Test Report

Curtis-Straus LLC, *a wholly owned subsidiary of BV CPS*

Report No	ES1587-1
Client	OSRAM SYLVANIA INC Sivakumar Thangavelu
Address	200 Ballardvale Street Wilmington, MA 01887
Phone	978-750-3865
Items tested	iQ ZigBee RF PCB Trace Controller
FCC ID	DZO-OSREFRMG1PP
IC ID	23566-OSREFRMG1PP
FRN	0021513163
Equipment Type	Digital Transmission System
Equipment Code	DTS
FCC/IC Rule Parts	CFR Title 47 FCC Part 15.247, ISED Canada RSS-247 Issue 2
Test Dates	July 10th to July 16th, 2018
Results	As detailed within this report
Prepared by	Zachary Johnson – EMC Engineer
Authorized by	Yunus Faziloglu – Sr. Engineer
Issue Date	10/19/2018
Conditions of Issue	This Test Report is issued subject to the conditions stated in the '*Conditions of Testing*' section on page 36 of this report.

Curtis-Straus LLC is accredited by the American Association for Laboratory Accreditation for the specific scope of accreditation under Certificate Number 1627-01. This report may contain data which is not covered by the A2LA accreditation.

ACCREDITED Cert No. 1627-01

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Form Final Report REV 12-07-15

Summary

This test report supports an application for certification of a transmitter operating pursuant to CFR Title 47 FCC Part 15.247, ISED Canada RSS-247 Issue 2.
The product is the iQ ZigBee RF PCB Trace Controller. It is a transmitter that operates in the 2405-2480MHz frequency range. It has a PCB trace antenna with -0.58dBi gain and powered by 3VDC.

We found that the product met the above requirements without modifications. The test sample was received in good condition on July 10th, 2018.

Test Methodology

All testing was performed according to the following rules/procedures/documents;
CFR 47 FCC Part 15.247, RSS-247 Issue 2, RSS-Gen Issue 4, FCC KDB 558074 D01 DTS Measurement Guidance v04 and ANSI C63.10-2013.
Radiated emissions were maximized by rotating the device around three orthogonal axes as well as varying the test antenna's height and polarity. AC line conducted emissions testing was performed with a 50Ω/50μH LISN on AC side of a DC supply.
RF measurements were performed at the antenna port.

The environmental conditions were as shown below.

Date	Temperature	Humidity
July 10, 2017	23.1°C	48%RH
July 16, 2018	22.8°C	47%RH

The following bandwidths were used during radiated spurious and line conducted emissions.

Frequency	RBW	VBW
0.15-30MHz	9kHz	30kHz
30-1000MHz	120kHz	1MHz
1-25GHz	1MHz	3MHz

Product Tested - Configuration Documentation

EUT Configuration			
Work Order:	S1587		
Company:	OSRAM SYLVANIA INC		
Company Address:	200 Ballardvale Street		
	Wilmington, MA, 01887		
Contact:	Sivakumar Thangavelu (3)		
	MN	**PN**	**SN**
EUT:	OSREFRMG1PP	--	SK01BP
EUT Description:	ZigBee device		
EUT Max Frequency:	2480 MHz		

Port Label	Port Type	# ports	# populated	cable type	shielded	ferrites	length (m)	in/out	under test	comment
DC Power	Power DC	1	1	Power DC	No	No	0.1	in	yes	short cable to battery, 3V

Software Operating Mode Description: Test Firmware

Statement of Conformity

RSS-GEN	RSP-100	RSS 247	Part 15	Comments
6.3			15.15(b)	There are no controls accessible to the user that varies the output power to operate in violation of the regulatory requirements.
	3.1		15.19	The label is shown in the label exhibit.
	4		15.21	Information to the user is shown in the instruction manual exhibit.
			15.27	No special accessories are required for compliance.
3, 6.1			15.31	The EUT was tested in accordance with the measurement standards in this section.
6.13			15.33	Frequency range was investigated according to this section, unless noted in specific rule section under which the equipment operates.
8.1			15.35	The EUT emissions were measured using the measurement detector and bandwidth specified in this section, unless noted in specific rule section under which the equipment operates.
8.3			15.203	The antenna of this device is a PCB trace antenna with -0.5dBi gain.
8.10			15.205 15.209	The fundamental is not in a Restricted band and the spurious and harmonic emissions in the Restricted bands comply with the general emission limits of 15.209 or RSS-Gen as applicable
8.8			15.207	EUT meets the AC Line conducted emissions requirements of this section.
			15.247	The unit complies with the requirements of 15.247
		RSS 247		The unit complies with the requirements of RSS-247
6.6				Occupied Bandwidth measurements were made.

Modifications Required for Compliance

No modifications required for Compliance

Test Results

Bandwidth

LIMIT

The minimum 6 dB bandwidth shall be at least 500 kHz. [15.247(a) (2)]

MEASUREMENTS / RESULTS

6dB Bandwidth

Date: 7/16/2018 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT:** iQ ZigBee Controller – PCB Antenna **Operating Voltage/Frequency:** 3V DC
Temp: 22.8°C **Humidity:** 48% **Pressure:** 1000mBar
Frequency Range: 2405-2480 MHz **Measurement Type:** Conducted
Measurement Method: FCC KDB 558074 D01 DTS Meas Guidance V04
Notes:

Frequency (MHz)	Reading (kHz)	6dB Bandwidth Limit (kHz)	Margin (kHz)	Result (Pass/Fail)
2405	1644	≥500	1144	Pass
2440	1646	≥500	1146	Pass
2475	1649	≥500	1149	Pass
2480	1648	≥500	1148	Pass

Test Site: CEMI-5 **Cable:** 2286 Cbl **Attenuator:** 2107 40dB
Analyzer: 1118472 SA

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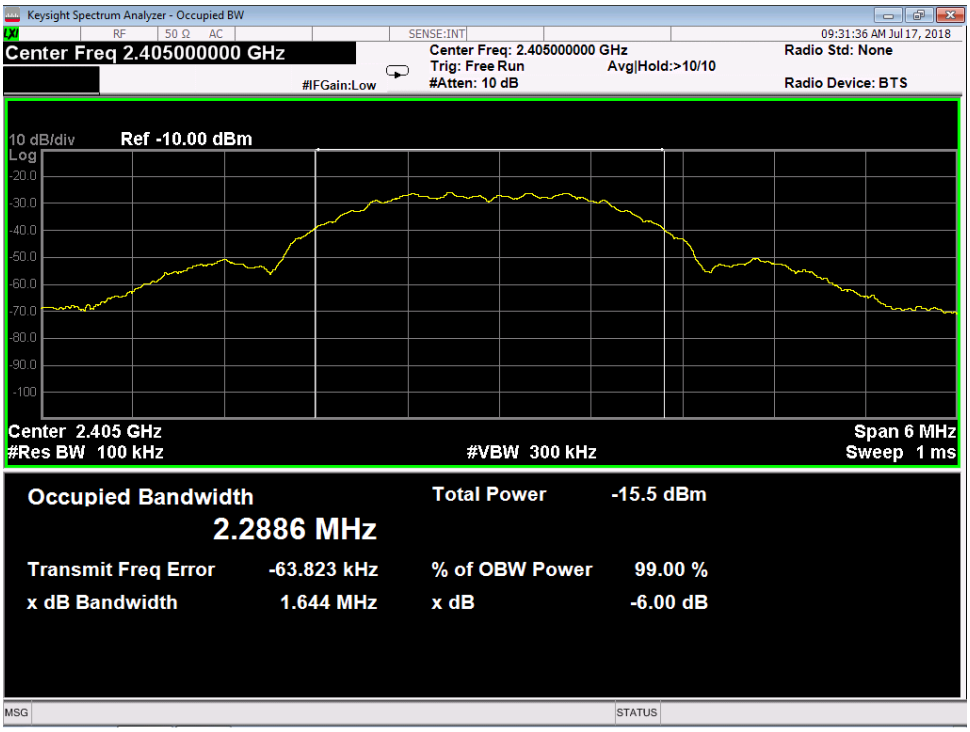
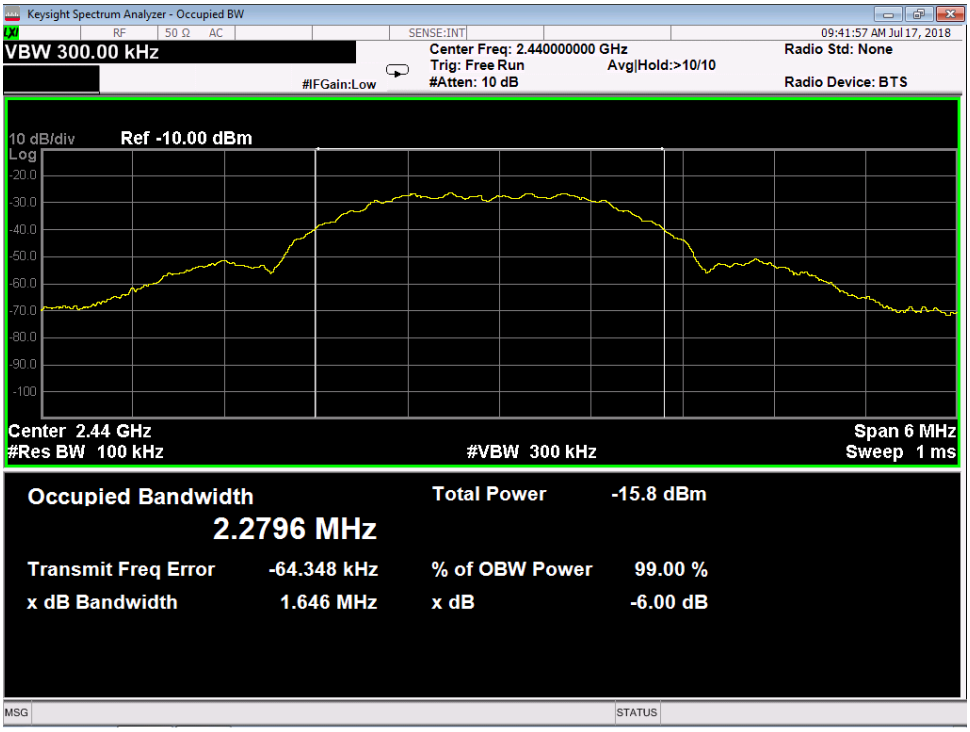
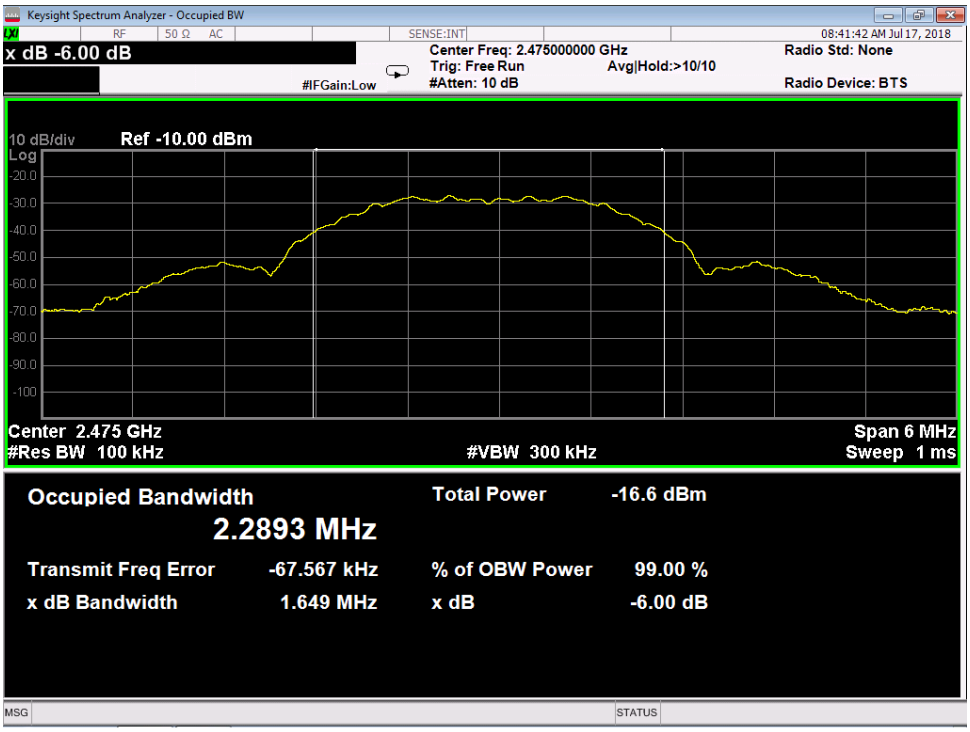
PLOTS



