FCC Test Report

Equipment	:	**Philips HUE Motion sensor**
Brand Name	:	**PHILIPS**
Model No.	:	**9290012607**
FCC ID	:	**2AGBW9290012607X**
Standard	:	**47 CFR FCC Part 15.247**
Frequency	:	**2400 MHz – 2483.5 MHz**
FCC Classification	:	**DTS**
Function	:	☒ **Point-to-multipoint;** ☐ **Point-to-point**
Applicant Manufacturer	:	**Philips Lighting(China) Investment Co., Ltd.** Building 9, Lane 888, Tianlin Road, Minhang District, Shanghai 200233 China

The product sample received on May 12, 2016 and completely tested on Jun. 21, 2016. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown 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:

Kevin Liang / Assistant Manager

Testing Laboratory
1190

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Summary of Test Result

Conformance Test Specifications					
Report Clause	**Ref. Std. Clause**	**Description**	**Measured**	**Limit**	**Result**
1.1.2	15.203	Antenna Requirement	Antenna connector mechanism complied	FCC 15.203	Complied
0	15.247(a)	DTS Bandwidth	6dB bandwidth: 1.54 MHz	≥500kHz	Complied
3.2	15.247(b)	Fundamental Emission Output Power	Power [dBm]:3.75	Power [dBm]:30	Complied
3.3	15.247(e)	Power Spectral Density	PSD [dBm/3kHz]:-8.10	PSD [dBm/3kHz]:8	Complied
3.5	15.247(d)	Test Result of Transmitter Radiated Bandedge Emissions	Non-Restricted Bands: 2399.99 MHz: 39.65 dB Restricted Bands [dBuV/m at 3m]: 2483.61MHz 49.87 (Margin 4.13 dB) - AV 58.27 (Margin 15.73 dB) - PK	Non-Restricted Bands:> 20 dBc Bands: FCC 15.209	Complied
3.6	15.247(d)	Transmitter Radiated Unwanted Emissions	Restricted Bands [dBuV/m at 3m]: 4950.00 MHz 44.36 (Margin 9.64dB) - AV 51.73 (Margin 22.27dB) - PK	Non-Restricted Bands:> 20 dBc Restricted Bands: FCC 15.209	Complied

Revision History

Report No.	Version	Description	Issued Date
FR650628	Rev. 02	Initial issue of report	Jul. 15, 2016

1 General Description

1.1 Information

1.1.1 RF General Information

Band	Mode	BWch (MHz)	Nss-Min	Nant
2.4G	Zigbee	5	1	1

Note:
- 2.4G is the 2.4GHz Band (2.4-2.4835GHz).
- Zigbee using QPSK modulation for DTS digital modulation.
- BWch is the nominal channel bandwidth.
- Nss-Min is the minimum number of spatial streams.
- Nant is the number of outputs.

1.1.2 Antenna Information

Antenna Category			
☒	Integral antenna (antenna permanently attached)		
	☒	Temporary RF connector provided	
	☐	No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.	
☐	External antenna (dedicated antennas)		
	☐	Single power level with corresponding antenna(s).	
	☐	Multiple power level and corresponding antenna(s).	
	☐	RF connector provided	
		☐	Unique antenna connector. (e.g., MMCX, U.FL, IPX, and RP-SMA, RP-N type…)
		☐	Standard antenna connector. (e.g., SMA, N, BNC, and TNC type…)

Antenna General Information			
No.	Ant. Cat.	Ant. Type	Gain (dBi)
1	Integral	chip	3.14

1.1.3 Type of EUT

Identify EUT	
EUT Serial Number	N/A
Presentation of Equipment	☐ Production ; ☒ Pre-Production ; ☐ Prototype

Type of EUT	
☒	Stand-alone
☐	Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.: …
☐	Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.: …
☐	Other:

1.1.4 Mode Test Duty Cycle

Operated Mode for Worst Duty Cycle	
☒ Operated test mode for worst duty cycle	
Test Signal Duty Cycle (x)	**Power Duty Factor [dB] – (10 log 1/x)**
☒ 100.00% - Zigbee	0.00

1.1.5 EUT Operational Condition

Supply Voltage	☐ AC mains	☒ DC	
Type of DC Source	☐ External AC adapter	☐ From Host System	☒ Battery

1.2 Testing Applied Standards

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

- 47 CFR FCC Part 15
- ANSI C63.10-2013
- FCC KDB 558074 D01 v03r05

1.3 Testing Location Information

Testing Location						
☒	HWA YA	ADD :	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan, R.O.C.			
		TEL :	886-3-327-3456	FAX :	886-3-327-0973	
Test Condition		Test Site No.	Test Engineer	Test Environment	Test Date	
RF Conducted		TH01-HY	Howard	23.5°C / 65%	14/06/2016	
Radiated		03CH09-HY	Thor	24.1°C / 67%	17/06/2016	

Test site registered number [553509] with FCC.

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty		
Test Item		**Uncertainty**
AC power-line conducted emissions		±2.3 dB
Emission bandwidth, 6dB bandwidth		±0.6 %
RF output power, conducted		±0.1 dB
Power density, conducted		±0.6 dB
Unwanted emissions, conducted	9 – 150 kHz	±0.4 dB
	0.15 – 30 MHz	±0.4 dB
	30 – 1000 MHz	±0.6 dB
	1 – 18 GHz	±0.5 dB
	18 – 40 GHz	±0.5 dB
	40 – 200 GHz	N/A
All emissions, radiated	9 – 150 kHz	±2.5 dB
	0.15 – 30 MHz	±2.3 dB
	30 – 1000 MHz	±2.6 dB
	1 – 18 GHz	±3.6 dB
	18 – 40 GHz	±3.8 dB
	40 – 200 GHz	N/A
Temperature		±0.8 °C
Humidity		±5 %
DC and low frequency voltages		±0.9%
Time		±1.4 %
Duty Cycle		±0.6 %

2 Test Configuration of EUT

2.1 Test Channel Mode

Test Software	CMD

Band	Mode	BWch (MHz)	Nss-Min	Nant	Ch. (MHz)	Range	Power Setting
2.4G	Zigbee	5	1	1	2405	L	0
2.4G	Zigbee	5	1	1	2440	M	0
2.4G	Zigbee	5	1	1	2475	H	0

2.2 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	DTS Bandwidth, Fundamental Emission Output Power, Power Spectral Density, Emissions in Non-restricted Frequency Bands
Test Condition	Conducted measurement at transmit chains

