TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.247

TEST REPORT

For

Ideal Industries Lighting LLC, DBA CREE Lighting

4401 Silicon Dr Durham, NC 27703 United States

FCC ID: 2ACQ6-CWC

Report Type:	**Product Type:**
CIIPC	Wireless Wall Controls

Test Engineer:	Chao Gao
Report Number:	RKSB200708002-00BM1
Report Date:	2021-02-08
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TABLE OF CONTENTS

REPORT REVISION **4**

GENERAL INFORMATION **5**

PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 5
OBJECTIVE 5
RELATED SUBMITTAL(S)/GRANT(S) 6
TEST METHODOLOGY 6
MEASUREMENT UNCERTAINTY 6
TEST FACILITY 6

SYSTEM TEST CONFIGURATION **7**

DESCRIPTION OF TEST CONFIGURATION 7
EQUIPMENT MODIFICATIONS 7
EUT EXERCISE SOFTWARE 7
SUPPORT EQUIPMENT LIST AND DETAILS 8
EXTERNAL I/O CABLE 8
BLOCK DIAGRAM OF TEST SETUP 9

SUMMARY OF TEST RESULTS **11**

TEST EQUIPMENT LIST **12**

FCC §1.1307(b) & §2.1093 - RF EXPOSURE INFORMATION **13**

FCC §15.203 - ANTENNA REQUIREMENT **14**

APPLICABLE STANDARD 14
ANTENNA CONNECTOR CONSTRUCTION 14

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS **15**

APPLICABLE STANDARD 15
EUT SETUP 15
EMI TEST RECEIVER SETUP 15
TEST PROCEDURE 15
CORRECTED FACTOR & OVER LIMIT CALCULATION 16
TEST RESULTS SUMMARY 16
TEST DATA 16

FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS **23**

APPLICABLE STANDARD 23
EUT SETUP 23
EMI TEST RECEIVER SETUP 24
TEST PROCEDURE 24
CORRECTED AMPLITUDE & MARGIN CALCULATION 24
TEST RESULTS SUMMARY 24
TEST DATA 25

FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH **35**

APPLICABLE STANDARD 35
TEST PROCEDURE 35
TEST DATA 35

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER **38**

APPLICABLE STANDARD 38
TEST PROCEDURE 38
TEST DATA 38

FCC §15.247(d) – BAND EDGE.....41
APPLICABLE STANDARD 41
TEST PROCEDURE 41
TEST DATA 41
FCC §15.247(e) - POWER SPECTRAL DENSITY 43
APPLICABLE STANDARD 43
TEST PROCEDURE 43
TEST DATA 43

REPORT REVISION

Report Number	Report Date	Contents
RKSB200708002-00B	2020-09-08	Original Report
RKSB200708002-00BM1	2021-02-08	1. Change report type for submit request 2. Chang evaluation method

The items used black in italics in the report was revised due to the applicant's requirements.

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant:	*Ideal Industries Lighting LLC, DBA CREE Lighting*
Tested Model:	CSC-CWD-UNVN-XX
Series Model:	CSC-CWS-UNVN-XX, CSC-CCD-UNVN-XX
Model Difference:	See Declaration of Similarity
Product Type:	Wireless Wall Controls
Power Supply:	AC120~277V
RF Function:	Zigbee
Operating Band/Frequency:	2405~2480MHz
Channel Number:	16
Channel Separation:	5MHz
Modulation Type	OQPSK
Antenna Type:	PCB Antenna
Maximum Antenna Gain:	1.0 dBi

**All measurement and test data in this report was gathered from production sample serial number: 20200708002(CSC-CWD-UNVN-XX), 20200708003(CSC-CWS-UNVN-XX) and 20200708004(CSC-CCD-UNVN-XX).(Assigned by the BACL. The EUT supplied by the applicant was received on 2020-07-08).*

Note: The model (CSC-CWD-UNVN-XX) was tested all items, but the model (CSC-CWS-UNVN-XX) and the model (CSC-CCD-UNVN-XX) only be test AC Line Conducted Emissions and Radiated Spurious Emissions (Below 1GHz). Remark: XX=additional information that indicate the characteristic of the product, or color of button, or other or not used.

Objective

This report is prepared on behalf of *Ideal Industries Lighting LLC, DBA CREE Lighting* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

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

This is a CIIPC report base on the original report R10015049-RF with FCC ID: 2ACQ6-CWC, the differences between the original device and the current one are as follows:

1. Change the key and power setting by software.

The above differences will affect all tests.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliant Testing of Unlicensed Wireless Devices and FCC 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliant Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
Humidity		6%

Test Facility

The Test site used by Bay Area Compliant Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliant Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01), the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

Channel list for Zigbee mode:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
11	2405	19	2445
12	2410	…	…
…	…	…	…
…	…	…	…
…	…	25	2475
18	2440	26	2480

EUT was tested with Channel 11, 18 and 26.

Equipment Modifications

No modification was made to the EUT tested.

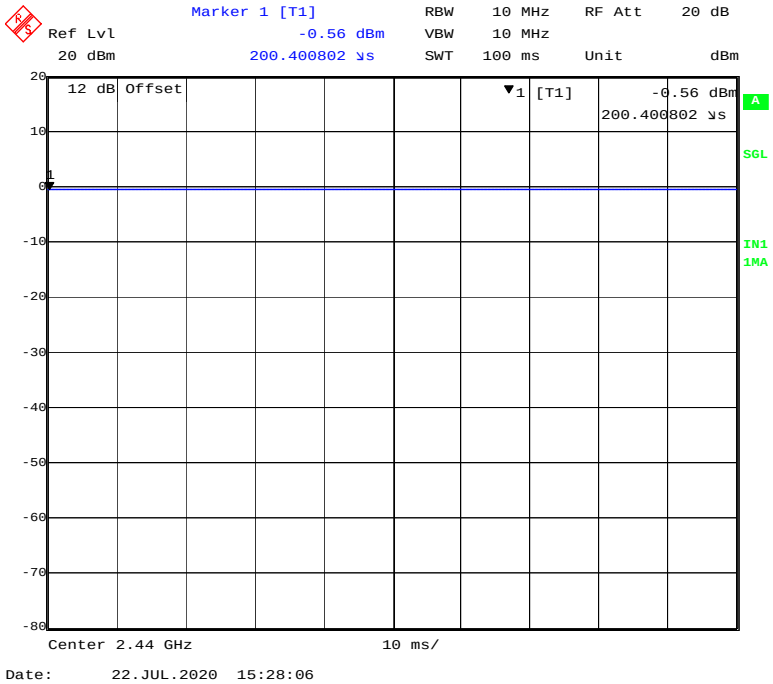
EUT Exercise Software

RF test tool: Serialport Assistor

Power Level Setting: 0

Duty Cycle:

Middle Channel



Mode	Duty Cycle (%)	T(ms)	1/T(kHz)	10log(1/x)
Zigbee	100	/	/	0

Note: "x" means the Duty Cycle.

Support Equipment List and Details

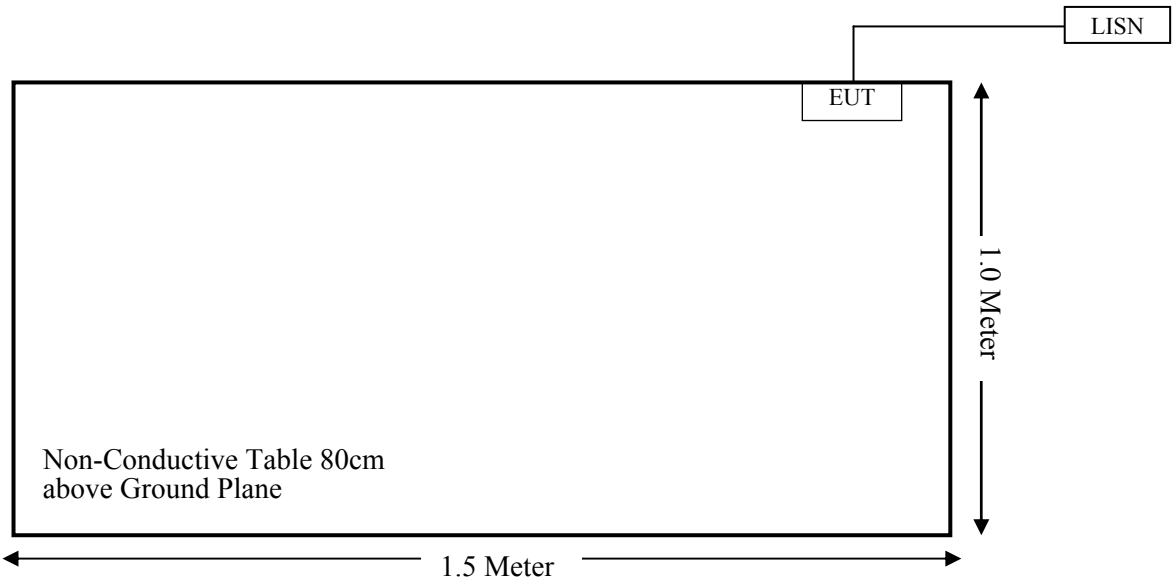
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

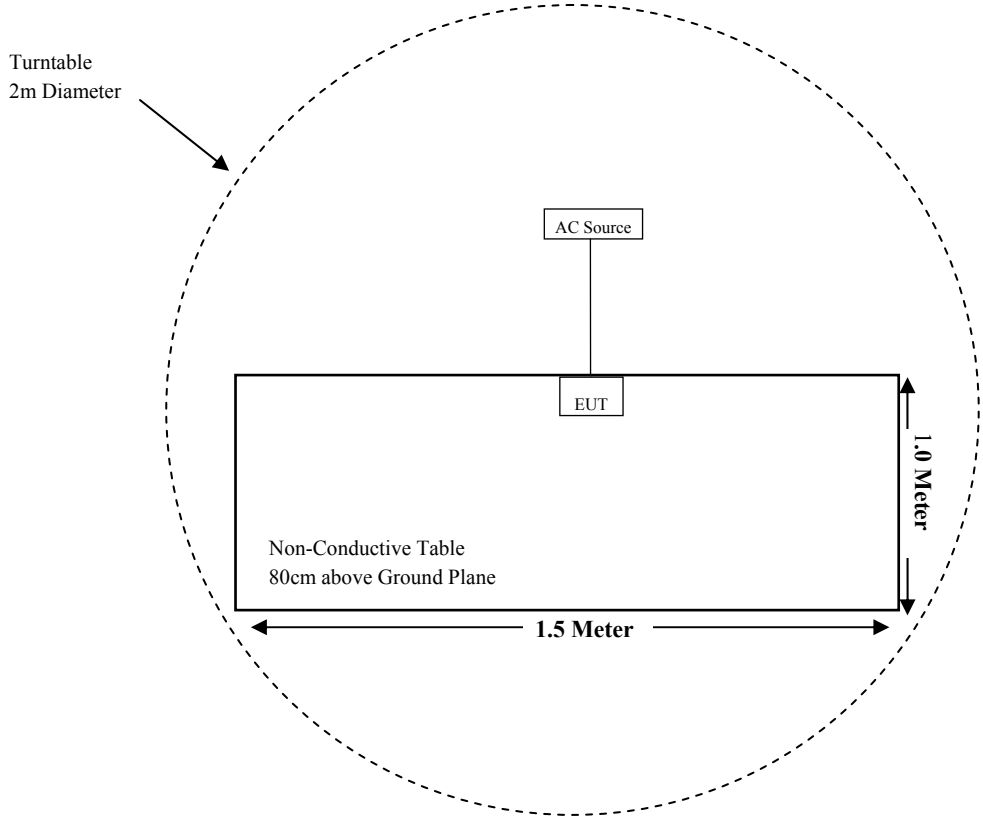
Cable Description	Length (m)	From Port	To
Power Cable	1.0	EUT	AC Source