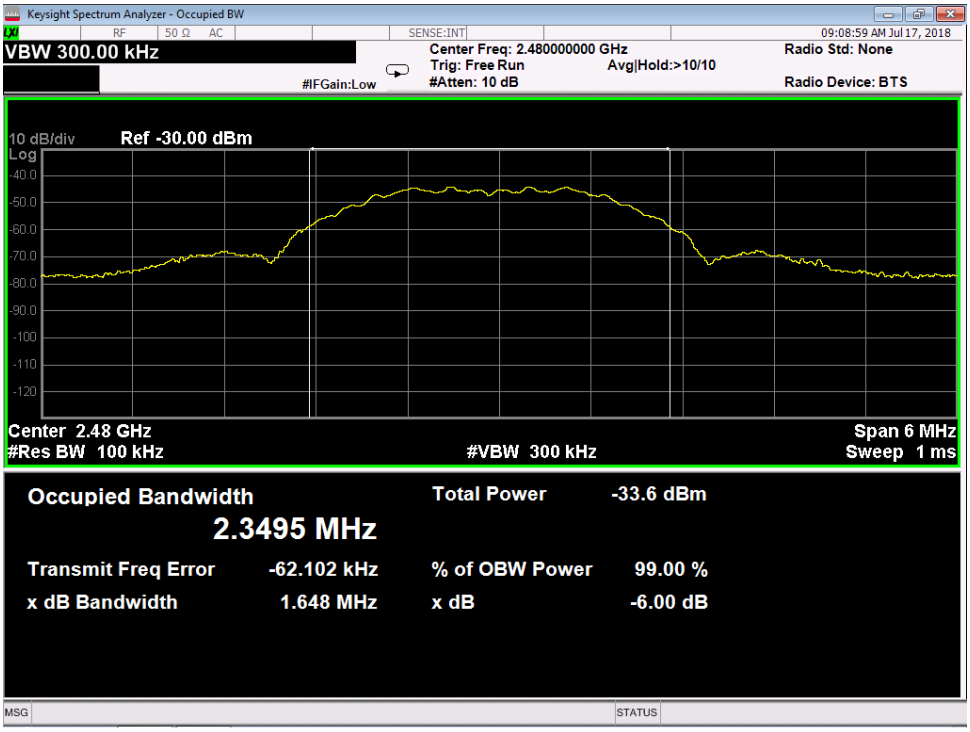
DTS Bandwidth, Low Channel



DTS Bandwidth, Mid Channel



DTS Bandwidth, High Channel 25 (19dBm)



DTS Bandwidth, High Channel 26 (0dBm)

Peak Power

LIMIT

Conducted Output Power
1 Watt
[15.247(b) (3)]

MEASUREMENTS / RESULTS

Peak Output Power

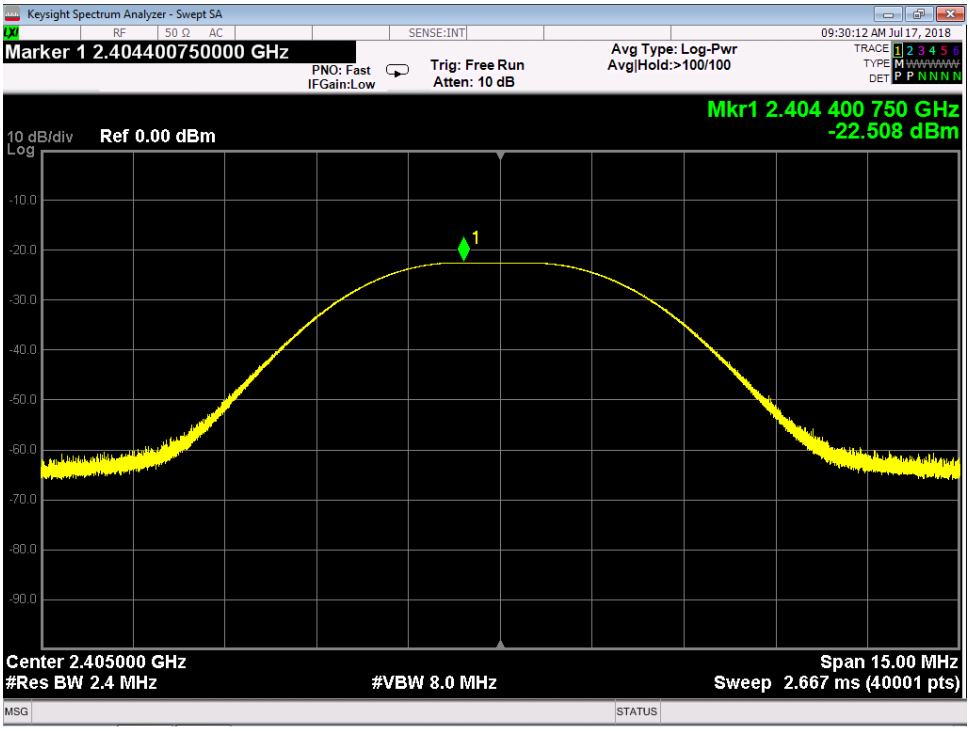
Date: 7/16/2018 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT:** iQ ZigBee Controller – PCB Antenna **Operating Voltage/Frequency:** 3V DC
Temp: 22.8°C **Humidity:** 48% **Pressure:** 1000mBar
Frequency Range: 2405-2480 MHz **Measurement Type:** Conducted

Notes: 19dBm output power for all channels except Ch26 at 0dBm

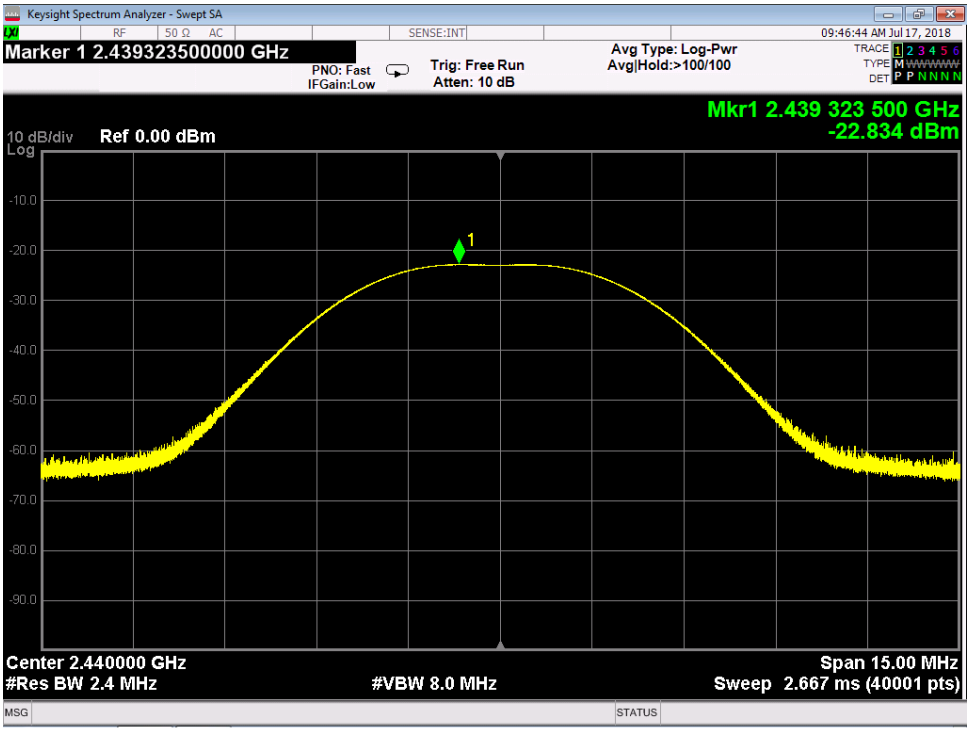
Frequency (MHz)	Peak Reading (dBm)	Cable Loss (dB)	Attenuator Loss (dB)	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)	Result (Pass/Fail)
2405	-22.51	0.38	39.42	17.29	30.0	-12.71	Pass
2440	-22.83	0.38	39.42	16.97	30.0	-13.03	Pass
2475	-23.59	0.38	39.42	16.21	30.0	-13.79	Pass
2480	-40.16	0.38	39.42	-0.36	30.0	-30.36	Pass

Test Site: CEMI-5 **Cable:** 2286 Cbl **Attenuator:** 2107 40dB
Analyzer: 1118472 SA
Peak Output Power (dBm)= Peak Reading (dBm) + Cable Loss (dB) + Attenuator Loss (dB)

