

Report No.: ER/2017/90137

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ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

Applicant: Fuji Film Corporation

7-3, Akasaka 9-Chome, Minato-ku, Tokyo 107-0052, Japan

Product Name: Communication module

Brand Name: FUJIFILM TYPE1FJ Model No.:

Model Difference: N/A

W2Z-02100005 FCC ID: ER/2017/90137 **Report Number:** §15.247, Cat: DTS **FCC Rule Part:** Issue Date: Nov. 14, 2017

Sep. 20, 2017 ~ Nov. 14, 2017 Date of Test:

Date of EUT Received: Sep. 20, 2017

We hereby certify that:

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

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

Prepared By:

Karen Huang / Clerk

Approved By: Jim Chang / Asst. Manager





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Revision History

Report Number	Number Revision Description		Issue Date	
ER/2017/90137	Rev.00	Initial creation of document	Nov. 14, 2017	

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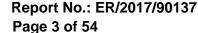




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GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Communication module	
Brand Name:	FUJIFILM	
Model No.:	TYPE1FJ	
Model difference:	N/A	
Product HW Version:	N/A	
Product SW Version:	N/A	
Power Supply:	3.3Vdc from Test Kit	

Bluetooth Low Energy:

Bluetooth Version:	V4.1 single mode	
Channel number:	40 channels	
Modulation type:	GFSK	
Transmit Power:	8.01dBm	
Frequency Range:	2402 – 2480MHz	

Antenna Designation

Antenna Type	Part Number	Supplier	Peak Gain (dBi)
Monopole Pattern	N/A	N/A	0.8
Antenna			

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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.

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 Number and Designation number 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.

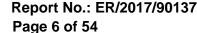
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SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

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

2.3 Test Procedure

2.3.1 Conducted Emissions

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

2.3.2 Radiated Emissions

The EUT is a placed on as turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plan. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

2.4 Measurement Results Explanation Example

For all conducted test items:

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

Note:

The spectrum analyzer offset is derived from RF cable loss 11.3dB.

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2.5 Configuration of Tested System

Fig. 2-1 Conducted (Antenna Port) Emission Configuration

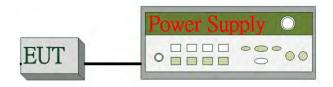


Fig 2-2 Radiated Emission & Conduction

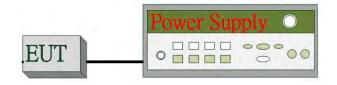


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Ca- ble	Power Cord
1.	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	MY52410006	N/A	Unshielded
			·			

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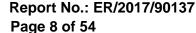
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SUMMARY OF TEST RESULTS

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

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DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

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

TO THE ENGLISH TEST:					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	
RADIATED EMISSION TEST (BELOW 1 GHz)					
Bluetooth LE	0 to 39	37,17,39	GFSK	1	
RADIATED EMISSION TEST (ABOVE 1 GHz)					
Bluetooth LE	0 to 39	37,17,39	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 TESTED MODULATION DATA RATE (Mbps)					
Bluetooth LE	0 to 39	37,17,39	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:

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

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

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

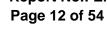
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CONDUCTED EMISSION TEST

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.		
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018		
LISN	SCHWARZ- BECK	NSLK 8127	8127-649	05/22/2017	05/21/2018		
LISN	MESS TEC	FCC-LISN-50/250-25-2- 01	4034	03/19/2017	03/18/2018		
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2016	11/25/2017		

6.3 EUT Setup:

- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 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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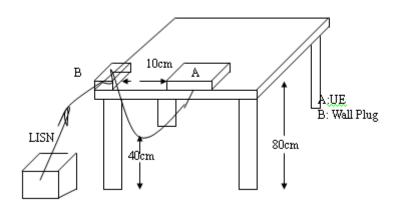
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^{1.} The lower limit shall apply at the transition frequencies

^{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

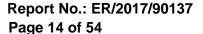
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6.6 Measurement Result:

Temperature: 20 (Site Conduction Room Phase: L1

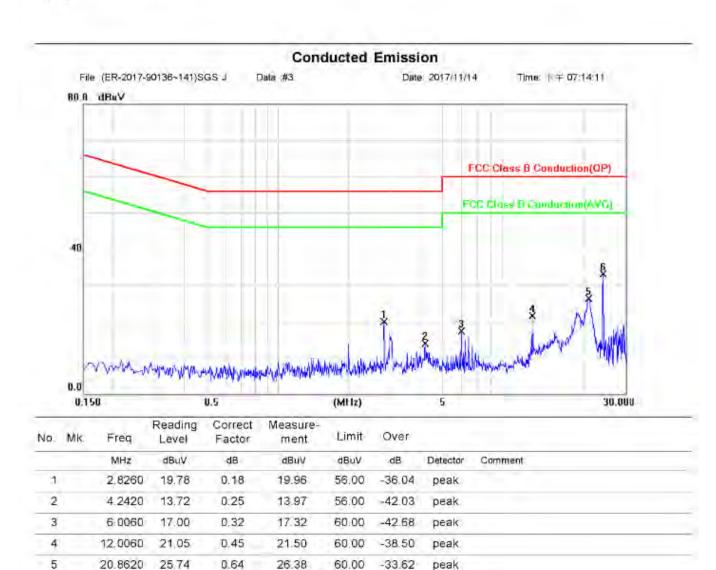
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 58 %

Mode. Operation mode

Note:

6 *

24.0620



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33.05

0.73

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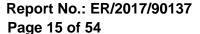
60.00

-26.95

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peak.

