

EMC Test Report

Project Number: 4054596

Report Number: 4054596EMC01

Revision Level: 0

Client: ClearOne, Inc.

Equipment Under Test: Dialog 20 Beltpack Transmitter

Model: 910-6104-001

FCC ID: FBI- DIALOG20BLT

IC ID: 1970A- DIALOG20BLT

Applicable Standards: FCC Part 15 Subpart C, § 15.247

RSS-247, Issue 1

ANSI C63.10: 2013

Report issued on: 18 November 2016

Test Result: Compliant

Tested by:



Fabian Nica, Senior Engineering Technician

Reviewed by:



Jeremy O. Pickens, Senior EMC Engineer

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(d)	RSS-247 S5.2 (1) RSS-GEN S6.6	Compliant
Transmitter Output Power	15.247(b)(3)	RSS-247 S5.4 (4)	Compliant
Power Spectral Density	15.247(e)	RSS-247 S5.2 (2)	Compliant
Conducted Spurious Emissions / Band edge	15.247(d)	RSS-247 S5.5	Compliant
Radiated Spurious Emissions / Restricted Bands	15.35(b),15.209	RSS-GEN S6.13 RSS-GEN S8.10	Compliant
AC Powerline Conducted Emission	15.107, 15.207	RSS-GEN S8.8	Compliant

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: CLEARONE INC
Address: 5225 WILEY POST WAY SUITE 500
City, State, Zip, Country: SALT LAKE CITY, UT 84116, USA

2.1 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

2.2 General Information of EUT

Type of Product: Dialog 20 Beltpack Transmitter
Model Number: 910-6104-001
Serial Number: 1 (Conducted measurements)
2 (Radiated measurements)

Frequency Range: 2403-2481MHz (79 Channels)

Antenna: External, Monopole: 1.5dBi

Rated Voltage: 2.4 Vdc (2xAA Batteries)
Test Voltage: 2.4 Vdc

Sample Received Date: 18 October 2016
Dates of testing: 16 - 29 November 2016
Dates of testing: 26 October - 18 November 2016

2.3 Operating Modes and Conditions

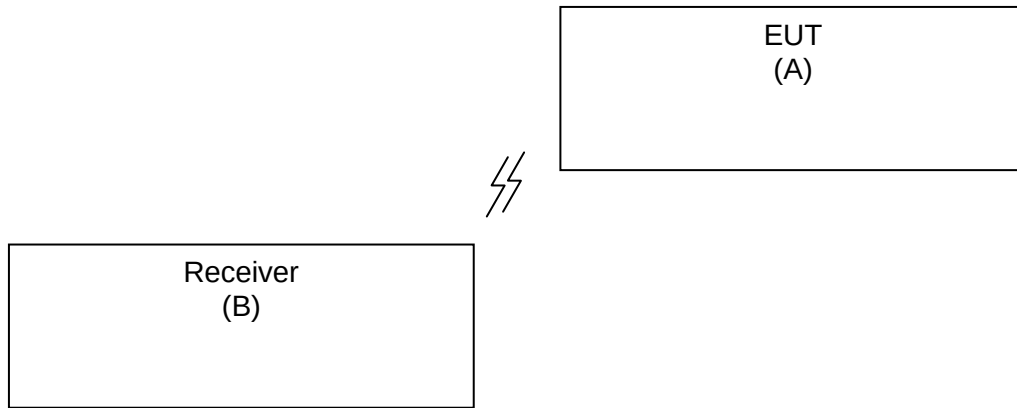
The transmitter was programmed by setting the receiver to the desired channel and then syncing the transmitter to the receiver. Once connected, the device transmitted continuously at full power. The device was programmed to transmit at low, middle, and high channels.

Channel 03, 2403MHz

Channel 42, 2442MHz

Channel 81, 2481MHz

2.4 EUT Connection Block Diagram



2.5 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	ClearOne	Dialog 20 Beltpack Transmitter	910-6104-XXX	1 (Conducted measurements) 2 (Radiated measurements)
B	ClearOne	Dialog 20 Receiver	910-6100-XXX	20

3 Bandwidth

3.1 Test Result

Test Description	Test Specification		Test Result
6 dB bandwidth / 99% OBW	15.247(d)	RSS-247 S5.2 (1) RSS-GEN S6.6	Compliant

3.2 Test Method

The procedures from ANSI C63.10: 2013 clause 11.8 and 558074 D01 DTS Meas Guidance v03r05 were used to determine the 6 dB bandwidth and 99% OBW.

3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.5 °C
Relative Humidity: 33.3 %

3.4 Test Equipment

Test End Date: 16-Nov-2016

Tester: JOP

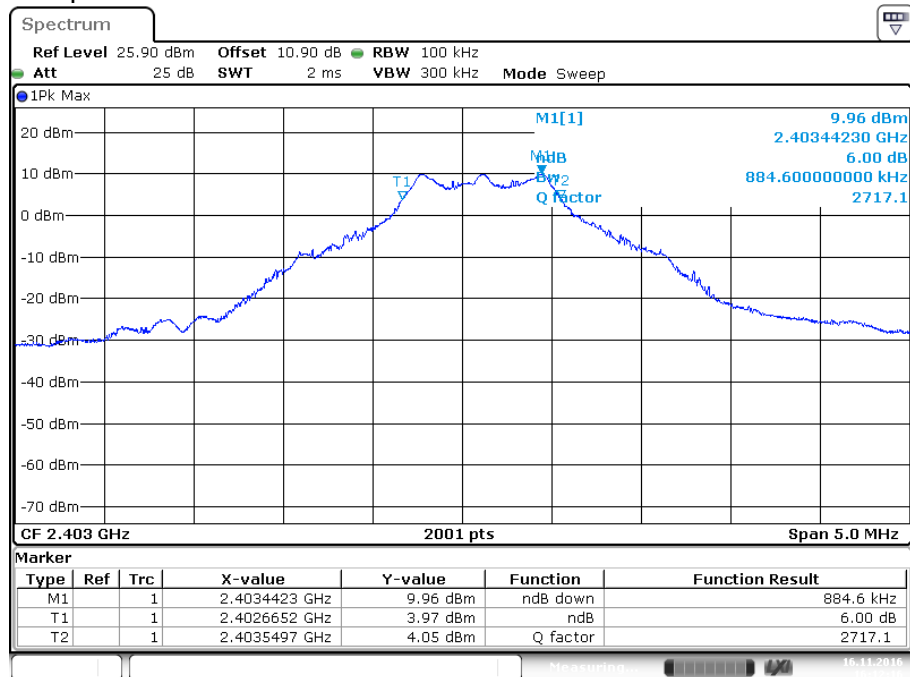
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	1134	GORE	B094785	26-Jul-2017
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095593	27-Jul-2017

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

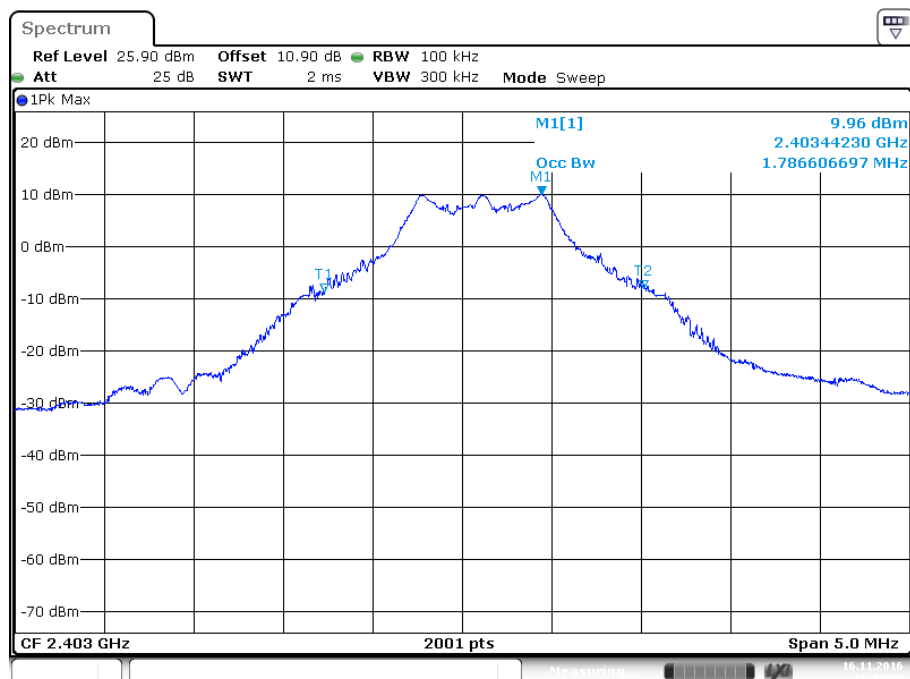
3.5 Test Data

Channel	6dB Bandwidth (MHz)	Occupied Bandwidth (99%) (MHz)
3	0.885	1.787
42	0.882	1.792
81	0.877	1.769

Sample Plots



Date: 16.NOV.2016 16:12:16



Date: 16.NOV.2016 16:13:05

4 Output Power

4.1 Test Result

Test Description	Test Specification		Test Result
Peak Output Power	15.247(b) (3)	RSS-247 S5.4 (4)	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 Measurement Guidance v03r05.