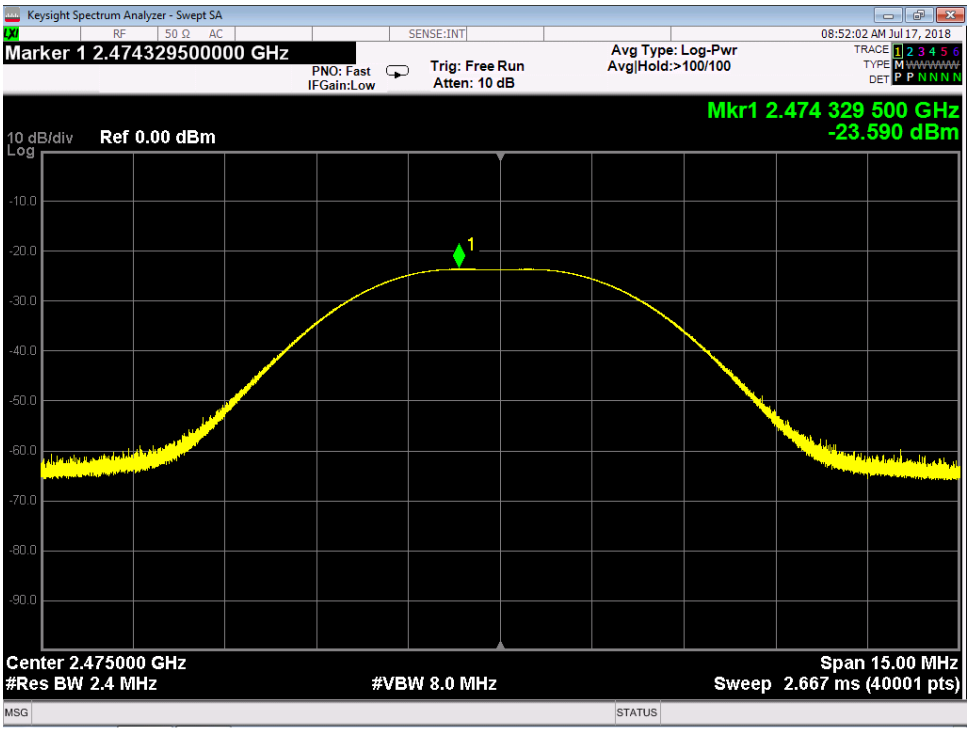
PLOTS



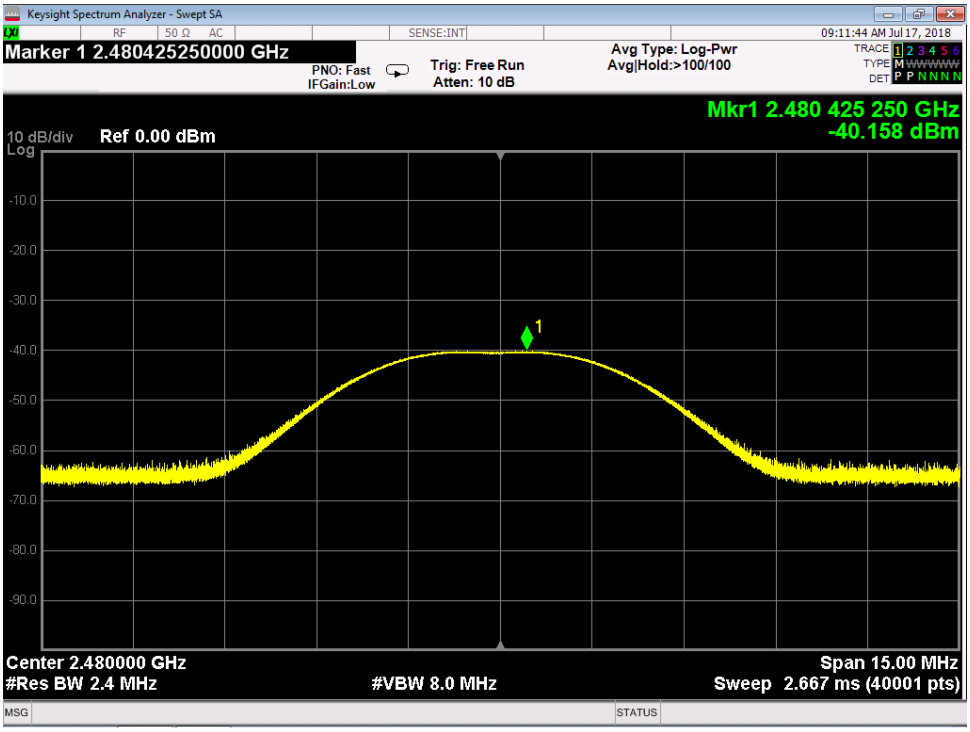
Peak Output Power, Low Channel



Peak Output Power, Mid Channel



Peak Output Power, High Channel 25 (19dBm)



Peak Output Power, High Channel 26 (0dBm)

Radiated Spurious Emissions

LIMITS

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).
[15.247(d)]

Testing has been performed on 3 channels (low, middle and high). The worst case channel from each range is shown in the following data tables.

MEASUREMENTS / RESULTS

Curtis Straus - a Bureau Veritas Company	Work Order - S1587
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 3V DC battery
Top Peaks Vertical 30-1000MHz	Test Site - CH-2
Operator: ZJ	Conditions - 23.1°C; 48%RH; 1005mBar
Notes:	Witnessed by - Sivakumar Thangavelu
Channel 11, 19dBm power setting	EUT Maximum Frequency - 2480MHz

Data Taken at 03:16:57 PM, Tuesday, July 10, 2018

Frequency (MHz)	Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Antenna Height (cm)	Turntable Azimuth (degrees)
30.097	32.6	-6.6	26	40	-14	PASS		150	180
444.796	34.3	-9.8	24.5	46	-21.5	PASS		200	180
469.652	34.9	-8.8	26	46	-20	PASS		200	180
713.147	40.3	-4.8	35.4	46	-10.6	PASS	-10.6	150	0
910.518	32.2	-1.9	30.4	46	-15.7	PASS		200	135
975.774	32.1	-1	31.1	54	-22.8	PASS		150	90

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Horizontal 30-1000MHz
Operator: ZJ
Notes:
Channel 11, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 03:16:57 PM, Tuesday, July 10, 2018

Frequency (MHz)	Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
462.208	39.8	-9.4	30.4	46	-15.6	PASS		200	315
476.782	38.8	-8.5	30.4	46	-15.6	PASS		200	135
482.408	39.1	-8.5	30.6	46	-15.4	PASS		200	315
830.808	38.4	-3.2	35.3	46	-10.7	PASS	-10.7	150	180
832.893	38.1	-3.1	35	46	-11	PASS		150	180
996.241	31.5	-0.2	31.4	54	-22.6	PASS		200	270

30-1000MHz Low Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Vertical 30-1000MHz
Operator: ZJ
Notes:
Channel 18, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 03:27:46 PM, Tuesday, July 10, 2018

Frequency (MHz)	Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Antenna Height (cm)	Turntable Azimuth (degrees)
31.479	33.3	-7.6	25.7	40	-14.3	PASS	-14.3	150	225
132.674	33.6	-14	19.6	43.5	-23.9	PASS		150	270
475.691	34.4	-8.5	25.9	46	-20.1	PASS		200	225
933.288	32.7	-1.5	31.2	46	-14.8	PASS		150	315
994.519	31.5	-0.2	31.2	54	-22.7	PASS		100	225

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Horizontal 30-1000MHz
Operator: ZJ
Notes:
Channel 18, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 03:37:12 PM, Tuesday, July 10, 2018

Frequency (MHz)	Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
462.765	40.1	-9.4	30.7	46	-15.3	PASS		200	135
469.022	39.1	-8.9	30.2	46	-15.9	PASS		200	270
482.82	38.6	-8.5	30.1	46	-15.9	PASS		200	135
489.004	39.7	-8.7	31.1	46	-15	PASS		200	315
779.01	39.9	-3.4	36.5	46	-9.5	PASS	-9.5	200	0
959.308	32.8	-1.5	31.3	46	-14.7	PASS		150	0

30-1000MHz Center Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Vertical 30-1000MHz
Operator: ZJ
Notes:
Channel 26, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 03:47:20 PM, Tuesday, July 10, 2018

Frequency (MHz)	Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Antenna Height (cm)	Turntable Azimuth (degrees)
32.449	34.9	-8.4	26.4	40	-13.6	PASS		150	135
39.433	43.3	-13.8	29.5	40	-10.5	PASS	-10.5	150	225
40.694	41.9	-14.7	27.2	40	-12.8	PASS		100	225
43.629	43.4	-17	26.5	40	-13.5	PASS		200	270
907.317	32.3	-1.9	30.4	46	-15.6	PASS		200	270
994.229	31.4	-0.2	31.2	54	-22.8	PASS		200	180

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Horizontal 30-1000MHz
Operator: ZJ
Notes:
Channel 26, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 04:01:20 PM, Tuesday, July 10, 2018

Frequency (MHz)	Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
462.135	37.8	-9.4	28.3	46	-17.7	PASS		200	135
469.677	36.8	-8.8	27.9	46	-18.1	PASS		200	315
481.002	36.4	-8.4	28	46	-18	PASS		200	135
488.446	36.7	-8.7	28.1	46	-17.9	PASS		200	315
899.411	32.5	-1.7	30.8	46	-15.2	PASS	-15.2	200	0
990.712	31.7	-0.4	31.3	54	-22.6	PASS		150	180

30-1000MHz High Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Vertical 1-6GHz
Operator: ZJ
Notes:
Channel 11, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 10:55:13 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Margin to Peak Limit (dB)	Peak Limit Test Results (Pass/Fail)	Peak Limit Worst Margin (dB)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Margin to Average Limit (dB)	Average Limit Test Result (Pass/Fail)	Average Limit Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1724.63	53.5	-5.6	47.9	74	-26.1	PASS		54	-6.1	PASS		200	297
2181.75	44.4	-2	42.4	74	-31.6	PASS		54	-11.6	PASS		200	198
5806.38	43.4	5.1	48.5	74	-25.4	PASS	-25.4	54	-5.4	PASS	-5.4	100	0

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Horizontal 1-6GHz
Operator: ZJ
Notes:
Channel 11, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 10:55:13 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Margin to Peak Limit (dB)	Peak Limit Results (Pass/Fail)	Peak Limit Worst Margin (dB)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Margin to Avg Limit (dB)	Avg Limit Results (Pass/Fail)	Avg Limit Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2179.88	44.2	-2	42.1	74	-31.8	PASS		54	-11.8	PASS		100	39
3129.75	45.2	0	45.2	74	-28.8	PASS		54	-8.8	PASS		300	256
5704.38	43.2	4.9	48.1	74	-25.8	PASS	-25.8	54	-5.8	PASS	-5.8	300	78

1-6GHz Low Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Vertical 1-6GHz
Operator: ZJ
Notes:
Channel 18, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 11:45:15 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Margin to Peak Limit (dB)	Peak Limit Test Results (Pass/Fail)	Peak Limit Worst Margin (dB)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Margin to Average Limit (dB)	Average Limit Test Result (Pass/Fail)	Average Limit Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1729	54.1	-5.6	48.6	74	-25.4	PASS		54	-5.4	PASS		100	26
2129.13	44.1	-2.1	42.1	74	-31.9	PASS		54	-11.9	PASS		200	84
3210.5	45	0.2	45.2	74	-28.8	PASS		54	-8.8	PASS		200	260
5681	44.5	4.8	49.3	74	-24.7	PASS	-24.7	54	-4.7	PASS	-4.7	100	260

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Horizontal 1-6GHz
Operator: ZJ
Notes:
Channel 18, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 11:45:15 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Margin to Peak Limit (dB)	Peak Limit Results (Pass/Fail)	Peak Limit Worst Margin (dB)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Margin to Avg Limit (dB)	Avg Limit Results (Pass/Fail)	Avg Limit Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2165.88	44.1	-2	42	74	-32	PASS		54	-12	PASS		100	55
3187	44.8	0.3	45.1	74	-28.9	PASS		54	-8.9	PASS		300	206
5851.25	42.8	5.1	47.8	74	-26.1	PASS	-26.1	54	-6.1	PASS	-6.1	200	259

1-6GHz Center Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
1-6GHz Vertical Data
Operator: ZJ
Notes:
Channel 26, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 01:09:28 PM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1710.8	41.1	32.4	-5.6	35.5	74	-38.4	PASS	-38.4	26.8	54	-27.2	PASS	-27.2	100	235

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
Top Peaks Horizontal 1-6GHz
Operator: ZJ
Notes:
Channel 26, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 11:58:22 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Margin to Peak Limit (dB)	Peak Limit Results (Pass/Fail)	Peak Limit Worst Margin (dB)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Margin to Avg Limit (dB)	Avg Limit Results (Pass/Fail)	Avg Limit Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2122.88	44.1	-2.1	42	74	-32	PASS		54	-12	PASS		300	259
3189.88	45.4	0.3	45.7	74	-28.3	PASS		54	-8.3	PASS		300	55
5761.88	43.6	5.1	48.7	74	-25.3	PASS	-25.3	54	-5.3	PASS	-5.3	100	261

