TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.249

TEST REPORT

For

OKIN Refined Electric Technology Co., Ltd.

Plant 4, No. 410, Xinyonglian Road, Wangjiangjing Development Zone, Jiaxing, Zhejiang, China

FCC ID: PCU-CB0920

Report Type:	Product Type:
Original Report	Control Box

Test Engineer:	Hope Zhang
Report Number:	RSHA180827012-00B
Report Date:	2018-09-08
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	OKIN Refined Electric Technology Co., Ltd.
Tested Model	CB0920
Product Type	Control Box
Dimension	150mm(L)×55 mm(W)×25 mm(H)
Power Supply	DC 29V

All measurement and test data in this report was gathered from production sample serial number: 20180827012. (Assigned by BACL, Kunshan). The EUT was received on 2018-08-27.

Objective

This type approval report is prepared on behalf of *OKIN Refined Electric Technology Co., Ltd.* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS submissions with FCC ID: PCU-CB0920.
FCC Part15.249 DXX submissions with FCC ID: PCU-RF2406.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Lab 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		3.19 dB
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 Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

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

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SYSTEM TEST CONFIGURATION

Justification

The system was configured in testing mode which was provided by manufacturer, below is the channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2403	40	2442
2	2404	…	…
…	…	…	…
…	…	…	…
37	2439	…	…
38	2440	77	2479
39	2441	78	2480

EUT was tested with Channel 1, 38 and 78.

All buttons triggered the same RF parameters (Contain bandwidth, power level, duty cycle).

EUT Exercise Software

No software was used during the test.

Support Equipment List and Details

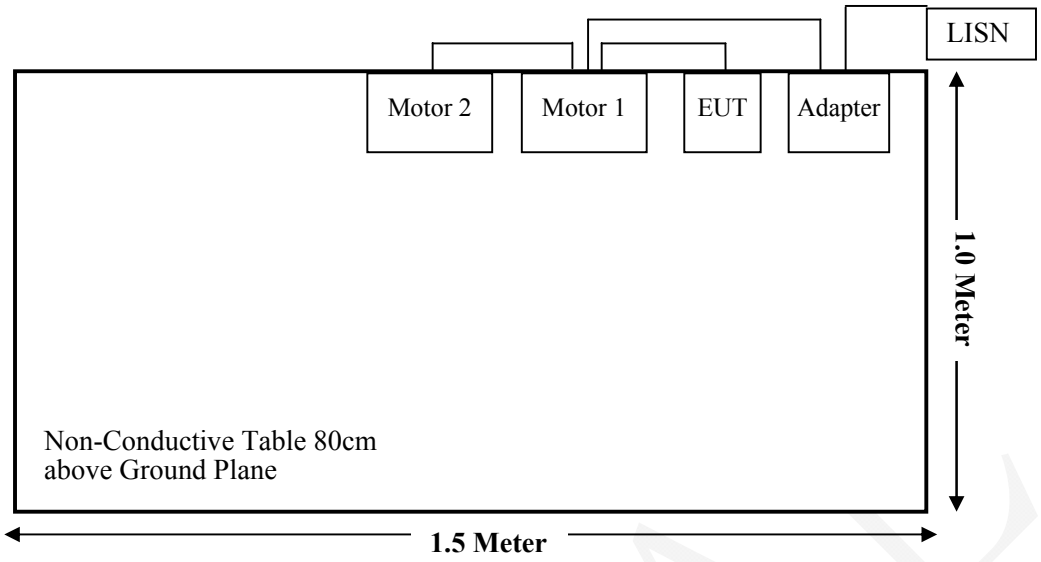
Manufacturer	Description	Model	Serial Number
OKIN	Motor 1	B11573	Q1707233700010
OKIN	Motor 2	B11574	Q1707235800010
OKIN	Adapter	02-290018 (Input AC100-240V 50/60Hz 1.5A Output: DC29V 1.8A)	6800056715R184233974

External I/O Cable

Cable Description	Length (m)	From Port	To
Motor 1 Cable	0.8	EUT	Motor 1
Power Cable	0.8	Motor 1	Adapter
Motor 2 Cable	0.8	Motor 1	Motor 2

