Report No.: 160406120GZU-006
Issued: 2016-05-18

TEST REPORT

Applicant Name & Address	:	Hafele America Co. 3901 Cheyenne Drive Archdale, NC 27263 United States, America
Manufacturing Name & Address		Hafele Engineering & Trading Shenzhen Ltd. 2/F, Yuyi Industrial Building, Yugang, Wanhai Rd., Shekou, Shenzhen, China
Sample Description		
Product	:	RGB Remote Control
FCC ID	:	PW3-HAFELESZOF
Model No.	:	833.74.708
Electrical Rating	:	6Vdc (2*button cell "CR2032")
Date Received	:	06 April, 2016
Date Test Conducted	:	06 April, 2016 –10 May, 2016
Test standards	:	**47 CFR PART 15 Subpart C: 2014 section 15.249**
Test Result	:	Pass
Conclusion	:	The submitted samples complied with the above rules/standards.
Remark	:	None.

**********End of Page**********

Prepared and Checked By:

Daniel.He

Daniel He
Project Engineer
Intertek Guangzhou

Approved By:

Helen Ma ***Signature***

Helen Ma
Team Leader
Intertek Guangzhou
18 May 2016 Date

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD Guangzhou, China
Tel / Fax: 86-20-8213 9688/86-20-3205 7538

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1.0 Summary of Test

TEST	TEST REQUIREMENT	TEST METHOD	RESULT
Antenna Requirement	FCC PART 15 C Section 15.203	FCC PART 15 C Section 15.203	PASS
Occupied Bandwidth	FCC PART 15 C section 15.215(c)	ANSI C63.10: Clause 6.9	PASS
Radiated Emission	FCC PART 15 C section 15.249 (a), (d)	ANSI C63.10: Clause 6.4, 6.5 & 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.249 (d)	ANSI C63.10: Clause 6.10	PASS

Remark 1:

N/A: not applicable. Refer to the relative section for the details.
EUT: In this whole report EUT means Equipment Under Test.
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radio Frequency.
ANSI C63.10: the detail version is ANSI C63.10:2013 in the whole report.

Remark 2:
Measurement uncertainty:

Test items		uncertainty
Radiated Emission	Below 1GHz	4.87dB
	Above 1GHz	4.79dB

2.0 General Description

2.1 Product Description

Operating Frequency	2436MHz
Type of Modulation:	MSK
Number of Channels	1 Channel
Channel Separation:	None
Antenna Type	PCB layout
Antenna gain:	0 dBi
Function:	Remote control 2.4GHz receiver
Power Supply:	6Vdc (2*button cell “CR2032”)

2.2 Related Submittal(s) Grants

This is an application for certification of:
Part 15 Low Power Communications Device Transmitter

2.3 Test Methodology

Radiated emission measurements was performed according to the procedures in ANSI C63.10:2013. Radiated emission measurement was performed in semi-anechoic chamber. For radiated emission measurement, preliminary scans and final tests were performed in the semi-anechoic chamber to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise.

2.4 Test Facility

All of the tests are performed at:
Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD Guangzhou, China.

Except Radiated Emission was performed at:
EST Technology Co., Ltd.
Santun (guantai Road), Houjie Town, DongGuan City, GuangDong, China.

This test facility and site measurement data have been fully placed on file with the FCC, test firm registration number is 989591.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. It was powered by 6Vdc (2*button cell "CR2032").

The signal is maximized through rotation and placement in the three orthogonal axes; the antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. The spurious emissions more than 20 dB below the permissible value are not reported.

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

3.2 EUT Exercising Software

No special exercising software

3.3 Special Accessories

No special accessories used.

3.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance – Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

3.5 Equipment Modification

Any modifications installed previous to testing by Hafele America Co.will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch.