1-6GHz High Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Vertical Data
Operator: ZJ
Notes:
Channel 11, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 02:18:45 PM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
17919.9	40.1	30.4	24.5	64.6	83.5	-18.9	PASS	-18.9	54.9	63.5	-8.6	PASS	-8.6	153	222

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Horizontal Data
Operator: ZJ
Notes:
Channel 11, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 02:24:08 PM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Test Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Test Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
17748.9	39.7	30.7	24.4	64.1	83.5	-19.4	PASS	-19.4	55.1	63.5	-8.4	PASS	-8.4	100	229

6-18GHz Low Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Vertical Data
Operator: ZJ
Notes:
Channel 18, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 09:48:01 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
14070.8	40.2	31	17.6	57.8	83.5	-25.7	PASS		48.6	63.5	-14.9	PASS		100	13
17660.4	41.3	31.1	24	65.4	83.5	-18.1	PASS	-18.1	55.1	63.5	-8.4	PASS		100	172
17978.3	39.2	30.4	25.3	64.5	83.5	-19	PASS		55.6	63.5	-7.9	PASS	-7.9	200	322

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Horizontal Data
Operator: ZJ
Notes:
Channel 18, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 09:54:13 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Test Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Test Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
17740.4	39.5	30.6	24.4	63.9	83.5	-19.6	PASS	-19.6	55	63.5	-8.5	PASS	-8.5	143	121

6-18GHz Center Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Vertical Data
Operator: ZJ
Notes:
Channel 26, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 10:17:10 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
17816.2	39.6	30.9	24.1	63.7	83.5	-19.8	PASS	-19.8	55	63.5	-8.5	PASS	-8.5	100	13

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Horizontal Data
Operator: ZJ
Notes:
Channel 26, 19dBm power setting

Work Order - S1587
EUT Power Input - 3V DC battery
Test Site - CH-2
Conditions - 23.1°C; 48%RH; 1005mBar
Witnessed by - Sivakumar Thangavelu
EUT Maximum Frequency - 2480MHz

Data Taken at 10:23:59 AM, Tuesday, July 10, 2018

Frequency (MHz)	Raw Peak Reading (dBµV)	Raw Avg Reading (dBµV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBµV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBµV/m)	Peak Margin (dB)	Peak Test Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBµV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBµV/m)	Avg Margin (dB)	Avg Test Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
17961.1	37.4	30.5	25.1	62.5	83.5	-21	PASS	-21	55.5	63.5	-8	PASS	-8	123	26

6-18GHz High Channel

Radiated Emissions Table

Date: 10-Jul-18 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT Desc:** iQ Zigbee Antenna **EUT Operating Voltage/Frequency:** 3V DC
Temp: 23.1°C **Humidity:** 48% **Pressure:** 1005mBar
Frequency Range: 18-26.5GHz **Measurement Distance:** 0.1 m
Notes: **EUT Max Freq:** 2480MHz

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	FCC Class B High Frequency - Peak Margin (dB)	FCC Class B High Frequency - Peak Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	FCC Class B High Frequency - Average Margin (dB)	FCC Class B High Frequency - Average Result (Pass/Fail)
H / V	No emissions found within 20dB of the limit			---	---	---	---	---	---	---	---	---	---	---

Table Result: Pass by --- dB ***Worst Freq:*** --- MHz

Test Site: EMI Chamber 2 **Cable 1:** Asset #2324 **Cable 2:** --- **Cable 3:** ---
Analyzer: 1860 SA **Preamp:** 18-26.5GHz **Antenna:** 18-26.5GHz Horn **Preselector:** ---
CSsoft Radiated Emissions Calculator v 1.017.203
Adjusted Reading = Reading - Preamp Factor + Antenna Factor + Cable Factor

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18-26.5GHz All Channels

Radiated Emissions Table

Date: 10-Jul-18 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT Desc:** iQ Zigbee Antenna **EUT Operating Voltage/Frequency:** 3V DC
Temp: 23.1°C **Humidity:** 48% **Pressure:** 1005mBar
Frequency Range: 2390-2483.5MHz **Measurement Distance:** 3 m
Notes: **EUT Max Freq:** 2480MHz

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Channel 11				---	---	---	---	---	---	---	---	---	---	---
H	2390.0	37.8	18.2	0.0	28.4	4.1	70.3	50.7	74.0	-3.7	Pass	54.0	-3.3	Pass
V	2390.0	36.6	18.1	0.0	28.4	4.1	69.1	50.6	74.0	-4.9	Pass	54.0	-3.4	Pass
				---	---	---	---	---	---	---	---	---	---	---
Channel 25				---	---	---	---	---	---	---	---	---	---	---
H	2483.5	36.5	18.4	0.0	28.6	3.9	69.0	50.9	74.0	-5.0	Pass	54.0	-3.1	Pass
V	2483.5	34.2	18.3	0.0	28.6	3.9	66.7	50.8	74.0	-7.3	Pass	54.0	-3.2	Pass
				---	---	---	---	---	---	---	---	---	---	---

Table Result: Pass by -3.1 dB ***Worst Freq:*** 2483.5 MHz

Test Site: EMI Chamber 2 **Cable 1:** Asset #2051 **Cable 2:** Asset #2459 **Cable 3:** Asset #2467
Analyzer: 2093 SA **Preamp:** None **Antenna:** Black Horn **Preselector:** ---
CSsoft Radiated Emissions Calculator v 1.017.203
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Adjusted Reading = Reading - Preamp Factor + Antenna Factor + Cable Factor

Radiated Bandedges CH11 and CH25 at 19dBm

Radiated Emissions Table

Date: 19-Sep-18 **Company:** Osram **Work Order:** S1587
Engineer: Dara Seng **EUT Desc:** iQ ZigBee Controller **EUT Operating Voltage/Frequency:** 3V DC
Temp: 23.2°C **Humidity:** 32% **Pressure:** 1006mBar
Frequency Range: 2390-2483.5MHz **Measurement Distance:** 3 m
Notes: **EUT Max Freq:** 2480MHz

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Channel 26 at 0dBm				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	15.8	15.8	0.0	32.4	3.1	51.3	51.3	74.0	-22.7	Pass	54.0	-2.7	Pass
H	2483.5	19.8	11.8	0.0	32.4	3.1	55.3	47.3	74.0	-18.7	Pass	54.0	-6.7	Pass
				---	---	---	---	---	---	---	---	---	---	---

Table Result: Pass by -2.7 dB ***Worst Freq:*** 2483.5 MHz

Test Site: EMI Chamber 1 **Cable 1:** Asset #2456 **Cable 2:** Asset #2480 **Cable 3:** ---
Analyzer: Rental SA#1 **Preamp:** None **Antenna:** Blue Horn **Preselector:** ---
CSsoft Radiated Emissions Calculator v 1.017.203
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Adjusted Reading = Reading - Preamp Factor + Antenna Factor + Cable Factor

Radiated Bandedges CH26 at 0dBm

Rev. 6/27/2018

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
SA #2 (1860)	9kHz-26.5 GHz	E7405A	Agilent	MY45104916	1860	I	3/15/2019	3/15/2018
2093 MXE EMI Receiver	20Hz-26.5GHz	N9038A	Agilent	MY51210181	2093	I	11/16/2018	11/16/2017

Radiated Emissions Sites	FCC Code	IC Code	VCCI Code	Range	Asset	Cat	Calibration Due	Calibrated on
EMI Chamber 2	719150	2762A-7	A-0015	30-1000MHz	1686	I	12/21/2018	12/21/2016
EMI Chamber 2	719150	2762A-7	A-0015	1-18GHz	1686	I	12/21/2018	12/21/2016

Preamps /Couplers Attenuators / Filters	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
2311 PA	1-1000MHz	PAM-103	COM-POWER	441174	2311	II	10/29/2018	10/29/2017
2111 HF Preamp	0.5-18GHz	PAM-118A	COM-POWER	551063	2111	II	11/19/2018	11/19/2017
HF (Yellow)	18-26.5GHz	AFS4-18002650-60-8P-4	CS	467559	1266	II	10/16/2018	10/16/2017
2116 BRF	0.009-18000MHz	BRM50702	Micro-Tronics	G226	2116	II	11/8/2018	11/8/2017

Antennas	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Red-White Bilog	30-2000MHz	JB1	Sunol	A091604-1	1105	I	8/21/2019	8/21/2017
Black Horn	1-18GHz	3115	EMCO	9703-5148	56	I	8/29/2018	8/29/2016
HF (White) Horn	18-26.5GHz	801-WLM	Waveline	758	758	III	Verify before Use	date of test

Meteorological Meters/Chambers		MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	5/15/2020	5/15/2018
TH A#2080		HTC-1	HDE		2080	II	3/22/2019	3/22/2018

Cables	Range		Mfr			Cat	Calibration Due	Calibrated on
Asset #2051	9kHz - 18GHz		Florida RF			II	3/7/2019	3/7/2018
Asset #2459	9KHz-18GHz		MegaPhase			II	10/29/2018	10/29/2017
Asset #2467	9KHz-18GHz		MegaPhase			II	10/29/2018	10/29/2017
Asset #2324	1-26.5GHz	TM26-S1S1-120	MEGAPHASE	17139101 001	2324	II	8/19/2018	8/19/2017

