test Site									
EQUIPMENT MFR MODEL SERIAL LAST C									
TYPE		NUMBER	NUMBER	CAL.					
Spectrum Analyzer	Agilent	N9010A	MY51440113	2017/06/21	2018/06/20				
Attenuator	Marvelous	MVE2213-10	RF30	2017/12/26	2018/12/25				
DC Block	PASTERNACK	PE8210	RF29	2017/12/26	2018/12/25				
Notebook	Lenovo	L420	S0011721	N/A	N/A				

9.3 Test SET-UP:



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9.4 Measurement Procedure

Conducted Band Edge Limit

- 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 = 100kHz & VBW = 300 kHz.
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level.

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 =
- 6. Mark the highest reading of the emission as the reference level measurement.
- 7. 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.

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Conducted Spurious Emission:

- 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.

9.5 Measurement Result

Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	0.90	-19.10
2480	-3.95	-23.95

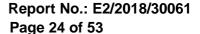
NOTE: cable loss as dB that offsets in the spectrum

NOTE: Refer to next page for plots.

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Power Spectral Density for Bandedge Limit (CH-Low)



Power Spectral Density for Bandedge Limit (CH-High)



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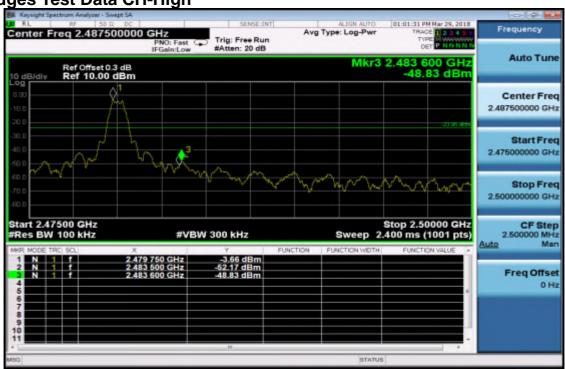
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Band Edges Test Data CH-Low



Band Edges Test Data CH-High



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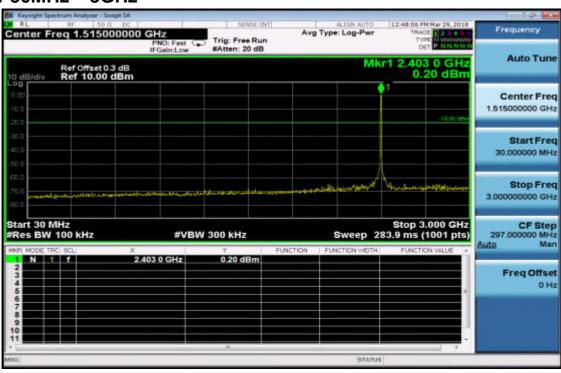
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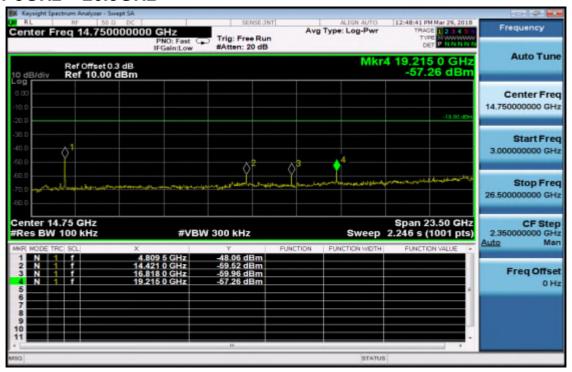
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Conducted Spurious Emission Measurement Result CH-Low 30MHz - 3GHz



CH-Low 3GHz - 26.5GHz



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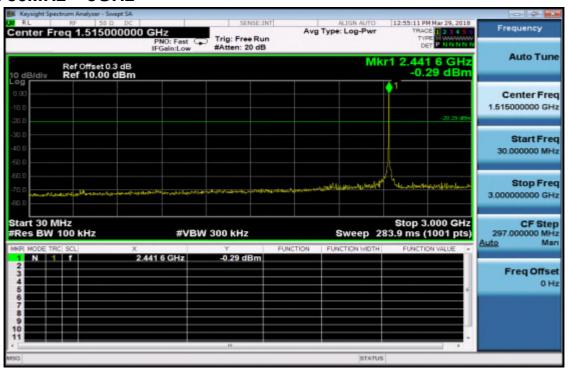
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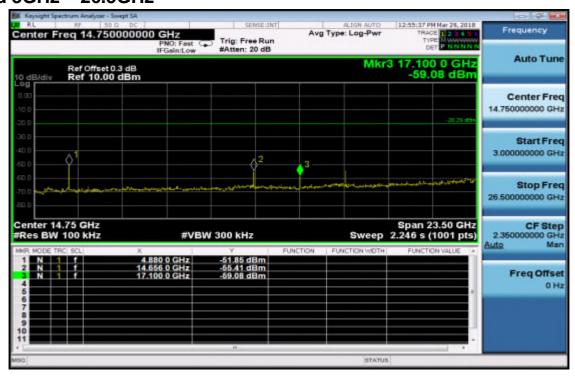
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CH-Mid 30MHz - 3GHz



