FCC PART 15.247

TEST REPORT

For

GLEDOPTO CO.,LIMITED

Floor 7,Building1B,Yusheng Industrial Park,Xixiang Street,Bao'an,Shenzhen

FCC ID:2AR8F-GL-C-008

FCC Rule(s):	FCC Part 15C
Product Description:	Zigbee LED Controller
Tested Model:	GL-C-008
Report No.:	BSL18118544501RF
Tested Date:	2018-12-10 to 2018-12-21
Issued Date:	2018-12-21
Tested By:	Messi Wang / Engineer
Reviewed By:	Lisa. Ji / EMC Manager
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Client Information

Applicant:	GLEDOPTO CO.,LIMITED
Address of applicant:	Floor 7,Building1B,Yusheng Industrial Park,Xixiang Street,Bao'an,Shenzhen
Manufacturer:	GLEDOPTO CO.,LIMITED
Address of manufacturer:	Floor 7,Building1B,Yusheng Industrial Park,Xixiang Street,Bao'an,Shenzhen

General Description of EUT	
Product Name:	Zigbee LED Controller
Trade Name:	GLEDOPTO
Model No.:	GL-C-008
Adding Model(s):	N/A
Rated Voltage:	DC 12-24V
Note: The test data is gathered from a production sample provided by the manufacturer. The appearance of others models listed in the report is different from main-test model GL-C-008, but the circuit and the electronic construction do not change, declared by the manufacturer.	

Technical Characteristics of EUT	
Support Standards:	IEEE802.15.4
Frequency Range:	2405-2480MHz
RF Output Power:	9.22dBm (Conducted)
Type of Modulation:	OQPSK
Data Rate:	250kbps
Quantity of Channels:	16
Channel Separation:	5MHz
Type of Antenna:	Internal
Antenna Gain:	0dBi
Lowest Internal Frequency	32.768KHz

Test Standards

This report is prepared on behalf of *GLEDOPTO CO.,LIMITED* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communications Commission's rules

The tests were performed in order to determine the compliance of the EUT with FCC Part 15-Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. The measurement guide KDB 558074 D01 v05 for digital transmission systems shall be performed also.

Test Facility

BSL Testing Co.,LTD.
NO. 24, ZH Park, Nantou, Shenzhen, 518000 China
Designation Number : CN1217
Test Firm Registration Number: 866035
Tel: 86- 755-26508703
Fax: 86- 755-26508703

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode, which was provided by manufacturer.

For Zigbee mode, 16 channels are provided to testing and CH11, CH19, CH26 were selected to test.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	20	2450
13	2415	21	2455
14	2420	22	2460
15	2425	23	2465
16	2430	24	2470
17	2435	25	2475
18	2440	26	2480

The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates bandwidths, and modulations.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

The worst condition (maximum power with 100% duty cycle) was setting by the software as following table:

Test Mode	Test Software Version	COMDBG V1.3		
Zigbee	Test Frequency	2405MHz	2445 MHz	2480MHz
	Power Level Setting	40	40	40

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Ntebook	Lenovo	Lenovo B490	BSTSZEMC-77
DC Adapter	GEZ	GPUSW1351000WD00	/

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Power Spectral Density	Conducted	±1.8dB
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	±2.88dB
Transmitter Spurious Emissions	Radiated	±5.1dB

Test Equipment List and Details

Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
Communication Tester	Rohde & Schwarz	CMW500	100358	2018-11-08	2019-11-07
Spectrum Analyzer	R&S	FSP40	100550	2018-10-08	2019-10-07
Test Receiver	R&S	ESCI7	US47140102	2018-10-08	2019-10-07
Signal Generator	HP	83630B	3844A01028	2018-10-08	2019-10-07
Test Receiver	R&S	ESPI-3	100180	2018-10-08	2019-10-07
Amplifier	Agilent	8449B	4035A00116	2018-10-08	2019-10-07
Amplifier	HP	8447E	2945A02770	2018-10-08	2019-10-07
Signal Generator	IFR	2023A	202307/242	2018-10-08	2019-10-07
Broadband Antenna	SCHAFFNER	2774	2774	2018-10-21	2019-10-20
Biconical and log periodic antennas	ELECTRO-METRICS	EM-6917B-1	171	2018-10-21	2019-10-20
Horn Antenna	R&S	HF906	100253	2018-10-21	2019-10-20
Horn Antenna	EM	EM-6961	6462	2018-10-21	2019-10-20
LISN	R&S	ESH3-Z5	100196	2018-10-08	2019-10-07
LISN	COM-POWER	LI-115	02027	2018-10-08	2019-10-07
3m Semi-Anechoic Chamber	Chengyu Electron	9 (L)*6 (W)* 6 (H)	BSL086	2018-10-08	2019-10-07
Horn Antenna	Schwarzbeck	BBHA9170	00814	2018-10-21	2019-10-20
Spectrum Analyzer	Agilent	E4407B	MY41440401	2018-10-08	2019-10-07
Loop Antenna	Schwarz beck	FMZB 1516	9773	2018-06-16	2019-06-15

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.247(d)	Spurious Emissions at Antenna Port	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum conducted output power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

FCC §15.247 (i) & §1.1307 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i) and subpart §1.1307, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Result:
This product complied with the requirement of the RF exposure, please see the RF Exposure Report.
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FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Connector Construction

The EUT has one integral antenna arrangement, which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