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

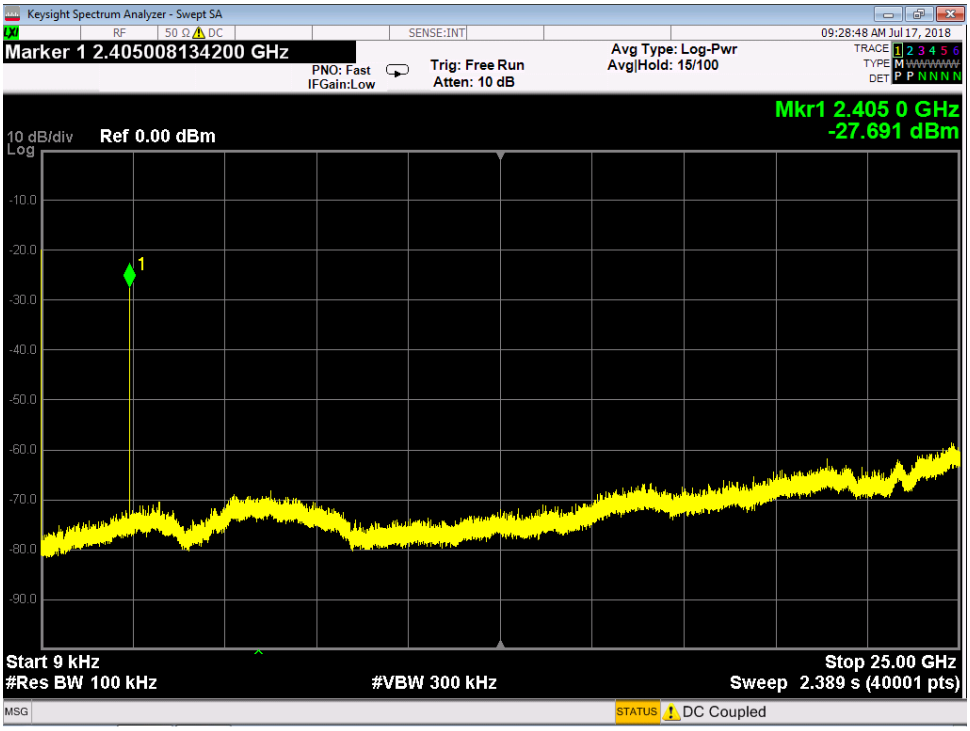
REMI TEU

Conducted Spurious Emissions

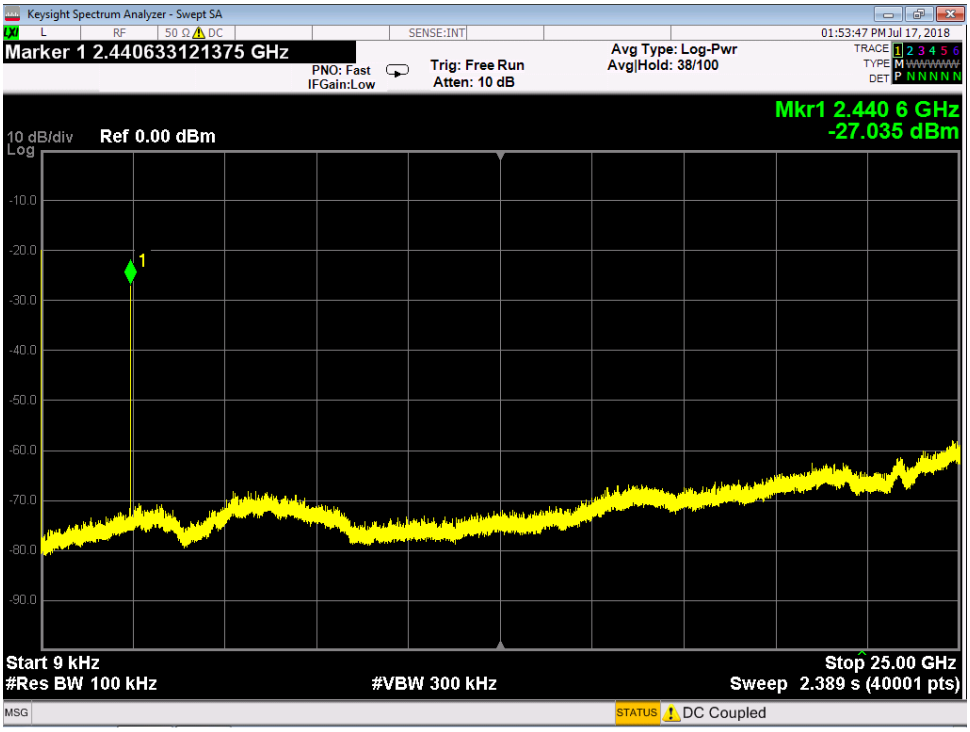
LIMITS

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 20dB below that in the 100kHz bandwidth that contains the highest level of desired power based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. [15.247(d)]

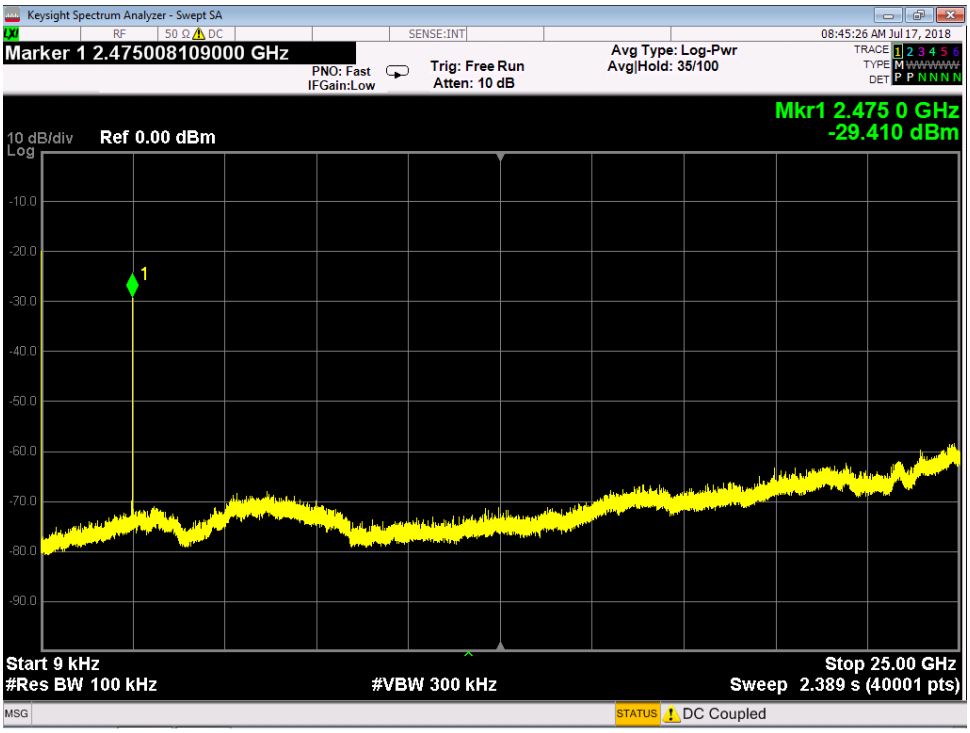
MEASUREMENTS / RESULTS



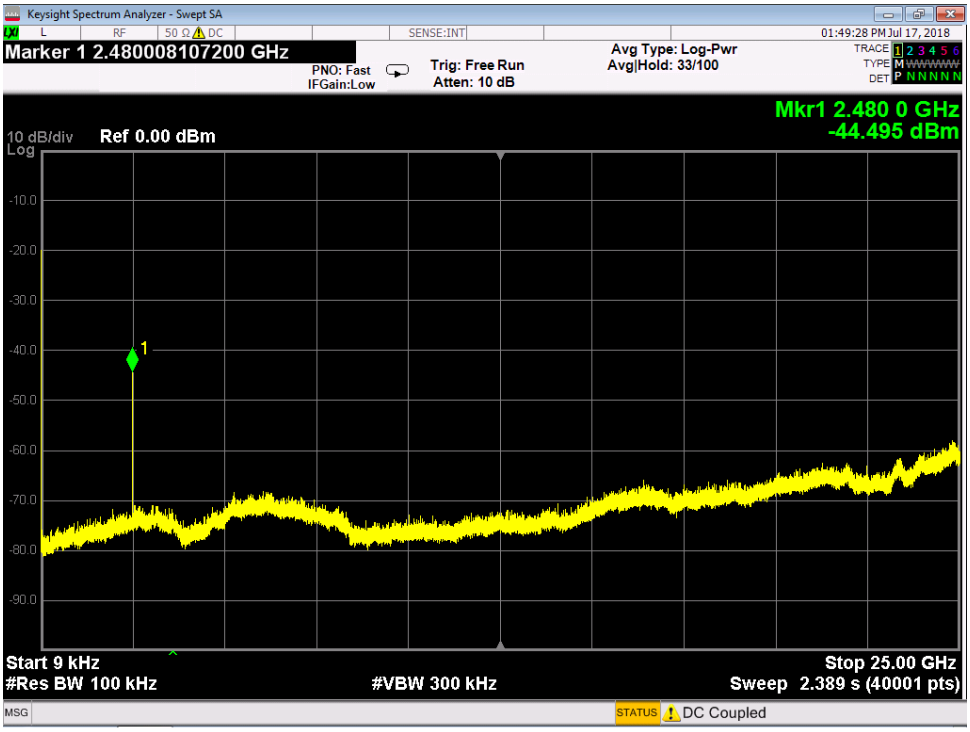
Low Channel



Mid Channel



High Channel 25



High Channel 26

Band Edge Measurements

Conducted Bandedge

Date: 7/16/2018 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT:** iQ ZigBee Controller – PCB Antenna **Operating Voltage/Frequency:** 3V DC
Temp: 22.8°C **Humidity:** 48% **Pressure:** 1000mBar

Frequency Range: 2405-2480 MHz **Measurement Type:** Conducted
Measurement Method: FCC KDB 558074 D01 DTS Meas Guidance V04

Notes:

	Channel Frequency (MHz)	Bandedge Frequency (MHz)	Delta to Peak (dB)	Limit (dB)	Limit (Pass/Fail)
Low Bandedge	2405	2390	52.522	≥ 20	Pass
High Bandedge Ch 25 19dBm	2475	2483.5	51.624	≥ 20	Pass
High Bandedge Ch 26 0dBm	2480	2483.5	34.374	≥ 20	Pass

Test Site: CEMI-5 **Cable:** 2286 Cbl **Attenuator:** 2107 40dB
Analyzer: 1118472 SA