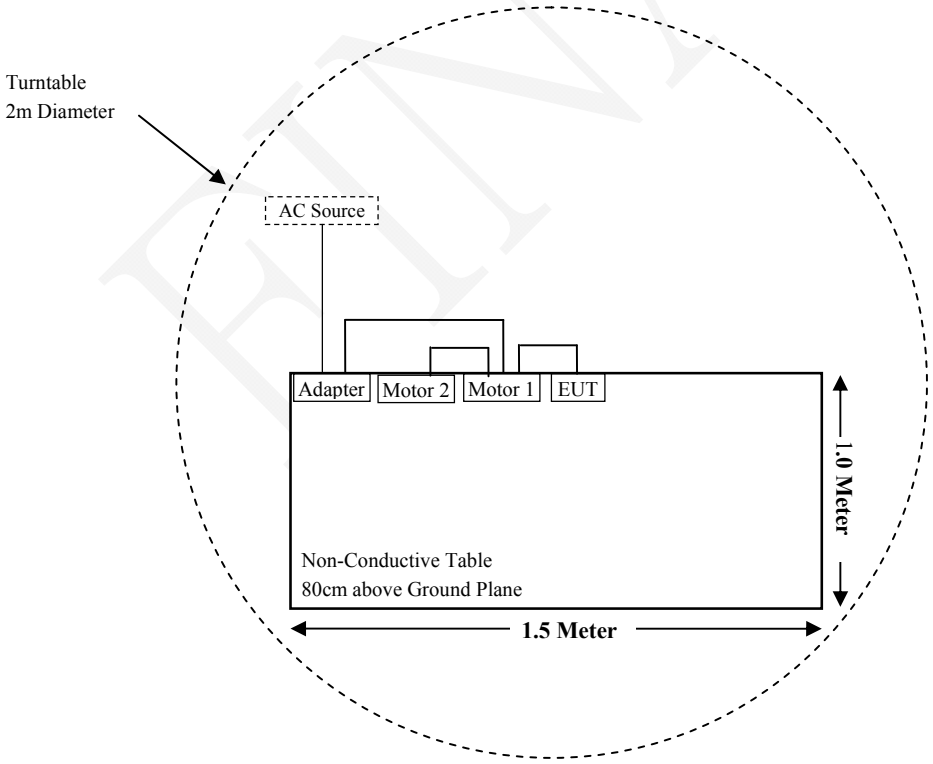
Block Diagram of Test Setup

For Conducted Emissions:

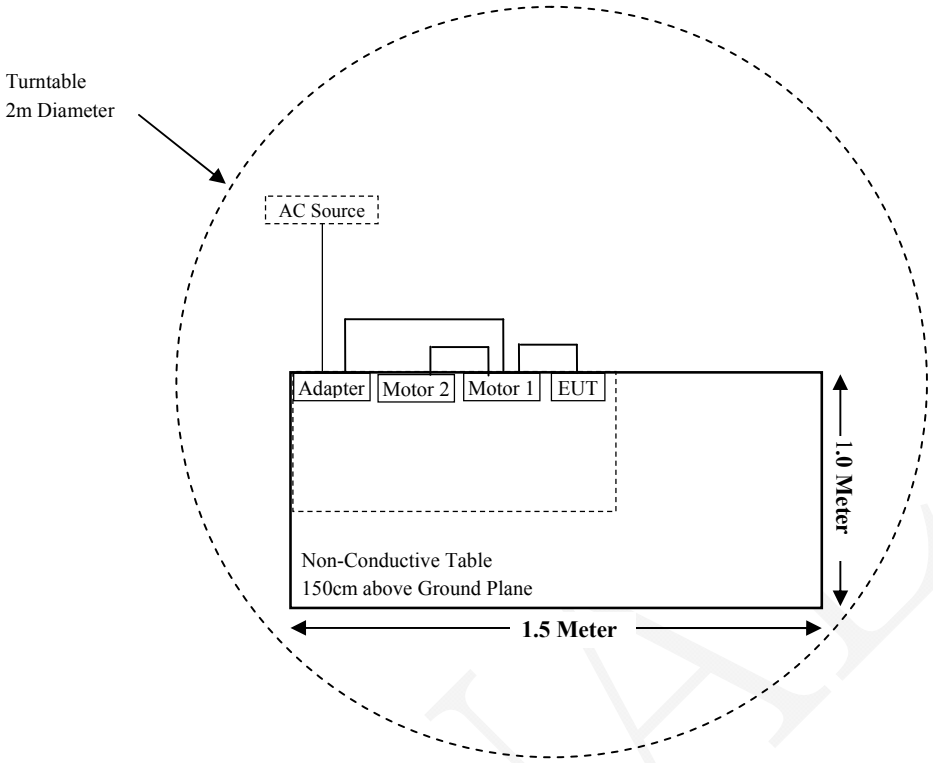


Block Diagram of Test Setup

For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliant
§15.207(a)	Conduction Emissions	Compliant
15.205, §15.209, §15.249	Radiated Emissions& Out of Band Emission	Compliant
§15.215 (c)	20 dB Bandwidth	Compliant

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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	2017-11-12	2018-11-11
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrunent	Pre-amplifier	310N	171205	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2018-08-15	2019-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2018-08-27	2019-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
MICRO-TRONICS	Notch Filter	BRM50702	/	2018-08-05	2019-08-04
Mini-Circuits	Amplifier	ZVA-183W-S+	220701818	2018-05-20	2019-05-19
EM Electronics Corporation	Amplifier	EM18G40G	060726	2018-03-22	2019-03-21
Narda	Attenuator/10dB	10dB	/	2018-08-15	2019-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2018-08-15	2019-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2018-08-15	2019-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2017-09-21	2018-09-20
Narda	Attenuator/10dB	10dB	/	2018-08-15	2019-08-14
OKIN	RF Cable	/	/	Each Time	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2017-11-12	2018-11-11
Rohde & Schwarz	LISN	ENV216	3560655016	2017-11-12	2018-11-11
BACL	Auto test Software	BACL-EMC	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2018-08-15	2019-08-14

*** Statement of Traceability:** Bay Area Compliance 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§15.203 - ANTENNA REQUIREMENT

Applicable Standard

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

Antenna Connector Construction

The EUT has a PCB antenna and antenna gain is 0 dBi, which was permanently attached, fulfill the requirement of this section, please refer to the EUT photos.