32.32



30.000



Site Conduction Room

Limit: FCC Class B Conduction(QP)

Mode. Operation mode

0.150

Note:

Temperature: Phase: 20 V

AC 120V/60Hz Humidity: 58 % Power:

Conducted Emission File:(ER-2017-90136~141)SGS J Date 2017/11/14 Data #2 Time | + 07,10 30 80 0 dBuV FCC Class B Conduction(QP) FCC Class B Combosion(AVG) 40 0.0

No:	Mk.	Freq.	Reading Level	Correct	Measure-	Limit	Over		
140-	Juric.	MHz	dBuV	dB	ment	dBuV	dB	Detector	Comment
1		2,8260	21.01	0.15	21.16	56,00	-34.84	peak	
2		4.1540	19,20	0.21	19.41	56,00	-36.59	peak	
3		6.0060	17.80	0.28	18.08	60.00	-41.92	peak	
4	- 1	12.0300	20.64	0.38	21.02	60.00	-38.98	peak	
5		20.8340	27.97	0.51	28.48	60.00	-31.52	peak	
6	*	24.0140	31.03	0.56	31.59	60.00	-28.41	peak	

(MHz)

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0.5

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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.

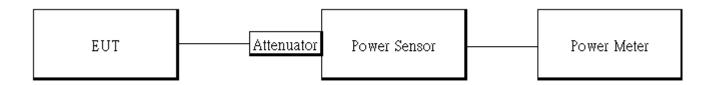
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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

7.3 Test Set-up:



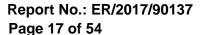
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7.4 Measurement Procedure:

- 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.

Formula:

Duty Cycle = Ton / (Ton+Toff)

Duty Factor:

	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW setting (kHz)
BLE	62.40	2.05	2.40	3.00



Duty Cycle Factor:10*log(1/(62.4/100))=2.05

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7.5 **Measurement Result:**

RI F mode:

BLE mode.			
СН	Frequency (MHz)	Peak Power Output (dBm)	Required Limit
37	2402	6.93	1 Watt = 30 dBm
17	2440	7.37	1 Watt = 30 dBm
39	2480	8.01	1 Watt = 30 dBm
BLE mode:			
СН	Frequency (MHz)	Max. Avg. Output include tune up tolerance Power (dBm)	Required Limit
37	2402	6.61	1 Watt = 30 dBm
17	2440	7.06	1 Watt = 30 dBm
39	2480	7.54	1 Watt = 30 dBm

*Note: Measured by power meter, cable loss as 11.3 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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6DB BANDWIDTH MEASUREMENT 8

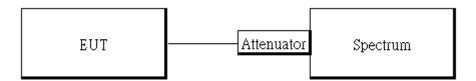
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

Conducted Emission Test Site						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018	
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018	
Coaxial Cable	HU- BER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018	
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018	
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018	
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017	

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.
- 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. For 99% Bandwidth:

Set the spectrum analyzer as RBW=1%, VBW=3*RBW, Span = 2MHz, Detector=Sample, Sweep=auto.

- 7. Turn on the 99% bandwidth function, max reading.
- 8. Repeat above procedures until all test default channel is completed

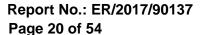
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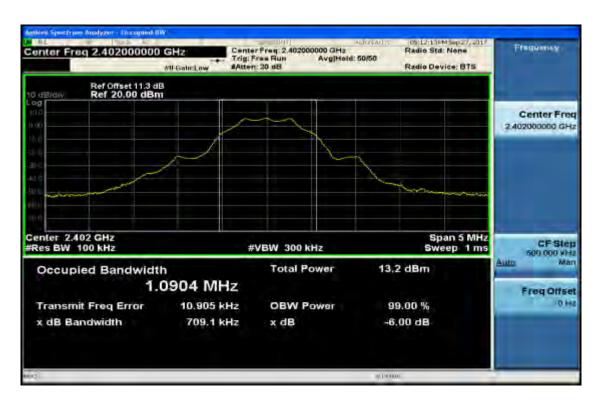


8.5 Measurement Result:

BI F mode

Frequency (MHz)	6dB BW (MHz)	BW (MHz)	Result
2402	0.7091	> 0.5	PASS
2440	0.706	> 0.5	PASS
2480	0.7005	> 0.5	PASS

6dB Band Width Test Data CH-Low



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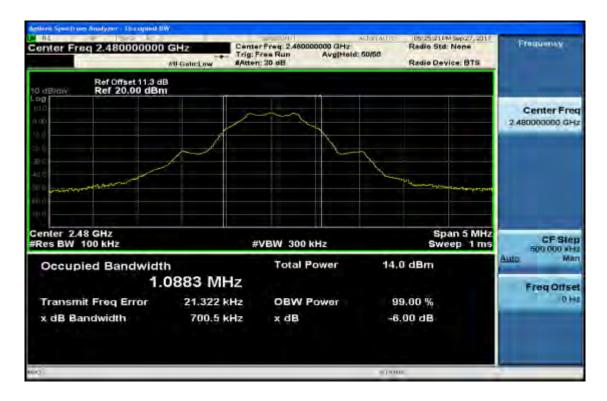
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6dB Band Width Test Data CH-Mid



6dB Band Width Test Data CH-High



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CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT 9

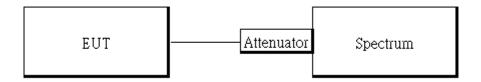
9.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

9.2 Measurement Equipment Used:

Conducted Emission Test Site						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
EXA Spectrum Ana- lyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018	
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018	
Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018	
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018	
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018	
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017	

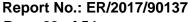
9.3 Test SET-UP:



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9.4 Measurement Procedure

Band Edge Limit Calculation:

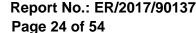
- Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 100kHz & VBW = 300 kHz.
- 5. Detector = peak.
- 6. Sweep time = auto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

Conducted Band Edge:

- 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.
- 7. 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.
- 8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

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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.