CH-Mid 3GHz - 26.5GHz



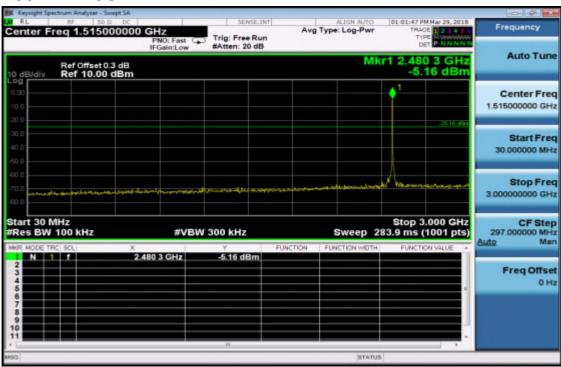
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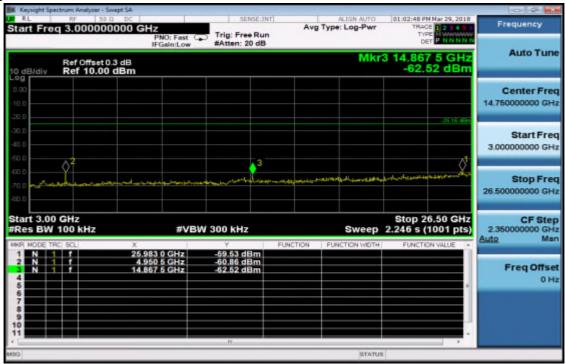
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CH-High 30MHz – 3GHz



CH- High 3GHz - 26.5GHz



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10 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

Standard Applicable 10.1

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 & RSS-Gen §8.10 Table 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §8.9 Table 4 & 5, 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

<u> </u>							
966 Chamber							
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.		
TYPE		NUMBER	NUMBER	CAL.			
Broadband Antenna	SCHWAZBECK	VULB 9168	9168-617	2017/10/27	2018/10/26		
Horn Antenna	Schwarzbeck	BBHA9120D	1341	2017/05/31	2018/05/30		
Loop Antenna	ETS.LINDGREN	6502	148045	2017/09/26	2018/09/25		
EMI Test Receiver	R&S	ESU 40	100363	2017/04/18	2018/04/17		
Pre-Amplifier	EMC Instru-	EMC184045B	980135	2017/10/27	2018/10/26		
	ments						
Pre-Amplifier	EMC Instru-	EMC9135	980234	2017/12/26	2018/12/25		
1 10 / (III)pililoi	ments	LIVIO3133	300234	2017/12/20	2010/12/23		
Pre-Amplifier	EMC Instru-	EMC12630SE	980271	2017/12/26	2018/12/25		
Fie-Ampliner	ments	EIVIC 120303E	900271	2017/12/20	2010/12/23		
Attenuator	Marvelous	WATT-218FS-10	RF246	2017/12/26	2018/12/25		
Coaxial Cable	Huber+Suhner	RG 214/U	W21.01	2017/12/26	2018/12/25		
Coaxial Cable	Huber Suhner	EMC106-SM-SM -7200	150703	2017/12/26	2018/12/25		
Notebook	Lenovo	L420	S0012467	N/A	N/A		

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Proceedings

Procedure

**Procedure

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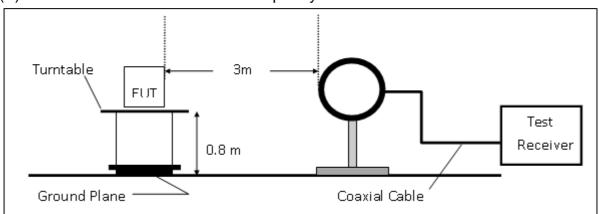
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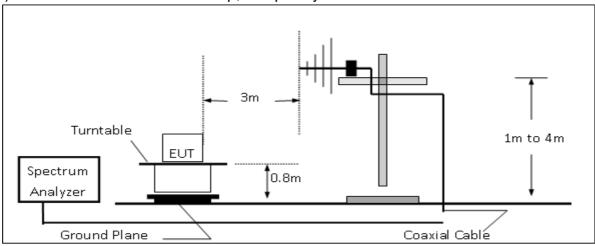