Block Diagram of Test Setup

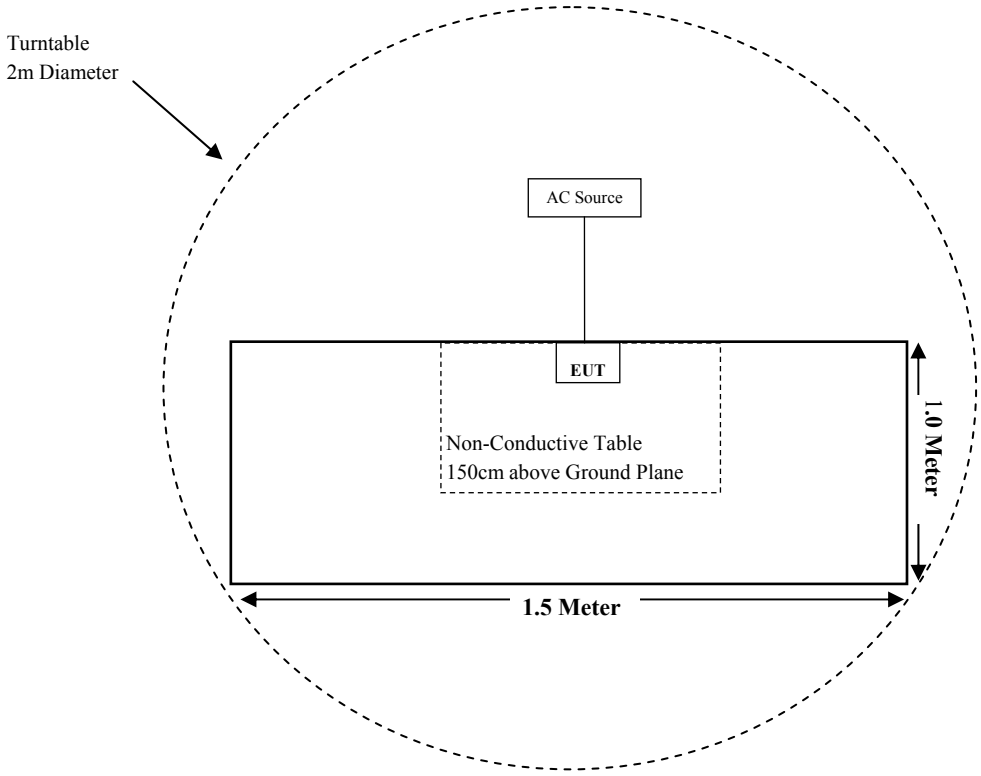
For Conducted Emissions:



For Radiated Emissions (Below 1GHz):



For Radiated Emissions (Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1307(b)(1) & §2.1093	RF Exposure Information	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.247(d)	Spurious Emissions at Antenna Port	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test receiver	ESCI	100195	2019-12-14	2020-12-13
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2017-12-26	2020-12-25
Sonoma Instrument	Pre-amplifier	310N	171205	2019-08-14	2020-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2019-08-15	2020-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2020-04-01	2021-03-31
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2020-07-15	2023-07-14
ETS-LINDGREN	Horn Antenna	3116	00084159	2020-01-17	2023-01-16
A.H.Systems, inc	Amplifier	PAM-0118P	512	2020-02-20	2021-02-19
SELECTOR	Amplifier	EM18G40G	060726	2020-03-22	2021-03-21
MICRO-TRONICS	Band Reject Filter	BRM50702	G024	2019-08-05	2020-08-04
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2019-08-15	2020-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/0009	2019-12-14	2020-12-13
Narda	Attenuator	10dB	010	2019-08-15	2020-08-14
Katerra	RF Cable	Katerra C01	/	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2019-08-05	2020-08-04
Rohde & Schwarz	LISN	ENV216	3560655016	2019-12-14	2020-12-13
Audix	Test Software	e3	V9	---	---
Rohde & Schwarz	Pulse limiter	ESH3-Z2	0357.8810.54	2019-08-10	2020-08-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2019-08-15	2020-08-14

*** Statement of Traceability:** Bay Area Compliant Laboratories Corp. (Kunshan) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1307(b) & §2.1093 - RF EXPOSURE INFORMATION

Applicable Standard

According to§15.247(i) and §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB447498 D01 General RF Exposure Guidance v06:

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Calculated Data:

Mode	Frequency Range (MHz)	Max Tune-up Conducted Power		Calculated Distance (mm)	Calculated Value	Threshold (1-g SAR)	SAR Test Exclusion
		(dBm)	(mW)				
Zigbee	2405~2480	4.0	2.51	5.0	0.79	3.0	Yes

Result: So the standalone SAR evaluation is not necessary.

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 Compliant 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.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has a PCB antenna and the antenna gain is 1.0 dBi, which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

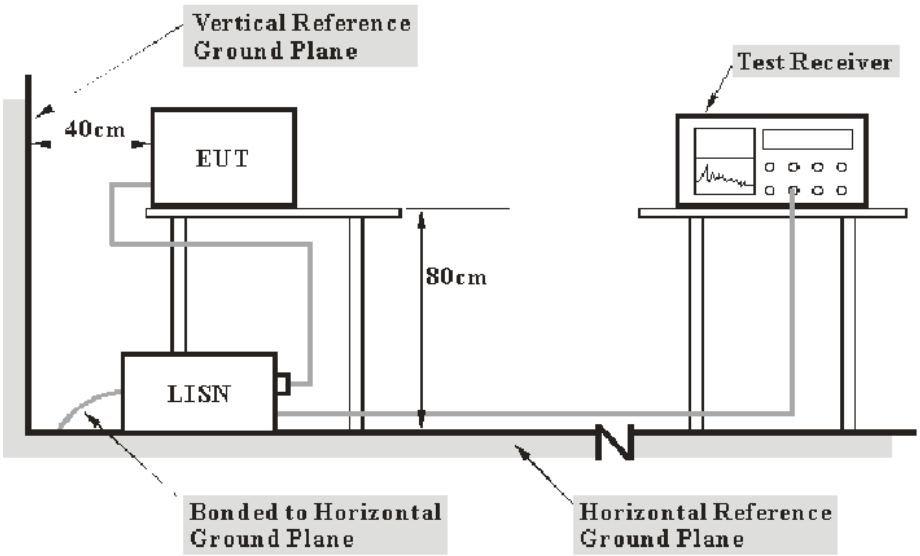
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

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 C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

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 EUT was connected to the outlet of the LISN.

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

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

Corrected Factor & Over Limit Calculation

The Corrected Factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

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

Over Limit (dB) = Read level (dBμV) + Factor (dB) - Limit (dBμV)

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

Environmental Conditions

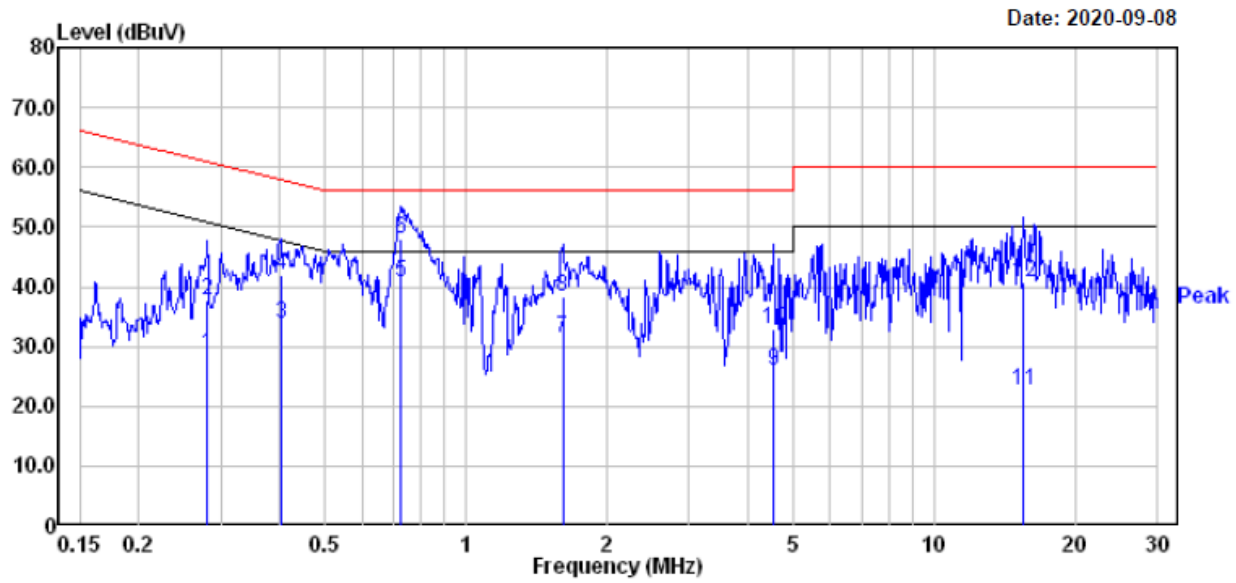
Temperature:	24.3℃
Relative Humidity:	50%
ATM Pressure:	102.3kPa

The testing was performed by Chao Gao on 2020-09-08.