3.6 Support Equipment List and Description

The client make a continuous transmit sample for test, in actual use will be with duty cycle (detail information can refer to page 12)

4.0 Measurement Results

4.1 Antenna Requirement:

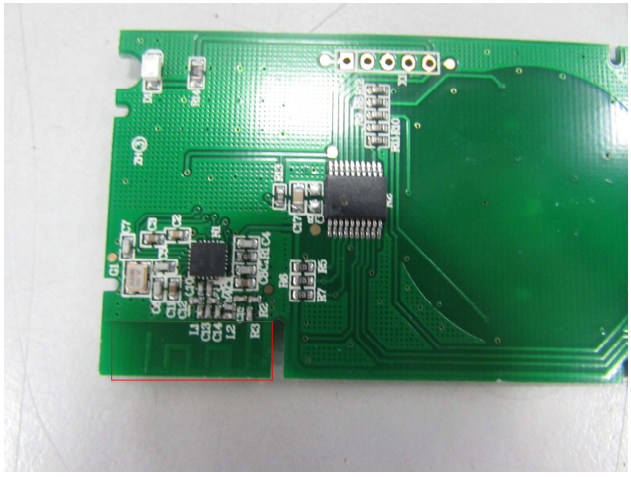
Standard requirement

15.203 requirement:

For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

EUT Antenna

The antenna is an integral antenna and no consideration of replacement. The best case gain of the antenna is 0 dBi.



4.2 Occupied Bandwidth:

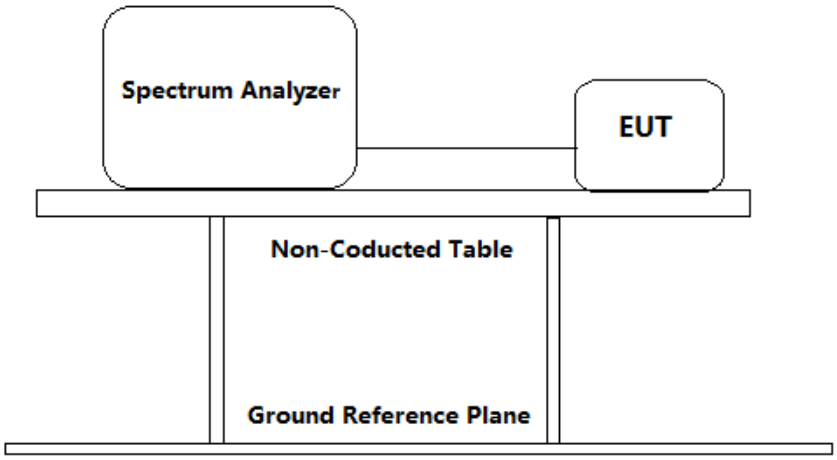
Test Requirement: FCC PART 15 C section 15.215(c)

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated

Test Method: ANSI C63.10: Clause 6.9

Test Status: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test Configuration:



Test Procedure:

The transmitter was operated at its maximum carrier power measured under normal test conditions.

a) The instrument center frequency was set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer was between 1.5 times and 5.0 times the OBW(20 dB Bandwidth).
b) The nominal IF filter bandwidth (3 dB RBW) was in the range of 1% to 5% of the OBW, and VBW was approximately three times the RBW.
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral

envelope was more than [10 log (OBW/RBW)] below the reference level.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) The dynamic range of the instrument at the selected RBW was more than 10 dB below the target "−20 dB down" requirement; that is, if the requirement calls for measuring the −20 dB OBW, the instrument noise floor at the selected RBW was at least 30 dB below the reference value.

f) Peak detection and max hold mode (until the trace stabilizes) was used.

g) Used the 20dB bandwidth function of the instrument and reported the measured bandwidth.

