

RF Test Report

Project Number: 4134783 **Proposal Number:** 3732

Report Number: 4134783EMC04 **Revision Level:** 3

Client: Crestron Electronics Inc.

Equipment Under Test: ZigBee Radio

Model: CWD7549

FCC ID: EROCWD7549

IC ID: 5683C-CWD7549

Applicable Standards: ANSI C63.10: 2013

FCC Part 15 Subpart C, § 15.247


RSS-247, Issue 2, February 2017

RSS-GEN, Issue 5, April 2018

Report issued on: 21 February 2019

Test Result: Compliant

Tested by:



Martin Taylor, RF/EMC Engineer
For Jeremy O. Pickens, Senior EMC Engineer

Reviewed by:



David Schramm, Operations Manager

Remarks: This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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1 Summary of Test Results

Test Description	Test Specification		Test Result
Bandwidth	15.247(a)(2)	RSS-247 S5.2 (a) RSS-GEN S6.7	Compliant
Transmitter Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	Compliant
Conducted Spurious Emissions / Band edge	15.247(d)	RSS-247 S5.5	Compliant
Radiated Spurious Emissions / Restricted Bands	15.35, 15.247(d), 15.205, 15.209	RSS-GEN S6.13 RSS-GEN S8.9 RSS-GEN S8.10	Compliant
Antenna Requirement	15.203	RSS-GEN S6.8	Compliant ⁽¹⁾
AC Powerline Conducted Emission	15.107, 15.207	RSS-GEN S8.8	NA ⁽²⁾

(1) Non-detachable chip antenna.

(2) The device is DC-powered and cannot connect to the AC mains.

1.1 Modifications Required for Compliance

To meet the restricted band edge and spurious emissions in restricted bands, the target power settings had to be reduced as follows:

- Channel 11 – Reduced to -3dBm target power
- Channel 18 – Reduced to -2dBm target power
- Channel 24 – Reduced to -4dBm target power
- Channel 25 – Reduced to -12dBm target power
- Channel 26 – Reduced to -43dBm target power

2 General Information

2.1 Client Information

Name: Crestron Electronics Inc
 Address: 15 Volvo Drive
 City, State, Zip, Country: Rockleigh, NJ 07647, USA

2.2 Test Laboratory

Name: SGS North America, Inc.
 Address: 620 Old Peachtree Road NW, Suite 100
 City, State, Zip, Country: Suwanee, GA 30024, USA

Accrediting Body: A2LA
 Type of lab: Testing Laboratory
 Certificate Number: 3212.01

2.3 General Information of EUT

Type of Product: ZigBee Radio
 Model Number: CWD7549
 Serial Number: CNA9255966
 (second sample not labeled)
 Frequency Range: 2405-2480MHz
 Modulation: 802.15.4 (ZigBee)
 Antenna: -2.0dBi Chip Antenna (Johansson Technology, P/N: 2450AT42E010B)

Rated Voltage: 5Vdc
 Test Voltage: 5Vdc

Sample Received Dates: 21 April 2017
 23 August 2018

Dates of testing: 26-27 March 2018 (Antenna Port Conducted Measurements and
 Radiated Spurious Emissions <1GHz)
 8-24 October 2018 (Radiated Spurious Emissions >1GHz)
 5-8 February 2019 (Output Power, Restricted Band Edge & Duty Cycle)

2.4 Operating Modes and Conditions

Continuous traffic was generated using test commands. The device was programmed to transmit at 100% duty cycle at low, middle and high channels as shown below.

Channel 11, 2405MHz (low channel)

Channel 18, 2440MHz (middle channel)

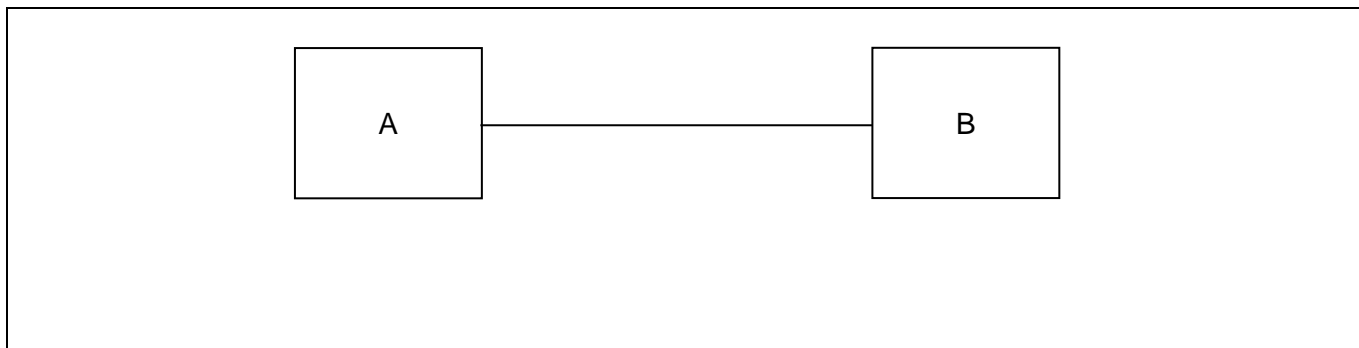
Channel 24, 2470MHz (high channel)

Channel 25, 2475MHz (high channel – reduced power required to meet restricted band limits)

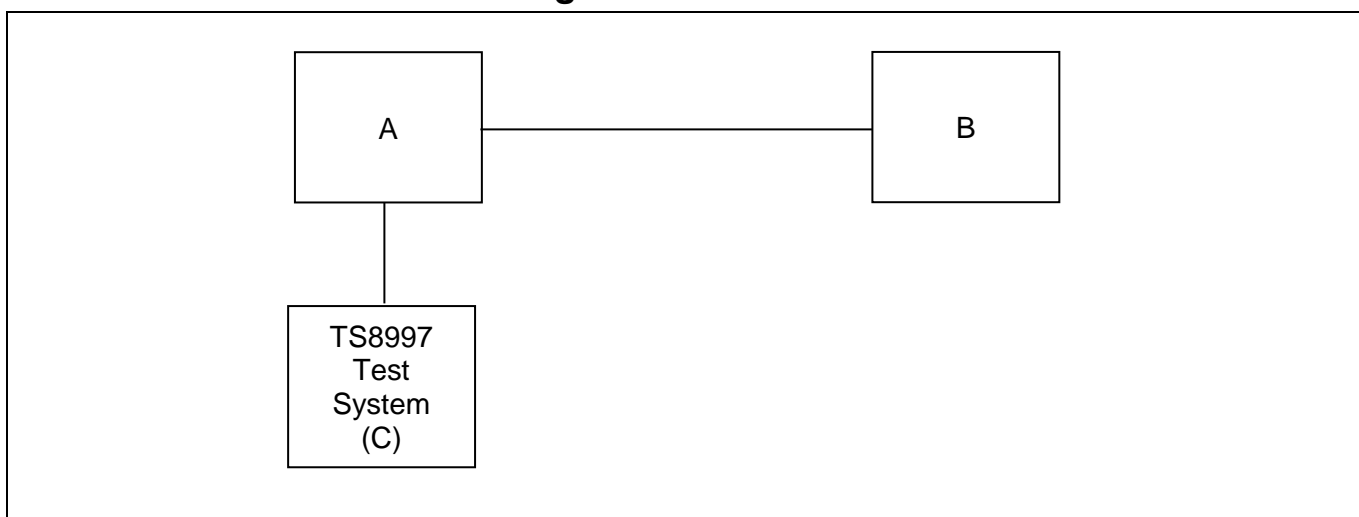
Channel 26, 2480MHz (high channel – greatly reduced power required to meet restricted band limits)

Average measurements for transmitter-related radiated emissions (i.e. harmonics) were adjusted by a -13.4dB duty cycle correction factor (DCCF). Duty cycle measurements are shown in Appendix A. The client states that this is the maximum duty cycle that will be seen in normal operation and that it cannot be changed by the device or by the end user.

2.5 EUT Connection Block Diagram – Radiated Measurements



2.6 EUT Connection Block Diagram – Conducted Measurements



2.7 System Configuration

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Crestron	ZigBee Radio (EUT)	CWD7549	CNA9255966
B	Rigol	DC Power Supply	DP711	DP7A182700833
B	Soul Bay	DC Power Supply	UC05U	Not labeled
C	Rohde & Schwarz	Wireless Test System	TS8997	Not Labeled

Note: The Rigol DC Power Supply was used for the March 2018 testing and the Soul Bay Power Supply was used for the subsequent testing.

3 Bandwidth

3.1 Test Result

Test Description	Test Specification		Test Result
6 dB bandwidth / 99% OBW	15.247(a)(2)	RSS-247 S5.2 (a) RSS-GEN S6.7	Compliant

3.2 Test Method

The procedures from ANSI C63.10: 2013 clause 11.8 and KDB 558074 D01 DTS Meas Guidance v04 were used to determine the 6 dB bandwidth and 99% OBW.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.9 °C

Relative Humidity: 32.9 %

3.4 Test Equipment

Test End Date: 27-Mar-2018

Tester: JOP

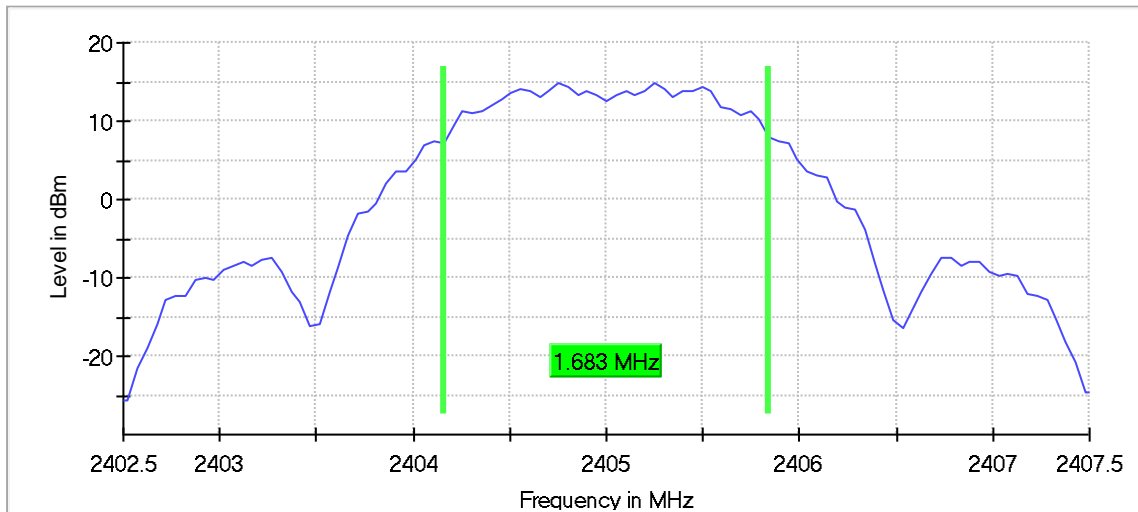
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018
OPEN SWITCH AND CONTROL UNIT	OSP 120	ROHDE & SCHWARZ	S/N: 101182	CNR
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018

Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year calibration cycle.

3.5 Test Data – 6 dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2405.000000	1.683168	0.500000	---	2404.158416	2405.841584	14.8	PASS
2440.000000	1.683168	0.500000	---	2439.158416	2440.841584	14.7	PASS
2480.000000	1.683168	0.500000	---	2479.158416	2480.841584	-8.2	PASS

Representative Plot



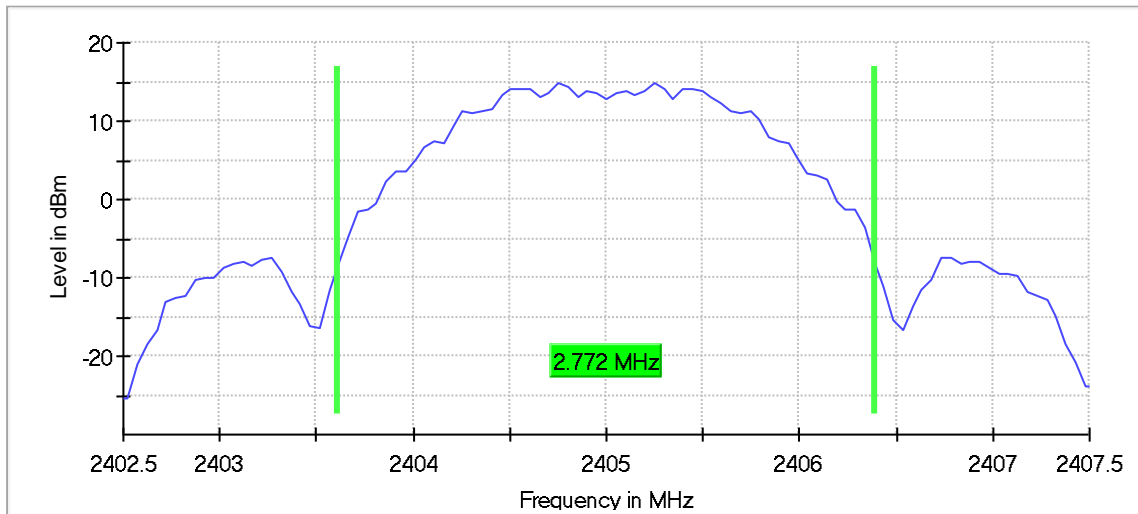
Representative Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.40250 GHz	2.40250 GHz
Stop Frequency	2.40750 GHz	2.40750 GHz
Span	5.000 MHz	5.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 50
Sweeptime	18.938 μ s	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	20 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.22 dB	0.50 dB

3.6 Test Data – 99% Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)	Max Level (dBm)	Result
2405.000000	2.772278	---	---	2403.613861	2406.386139	14.9	PASS
2440.000000	2.772278	---	---	2438.613861	2441.386139	14.5	PASS
2480.000000	2.772278	---	---	2478.613861	2481.386139	-8.2	PASS

Representative Plot



Representative Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.40250 GHz	2.40250 GHz
Stop Frequency	2.40750 GHz	2.40750 GHz
Span	5.000 MHz	5.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 100
Sweeptime	18.938 μ s	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	18 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.00 dB	0.50 dB

4 Output Power

4.1 Test Result

Test Description	Test Specification		Test Result
Peak Output Power	15.247(b)(3)	RSS-247 S5.4 (d)	Compliant

4.2 Test Method

Fundamental power measurements were recorded using the peak power procedures from ANSI C63.10: 2013 clause 11.9 and KDB 558074 D01 15.247 Meas Guidance v05.