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: 23.5 °C
Relative Humidity: 33.3 %

4.4 Test Equipment

Test End Date: 16-Nov-2016

Tester: JOP

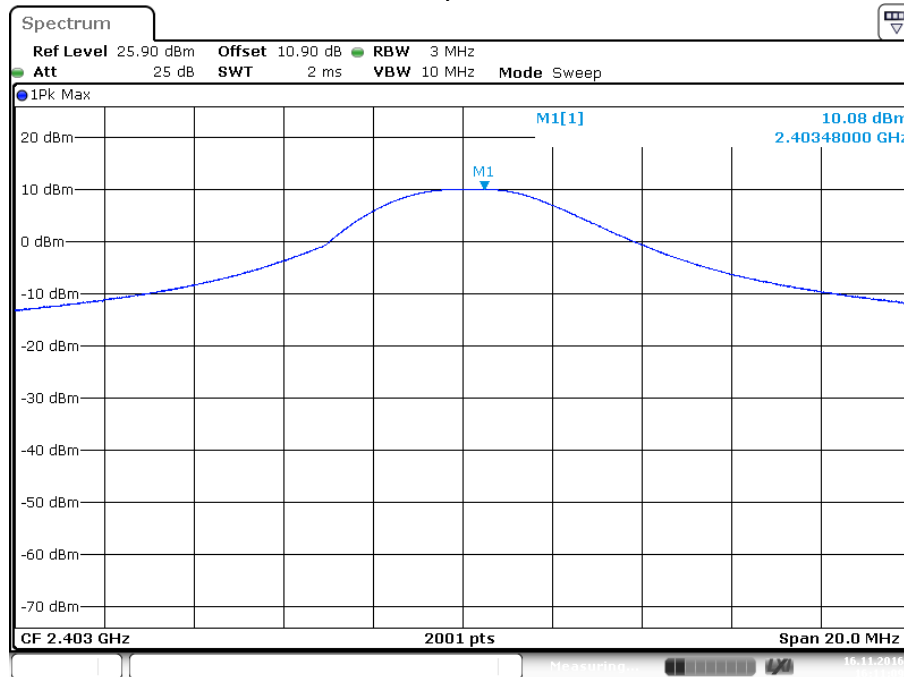
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	1134	GORE	B094785	26-Jul-2017
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095593	27-Jul-2017

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

4.5 Test Data

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (30dBm)	Margin (dB)
3	2403	10.08	30	-19.92
42	2442	12.32	30	-17.68
81	2481	9.17	30	-20.83

Sample Plot



Date: 16.NOV.2016 16:11:10

5 Power Spectral Density

5.1 Test Result

Test Description	Test Specification		Test Result
Power Spectral Density	15.247(e)	RSS-247 S5.2 (2)	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 Measurement Guidance v03r05.

Limit

The limit is 8 dBm.

5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.5 °C
Relative Humidity: 33.3 %

5.4 Test Equipment

Test End Date: 16-Nov-2016

Tester: JOP

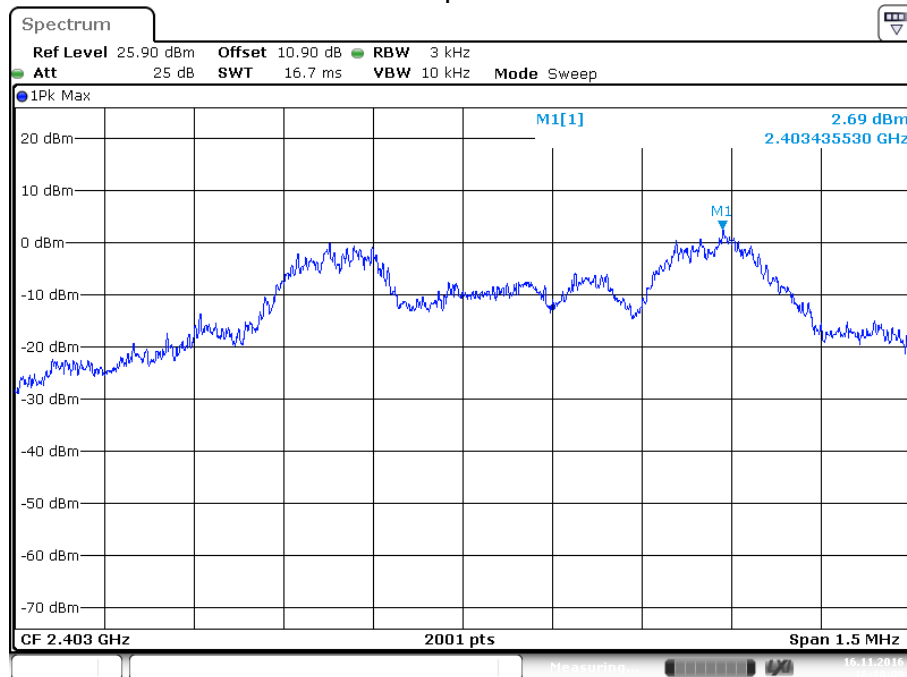
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	1134	GORE	B094785	26-Jul-2017
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095593	27-Jul-2017

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

5.5 Test Data

Channel	Frequency (MHz)	Peak PSD (dBm)	Limit (30dBm)	Margin (dB)
3	2403	2.69	8	-5.31
42	2442	5.64	8	-2.36
81	2481	-3.7	8	-11.7

Sample Plot



Date: 16.NOV.2016 16:10:08

6 Conducted Spurious Emissions

6.1 Test Result

Test Description	Test Specification		Test Result
Conducted Spurious Emissions	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 Measurement Guidance v03r05.

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: 23.5 °C
Relative Humidity: 33.3 %

6.4 Test Equipment

Test End Date: 16-Nov-2016

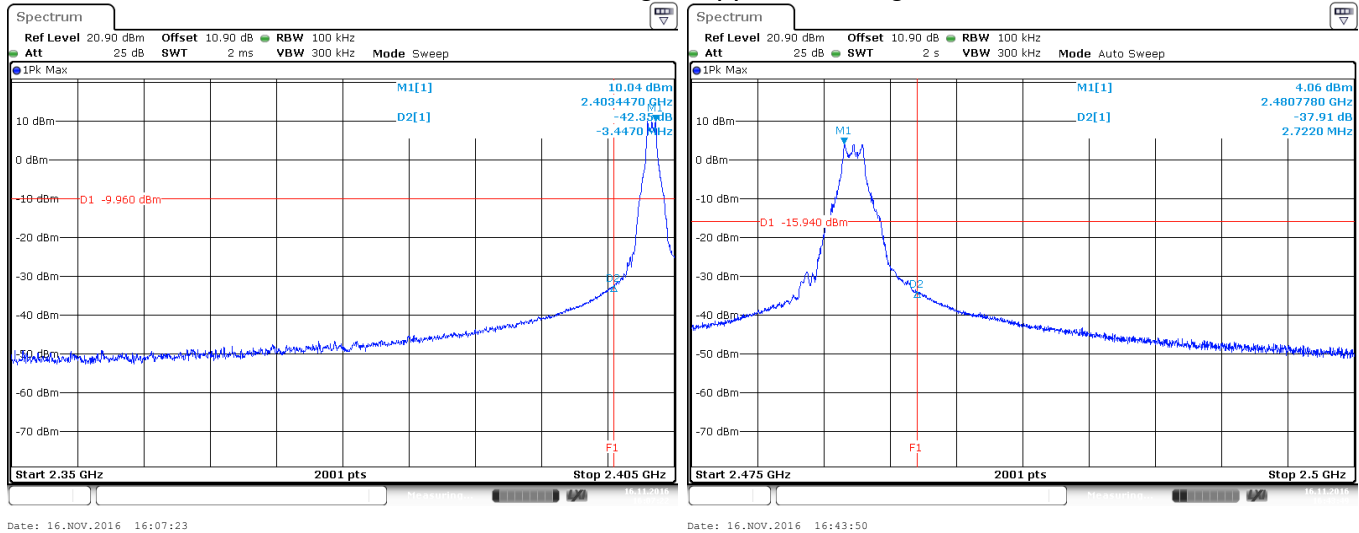
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	1134	GORE	B094785	26-Jul-2017
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095593	27-Jul-2017