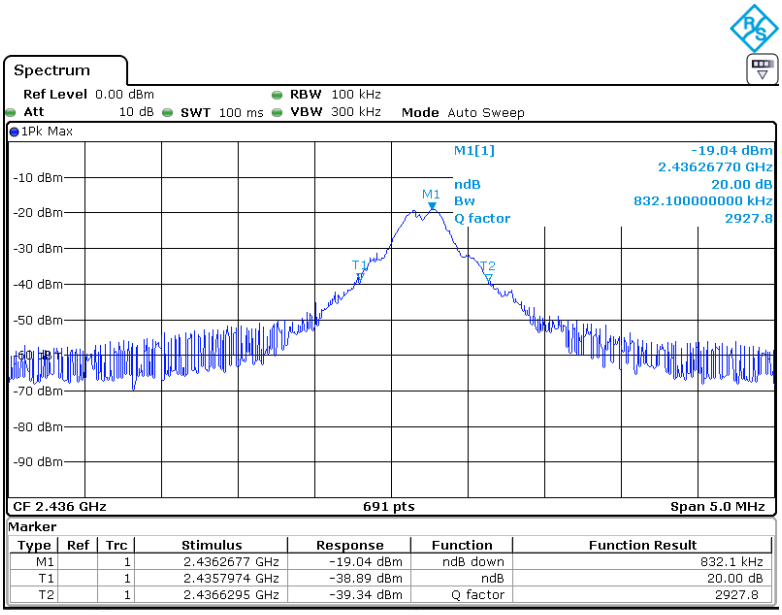
h) The occupied bandwidth was reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division was clearly labeled. Tabular data was reported in addition to the plot(s).

20 dB bandwidth:

Frequency (MHz)	Measured 20 dB bandwidth (kHz)	Limit (kHz)	Result
2436	832.1	/	Pass

20dB bandwidth:

Result plot as follows:



4.7 Radiated Emission

Test Requirement: FCC PART 15 C section 15.249 (a), (d)

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (dBμV/m @ 3m)	Field Strength of Harmonics (dBμV/m @ 3m)
902 to 928	94.0	54.0
2400 to 2483.5	94.0	54.0
5725 to 5875	94.0	54.0

Note: The limits shown in the above table are based on measurements using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using a CISPR quasi-peak detector.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in§ 15.209, whichever is the lesser attenuation.

Test Method: ANSI C63.10: Clause 6.4, 6.5 and 6.6

Test Status: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test site: Measurement Distance: 3m (Semi-Anechoic Chamber)

Limit: The field strength of radiated emission outside of the specified frequency bands, except for harmonics at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field Strength (dBμV/m @ 3m)
30-88	40.0
88-216	43.5
216-960	46.0
Above 960	54.0

Detector: For Peak and Quasi-Peak value:
200 Hz for 9 kHz to 150 kHz
9 kHz for 150 kHz to 30 MHz
120 kHz for 30 MHz to 1GHz

RBW = 1 MHz for f ≥ 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak for f ≥ 1 GHz, QP for f < 1 GHz
Trace = max hold

According 15.35(c), when the field strength (or envelope power) is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train, including blanking intervals within the pulse train, as long as the pulse train does not exceed 0.1 seconds. In cases where the pulse train exceeds 0.1 second, the average value of field strength or output power shall be determined during a 0.1 second interval during which the field strength or power is at its maximum value.

The average correction factor was computed by analyzing the on time in 100ms over one complete pulse train. Analysis of the remote transmitter on time in one complete pulse train, therefore the average value of fundamental frequency was: Average = Peak value + 20log (Duty cycle), where the duty factor is calculated from following formula:

The duration of one cycle >100ms

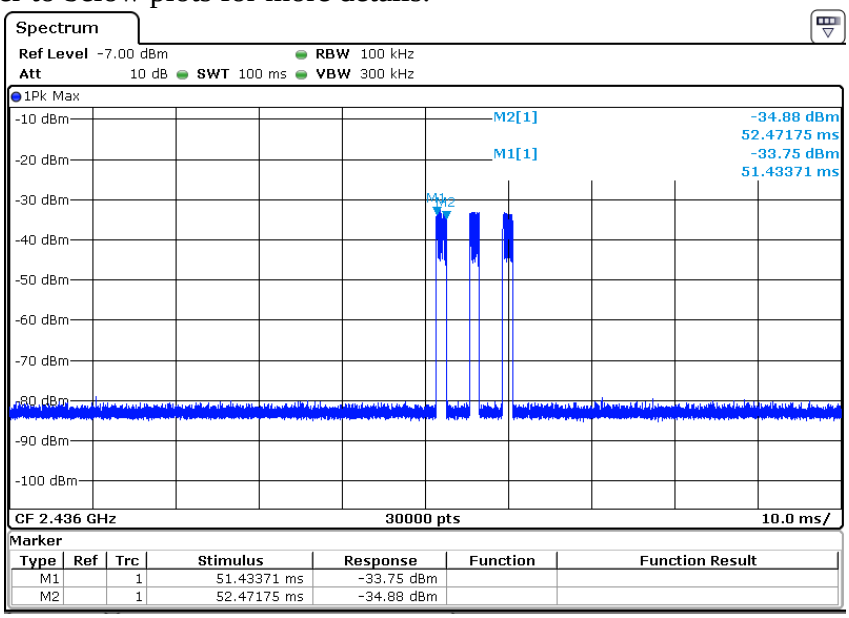
Effective period of the cycle =(1.03804x3) ms=3.11412 ms

DC =3.11412/100=0.0311412 or 3.11412%

Therefore, the averaging factor is found by 20lg0.0311412=-30.133

The duty cycle was calculated at “S1” button, it’s the worst case found.

Please refer to below plots for more details.

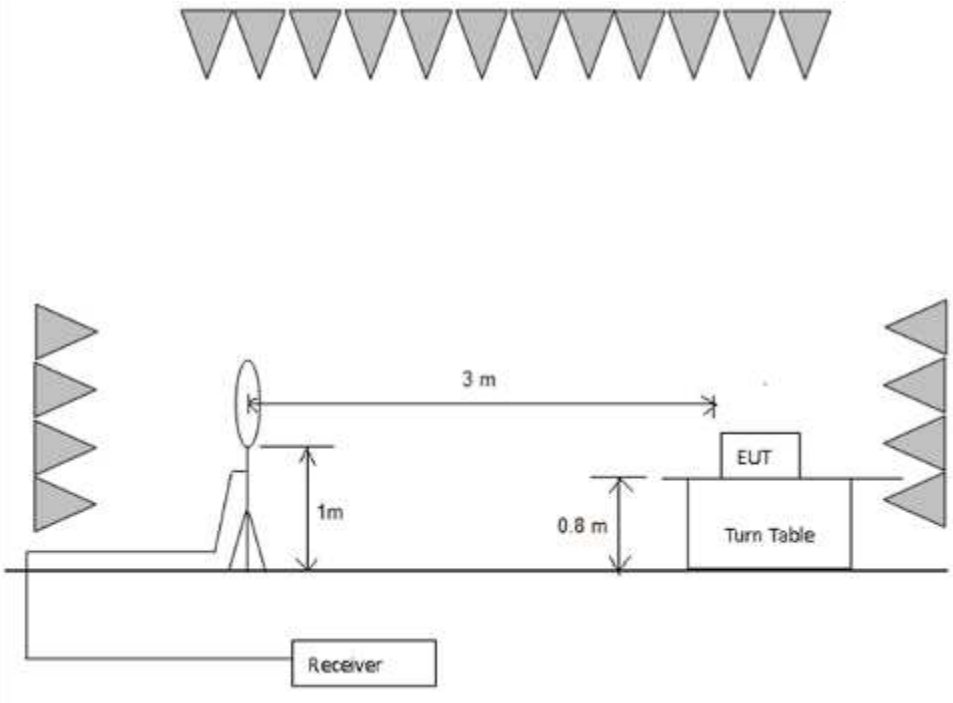


Section 15.205 Restricted bands of operation.

