ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT CLASS II PC REPORT

OF

Product Name:	**BT 4.0 Module**
Brand Name:	**Raytac**
Model No.:	**MDBT40**
Model Difference:	**N/A**
FCC ID:	**SH6MDBT40**
Report No.:	**ER/2015/10100**
Issue Date:	**Mar. 06, 2015**
FCC Rule Part:	**§15.247, Cat: DTS**
Prepared for:	**Raytac Corporation** **5F., No.3, Jiankang Road, Zhonghe District 23586, Taiwan**
Prepared by:	**SGS Taiwan Ltd.** **Electronics & Communication Laboratory** **No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803**

Testing Laboratory
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VERIFICATION OF COMPLIANCE

Applicant:	Raytac Corporation 5F., No.3, Jiankang Road, Zhonghe District 23586, Taiwan
Product Name:	BT 4.0 Module
Brand Name:	Raytac
Model No.:	MDBT40
Model Difference:	N/A
File Number:	ER/2015/10100
FCC ID:	SH6MDBT40
Date of test:	Jan. 27, 2015 ~ Feb. 26, 2015
Date of EUT Received:	Jan. 27, 2015

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 C63.4:2009 the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.

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

Test By:	Curry Chen	***Date:***	Mar. 06, 2015
	Curry Chen / Engineer		
Prepared By:	Violetta Tang	***Date:***	Mar. 06, 2015
	Violetta Tang / Clerk		
Approved By:	Jim Chang	***Date:***	Mar. 06, 2015
	Jim Chang / Asst. Manager		

Version

Version No.	Date	Description
00	Mar. 06, 2015	Initial creation of document

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1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	BT 4.0 Module
Brand Name:	Raytac
Model No.:	MDBT40
Model difference:	N/A
Hardware Version:	02
Software Version:	01
Power Supply:	3Vdc from Host
Class II Permissive change:	The major change field under this application is antenna, changed from chip antenna to printed antenna.

Bluetooth V4.0:

Frequency Range:	2.402GHz – 2.480GHz
Bluetooth Version:	V4.0 single mode (GFSK)
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	4.18dBm (Peak)
Antenna Designation:	Printed Trace Antenna, Peak Gain: -0.8dBi

This test report applies for Bluetooth V4.0 function.

1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: SH6MDBT40** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

1.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4:2009. Radiated testing was performed at an antenna to EUT distance 3 meters.

Tested in accordance with KDB558074 D01 V03r02 for compliance to FCC 47CFR 15.247 requirements

1.4 Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2009. FCC Registration Numbers are: 990257, Canada Registration Number: 4620A-4.

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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 plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 is followed to carry out the test. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna. according to the requirements in Section 8 and 13 and of ANSI C63.4:2009,.

2.4 Configuration of Tested System

Fig. 2-1 Radiated Emission Configuration

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

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 (Extender Test Board)	RAYTAC	NRF51822_M5 140714 1.0t	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.247(b) (3)	Peak Output Power	Compliant
§15.247(d)	100 KHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(d)	Spurious Emission	Compliant
§15.203	Antenna Requirement	Compliant
§1.1307(b)(1)	RF Exposure Evaluation	Compliant

Note: The major change field under this Class II Permissive change application is antenna, changed from chip antenna to printed antenna. After the evaluation of the output power test results, the other conducted tests should follow the original report data; as for the change of antenna type, the radiated test items should be done.

4 DESCRIPTION OF TEST MODES

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

Channel low (2402MHz)、mid (2442MHz) and high (2480MHz) with BT4.0 mode are chosen for full testing.

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for BT4.0 mode Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

Note: The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
Peak Output Power	+/- 1.42 dB
100 KHz Bandwidth Of Frequency Band Edges	+/- 1.55 dB
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC=+/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : **Vertical**)	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**)	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.