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

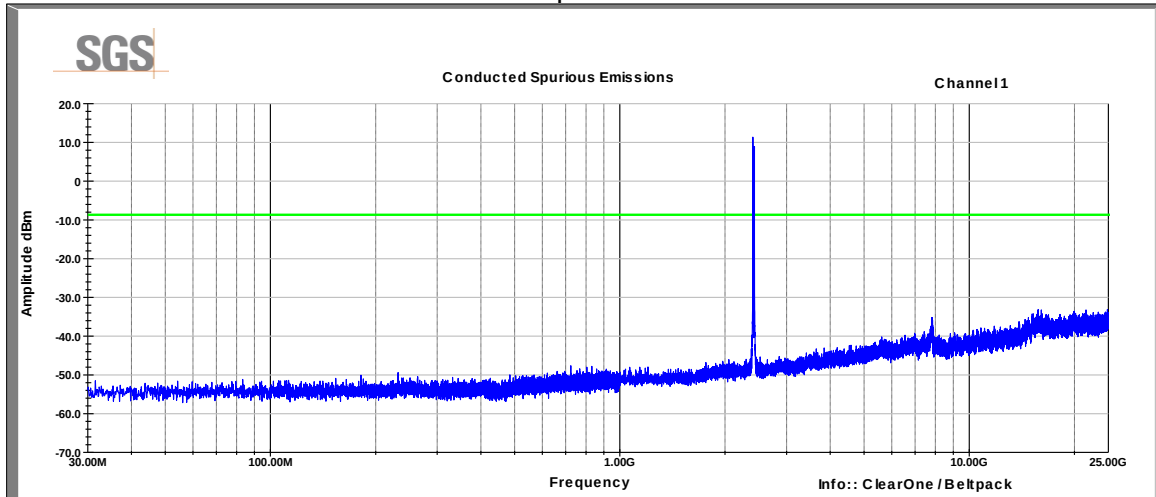
6.5 Test Data – DTS Bandedge

Lower band edge / Upper band edge

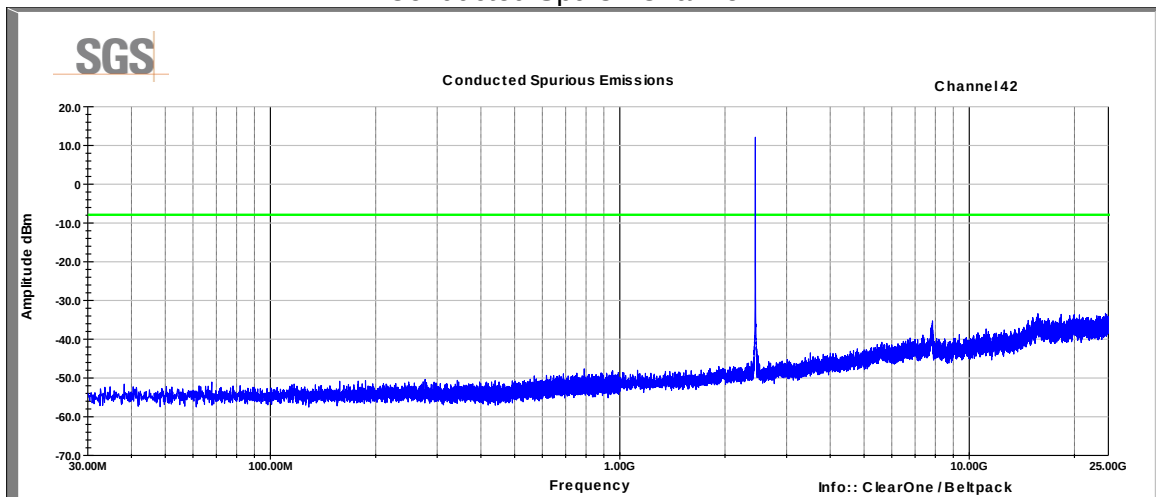


6.6 Test Data – Conducted Spurious Emissions

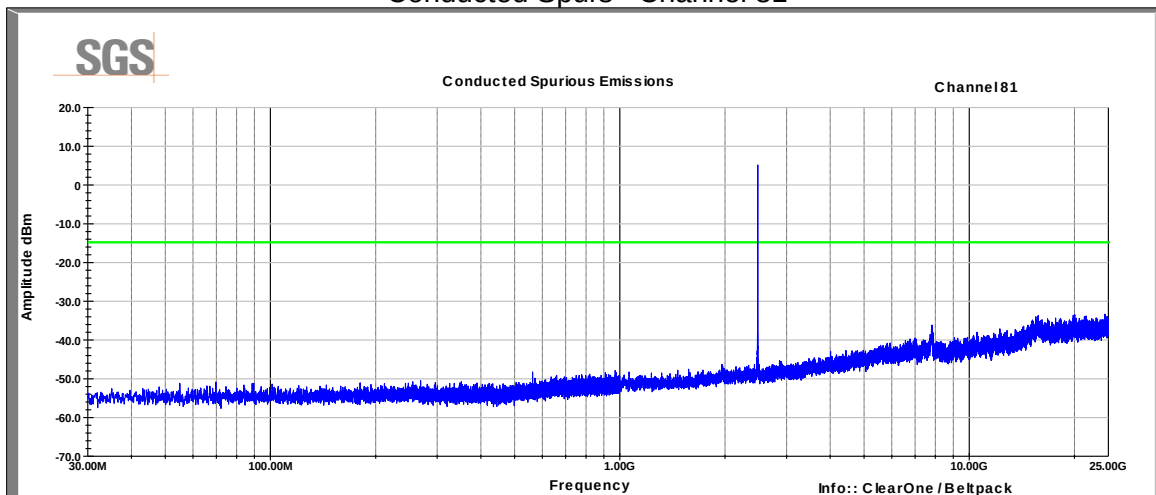
Conducted Spurs –Channel 03



Conducted Spurs –Channel 42



Conducted Spurs –Channel 81



7 Field Strength of Spurious Radiation

7.1 Test Result

Test Description	Test Specification		Test Result
Spurious Emissions	15.247 (d) and 15.209	RSS-247 S5.5	Compliant

7.2 Test Method

Radiated emission measurements were performed with the antenna installed as intended. The measurement methods defined in ANSI C63.4: 2014 were used.

Lowest, middle, and highest channels were investigated.

Test distance:

- 9k to 30 MHz – Near field prescan to determine if there were any emissions.
- 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 1 meter

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

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 21.7 °C
Relative Humidity: 32.9 %

7.4 Test Equipment

Test Date: 29-Nov-2016

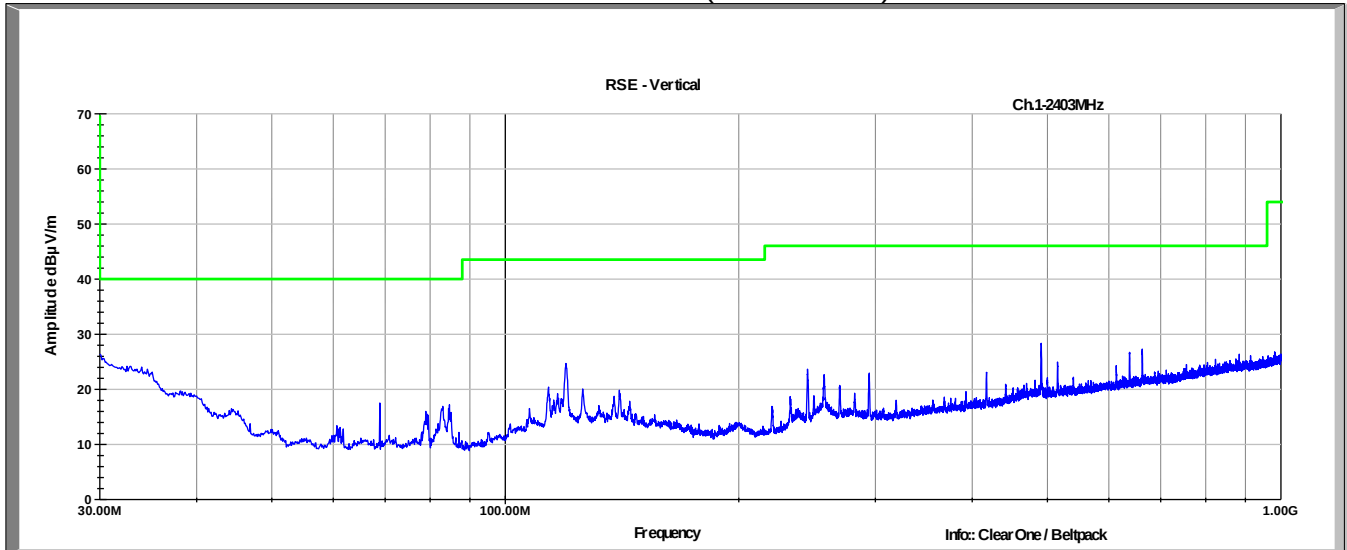
Tester: FN

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	20-Jun-2017
ANTENNA, BILOG	JB6	SUNOL	B079690	10-Nov-2017
RF CABLE	SF106	HUBER & SUHNER	B079716	27-Jul-2017
RF CABLE	SF106	HUBER & SUHNER	B079713	27-Jul-2017
RF CABLE	SF106	HUBER & SUHNER	B085892	27-Jul-2017
RF CABLE	SUCOFLEX 100	HUBER & SUHNER	B108523	4-Aug-2017
LOW NOISE AMPLIFIER	TS-PR18	ROHDE & SCHWARZ	B094463	16-Feb-2017
DRG HORN (MEDIUM)	3117	ETS LINDGREN	B079699	26-Apr-2017
RF CABLE	SF106	HUBER & SUHNER	B079712	27-Jul-2017
RF CABLE	SF102	HUBER & SUHNER	B079822	27-Jul-2017
RF CABLE	SF102	HUBER & SUHNER	B079823	27-Jul-2017
DRG HORN (SMALL)	3116B	ETS LINDGREN	B079695	15-Jul-2017
LOW NOISE AMPLIFIER	NSP1800-25-HG	MITEQ	B085930	29-Jul-2017
FILTER, BAND REJECT	BRM50702	MICRO-TRONICS	B079791	29-Jul-2017

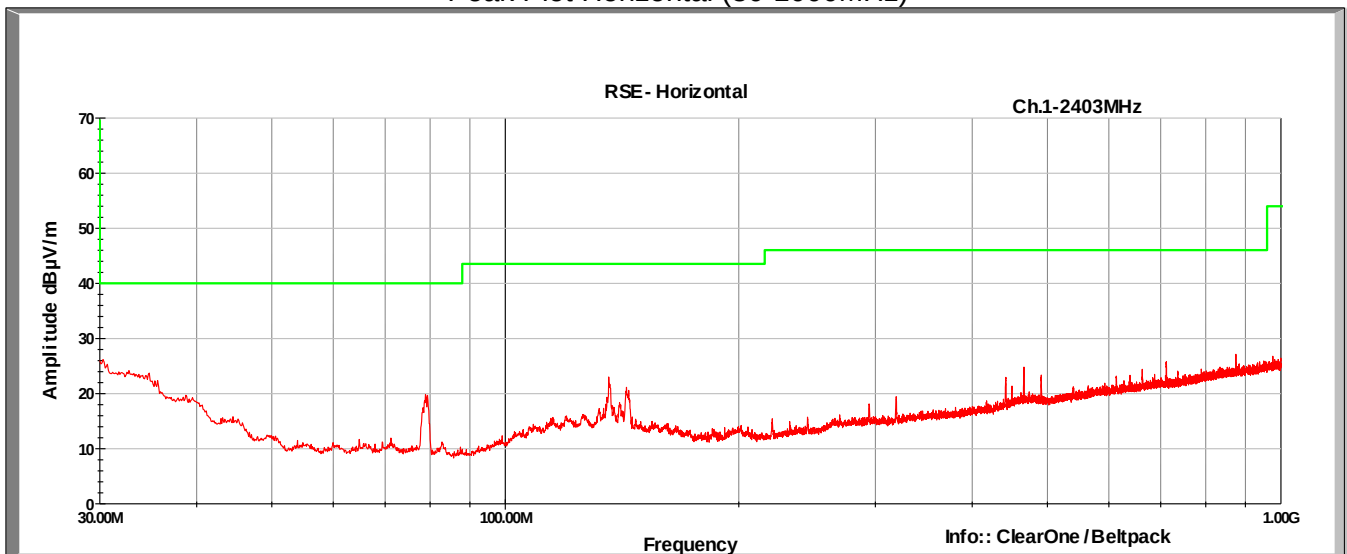
Note: The equipment calibration period is 1 year.

