RF
TEST REPORT

Report No. : **170830013SZN-004**
Model No. : **NTUD-B10**
Issued Date : **22 October 2017**

Applicant: **Shenzhen Chuangwei-RGB Electronics Co., Ltd.**
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Test Method/ Standard: **FCC Part 15 Subpart E;**
KDB 789033 D02 v01r04;
KDB 662911 D01 v02r01;
ANSI C63.10-2013

Test By: **Intertek Testing Services Shenzhen Ltd. Longhua Branch**
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Summary of Tests

FCC Parts	Test	Section	Results
15.203	Antenna Requirement	1.3	Pass
15.407 a (1)/(3)	Maximum output power test	3	Pass
15.407 a (1)/(3)	Power Spectrum Density test	4	Pass
15.407 e	6dB Bandwidth	5	N/A
15.407 b, 15.205, 15.209	Radiated spurious emission test	6	Pass
15.207	AC line conducted emission test	7	Pass
15.407 g	Frequency Stability	8	Pass

1. General information

1.1 Identification of the EUT

Product:	WiFi USB DONGLE
Model No.:	NTUD-B10
Type of Device:	Slave device
Nominal Channel Bandwidth:	802.11a/n-HT20 (20 MHz), 802.11n-HT40 (40MHz), 802.11ac (20/40/80MHz)
Operating Frequency:	5150 MHz ~ 5250 MHz
Channel Number:	4 channels for 5180 MHz ~ 5240 MHz for 802.11a/n/ac-HT20; 2 channels for 5190 MHz ~ 5230 MHz for 802.11n/ac-HT40; 1 channels for 5210 MHz for 802.11ac-HT80;
Rated Power:	5.0Vdc by USB operated
Test Date(s):	30 August 2017 to 20 September 2017
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

The EUT is a WiFi USB DONGLE with 2 Antennas. 2 antennas can be used for WiFi 5GHz band and 2.4GHz band. The product can be operated on SISO mode 802.11a/n/ac mode (5.2G band). When product operates on MIMO mode (2Tx), Ant1 and Ant2 will transmit simultaneously.

For more detail features, please refer to User's description as file name “descri.pdf”.

1.3 Antenna description (15.203)

The EUT uses Integral Antenna which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

1.4 Peripherals equipment

Description	Manufacturer	Model No.
Laptop (Provided by Intertek)	Lenovo	T420
USB Cable (Provided by Chuangwei)	N/A	Unshielded, Length 13cm
Extended USB Cable (Provided by Intertek)	N/A	Unshielded, Length 80cm

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 E, Section15.203, 15.207, 15.209, 15.407 and ANSI C63.10/2013, method of measurement: KDB 789033.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band was all meet limit requirement, thus we evaluate the EUT pass the specified test.

The AC power conducted emissions was invested over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9 kHz (15.207 paragraph).

Radiated emissions were invested cover the frequency range from 9KHz to 30MHz using a receiver RBW of 9kHz, from 30 MHz to 1000 MHz using a receiver RBW of 120 kHz record QP reading, and the frequency over 1 GHz using a spectrum analyzer RBW of 1 MHz, VBW of 3MHz, Detector=Peak record for Peak reading, RBW of 1 MHz, VBW of 3MHz, Detector=RMS record for Average reading recorded on the report.

The EUT setup configurations please refer to the photo of radiated setup photos.pdf & conducted setup photos.pdf.

2.2 Operation mode

The EUT was supplied by USB port and it was run in TX mode that was controlled by client provided RF testing program.

The EUT was transmitted continuously during the test. The worst case test result was showed in the report.

With individual verifying, the maximum output power was found at 6 Mbps data rate for 802.11a mode, 6.5 Mbps data rate for 802.11n-HT20 mode, 13.5 Mbps data rate for 802.11n-HT40 mode, 29.3Mbps data rate for 802.11ac. The final tests were executed under these conditions and recorded in this report individually.

Table for Parameters of Test Software Setting
During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. 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. Maximum Output Power test (FCC 15.407)

3.1 Operating environment

Temperature:	25	℃
Relative Humidity:	50	%
Atmospheric Pressure:	1023	hPa

3.2 Test setup & procedure

The power output per FCC §15.407(a) was measured on the EUT using a 50 ohm SMA cable connected to Power Meter and the measurement method refer to 789033 D02. Power was read directly and cable loss correction (1.0dB) was added to the reading to obtain power at the EUT antenna terminals.

3.3 Limit

Operating Frequency (MHz)	Max Conducted TX Power	Max EIRP
5150~5250	*1 30dBm (1W) for master device	*2 4W (36dBm) with 6dBi antenna
	24dBm (250mW) for client device	

Remark: *1 The device declare as Slave device.

*2 1).Tx Power Reduction (dBm-by-dBi) required when antenna exceeds 6dBi.

2). For MIMO system of 802.11n/ac, total power is calculated by combining the output power of each antenna according to KDB662911.

3). 5.2 band Ant: 4.0dBi

4). In MIMO (2Tx), Ant1+Ant2 Directional gain = GANT + 10 log(N) dBi = 4.0 + 10 log(2) = 7.0 dBi> 6 dBi. So the Power limit will reduce to 23.0m (199.5mW) for conducted TX power and 35.0dBm (3162.3mW) for EIRP.