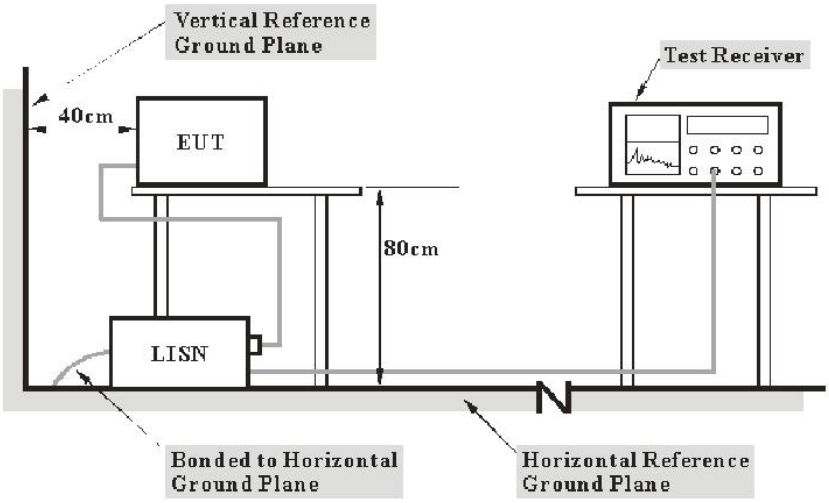
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The adapter of laptop was connected to a 120 VAC/60 Hz power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter of laptop was connected to thefirst LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$
$C_f = A_C + VDF$

Herein,
V_C (cord. Reading): corrected voltage amplitude
V_R: reading voltage amplitude
A_c: attenuation caused by cable loss
VDF: voltage division factor of AMN
C_f: Correction Factor

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207, with the worst margin reading of:

1. Worst-case CONDUCTED emission is CH High mode.

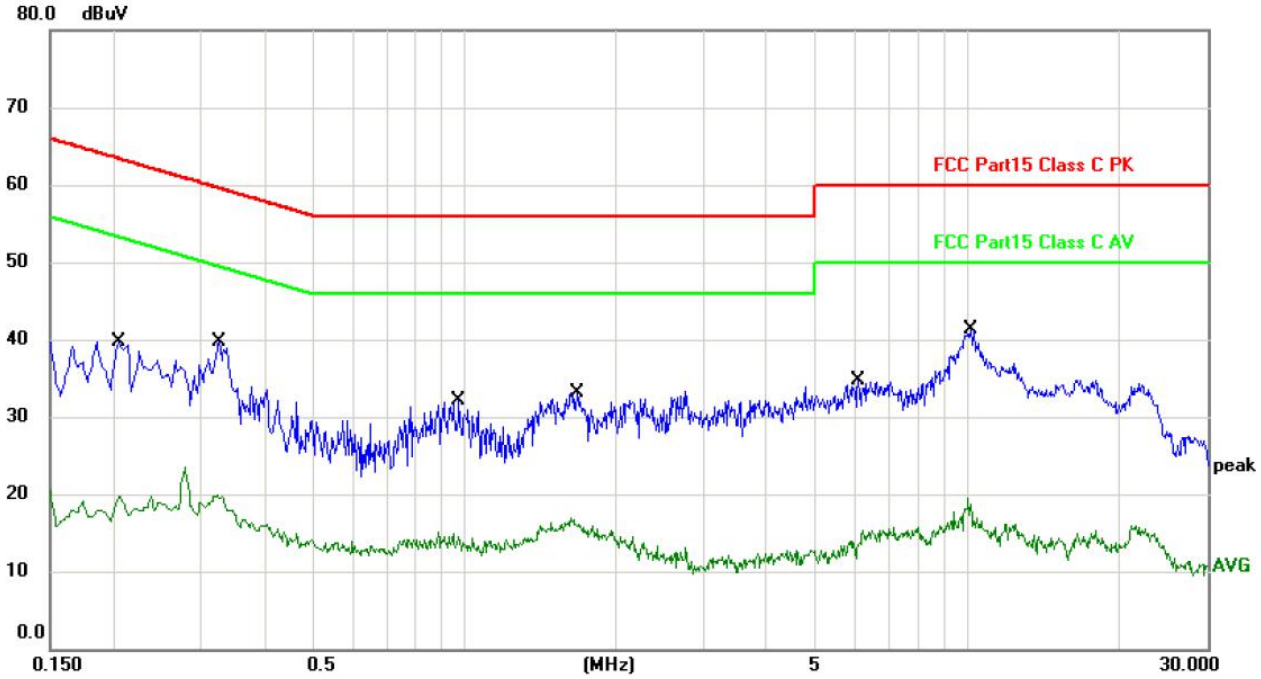
Test Data

Environmental Conditions

Temperature:	27.4 °C
Relative Humidity:	59 %
ATM Pressure:	100.1 kPa

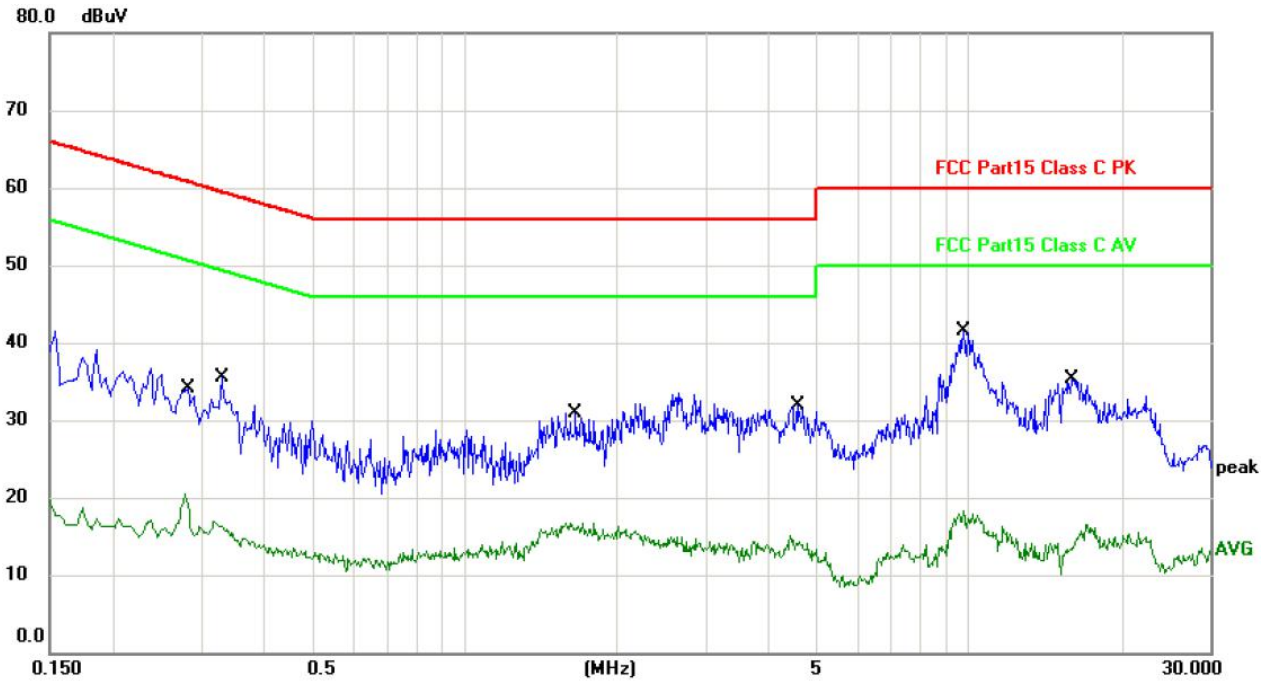
Test Mode: Transmitting

AC120 V/60 Hz, Line:



No.	Mk.	Freq.	Measure-ment	Limit	Over		
		MHz	dBuV	dBuV	dB	Detector	Comment
1		0.2060	39.65	63.36	-23.71	QP	
2		0.2060	21.14	53.36	-32.22	AVG	
3		0.3260	39.75	59.55	-19.80	QP	
4		0.3260	18.32	49.55	-31.23	AVG	
5		0.9740	32.03	56.00	-23.97	QP	
6		0.9740	13.52	46.00	-32.48	AVG	
7		1.6740	33.08	56.00	-22.92	QP	
8		1.6740	16.19	46.00	-29.81	AVG	
9		6.0699	34.62	60.00	-25.38	QP	
10		6.0699	14.58	50.00	-35.42	AVG	
11	*	10.1379	41.25	60.00	-18.75	QP	
12		10.1379	17.36	50.00	-32.64	AVG	

AC120 V, 60 Hz, Neutral:



No.	Mk.	Freq.	Measure-ment	Limit	Over		
		MHz	dBuV	dBuV	dB	Detector	Comment
1		0.2819	34.05	60.76	-26.71	QP	
2		0.2819	19.67	50.76	-31.09	AVG	
3		0.3300	35.52	59.45	-23.93	QP	
4		0.3300	16.70	49.45	-32.75	AVG	
5		1.6580	30.96	56.00	-25.04	QP	
6		1.6580	15.88	46.00	-30.12	AVG	
7		4.5500	31.84	56.00	-24.16	QP	
8		4.5500	13.95	46.00	-32.05	AVG	
9	*	9.7420	41.51	60.00	-18.49	QP	
10		9.7420	17.24	50.00	-32.76	AVG	
11		15.9780	35.37	60.00	-24.63	QP	
12		15.9780	16.03	50.00	-33.97	AVG	

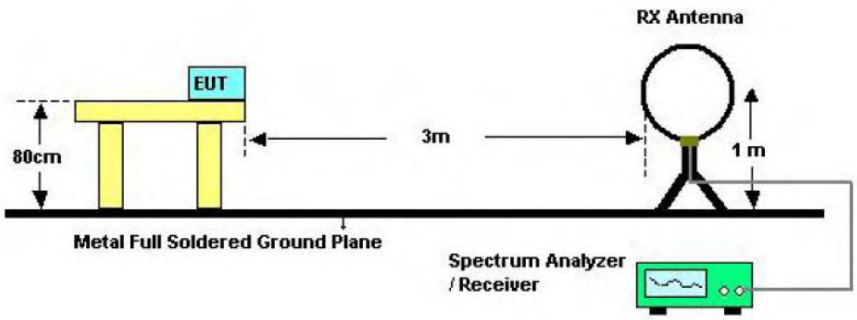
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

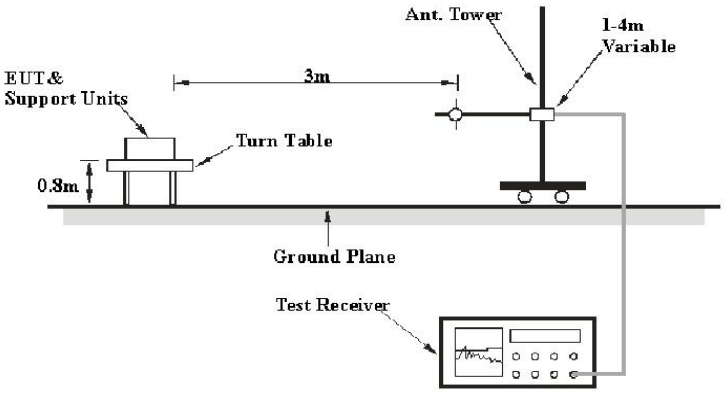
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