7.5 Peak Plots

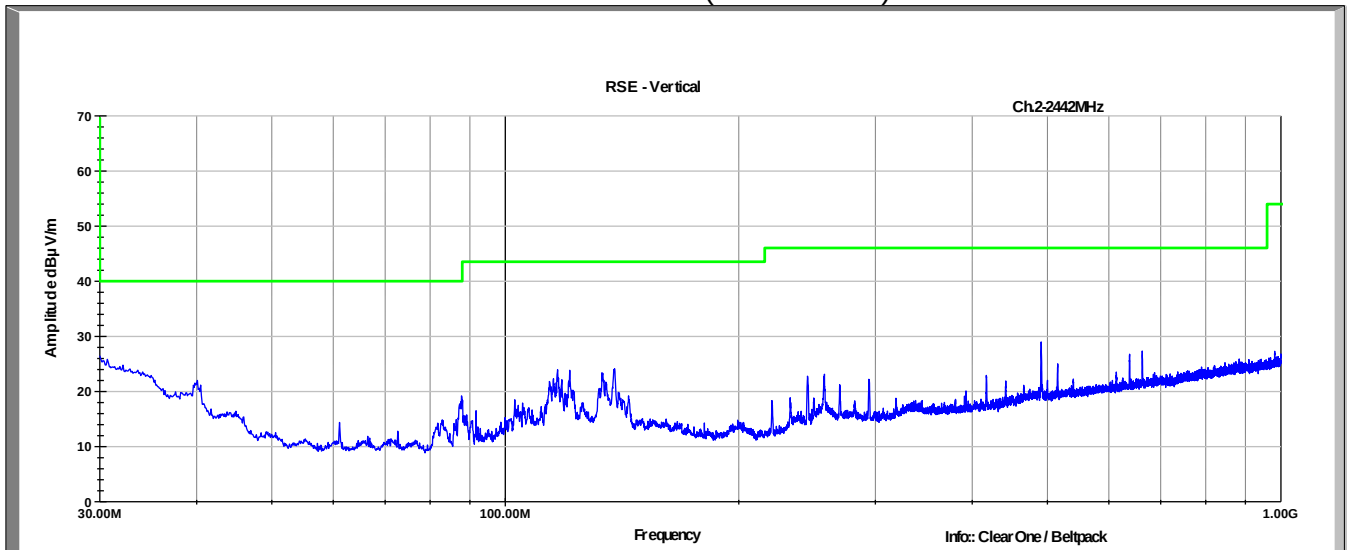
Low Channel (Channel 03)
Peak Plot Vertical (30-1000MHz)



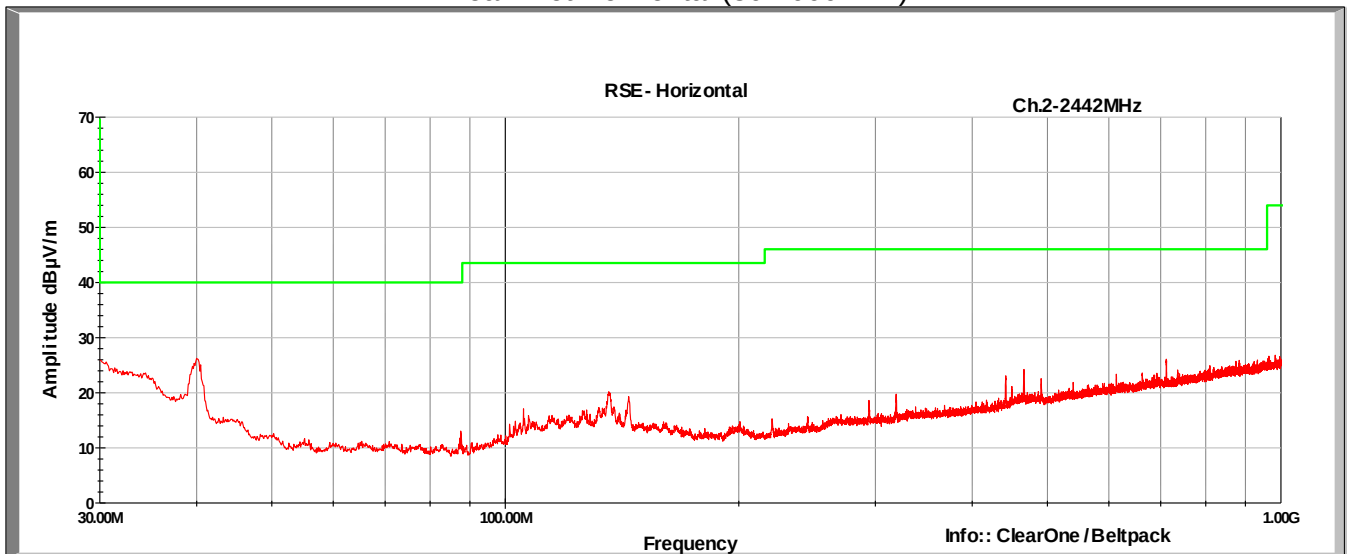
Low Channel (Channel 03)
Peak Plot Horizontal (30-1000MHz)



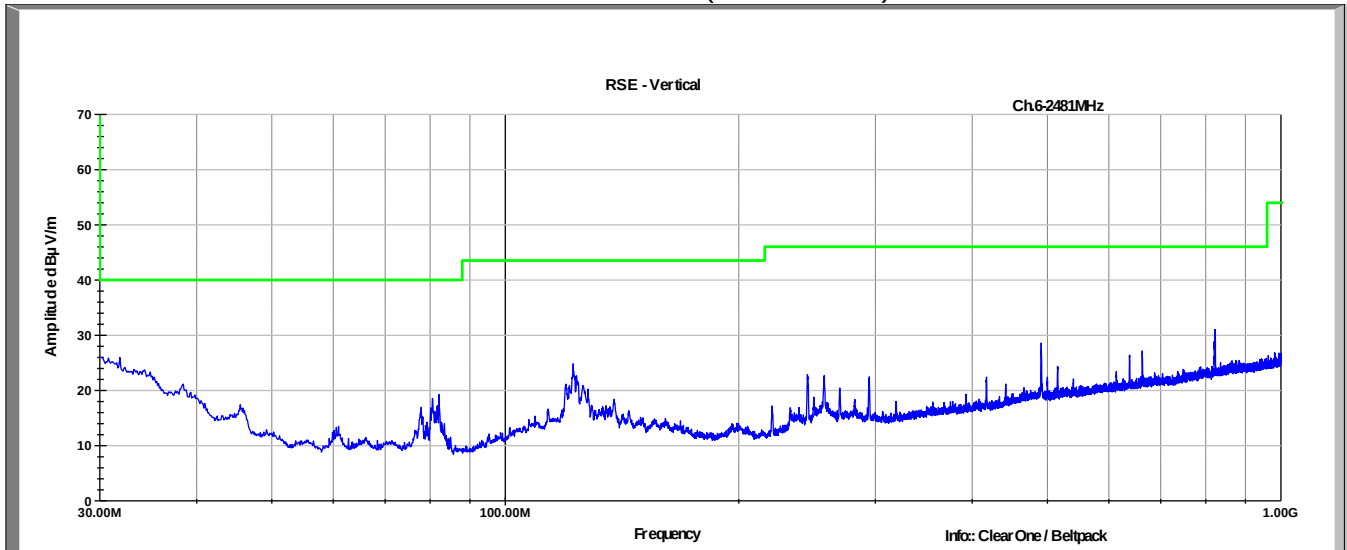
Mid Channel (Channel 42)
Peak Plot Vertical (30-1000MHz)



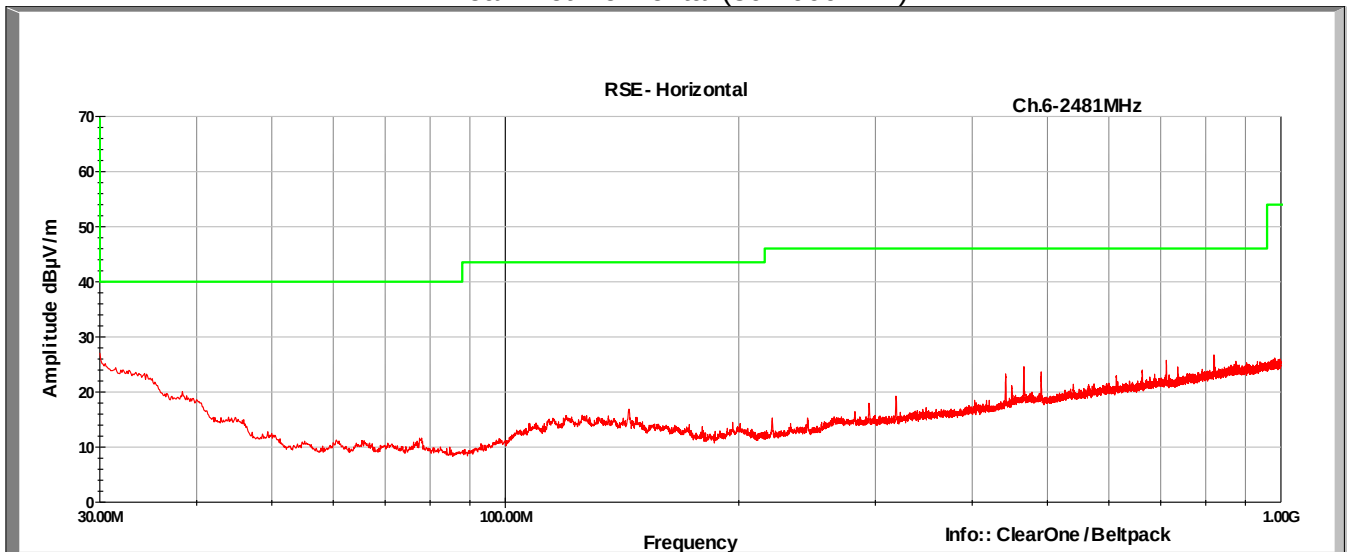
Mid Channel (Channel 42)
Peak Plot Horizontal (30-1000MHz)