Result: Compliant.

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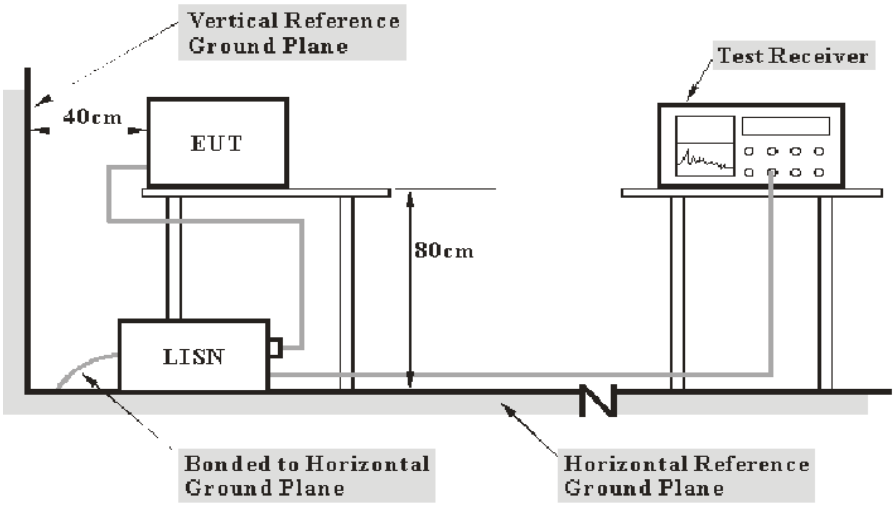
FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

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

The spacing between the peripherals was 10 cm.

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 was connected to the outlet of the 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 Factor & Margin 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:

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 compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB 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 complied with the FCC Part 15.207.

Test Data

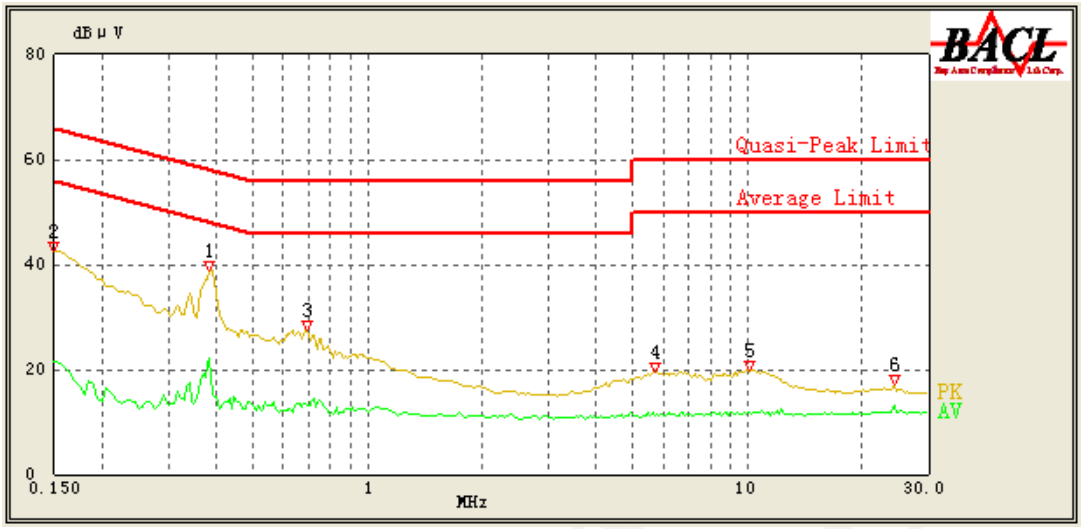
Environmental Conditions

Temperature:	24.2°C
Relative Humidity:	51%
ATM Pressure:	101.2 kPa

The testing was performed by Hope Zhang on 2018-09-07.

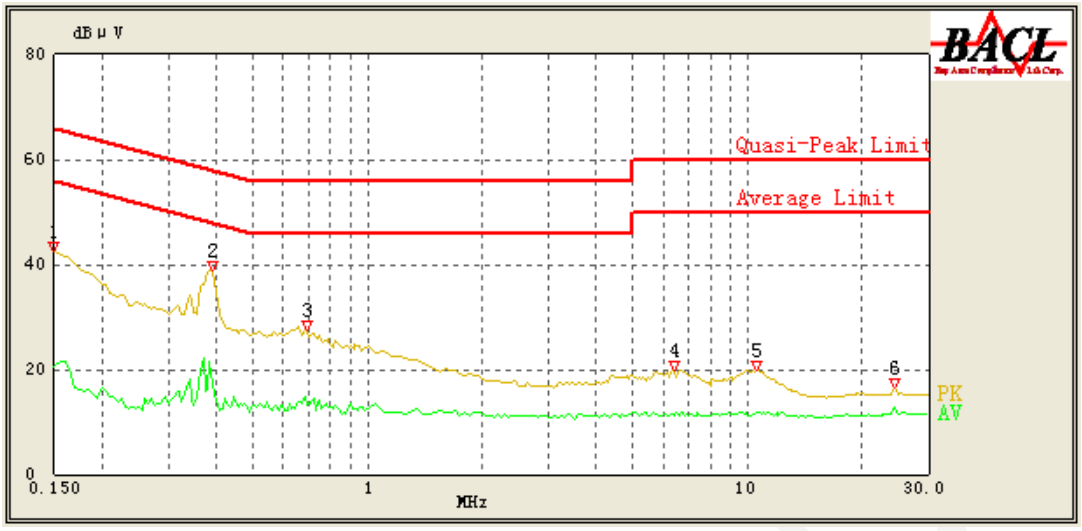
EUT operation mode: Transmitting in high channel (worst case)

AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBμV)	Margin (dB)	Comment
0.385	38.87	QP	9.000	L1	16.05	58.17	19.30	Compliant
0.385	22.14	AV	9.000	L1	16.05	48.17	26.03	Compliant
0.150	42.62	QP	9.000	L1	16.06	66.00	23.38	Compliant
0.150	21.51	AV	9.000	L1	16.06	56.00	34.49	Compliant
0.690	27.41	QP	9.000	L1	15.96	56.00	28.59	Compliant
0.690	13.24	AV	9.000	L1	15.96	46.00	32.76	Compliant
5.700	19.61	QP	9.000	L1	15.90	60.00	40.39	Compliant
5.700	11.21	AV	9.000	L1	15.90	50.00	38.79	Compliant
10.100	19.99	QP	9.000	L1	16.06	60.00	40.01	Compliant
10.050	11.89	AV	9.000	L1	16.06	50.00	38.11	Compliant
24.350	17.27	QP	9.000	L1	16.46	60.00	42.73	Compliant
24.350	13.04	AV	9.000	L1	16.46	50.00	36.96	Compliant

AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	42.39	QP	9.000	N	16.06	66.00	23.61	Compliant
0.150	20.49	AV	9.000	N	16.06	56.00	35.51	Compliant
0.390	38.85	QP	9.000	N	16.09	58.06	19.21	Compliant
0.390	17.50	AV	9.000	N	16.09	48.06	30.56	Compliant
0.690	27.61	QP	9.000	N	16.00	56.00	28.39	Compliant
0.690	13.15	AV	9.000	N	16.00	46.00	32.85	Compliant
6.400	19.70	QP	9.000	N	15.90	60.00	40.30	Compliant
6.450	11.06	AV	9.000	N	15.91	50.00	38.94	Compliant
10.550	19.83	QP	9.000	N	15.99	60.00	40.17	Compliant
10.600	11.75	AV	9.000	N	15.99	50.00	38.25	Compliant
24.350	16.54	QP	9.000	N	16.23	60.00	43.46	Compliant
24.350	12.88	AV	9.000	N	16.23	50.00	37.12	Compliant

Note:
1. Corrected Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
   Margin (dB) = Limit (dBµV) – Corrected Amplitude (dBµV)

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS& OUT OF BAND EMISSION

Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

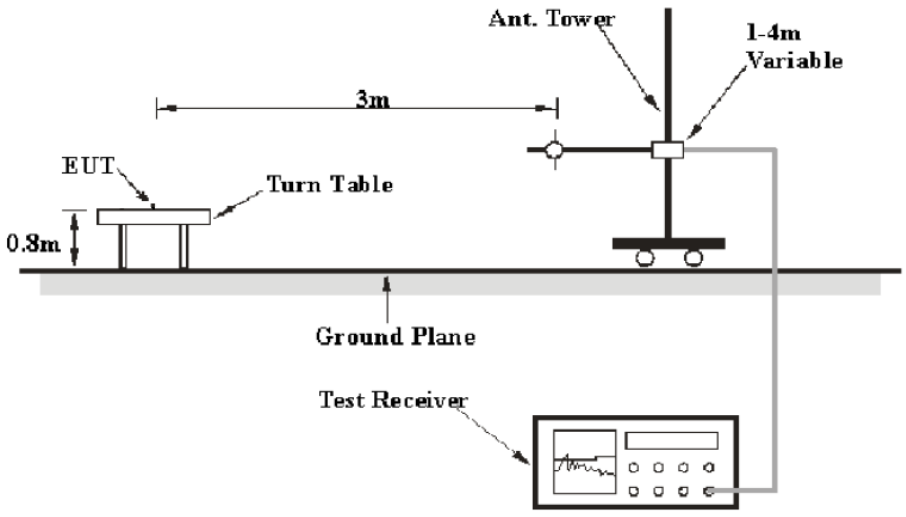
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