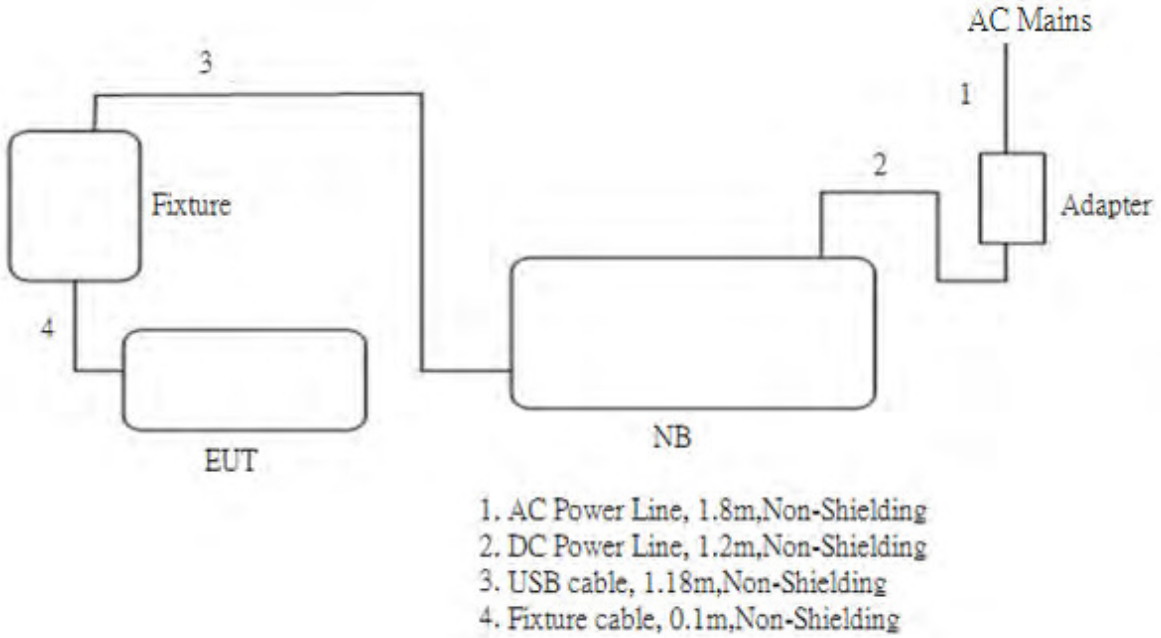
The Worst Case Mode for Following Conformance Tests			
Tests Item	Emissions in Restricted Frequency Bands		
Test Condition	Radiated measurement		
User Position	☐ EUT will be placed in fixed position.		
	☒ EUT will be placed in mobile position and operating multiple positions. EUT shall be performed three orthogonal planes.		
	☐ EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions.		
Operating Mode < 1GHz	☒ 1. Transmit Mode		
Orthogonal Planes of EUT	**X Plane**	**Y Plane**	**Z Plane**
Worst Planes of EUT		V	

2.3 Support Equipment

Support Equipment - Conducted and Radiated emission				
No.	Equipment	Brand Name	Model Name	FCC ID.
1	Notebook	DELL	E5540	DoC
2	Adapter for NB	DELL	HA65NM130	DoC
3	AC Mains	-	-	-
4	USB cable	-	-	-

2.4 Test Setup Diagram

Test Setup Diagram - Radiated Test



3 Transmitter Test Result

3.1 DTS Bandwidth

3.1.1 6dB Bandwidth Limit

6dB Bandwidth Limit
Systems using digital modulation techniques:
▪ 6 dB bandwidth ≥ 500 kHz.

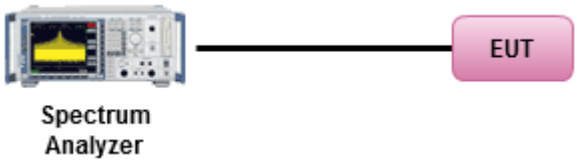
3.1.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method	
▪ For the emission bandwidth shall be measured using one of the options below:	
	☒ Refer as FCC KDB 558074, clause 8.1 Option 1 for 6 dB bandwidth measurement.
	☐ Refer as FCC KDB 558074, clause 8.2 Option 2 for 6 dB bandwidth measurement.
	☒ Refer as ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.

3.1.4 Test Setup

Emission Bandwidth


3.1.5 Test Result of Emission Bandwidth

Refer as Appendix A

3.2 Fundamental Emission Output Power

3.2.1 Fundamental Emission Output Power Limit

Maximum Peak Conducted Output Power or Maximum Conducted Output Power Limit			
▪ 2400-2483.5 MHz Band:			
	▪ If $G_{TX} \leq 6$ dBi, then $P_{Out} \leq 30$ dBm (1 W)		
	▪ Point-to-multipoint systems (P2M): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)$ dBm		
	▪ Point-to-point systems (P2P): If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3$ dBm		
	▪ Smart antenna system (SAS):		
		- Single beam: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3$ dBm	
		- Overlap beam: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3$ dBm	
		- Aggregate power on all beams: If $G_{TX} > 6$ dBi, then $P_{Out} = 30 – (G_{TX} – 6)/3 + 8$dB dBm	
e.i.r.p. Power Limit:			
▪ 2400-2483.5 MHz Band			
	▪ Point-to-multipoint systems (P2M): $P_{eirp} \leq 36$ dBm (4 W)		
	▪ Point-to-point systems (P2P): $P_{eirp} \leq MAX(36, [P_{Out} + G_{TX}])$ dBm		
	▪ Smart antenna system (SAS)		
		- Single beam: $P_{eirp} \leq MAX(36, P_{Out} + G_{TX})$ dBm	
		- Overlap beam: $P_{eirp} \leq MAX(36, P_{Out} + G_{TX})$ dBm	
		- Aggregate power on all beams: $P_{eirp} \leq MAX(36, [P_{Out} + G_{TX} + 8])$ dBm	
P_{Out} = maximum peak conducted output power or maximum conducted output power in dBm, **G_{TX}** = the maximum transmitting antenna directional gain in dBi. **P_{eirp}** = e.i.r.p. Power in dBm.			

3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method	
▪ Maximum Peak Conducted Output Power	
	☐ Refer as FCC KDB 558074, clause 9.1.1 Option 1 (RBW ≥ EBW method).
	☒ Refer as FCC KDB 558074, clause 9.1.2 Option 2 (peak power meter for VBW ≥ DTS BW)
▪ Maximum Conducted Output Power	
	[duty cycle ≥ 98% or external video / power trigger]
	☐ Refer as FCC KDB 558074, clause 9.2.2.2 Method AVGSA-1 (spectral trace averaging).
	☐ Refer as FCC KDB 558074, clause 9.2.2.3 Method AVGSA-1 Alt. (slow sweep speed)
	duty cycle < 98% and average over on/off periods with duty factor
	☐ Refer as FCC KDB 558074, clause 9.2.2.4 Method AVGSA-2 (spectral trace averaging).
	☐ Refer as FCC KDB 558074, clause 9.2.2.5 Method AVGSA-2 Alt. (slow sweep speed)
	RF power meter and average over on/off periods with duty factor or gated trigger
	☒ Refer as FCC KDB 558074, clause 9.2.3 Method AVGPM (using an RF average power meter).
▪ For conducted measurement.	
	▪ If the EUT supports multiple transmit chains using options given below: Refer as FCC KDB 662911, In-band power measurements. Using the measure-and-sum approach, measured all transmit ports individually. Sum the power (in linear power units e.g., mW) of all ports for each individual sample and save them.
	▪ If multiple transmit chains, EIRP calculation could be following as methods: $P_{total} = P_1 + P_2 + \ldots + P_n$ (calculated in linear unit [mW] and transfer to log unit [dBm]) $EIRP_{total} = P_{total} + DG$

3.2.4 Test Setup

RF Output Power (Power Meter)