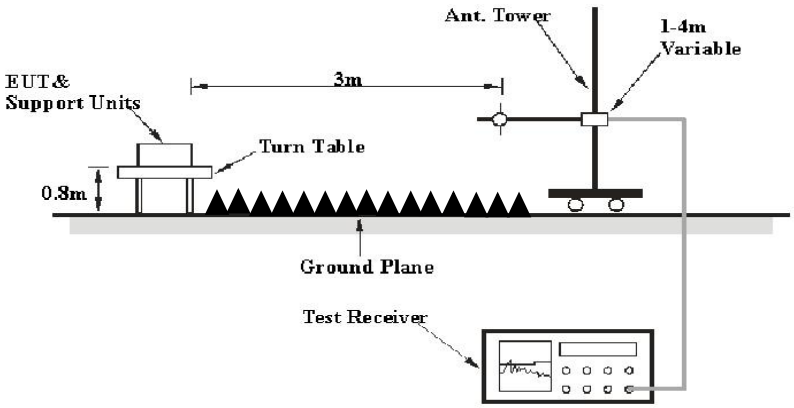
Below 30MHz Test Setup



30M-1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.4-2014. The specification used was the FCC 15.209, and FCC 15.247 limits.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

The adapter of laptop was connected to a 120VAC/60 Hz power source.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 KHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
9kHz-30MHz	10KHz	30KHz	/	PK
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

During the radiated emission test, the adapter of laptop was connected to the first AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in peak detection mode for frequency range of 9KHz-30MHz,Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Loss and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Loss + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit –Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Section 15.205, 15.209 and 15.247, with the worst margin reading of:

Note:
1. Worst-case radiated emission below 1GHz is CH High mode.

Test Data

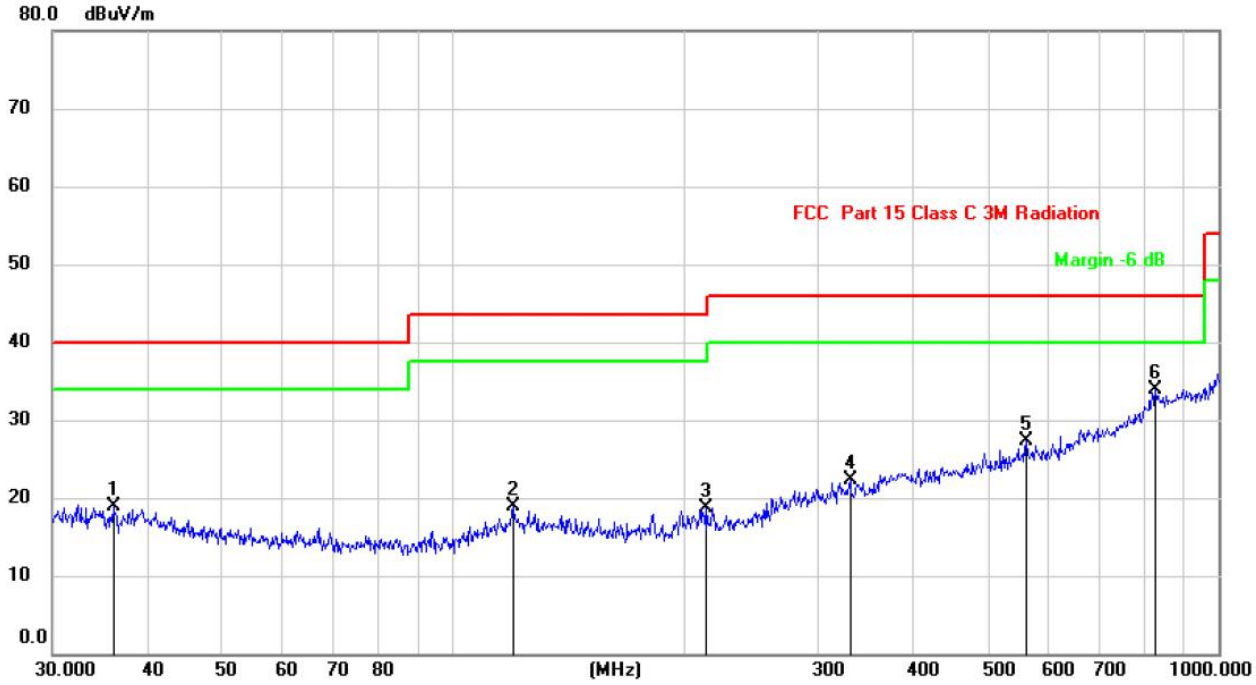
Environmental Conditions

Temperature:	27.9°C
Relative Humidity:	66 %
ATM Pressure:	100.1 kPa

There is no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

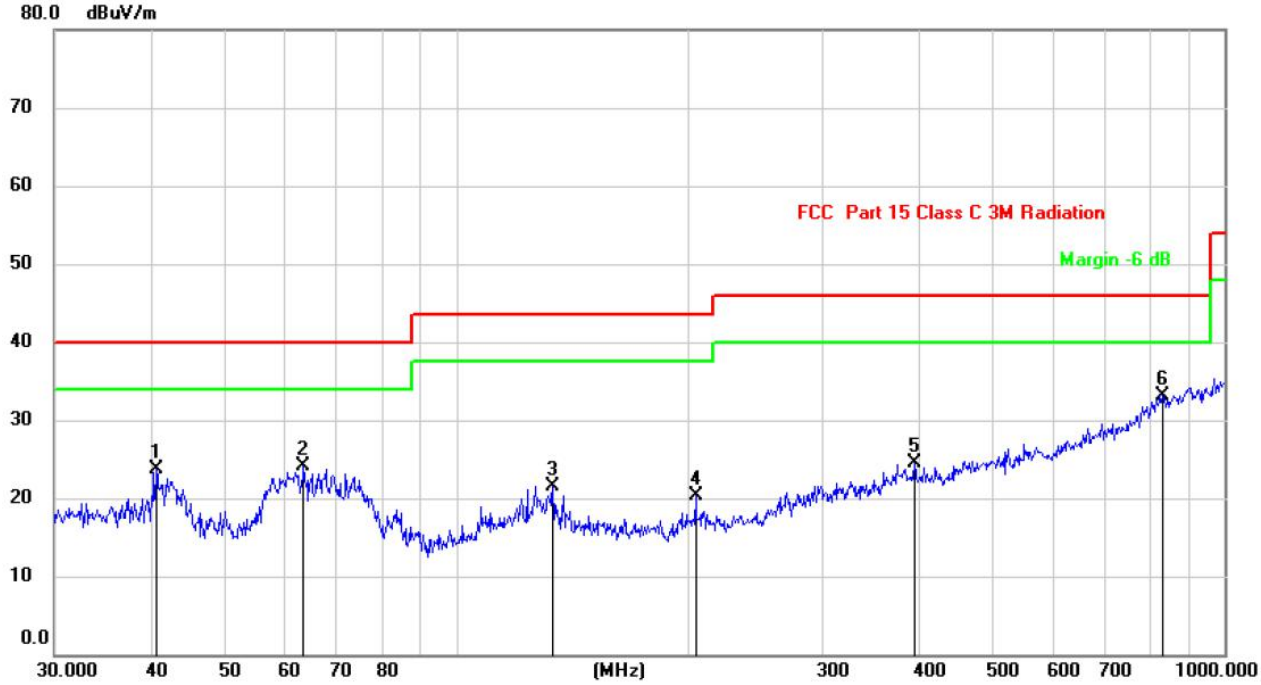
Test Data 30MHz-1GHz(Transmitting Mode):