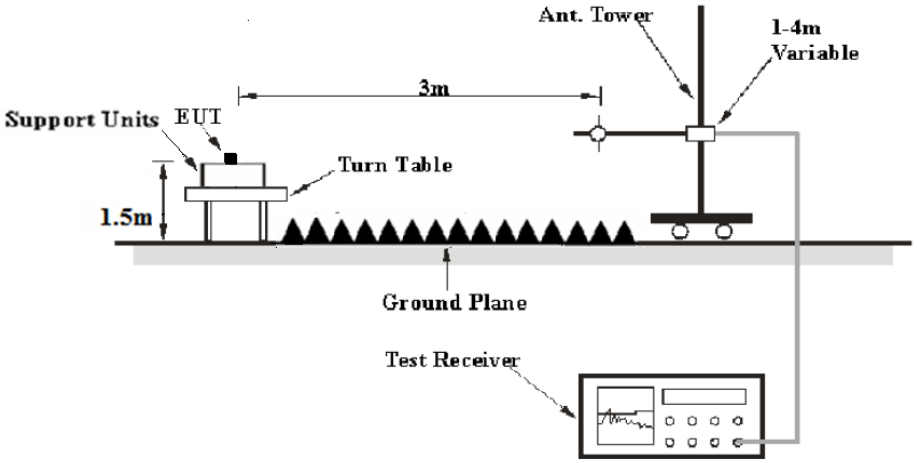
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

Test Equipment 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	/	Ave

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 modes 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 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 (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV /m)

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209 &15.205 & 15.249.

Test Data

Environmental Conditions

Temperature:	24.2°C
Relative Humidity:	50%
ATM Pressure:	101.1kPa

The testing was performed by Hope Zhang on 2018-09-06.

Test Mode: Transmitting

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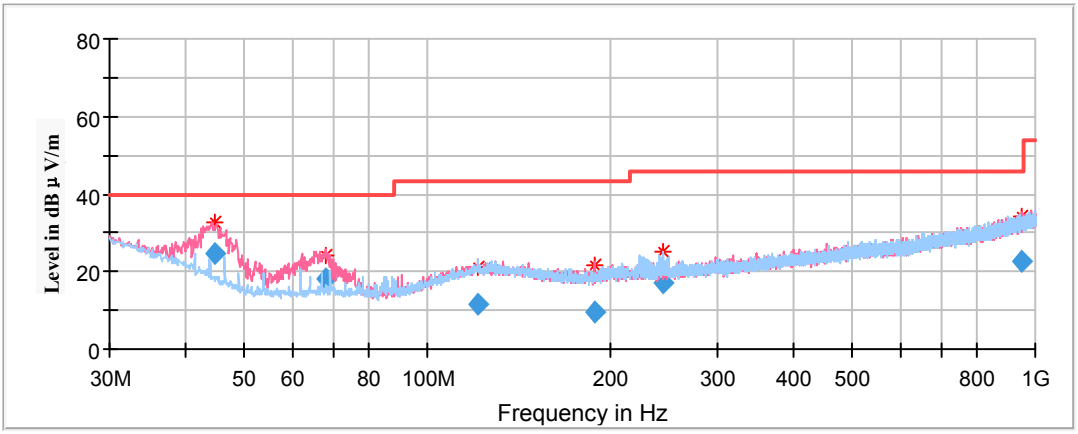
Spurious Emission Test:

30MHz-1GHz

*(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)*



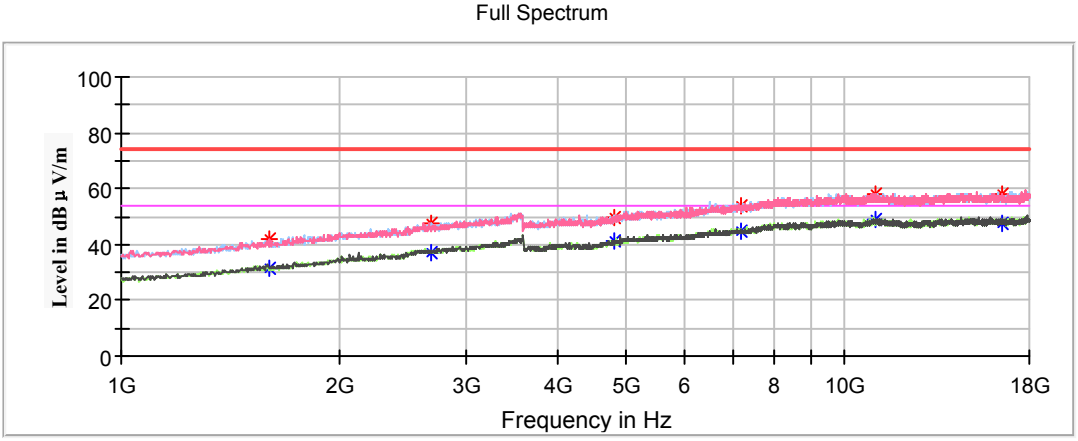
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	Quasi-peak (dB µ V/m)	Height (cm)	Polar (H/V)				
44.638400	24.54	101.0	V	133.0	-13.9	40.00	15.46
68.275800	18.04	101.0	V	138.0	-17.4	40.00	21.96
120.720550	11.61	199.0	H	314.0	-11.2	43.50	31.89
188.858100	9.33	101.0	V	336.0	-13.0	43.50	34.17
243.248750	17.15	100.0	H	253.0	-12.1	46.00	28.85
949.965500	22.51	199.0	V	66.0	1.3	46.00	23.49