3.2.5 Test Result of Maximum Peak Conducted Output Power

Refer as Appendix B

3.2.6 Test Result of Maximum Average Conducted Output Power

Refer as Appendix B

3.3 Power Spectral Density

3.3.1 Power Spectral Density Limit

Power Spectral Density Limit
▪ Power Spectral Density (PSD) ≤ 8 dBm/3kHz

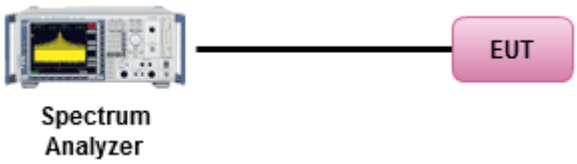
3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method			
▪ Peak power spectral density procedures that the same method as used to determine the conducted output power. If maximum peak conducted output power was measured to demonstrate compliance to the output power limit, then the peak PSD procedure below (Method PKPSD) shall be used. If maximum conducted output power was measured to demonstrate compliance to the output power limit, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option).			
	☒ Refer as FCC KDB 558074, clause 10.2 Method PKPSD (RBW=3-100kHz; Detector=peak).		
	[duty cycle ≥ 98% or external video / power trigger]		
	☐ Refer as FCC KDB 558074, clause 10.3 Method AVGPSD-1 (spectral trace averaging).		
	☐ Refer as FCC KDB 558074, clause 10.4 Method AVGPSD-2 (slow sweep speed)		
	duty cycle < 98% and average over on/off periods with duty factor		
	☐ Refer as FCC KDB 558074, clause 10.5 Method AVGPSD-1 Alt (spectral trace averaging).		
	☐ Refer as FCC KDB 558074, clause 10.6 Method AVGPSD-2 Alt. (slow sweep speed)		
▪ For conducted measurement.			
	▪ If The EUT supports multiple transmit chains using options given below:		
		☐ Option 1: Measure and sum the spectra across the outputs. Refer as FCC KDB 662911, In-band power spectral density (PSD). Sample all transmit ports simultaneously using a spectrum analyzer for each transmit port. Where the trace bin-by-bin of each transmit port summing can be performed. (i.e., in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 and that from the first spectral bin of output 3, and so on up to the N_{TX} output to obtain the value for the first frequency bin of the summed spectrum.). Add up the amplitude (power) values for the different transmit chains and use this as the new data trace.	
		☐ Option 2: Measure and sum spectral maxima across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs. These operations shall be performed separately over frequency spans that have different out-of-band or spurious emission limits,	
		☐ Option 3: Measure and add 10 log(N) dB, where N is the number of transmit chains. Refer as FCC KDB 662911, In-band power spectral density (PSD). Performed at each transmit chains and each transmit chains shall be compared with the limit have been reduced with 10 log(N). Or each transmit chains shall be add 10 log(N) to compared with the limit.	

3.3.4 Test Setup

Power Spectral Density


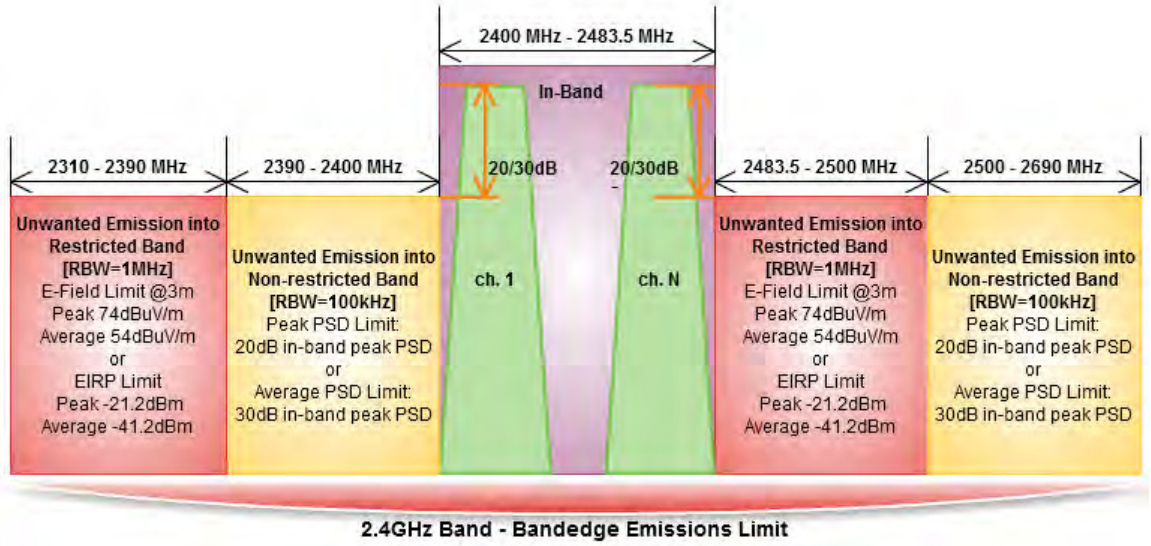
3.3.5 Test Result of Power Spectral Density