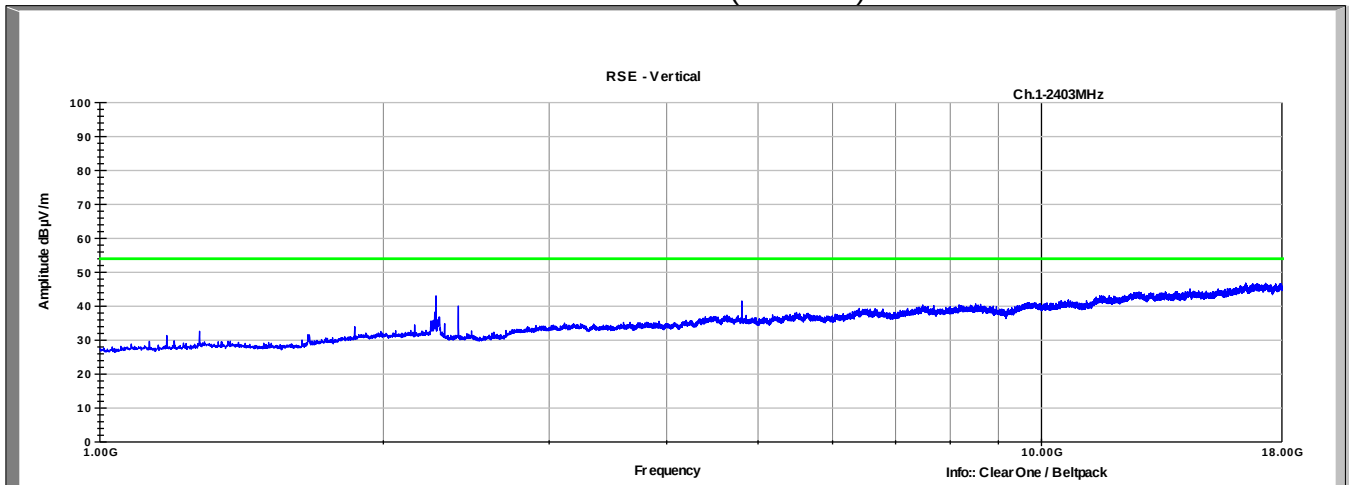
High Channel (Channel 81)
Peak Plot Vertical (30-1000MHz)



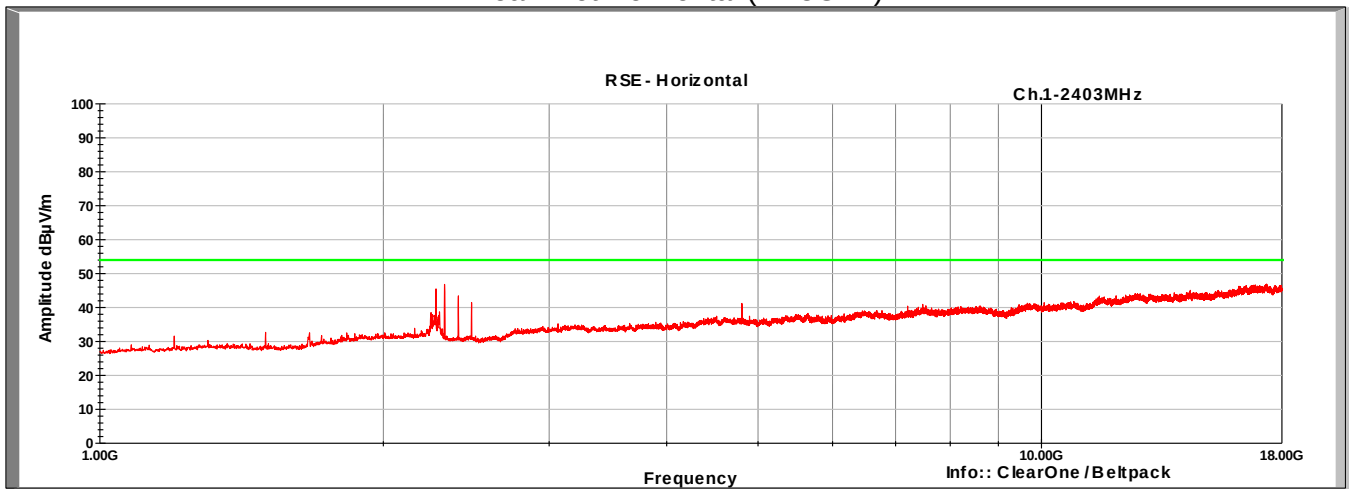
High Channel (Channel 81)
Peak Plot Horizontal (30-1000MHz)



Low Channel (Channel 03)
Peak Plot Vertical (1-18GHz)

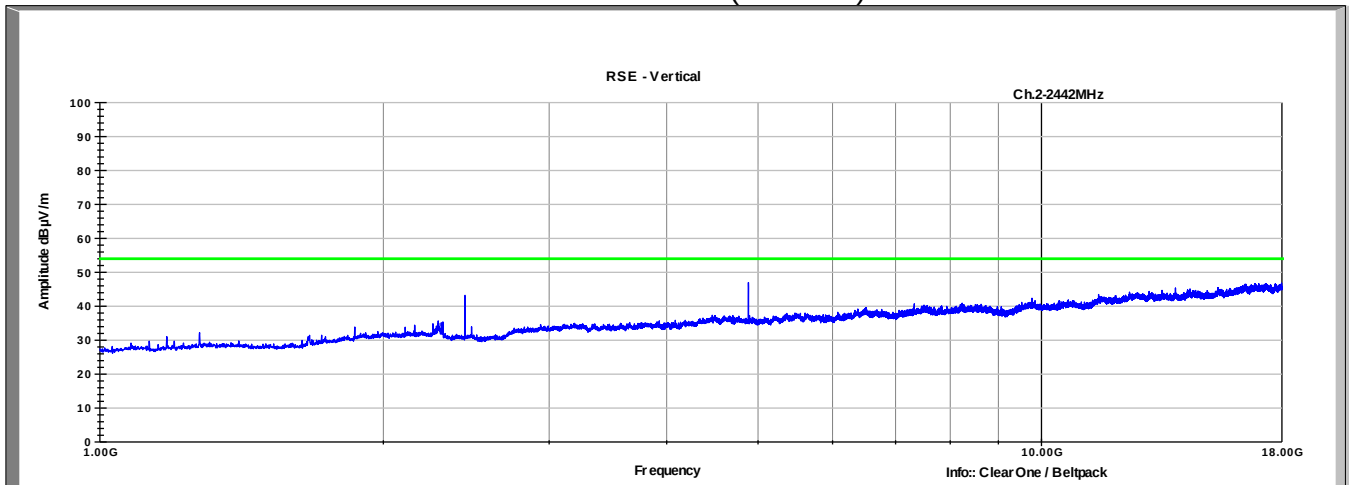


Low Channel (Channel 03)
Peak Plot Horizontal (1-18GHz)



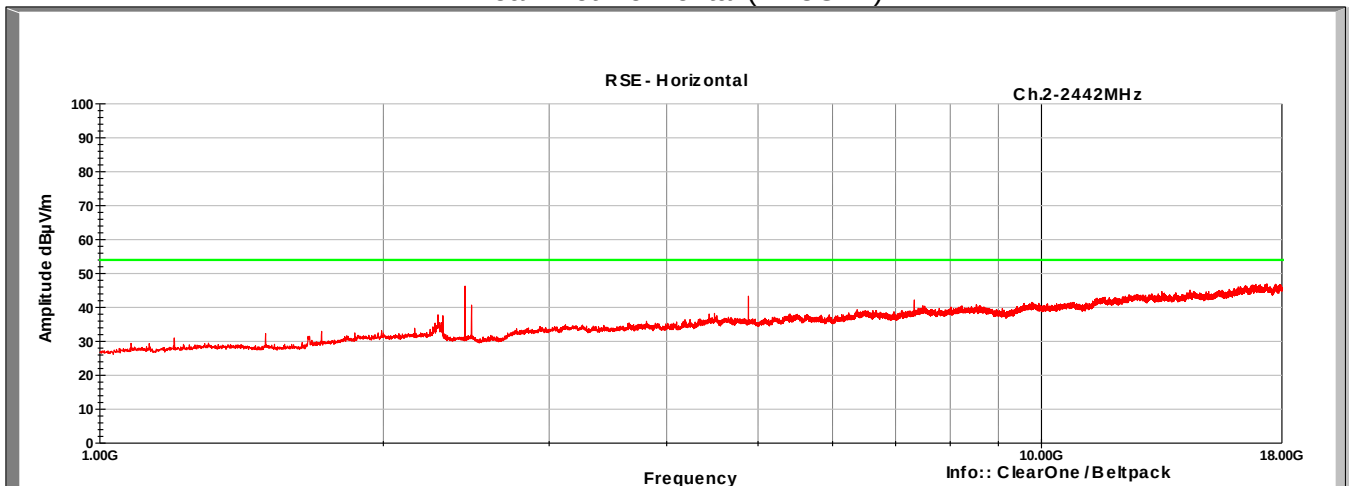
Worst case spurious emission: 2.32345GHz, 46.8dBµV/m Peak (7.2dB Margin)

Mid Channel (Channel 42)
Peak Plot Vertical (1-18GHz)

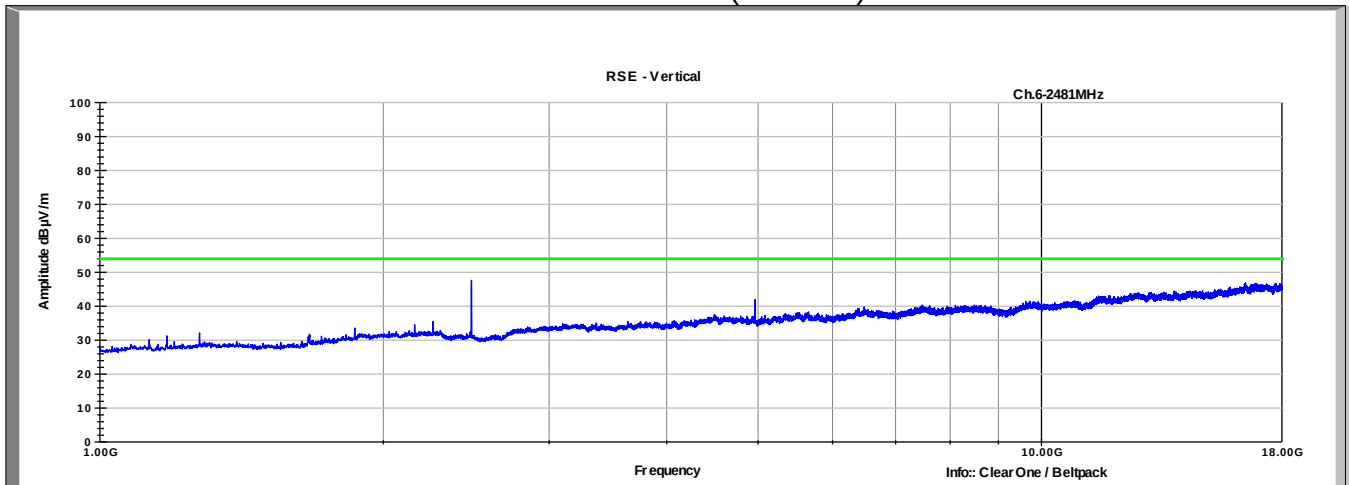


Worst case spurious emission: 4.884GHz, 47.0dBμV/m Peak (7.0dB Margin)