EUT operation mode: Transmitting in high channel (worst case)

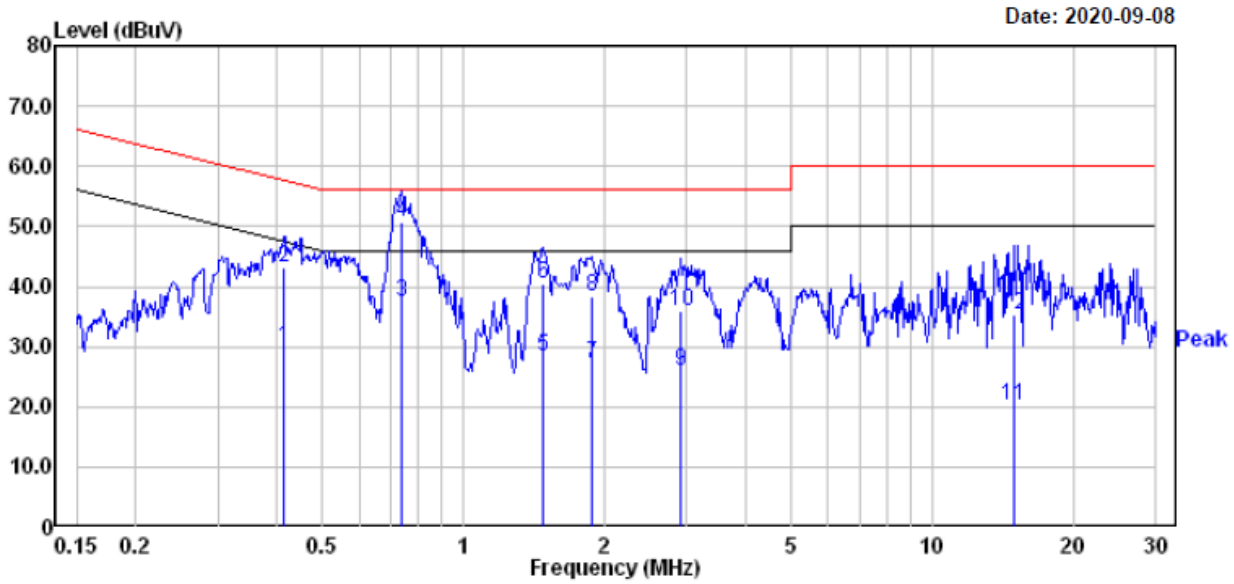
Model: CSC-CWD-UNVN-XX

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.280	9.00	19.82	28.82	50.81	-21.99	Average
2	0.280	18.00	19.82	37.82	60.81	-22.99	QP
3	0.402	14.00	19.74	33.74	47.81	-14.07	Average
4	0.402	22.30	19.74	42.04	57.81	-15.77	QP
5	0.724	21.00	19.74	40.74	46.00	-5.26	Average
6	0.724	28.40	19.74	48.14	56.00	-7.86	QP
7	1.610	11.69	19.85	31.54	46.00	-14.46	Average
8	1.610	18.39	19.85	38.24	56.00	-17.76	QP
9	4.525	6.59	19.49	26.08	46.00	-19.92	Average
10	4.525	13.49	19.49	32.98	56.00	-23.02	QP
11	15.552	2.99	19.68	22.67	50.00	-27.33	Average
12	15.552	21.09	19.68	40.77	60.00	-19.23	QP

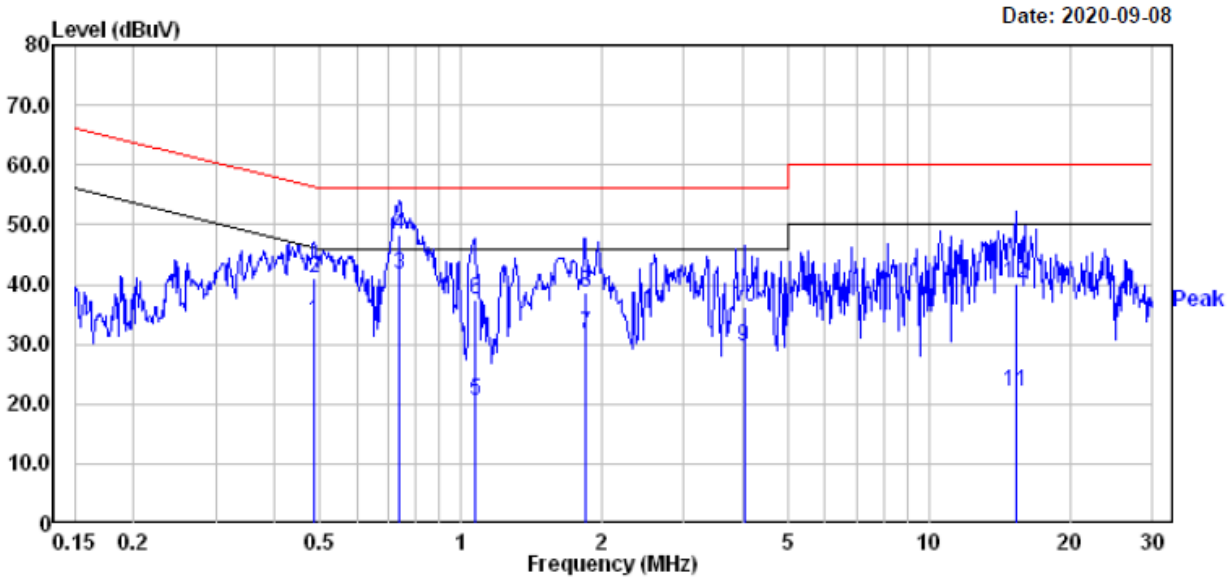
AC 120V/60 Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.415	10.20	19.74	29.94	47.55	-17.61	Average
2	0.415	23.40	19.74	43.14	57.55	-14.41	QP
3	0.739	17.80	19.73	37.53	46.00	-8.47	Average
4	0.739	30.90	19.73	50.63	56.00	-5.37	QP
5	1.480	8.40	19.84	28.24	46.00	-17.76	Average
6	1.480	20.70	19.84	40.54	56.00	-15.46	QP
7	1.888	7.40	19.83	27.23	46.00	-18.77	Average
8	1.888	18.40	19.83	38.23	56.00	-17.77	QP
9	2.915	6.50	19.46	25.96	46.00	-20.04	Average
10	2.915	16.60	19.46	36.06	56.00	-19.94	QP
11	14.907	0.60	19.63	20.23	50.00	-29.77	Average
12	14.907	15.60	19.63	35.23	60.00	-24.77	QP

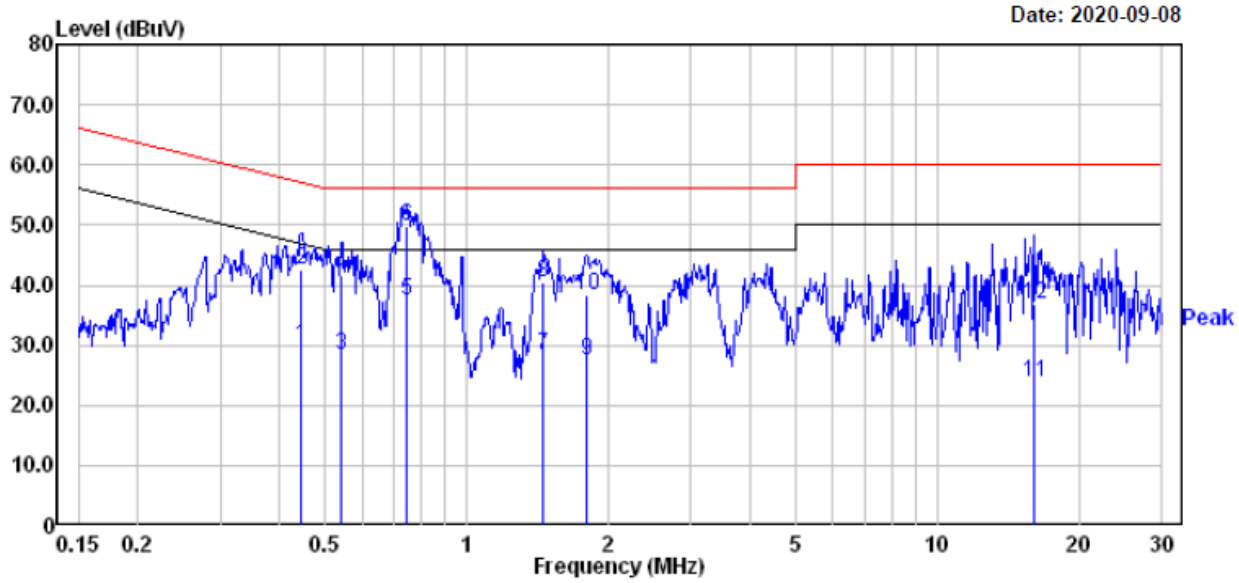
Model: CSC-CWS-UNVN-XX

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.486	14.20	19.76	33.96	46.23	-12.27	Average
2	0.486	21.20	19.76	40.96	56.23	-15.27	QP
3	0.739	21.90	19.73	41.63	46.00	-4.37	Average
4	0.739	28.60	19.73	48.33	56.00	-7.67	QP
5	1.071	0.60	19.82	20.42	46.00	-25.58	Average
6	1.071	17.60	19.82	37.42	56.00	-18.58	QP
7	1.848	11.79	19.84	31.63	46.00	-14.37	Average
8	1.848	18.89	19.84	38.73	56.00	-17.27	QP
9	4.027	10.00	19.47	29.47	46.00	-16.53	Average
10	4.027	16.80	19.47	36.27	56.00	-19.73	QP
11	15.307	2.40	19.65	22.05	50.00	-27.95	Average
12	15.307	20.40	19.65	40.05	60.00	-19.95	QP