3.4 Measured data of Maximum Output Power test results

5150 MHz ~ 5250 MHz

Max Conducted TX Power

SISO Mode, Ant1

Mode	Channel	Data Rate (Mbps)	Output Power (dBm)	Limit (dBm)
802.11a	36	6	11.46	23
	40		11.53	23
	48		11.37	23
802.11n-HT20	36	6.5	9.08	23
	40		9.20	23
	48		10.12	23
802.11n-HT40	38	13.5	8.66	23
	46		8.98	23
802.11ac-HT20	36	6.5	10.02	23
	40		9.76	23
	48		9.91	23
802.11ac-HT40	38	13.5	9.01	23
	46		9.08	23
802.11ac-HT80	42	29.3	8.57	23

SISO Mode, Ant2

Mode	Channel	Data Rate (Mbps)	Output Power (dBm)	Limit (dBm)
802.11a	36	6	14.15	23
	40		14.24	23
	48		14.43	23
802.11n-HT20	36	6.5	12.65	23
	40		12.87	23
	48		12.71	23
802.11n-HT40	38	13.5	11.93	23
	46		12.14	23
802.11ac-HT20	36	6.5	12.69	23
	40		12.72	23
	48		12.71	23
802.11ac-HT40	38	13.5	12.05	23
	46		12.22	23
802.11ac-HT80	42	29.3	11.20	23

MIMO Mode, Ant1+Ant2

Mode	Channel	Data Rate (Mbps)	Output Power (dBm)			Limit (dBm)
			Ant 1	Ant 2	Total	
802.11n-HT20	36	26	8.83	11.36	13.29	23
	40		9.50	12.39	14.19	23
	48		9.65	10.61	13.17	23
802.11n-HT40	38	54	8.91	11.85	13.63	23
	46		9.06	11.20	13.27	23
802.11ac-HT20	36	26	9.75	11.52	13.73	23
	40		9.86	12.32	14.27	23
	48		9.64	12.22	14.13	23
802.11ac-HT40	38	54	8.81	11.73	13.52	23
	46		8.18	11.98	13.49	23
802.11ac-HT80	42	117.2	7.53	10.13	12.03	23

Max EIRP
SISO Mode, Ant1

Mode	Channel	Data Rate (Mbps)	Duty cycle	Output Power (dBm)	Gain (dBi)	E.I.R.P (dBm)	Limit (dBm)
802.11a	36	6	99%	11.46	4.0	15.46	35
	40			11.53	4.0	15.53	35
	48			11.37	4.0	15.37	35
802.11n-HT20	36	6.5	99%	9.08	4.0	13.08	35
	40			9.20	4.0	13.20	35
	48			10.12	4.0	14.12	35
802.11n-HT40	38	13.5	99%	8.66	4.0	12.66	35
	46			8.98	4.0	12.98	35
802.11ac-HT20	36	6.5	99%	10.02	4.0	14.02	35
	40			9.76	4.0	13.76	35
	48			9.91	4.0	13.91	35
802.11ac-HT40	38	13.5	99%	9.01	4.0	13.01	35
	46			9.08	4.0	13.08	35
802.11ac-HT80	42	29.3	99%	8.57	4.0	12.57	35

Max EIRP
SISO Mode, Ant2

Mode	Channel	Data Rate (Mbps)	Duty cycle	Output Power (dBm)	Gain (dBi)	E.I.R.P (dBm)	Limit (dBm)
802.11a	36	6	99%	14.15	4.0	18.15	35
	40			14.24	4.0	18.24	35
	48			14.43	4.0	18.43	35
802.11n-HT20	36	6.5	99%	12.65	4.0	16.65	35
	40			12.87	4.0	16.87	35
	48			12.71	4.0	16.71	35
802.11n-HT40	38	13.5	99%	11.93	4.0	15.93	35
	46			12.14	4.0	16.14	35
802.11ac-HT20	36	6.5	99%	12.69	4.0	16.69	35
	40			12.72	4.0	16.72	35
	48			12.71	4.0	16.71	35
802.11ac-HT40	38	13.5	99%	12.05	4.0	16.05	35
	46			12.22	4.0	16.22	35
802.11ac-HT80	42	29.3	99%	11.20	4.0	15.20	35

MIMO Mode, Ant1+Ant2

Mode	Channel	Data Rate (Mbps)	Duty cycle	Output Power (dBm)	Gain (dBi)	E.I.R.P (dBm)	Limit (dBm)
802.11n-HT20	36	26	99%	13.29	7.0	20.29	35
	40			14.19	7.0	21.19	35
	48			13.17	7.0	20.17	35
802.11n-HT40	38	54	99%	13.63	7.0	20.63	35
	46			13.27	7.0	20.27	35
802.11ac-HT20	36	26	99%	13.73	7.0	20.73	35
	40			14.27	7.0	21.27	35
	48			14.13	7.0	21.13	35
802.11ac-HT40	38	54	99%	13.52	7.0	20.52	35
	46			13.49	7.0	20.49	35
802.11ac-HT80	42	117.2	99%	12.03	7.0	19.03	35

4. Power Spectrum Density test (FCC 15.407)

4.1 Operating environment

Temperature:	25	℃
Relative Humidity:	50	%
Atmospheric Pressure:	1023	hPa

4.2 Test setup & procedure

Method of Measurement:

The power spectrum density per FCC §15.407(a) was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set at 1MHz/500KHz, the video bandwidth set at 3 MHz/2MHz (measurement method refer to KDB 789033 D02). Power spectrum density was read directly and cable loss (1.0 dB) reading to obtain power at the EUT antenna terminals.