Limit

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. For using antennas with greater than 6dBi of gain, the limit is reduced in dB by the amount the gain exceeds 6dBi

4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.3 °C
Relative Humidity: 47.7 %

4.4 Test Equipment

Test End Date: 5-Feb-2019

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF MEASUREMENT PROBE	MXHS83QE3000	MURATA		VBU

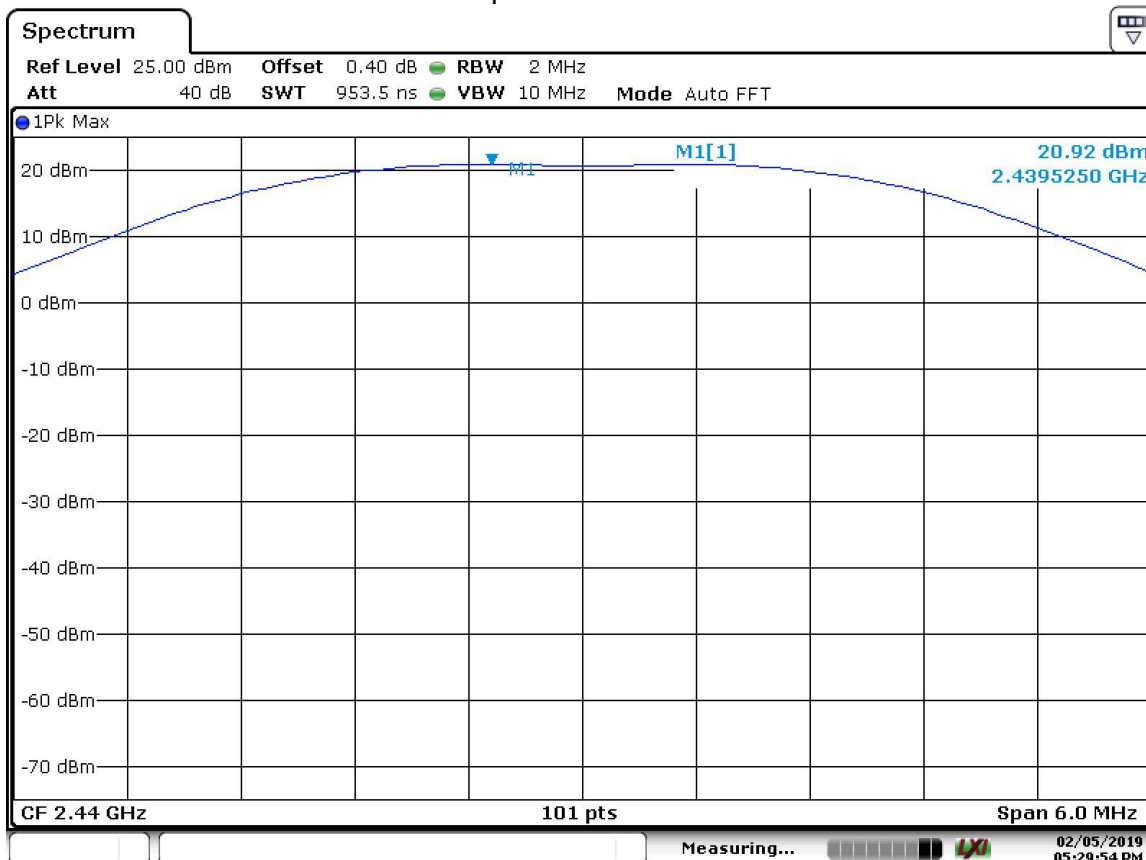
- The FSV30 is on a 2-year calibration cycle.
- VBU = Verify before use.

4.5 Test Data

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2405.000000	20.4	30.0	PASS
2440.000000	20.9	30.0	PASS
2470.000000	19.7	30.0	PASS
2475.000000	11.6	30.0	PASS
2480.000000	-40.7	30.0	PASS

Note: Above measurements were taken at the reduced power settings at which all tests are compliant.

Representative Plot



Representative Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.43700 GHz	2.43700 GHz
Stop Frequency	2.44300 GHz	2.44300 GHz
Span	6.000 MHz	6.000 MHz
RBW	2.000 MHz	>= 1.683 MHz
VBW	10.000 MHz	>= 6.000 MHz
SweepPoints	101	~ 101
SweepTime	953.450 ns	AUTO
Reference Level	25.000 dBm	20.000 dBm
Attenuation	40.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.02 dB	0.50 dB

5 Power Spectral Density

5.1 Test Result

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-247 S5.2 (b)	Compliant

5.2 Test Method

Fundamental power spectral density measurements were recorded using the peak PSD procedures from ANSI C63.10: 2013 clause 11.10 and KDB 558074 D01 DTS Meas Guidance v04.

Limit

The limit is 8 dBm.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.9 °C
Relative Humidity: 32.9 %

5.4 Test Equipment

Test End Date: 27-Mar-2018

Tester: JOP

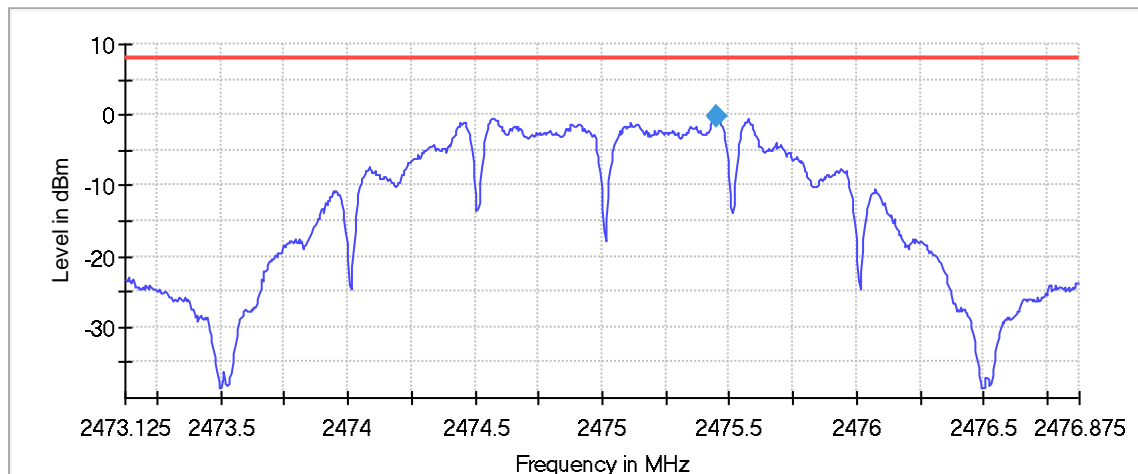
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018
OPEN SWITCH AND CONTROL UNIT	OSP 120	ROHDE & SCHWARZ	S/N: 101182	CNR
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018

Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year calibration cycle.

5.5 Test Data

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2405.000000	2405.437500	0.218	8.0	PASS
2440.000000	2440.447500	0.010	8.0	PASS
2475.000000	2475.447500	-0.156	8.0	PASS
2480.000000	2480.452500	-21.909	8.0	PASS

Representative Plot



— Limit
 — Sum Level
 ◆ PSD

Representative Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.47313 GHz	2.47313 GHz
Stop Frequency	2.47688 GHz	2.47688 GHz
Span	3.750 MHz	3.750 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	750	~ 750
Sweeptime	3.750 s	3.750 s
Reference Level	10.000 dBm	10.000 dBm
Attenuation	30.000 dB	AUTO
Detector	RMS	RMS
SweepCount	1	1
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	32 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.14 dB	0.50 dB

6 Conducted Spurious Emissions / Band Edge

6.1 Test Result

Test Description	Test Specification		Test Result
Conducted Spurious Emissions and Band Edge	15.247(d)	RSS-247 S5.5	Compliant

6.2 Test Method

Spurious emissions in non-restricted frequency bands were recorded using the methods defined in ANSI C63.10: 2013 clause 11.11 and KDB 558074 D01 DTS Meas Guidance v04.

Lowest, middle, and highest channels were investigated.

Because the maximum conducted peak output power was used to determine compliance with the output power limits, the limit is 20 dB below the maximum in-band peak PSD level in 100 kHz.

6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.9 °C

Relative Humidity: 32.9 %

6.4 Test Equipment

Test End Date: 27-Mar-2018

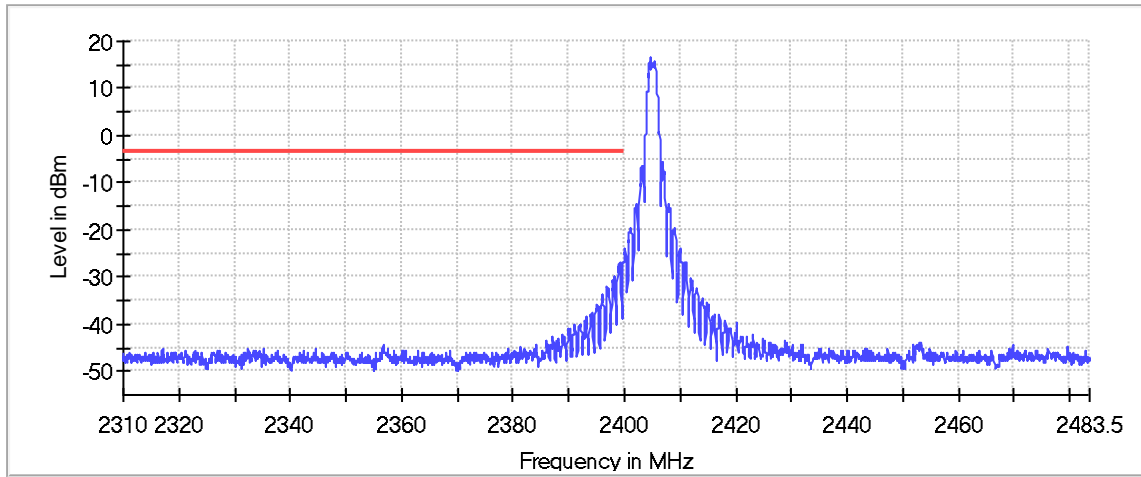
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2018
OPEN SWITCH AND CONTROL UNIT	OSP 120	ROHDE & SCHWARZ	S/N: 101182	CNR
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095591	28-Jul-2018

Note: The equipment calibration period is 1 year except for the FSV which is on a 2-year calibration cycle.

