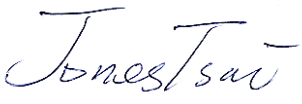
FCC RF Test Report

APPLICANT	:	**Realtek Semiconductor Corp**
EQUIPMENT	:	**802.11b/g/n RTL8723BE Combo module**
BRAND NAME	:	**Realtek**
MODEL NAME	:	**RTL8723BE**
FCC ID	:	**TX2-RTL8723BE**
STANDARD	:	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	:	**(DTS) Digital Transmission System**

This is a partial report which is included the RF output power, radiated band edges, and spurious emission measurement test items. The product was received on Jan. 01, 2015 and testing was completed on Jan. 28, 2015. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Joseph Lin / Supervisor



Approved by: Jones Tsai / Manager

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR510105C	Rev. 01	Initial issue of report	Feb. 03, 2015

SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(d)	RSS-210 A8.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.16 dB at 2390.000 MHz
3.2	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

Realtek Semiconductor Corp
No. 2, innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan.

1.2 Manufacturer

Realtek Semiconductor Corp
No. 2, innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	802.11b/g/n RTL8723BE Combo module
Brand Name	Realtek
Model Name	RTL8723BE
FCC ID	TX2-RTL8723BE
Installed into Notebook	Band Name: lenovo Model Name: TP00066B Notebook with Antenna 2
EUT supports Radios application	WLAN 11b/g/n HT20/HT40 Bluetooth v 4.0 EDR/LE
EUT Stage	Production Unit

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

Antenna Information for Host			
Antenna 1 (WNC)	Manufacturer	WNC	
	P/N	Main: DQ6G15G8100	Aux: DQ6G15G8000
	Antenna Type	Main:PIFA Antenna	Aux:PIFA Antenna
	Peak gain	Main Antenna : WLAN: 0.12 dBi	Aux Antenna : Bluetooth: -2.16dBi WLAN: -2.16 dBi
Antenna 2 (Tongda)	Manufacturer	Tongda	
	P/N	Main:DQ690210201	Aux: DQ690210200
	Antenna Type	Main:PIFA Antenna	Aux:PIFA Antenna
	Peak gain	Main Antenna : WLAN: 0.79dBi	Aux Antenna : Bluetooth: -1.57dBi WLAN: -1.57dBi

1.4 Product Specification subjective to this standard

<table>
<tr><th colspan="2">Product Specification subjective to this standard</th></tr>
<tr><td>Tx/Rx Channel Frequency Range</td><td>802.11b/g/n : 2412 MHz ~ 2462 MHz</td></tr>
<tr><td>Maximum (Peak) Output Power to antenna</td><td><Ant. Port 1>
802.11b : 18.55 dBm (0.0716 W)
802.11g : 25.22 dBm (0.3327 W)
802.11n HT20 : 24.93 dBm (0.3112 W)
802.11n HT40 : 24.35 dBm (0.2723 W)
<Ant. Port 2>
802.11b : 18.53 dBm (0.0713 W)
802.11g : 24.94 dBm (0.3119 W)
802.11n HT20 : 24.67 dBm (0.2931 W)
802.11n HT40 : 24.29 dBm (0.2685 W)</td></tr>
<tr><td>Type of Modulation</td><td>802.11b : DSSS (DBPSK / DQPSK / CCK)
802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)</td></tr>
<tr><td>Antenna Function for Transmitter</td><td><table><tr><td></td><td>Ant. Port 1</td><td>Ant. Port 2</td></tr><tr><td>802.11 b</td><td>V</td><td>V</td></tr><tr><td>802.11 g</td><td>V</td><td>V</td></tr><tr><td>802.11 n</td><td>V</td><td>V</td></tr></table></td></tr>
</table>

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

<table>
<tr><td>Test Site</td><td colspan="2">SPORTON INTERNATIONAL INC.</td></tr>
<tr><td>Test Site Location</td><td colspan="2">No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park,
Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.
TEL: +886-3-327-3456
FAX: +886-3-328-4978</td></tr>
<tr><td rowspan="2">Test Site No.</td><td colspan="2">Sporton Site No.</td></tr>
<tr><td>TH02-HY</td><td>03CH10-HY</td></tr>
</table>

Note: The test site complies with ANSI C63.4 2009 requirement.