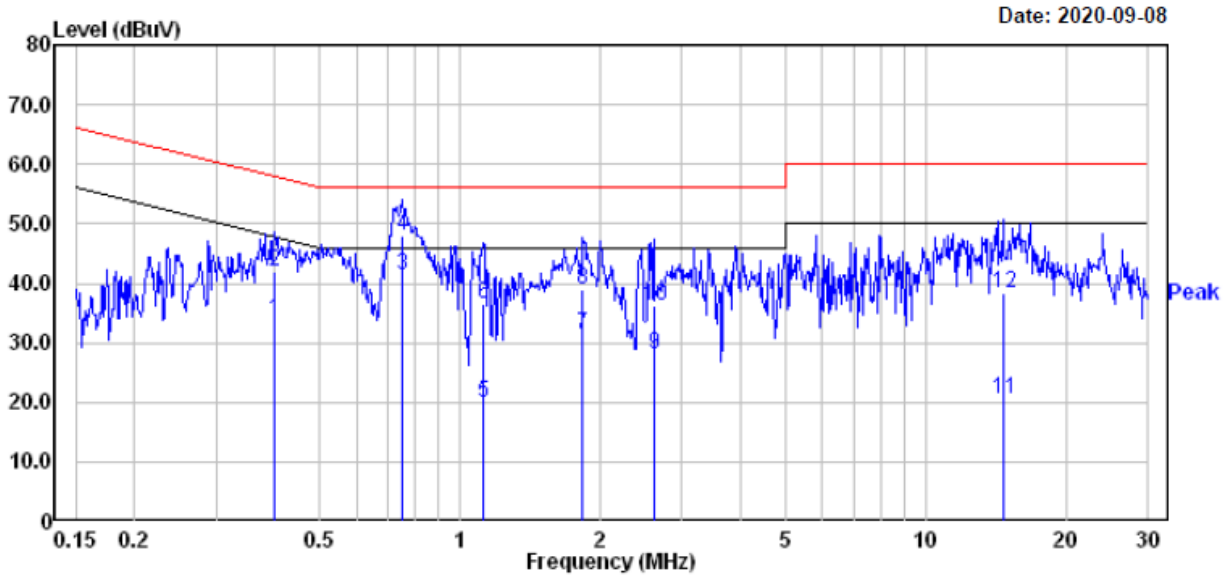
AC 120V/60 Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.444	10.10	19.75	29.85	46.98	-17.13	Average
2	0.444	22.70	19.75	42.45	56.98	-14.53	QP
3	0.541	8.71	19.75	28.46	46.00	-17.54	Average
4	0.541	21.91	19.75	41.66	56.00	-14.34	QP
5	0.743	17.80	19.73	37.53	46.00	-8.47	Average
6	0.743	30.20	19.73	49.93	56.00	-6.07	QP
7	1.456	8.60	19.84	28.44	46.00	-17.56	Average
8	1.456	20.70	19.84	40.54	56.00	-15.46	QP
9	1.800	7.50	19.84	27.34	46.00	-18.66	Average
10	1.800	18.60	19.84	38.44	56.00	-17.56	QP
11	16.140	4.10	19.71	23.81	50.00	-26.19	Average
12	16.140	17.20	19.71	36.91	60.00	-23.09	QP

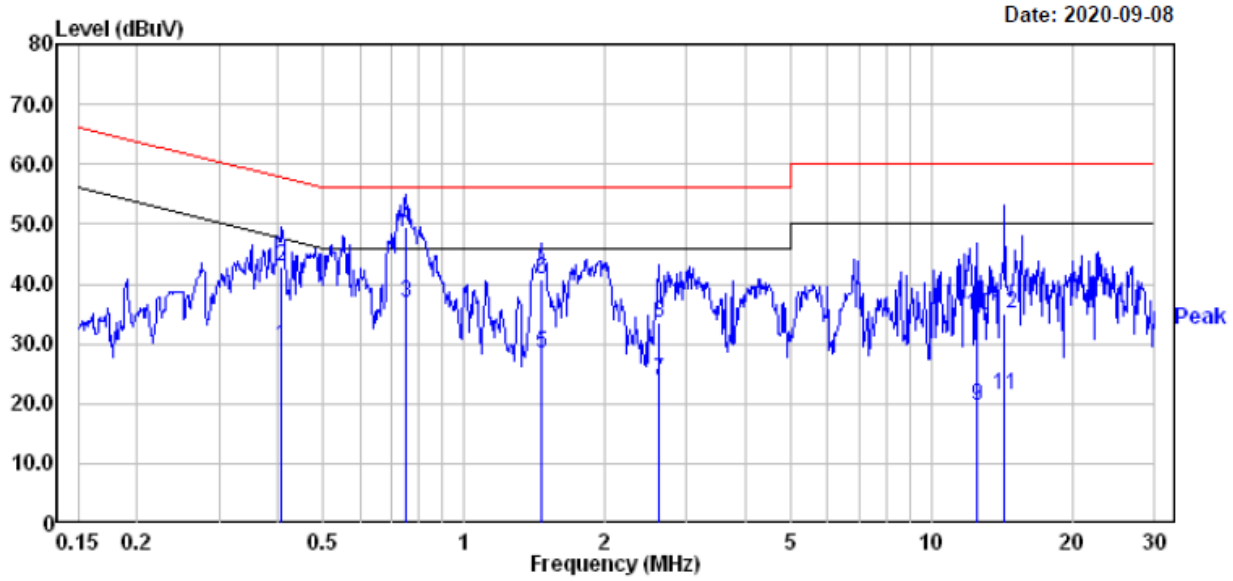
Model: CSC-CCD-UNVN-XX

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.400	14.00	19.74	33.74	47.86	-14.12	Average
2	0.400	22.20	19.74	41.94	57.86	-15.92	QP
3	0.755	21.50	19.72	41.22	46.00	-4.78	Average
4	0.755	28.30	19.72	48.02	56.00	-7.98	QP
5	1.123	0.10	19.81	19.91	46.00	-26.09	Average
6	1.123	16.80	19.81	36.61	56.00	-19.39	QP
7	1.839	11.69	19.84	31.53	46.00	-14.47	Average
8	1.839	18.99	19.84	38.83	56.00	-17.17	QP
9	2.608	8.69	19.48	28.17	46.00	-17.83	Average
10	2.608	16.79	19.48	36.27	56.00	-19.73	QP
11	14.672	1.00	19.63	20.63	50.00	-29.37	Average
12	14.672	18.60	19.63	38.23	60.00	-21.77	QP

AC 120V/60 Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.408	9.90	19.74	29.64	47.68	-18.04	Average
2	0.408	23.10	19.74	42.84	57.68	-14.84	QP
3	0.755	17.20	19.72	36.92	46.00	-9.08	Average
4	0.755	29.80	19.72	49.52	56.00	-6.48	QP
5	1.464	8.40	19.84	28.24	46.00	-17.76	Average
6	1.464	21.00	19.84	40.84	56.00	-15.16	QP
7	2.622	4.30	19.47	23.77	46.00	-22.23	Average
8	2.622	14.00	19.47	33.47	56.00	-22.53	QP
9	12.516	-0.11	19.60	19.49	50.00	-30.51	Average
10	12.516	14.99	19.60	34.59	60.00	-25.41	QP
11	14.364	1.70	19.62	21.32	50.00	-28.68	Average
12	14.364	15.40	19.62	35.02	60.00	-24.98	QP

Note:

1) Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
2) Over Limit (dB) = Read level (dBµV) + Factor (dB) - Limit (dBµV)

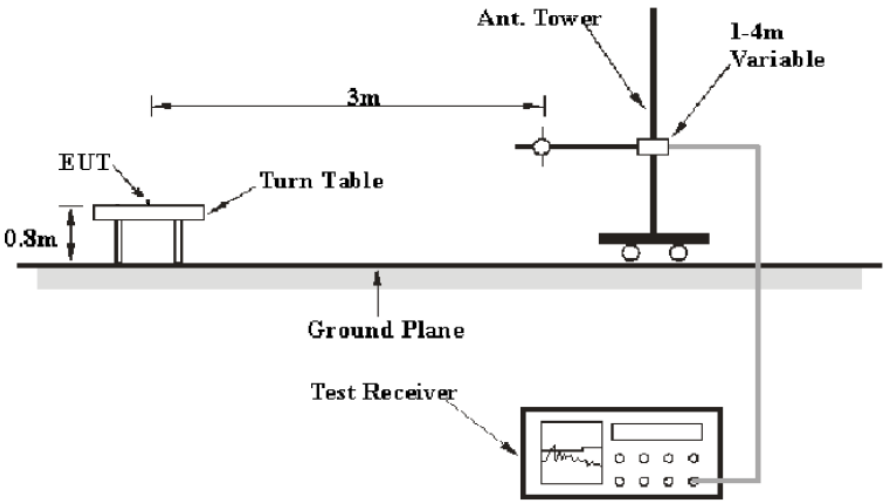
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

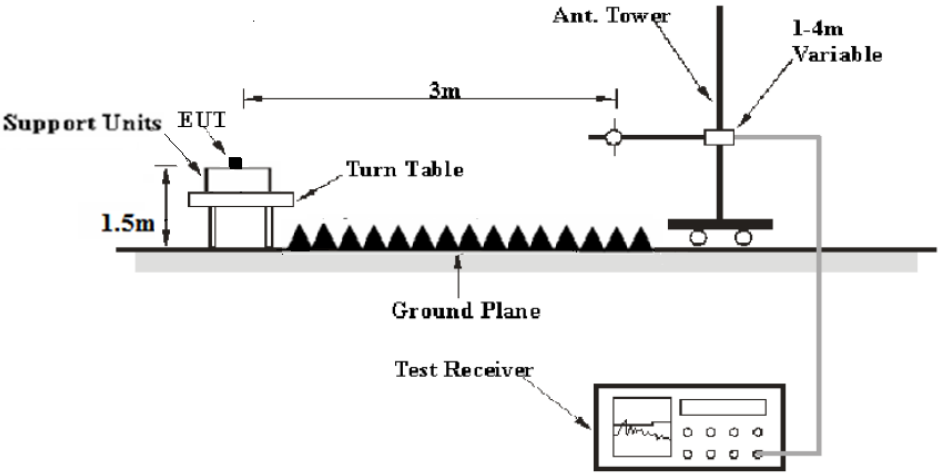
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 25 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	AVG

Test Procedure

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

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

Corrected Amplitude & Margin Calculation

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

Corrected Amplitude (dBμV/m) = Meter Reading (dBμV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB)

The "**Margin**" column of the following data tables indicates the degree of Compliant 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 (dB) = Limit (dBμV/m) - Corrected Amplitude (dBμV/m)

Test Results Summary

According to the recorded data in following table, the EUT is compliant with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

Environmental Conditions

Temperature:	23.6~24.3℃
Relative Humidity:	50~52%
ATM Pressure:	101.1~101.3 kPa

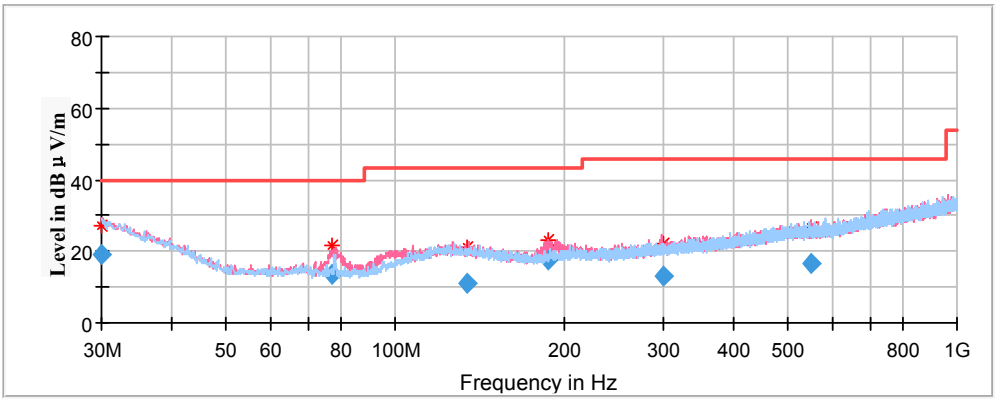
The testing was performed by Chao Gao from 2020-07-17 to 2020-07-22.