For MIMO system 2Tx the antenna ports is checked, the worst case power density is calculated from the method of Measure by adding 10Log(2)/10Log(3) according KDB662911.

4.3 Limit

Operating Frequency (MHz)	Max Conducted Power Spectral Density
5150~5250	*1 17dBm/MHz for master device
	11dBm/MHz for mobile/portable client device

Remark: *1 The device declare as Slave device.

1).Tx Power Reduction (dBm-by-dBi) required when antenna exceeds 6dBi.

2). 5.2 band Ant: 4.0dBi

3). In MIMO (2Tx), Ant1+Ant2 Directional gain = GANT + 10 log(N) dBi = 4.0 + 10 log(2) = 7.0 dBi> 6 dBi. So for the band 5150~5250MHz the Power Spectral Density limit will reduce to 10.0dBm/MHz.

4). The plots are saved with filename: PSD.pdf

4.4 Measured data of Power Spectrum Density test results

5150 MHz ~ 5250 MHz

SISO Mode, Ant1

Mode	Channel	Data Rate (Mbps)	PSD (dBm/MHz)	Limit (dBm/MHz)
802.11a	36	6	8.07	10
	40		8.02	10
	48		8.10	10
802.11n-HT20	36	6.5	5.86	10
	40		6.48	10
	48		6.83	10
802.11n-HT40	38	13.5	3.56	10
	46		4.53	10
802.11ac-HT20	36	6.5	5.59	10
	40		6.60	10
	48		6.61	10
802.11ac-HT40	38	13.5	2.65	10
	46		3.45	10
802.11ac-HT80	42	29.3	-0.48	10

SISO Mode, Ant2

Mode	Channel	Data Rate (Mbps)	PSD (dBm/MHz)	Limit (dBm/MHz)
802.11a	36	6	8.04	10
	40		8.76	10
	48		8.68	10
802.11n-HT20	36	6.5	6.14	10
	40		6.11	10
	48		7.39	10
802.11n-HT40	38	13.5	4.75	10
	46		4.86	10
802.11ac-HT20	36	6.5	6.98	10
	40		6.72	10
	48		7.26	10
802.11ac-HT40	38	13.5	4.24	10
	46		4.79	10
802.11ac-HT80	42	29.3	1.94	10

MIMO Mode, Ant1+Ant2

Mode	Channe	Data Rate (Mbps)	PSD (dBm/MHz)			Limit (dBm/MHz)
			Ant 1	Ant 2	Total	
802.11n-HT20	36	26	6.31	6.65	9.49	10
	40		6.29	6.05	9.18	10
	48		5.29	5.20	8.26	10
802.11n-HT40	38	54	4.11	4.30	7.22	10
	46		3.00	3.31	6.17	10
802.11ac-HT20	36	26	5.48	6.55	9.06	10
	40		3.86	6.36	8.30	10
	48		3.54	5.35	7.55	10
802.11ac-HT40	38	54	1.25	3.64	5.62	10
	46		0.42	3.75	5.41	10
802.11ac-HT80	42	117.2	-1.58	1.29	3.10	10

5. Minimum 6 dB RF Bandwidth (FCC 15.407)

5.1 Operating environment

Temperature:	25	℃
Relative Humidity:	50	%
Atmospheric Pressure:	1001	hPa

5.2 Test setup & procedure

The Minimum 6 dB RF Bandwidth per 789033 D02 was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100KHz, and set the video bandwidth (VBW) ≥ 3 x RBW. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

For 26dB down Emission Bandwidth

The 26dB down Emission Bandwidth per 789033 D02 was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set RBW = approximately 1% of the emission bandwidth. Set the VBW > RBW, Detector = Peak, Trace mode = max hold (Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%).

For 99% Occupied Bandwidth

The 99% Occupied Bandwidth per 789033 D02 was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set center frequency to the nominal EUT channel center frequency, set span = 1.5 times to 5.0 times the OBW, set RBW = 1 % to 5 % of the OBW, set VBW ≥ 3x RBW, The 99% occupied bandwidth was determined from where the channel output spectrum intersected the display line.