1GHz-18GHz

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

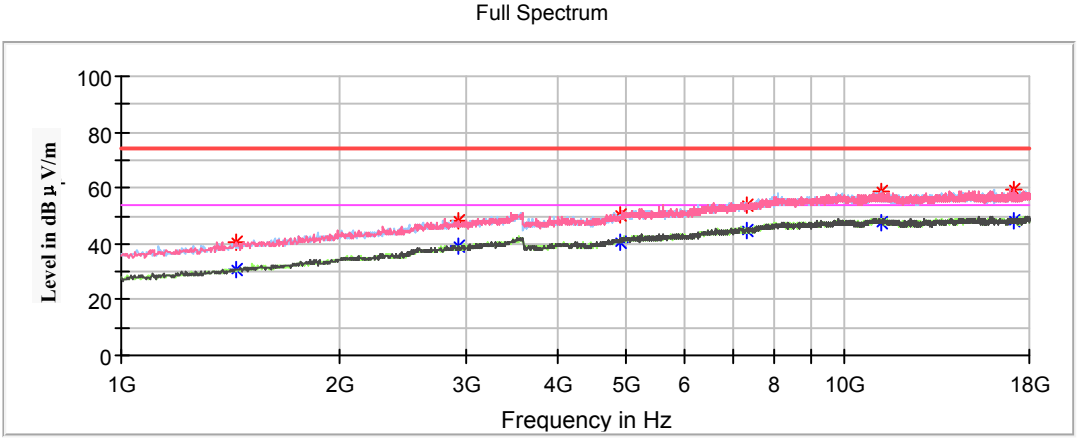
Note:
1. This test was performed with the 2.4-2.5GHz notch filter.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)
   Corrected Amplitude (dBμV /m) = Corrected Factor (dB/m) + Reading (dBμV)
   Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV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

Low Channel: 2403MHz



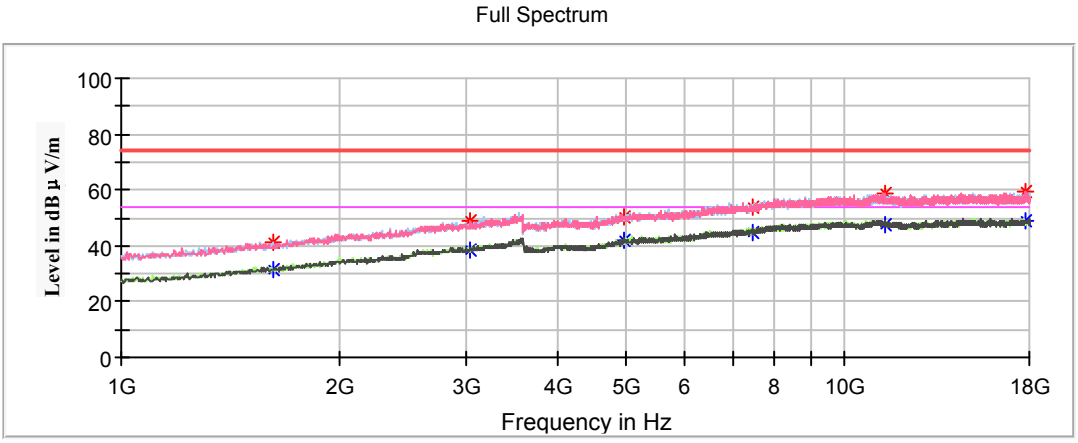
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1605.200000	---	31.20	200.0	V	35.0	-0.5	54.00	22.80
1605.200000	42.06	---	200.0	V	35.0	-0.5	74.00	31.94
2686.400000	---	37.36	150.0	H	141.0	4.2	54.00	16.64
2686.400000	47.60	---	150.0	H	141.0	4.2	74.00	26.40
4806.000000	---	41.33	100.0	V	79.0	10.7	54.00	12.67
4806.000000	49.54	---	100.0	V	79.0	10.7	74.00	24.46
7209.000000	---	44.56	100.0	V	335.0	15.2	54.00	9.44
7209.000000	53.88	---	100.0	V	335.0	15.2	74.00	20.12
10996.000000	---	48.75	150.0	V	116.0	19.1	54.00	5.25
10996.000000	57.70	---	150.0	V	116.0	19.1	74.00	16.30
16504.000000	---	47.54	200.0	V	121.0	18.1	54.00	6.46
16504.000000	58.11	---	200.0	V	121.0	18.1	74.00	15.89

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)				
1445.400000	---	30.72	200.0	V	31.0	-1.6	54.00	23.28
1445.400000	40.46	---	200.0	V	31.0	-1.6	74.00	33.54
2931.200000	---	38.82	150.0	V	200.0	5.6	54.00	15.18
2931.200000	48.15	---	150.0	V	200.0	5.6	74.00	25.85
4880.000000	---	40.81	100.0	H	110.0	11.1	54.00	13.19
4880.000000	50.56	---	100.0	H	110.0	11.1	74.00	23.44
7320.000000	---	44.82	150.0	V	168.0	15.4	54.00	9.18
7320.000000	54.08	---	150.0	V	168.0	15.4	74.00	19.92
11240.800000	---	47.43	150.0	H	1.0	18.7	54.00	6.57
11240.800000	58.64	---	150.0	H	1.0	18.7	74.00	15.36
17170.400000	59.53	---	100.0	V	19.0	18.2	74.00	14.47
17170.400000	---	48.31	100.0	V	19.0	18.2	54.00	5.69