EUT operation mode: Transmitting

Spurious Emission Test:

Model: CSC-CWD-UNVN-XX

30MHz-1GHz
*(Pre-scan with Low channel, Middle channel, High channel of operation in the X,Y and Z axes of orientation, the worst case **high channel of operation in X-axis of orientation** was recorded)*

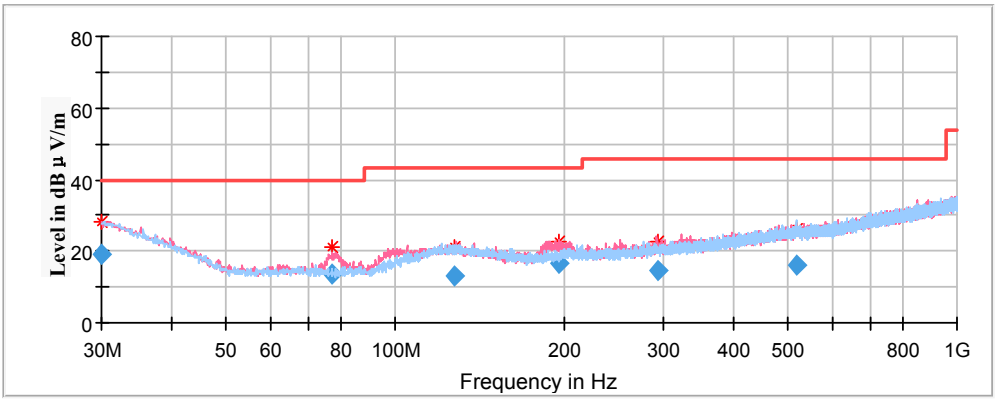


Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
30.03	18.99	100	H	271	-4.4	40.00	21.01
77.40	13.45	100	V	73	-18.1	40.00	26.55
134.19	10.83	100	V	115	-12.2	43.50	32.67
186.67	17.65	100	V	194	-13.7	43.50	25.85
299.43	13.27	200	V	183	-11	46.00	32.73
550.01	16.44	200	V	109	-5.8	46.00	29.56

Model: CSC-CWS-UNVN-XX

30MHz-1GHz

*(Pre-scan with Low channel, Middle channel, High channel of operation in the X,Y and Z axes of orientation, the worst case **high channel of operation in X-axis of orientation** was recorded)*

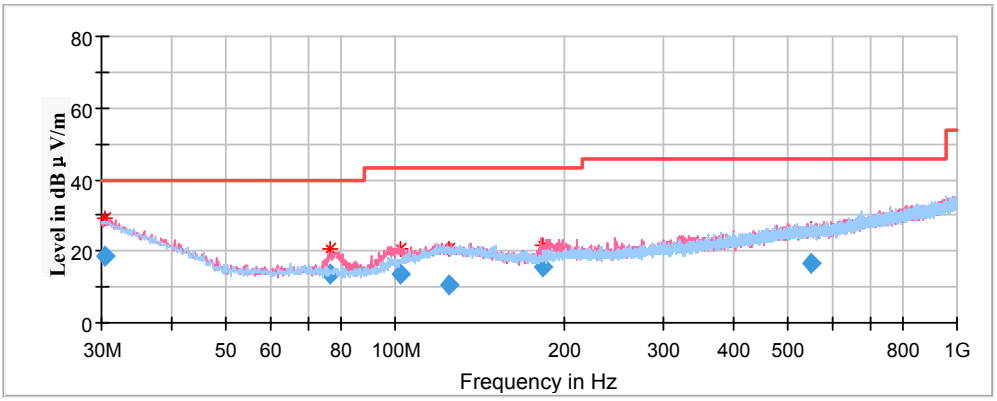


Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
30.07	19.10	200	V	286	-4.4	40.00	20.90
77.36	13.68	100	V	42	-18.1	40.00	26.32
127.70	12.93	200	V	67	-11.9	43.50	30.57
195.95	16.61	100	V	199	-13	43.50	26.89
292.58	14.42	100	V	162	-11.3	46.00	31.58
517.44	16.19	200	H	250	-6	46.00	29.81

Model: CSC-CCD-UNVN-XX

30MHz-1GHz

*(Pre-scan with Low channel, Middle channel, High channel of operation in the X,Y and Z axes of orientation, the worst case **high channel of operation in X-axis of orientation** was recorded)*



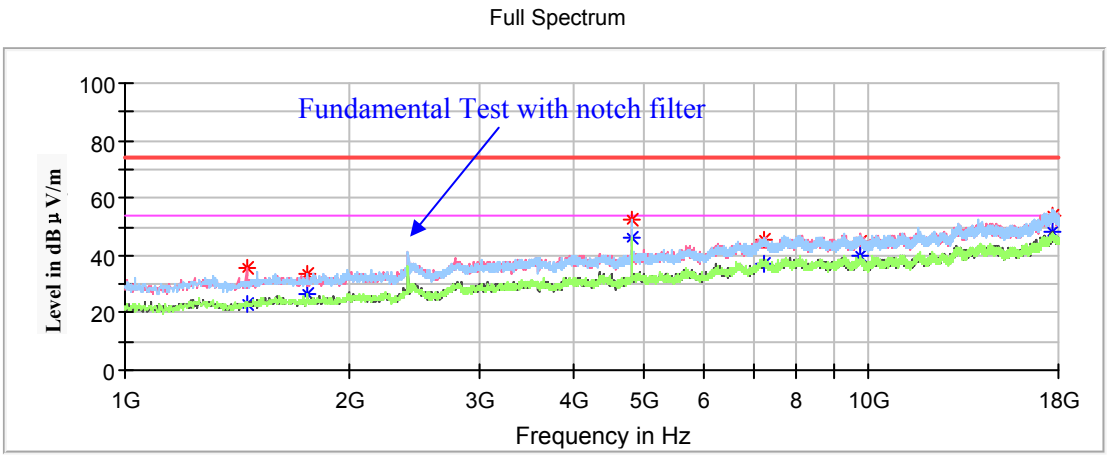
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
30.54	18.82	100	V	325	-4.7	40.00	21.18
76.81	13.40	100	V	16	-18.0	40.00	26.60
102.37	13.79	100	V	79	-14.9	43.50	29.71
124.71	10.77	200	V	297	-11.8	43.50	32.73
182.63	15.49	100	V	189	-13.9	43.50	28.01
549.57	16.44	200	H	288	-5.8	46.00	29.56

1GHz-18GHz

*(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

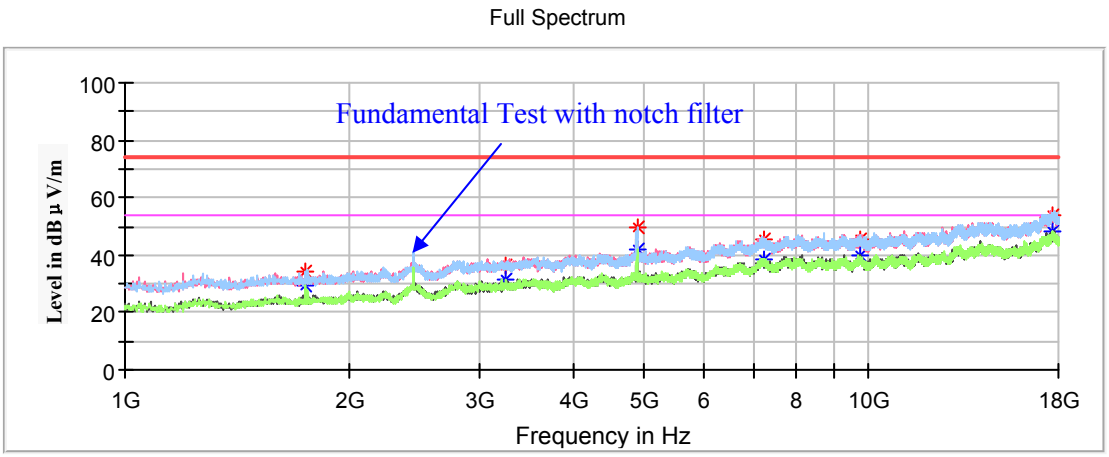
Note:
1. This test was performed with the 2.4 - 2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) - Amplifier Factor (dB)
   Corrected Amplitude (dBµV/m) = Corrected Factor (dB/m) + Reading (dBµV)
   Margin (dB) = Limit (dBµV/m) - Corrected Amplitude (dBµV/m)

Low Channel: 2405MHz



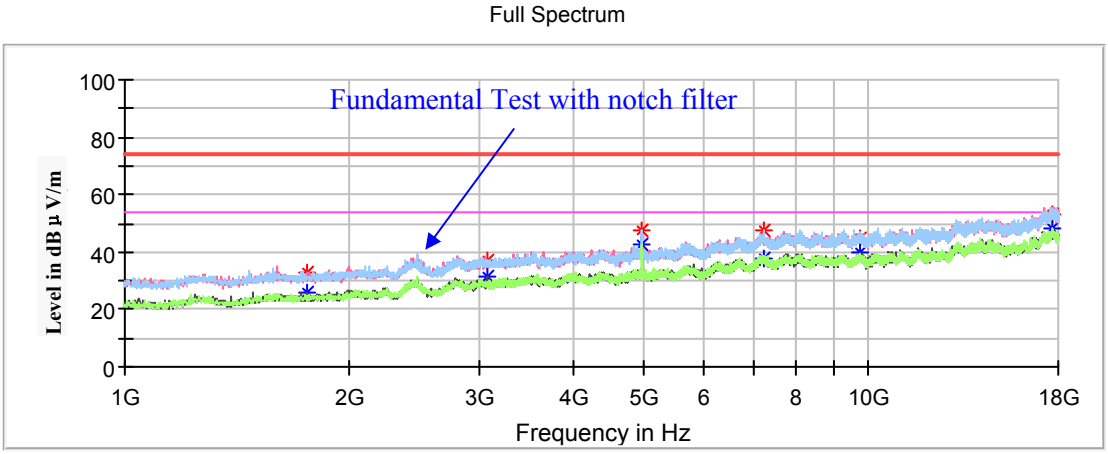
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1455.60	---	22.81	150	V	285	-16.6	54.00	31.19
1455.60	35.69	---	150	V	285	-16.6	74.00	38.31
1756.50	---	26.65	200	H	73	-15.4	54.00	27.35
1756.50	33.91	---	200	H	73	-15.4	74.00	40.09
4810.00	---	45.85	200	H	324	-5.6	54.00	8.15
4810.00	52.22	---	200	H	324	-5.6	74.00	21.78
7215.00	---	37.18	200	H	0	0.4	54.00	16.82
7215.00	45.37	---	200	H	0	0.4	74.00	28.63
9739.70	---	39.65	200	H	4	2.0	54.00	14.35
9739.70	44.88	---	200	H	4	2.0	74.00	29.12
17666.80	---	47.97	150	V	89	8.9	54.00	6.03
17666.80	54.04	---	150	V	89	8.9	74.00	19.96