6 PEAK OUTPUT POWER MEASUREMENT

6.1 Standard Applicable:

According to §15.247 (b)

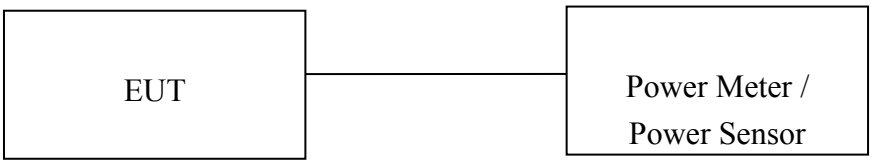
(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

6.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2495A	1005007	12/20/2014	12/19/2015
Power Sensor	Anritsu	MA2411B	917032	12/20/2014	12/19/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016
Splitter	Agilent	11636B	N/A	01/02/2015	01/01/2016

6.3 Test Set-up:



6.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (**Peak power setting on Spectrum:** Channel power function, RBW = 1MHz, VBW = 3MHz, Span: 30/60MHz, Detector =peak, Sweep = Auto.)
(**Avg. power setting on Spectrum:** Channel power function, RBW = 1MHz, VBW = 3MHz, Span: 30/60MHz, Detector =Avg., Trace avg =100, Sweep = Auto).
Power Meter is used as the auxiliary test equipment to conduct the output power measurement. 9.2.3, option 3 in KDB558074 is followed.

3. Record the max. Reading as observed from Spectrum or Power Meter.

4. Repeat above procedures until all test default channel measured was complete.

6.5 Measurement Result:

BT4.0 mode:

CH	Frequency (MHz)	Peak Power Output(dBm)	Required Limit
0	2402	4.14	1 Watt = 30 dBm
20	2442	**4.18**	1 Watt = 30 dBm
39	2480	4.13	1 Watt = 30 dBm

Note: Measured by power meter,* ***cable loss as 1dB that offsets on the power meter in Peak*

7 BAND EDGES MEASUREMENT

7.1 Standard Applicable:

According to §15.247(c), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, 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 in15.209(a).

7.2 Measurement Equipment Used:

7.2.1 Conducted Emission at antenna port:

Refer to section 6.2 for details.

7.2.2 Radiated emission:

966 Chamber					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	12/22/2014	12/21/2015
Loop Antenna	ETS.LINDGREN	6502	00148045	07/03/2014	07/02/2015
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/23/2014	12/22/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/19/2014	05/18/2015
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2014	12/24/2015
Pre-Amplifier	Agilent	8447D	2944A07676	01/02/2015	01/01/2016
Pre-Amplifier	Agilent	8449B	3008A00578	01/02/2015	01/01/2016
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/02/2015	01/01/2016
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	004	01/02/2015	01/01/2016
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/02/2015	01/01/2016
3m Site NSA	SGS	966 chamber	N/A	07/15/2014	07/14/2015

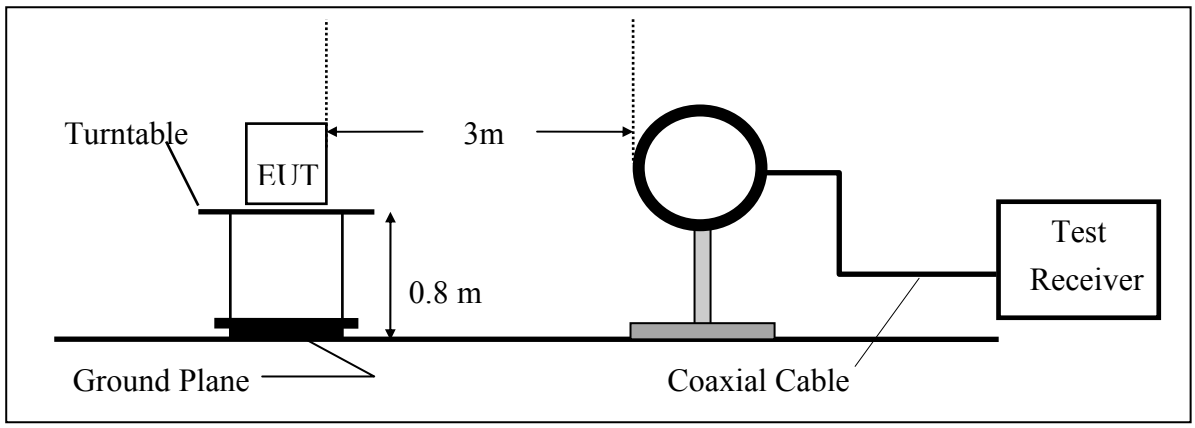
7.3 Test SET-UP:

7.3.1 Conducted Emission at antenna port:

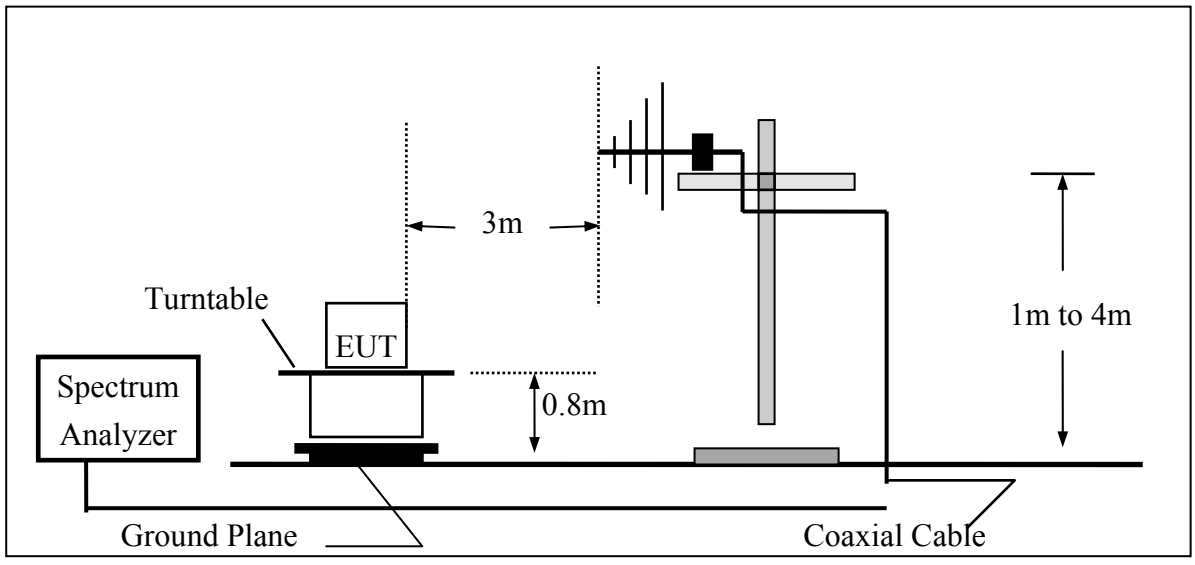
Refer to section 6.3 for details.

7.3.2 Radiated emission:

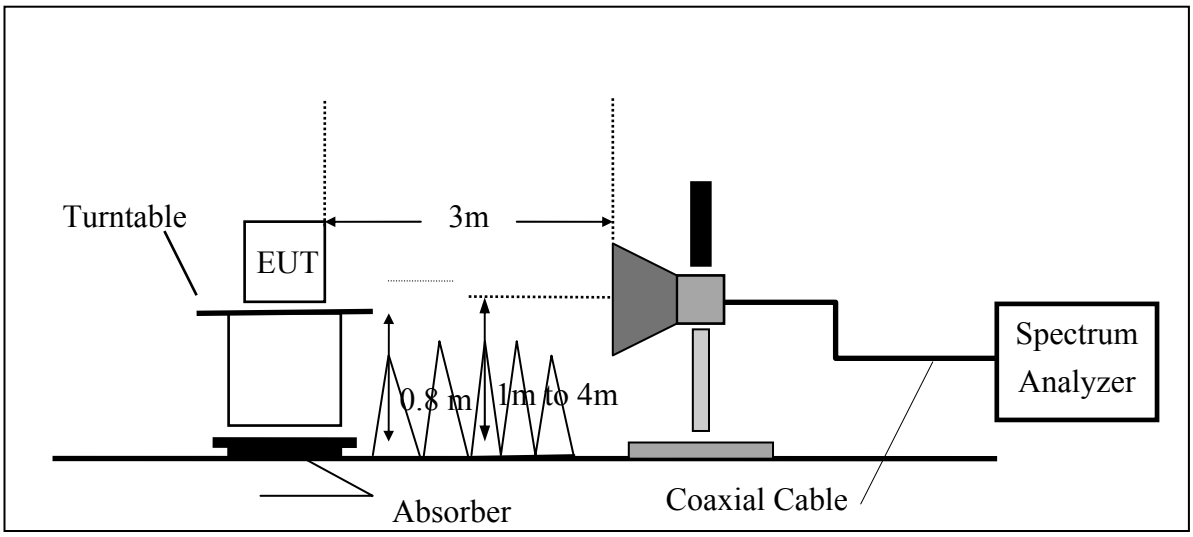
(A)Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