Mid Channel (Channel 42)
Peak Plot Horizontal (1-18GHz)

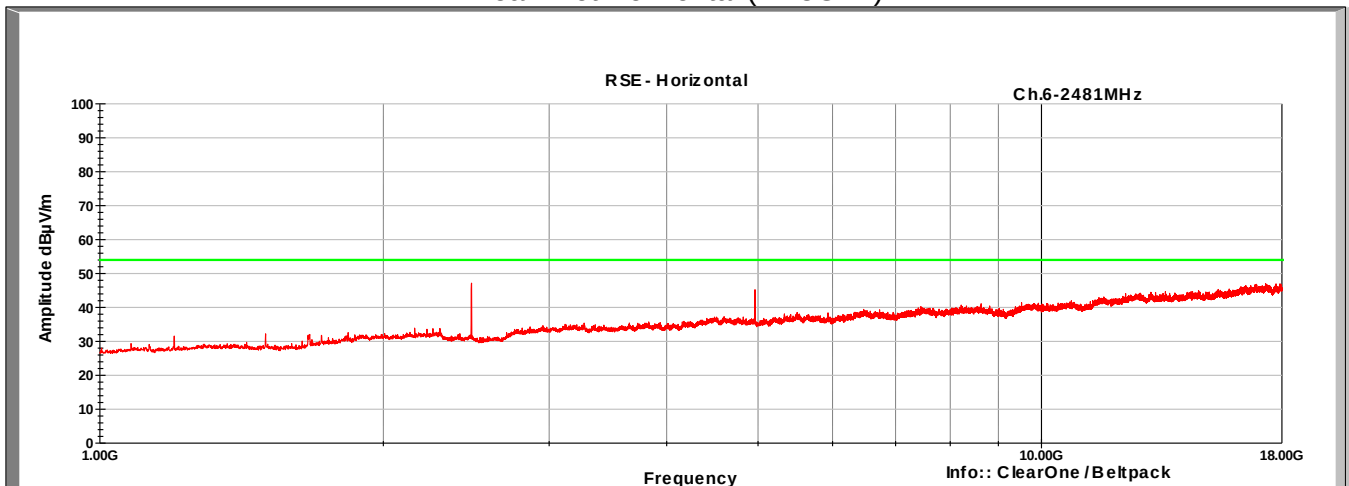


High Channel (Channel 81) Peak Plot Vertical (1-18GHz)



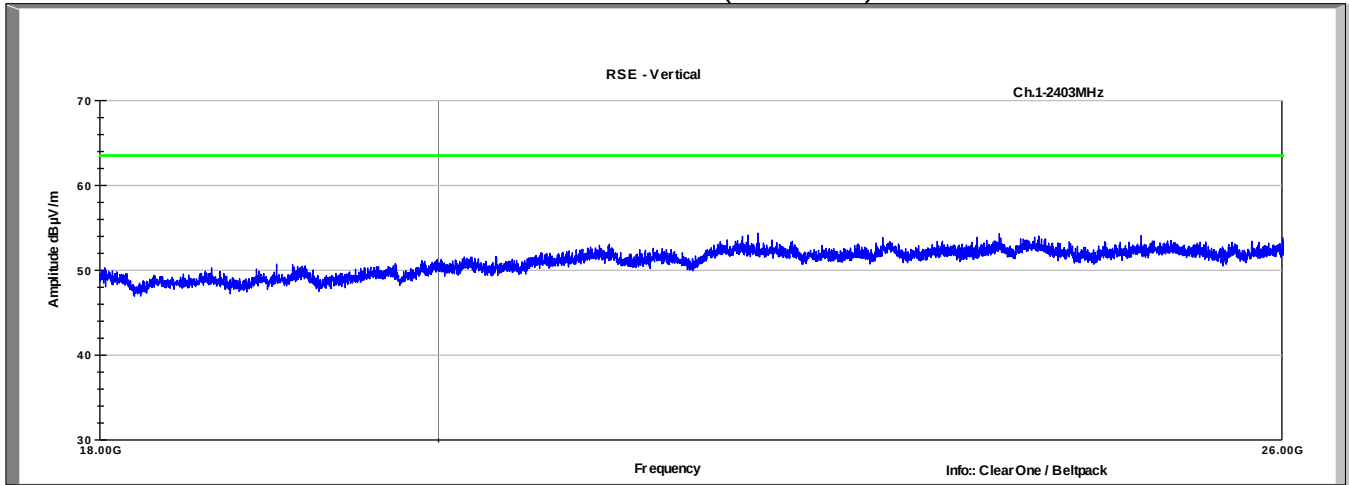
Fundamental at 2481 is at the edge of the notch filter's effectiveness.

High Channel (Channel 81) Peak Plot Horizontal (1-18GHz)

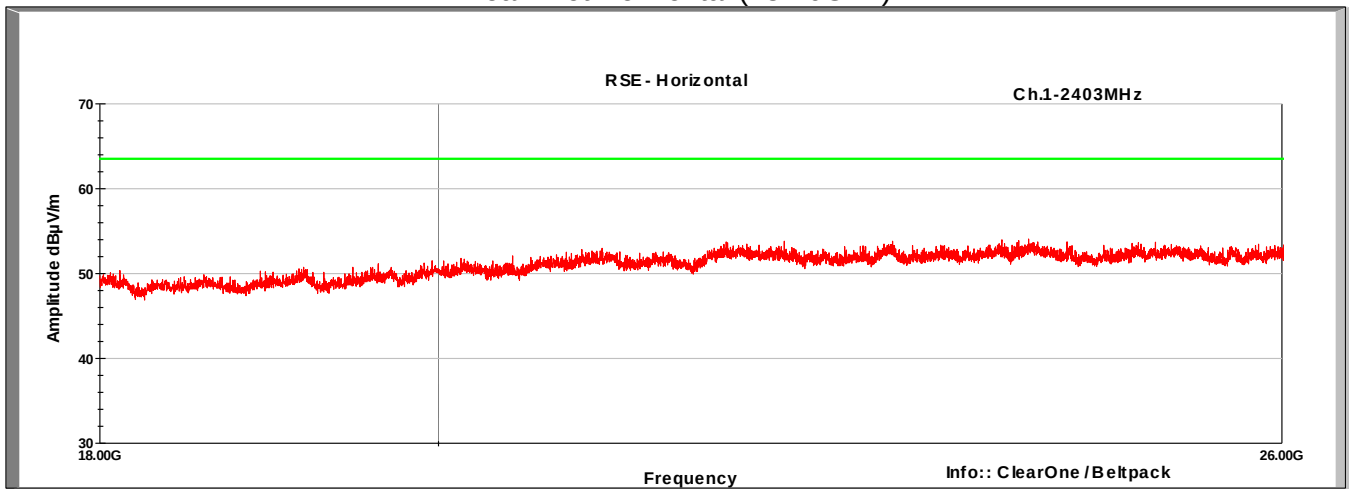


Fundamental at 2481 is at the edge of the notch filter's effectiveness.

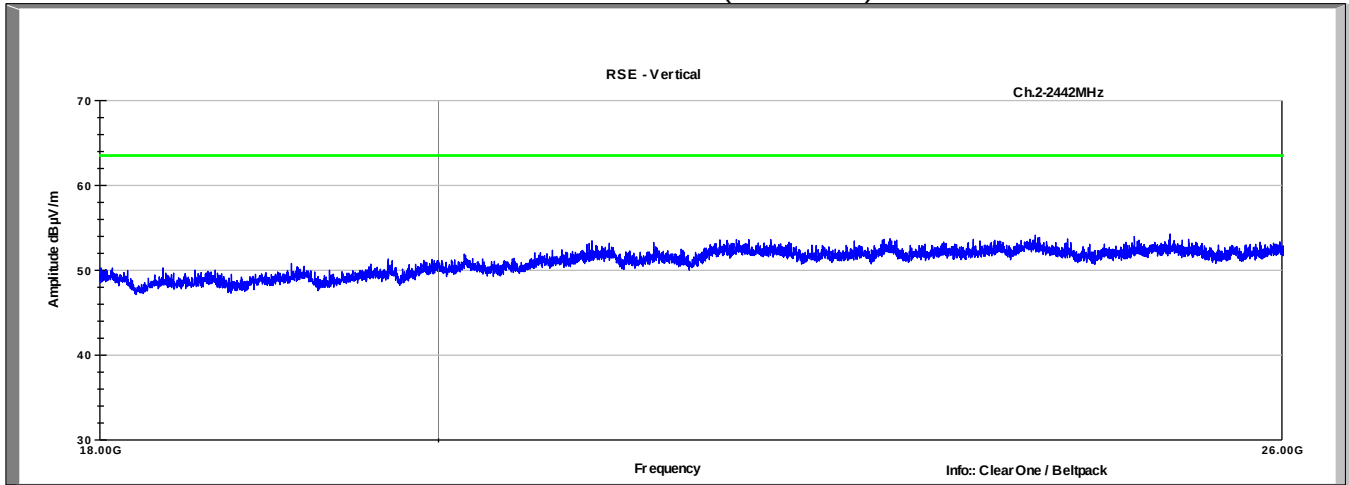
Low Channel (Channel 03)
Peak Plot Vertical (18-26GHz)