Middle Channel: 2440MHz



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1748.00	---	29.52	150	H	0	-15.4	54.00	24.48
1748.00	34.43	---	150	H	0	-15.4	74.00	39.57
3259.30	---	31.54	200	H	257	-9.4	54.00	22.46
3259.30	36.54	---	200	H	257	-9.4	74.00	37.46
4880.00	---	41.96	150	H	320	-5.4	54.00	12.04
4880.00	49.51	---	150	H	320	-5.4	74.00	24.49
7244.10	---	38.45	150	V	352	0.5	54.00	15.55
7244.10	45.65	---	150	V	352	0.5	74.00	28.35
9731.20	---	39.77	150	V	9	2.0	54.00	14.23
9731.20	45.36	---	150	V	9	2.0	74.00	28.64
17663.40	---	48.24	200	V	202	8.9	54.00	5.76
17663.40	53.83	---	200	V	202	8.9	74.00	20.17

High Channel: 2480MHz

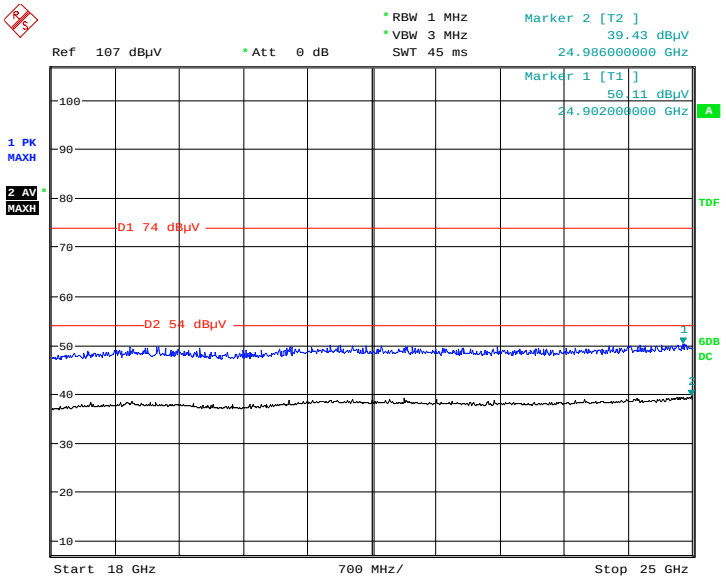


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
1761.60	---	26.12	200	V	352	-15.4	54.00	27.88
1761.60	32.81	---	200	V	352	-15.4	74.00	41.19
3070.60	---	31.31	150	V	207	-9.9	54.00	22.69
3070.60	37.29	---	150	V	207	-9.9	74.00	36.71
4960.00	---	42.79	200	H	323	-5.3	54.00	11.21
4960.00	47.23	---	200	H	323	-5.3	74.00	26.77
7240.00	---	37.84	150	H	269	0.5	54.00	16.16
7240.00	47.29	---	150	H	269	0.5	74.00	26.71
9739.70	---	40.03	200	V	345	2.0	54.00	13.97
9739.70	44.90	---	200	V	345	2.0	74.00	29.10
17671.90	---	47.93	150	H	296	8.9	54.00	6.07
17671.90	53.40	---	150	H	296	8.9	74.00	20.60

18GHz - 25GHz

*(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **high channel of operation in X-axis of orientation** was recorded)*

Horizontal



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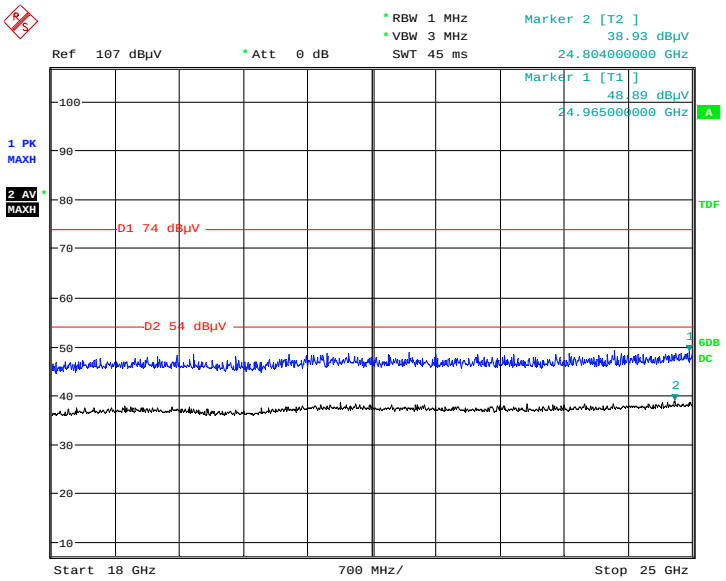
Vertical



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Restricted Bands Emissions Test:

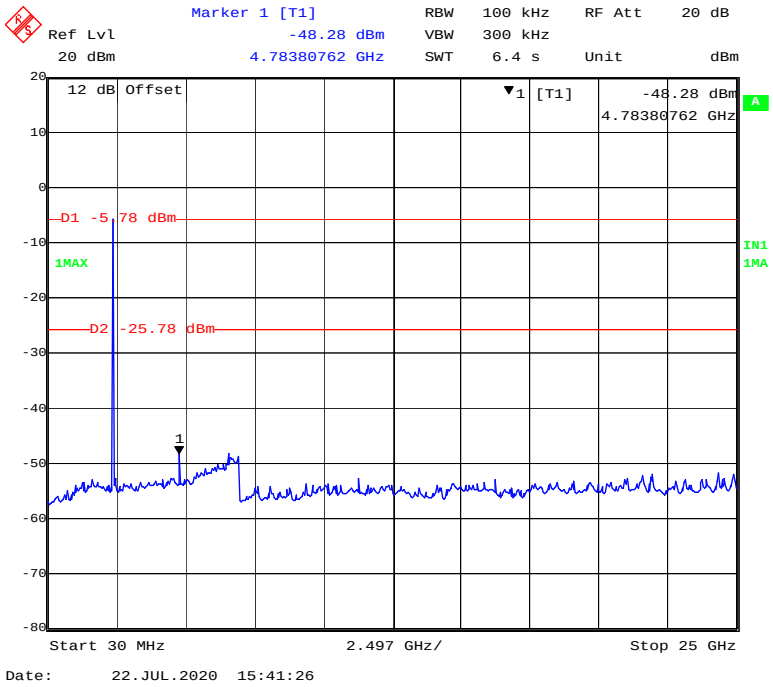
*(Pre-scan in the X, Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

Note:
1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) - Amplifier Factor (dB)
   Corrected Amplitude (dBµV/m) = Corrected Factor (dB/m) + Reading (dBµV)
   Margin (dB) = Limit (dBµV/m) - Corrected Amplitude (dBµV/m)

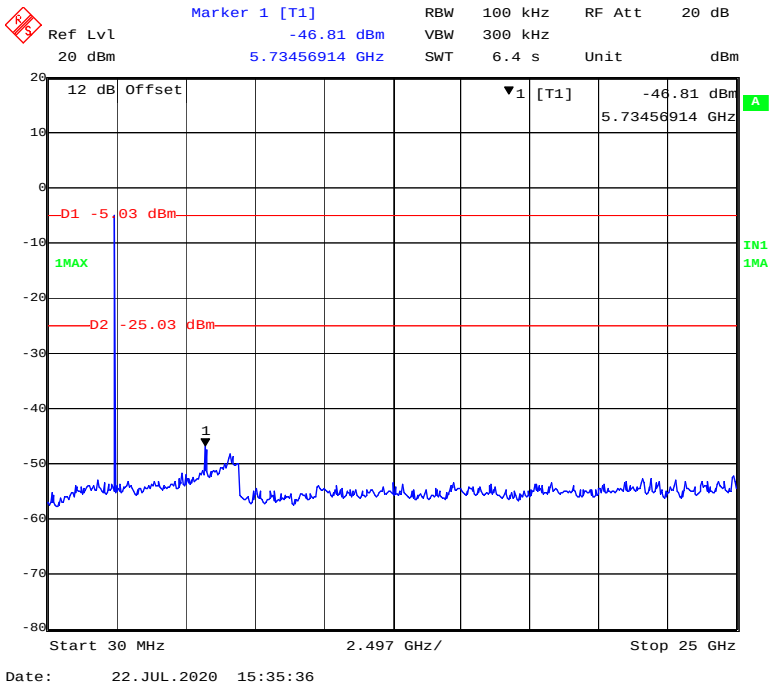
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV/m)	Average (dBµV/m)	Height (cm)	Polar (H/V)				
Low Channel: 2405MHz								
2390.00	---	38.37	200	H	269	-2.9	54.00	15.63
2390.00	43.76	---	200	H	269	-2.9	74.00	30.24
High Channel: 2480MHz								
2483.50	---	44.77	150	H	140	-2.5	54.00	9.23
2483.50	52.66	---	150	H	140	-2.5	74.00	21.34

Conducted Spurious Emissions at Antenna Port

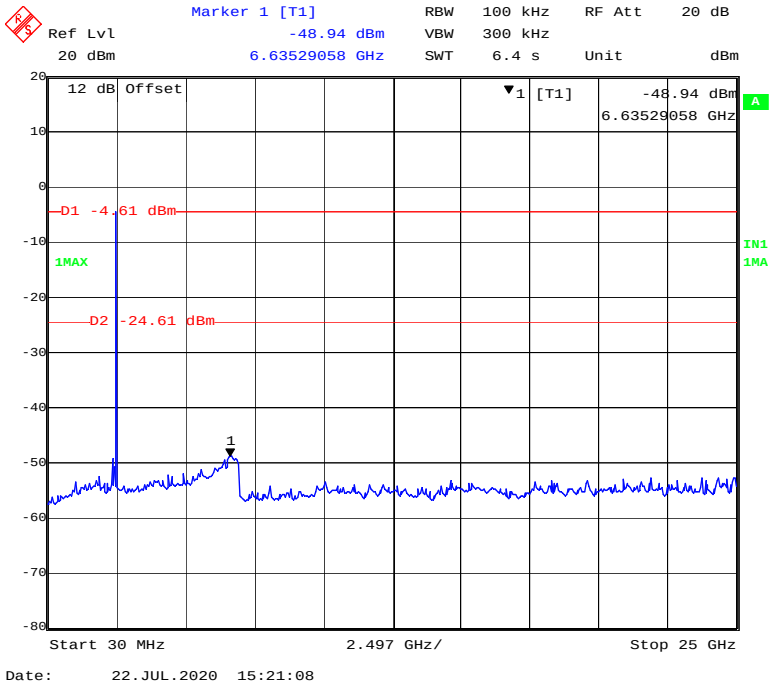
Low Channel : 2405MHz



Middle Channel : 2440MHz



High Channel : 2480MHz



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

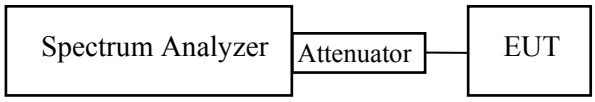
Applicable Standard

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 ANSI C63.10-2013 sub-clause 11.8.1