9.5 Measurement Result

Band Edge Limit

Frequency (MHz)	RF Power Density (dBm)	Bandedge Limit = PSD - 20dB (dBm)
2402	5.94	-14.06
2480	6.97	-13.03

NOTE: cable loss as 11.3dB 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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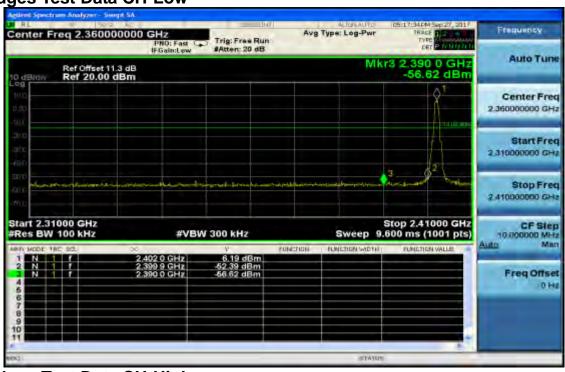
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BLE mode

Band Edges Test Data CH-Low



Band Edges Test Data CH-High



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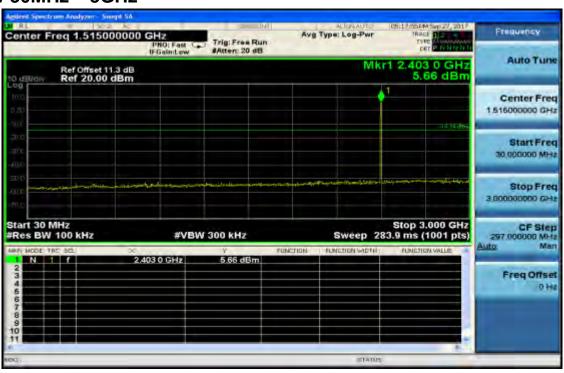
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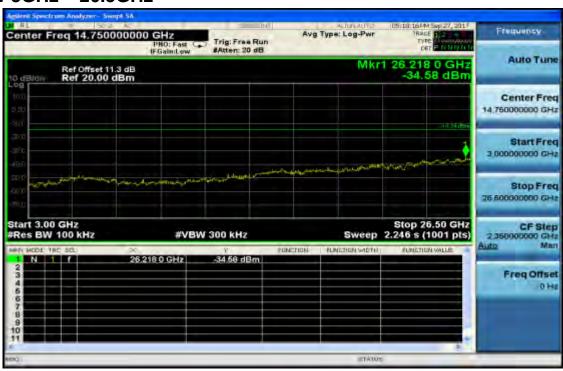
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Conducted Spurious Emission Measurement Result CH-Low 30MHz - 3GHz



CH-Low 3GHz - 26.5GHz



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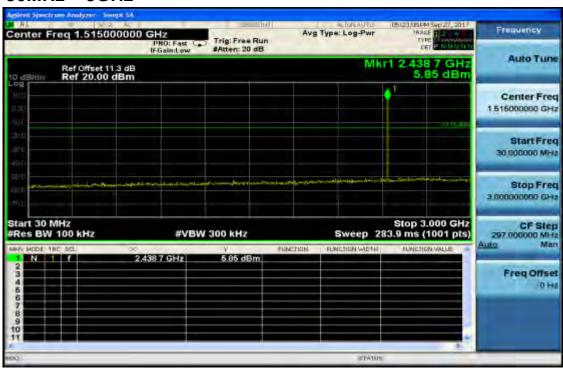
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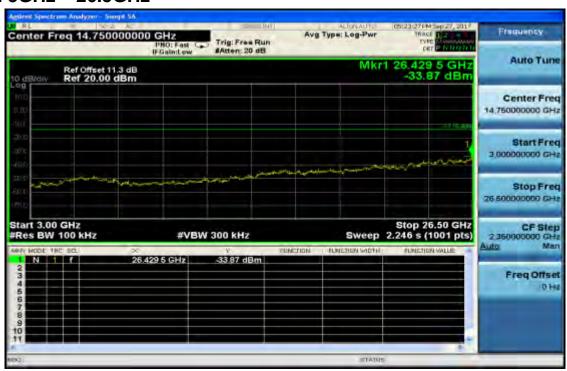
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CH-Mid 30MHz - 3GHz



