



FCC RF Test Report

APPLICANT : Qualcomm Atheros, Inc.
EQUIPMENT : Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card
BRAND NAME : Qualcomm
MODEL NAME : QCNFA435
FCC ID : PPD-QCNFA435
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DSS) Spread Spectrum Transmitter

The product was installed into Notebook (Brand Name Lenovo, Model Name: TP00066D) during test. This is a partial report which is included the RF conducted power, conduction emission test items. The product was received on Nov. 15, 2016 and testing was completed on Dec. 13, 2016. 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



SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.

SPORTON INTERNATIONAL INC.

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : PPD-QCNFA435

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR6N1538A	Rev. 01	Initial issue of report	Jan. 25, 2017



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(b)(1)	Peak Output Power	≤ 125 mW	Pass	-
3.2	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 13.90 dB at 0.190 MHz
3.3	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Qualcomm Atheros, Inc.

1700 Technology Dr., San Jose, California, United States 95110

1.2 Manufacturer

Qualcomm Atheros, Inc.

1700 Technology Dr., San Jose, California, United States 95110

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card
Brand Name	Qualcomm
Model Name	QCNFA435
FCC ID	PPD-QCNFA435
Sample 1	EUT with Antenna 1
Sample 2	EUT with Antenna 2
Installed into Notebook	Brand Name: Lenovo Model Name: TP00066D
EUT supports Radios application	WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/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			
Antenna 1 (touch)	Manufacturer	TONGDA	
	Antenna Type	Main: PIFA Antenna	Aux: PIFA Antenna
	Part number	DQ690210902	DQ690210903
	Peak gain	Main Antenna : WLAN(2.4GHz):0.71 WLAN(5GHz):-0.04	Aux Antenna : WLAN(2.4GHz):-0.6 Bluetooth :-0.6 WLAN(5GHz):0.29
Antenna 2 (touch)	Manufacturer	WNC	
	Antenna Type	Main: PIFA Antenna	Aux: PIFA Antenna
	Part number	DQ6G15G9100	DQ6G15G9200
	Peak gain	Main Antenna : WLAN(2.4GHz):-1.26 WLAN(5GHz):1.35	Aux Antenna : WLAN(2.4GHz):-1.85 Bluetooth :-1.85 WLAN(5GHz):-1.6

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Maximum Output Power to Antenna	Bluetooth BR(1Mbps) : 5.10 dBm (0.0032 W) Bluetooth EDR (2Mbps) : 6.24 dBm (0.0042 W) Bluetooth EDR (3Mbps) : 5.48 dBm (0.0035 W)
Antenna Type / Gain	PIFA Antenna type with gain -0.60 dBi
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

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.

Test Site	SPORTON INTERNATIONAL INC.	
Test Site Location	No. 52, Hwa Ya 1 st 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	
Test Site No.	Sporton Site No.	
	TH05-HY	CO05-HY

Note: The test site complies with ANSI C63.4 2014 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
- ♦ ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Channel	Frequency	Bluetooth RF Output Power		
		Data Rate / Modulation		
		GFSK	$\pi/4$ -DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	4.45 dBm	5.57 dBm	4.91 dBm
Ch39	2441MHz	4.91 dBm	6.02 dBm	5.32 dBm
Ch78	2480MHz	5.10 dBm	6.24 dBm	5.48 dBm

Remark:

1. All the test data for each data rate were verified, but only the worst case was reported.
 2. The data rate was set in 2Mbps for all the test items due to the highest RF output power.
- a. 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: conduction (150 kHz to 30 MHz).
- b. AC power line Conducted Emission was tested under maximum output power.