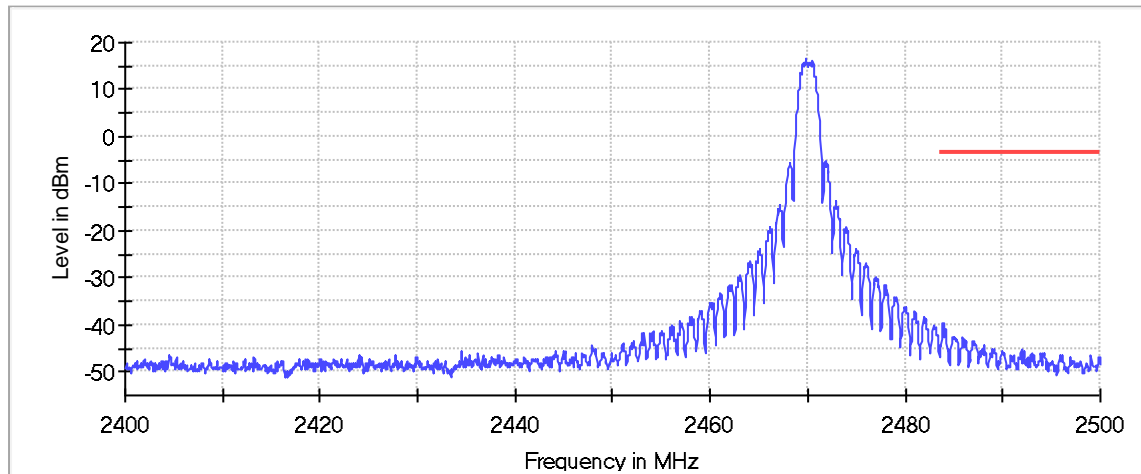
6.5 Test Data – DTS Band Edge

Lower band edge – Channel 11



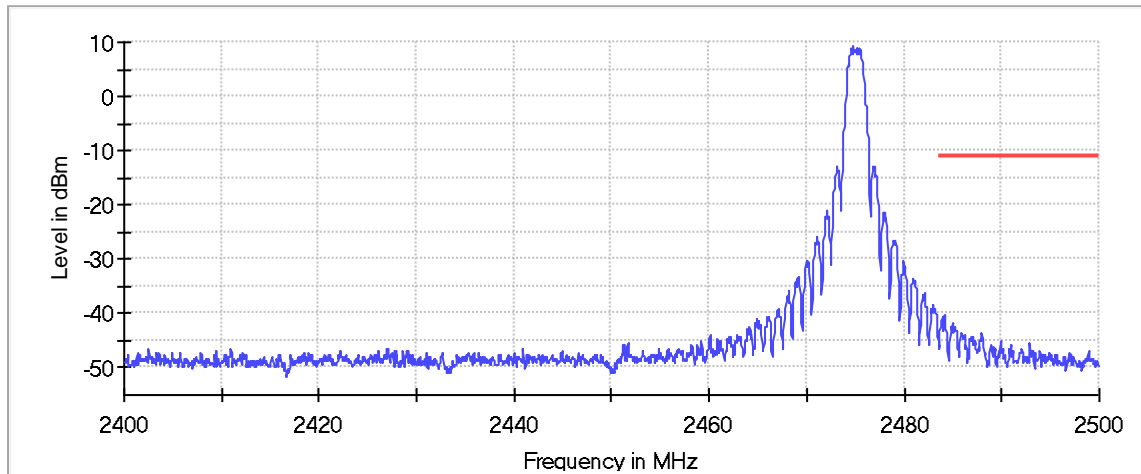
— Limit — Sum Level × Fail

Upper band edge – Channel 24



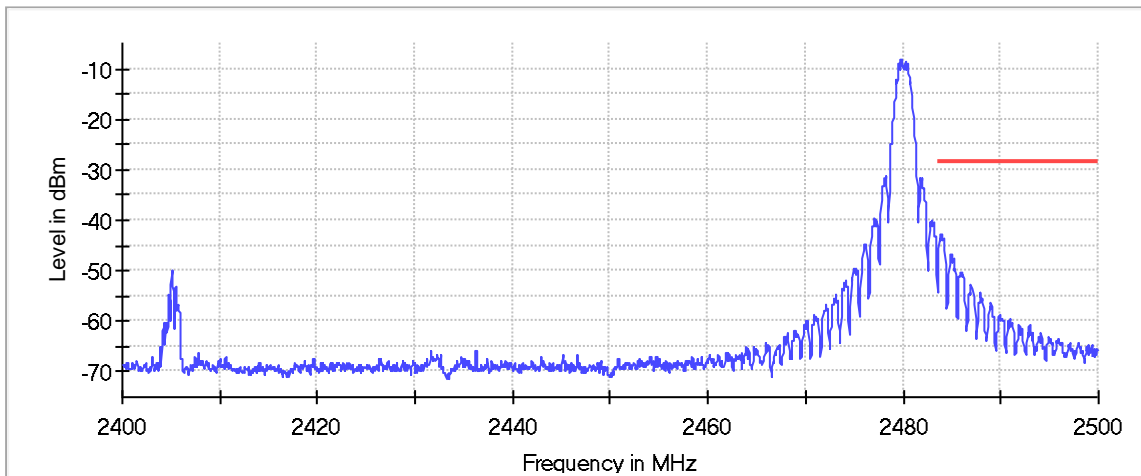
— Limit — Sum Level × Fail

Upper band edge – Channel 25



— Limit — Sum Level × Fail

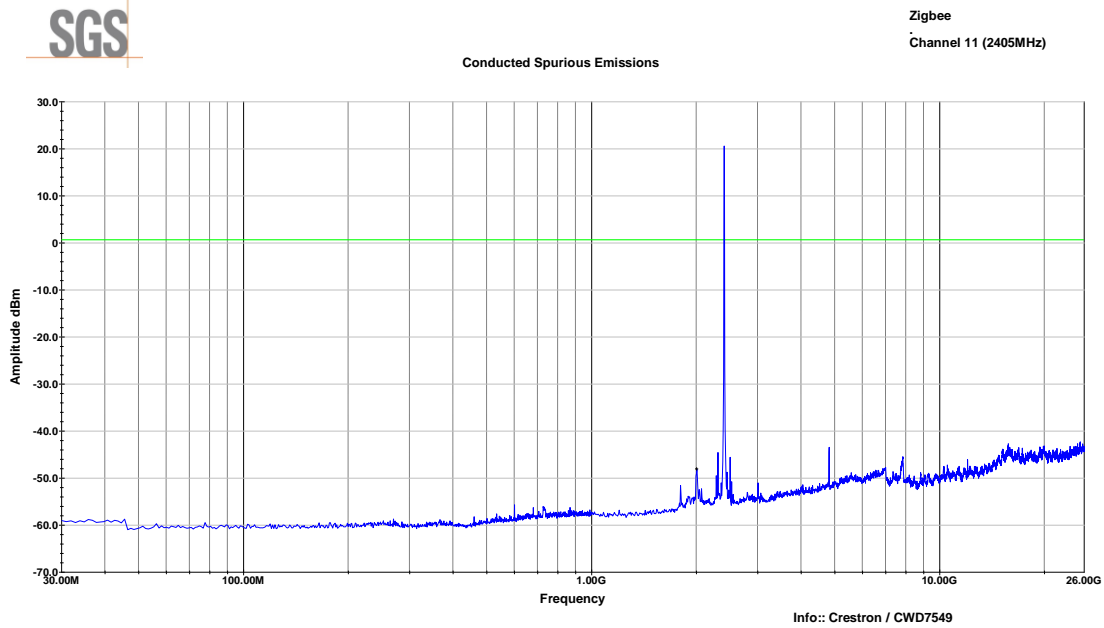
Upper band edge – Channel 26



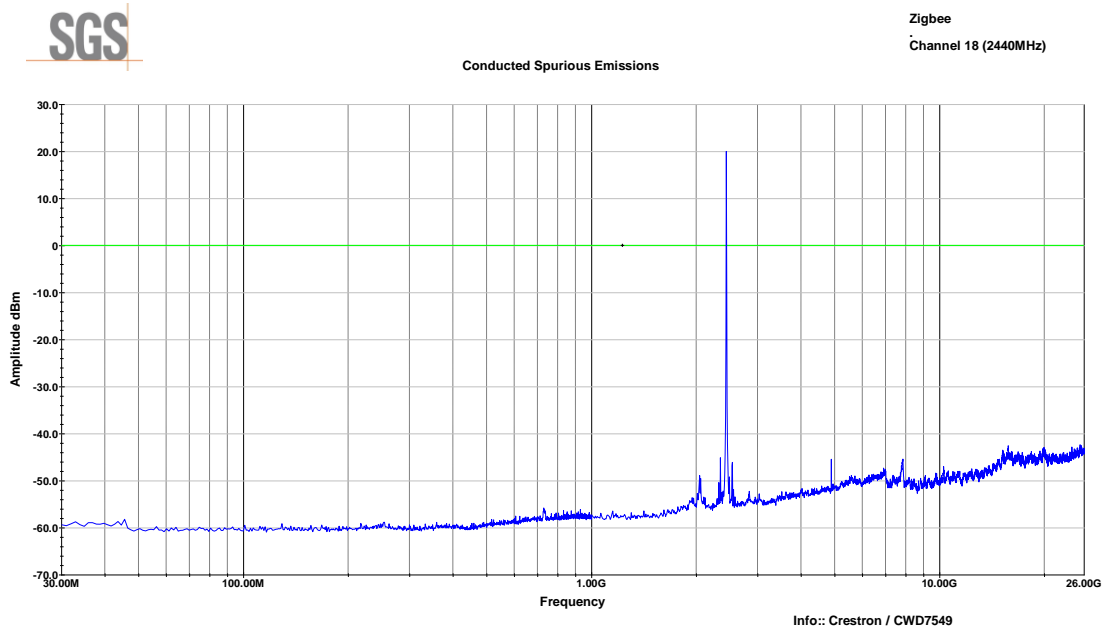
— Limit — Sum Level × Fail

6.6 Test Data – Conducted Spurious Emissions

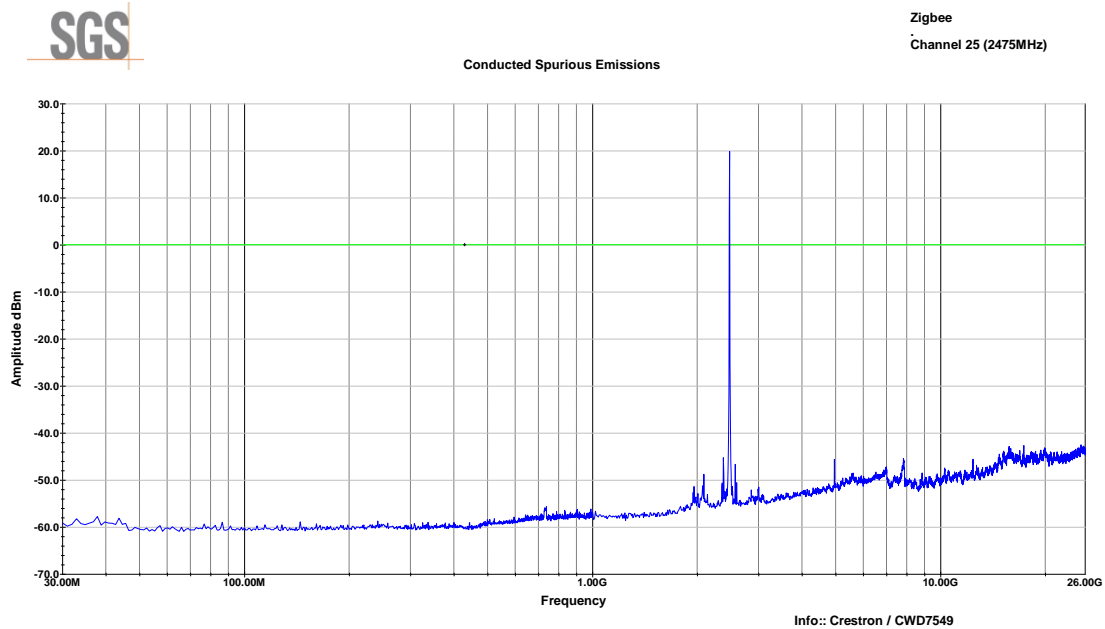
Conducted Spurs –Channel 11



Conducted Spurs –Channel 18



Conducted Spurs –Channel 25



7 Field Strength of Spurious Radiation

7.1 Test Result

Test Description	Test Specification		Test Result
Radiated Spurious Emissions	15.35, 15.247(d), 15.205, 15.209	RSS-GEN S6.13 RSS-GEN S8.9 RSS-GEN S8.10	Compliant

7.2 Test Method

Radiated emission measurements were performed with the antenna port terminated. The measurement methods defined in ANSI C63.10: 2013 clause 11.12 and KDB 558074 D01 15.247 Meas Guidance v05 were used.

Lowest, middle, and highest channels were investigated. For this evaluation, channel 25 was used as the upper channel for spurious emissions measurements. This was chosen due to the significant power reduction at Channel 26.

Test distance:

30 to 1000 MHz - The EUT to measurement antenna distance was 3 meters

1 to 18 GHz - The EUT to measurement antenna distance was 3 meters

18 to 26 GHz - The EUT to measurement antenna distance was 3 meters

Limits within restricted bands of operation:

Frequency	Limits ⁽¹⁾		Peak Limits dBuV/m
	Microvolts/m	dBuV/m	
30 - 88 MHz	100	40 ⁽²⁾	--
88 - 216 MHz	150	43.5 ⁽²⁾	--
216 - 960 MHz	200	46 ⁽²⁾	--
960 - 1000 MHz	500	54 ⁽²⁾	--
1 - 40 GHz	500	54 ⁽³⁾	74

(1) These limits are applicable to emissions outside of the intentional transmit frequency band.

(2) Quasi-peak limit

(3) Average limit

7.3 Test Site

Absorber Lined Shielded Enclosure (ALSE), SGS EMC Laboratory, Suwanee, GA

Environmental Conditions	30-1000MHz	1-3GHz	3-18GHz	18-26GHz
Enclosure:	10m Chamber	10m Chamber	3m Chamber	3m Chamber
Temperature:	22.1 °C	23.9 °C	22.6 °C	22.9 °C
Relative Humidity:	38.4 %	38.8 %	55.7 %	53.6 %

7.4 Test Equipment

30-1000MHz Measurements

Test End Date: 26-Mar-2018

Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	25-Apr-2018
ANTENNA, BILOG	JB6	SUNOL	B079690	29-Nov-2018
RF CABLE	SF106	HUBER & SUHNER	B079661	25-Jul-2018
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2018
RF CABLE	UC-N-MM-78	MAURY MICROWAVE	17017	25-Jul-2018
RF CABLE	104PE	HUBER & SUHNER	B079793	24-Jul-2018
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019

1-3GHz Measurements

Test End Date: 24-Oct-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079691	10-Aug-2019
RF CABLE	SF106	HUBER & SUHNER	B079712	24-Jul-2019
RF CABLE	SF106	HUBER & SUHNER	B079713	24-Jul-2019
RF CABLE	SF106	HUBER & SUHNER	B079659	23-Jul-2019
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019

3-18GHz Measurements

Test End Date: 9-Oct-2018

Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	2-Jul-2019
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	23-Jul-2019
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	24-Jul-2019
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	6-Mar-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019
FILTER, HIGH PASS (>2800MHZ)	HPM50111	MICRO-TRONICS	B085747	26-Jul-2019

18-26GHz Measurements

Test End Date: 9-Oct-2018

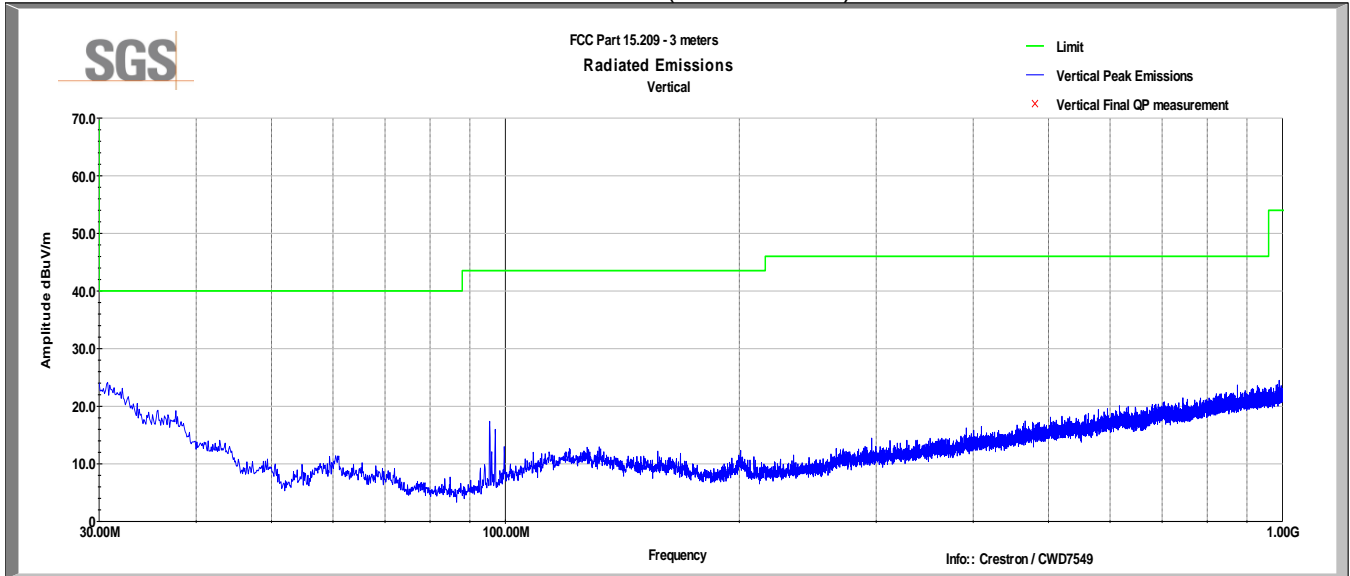
Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, HORN (SMALL)	LB-180400-20-C-KF	A-INFO	15007	30-Mar-2019
RF CABLE	SF102	HUBER & SUHNER	B079822	25-Jul-2019
RF CABLE	SF102	HUBER & SUHNER	B079824	25-Jul-2019
LOW NOISE AMPLIFIER	NSP1840-HG	MITEQ	B087572	27-Jul-2019
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	2-Jul-2019

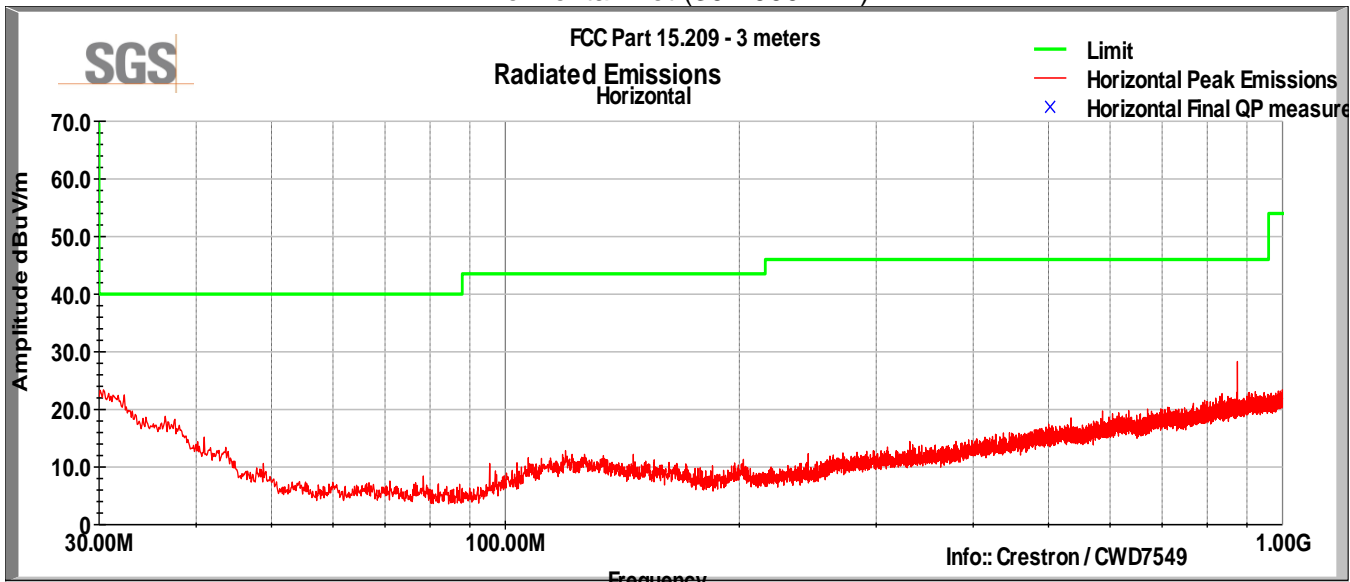
Note: The equipment calibration period is 1 year.