10.3 Test SET-UP

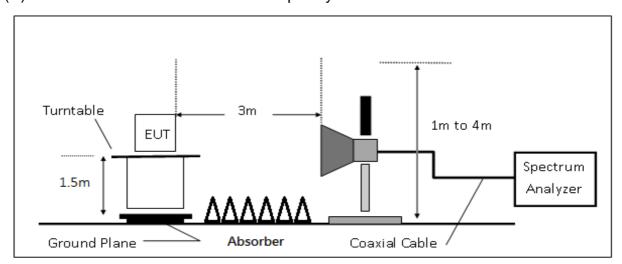
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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

- The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. 1. Guidance.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 0.8m for frequency> 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.
- Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) 5. and Quasi-peak (QP) at frequency below 1 GHz.
- Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency 6. 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.
- Maximum procedure was performed on the six highest emissions to ensure EUT compli-9. ance.
- And also, each emission was to be maximized by changing the polarization of receiving an-10. tenna 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	<u> </u>	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.

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.

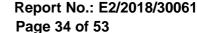
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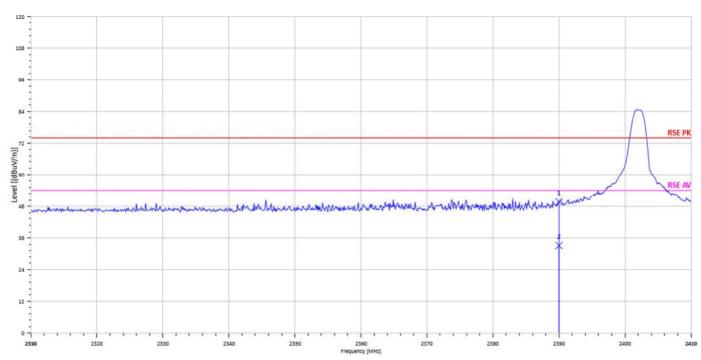


Radiated Band Edge Measurement Result (BLE mode)

Operation Mode: **BLE** Test Date: 2018/4/2

Fundamental Frequency: 2402 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band: BE CH Low Test Engineer: Jerry EUT Pol.: Measurement Antenna Pol. : Vertical E2

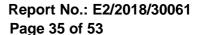


Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Peak	56.53	-6.84	49.69	74	-24.31
2390.00	E	Average	40.02	-6.84	33.18	54	-20.82

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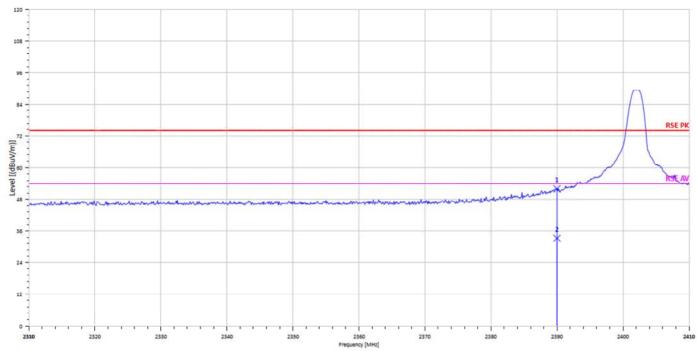




Test Date: Operation Mode: BLE 2018/4/2

Fundamental Frequency: 2402 MHz Temp. / Humi. : 22.7deg_C/57RH

Operation Band: BE CH Low Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Horizontal

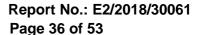


Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	_
2390.00	Е	Peak	58.85	-6.84	52.01	74	-21.99	
2390.00	Е	Average	40.07	-6.84	33.23	54	-20.77	