5.3 Limit

Operating Frequency (MHz)	Minimum 6 dB RF Bandwidth Limit
5150~5250	N/A

Note: 99% Occupied Bandwidth within the U-NII-1 band and 26dB Emission Bandwidth for reference. The plots are saved with filename: "26dB OBW" and "99% OBW"

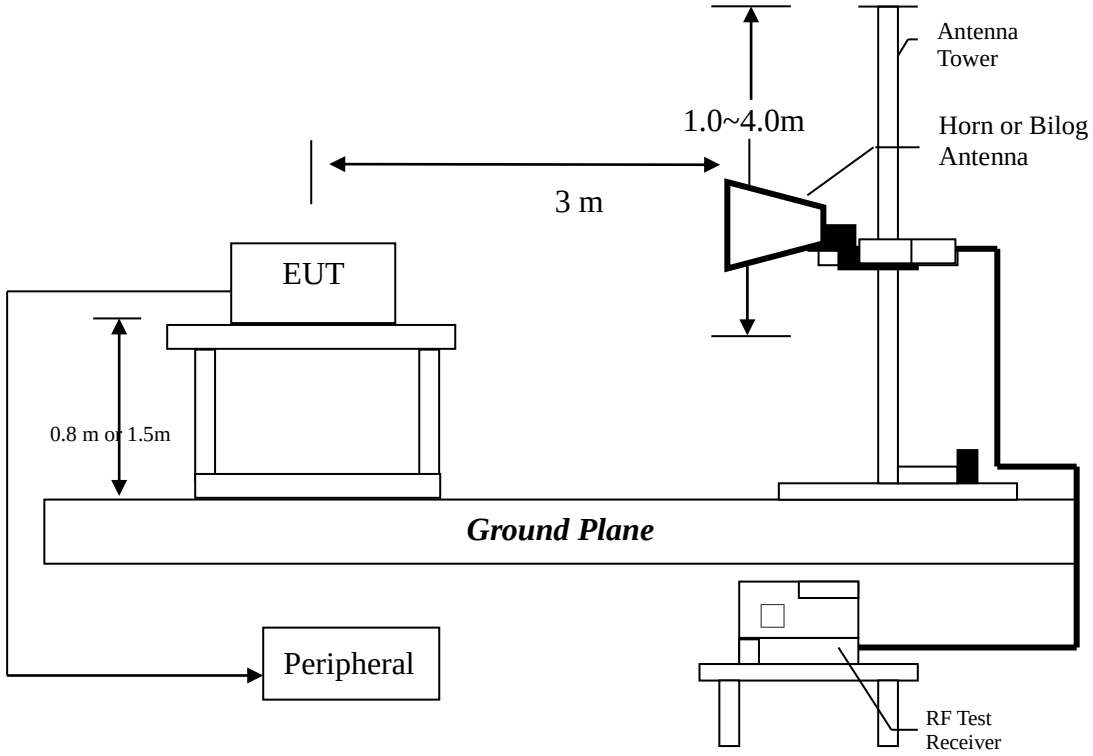
6. Radiated Emission test (FCC 15.205 & 15.209 & 15.407)

6.1 Operating environment

Temperature:	23	℃
Relative Humidity:	58	%
Atmospheric Pressure	1001	hPa

6.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



Radiated emission measurements were performed from 9KHz to tenth harmonic or 40GHz.
The EUT for testing is arranged on a styrene turntable with the height of 0.8m up to 1GHz and 1.5m above 1GHz. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

Testing settings (refer to KDB 789033 D02)
Peak Measurements below 1GHz
1, Analyzer center frequency was set to the frequency of the radiated spurious emission.
2, Span=encompass the entire emission
3, RBW=120KHz
4, Detector=Quasi-Peak
5, Trace was allowed to stabilize

Peak Measurements above 1GHz
1, Analyzer center frequency was set to the frequency of the radiated spurious emission.
2, Span=encompass the entire emission
3, RBW=1MHz
4, VBW=3MHz
4, Detector= Peak (Max-hold)
5, Trace was allowed to stabilize

Average Measurements above 1GHz
1, Analyzer center frequency was set to the frequency of the radiated spurious emission.
2, Span=encompass the entire emission
3, RBW=1MHz
4, VBW=3MHz
4, Detector= RMS (Max-hold)
5, Trace was allowed to stabilize

6.3 Limit

The spurious Emission shall test through the 10th harmonic or 40GHz (whichever is lower). 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).

Notes:
1, All emission out-side of the 5.15-5.35GHz & 5.47-5.725GHz band shall not exceed an EIRP of -27dBm/MHz (68.2dBuV/m, test distance: 3 meter), for band 5.725-5.85GHz shall not exceed an≤-17dBm/MHz (78.2dBuV/m, test distance: 3 meter) within 5715-5725MHz and 5850-5860MHz, ≤-27dBm/MHz (68.2dBuV/m, test distance: 3 meter) outside 5715-5860MHz.
2, The spectrum is measured from 9KHz to the 10^{th} harmonic of the fundamental frequency of the transmitter using QP detector below 1GHz, above 1GHz, average & peak measurements were taken using for test. The worst-case emission are reported however emission whose levels were not within 20dB of the respective limited were not reported.
3, The test was performed on EUT under 802.11a/n-HT20/40/ac-HT20/40/80 continuously transmitting mode. Simultaneous transmitting was considered during the testing. All mode had been tested, but only the worst-case is recorded in the following graph and table.

Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD

Example
Assume a receiver reading of 62.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB. The net field strength for comparison to the appropriate emission limit is 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 62.0 dBμV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB
FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 dBμV/m

Level in mV/m = Common Antilogarithm [(42 dBμV/m)/20] = 125.9 μV/m

6.4 Radiated spurious emission test data

6.4.1 Measurement results: frequencies equal to or less than 1 GHz

The worst case occurred at 802.11ac-HT20, MIMO, 2Tx, Channel 36/54Mbps

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	42.610	25.8	20.0	11.1	16.9	40.0	-23.1
Horizontal	160.465	30.0	20.0	9.2	19.2	43.5	-24.3
Horizontal	524.215	28.1	20.0	18.3	26.4	46.0	-19.6
Vertical	51.340	38.4	20.0	5.9	24.3	40.0	-15.7
Vertical	190.535	37.5	20.0	6.7	24.2	43.5	-19.3
Vertical	456.800	29.9	20.0	15.8	25.7	46.0	-20.3

6.4.2 Measurement results: frequency above 1GHz

The worst case occurred at 802.11ac-HT20, MIMO, 2Tx

Channel 36/54Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	10360.000	61.1	36.3	38.9	63.7	68.2	-4.5
Horizontal	15540.000	55.6	34.7	41.0	61.9	68.2	-6.3

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	10360.000	45.0	36.3	38.9	47.6	54.0	-6.4
Horizontal	15540.000	38.5	34.7	41.0	44.8	54.0	-9.2

Channel 40/54Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	10400.000	62.3	36.3	38.9	64.9	68.2	-3.3
Horizontal	15600.000	57.4	34.7	41.0	63.7	68.2	-4.5

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	10400.000	47.1	36.3	38.9	49.7	54.0	-4.3
Horizontal	15600.000	39.5	34.7	41.0	45.8	54.0	-8.2

Channel 48/54Mbps

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	10480.000	59.9	36.3	38.9	62.5	68.2	-5.7
Horizontal	15720.000	53.8	34.7	41.0	60.1	68.2	-8.1

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	10480.000	45.6	36.3	38.9	48.2	54.0	-5.8
Horizontal	15720.000	40.2	34.7	41.0	46.5	54.0	-7.5

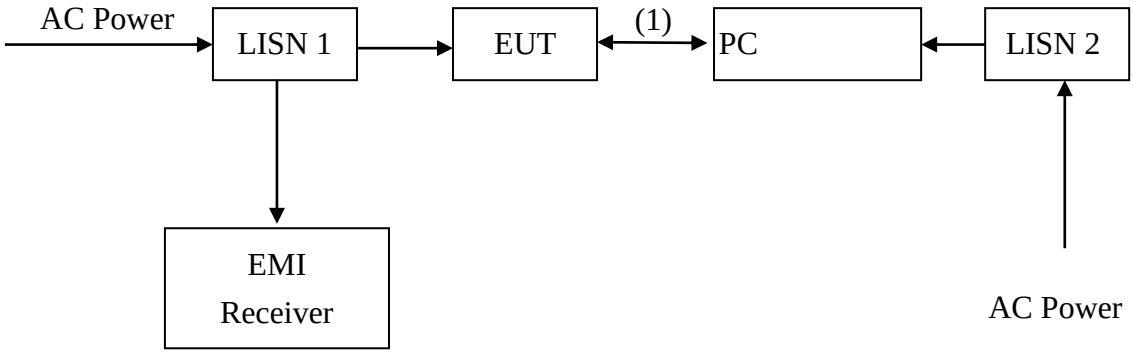
* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

7. Power Line Conducted Emission test

7.1 Operating environment

Temperature:	23	℃
Relative Humidity:	55	%
Atmospheric Pressure	1001	hPa

7.2 Test setup & procedure



The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 ohm/50 uH coupling impedance with 50 ohm termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10/2013 on conducted measurement.
The bandwidth of the field strength meter (R & S Test Receiver ESCI 30) is set at 9 kHz.

7.3 Limit

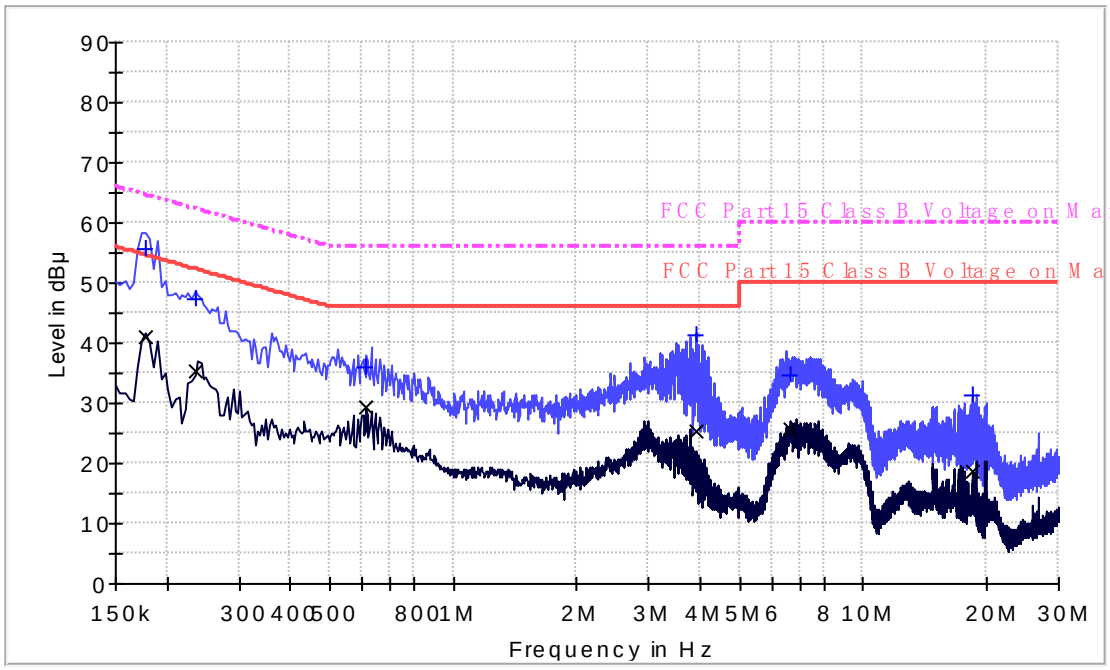
Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*
0.50~5.00	56	46
5.00~30.0	60	50