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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:	24 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

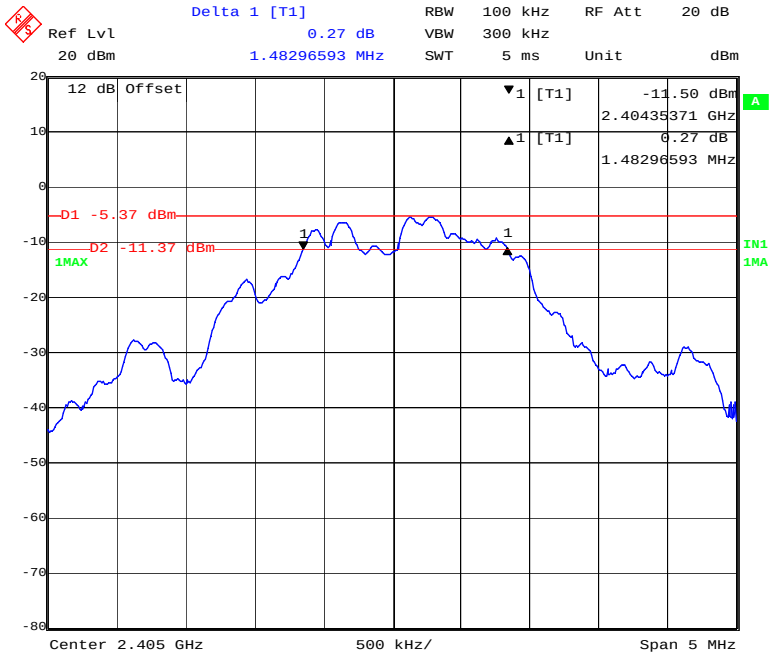
The testing was performed by Chao Gao on 2020-07-22.

Test Result: Compliant.

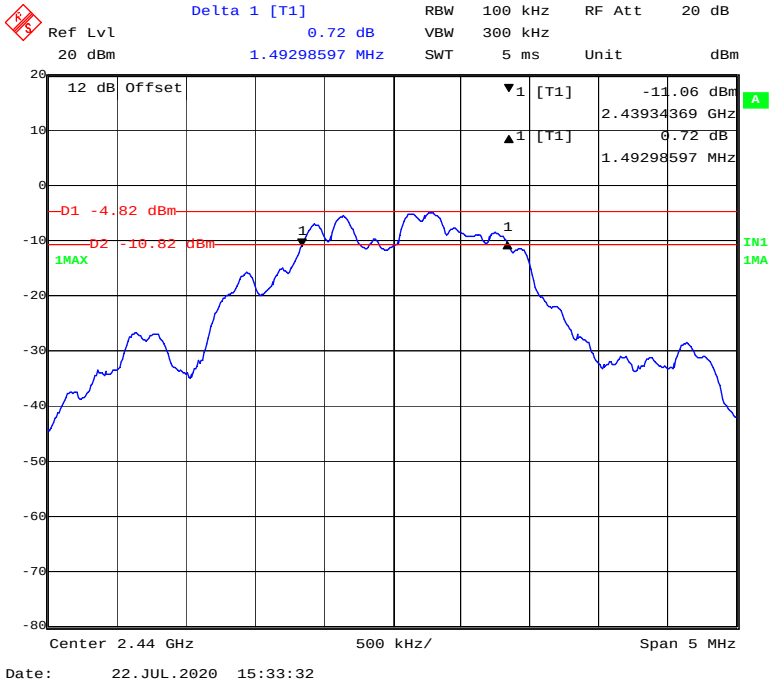
EUT operation mode: Transmitting

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
Low	2405	1.483	≥0.5
Middle	2440	1.493	≥0.5
High	2480	1.453	≥0.5

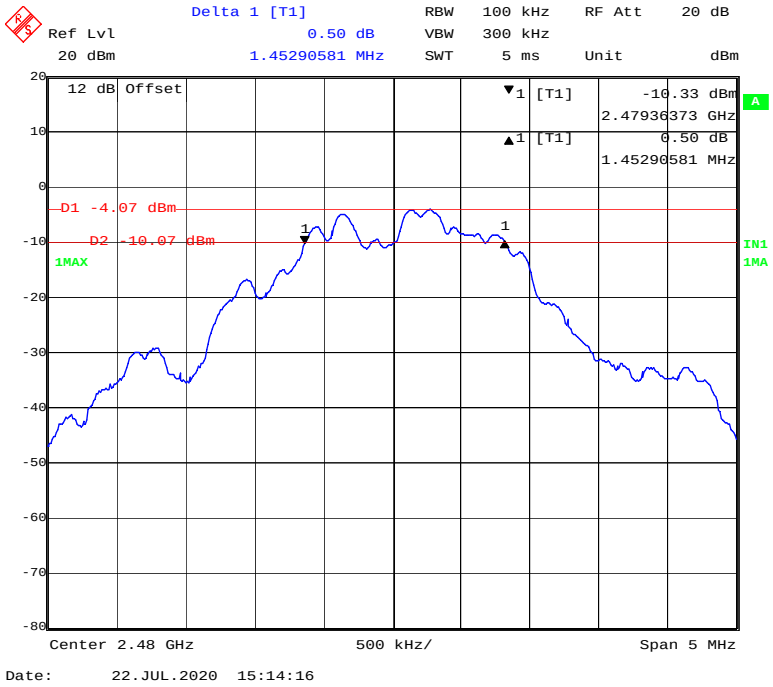
Low Channel : 2405MHz



Middle Channel : 2440MHz



High Channel : 2480MHz



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

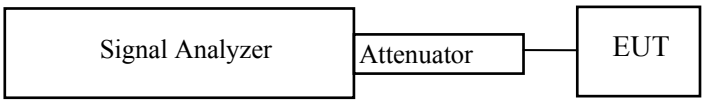
Applicable Standard

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, Compliant 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 ANSI C63.10-2013 sub-clause 11.9.1.3

1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW.
3. Set span ≥ 3 x RBW
4. Sweep time = auto couple.
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use peak marker function to determine the peak amplitude level.



Test Data

Environmental Conditions

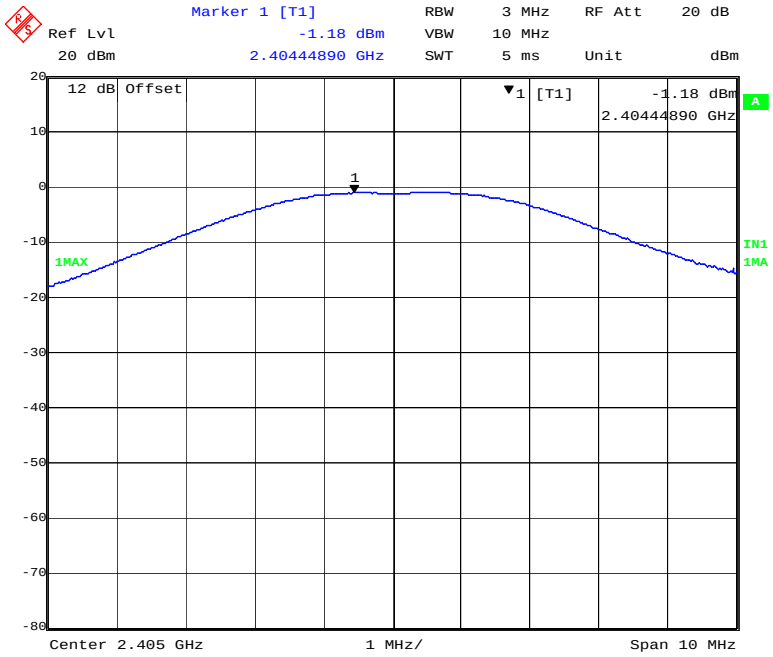
Temperature:	23.8 ℃
Relative Humidity:	54 %
ATM Pressure:	101.2 kPa

The testing was performed by Chao Gao on 2020-07-22.

EUT operation mode: Transmitting

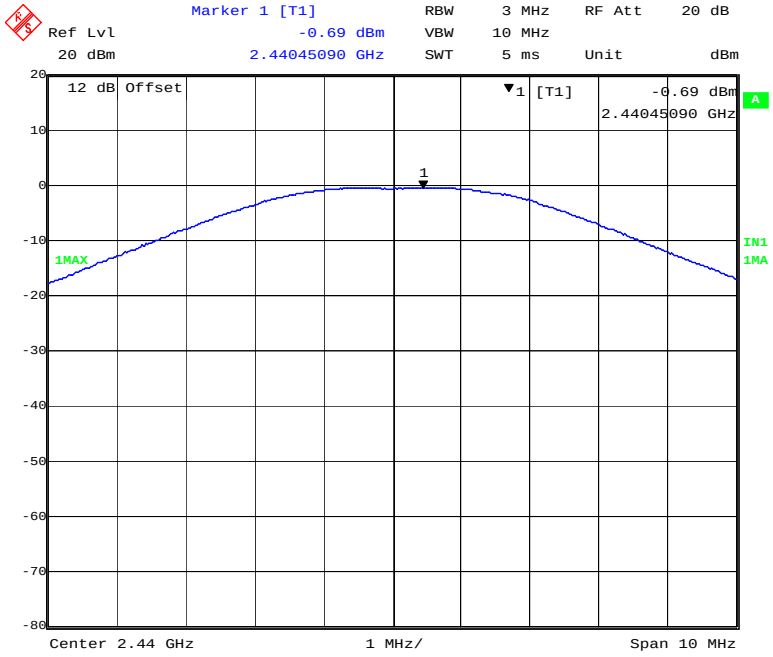
Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	2405	-1.18	30	Pass
Middle	2440	-0.69	30	Pass
High	2480	-0.06	30	Pass

Low Channel : 2405MHz



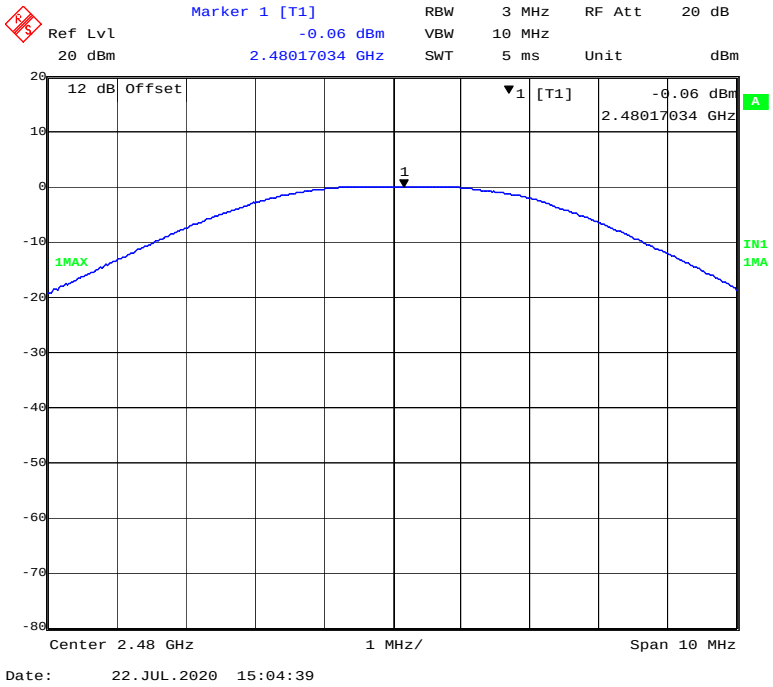
Date: 22.JUL.2020 15:51:38

Middle Channel : 2440MHz



Date: 22.JUL.2020 15:31:41

High Channel : 2480MHz



FCC §15.247(d) – 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 Compliant 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

According to ANSI C63.10-2013 sub-clause 6.10.