7.5 Test Data – Plots

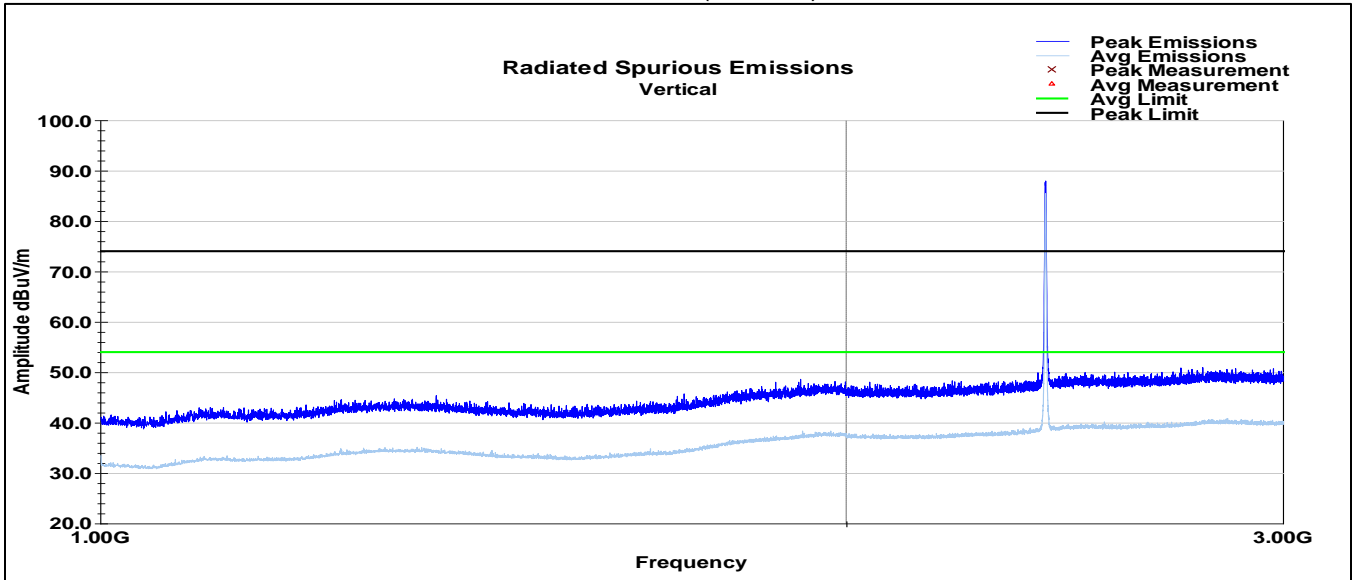
Low Channel (Channel 11, 2405MHz)
Vertical Plot (30-1000MHz)



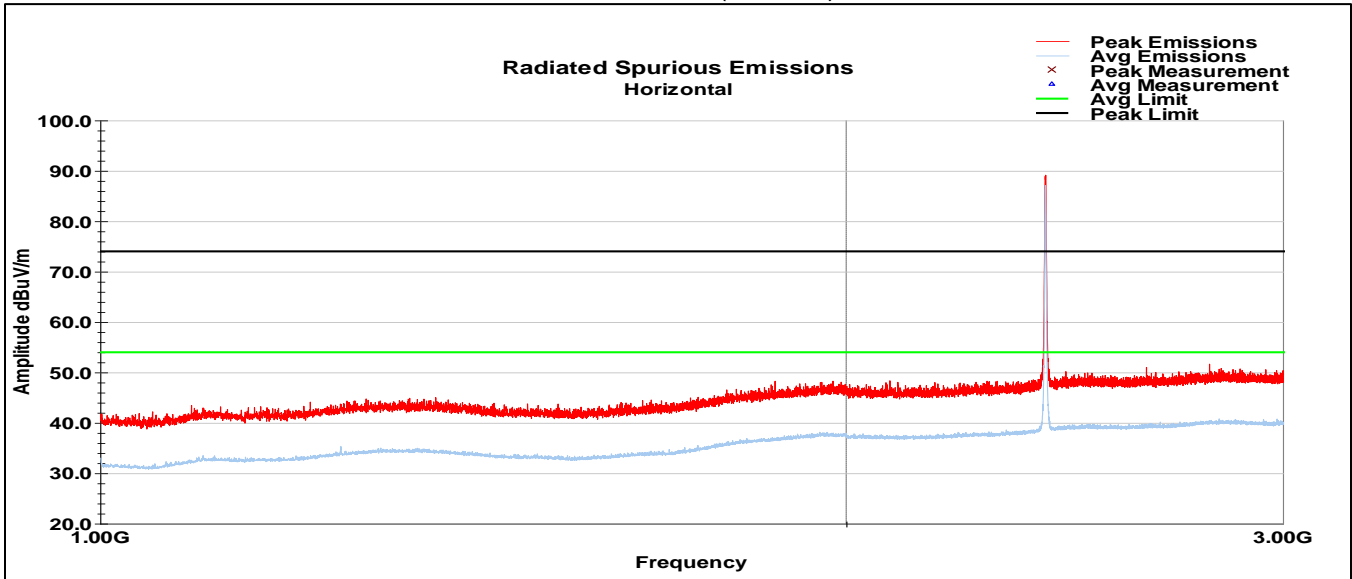
Low Channel (Channel 11, 2405MHz)
Horizontal Plot (30-1000MHz)



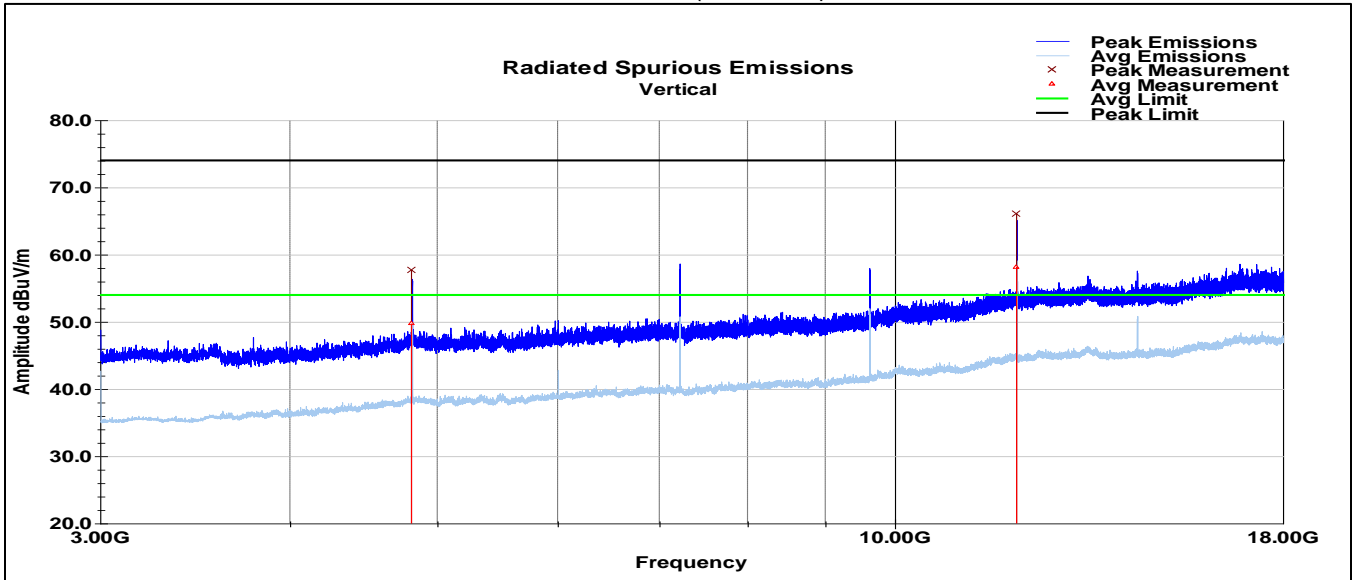
Low Channel (Channel 11, 2405MHz)
Vertical Plot (1-3GHz)



Low Channel (Channel 11, 2405MHz)
Horizontal Plot (1-3GHz)

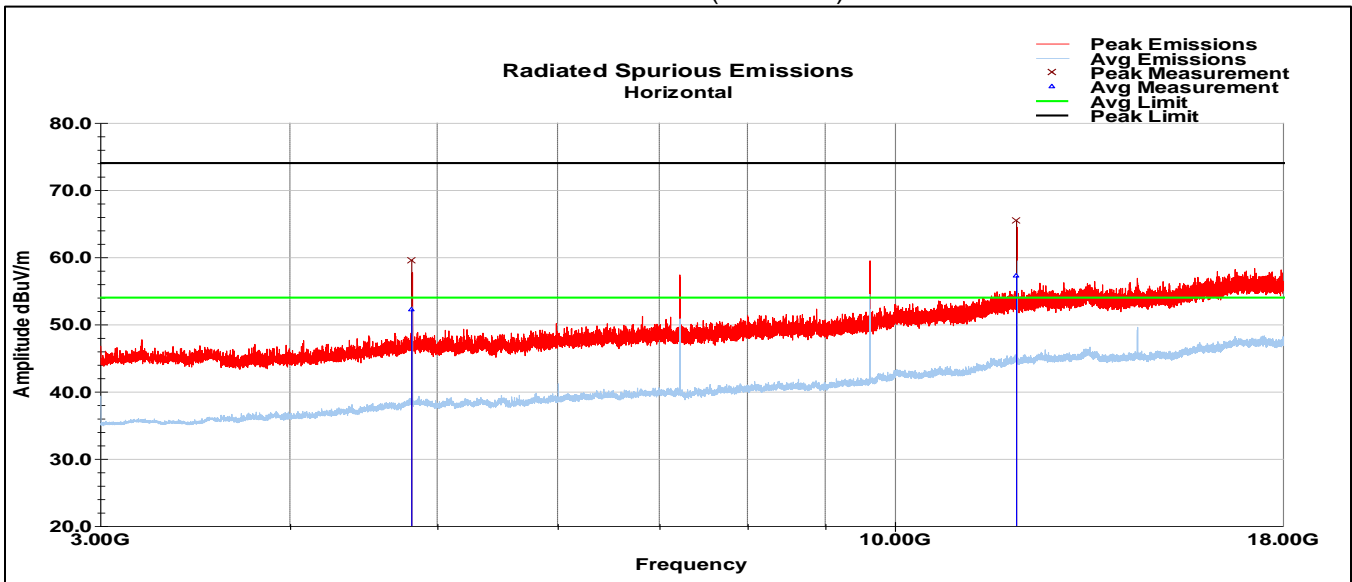


Low Channel (Channel 11, 2405MHz)
Vertical Plot (3-18GHz)



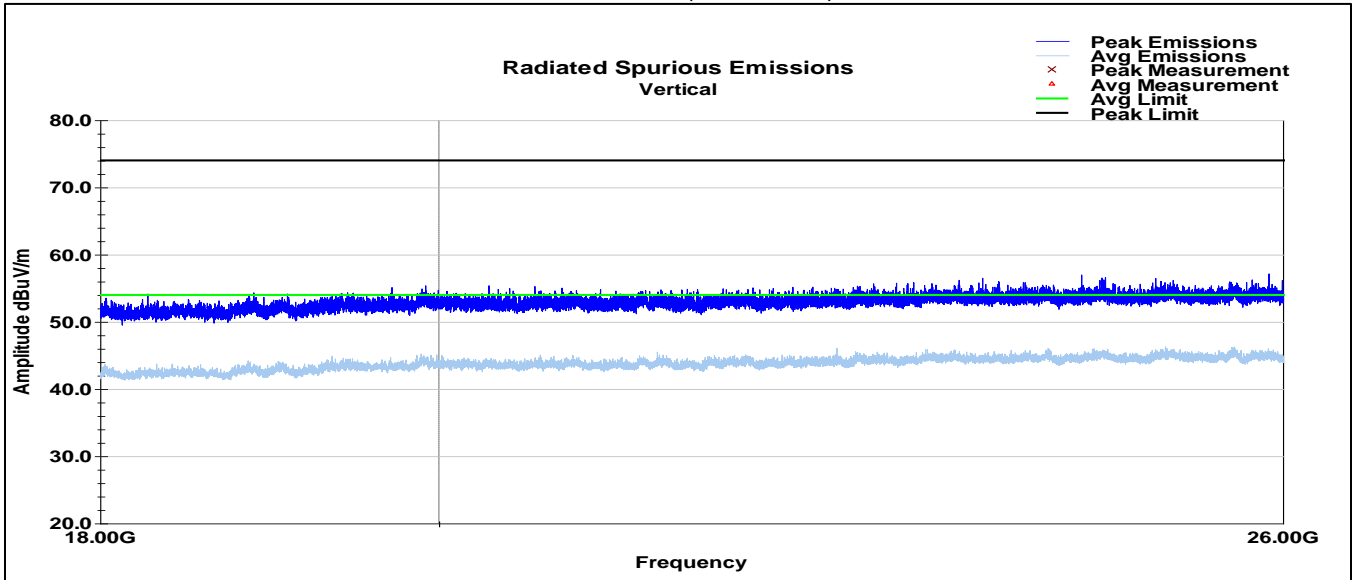
Note: The emissions at 7.215GHz and 9.62GHz do not fall in restricted bands. See the table in the next section for final measurement data on the emissions that do fall in restricted bands.

Low Channel (Channel 11, 2405MHz)
Horizontal Plot (3-18GHz)

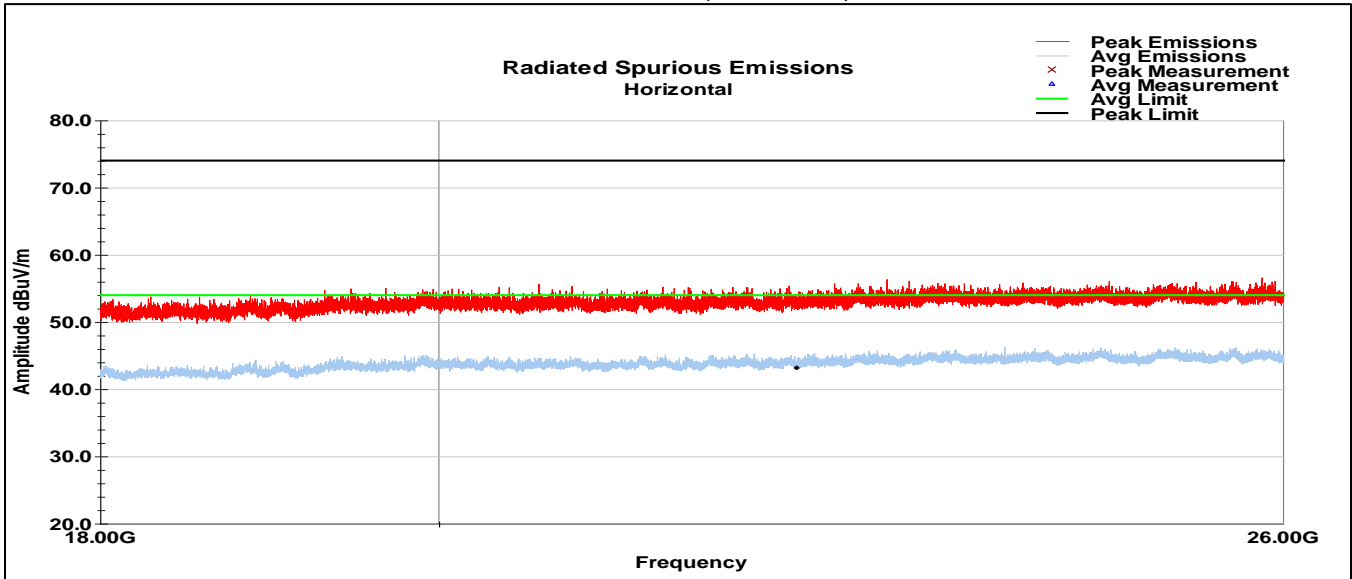


Note: The emissions at 7.215GHz and 9.62GHz do not fall in restricted bands. See the table in the next section for final measurement data on the emissions that do fall in restricted bands.