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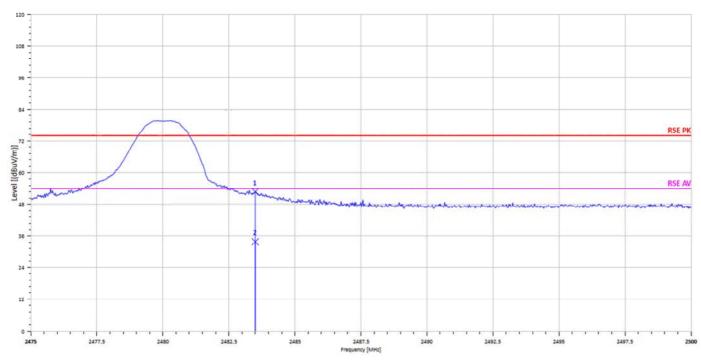




Operation Mode: BLE Test Date: 2018/4/2

Fundamental Frequency: 2480 MHz Temp. / Humi. : 22.7deg_C/57RH

Operation Band: BE CH High Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical

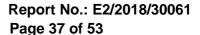


Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dΒμV/m	dΒμV/m	dB
2483.50	E	Peak	59.21	-6.38	52.83	74	-21.17
2483.50	E	Average	40.18	-6.38	33.79	54	-20.21

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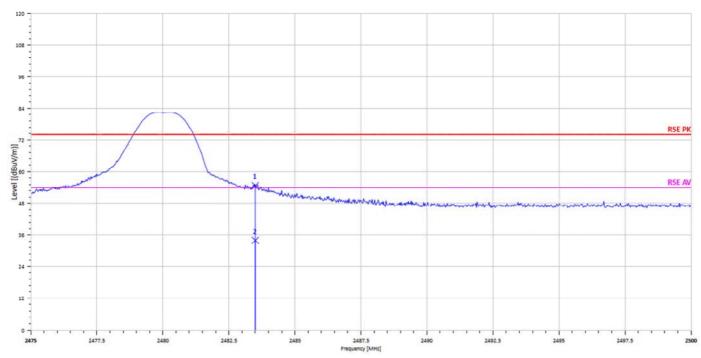
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Fundamental Frequency: 2480 MHz Temp. / Humi. : 22.7deg_C/57RH

Operation Band: BE CH High Test Engineer: EUT Pol.: E2 Measurement Antenna Pol.: Horizontal



Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dΒμV/m	dBµV/m	dB
2483.50	E	Peak	61.12	-6.38	54.74	74	-19.26
2483.50	Е	Average	40.33	-6.38	33.95	54	-20.05

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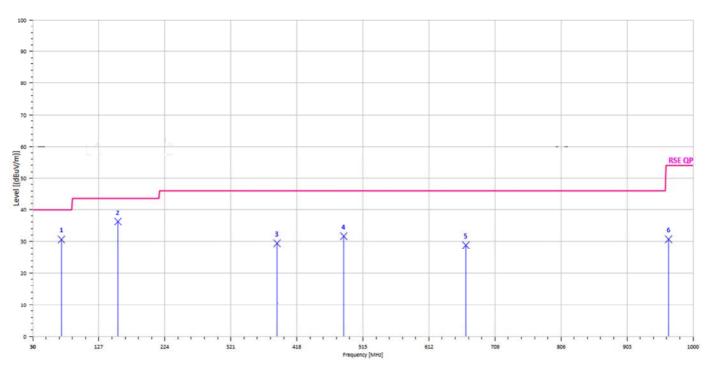


Radiated Spurious Emission Measurement Result (BLE mode) For Frequency form 30MHz to 1000MHz

Operation Mode: **BLE** Test Date: 2018/4/2

Fundamental Frequency: 2402 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band: Tx CH Low Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical



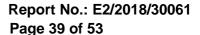
Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
72.13	S	Peak	50.29	-19.70	30.59	40	-9.41
155.13	S	Peak	51.90	-15.68	36.23	43.5	-7.27
388.90	S	Peak	42.58	-13.13	29.45	46	-16.55
486.87	S	Peak	42.81	-11.22	31.60	46	-14.40
666.32	S	Peak	37.31	-8.48	28.83	46	-17.17
964.11	S	Peak	34.97	-4.30	30.67	54	-23.33

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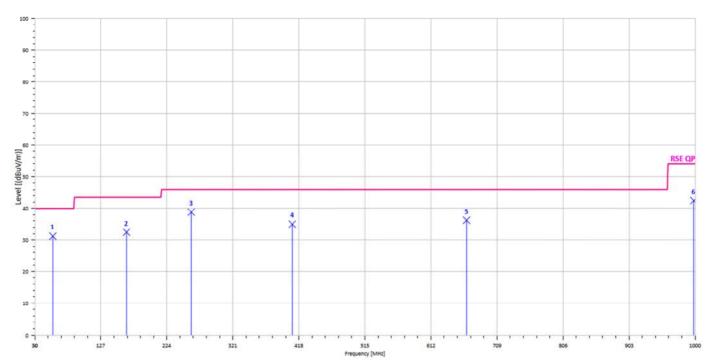
台灣檢驗科技股份有限公司