CH-Mid 3GHz - 26.5GHz



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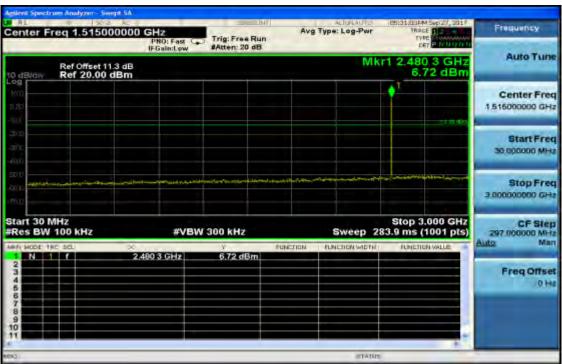
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CH-High 30MHz – 3GHz



CH- High 3GHz - 26.5GHz

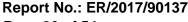


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10 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

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 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

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

Note:

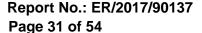
- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level $(dB\mu V/m) = 20 \log Emission level (dB\mu V/m)$

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10.2 **Measurement Equipment Used**

966 Chamber							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018		
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/25/2017	04/24/2018		
Loop Antenna	ETS-Lindgren	6502	148045	09/20/2017	09/19/2018		
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/19/2016	12/18/2017		
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/04/2017	08/03/2018		
Pre-Amplifier	Agilent	8447D	2944A07676	01/03/2017	01/02/2018		
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/03/2017	01/02/2018		
Turn Table	HD	DT420	N/A	N.C.R	N.C.R		
Antenna Tower	ChamPro	AM-BS-4500-B	060776-ABS	N.C.R	N.C.R		
Controller	ChamPro	EM1000	60776	N.C.R	N.C.R		
Low Loss Cable	Huber Suhner	966_RX	9	01/05/2017	01/04/2018		
3m Site NSA	SGS	966 chamber	N/A	07/01/2017	06/30/2018		
Low Loss Cable	Huber Suhner	966 TX	1	01/05/2017	01/04/2018		
Horn Antenna	Schwarzbeck	BBHA9170	184	12/12/2016	12/11/2017		
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/05/2017	01/04/2018		

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

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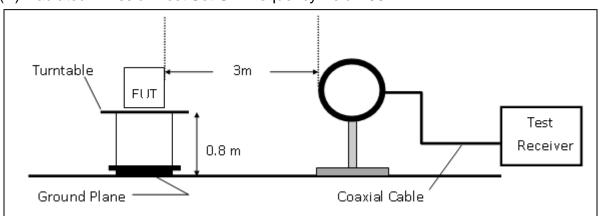
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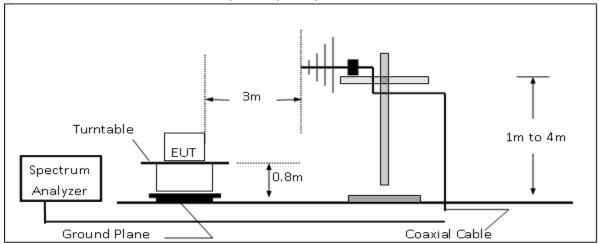


10.3 **Test SET-UP**

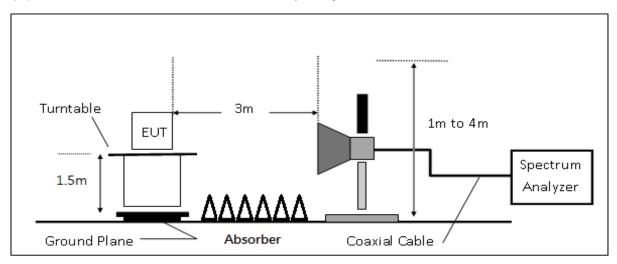
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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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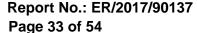
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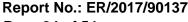
10.4 **Measurement Procedure**

- 1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plan.
- 3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 5. 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.
- 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	•	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.

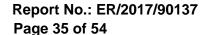
Note: There is a comparison data of both open-field test site and semi-Anechoic, and test result came out very similar

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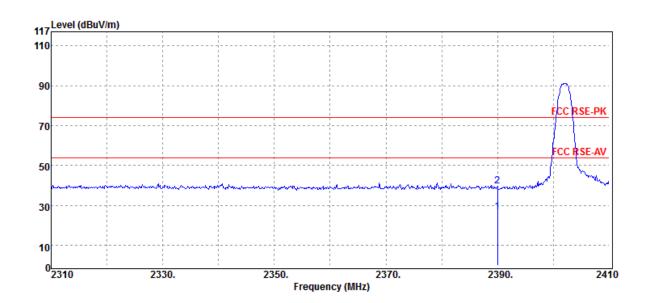
Radiated Band Edge Measurement Result

Operation Band :BLE **Test Date** :2017-09-28

Fundamental Frequency :2402 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Bandedge CH LOW Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL

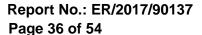


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2390.00	Е	Average	28.56	-1.74	26.82	54.00	-27.18
2390.00	Е	Peak	41.53	-1.74	39.79	74.00	-34.21

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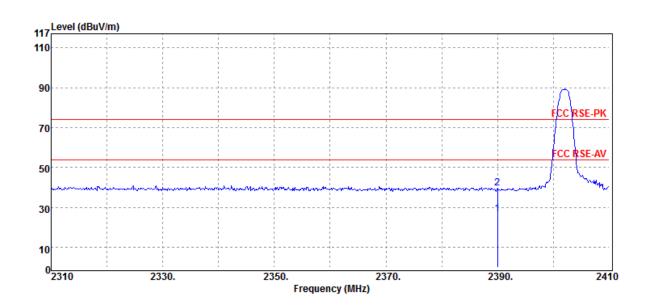