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

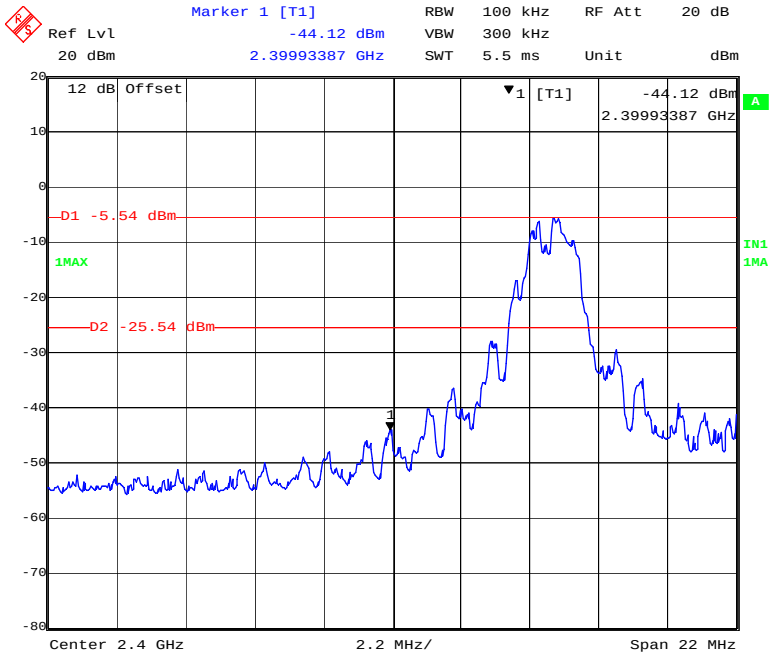
Temperature:	24.3 ℃
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Chao Gao on 2020-07-22.

EUT operation mode: Transmitting

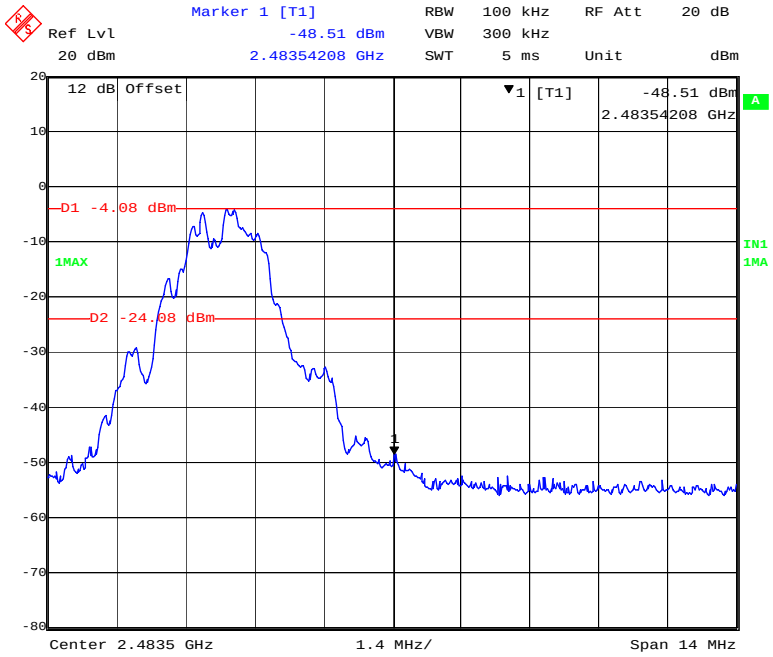
Test Result: Compliant.

Left Side



Date: 22.JUL.2020 15:46:54

Right Side



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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 ANSI C63.10-2013 sub-clause 11.10.2

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate Compliant.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	24.1 ℃
Relative Humidity:	50%
ATM Pressure:	101.3 kPa

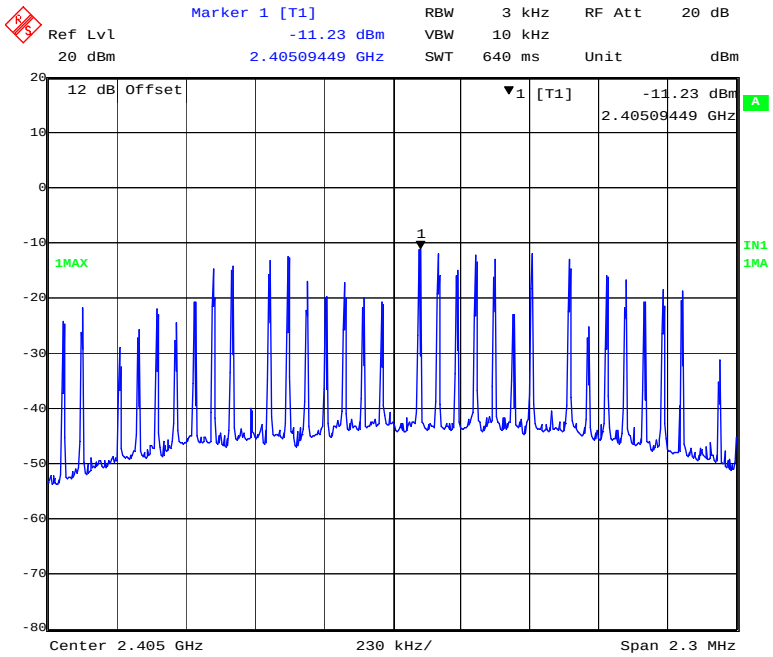
The testing was performed by Chao Gao on 2020-07-22.

EUT operation mode: Transmitting

Test Result: Compliant.

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)
Low Channel	2405	-11.23	≤8
Middle Channel	2440	-11.16	≤8
High Channel	2480	-9.79	≤8

Low Channel : 2405MHz



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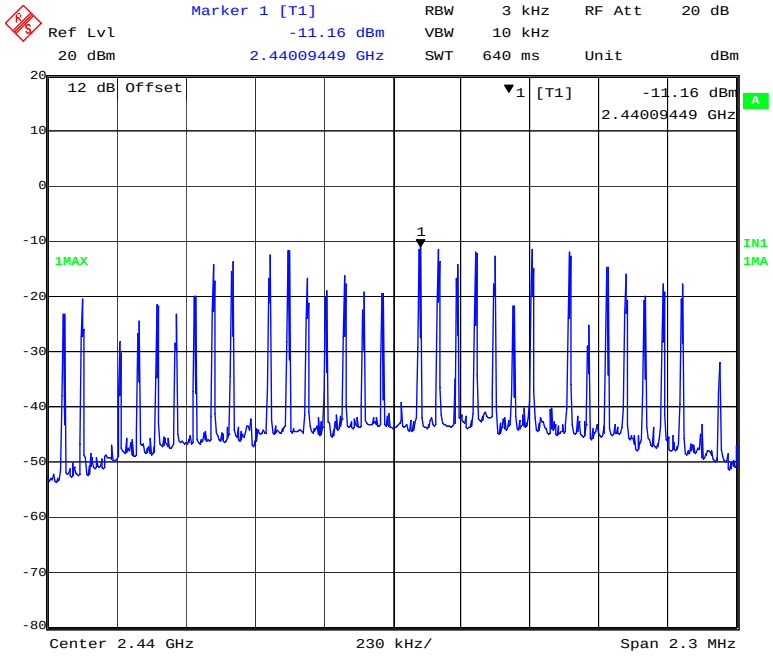
Middle Channel : 2440MHz



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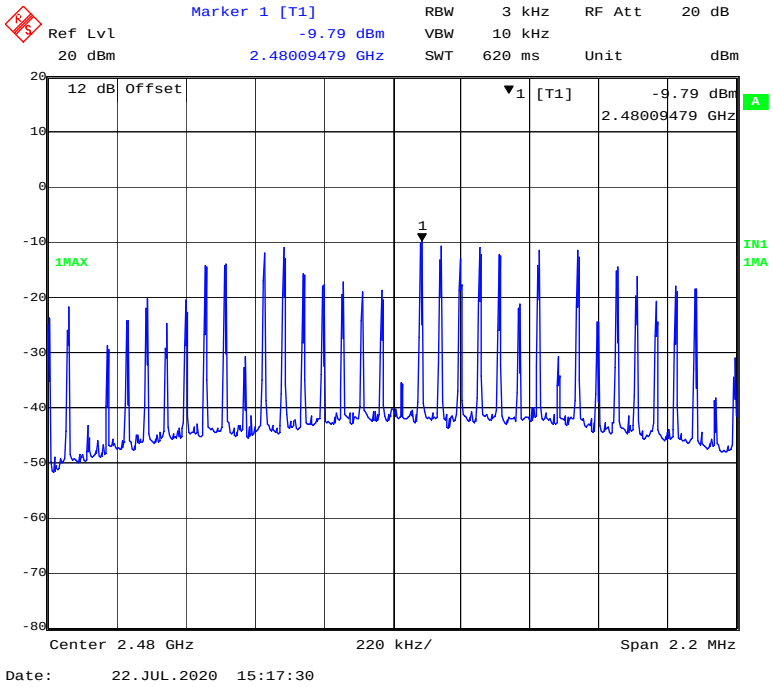
High Channel : 2480MHz



Declarations

1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

3: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

5: This report cannot be reproduced except in full, without prior written approval of the Company.

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