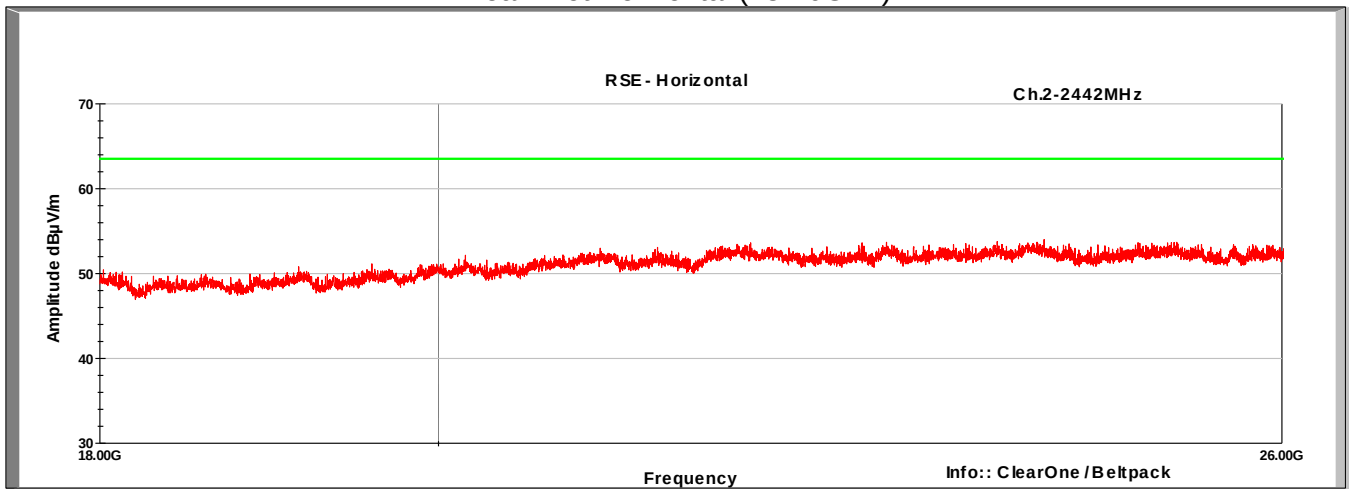
Low Channel (Channel 03)
Peak Plot Horizontal (18-26GHz)



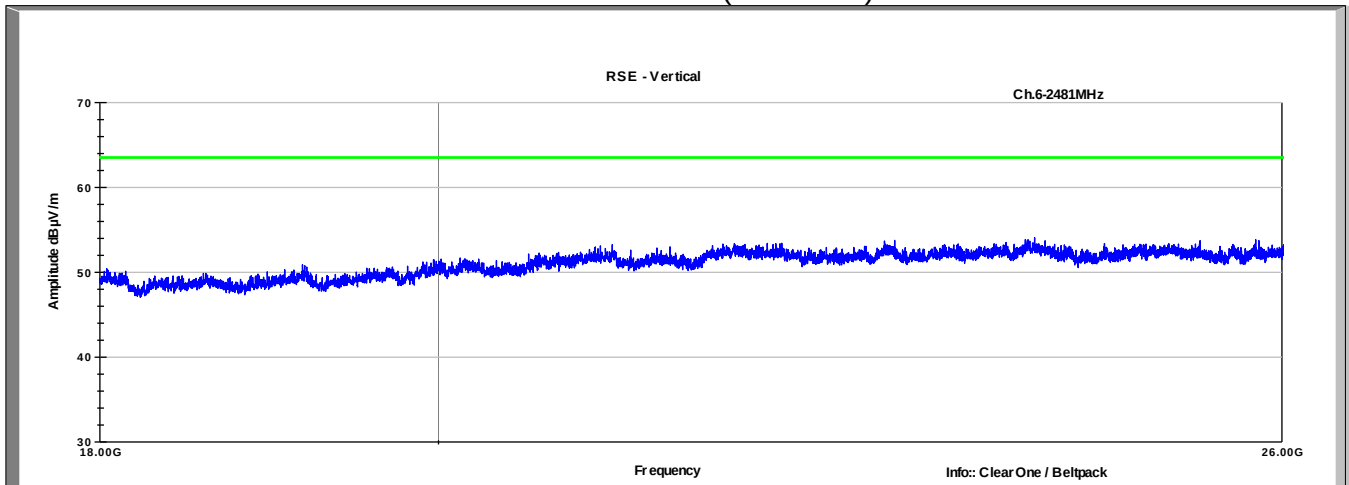
Mid Channel (Channel 42)
Peak Plot Vertical (18-26GHz)



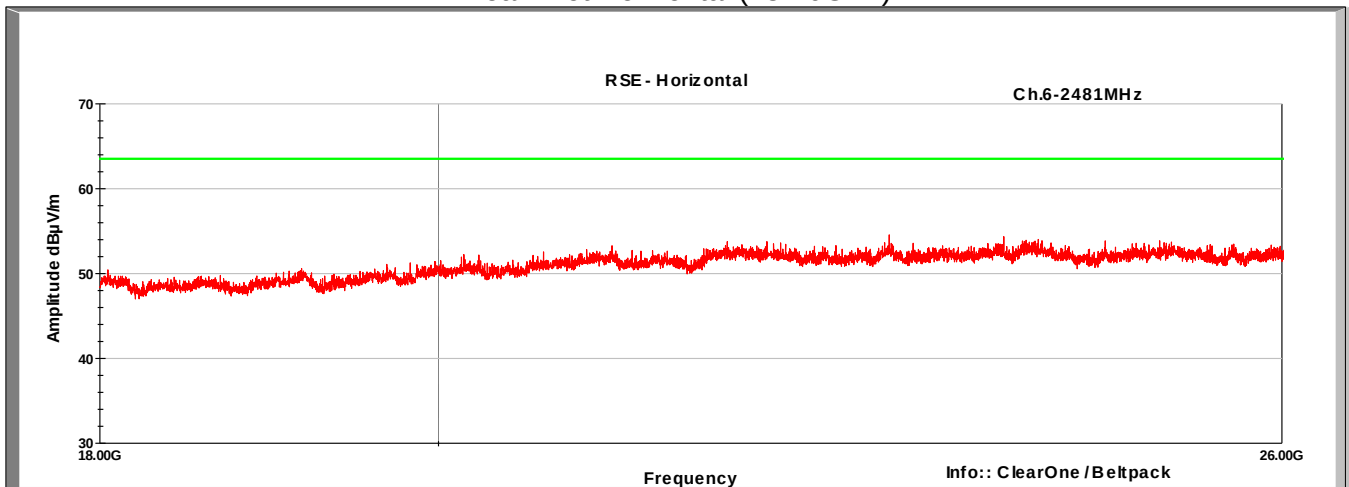
Mid Channel (Channel 42)
Peak Plot Horizontal (18-26GHz)



High Channel (Channel 81)
Peak Plot Vertical (18-26GHz)



High Channel (Channel 81)
Peak Plot Horizontal (18-26GHz)



8 Radiated Emissions at Band Edge / Restricted Band

8.1 Test Result

Test Description	Test Specification	Test Result
Field strength of spurious radiation	15.247 (d) and 15.209	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 FCC KDB publication 558074 D01 DTS Meas Guidance v03r05. At the upper band edge, the marker-delta method defined in ANSI C63.10, Section 6.10.6 was employed.

Offset was determined using the following equation from the KDB:

Offset = $-20 \cdot \log(D) + 104.8 - 107 + CL + DC + AG$

Where:

D (Distance) = 3m

CL (Cable Loss) = 10.9dB

DC (Duty Cycle) = 63.7%, $10 \cdot \log(1/DC) = 2\text{dB}$

AG (Antenna Gain) = 2dBi

Offset = $-20 \cdot \log(3) + 104.8 - 107 + 10.9 + 2 + 2 = 3.2$

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.5 °C

Relative Humidity: 33.3 %

8.4 Test Equipment

Test End Date: 16-Nov-2016

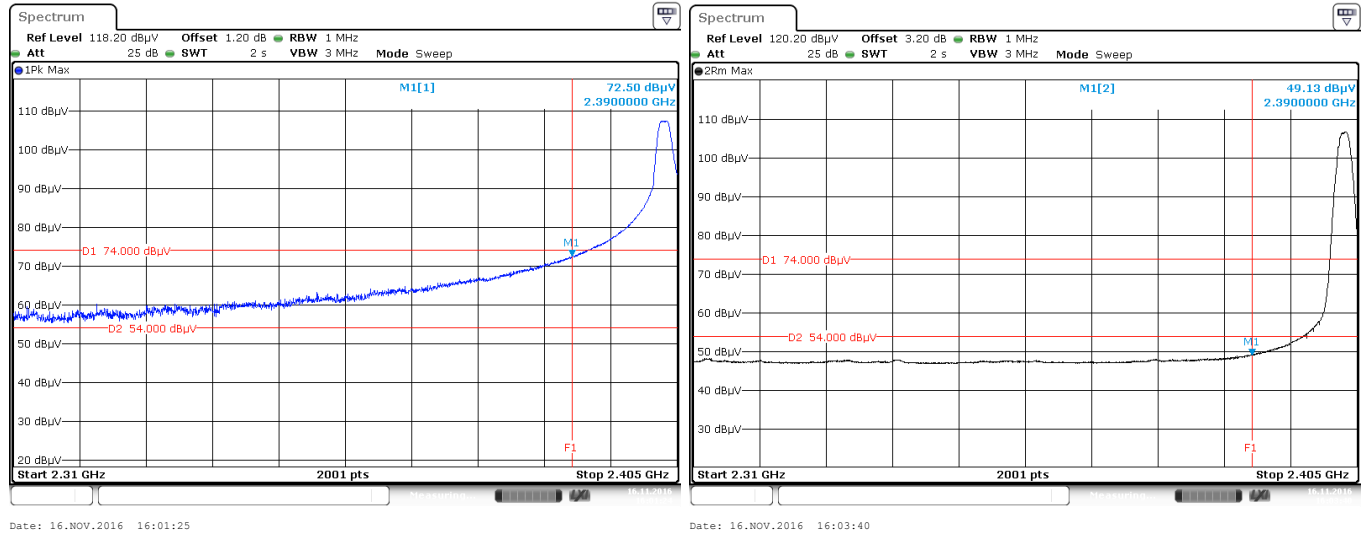
Tester: JOP

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
SIGNAL ANALYZER	FSV30	ROHDE & SCHWARZ	B085749	8-Oct-2017
RF CABLE	1134	GORE	B094785	26-Jul-2017
ATTENUATOR, 10DB	10DB	ROHDE & SCHWARZ	B095593	27-Jul-2017