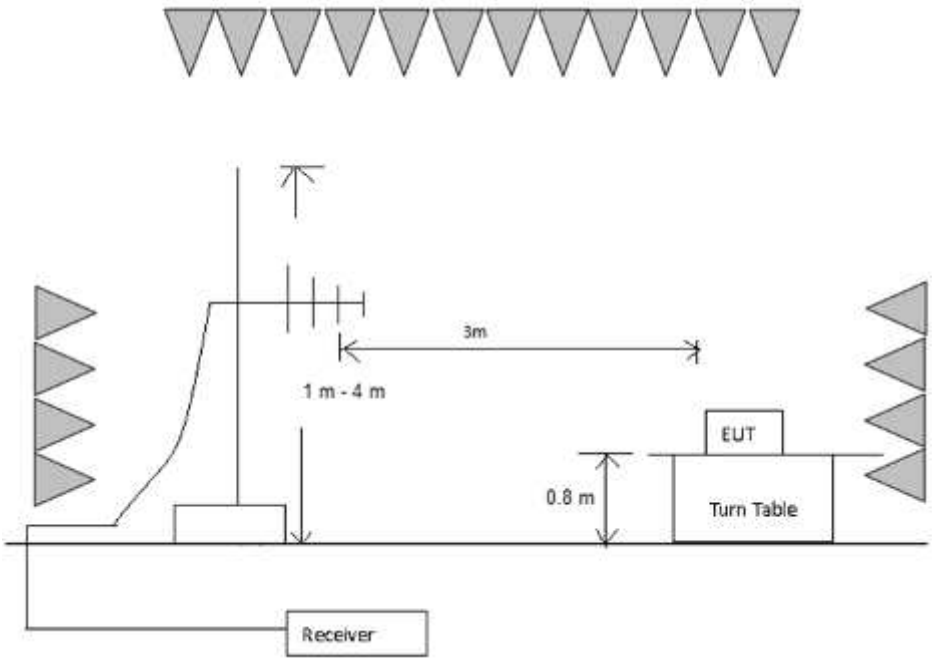
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			

Test Configuration:

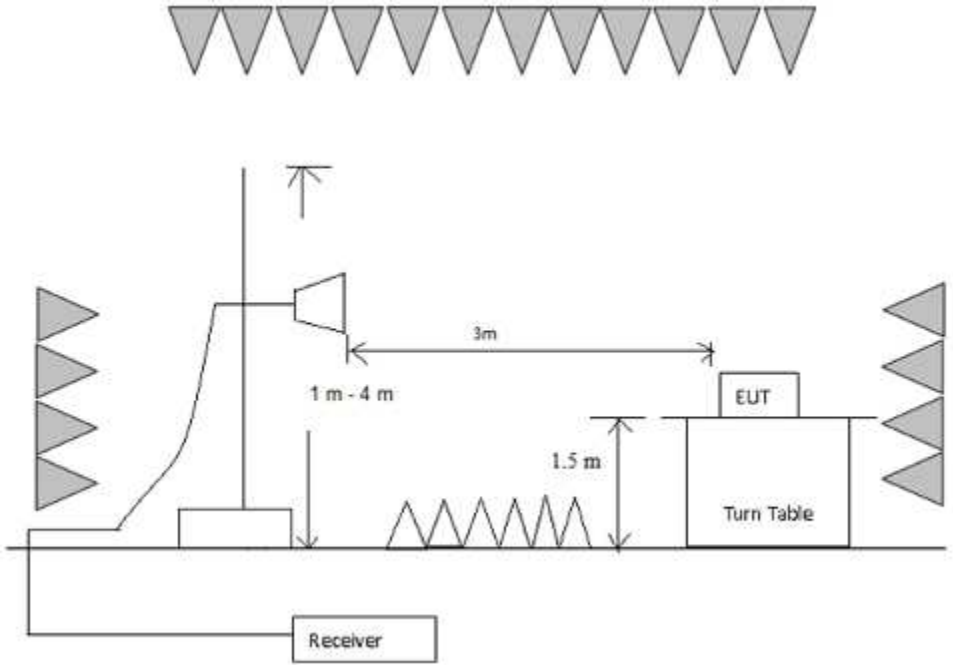
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