High Channel: 2480MHz

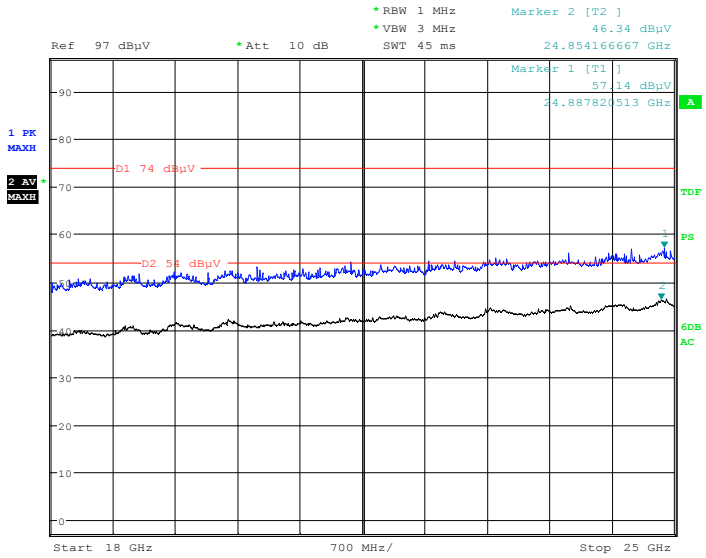


Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1618.800000	---	31.34	150.0	H	284.0	-0.4	54.00	22.66
1618.800000	41.37	---	150.0	H	284.0	-0.4	74.00	32.63
3043.400000	---	38.18	150.0	V	224.0	6.1	54.00	15.82
3043.400000	49.03	---	150.0	V	224.0	6.1	74.00	24.97
4960.000000	---	41.63	200.0	H	0.0	11.5	54.00	12.37
4960.000000	50.49	---	200.0	H	0.0	11.5	74.00	23.51
7440.000000	---	44.93	100.0	H	357.0	15.6	54.00	9.07
7440.000000	54.03	---	100.0	H	357.0	15.6	74.00	19.97
11397.200000	---	47.63	150.0	V	346.0	18.5	54.00	6.37
11397.200000	58.49	---	150.0	V	346.0	18.5	74.00	15.51
17819.800000	---	48.70	200.0	H	204.0	18.9	54.00	5.30
17819.800000	59.72	---	200.0	H	204.0	18.9	74.00	14.28

18GHz-25GHz

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

Horizontal



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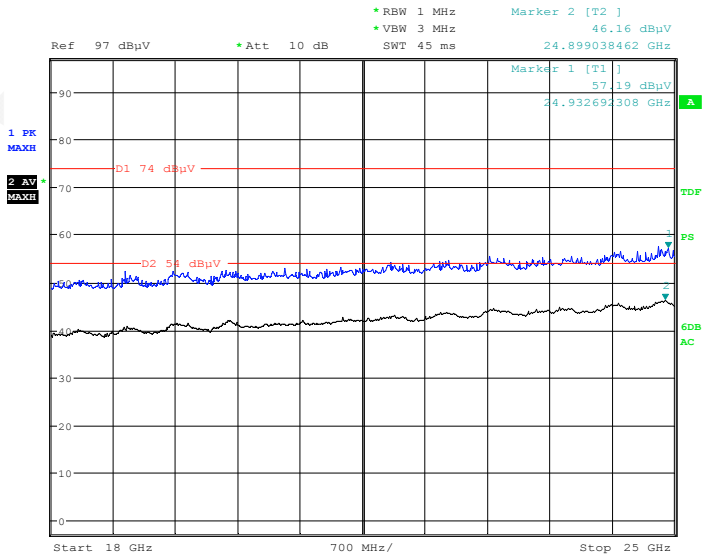
Vertical



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Fundamental Test & 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: 2403MHz								
2403.00	---	90.96	200.0	H	243	2.8	94	3.04
2403.00	91.85	---	200.0	H	243	2.8	114	22.15
2403.00	---	88.72	150.0	V	343	2.8	94	5.28
2403.00	89.64	---	150.0	V	343	2.8	114	24.36
2400.00	---	49.51	100.0	V	176	2.8	54	4.49
2400.00	62.68	---	100.0	V	176	2.8	74	11.32
Middle Channel: 2440MHz								
2440.00	91.78	---	200.0	H	169	2.9	114	22.22
2440.00	---	90.63	200.0	H	169	2.9	94	3.37
2440.00	90.82	---	220.0	V	115	2.9	114	23.18
2440.00	---	89.27	220.0	V	115	2.9	94	4.73
High Channel: 2480MHz								
2480.00	92.42	---	150.0	H	124	3.0	114	21.58
2480.00	---	91.31	150.0	H	124	3.0	94	2.69
2480.00	90.21	---	200.0	V	140	3.0	114	23.79
2480.00	---	89.46	200.0	V	140	3.0	94	4.54
2483.50	55.43	---	100.0	V	312	3.0	74	18.57
2483.50	---	38.59	100.0	V	312	3.0	54	15.41