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

8.5 Test Data

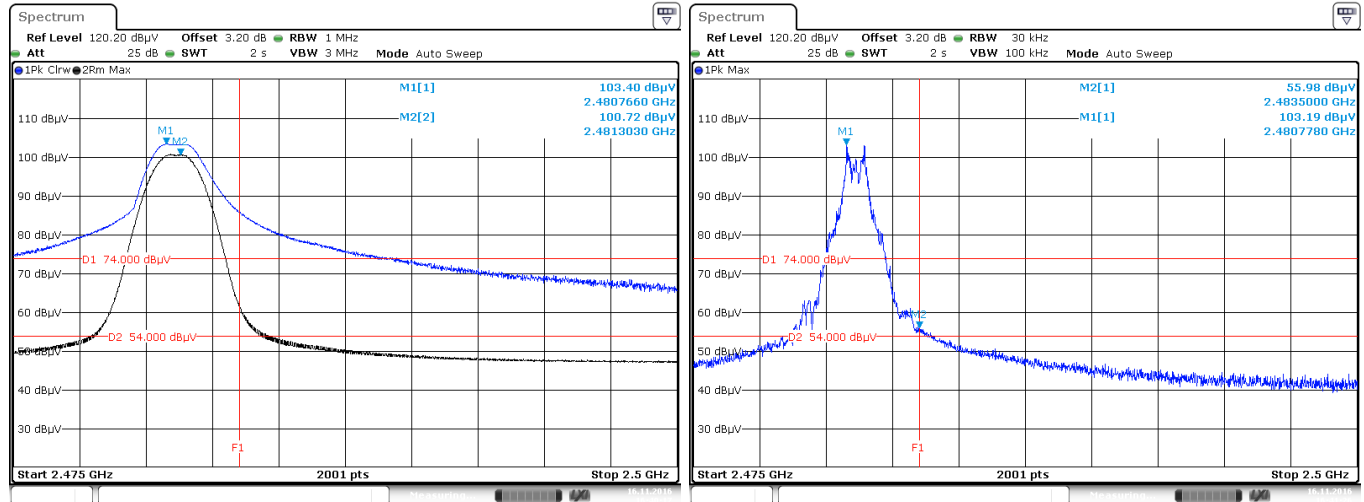
Channel 03



Channel	Frequency (MHz)	Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Measurement Detector
11	2390	72.5	74	-1.5	Peak
11	2390	49.13	54	-4.87	RMS

Channel 81

Marker-Delta Measurements



Marker-Delta Method							
Detector	A 2481MHz 1MHz RBW (dBuV/m)	B 2481MHz 30kHz RBW (dBuV/m)	C 2483.5MHz 30kHz RBW (dBuV/m)	D Delta (dB)	E Corrected Measurement (dBuV/m)	F Limit (dBuV/m)	G Margin (dB)
Peak	103.4	103.19	55.98	47.21	56.19	74	-17.8
Average	100.72			47.21	53.51	54	-0.5

Formulas:
D=B-C
E=A-D
G=E-F

9 Conducted Emissions

9.1 Test Result

Test Description	Basic Standards	Test Result
Conducted Emissions, Class B	15.107, 15.207 RSS-GEN S8.8	Compliant

9.2 Test Method

With the receivers resolution bandwidth was set to 9 kHz the initial preliminary exploratory scans were performed over the measuring frequency range (0.15MHz to 30MHz) using a max hold mode incorporating a Peak detector and Average detector and using the TILE! software. The final test data was measured using a Quasi-Peak detector and Average detector and compared against the limits indicated in the table below.

Frequency Range	Class A Limits (dBuV)	Class B Limits (dBuV)
0.15 to 0.5 MHz	Avg 66 QP 79	Avg 56 to 46 QP 66 to 56
0.5 to 5 MHz	Avg 60 QP 73	Avg 46 Pk 56
5 to 30 MHz	Avg 60 QP 73	Avg 50 Pk 60

9.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 23.5°C
Relative Humidity: 50.3%

9.4 Test Equipment

Test Date: 3-Nov-2016

Tester: FRN

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jul-2017
LINE IMPEDANCE STABILIZATION NETWORK	NNB 51	TESEQ	B087573	12-Nov-2016
RF CABLE	SF106	HUBER & SUHNER	B079661	29-Jul-2017

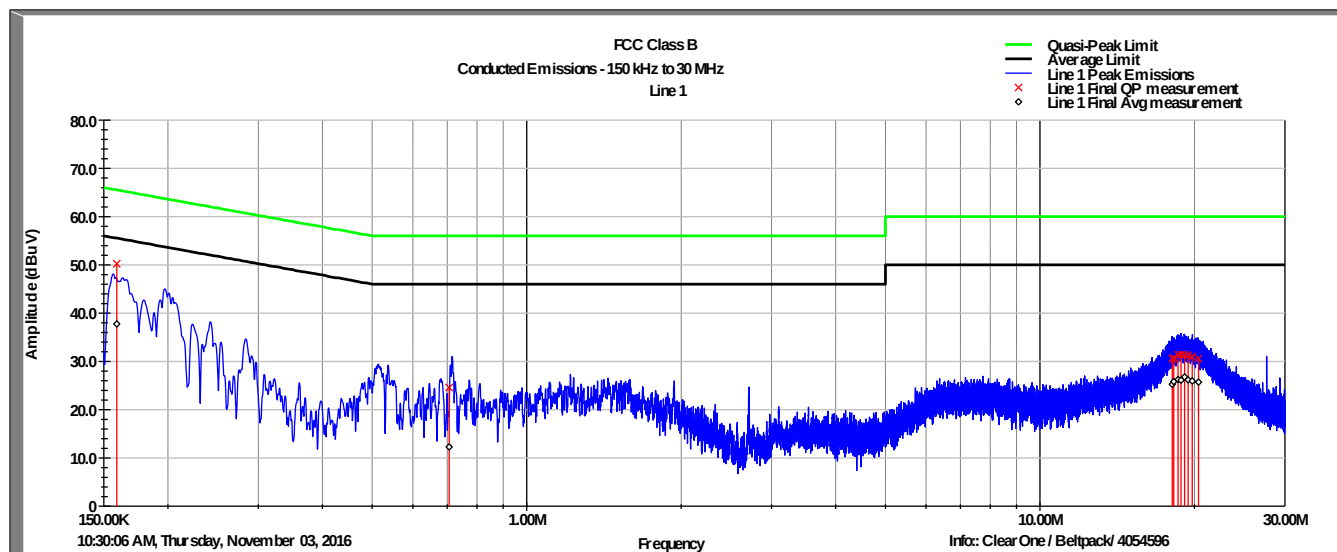
Note: The equipment calibration period is 1 year.

Software:

"Conducted Emissions" TILE! profile dated 2013

9.5 Test Data

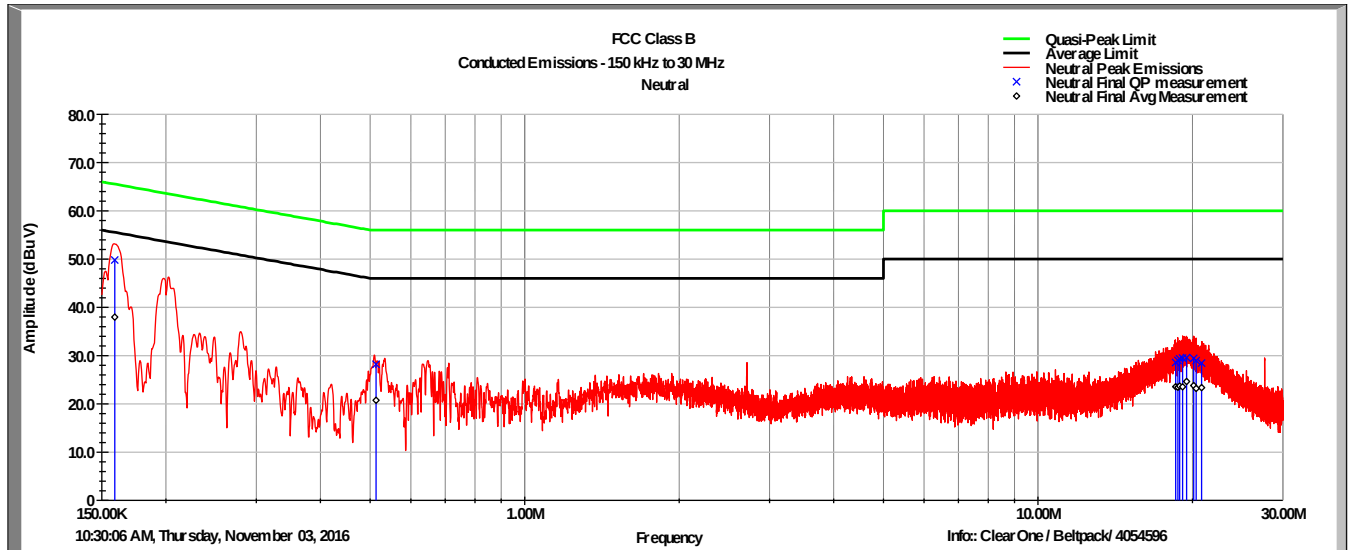
Line 1 Conducted Emissions Plot



Line 1 Conducted Emissions Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.159	50.2	65.5	-15.3	37.7	55.5	-17.8
0.706	24.6	56.0	-31.4	12.3	46.0	-33.7
18.108	30.5	60.0	-29.5	25.3	50.0	-24.7
18.220	30.8	60.0	-29.2	25.8	50.0	-24.2
18.577	31.4	60.0	-28.6	26.2	50.0	-23.8
18.829	31.4	60.0	-28.6	26.1	50.0	-23.9
19.127	31.3	60.0	-28.7	26.8	50.0	-23.2
19.445	31.3	60.0	-28.7	26.2	50.0	-23.8
19.799	31.0	60.0	-29.0	25.9	50.0	-24.1
20.360	30.6	60.0	-29.4	25.7	50.0	-24.3

Neutral Conducted Emissions Plot



Neutral Conducted Emissions Data

Frequency MHz	QP Value dBuV	QP Limit dBuV	QP Margin dB	Avg Value dBuV	Avg Limit dBuV	Avg Margin dB
0.159	49.8	65.5	-15.7	38.0	55.5	-17.6
0.513	28.2	56.0	-27.8	20.7	46.0	-25.3
18.548	28.6	60.0	-31.4	23.6	50.0	-26.4
18.737	29.0	60.0	-31.0	23.4	50.0	-26.6
18.886	29.3	60.0	-30.7	23.7	50.0	-26.3
19.130	29.5	60.0	-30.5	23.5	50.0	-26.5
19.478	29.6	60.0	-30.4	24.6	50.0	-25.4
20.112	29.4	60.0	-30.6	23.8	50.0	-26.2
20.338	29.0	60.0	-31.0	23.2	50.0	-26.8
20.827	28.4	60.0	-31.6	23.4	50.0	-26.6

10 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	30 November 2016