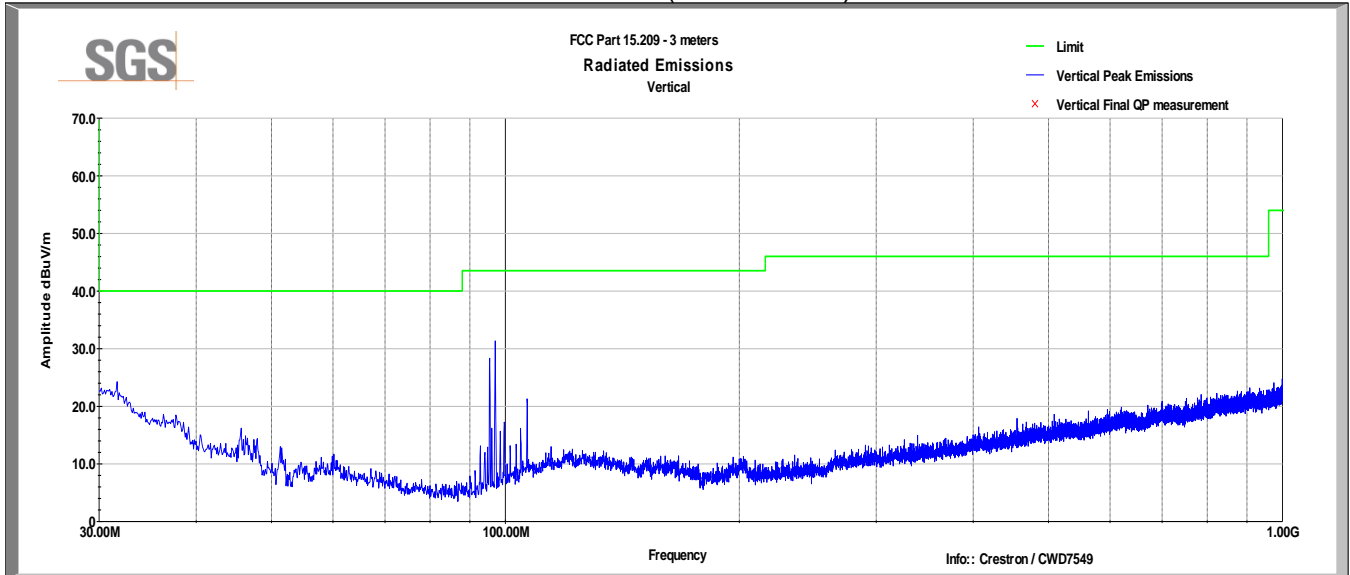
Low Channel (Channel 11, 2405MHz)
Vertical Plot (18-26GHz)



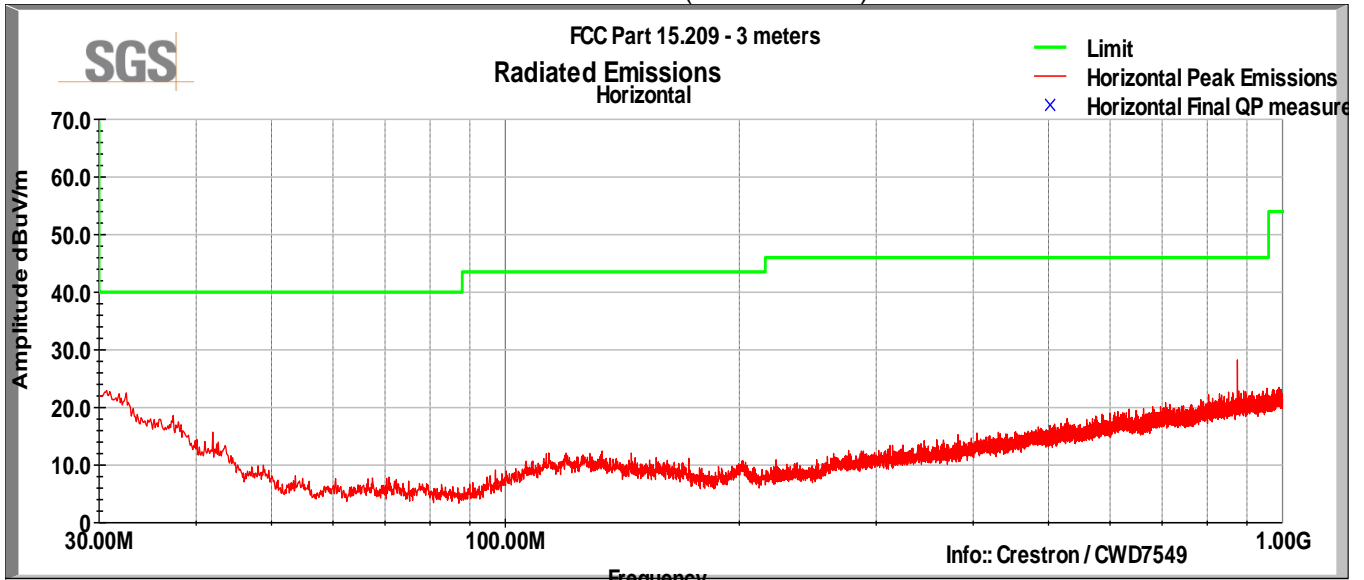
Low Channel (Channel 11, 2405MHz)
Horizontal Plot (18-26GHz)



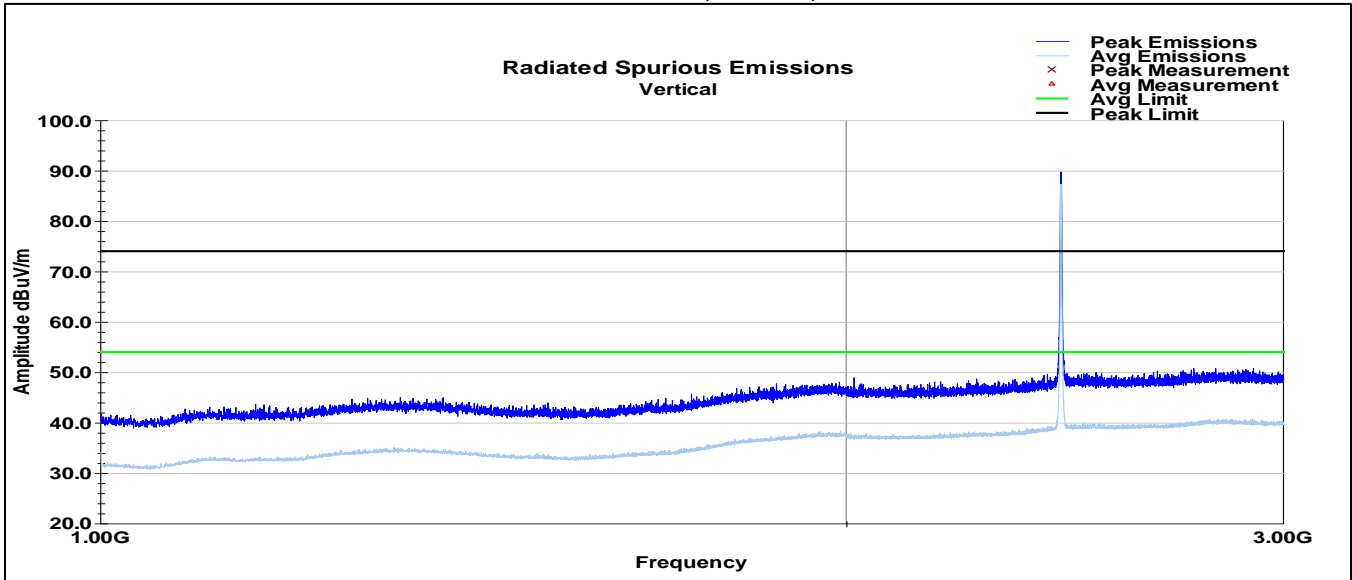
Mid Channel (Channel 18, 2440MHz)
Vertical Plot (30-1000MHz)



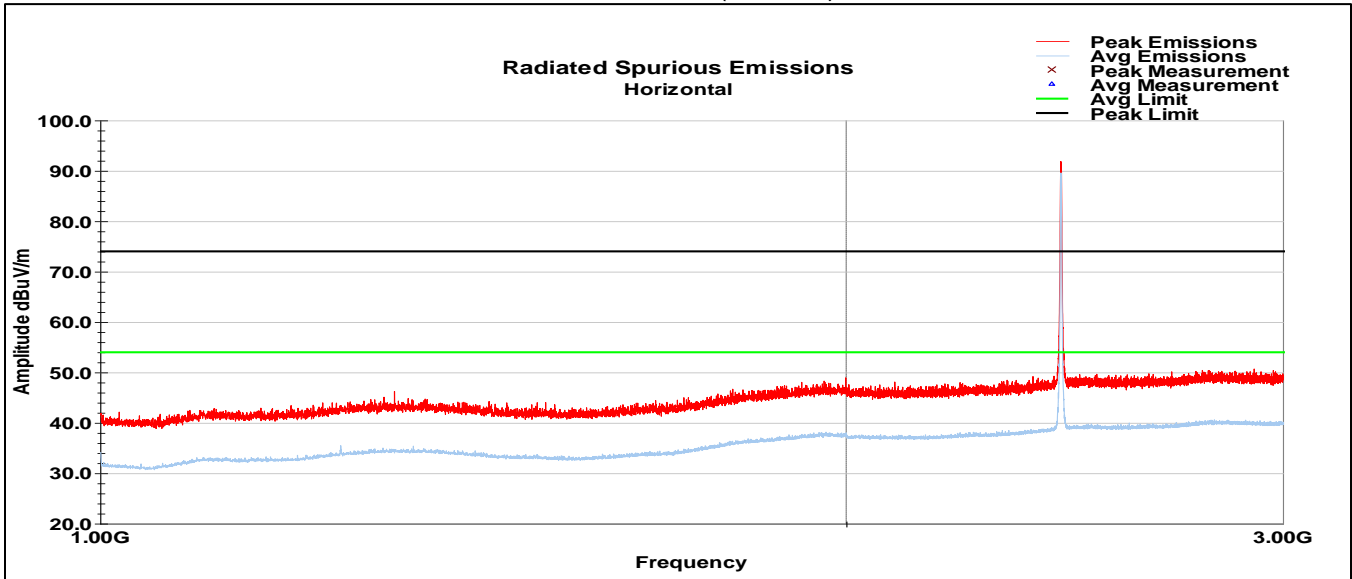
Mid Channel (Channel 18, 2440MHz)
Horizontal Plot (30-1000MHz)



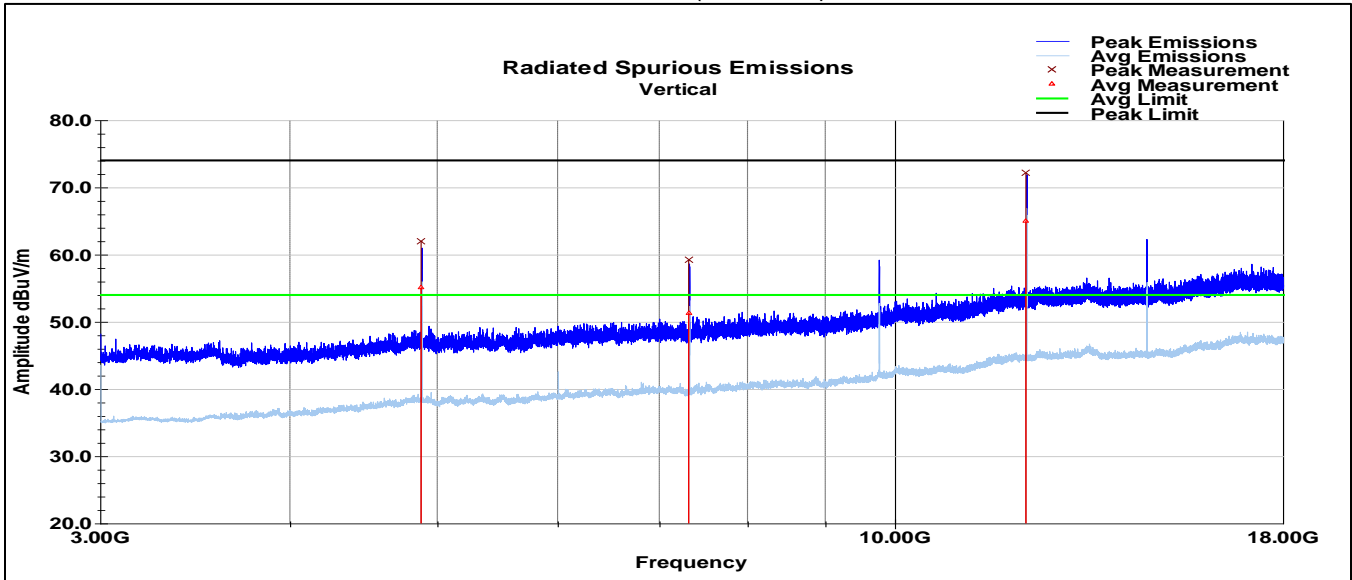
Mid Channel (Channel 18, 2440MHz)
Vertical Plot (1-3GHz)



Mid Channel (Channel 18, 2440MHz)
Horizontal Plot (1-3GHz)

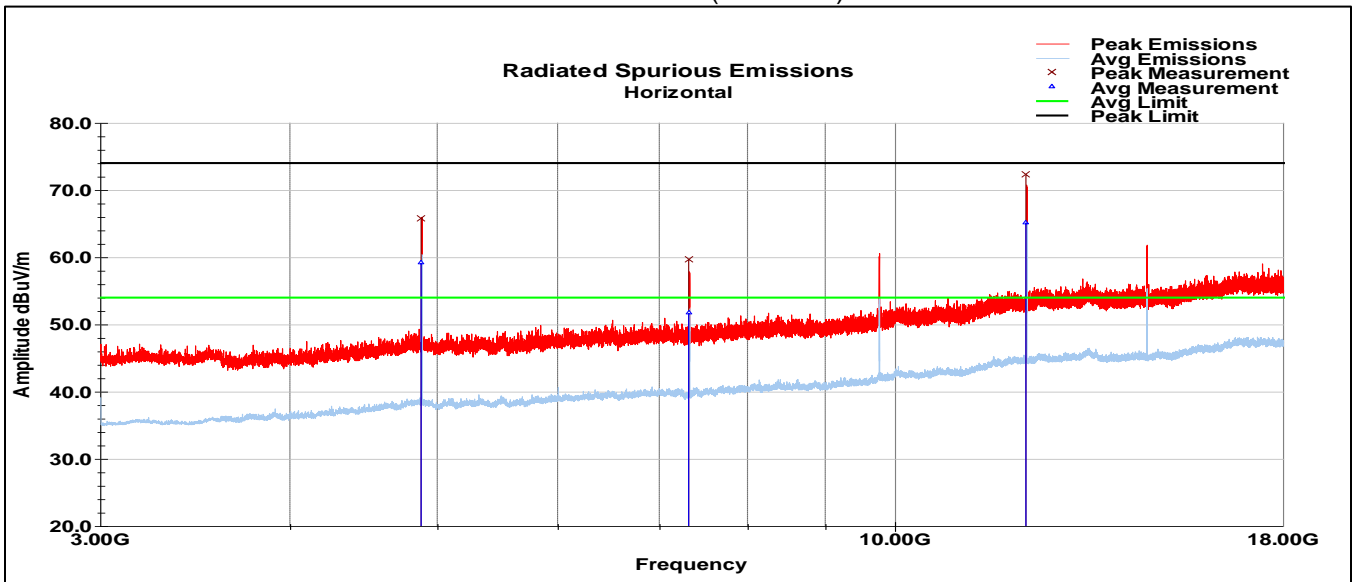


Mid Channel (Channel 18, 2440MHz)
Vertical Plot (3-18GHz)



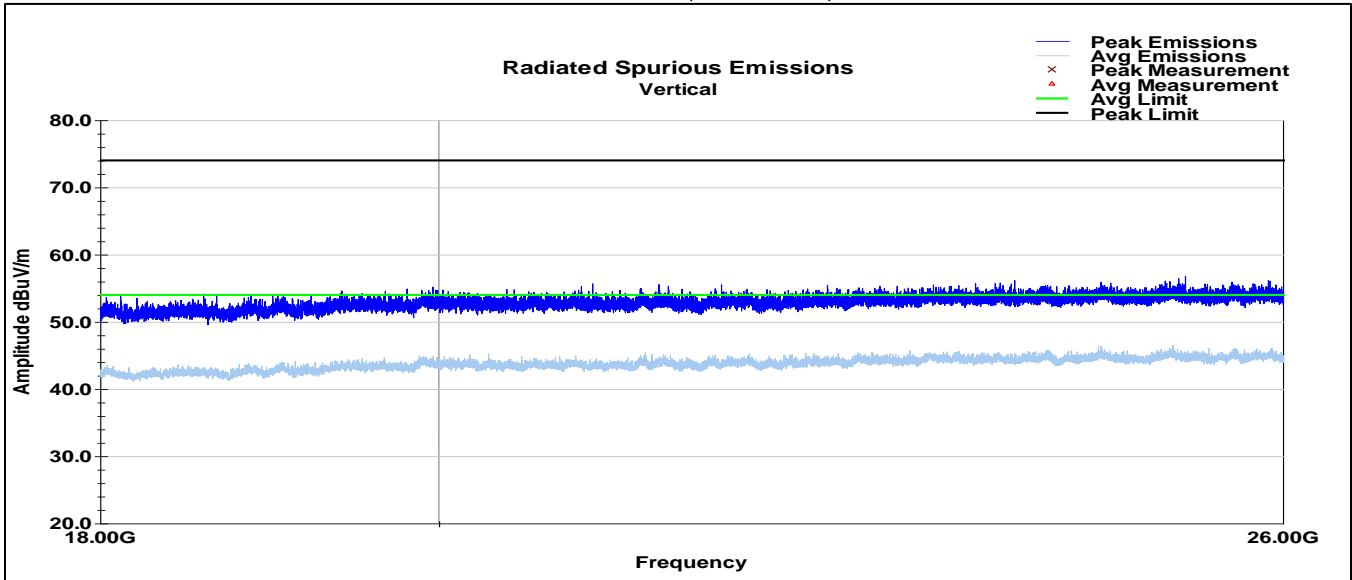
Note: The emissions at 9.76GHz and 14.64GHz do not fall in restricted bands. See the table in the next section for final measurement data on the emissions that do fall in restricted bands.