Test Procedure:

1) 9 kHz to 30 MHz emissions:

For testing performed with the loop antenna. The centre of the loop was positioned 1 m above the ground and positioned with its plane vertical at the special distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

2) 30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna. The measurement is performed with the EUT rotated 360º, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

3) 1 GHz to 25 GHz emissions:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2010 was used to perform radiated emission test above 1 GHz.

For testing performed with the horn antenna. The measurement is performed with the EUT rotated 360º, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

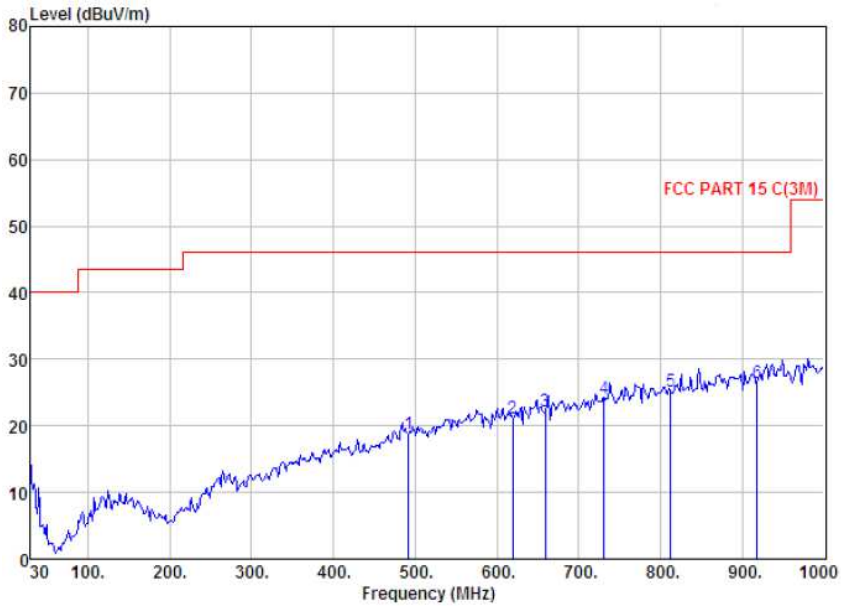
4) The receiver was scanned from 9 kHz to 25 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak

detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement
The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

Radiated Emissions (Below 1GHz)

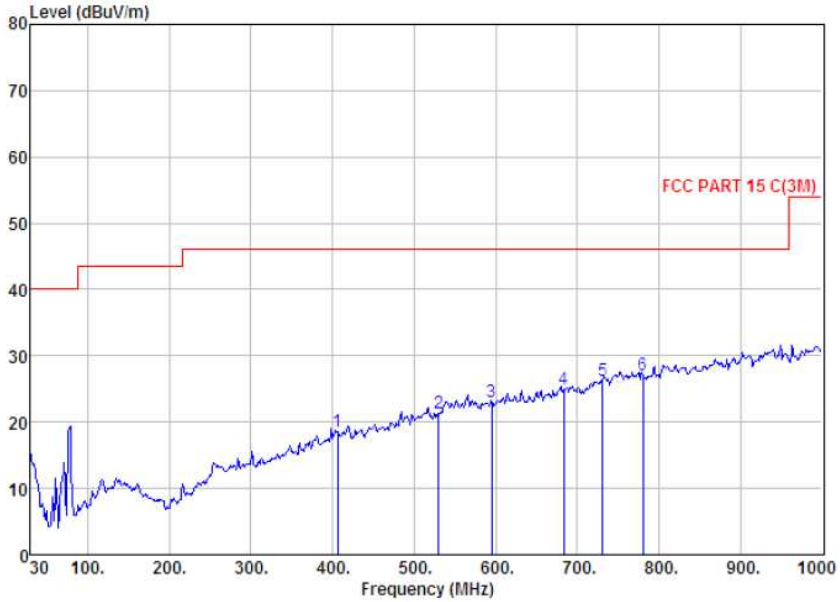
Test Curve and test data
Horizontal:



Quasi-peak measurement:

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)
1	491.72	17.82	6.69	25.23	18.88	46.00	27.12
2	619.76	20.03	7.49	24.81	21.19	46.00	24.81
3	659.53	20.06	7.68	25.08	22.13	46.00	23.87
4	731.31	22.17	7.84	25.28	24.21	46.00	21.79
5	812.79	22.37	8.45	24.49	25.15	46.00	20.85
6	918.52	23.88	9.28	23.53	26.56	46.00	19.44

Vertical:



Quasi-peak measurement:

	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)
1	406.36	16.20	6.07	27.02	18.53	46.00	27.47
2	530.52	18.34	6.92	26.90	21.34	46.00	24.66
3	595.51	19.52	7.34	27.42	23.01	46.00	22.99
4	683.78	20.32	7.96	27.39	24.88	46.00	21.12
5	731.31	22.17	7.84	27.26	26.19	46.00	19.81
6	780.78	22.00	8.47	27.11	27.08	46.00	18.92

Radiated Emissions (Above 1GHz)

1~25 GHz Harmonics & Spurious Emissions. Peak & Average Measurement

Peak Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2436.00	27.59	6.67	34.09	82.41	82.58	114.00	V
4872.00	31.37	12.07	31.90	41.28	52.82	74.00	V
7308.00	36.55	11.57	31.99	41.94	58.07	74.00	V
9744.00	38.03	11.62	31.84	41.74	59.55	74.00	V
2436.00	27.59	6.67	34.09	90.22	90.39	114.00	H
4872.00	31.37	12.07	31.90	42.29	53.83	74.00	H
7308.00	36.55	11.57	31.99	42.86	58.99	74.00	H
9744.00	38.03	11.62	31.84	41.66	59.47	74.00	H

Average Measurement:

Frequency (MHz)	Antenna factors (dB/m)	Cable loss (dB)	Preamp factor (dB)	Average Factor (dB)	Emission Level (dBμV/m)	Limit (dBμV/m)	Antenna polarization
2436.00	-	-	-	-30.13	-	94.00	V
4872.00	-	-	-	-30.13	22.69	54.00	V
7308.00	-	-	-	-30.13	27.94	54.00	V
9744.00	-	-	-	-30.13	29.42	54.00	V
2436.00	-	-	-	-30.13	-	94.00	H
4872.00	-	-	-	-30.13	23.70	54.00	H
7308.00	-	-	-	-30.13	28.86	54.00	H
9744.00	-	-	-	-30.13	29.34	54.00	H

Notes:

1. AT frequencies equal to or less than 1000MHz, quasi-peak detector was used, above 1000MHz, Peak detector was used.
2. All measurements were made at 3 meter.
3. Horn antenna is used for the emission over 1000MHz.
4. When Peak emission level was below AV limit, the AV emission level did not be recorded.
5. Emission Level (PK) =Reading Level + Antenna Factor + Cable Loss –Preamplifier Factor.
6. Average = Peak value + 20log (Duty cycle)

4.8 Band Edges Requirement

Test Requirement: FCC PART 15 C section 15.249 (d)