Fundamental Frequency: 2402 MHz Temp. / Humi. : 22.7deg_C/57RH

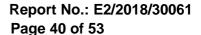
Operation Band: Tx CH Low Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Horizontal



Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
56.56	S	Peak	48.91	-17.72	31.19	40	-8.81
164.83	S	Peak	48.45	-15.98	32.47	43.5	-11.03
259.89	S	Peak	55.94	-17.13	38.81	46	-7.19
408.30	S	Peak	47.07	-12.05	35.02	46	-10.98
664.38	S	Peak	44.64	-8.37	36.27	46	-9.73
998.06	S	Peak	46.28	-3.79	42.49	54	-11.51

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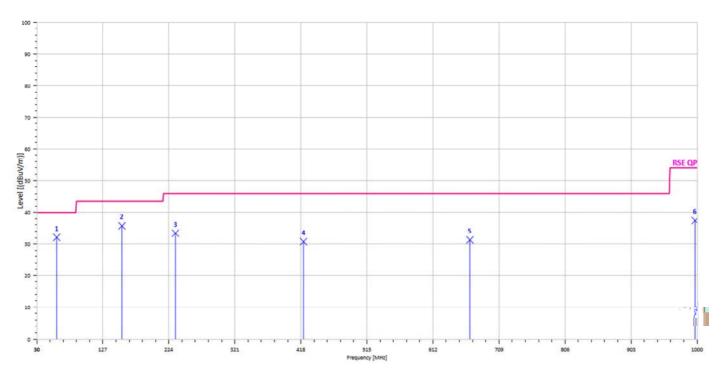
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Fundamental Frequency: 2442 MHz Temp. / Humi. : 22.7deg_C/57RH

Operation Band: Tx CH Mid Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical

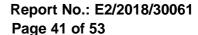


Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
59.31	S	Peak	50.02	-17.94	32.08	40	-7.92
155.13	S	Peak	51.41	-15.68	35.74	43.5	-7.76
233.70	S	Peak	50.85	-17.44	33.41	46	-12.59
421.88	S	Peak	42.89	-12.14	30.75	46	-15.25
666.32	S	Peak	39.77	-8.48	31.29	46	-14.71
997.09	S	Peak	41.24	-3.83	37.41	54	-16.59

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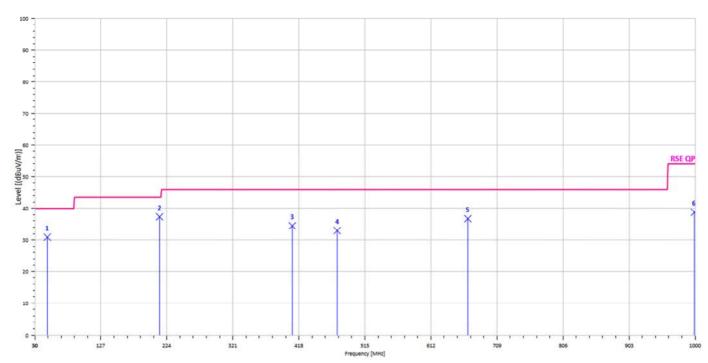
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Fundamental Frequency: 2442 MHz Temp. / Humi. : 22.7deg_C/57RH

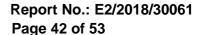
Operation Band: Tx CH Mid Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Horizontal



Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
48.43	S	Peak	48.07	-17.17	30.90	40	-9.10
213.33	S	Peak	55.91	-18.57	37.33	43.5	-6.17
408.30	S	Peak	46.52	-12.05	34.47	46	-11.53
474.26	S	Peak	44.06	-11.10	32.97	46	-13.03
666.32	S	Peak	45.22	-8.48	36.74	46	-9.26
999.03	S	Peak	42.54	-3.76	38.78	54	-15.22