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



7.4 Measurement Procedure:

Unwanted Emissions into Non-Restricted Frequency Bands, Measurement Procedure followed by 11.1 of KDB558074 D01

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
4. Set the spectrum analyzer as RBW, VBW=300KHz, Detector = Peak, Sweep = auto
5. Mark the highest reading of the emission as the reference level measurement.
6. Set DL as the limit = reading on marker 1 – 20dBm
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.

Unwanted Emission falling into Restricted Frequency Bands, Measurement Procedure followed by 12.1 of KDB558074 D01:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. 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 highest emissions.
4. 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.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. On spectrum, following 8.1.2, and RBW = 1MHz, VBW = 3MHz, & Marker 2390MHz, and 2483.5MHz (Peak Measurement). Average Measurement: following 8.2 with the modification span to 1MHz, &RBW = 1MHz, VBW = 3MHz and peak marker function to obtain the highest reading on 2390, and 2483.5MHz.

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

7.5 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	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

7.6 Measurement Result:

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

Radiated Emission: BT4.0 mode

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2402 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:Band Edge LOW	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV / m	dBµV / m	dB
2350.60	S	Average	30.01	5.09	35.10	54.00	-18.90
2350.60	S	Peak	47.99	5.09	53.08	74.00	-20.92
2380.00	S	Average	30.25	5.13	35.38	54.00	-18.62
2380.00	S	Peak	49.04	5.13	54.17	74.00	-19.83
2390.00	E	Average	30.30	5.16	35.46	54.00	-18.54
2390.00	E	Peak	44.30	5.16	49.46	74.00	-24.54

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2402 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:Band Edge LOW	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV / m	dBµV / m	dB
2350.70	S	Average	30.04	5.09	35.13	54.00	-18.87
2350.70	S	Peak	54.58	5.09	59.67	74.00	-14.33
2380.30	S	Average	30.27	5.14	35.41	54.00	-18.59
2380.30	S	Peak	56.21	5.14	61.35	74.00	-12.65
2390.00	E	Average	30.30	5.16	35.46	54.00	-18.54
2390.00	E	Peak	50.45	5.16	55.61	74.00	-18.39

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + 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.
"---" : denotes Noise Floor.
The trace on RE (radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:Band Edge HIGH	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV / m	dBµV / m	dB
2483.50	E	Average	30.23	6.01	36.24	54.00	-17.76
2483.50	E	Peak	43.59	6.01	49.60	74.00	-24.40

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:Band Edge HIGH	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV / m	dBµV / m	dB
2483.50	E	Average	30.06	6.01	36.07	54.00	-17.93
2483.50	E	Peak	50.29	6.01	56.30	74.00	-17.70
2498.90	S	Average	29.87	6.22	36.09	54.00	-17.91
2498.90	S	Peak	50.85	6.22	57.07	74.00	-16.93

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + 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.
"---" : denotes Noise Floor.
The trace on RE (radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

8 SPURIOUS RADIATED EMISSION TEST

8.1 Standard Applicable

According to §15.247(d),

Emission at antenna port:

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Radiated Spurious Emission

Attenuation below the general limits specified in § 15.209(a) is not required. 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) (see § 15.205(c)).