AC120 V/60 Hz, Horizontal:



No.	Mk.	Freq.	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		36.0007	18.84	40.00	-21.16	QP			
2		119.8556	18.89	43.50	-24.61	QP			
3		214.5143	18.75	43.50	-24.75	QP			
4		330.1949	22.32	46.00	-23.68	QP			
5		560.6928	27.38	46.00	-18.62	QP			
6	*	827.4934	33.85	46.00	-12.15	QP			

AC120 V/60 Hz, Vertical:



No.	Mk.	Freq.	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		40.7014	23.70	40.00	-16.30	QP			
2		63.3132	24.02	40.00	-15.98	QP			
3		133.6187	21.57	43.50	-21.93	QP			
4		204.9550	20.24	43.50	-23.26	QP			
5		394.8544	24.51	46.00	-21.49	QP			
6	*	830.4002	33.16	46.00	-12.84	QP			

Test Data Above 1GHz:

Frequency	Degree	Height	Result	Limit	Margin	Polar	Detector
(MHz)	(•)	(cm)	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2405MHz							
4810.000	32	150	49.24	74	-24.76	H	PK
4810.000	55	150	37.85	54	-16.15	H	AV
7215.000	32	150	54.53	74	-19.47	H	PK
7215.000	32	150	48.65	54	-5.35	H	AV
4810.000	11	150	55.28	74	-18.72	V	PK
4810.000	22	150	45.76	54	-8.24	V	AV
7215.000	183	150	56.69	74	-17.31	V	PK
7215.000	11	150	48.32	54	-5.68	V	AV
Middle Channel-2445MHz							
4890.000	12	150	55.28	74	-18.72	H	PK
4890.000	23	150	45.37	54	-8.63	H	AV
7335.000	56	150	56.87	74	-17.13	H	PK
7335.000	33	150	44.21	54	-9.79	H	AV
4890.000	33	150	51.24	74	-22.76	V	PK
4890.000	12	150	35.89	54	-18.11	V	AV
7335.000	33	150	54.17	74	-19.83	V	PK
7335.000	12	150	48.61	54	-5.39	V	AV
High Channel-2480MHz							
4960.000	130	150	52.17	74	-21.83	H	PK
4960.000	23	150	44.52	54	-9.48	H	AV
7440.000	184	150	55.29	74	-18.71	H	PK
7440.000	12	150	42.19	54	-11.81	H	AV
4960.000	23	150	55.58	74	-18.42	V	PK
4960.000	56	150	38.47	54	-15.53	V	AV
7440.000	33	150	55.23	74	-18.77	V	PK
7440.000	33	150	42.78	54	-11.22	V	AV

**wihtin measurement uncertainty!*

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured

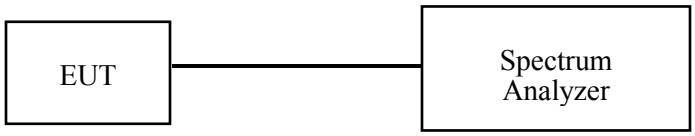
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

According to KDB 558074 D01 DTS Meas Guidance v05
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ⩾ 3×RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



Test Data

Environmental Conditions

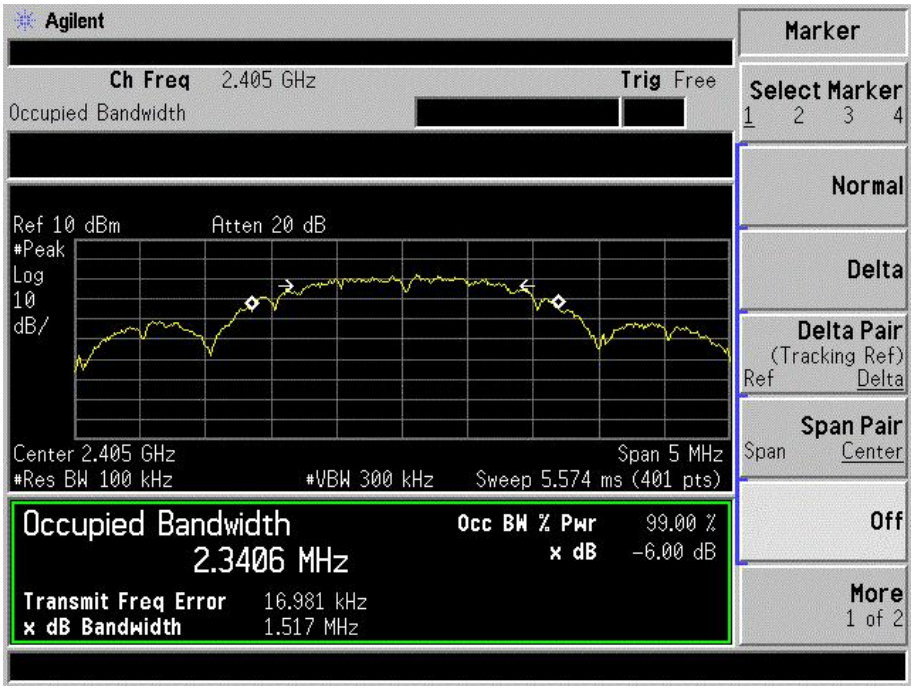
Temperature:	27.9°C
Relative Humidity:	66 %
ATM Pressure:	100.1 kPa