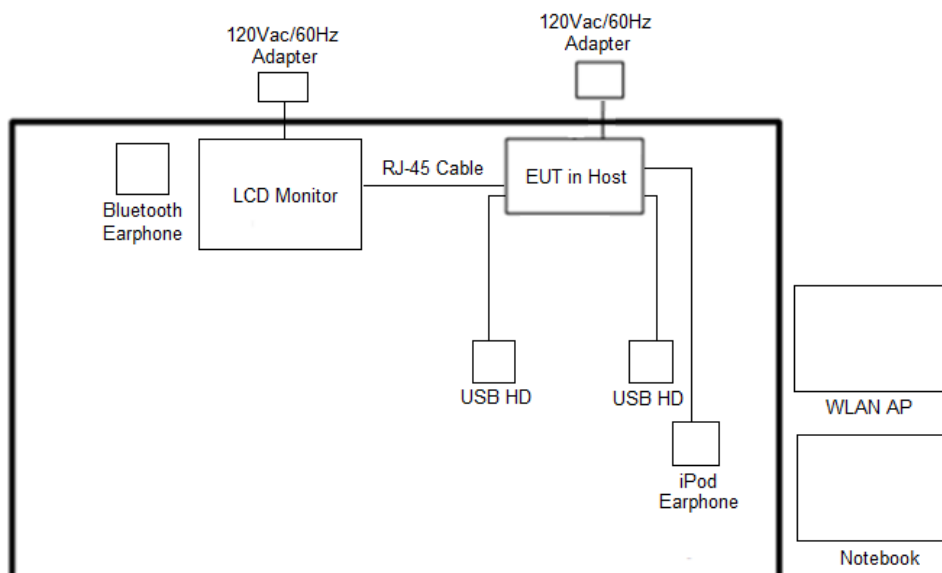
2.2 Test Mode

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases			
Test Item	Data Rate / Modulation		
	Bluetooth BR 1Mbps GFSK	Bluetooth EDR 2Mbps $\pi/4$ -DQPSK	Bluetooth EDR 3Mbps 8-DPSK
Conducted Test Cases	Mode 1: CH00_2402 MHz	Mode 4: CH00_2402 MHz	Mode 7: CH00_2402 MHz
	Mode 2: CH39_2441 MHz	Mode 5: CH39_2441 MHz	Mode 8: CH39_2441 MHz
	Mode 3: CH78_2480 MHz	Mode 6: CH78_2480 MHz	Mode 9: CH78_2480 MHz
AC Conducted Emission	Mode 1 :Bluetooth Link + WLAN (2.4GHz) Link + TC + TF		
Remark: 1. The conducted spurious emissions and conducted band edge measurement for each data rate are no worse than 2Mbps, and no other significantly frequencies found in conducted spurious emission. 2. TC stands for Test Configuration, and consists of Adapter, USB HD, SD Card, Earphone, HDMI Cable, and RJ-45 Cable. 3. TF stands for Test Configuration, and consists of MPEG4, Camera, H Pattern. 4. HDMI Cable means media application transferred between EUT and external display.			

2.3 Connection Diagram of Test System

<AC Conducted Emission Mode>



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-Link	DIR-628	KA2DIR628A2	N/A	Unshielded, 1.8 m
2.	Notebook	DELL	P20G	FCC DoC/ Contains FCC ID: QDS-BRCM1051	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
3.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	LCD Monitor	DELL	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
5.	Bluetooth Earphone	Sony Ericsson	MW600	PY7DDA-2029	N/A	N/A
6.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A
7.	USB HD	PQI	H568V	FCC DoC	Unshielded, 0.5m	N/A
8.	SD Card	SanDisk	MicroSD HC	FCC DoC	N/A	N/A

3 Test Result

3.1 Peak Output Power Measurement

3.1.1 Limit of Peak Output Power

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps, 2Mbps, 3Mbps and AFH modes are 0.125 watts.

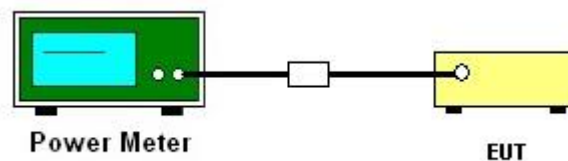
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
1. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power with cable loss and record the results in the test report.
4. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of Peak Output Power

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Aking Chang	Relative Humidity :	48~51%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	4.45	20.97	Pass
39	2441	4.91	20.97	Pass
78	2480	5.10	20.97	Pass

Note: For AFH mode using 20 hopping channels, the maximum output power limit is 20.97dBm.

Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Aking Chang	Relative Humidity :	48~51%

Channel	Frequency (MHz)	RF Power (dBm)		
		$\pi/4$ -DQPSK	Max. Limits (dBm)	Pass/Fail
		2 Mbps		
00	2402	5.57	20.97	Pass
39	2441	6.02	20.97	Pass
78	2480	6.24	20.97	Pass

Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Aking Chang	Relative Humidity :	48~51%

Channel	Frequency (MHz)	RF Power (dBm)		
		8-DPSK	Max. Limits (dBm)	Pass/Fail
		3 Mbps		
00	2402	4.91	20.97	Pass
39	2441	5.32	20.97	Pass
78	2480	5.48	20.97	Pass

3.2 AC Conducted Emission Measurement

3.2.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

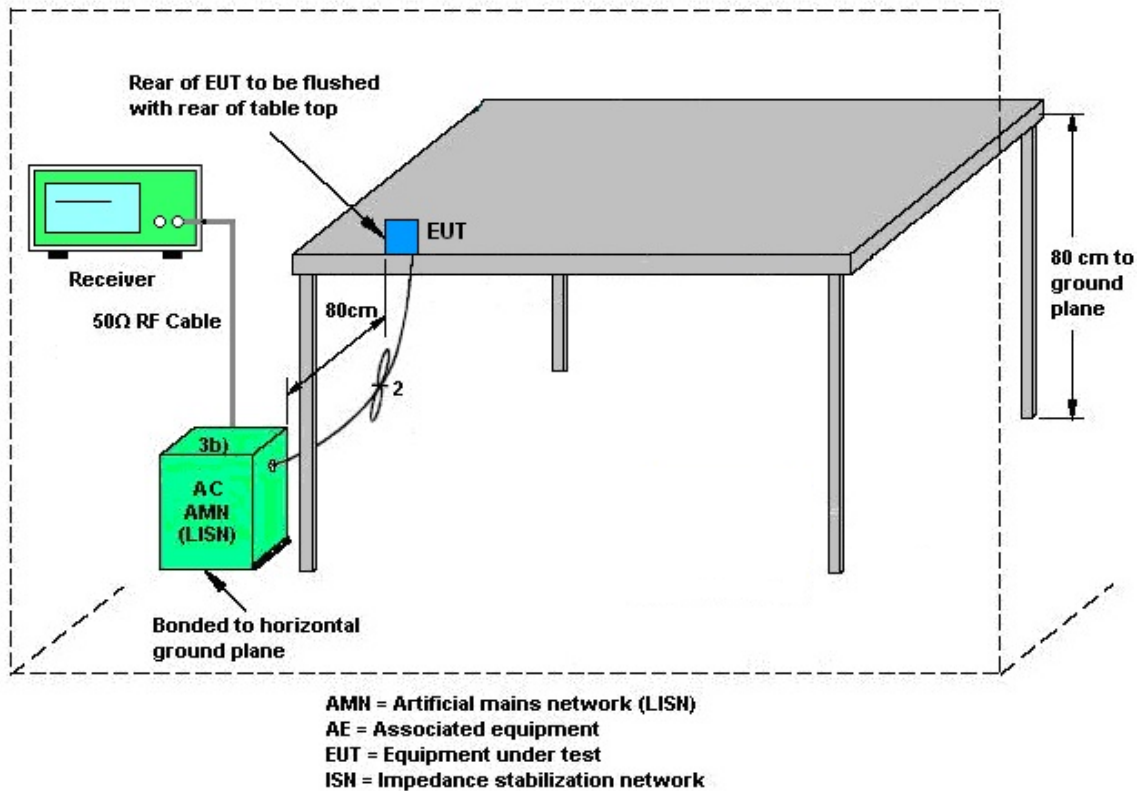
3.2.2 Measuring Instruments

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

3.2.3 Test Procedures

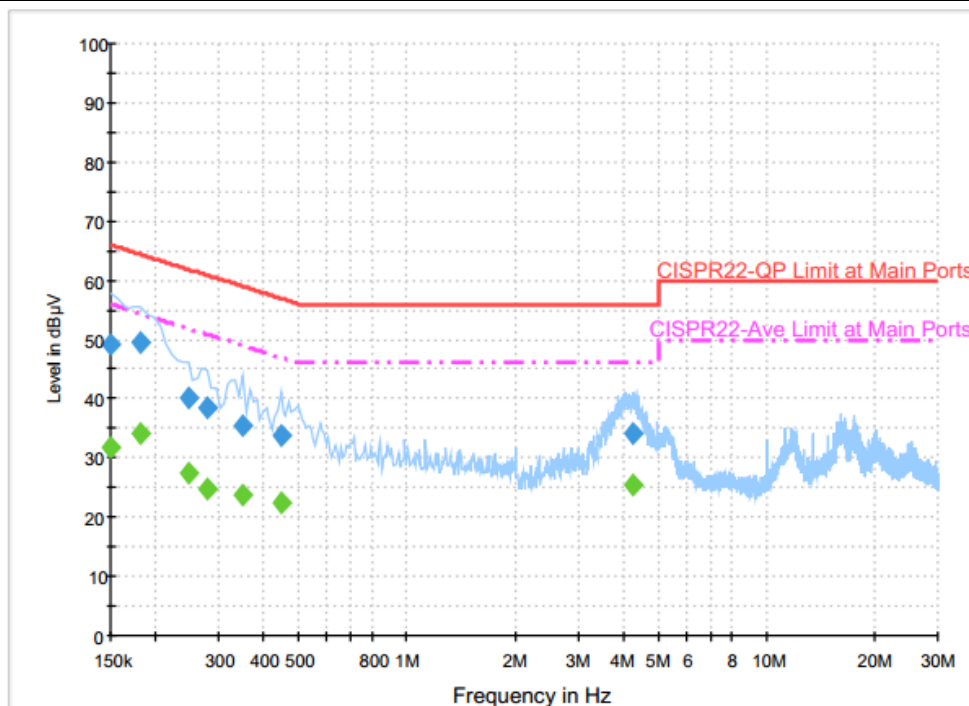
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.2.4 Test Setup



3.2.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	21~24°C
Test Engineer :	Arthur Hsieh	Relative Humidity :	51~53%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Link + WLAN (2.4GHz) Link + TC + TF		