*Decreases with the logarithm of the frequency.

7.4 Power Line Conducted Emission test data

The worst case test was performed on EUT under 802.11 ac-HT20 Link

Phase: Live
Test Condition: 802.11ac-HT20, MIMO, 36/54Mpbs



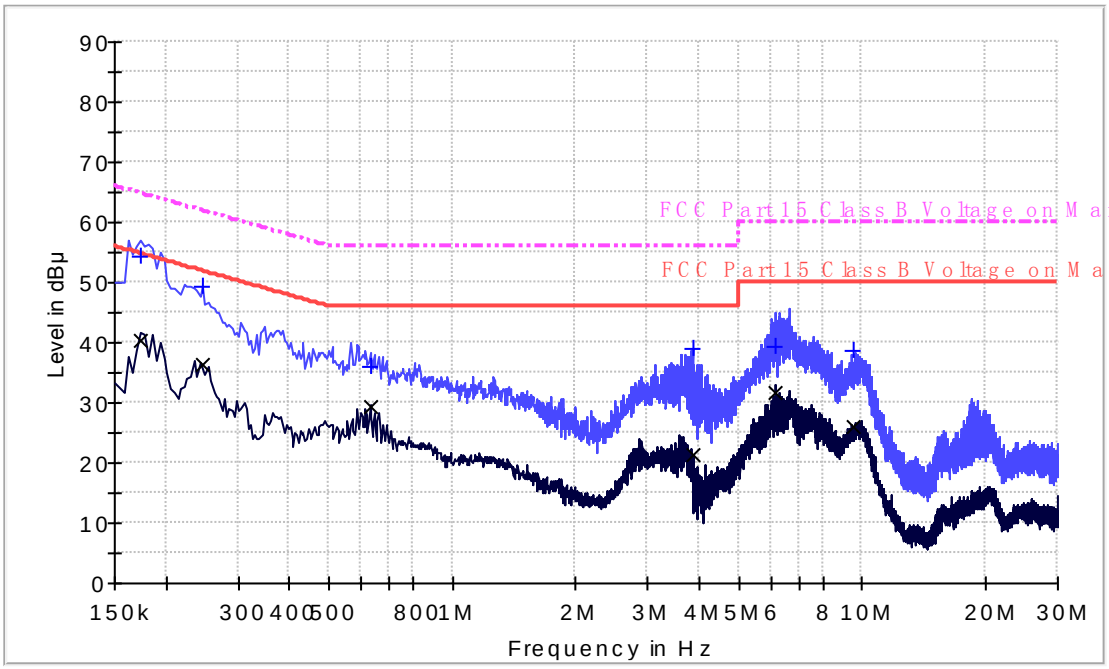
Result Table QP

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.178000	55.7	9.000	L1	9.7	8.9	64.6
0.234000	47.2	9.000	L1	9.7	15.1	62.3
0.614000	36.1	9.000	L1	9.7	19.9	56.0
3.930000	41.3	9.000	L1	9.8	14.7	56.0
6.678000	34.8	9.000	L1	9.8	25.2	60.0
18.560000	31.5	9.000	L1	10.3	28.5	60.0

Result Table AV

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.178000	41.0	9.000	L1	9.7	13.6	54.6
0.234000	35.2	9.000	L1	9.7	17.1	52.3
0.614000	29.4	9.000	L1	9.7	16.6	46.0
3.930000	25.2	9.000	L1	9.8	20.8	46.0
6.678000	25.7	9.000	L1	9.8	24.3	50.0
18.560000	18.6	9.000	L1	10.3	31.4	50.0