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.

8.2 Measurement Equipment Used:

8.2.1 Conducted Emission at antenna port:

Refer to section 6.2 for details.

8.2.2 Radiated emission:

Refer to section 7.2.2 for details.

8.3 Test SET-UP:

8.3.1 Conducted Emission at antenna port:

Refer to section 6.3 for details.

8.3.2 Radiated emission:

Refer to section 7.3.2 for details.

8.4 Measurement Procedure:

Radiated Emission:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. 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 highest emissions.
4. 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.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. 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.
7. Repeat above procedures until all frequency measured were complete.

Conducted Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 300K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30 to 3G, 3G to 8G, 8G to 13G, 13G to 18G and 18G to 26.5GHz
4. Via Software, combine 5 spans of frequency range into one plot
5. Repeat above procedures until all default test channel measured were complete.

8.5 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	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

8.6 Measurement Result:

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

Radiated Spurious Emission Measurement Result (BT4.0 mode)

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2402 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + 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.
"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
31.94	S	Peak	40.25	-10.22	30.03	40.00	-9.97
58.13	S	Peak	37.28	-10.03	27.25	40.00	-12.75
99.84	S	Peak	36.78	-14.32	22.46	43.50	-21.04
326.82	S	Peak	29.71	-7.70	22.01	46.00	-23.99
556.71	S	Peak	30.89	-3.93	26.96	46.00	-19.04
922.40	S	Peak	27.74	2.50	30.24	46.00	-15.76
4804.00	H	Average	24.92	9.56	34.48	54.00	-19.52
4804.00	H	Peak	37.88	9.56	47.44	74.00	-26.56
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

Note : No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2402 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + 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.
"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
59.10	S	Peak	28.84	-10.10	18.74	40.00	-21.26
128.94	S	Peak	30.06	-10.59	19.47	43.50	-24.03
371.44	S	Peak	26.92	-6.76	20.16	46.00	-25.84
593.57	S	Peak	28.92	-1.59	27.33	46.00	-18.67
757.50	S	Peak	27.86	0.97	28.83	46.00	-17.17
954.41	S	Peak	26.52	3.49	30.01	46.00	-15.99
4804.00	H	Average	25.13	9.56	34.69	54.00	-19.31
4804.00	H	Peak	37.95	9.56	47.51	74.00	-26.49
7206.00	H	---					
9608.00	H	---					
12010.00	H	---					
14412.00	H	---					
16814.00	H	---					
19216.00	H	---					
21618.00	H	---					
24020.00	H	---					

Note : No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2442 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + 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.
"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
30.97	S	Peak	40.25	-10.24	30.01	40.00	-9.99
58.13	S	Peak	37.79	-10.03	27.76	40.00	-12.24
99.84	S	Peak	35.80	-14.32	21.48	43.50	-22.02
326.82	S	Peak	29.78	-7.70	22.08	46.00	-23.92
596.48	S	Peak	28.81	-1.73	27.08	46.00	-18.92
757.50	S	Peak	27.33	0.97	28.30	46.00	-17.70
4884.00	H	Average	24.89	9.85	34.74	54.00	-19.26
4884.00	H	Peak	37.89	9.85	47.74	74.00	-26.26
7326.00	H	---					
9768.00	H	---					
12210.00	H	---					
14652.00	H	---					
17094.00	H	---					
19536.00	H	---					
21978.00	H	---					
24420.00	H	---					