Test Mode: Transmitting

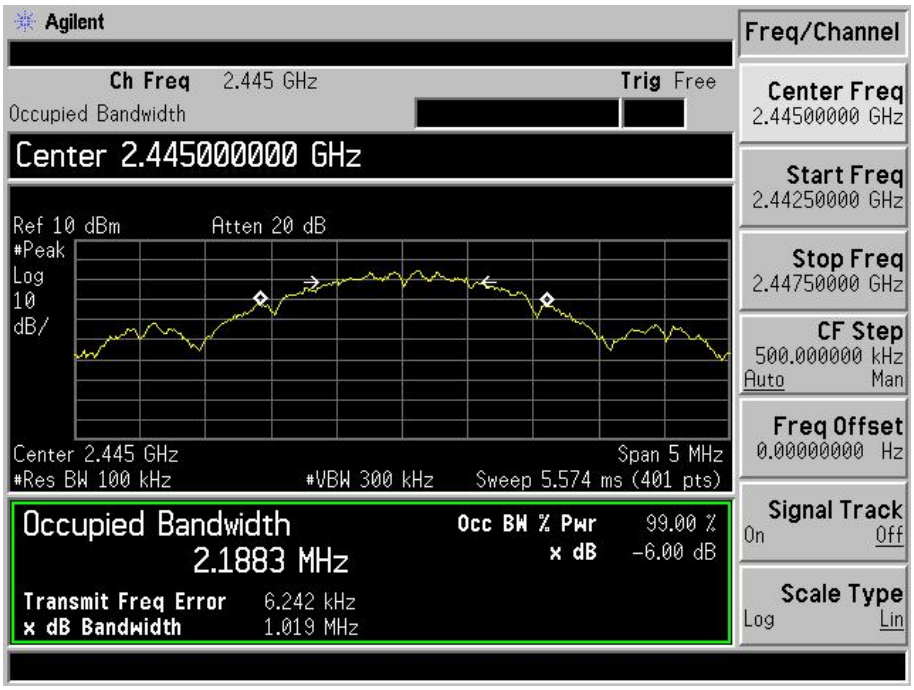
Test Result: Compliant. Please refer to the following table and plots.

Test mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)
Zigbee	Low	2405	1.517	⩾0.5
	Middle	2445	1.019	⩾0.5
	High	2480	1.707	⩾0.5

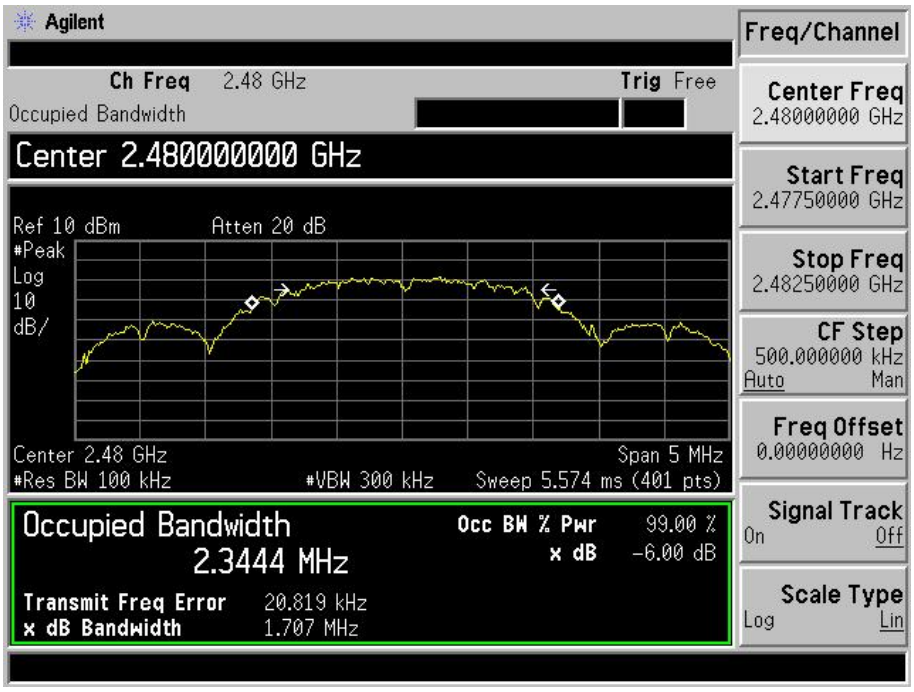
Low Channel



Middle Channel



High Channel



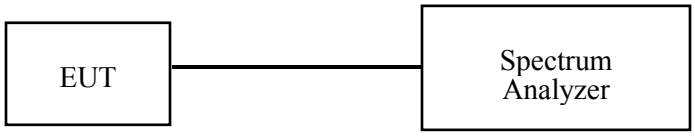
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

According to KDB 558074 D01 DTS Meas Guidance v05
a) Set the RBW ⩾ DTS bandwidth.
b) Set VBW ⩾ 3×RBW.
c) Set span ⩾ 3×RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.