Refer as Appendix C

3.4 Transmitter Radiated Bandedge Emissions

3.4.1 Transmitter Radiated Bandedge Emissions Limit

Transmitter Radiated Bandedge Emissions Limit



3.4.2 Measuring Instruments

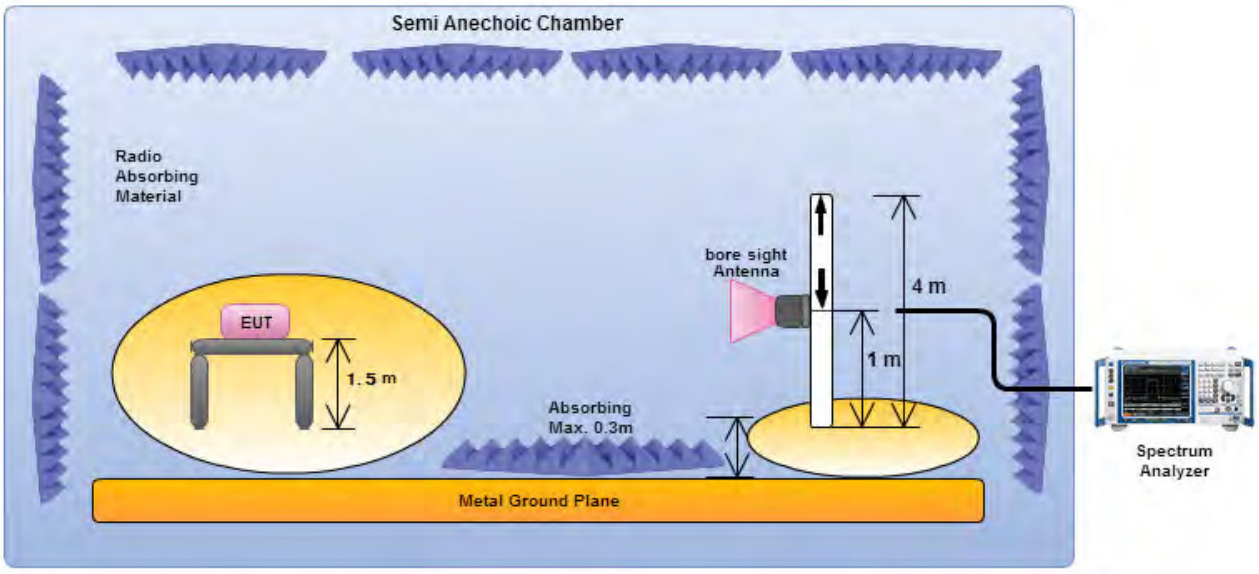
Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method			
☒	The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].		
☒	Refer as ANSI C63.10, clause 6.10 bandedge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.		
☒	For the transmitter unwanted emissions shall be measured using following options below:		
	☒	Refer as FCC KDB 558074, clause 11 for unwanted emissions into non-restricted bands.	
	☒	Refer as FCC KDB 558074, clause 12 for unwanted emissions into restricted bands.	
		☐	Refer as FCC KDB 558074, clause 12.2.5.1 Option 1 (trace averaging for duty cycle ≥98%)
		☐	Refer as FCC KDB 558074, clause 12.2.5.2 Option 2 (trace averaging + duty factor).
		☒	Refer as FCC KDB 558074, clause 12.2.5.3 Option 3 (Reduced VBW≥1/T).
		☐	Refer as ANSI C63.10, clause 4.1.4.2.3 (Reduced VBW). VBW ≥ 1/T, where T is pulse time.
		☐	Refer as ANSI C63.10, clause 4.1.4.2.4 average value of pulsed emissions.
		☒	Refer as FCC KDB 558074, clause 11.3 and 12.2.4 measurement procedure peak limit.
☒	For the transmitter bandedge emissions shall be measured using following options below:		
	☐	Refer as FCC KDB 558074, clause 13.3 for narrower resolution bandwidth (100kHz) using the band power and summing the spectral levels (i.e., 1 MHz).	
	☒	Refer as ANSI C63.10, clause 6.10 for band-edge testing.	
	☐	Refer as ANSI C63.10, clause 6.10.6.2 for marker-delta method for band-edge measurements.	
☒	For radiated measurement, refer as FCC KDB 558074, clause 12.2.7 and ANSI C63.10, clause 6.6. Test distance is 3m.		

3.4.4 Test Setup

Transmitter Radiated Bandedge Emissions



Electric field tests shall be performed in transmitter bandedge emissions using a calibrated horn antenna.

3.4.5 Test Result of Emissions in Non-restricted Frequency Bands

Refer as Appendix D

3.5 Transmitter Radiated Unwanted Emissions

3.5.1 Transmitter in Radiated Unwanted Emissions Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Un-restricted Band Emissions Limit	
RF output power procedure	**Limit (dB)**
Peak output power procedure	20
Average output power procedure	30

Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.

Note 2: If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured in-band average PSD level.

3.5.2 Measuring Instruments

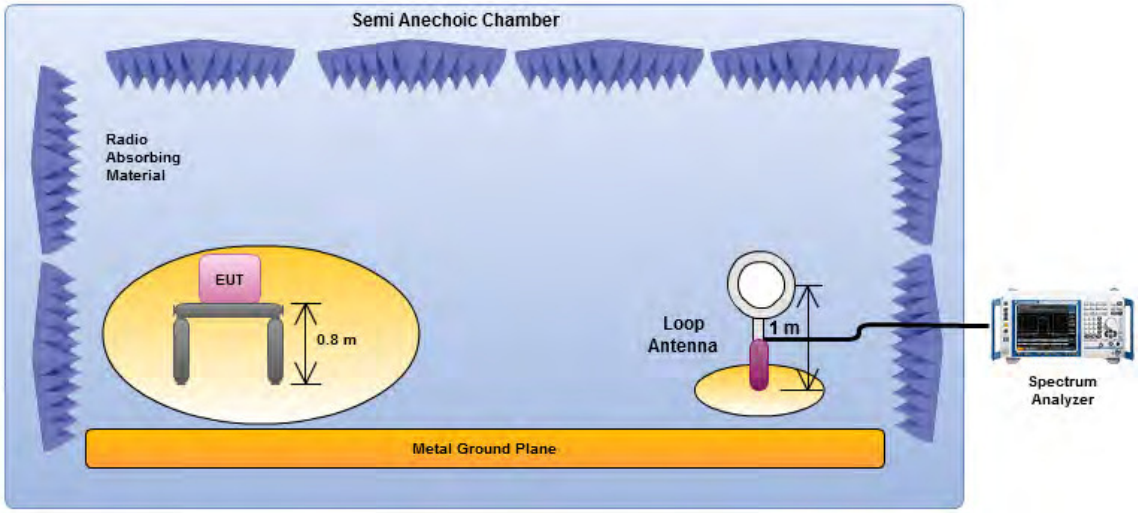
Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method			
☒	Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).		
☒	The average emission levels shall be measured in [duty cycle ≥ 98 or duty factor].		
☒	For the transmitter unwanted emissions shall be measured using following options below:		
	☒	Refer as FCC KDB 558074, clause 11 for unwanted emissions into non-restricted bands.	
	☒	Refer as FCC KDB 558074, clause 12 for unwanted emissions into restricted bands.	
		☐	Refer as FCC KDB 558074, clause 12.2.5.1 Option 1 (trace averaging for duty cycle ≥98%)
		☐	Refer as FCC KDB 558074, clause 12.2.5.2 Option 2 (trace averaging + duty factor).
		☒	Refer as FCC KDB 558074, clause 12.2.5.3 Option 3 (Reduced VBW≥1/T).
		☐	Refer as ANSI C63.10, clause 4.1.4.2.3 (Reduced VBW). VBW ≥ 1/T, where T is pulse time.
		☐	Refer as ANSI C63.10, clause 4.1.4.2.4 average value of pulsed emissions.
		☒	Refer as FCC KDB 558074, clause 11.3 and 12.2.4 measurement procedure peak limit.
		☒	Refer as FCC KDB 558074, clause 12.2.3 measurement procedure Quasi-Peak limit.
☒	For radiated measurement, refer as FCC KDB 558074, clause 12.2.7.		
	☒	Refer as ANSI C63.10, clause 6.4 for radiated emissions below 30 MHz and test distance is 3m.	
	☒	Refer as ANSI C63.10, clause 6.5 for radiated emissions 30 MHz to 1 GHz and test distance is 3m.	
	☒	Refer as ANSI C63.10, clause 6.6 for radiated emissions above 1 GHz and test distance is 3m.	
☒	The any unwanted emissions level shall not exceed the fundamental emission level.		
☒	All amplitude of spurious emissions that are attenuated by more than 30 dB below the permissible value has no need to be reported.		