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r02
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. FCC permits the use of the 1.5 meter table for frequency above 1GHz as an alternative in C63.10-2013 through inquiry tracking number 961829.

2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiated emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in four orthogonal panels, X, Y, Z, Notebook type. The worst cases (Notebook type plane) were recorded in this report.

The final configuration from all the combinations and the worst-case data rates were investigated by measuring the maximum power across all the data rates and modulation modes under section 2.2.

Based on the worst configuration found above, the RF power setting is set individually to meet FCC compliance limit for the final conducted and radiated tests shown in section 2.3.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Pre-Scanned RF Power

Preliminary tests were performed in different data rate and data rate associated with the highest power were chosen for full test shown in the following tables.

<Ant. Port 1>

2.4GHz 802.11b RF Output Power (dBm)			
Channel	**Ch01**	**Ch06**	**Ch11**
Frequency (MHz)	**2412**	**2437**	**2462**
Peak Power	**18.55**	18.44	18.42

2.4GHz 802.11g RF Output Power (dBm)			
Channel	**Ch01**	**Ch06**	**Ch11**
Frequency (MHz)	**2412**	**2437**	**2462**
Peak Power	23.72	**25.22**	23.92

2.4GHz 802.11n HT20 RF Output Power (dBm)			
Channel	**Ch01**	**Ch06**	**Ch11**
Frequency (MHz)	**2412**	**2437**	**2462**
Peak Power	23.32	**24.93**	23.52

2.4GHz 802.11n HT40 RF Output Power (dBm)			
Channel	**Ch03**	**CH06**	**CH09**
Frequency (MHz)	**2422**	**2437**	**2452**
Peak Power	23.46	**24.35**	23.50

<Ant. Port 2>

2.4GHz 802.11b RF Output Power (dBm)			
Channel	**Ch01**	**Ch06**	**Ch11**
Frequency (MHz)	**2412**	**2437**	**2462**
Peak Power	**18.53**	18.40	18.43

2.4GHz 802.11g RF Output Power (dBm)			
Channel	**Ch01**	**Ch06**	**Ch11**
Frequency (MHz)	**2412**	**2437**	**2462**
Peak Power	23.65	**24.94**	23.85

2.4GHz 802.11n HT20 RF Output Power (dBm)			
Channel	**Ch01**	**Ch06**	**Ch11**
Frequency (MHz)	**2412**	**2437**	**2462**
Peak Power	23.17	**24.67**	23.31

2.4GHz 802.11n HT40 RF Output Power (dBm)			
Channel	**Ch03**	**CH06**	**CH09**
Frequency (MHz)	**2422**	**2437**	**2452**
Peak Power	23.47	**24.29**	23.49

2.3 Test Mode

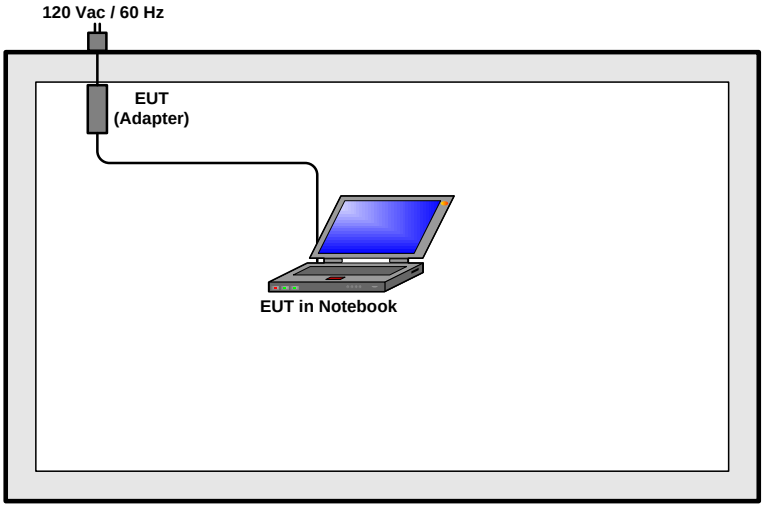
Final test mode of conducted test items and radiated spurious emissions are considering the modulation and worse data rates from the power table described in section 2.2.