Test Data

Environmental Conditions

Temperature:	27.9°C
Relative Humidity:	66 %
ATM Pressure:	100.1 kPa

Test Mode: Transmitting

Test Result: Compliant. Please refer to the following table.

Test mode	Channel	Frequency	Max Peak Conducted Output Power	Limit	Result
		(MHz)	(dBm)	(dBm)	
Zigbee	Low	2405	5.23	30	PASS
	Middle	2445	9.22	30	PASS
	High	2480	8.94	30	PASS

FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

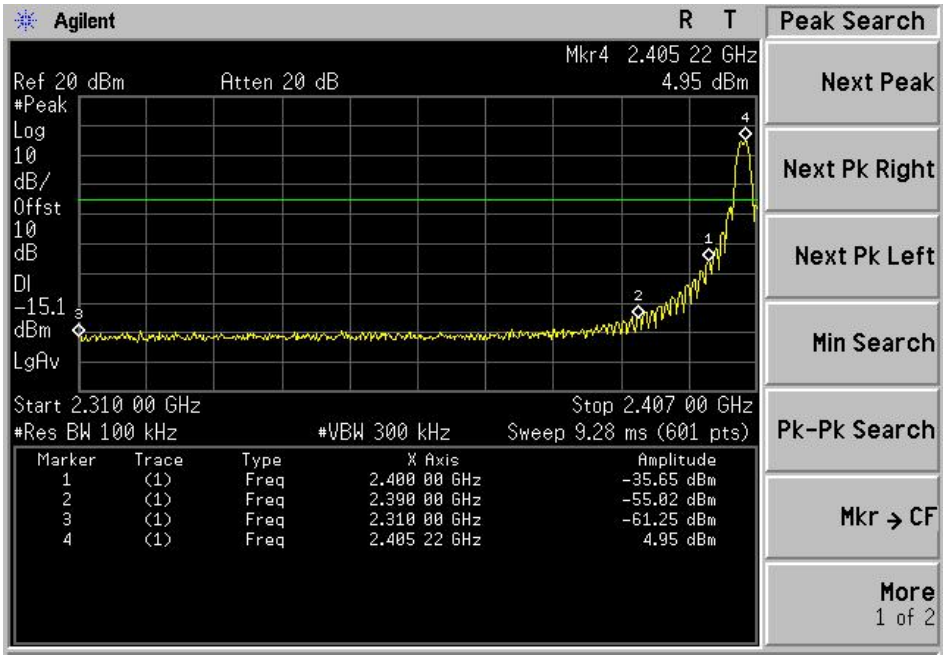
Environmental Conditions

Temperature:	27.9°C
Relative Humidity:	66 %
ATM Pressure:	100.1 kPa

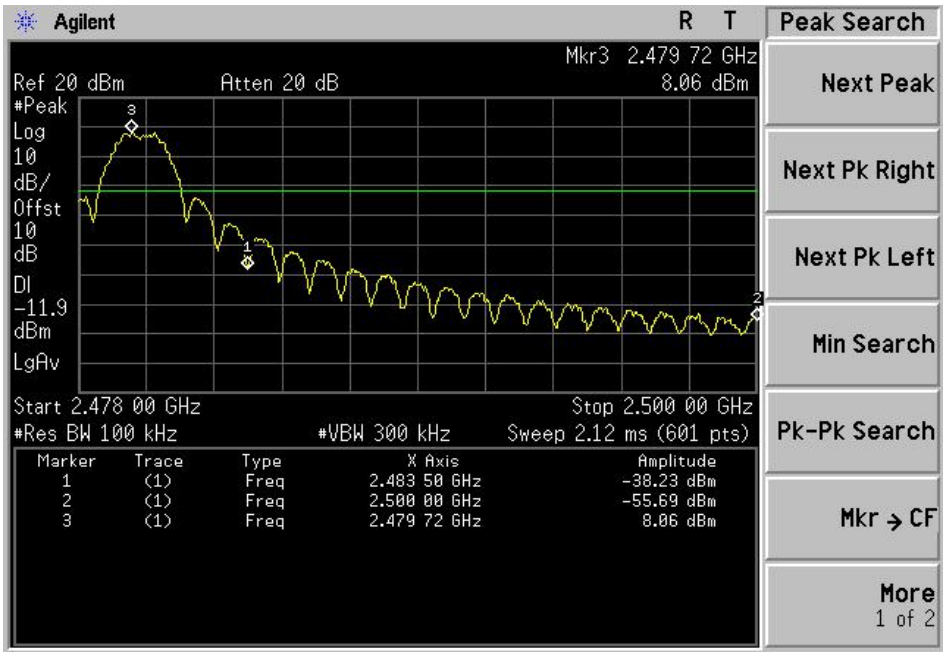
Test mode: Transmitting

Test Result: Compliant. Please refer to following plots.

Band Edge, Left Side



Band Edge, Right Side



FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

According to KDB 558074 D01 DTS Meas Guidance v05

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3×RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