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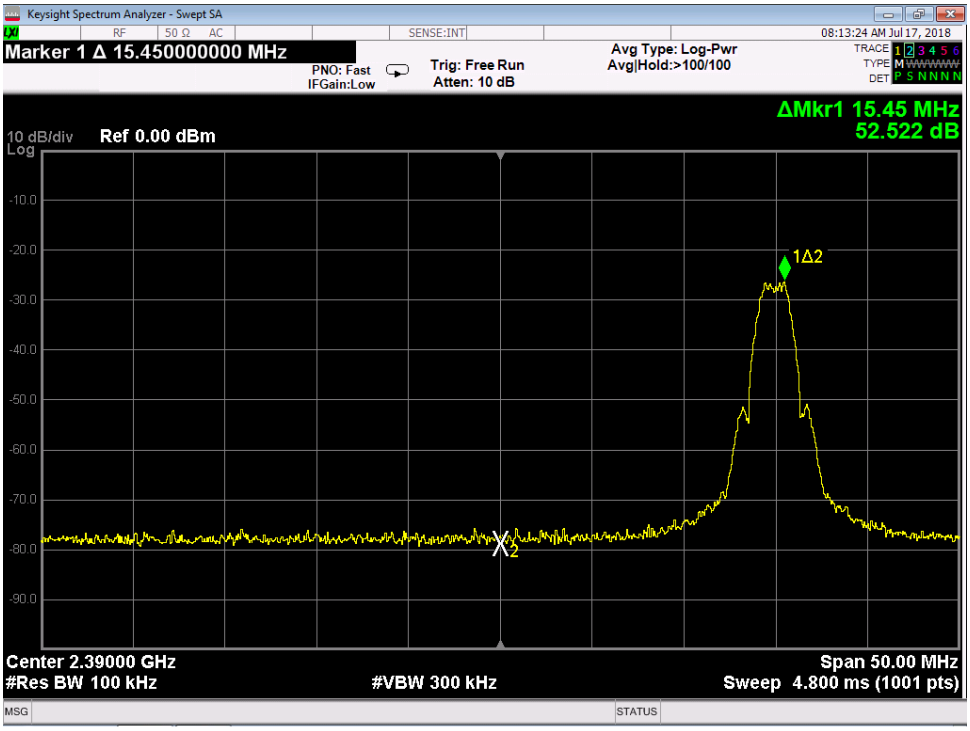
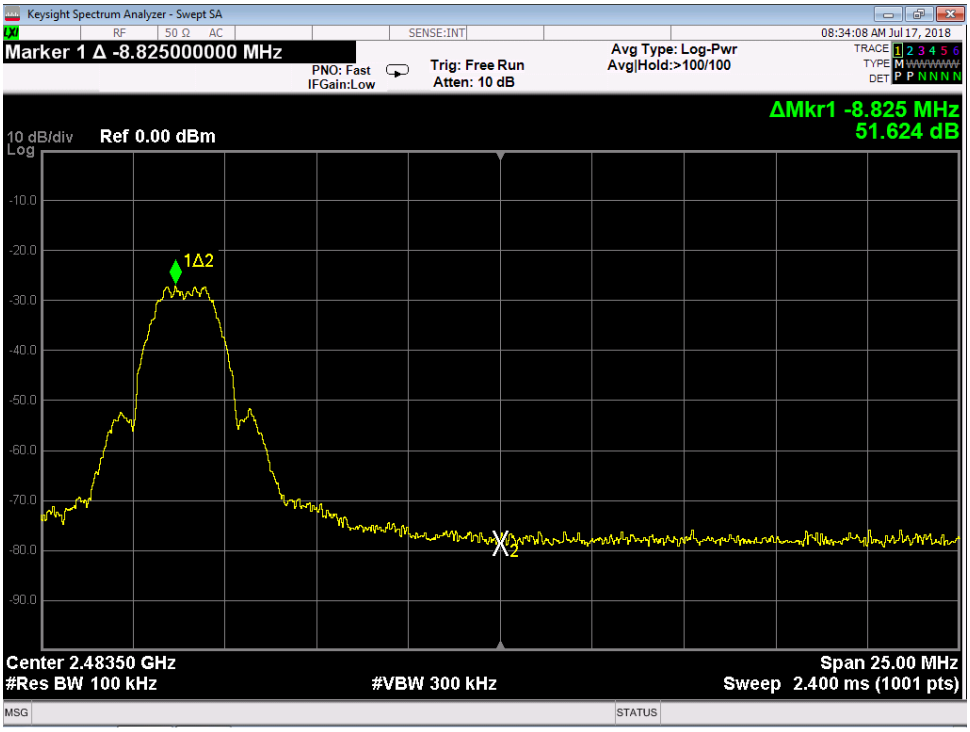
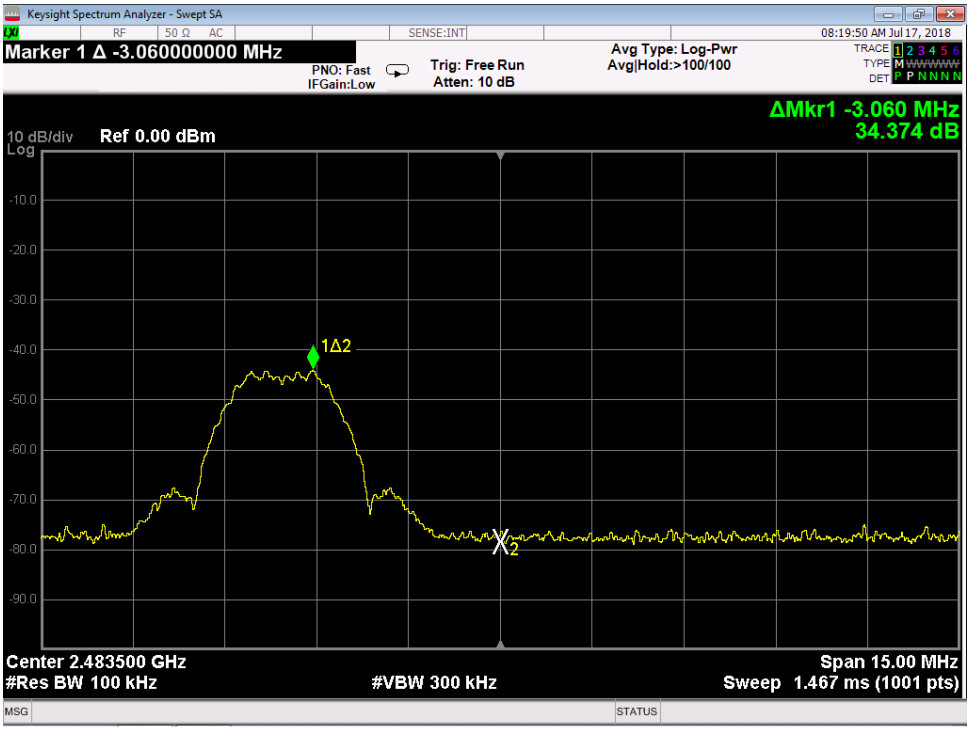
PLOTS



Band Edge, Lower Channel



Band Edge, High Channel 25 (19dBm)



Band Edge, High Channel 26 (0dBm)

Power Spectral Density

LIMIT

…the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission. [15.247(e)]

MEASUREMENTS / RESULTS

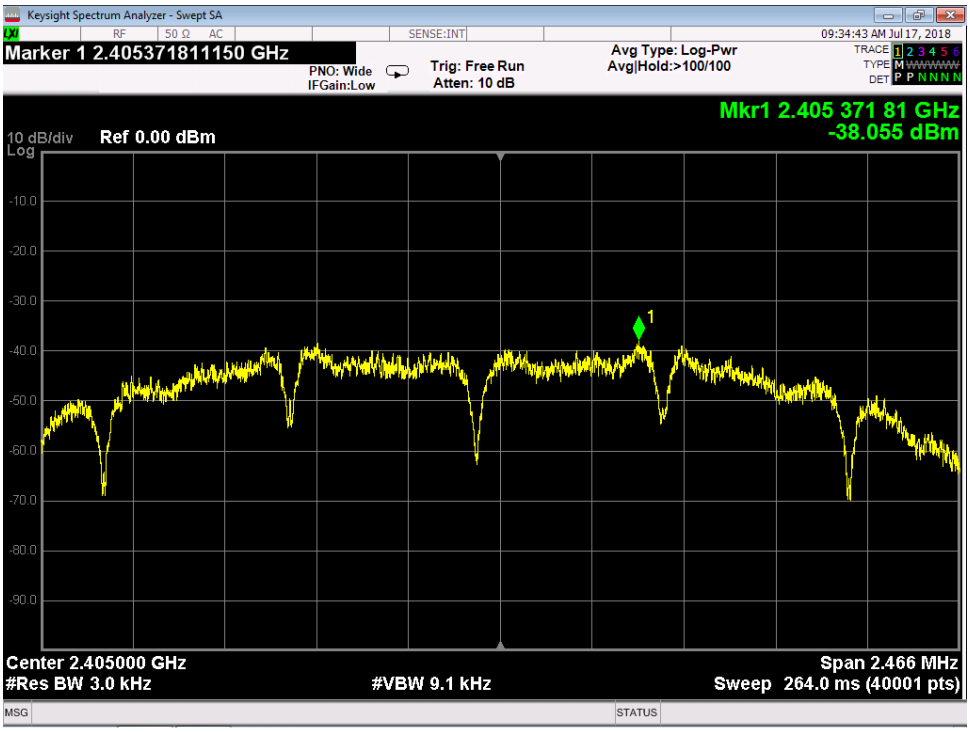
Peak Power Spectral Density

Date: 7/16/2018 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT:** iQ ZigBee Controller – PCB Antenna **Operating Voltage/Frequency:** 3V DC
Temp: 22.8°C **Humidity:** 48% **Pressure:** 1000mBar
Frequency Range: 2405-2480 MHz **Measurement Type:** Conducted
Notes: 19dBm output power for all channels except Ch26 at 0dBm

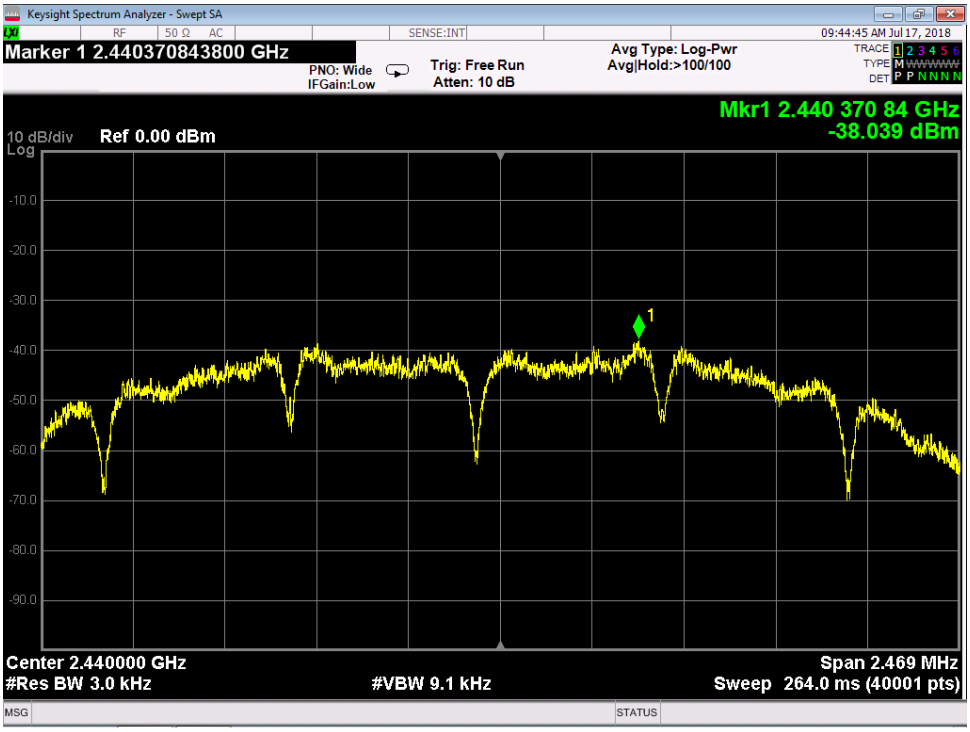
Frequency (MHz)	Peak Reading (dBm)	Cable Loss (dB)	Attenuator Loss (dB)	Peak PSD (dBm)	Limit (dBm)	Margin (dB)	Result
2405	-38.06	0.38	39.42	1.75	8.0	-6.26	Pass
2440	-38.04	0.38	39.42	1.76	8.0	-6.24	Pass
2475	-38.88	0.38	39.42	0.92	8.0	-7.08	Pass
2480	-55.84	0.38	39.42	-16.04	8.0	-24.04	Pass

Test Site: CEMI-5 **Cable:** 2286 Cbl **Attenuator:** 2107 40dB
Analyzer: 1118472 SA
PSD(dBm) = Reading (dBm) + Cable Loss (dB) + Attenuator Loss (dBm)