Mid Channel (Channel 18, 2440MHz)
Horizontal Plot (3-18GHz)

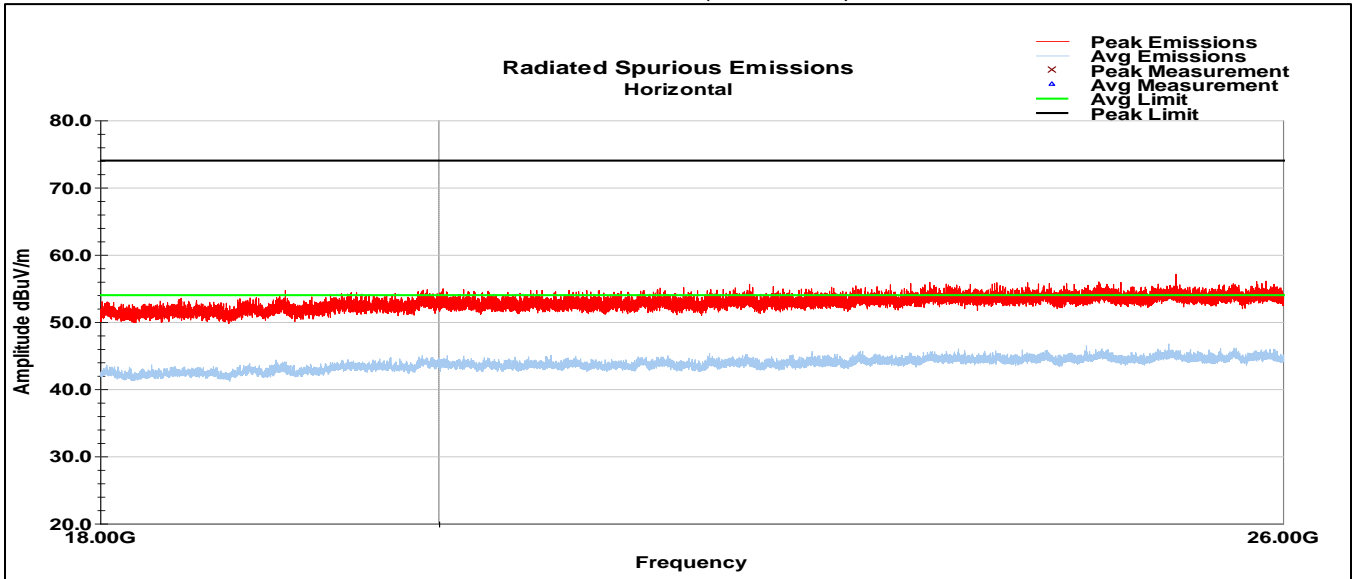


Note: The emissions at 9.76GHz and 14.64GHz do not fall in restricted bands. See the table in the next section for final measurement data on the emissions that do fall in restricted bands.

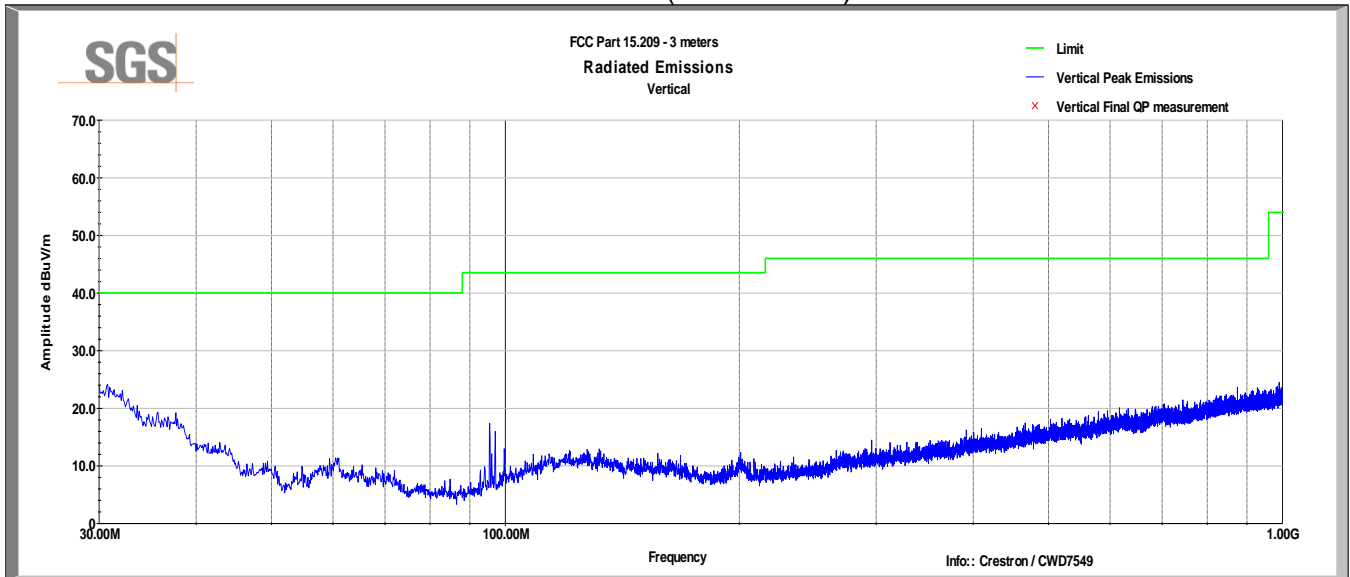
Mid Channel (Channel 18, 2440MHz)
Vertical Plot (18-26GHz)



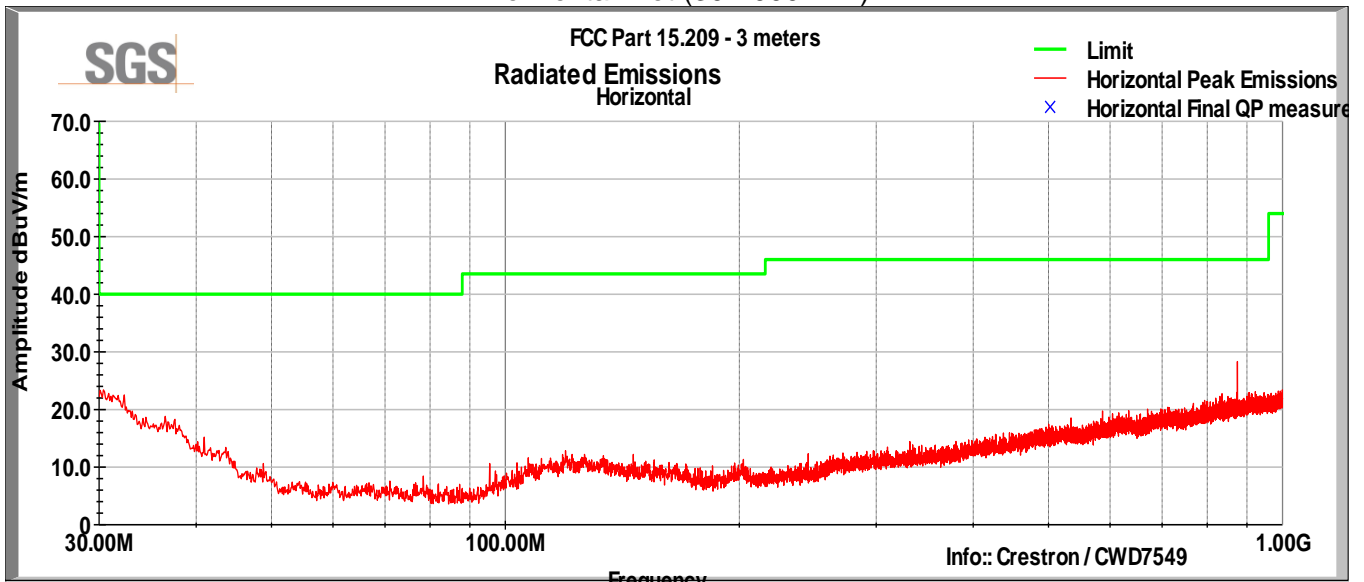
Mid Channel (Channel 18, 2440MHz)
Horizontal Plot (18-26GHz)



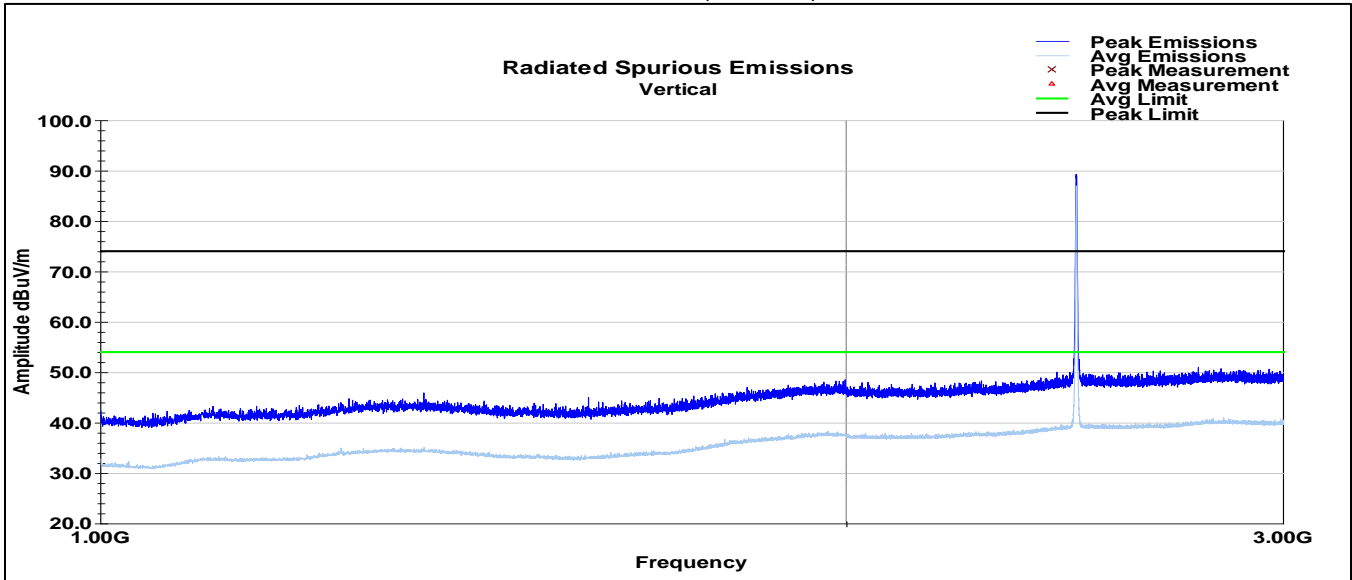
High Channel (Channel 25, 2475MHz)
Vertical Plot (30-1000MHz)



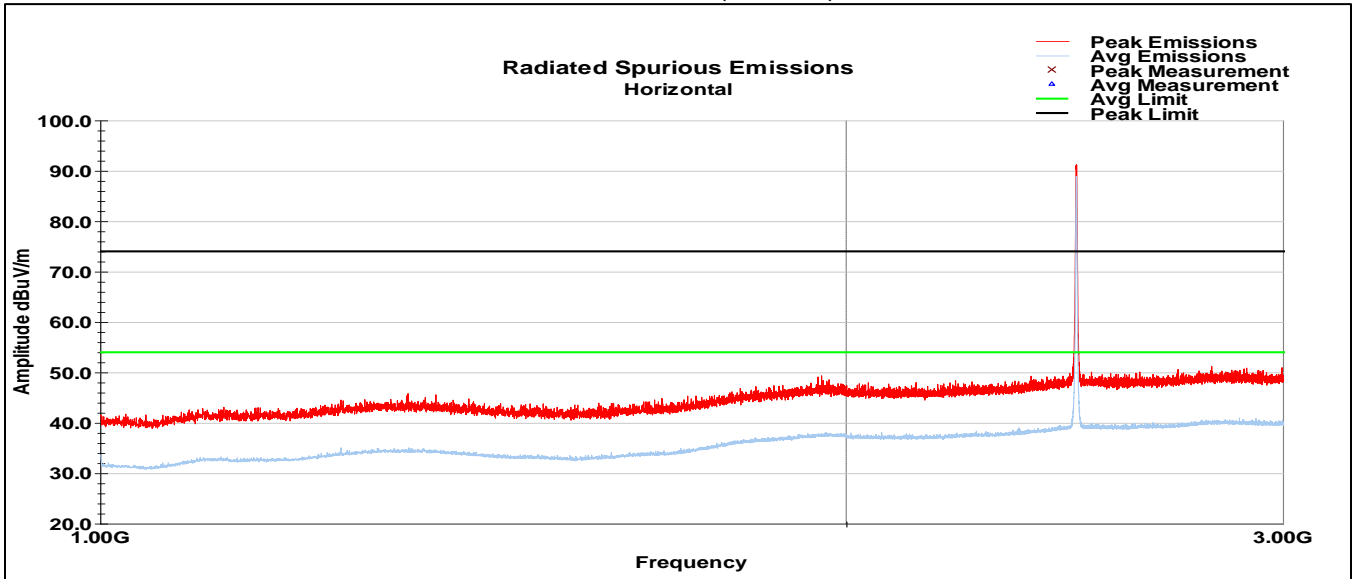
High Channel (Channel 25, 2475MHz)
Horizontal Plot (30-1000MHz)