Phase: Neutral
Test Condition: 802.11ac-HT20, MIMO, 36/54Mpbs



Result Table QP

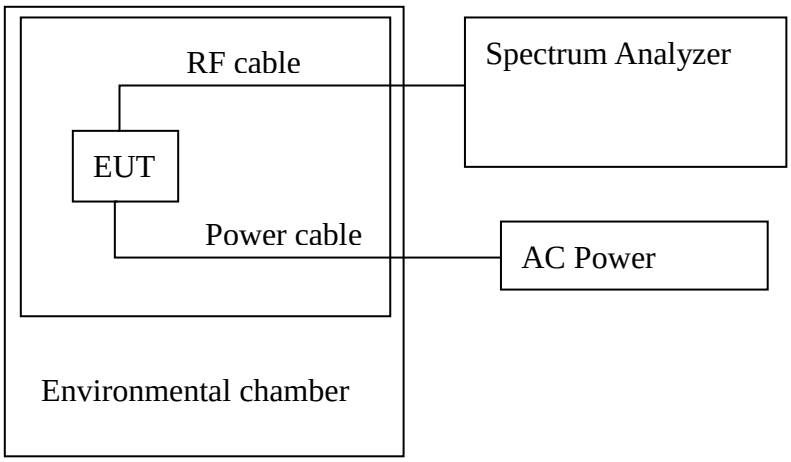
Frequency (MHz)	QuasiPeak (dB µV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µV)
0.174000	54.4	9.000	N	9.7	10.4	64.8
0.245000	49.4	9.000	N	9.7	12.5	61.9
0.630000	36.0	9.000	N	9.7	20.0	56.0
3.853000	39.0	9.000	N	9.8	17.0	56.0
6.158000	39.3	9.000	N	9.8	20.7	60.0
9.576000	38.7	9.000	N	9.9	21.3	60.0

Result Table AV

Frequency (MHz)	Average (dB µV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB µV)
0.174000	40.5	9.000	N	9.7	14.3	54.8
0.245000	36.2	9.000	N	9.7	15.7	51.9
0.630000	29.3	9.000	N	9.7	16.7	46.0
3.853000	21.5	9.000	N	9.8	24.5	46.0
6.158000	31.8	9.000	N	9.8	18.2	50.0
9.576000	26.1	9.000	N	9.9	23.9	50.0

8. Frequency Stability Test

8.1 Test setup & procedure



Note1: The frequency stability is measured with the temperature variation range of 0˚C to +60˚C (10˚C increment), and voltage supply variation range of 90% to 110% of nominal DC supply voltage.

2: To ensure emission at the band-edge is maintained within the authorized band, the frequency 802.11a/n-HT20/40/ac-HT20/40/80 channel 36, 48, 38, 46, 42, 149, 165, 151, 159, 155 are selected to test and the worst case of ant1 was reported.

8.2 Frequency Stability Test Data

20˚C is taken as temperature in normal condition.

Model: 802.11a, Operation frequency: 5180MHz, Channel: 36, Rate: 6Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5180.002170	2170	Pass
	+10	5180.000950	950	Pass
	+20	5180.001675	1675	Pass
	+30	5180.001276	1276	Pass
	+40	5180.000879	879	Pass
	+50	5180.001573	1573	Pass
	+60	5180.000791	791	Pass
4.5	+20	5180.001492	1492	Pass
5.5	+20	5180.000438	438	Pass

Model: 802.11a, Operation frequency: 5240MHz, Channel: 48, Rate: 6Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5240.000720	720	Pass
	+10	5240.000182	182	Pass
	+20	5240.000573	573	Pass
	+30	5240.000697	697	Pass
	+40	5240.000831	831	Pass
	+50	5240.000382	382	Pass
	+60	5240.000692	692	Pass
4.5	+20	5240.000294	294	Pass
5.5	+20	5240.000279	279	Pass

Model: 802.11n-HT20, Operation frequency: 5180MHz, Channel: 36, Rate: 6.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5180.000000	0	Pass
	+10	5179.999814	-186	Pass
	+20	5179.999672	-328	Pass
	+30	5179.999695	-305	Pass
	+40	5179.999437	-563	Pass
	+50	5180.001251	1251	Pass
	+60	5180.000836	836	Pass
4.5	+20	5180.000169	169	Pass
5.5	+20	5180.000273	273	Pass

Model: 802.11n-HT20, Operation frequency: 5240MHz, Channel: 48, Rate: 6.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5240.000000	0	Pass
	+10	5240.000279	279	Pass
	+20	5240.000364	364	Pass
	+30	5240.000597	597	Pass
	+40	5240.000672	672	Pass
	+50	5240.001071	1071	Pass
	+60	5240.000719	719	Pass
4.5	+20	5240.000598	598	Pass
5.5	+20	5240.000647	647	Pass

Model: 802.11n-HT40, Operation frequency: 5190MHz, Channel: 38, Rate: 13.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5190.000000	0	Pass
	+10	5189.999497	-503	Pass
	+20	5189.999375	-625	Pass
	+30	5189.999618	-382	Pass
	+40	5190.000527	527	Pass
	+50	5189.999761	-239	Pass
	+60	5189.999493	-507	Pass
4.5	+20	5190.000436	436	Pass
5.5	+20	5190.000529	529	Pass

Model: 802.11n-HT40, Operation frequency: 5230MHz, Channel: 46, Rate: 13.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5230.000000	0	Pass
	+10	5230.000579	579	Pass
	+20	5230.000687	687	Pass
	+30	5230.000364	364	Pass
	+40	5230.000521	521	Pass
	+50	5230.000812	812	Pass
	+60	5230.000375	375	Pass
4.5	+20	5230.000295	295	Pass
5.5	+20	5230.000689	689	Pass