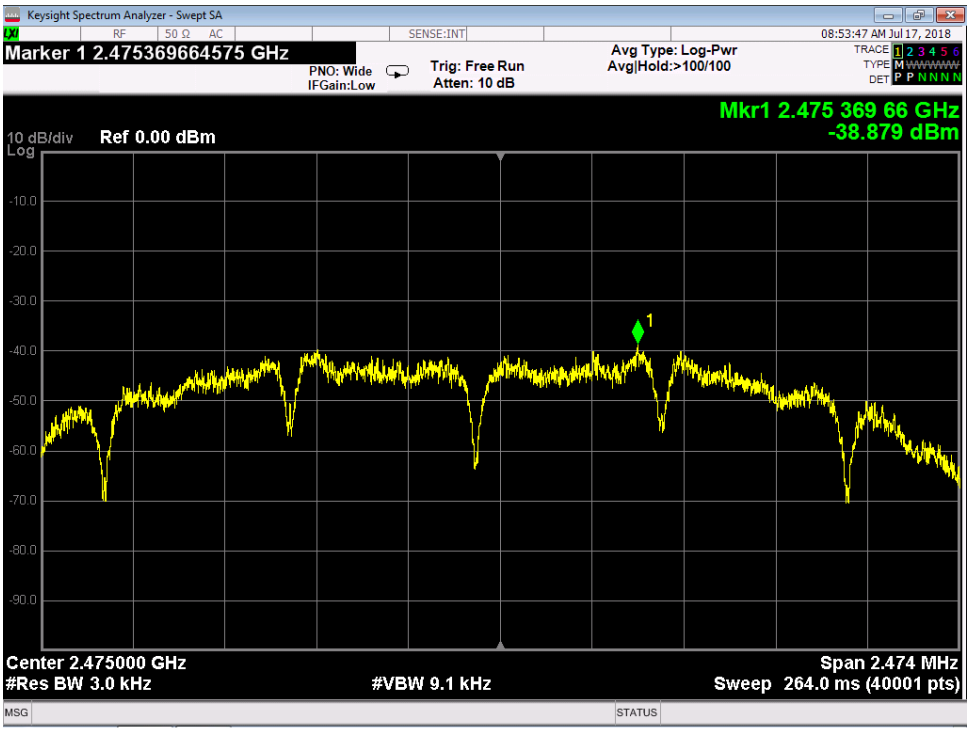
PLOTS



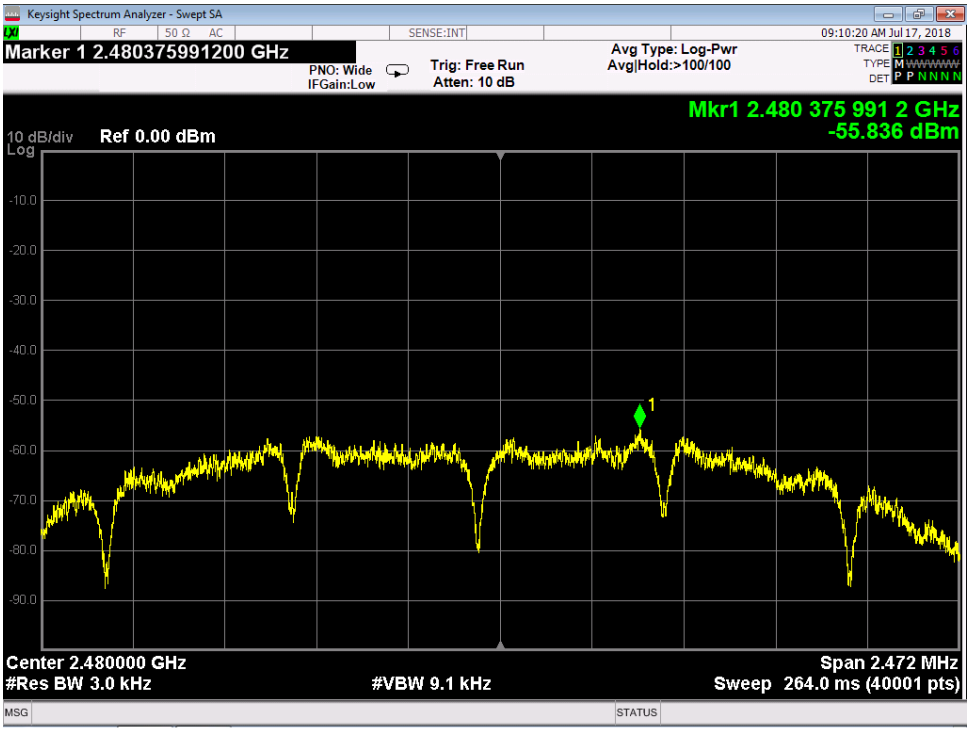
Power Spectral Density, Low Channel



Power Spectral Density, Mid Channel



Power Spectral Density, High Channel 25 (19dBm)



Power Spectral Density, High Channel 26 (0dBm)

AC Line Conducted Emissions

LIMITS

Frequency of emission (MHz)	Quasi-peak limit (dBµV)	Average limit (dBµV)
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

[47 CFR 15.207(a)]

MEASUREMENTS / RESULTS

Curtis Straus - a Bureau Veritas Company
Conducted Emissions per CISPR 16-2-1
Peak Detector Data
Notes:
EUT Line tested: 120VAC/60Hz; Hot Phase
EUT Power: 3V DC

Work Order # - S1587
EUT Power Input - 120VAC/ 60Hz
Test Site - CEMI-5
Conditions: - 22.8°C; 47%RH; 1000mBar
Test Engineer - Zac Johnson
Witnessed by - Sivakumar Thangavelu

Data Taken at 02:05:50 PM, Monday, July 16, 2018

Frequency (MHz)	Raw Pk Reading (dBµV)	Correction Factor (dB)	Adjusted Pk Amplitude (dBµV)	QP Lim: Mains_FCC&CISPR_QP_Class_B (dBµV)	Margin to the QP Limit (dB)	Pk to QP Limit Results (Pass/Fail)	Worst Margin (QP Limit) (dB)
0.15	36.2	20.9	57.1	66	-8.9	PASS	
0.163	39.2	20.9	60	65.3	-5.2	PASS	-5.2
0.256	31.8	20.9	52.7	61.6	-8.9	PASS	
0.281	29.4	20.8	50.3	60.8	-10.5	PASS	
0.328	26.8	20.8	47.6	59.5	-11.9	PASS	
0.362	25.5	20.8	46.4	58.7	-12.3	PASS	

Hot Lead – Peak

Curtis Straus - a Bureau Veritas Company
Conducted Emissions per CISPR 16-2-1, CISPR Average Detector
Final Average Detector Data
Notes:
EUT Line tested: 120VAC/60Hz; Hot Phase
EUT Power: 3V DC

Work Order # - S1587
EUT Power Input - 120VAC/ 60Hz
Test Site - CEMI-5
Conditions: - 22.8°C; 47%RH; 1000mBar
Test Engineer - Zac Johnson
Witnessed by - Sivakumar Thangavelu

Data Taken at 02:05:50 PM, Monday, July 16, 2018

Frequency (MHz)	Raw Avg Reading (dBµV)	Correction Factor (dB)	Adjusted Avg Amplitude (dBµV)	Av Lim: Mains_FCC&CISPR_Avg_Class_B (dBµV)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)
0.154	12.7	20.9	33.5	55.8	-22.2	PASS	
0.16	12.7	20.9	33.6	55.5	-21.9	PASS	
0.175	12.7	20.8	33.5	54.7	-21.3	PASS	
0.203	11.5	20.9	32.4	53.5	-21	PASS	-21
0.204	11.5	20.9	32.4	53.5	-21.1	PASS	
0.338	6.8	20.8	27.6	49.2	-21.7	PASS	

Hot Lead - Average

Curtis Straus - a Bureau Veritas Company
Conducted Emissions per CISPR 16-2-1
Peak Detector Data
Notes:
EUT Line tested: 120VAC/60Hz; Neutral Phase
EUT Power: 3V DC

Work Order # - S1587
EUT Power Input - 120VAC/ 60Hz
Test Site - CEMI-5
Conditions: - 22.8°C; 47%RH; 1000mBar
Test Engineer - Zac Johnson
Witnessed by - Sivakumar Thangavelu

Data Taken at 01:46:57 PM, Monday, July 16, 2018

Frequency (MHz)	Raw Pk Reading (dBµV)	Correction Factor (dB)	Adjusted Pk Amplitude (dBµV)	QP Lim: Mains_FCC&CISPR_QP_Class_B (dBµV)	Margin to the QP Limit (dB)	Pk to QP Limit Results (Pass/Fail)	Worst Margin (QP Limit) (dB)	Av Lim: Mains_FCC&CISPR_Avg_Class_B (dBµV)	Margin to Avg Limit (dB)	Pk to Avg Limit Results (Pass/Fail)	Worst Margin (Avg Limit) (dB)
0.16	24.9	20.9	45.8	65.4	-19.6	PASS	-19.6	55.4	-9.6	PASS	-9.6
0.213	20.4	20.9	41.3	63.1	-21.8	PASS		53.1	-11.8	PASS	
0.246	18.8	20.9	39.7	61.9	-22.2	PASS		51.9	-12.2	PASS	
0.279	12.7	20.9	33.5	60.8	-27.3	PASS		50.8	-17.3	PASS	
0.304	15.2	20.9	36.1	60.1	-24	PASS		50.1	-14	PASS	
0.362	12.1	20.9	33	58.7	-25.7	PASS		48.7	-15.7	PASS	

Neutral Lead - Peak

Rev. 7/10/2018

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Rental EXA Signal Analyzer(1118472)	9KHz-26.5GHz	N9010A-526;K	AT	MY51170010	1118472	I	7/25/2018	7/25/2017
LISNs/Measurement Probes	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
LISN Asset 1730	150kHz-30MHz	LI-150A	Com-Power	201090	1730	I	4/19/2019	4/19/2018
LISN Asset 1731	150kHz-30MHz	LI-150A	Com-Power	201091	1731	I	4/19/2019	4/19/2018
Conducted Test Sites (Mains / Telco)	**FCC Code**		**VCCI Code**			**Cat**	**Calibration Due**	**Calibrated on**
CEMI 5	719150		A-0015			III	NA	N/A
Meteorological Meters/Chambers		**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	5/15/2020	5/15/2018
TH A#2079		HTC-1	HDE		2079	II	3/22/2019	3/22/2018
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**	**Calibrated on**
CEMI-14	9kHz - 2GHz		C-S			II	10/2/2018	10/2/2017
Attenuators	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
20dB Attenuator-64	9kHz-2GHz			N/A		II	11/6/2018	11/8/2017

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Occupied Bandwidth

REQUIREMENT

When an occupied bandwidth is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. [RSS-GEN 6.6]

MEASUREMENTS / RESULTS

99% Occupied Bandwidth

Date: 7/16/2018 **Company:** Osram **Work Order:** S1587
Engineer: Zac Johnson **EUT:** iQ ZigBee Controller – PCB Antenna **Operating Voltage/Frequency:** 3V DC
Temp: 22.8°C **Humidity:** 48% **Pressure:** 1000mBar
Frequency Range: 2405-2480 MHz **Measurement Type:** Conducted
Notes:

Frequency (MHz)	99% OBW (MHz)
2405	2.292
2440	2.283
2475	2.291
2480	2.339

Test Site: CEMI-5 **Cable:** 2286 Cbl **Attenuator:** 2107 40dB
Analyzer: 1118472 SA