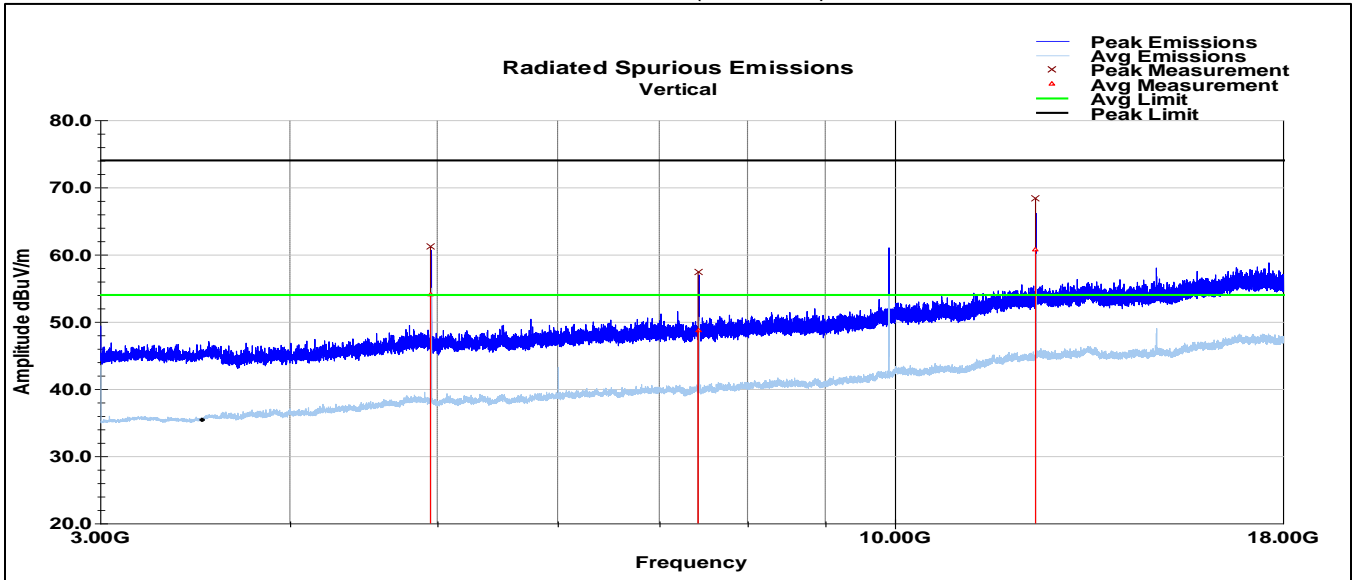
High Channel (Channel 25, 2475MHz)
Vertical Plot (1-3GHz)



High Channel (Channel 25, 2475MHz)
Horizontal Plot (1-3GHz)

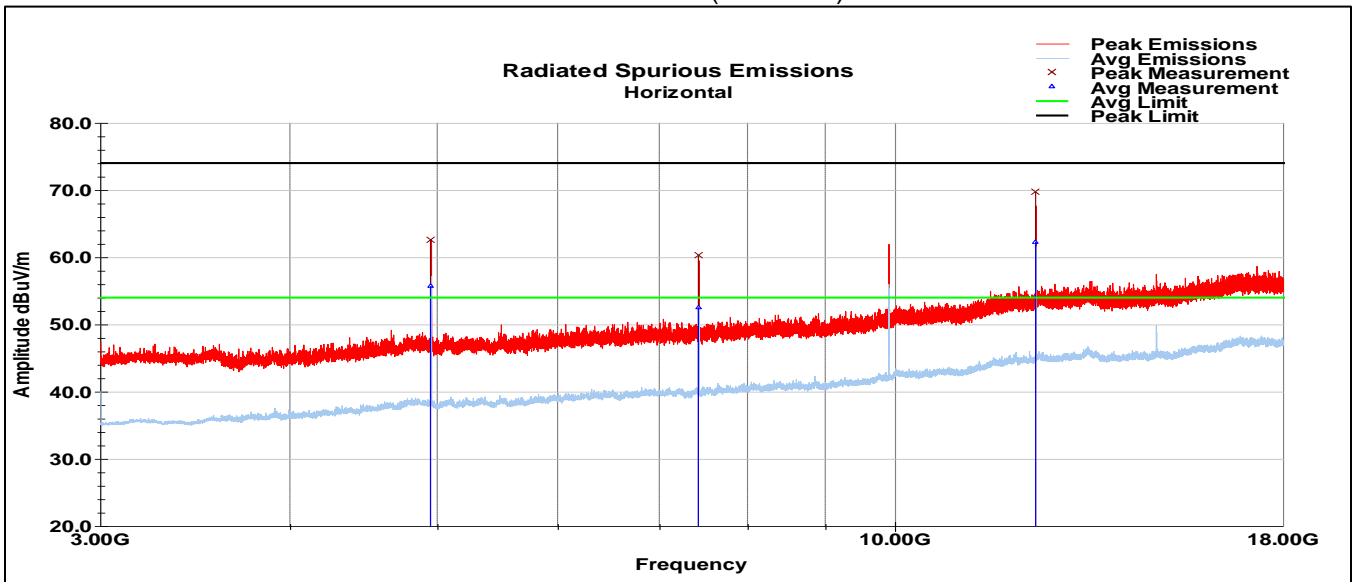


High Channel (Channel 25, 2475MHz)
Vertical Plot (3-18GHz)



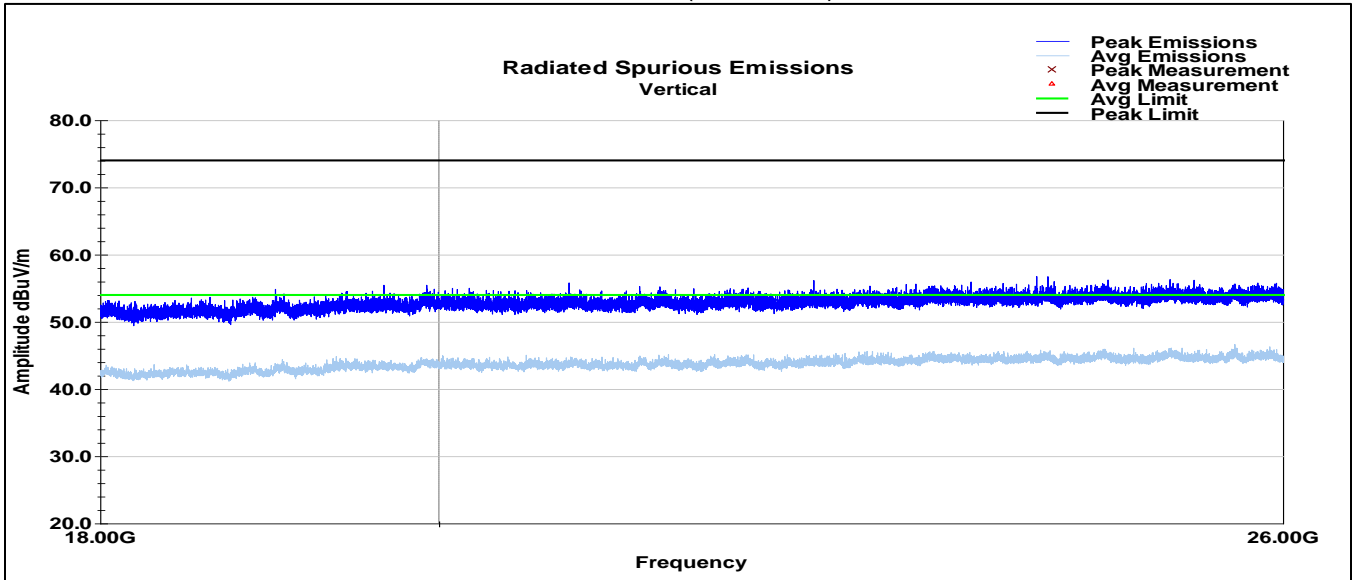
Note: The emissions at 9.9GHz and 14.85GHz do not fall in restricted bands. See the table in the next section for final measurement data on the emissions that do fall in restricted bands.

High Channel (Channel 25, 2475MHz)
Horizontal Plot (3-18GHz)

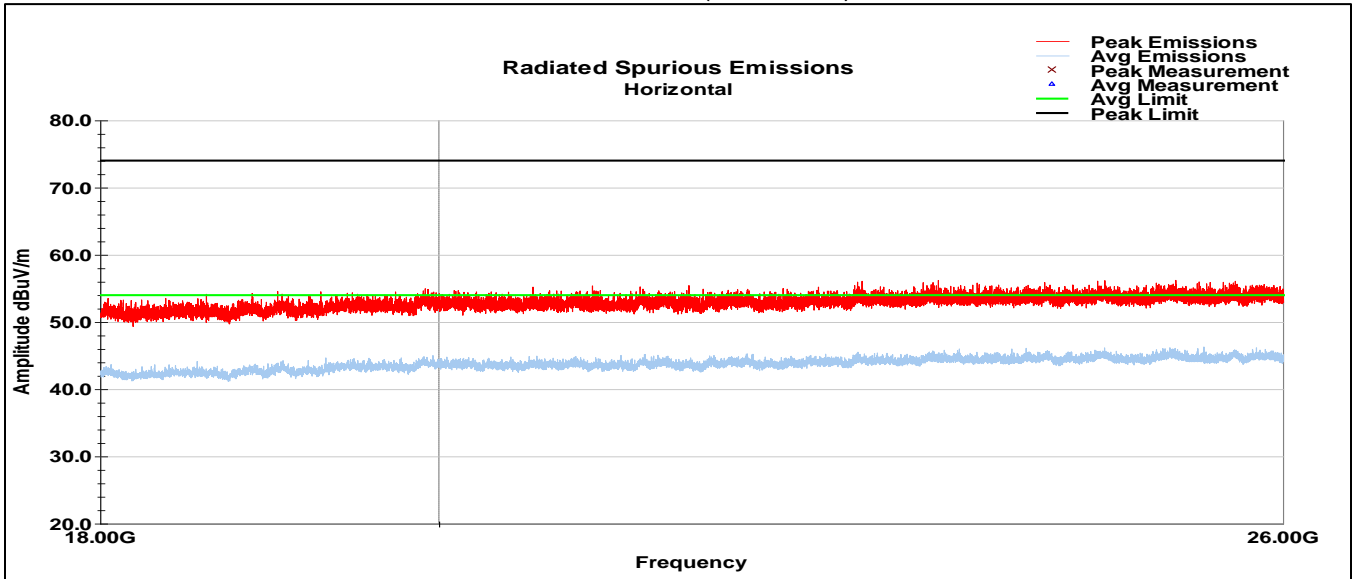


Note: The emissions at 9.9GHz and 14.85GHz do not fall in restricted bands. See the table in the next section for final measurement data on the emissions that do fall in restricted bands.

High Channel (Channel 25, 2475MHz)
Vertical Plot (18-26GHz)



High Channel (Channel 25, 2475MHz)
Horizontal Plot (18-26GHz)



7.6 Test Data – Tabular Data

Frequency (MHz)	Raw Meas (dBuV)	Polarity (V/H)	Correction (dB/m)	Corr Value (dBuV/m)	DCCF (dB)	Final Value (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
Channel 11 (2405MHz)									
4810	45.5	V	4.2	49.7	-13.4	36.3	54.0	-17.7	Average
4810	53.5	V	4.2	57.7	0.0	57.7	74.0	-16.3	Peak
4810	48.1	H	4.2	52.3	-13.4	38.9	54.0	-15.1	Average
4810	55.4	H	4.2	59.6	0.0	59.6	74.0	-14.4	Peak
12025	47.5	V	10.7	58.2	-13.4	44.8	54.0	-9.2	Average
12025	55.4	V	10.7	66.1	0.0	66.1	74.0	-7.9	Peak
12025	46.5	H	10.7	57.2	-13.4	43.8	54.0	-10.2	Average
12025	54.7	H	10.7	65.4	0.0	65.4	74.0	-8.6	Peak
Channel 18 (2440MHz)									
4880	50.9	V	4.2	55.1	-13.4	41.7	54.0	-12.3	Average
4880	57.8	V	4.2	62.0	0.0	62.0	74.0	-12.0	Peak
4880	54.9	H	4.2	59.1	-13.4	45.7	54.0	-8.3	Average
4880	61.6	H	4.2	65.8	0.0	65.8	74.0	-8.2	Peak
7320	45.7	V	5.5	51.2	-13.4	37.8	54.0	-16.2	Average
7320	53.6	V	5.5	59.1	0.0	59.1	74.0	-14.9	Peak
7320	46.1	H	5.5	51.6	-13.4	38.2	54.0	-15.8	Average
7320	54.0	H	5.5	59.5	0.0	59.5	74.0	-14.5	Peak
12200	54.3	V	10.8	65.1	-13.4	51.7	54.0	-2.3	Average
12200	61.3	V	10.8	72.1	0.0	72.1	74.0	-1.9	Peak
12200	54.3	H	10.8	65.1	-13.4	51.7	54.0	-2.3	Average
12200	61.4	H	10.8	72.2	0.0	72.2	74.0	-1.8	Peak
Channel 25 (2475MHz)									
4950	50.2	V	4.0	54.2	-13.4	40.8	54.0	-13.2	Average
4950	57.2	V	4.0	61.2	0.0	61.2	74.0	-12.8	Peak
4950	51.8	H	4.0	55.8	-13.4	42.4	54.0	-11.6	Average
4950	58.6	H	4.0	62.6	0.0	62.6	74.0	-11.4	Peak
7425	43.0	V	5.9	48.9	-13.4	35.5	54.0	-18.5	Average
7425	51.6	V	5.9	57.5	0.0	57.5	74.0	-16.5	Peak
7425	46.7	H	5.9	52.6	-13.4	39.2	54.0	-14.8	Average
7425	54.4	H	5.9	60.3	0.0	60.3	74.0	-13.7	Peak
12375	49.9	V	10.7	60.6	-13.4	47.2	54.0	-6.8	Average
12375	57.6	V	10.7	68.3	0.0	68.3	74.0	-5.8	Peak
12375	51.5	H	10.7	62.2	-13.4	48.8	54.0	-5.2	Average
12375	58.9	H	10.7	69.6	0.0	69.6	74.0	-4.4	Peak

Note: Duty Cycle Correction Factor (DCCF) is used in accordance with KDB 558074 D01 15.247 Meas Guidance v05 Clause 11 Answer 3, which states that the following conditions must be met:

- (i) the spurious emission falls in restricted bands,
- (ii) the emissions are temporally related to the fundamental,
- (iii) the maximum duty cycle used in determining the reduction factor is “hardwired” such that under no condition can it be changed or modified by either the device or the end user,
- (iv) a documented justification for use of Section 15.35(c) including the measurements used to determine the worst-case duty cycle must be included in the test report, and
- (v) the duty cycle correction factor is the worst-case operational duty cycle based on the maximum transmission time in any 100 msec period.

These conditions are all met. Duty cycle measurements are located in Appendix A.

Tests were performed using 100% duty cycle test signals, and then a DCCF of -13.4dB was applied to the RMS average measurements to account for the protocol limited duty cycle of normal ZigBee operation in accordance with measurement technique c of Answer 3 of the Frequently Asked Questions in the aforementioned KDB.

8 Radiated Emissions at Band Edge / Restricted Band

8.1 Test Result

Test Description	Test Specification		Test Result
Emissions in Restricted Frequency Bands	15.247(d), 15.205, 15.209	RSS-GEN S8.9 RSS-GEN S8.10	Compliant

8.2 Test Method

Peak and average field strength measurements were performed at the restricted band edges of 2390MHz and 2483.5MHz. Measurements were made using the conducted methods defined in ANSI C63.10: 2013 clause 11.12.