Single Antenna

<2.4GHz>

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0

2.4 Connection Diagram of Test System



2.5 EUT Operation Test Setup

The programmed RF utility “MP tool” is installed in notebook to provide channel selection, power level, data rate and the application type. RF Utility can send transmitting signal for all testing. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

3 Test Result

3.1 Radiated Band Edges and Spurious Emission Measurement

3.1.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

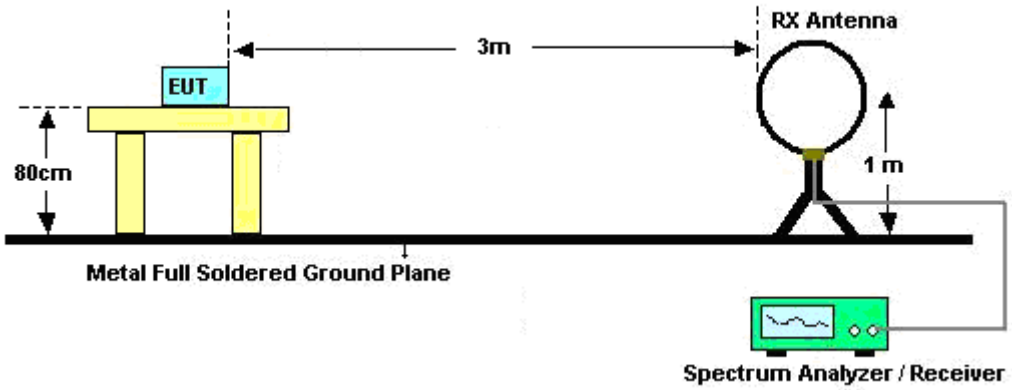
3.1.3 Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r02.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

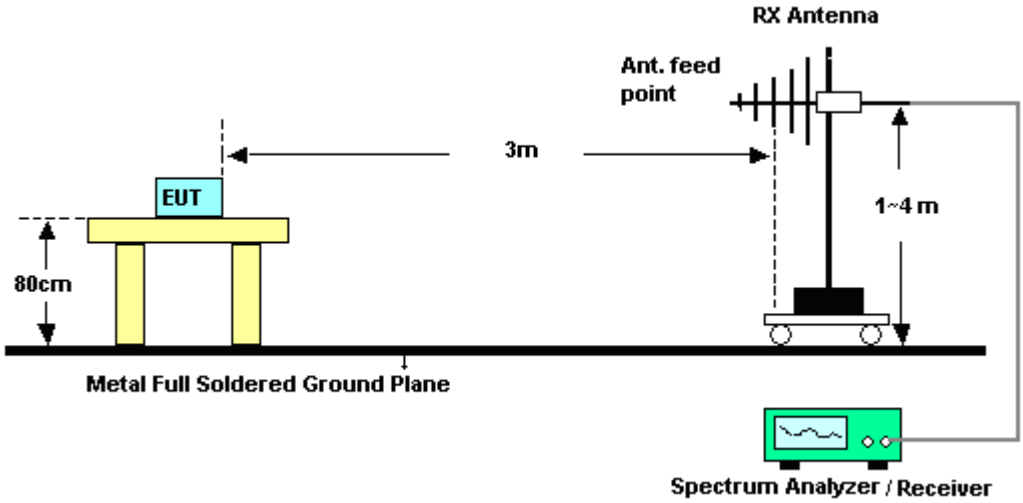
Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
1	802.11b	100	-	-	10Hz
1	802.11g	100	-	-	
1	2.4GHz 802.11n HT20	100	-	-	
1	2.4GHz 802.11n HT40	100	-	-	
2	802.11b	100	-	-	
2	802.11g	100	-	-	
2	2.4GHz 802.11n HT20	100	-	-	
2	2.4GHz 802.11n HT40	100	-	-	