Final Result : Quasi-Peak

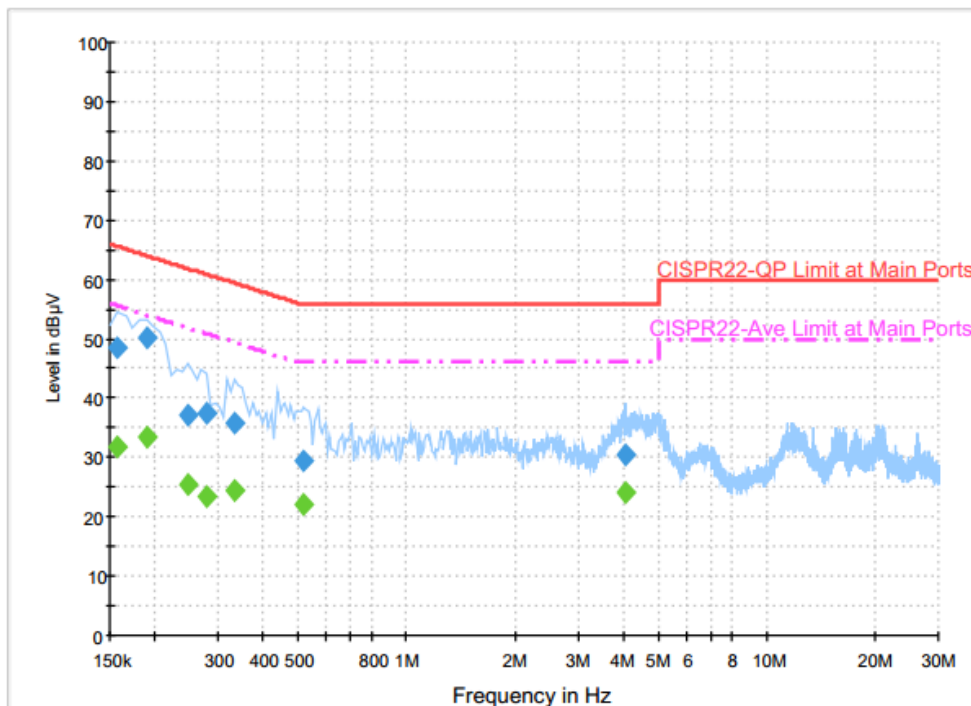
Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	49.0	Off	L1	19.6	17.0	66.0
0.182000	49.7	Off	L1	19.6	14.7	64.4
0.246000	40.3	Off	L1	19.6	21.6	61.9
0.278000	38.3	Off	L1	19.6	22.6	60.9
0.350000	35.6	Off	L1	19.6	23.4	59.0
0.446000	33.9	Off	L1	19.6	23.0	56.9
4.270000	34.2	Off	L1	19.8	21.8	56.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	31.9	Off	L1	19.6	24.1	56.0
0.182000	34.1	Off	L1	19.6	20.3	54.4
0.246000	27.4	Off	L1	19.6	24.5	51.9
0.278000	24.7	Off	L1	19.6	26.2	50.9
0.350000	23.6	Off	L1	19.6	25.4	49.0
0.446000	22.3	Off	L1	19.6	24.6	46.9
4.270000	25.6	Off	L1	19.8	20.4	46.0



Test Mode :	Mode 1	Temperature :	21~24°C
Test Engineer :	Arthur Hsieh	Relative Humidity :	51~53%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Link + WLAN (2.4GHz) Link + TC + TF		

**Final Result : Quasi-Peak**

Frequency (MHz)	Quasi-Peak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	48.5	Off	N	19.6	17.1	65.6
0.190000	50.1	Off	N	19.6	13.9	64.0
0.246000	37.3	Off	N	19.6	24.6	61.9
0.278000	37.5	Off	N	19.6	23.4	60.9
0.334000	35.8	Off	N	19.6	23.6	59.4
0.518000	29.5	Off	N	19.6	26.5	56.0
4.062000	30.4	Off	N	19.7	25.6	56.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	31.9	Off	N	19.6	23.7	55.6
0.190000	33.5	Off	N	19.6	20.5	54.0
0.246000	25.5	Off	N	19.6	26.4	51.9
0.278000	23.4	Off	N	19.6	27.5	50.9
0.334000	24.4	Off	N	19.6	25.0	49.4
0.518000	22.0	Off	N	19.6	24.0	46.0
4.062000	24.2	Off	N	19.7	21.8	46.0



3.3 Antenna Requirements

3.3.1 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. 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.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 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	Agilent	E4416A	GB412923 44	300MHz~40GHz	Jan. 08, 2016	Dec. 02, 2016	Jan. 07, 2017	Conducted (TH05-HY)
Power Sensor	Agilent	E9327A	US404415 48	300MHz~40GHz	Jan. 07, 2016	Dec. 02, 2016	Jan. 06, 2017	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz-40GHz	Jul. 17, 2016	Dec. 02, 2016	Jul. 16, 2017	Conducted (TH05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Dec. 13, 2016	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Aug. 30, 2016	Dec. 13, 2016	Aug. 29, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Nov. 29, 2016	Dec. 13, 2016	Nov. 28, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100081	9kHz~30MHz	Dec. 06, 2016	Dec. 13, 2016	Dec. 05, 2017	Conduction (CO05-HY)



5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.7
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