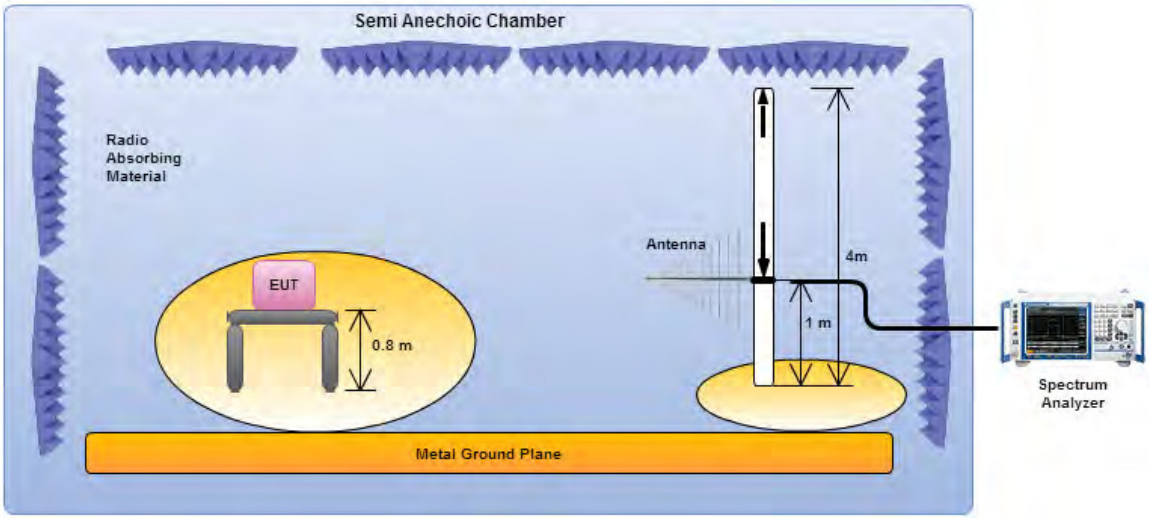
3.5.4 Test Setup

Transmitter Spurious and Out of Band Emissions (9 kHz - 30 MHz)



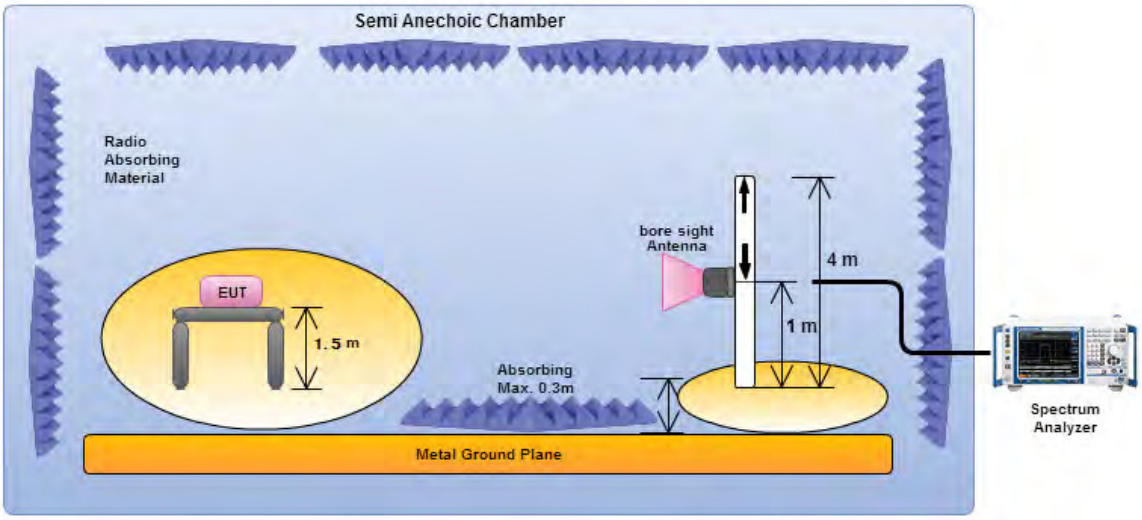
Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna.

Transmitter Radiated Unwanted Emissions (below 1GHz)



Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna.

Transmitter Radiated Unwanted Emissions (above 1GHz)



Electric field tests shall be performed in the frequency range of 1 GHz to 10th harmonic of highest fundamental frequency or 40 GHz using a calibrated horn antenna.

3.5.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

3.5.6 Transmitter Radiated Unwanted Emissions

Refer as Appendix E

4 Test Equipment and Calibration Data

Instrument for Conducted Test

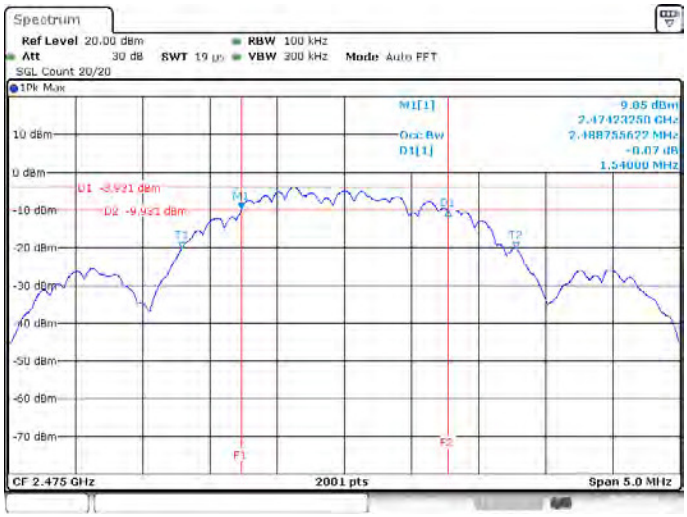
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Last Cal.	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101013	9KHz~40GHz	Feb 16, 2016	Feb 15, 2017
Signal Generator	R&S	SMR40	100116	10MHz ~ 40GHz	Jul. 28, 2015	Jul. 27, 2016
DC Power Source	G.W.	GPC-6030D	C671845	DC 1V ~ 60V	Jul. 22, 2015	Jul. 21, 2016
Power Sensor	Anritsu	MA2411B	0917017	300MHz ~ 40GHz	Feb. 04 ,2016	Feb. 03 ,2017
Power Meter	Anritsu	ML2495A	0949003	300MHz ~ 40GHz	Feb. 04, 2016	Feb. 03, 2017

Instrument for Radiated Test

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Last Cal.	Calibration Due Date
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	30MHz ~ 1GHz 3m	May 14, 2016	May 13, 2017
3m Semi Anechoic Chamber	TDK	SAC-3M	03CH09-HY	1GHz ~ 18GHz 3m	Jul. 01, 2015	Jul. 30, 2016
Amplifier	EMC	EMC9135	980232	9kHz ~ 1.0GHz	Jan. 29, 2016	Jan. 28, 2017
Amplifier	Agilent	8449B	3008A02096	1GHz ~ 26.5GHz	Apr. 11.2016	Apr. 10.2017
Spectrum	KEYSIGHT	N9010A	MY54200885	10Hz ~ 44GHz	Jul. 15, 2015	Jul. 14, 2016
Bilog Antenna & 5dB Attenuator	TESEQ & MTJ	CBL 6111D & MTJ6102	35418	30MHz ~ 1GHz	Mar. 31, 2016	Mar. 30, 2017
Loop Antenna	ROHDE&SCHWARZ	HFH2-Z2	100330	9 kHz~30 MHz	Nov. 10, 2014	Nov. 09, 2016
Horn Antenna	SCHWARZBECK	BBHA 9120D	BBHA 9120D 1534	1GHz ~ 18GHz	Apr. 22, 2016	Apr. 21, 2017
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170614	18GHz ~ 40GHz	Jan. 04, 2016	Jan. 03, 2017