Note : No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2442 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + 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.
"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
77.53	S	Peak	32.02	-12.90	19.12	40.00	-20.88
169.68	S	Peak	28.76	-9.19	19.57	43.50	-23.93
286.08	S	Peak	27.76	-8.26	19.50	46.00	-26.50
591.63	S	Peak	28.11	-1.53	26.58	46.00	-19.42
773.02	S	Peak	27.89	0.82	28.71	46.00	-17.29
935.01	S	Peak	27.03	2.83	29.86	46.00	-16.14
4884.00	H	Average	25.13	9.85	34.98	54.00	-19.02
4884.00	H	Peak	38.08	9.85	47.93	74.00	-26.07
7326.00	H	---					
9768.00	H	---					
12210.00	H	---					
14652.00	H	---					
17094.00	H	---					
19536.00	H	---					
21978.00	H	---					
24420.00	H	---					

Note : No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + 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.
"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
31.94	S	Peak	39.67	-10.22	29.45	40.00	-10.55
50.37	S	Peak	37.39	-9.40	27.99	40.00	-12.01
99.84	S	Peak	36.19	-14.32	21.87	43.50	-21.63
157.07	S	Peak	30.50	-8.94	21.56	43.50	-21.94
654.68	S	Peak	29.28	-1.19	28.09	46.00	-17.91
948.59	S	Peak	26.78	3.23	30.01	46.00	-15.99
4960.00	H	Average	24.26	9.86	34.12	54.00	-19.88
4960.00	H	Peak	37.58	9.86	47.44	74.00	-26.56
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

Note : No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)

Operation Band	:BT 4.0	Test Date	:2015-02-13
Fundamental Frequency	:2480 MHz	Temp./Humi.	:22.1 deg_C/60 RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dBμV / m) = SPA. Reading level(dBμV) + 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.
"---" : denotes Noise Floor.

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
59.10	S	Peak	28.30	-10.10	18.20	40.00	-21.80
175.50	S	Peak	30.94	-9.95	20.99	43.50	-22.51
286.08	S	Peak	28.45	-8.26	20.19	46.00	-25.81
508.21	S	Peak	27.91	-4.48	23.43	46.00	-22.57
643.04	S	Peak	28.69	-1.68	27.01	46.00	-18.99
931.13	S	Peak	27.50	2.76	30.26	46.00	-15.74
4960.00	H	Average	24.47	9.86	34.33	54.00	-19.67
4960.00	H	Peak	36.89	9.86	46.75	74.00	-27.25
7440.00	H	---					
9920.00	H	---					
12400.00	H	---					
14880.00	H	---					
17360.00	H	---					
19840.00	H	---					
22320.00	H	---					
24800.00	H	---					

Note : No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)

9 ANTENNA REQUIREMENT

9.1 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.

9.2 Antenna Connected Construction:

The directional gains of antenna used for transmitting is -0.8dBi, and the antenna is designed with permanent attached type and no consideration of replacement. Please see EUT photo and antenna spec. for details.

10 RF EXPOSURE EVALUATION

10.1 Standard Applicable:

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in the manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Portable device with its physical nature to be used nearby, the distance between radiating structure and human is less than 20cm.

As per KDB 447498 D01 $4.3.1.1, The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm, and <= 5m (not to exceed) are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

f (GHz) is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

The operational distance is 5mm with the verification of KDB inquiry, BT 4.0 Module, that KDB941225 D07 can be referred and used to evaluate the most proper way how RF exposure concern shall be met.

10.2 Measurement Result:

BLE:

Frequency (MHz)	Output Power (dBm)	Duty Cycle	Output Power (mW)
2402.00	4.14	0.02	0.05188
2442.00	**4.18**	0.02	0.05236
2480.00	4.13	0.02	0.05176

Step 1: (<=5mm)

This is a portable device and the Max Peak Output Power is (0.052mW) lower than the threshold given and derived as formula given above, where

Mode	Frequency	Power (peak in dBm)	Power (peak mw)	Distance (mm)	Threshold (<10mm)
GFSK	2442	4.18	2.618183008	5	0.818281675

Conclusion:

As the result of calculation result indicates, the RF exposure generating from given transmitter (transmitter employed digital modulation) can be excluded from SAR measurement, (<0.3), and therefore is deemed compliant with RF exposure as per KDB 447498 D01, FCC.

~ End of Report ~