Model: 802.11ac-HT20, Operation frequency: 5180MHz, Channel: 36, Rate: 6.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5180.000720	720	Pass
	+10	5180.000597	597	Pass
	+20	5180.000379	379	Pass
	+30	5180.000256	256	Pass
	+40	5180.000834	834	Pass
	+50	5180.000637	637	Pass
	+60	5180.000837	837	Pass
4.5	+20	5180.000641	641	Pass
5.5	+20	5180.000295	295	Pass

Model: 802.11ac-HT20, Operation frequency: 5240MHz, Channel: 48, Rate: 6.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5240.000000	0	Pass
	+10	5240.000179	179	Pass
	+20	5240.000267	267	Pass
	+30	5240.000395	395	Pass
	+40	5240.000495	495	Pass
	+50	5240.000712	712	Pass
	+60	5240.000293	293	Pass
4.5	+20	5240.000682	682	Pass
5.5	+20	5240.000641	641	Pass

Model: 802.11ac-HT40, Operation frequency: 5190MHz, Channel: 38, Rate: 13.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5190.000000	0	Pass
	+10	5189.999836	-164	Pass
	+20	5189.999472	-528	Pass
	+30	5189.999159	-841	Pass
	+40	5190.000673	673	Pass
	+50	5190.000331	331	Pass
	+60	5190.000527	527	Pass
4.5	+20	5190.000859	859	Pass
5.5	+20	5190.000622	622	Pass

Model: 802.11ac-HT40, Operation frequency: 5230MHz, Channel: 46, Rate: 13.5Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5230.000720	720	Pass
	+10	5230.000495	495	Pass
	+20	5230.000672	672	Pass
	+30	5230.000561	561	Pass
	+40	5230.000384	384	Pass
	+50	5230.000859	859	Pass
	+60	5230.000372	372	Pass
4.5	+20	5230.000695	695	Pass
5.5	+20	5230.000611	611	Pass

Model: 802.11ac-HT80, Operation frequency: 5210MHz, Channel: 42, Rate: 29.3Mbps

Input voltage (VDC)	Temperature (˚C)	Measured Frequency (MHz)	Frequency deviation (Hz)	Result
5	0	5210.000000	0	Pass
	+10	5210.000127	127	Pass
	+20	5210.000382	382	Pass
	+30	5210.000667	667	Pass
	+40	5210.000594	594	Pass
	+50	5210.000179	179	Pass
	+60	5210.000726	726	Pass
4.5	+20	5210.000189	189	Pass
5.5	+20	5210.000672	672	Pass

Note: All emissions are maintained within the band of operation under all conditions of normal operation as specified in the user manual. It fulfills the requirement of 15.407(g).

Appendix A: Test equipment list

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ182-02	RF Power Meter	Anritsu	ML2496A	1302005	1-Jun-2017	1-Jun-2018
SZ182-02-01	Pulse Power Sensor	Anritsu	MA2411B	1207429	1-Jun-2017	1-Jun-2018
SZ070-24	Open Switch and Control Unit with TS8997 option for power measurement test	R&S	OSP120+B157	--	27-Oct-2016	27-Oct-2017
SZ061-03	BiConiLog Antenna	ETS	3142C	00078828	12-Oct-2016	12-Oct-2017
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	26-May-2017	26-May-2018
SZ061-09	Horn Antenna	ETS	3115	00092346	27-Oct-2016	27-Oct-2017
SZ061-07	Pyramidal Horn Antenna	ETS	3160-09	00083067	16-Mar-2017	16-Mar-2018
SZ185-01	EMI Receiver	R&S	ESCI	100547	9-Feb-2017	9-Feb-2018
SZ056-06	EXA Spectrum Analyzer	R&S	FSV40	101101	7-Jul-2017	7-Jul-2018
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	9-Feb-2017	9-Feb-2018
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	16-Jan-2017	16-Jan-2019
SZ062-02	RF Cable	RADIALL	RG 213U	--	30-Jun-2017	30-Dec-2017
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	6-Apr-2017	6-Oct-2017
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	6-Apr-2017	6-Oct-2017
SZ067-21	Notch Filter	Micro-Tronics	High-pass filter	--	9-Feb-2017	9-Feb-2018
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	14-Jun-2017	14-Jun-2018
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	1-Nov-2016	1-Nov-2017
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	1-Nov-2016	1-Nov-2017
SZ187-02	Two-Line V-Network	R&S	ENV216	100073	12-Jul-2017	12-Jul-2018
SZ188-03	Shielding Room	ETS	RFD-100	4100	16-Jan-2017	16-Jan-2019
SZ016-12	Programmable Temperature & Humidity Chamber	Taili	MHK-120NK	AB0105	9-Mar-2017	9-Mar-2018
SZ006-11	AC Power Source	Apcpowers	AFC-11005G	F311040110	23-Mar-2017	23-Sep-2017

Expanded uncertainty of radiated emission measurement is ±4.9 dB.
Expanded uncertainty of conducted emission measurement is ±3.6 dB.