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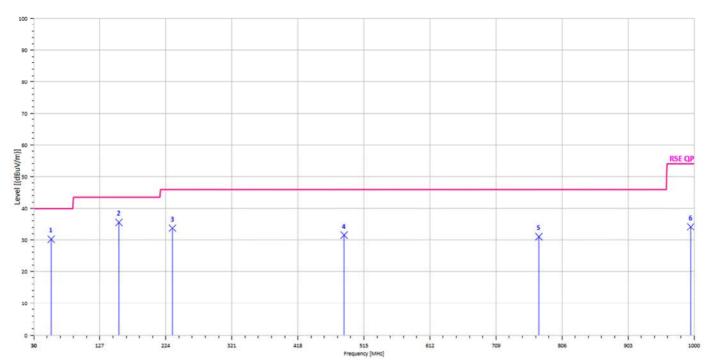
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Fundamental Frequency: 2480 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band: Tx CH High Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical

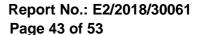


Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
55.65	S	Peak	47.89	-17.65	30.24	40	-9.76
155.13	S	Peak	51.26	-15.68	35.59	43.5	-7.91
233.70	S	Peak	51.18	-17.44	33.74	46	-12.26
485.90	S	Peak	42.72	-11.20	31.52	46	-14.48
772.05	S	Peak	37.38	-6.37	31.01	46	-14.99
995.15	S	Peak	38.07	-3.90	34.17	54	-19.83

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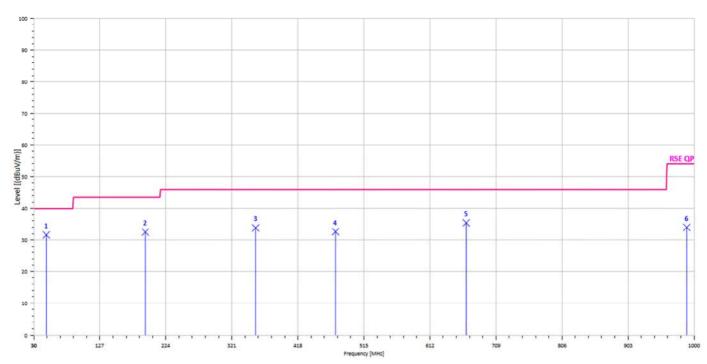
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Fundamental Frequency: 2480 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band: Tx CH High Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Horizontal



Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	<u>dB</u>
48.43	S	Peak	48.78	-17.17	31.61	40	-8.39
193.93	S	Peak	51.19	-18.69	32.50	43.5	-11.00
355.92	S	Peak	47.95	-14.12	33.83	46	-12.17
473.29	S	Peak	43.72	-11.10	32.62	46	-13.38
665.35	S	Peak	43.86	-8.43	35.43	46	-10.57
989.33	S	Peak	38.08	-4.09	33.99	54	-20.01

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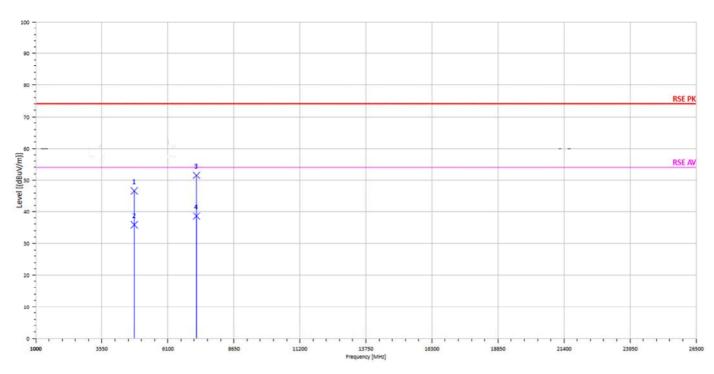
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Radiated Spurious Emission Measurement Result (BLE mode) For Frequency above 1GHz

Operation Mode: BLE Test Date: 2018/4/2

Fundamental Frequency: 2402 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band: Tx CH Low Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical



Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4804.00	Н	Peak	47.78	-1.16	46.62	74	-27.38
4804.00	Н	Average	36.99	-1.16	35.83	54	-18.17
7206.00	Н	Peak	46.07	5.41	51.48	74	-22.52
7206.00	Н	Average	33.15	5.41	38.57	54	-15.43