:BLE **Operation Band Test Date** :2017-09-28

Fundamental Frequency :2402 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Bandedge CH LOW Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL

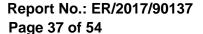


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2390.00	Е	Average	28.57	-1.74	26.83	54.00	-27.17
2390.00	E	Peak	41.26	-1.74	39.52	74.00	-34.48

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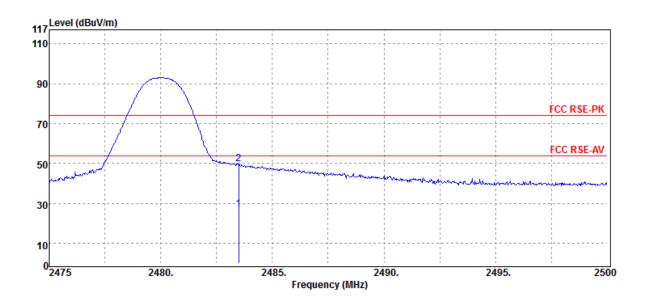


:BLE **Operation Band Test Date** :2017-09-28

Fundamental Frequency :2480 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Bandedge CH HIGH Engineer :Kane

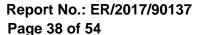
EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
2483.50	Е	Average	28.77	-1.62	27.15	54.00	-26.85
2483.50	Е	Peak	51.25	-1.62	49.63	74.00	-24.37

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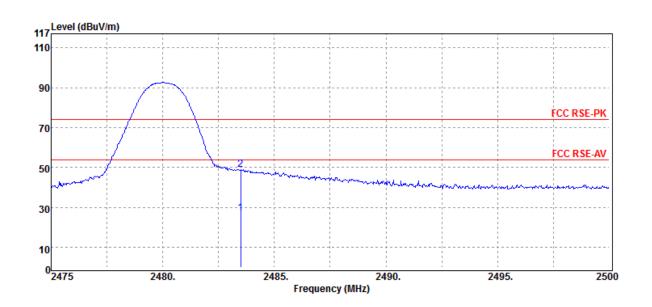


:BLE **Operation Band Test Date** :2017-09-28

Fundamental Frequency :2480 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Bandedge CH HIGH Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL

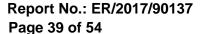


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
2483.50	Е	Average	28.76	-1.62	27.14	54.00	-26.86
2483.50	Е	Peak	50.66	-1.62	49.04	74.00	-24.96

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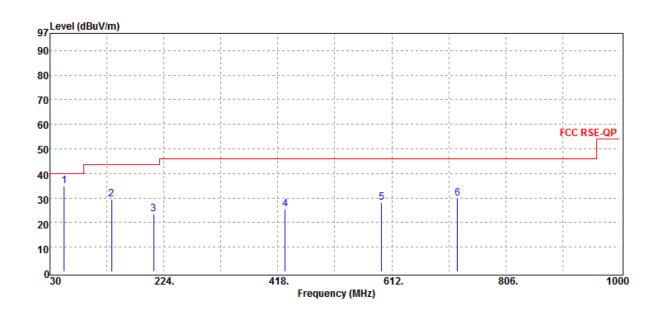
Radiated Spurious Emission Measurement Result For Frequency form 30MHz to 1000MHz

Operation Band :BLE **Test Date** :2017-09-28

:21 deg_C / 61 RH **Fundamental Frequency** Temp./Humi. :2402 MHz

Operation Mode :Tx CH LOW Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



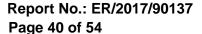
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
54.25	S	Peak	42.61	-7.82	34.79	40.00	-5.21
134.76	S	Peak	38.32	-8.84	29.48	43.50	-14.02
206.54	S	Peak	33.07	-9.71	23.36	43.50	-20.14
430.61	S	Peak	28.67	-3.33	25.34	46.00	-20.66
594.54	S	Peak	28.23	0.08	28.31	46.00	-17.69
723.55	S	Peak	28.27	1.61	29.88	46.00	-16.12

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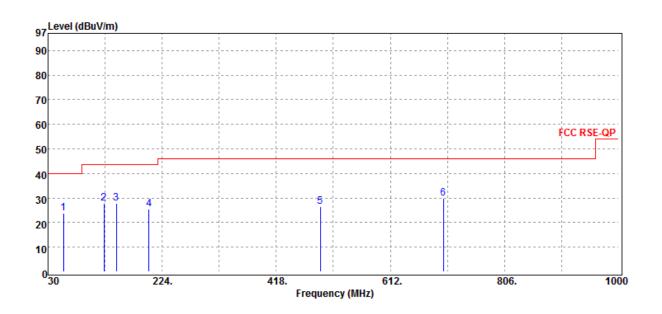




Fundamental Frequency :2402 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH LOW Engineer :Kane

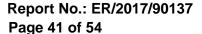
EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB
56.19	S	Peak	31.84	-7.91	23.93	40.00	-16.07
125.06	S	Peak	37.74	-9.98	27.76	43.50	-15.74
146.40	S	Peak	36.05	-8.05	28.00	43.50	-15.50
201.69	S	Peak	35.23	-9.67	25.56	43.50	-17.94
492.69	S	Peak	29.02	-2.60	26.42	46.00	-19.58
702.21	S	Peak	28.51	1.37	29.88	46.00	-16.12