FCC §15.215(c) – 20 dB BANDWIDTH TESTING

Applicable Standard

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

Test 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 on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	24.2°C
Relative Humidity:	50%
ATM Pressure:	101.3kPa

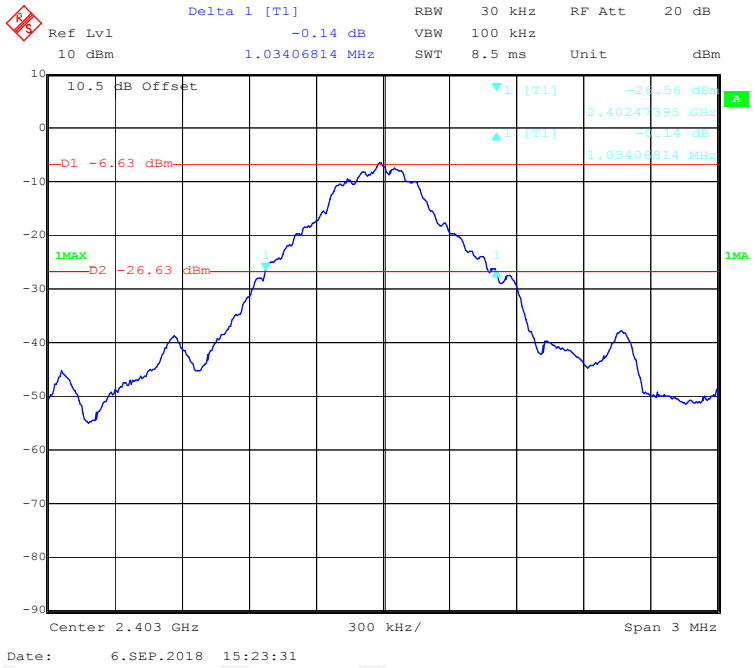
The testing was performed by Hope Zhang on 2018-09-06.

Test Result: Compliant.

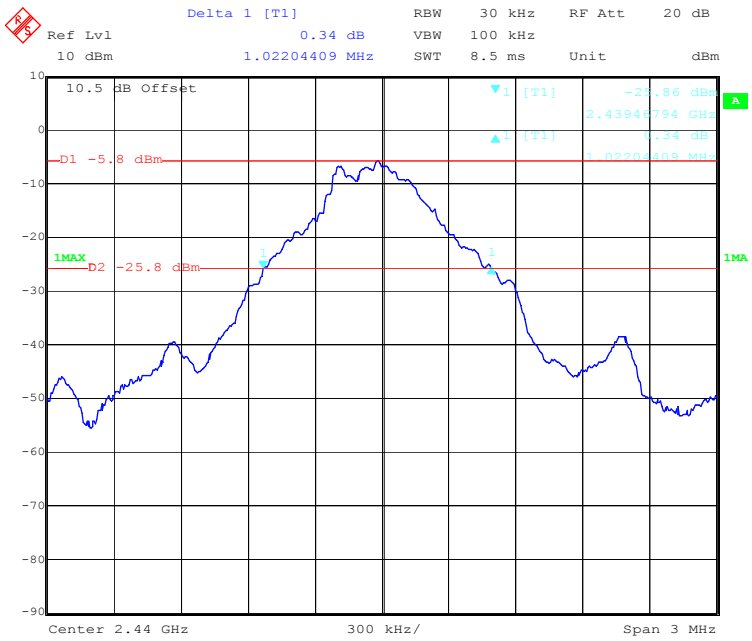
Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2403	1.034
Middle	2440	1.022
High	2480	1.022

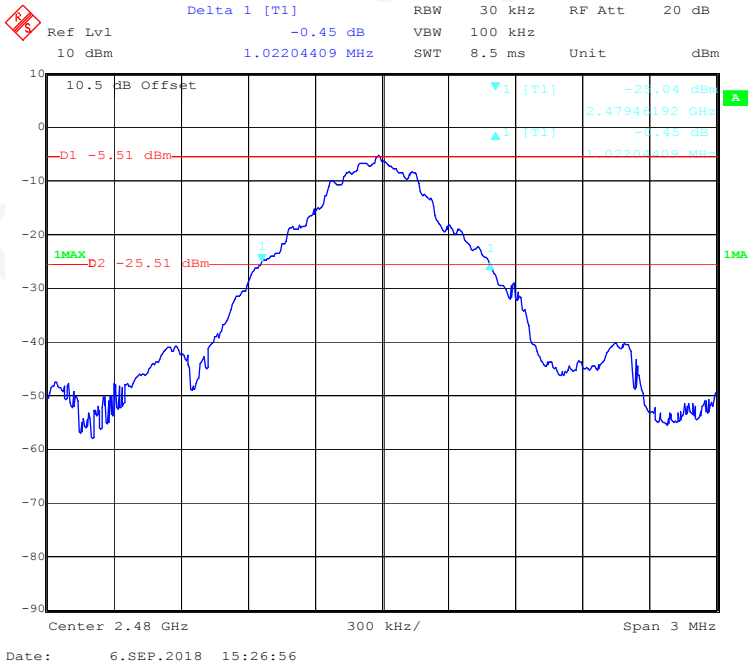
Low Channel



Middle Channel



High Channel



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