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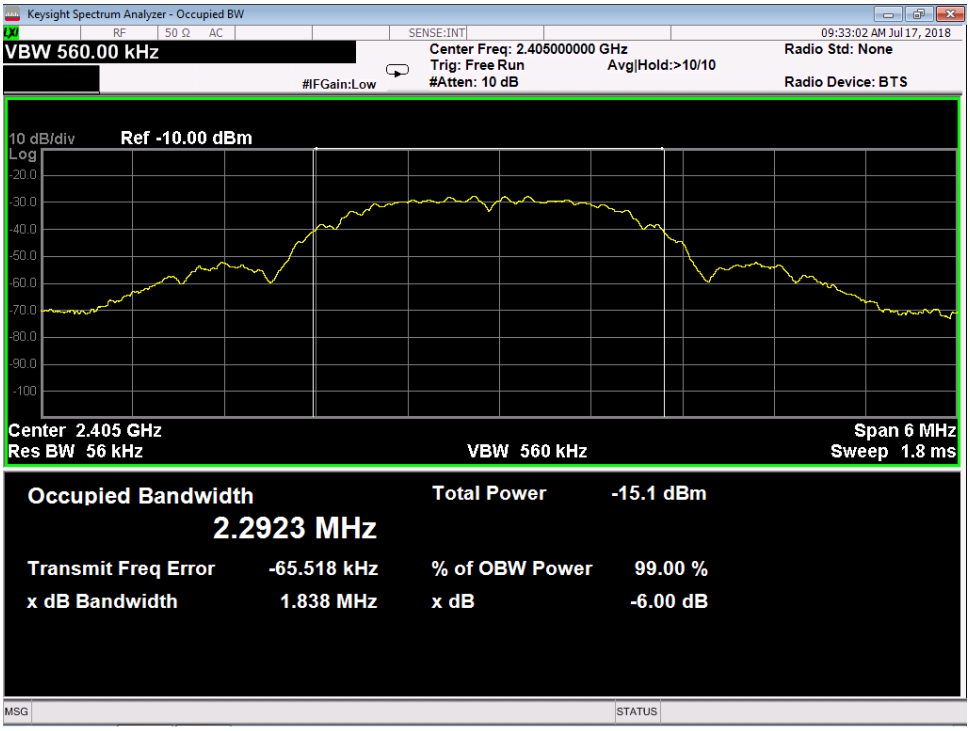
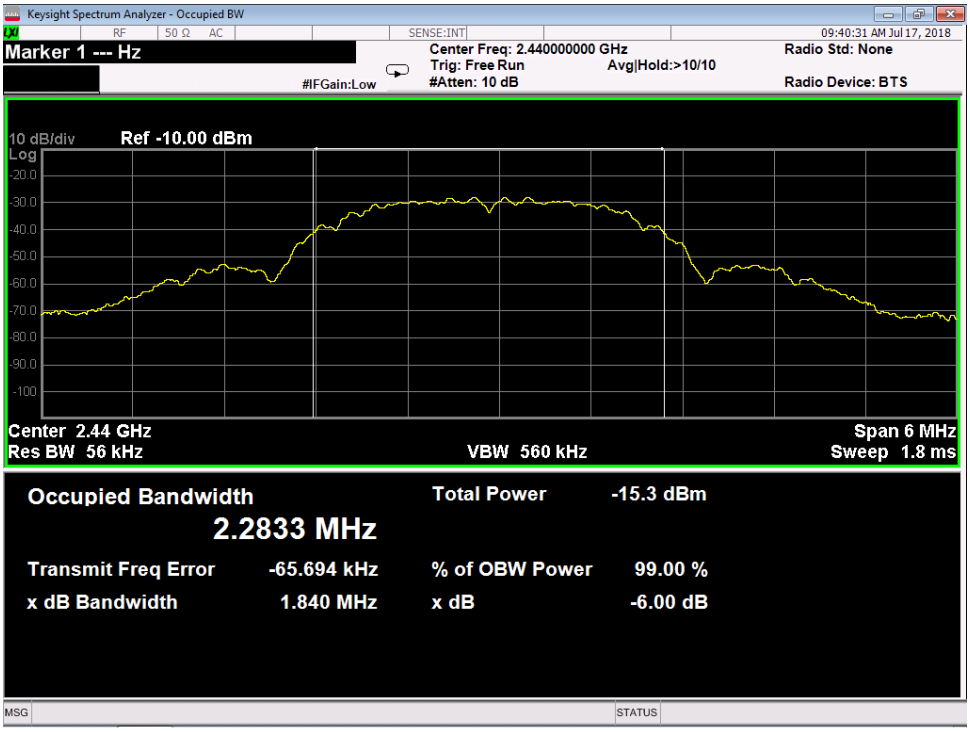
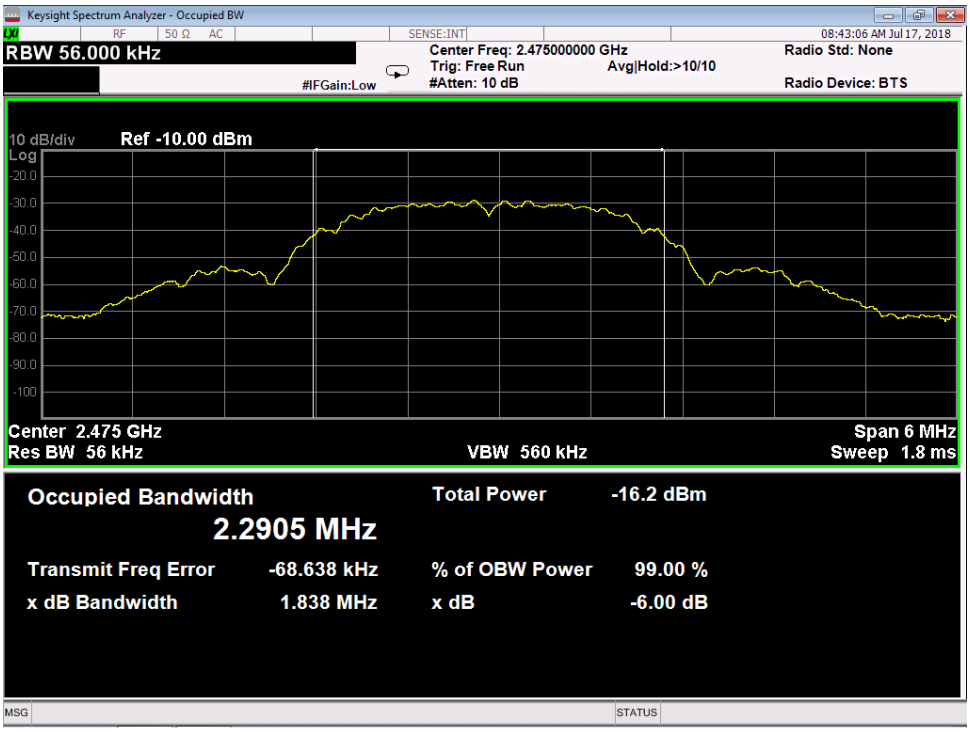
PLOTS



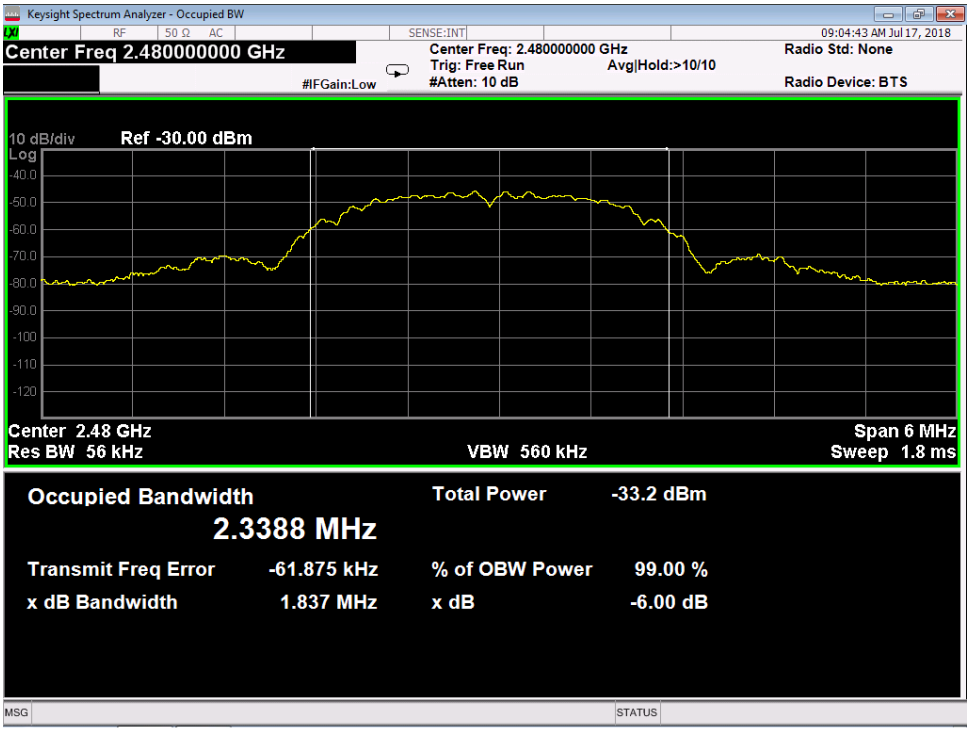
Occupied Bandwidth, Low Channel



Occupied Bandwidth, Mid Channel



Occupied Bandwidth, High Channel 25 (19dBm)



Occupied Bandwidth, High Channel 26 (0dBm)

Rev. 7/10/2018

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Rental EXA Signal Analyzer(1118472)	9KHz-26.5GHz	N9010A-526;K	AT	MY51170010	1118472	I	7/25/2018	7/25/2017
Conducted Test Sites (Mains / Telco)	**FCC Code**		**VCCI Code**			**Cat**	**Calibration Due**	**Calibrated on**
CEMI 5	719150		A-0015			III	NA	N/A
Preamps /Couplers Attenuators / Filters	**Range**	**MN**	**Mfr**	**SN**	**Asset**	**Cat**	**Calibration Due**	**Calibrated on**
API - 40dB 100W Attenuator	0.009-18GHz	48-40-34	API Weinschel	CG7990	2107	II	10/4/2018	10/4/2017
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**	**Calibrated on**
Asset #2286	9KHz-26.5GHz	FLC-1.5FT-SMSM+	Mini-Circuits	16021030		II	1/29/2019	1/29/2018

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

TEU for all conducted antenna port measurements

Measurement Uncertainty

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Expanded Uncertainty k=2	Maximum allowable uncertainty
Radiated Emissions (30-1000MHz) NIST CISPR	 5.6dB 4.6dB	 N/A 5.2dB (Ucispr)
Radiated Emissions (1-26.5GHz)	4.6dB	N/A
Radiated Emissions (above 26.5GHz)	4.9dB	N/A
Magnetic Radiated Emissions	5.6dB	N/A
Conducted Emissions NIST CISPR	 3.9dB 3.6dB	 N/A 3.6dB (Ucispr)
Telco Conducted Emissions (Current)	2.9dB	N/A
Telco Conducted Emissions (Voltage)	4.4dB	N/A
Electrostatic Discharge	11.5%	N/A
Radiated RF Immunity (Uniform Field)	1.6dB	N/A
Electrical Fast Transients	23.1%	N/A
Surge	23.1%	N/A
Conducted RF Immunity	3dB	N/A
Magnetic Immunity	12.8%	N/A
Dips and Interrupts	2.3V	N/A
Harmonics	3.5%	N/A
Flicker	3.5%	N/A
Radio frequency (@ 2.4GHz)	3.23×10^{-8}	1×10^{-7}
RF power, conducted	0.40dB	0.75dB
Maximum frequency deviation: • Within 300Hz and 6kHz of audio frequency / Within 6kHz and 25kHz of audio frequency	 3.4% 0.3dB	 5% 3dB
Adjacent channel power	1.9dB	3dB
Conducted spurious emission of transmitter, valid up to 12.75GHz	2.39dB	3dB
Conducted emission of receivers	1.3dB	3dB
Radiated emission of transmitter, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of transmitter, valid up to 80GHz	3.3dB	6dB
Radiated emission of receiver, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of receiver, valid up to 80GHz	3.3dB	6dB
Humidity	2.37%	5%
Temperature	0.7°C	1.0°C
Time	4.1%	10%
RF Power Density, Conducted	0.4dB	3dB
DC and low frequency voltages	1.3%	3%
Voltage (AC, <10kHz)	1.3%	2%
Voltage (DC)	0.62%	1%
The above reflects a 95% confidence level		

Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("Client"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "Conditions"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("Test Report") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "**BUREAU VERITAS," "BUREAU VERITAS CONSUMER PRODUCTS SERVICES," "BVCPS", "MTL", "ACTS", "MTL-ACTS" and CURTIS-STRAUS** (collectively, the "Marks") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only were such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.
13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.
14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B)NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

The complete list of the Approved Subcontractors Curtis-Straus may use to delegate the performance of work can be provided upon request.

Rev.160009121(2)_#684340 v14CS