3.1.4 Test Setup

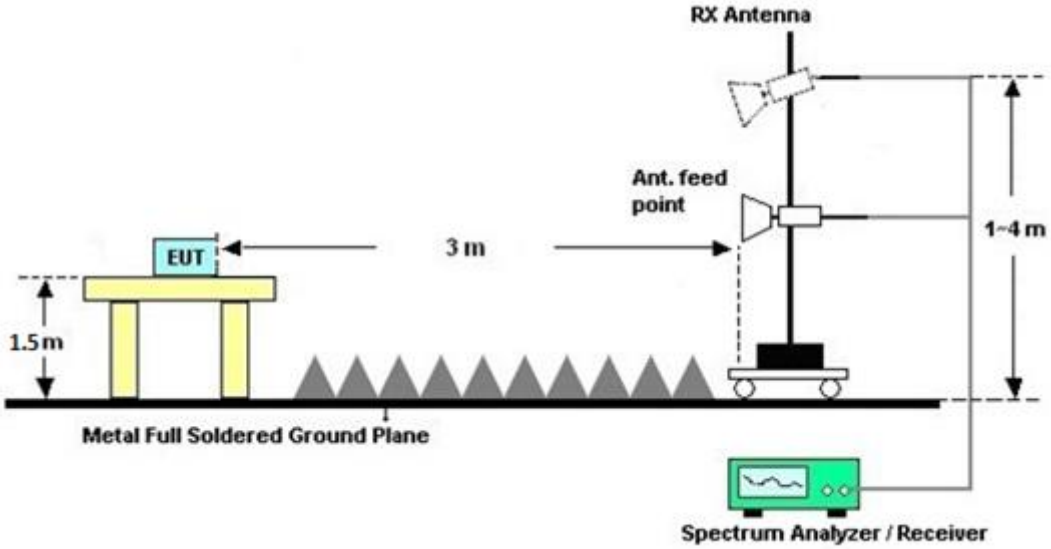
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 Test Results of Radiated Emissions (9kHz ~ 30MHz)

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

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A of this test report.

3.1.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix A of this test report.

3.2 Antenna Requirements

3.2.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.2.3 Antenna Gain

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

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Anritsu	ML2495A	1036004	300MHz~40GHz	Aug. 09, 2014	Jan. 13, 2015	Aug. 08, 2015	Conducted (TH02-HY)
Power Sensor	Anritsu	MA2411B	1027253	300MHz~40GHz	Aug. 09, 2014	Jan. 13, 2015	Aug. 08, 2015	Conducted (TH02-HY)
Loop Antenna	R&S	HFH2-Z2	100315	9 kHz~30 MHz	Jul. 28, 2014	Jan. 27, 2015~ Jan. 28, 2015	Jul. 27, 2015	Radiation (03CH10-HY)
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 03, 2014	Jan. 27, 2015~ Jan. 28, 2015	Nov. 02, 2015	Radiation (03CH10-HY)
Amplifier	SONOMA	310N	187311	0.1MHz~1000MHz	Nov. 24, 2014	Jan. 27, 2015~ Jan. 28, 2015	Nov. 23, 2015	Radiation (03CH10-HY)
Bilog Antenna	TESEQ	CBL 6111D	35413	30MHz~1GHz	Oct. 24, 2014	Jan. 27, 2015~ Jan. 28, 2015	Oct. 23, 2015	Radiation (03CH10-HY)
Preamplifier	Keysight	83017A	MY53270078	1GHz~26.5GHz	Nov. 20, 2014	Jan. 27, 2015~ Jan. 28, 2015	Nov. 19, 2015	Radiation (03CH10-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz ~ 44GHZ	Oct. 14, 2014	Jan. 27, 2015~ Jan. 28, 2015	Oct. 13, 2015	Radiation (03CH10-HY)
Double Ridged Guide Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1325	1GHz ~ 18GHz	Oct. 03, 2014	Jan. 27, 2015~ Jan. 28, 2015	Oct. 02, 2015	Radiation (03CH10-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Jan. 27, 2015~ Jan. 28, 2015	N/A	Radiation (03CH10-HY)
Turn Table	EMEC	TT 2200	N/A	0-360 degree	N/A	Jan. 27, 2015~ Jan. 28, 2015	N/A	Radiation (03CH10-HY)

5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.90**