Emission Bandwidth Result			
Modulation Mode	**Freq. (MHz)**	**99% Bandwidth (MHz)**	**6dB Bandwidth (MHz)**
Zigbee	2405	2.39	1.55
Zigbee	2440	2.43	1.63
Zigbee	2475	2.48	1.54
Limit		**N/A**	**≥500 kHz**
Result		**Complied**	

Worst Emission Bandwidth Plots
Zigbee



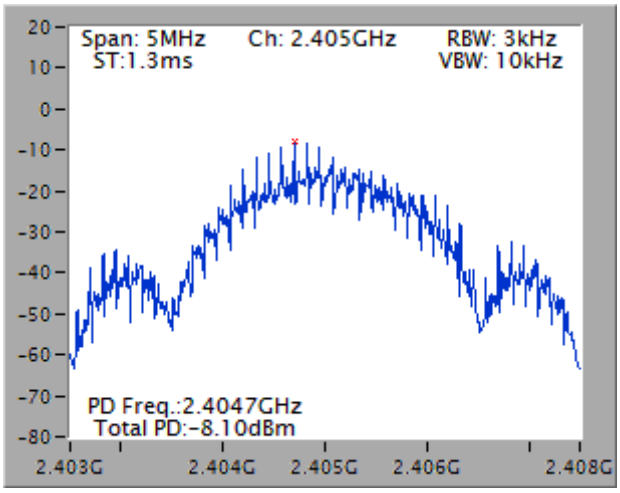
Maximum Peak Conducted Output Power Result						
Condition		RF Output Power (dBm)				
Modulation Mode	Freq. (MHz)	RF Output Power	Power Limit	Antenna Gain (dBi)	EIRP Power	EIRP Limit
Zigbee	2405	3.75	30.00	3.14	6.89	36
Zigbee	2440	3.49	30.00	3.14	6.63	36
Zigbee	2475	3.40	30.00	3.14	6.54	36
Result		Complied				

Test Result of Maximum Average Conducted Output Power

Maximum Average Conducted Output Power Result						
Condition		RF Output Power (dBm)				
Modulation Mode	Freq. (MHz)	RF Output Power	Power Limit	Antenna Gain (dBi)	EIRP Power	EIRP Limit
Zigbee	2405	3.68	30.00	3.14	6.82	36.00
Zigbee	2440	3.41	30.00	3.14	6.55	36.00
Zigbee	2475	3.33	30.00	3.14	6.47	36.00
Result		Complied				

Power Spectral Density Result			
Modulation Mode	**Freq. (MHz)**	**PSD (dBm/3kHz)**	**PSD Limit (dBm/3kHz)**
Zigbee	2405	-8.10	8
Zigbee	2440	-8.38	8
Zigbee	2475	-8.50	8
Result		**Complied**	

Worst Power Spectral Density Plots
LE-1Mbps

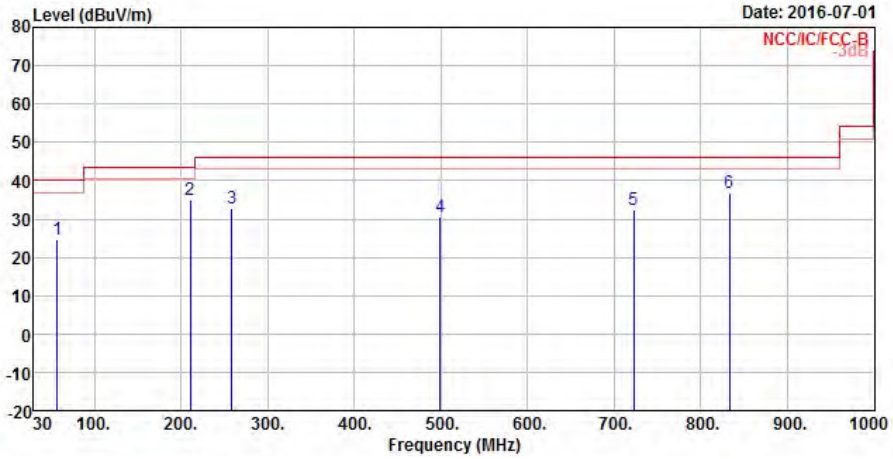


2400-2483.5MHz Transmitter Radiated Bandedge Emissions (Non-restricted Band)								
Modulation	**N_{TX}**	**Test Freq. (MHz)**	**In-band PSD [i] (dBuV/100kHz)**	**Freq. (MHz)**	**Out-band PSD [o] (dBuV/100kHz)**	**[i] – [o] (dB)**	**Limit (dB)**	**Pol.**
Zigbee	1	2405	96.63	2399.990	56.98	39.65	20	H
Zigbee	1	2475	97.69	2500.180	41.91	55.78	20	H
Note 1: Measurement worst emissions of receive antenna polarization								

2400-2483.5MHz Transmitter Radiated Bandedge Emissions (Restricted Band)										
Modulation Mode	**N_{TX}**	**Freq. (MHz)**	**Measure Distance (m)**	**Freq. (MHz) PK**	**Level (dBuV/m) PK**	**Limit (dBuV/m) PK**	**Freq. (MHz) AV**	**Level (dBuV/m) AV**	**Limit (dBuV/m) AV**	**Pol.**
Zigbee	1	2405	3	2388.540	52.36	74	2389.905	42.20	54	H
Zigbee	1	2475	3	2483.610	58.27	74	2483.610	49.87	54	H
Note 1: Measurement worst emissions of receive antenna polarization.										

Transmitter Radiated Unwanted Emissions (Below 1GHz)

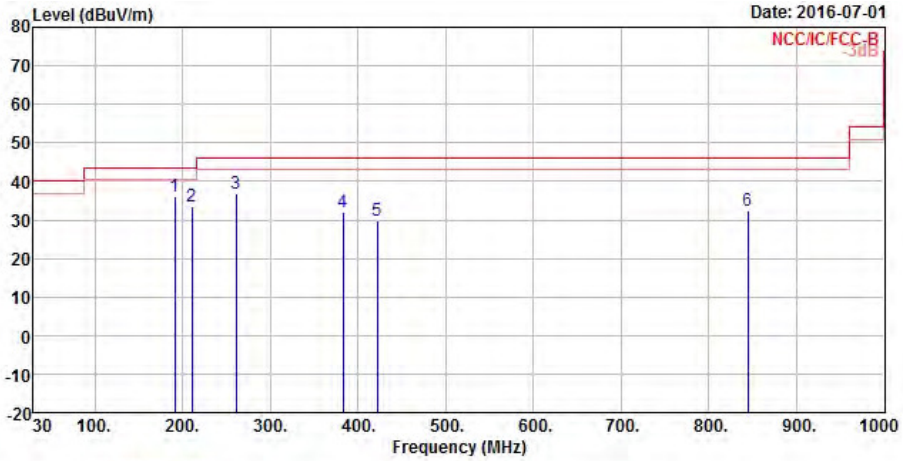
Radiated Unwanted Emissions (Below 1GHz)			
Operating Mode	1	**Polarization**	V
Operating Function	Transmis Mode		