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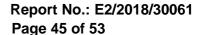
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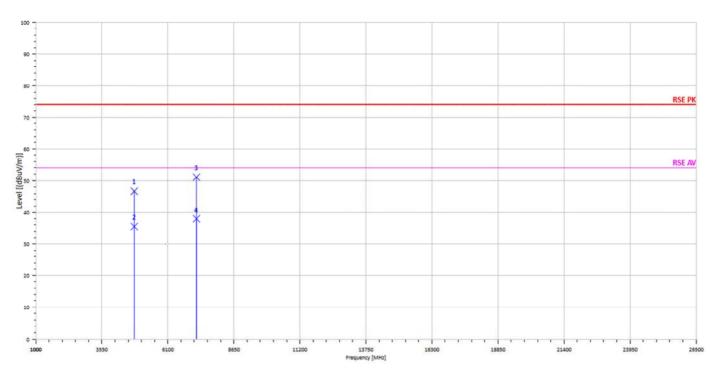
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Fundamental Frequency: 2402 MHz Temp. / Humi. : 22.7deg_C/57RH

Operation Band: Tx CH Low Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Horizontal

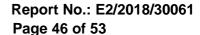


Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4804.00	Н	Peak	47.88	-1.16	46.72	74	-27.28
4804.00	Н	Average	36.70	-1.16	35.54	54	-18.46
7206.00	Н	Peak	45.63	5.41	51.05	74	-22.95
7206.00	Н	Average	32.55	5.41	37.97	54	-16.03

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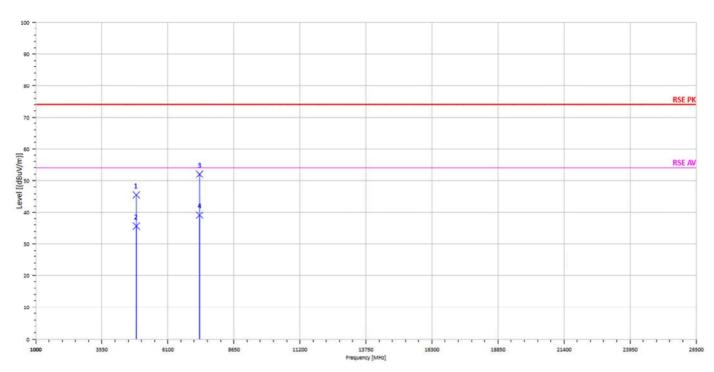
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Fundamental Frequency: 2442 MHz Temp. / Humi. : 22.7deg_C/57RH

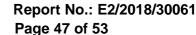
Operation Band: Tx CH Mid Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical



Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4884.00	Н	Peak	46.24	-0.69	45.55	74	-28.45
4884.00	Н	Average	36.37	-0.69	35.68	54	-18.32
7326.00	Н	Peak	45.87	6.12	51.99	74	-22.01
7326.00	Н	Average	33.03	6.12	39.14	54	-14.86

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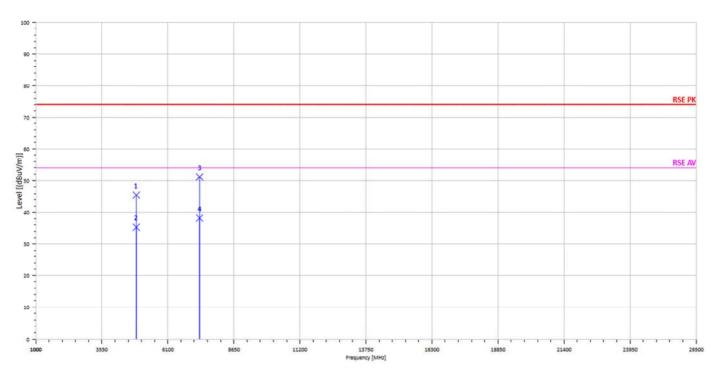
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Fundamental Frequency: 2442 MHz Temp. / Humi. : 22.7deg_C/57RH

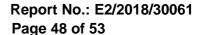
Operation Band: Tx CH Mid Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Horizontal



Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4884.00	Н	Peak	46.17	-0.69	45.48	74	-28.52
4884.00	Н	Average	36.01	-0.69	35.32	54	-18.68
7326.00	Н	Peak	45.02	6.12	51.14	74	-22.86
7326.00	Н	Average	32.08	6.12	38.19	54	-15.81

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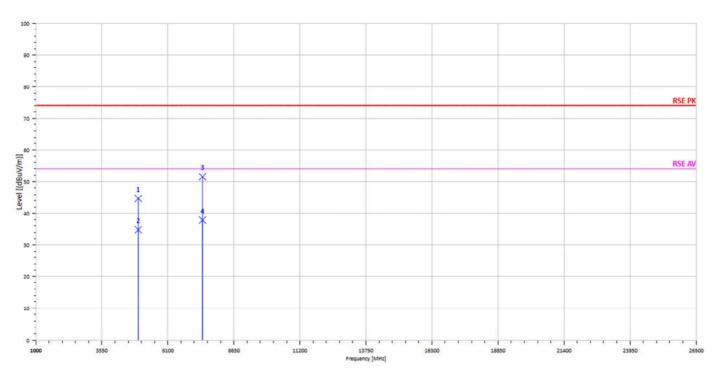
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Fundamental Frequency: 2480 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band: Tx CH High Test Engineer: Jerry EUT Pol.: E2 Measurement Antenna Pol.: Vertical