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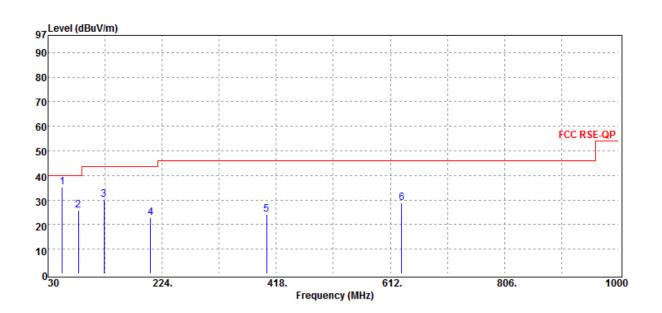




Fundamental Frequency :2440 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH MID Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



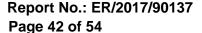
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
54.25	S	Peak	43.04	-7.82	35.22	40.00	-4.78
81.41	S	Peak	38.36	-12.53	25.83	40.00	-14.17
125.06	S	Peak	40.16	-9.98	30.18	43.50	-13.32
204.60	S	Peak	32.67	-9.70	22.97	43.50	-20.53
401.51	S	Peak	28.17	-3.95	24.22	46.00	-21.78
631.40	S	Peak	28.58	0.16	28.74	46.00	-17.26

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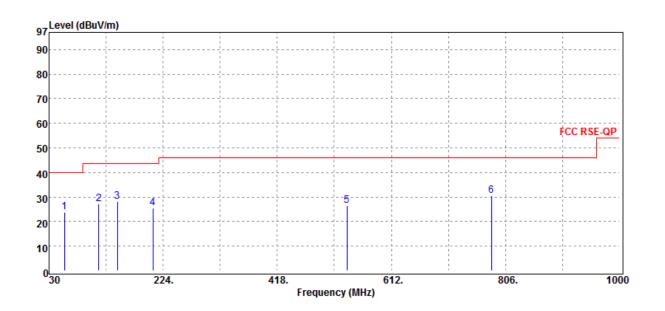




Fundamental Frequency :2440 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH MID Engineer :Kane

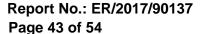
EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
56.19	S	Peak	31.82	-7.91	23.91	40.00	-16.09
114.39	S	Peak	38.00	-10.87	27.13	43.50	-16.37
146.40	S	Peak	36.36	-8.05	28.31	43.50	-15.19
206.54	S	Peak	35.38	-9.71	25.67	43.50	-17.83
536.34	S	Peak	27.90	-1.49	26.41	46.00	-19.59
781.75	S	Peak	27.70	2.75	30.45	46.00	-15.55

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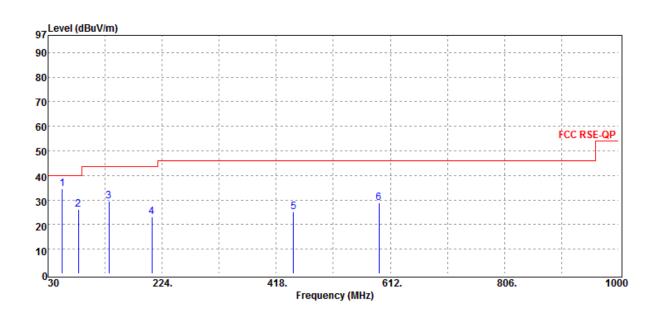




Fundamental Frequency :2480 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH HIGH Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL

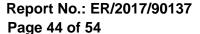


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
54.25	S	Peak	42.54	-7.82	34.72	40.00	-5.28
81.41	S	Peak	38.79	-12.53	26.26	40.00	-13.74
133.79	S	Peak	38.53	-8.99	29.54	43.50	-13.96
206.54	S	Peak	32.75	-9.71	23.04	43.50	-20.46
447.10	S	Peak	28.01	-2.95	25.06	46.00	-20.94
592.60	S	Peak	28.73	0.00	28.73	46.00	-17.27

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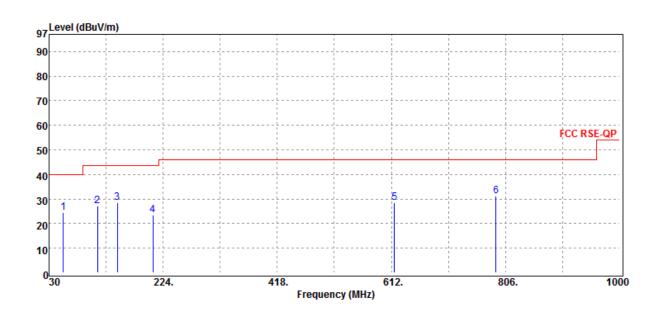




Fundamental Frequency :2480 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH HIGH Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL



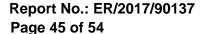
Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
54.25	S	Peak	32.22	-7.82	24.40	40.00	-15.60
112.45	S	Peak	38.17	-11.01	27.16	43.50	-16.34
146.40	S	Peak	36.52	-8.05	28.47	43.50	-15.03
206.54	S	Peak	33.26	-9.71	23.55	43.50	-19.95
616.85	S	Peak	28.65	-0.16	28.49	46.00	-17.51
789.51	S	Peak	28.24	2.83	31.07	46.00	-14.93