Offset Calculations:

Offset calculations so that conducted measurements on the spectrum analyzer in dBμV represent field strength measurements in dBμV/m.

$$\text{Offset} = -20\text{Log}(D) + 104.8 - 107 + \text{CL} + \text{DC} + \text{AG}$$

$$\text{Offset}_{3\text{m}} = -11.7 + \text{CL} + \text{DC} + \text{AG}$$

D = 3m	Distance
CL = 0.4 dB	Cable Loss
DC = 0 dB (100%)	Duty Cycle Correction Factor
AG = 2 dB*	Antenna Gain

$$\text{Offset} = -9.3 \text{ dB}$$

* The actual antenna gain is -2 dBi according to the datasheet. 2 dB correction is the minimum allowed by the test method.

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.4 °C
Relative Humidity: 42.0 %

8.4 Test Equipment

Test End Date: 5-Feb-2019

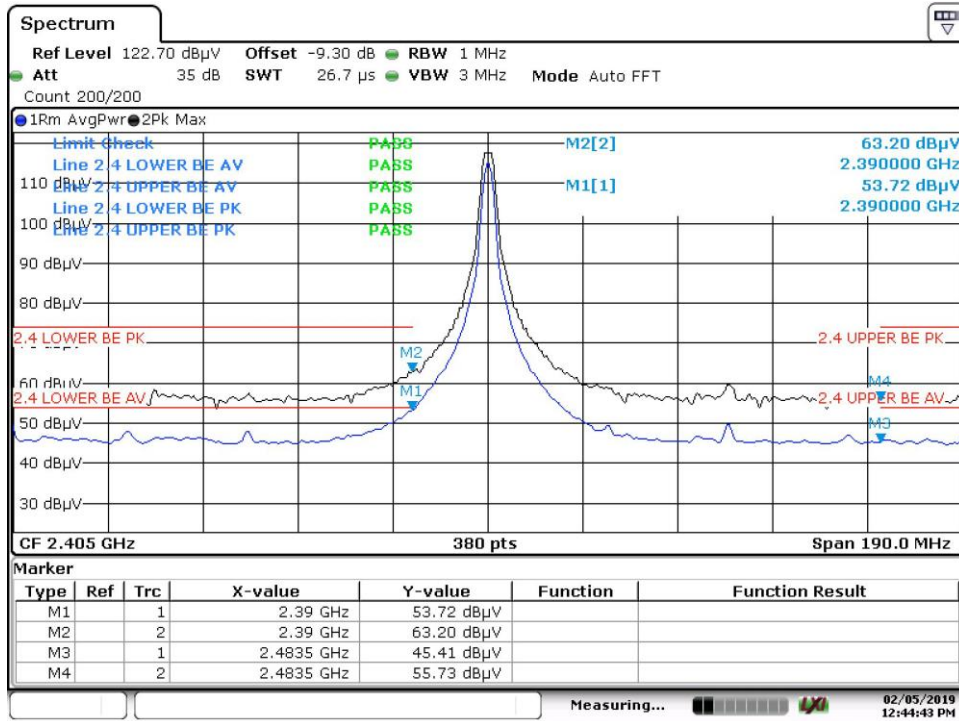
Tester: MT

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER (TS8997)	FSV30	ROHDE & SCHWARZ	B085749	1-Nov-2019
RF MEASUREMENT PROBE	MXHS83QE3000	MURATA		VBU

- The FSV30 is on a 2-year calibration cycle.
- VBU = Verify before use.

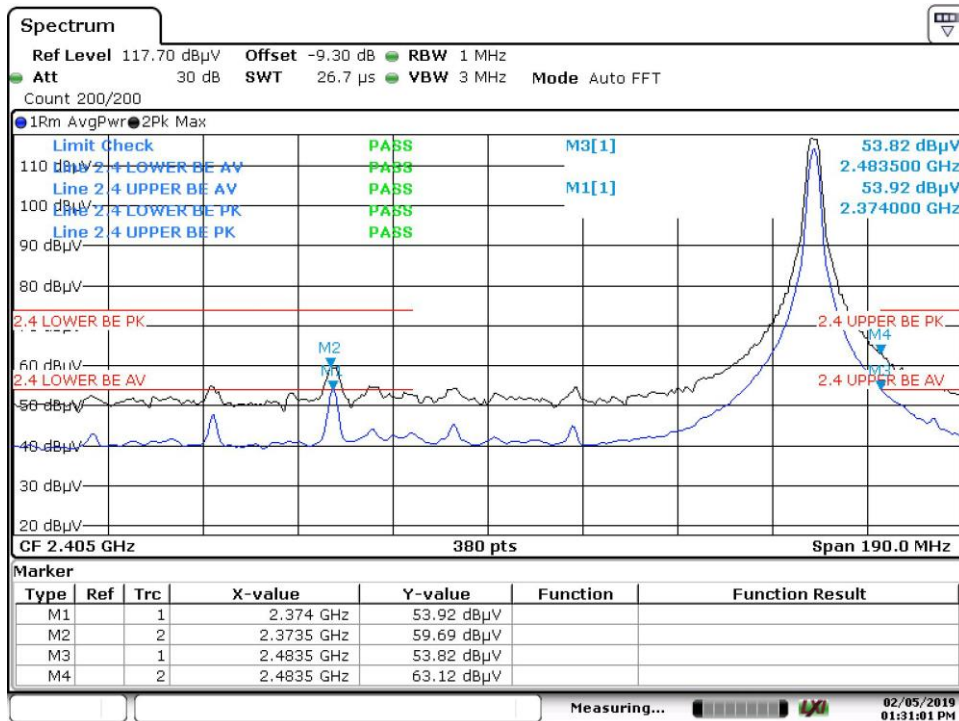
8.5 Test Data

Channel 11



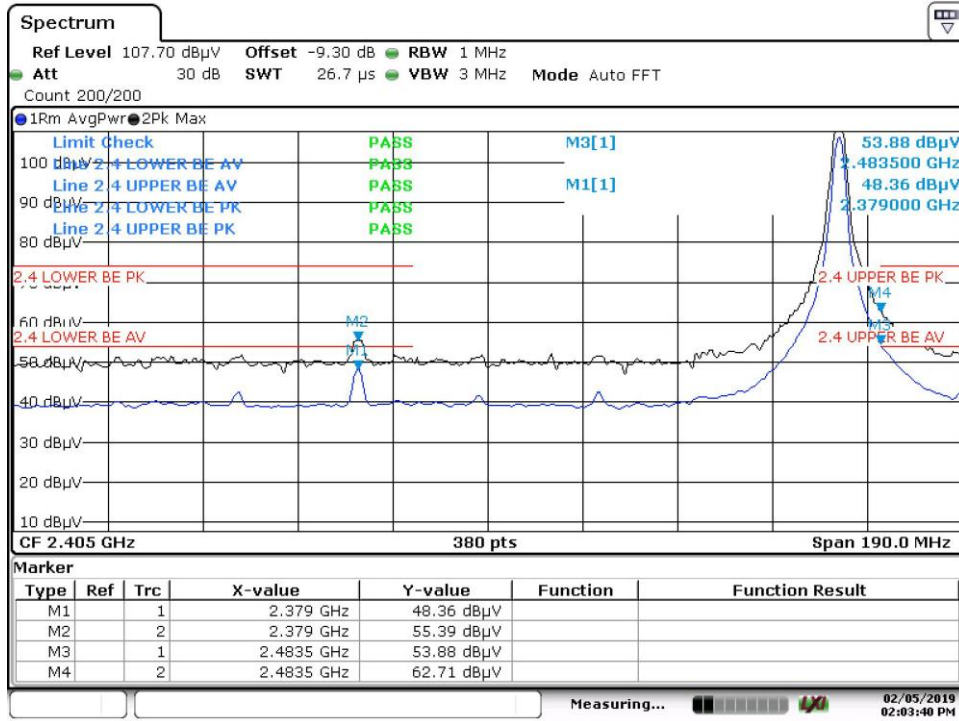
Date: 5.FEB.2019 12:44:43

Channel 24



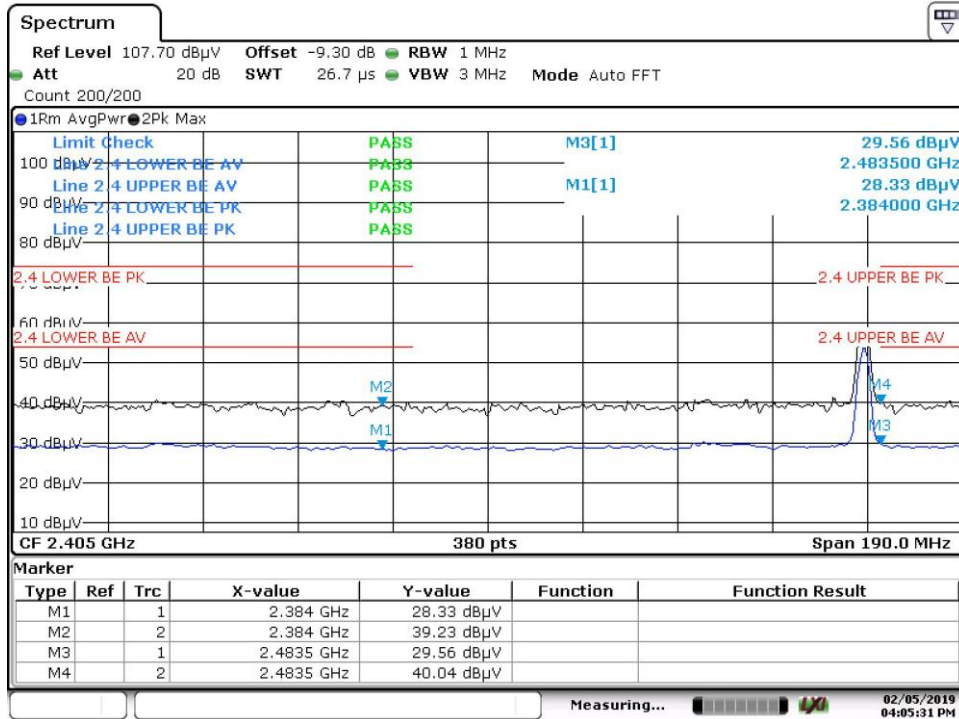
Date: 5.FEB.2019 13:31:02

Channel 25



Date: 5.FEB.2019 14:03:41

Channel 26



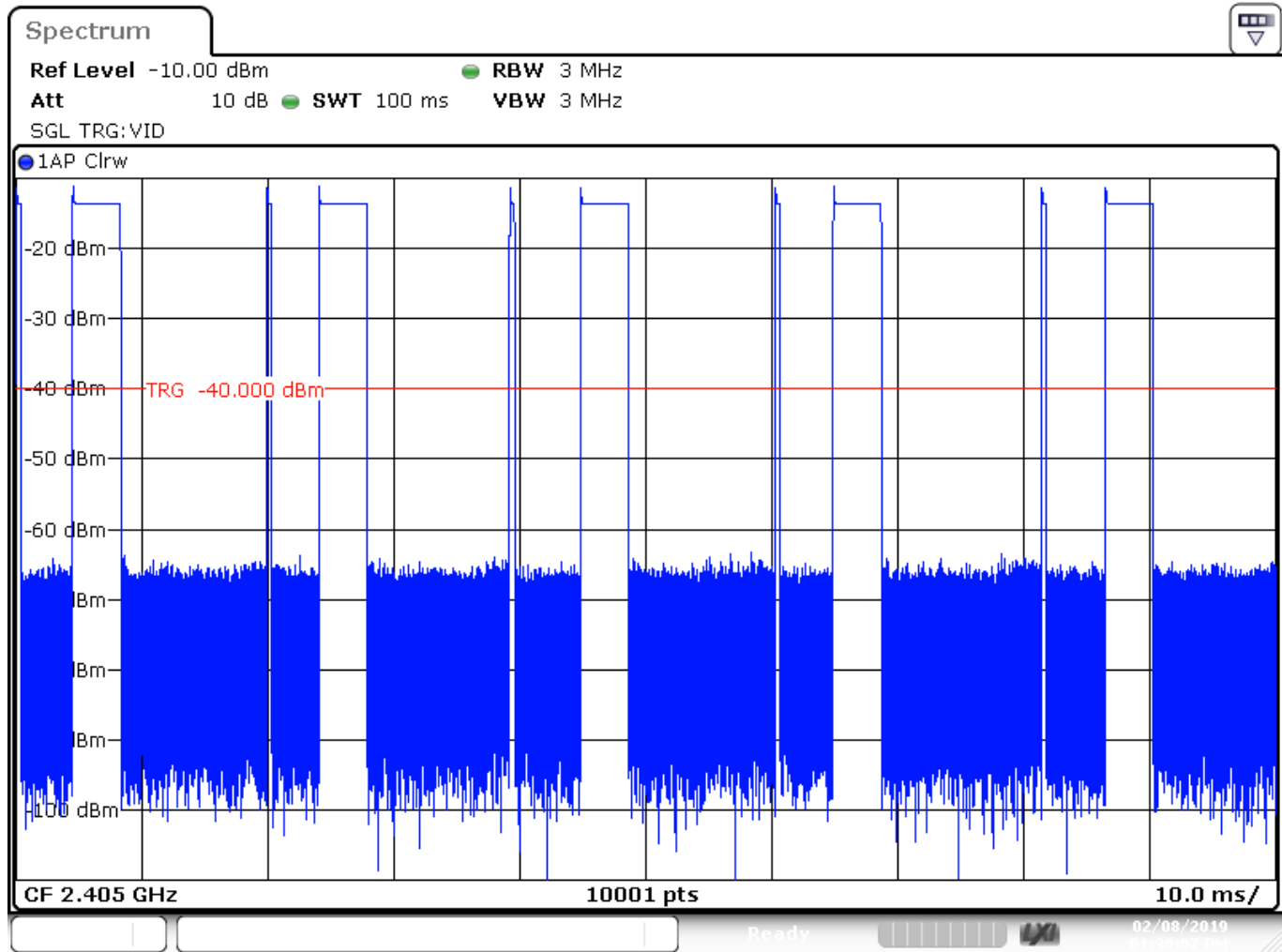
Date: 5.FEB.2019 16:05:32

9 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	12 April 2018
1	Added DCCF (Duty Cycle Correction Factor) explanation to operating modes and conditions section of report	11 June 2018
2	<ul style="list-style-type: none"> - Removed the word "Module" from EUT description (title page) - Added Proposal Number (title page) - Updated RSS-GEN reference from Issue 4 to Issue 5 (title page) - Corrected rule part references (sections 1, 3.1, 4.1, 5.1, 7.1, 8.1) - Added target power reductions required for compliance (section 1.1) - Corrected numbering in section 2 - Updated sample received dates and dates of testing (section 2.3) - Added info under Operating Modes and Conditions (section 2.4) - Added a DC Power Supply to System Configuration (section 2.7) - Updated KDB 558074 references v04 to v05 (sections 4.2, 7.2, 8.2) - Updated Output Power test data (sections 4.3 – 4.5) - Updated expired RSE>1GHz test data (sections 7.3 – 7.6) - Expanded justification for use of DCCF (section 7.6) - Updated test method for Restricted Band Edge test (section 8.2) - Updated expired Restricted Band Edge test data (sections 8.3 – 8.5) - Added Appendix A: Duty Cycle Measurements 	13 February 2019
3	Added Conducted Band Edge plots for channels 24 & 25 (section 6.5) Corrected Test Report Number (title page and header)	21 February 2019

Appendix A: Duty Cycle Measurements

Shown below is the measurement of the normal ZigBee operational duty cycle of the CWD7549.



Data analysis of the above 100ms trace capture shows 21.35ms of total on-time and 78.65ms of off-time. This results in a duty cycle of 21.35%. So the duty cycle correction factor (DCCF) to be applied to the field strength measurements would be $20 \cdot \log_{10}(0.2135) = -13.4\text{dB}$.