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	57.160	24.61	-15.39	40.00	49.41	11.88	0.46	37.14	QP
2	210.420	35.16	-8.34	43.50	55.35	15.39	0.81	36.39	Peak
3	258.920	32.75	-13.25	46.00	49.36	18.89	0.90	36.40	Peak
4	499.480	30.58	-15.42	46.00	42.98	23.29	1.29	36.98	Peak
5	722.580	32.34	-13.66	46.00	41.86	26.41	1.57	37.50	Peak
6	833.160	36.89	-9.11	46.00	44.84	27.93	1.71	37.59	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Radiated Unwanted Emissions (Below 1GHz)			
Operating Mode	1	**Polarization**	H
Operating Function	Transmis Mode		

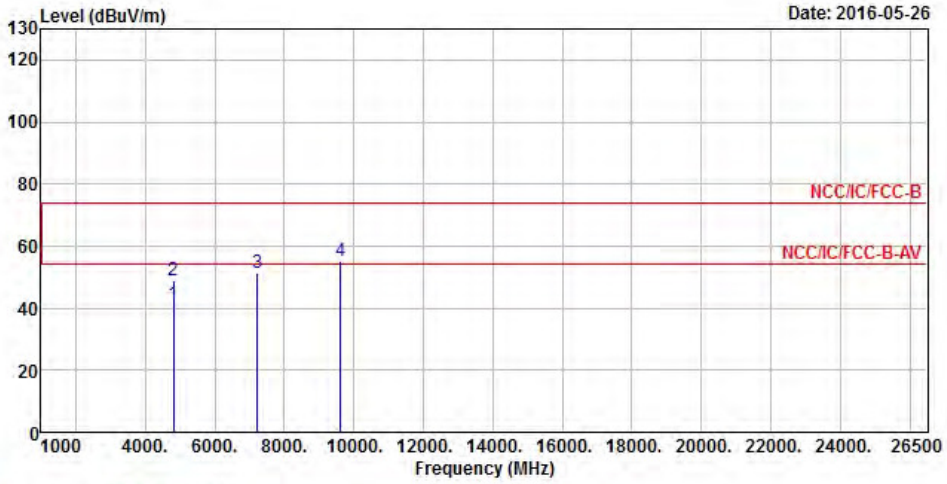


	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	191.020	36.11	-7.39	43.50	57.11	14.65	0.78	36.43	Peak
2	210.420	33.51	-9.99	43.50	53.70	15.39	0.81	36.39	Peak
3	260.860	36.88	-9.12	46.00	53.41	18.97	0.90	36.40	Peak
4	383.080	32.02	-13.98	46.00	46.46	21.09	1.09	36.62	Peak
5	421.880	29.97	-16.03	46.00	43.65	21.89	1.16	36.73	Peak
6	844.800	32.52	-13.48	46.00	40.29	28.12	1.72	37.61	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)

Transmitter Radiated Unwanted Emissions (Above 1GHz)

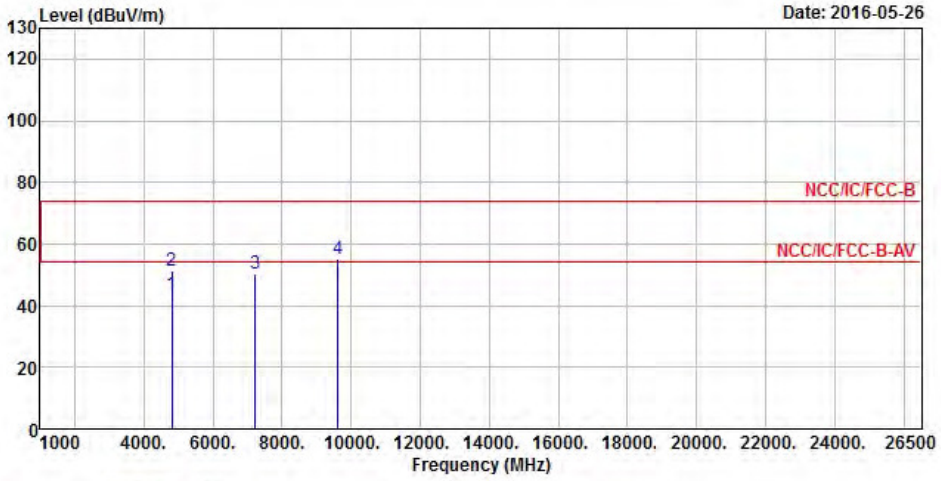
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	Zigbee	**Test Freq. (MHz)**	2405
Operating Function	Transmit	**Polarization**	V



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	4810.00	41.38	-12.62	54.00	39.30	31.13	6.11	35.16	Average
2	4810.00	48.81	-25.19	74.00	46.73	31.13	6.11	35.16	Peak
3	7215.00	51.38			43.37	35.86	7.56	35.41	Peak
4	9620.00	55.22			43.75	38.67	8.75	35.95	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (100.61 dBuV/m).
Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.

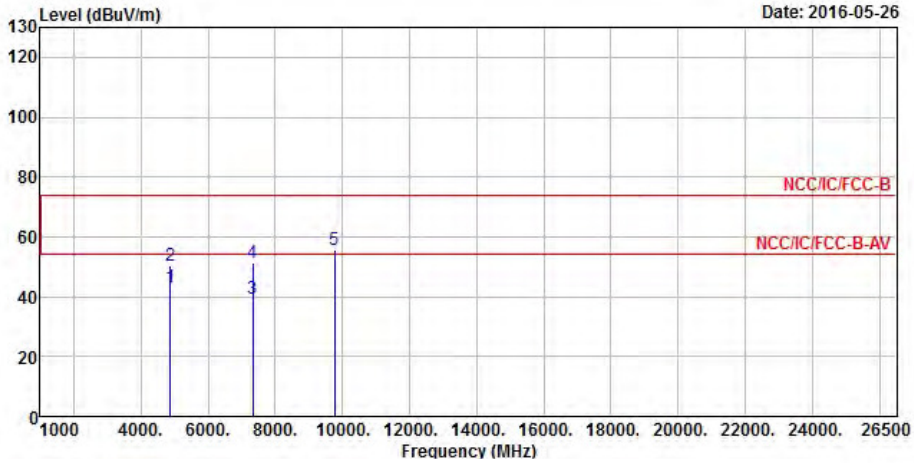
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	Zigbee	**Test Freq. (MHz)**	2405
Operating Function	Transmit	**Polarization**	H



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	4810.00	43.65	-10.35	54.00	41.57	31.13	6.11	35.16	Average
2	4810.00	51.10	-22.90	74.00	49.02	31.13	6.11	35.16	Peak
3	7215.00	50.56			42.55	35.86	7.56	35.41	Peak
4	9620.00	55.09			43.62	38.67	8.75	35.95	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (100.61dBuV/m).
Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.