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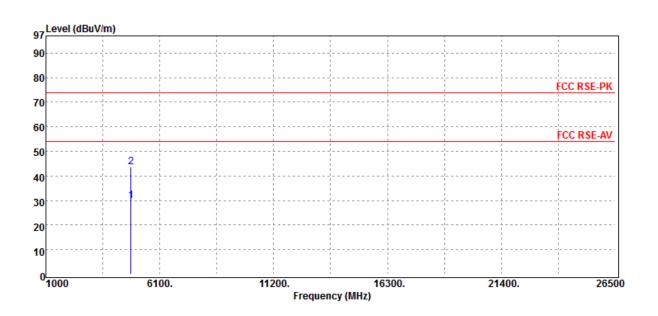
Radiated Spurious Emission Measurement Result For Frequency above 1GHz

Operation Band :BLE **Test Date** :2017-09-28

Fundamental Frequency Temp./Humi. :2402 MHz :21 deg_C / 61 RH

Operation Mode :Tx CH LOW Engineer :Kane

EUT Pol. :VERTICAL :E2 Plane Measurement Antenna Pol.

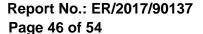


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
		Mode	Reading Level		FS	@3m	Margin	
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB	
4804.00	Н	Average	24.83	4.92	29.75	54.00	-24.25	
4804.00	Н	Peak	38.77	4.92	43.69	74.00	-30.31	

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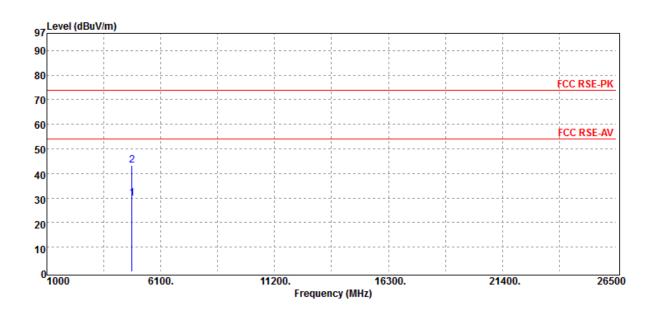




Fundamental Frequency :2402 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH LOW Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL



ual Limit Safe
S @3m Margin
//m dBµV/m dB
76 54.00 -24.24
40 74.00 -30.60
7

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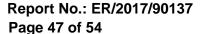
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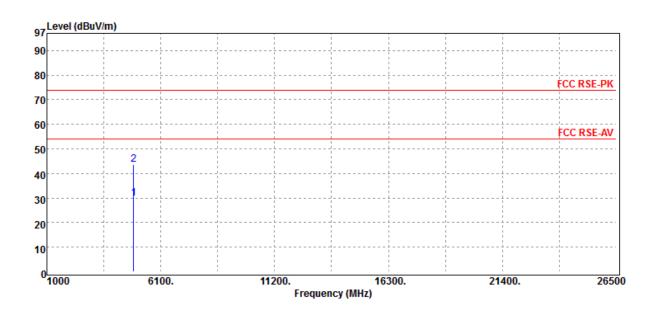




Fundamental Frequency :2440 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH MID Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL



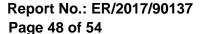
Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
	Mode	Reading Level		FS	@3m	Margin	
F/H/E/S	PK/QP/AV	dΒμV	dB	dBµV/m	dBµV/m	dB	
Н	Average	24.56	5.20	29.76	54.00	-24.24	
Н	Peak	38.51	5.20	43.71	74.00	-30.29	
	Н	Mode F/H/E/S PK/QP/AV H Average	Mode Reading Level F/H/E/S PK/QP/AV dBμV H Average 24.56	Mode Reading Level F/H/E/S PK/QP/AV dBμV dB H Average 24.56 5.20	Mode Reading Level FS F/H/E/S PK/QP/AV dBμV dB dBμV/m H Average 24.56 5.20 29.76	Mode Reading Level FS @3m F/H/E/S PK/QP/AV dBμV dB dBμV/m dBμV/m H Average 24.56 5.20 29.76 54.00	Mode Reading Level FS @3m Margin F/H/E/S PK/QP/AV dBμV dB dBμV/m dBμV/m dB H Average 24.56 5.20 29.76 54.00 -24.24

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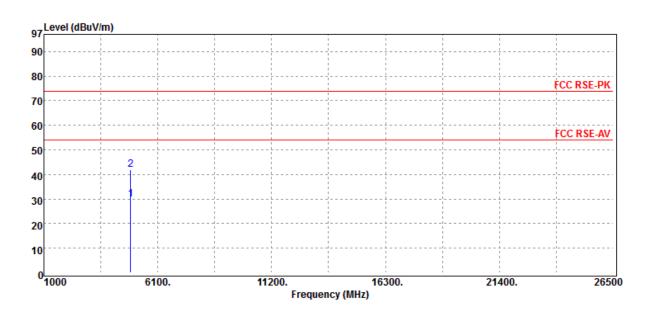




Fundamental Frequency :2440 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH MID Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL

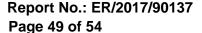


Note	Detector	Spectrum	Factor	Actual	Limit	Safe	
	Mode	Reading Level		FS	@3m	Margin	
F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB	
Н	Average	24.58	5.20	29.78	54.00	-24.22	
Н	Peak	36.64	5.20	41.84	74.00	-32.16	
	Н	Mode F/H/E/S PK/QP/AV H Average	Mode Reading Level F/H/E/S PK/QP/AV dBμV H Average 24.58	Mode Reading Level F/H/E/S PK/QP/AV dBμV dB H Average 24.58 5.20	Mode Reading Level FS F/H/E/S PK/QP/AV dBμV dB dBμV/m H Average 24.58 5.20 29.78	Mode Reading Level FS @3m F/H/E/S PK/QP/AV dBμV dB dBμV/m dBμV/m H Average 24.58 5.20 29.78 54.00	Mode Reading Level FS @3m Margin F/H/E/S PK/QP/AV dBμV dB dBμV/m dBμV/m dBμV/m dB H Average 24.58 5.20 29.78 54.00 -24.22

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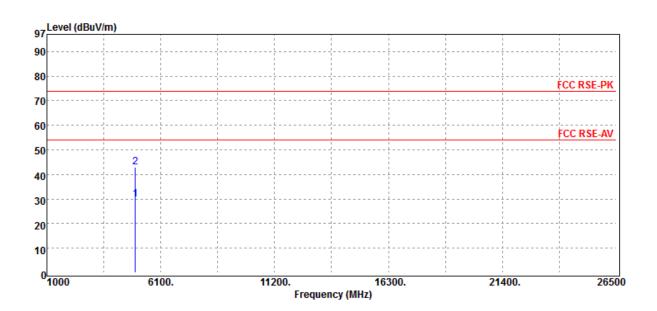




Fundamental Frequency :2480 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH HIGH Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :VERTICAL

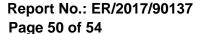


Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
		Mode	Reading Level		FS	@3m	Margin
MHz	F/H/E/S	PK/QP/AV	dΒμV	dB	dBμV/m	dBµV/m	dB
4960.00	Н	Average	24.50	5.29	29.79	54.00	-24.21
4960.00	Н	Peak	37.67	5.29	42.96	74.00	-31.04

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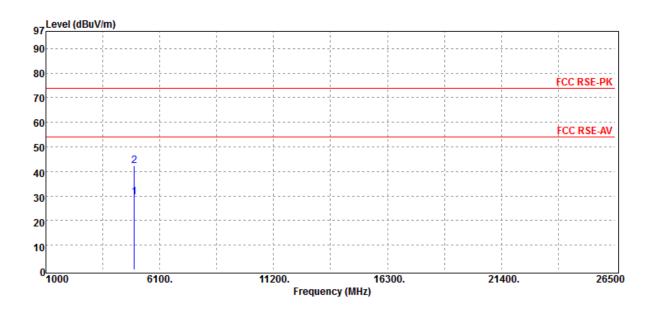




Fundamental Frequency :2480 MHz Temp./Humi. :21 deg_C / 61 RH

Operation Mode :Tx CH HIGH Engineer :Kane

EUT Pol. :E2 Plane Measurement Antenna Pol. :HORIZONTAL



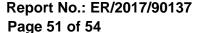
Actual	Limit	Safe	
FS	@3m	Margin	
dBμV/m	dBµV/m	dB	_
29.57	54.00	-24.43	
42.33	74.00	-31.67	
	FS dBµV/m 29.57	FS @3m dBμV/m dBμV/m 29.57 54.00	FS @3m Margin dBμV/m dBμV/m dB

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11 PEAK POWER SPECTRAL DENSITY

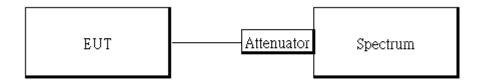
Standard Applicable:

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.

Measurement Equipment Used: 11.2

Conducted Emission Test Site						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018	
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018	
Coaxial Cable	HU- BER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018	
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018	
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018	
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017	

11.3 Test Set-up:



11.4 **Measurement Procedure:**

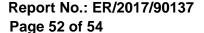
- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
- 3. Set the span to 1.5 times the DTS channel bandwidth.
- 4. Set the RBW = 3 kHz. & the VBW = 10 kHz
- 5. For defining Restricted Band Edge 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.
- Use the peak marker function to determine the maximum amplitude level.

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11.5 **Measurement Result:**

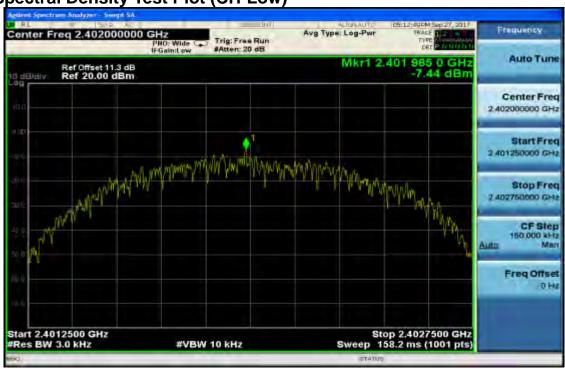
RI F mode

DEL IIIOGE			
Frequency (MHz)	RF Power Density (dBm)	Maximum Limit (dBm)	Result
2402	-7.44	8	PASS
2440	-6.89	8	PASS
2480	-6.56	8	PASS

NOTE: cable loss as 11.3dB that offsets in the spectrum

BLE mode

Power Spectral Density Test Plot (CH-Low)



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Power Spectral Density Test Plot (CH-Mid)



Power Spectral Density Test Plot (CH-High)



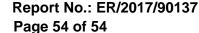
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12 ANTENNA REQUIREMENT

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

~ End of Report ~

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