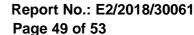


Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4960.00	Н	Peak	45.38	-0.66	44.72	74	-29.28
4960.00	Н	Average	35.53	-0.66	34.87	54	-19.13
7440.00	Н	Peak	45.28	6.19	51.46	74	-22.54
7440.00	Н	Average	31.68	6.19	37.87	54	-16.13

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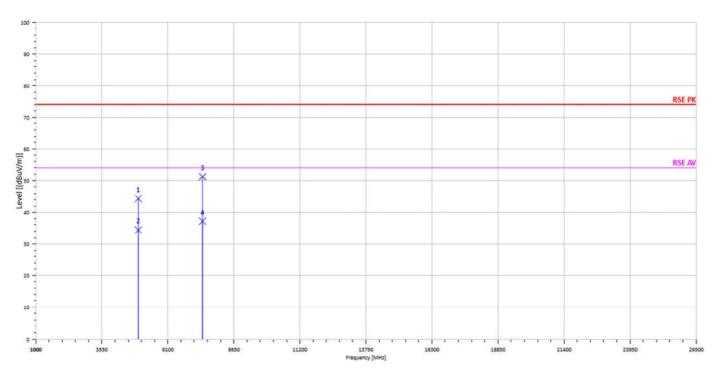
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Fundamental Frequency: 2480 MHz Temp. / Humi.: 22.7deg_C/57RH

Operation Band : Tx CH High Test Engineer : Jerry EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
4960.00	Н	Peak	45.03	-0.66	44.37	74	-29.63
4960.00	Н	Average	35.07	-0.66	34.41	54	-19.59
7440.00	Н	Peak	45.01	6.19	51.20	74	-22.80
7440.00	Н	Average	31.01	6.19	37.20	54	-16.80

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11 PEAK POWER SPECTRAL DENSITY

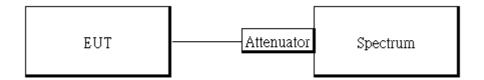
11.1 Standard Applicable:

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:**

Conducted Emission Test Site									
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.				
TYPE		NUMBER	NUMBER	CAL.					
Spectrum Analyzer	Agilent	N9010A	MY51440113	2017/06/21	2018/6/20				
Attenuator	Marvelous	MVE2213-10	RF30	2017/12/26	2018/12/25				
DC Block	PASTERNACK	PE8210	RF29	2017/12/26	2018/12/25				
Notebook	Lenovo	L420	S0011721	N/A	N/A				

11.3 Test Set-up:



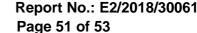
11.4 Measurement Procedure:

- 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. & the VBW = 10 kHz
- 5. Detector = peak.
- 6. Sweep time = auto couple.
- 7. Trace mode = max hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level.

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11.5 Measurement Result:

BLE mode

BLE mode

Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result				
2402	-14.65	8	PASS				
2442	-15.01	8	PASS				
2480	-19.64	8	PASS				

NOTE: cable loss as 0.3dB that offsets in the spectrum

BLE mode

Power Spectral Density Test Plot (CH-Low)



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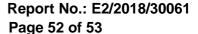
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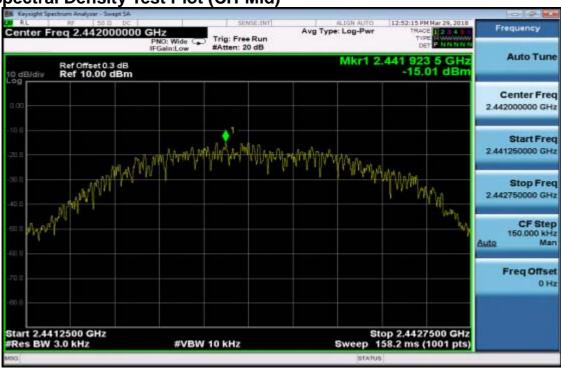
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Power Spectral Density Test Plot (CH-Mid)



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 has no consideration of replacement. Please see EUT photo and antenna spec. for details.

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