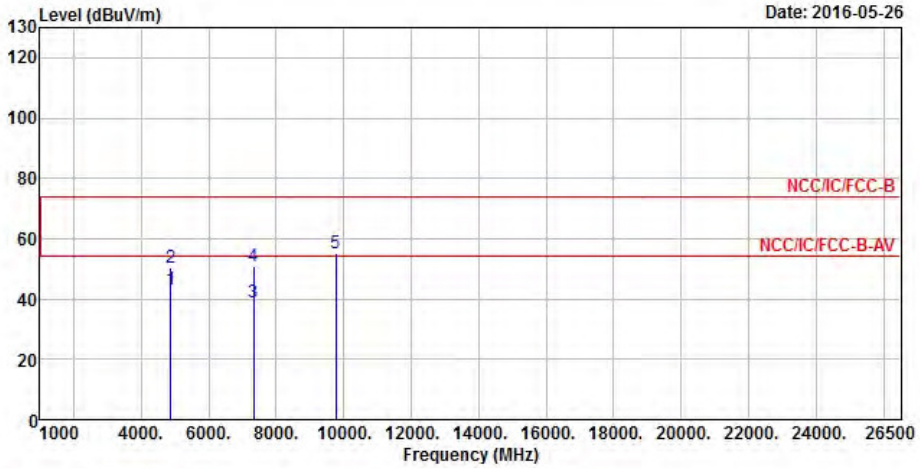
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	Zigbee	**Test Freq. (MHz)**	2440
Operating Function	Transmit	**Polarization**	V



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	4880.00	43.35	-10.65	54.00	41.14	31.23	6.13	35.15	Average
2	4880.00	50.43	-23.57	74.00	48.22	31.23	6.13	35.15	Peak
3	7320.00	39.16	-14.84	54.00	30.85	36.13	7.60	35.42	Average
4	7320.00	51.34	-22.66	74.00	43.03	36.13	7.60	35.42	Peak
5	9760.00	55.45			43.71	38.76	8.94	35.96	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (101.78 dBuV/m).
Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.

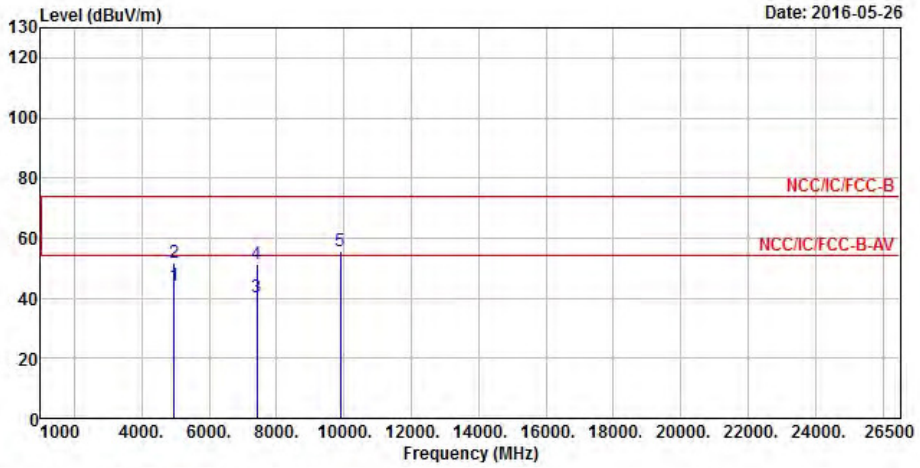
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	Zigbee	**Test Freq. (MHz)**	2440
Operating Function	Transmit	**Polarization**	H



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	4880.00	43.32	-10.68	54.00	41.11	31.23	6.13	35.15	Average
2	4880.00	50.43	-23.57	74.00	48.22	31.23	6.13	35.15	Peak
3	7320.00	39.06	-14.94	54.00	30.75	36.13	7.60	35.42	Average
4	7320.00	50.86	-23.14	74.00	42.55	36.13	7.60	35.42	Peak
5	9760.00	55.09			43.35	38.76	8.94	35.96	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (101.78 dBuV/m).
Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.

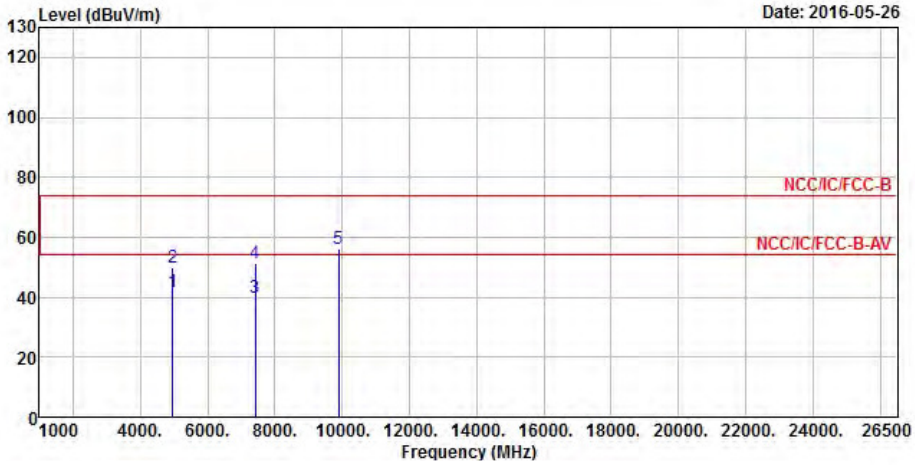
Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	Zigbee	**Test Freq. (MHz)**	2475
Operating Function	Transmit	**Polarization**	V



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	4950.00	44.36	-9.64	54.00	42.01	31.33	6.17	35.15	Average
2	4950.00	51.73	-22.27	74.00	49.38	31.33	6.17	35.15	Peak
3	7425.00	40.48	-13.52	54.00	31.87	36.40	7.64	35.43	Average
4	7425.00	51.26	-22.74	74.00	42.65	36.40	7.64	35.43	Peak
5	9900.00	55.77			43.81	38.84	9.08	35.96	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (99.11 dBuV/m).
Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.

Transmitter Radiated Unwanted Emissions (Above 1GHz)			
Modulation Mode	Zigbee	**Test Freq. (MHz)**	2475
Operating Function	Transmit	**Polarization**	H



	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	4950.00	41.66	-12.34	54.00	39.31	31.33	6.17	35.15	Average
2	4950.00	49.66	-24.34	74.00	47.31	31.33	6.17	35.15	Peak
3	7425.00	39.83	-14.17	54.00	31.22	36.40	7.64	35.43	Average
4	7425.00	51.42	-22.58	74.00	42.81	36.40	7.64	35.43	Peak
5	9900.00	56.19			44.23	38.84	9.08	35.96	Peak

Note 1: “>20dB” means spurious emission levels that exceed the level of 20 dB below the applicable limit.
Note 2: “N/F” means Nothing Found spurious emissions (No spurious emissions were detected.)
Note 3: Measurement receive antenna polarization: H (Horizontal), V (Vertical)
Note 4: For restricted bands, the peak measurement is fully sufficient, as the max field strength as measured with the Peak-Detector meets the AV-Limit so that the AV level does not need to be reported in addition.
Note 5: For un-restricted bands, unwanted emissions shall be attenuated by at least 20 dB relative to the maximum measured in-band level (99.11dBuV/m).
Note 6: No level of unwanted emissions exceeds the level of the fundamental emission.