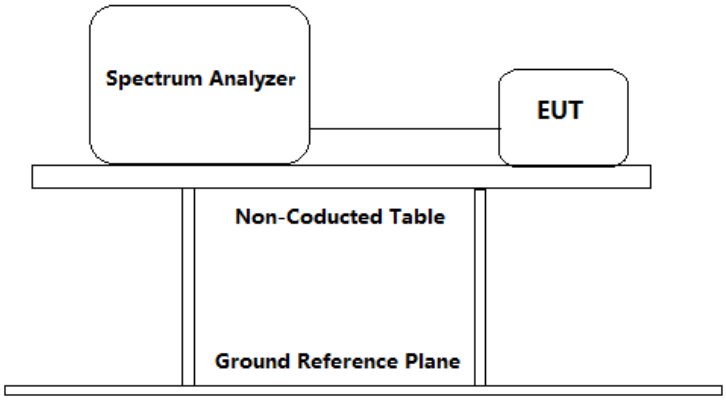
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in§ 15.209, whichever is the lesser attenuation.

Frequency Band: 2400 MHz to 2483.5 MHz

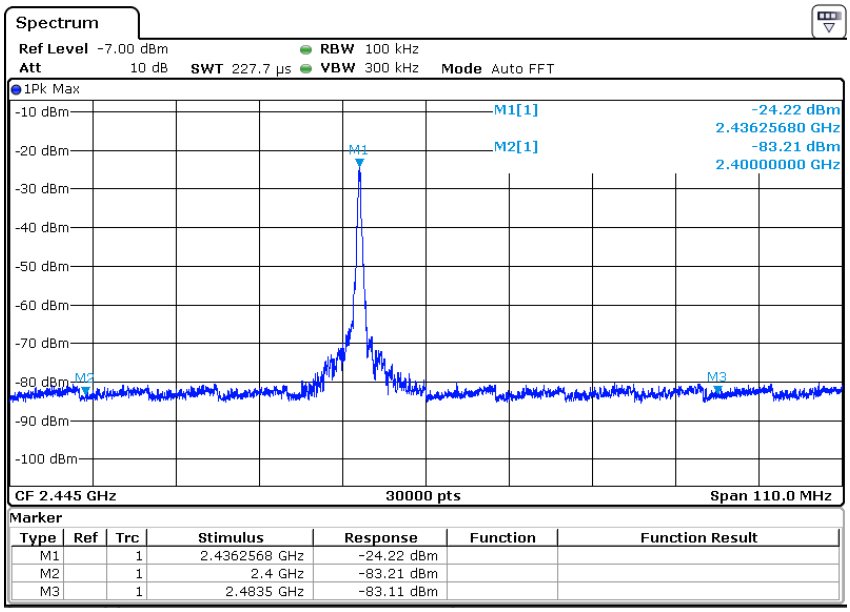
Test Method: ANSI C63.10: Clause 6.10

Test Status: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture)

Test Configuration:



Test result with plots as follows:



Peak Measurement

Band-edge compliance is determined by applying marker-delta method, i.e (Band-edge Plot).

(i) Lower band-edge:
Peak Resultant field strength
=Fundamental emissions (peak value) – delta from the band-edge plot
= 90.39dBµv/m – 58.99dB
= 31.40dBµv/m

(ii) Upper band-edge:
Peak Resultant field strength
=Fundamental emissions (peak value) – delta from the band-edge plot
= 90.39dBµv/m – 58.89dB
= 31.50dBµv/m

The Peak resultant field strength meets the general radiated emission AV limit 54dBµv/m, so it complies with the requirement.

5.0 Test Equipment List

Radiated Emission

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde & Schwarz	ESVS10	100004	June,28,15	1 Year
Spectrum Analyzer	Agilent	E4411B	MY50140697	June,28,15	1 Year
Bilog Antenna	Teseq	CBL 6111D	27090	June,28,15	1 Year
Signal Amplifier	Agilent	310N	187037	June,28,15	1 Year
Horn Antenna	SCHWARZBECK	BBHA 9120 D	BBHA9120D1002	June,28,15	1 Year
Signal Amplifier	SCHWARZBECK	BBV9718	9718-212	June,28,15	1 Year
Spectrum Analyzer	Agilent	E4408B	MY44211139	June,28,15	1 Year