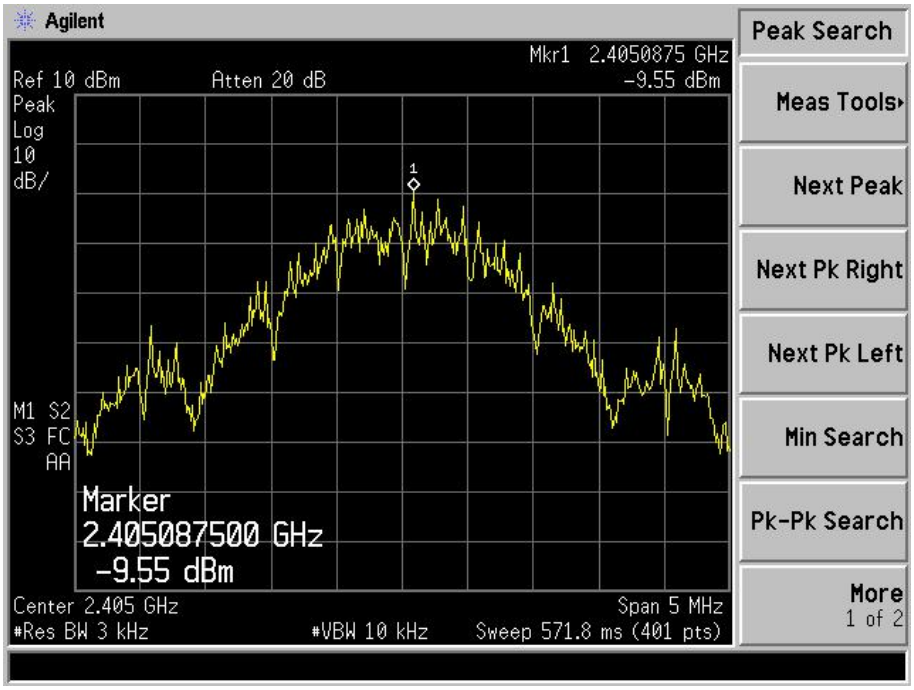
Temperature:	27.9°C
Relative Humidity:	66 %
ATM Pressure:	100.1 kPa

Test Mode: Transmitting

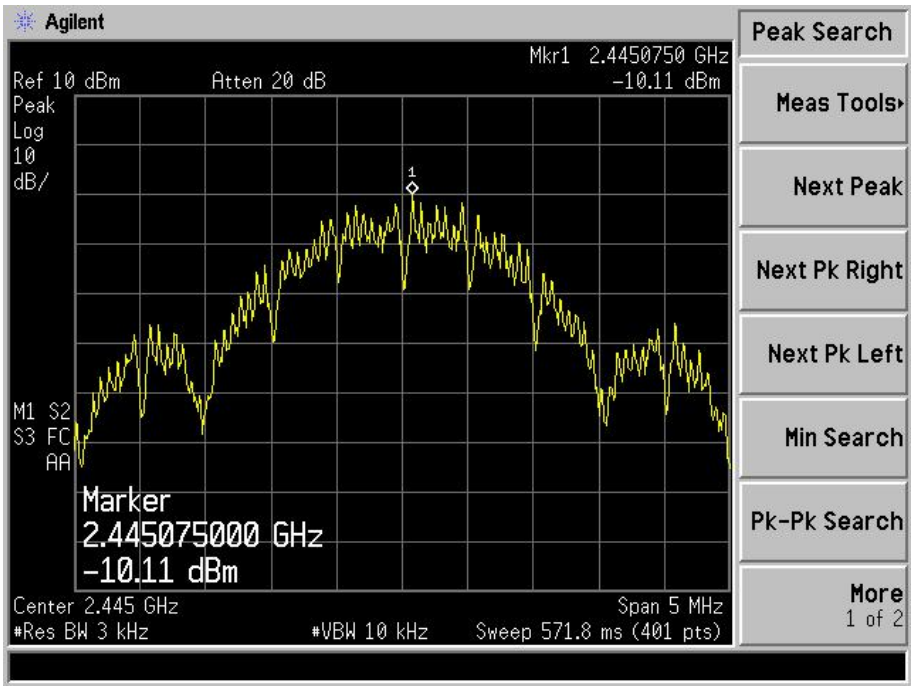
Test Result: Compliant. Please refer to the following table and plots

Test mode	Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Zigbee	Low	2405	-9.55	≤8
	Middle	2445	-10.11	≤8
	High	2480	-12.07	≤8

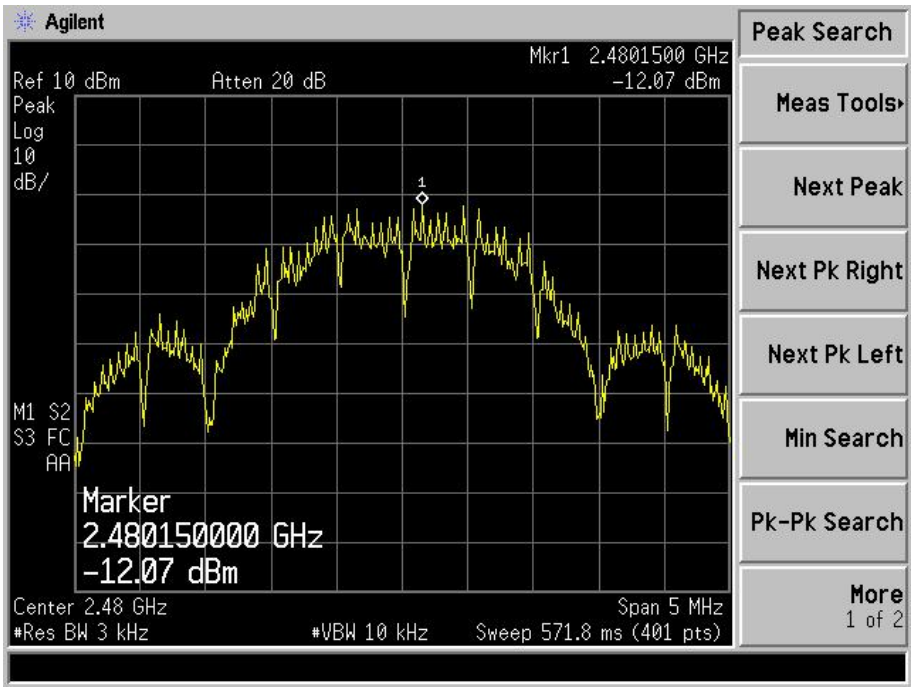
Power Spectral Density, Low Channel



Power Spectral Density, Middle Channel



Power Spectral Density, High Channel



*******END OF REPORT*******